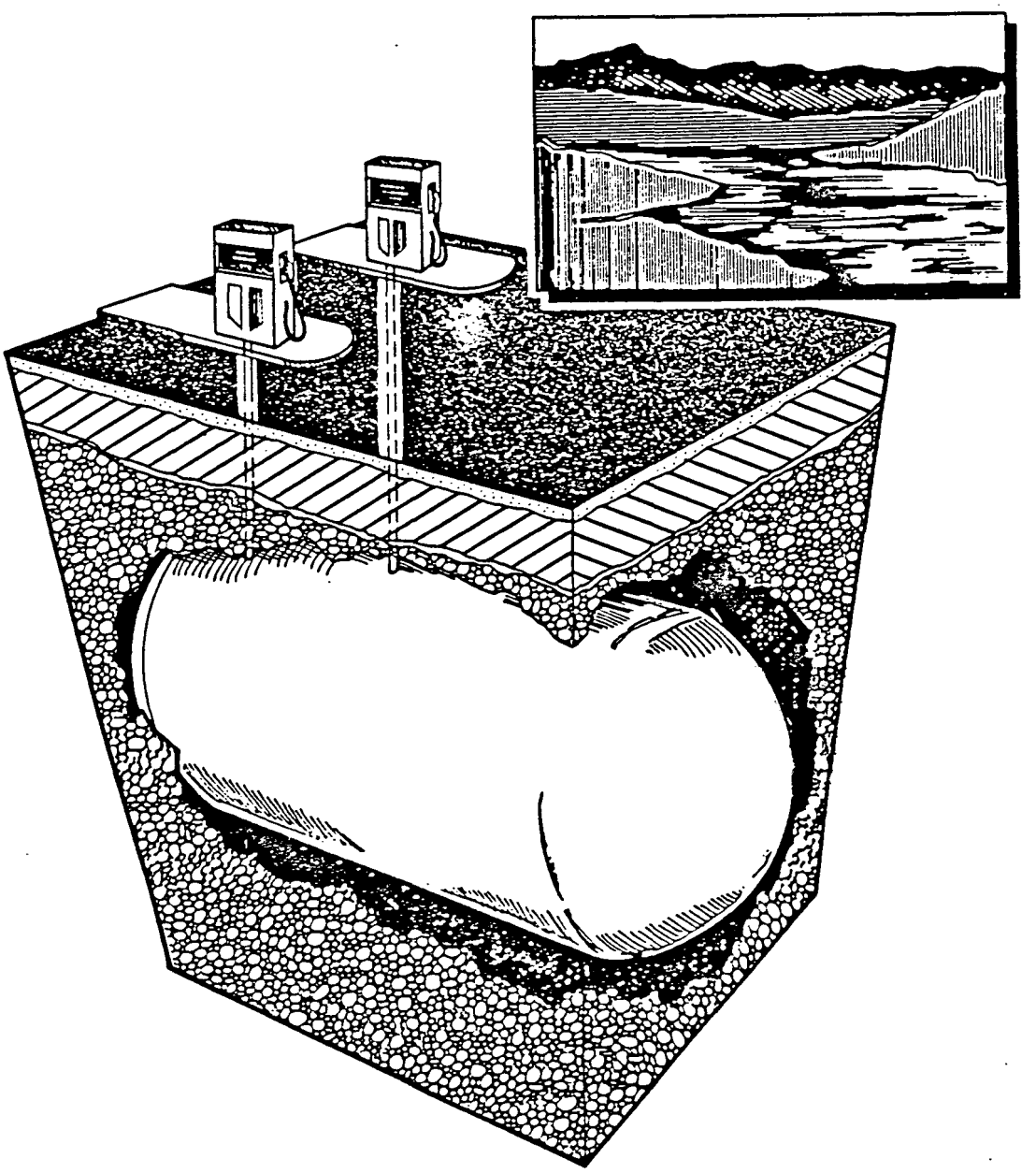
United States
Environmental Protection
Agency

EPA

# Model NPDES Permit for Discharges Resulting From The Cleanup of Gasoline Released From Underground Storage Tanks



# PART I

## INSTRUCTIONS FOR MODEL NPDES PERMIT PACKAGE FOR DISCHARGES RESULTING FROM THE CLEANUP OF GASOLINE RELEASED FROM UNDERGROUND STORAGE TANKS

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# 1.0 INSTRUCTIONS FOR MODEL NPDES PERMIT PACKAGE

This package was developed to assist U.S. Environmental Protection Agency (EPA) Regional and State permitting authorities in writing National Pollutant Discharge Elimination System (NPDES) permits for direct discharges to surface waters resulting from the cleanup of gasoline from leaking underground storage tank (UST) sites.

The UST program originally was mandated under Subtitle I of the Resource Conservation and Recovery Act of 1976 (RCRA) to regulate the installation, operation, and closure of USTs. The Hazardous and Solid Waste Amendments of 1984 (HSWA) strengthened the existing RCRA provisions to provide for a comprehensive regulatory program to address USTs and releases of regulated substances (primarily petroleum products) into the environment. Like other RCRA programs, States may be authorized by EPA to implement their own UST programs.

When a release is detected, the enforcement agency (either EPA or its delegated State) has the authority to require the owner/operator to conduct a release response and corrective action to cleanup the release. Depending on the situation, the EPA or delegated State may choose to conduct the release response or corrective action. Any discharge to surface waters occurring during a release response or corrective action would be subject to regulation under an NPDES permit.

This Model Permit package is only intended for use at facilities where gasoline has been released and the cleanup (or corrective action) involves a release or discharge of waters and wastewaters to surface waters. It is not intended for use at sites where nongasoline products are the primary source of contamination (e.g., jet fuels, fuel oil, diesel fuel, etc.). This package consists of four documents. Part I, Instructions for Model NPDES Permit Package, briefly describes NPDES permit requirements. The remaining three documents are briefly described below:

- Part II - Model NPDES Permit For Discharges Resulting From The Cleanup Of Gasoline Released From Underground Storage Tanks
- Part III - Fact Sheet For Model NPDES Permit For Discharges Resulting From The Cleanup Of Gasoline Released From Underground Storage Tanks
- Part IV - Decision Tool For Developing Water Quality-Based Effluent Limitations.

The UST Model Permit Package is available on diskette in WordPerfect® version 4.2. In addition, the Model Permit Package can be made available in IBM® Document Control Architecture revisable-format-text (DCA RFT) or ASCII formats for use on IBM PC (or compatibles) or for Apple Macintosh® computers.

## 1.1 NPDES PERMITTING AUTHORITY

This Model Permit is intended for use in developing individual, site-specific NPDES permits. NPDES permit application requirements (discussed in Section 1.1.1 below) may vary depending upon the NPDES permitting authority. Under the NPDES Program, a total of 57 jurisdictions are regulated including the 50 States plus the District of Columbia, Puerto Rico, the Virgin Islands, American Samoa, Guam, West Marinaras, and U.S. Trust Territories. Thirty-nine of these jurisdictions have the authority to conduct their own NPDES program. In the remaining 18 jurisdictions, EPA is responsible for implementing the NPDES program.

According to 40 CFR §122.28, States can apply for the authority to issue general NPDES permits. General permits apply the same set of limitations to a group of dischargers that discharge the same types of wastes, require the same effluent limitations or operating conditions, and require similar monitoring. The information provided in this Model Permit Package may also be used as the basis for developing a general permit. Thirteen NPDES-approved States have the authority to issue general permits. EPA can issue general permits in all of the 18 jurisdictions where EPA is the permitting authority. Currently, general permits cannot be issued in 26 jurisdictions.

### 1.1.1 NPDES Permit Application Requirements

Dischargers must submit an NPDES permit application before an individual NPDES permit can be issued. The information provided in the permit application serves as one source of data for developing NPDES permit requirements. States may have their own permit application forms and requirements but must request from the applicant as a minimum, the information required by the Federal NPDES regulations.

Some of the major constituents of gasoline can be detected by analytical methods for volatile organics. Analytical methods are specified at 40 CFR Part 136. Certain other chemicals (e.g., xylene) should be tested for if the applicant believes that other substances are present in the discharge, for which there are no approved analytical methods. For these other substances, the applicant is required to use another suitable analytical method. One such method that is particularly suitable for potential gasoline constituents is EPA Method 8240. This method is an approved RCRA method for the analysis of volatile organic compounds such as xylene.

The data provided in the NPDES permit application should be carefully reviewed by the permit writer. Specifically, information such as discharge flow rates and the presence of toxic pollutants should be carefully evaluated. For example, the effluent limits in the Model Permit may be modified to account for the presence of additional pollutants. Similarly, the monitoring requirements may need to be modified based upon unique discharge characteristics (e.g., batch discharges).

## 1.2 MODEL NPDES PERMIT

This Model Permit is based on the approach taken, in part, by several States and EPA Regional Offices. While a Model Permit may not be applicable in every situation, the information contained in this Model Permit Package should serve as a framework for the permit writer and expedite the NPDES permit issuance process. Key elements of the Model Permit include chemical-specific effluent limitations, standard conditions, and special conditions including Best Management Practices (BMPs) and biomonitoring requirements. These elements are recommended for inclusion in all NPDES permits for discharges from the cleanup of gasoline-related UST sites.

This Model Permit was based principally on guidance provided by the NPDES regulations and the Training Manual For NPDES Permit Writers, EPA Office of Water and Permits, May 1987. However, the Model Permit should be modified to conform with State regulations and policies, air and ground-water protection strategies or requirements, or site-specific conditions. This Model Permit differs from most NPDES permits in that gasoline cleanups typically last for one or two years while most NPDES permits are issued for a five year period. Due to this shorter time span, biomonitoring requirements may need to be altered or deleted in some cases. The following subsections highlight four major components of the Model Permit.

### 1.2.1 Authorization to Discharge

The "Authorization to Discharge" section of the Model Permit must be completed by the permit writer. In order to fill in this section the following information must be provided:

- Name and Address of Facility
- Outfall Designations
- Receiving Water Name and Present/Future Water Quality Standard Classification of Receiving Water
- Effective Date of Permit
- Expiration Date of Permit.

### 1.2.2 Effluent Limitations and Monitoring Requirements

Part I of the Model Permit provides technology-based effluent limitations and monitoring requirements for surface water discharges from corrective actions at gasoline underground storage tank sites. Specifically, effluent limitations have been developed for benzene and the aggregate parameter BETX (benzene, ethylbenzene, toluene, and the xylenes). The technology basis used to develop these limits is free product recovery, followed by air stripping. These effluent limits are based on the characterization of constituents commonly found in gasoline as described in the Fact Sheet (listed in Tables 3-1, 5-1, and 5-2 of the Fact Sheet). Additional site-specific constituents, such as gasoline additives, may be reported in the sampling data required as

part of the NPDES permit application. Should this occur, the permit writer may need to develop additional effluent limitations.

> **NOTE:** An optional set of effluent limitations has also been developed based upon consideration of the potential impacts of treatment costs, particularly on smaller firms that own retail motor fuel outlets. These optional effluent limitations, based upon a reduction in air stripping efficiency, could be used by permit writers if a firm could not afford the cost of compliance with the more stringent effluent limitations. However, if these optional effluent limitations, as with all technology-based limitations, would result in the exceedance of water quality standards and/or endanger aquatic life, human health, or the environment, then water-quality based limitations should be established.

Weekly flow and chemical-specific monitoring is recommended based on EPA guidelines. In addition, chronic toxicity testing requirements are recommended and provided in the permit. Alternative approaches to establishing biomonitoring requirements, such as the whole effluent toxicity screening approach, are provided in the Fact Sheet.

### 1.2.3 Standard Conditions

The standard conditions established in Part II of the Model NPDES Permit are based on those required in 40 CFR §122.41. Standard conditions may vary from State to State. Therefore, the permit writer is free to substitute State requirements for the Standard Conditions in this Model Permit as appropriate.

### 1.2.4 Special Conditions

Part III of the Model Permit requires the permittee to develop a Best Management Practices (BMP) plan. In addition, biomonitoring is recommended for inclusion in each gasoline UST cleanup NPDES permit. The Fact Sheet provides additional guidance for developing and implementing biomonitoring requirements. Additional special conditions may be required to address site-specific problems. The conditions presented in this Model Permit are severable, which means if one condition is proven to be invalid the other conditions still hold. Regions and States may choose to incorporate additional requirements in accordance with their own policies on BMPs and biomonitoring requirements.

## 1.3 FACT SHEET

The NPDES regulations [40 CFR §124.8(a)] require the preparation of a Fact Sheet for every major NPDES permit to document the facts, methodology, and basis used to develop the permit. For purposes of this Model Permit it is assumed that the discharge from an UST cleanup may constitute a major point source discharge. Therefore, a Fact Sheet has been prepared as part of this package that provides a rationale for the effluent limitations, monitoring requirements, and special conditions set forth in the Model Permit. This Fact Sheet should be reviewed carefully by the permit writer before using the Model Permit. The rationale given in the Fact Sheet may need to be modified to account for site-specific considerations.

## 1.4 DECISION TOOL FOR DEVELOPING WATER QUALITY-BASED EFFLUENT LIMITATIONS

Both the Clean Water Act and NPDES regulations require all NPDES permits to include effluent limitations to achieve applicable State water quality standards. Since State standards are typically specified on a site-specific basis, water quality-based effluent limitations have not been developed for this Model Permit. However, a Decision Tool for addressing site-specific water quality criteria is presented for use by State and EPA Regional permit writers. This Decision Tool includes EPA's ambient water quality criteria for the protection of aquatic life and human health for benzene, ethylbenzene, toluene, xylene, and naphthalene, the only constituents of gasoline for which water quality criteria have been established.

MODEL NPDES PERMIT FOR DISCHARGES RESULTING FROM THE CLEANUP OF GASOLINE RELEASED FROM UNDERGROUND STORAGE TANKS

AUTHORIZATION TO DISCHARGE UNDER THE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with the provisions of the Federal Water Pollution Control Act, as amended (33 U.S.C. Section 1251 et seq., hereinafter the "Clean Water Act" or "Act"), and attendant regulations incorporated by the U.S. Environmental Protection Agency under Title 40 of the Code of Federal Regulations,

(Name of Discharger) (hereinafter "Permittee")

is authorized to discharge from (description of facility), located at

(insert Address)

to the receiving waters named (identify) in accordance with effluent limitations, monitoring requirements, and other conditions set forth in Parts I, II, and III herein. The permit consists of this cover sheet, Part I - 1 page, Part II - 13 pages, and Part III - 3 pages.

All references to Title 40 of the Code of Federal Regulations are to regulations that are in effect on the effective date of this permit. Unless otherwise specified herein, all terms are defined as provided in the applicable regulations in Title 40 of the Code of Federal Regulations.

This permit shall become effective on (insert date). This permit and the authorization to discharge shall expire at midnight (insert date).

Date

Director
(or Other Authorized Official)

Permit No. _____

PART I

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS: Outfall 001 - discharge resulting from gasoline underground storage tank corrective actions.

1. During the period beginning on the effective date of the permit and lasting through the term of this permit, the permittee is authorized to discharge treated water and wastewater that has been contaminated by gasoline.

   Such discharges shall be limited and monitored by the Permittee as specified below:

| Effluent Characteristic | Discharge Limitations Micrograms per Liter | | Monitoring Requirements | |
|---|---|---|---|---|
| | Daily Avg. | Daily Max. | Measurement Frequency | Sample Type |
| Flow, MGD | Report | Report | 1 per week | Continuous |
| Benzene | 5 | 5 | 1 per week | Grab |
| Total BETX* | 100 | 100 | 1 per week | Grab |

The pH shall neither be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored once per week by grab sample.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): nearest accessible point after final treatment but prior to actual discharge or mixing with the receiving waters.

* BETX shall be measured as the sum of benzene, ethylbenzene, toluene, and xylenes. EPA methods 602, 624, or 1624 shall be used for the measurement of benzene, ethylbenzene, and toluene. EPA method 8240, or an equivalent method, shall be used for the measurement of xylenes including ortho-, meta-, and para-xylene. (Note: Depending on Regional/State policy, EPA Method 8240 may be used as a substitute or equivalent for the CWA methods 602, 624, or 1624 required under the CWA in 40 CFR Part 136.)

# OPTIONAL EFFLUENT LIMITATIONS FOR DISCHARGES RESULTING FROM THE CLEANUP OF GASOLINE RELEASED FROM UNDERGROUND STORAGE TANKS

PART I

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS: Outfall 001 - discharge resulting from gasoline underground storage tank corrective actions.

1. During the period beginning on the effective date of the permit and lasting through the term of this permit, the permittee is authorized to discharge treated water and wastewater that has been contaminated by gasoline.

   Such discharges shall be limited and monitored by the Permittee as specified below:

| Effluent Characteristic | Discharge Limitations Micrograms per Liter | | Monitoring Requirements | |
|---|---|---|---|---|
| | Daily Avg. | Daily Max. | Measurement Frequency | Sample Type |
| Flow, MGD | Report | Report | 1 per week | Continuous |
| Benzene | 50 | 50 | 1 per week | Grab |
| Total BETX* | 750 | 750 | 1 per week | Grab |

The pH shall neither be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored once per week by grab sample.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): nearest accessible point after final treatment but prior to actual discharge or mixing with the receiving waters.

* BETX shall be measured as the sum of benzene, ethylbenzene, toluene, and xylenes. EPA methods 602, 624, or 1624 shall be used for the measurement of benzene, ethylbenzene, and toluene. EPA method 8240, or an equivalent method, shall be used for the measurement of xylenes including ortho-, meta-, and para-xylene. (Note: Depending on Regional/State policy, EPA Method 8240 may be used as a substitute or equivalent for the CWA methods 602, 624, or 1624 required under the CWA in 40 CFR Part 136.)

# PART II

# MODEL NPDES PERMIT FOR DISCHARGES RESULTING FROM THE CLEANUP OF GASOLINE RELEASED FROM UNDERGROUND STORAGE TANKS

PART II

STANDARD CONDITIONS

SECTION A. GENERAL CONDITIONS

1. Duty to Comply

The Permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Clean Water Act and is grounds for enforcement action, for permit termination, permit revocation and permit reissuance, or modification, or for denial of a permit renewal application.

2. Toxic Pollutants

The Permittee shall comply with effluent standards or prohibitions established under Section 307(a) of the Clean Water Act for toxic pollutants within the time provided in the regulations that establish those standards or prohibitions, even if the permit has not yet been modified to incorporate the requirement.

3. Penalties for Violations of Permit Conditions

Any person who violates a permit condition is subject to a civil penalty not to exceed $10,000 per day for each violation. Any person who willfully or negligently violates permit conditions is subject to a fine of not less than $2,500 nor more than $25,000 per day for each violation, or by imprisonment for not more than 1 year, or both.

4. Duty to Reapply

(a) If the Permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the Permittee must apply for and obtain a reneval permit. The Permittee shall submit a new application at least 180 days before the expiration date of this permit, unless permission for a later date has been granted by the Director.

(b) Where EPA is the Permit Issuing Authority for the renewal permit, the terms and conditions of this permit continue in force under 5 U.S.C. Section 558(c) until the effective date of the new permit (or permit denial) only if the Permittee has submitted a timely and complete application under 40 CFR Section 122.21 for a renewal permit and the Permit Issuing Authority, through no fault of the Permittee, does not issue a new permit (or deny the permit) before the expiration date of this permit. The permit continued under 5 U.S.C. Section 558(c) remains fully effective and enforceable, including subject to the actions set forth in 40 CFR §122.6(c).

5. Duty to Mitigate

The Permittee shall take all reasonable steps to minimize or prevent any discharge in violation of this permit that has a reasonable likelihood of adversely affecting human health or the environment.

6. Permit Actions (Modification, Revocation and Reissuance, or Termination)

(a) This permit may be modified, revoked and reissued, or terminated for causes (as described in 40 CFR Sections 122.62, 122.63, and 122.64), including, but not limited to: violation of any terms or conditions of this permit; obtaining this permit by misrepresentation or failure to disclose fully all relevant facts; or a change in any condition that requires either a temporary or permanent reduction or elimination of the permitted discharge. The filing of a request by the Permittee for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance, does not stay any permit condition.

(b) Notwithstanding Paragraph II-A-6(a) above, if a toxic effluent standard or prohibition (including any schedule of compliance specified in such effluent standard or prohibition) is established under Section 307(a) of the Clean Water Act for a toxic pollutant that is present in the discharge and such standard or prohibition is more stringent than any limitation for such pollutant in this permit, this permit may be modified or revoked and reissued to conform to the toxic effluent standard or prohibition.

(c) Nothwithstanding Paragraph II-A-6(a) above, this permit may be modified, or alternatively revoked and reissued, to comply with any applicable effluent standard or limitation issued or approved under Sections 301(b)(2)(A), (C), (D), (E), and (F), or 304(b)(2) of the Clean Water Act, if the effluent standards or limitation so issued or approved contains different conditions or is otherwise more stringent than any effluent limitation in this permit; or controls any pollutant not limited in this permit.

7. Effect of Permit/Other Laws

(a) Issuance of this permit does not convey any property rights of any sort, or any exclusive privileges, nor does it authorize any injury to persons or property, or invasion of other private rights, or any infringement of Federal, State, or local laws or regulations.

(b) Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the Permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable State law or regulation under authority preserved by Section 510 of the Clean Water Act.

(c) Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the Permittee from any responsibilities, liabilities, or penalties to which the Permittee is or may be subject to under Section 311 of the Act.

(d) Except as provided in permit conditions on "Upsets," Paragraph II-B-4 below, and pH Excursions, Paragraph II-C-7(c) below, nothing in this permit shall be construed to relieve the Permittee from civil or criminal penalties for noncompliance with a permit condition.

(e) Pursuant to Section 509(b)(1)(F) of the Clean Water Act, a challenge to the validity of permit conditions, including the effluent limitations in Part I-A of this permit, shall not be a defense to an enforcement action under Section 309 or 505 of the Clean Water Act. Each and every violation of a permit condition is subject to an enforcement action.

(f) Compliance with the terms of this permit does not constitute a defense to any action brought under Section 504 of the Clean Water Act, or any other law governing protection of public health or welfare, for any imminent and substantial endangerment to public health or welfare.

8. Onshore or Offshore Construction

This permit does not authorize or approve the construction of any onshore or offshore physical structures or facilities or the undertaking of any work in any waters of the United States.

9. Inspection and Entry

The Permittee shall allow the Director, or an authorized representative, upon the presentation of credentials and other documents as may be required by law, to:

a. Enter upon the Permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this permit;

b. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit;

c. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit; and

d. Sample or monitor at reasonable times, for the purposes of ensuring permit compliance or as otherwise authorized by the Clean Water Act, any substances or parameters at any location.

10. Severability

The provisions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby.

SECTION B. OPERATION AND MAINTENANCE OF POLLUTION CONTROLS

1. Proper Operation and Maintenance

The Permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) that are installed or used by the Permittee to achieve compliance with the conditions of this permit. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems that are installed by a Permittee only when the operation is necessary to achieve compliance with the conditions of the permit.

2. Need to Halt or Reduce not a Defense

It shall not be a defense for a Permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

3. Bypass of Treatment Facilities

a. Definitions

(1) "Bypass" means the intentional diversion of waste streams from any portion of a treatment facility, which is not a designed or established operating mode for the facility.

(2) "Severe property damage" means substantial physical damage to property, damage to the treatment facilities that renders them inoperable, or substantial and permanent loss of natural resources that can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.

b. Bypass Not Exceeding Limitations

The Permittee may allow any bypass to occur that does not cause effluent limitations to be exceeded, but only if it also is for essential maintenance to ensure efficient operation. These bypasses are not subject to the provisions of Paragraphs c. and d. of this section.

c. Notice

(1) Anticipated bypass. If the Permittee knows in advance of the need for a bypass, it shall submit prior notice, if possible at least ten days before the date of the bypass; including an evaluation of the anticipated quality and effect of the bypass.

(2) Unanticipated bypass. The Permittee shall submit notice of an unanticipated bypass as required in Paragraph II-D-6 (24-hour notice).

d. Prohibition of Bypass

(1) Bypass is prohibited and the Permit Issuing Authority may take enforcement action against a Permittee for bypass, unless:

(a) Bypass was unavoidable to prevent loss of life, personal injury, or severe and extensive property damage;

(b) There were no feasible alternatives to the bypass, such as maintenance of sufficient reserve holding capacity, the use of auxiliary treatment facilities, retention of untreated wastes, waste hauling, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate back-up equipment

should have been installed in the exercise of reasonable engineering judgment to prevent a bypass that occurred during normal periods of equipment downtime or preventive maintenance; and

(c) The Permittee submitted notices as required under Paragraph b. of this section.

(2) The Permit Issuing Authority may, within its authority, approve an anticipated bypass, after considering its adverse effects, if the Permit Issuing Authority determines that it will meet the three conditions listed above in Paragraph d.(1) of this section.

4. Upsets

"Upset" means an exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limitations because of factors beyond the control of the Permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation. An upset constitutes an affirmative defense to an action brought for noncompliance with such technology-based permit limitations if the requirements of 40 CFR Section 122.41(n)(3) are met. (Note that this provision does not apply to water quality requirements).

5. A Schedule of Maintenance

Any maintenance of facilities, which might necessitate unavoidable interruption of operation and degradation of effluent quality, shall be scheduled during noncritical water quality periods and carried out in a manner approved by the Permitting Authority.

6. Removed Substances

This permit does not authorize discharge of solids, sludge, filter backwash, or other pollutants removed in the course of treatment or control of wastewaters to waters of the United States unless specifically limited in Part I.

SECTION C. MONITORING AND RECORDS

1. Representative Sampling

Samples and measurements taken as required herein shall be representative of the volume and nature of the monitored discharge. All samples shall be taken at the monitoring points specified in this permit and, unless otherwise specified, before the effluent joins or is diluted by any other wastestream, body of water, or substance. Monitoring points shall not be changed without notification to and the approval of the Permit Issuing Authority.

2. Sampling Points

All samples shall be taken at the monitoring points specified in this permit and, unless otherwise specified, before the effluent joins or is diluted by

any other wastestream, body of water, or substance. Monitoring points shall not be changed without notification to and the approval of the Permitting Authority.

3. Flow Measurements

Appropriate flow measurement devices and methods consistent with accepted scientific practices shall be selected and used to ensure the accuracy and reliability of measurements of the volume of monitored discharges. The devices shall be installed, calibrated, and maintained to ensure that the accuracy of the measurements is consistent with the accepted capability of that type of device. Devices selected shall be capable of measuring flows with a maximum deviation of less than ± 10 percent from the true discharge rates throughout the range of expected discharge volumes. Guidance in selection, installation, calibration, and operation of acceptable flow measurement devices can be obtained from the following references:

(1) "A Guide of Methods and Standards for the Measurement of Water Flow," U.S. Department of Commerce, National Bureau of Standards, NBS Special Publication 421, May 1975, 97 pp. (Available from the U.S. Government Printing Office, Washington, DC 20402. Order by SD Catalog No. C13.10:421).

(2) "Water Measurement Manual," U.S. Department of Interior, Bureau of Reclamation, Second Edition, Revised Reprint, 1974, 327 pp. (Available from the U.S. Government Printing Office, Washington, DC 20402. Order by Catalog No. 127.19/2:W29/2, Stock No. S/N 24003-0027).

(3) "Flow Measurement in Open Channels and Closed Conduits," U.S. Department of Commerce, National Bureau of Standards, NBS Special Publication 484, October 1977, 982 pp. (Available in paper copy or microfiche from National Technical Information Service (NTIS), Springfield, VA 22151. Order by NTIS No. PB-273 535/5ST).

(4) "NPDES Compliance Flow Measurement Manual," U.S. Environmental Protection Agency, Office of Water Enforcement, Publication MCD-77, September 1981, 135 pp. (Available from the General Services Administration (8BRC), Centralized Mailing Lists Services, Building 41, Denver Federal Center, Denver, CO 80225).

4. Monitoring Procedures

Monitoring must be conducted according to test procedures approved under 40 CFR Part 136, unless other test procedures have been specified in this permit.

5. Calibration

The Permittee shall periodically calibrate and perform maintenance on all monitoring and analytical equipment used to monitor the pollutants discharged under this permit, at intervals that will ensure the accuracy of measurements.

6. Testing Variability Not a Defense

If the Permittee believes or has reason to believe that monitoring or sampling results reflect an analytical variability so as to render the results inaccurate, he may monitor or sample more frequently than required by this permit. The validity of the testing results, whether or not the Permittee has monitored or sampled more frequently, shall not be a defense to an enforcement action under Sections 309 or 505 of the Clean Water Act.

7. pH Effluent Limitations Under Continuous Monitoring

Notwithstanding Part I of this permit, where the Permittee continuously measures the pH of water and wastewater discharges pursuant to a requirement or option in this permit, excursions from the range provided in Part I are permitted, provided:

(a) The pH limitation in Part I of this permit is based upon a requirement imposed under 40 CFR Part 401, Subpart N.

(b) The total time during which the pH values are outside the required range of pH values shall not exceed 446 minutes in any calendar month.

(c) No individual excursions from the range of pH values shall exceed 60 minutes.

(d) For purposes of this section, an "excursion" is an unintentional and temporary incident in which the pH value of the discharge exceeds the range set forth in Part I of this permit. The number of individual excursions exceeding 60 minutes and the total accumulated excursion time in minutes occurring in any calendar month shall be reported in accordance with Paragraph II-D-4 of this permit.

8. Penalties for Tampering

The Clean Water Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate, any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than 2 years per violation, or by both.

9. Retention of Records

The Permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit, for a period of at least three years from the date of the sample, measurement, report or application. This period may be extended by the Permitting Authority at any time.

10. Monitoring Records

Records of monitoring information shall include:

a. The date, exact place, and time of sampling or measurements;
b. The individual(s) who performed the sampling or measurements;
c. The date(s) analyses were performed;
d. The individual(s) who performed the analyses;
e. The analytical techniques or methods used; and
f. The results of such analyses.

11. Additional Monitoring by the Permittee

If the Permittee monitors any pollutant more frequently than required by this permit, using test procedures approved under 40 CFR Part 136 or as specified in this permit, the results of this monitoring shall be included in the calculation and reporting of the data submitted in the Discharge Monitoring Report (DMR). Such increased frequency shall also be indicated.

12. Averaging of Measurements

Calculations for limitations that require averaging of measurements shall utilize an arithmetic mean unless otherwise specified by the Permitting Authority in the permit.

SECTION D. REPORTING REQUIRMENTS

1. Change in Discharge

The Permittee shall give notice to the Permitting Authority as soon as possible of any planned physical alterations or additions to the permitted facility. Notice is required only when:

a. The alteration or addition to a permitted facility may meet one of the criteria for determining whether a facility is a new source; or

b. The alteration or addition could significantly change the nature or increase the quantity of pollutants discharged. This notification applies to pollutants that are subject neither to effluent limitations in the permit, nor to notification requirements under Section D, Paragraph 10(a).

2. Anticipated Noncompliance

The Permittee shall give advance notice to the Permitting Authority of any planned change in the permitted facility or activity that may result in noncompliance with permit requirements. Any maintenance of facilities, which might necessitate unavoidable interruption of operation and degradation of effluent quality, shall be scheduled during noncritical water quality periods and carried out in a manner approved by the Permitting Authority.

3. Transfer of Ownership or Control

A permit may be automatically transferred to another party if:

a. The Permittee notifies the Permitting Authority of the proposed transfer at least 30 days in advance of the proposed transfer date;

b. The notice includes a written agreement between the existing and new Permittees containing a specific date for transfer of permit responsibility, coverage, and liability between them; and

c. The Permitting Authority does not notify the existing Permittee of its intent to modify or revoke and reissue the permit. If this notice is not received, the transfer is effective on the date specified in the agreement mentioned in Paragraph b, above.

4. Reporting of Monitoring Results

Monitoring results obtained during the previous calendar quarter shall be summarized for each month (each quarter if monitoring frequency is quarterly) and must be reported on a Discharge Monitoring Report Form (EPA No. 3320-1), postmarked no later than the day of the month following the completed calendar quarter. Duplicate signed copies of these, and all other reports required by Section D of Part II, Reporting Requirements, shall be submitted to the Permitting Authority at the following addresses:

| U.S. EPA Regional Office: | State Office: |
|---|---|
| (insert address) _____ | (insert address) _____ |
| _____ | _____ |
| _____ | _____ |

5. Compliance Schedules

Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of this permit shall be submitted no later than 14 days following each schedule date. Any reports of noncompliance shall include the cause of noncompliance, any remedial actions taken, and the probability of meeting the next scheduled requirement.

6. Twenty-Four Hour Reporting

The Permittee shall orally report any noncompliance that may endanger health or the environment within 24 hours from the time the Permittee becomes aware of the circumstances. A written submission shall also be provided within five days of the time the Permittee becomes aware of the circumstances. The written submission shall contain a description of the noncompliance, its cause, and the period of noncompliance, including exact dates and times. If the noncompliance has not been corrected, the written submission shall also include the anticipated time it is expected to continue, and steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance. The Permitting Authority may verbally waive the written report, on a case-by-case basis, when the oral report is made.

The following violations shall be included in the 24-hour report when they might endanger health or the environment:

a. An unanticipated bypass that exceeds any effluent limitation in the permit.

b. Any upset that exceeds any effluent limitation in the permit.

7. Other Noncompliance

The Permittee shall report, in narrative form, all instances of noncompliance not previously reported under Section D, Paragraphs 2, 4, 7, and 8, at the time monitoring reports are submitted. The reports shall contain the information listed in Paragraph 8.

8. Other Information

Where the Permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or in any report to the Permitting Authority, it shall promptly submit such facts or information.

9. Changes in Discharges of Toxic Substances

The Permittee shall notify the Permit Issuing Authority as soon as it knows or has reason to believe:

a. That any activity has occurred or will occur that would result in the discharge, on a routine or frequent basis, of any toxic substance(s) (listed at 40 CFR Part 122, Appendix D, Tables II and III) that is not limited in the permit, if that discharge will exceed the highest of the following "notification levels":

(1) One hundred micrograms per liter (100 ug/l);

(2) Two hundred micrograms per liter (200 ug/l) for acrolein and acrylonitrile; five hundred micrograms per liter (500 ug/l) for 2,4-dinitrophenol and for 2-methyl-4,6-dinitrophenol; and one milligram per liter (1 mg/l) for antimony; or

(3) Five (5) times the maximum concentration value reported for that pollutant(s) in the permit application.

b. That any activity has occurred or will occur that would result in any discharge, on a nonroutine or infrequent basis, of a toxic pollutant (listed at 40 CFR Part 122, Appendix D, Tables II and III) that is not limited in the permit, if that discharge will exceed the highest of the following "notification levels:"

(1) Five hundred micrograms per liter (500 ug/l);

(2) One milligram per liter (1 mg/l) for antimony; or

(3) Ten (10) times the maximum concentration value reported for that pollutant(s) in the permit application.

10. Duty to Provide Information

The Permittee shall furnish to the Permitting Authority, within a reasonable time, any information that the Director may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit, or to determine compliance with this permit. The Permittee also shall furnish to the Permitting Authority, upon request, copies of records required to be kept by this permit.

11. Signatory Requirements

All applications, reports, or information submitted to the Permit Issuing Authority shall be signed and certified.

a. All permit applications shall be signed as follows:

(1) For a corporation: by a responsible corporate officer. For the purpose of this Section, a responsible corporate officer means: (1) a president, secretary, treasurer or vice president of the corporation in charge of a principal business function, or any other person who performs similar policy or decisionmaking functions for the corporation; or (2) the manager of one or more manufacturing, production, or operating facilities employing more than 250 persons or having gross annual sales or expenditures exceeding $25 million (in second-quarter 1980 dollars), if authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures.

(2) For a partnership or sole proprietorship: by a general partner or the proprietor, respectively; or

(3) For a municipality, State, Federal, other political subdivision, public agency/agents thereof: by either a principal executive officer or ranking elected official.

b. All reports required by the permit and other information requested by the Permitting Authority shall be signed by a person described above or by a duly authorized representative of that person. A person is a duly authorized representative only if:

(1) The authorization is made in writing by a person described above;

(2) The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity, such as the position of plant manager, operator of a well or a well field, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters for the company (A duly authorized representative thus may be either a named individual or any individual occupying a named position.); and

(3) The written authorization is submitted to the Permit Issuing Authority.

c. Certification. Any person signing a document under Paragraphs (a) or (b) of this section shall make the following certification:

> "I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

12. Availability of Reports

Except for data determined to be confidential under 40 CFR Part 2, all reports prepared in accordance with the terms of this permit shall be available for public inspection at the offices of the Permitting Authority. As required by the Act, permit applications and permit and effluent data shall not be considered confidential.

13. Penalties for Falsification of Reports

The Clean Water Act provides that any person who knowingly makes any false statement, representative, or certification in any record or other document submitted or required to be maintained under this permit, including monitoring reports or reports of compliance or noncompliance, shall, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than 2 years per violation, or by both.

SECTION E. DEFINITIONS

1. Permit Issuing Authority

The Regional Administrator or his designee, unless at some time in the future the State receives the authority to administer the NPDES program and assumes jurisdiction over the permit, at which time the Director of the State program receiving authorization becomes the issuing authority.

2. Act

"Act" means the Clean Water Act (formerly referred to as the Federal Water Pollution Control Act) Public Law 92-500, as amended by Public Law 95-217, Public Law 95-576 and Public Law 100-4, 33 U.S.C. 1251 et seq.

3. Concentration Measurements

a. The "average monthly concentration" is the sum of the concentrations of all daily discharges sampled and/or measured during a calendar month on which daily discharges are sampled and measured, divided by the number of daily discharges sampled and/or measured during such

month (arithmetic mean of the daily concentration values). The daily concentration value is equal to the concentration of a composite sample or, in the case of grab samples, is the arithmetic mean (weighted by flow value) of all the samples collected during the calendar day.

b. The "maximum daily concentration" is the concentration of a pollutant discharge during a calendar day. It is identified as "Daily Maximum" in Part I of the permit and the highest such value recorded during the reporting period is reported under the "Maximum" column under "Quality" on the DMR.

4. Other Measurements

a. The effluent flow, expressed as MGD, is the 24-hour average flow averaged monthly. It is the arithmetic mean of the total daily flows recorded during the calendar month. Where monitoring requirements for flow are specified in Part I of the permit, the flow rate values are reported in the "Average" column under "Quantity" on the DMR.

b. An "instantaneous flow measurement" is a measure of flow taken at the time of sampling, when both the sample and flow will be representative of the total discharge.

c. Where monitoring requirements for pH or dissolved oxygen are specified in Part I of the permit, the values are generally reported in the "Quality or Concentration" column on the DMR.

5. Types of Samples

a. Grab Sample: A "grab sample" is a single influent or effluent portion that is not a composite sample. The sample(s) shall be collected at the period(s) most representative of the total discharge.

6. Calendar Day

A calendar day is defined as the period from midnight of one day until midnight of the next day. However, for purposes of this permit, any consecutive 24-hour period that reasonably represents the calendar day may be used for sampling.

7. Hazardous Substance

A hazardous substance means any substance designated under 40 CFR Part 116 pursuant to Section 311 of the Clean Water Act.

8. Toxic Pollutant

A toxic or "priority" pollutant is one of 126 substances listed as toxic under Section 307(a)(1) of the Clean Water Act.

PART III

A. SPECIAL CONDITIONS

1. Best Management Practices Requirements

A Best Management Practices (BMP) plan shall be developed within one month after the effective date of the permit and shall be implemented as soon as practicable but no later than two months from the effective date of the permit. The plan must address the following BMPs:

a. Prevention of run-on/interception of runoff: Technologies that are designed to prevent or reduce run-on include dikes, diversion channels, flood walls, terraces, grading, and revegetation. Temporary diversion dikes, diversion channels, and terraces are constructed upslope of a site to direct run-on from offsite to a collection system or away from the site. Terraces are used in combination with dikes or ditches to channel water stopped by the terraces away from the site.

b. Prevention of infiltration: The primary method for preventing infiltration of onsite surface water is capping. Grading also helps to minimize infiltration by maximizing the amount of water that will run off without causing significant erosion. Revegetation can either promote or minimize infiltration.

c. Collection and transfer of water: Several technologies can be used to collect diverted water for discharge or transfer to a storage or treatment system. Chutes (or flumes) and downpipes are designed to transfer water away from diversion structures such as dikes or terraces to stabilized channels or outlets. Waterways can be used to intercept or divert water as well as to collect and transfer water diverted elsewhere.

d. Storage and discharge of water: Technologies for this purpose include seepage basins and ditches, sedimentation basins, and storage ponds. Their function depends on the level of contamination of the water they receive. Seepage basins and ditches are used to discharge uncontaminated or treated water down and away from the site. Sedimentation basins are used to control suspended solid particles in surface-water flow.

2. Reopener Clause

This permit shall be modified, or alternatively revoked and reissued, to comply with any applicable effluent standard or limitation issued or approved under Sections 301(b)(2)(C) and (D), 304(b)(2), and 307(a)(2) of the Clean Water Act, if the effluent standard or limitation so issued or approved:

a. Contains different conditions or is otherwise more stringent than any condition in the permit; or

b. Controls any pollutant not limited in the permit.

3. Chronic Toxicity Testing Requirements for Characterizing Effluent Toxicity

The Permittee shall perform toxicity testing, as described below, on the discharge from Outfall 001.

a. The Permittee shall initiate the following series of tests as soon as practicable, but within 30 days of the effective date of this permit to evaluate toxicity of the discharge. Such testing will determine if an appropriately dilute effluent sample affects the survival, growth, or reproduction of the test species. All tests will be conducted on 24-hour composite samples. A minimum of four replicates will be used in each of the following tests. The Student's t test shall be used to determine whether differences in control and effluent data are significant.

(1) The Permittee shall conduct a seven-day Ceriodaphnia survival and reproduction toxicity test on the final effluent diluted by appropriate control water. Toxicity will be demonstrated if there is a statistically significant difference at the 95-percent confidence level in survival or reproduction between Ceriodaphnia exposed to an appropriate control water and the final effluent. All test solutions shall be renewed using an approved renewal schedule. If, in any control, more than 20 percent of the test organisms die, that test shall be repeated.

(2) The Permittee shall conduct a seven-day fathead minnow survival and growth toxicity test on the final effluent diluted by appropriate control water. Toxicity will be demonstrated if there is a statistically significant difference at the 95-percent confidence level in survival or growth between fathead minnows exposed to an appropriate control water and the final effluent. All test solutions shall be renewed using an approved renewal schedule. If, in any control, more than 20 percent of the test organisms die, that test shall be repeated.

b. The toxicity tests specified in Paragraph (a) above, shall be conducted once per month for a period of one year following initiation of the tests and once every six months thereafter for the duration of the permit. Results shall be reported according to EPA/600/4-85/014, Section 10 Report Preparation, and shall be submitted to EPA with the monthly Discharge Monitoring Report. If any one test indicates the effluent is toxic, another confirmatory chronic toxicity test using the same species and the same methodology shall be conducted within one week.

c. All test species, procedures, and quality assurance criteria used shall be in accordance with Short Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms, Section 13; Ceriodaphnia Survival and Reproduction Test Method 1002.0; Section 11; Fathead Minnow (Pimephales promelas); Larval Survival and Growth Test Method 1000.0, EPA 600/4-85/04. The selection of an appropriate control water for all toxicity tests shall be submitted to EPA for review and approval prior to use.

4. Modification of Monitoring Requirements

a. After three months of weekly flow and chemical-specific monitoring, the Permittee may submit a written request for reduced frequency of monitoring requirements. The Permitting Authority may grant or refuse the request based on site-specific conditions, as appropriate.

b. After three months of monthly toxicity testing as required in Paragraph III-A-3, the Permittee may submit a written request for cessation or reduction of biomonitoring requirements. The Permitting Authority may grant or refuse the request based on site-specific conditions, as appropriate.

# PART III

## FACT SHEET FOR MODEL NPDES PERMIT FOR DISCHARGES RESULTING FROM THE CLEANUP OF GASOLINE RELEASED FROM UNDERGROUND STORAGE TANKS

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## LIST OF TABLES

# 1.0 FACT SHEET FOR MODEL NPDES PERMIT FOR DISCHARGES RESULTING FROM THE CLEANUP OF GASOLINE RELEASED FROM UNDERGROUND STORAGE TANKS

Pursuant to the Clean Water Act (CWA), the U.S. Environmental Protection Agency (EPA), or an EPA-approved State, is authorized to issue a National Pollutant Discharge Elimination System (NPDES) permits for the discharge of "pollutants" from any "point source" into "waters of the United States." CWA 301(b) requires all point sources that discharge directly to the waters of the U.S. to meet technology-based effluent limitations and State water quality standards for the discharge of pollutants. EPA has determined technology-based effluent limitations through the development of National effluent limitations guidelines for many specific categories of industries. However, national effluent guidelines have not been promulgated for wastewater discharges resulting from gasoline underground storage tank (UST) cleanups. Consequently, this technology-based permit has been developed on a best professional judgment (BPJ) basis in accordance with 40 CFR 125.3. BPJ is used to develop technology-based effluent limits in those cases where an effluent guideline has not been promulgated for the industry and water quality standards do not dictate limits more stringent than technology-based limits.

Water quality-based limitations should be used in a permit when technology-based effluent limits are not stringent enough to protect the "designated use" of the receiving waters (as determined by the State). Water quality-based permits involve a site-specific evaluation of the discharge, the State's water quality standards, the designated use of the receiving water, and published EPA water quality criteria. Therefore, the Model Permit and this Fact Sheet only address technology-based effluent limitations. Guidance for addressing water quality considerations is included in Part IV - Decision Tool for Developing Water Quality-Based Effluent Limitations.

## 2.0 SCOPE OF THE PROBLEM

It is estimated that 1.7 million underground storage tanks exist in the United States. Based on data collected by EPA's Office of Underground Storage Tanks (OUST) (Ref. No. 1)*, 15 percent of these tanks are currently leaking. Gasoline leaks have been cited in more than 70 percent of the reported release incidents (Ref. No. 14). The OUST estimates that over the next 5 years, approximately 200,000 cleanups will be conducted to mitigate releases of petroleum-related products into the environment. Assuming that 70 percent of all underground tank releases involve gasoline, then as many as 140,000 gasoline-related UST cleanups could occur over the next 5 years.

Any discharges to surface waters resulting from gasoline UST cleanups fall under the auspices of the NPDES program. These discharges could include treated ground water, storm water, and tank cleaning wastewaters. The treatment technologies commonly employed for gasoline UST cleanups are discussed in greater detailed in Section 4.0.

*Reference numbers correspond to the number assigned to each reference listed in Section 8.0 of this Fact Sheet.

# 3.0 DISCHARGE CHARACTERIZATION

The volume and nature of discharges resulting from gasoline UST cleanups is expected to be highly variable. Based on available data, the following sections briefly describe the volume and nature of the discharges that would be expected from gasoline UST cleanups.

## 3.1 VOLUME OF DISCHARGE

The volume of discharges generated from gasoline UST cleanups varies. Such variation is due to site-specific factors such as the size of the release, depth to ground water, etc. However, OUST estimates the typical flow rate of treated water and wastewater discharges resulting from gasoline cleanups falls in the range of three to 20 gallons per minute, or about 4,000 to 30,000 gallons per day (Ref. No. 2).

## 3.2 CONSTITUENTS OF GASOLINE

Available data that enumerate the constituents of gasoline was reviewed, based on the assumption that the same compounds identified in gasoline would likely be found in treated water and wastewater resulting from gasoline cleanups. Those constituents are shown in Table 3-1. The chemical properties of these constituents, such as solubility (in water) and volatility, have been used to characterize the treatability of discharges resulting from gasoline UST cleanups (see Section 5.0). It should be noted that lead is used as an anti-knocking compound in gasoline. However, lead is present in gasoline as a component of the organic compound tetraethyllead.

The characterization of gasoline shown in Table 3-1 is based on an analysis of constituents commonly found in gasoline. However, little to no data are available regarding the concentration of pollutants in treated water and wastewater discharges from UST cleanups of gasoline. Similarly, additional site-specific constituents, such as gasoline additives, may be present. Some of these are proprietary additives for which little or no data exist (Ref. No. 6).

TABLE 3-1. CONSTITUENTS OF GASOLINE

| Gasoline Constituent | Reference |
|---|---|
| Isobutane | 3,4,5 |
| n-Butane | 3,4,5 |
| Isopentane | 3,4,5 |
| n-Pentane | 3,4,5 |
| n-Octane | 3 |
| Benzene | 3,4,5 |
| Toluene | 3,4,5 |
| o-Xylene | 5 |
| m-Xylene | 5 |
| p-Xylene | 5 |
| n-Hexane | 3,4,5 |
| 2-Methylpentane | 3,4,5 |
| 3-Methylpentane | 4,5 |
| 2,2-Dimethylhexane | 5 |
| 2,4-Dimethylhexane | 3 |
| Ethylbenzene | 3,4,5 |
| 2,2,4-Trimethylhexane | 3 |
| 2,2,5,5-Tetramethylhexane | 3 |
| 1-Hexene | 3 |
| 1,3,5-Trimethylbenzene | 3 |
| 2,2-Dimethylpropane | 4 |
| 2,2-Dimethylbutane | 4 |
| 1,2,4-Trimethylbenzene | 4 |
| 2,3-Dimethylbutane | 5 |
| 2-Methylhexane | 5 |
| 3-Methylhexane | 5 |
| 2,3-Dimethylpentane | 5 |
| 2,4-Dimethylpentane | 5 |
| 2,2,4-Trimethylpentane | 5 |
| 2,3,4-Trimethylpentane | 5 |
| 2,3,3-Trimethylpentane | 5 |
| 2,2,3-Trimethylpentane | 5 |
| 2-Methyloctane | 5 |
| 3-Methyloctane | 5 |
| 4-Methyloctane | 5 |
| Cyclopentane | 5 |
| Methylcyclopentane | 5 |
| Methylcyclohexane | 5 |
| 1,cis,3-Dimethylcyclopentane | 5 |
| Cyclohexane | 5 |
| n-Heptane | 5 |

TABLE 3-1. CONSTITUENTS OF GASOLINE (Continued)

| Gasoline Constituent | Reference |
|---|---|
| 1,cis,3-Dimethyl-cyclopentane | 5 |
| 1,trans,3-Dimethyl-cyclopentane | 5 |
| Propylene | 5 |
| trans Butene-2 | 5 |
| cis Butene-2 | 5 |
| 1-Pentene | 5 |
| trans Pentene-2 | 5 |
| cis Pentene-2 | 5 |
| 2-Methylpentene-1 | 5 |
| 2-Methylpentene-2 | 5 |
| 1-Methyl, 3-Ethylbenzene | 5 |
| 1-Methyl, 4-Ethylbenzene | 5 |
| 1,2,4-Trimethylbenzene | 5 |
| Tetraethyllead | 6 |
| Naphthalene | 5 |

## 3.3 POTENTIAL SOURCES OF DISCHARGE

Discharges from gasoline UST cleanups can originate from one or more of several sources. Examples of these sources include:

- Contaminated ground water that has been extracted and treated
- Contaminated storm water that has been collected and treated
- Wastewaters that are generated from tank cleaning operations
- Contaminated water that results from product recovery operations.

As discussed in Section 1.1, any direct discharge to waters of the U.S. would be subject to regulation under a NPDES permit.

# 4.0 TREATMENT TECHNOLOGIES

The cleanup or "corrective action" for releases from gasoline USTs usually involves two phases. The first phase includes actions designed to immediately contain and control a release. The second phase involves assessing and developing long-term measures designed to rectify and mitigate contamination to a level that will protect human health and the environment.

## 4.1. FREE PRODUCT RECOVERY

Where site conditions permit, an UST cleanup typically begins with recovery of gasoline (known as free product) floating on the water table. Prompt removal of free product can minimize the extent of soil and ground water that may potentially be contaminated by an UST release.

Free product is often removed by digging a trench to intercept the flow of floating gasoline or by pumping ground water to create a cone of depression in the water table. In either case, the free product flows toward the collection point where it is removed by pumping. The ongoing process of free product removal often requires the pumping or collection of substantial amounts of ground water which may contain dissolved gasoline constituents. This water may require treatment prior to discharge. This Fact Sheet describes two technologies commonly used to treat such water. These technologies are air stripping and carbon adsorption.

## 4.2 TREATMENT OF CONTAMINATED WATER AND WASTEWATERS

As product recovery continues, a variety of aqueous wastestreams and contaminated waters may require additional treatment (see section 3.3). There are many treatment technologies and methods available that could remove gasoline constituents from these aqueous wastestreams and contaminated waters including air stripping, carbon adsorption, biorestoration, reverse osmosis, steam stripping, ozonation, etc. Use of any one of these treatment technologies will depend upon the site-specific factors involved in an UST corrective action. For example, due to equipment and utility requirements, the use of steam stripping is not practicable for emergency field use unless the contaminated ground water can be transported form the site to a steam

stripping facility (Ref. No. 7). However, air stripping and carbon adsorption are the most cost-effective and widely used treatment technologies available. In fact, these two technologies are used in over 95 percent of ground-water cleanups and are applicable to most cases where gasoline has contaminated the groundwater (Ref. No. 6). Therefore, both air stripping and carbon adsorption are described below.

### 4.2.1 Air Stripping

Due to the high volatility of many of the soluble constituents of gasoline that remain in contaminated water and wastewater, air stripping is an efficient and cost effective wastewater treatment technology. Air stripping is a proven, effective means to remove volatile organic compounds (VOCs) from ground water. Less volatile compounds (e.g., compounds with low Henry's Law Constants) are not as easily removed via air stripping. There are several methods of air stripping including diffused aeration, tray aerators, spray basins, and packed towers. Regardless of the configuration used, all air stripping units provide contact between air and water to allow the volatile substances to diffuse from the liquid to the gaseous phase (Ref. No. 6).

Air stripping transfers the pollutants removed from the contaminated water into the air. In some cases, volatilized pollutants may require additional treatment (e.g., vapor phase carbon adsorption) to control pollutant discharges to air.

### 4.2.2 Carbon Adsorption

Activated carbon is widely used in the treatment of wastewater contaminated with gasoline (Ref. No. 6). This treatment may be used either separately or in combination with air stripping to address air quality concerns that may arise from volatilizing the constituents of gasoline. The process of absorption onto activated carbon requires the wastewater to come into contact with the carbon, which selectively adsorbs organic constituents by a surface attraction phenomenon (due to chemical or physical properties). The organic molecules are attracted to the internal pores of the carbon granules. Adsorption depends on the strength of the molecular attraction between

adsorbent and adsorbate, molecular weight, type and characteristic of adsorbent, electrokinetic charge, pH, and adsorbent surface area.

Most waste treatment applications use granular activated carbon (GAC) adsorption units. These units are generally used in a downflow fixed bed series mode where the waste stream flows through a series of packed bed reactors. Eventually the carbon surfaces become saturated with organic molecules, and reach the "breakthrough" point. The carbon must be replaced and disposed of or regenerated for treatment to continue.

Use of GAC may be limited by site-specific conditions and cost considerations. For example, treatment of ground water with naturally high iron and manganese levels can clog the carbon filters. In addition, requirements for disposing of the spent carbon may add significantly to treatment costs (see section 5.3.3).

# 5.0 TECHNOLOGY-BASED EFFLUENT LIMITATIONS

After a gasoline UST release has occurred, free product floats on the surface or ground water near the site where it is skimmed or recovered using a product recovery system. While many gasoline constituents remain as part of a free floating gasoline layer (as opposed to dissolving into the water), the more soluble fractions of the gasoline can dissolve into the surface or ground water. Dissolved gasoline constituents typically remain in oil/water separator effluent at a concentration of 15 ppm (Ref. No. 6).

The technology-based effluent limitations developed in the Model Permit were based on the use of an air stripping unit. Air stripping units have been demonstrated to be effective in removing the same or similar pollutants that are found in gasoline. In addition, air stripping units are widely used and readily available, and are generally less expensive than other available treatment technologies. It is important to note that EPA does not intend to specify the actual treatment that must be used at gasoline UST cleanup sites. Other treatment technologies, such as carbon adsorption and biorestoration, have also been used to treat contaminated water and wastewater resulting from gasoline UST cleanups. Air stripping units are only used as the technology-basis for justifying BPJ effluent limitations that are achievable with an existing treatment technology.

## 5.1 SELECTION OF POLLUTANTS TO BE REGULATED

As discussed in Section 3.0, the chemical properties of gasoline constituents determine the treatability of these constituents. Constituent treatability forms the primary basis for selecting pollutants for which effluent limitations should be developed.

### 5.1.1 Solubility of Gasoline Constituents

Gasoline constituent solubilities in water are shown in Table 5-1. Generally, the higher the solubility of a constituent in water, the more difficult it is to remove the constituent from water using an air stripper.

TABLE 5-1. SOLUBILITY OF CONSTITUENTS OF GASOLINE

| Gasoline Constituent | Solubility in Water (mg/l) |
|---|---|
| Isobutane | 48.9 |
| n-Butane | 61.4 |
| Isopentane | 47.8 |
| n-Pentane | 38.5 |
| n-Octane | $6.57 \times 10^{-1}$ |
| Benzene | 1,780.0 |
| Toluene | 515.0 |
| o-Xylene | 175.0 |
| m-Xylene | 162.0 |
| p-Xylene | 198.0 |
| n-Hexane | 9.5 |
| 2-Methylpentane | 13.8 |
| 3-Methylpentane | 12.8 |
| 2,2-Dimethylhexane | 2.24 |
| 2,4-Dimethylhexane | 1.28 |
| Ethylbenzene | 152.0 |
| 2,2,4-Trimethylhexane | 0.87 |
| 2,2,5,5-Tetramethylhexane | 0.33 |
| 1-Hexene | 59.5 |
| 1,3,5-Trimethylbenzene | 69.1 |
| 2,2-Dimethylpropane | 33.2 |
| 2,2-Dimethylbutane | 18.4 |
| 1,2,4-Trimethylbenzene | 57.0 |
| 2,3-Dimethylbutane | 22.5 |
| 2-Methylhexane | 2.54 |
| 3-Methylhexane | 2.64 |
| 2,3-Dimethylpentane | 5.25 |
| 2,4-Dimethylpentane | 4.06 |
| 2,2,4-Trimethylpentane | 1.14 |
| 2,3,4-Trimethylpentane | 1.36 |
| 2,3,3-Trimethylpentane | 2.59 |
| 2,2,3-Trimethylpentane | 2.59 |
| 2-Methyloctane | 1.42 |
| 3-Methyloctane | 1.42 |
| 4-Methyloctane | 0.01 |
| Cyclopentane | 160.0 |
| Methylcyclopentane | 61.1 |
| Methylcyclohexane | 14.0 |
| Cyclohexane | 55.6 |
| n-Heptane | 2.96 |

TABLE 5-1. SOLUBILITY OF CONSTITUENTS OF GASOLINE (Continued)

| Gasoline Constituent | Solubility in Water (mg/l) |
|---|---|
| 1,cis,3-Dimethyl-cyclopentane | 7.07 |
| 1,trans,3-Dimethyl-cyclopentane | 7.07 |
| Propylene | 2006.0 |
| trans Butene-2 | 430.0 |
| cis Butene-2 | 430.0 |
| 1-Pentene | 148.0 |
| trans Pentene-2 | 203.0 |
| cis Pentene-2 | 203.0 |
| 2-Methylpentene-1 | 78.0 |
| 2-Methylpentene-2 | 84.2 |
| 1-Methyl, 3-Ethylbenzene | 40.0 |
| 1-Methyl, 4-Ethylbenzene | 40.0 |
| 1,2,4-Trimethylbenzene | 57.0 |
| Tetraethyllead | 0.80 |
| Naphthalene | 3,400.0 |

Source: Reference No. 8

The three compounds of gasoline with the highest solubilities are naphthalene (3,400 mg/l), propylene (2,006 mg/l) and benzene (1,780 mg/l). Propylene, however, accounts for only 0.03 percent of gasoline (Ref. No. 5) and would not be likely to dissolve into ground water in significant amounts. Naphthalene is also a minor constituent of gasoline. Therefore, effluent limitations for naphthalene and propylene were not included in this Model Permit. Benzene was selected as the main pollutant of concern since it is a more significant constituent of gasoline than naphthalene or propylene.

### 5.1.2 Henry's Law Constants of Gasoline Constituents

The Henry's Law Constant for each of the constituents of gasoline is shown in Table 5-2 (Ref. No. 8). As discussed in Section 4.2, the Henry's Law Constant describes the ease with which specific compounds can be removed by air stripping. Compounds with lower Henry's Law Constants are more difficult to remove by air stripping than compounds with higher Henry's Law Constants. Where multiple volatile organic compounds are present, the compound with the lowest Henry's Law Constant will generally be the limiting compound (Ref. No. 6). As shown in Table 5-2, benzene, ethylbenzene, toluene, the xylenes, 1,3,5-trimethylbenzene, and naphthalene have the lowest Henry's Law Constants. While these compounds are the least strippable constituents of gasoline, all of the gasoline constituents are within the range where air stripping is considered to be effective (Ref. No. 6).

### 5.1.3 Indicator Pollutants Recommended for Limitation

Based on the chemical properties of gasoline constituents (i.e., solubility and Henry's Law Constants), there are several primary pollutants of concern for discharges from UST cleanups:

- Benzene
- Propylene
- Ethylbenzene
- Xylene

TABLE 5-2. HENRY'S LAW CONSTANTS FOR CONSTITUENTS OF GASOLINE

| Gasoline Constituent | Henry's Law Constant (20°C) ($atm \cdot m^3/mole$) |
|---|---|
| Isobutane | 0.9 to 1.0(1) |
| n-Butane | 0.859 |
| Isopentane | 1.31 |
| n-Pentane | 1.26 |
| n-Octane | 3.20 |
| Benzene | $5.47 \times 10^{-3}$ |
| Toluene | $6.65 \times 10^{-3}$ |
| o-Xylene | $5.20 \times 10^{-3}$ |
| m-Xylene | $5.27 \times 10^{-3}$ |
| p-Xylene | $5.27 \times 10^{-3}$ |
| n-Hexane | 1.86 |
| 2-Methylpentane | 1.53 |
| 3-Methylpentane | 1.07 |
| 2,2-Dimethylhexane | 2.28 |
| 2,4-Dimethylhexane | 3.55 |
| Ethylbenzene | $8.74 \times 10^{-3}$ |
| 2,2,4-Trimethylhexane | 3.03 |
| 2,2,5,5-Tetramethylhexane | 5.94 |
| 1-Hexene | 0.346 |
| 1,3,5-Trimethylbenzene | $5.70 \times 10^{-3}$ |
| 2,2-Dimethylpropane | 1.25 |
| 2,2-Dimethylbutane | 1.27 |
| 1,2,4-Trimethylbenzene | $3.02 \times 10^{-2}$ |
| 2,3-Dimethylbutane | 0.993 |
| 2-Methylhexane | 1.73 |
| 3-Methylhexane | 1.42 |
| 2,3-Dimethylpentane | 1.81 |
| 2,4-Dimethylpentane | 1.61 |
| 2,2,4-Trimethylpentane | 2.34 |
| 2,3,4-Trimethylpentane | 1.24 |
| 2,3,3-Trimethylpentane | 1.28 |
| 2,2,3-Trimethylpentane | 1.52 |
| 2-Methyloctane | 2.56 |
| 3-Methyloctane | 2.48 |
| 4-Methyloctane | 2.64 |
| Cyclopentane | 0.144 |
| Methylcyclopentane | 0.250 |
| Methylcyclohexane | 0.374 |
| Cyclohexane | 0.194 |
| n-Heptane | 2.04 |

TABLE 5-2. HENRY'S LAW CONSTANTS FOR CONSTITUENTS OF GASOLINE
(Continued)

| Gasoline Constituent | Henry's Law Constant (20°C) ($atm \cdot m^3/mole$) |
|---|---|
| 1,cis,3-Dimethyl-cyclopentane | 0.468 |
| 1,trans,3-Dimethyl-cyclopentane | 0.47 to 0.50(2) |
| Propylene | 0.230 |
| trans Butene-2 | 0.193 |
| cis Butene-2 | 0.172 |
| 1-Pentene | 0.294 |
| trans Pentene-2 | 0.229 |
| cis Pentene-2 | 0.224 |
| 2-Methylpentene-1 | 0.271 |
| 2-Methylpentene-2 | 0.211 |
| 1-Methyl, 3-Ethylbenzene | $2.63 \times 10^{-2}$ |
| 1-Methyl, 4-Ethylbenzene | 0.027 to .030(3) |
| Tetraethyllead | $3 \times 10^{-2}$ (4) |
| Naphthalene | $5.47 \times 10^{-4}$ |

(1)Although no Henry's Law Constant was found for this compound, the number shown was estimated based on the values for n-Butane and Isopentane.

(2)Although no Henry's Law Constant was found for this compound, the number shown was estimated based on the value for 1,cis,3-Dimethyl-cyclopentane.

(3)Although no Henry's Law Constant was found for this compound, the number shown was estimated based on the value for 1-Methyl,3-Ethylbenzene.

(4)Reference No. 6

Source: Reference No. 8

- Toluene
- 1,3,5 - Trimethylbenzene
- Naphthalene

The Model Permit includes effluent limitations for the aggregate parameter of benzene, ethylbenzene, toluene, and the xylenes (BETX). In addition, a limitation for benzene has been developed for use as an indicator parameter for the removal of propylene, 1,3,5-trimethylbenzene, and naphthalene. As an indicator, it is assumed that if benzene is removed, then the other compounds with similar treatability characteristics will also be removed. The primary advantage of using an indicator parameter is the reduction of monitoring required to ensure compliance. In addition, an indicator can be used for constituents for which no EPA approved analytical methods are available for monitoring.

A traditional approach to limiting effluent contaminated with gasoline or other fuel oils has been to limit BETX. This approach stems from petroleum industry practices for determining the quality of fuels by measuring BETX. Monitoring and limitation of BETX in discharges from gasoline UST corrective actions is prudent for several reasons. First, the composition of gasoline is highly variable and for some gasoline products any one of the four BETX constituents can be the predominant constituent. Second, EPA has promulgated or proposed water quality criteria for benzene, ethylbenzene, toluene, and the xylenes. Except for naphthalene, criteria have not been proposed for the other constituents of gasoline. Finally, as shown in Table 5-2, benzene, ethylbenzene, toluene, and the xylenes are gasoline constituents with low Henry's Law Constants. Therefore, limitation of the aggregate parameter, BETX, is provided in this Model Permit. On a site-specific basis, however, it may be more appropriate to individually limit ethylbenzene, toluene, and xylenes in addition to benzene.

In addition to BETX, the Henry's Law Constants for 1,3,5-trimethylbenzene and naphthalene are relatively low, as compared to other constituents contained in gasoline. The Merck Index (Ref. No. 19) states that 1,3,5-trimethylbenzene is "practically insoluble in water..." but may be

soluble in benzene. Furthermore, naphthalene is insoluble in water, but soluble in both benzene and toluene. Therefore, benzene is considered an appropriate indicator parameter for 1,3,5-trimethylbenzene and naphthalene. That is, if benzene is sufficiently treated or removed, then 1,3,5-trimethylbenzene and naphthalene should also be removed. In addition, naphthalene is considered to be a minor constituent in gasoline, accounting for less than 1 percent of the total gasoline product (Refs. No. 3 and 5).

The removal of benzene is also an indicator of the removal of propylene. As discussed in Section 5.1.1, propylene is slightly more soluble in water than benzene. However, propylene has a much higher Henry's Law Constant. Consequently, propylene is more amenable to treatment, by air stripping, than benzene. Therefore, removal of benzene is assumed to be indicative of the removal of propylene. As such, benzene is limited in this Model Permit.

## 5.2 CALCULATION OF TECHNOLOGY-BASED EFFLUENT LIMITATIONS

A recent EPA publication (Ref. No. 6) on UST cleanup technologies estimates that 15 ppm (or 15 mg/l) of dissolved product remains in ground water following free product recovery, under optimal operating conditions. Case studies have documented dissolved hydrocarbon levels of 2 to 10 mg/l after free product recovery was completed (Refs. No. 6, 18, and 20). These values have been used to estimate that the potential influent levels of total BETX into an air stripper (or other wastewater treatment system) varies from 2 to 15 mg/l. Vendors report that the potential removal efficiency of BETX using a commercially available air stripper unit is 99.5 percent. If air stripping is applied to influent BETX levels of 15 mg/l, the stripped effluent would contain 0.075 mg/l (or 75 ug/l) total BETX. One case study reported air stripper performance capable of reducing hydrocarbon influent levels of 4 to 6 mg/l to less than 100 ug/l after initial startup and shakedown testing was completed (Ref. No. 18). However, product recovery and air stripping technologies may not always occur under optimal conditions. Therefore, the total BETX discharge limit is 0.1 mg/l (or 100 ug/l). This is in keeping with total BETX effluent limitations currently required by EPA Region 1 (Ref. No. 20) and the State of Louisiana (Ref. No. 22).

Influent concentrations of benzene, which have rarely exceeded 1 mg/l in the State of Maryland, would be stripped to 0.005 mg/l (or 5 ug/l) at 99.5 percent efficiency (Ref. No. 21). Therefore, the limit of 5 ug/l was chosen for benzene. Further, EPA Region 1 (Ref. No. 20) and the States of Maryland (Ref. No. 21) and Nebraska (Ref. No. 23) have all indicated that dischargers in their jurisdictions have been able to meet the 5 ug/l limit for benzene.

### 5.2.1 Optional Effluent Limitations

Permit limitations based on BPJ must be achievable with existing technology at a reasonable cost. Based on data contained in the Regulatory Impact Analysis of Technical Standards for Underground Storage Tanks (Ref. No. 1), over 75 percent of retail motor fuel outlets (which accounts for the majority of gasoline USTs) in the U.S. are either owned or operated by businesses meeting the Small Business Administrations's definition for small businesses. Almost one-half of these own a single outlet with assets totaling over $400,000. Therefore, many of the smaller firms may be severely affected by the cost of compliance with the effluent limitations established in Section 5.2. Therefore, optional technology-based effluent limitations have been developed for discharges from gasoline UST cleanups where these costs will severely hinder a firm's ability to perform the remedial cleanup activities.

The same treatment technologies (i.e., free product recovery followed by air stripping) were used to establish the optional effluent limitations. However, the optional limitations are based on a 95 percent removal efficiency for both benzene and BETX. Using the same influent concentrations described in Section 5.2, the resultant effluent limitations will be 50 ug/l for benzene and 750 ug/l for BETX. This relaxed removal efficiency for benzene and BETX reduces the capital and operating costs for air stripping. This cost savings could be realized through a reduction in the tower height and packing depth, or a reduction in power requirements because a lower air-water ratio can be used, or both. For example, assuming the benzene influent concentration and all other operating conditions (e.g., loading rate, air-water ratio) remain the same, the depth of packing could be reduced by about 7 feet if the desired removal efficiency requirements were reduced from 99.5 percent removal to 95 percent removal.

### 5.2.2 Additional Effluent Limitations

The Daily Discharge limits set forth in Part I of the Model Permit restrict benzene and total BETX. In addition, pH is limited to the widely-accepted range of 6-9 standard units established for most industrial point source categories.

Some NPDES permit writers may be concerned about the potential presence of lead in gasoline at UST sites. In gasoline, however, lead is present as tetraethyllead (TEL) a component of an organic compound and thus not amenable to traditional metals removal technologies such as pH adjustment, flocculation and sedimentation. Based on the Henry's Law Constant for TEL, it would likely be removed by air stripping. TEL is also amenable to treatment by GAC, as discussed earlier in Section 4.2 (Ref. No. 6). Permit writers may consider applying monitoring requirements for lead, if lead is expected to be present in gasoline contaminated ground water in concentrations or quantities of concern.

## 5.3 TREATMENT COSTS

The following subsections briefly describes the cost of implementing product recovery, air stripping and carbon adsorption technologies.

### 5.3.1 Costs of Selected Treatment Technologies

According to Cleanup of Releases from Petroleum USTs: Selected Technologies (Ref. No. 6) the costs for free product recovery equipment will vary according to the methods chosen for remediation (e.g., surface vs. subsurface). Generally, the purchase costs will range from $6,000 to $10,000 for product recovery equipment.

Numerous literature sources report capital and operating and maintenance (O&M) costs for air stripping treatment systems. However, the literature reports costs for permanent structures rather than more flexible equipment. Because flexible equipment is more appropriate for use over the relatively short duration of many UST corrective actions, cost data has been collected for this Model Permit from vendors for pre-engineered, sled-mounted air stripping units (Ref. No. 10). Table 5-3 presents a summary of these costs, including total purchase costs and estimated annual operation and maintenance

TABLE 5-3. PURCHASE AND RENTAL COSTS FOR PRE-ENGINEERED PACKED COLUMN AIR STRIPPER UNITS

| Air Stripper Design Flow (gallons/minute) | Tower Height/Diameter (feet) | Packing Height (feet) | Total Purchase Cost ($)[1] | Monthly Rental Cost ($)[2] | Estimated Annual Operations and Maintenance Costs ($)[3] |
|---|---|---|---|---|---|
| 3-20 | 18.5/1 | 13 | 6,000 | 1,160 | 1,200 |
| 3-20 | 28.5/1 | 21 | 8,595 | NA | 1,700 |
| 30 | 16/1 | 11 | 5,150 | 1,400 | 1,030 |
| 30 | 19/1 | 14 | 5,400 | 1,400 | 1,080 |
| 15-60 | 12.5/2 | 8 | 8,450 | 1,699 | 1,690 |
| 15-60 | 22.5/2 | 16 | 11,700 | NA | 2,340 |
| 150 | 11/3 | 5.5 | 7,900 | 1,800 | 1,580 |
| 150 | 19/3 | 13.5 | 12,900 | 1,800 | 2,580 |

NA - Not Available

[1] Does not include delivery, installation, engineering, and contingency costs. These costs are estimated to be about 30-50 percent of purchase cost.

[2] Rental costs will vary according to the length of rental time. At least a 6 month rental period was assumed.

[3] Operational and maintenance costs are highly variable; assumed to be 20 percent of total purchase cost based on vendor estimates.

costs. In addition, if the corrective action is anticipated to be a relatively short term cleanup, the owner/operator or cleanup contractor may consider renting an air stripping treatment system. Therefore Table 5-3 also presents monthly rental costs.

Effluent limitations for pH are established as 6.0 (minimum) and 9.0 (maximum) standard units based on available pH adjustment technologies. These technologies include acid and/or base addition, the costs of which are incidental to the overall costs of treating water and wastewater prior to discharge.

### 5.3.2 Air Emissions Control

Emissions of volatile organics from wastewater treatment systems may impact local air quality. Carbon adsorption can be used to treat vapors containing volatile organics that are emitted from air strippers in those areas of the Nation where such controls are necessary (Ref. No. 7). Based on the procedures outlined in Underground Storage Tank Corrective Action Technologies (Ref. No. 7), costs for control of air emissions are estimated below for three daily discharge flows:

| | Discharge Flow | | |
|---|---|---|---|
| | <50,000 gpd | 150,000 gpd | 750,000 gpd |
| Airflow rate, cfm | 500 | 5,000 | 8,000 |
| Capital Cost | $40,000 | $75,000 | $100,000 |
| Annual Operating and Maintenance Cost | $6,000 | $60,000 | $100,000 |

### 5.3.3 Costs of Alternative Treatment Technologies

Free product recovery followed by air stripping is the treatment technology used as a basis for the development of effluent limitations in the Model Permit. Carbon adsorption and biological treatment technologies are also reported, in the literature, as examples of appropriate treatment

technologies for discharges resulting from gasoline underground storage tank cleanups.

The use of GAC may substantially increase treatment costs. Capital costs may be twice to four times those capital costs generally needed for use of air stripping treatment units. Operation and maintenance (O&M) costs incurred when using GAC may increase to up to eight times the O&M cost of air stripping. This eight-fold increase in O&M costs is due to the need to renew the GAC carbon and dispose of spent carbon. These relative costs are shown in greater detail in Table 5-4.

TABLE 5-4. RELATIVE COST FACTORS FOR TREATMENT OF GROUND WATER

| Technique | Relative Cost Factors[1] | | |
|---|---|---|---|
| | Capital | O&M[2] | O&M (RCRA)[3] |
| Air stripping | 1* | 1* | 1 |
| Air stripping & vapor-phase GAC | 2.0 | 3.0 | 4.0 |
| Air stripping & liquid-phase GAC | 3.0 | 3.0 | 4.5 |
| Air stripping & liquid-phase & vapor-phase GAC | 4.0 | 5.0 | 7.5 |
| Liquid GAC only | 1.5 | 4.0 | 8.0 |

*Assigned

[1]Cost factors indicated are relative to air stripping.

[2]O&M costs for GAC include costs for carbon replacement/regeneration.

[3]Indicates cost if spent carbon must be treated as a hazardous waste under RCRA.

Source: Reference No. 6

# 6.0 BEST MANAGEMENT PRACTICES

The Model Permit requires the permittee to develop a Best Management Practices (BMP) plan to minimize potential for release of pollutants from corrective action activities. BMPs are designed to minimize contamination of surface waters as a result of cleanup operations. In addition, BMPs such as diversion and collection of runoff, prevent offsite transport of surface waters that may have become contaminated. The BMPs set forth in Part III, Section A.1, of the Model Permit are based on recommendations provided in the OUST document entitled Underground Storage Tank Corrective Action Technologies (Ref. No. 7).

# 7.0 MONITORING

Monitoring is the primary means of ensuring that the permit limitations are met. It is also the basis for enforcement actions against permittees who are in violation of their permit limits. State and EPA Regional offices usually recommend monitoring frequencies based on the design capacity of the treatment facility (Ref. No. 12).

The permittee may request reduced frequency of monitoring requirements (or elimination of toxicity monitoring requirements) after 3 months of the effective date of the permit. Part IV, Section A.4 of the Model Permit allows the permittee to collect data sufficient to demonstrate that the treatment system is performing well. After a review of discharge data collected over a 3 month period, the Permitting Authority may reduce the frequency of, or eliminate monitoring requirements.

## 7.1 FLOW MONITORING

Weekly flow monitoring is recommended for discharges less than 100,000 gallons per day (Ref. No. 12). Since discharges from gasoline UST cleanups are expected to be approximately 30,000 gallons per day (see Section 3.1), the Model Permit requires weekly flow monitoring.

## 7.2 CHEMICAL-SPECIFIC MONITORING

Chemical-specific monitoring is recommended on a quarterly basis for flows less than 100,000 gallons per day (Ref. No. 12). However, high concentrations of hydrocarbons are expected to be present in water and wastewater resulting from UST site corrective actions. Therefore weekly chemical-specific monitoring is recommended.

Chemical-specific monitoring is required for benzene, ethylbenzene, toluene, and the xylenes. Analytical methods 602, 624, and 1624 are approved under authority of the CWA for analyses of benzene, ethylbenzene, and toluene. EPA Method 8240 is an approved RCRA method for the analysis of ortho-, meta-, and para-xylene which are reported as "total xylenes" or "xylene." EPA Method 8240 should be used to test "xylenes" unless State or EPA Regional policies specify alternative analytical methods. EPA Method 8240 can also be used to

analyze for benzene, ethylbenzene, and toluene. Depending upon EPA Regional or State policy, the permit writer may opt to substitute Method 8240, when using the Model Permit for the CWA methods generally required under the NPDES program. Hence the permittee would not be required to perform two tests to report the required data for benzene, ethylbenzene, toluene, and total xylenes. Method 8240 is described in Test Methods for Evaluating Solid Waste Volume IA: Laboratory Manual Physical/Chemical Methods (Ref. No. 15).

Grab sample collection is required based on procedures recommended in the EPA Handbook for Sampling and Sample Preservation of Water and Wastewater (Ref. No. 13).

## 7.3 BIOMONITORING

In the absence of information on the toxicity of a specific discharge the EPA recommends biological monitoring requirements (Ref. No. 11). There are three principal reasons for generating biomonitoring data:

1) to ascertain whether a permittee exceeds the narrative no toxics water quality standard and thus needs water quality-based permit limits for toxicants

2) to identify a sensitive test species for toxicity monitoring purposes

3) to generate data on the variability of effluent toxicity.

Permits can be and are routinely issued with data generation requirements described in Part III, Special Conditions, of the permit to augment the limits imposed on other parameters. These testing procedures require permittees to generate data on their effluent so that the permit writer can determine whether additional permit limits or controls will be necessary to meet other statutory requirements, such as water quality standards.

This data generation mechanism should result in subsequent modification of the NPDES permit if the data generated show unacceptable toxicity. Should toxicity be demonstrated, the permit writer should consider developing site-specific water quality-based limits (see Part IV - Decision Tool for Developing Water Quality-Based Limitations).

The biomonitoring requirements set forth in Part III(A)(3) of the Model Permit were adapted from EPA guidance on developing water-quality based permits (Ref. No. 11). Specifically, chronic aquatic life toxicity testing is required to characterize effluent toxicity. As an alternative, the permit writer could use the whole-effluent toxicity screening procedure that is recommended in the EPA Technical Support Document for Water Quality-Based Toxics Control (Ref. No. 24). This approach, provided in Table 7-1, allows for decisions to be made regarding toxic impact early in the testing process. Effluents with low potential for instream toxicity can be eliminated as a priority or given a low priority for further analysis.

States may also have their own toxicity testing requirements that can be substituted as appropriate. One such approach has been successfully used in the State of North Carolina and has been included for consideration as an alternative for gasoline UST cleanups. The State of North Carolina developed a standard approach to whole-effluent toxicity testing that is based on the instream waste concentration (IWC) resulting from a discharge. The IWC, which is expressed as a percentage, is calculated by dividing the effluent flow or discharge flow by the sum of the receiving water low flow (defined as 7Q10 low flow) plus the effluent flow. Depending upon the IWC, one of three types of toxicity tests are generally required (Ref. No. 16):

- If the IWC exceeds 1 percent, then the permittee is required to perform the Ceriodaphnia Pass/Fail chronic toxicity test. This static renewal test is conducted at the IWC and runs for 7 days. Passing the Pass/Fail chronic test means there is no observable inhibition of reproduction or significant mortality at the IWC.

- If the IWC is between 0.25 and 1 percent, then the permittee is required to perform a static, nonrenewal, 48 hour acute toxicity test. This test is conducted over a range of effluent concentrations using either Ceriodaphnia dubia or Daphnia pulex. To pass, the 48 hour concentration of effluent lethal to 50 percent of the organisms (LC50) must be greater than or equal to the IWC (expressed as a concentration).

- If the IWC is less than 0.25 percent, then a short term Pass/Fail acute toxicity test must be performed by the permittee. This static nonrenewal test uses either the fathead minnow (Pimephales promelas), Daphnia pulex, or Ceriodaphnia dubia, and runs for 24 hours; typically at 90 percent of the effluent concentration. This test is failed if it is determined that mortality in the effluent treatment is significantly different than the control population (measured using the Student's test and a 99 percent confidence interval).

TABLE 7-1. RECOMMENDATIONS FOR WHOLE-EFFLUENT TOXICITY SCREENING

- Individual Dischargers - Compare receiving water flow rate (in terms of whatever water quality-based design low flow is specified by the State) to average effluent flow rate.

  - If dilution exceeds 10,000 to 1, and there is a reasonably rapid mix of the effluent outside of the rapid initial dilution area in the receiving water, then the effluent should be given a low priority for any further attention.

  - If dilution is less than 10,000 to 1, or mixing is not rapid and toxicity within a plume is of concern, then toxicity screening tests should be performed.

  - If dilution is between 1,000 to 1 and 10,000 to 1, or a poorly mixed effluent plume in a large receiving water (>10,000 to 1 dilution) is of concern, conduct acute toxicity screens as follows:

    1. Collect four to six effluent samples on one day (grab or short term composite), quarterly. Conduct screening tests (24-hour) in 100% effluent, using a daphnid and a fish, on each sample.

    2. If 50% mortality or greater is observed in three samples, the potential for toxicity is assumed and further testing is required.

    3. If 50% mortality or greater is observed for two or fewer samples, the discharge should be given a low priority for further analysis.

  - If dilution is less than 1,000 to 1, conduct chronic toxicity screens (short term chronic tests are recommended) as follows:

    1. Collect four to six effluent samples (24-hour composite) on four to six successive days. Conduct static screening tests (seven-day) in 100% effluent, using a cladoceran and a fish, on each sample.

    2. If a 50% or greater effect is observed between controls and test organisms, the potential for toxicity is assumed and further testing is required.

    3. If less than 50% effect is observed, the discharge should be given a low priority for further analysis

Acute tests can be used in these dilution situations, but it should be noted that there will be cases where no acute toxicity is measured but the effluent is chronically toxic.

TABLE 7-1. RECOMMENDATIONS FOR WHOLE-EFFLUENT TOXICITY SCREENING (Continued)

- Where dilution is less than 100 to 1, the use of a toxicity-testing-based screening procedure is not recommended. Screening has already been accomplished through dilution analysis. Even in discharge situations where no toxicity is observed in screening tests, the narrow margin between effect concentration and available dilution suggests more complete effluent toxicity characterization is mandatory. If uncertainty factors are applied in a 100 to 1 discharge situation, dilution alone would mandate further testing. Where very limited dilution is available, it is recommended that toxicity-testing screening be skipped and the discharger be required to begin DEFINITIVE DATA GENERATION procedures (see Ref. No 24).

- Ambient Toxicity Analysis - Use ambient toxicity analysis to identify areas of instream toxicity associated with specific dischargers. This analysis may be most useful when conducted by the regulatory agency, but dischargers may be required to conduct the tests in conjunction with effluent tests. A systematic plan for identifying problem areas is recommended. This procedure is useful for multiple source discharge situations. The analysis should be conducted concurrently with discharge-specific screening and must be done at low flow conditions. A procedure is described in Appendix C (contained in Ref. No. 24).

Source: Reference No. 24.

## 8.0 REFERENCES


1. Regulatory Impact Analysis of Technical Standards for Underground Storage Tanks. Prepared for the EPA Office of Underground Storage Tanks by ICF, Inc. August 24, 1988.

2. Based on SAIC conversations with EPA staff members, Office of Underground Storage Tanks.

3. Based on draft data submitted to EPA, Office of Underground Storage Tanks by Camp, Dresser and McKee, Inc. (1987).

4. Guard, H.E. James, N.G., Roy B. Laughlin, Jr. Characterization of Gasolines, Diesel Fuels and Their Water Soluble Fractions. Naval Biosciences Laboratory, Naval Supply Center, Oakland, CA. September 1983.

5. Fate and Transport of Substances Leaking from USTs; CDM Draft Report January, 1986.

6. Cleanup of Releases From Petroleum USTs: Selected Technologies. EPA Office of Underground Storage Tanks, (EPA/530/UST-88/001) April 1988.

7. Underground Storage Tank Corrective Action Technologies. Hazardous Waste Engineering Research Laboratory, ORD/Office of Underground Storage Tanks/OSWER (EPA/625/6-87-015) January 1987.

8. Quantitative Structure Activity Relationship System (QSARS) Data Base. Environmental Research Lab, EPA Office of Research and Development, Duluth, MN.

9. Quality Criteria For Water 1986. EPA Office of Water Regulations and Standards (EPA 440/5-86-001) May 1, 1987.

10. Delta Cooling Towers, Inc.; Ground Water Technology, Inc.

11. Permit Writer's Guide to Water Quality-Based Permitting for Toxic Pollutants. EPA Office of Water (EPA 440/4-87-005) July 1987.

12. Training Manual for NPDES Permit Writers. EPA Office of Water Enforcement and Permits. May 1987.

13. Handbook for Sampling and Sample Preservation of Water and Wastewater. U.S. Environmental Protection Agency (EPA-600/4-82-029) September 1982.

14. Summary of State Reports on Releases from Underground Storage Tanks. EPA Office of Underground Storage Tanks (EPA/600-M-86/020) August 1986.

15. Test Methods for Evaluating Solid Waste Volume IA: Laboratory Manual Physical/Chemical Methods. EPA Office of Solid Waste and Emergency Response (SW-846) November 1986.

16. North Carolina Whole Effluent Toxicity Program. North Carolina Division of Environmental Management, Biological Services Unit, (Undated).

17. Kirk-Othmer Encyclopedia of Chemical Technology, Third Edition, Volume 11. John Wiley & Sons, 1980.

18. Oil Spill Conference Proceedings, sponsored by USEPA, U.S. Coast Guard, American Petroleum Institute held in Los Angeles, CA, February 25-28, 1985.

19. The Merck Index, Tenth Edition. Merck and Company, Inc. 1983.

20. Science Applications International Corporation. Based on memos and telephone conversations with EPA Region I, Industrial Permits Section.

21. Science Applications International Corporation. Based on memos and telephone conversations with the Maryland Department of the Environment.

22. Science Applications International Corporation. Based on memo submitted by the Louisiana Department of Environmental Quality, Office of Water Resources, Permits Section.

23. Science Applications International Corporation. Based on memos and telephone conversations with the Nebraska Department of Environmental Control, Water Quality Division.

24. Technical Support Document for Water Quality-Based Toxics Control. EPA Office of Water, September 1985.

25. Lange's Handbook of Chemistry, Thirteenth Edition McGraw-Hill Book Company, 1985.

# PART IV

# DECISION TOOL FOR DEVELOPING WATER QUALITY-BASED EFFLUENT LIMITATIONS

## TABLE OF CONTENTS

## LIST OF TABLES

# 1.0 DECISION TOOL FOR DEVELOPING WATER QUALITY-BASED EFFLUENT LIMITATIONS

This document defines a procedure for deciding whether water quality-based effluent limitations should be required in a NPDES permit for discharges resulting from the cleanup of gasoline from leaking underground storage tank (UST) sites.

The development of one-hour maximum and four-day average water quality-based effluent limitations according to guidance set forth in the EPA Technical Support Document for Water Quality-Based Toxics Control (September 1985), or TSD, requires site-specific information. Certain assumptions have been made to simplify the application of this Decision Tool to a wide variety of site-specific conditions and circumstances in a manner consistent with the way the majority of the States now develop water quality-based effluent limitations. The site-specific information required for this simplified approach is limited to effluent flow, effluent concentration, and receiving water flow. Where the simplifying assumptions are not applicable, the procedure developed here for use as a Decision Tool should be modified accordingly. The simplifying assumptions and the limits they place on the application of the Decision Tool are summarized following the discussion of the methodology and its application to leaking UST cleanups.

## 1.1 BACKGROUND

Both the Clean Water Act and promulgated Federal regulations require that all NPDES permits include limitations to achieve all applicable State water quality standards. Further, NPDES permits must include limitations that reflect any total maximum daily loads or wasteload allocations set by EPA or States to achieve applicable water quality standards.

EPA's policy and legal basis regarding the use of State water quality standards to set NPDES permit limits on toxicants is provided by the Office of Water's Policy for the Development of Water Quality-Based Permit Limits for

Toxic Pollutants, 49 FR 9016, March 9, 1984. In part, this policy states that:

> Where violations of water quality standards are identified or projected, the State will be expected to develop water quality-based effluent limits for inclusion in any issued permit. Where necessary, EPA will develop these limits in consultation with the State. Where there is a significant likelihood of toxic effects to biota in the receiving water, EPA and the States may impose permit limits on effluent toxicity and may require an NPDES permittee to conduct a toxicity reduction evaluation (TRE). Where toxic effects are present but there is a significant likelihood that compliance with technology-based requirements will sufficiently mitigate the effects, EPA and the States may require chemical and toxicity testing after installation of treatment and may reopen the permit to incorporate additional limitations if needed to meet water quality standards. [Toxicity data, which are considered "new information" in accordance with 40 CFR 122.62(a)(2), could constitute cause for permit modification where necessary].

Two forms of State water quality standards for toxicants can be used to set NPDES permit limits: numerical standards and narrative standards. Numerical standards for some individual toxicants are contained in virtually all State water quality standards. They are usually expressed as an instream "not-to-be-exceeded" concentration of a toxicant (e.g., 0.019 mg/l for total residual chlorine).

All States also have narrative standards for pollutants. The most common form of the narrative standard contains language establishing that the waters are free from substances in amounts that will:

1. Settle to form objectionable deposits;
2. Float as debris, scum, oil, or other matter to form nuisances;
3. Produce objectionable color, odor, taste, or turbidity;
4. Injure, be toxic to, or produce adverse physiological responses in humans, animals, or plants; and
5. Produce undesirable or nuisance aquatic life.

States must also include a procedure for translating this "free from" language into numerical "water quality criteria," from which can be derived water quality-based effluent limitations. In addition, a State's water quality standards rule is not considered administratively complete unless it contains an antidegradation provision to protect existing water quality, where it is better than the minimum required to support at least fishing and swimming. Degradation only can be allowed when certain tests of social or economic benefit are met. Those tests are set forth in Section 302(b) of the Clean Water Act and the regulations developed to implement that section.

The standard under (4) above pertains to toxic effects and is an important element in any effective toxics control strategy. This standard should be used by States and EPA Regions to limit both individual toxicants (where a toxic effect can be traced to a specific chemical for which no standards or criteria exist) and whole effluent toxicity (where it is not obvious which chemicals are causing toxicity or where the limitation of generic effluent toxicity is more appropriate to that particular discharge situation).

Clean Water Act Section 303(d)(1)(C) mandates that water-quality based effluent limits more stringent than those required by Best Available Technology (BAT) regulations be imposed on a site-specific basis to assure the protection of receiving water quality with an ample margin of safety. Such limits, developed by the States, are to be based on the capacity of receiving waters to assimilate a particular toxic substance entering the system from all well-characterized sources. The assimilative capacity of the receiving water for a particular pollutant is defined in terms of the rate at which that pollutant is degraded at a concentration equal to the water quality standard or the existing concentration, whichever is lower under design low flow conditions. That rate in pounds or kilograms per day is specified as the Total Maximum Daily Load (TMDL).

The maximum load attributable to nonpoint sources (load allocation) is then subtracted from the TMDL, and the difference is apportioned among point sources according to an allocation rule. This is the point source waste load allocation (WLA) for the particular substance and receiving water. TMDL/WLA-

based toxic substance effluent limits are then incorporated into all affected point source discharge permits.

NPDES permits must be developed and issued in accordance with current permit issuance policies, including current Agency operating guidance, permit issuance strategies, and State-specific agreements and workplans. Applicable water quality standards and site-specific water quality data, as well as effluent composition data, should be assessed during the permit issuance process to determine whether water quality-based permit requirements for toxics are necessary for a particular discharge.

This is particularly important for waterbodies that have been identified as not achieving water quality standards pursuant to Section 304(l) of the Clean Water Act. For each stream segment or waterbody identified, Section 304(l) requires that individual control strategies be developed to reduce the discharge of toxic pollutants from point source discharges to the stream segment or waterbody. In addition, NPDES permits incorporating all necessary and appropriate elements should be developed for all point sources identified.

However, the requirement to develop water quality-based effluent limitations as necessary to achieve applicable water quality standards in the receiving water is not limited to 304(l) waterbodies. The requirements of Section 303(d)(1)(C) of the Clean Water Act apply to all U.S. waterbodies whose water quality is protected under the Clean Water Act.

## 1.2 METHODOLOGY

The technology-based effluent limitations set forth in the Model Permit are based on removal efficiencies of product recovery and air stripping treatment systems. While use of such technologies may significantly reduce the contaminant levels of the pollutants of concern, technology-based effluent limitations may not adequately address water quality concerns of affected receiving waters.

To guide NPDES permit writers in implementing the requirements of CWA Section 303(d)(1)(C), EPA's Office of Water published the TSD. This guidance

describes approved approaches for measuring or calculating the dimensions of and dilution afforded by zones of initial dilution (ZIDs) and mixing zones. This guidance also provides procedures for the calculation of chemical-specific and whole effluent toxicity-based 1-hour maximum or 4-day average effluent limitations, taking into account dilution within the ZID or mixing zone, the applicable acute or chronic water quality criterion, effluent composition variability, the receiving water flow, and the statistical confidence level equivalent to an acceptable frequency of recurrence of effluent limitation exceedance.

To quantify the relationship between the chemical-specific pollutant loading rate from a single discharge, or from multiple discharges, and the downstream receiving water quality at any point outside of the mixing zone, the permit writer has several options. For toxic pollutant discharges to rivers and run-of-river reservoirs, a simple mass balance equation can be used. This equation is based on the assumption that the flow and pollutant concentration of the effluent are fixed at their average values [i.e., constant average loading rate); the flow of the receiving water is treated as a constant (generally the once-in-ten-year, 7-day (7Q10) drought flow is applied for the chronic scenario and the once-in-three-year, 1-day low flow (1Q3) is applied for the acute scenario); and the rates of pollutant production, destruction, and storage within the system are assumed to be zero.

The simple mass balance equation as it applies to a single discharge and assuming complete mixing is as follows:

$$C = \frac{C_s Q_s + C_e Q_e}{Q_s + Q_e}$$

where: $C$ = downstream concentration of pollutant

$C_s$ = upstream concentration of pollutant

$Q_s$ = upstream design flow of receiving water

$C_e$ = effluent pollutant-specific concentration limit

$Q_e$ = effluent design flow.

In situations where only a fraction of the receiving water flow is allocated for mixing to ensure that the mixing zone does not inhibit the free passage of fish, then a factor "f" is used. This factor accounts for the fraction of the upstream receiving water flow that constitutes the allocated mixing zone. To ensure that applicable water quality criteria are achieved downstream of the effluent discharge, C is defined such that:

$$C = f \cdot WQC$$

where: WQC = the pollutant-specific water quality criteria to be achieved in the receiving water

Rearranging and solving for the effluent concentration:

$$C_e = \frac{[f \cdot WQC \cdot (Q_e + Q_s)] - C_s \cdot Q_s}{Q_e}$$

According to the TSD, the final effluent limitations should be derived taking into account effluent variability. The more restrictive of the aquatic acute, aquatic chronic or long-term human health-based 1-hour maximum and 4-day average limitations are then used as the basis for the final effluent limitations. If the permit writer chooses not to address effluent variability, then acute aquatic and chronic aquatic or human health-based effluent limitations should be treated as "not to exceed" levels. As most States use the "not to exceed" approach, that approach will be followed here.

The above mass dilution equation is used to calculate 4-day average "not to exceed" effluent limitations from the more protective of chronic aquatic criteria or human health criteria, using the appropriate flow of the receiving water and "f" is taken to be the fraction of the receiving water flow with which the effluent mixes in the mixing zone.

The mass dilution equation can also be used to calculate 1-day maximum effluent limitations. For this purpose, the upstream concentration is usually assumed to be zero, the WQC becomes the acute aquatic criterion, and "f" is taken to be the fraction of the flow of the receiving water with which the

effluent mixes in the ZID. In the absence of a ZID and mixing zone, however, water quality criteria must be met at the end-of-pipe.

Where specific numerical criteria for a chemical or biological parameters (such as toxicity) are absent or where exposure to multiple pollutants is occurring via a complex effluent, compliance with the standards must be based on the general narrative criteria and on protection of the designated use of the receiving water. This standard is implemented via whole effluent toxicity testing using short-term tests (e.g., 48 to 96 hour) to protect from acute lethal effects at the edge of the ZID and long-term tests to protect from chronic sub-lethal effects at the edge of the mixing zone. In both circumstances the testing includes exposure to effluent diluted with upstream receiving water to the extent dictated by mixing within the ZID or within the mixing zone under drought flow conditions.

## 1.3 DISCHARGES FROM GASOLINE UNDERGROUND STORAGE TANK CLEANUPS

For the pollutants known to be present in gasoline UST discharges (see Part III - Fact Sheet), Federal water quality criteria have been developed only for benzene, ethylbenzene, toluene and naphthalene. The water criteria for each of these pollutants are shown in Table 1-1, as reported in Quality Criteria for Water 1986 (EPA 440/5-86-001). The air stripping effluent concentrations are reported in the Fact Sheet.

A comparison of water quality criteria to achievable undiluted air stripping effluent concentrations (i.e., the technology-based effluent limitations included in the Model Permit) reveals that only the water and fish ingestion criteria for protection of human health would be exceeded for benzene. A relationship for the downstream concentration of benzene is established below. First, the assumptions explained in the legend below are made, and the corresponding values are substituted in the mass balance equation.

$C_s$ = assumed zero

WQC = human health criterion for benzene (water and fish ingestion) assuming an acceptable increased lifetime cancer risk at $10^{-6}$

TABLE 1-1. WATER QUALITY CRITERIA FOR POLLUTANTS PRESENT IN DISCHARGES FROM GASOLINE UST CLEANUPS
(Concentrations in mg/l)

| | Priority Pollutant | Carcinogen | Aquatic Life Protection | | | Human Health Protection | |
|---|---|---|---|---|---|---|---|
| | | | Fresh Acute Criteria | Marine Acute Criteria | Marine Chronic Criteria | Water and Fish Ingestion | Fish Consumption Only |
| Benzene | Yes | Yes | 5.30* | 5.10* | 0.70* | 0.00066** | 0.040** |
| Ethylbenzene | Yes | No | 32* | 0.430* | | 1.4 | 3.28 |
| Toluene | Yes | No | 17.5* | 6.30* | 5.0* | 14.3 | 424 |
| Xylene | No | No | | | | | |
| Naphthalene | Yes | No | 2.3* | .620* | 2.35* | | |

* Means the data were insufficient to develop criteria; the value presented is the lowest observed effect level (L.O.E.L.).
** Human health criteria for carcinogens are generally reported for three risk levels; the value presented is for the $10^{-6}$ risk level.

$C_e$ = technology-based effluent concentration for benzene

f = assumed 1.0 (i.e., the entire upstream receiving water flow is allocated for mixing).

$$C = f \cdot WQC = \frac{C_s Q_s + C_e Q_e}{Q_e + Q_s}$$

$$0.00066 \text{ mg/l} = \frac{(0.005 \text{ mg/l})\ Q_e}{Q_e + Q_s} \text{ or } Q_e = (0.152)Q_s$$

For the optional effluent limitations:

$$0.00066 \text{ mg/l} = \frac{(0.05 \text{ mg/l})\ Q_e}{Q_e + Q_s} \text{ or } Q_e = (0.013)Q_s$$

The relationship between the effluent flow and the receiving stream flow calculated above can also be expressed in tabular form. Table 1-2 shows the receiving stream flow required to provide sufficient dilution to achieve the water quality criterion for benzene.

It should be noted that while the benzene water quality criterion to protect human health is lower than that to protect aquatic life, the potential need for a whole effluent toxicity-based effluent limitation is not removed. This is because of the potential complex composition of UST-contaminated ground water even after treatment has been carried out utilizing the equivalent of the best available technology. Whereas benzene, singly, is not expected to be acutely or chronically toxic to aquatic life at effluent concentrations necessary to protect human health, this situation may not necessarily hold for other constituents that may be present. In the absence of water quality criteria for all the potential contaminants present in the effluent or in anticipation of a potentially additive or synergistic toxic effect from the complex mixture, it is appropriate to also include a whole effluent toxicity monitoring requirement in the permit.

TABLE 1-2. RECEIVING STREAM FLOW REQUIRED TO ACHIEVE WATER QUALITY CRITERION FOR BENZENE

| Effluent Flow (Gallons per minute) | Effluent Flow (Gallons per day) | Receiving Stream Flow (Gallons per minute) | Receiving Stream Flow (Cubic feet per second) |
|---|---|---|---|
| Air stripping effluent = 0.005 mg/l | | | |
| 1 | 1,440 | 7 | 0.015 |
| 5 | 7,200 | 33 | 0.07 |
| 10 | 14,400 | 66 | 0.15 |
| 20 | 28,800 | 132 | 0.29 |
| 50 | 72,000 | 329 | 0.73 |
| 100 | 144,000 | 658 | 1.47 |
| Air stripping effluent = 0.05 mg/l (optional effluent limitations) | | | |
| 1 | 1,440 | 77 | 0.17 |
| 5 | 7,200 | 384 | 0.83 |
| 10 | 14,400 | 769 | 1.7 |
| 20 | 28,800 | 1,538 | 3.4 |
| 50 | 72,000 | 3,846 | 8.6 |
| 100 | 144,000 | 7,692 | 17.1 |

## 1.4 DISCUSSION

The use of the simple mass balance equation for calculating water quality-based effluent limitations presupposes that the volumes of the ZID and mixing zone have been defined and that the dilutions afforded by mixing within those volumes have been accurately quantified. In many States no provisions are made for ZIDs (acute limitations are met at the end-of-pipe) and the mixing zone is defined as a function of the cross-sectional area of the receiving water under 7Q10 conditions (e.g., 1/4 to 1/2). The length of the mixing zone is often chosen based on a maximum allowable distance (e.g., 1000 meters). Complete mixing with the 7Q10 flow of the receiving water is assumed to occur within the mixing zone.

For fast-flowing or highly turbulent rivers, the complete mix assumption may be valid. But under 7Q10 conditions many rivers are slow moving and relatively quiescent. Under these conditions, mixing can be slow. More so than for rivers and run-of-river estuaries, the assumption of uncomplicated, rapid mixing with receiving water flow to achieve a chemical-specific or narrative standard at the edge of the ZID or edge of the mixing zone is likely to be inapplicable for lakes and impoundments, or for estuaries and near-shore ocean discharges.

For complex mixing situations, permit writers should refer to the various hydrodynamic mixing models, referenced in the TSD. Such situations include submerged, low velocity discharges, particularly those with significant temperature and or salinity differences than the surrounding water. The application of the simple mass balance equation is inappropriate for these situations. This is also true of surface discharges with the same properties. In these circumstances it is necessary to conduct site-specific mixing studies under conditions that represent a worst-case (e.g., maximum temperature and density differences; lowest near-shore flow, tidal or wave action). The general approach for performing appropriate mixing studies and reference to more detailed guidance are contained in the TSD.