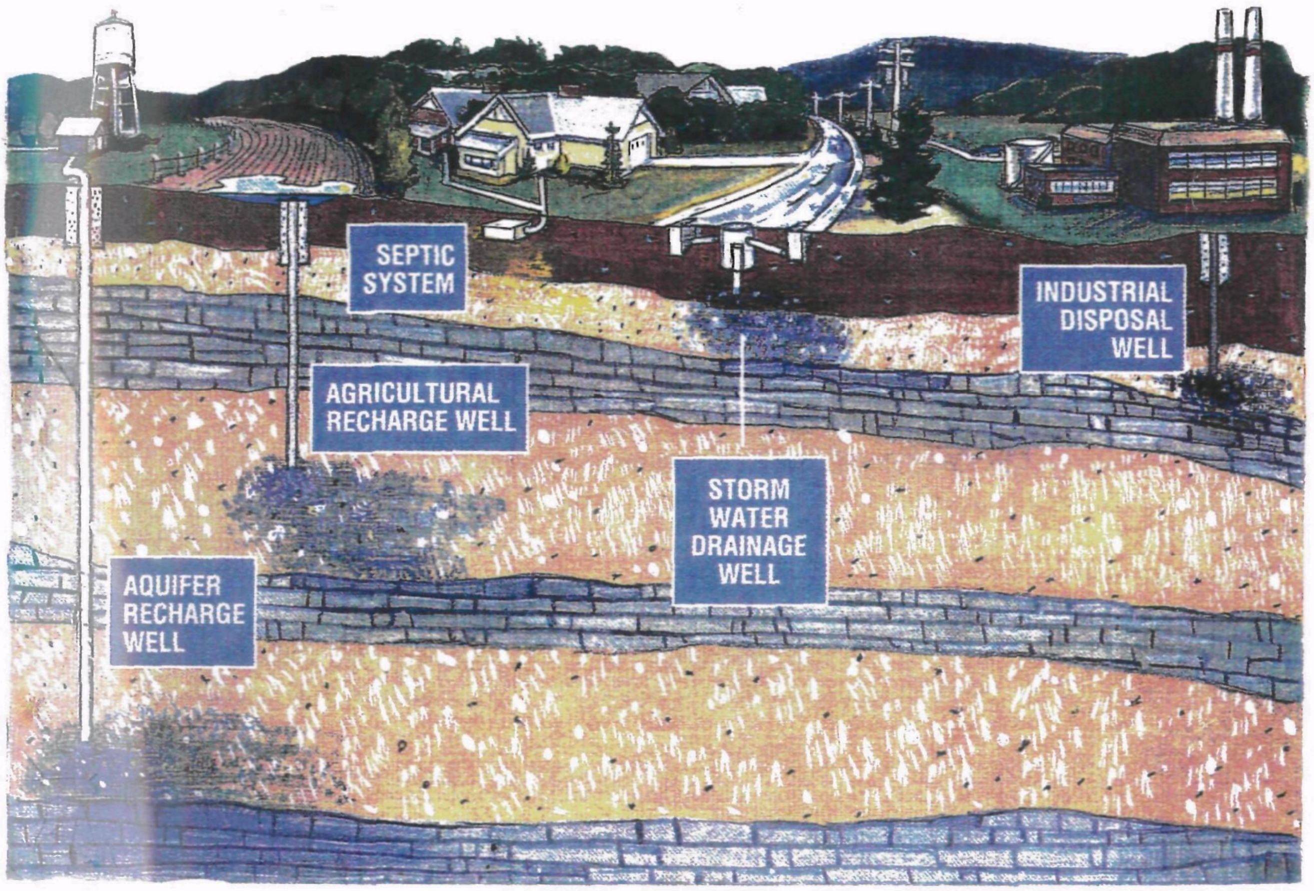
EPA - REGION 9

GUIDELINES FOR CLOSURE OF SHALLOW DISPOSAL WELLS



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I. INTRODUCTION

The Safe Drinking Water Act (SDWA) of 1974, as amended, requires the U. S. Environmental Protection Agency (U.S. EPA) to establish a program which provides for the safety of the nation's drinking water. The Underground Injection Control (UIC) program was established under the SDWA to prevent contamination of underground sources of drinking water from improper use of disposal wells.

Underground sources of drinking water vary in depth and quality from pristine aquifers a few feet beneath the ground surface to aquifers that are thousands of feet deep containing up to 10,000 parts per million of dissolved solids, usually in the form of salts. Over 50% of the U.S. population relies on these aquifers for drinking water, and the percentage is increasing every year.

Disposal wells covered by the UIC program include bored, driven or drilled shafts or dug holes whose depth is greater than the largest surface dimension, where the principal function of the shaft or hole is the emplacement of fluids. Under certain conditions, sumps, septic tanks, cesspools and drainfields may also be considered disposal wells. For the purposes of the UIC program, a fluid is any material or substance which flows or moves, whether in a semisolid, liquid, sludge, gas or any other form or state. Contaminants introduced into underground sources of drinking water through the use of disposal wells include bacteria and viruses, minerals and nitrates, heavy metals, organic chemicals and pesticides.

Most types of disposal wells are subject to construction, performance and monitoring requirements designed to ensure that no contamination of underground sources of drinking water occurs through their use. Wells that discharge fluids into or above an underground source of drinking water are generally classified as shallow disposal wells and are not always subject to these requirements. The disposal of hazardous fluids into shallow wells (Class IV wells) is prohibited under the SDWA. However, many shallow wells (Class V) accept fluids that are not defined as hazardous, but still have a potential to contaminate underground sources of drinking water. EPA Region 9 is requesting closure of such wells.

This guidance is designed to aid in the proper closure of shallow disposal wells. In addition to providing guidelines for the closure of these wells, general information is included concerning sampling equipment, methods and procedures for collecting liquid, sediment and soil samples; required methods of sample analysis; contractor and laboratory requirements; and sample chain of custody requirements.

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It is important to note that this guidance is designed to aid in the closure of wells. The owner or operator of a facility is ultimately responsible for proper closure of the wells and is also responsible for complying with other federal regulations such as RCRA and CERCLA, and with state and local regulations. The owner or operator must ensure that facility practices do not contribute to the contamination of ground water.

II. REQUIREMENTS FOR CONTRACTORS

Activities involving site assessment and well closure require a professional level of expertise. In addition to knowledge regarding the correct procedures and methods used in collecting samples, some investigations may require a knowledge of the mechanisms of contaminant transport; federal, state and local regulations and ordinances relating to waste management; and actions needed to remediate a contaminated site.

To ensure that the contractor has the qualifications -- through a combination of education and experience -- to perform sampling and site assessment requirements, EPA Region 9 requires that:

1. The contractor submit an acceptable sampling plan which addresses:

    a. types of sampling containers and their preparation
    b. sample preservation methods
    c. sampling equipment and method of sample retrieval
    d. familiarity with specified sampling methods
    e. quality assurance/quality control measures
    f. certified lab to which samples will be sent
    g. chain of custody

2. The individual signing any report related to a workplan for closure of a well or a sampling plan must be a registered geologist or professional engineer registered with the state. This individual shall be responsible for the content, validity and completeness of the report. All reports related to well closure activities shall include 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, I certify that 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.

III. LABORATORY SELECTION

Either state-certified laboratories or those associated with EPA's Contract Lab Program must be used for sample analyses. If the distance to the nearest laboratory is such that hand-delivery is not possible, samples should be express/overnight delivered. All laboratories involved in the analysis of samples must retain their calibration logs for two years, laboratory data logs for three years, and sampling labels or information from the labels for three years. All analytical tests must be performed in accordance with methods acceptable under quality assurance guidelines. A quality assurance plan must be submitted with the sampling plan. For more information regarding laboratory selection, see the reference section of this document.

IV. CLASS IV AND V WELL CLOSURE GUIDELINES

When any Class IV or Class V well threatens to violate a primary drinking water regulation or otherwise causes conditions that may adversely affect public health, EPA Region 9, upon learning of such violation or conditions, will require closure of the well. Closure must then be accomplished in such a manner as to ensure that no movement of fluid containing any contaminant will move into underground sources of drinking water (USDWs). As an element of proper well closure, Region 9 may require cleanup of soil and/or groundwater in and around the Class IV or V well.

To meet EPA requirements, well closure should, at a minimum, include the elements of the following guidelines:

1. Provide an acceptable alternative to well discharge for disposal of waste fluids. The alternative must comply with all regulations such that no violation or future violation of primary drinking water standards will result. EPA requests the use of management practices that reduce the amount of contaminants released into the environment through product changes, improved operating practices, reuse of materials, onsite closed-loop recycling, on and off-site reclamation, and water conservation.

2. Identify the locations of all drains, drain lines, drywells, and cesspools or septic systems at the facility.

3. Contact EPA at least seven (7) days in advance of any site operations relating to closure activities.

4. Take representative samples from the liquid and/or sludge phase present in the drain(s) and the well(s) or septic tank(s) in accordance with the procedures described in "Sampling Methods and Procedures" under "Sample Collection". Have the samples analyzed for volatile organics, metals, total petroleum hydrocarbons and oil and grease in accordance with the methods described under "Sample Analysis" and, when necessary, prepared in accordance with the methods for the Toxicity Characteristic Leaching Procedure (TCLP) in 40 C.F.R. Part 261 Appendix II as amended June 29, 1990. Copies of sampling and analysis results, and results of all quality control samples, must be submitted to EPA.

5. Remove the contents from the drains and drain lines and the well(s) or septic tank(s) and determine appropriate disposal methods based on the results of the sample analyses. The owner/operator is ultimately responsible for proper disposal of all wastes, and should carefully review all arrangements for disposal to ensure compliance with federal, state and local regulatory requirements.

6. Disconnect the drain lines from the well, pressure wash the drains and lines, fill them with grout or cement, and permanently seal them. All waste associated with cleaning the drains and lines should be disposed of in accordance with federal, state, and local regulations.

7. Observe the following closure requirements for septic tanks and wells:

Case A: **Septic system accepting industrial and sanitary wastewater into a common septic tank and drainfield or leachfield.**

The septic tank should have the contents removed and disposed of appropriately. If a visual inspection of the tank indicates cracks or leaks, the tank and any visibly or potentially contaminated soil in the vicinity should be removed and disposed of appropriately. Soil samples should be taken below the bottom of the tank excavation in the manner described in "Sampling Methods and Procedures" under "Sample Collection" and analyzed by a certified analytical laboratory. If the tank does not have any cracks or leaks, soil samples may be taken at either end of the tank at a depth that is at least as deep as the bottom of the tank. The tank may then be used for sanitary waste only, and the drain pipes leading from the restrooms need not be disconnected. Soil samples must also be taken along every twenty feet of drainfield or leachfield and sent to a certified laboratory for analysis. It is recommended that soil samples be taken at other locations where there is a potential for a high degree of contamination (worst-case locations) such as elbows and joints in pipe lines, floor drains and clarifiers. All soil samples should be analyzed according to the methods in "Sampling Methods and Procedures" under "Sample Analysis". ***In addition, at least two soil samples, taken at the worst-case location around either the tank or drainfield, must be both analyzed for total concentrations and prepared in accordance with the methods for the Toxicity Characteristic Leaching Procedure (TCLP) in 40 C.F.R. Part 261 Appendix II as amended June 29, 1990.*** See Figures A-1 and A-2 for required and recommended soil sample locations.

Case B: **Septic system accepting only industrial wastewater into a septic tank and drainfield or leachfield.**

The septic tank and the contents should be removed and disposed of appropriately. Any visibly or potentially contaminated soil in the vicinity of the tank should be removed and disposed of appropriately. Soil samples should be taken below the bottom of the tank excavation in the manner described in "Sampling Methods and Procedures" under "Sample Collection" and analyzed by a certified analytical laboratory. Soil samples must also be taken along every twenty feet of drainfield or leachfield. It is recommended that soil samples be taken at other suspected worst-case locations such as elbows and joints in pipe lines, floor drains and clarifiers. All soil samples should be analyzed according to the methods in "Sampling Methods and Procedures". ***In addition, at least two soil samples, taken at the worst-case location around either the tank or drainfield, must be both analyzed for total concentrations and prepared in accordance with the methods for the***

Toxicity Characteristic Leaching Procedure (TCLP) in 40 C.F.R. Part 261 Appendix II as amended June 29, 1990. The excavated area should then be backfilled with clean suitable fill material. See Figures B-1 and B-2 for required and recommended soil sample locations.

Case C: **Drywells, cesspools or drainage wells accepting industrial and sanitary wastewaters, or only industrial wastewaters.**

The contents of the drywell, cesspool or drainage well (identified hereafter as "well") should be removed and disposed of appropriately. It is required that the well casing be removed if it is practicable. Any visibly or potentially contaminated soil underlying the contents of the well should be removed. Soil samples should be taken in the center of the bottom of the well in the manner described in "Sampling Methods and Procedures" under "Sample Collection" and analyzed by a certified analytical laboratory. If taking samples from the bottom of the well is not feasible, samples should be taken on opposite sides of the well, at a distance not to exceed one foot away from the borehole, and starting at a depth that is equivalent to the depth of the bottom of the well. It is recommended that soil samples be taken at other suspected worst-case locations such as elbows and joints in pipe lines, floor drains and clarifiers. All soil samples should be analyzed according to the methods in "Sampling Methods and Procedures". ***In addition, at least two soil samples, taken at the worst-case location, must be both analyzed for total concentrations and prepared in accordance with the methods for the Toxicity Characteristic Leaching Procedure (TCLP) in 40 C.F.R. Part 261 Appendix II as amended June 29, 1990.*** The remaining hole where the well has been removed should then be filled with grout and sealed with asphalt or cement. See Figures C-1 and C-2 for required and recommended soil sample locations.

Case D: **Leachfield/infiltration gallery accepting sanitary and industrial wastewaters, or only industrial wastewaters.**

The practice of disposing sanitary and/or industrial wastewaters directly to a leachfield/filtration gallery without the use of a septic tank is unacceptable. The leachfield should be excavated, and all visibly or potentially contaminated soils removed and disposed of appropriately. Soil samples must be taken along every twenty feet of drainfield or leachfield in the manner described in "Sampling Methods and Procedures" under "Sample Collection" and sent to a certified laboratory for analysis. It is recommended that soil samples be taken at other suspected worst-case locations such as elbows and joints in pipe lines, floor drains and clarifiers. All soil samples should be analyzed according to the methods in "Sampling Methods and Procedures". ***In addition, at least two soil samples, taken at the worst-case locations in the drainfield or leachfield, must be both analyzed for total concentrations and prepared in accordance with the methods for the Toxicity Characteristic Leaching Procedure (TCLP) in 40 C.F.R. Part 261 Appendix II as amended June 29, 1990.*** The area should be regraded using clean fill. See Figures D-1 and D-2 for required and recommended soil sample locations.

8. Contact state and local agencies and incorporate their requirements into the well closure plans.

9. Submit a report, upon completion of well closure activities, that includes the following items:

- A plot plan showing locations of disposal or drainage well(s), sampling points, buildings and adjacent streets. Indicate the north direction by an arrow.
- Copies of all fluid, sludge and soil sample analysis results, and results of all quality control samples.
- Copies of manifests or other documentation pertaining to proper disposal of all removed liquid, sludge and soil.
- A description of the extent of site contamination. Should site remediation appear necessary, recommendations from a registered geologist or professional engineer, with sufficient experience in soils, should be included to address the problem.

10. Include, on all reports submitted to EPA that relate to well closure activities, the certification given in "Requirements for Contractors".

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These guidelines do not constitute a remediation plan. It is the responsibility of the owner or operator to ensure that further site evaluation be conducted if analytical results of the soil samples indicate the presence of contamination.

All submittals are to be sent to:

Groundwater Pollution Control Section
U.S. Environmental Protection Agency
75 Hawthorne Street, W-6-2
San Francisco, CA 94105
Contact: (415) 744-1832

Case A: Soil Sample Locations for a Septic System Receiving Both Industrial and Sanitary Wastes

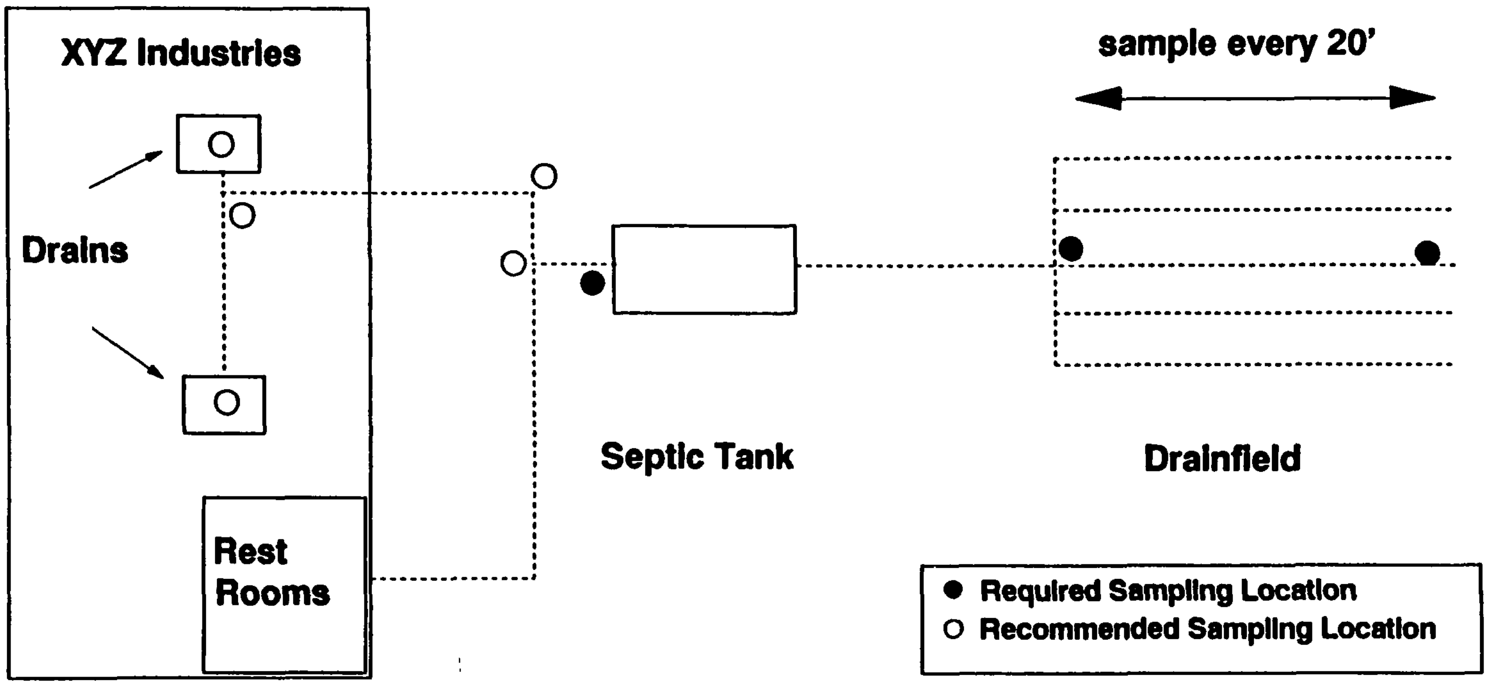

Figure A-1: Plan View

Note: The soil sample locations shown above meet the minimum requirements of the EPA UIC Program. However, the owner and/or operator of the well is also responsible for meeting the requirements of all other applicable federal, state, and local laws, and for adequately assessing the extent of any soil or ground water contamination.

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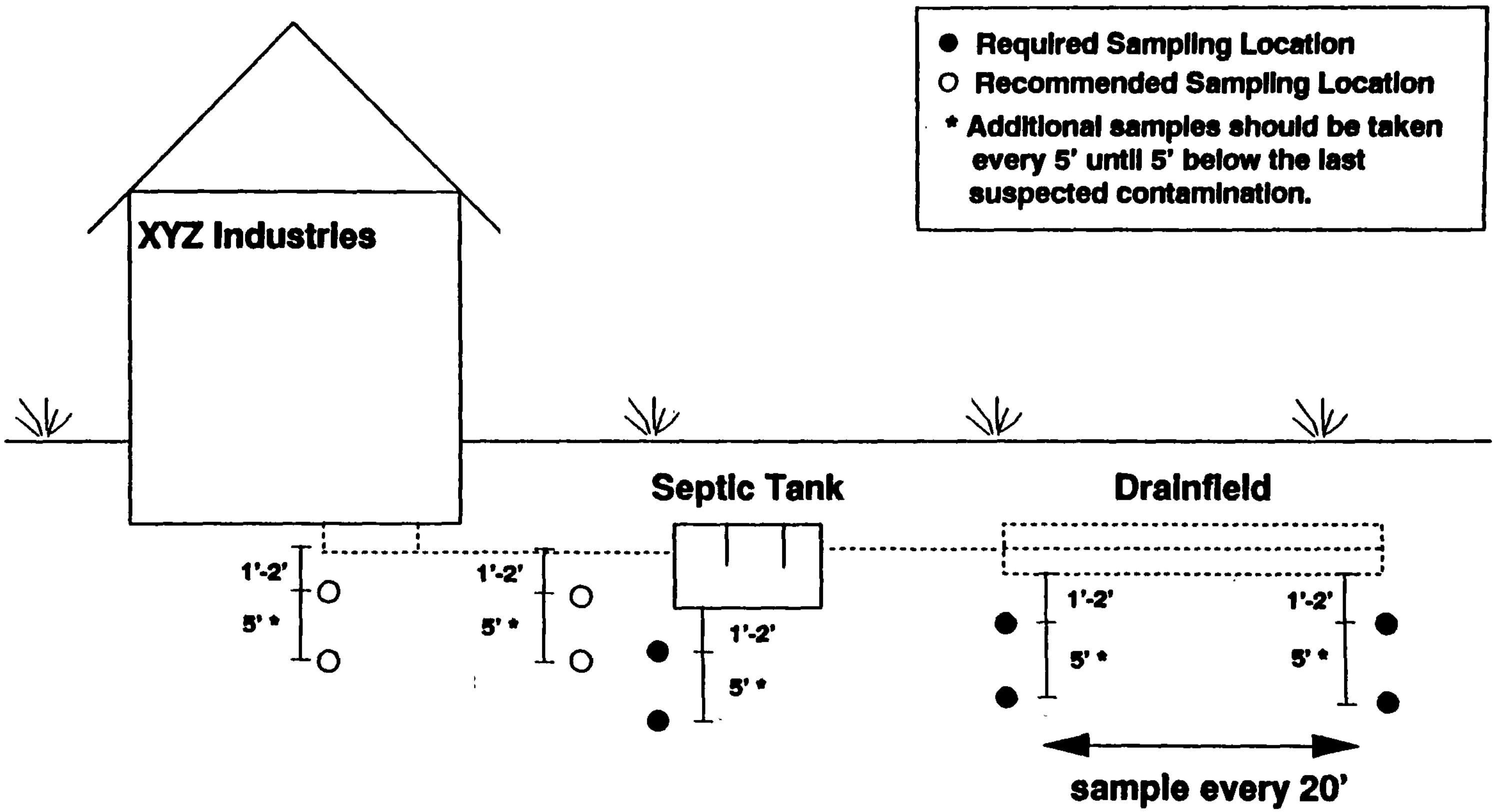

Figure A-2: Side View

Note: The soil sample locations shown above meet the minimum requirements of the EPA UIC Program. However, the owner and/or operator of the well is also responsible for meeting the requirements of all other applicable federal, state, and local laws, and for adequately assessing the extent of any soil or ground water contamination.

Case B: Soil Sample Locations for a Septic System Receiving Only Industrial Wastes

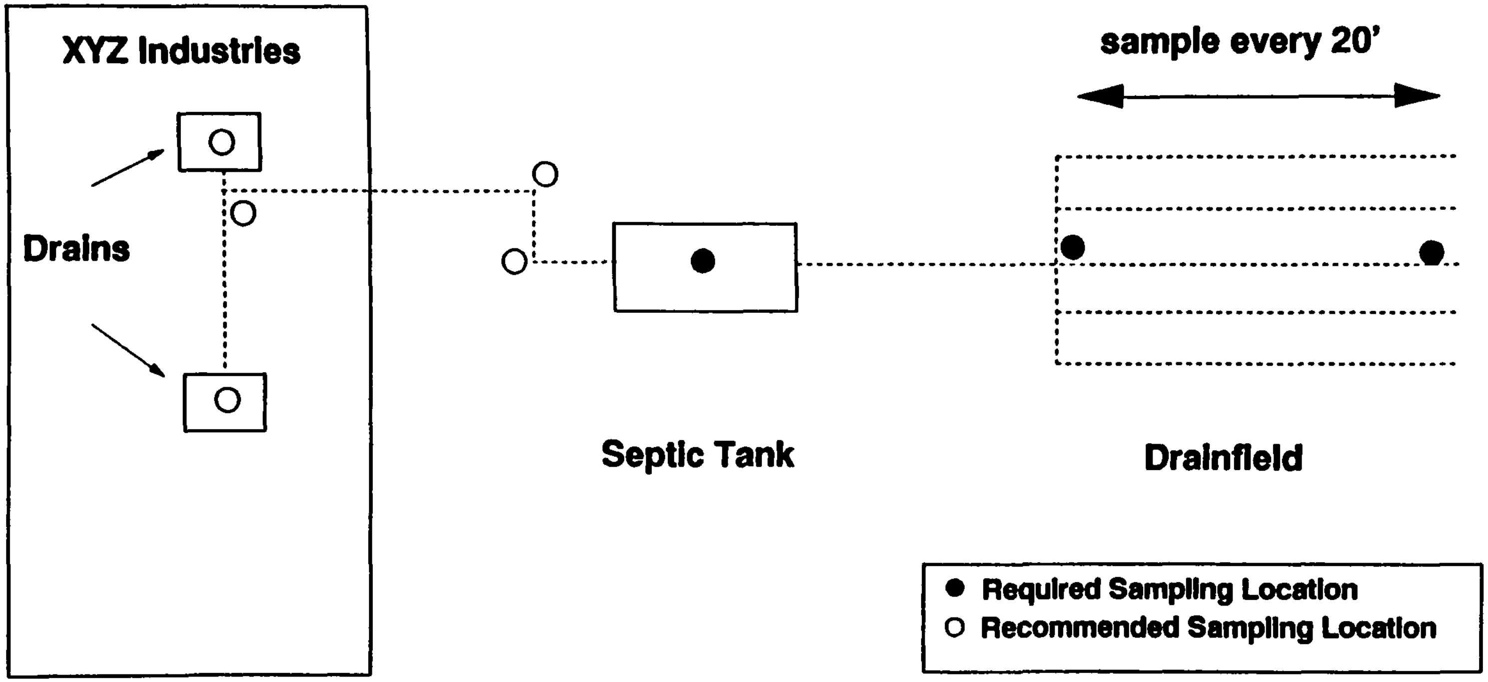

Figure B-1: Plan View

Note: The soil sample locations shown above meet the minimum requirements of the EPA UIC Program. However, the owner and/or operator of the well is also responsible for meeting the requirements of all other applicable federal, state, and local laws, and for adequately assessing the extent of any soil or ground water contamination.

Case B: Soil Sample Locations for a Septic System Receiving Only Industrial Wastes

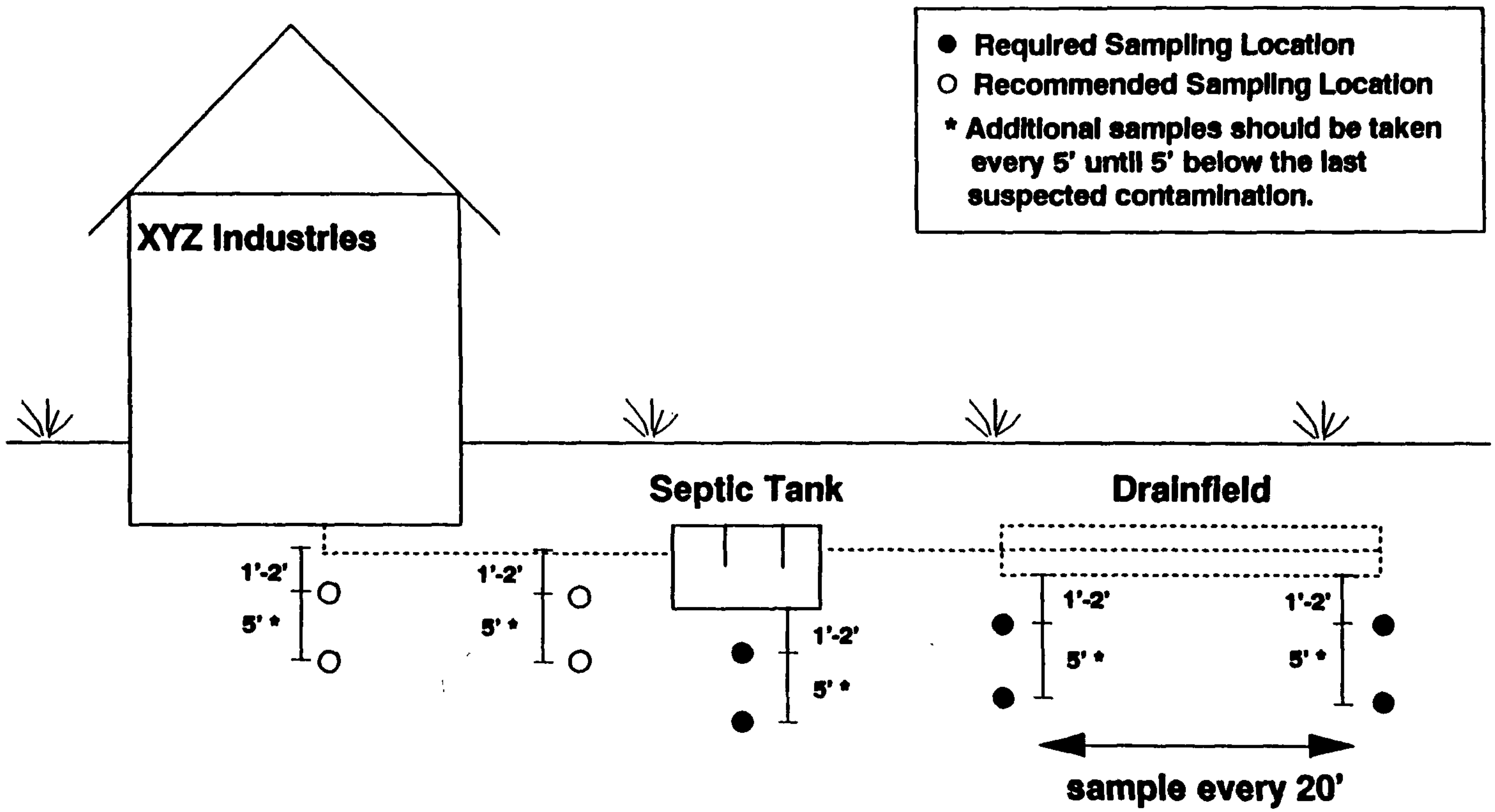

Figure B-2: Side View

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Case C: Drywell, Cesspool, or Drainage Well Receiving Both Industrial and Sanitary Wastes or Only Industrial Wastes

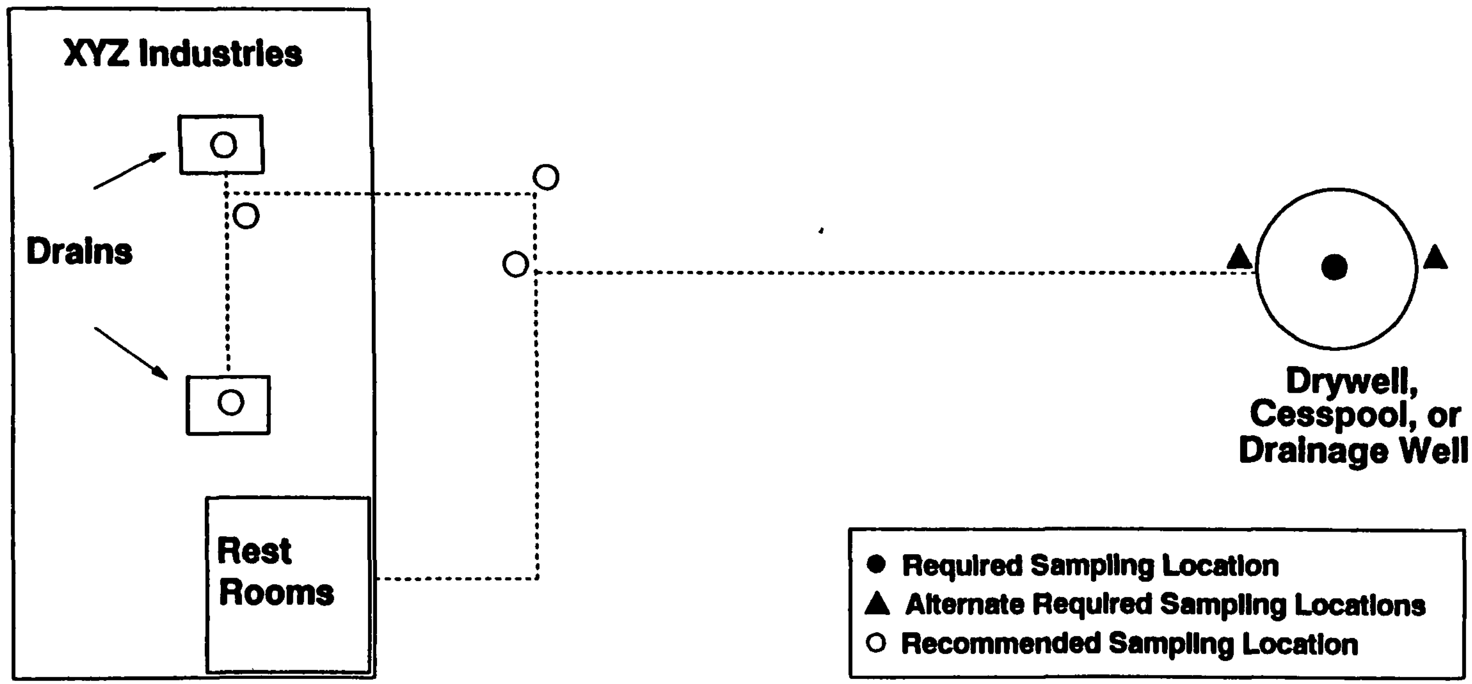

Figure C-1: Plan View

Note: The soil sample locations shown above meet the minimum requirements of the EPA UIC Program. However, the owner and/or operator of the well is also responsible for meeting the requirements of all other applicable federal, state, and local laws, and for adequately assessing the extent of any soil or ground water contamination.

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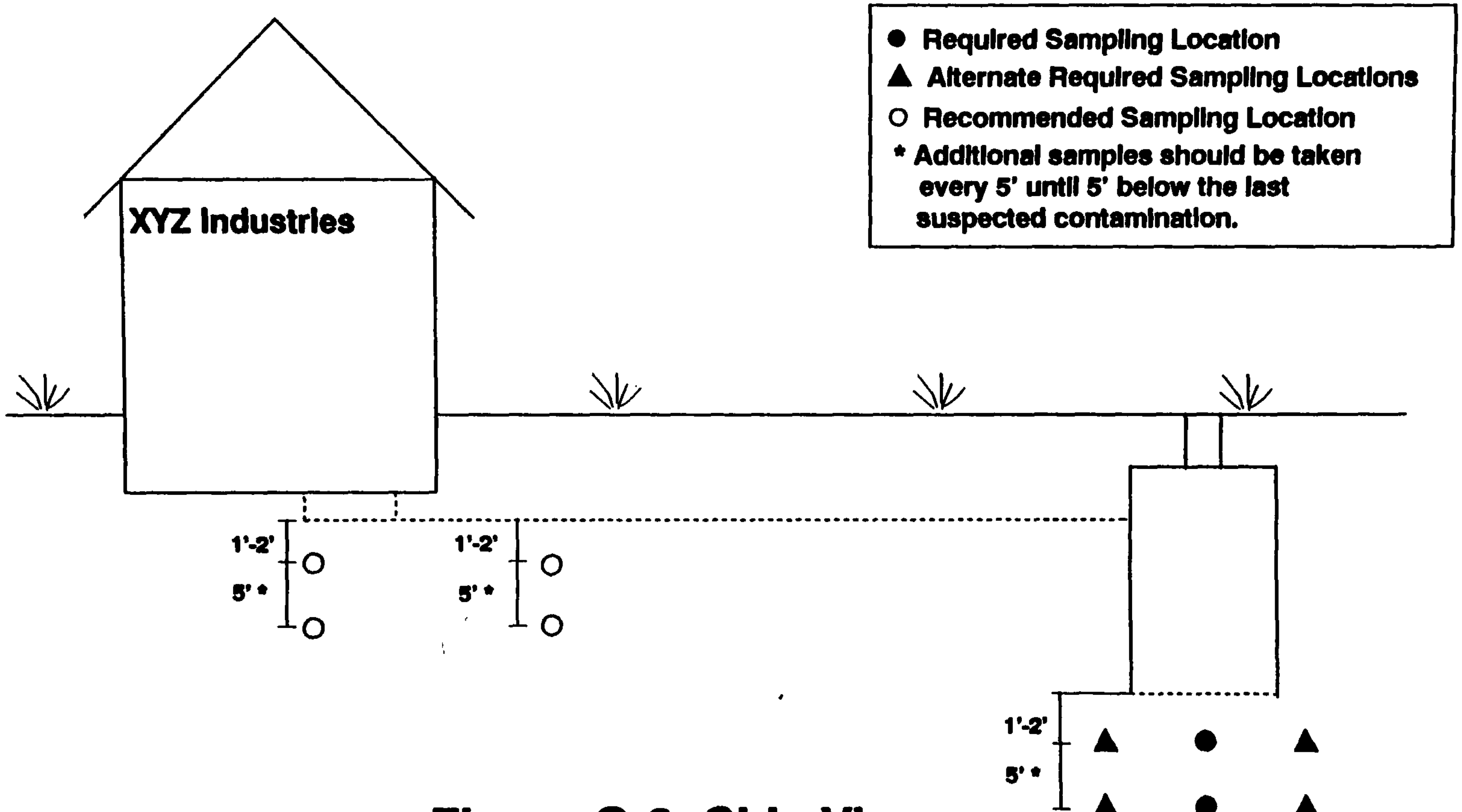

Figure C-2: Side View

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Case D: Leachfield/Infiltration Gallery Receiving Both Industrial and Sanitary Wastes or Only Industrial Wastes

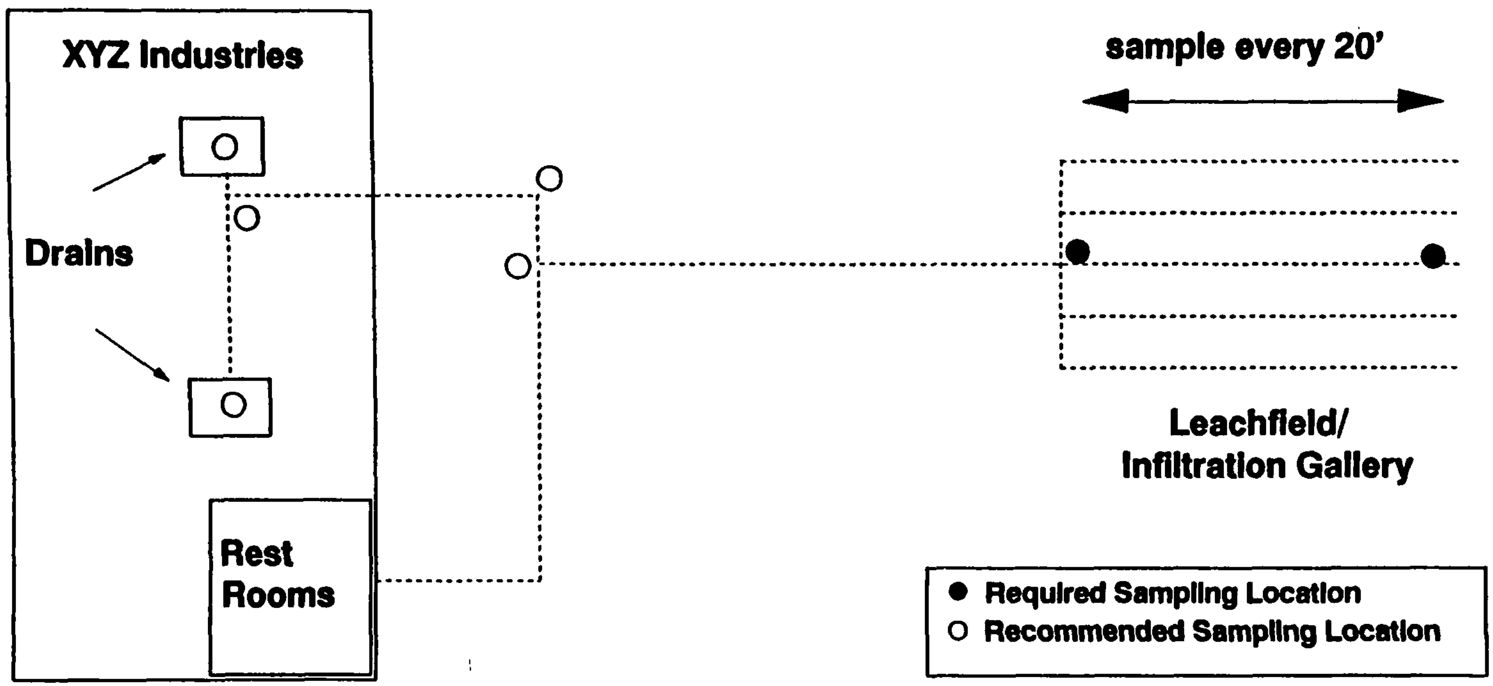

Figure D-1: Plan View

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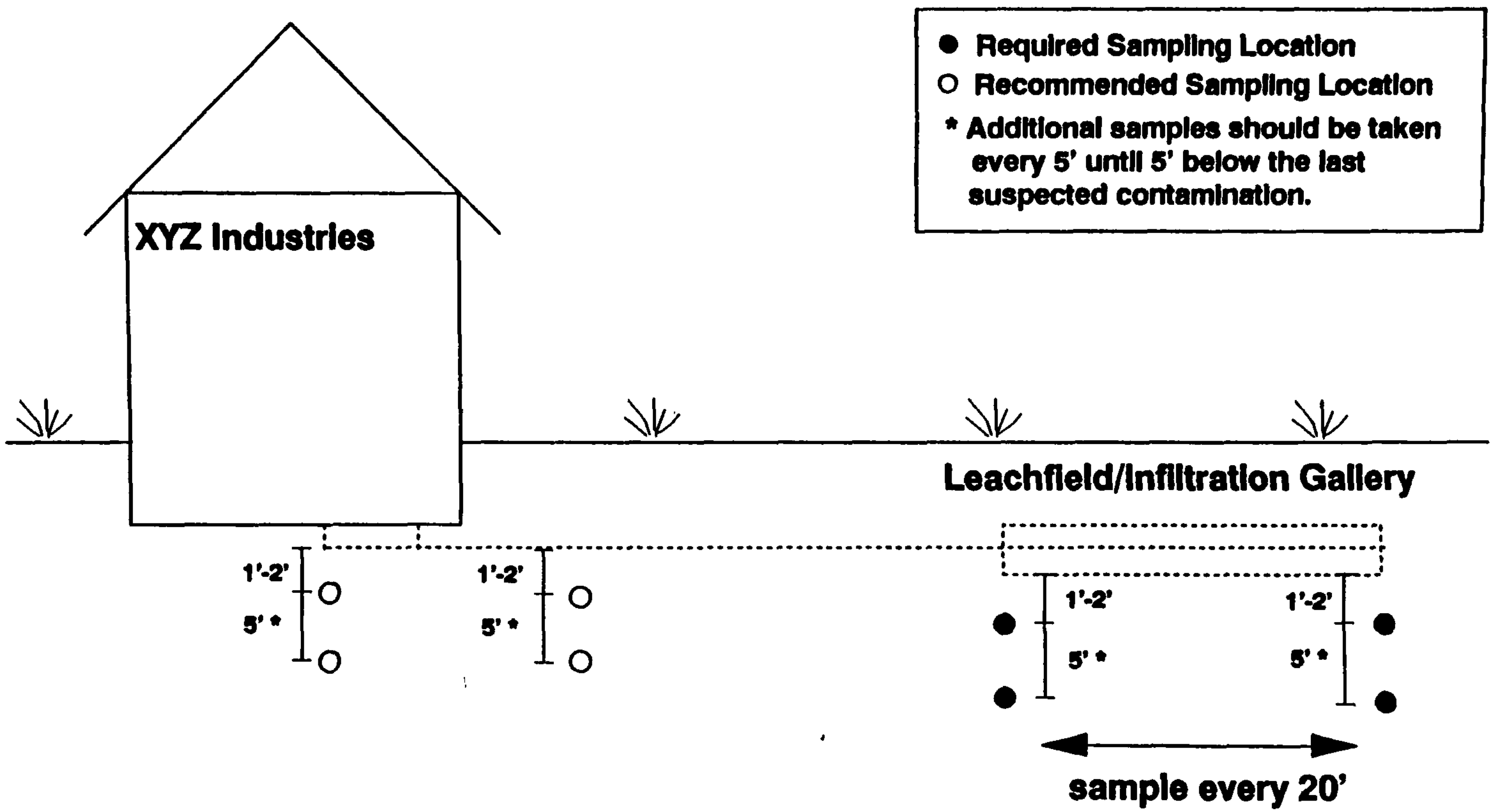

Figure D-2: Side View

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V. SAMPLING METHODS AND PROCEDURES

A. Sampling Equipment

Various types of equipment may be used to collect grab samples from shallow well systems. Typical sampling equipment includes pond samplers, weighted bottles, and bailers. The equipment is usually made of stainless steel, glass or Teflon. Other equipment may be used when the situation warrants.

The pond sampler is used when the system is easily accessible and when the sampling point is deeper than arm's length. This sampling device consists of a telescoping aluminum rod to which a stainless steel or nalgene beaker is attached using an adjustable stainless steel C-clamp. The size of the beaker is determined by the volume and number of samples to be collected.

Weighted bottles or similar devices may be utilized to sample fluid at a depth below an oil/water interface. Such devices must be lowered below the floating product phase before opening. Fluid from below the interface may then be retrieved.

The bailer is useful for sampling from small diameter wells, septic tanks, and other areas where openings are too small to permit use of the pond sampler. A bailer is lowered into the fluid with a rope and retrieved with a sample of the fluid.

Often sediment samples from the bottom of a sump are collected using a beaker attached to a pond sampler. A stainless steel lab scoop is generally used to transfer the sediment from the beaker to the required container. Trowels and drive samplers are also used to collect samples.

In addition to the sampling equipment typically used to obtain samples, nalgene bottles for liquid sample transfer; certified organic-free, metal-free water for quality assurance blank samples; and instruments for measurement of fluid pH and temperature are used.

It is important to avoid using equipment or containers that may alter the sample through the introduction of foreign matter. Contaminated sampling equipment can result in leaching or particulate fallout, volatilization or adsorption of the sample.

B. Equipment Decontamination

All sampling equipment must be decontaminated before and after each sampling event. All quality control equipment blank samples must be obtained after equipment has been thoroughly decontaminated, prior to collecting fluid, sediment or soil samples. Decontamination procedures should be as follows:

1. Disassemble equipment
2. Wash with non-phosphate detergent (alconox) and tap water
3. Rinse with tap water
4. Rinse with isopropyl alcohol (use a squirt bottle)
5. Triple rinse with deionized or distilled water
6. Rinse with acid
7. Rinse with certified organic free (HPLC grade) water

C. Quality Assurance/Quality Control

Quality assurance (QA) is the process of assuring that data obtained are technically sound and properly documented. Quality control (QC) procedures are employed to measure the degree to which quality assurance objectives are met. The laboratory is not informed of the existence of field QC samples.

This document is intended to provide guidelines on some of the minimum requirements necessary to ensure the quality of the data produced during sampling/analysis activities. The regulated facilities are responsible for the quality of the data produced, and are expected to provide data of known, documented, and verifiable quality.

Following is a list of some of the quality control samples which can be employed. Blanks are a check for cross-contamination during sample collection and shipment and in the laboratory. Use analytically-certified organic-free (HPLC grade) water for organic parameters and metal-free (deionized-distilled) water for inorganic parameters. In general, at least one replicate sample, and one type of blank must be obtained for every ten field samples. If there are less than ten field sampling points, at least one replicate sample and one type of blank must be obtained.

1. Equipment Blanks

Quality control (QC) equipment blanks are used to assess the caliber of field decontamination procedures. After the sampling equipment has undergone decontamination procedures, the appropriate (certified metal-free or organic-free) water is poured into the sampling equipment and from there into sampling containers. These containers are preserved, documented and analyzed in exactly the same manner as those containers holding samples of waste fluid.

2. Field Blanks

This type of sample should be collected when equipment decontamination is unnecessary and when a sample collection vessel will not be used. The field sample should be taken at the sampling point. The sample consists of the appropriate (certified metal-free or organic-free) water to which the same quantity of preservative is added as is added to the field samples. These samples provide a check on any contamination of chemical preservatives.

3. Trip Blanks

Trip blanks are used to detect contamination or cross-contamination which may have occurred during sample handling and transportation. These blanks must be prepared prior to the sampling effort and will accompany sample containers used during sampling and in the transport cooler. The trip blanks consist of certified metal-free, organic-free water and will be analyzed by a certified laboratory at the time the other samples are analyzed.

4. Replicate Samples

Replicate sampling is used to determine consistency in both sampling procedures and analytical methods. In general, replicate samples must be obtained at one out of every ten sampling points, and at least one replicate sample must be obtained if there are less than ten sampling points. To collect these samples, fluid is obtained from a sampling point and split between two identical containers. Both containers undergo the same method of analysis at the laboratory.

In addition, split samples and spiked samples are used for QA/QC purposes. These can be briefly described as follows:

5. Split Samples

A split sample is divided into two containers for analysis by separate laboratories. The purpose of this type of sample is to independently confirm laboratory results.

6. Spiked Samples

A spiked sample is produced by adding a known quantity of analyte(s) of interest to the sample. Spiked samples are used to check the accuracy of analytical procedures.

D. Sample Analysis

Region 9 requires that all samples associated with well closure activities be analyzed for the compounds listed below using the indicated methods. Analysis for semi-volatile organic compounds is only necessary when such compounds are suspected of being in the waste stream.

1. **Volatile Organics:** EPA Method 8240 (Volatile Organics); EPA Method 8260 (Volatile Organics by Capillary Column); or a combination of EPA Methods 8010 (Halogenated Volatile Organics), 8015 (Nonhalogenated Volatile Organics) and 8020 (Aromatic Volatile Organics).

2. **Semi-Volatile Organics:** EPA Method 8270 (Semi-volatile Organics) is recommended when the presence of semi-volatile organics is suspected in the waste stream.

3. **Metals:** Appropriate EPA Methods for all metals on the Toxicity Characteristics (TC) list (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver).

4. **Total Petroleum Hydrocarbons (TPH):** EPA Methods 5030/8015 and 5030/8020 to analyze for gasoline in liquid or soil, EPA Method 3510/8015 for diesel in liquid, and EPA Method 3540/8015 for diesel in soil.

5. **Total Recoverable Petroleum Hydrocarbons (TRPH):** EPA Methods 9070A/418.1 for liquid and EPA Methods 9071A/418.1 for soil. As of 10/1/92 EPA Methods 9071A/418.1 will be replaced by EPA Methods 3560/8440. For information on these methods, contact:

Quality Assurance Management Section
U.S. Environmental Protection Agency
75 Hawthorne Street, P-3-2
San Francisco, CA 94105
(415) 744-1492

Note: *Some waste streams may contain additional constituents not covered by these methods. In those cases, additional EPA analytical methods must be employed to determine whether other constituents are present at concentrations which violate the primary drinking water standards or may otherwise adversely affect the health of persons. For literature regarding appropriate methods, see the reference section at the end of this document.*

E. Sample Labeling

All samples should be tagged with an identification number; the date and time of sample collection; type of sample (water, sediment, soil etc.); signature of the sampler; whether the sample is preserved or unpreserved; the general types of analyses to be conducted; and, if the sample is known or thought to be hazardous, the tag should be so marked with information on the nature of the hazard (e.g. corrosive, flammable, poisonous).

F. Sample Collection - Liquid

1. Volatile Organics

Samples for volatile organics are generally taken first to minimize the disturbance of the fluid and resulting loss of volatiles.

An oil/water interface probe should be utilized to define the base of any free floating product encountered while sampling. If no floating liquid phase is present, a sampling device can be lowered into the fluid -- as deeply as possible without disturbing the sediment -- and extracted with a representative grab sample of fluid. The fluid can then be transferred to pre-chilled, pre-labeled 40-ml volatile organic analysis (VOA) vials with Teflon septa. The sample should be preserved by adding hydrochloric acid (HCl) to a pH of less than 2. Two 40-ml vials should be obtained for each VOA sample. When analyzing using the Toxicity Characteristic Leaching Procedure (TCLP), bear in mind that the volume of sample to be collected is dependent on the solids content of the sample. Sufficient sample volume is needed to allow for each physical phase to be analyzed separately. Sample bottles should be filled as completely as possible so that no head space remains. Do not add HCl to samples that will be prepared using the TCLP.

If a separate floating phase is encountered while sampling, a sampling device that collects fluid from beneath the floating phase should be used. This device is operated by gently lowering it in the closed position to a depth below the oil/water interface, carefully opening and filling it with sampling fluid, and then closing and retrieving the sample.

When transferring the sampling fluid from the sampling container to a VOA vial, the fluid must be poured slowly and smoothly to produce a meniscus over the lip of the vial. The screw-top lid with the Teflon septum is then tightened onto the vial, and the vial turned upside down and gently tapped to check for the presence of air bubbles. If air is trapped in the vial, i.e. head space is present, the sample must be retaken. VOA samples should not be taken near any exhaust systems which may cause contamination of the sample.

The sample should tagged and chilled to approximately 4°C in a cooler and sent to a certified analytical laboratory.

2. Semi-Volatile Organics

Samples for semi-volatile organics should be collected after those for volatile organics. The method of collection is the same as that described for volatiles. After the fluid is collected, it should be transferred to a pre-labeled, one-liter amber glass bottle with a Teflon septum. The sample must be tagged and chilled to approximately 4°C for shipping to the analytical laboratory.

3. Metals

Samples for total metals should be taken after those for volatile and semi-volatile organics. After collection, the sample is transferred to a one-liter, polyethylene, certified metal-free bottle and the unfiltered sample is acidified with 1:1 redistilled HNO_3 to a pH of less than 2 at the time of collection. Do not add HNO_3 to samples that will be analyzed for mercury or those that will be prepared using the TCLP.

4. Total Petroleum Hydrocarbons (TPH)

Use collection methods described for sampling for volatile organics. If sampling for TPH as gasoline, the fluid should be transferred to two pre-labeled 40-ml vials with Teflon septa (as described for volatile organics). If sampling for TPH as Diesel, the fluid should be transferred using a funnel to a pre-labeled, one-liter glass bottle with a Teflon septum. Preserve the sample by adding hydrochloric acid (HCl) to a pH of less than 2. The sample must be tagged and chilled to 4°C for shipping to the analytical laboratory.

5. Total Recoverable Petroleum Hydrocarbons (TRPH)

Use the collection methods described for volatile organics. The fluid should be transferred to a one-liter glass bottle with a Teflon septum. The sample must then be preserved, tagged and chilled as above.

G. Sample Collection - Sediment

Often sediment samples from the bottom of a sump are collected using a beaker attached to a pond sampler. A stainless steel lab scoop is generally used to transfer the sediment from the beaker to the required container. Sediment samples should be placed in an 8-oz. wide-mouthed glass jar. The jar should be completely filled so that no headspace is present. After being taped and labeled, the sample should be placed immediately in an ice chest and kept cold (4°C) for delivery to the laboratory. Care should be taken throughout to avoid contamination of both the inside and outside of the jar and its contents.

H. Sample Collection - Soil

The bore hole can be made with a continuous flight or hollow stem auger, rotary core drill or other drilling method. It is recommended that core sampling equipment avoid the use of drilling fluids since these greatly increase the potential for sample contamination. Soil sampling kits are commercially available that can be used at relatively shallow depths to both drill the bore hole and collect a soil core. These units contain augers, coring tubes and sufficient drill rod extensions to sample up to depths of twenty-five feet.

The most common procedures for collecting soil samples use a thin-wall steel tube (core barrel), fitted with a brass liner, which is forced into the undisturbed soil at the bottom of the bore hole. This is sometimes referred to as drive sampling. Core barrels are generally from one inch to three inches in diameter and 12 to 24 inches long. When the core barrel is retrieved, friction will usually retain the sample inside the barrel in most unsaturated materials.

Samples should be taken at locations where the potential for a high degree of contamination exists (suspected worst-case locations) such as elbows, joints in pipe lines, clarifiers, floor drains, tanks and wells. Several depth borings should be planned to be sampled for chemical analysis. Sample intervals will vary, but in general should be taken between one and two feet beneath the excavation or the bottom of the septic tank, cesspool, well, pipe line or floor drain surface, and then every five feet to the water table, or until five feet past the last suspected contamination.

Upon retrieval from the borehole, the sample liners should be removed and placed on clean plastic. Using cuttings or corings, the borehole should be logged to the full depth by an on-site geologist according to the Unified Soil Classification System.

After logging, the exposed ends of the liner should be covered. Typically, Teflon sheets and plastic end caps are used and secured with silicone-based tape. After each use, sampling equipment must be decontaminated.

Sample labels should be written or attached securely to the end caps and should contain the following information: boring number, sample location, sample number, sample depth, date and time of sampling, name of sampler, and required analytical method. Sealed and labeled samples must be placed in cooled ice chests and shipped to the analytical laboratory.

I. Field Documentation

Field information about sampling efforts should include sample identification numbers; date and time of sample collection; description of the location of the collection; the collection method; the rationale for selecting the sample and representativeness of the sample; and a description of any deviations from standard protocols.

J. Sample Packaging and Shipping

Samples should be packaged to prevent breakage. The shipping container should be sealed or locked so that any evidence of tampering may be readily detected. Packaging, labeling and shipping of samples must follow the Department of Transportation (DOT) regulations. Samples that meet DOT's hazardous materials criteria must be packed and labeled according to the requirements set forth in 49 CFR 172.101.

TABLE I
SAMPLING METHODS
Recommended Sampling Containers[@], Preservation Techniques, and Holding Times

Analysis Method	Fluid	Sediment and Soil	Preservation	Holding Time
Volatile Organics: -EPA 8240, -EPA 8260, or -EPA 8010 and 8020	Two 40-ml volatile organic analysis vials fitted with Teflon septa (VOA vials)	One 8-oz. wide mouth glass jar with Teflon septum, brass tube, or stainless steel tube	Chill to 4°C For liquid samples, add HCl to pH<2	14 days
Semi-volatile Organics: -EPA Method 8270	One 1-liter amber glass bottle with Teflon septum	One 8-oz. wide mouth glass jar with Teflon septum, brass tube, or stainless steel tube	Chill to 4°C[+]	7 days
Metals: Appropriate EPA methods for arsenic, barium, cadmium, chromium, lead, selenium, and silver	One 1-liter polyethylene bottle	One 8-oz. wide mouth glass jar, or two 4-oz. wide mouth glass jars	Chill to 4°C For liquid samples, add HNO_3 to pH<2	180 days
Mercury: Appropriate EPA method	One 1-liter polyethylene bottle	One 8-oz. wide mouth glass jar, or brass tube	Chill to 4°C	28 days
Total Petroleum Hydrocarbons-Gasoline: -EPA 5030/8015 and 5030/8020 (liquid) -EPA 5030/8015 and 5030/8020 (soil) Diesel: -EPA 3510/8015 (liquid) -EPA 3540/8015 (soil)	Two 40-ml VOA vials (gasoline) or one 1-liter glass bottle with Teflon septum (diesel)	One 8-oz. wide mouth glass jar with Teflon septum, brass tube, or stainless steel tube	Chill to 4°C For liquid samples, add HCl to pH<2	14 days
Total Recoverable Petroleum Hydrocarbons: -EPA 9070A/418.1 (liquid) -EPA 9071A/418.1* (soil)	One 1-liter glass bottle with Teflon septum	One 8-oz. wide mouth glass jar with Teflon septum, brass tube, or stainless steel tube	Chill to 4°C For liquid samples, add HCl to pH<2	14 days

Notes: @ Additional sample volume may be needed for quality control samples.
* As of October 1, 1992, use EPA Methods 3560/8440 for soil samples. Copies of these methods can be obtained from the USEPA Region IX Quality Assurance Management Section at (415) 744-1492.
\+ Check with the laboratory to see if any additional preservatives are needed for chemicals of concern.

TABLE II
TCLP SAMPLING METHODS*
Recommended Sampling Containers+, Preservation Techniques, and Holding Times

Analysis Method	Fluid	Sediment and Soil	Preservation	Holding Time
Volatile Organics: -Appropriate TCLP methods	Two 40-ml volatile organic analysis vials fitted with Teflon septa (VOA vials) and two 1-liter amber glass bottles with Teflon septa	One 8-oz. wide mouth glass jar with Teflon septum, brass tube, or stainless steel tube	Chill to 4°C	14 days
Semi-volatile Organics: -Appropriate TCLP methods	One 1-liter amber glass bottle with Teflon septum	One 8-oz. wide mouth glass jar with Teflon septum, brass tube, or stainless steel tube	Chill to 4°C	7 days
TCLP metals -Arsenic: 7060 -Barium: 6010 -Cadmium: 6010 -Chromium: 6010 -Lead: 7421 -Selenium: 7740 -Silver: 6010	One 1-liter polyethylene bottle	One 8-oz. wide mouth glass jar with Teflon septum	Chill to 4°C	180 days
Mercury: 7470	One 1-liter polyethylene bottle	One 8-oz. wide mouth glass jar with Teflon septum, brass tube, or stainless steel tube	Chill to 4°C	28 days

Notes: * The TCLP cannot be used with analytical methods for total petroleum hydrocarbons (TPH) and total recoverable petroleum hydrocarbons (TRPH).
+ Additional sample volume may be needed for quality control samples and for each physical phase to be analyzed separately.

K. Common Sampling Errors

The following are common errors made during sampling that lead to inconsistent analytical results:

- Failure to calibrate instruments
- Lack of equipment maintenance
- Use of inappropriate sample containers
- Lack of QA samples to assure precision of sampling methods and laboratory analysis.
- Sample loss or leakage during shipping or handling due to improper packaging
- Mislabelling
- Poor field records

L. Chain of Custody

The purpose of chain of custody procedures is to be able to trace possession of a sample from the time it is collected until the analytical results are obtained by the laboratory. Chain of custody procedures are important when analytical results are introduced as evidence in a legal proceeding.

A sample is in "custody" if:

- It is actually in one's physical possession
- It is in one's view
- It was in one's possession and it was secured so that it could not be tampered with.
- It is kept in a secured area with access restricted to authorized personnel only.
- It is placed in a container that is sealed with an official seal that will be broken when the container is opened.

Chain of custody documentation includes, but is not limited to, the entries in the sampler's field notebook, the official seals on the sampling containers and the chain of custody record. The inspector needs to assure that the relationship between the physical sample and the related documentation is clear, complete, and accurate. The sample number, date and time of sampling, location and sample type, preservative used, analysis required, and sampler's initials should appear on all documents.

When transferring the samples, the individual relinquishing and the individual receiving the sample must sign and record the date and time on the chain of custody record. Every person who takes custody must fill in the appropriate section of the chain of custody record. For a sample of a chain of custody record see Figure E. When the samples are sent by mail, the package must be registered with return receipt requested.

ENVIRONMENTAL PROTECTION AGENCY
Office of Enforcement

REGION 9
75 Hawthorne Street
San Francisco, California 94105-3901

CHAIN OF CUSTODY RECORD

PROJ. NO.	PROJECT NAME

SAMPLERS: *(Signature)*

STA. NO.	DATE	TIME	COMP.	GRAB	STATION LOCATION	NO. OF CON-TAINERS								REMARKS

Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*
Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*
Relinquished by: *(Signature)*	Date / Time	Received for Laboratory by: *(Signature)*	Date / Time	Remarks	

Distribution: Original Accompanies Shipment; Copy to Coordinator Field Files

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