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CHAPTER TWO

CHOOSING THE CORRECT PROCEDURE

SW-846 is not intended to be an analytical training manual. Therefore, method procedures are written based on the assumption that they will be performed by analysts who are formally trained in at least the basic principles of chemical analysis and in the use of the subject technology.

In addition, SW-846 methods, with the exception of required method use for the analysis of method-defined parameters, are intended to be guidance methods containing general information on how to perform an analytical procedure or technique which a laboratory can use as a basic starting point for generating its own detailed Standard Operating Procedure (SOP), either for its own general use or for a specific project application. The performance data included in these methods are for guidance purposes only, and are not intended to be and must not be used as absolute quality control (QC) acceptance criteria for the purposes of laboratory accreditation.

2.0 INTRODUCTION

The purpose of this chapter is to aid the analyst in choosing the appropriate methods for sample analyses, based upon the sample matrix and the analytes to be determined. The ultimate responsibility for producing reliable analytical results lies with the entity subject to the regulation. Therefore, members of the regulated community are advised to refer to this chapter and to consult with knowledgeable laboratory personnel when choosing the most appropriate suite of analytical methods. In addition, analysts and data users are advised that, except where explicitly specified in a regulation, the use of SW-846 methods is not mandatory in response to Federal testing requirements.

SW-846 analytical methods are written as quantitative analytical methods, and specific methods may be used to demonstrate that a waste does not contain analytes of concern that cause it to be managed as a hazardous waste. SW-846 methods typically contain relatively stringent recommended QC criteria appropriate to many levels of analyses, including trace. However, if a particular application does not require data of this quality, less stringent QC criteria may and should be used.

The choice of the appropriate sequence of analytical methods depends on the information sought and on the experience of the analyst. Appropriate selection is confirmed by the usability of data (i.e., adequate for its intended use). The use of the recommended procedures, whether they are approved or mandatory, does not release the analyst from demonstrating the correct execution of the method.

Sec. 2.1 provides guidance regarding the analytical flexibility inherent to SW-846 methods and the precedence of various QC criteria. Sec. 2.2 reviews the information required to choose the correct combination of methods for an analytical procedure. Sec. 2.3 provides useful information on implementing the method selection guidance for organic analyses. Sec. 2.4 provides guidance on choosing procedures for characteristic analyses. Sec. 2.5 provides guidance on the determination of analytes in groundwater. Finally, Sec. 2.6 provides

information regarding choosing procedures for inorganic analyte analyses. Tables and figures referenced in this chapter are sequentially located after the last page of chapter text.

2.1 GUIDANCE REGARDING FLEXIBILITY INHERENT TO SW-846 METHODS AND THE PRECEDENCE OF SW-846 QUALITY CONTROL CRITERIA

The specific products and instrument settings cited in SW-846 methods represent those products and settings used during method development or subsequently evaluated by the Agency for use in the method. Glassware, reagents, supplies, equipment and settings other than those listed in this manual may be employed, provided that method performance appropriate for the intended application has been documented. Such performance includes consideration of precision, accuracy (or bias), recovery, representativeness, comparability, and sensitivity (quantitation or reporting limits, now referred to as lower limit of quantitation (LLOQ)) relative to the data quality objectives (DQOs) for the intended use of the analytical results. In response to this inherent flexibility, if an alternative analytical procedure is employed, then EPA expects the laboratory to demonstrate and document that the procedure is capable of providing appropriate performance for its intended application. This demonstration must not be performed after the fact, but as part of the laboratory's initial demonstration of proficiency with the method. The documentation should be in writing, maintained in the laboratory, and available for inspection upon request by authorized representatives of the appropriate regulatory authorities. The documentation should include the performance data as well as a detailed description of the procedural steps as performed (i.e., a written standard operating procedure).

Given this allowance for flexibility, EPA wishes to emphasize that this manual also contains procedures for "method-defined parameters," where the analytical result is wholly dependent on the process used to make the measurement. Examples include: the use of the toxicity characteristic leaching procedure (TCLP) to prepare a leachate, and the flash point, pH, paint filter liquids, and corrosivity tests. In these instances, changes to the specific methods may change the end result and incorrectly identify a waste as nonhazardous. Therefore, when the measurement of such method-defined parameters is required by regulation, those methods are <u>not</u> subject to the flexibility afforded in other methods.

Analysts and data users are advised that even for those analytes that are not method-defined, different procedures may produce some difference in results. Common examples include the differences in recoveries of phenolic compounds extracted from water by separatory funnel (Method 3510) and continuous liquid-liquid (Method 3520) extraction techniques, differences in recoveries of many compounds between Soxhlet (Method 3540) and ultrasonic (Method 3550) extraction techniques, and differences resulting from the choice of acid digestion of metals (Method 3050) or microwave digestion (Method 3051). Where practical, the Agency has included guidance in the individual methods regarding known potential problems, and analysts are advised to review this information carefully in choosing or modifying analytical procedures. Chapter One describes a variety of QC procedures that may be used to evaluate the quality of the analytical results. Additional QC procedures may be described in the individual methods. The results of these QC procedures should be used by the analyst to evaluate if the analytical procedures and/or any modifications are appropriate to generate data of the quality necessary to satisfy the data quality needs of the intended application.

The performance data included in the SW-846 methods are <u>not</u> intended to be used as absolute QC acceptance criteria for method performance. The data are intended to be guidance, by providing typical method performance in typical matrices, to assist the analyst in selection of the appropriate method for the intended application. In addition, it is the

responsibility of the laboratory to establish actual operating parameters and in-house QC acceptance criteria, based on its own laboratory SOPs and in-house QC program, to demonstrate appropriate performance of the methods used in that laboratory for the RCRA analytical applications for which they are intended.

The regulated community is further advised that the methods here or from other sources need only be used for those specific analytes of concern that are subject to regulation or other monitoring requirements. The fact that a method provides a long list of analytes does not mean that each of those analytes is subject to any or all regulations, or that all of those analytes must be analyzed each time the method is employed, or that all of the analytes can be analyzed using a single sample preparation procedure. It is EPA's intention that the target analyte list for any procedure includes those analytes necessary to meet the DQOs of the project (i.e., those analytes subject to monitoring requirements and set out in a RCRA permit or other applicable regulation, plus those analytes used in the methods for QC purposes, such as surrogates, internal standards, system performance check compounds, etc.). Additional analytes, not included on the analyte list of a particular method(s) but needed for a specific project, may be analyzed by that particular method(s), if appropriate performance can be demonstrated for those analytes in the matrices of concern at the levels of concern.

2.1.1 Trace analysis vs. macroanalysis

Through the choice of sample size and concentration procedures, the methods presented in SW-846 were designed to address the problem of "trace" analyses (<1000 ppm), and have been developed for an optimized working range. These methods are also applicable to "minor" (1000 ppm - 10,000 ppm) and "major" (>10,000 ppm) analyses, as well, through use of appropriate sample preparation techniques that result in analyte concentrations within that optimized range. Such sample preparation techniques include:

1. Adjustment of size of sample prepared for analysis (for homogeneous samples)
2. Adjustment of injection volumes
3. Dilution or concentration of sample
4. Eelimination of concentration steps prescribed for "trace" analyses
5. Direct injection (of samples to be analyzed for volatile constituents)

The performance data presented in each of these methods were generated from "trace" analyses, and may not be applicable to "minor" and "major" analyses. Generally, extraction efficiency improves as concentration increases.

CAUTION: Great care should be taken when performing trace analyses after the analysis of concentrated samples, given the possibility of contamination.

2.1.2 Choice of apparatus and preparation of reagents

Since many types and sizes of glassware and supplies are commercially available, and since it is possible to prepare reagents and standards in many different ways, the apparatus, reagents, and volumes included in these methods may be replaced by any similar types as long as this substitution does not affect the overall quality of the analyses.

2.1.3 Quality control criteria precedence

Chapter One contains general QC guidance for analyses using SW-846 methods. QC guidance specific to a given analytical technique (e.g., extraction, cleanup, sample introduction, or analysis) may be found in Methods 3500, 3600, 5000, 7000, and 8000. Method-specific QC criteria may be found in Sec. 8.0 of most older individual methods, in Sec. 9.0 of newer methods, or in Sec. 11.0 of some air sampling methods. When inconsistencies exist between the information in these locations, method-specific QC criteria take precedence over both technique-specific criteria and those criteria given in Chapter One, and technique-specific QC criteria take precedence over the criteria in Chapter One.

2.2 INFORMATION NECESSARY FOR CHOOSING THE CORRECT PROCEDURE

In order to choose the correct combination of methods to comprise the appropriate analytical procedure, some basic information is necessary. This includes information on:

1. The physical state of the sample
2. The analytes of interest
3. The analytical sensitivity needed
4. The analytical objective
5. Whether the purpose is quantitation or monitoring
6. What sample containers and preservation will be used and what holding times may apply

2.2.1 Physical state(s) of sample

The phase characteristics of the sample must be known. There are several general categories of phases into which the sample may be categorized, including:

Aqueous	Oil or other Organic Liquid
Sludge	Multiphase Sample
Solid	Groundwater
Stack Sampling –Volatile Organics Sampling Train (VOST) Condensate	
TCLP or Extraction Procedure (EP) Extract	

There may be a substantial degree of overlap between the phases listed above and it may be useful to further divide these phases in certain instances. A multiphase sample may be a combination of aqueous, organic liquid, sludge, and/or solid phases, and generally must undergo a phase separation as the first step in the analytical procedure.

2.2.2 Analytes of interest

Analytes may be divided into various classes, based on the determinative methods used to identify and quantify them. The most basic differentiation is between organic (e.g., carbon-containing) analytes and inorganic (e.g., metals and anions) analytes.

Table 2-1 is an alphabetical list of analytes cited within the SW-846 organic determinative methods (excludes immunoassay and other screening methods). These analytes have been evaluated by those methods. The methods may also be applicable to other analytes that are similar to those listed. Tables 2-2 through 2-38 list the analytes for each organic determinative method. Table 2-39 indicates which methods are applicable to inorganic analytes.

NOTE: Analysts should review the discussion in Sec. 2.1 of this chapter with regard to the presence of an analyte in a method versus the need for its analysis for a given project.

2.2.3 Sensitivity

Some regulations may require a specific sensitivity or quantitation limit (LLOQ) for an analysis, as in the determination of analytes for the Toxicity Characteristic (TC). Drinking water quantitation limits, for those specific organic and metallic analytes covered by the National Primary Drinking Water Regulations, are desired in the analysis of groundwater.

2.2.4 Analytical objective

Knowledge of the analytical objective is essential in the choice of sample preparation procedures and in the selection of a determinative method. This is especially true when the sample has more than one phase. Knowledge of the analytical objective may not be possible or desirable at all management levels, but that information should be included in the project planning document and transmitted to the analytical laboratory management to ensure that the correct techniques are used during the analytical effort. Screening methods or composite sampling may be highly beneficial for some applications in order to generate a broader view of contaminant distribution than may be possible with a more precise and more costly method. Table 2-46 identifies some screening methods appropriate for different classes of organic chemicals in certain matrices.

2.2.5 Quantitation or monitoring

The strategy for quantitation of compounds in environmental or process samples may be contrasted with the strategy for collecting monitoring data. When there is little information available about the composition of the sample source (e.g., a well or process stream), mass spectral identification of organic analytes leads to fewer false positive results. Thus, the most practical form of quantitation for organic analytes is often mass spectral identification. However, where the sensitivity requirements exceed those that can be achieved using mass spectral methods (e.g., gas chromatography/mass spectrometry (GC/MS) or high performance liquid chromatography (HPLC)/MS), it may be necessary to employ a more sensitive quantitation method (e.g., electron capture). In these instances, the risk of false positive results may be minimized by confirming the results through a second analysis with a dissimilar detector or chromatographic column. Thus, the choice of technique for organic analytes may be governed by the sensitivity requirements and potential interferants.

Similarly, the choice of technique for metals may be governed by the sensitivity requirements and potential interferants.

In contrast, monitoring samples are analyzed to confirm existing and ongoing conditions, tracking the presence or absence of known constituents in an environmental or process matrix. In well-defined matrices and under stable analytical conditions, less compound-specific quantitation modes may be used, as the risk of false positive results is less.

2.2.6 Sample preservation and holding times

Table 2-40 provides information regarding recommended sample preservation techniques, sample holding times, and other information. Similar information may be found in Table 3-1 of Chapter Three (inorganic analytes) and Table 4-1 of Chapter Four (organic analytes). Samples

need to be extracted and analyzed within the recommended holding times for the results to be considered reflective of native concentrations as collected. Analytical data generated outside of the recommended holding times should typically be considered as minimum values only. Such data may be used to demonstrate that a waste is hazardous where it shows the concentration of a constituent to be above the regulatory threshold, but cannot be used to demonstrate that a waste is not hazardous. However, regarding the information in Table 2-40, a longer holding time may be appropriate if it can be demonstrated that reported concentrations are not adversely affected from preservation, storage and analyses performed outside the recommended holding times.

2.3 CHOOSING PROCEDURES FOR ORGANIC ANALYSES

Table 2-1 summarizes the organic analysis options available in SW-846.

2.3.1 Extraction and sample preparation procedures for organic analytes

SW-846 methods for preparing samples for organic analytes are shown in Table 2-41. Method 3500 and associated methods should be consulted for further details on preparing the sample for analysis.

2.3.1.1 Aqueous samples

Methods 3510, 3520, and 3535 may be used for extraction of the semivolatile organic compounds (SVOCs) from aqueous samples. The choice of a preparative method depends on the sample. Method 3510, a separatory funnel liquid-liquid extraction technique, is appropriate for samples which will not form a persistent emulsion interface between the sample and the extraction solvent. The formation of an emulsion that cannot be broken up by mechanical techniques will prevent proper extraction of the sample. Method 3520, a continuous liquid-liquid extraction technique, may be used for any aqueous sample and will minimize emulsion formation.

Method 3535 is solid-phase extraction technique that has been tested for organochlorine pesticides, phthalate esters, polychlorinated biphenyls (PCBs), organophosphorus pesticides, nitroaromatics and nitramines, and some explosive compounds, and may be applicable to other semivolatile and extractable compounds as well. The aqueous sample is passed through a solid sorbent material which traps the analytes. They are then eluted from the solid-phase sorbent with a small volume of organic solvent. This technique may be used to minimize the volumes of organic solvents that are employed, but may not be appropriate for aqueous samples with high suspended solids contents.

2.3.1.1.1 Acidic extraction of phenols and acid analytes

The solvent extract obtained by performing Method 3510, 3520, or 3535 at a pH less than or equal to 2 will contain the phenols and acid/neutral extractable organics of interest, and may contain some mildly basic compounds. The particular pH extraction conditions needs to be defined during the project planning process based on the desired target analytes and performance goals.

2.3.1.1.2 Basic or neutral extraction of semivolatile analytes

The solvent extract obtained by performing Method 3510, 3520, or 3535 at a basic pH will contain the organic bases of interest, if acid extraction is performed first. It will also contain the neutral compounds of interest, if acid extraction is not performed. Refer to Table 1 in the extraction methods (3510 and/or 3520) for guidance on the requirements for pH adjustment prior to extraction and analysis.

2.3.1.2 Solid samples

Soxhlet extraction (Methods 3540, 3541 and 3542), pressurized fluid extraction (Method 3545), microwave extraction (Method 3546) and ultrasonic extraction (Method 3550) may be used with solid samples. Consolidated samples should be ground finely enough to pass through a 1-mm sieve. In limited applications, waste dilution (Methods 3580 and 3585) may be used if the entire sample is soluble in the specified solvent.

Methods 3540, 3541, 3542, 3545, 3546 and 3550 are neutral-pH extraction techniques and therefore, depending on the analysis requirements, acid-base partition cleanup (Method 3650) may be necessary. Method 3650 will only be needed if chromatographic interferences are severe enough to prevent quantitation of the analytes of interest. This separation will be most important if a gas chromatography (GC) method is chosen for analysis of the sample. If GC/MS is used, the ion selectivity of the technique may compensate for chromatographic interferences.

There are three extraction procedures for solid samples that employ supercritical fluid extraction (SFE). Method 3560 is a technique for the extraction of petroleum hydrocarbons from various solid matrices using carbon dioxide at elevated temperature and pressure. Method 3561 may be used to selectively extract polynuclear aromatic hydrocarbons (PAHs) from solid matrices using supercritical carbon dioxide and appropriate modifiers, based on the determinative procedure to be used. Method 3562 may be used to selectively extract organochlorine pesticides or PCBs from solid matrices using supercritical carbon dioxide.

2.3.1.3 Oils and organic liquids

Method 3580, waste dilution, may be used to prepare oils and organic liquid samples for analysis of semivolatile and extractable organic analytes by GC or GC/MS. Method 3585 may be employed for the preparation of these matrices for volatiles analysis by GC or GC/MS. To avoid overloading the analytical detection system, care must be exercised to ensure that proper dilutions are made. Methods 3580 and 3585 give guidance on performing waste dilutions.

To remove interferences for semivolatiles and extractables, Method 3611 (alumina cleanup) may be performed on an oil sample directly, without prior sample preparation.

Method 3650 is the only other preparative procedure for oils and other organic liquids. This procedure is a back extraction into an aqueous phase. It is generally introduced as a cleanup procedure for extracts rather than as a preparative procedure. Oils generally have a high concentration of semivolatile compounds and, therefore, preparation by Method 3650 should be done on a relatively small aliquot of the sample. Generally, extraction of 1 mL of oil will be sufficient to obtain a saturated aqueous phase and avoid emulsions.

NOTE: The use of traditional extraction techniques (i.e., 3510, 3520, 3535, 3540, 3541, 3545, 3546, and 3550), is neither suitable nor recommended for use in these matrices due to a high potential for hydrocarbon interferences and decreased determinative method sensitivity (i.e., poor analytical performance).

2.3.1.4 Sludge samples

Determining the appropriate methods for analysis of sludges is complicated because of the lack of precise definitions of sludges with respect to the relative percent of liquid and solid components. There is no set ratio of liquid to solid that enables the analyst to determine which of the three extraction methods cited is the most appropriate. Sludges may be classified into three categories: liquid sludges, solid sludges, and emulsions, but with appreciable overlap.

If the sample is an organic sludge (solid material and organic liquid, as opposed to an aqueous sludge), the sample should be handled as a multiphase sample.

2.3.1.4.1 Liquid sludges

Method 3510 or Method 3520 may be applicable to sludges that behave like, and have the consistency of, aqueous liquids. Ultrasonic extraction (Method 3550) and Soxhlet-type (Method 3540 series) procedures will, most likely, be ineffective because of the overwhelming presence of the liquid aqueous phase.

2.3.1.4.2 Solid sludges

Soxhlet extraction (Methods 3540 and 3541), pressurized fluid extraction (Method 3545), microwave extraction (Method 3546), and ultrasonic extraction (Method 3550) will be more effective when applied to sludge samples that resemble solids. Samples may be dried or centrifuged to form solid materials for subsequent determination of semivolatile compounds.

Using Method 3650, Acid-Base Partition Cleanup, on the extract may be necessary, depending on whether chromatographic interferences prevent determination of the analytes of interest.

2.3.1.4.3 Emulsions

Attempts should be made to break up and separate the phases of an emulsion. Several techniques are effective in breaking emulsions or separating the phases of emulsions, including:

1. Freezing/thawing -- Certain emulsions will separate if exposed to temperatures below 0 °C.

2. Salting out -- Addition of a salt to make the aqueous phase of an emulsion too polar to support a less polar phase promotes separation.

3. Centrifugation -- Centrifugal force may separate emulsion components by density.

4. Addition of water or ethanol -- Emulsion polymers may be destabilized when a preponderance of the aqueous phase is added.

5. Forced filtering through glass wool -- Many emulsions can be broken by forcing the emulsion through a pad of Pyrex glass wool in a drying column using a slight amount of air pressure (using a rubber bulb usually provides sufficient pressure).

If techniques for breaking emulsions fail, use Method 3520. If the emulsion can be broken, the different phases (aqueous, solid, or organic liquid) may then be analyzed separately.

2.3.1.5 Multiphase samples

Choice of the procedure for separating multiphase samples is highly dependent on the objective of the analysis. With a sample in which some of the phases tend to separate rapidly, the percent weight or volume of each phase should be calculated and each phase should be individually analyzed for the required analytes.

An alternate approach is to obtain a homogeneous sample and attempt a single analysis on the combination of phases. This approach will give no information on the abundance of the analytes in the individual phases other than what can be implied by solubility.

A third alternative is to select phases of interest and to analyze only those selected phases. This tactic must be consistent with the sampling/analysis objectives or it will yield insufficient information for the time and resources expended. The phases selected should be compared with Figure 2-1 and Table 2-41 for further guidance.

2.3.2 Cleanup procedures

Cleanup procedure selection is determined by the analytes of interest within the extract. Each analyte type in Table 2-42, Cleanup Methods for Organic Analyte Extracts, corresponds to one or more of the possible determinative methods available in the manual. However, the necessity of performing cleanup may also depend upon the matrix from which the extract was developed. Cleanup of a sample may be done exactly as instructed in the cleanup method for some of the analytes. There are some instances when cleanup using one of the methods may only proceed after the procedure is modified to optimize recovery and separation. Several cleanup techniques may be possible for each analyte category. The information provided is not meant to imply that any or all of these methods must be used for the analysis to be acceptable. Extracts with components which interfere with spectral or chromatographic determinations are expected to be subjected to cleanup procedures.

The analyst, in consultation with the regulator, customer, and other project planning participants as necessary, must determine the necessity for cleanup procedures, as there are no clear-cut criteria for indicating their use. Method 3600 and associated methods should be consulted for further details on extract cleanup.

2.3.3 Determinative procedures

In Table 2-43, the determinative methods for organic analytes are divided into four categories, specifically: GC/MS (this category includes single quadrupole MS, triple quadrupole (MS/MS), and time-of-flight instruments); GC with electromagnetic spectrometric (ES) detectors (i.e., Fourier Transform infrared (FT-IR) or atomic emission (AES)); specific quantitation methods (i.e., GC with specific non-MS detectors); and HPLC, including any HPLC-MS methods. This division is intended to help an analyst choose which determinative method will apply. Under each analyte column, SW-846 method numbers are indicated, if appropriate, for the determination of the analyte. A blank has been left if no chromatographic determinative method is available.

Generally, the MS procedures are more specific but less sensitive than the appropriate gas chromatographic/specific quantitation or ES method.

Method 8000 gives a general description of the techniques of GC and HPLC. Method 8000 should be consulted prior to application of any of the GC or HPLC methods.

Method 8081 (organochlorine pesticides), Method 8082 (PCBs), Method 8141 (organophosphorus pesticides), and Method 8151 (chlorinated herbicides), are preferred over GC/MS because of the combination of selectivity and sensitivity of the flame photometric, nitrogen-phosphorus, and electron capture detectors.

Method 8260 is a GC/MS method for volatile analytes. A variety of sample introduction techniques may be used with Method 8260, including Methods 5021, 5030, 5031, 5035, 5041, and 3585. A GC with a selective detector is also useful for the determination of volatile organic compounds in a monitoring scenario, as described in Sec. 2.2.5.

Method 8270 is a GC/MS method for semivolatile analytes. Method 8410 is another GC method for semivolatile analytes which uses a FT-IR detector. Method 8085 is a GC method for pesticides which uses an AES detector.

Table 2-43 lists several GC and HPLC methods that apply to only a small number of analytes. Methods 8031 and 8033 are GC methods for acrolein, acrylonitrile, and acetonitrile. Methods 8315 and 8316 are HPLC methods for these three analytes. Method 8316 also addresses acrylamide, which may be analyzed by Method 8032. Method 8325 is an HPLC coupled with particle beam MS for the determination of benzidines and nitrogen-containing pesticides in water and wastewater. Method 8520 measures formaldehyde in ambient air primarily for non-occupational exposure monitoring. Method 8540 is used for field-testing of soil samples for pentachlorophenol (PCP).

HPLC methods have been developed for other types of analytes, most notably N-methyl carbamates (Method 8318); azo dyes, phenoxy acid herbicides, carbamates, and organophosphorus pesticides (Method 8321); PAHs (Method 8310); explosives (Methods 8330, 8331, and 8332); and some volatile organics (Methods 8315 and 8316).

Method 8430 utilizes a FT-IR spectrometer coupled to a gas chromatograph to determine bis(2-chloroethyl) ether and its hydrolysis products. The sample is introduced by direct aqueous injection. Method 8440 may be employed for the determination of total recoverable petroleum hydrocarbons (TRPH) in solid samples by infrared (IR) spectrophotometry. The samples may be extracted with supercritical carbon dioxide, using Method 3560.

2.4 CHOOSING PROCEDURES FOR CHARACTERISTIC ANALYSES

2.4.1 Figure 2-2 outlines a sequence for determining if a waste exhibits one or more of the characteristics of a hazardous waste.

2.4.2 SPLP, EP and TCLP extracts

The leachate obtained from using either the Synthentic Precipitation Leaching procedure (SPLP), EP (Figure 2-3A) or the TCLP (Figure 2-3B) is an aqueous sample, and therefore, requires further solvent extraction prior to the analysis of semivolatile compounds.

The SPLP or TCLP leachate is solvent extracted with methylene chloride at a pH <2 and at a pH >11 by either Method 3510 or 3520. The leachate may also be extracted as received for organochlorine pesticides and semivolatiles and at pH <1.0 for phenoxyacid herbicides using the solid phase extraction (SPE) disk option in Method 3535. The best recoveries are usually obtained using either Method 3520 or Method 3535.

The solvent extract obtained by performing either Method 3510 or 3520 at an acidic pH will contain the acid/neutral compounds of interest. Refer to the specific determinative method for guidance on the pH requirements for extraction prior to analysis. Method 5031 (azeotropic distillation) may be used as an effective preparative method for pyridine.

Due to the high concentration of acetate in the TCLP extract, it is recommended that purge-and-trap be used to introduce the volatile sample into the gas chromatograph.

The SPLP, EP and/or TCLP extracts can also be digested using acids (Method 3010, 3015, or 3020) and analyzed for metals using a 6000 or 7000 series method (Figures 2-3A and 2-3B).

2.5 CHOOSING PROCEDURES FOR GROUNDWATER ANALYSES

Appropriate analysis schemes for the determination of analytes in groundwater are presented in Figures 2-4A, 2-4B, and 2-4C. Quantitation limits (LLOQs) for the inorganic analytes should correspond to the drinking water limits, where such limits are available.

2.5.1 Special techniques for inorganic analytes

All atomic absorption (AA) analyses should employ appropriate background correction systems whenever spectral interferences could be present. Several background correction techniques are employed in modern AA spectrometers. Matrix modification can complement background correction in some cases. Since no approach to interference correction is completely effective in all cases, the analyst should attempt to verify the adequacy of correction. If the interferant is known (e.g., high concentrations of iron in the determination of selenium), accurate analyses of synthetic solutions of the interferant (with and without analyte) could establish the efficacy of the background correction. If the nature of the interferant is not established, good agreement of analytical results using two substantially different wavelengths could substantiate the adequacy of the background correction.

To reduce matrix interferences, all graphite furnace atomic absorption (GFAA) analyses should be performed using techniques which maximize an isothermal environment within the furnace cell. Data indicate that two such techniques, L'vov platform and the delayed atomization cuvette (DAC), are equivalent in this respect, and produce high quality results.

All GFAA analysis should be carried out using the best matrix modifier for the analysis. Some examples of modifiers are listed below. (See also the appropriate methods.)

Element(s)	Modifier(s)
As and Se	Nickel nitrate, palladium
Pb	Phosphoric acid, ammonium phosphate, palladium
Cd	Ammonium phosphate, palladium
Sb	Ammonium nitrate, palladium
Tl	Platinum, palladium

Inductively coupled plasma (ICP), AA, and GFAA calibration standards need to match the acid composition and strength of the acids contained in the samples. Acid strengths of the calibration standards should be stated in the raw data. When using a method which permits the use of internal standardization, and the internal standardization option is being used, matrix matching is not required.

2.6 CHOOSING PROCEDURES FOR INORGANIC ANALYSES

Methods for preparing different sample matrices for inorganic analyses are shown in Table 2-44. Guidance regarding the use of leaching and digestive methods for inorganic analysis is provided in Table 2-45.

2.7 REFERENCES

1. M. J. Barcelona, "TOC Determinations in Ground Water," Ground Water 1984, 22(1), 18-24.

2. R. Riggin, et al.; Development and Evaluation of Methods for Total Organic Halide and Purgeable Organic Halide in Wastewater; U.S. Environmental Protection Agency; Office of Research and Development; Environmental Monitoring and Support Laboratory; ORD Publication Offices of Center for Environmental Research Information; Cincinnati, OH, 1984; EPA-600/4-84-008.

3. G. McKee, et al.; Determination of Inorganic Anions in Water by Ion Chromatography (Technical addition to Methods for Chemical Analysis of Water and Wastewater, EPA 600/4-79-020); U.S. Environmental Protection Agency; Environmental Monitoring and Support Laboratory; ORD Publication Offices of Center for Environmental Research Information; Cincinnati, OH, 1984; EPA-600/4-84-017.

TABLE 2-1

DETERMINATIVE METHODS FOR ORGANIC ANALYTES

Analytes are listed in alphabetical order and alternative analyte names are in parenthesis. The applicable method listing does not include immunoassay or screening methods.

Analyte	Applicable Method
Abate (Temephos)	8085
Acenaphthene	8100, 8270, 8275, 8310, 8410
Acenaphthylene	8100, 8270, 8275, 8310, 8410
Acetaldehyde	8315
Acetone	8015, 8260, 8261, 8315
Acetonitrile	8015, 8033, 8260, 8261
Acetophenone	8261, 8270
2-Acetylaminofluorene	8270
1-Acetyl-2-thiourea	8270
Acifluorfen	8085, 8151
Acrolein (Propenal)	8015, 8260, 8261, 8315, 8316
Acrylamide	8032, 8316
Acrylonitrile	8015, 8031, 8260, 8261, 8316
Alachlor	8081, 8085
Aldicarb (Temik)	8318, 8321
Aldicarb sulfone	8318, 8321
Aldicarb sulfoxide	8321
Aldrin	8081, 8085, 8270
Allyl alcohol	8015, 8260
Allyl chloride	8021, 8260, 8261
Ametryn	8085
2-Aminoanthraquinone	8270
Aminoazobenzene	8270
4-Aminobiphenyl	8270
Aminocarb	8321
2-Amino-4,6-dinitrotoluene (2-Am-DNT)	8095, 8330
4-Amino-2,6-dinitrotoluene (4-Am-DNT)	8095, 8330
3-Amino-9-ethylcarbazole	8270
t-Amyl alcohol (TAA)	8015
t-Amyl ethyl ether (TAEE, 4,4-Dimethyl-3-oxahexane)	8015, 8260, 8261
t-Amyl methyl ether (TAME)	8015, 8260, 8261
Anilazine	8270
Aniline	8131, 8261, 8270
o-Anisidine	8270
Anthracene	8100, 8270, 8275, 8310, 8410
Aramite	8270
Aroclor-1016 (PCB-1016)	8082, 8270
Aroclor-1221 (PCB-1221)	8082, 8270
Aroclor-1232 (PCB-1232)	8082, 8270
Aroclor-1242 (PCB-1242)	8082, 8270
Aroclor-1248 (PCB-1248)	8082, 8270
Aroclor-1254 (PCB-1254)	8082, 8270

TABLE 2-2

METHOD 8011 (MICROEXTRACTION AND GAS CHROMATOGRAPHY)

1,2-Dibromo-3-chloropropane (DBCP)
1,2-Dibromoethane (EDB)

TABLE 2-3

METHOD 8015 (GC/FID) - NONHALOGENATED VOLATILES

Acetone	Ethylene oxide
Acetonitrile	Gasoline range organics (GRO)
Acrolein	Isopropyl alcohol
Acrylonitrile	Methanol
Allyl alcohol	Methyl ethyl ketone (MEK, 2-Butanone)
t-Amyl alcohol (TAA)	*N*-Nitroso-di-*n*-butylamine
t-Amyl ethyl ether (TAEE)	Paraldehyde
t-Amyl methyl ether (TAME)	2-Pentanone
Benzene	2-Picoline
t-Butyl alcohol	1-Propanol (*n*-Propyl alcohol)
Crotonaldehyde	Propionitrile
Diesel range organics (DRO)	Pyridine
Diethyl ether	Toluene
Diisopropyl ether (DIPE)	*o*-Toluidine
Ethanol	*m*-Xylene
Ethyl acetate	*o*-Xylene
Ethyl benzene	*p*-Xylene
Ethyl *tert*-butyl ether (ETBE)	Triethylamine

TABLE 2-4

METHOD 8021 (GC, PHOTOIONIZATION AND ELECTROLYTIC CONDUCTIVITY DETECTORS) - AROMATIC AND HALOGENATED VOLATILES

Allyl chloride	*cis*-1,2-Dichloroethene
Benzene	*trans*-1,2-Dichloroethene
Benzyl chloride	1,2-Dichloropropane
Bis(2-chloro-1-methylethyl) ether	1,3-Dichloropropane
Bromoacetone	2,2-Dichloropropane
Bromobenzene	1,3-Dichloro-2-propanol
Bromochloromethane	1,1-Dichloropropene
Bromodichloromethane	*cis*-1,3-Dichloropropene
Bromoform	*trans*-1,3-Dichloropropene
Bromomethane	Epichlorhydrin
n-Butylbenzene	Ethylbenzene
sec-Butylbenzene	Hexachlorobutadiene
tert-Butylbenzene	Isopropylbenzene
Carbon tetrachloride	*p*-Isopropyltoluene
Chlorobenzene	Methylene chloride
Chlorodibromomethane	Naphthalene
Chloroethane	*n*-Propylbenzene
2-Chloroethanol	Styrene
2-Chloroethyl vinyl ether	1,1,1,2-Tetrachloroethane
Chloroform	1,1,2,2-Tetrachloroethane
Chloromethane	Tetrachloroethene
Chloromethyl methyl ether	Toluene
Chloroprene	1,2,3-Trichlorobenzene
2-Chlorotoluene	1,2,4-Trichlorobenzene
4-Chlorotoluene	1,1,1-Trichloroethane
1,2-Dibromo-3-chloropropane	1,1,2-Trichloroethane
1,2-Dibromoethane	Trichloroethene
Dibromomethane	Trichlorofluoromethane
1,2-Dichlorobenzene	1,2,3-Trichloropropane
1,3-Dichlorobenzene	1,2,4-Trimethylbenzene
1,4-Dichlorobenzene	1,3,5-Trimethylbenzene
Dichlorodifluoromethane	Vinyl chloride
1,1-Dichloroethane	*o*-Xylene
1,2-Dichloroethane	*m*-Xylene
1,1-Dichloroethene	*p*-Xylene

TABLE 2-5

METHODS 8031 AND 8033 (GC WITH NITROGEN-PHOSPHORUS DETECTION)
AND METHOD 8032 (GC WITH ELECTRON CAPTURE DETECTION)

Method 8031: Acrylonitrile
Method 8032: Acrylamide
Method 8033: Acetonitrile

TABLE 2-6

METHOD 8041 (GC) - PHENOLS

2-Chloro-5-methylphenol	2,5-Dinitrophenol
4-Chloro-2-methylphenol	Dinoseb (2-*sec*-butyl-4,6-dinitro phenol)
4-Chloro-3-methylphenol	2-Methyl-4,6-dinitrophenol
2-Chlorophenol	2-Methylphenol (*o*-Cresol)
3-Chlorophenol	3-Methylphenol (*m*-Cresol)
4-Chlorophenol	4-Methylphenol (*p*-Cresol)
2-Cyclohexyl-4,6-dinitrophenol	2-Nitrophenol
2,3-Dichlorophenol	3-Nitrophenol
2,4-Dichlorophenol	4-Nitrophenol
2,5-Dichlorophenol	Pentachlorophenol
2,6-Dichlorophenol	Phenol
3,4-Dichlorophenol	2,3,4,5-Tetrachlorophenol
3,5-Dichlorophenol	2,3,4,6-Tetrachlorophenol
2,3-Dimethylphenol	2,3,5,6-Tetrachlorophenol
2,4-Dimethylphenol	2,3,4-Trichlorophenol
2,5-Dimethylphenol	2,3,5-Trichlorophenol
2,6-Dimethylphenol	2,3,6-Trichlorophenol
3,4-Dimethylphenol	2,4,5-Trichlorophenol
2,4-Dinitrophenol	2,4,6-Trichlorophenol

TABLE 2-7

METHOD 8061 (GC/ECD) - PHTHALATE ESTERS

Bis(2-*n*-butoxyethyl) phthalate	Diethyl phthalate
Bis(2-ethoxyethyl) phthalate	Dihexyl phthalate
Bis(2-ethylhexyl) phthalate	Diisobutyl phthalate
Bis(2-methoxyethyl) phthalate	Di-*n*-butyl phthalate
Bis(4-methyl-2-pentyl) phthalate	Dimethyl phthalate
Butyl benzyl phthalate	Di-*n*-octyl phthalate
Diamyl phthalate	Dinonyl phthalate
Dicyclohexyl phthalate	Hexyl 2-ethylhexyl phthalate

TABLE 2-8

METHOD 8070 (GC) - NITROSAMINES

N-Nitrosodimethylamine
N-Nitrosodiphenylamine
N-Nitrosodi-*n*-propylamine

TABLE 2-9

METHOD 8081 (GC) - ORGANOCHLORINE PESTICIDES

Alachlor	4,4'-DDE	Halowax-1051
Aldrin	4,4'-DDT	Halowax-1099
α-BHC	Diallate	Heptachlor
β-BHC	Dichlone	Heptachlor epoxide
δ-BHC	Dichloran	Hexachlorobenzene
γ-BHC (Lindane)	Dicofol	Hexachlorocyclopentadiene
Captafol	Dieldrin	Isodrin
Carbophenothion	Endosulfan I	Methoxychlor
Chlordane (NOS)	Endosulfan II	Mirex
cis-Chlordane	Endosulfan sulfate	Nitrofen
trans-Chlordane	Endrin	*trans*-Nonachlor
Chlorobenzilate	Endrin aldehyde	Pentachloronitrobenzene (PCNB)
Chloroneb	Endrin ketone	Permethrin (*cis* + *trans*)
Chloropropylate	Etridiazole	Perthane
Chlorothalonil	Halowax-1000	Propachlor
Dacthal (DCPA)	Halowax-1001	Strobane
DBCP	Halowax-1013	Toxaphene
4,4'-DDD	Halowax-1014	Trifluralin

TABLE 2-10

METHOD 8082 (GC) - POLYCHLORINATED BIPHENYLS

Aroclor 1016	2,2',3,4,5,5'-Hexachlorobiphenyl
Aroclor 1221	2,2',3,5,5',6-Hexachlorobiphenyl
Aroclor 1232	2,2',4,4',5,5'-Hexachlorobiphenyl
Aroclor 1242	2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl
Aroclor 1248	2,2',3,4,5'-Pentachlorobiphenyl
Aroclor 1254	2,2',4,5,5'-Pentachlorobiphenyl
Aroclor 1260	2,3,3',4',6-Pentachlorobiphenyl
2-Chlorobiphenyl	2,2',3,5'-Tetrachlorobiphenyl
2,3-Dichlorobiphenyl	2,2',5,5'-Tetrachlorobiphenyl
,2',3,3',4,4',5-Heptachlorobiphenyl	2,3',4,4'-Tetrachlorobiphenyl
2,2',3,4,4',5,5'-Heptachlorobiphenyl	2,2',5-Trichlorobiphenyl
2,2',3,4,4',5',6-Heptachlorobiphenyl	2,4',5-Trichlorobiphenyl
2,2',3,4',5,5',6-Heptachlorobiphenyl	

TABLE 2-11

METHOD 8085 (GC/AED) – PESTICIDES

Abate (Temephos)	Cycloate	Diphenamid
Acifluorfen	Coumaphos	Disulfoton (Disyston)
Alachlor	2,4-D acid	Diuron
Aldrin	2,4-DB acid	Endosulfan I
Ametryn	DCPA (Dacthal)	Endosulfan II
Atraton	2,4'-DDD	Endosulfan sulfate
Atrazine	4,4'-DDD	Endrin
Azinphos ethyl (Ethyl guthion)	2,4'-DDE	Endrin aldehyde
Azinphos methyl (Guthion)	4,4'-DDE	Endrin ketone
Benfluralin	2,4'-DDT	EPN
α-BHC	4,4'-DDT	Eptam (EPTC)
β-BHC	DEF (Butifos)	Ethalfluralin (Sonalan)
δ-BHC	Demeton-O	Ethion
γ-BHC (Lindane)	Demeton-S	Ethoprop
Bromacil	Diallate	Fenamiphos
Bromoxynil (Brominal)	Diazinon	Fenarimol
Butachlor	Dicamba	Fenitrothion
Butylate	Dichlobenil (Casoron)	Fensulfothion
Captafol	3,5-Dichlorobenzoic acid	Fenthion
Captan	Dichlorprop	Fluridone
Carbophenothion	Dichlorvos (DDVP)	Fonofos
Carboxin	Diclofol (Kelthane)	Gardona (Tetrachlovinphos)
trans-Chlordane	Diclofop-methyl	Heptachlor
Chlorpropham	Dieldrin	Heptachlor epoxide
Chlorpyrifos	Dimethoate	Hexachlorobenzene
Chlorthalonil (Daconil)	Dinoseb	Hexachlorocyclopentadiene
Cyanazine	Dioxathion	Hexazinone

TABLE 2-11 (continued)

Imidan (Phosmet)	Norflurazon	Sulfotepp
Ioxynil	Oxyfluorfen	Sulprofos (Bolstar)
Malathion	Parathion	Silvex
MCPA acid	Pebulate	2,4,5-T acid
MCPP acid	Pendimethalin	2,4,5-TB
Merphos	Pentachlorophenol (PCP)	Tebuthiuron
Metalaxyl	Phorate	Terbacil
Methoxychlor	Phosphamidon	Terbutryn (Igran)
Methyl chlorpyrifos	Picloram	2,3,4,5-Tetrachlorophenol
Methyl paraoxon	Profluralin	2,3,4,6-Tetrachlorophenol
Methyl parathion	Prometon (Pramitol 5p)	Triademefon
Metolachlor	Prometryn	Triallate
Metribuzin	Pronamide (Kerb)	2,4,5-Trichlorophenol
Mevinphos	Propachlor (Ramrod)	2,4,6-Trichlorophenol
MGK-264	Propargite (S-181)	Triclopyr (Garlon)
Mirex	Propazine	Trifluralin (Treflan)
Molinate	Propetamidophos	Vernolate
Napropamide	Ronnel	
4-Nitrophenol	Simazine	

TABLE 2-12

METHOD 8091 (GC) - NITROAROMATICS AND CYCLIC KETONES

Benefin	2,4-Dinitrotoluene
Butralin	2,6-Dinitrotoluene
1-Chloro-2,4-dinitrobenzene	Isopropalin
1-Chloro-3,4-dinitrobenzene	1,2-Naphthoquinone
1-Chloro-2-nitrobenzene	1,4-Naphthoquinone
1-Chloro-4-nitrobenzene	Nitrobenzene
2-Chloro-6-nitrotoluene	2-Nitrotoluene
4-Chloro-2-nitrotoluene	3-Nitrotoluene
4-Chloro-3-nitrotoluene	4-Nitrotoluene
2,3-Dichloronitrobenzene	Penoxalin [Pendimethalin]
2,4-Dichloronitrobenzene	Pentachloronitrobenzene
2,5-Dichloronitrobenzene	Profluralin
3,4-Dichloronitrobenzene	2,3,4,5-Tetrachloronitrobenzene
3,5-Dichloronitrobenzene	2,3,5,6-Tetrachloronitrobenzene
Dinitramine	1,2,3-Trichloro-4-nitrobenzene
1,2-Dinitrobenzene	1,2,4-Trichloro-5-nitrobenzene
1,3-Dinitrobenzene	2,4,6-Trichloronitrobenzene
1,4-Dinitrobenzene	Trifluralin

TABLE 2-13

METHOD 8095 (GC) - EXPLOSIVES

2-Amino-4,6-dinitrotoluene	2-Nitrotoluene
4-Amino-2,6-dinitrotoluene	3-Nitrotoluene
3,5-Dinitroaniline	4-Nitrotoluene
1,3-Dinitrobenzene	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
2,4-Dinitrotoluene	Pentaerythritoltetranitrate
2,6-Dinitrotoluene	1,3,5-Trinitrobenzene
Hexahydro-1,3,5-trinitro-1,3,5-triazine	2,4,6-Trinitrophenylmethylnitramine
Nitrobenzene	2,4,6-Trinitrotoluene
Nitroglycerine	

TABLE 2-14

METHOD 8100 - POLYNUCLEAR AROMATIC HYDROCARBONS

Acenaphthene	Dibenz(*a,h*)anthracene
Acenaphthylene	7H-Dibenzo(*c,g*)carbazole
Anthracene	Dibenzo(*a,e*)pyrene
Benz(*a*)anthracene	Dibenzo(*a,h*)pyrene
Benzo(*b*)fluoranthene	Dibenzo(*a,i*)pyrene
Benzo(*j*)fluoranthene	Fluoranthene
Benzo(*k*)fluoranthene	Fluorene
Benzo(*g,h,i*)perylene	Indeno(1,2,3-*cd*)pyrene
Benzo(*a*)pyrene	3-Methylcholanthrene
Chrysene	Naphthalene
Dibenz(*a,h*)acridine	Phenanthrene
Dibenz(*a,j*)acridine	Pyrene

TABLE 2-15

METHOD 8111 (GC) - HALOETHERS

Bis(2-chloroethoxy)methane	2,5-Dichlorophenyl 4-nitrophenyl ether
Bis(2-chloroethyl) ether	2,6-Dichlorophenyl 4-nitrophenyl ether
Bis(2-chloro-1-methylethyl) ether	3,4-Dichlorophenyl 4-nitrophenyl ether
4-Bromophenyl phenyl ether	3,5-Dichlorophenyl 4-nitrophenyl ether
4-Chlorophenyl phenyl ether	4-Nitrophenyl phenyl ether
2-Chlorophenyl 4-nitrophenyl ether	2,3,4-Trichlorophenyl 4-nitrophenyl ether
3-Chlorophenyl 4-nitrophenyl ether	2,3,5-Trichlorophenyl 4-nitrophenyl ether
4-Chlorophenyl 4-nitrophenyl ether	2,3,6-Trichlorophenyl 4-nitrophenyl ether
2,4-Dibromophenyl 4-nitrophenyl ether	2,4,5-Trichlorophenyl 4-nitrophenyl ether
2,4-Dichlorophenyl 3-methyl-4-nitrophenyl ether	2,4,6-Trichlorophenyl 4-nitrophenyl ether
2,3-Dichlorophenyl 4-nitrophenyl ether	3,4,5-Trichlorophenyl 4-nitrophenyl ether
2,4-Dichlorophenyl 4-nitrophenyl ether	

TABLE 2-16

METHOD 8121 (GC) - CHLORINATED HYDROCARBONS

Benzal chloride	δ-Hexachlorocyclohexane (δ-BHC)
Benzotrichloride	γ-Hexachlorocyclohexane (γ-BHC)
Benzyl chloride	Hexachlorocyclopentadiene
2-Chloronaphthalene	Hexachloroethane
1,2-Dichlorobenzene	Pentachlorobenzene
1,3-Dichlorobenzene	1,2,3,4-Tetrachlorobenzene
1,4-Dichlorobenzene	1,2,3,5-Tetrachlorobenzene
Hexachlorobenzene	1,2,4,5-Tetrachlorobenzene
Hexachlorobutadiene	1,2,3-Trichlorobenzene
α-Hexachlorocyclohexane (α-BHC)	1,2,4-Trichlorobenzene
β-Hexachlorocyclohexane (β-BHC)	1,3,5-Trichlorobenzene

TABLE 2-17

METHOD 8131 (GC) - ANILINE AND SELECTED DERIVATIVES

Aniline	2,6-Dibromo-4-nitroaniline
4-Bromoaniline	3,4-Dichloroaniline
2-Bromo-6-chloro-4-nitroanilne	2,6-Dichloro-4-nitroaniline
2-Bromo-4,6-dintroaniline	2,4-Dinitroaniline
2-Chloroaniline	2-Nitroaniline
3-Chloroaniline	3-Nitroaniline
4-Chloroaniline	4-Nitroaniline
2-Chloro-4,6-dinitroaniline	2,4,5-Trichloroaniline
2-Chloro-4-nitroaniline	2,4,6-Trichloroaniline
4-Chloro-2-nitroaniline	

TABLE 2-18

METHOD 8141 (GC) - ORGANOPHOSPHORUS COMPOUNDS

Aspon	Disulfoton	Parathion, methyl
Atrazine	EPN	Pebulate
Azinphos-ethyl	EPTC	*o*-Phenylenediamine
Azinphos-methyl	Ethion	Phorate
Bendiocarb	Ethoprop	Phosmet
Bolstar (Sulprofos)	Famphur	Phosphamidon
Butylate	Fenitrothion	Propham
Carbophenothion	Fensulfothion	Prosulfocarb
Chlorfenvinphos	Fenthion	Ronnel
Chlorpyrifos	Fonophos	Simazine
Chlorpyrifos methyl	Hexamethyl phosphoramide (HMPA)	Stirophos (Tetrachlorvinphos, Gardona)
Coumaphos	Leptophos	Sulfotepp
Crotoxyphos	Malathion	Terbufos
Demeton-O, and -S	Merphos	Tetraethyl pyrophosphate (TEPP)
Diazinon	Methiocarb	Thionazin (Zinophos)
Dichlorofenthion	Mevinphos	Tokuthion (Prothiofos)
Dichlorvos (DDVP)	Molinate	Triallate
Dicrotophos	Monocrotophos	Trichlorfon
Dimethoate	Naled	Trichloronate
Dioxathion	Parathion, ethyl	Tri-*o*-cresyl phosphate (TOCP)

TABLE 2-19

METHOD 8151 (GC USING METHYLATION OR PENTAFLUOROBENZYLATION DERIVATIZATION) - CHLORINATED HERBICIDES

Acifluorfen	Dicamba	MCPP
Bentazon	3,5-Dichlorobenzoic acid	4-Nitrophenol
Chloramben	Dichloroprop	Pentachlorophenol
2,4-D	Dinoseb	Picloram
Dalapon	5-Hydroxydicamba	2,4,5-T
2,4-DB	MCPA	2,4,5-TP (Silvex)
DCPA diacid		

TABLE 2-20

METHOD 8260 (GC/MS) - VOLATILE ORGANIC COMPOUNDS

Acetone	2-Chloroethyl vinyl ether	Diisopropyl ether (DIPE)
Acetonitrile	Chloroform	1,4-Dioxane
Acrolein (Propenal)	1-Chlorohexane	Epichlorohydrin
Acrylonitrile	Chloromethane	Ethanol
Allyl alcohol	Chloroprene	Ethyl acetate
Allyl chloride	2-Chlorotoluene	Ethyl t-butyl ether (ETBE)
t-Amyl ethyl ether (TAEE)	4-Chlorotoluene	Ethyl methacrylate
t-Amyl methyl ether (TAME)	Crotonaldehyde	Ethylbenzene
Benzene	Cyclohexane	Ethylene oxide
Benzyl chloride	1,2-Dibromo-3-chloropropane	Hexachlorobutadiene
Bis(2-chloroethyl)sulfide	1,2-Dibromoethane	Hexachloroethane
Bromoacetone	Dibromomethane	2-Hexanone
Bromobenzene	1,2-Dichlorobenzene	Iodomethane
Bromochloromethane	1,3-Dichlorobenzene	Isobutyl alcohol
Bromodichloromethane	1,4-Dichlorobenzene	Isopropylbenzene
Bromoform	cis-1,4-Dichloro-2-butene	p-Isopropyltoluene
Bromomethane	trans-1,4-Dichloro-2-butene	Malononitrile
n-Butanol	Dichlorodifluoromethane	Methacrylonitrile
2-Butanone (MEK)	1,1-Dichloroethane	Methanol
t-Butyl alcohol	1,2-Dichloroethane	Methyl acrylate
n-Butylbenzene	1,1-Dichloroethene	Methyl-t-butyl ether (MTBE)
sec-Butylbenzene	cis-1,2-Dichloroethene	Methyl methacrylate
tert-Butylbenzene	trans-1,2-Dichloroethene	Methylcyclohexane
Carbon disulfide	1,2-Dichloropropane	Methylene chloride
Carbon tetrachloride	1,3-Dichloropropane	4-Methyl-2-pentanone (MIBK)
Chloral hydrate	2,2-Dichloropropane	Naphthalene
Chloroacetonitrile	1,3-Dichloro-2-propanol	Nitrobenzene
Chlorobenzene	1,1-Dichloropropene	2-Nitropropane
1-Chlorobutane	cis-1,3-Dichloropropene	N-Nitroso-di-n-butylamine
Chlorodibromomethane	trans-1,3-Dichloropropene	Paraldehyde
Chloroethane	1,2,3,4-Diepoxybutane	Pentachloroethane
2-Chloroethanol	Diethyl ether	Pentafluorobenzene

TABLE 2-20 (continued)

2-Pentanone	Styrene	Trichloroethene
2-Picoline	1,1,1,2-Tetrachloroethane	Trichlorofluoromethane
1-Propanol	1,1,2,2-Tetrachloroethane	1,2,3-Trichloropropane
2-Propanol	Tetrachloroethene	1,2,4-Trimethylbenzene
Propargyl alcohol	Toluene	1,3,5-Trimethylbenzene
ß-Propiolactone	o-Toluidine	Vinyl acetate
Propionitrile (Ethyl cyanide)	1,2,3-Trichlorobenzene	Vinyl chloride
n-Propylamine	1,2,4-Trichlorobenzene	o-Xylene
n-Propylbenzene	1,1,1-Trichloroethane	m-Xylene
Pyridine	1,1,2-Trichloroethane	p-Xylene

TABLE 2-21

METHOD 8261 (VD/GC/MS) - VOLATILE ORGANIC COMPOUNDS

Acetone	1,3-Dichlorobenzene	Methacrylonitrile
Acetonitrile	1,4-Dichlorobenzene	Methyl *t*-butyl ether (MTBE)
Acetophenone	*cis*-1,4-Dichloro-2-butene	Methyl methacrylate
Acrolein	*trans*-1,4-Dichloro-2-butene	Methylene chloride
Acrylonitrile	Dichlorodifluoromethane	1-Methylnaphthalene
Allyl Chloride	1,1-Dichloroethane	2-Methylnaphthalene
t-Amyl ethyl ether (TAEE) (4,4-Dimethyl-3-oxahexane)	1,2-Dichloroethane	4-Methyl-2-pentanone
t-Amyl methyl ether (TAME)	1,1-Dichloroethene	Naphthalene
Aniline	*cis*-1,2-Dichloroethene	*N*-Nitrosodibutylamine
Benzene	*trans*-1,2-Dichloroethene	*N*-Nitrosodiethylamine
Bromochloromethane	1,2-Dichloropropane	*N*-Nitrosodimethylamine
Bromodichloromethane	1,3-Dichloropropane	*N*-Nitrosodi-*n*-propylamine
Bromoform	2,2-Dichloropropane	*N*-Nitrosomethylethylamine
Bromomethane	1,1-Dichloropropene	Pentachloroethane
2-Butanone	*cis*-1,3-Dichloropropene	2-Picoline
n-Butylbenzene	*trans*-1,3-Dichloropropene	Propionitrile
sec-Butylbenzene	Diethyl ether	*n*-Propylbenzene
tert-Butylbenzene	Diisopropyl ether (DIPE)	Pyridine
Carbon disulfide	1,4-Dioxane	Styrene
Carbon tetrachloride	Ethanol	1,1,2,2-Tetrachloroethane
Chlorobenzene	Ethyl acetate	Tetrachloroethene
Chlorodibromomethane	Ethyl *t*-butyl ether (ETBE)	Tetrahydrofuran
Chloroethane	Ethyl methacrylate	Toluene
Chloroform	Ethylbenzene	*o*-Toluidine
Chloromethane	Hexachlorobutadiene	1,2,3-Trichlorobenzene
2-Chlorotoluene	2-Hexanone	1,2,4-Trichlorobenzene
4-Chlorotoluene	Iodomethane	1,1,1-Trichloroethane
1,2-Dibromo-3-chloropropane	Isobutyl alcohol	1,1,2-Trichloroethane
Dibromomethane	Isopropylbenzene	Trichloroethene
1,2-Dichlorobenzene	*p*-Isopropyltoluene	Trichlorofluoromethane

TABLE 2-21 (continued)

1,2,3-Trichloropropane	Vinyl chloride	*p*-Xylene
1,2,4-Trimethylbenzene	*o*-Xylene	
1,3,5-Trimethylbenzene	*m*-Xylene	

TABLE 2-22

METHOD 8270 (GC/MS) - SEMIVOLATILE ORGANIC COMPOUNDS

Acenaphthene	Aroclor-1260
Acenaphthylene	Azinphos-methyl
Acetophenone	Barban
2-Acetylaminofluorene	Benz(a)anthracene
1-Acetyl-2-thiourea	Benzidine
Aldrin	Benzo(b)fluoranthene
2-Aminoanthraquinone	Benzo(k)fluoranthene
Aminoazobenzene	Benzoic acid
4-Aminobiphenyl	Benzo(g,h,i)perylene
3-Amino-9-ethylcarbazole	Benzo(a)pyrene
Anilazine	*p*-Benzoquinone
Aniline	Benzyl alcohol
o-Anisidine	α-BHC
Anthracene	β-BHC
Aramite	δ-BHC
Aroclor-1016	γ-BHC (Lindane)
Aroclor-1221	Bis(2-chloroethoxy)methane
Aroclor-1232	Bis(2-chloroethyl)ether
Aroclor-1242	Bis(2-chloro-1-methylethyl)ether
Aroclor-1248	Bis(2-ethylhexyl)phthalate
Aroclor-1254	4-Bromophenyl phenyl ether

Table 2-22 (continued)

Bromoxynil

Butyl benzyl phthalate

Captafol

Captan

Carbaryl

Carbofuran

Carbophenothion

Chlordane (NOS)

Chlorfenvinphos

4-Chloroaniline

Chlorobenzilate

5-Chloro-2-methylaniline

4-Chloro-3-methylphenol

3-(Chloromethyl)pyridine hydrochloride

1-Chloronaphthalene

2-Chloronaphthalene

2-Chlorophenol

4-Chloro-1,2-phenylenediamine

4-Chloro-1,3-phenylenediamine

4-Chlorophenyl phenyl ether

Chrysene

Coumaphos

p-Cresidine

Crotoxyphos

2-Cyclohexyl-4,6-dinitrophenol

4,4'-DDD

4,4'-DDE

4,4'-DDT

Demeton-O

Demeton-S

Diallate (*cis* or *trans*)

2,4-Diaminotoluene

Dibenz(*a,j*)acridine

Dibenz(*a,h*)anthracene

Dibenzofuran

Dibenzo(*a,e*)pyrene

1,2-Dibromo-3-chloropropane

Di-*n*-butyl phthalate

Dichlone

1,2-Dichlorobenzene

1,3-Dichlorobenzene

1,4-Dichlorobenzene

3,3'-Dichlorobenzidine

2,4-Dichlorophenol

2,6-Dichlorophenol

Dichlorovos

Dicrotophos

Dieldrin

Diethyl phthalate

Diethyl sulfate

Diethylstilbestrol

Dimethoate

3,3'-Dimethoxybenzidine

Dimethyl phthalate

Dimethylaminoazobenzene

7,12-Dimethylbenz(*a*)anthracene

3,3'-Dimethylbenzidine

α,α-Dimethylphenethylamine

Table 2-22 (continued)

2,4-Dimethylphenol
1,2-Dinitrobenzene
1,3-Dinitrobenzene
1,4-Dinitrobenzene
4,6-Dinitro-2-methylphenol
2,4-Dinitrophenol
2,4-Dinitrotoluene
2,6-Dinitrotoluene
Dinocap
Dinoseb
Di-*n*-octyl phthalate
Diphenylamine
5,5-Diphenylhydantoin
1,2-Diphenylhydrazine
Disulfoton
Endosulfan I
Endosulfan II
Endosulfan sulfate
Endrin
Endrin aldehyde
Endrin ketone
EPN
Ethion
Ethyl carbamate
Ethyl methanesulfonate
Famphur
Fensulfothion
Fenthion
Fluchloralin
Fluoranthene
Fluorene
Heptachlor
Heptachlor epoxide
Hexachlorobenzene
Hexachlorobutadiene
Hexachlorocyclopentadiene
Hexachloroethane
Hexachlorophene
Hexachloropropene
Hexamethylphosphoramide
Hydroquinone
Indeno(1,2,3-cd)pyrene
Isodrin
Isophorone
Isosafrole
Kepone
Leptophos
Malathion
Maleic anhydride
Mestranol
Methapyrilene
Methoxychlor
Methyl methanesulfonate
Methyl parathion
3-Methylcholanthrene
4,4'-Methylenebis(2-chloroaniline)

Table 2-22 (continued)

4,4'-Methylenebis(N,N-dimethylaniline)	N-Nitrosodimethylamine
2-Methylnaphthalene	N-Nitrosodiphenylamine
2-Methylphenol	N-Nitrosodi-n-propylamine
3-Methylphenol	N-Nitrosomethylethylamine
4-Methylphenol	N-Nitrosomorpholine
Mevinphos	N-Nitrosopiperidine
Mexacarbate	N-Nitrosopyrrolidine
Mirex	5-Nitro-o-toluidine
Monocrotophos	Octamethyl pyrophosphoramide
Naled	4,4'-Oxydianiline
Naphthalene	Parathion
1,4-Naphthoquinone	Pentachlorobenzene
1-Naphthylamine	Pentachloronitrobenzene
2-Naphthylamine	Pentachlorophenol
Nicotine	Phenacetin
5-Nitroacenaphthene	Phenanthrene
2-Nitroaniline	Phenobarbital
3-Nitroaniline	Phenol
4-Nitroaniline	1,4-Phenylenediamine
5-Nitro-o-anisidine	Phorate
Nitrobenzene	Phosalone
4-Nitrobiphenyl	Phosmet
Nitrofen	Phosphamidion
2-Nitrophenol	Phthalic anhydride
4-Nitrophenol	2-Picoline (2-methylpyridine)
Nitroquinoline-1-oxide	Piperonyl sulfoxide
N-Nitrosodi-n-butylamine	Pronamide
N-Nitrosodiethylamine	Propylthiouracil

Table 2-22 (continued)

Pyrene	Toluene diisocyanate
Resorcinol	o-Toluidine
Safrole	Toxaphene
Strychnine	1,2,4-Trichlorobenzene
Sulfallate	2,4,5-Trichlorophenol
Terbufos	2,4,6-Trichlorophenol
1,2,4,5-Tetrachlorobenzene	O,O,O-Triethylphosphorothioate
2,3,4,6-Tetrachlorophenol	Trifluralin
Tetrachlorvinphos	Trimethyl phosphate
Tetraethyl dithiopyrophosphate	2,4,5-Trimethylaniline
Tetraethyl pyrophosphate	1,3,5-Trinitrobenzene
Thionazine	Tris(2,3-dibromopropyl)phosphate
Thiophenol (Benzenethiol)	Tri-p-tolyl phosphate

TABLE 2-23

METHOD 8275 (TE/GC/MS) - SEMIVOLATILE ORGANIC COMPOUNDS

Acenaphthene	2,2',3,4',5,5',6- Heptachlorobiphenyl
Acenaphthylene	Hexachlorobenzene
Anthracene	2,2',3,3',4,4'- Hexachlorobiphenyl
Benz(*a*)anthracene	2,2',3,4,4',5'- Hexachlorobiphenyl
Benzo(*k*)fluoranthene	Indeno(1,2,3-*cd*)pyrene
Benzo(*b*)fluoranthene	Naphthalene
Benzo(*g,h,i*)perylene	2,2',3,3'4,4',5,5',6- Nonachlorobiphenyl
Benzo(*a*)pyrene	2,2',3,3',4,4',5,5'- Octachlorobiphenyl
4-Bromophenyl phenyl ether	2,2',4,5,5'-Pentachlorobiphenyl
2-Chlorobiphenyl	2,3',4,4',5-Pentachlorobiphenyl
1-Chloronaphthalene	Phenanthrene
Chrysene	Pyrene
2,2',3,3'4,4',5,5',6,6'- Decachlorobiphenyl	2,2'3,5'-Tetrachlorobiphenyl
Dibenz(*a,h*)anthracene	2,2'4,5'-Tetrachlorobiphenyl
Dibenzofuran	2,2',5,5'-Tetrachlorobiphenyl
Dibenzothiophene	2,3',4,4'-Tetrachlorobiphenyl
3,3'-Dichlorobiphenyl	1,2,4-Trichlorobenzene
Fluoranthene	2,2',5-Trichlorobiphenyl
Fluorene	2,3',5-Trichlorobiphenyl
2,2',3,3',4,4',5- Heptachlorobiphenyl	2,4',5-Trichlorobiphenyl
2,2',3,4,4',5,5'- Heptachlorobiphenyl	

TABLE 2-23A

METHOD 8276 (GC-NICI/MS) - TOXAPHENE AND TOXAPHENE CONGENERS

2-endo,3-exo,5-endo,6-exo,8,9,10-Heptachlorobornane (Hp-Sed)
2-exo,3-endo,6-exo,8,9,10-Hexachlorobornane (Hx-Sed)
2,2,5,5,8,9,9,10,10-Nonachlorobornane (P62)
2-endo,3-exo,5-endo,6-exo,8,8,9,10,10-Nonachlorobornane (P50)
2-endo,3-exo,5-endo,6-exo,8,8,10,10-Octachlorobornane (P26)
2-endo,3-exo,5-endo,6-exo,8,9,10,10-Octachlorobornane (P40)
2-exo,3-endo,5-exo,8,9,9,10,10-Octachlorobornane (P41)
2-exo,5,5,8,9,9,10,10-Octachlorobornane (P44)
Toxaphene

TABLE 2-24

METHODS 8280 (HRGC/LRMS) AND 8290 (HRGC/HRMS) - POLYCHLORINATED DIBENZO-*p*-DIOXINS (PCDDs) AND POLYCHLORINATED DIBENZOFURANS (PCDFs)

1,2,3,4,6,7,8-HpCDD	2,3,4,6,7,8-HxCDF
HpCDD, total	HxCDF, total
1,2,3,4,6,7,8-HpCDF	OCDD
1,2,3,4,7,8,9-HpCDF	OCDF TCDF, total
HpCDF, total	1,2,3,7,8-PeCDD
1,2,3,4,7,8-HxCDD	PeCDD, total
1,2,3,6,7,8-HxCDD	1,2,3,7,8-PeCDF
1,2,3,7,8,9-HxCDD	2,3,4,7,8-PeCDF
HxCDD, total	PeCDF, total
1,2,3,4,7,8-HxCDF	2,3,7,8-TCDD
1,2,3,6,7,8-HxCDF	TCDD, total
1,2,3,7,8,9-HxCDF	2,3,7,8-TCDF

TABLE 2-25

METHOD 8310 (HPLC) - POLYNUCLEAR AROMATIC HYDROCARBONS

Acenaphthene	Chrysene
Acenaphthylene	Dibenzo(*a,h*)anthracene
Anthracene	Fluoranthene
Benz(*a*)anthracene	Fluorene
Benzo(*b*)fluoranthene	Indeno(1,2,3-*cd*)pyrene
Benzo(*k*)fluoranthene	Naphthalene
Benzo(*g,h,i*)perylene	Phenanthrene
Benzo(*a*)pyrene	Pyrene

TABLE 2-26

METHOD 8315 - CARBONYL COMPOUNDS

Acetaldehyde	Decanal	Octanal
Acetone	2,5-Dimethylbenzaldehyde	Pentanal (Valeraldehyde)
Acrolein	Formaldehyde	Propanal (Propionaldehyde)
Benzaldehyde	Heptanal	*m*-Tolualdehyde
Butanal (Butyraldehyde)	Hexanal (Hexaldehyde)	*o*-Tolualdehyde
Crotonaldehyde	Isovaleraldehyde	*p*-Tolualdehyde
Cyclohexanone	Nonanal	

TABLE 2-27

METHOD 8316 (HPLC)

Acrolein
Acrylamide
Acrylonitrile

TABLE 2-28

METHOD 8318 (HPLC) - *N*-METHYLCARBAMATES

Aldicarb (Temik)	Dioxacarb	Mexacarbate
Aldicarb sulfone	Formetanate hydrochloride	Oxamyl
Bendiocarb	3-Hydroxycarbofuran	Promecarb
Carbaryl (Sevin)	Methiocarb (Mesurol)	Propoxur (Baygon)
Carbofuran (Furadan)	Methomyl (Lannate)	Thiodicarb
m-Cumenyl methylcarbamate	Metolcarb	

TABLE 2-29

METHOD 8321 (HPLC/TS/MS) - NONVOLATILE ORGANIC COMPOUNDS

Azo Dyes	Organophosphorus Compounds
Disperse Brown 1	Asulam
Disperse Orange 3	Dichlorvos (DDVP)
Disperse Orange 30	Dimethoate
Disperse Red 1	Disulfoton
Disperse Red 5	Famphur
Disperse Red 13	Fensulfothion
Disperse Yellow 5	Merphos
Solvent Red 3	Methomyl
Solvent Red 23	Monocrotophos
	Naled
Anthraquinone Dyes	Parathion methyl
Disperse Blue 3	Phorate
Disperse Blue 14	Thiofanox
Disperse Red 60	Trichlorfon
	Tris(2,3-dibromopropyl) phosphate (Tris-BP)
Chlorinated Phenoxyacid Compounds	
2,4-D	Silvex (2,4,5-TP)
2,4-D, butoxyethanol ester	2,4,5-T
2,4-D, ethylhexyl ester	2,4,5-T, butyl ester
Dalapon	2,4,5-T, butoxyethanol ester
2,4-DB	
Dicamba	
Dichlorprop	
Dinoseb	
MCPA	
MCPP	

Table 2-29 (continued)

Carbamates	
Aldicarb	Linuron
Aldicarb sulfone	Methiocarb
Aldicarb sulfoxide	Methomyl
Aminocarb	Metolcarb
Barban	Mexacarbate
Bendiocarb	Molinate
Benomyl	Monuron
Bromacil	Neburon
Butylate	Oxamyl
Carbaryl	Pebulate
Carbendazim	*o*-Phenylenediamine
Carbofuran	Physostigmine
Carbofuran phenol	Physostigmine salicylate
Carbosulfan	Promecarb
Chloropropham	Propham
Chloroxuron	Propoxur
m-Cumenyl methyl carbamate	Prosulfocarb
Diuron	Siduron
EPTC	Tebuthiuron
Fenuron	Thiodicarb
Fluometuron	Thiophanate-methyl
Formetanate hydrochloride	Triallate
3-Hydroxycarbofuran	

TABLE 2-29A

METHOD 8323 (MS) - ORGANOTINS BY MICRO-LIQUID CHROMATOGRAPHY-ELECTROSPRAY ION TRAP MASS SPECTROMETRY

Dibutyltin dichloride	Monophenyltin trichloride
Diphenyltin dichloride	Tributyltin chloride
Monobutyltin trichloride	Triphenyltin chloride

TABLE 2-30

METHOD 8325 (HPLC/PB/MS) - NONVOLATILE ORGANIC COMPOUNDS

Benzidine	3,3'-Dimethylbenzidine
Benzoylprop ethyl	Diuron
Carbaryl	Linuron (Lorox)
o-Chlorophenyl thiourea	Monuron
3,3'-Dichlorobenzidine	Rotenone
3,3'-Dimethoxybenzidine	Siduron

TABLE 2-31

METHOD 8330 (HPLC) - NITROAROMATICS AND NITRAMINES

2-Amino-4,6-dinitrotoluene (2-Am-DNT)	2-Nitrotoluene (2-NT)
4-Amino-2,6-dinitrotoluene (4-Am-DNT)	3-Nitrotoluene (3-NT)
3,5-Dinitroanaline (3,5-DNA)	4-Nitrotoluene (4-NT)
1,3-Dinitrobenzene (1,3-DNB)	Nitroglycerin
2,4-Dinitrotoluene (2,4-DNT)	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)
2,6-Dinitrotoluene (2,6-DNT)	Pentaerythritol tetranitrate (PETN)
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	1,3,5-Trinitrobenzene (1,3,5-TNB)
Methyl-2,4,6-trinitrophenyl-nitramine (Tetryl)	2,4,6-Trinitrotoluene (2,4,6-TNT)
Nitrobenzene (NB)	

TABLE 2-32

METHOD 8331 (HPLC)

Tetrazene

TABLE 2-33

METHOD 8332 (HPLC)

Nitroglycerine

TABLE 2-34

METHOD 8410 - SEMIVOLATILE ORGANIC COMPOUNDS

Acenaphthene	1,2-Dichlorobenzene
Acenaphthylene	1,3-Dichlorobenzene
Anthracene	1,4-Dichlorobenzene
Benzo(*a*)anthracene	2,4-Dichlorophenol
Benzo(*a*)pyrene	Diethyl phthalate
Benzoic acid	Dimethyl phthalate
Bis(2-chloroethoxy)methane	4,6-Dinitro-2-methylphenol
Bis(2-chloroethyl)ether	2,4-Dinitrophenol
Bis(2-chloro-1-methylethyl)ether	2,4-Dinitrotoluene
Bis(2-ethylhexyl) phthalate	2,6-Dinitrotoluene
4-Bromophenyl phenyl ether	Di-*n*-octyl phthalate
Butyl benzyl phthalate	Di-*n*-propyl phthalate
4-Chloroaniline	Fluoranthene
4-Chloro-3-methylphenol	Fluorene
2-Chloronaphthalene	Hexachlorobenzene
2-Chlorophenol	1,3-Hexachlorobutadiene
4-Chlorophenol	Hexachlorocyclopentadiene
4-Chlorophenyl phenyl ether	Hexachloroethane
Chrysene	Isophorone
Dibenzofuran	2-Methylnaphthalene
Di-*n*-butyl phthalate	2-Methylphenol

Table 2-34 (continued)

4-Methylphenol	*N*-Nitrosodiphenylamine
Naphthalene	*N*-Nitroso-di-*n*-propylamine
2-Nitroaniline	Pentachlorophenol
3-Nitroaniline	Phenanthrene
4-Nitroaniline	Phenol
	Pyrene
2-Nitrophenol	1,2,4-Trichlorobenzene
4-Nitrophenol	2,4,5-Trichlorophenol
N-Nitrosodimethylamine	2,4,6-Trichlorophenol

TABLE 2-35

METHOD 8430 (GC/FT-IR) - BIS(2-CHLOROETHYL) ETHER AND ITS HYDROLYSIS PRODUCTS

Bis(2-chloroethyl) ether
2-Chloroethanol
2-(2-Chloroethoxy) ethanol
Diethylene glycol
Ethylene glycol

TABLE 2-35A

METHOD 8440 - TOTAL RECOVERABLE PETROLEUM HYDROCARBONS BY INFRARED SPECTROPHOTOMETRY

This method does not give a specific compound list but is applicable to total recoverable petroleum hydrocarbons.

TABLE 2-36

METHOD 8510 (COLORIMETRIC SCREENING) - RDX AND HMX

Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)

TABLE 2-36A

METHOD 8520 (CONTINUOUS MEASUREMENT OF FORMALDEHYDE IN AMBIENT AIR)

Formaldehyde

TABLE 2-37

METHOD 8535 (COLORIMETRIC SCREENING) - VOLATILE ORGANIC HALIDES

Carbon tetrachloride
Perchloroethylene (Tetrachloroethene)
Trichloroethylene
Trihalomethanes

TABLE 2-38

METHOD 8540 (UV-INDUCED COLORIMETRY) - PENTACHLOROPHENOL

Pentachlorophenol

TABLE 2-39

DETERMINATIVE METHODS FOR INORGANIC ANALYTES

Analyte	Applicable Methods
Aluminum	6010, 6020, 7000, 7010
Antimony	6010, 6020, 6200, 6800, 7000, 7062
Arsenic	6010, 6020, 6200, 7010, 7061, 7062, 7063
Barium	6010, 6020, 6200, 6800, 7000, 7010
Beryllium	6010, 6020, 7000, 7010
Boron	6010, 6800
Bromide	6500, 9056, 9211
Cadmium	6010, 6020, 6200, 6800, 7000, 7010
Calcium	6010, 6020, 6200, 6800, 7000
Chloride	6500, 9056, 9057, 9212, 9250, 9251, 9253
Chromium	6010, 6020, 6200, 6800, 7000, 7010
Chromium, hexavalent	6800, 7195, 7196, 7197, 7198, 7199
Cobalt	6010, 6020, 6200, 7000, 7010
Copper	6010, 6020, 6200, 6800, 7000, 7010
Cyanide	9010, 9012, 9013, 9014, 9015, 9016, 9213
Fluoride	6500, 9056, 9214
Iron	6010, 6020, 6200, 6800, 7000, 7010
Lead	6010, 6020, 6200, 6800, 7000, 7010
Lithium	6010, 7000
Magnesium	6010, 6020, 6800, 7000
Manganese	6010, 6020, 6200, 7000, 7010
Mercury	6010, 6020, 6200, 6800, 7470, 7471, 7472, 7473, 7474
Molybdenum	6010, 6200, 6800, 7000, 7010
Nickel	6010, 6020, 6200, 6800, 7000, 7010
Nitrate	6500, 9056, 9210
Nitrite	6500, 9056, 9216
Osmium	7000
Perchlorate	6850, 6860
Phosphate	6500, 9056
Phosphorus	6010
Phosphorus, white	7580
Potassium	6010, 6020, 6200, 6800, 7000
Rubidium	6200
Selenium	6010, 6020, 6200, 6800, 7010, 7741, 7742
Silica	6010
Silver	6010, 6020, 6200, 6800, 7000, 7010
Sodium	6010, 6020, 7000
Strontium	6010, 6200, 6800, 7000
Sulfate	6500, 9035, 9036, 9038, 9056
Sulfide	9030, 9031, 9215
Thallium	6010, 6020, 6200, 6800, 7000, 7010
Thorium	6200
Tin	6010, 6200, 7000
Titanium	6010, 6200

TABLE 2-39 (cont)

Vanadium	6010, 6020, 6200, 6800, 7000, 7010
Zinc	6010, 6020, 6200, 6800, 7000, 7010
Zirconium	6200

TABLE 2-40A

RECOMMENDED SAMPLE CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES FOR ORGANIC CHEMICALS[a]

(Note: Footnotes are located on the last page of the table.)

VOLATILE ORGANICS

Sample Matrix	Container	Preservative[1]	Holding Time[1]
Concentrated waste samples	Method 5035: See the method. Method 5021: See the method. Methods 5031 and 5032: See the methods. Use PTFE-lined lids for all procedures.	Cool to 0 - 6 °C.	14 days
Aqueous samples with no residual chlorine present	Methods 5030, 5031, and 5032: 3 x 40-mL vials with PTFE-lined septum caps	Cool to 0 - 6 °C and adjust pH to less than 2 with H_2SO_4, HCl, or solid $NaHSO_4$	14 days
		If carbonaceous materials are present, or if MTBE and other fuel oxygenate ethers are present and a high temperature sample preparative method is to be used, do not acid preserve the samples.	*7 days*
		If the reactive compound 2-chloroethyl vinyl ether[b] is an analyte of interest, collect a second set of samples without acid preservatives and analyze immediately.	*7 days*

RECOMMENDED SAMPLE CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES FOR ORGANIC CHEMICALS[a]

VOLATILE ORGANICS (continued)

Sample Matrix	Container	Preservative[1]	Holding Time[1]
Aqueous samples WITH residual chlorine present	Methods 5030, 5031, and 5032: 3 x 40-mL vials with PTFE-lined septum caps	Collect sample in a 125-mL container which has been pre-preserved with 4 drops of 10% sodium thiosulfate solution. Gently swirl to mix sample and transfer to a 40-mL VOA vial. Cool to 0 - 6 °C and adjust pH to less than 2 with H_2SO_4, HCl, or solid $NaHSO_4$.	14 days
		If carbonaceous materials are present, or if MTBE and other fuel oxygenate ethers are present and a high temperature sample preparative method is to be used, do not acid preserve the samples.	*7 days*
		If the reactive compound 2-chloroethyl vinyl ether[b] is an analyte of interest, collect a second set of samples without acid preservatives and analyze immediately.	*7 days*
Acrolein and acrylonitrile in aqueous samples	Methods 5030, 5031, and 5032: 3 x 40-mL vials with PTFE-lined septum caps	Adjust to pH 4-5. Cool to 0 - 6 °C. *These compounds are highly reactive and should be analyzed as soon as possible.*	7 days
Solid samples (e.g., soils, sediments, sludges, ash)	Method 5035: See the method. Method 5021: See the method. Methods 5031 and 5032: See the methods.	See the individual methods.	14 days
		If vinyl chloride, styrene, or 2-chloroethyl vinyl ether are analytes of interest, collect a second set of samples without acid preservatives and analyze as soon as possible.	7 days

RECOMMENDED SAMPLE CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES FOR ORGANIC CHEMICALS[a]

SEMIVOLATILE ORGANICS/ORGANOCHLORINE PESTICIDES AND HERBICIDES

Sample Matrix	Container	Preservative[1]	Holding Time[1]
Concentrated waste samples	125-mL wide-mouth glass with PTFE-lined lid	None	Samples extracted within 14 days and extracts analyzed within 40 days following extraction.
Aqueous samples with no residual chlorine present	4 x 1-L amber glass container with PTFE-lined lid, or other size, as appropriate, to allow use of entire sample for analysis.	Cool to 0 - 6 °C.	Samples extracted within 7 days and extracts analyzed within 40 days following extraction.
Aqueous samples WITH residual chlorine present	4 x 1-L amber glass container with PTFE-lined lid, or other size, as appropriate, to allow use of entire sample for analysis.	Add 3 mL 10% sodium thiosulfate solution per gallon (or 0.008%). Addition of sodium thiosulfate solution to sample container may be performed in the laboratory prior to field use. Cool to 0 - 6 °C.	Samples extracted within 7 days and extracts analyzed within 40 days following extraction.
Solid samples (e.g., soils, sediments, sludges, ash)	250-mL wide-mouth glass container with PTFE-lined lid	Cool to 0 - 6 °C.	Samples extracted within 14 days and extracts analyzed within 40 days following extraction.

RECOMMENDED SAMPLE CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES FOR ORGANIC CHEMICALS[a]

POLYCHLORINATED BIPHENYLS, POLYCHLORINATED DIBENZO-*p*-DIOXINS, AND POLYCHLORINATED DIBENZOFURANS

Sample Matrix	Container	Preservative[1]	Holding Time[2]
Concentrated waste samples	125-mL wide-mouth glass with PTFE-lined lid	None	None
Aqueous samples with no residual chlorine present	4 x 1-L amber glass container with PTFE-lined lid, or other size, as appropriate, to allow use of entire sample for analysis.	Cool to 0 - 6 °C.	None
Aqueous samples WITH residual chlorine present	4 x 1-L amber glass container with PTFE-lined lid, or other size, as appropriate, to allow use of entire sample for analysis.	Add 3 mL 10% sodium thiosulfate solution per gallon (or 0.008%). Addition of sodium thiosulfate solution to sample container may be performed in the laboratory prior to field use. Cool to 0 - 6 °C	None
Solid samples (e.g., soils, sediments, sludges, ash)	250-mL wide-mouth glass container with PTFE-lined lid.	Cool to 0 - 6 °C.	None

[a] The information presented in this table does not represent EPA requirements, but rather is intended solely as guidance. Selection of containers, preservation techniques, and applicable holding times should be based on the stated project-specific DQOs.

[1] The exact sample, extract, and standard storage temperature should be based on project-specific requirements and/or manufacturer's recommendations for commercially available standards. Furthermore, alternative storage temperatures may be appropriate based on demonstrated analyte stability in a given matrix, provided the stated DQOs for a project-specific application are still attainable.

[2] A longer holding time may be appropriate if it can be demonstrated that the reported analyte concentrations are not adversely affected from preservation, storage, and analyses performed outside the recommended holding times.

TABLE 2-40B

RECOMMENDED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES FOR INORGANIC AND OTHER ANALYTES IN AQUEOUS MATRICES
(SEE CHAPTER THREE FOR MORE DETAILED GUIDANCE, INCLUDING REGARDING SOLID MATRICES)
(Footnotes are located on the next page.)

Name	Container[1]	Preservation[2]	Holding Time[3]
Inorganic Tests:			
Chloride	P, G	None required	28 days
Cyanide, total and amenable to chlorination	P, G	Cool to 0 - 6 ˚C; if oxidizing agents present add 5 mL 0.1N $NaAsO_2$ per L or 0.06 g of ascorbic acid per L; adjust pH>12 with 50% NaOH. See Method 9010 for other interferences.	14 days
Hydrogen ion (pH)	P, G	None required	As soon as possible
Nitrate	P, G	Cool to 0 - 6 ˚C.	48 hours
Sulfate	P, G	Cool to 0 - 6 ˚C.	28 days
Sulfide	P, G	Cool to 0 - 6 ˚C , add zinc acetate, NaOH to pH >9	7 days
Metals:			
Chromium VI	P, G	Cool to 0 - 6 ˚C.	24 hours
Mercury	P, G	HNO_3 to pH<2	28 days
Mercury (soil/sediment)	P, G	Cool to 0 - 6 ˚C.	28 days
Mercury Species in soil/sediment	P, G	Cool to 0 - 6 ˚C.	5 days
All Other Metals	P, G	HNO_3 to pH<2	6 months
Hexane Extractable Material (HEM; Oil and grease)	G	Cool to 0 - 6 ˚C,HCl or H_2SO_4 to pH<2	28 days
Organic carbon, total (TOC)	P, G	Cool to 0 - 6˚C, store in dark; HCl or H_2SO_4 to pH<2	28 days
Radiological Tests:			

Name	Container[1]	Preservation[2]	Holding Time[3]
Alpha, beta and radium	P, G	HNO_3 to pH<2	6 months

[a] The information presented in this table does not represent EPA requirements, but rather is intended solely as guidance. Selection of containers, preservation techniques and applicable holding times should be based on the stated project-specific DQOs. See Chapter Three, Chapter Four, or the individual methods for more information.

[1] Polyethylene (P) or glass (G)

[2] The exact sample, extract, and standard storage temperature should be based on project-specific requirements and/or manufacturer's recommendations for commercially available standards. Furthermore, alternative storage temperatures may be appropriate based on demonstrated analyte stability in a given matrix, provided the stated DQOs for a project-specific application are still attainable.

[3] A longer holding time may be appropriate if it can be demonstrated that the reported analyte concentrations are not adversely affected by preservation, storage, and analyses performed outside the recommended holding times.

TABLE 2-41
PREPARATION METHODS FOR ORGANIC ANALYTES
(Note: Footnotes are located on the last page of the table.)

	Matrix			
Analyte Type	Aqueous[1]	Solids	Sludges and Emulsions[1,2]	Organic Liquids, Tars, Oils
Acid Extractable	35103520 (pH ≤ 2)	3540 3541 3542[13] 3545 3546 3550	3520 (pH ≤ 2)	3650 3580[3]
Acrolein[12], Acrylonitrile[12], and Acetonitrile	5031 5032[12]	5031 5032[12]	5031 5032[12]	3585
Acrylamide	8032[4]			
Aniline and Selected Derivatives	3510 3520 (pH >11) 5031[11]	3540 3541 3545 3550	3520 (pH >11)	3580[3]
Aromatic Volatiles	5021 5030 5032	5021 5032 5035	5030 5032	3585
Base/Neutral Extractable	3510 3511 3520 (pH >11)	3540 3541 3542[13] 3545 3546 3550	3520 (pH >11)	3650 3580[3]
Carbamates	8318[5] 8321	8318[5] 8321	8318[5]	8318[5]
Chlorinated Herbicides	3535 (pH < 1) 8151[6] (pH ≤ 2) 8321	3545 3546 8151[6] 8321	8151[6] (pH ≤ 2)	3580[3]
Chlorinated Hydrocarbons	3510 3520 (pH as received)	3540 3541 3550	3520 (pH as received)	3580[3]
Dyes	3510 3520	3540 3541 3545 3550		

TABLE 2-41 (continued)
PREPARATION METHODS FOR ORGANIC ANALYTES

Analyte Type	Matrix			
	Aqueous[1]	Solids	Sludges and Emulsions[1,2]	Organic Liquids, Tars, Oils
Explosives	3535 8330[7] 8331[8]	8330[7] 8331[8]		
Formaldehyde	8315[9]	8315[9]		
Haloethers			3510 3520	3540 3541 3545 3550
Halogenated Volatiles	5021 5030 5032	5021 5032 5035	5030	5021 (methanol extr) 5035 / 5030 (methanol extr) 5032 3585
Nitroaromatics and Cyclic Ketones	3510 3520 (pH 5-9) 3535	3540 3541 3545 3550	3520 (pH 5-9)	3580[3]
Nitrosamines	3510 3520	3540 3541 3545 3550		
Non-halogenated Volatiles	5021 5030 5031 5032	5021 5031 5032 5035	5021 5031 5032	5021 (methanol extr) 5035 / 5030 (methanol extr) 5032 3585
Organochlorine Pesticides	3510 3520 3535 (pH 5-9)	3540 3541 3545 3546 3550 3562	3520 (pH 5-9)	3580[3]
Organophosphorus Pesticides	3510 3520 (pH 5-8) 3535	3540 3541 3545 3546	3520 (pH 5-8)	3580[3]

TABLE 2-41 (continued)
PREPARATION METHODS FOR ORGANIC ANALYTES

	Matrix			
	Aqueous[1]	Solids	Sludges and Emulsions[1,2]	Organic Liquids, Tars, Oils 3650 3580[3]
Phenols	3510 3520 (pH ≤ 2) 3535	3540 3541 3545 3546 3550 3562	3520 (pH ≤ 2)	3650 3580[3]
Phthalate Esters	3510 3520 3535 (pH 5-7)	3540 3541 3545 3546 3550	3520 (pH 5- 7)	3580[3]
Polychlorinated Biphenyls	3510 3520 3535 (pH 5-9)	3540 3541 3545 3546 3562	3520 (pH 5-9)	3580[3]
PCDDs and PCDFs	8280[10] 8290[10]	3545 3546 8280[10] 8290[10]	8280[10] 8290[10]	8280[10] 8290[10]
Polynuclear Aromatic Hydrocarbons	3510 3511 3520 (pH as received)	3540 3541 3545 3546 3550 3561	3520 (pH as received)	3580[3]
Volatile Organics	5021 5030 5031 5032	5021 5031 5032 5035	5021 5030 5031 5032	5021 (methanol extr) 5035 / 5030 (methanol extr) 5032 3585
Wipes (Chemical Agents only)		3572		

[1] The pH at which extraction should be performed is shown in parentheses.
[2] If attempts to break an emulsion are unsuccessful, these methods may be used.
[3] Method 3580 is only appropriate if the sample is soluble in the specified solvent.
[4] Method 8032 contains the extraction, cleanup, and determinative procedures for this analyte.

[5] Method 8318 contains the extraction, cleanup, and determinative procedures for these analytes.
[6] Method 8151 contains the extraction, cleanup, and determinative procedures for these analytes.
[7] Method 8330 contains the extraction, cleanup, and determinative procedures for these analytes.
[8] Method 8331 is for Tetrazene only, and contains the extraction, cleanup, and determinative procedures for this analyte.
[9] Method 8315 contains the extraction, cleanup, and determinative procedures for this analyte.
[10] Methods 8280 and 8290 contain the extraction, cleanup, and determinative procedures for these analytes.
[11] Method 5031 may be used when only aniline is to be determined.
[12] Method 5032 may be used for acrolein and acrylonitrile.
[13] Method 3542 is used for extraction of semivolatiles from stack samples collected using Method 0010.

TABLE 2-42

CLEANUP METHODS FOR ORGANIC ANALYTE EXTRACTS

Analyte Type	Method
Acid Extractable	3650, 3640
Base/Neutral Extractable	3650, 3640
Carbamates	8318[1]
Chlorinated Herbicides	8151[2]
Chlorinated Hydrocarbons	3620, 3640
Haloethers	3620, 3640
Nitroaromatics & Cyclic Ketones	3620, 3640
Nitrosamines	3610, 3620, 3640
Organochlorine Pesticides	3620, 3630, 3640 3660
Organophosphorus Pesticides	3620
Phenols	3630, 3640, 3650 8041[3]
Phthalate Esters	3610, 3611, 3620 3640
Polychlorinated Biphenyls	3620, 3630, 3640 3660, 3665
Polychlorinated Dibenzo-*p*-Dioxins and Polychlorinated Dibenzofurans	8280[4] 8290[4]
Polynuclear Aromatic Hydrocarbons	3610, 3611 3630, 3640, 3650

[1] Method 8318 contains the extraction, cleanup, and determinative procedures for these analytes.
[2] Method 8151 contains the extraction, cleanup, and determinative procedures for these analytes.
[3] Method 8041 includes a derivatization technique followed by GC/ECD analysis, if interferences are encountered using GC/FID.
[4] Methods 8280 and 8290 contain the extraction, cleanup, and determinative procedures for these analytes.

TABLE 2-43

DETERMINATIVE METHODS ORGANIC ANALYTES

Analyte Type	GC/MS Method	Specific GC Method[6]	HPLC Method
Acid Extractable	8270	8410[6]	
Acrolein, Acrylonitrile, Acetonitrile	8260, 8261	8015, 8031, 8033[1]	8315[2], 8316
Acrylamide	8260	8032	8316
Aniline and Selected Derivatives	8270	8131	
Aromatic Volatiles	8260, 8261	8021	
Base/Neutral Extractable	8270	8410[6]	8325[4]
Carbamates			8318, 8321
Chlorinated Herbicides	8270[3]	8151	8321
Chlorinated Hydrocarbons	8270	8121	
Diesel Range Organics (DRO)		8015, 8440[7]	
Dyes			8321
Explosives		8095	8330, 8331, 8332
Formaldehyde			8315
Gasoline Range Organics (GRO)		8015	
Haloethers	8270	8111, 8430	
Halogenated Volatiles	8260, 8261	8011, 8021	
Nitroaromatics and Cyclic Ketones	8270	8091	8330[5]
Nitrosoamines	8270	8070	
Non-halogenated Volatiles	8260	8015	8315
Organochlorine Pesticides	8270[3], 8276	8081, 8085[6]	
Organophosphorus Pesticides	8270[3]	8141, 8085[6]	8321
Phenols	8270	8041, 8410[6]	
Phthalate Esters	8270	8061, 8410[6]	
Polychlorinated Biphenyls	8270[3]	8082	
PCDDs and PCDFs	8280, 8290		
Polynuclear Aromatic Hydrocarbons	8270	8100, 8410[6]	8310
Volatile Organics	8260, 8261	8011, 8015, 8021, 8031, 8032, 8033	8315, 8316

[1] Of these analytes, Method 8033 is for acetonitrile only.
[2] Of these analytes, Method 8315 is for acrolein only.
[3] This method is an alternative confirmation method, not the method of choice.
[4] Benzidines and related compounds.
[5] Nitroaromatics (see "Explosives").
[6] Includes GC/ES methods, e.g., Methods 8085 and 8410.
[7] FT-IR determinative method only. Does not use GC.

TABLE 2-44

PREPARATION METHODS FOR INORGANIC ANALYSES [1]

Matrix	Method
Surface water	3005, 3010, 3015, 3020
Groundwater	3005, 3010, 3015, 3020
Extracts	3010, 3015, 3020
Aqueous samples containing suspended solids	3010, 3015, 3020
Oils	3031, 3040, 3051, 3052[2]
Oil sludges	3031, 3052[2]
Tars	3031, 3052[2]
Waxes	3031, 3040, 3052[2]
Paints	3031, 3052[2]
Paint sludges	3031, 3052[2]
Petroleum products	3031, 3040, 3052[2]
Sediments	3050, 3051, 3052[2], 3060[3], 3200[4]
Sludges	3050, 3051, 3052[2], 3060[3]
Soil samples	3050, 3051, 3052[2], 3060[3], 3200[4]
Ashes	3052[2]
Biological tissues	3052[2]

[1]It is the responsibility of the analyst to refer to each analytical method to determine applicability of the chosen method to a specific waste type and target analyte.

[2]For total decomposition analysis ONLY.

[3]For the analysis of samples for hexavalent chromium ONLY.

[4]For the analysis of samples for mercury or mercury species ONLY.

TABLE 2-45

USE OF LEACHING, EXTRACTION AND DIGESTION METHODS
FOR INORGANIC ANALYSIS (In order of increasing strength)

Method	Method Name	Reagents & Conditions	Use
1310	Extraction Procedure (EP) Toxicity Test Method and Structural Integrity Test	Dilute acetic acid	Simulate leaching that would result from codisposal of a solid waste and municipal waste in a sanitary landfill[1]
1311	Toxicity Characteristic Leaching Procedure	Extraction Fluid # 1 -- Dilute glacial acetic acid and NaOH, pH 4.93 ± 0.05 Extraction Fluid # 2 -- Dilute glacial acetic acid, pH 2.88 ± 0.05	Simulate leaching that would result from codisposal of a solid waste and municipal waste in a sanitary landfill[1]
1312	Synthetic Precipitation Leaching Procedure	Dilute H_2SO_4 and HNO_3 (synthetic acid rain)	Simulate acid rain leaching of a waste
1313	Liquid-Solid Partitioning as a Function of Extract pH Batch Extraction Procedure	Dilute HNO_3, KOH	Industrial wastes, soils, sludges, combustion residues, sediments, stabilized materials, construction materials, and mining wastes
1316	Liquid-Solid Partitioning as a Function of Liquid-to-Solid Ratio in Solid Materials Using a Parallel Batch Procedure	None	Industrial wastes, soils, sludges, combustion residues, sediments, stabilized materials, construction materials, and mining wastes
1320	Multiple Extraction Procedure	Dilute H_2SO_4 and HNO_3 (synthetic acid rain)	Simulate long-term acid rain leaching of a waste
3005	Acid Digestion of Waters for Total Recoverable or Dissolved Metals Analysis by FLAA or ICP Spectroscopy	HNO_3, heat	Surface water and groundwater
3010	Acid Digestion of Aqueous Samples and Extracts for Total Metals for Analysis by FLAA or ICP Spectroscopy	HNO_3, HCl, heat	Aqueous samples and extracts
3015	Microwave Assisted Acid Digestion of Aqueous Samples and Extracts	HNO_3 or alternatively HNO_3 and HCl, (pressure, heat)	Aqueous samples and extracts

TABLE 2-45 (continued)

USE OF LEACHING, EXTRACTION AND DIGESTION METHODS
FOR INORGANIC ANALYSIS (In order of increasing strength)

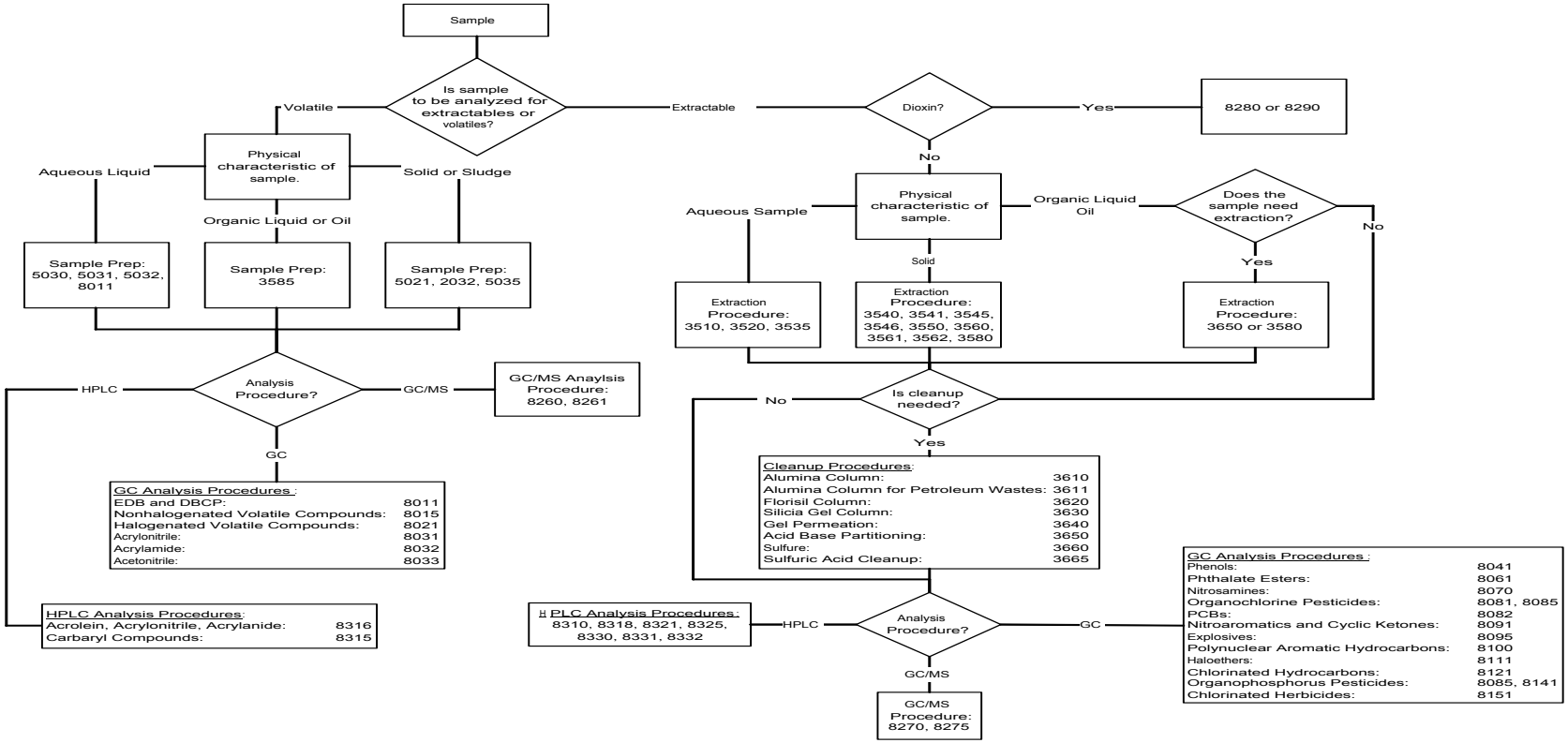
Method	Method Name	Reagents & Conditions	Use
3020	Acid Digestion of Aqueous Samples and Extracts for Total Metals for Analysis by GFAA Spectroscopy	HNO_3, heat	Aqueous samples and extracts for GFAA work only
3031	Acid Digestion of Oils for Metals Analysis by Atomic Absorption or ICP Spectrometry	Potassium permanganate, H_2SO_4, HNO_3, HCl, heat	Oils, oily sludges, tars, waxes, paint, paint sludge, and other viscous petroleum products
3040	Dissolution Procedure for Oils, Greases, or Waxes	Solvent (e.g., xylene, kerosene, or MIBK)	Dissolution of oils, oily wastes, greases and waxes
3050	Acid Digestion of Sediments, Sludges, and Soils	HNO_3 and H_2O_2, heat (for GFAA or ICPMS) HNO_3, H_2O_2, and HCl, heat (for ICP-AES or FLAA)	Sediments, soils, and sludges
3051	A Microwave Assisted Acid Digestion of Sediments Sludges, Soils, and Oils	HNO_3, or alternatively HNO_3 and HCl, microwave assisted (pressure, heat)	Sludges, sediments, soils and oils
3052	Microwave Assisted Acid Digestion of Siliceous and Organically Based Matrices	HNO_3, HF, HCl (optional) H_2O_2 (optional), heat, pressure	Siliceous, organic and other complex matrices for total sample decomposition
3060A	Alkaline Digestion for Hexavalent Chromium	Na_2CO_3/NaOH, heat	Soils, sludges, sediments and some industrial wastes for the analysis of hexavalent chromium only.

[1] As described in the respective background documents developed in support of the rulemakings, which added required use of these methods to the Toxicity Characteristic regulation (Method 1311 replaced Method 1310 for Toxicity Characteristic determinations on March 29, 1990, 55 FR 11862).

TABLE 2-46
SCREENING METHODS FOR ORGANIC ANALYTES

Analyte Type	Matrix			
	Aqueous	Solids	Sludges and Emulsions	Organic Liquids, Tars, Oils
Chlordane		4041		
2,4-Dichlorophenoxyacetic acid	4015	4015		
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)		4051 8510		
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)		8510		
Pentachlorophenol	4010	4010 8540	4010	
Petroleum Hydrocarbons		4030		
Poly-Chlorinated Biphenyls (PCBs)	4425 (coplanar)	4020 4425 (coplanar)		4020 (non-aqueous)
Polychlorinated Dibenzodioxins	4425	4425		
Polychlorinated Dibenzofurans	4425	4425		
Polynuclear Aromatic Hydrocarbons (PAHs)	4425	4035 4425		
Toxaphene		4040		
Triazine Pesticides	4670 (quantitative)			
1,1,1,-Trichloro-2,2-bis(chlorophenyl)ethane (DDT) and breakdown products		4042		
Trinitrotoluene (TNT)		4050 8515		

FIGURE 2-1
ORGANIC ANALYSIS OPTIONS FOR SOLID AND LIQUID MATRICES



For illustrative purposes only.

See the disclaimer and Sec. 2.1 for information on the flexibility inherent in SW-846 methods.

NOTE: Not all clean-up methods are applicable to all listed methods. Consult the individual methods for further information on what clean-up methods are applicable and appropriate.

FIGURE 2-2
SCHEMATIC OF SEQUENCE TO DETERMINE
IF A WASTE IS HAZARDOUS BY CHARACTERISTIC

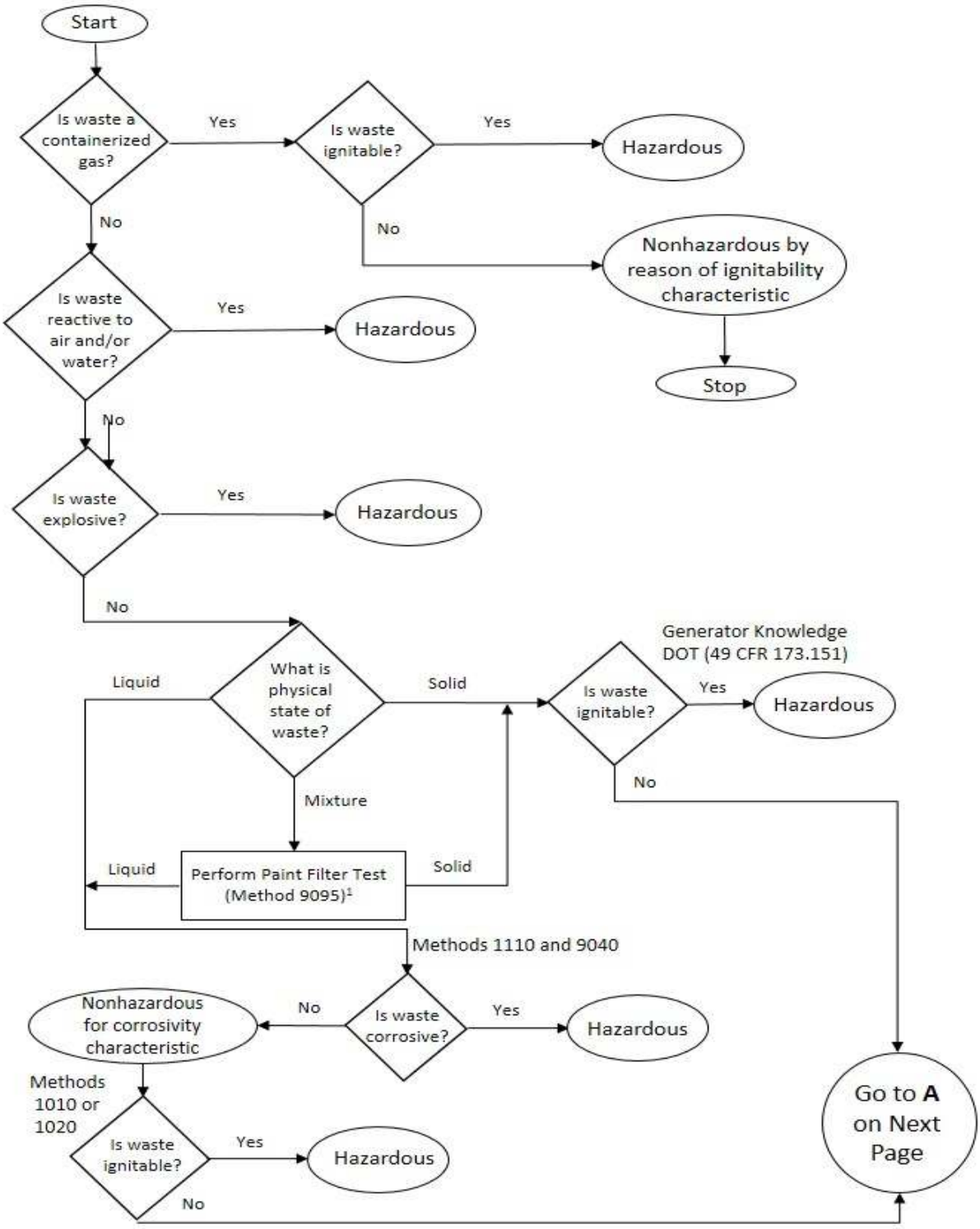
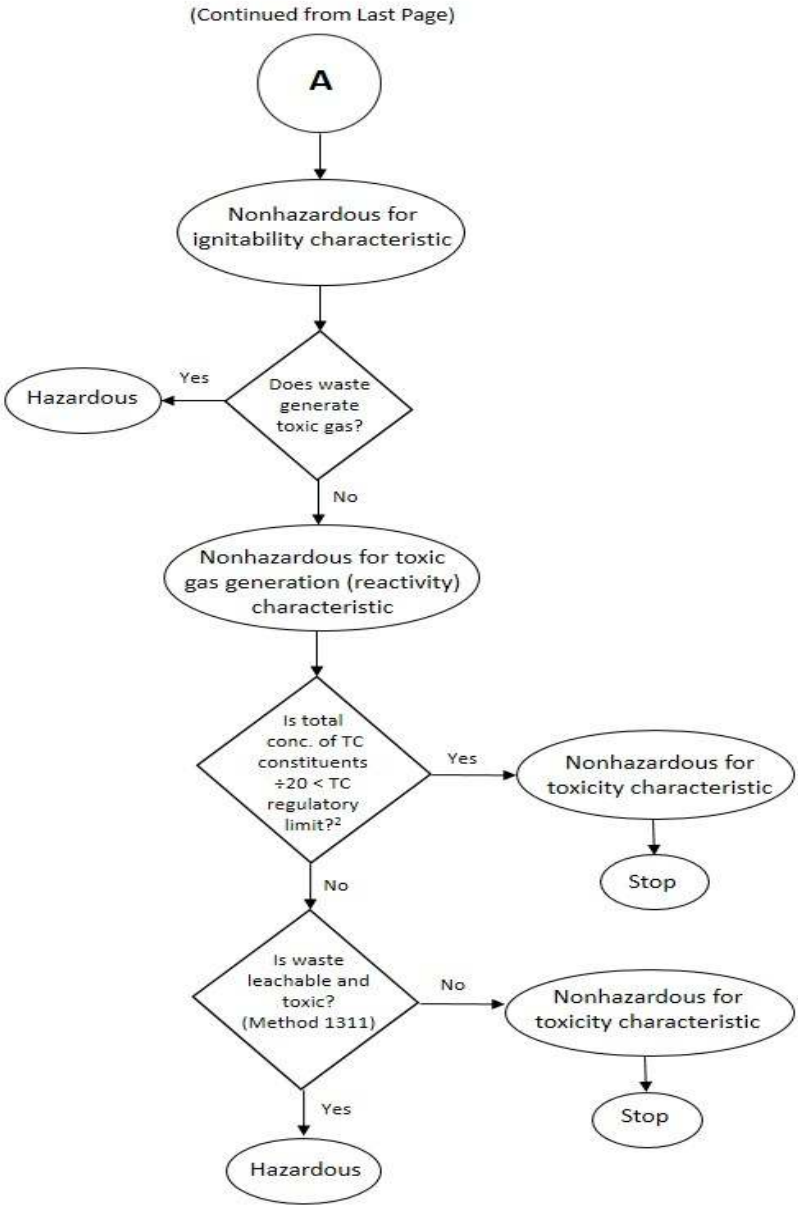


FIGURE 2-2 (continued)



1. Users can find information regarding the corrosivity characteristic for samples in a gel matrix at:http://yosemite.epa.gov/osw/rcra.nsf/0/7D573EA3E0F1576D8525670F006BEA5F/$file/11719.pdf.
2. Biphasic or multiphasic waste can present a unique challenge. More information can be found on this topic in the Federal Register (Dec 21, 1995 FR (page 66389). This can be found online at: http://nepis.epa.gov/Exe/ZyNET.exe/10001E3Y.txt?ZyActionD=ZyDocument&Client=EPA&Index=1995%20Thru%201999&Docs=&Query=&Time=&EndTime=&SearchMethod=1&TocRestrict=n&Toc=&TocEntry=&QField=&QFieldYear=&QFieldMonth=&QFieldDay=&UseQField=&IntQFieldOp=0&ExtQFieldOp=0&XmlQuery=&File=D%3A\ZYFILES\INDEX%20DATA\95THRU99\TXT\00000000\10001E3Y.txt&User=ANONYMOUS&Password=anonymous&SortMethod=h|-&MaximumDocuments=1&FuzzyDegree=0&ImageQuality=r75g8/r75g8/x150y150g16/i425&Display=p|f&DefSeekPage=x&SearchBack=ZyActionL&Back=ZyActionS&BackDesc=Results%20page&MaximumPages=1&ZyEntry=48

FIGURE 2-3A
RECOMMENDED SW-846 METHODS FOR ANALYSIS OF EP LEACHATES

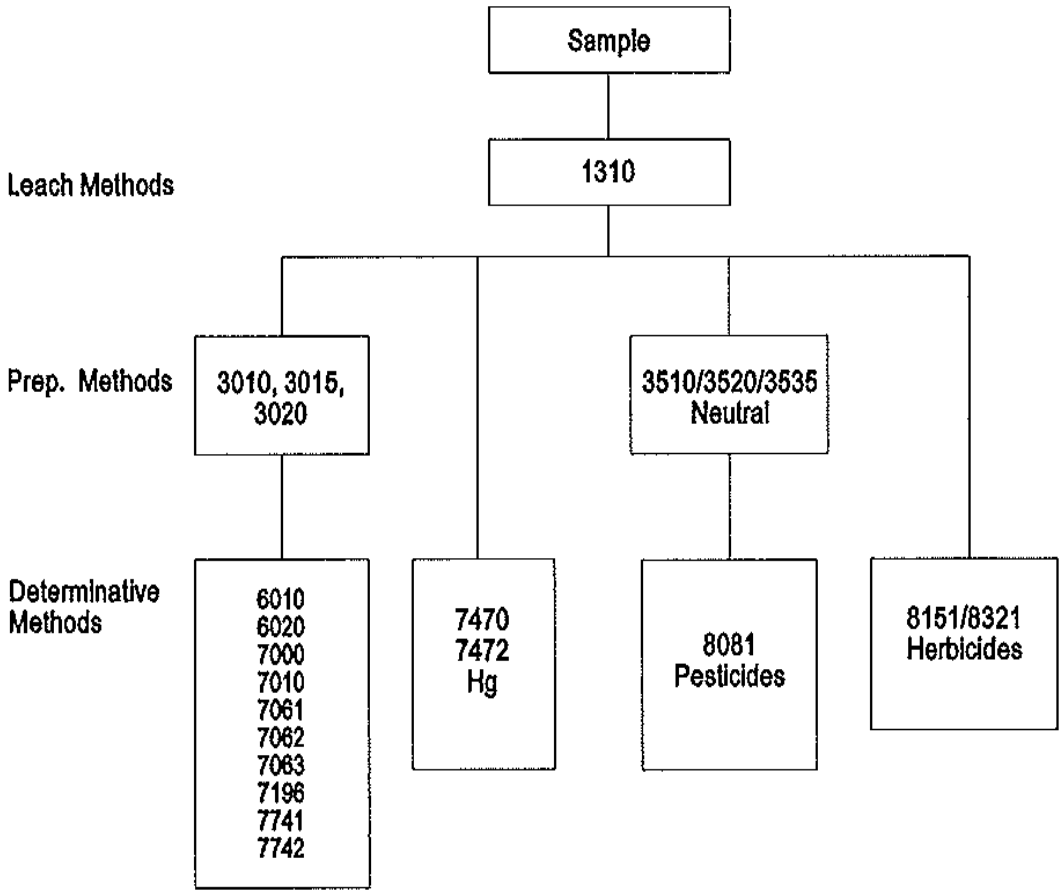


FIGURE 2-3B

RECOMMENDED SW-846 METHODS FOR ANALYSIS OF TCLP LEACHATES

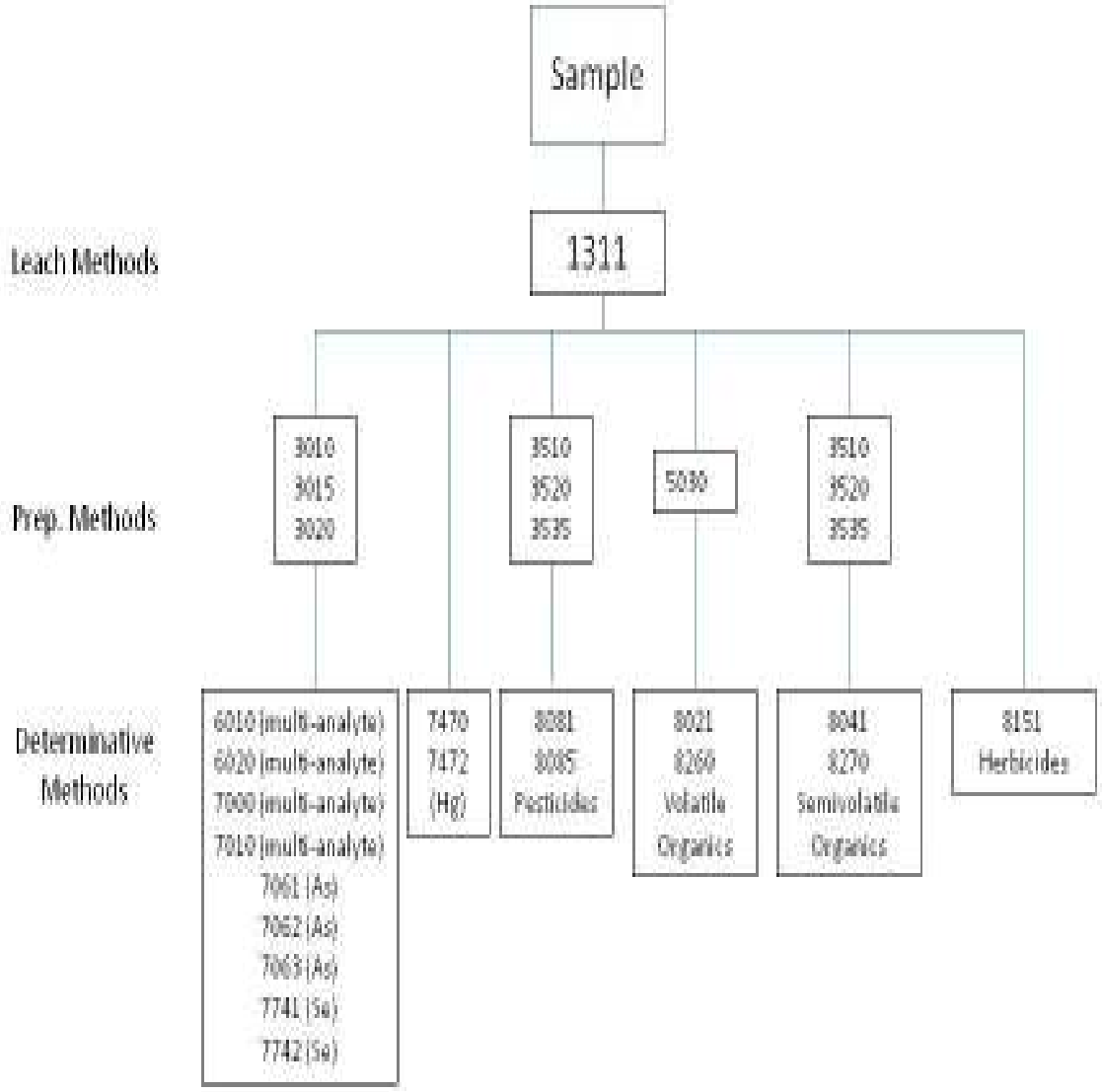
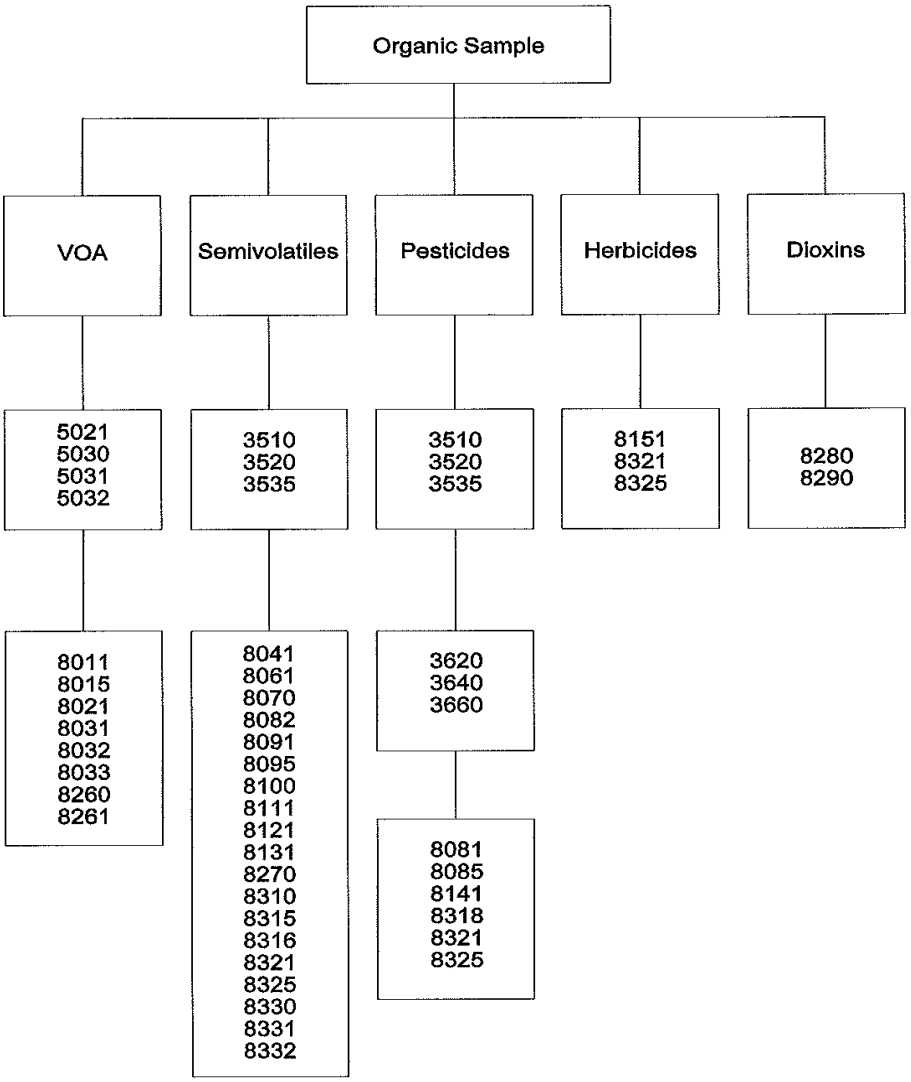
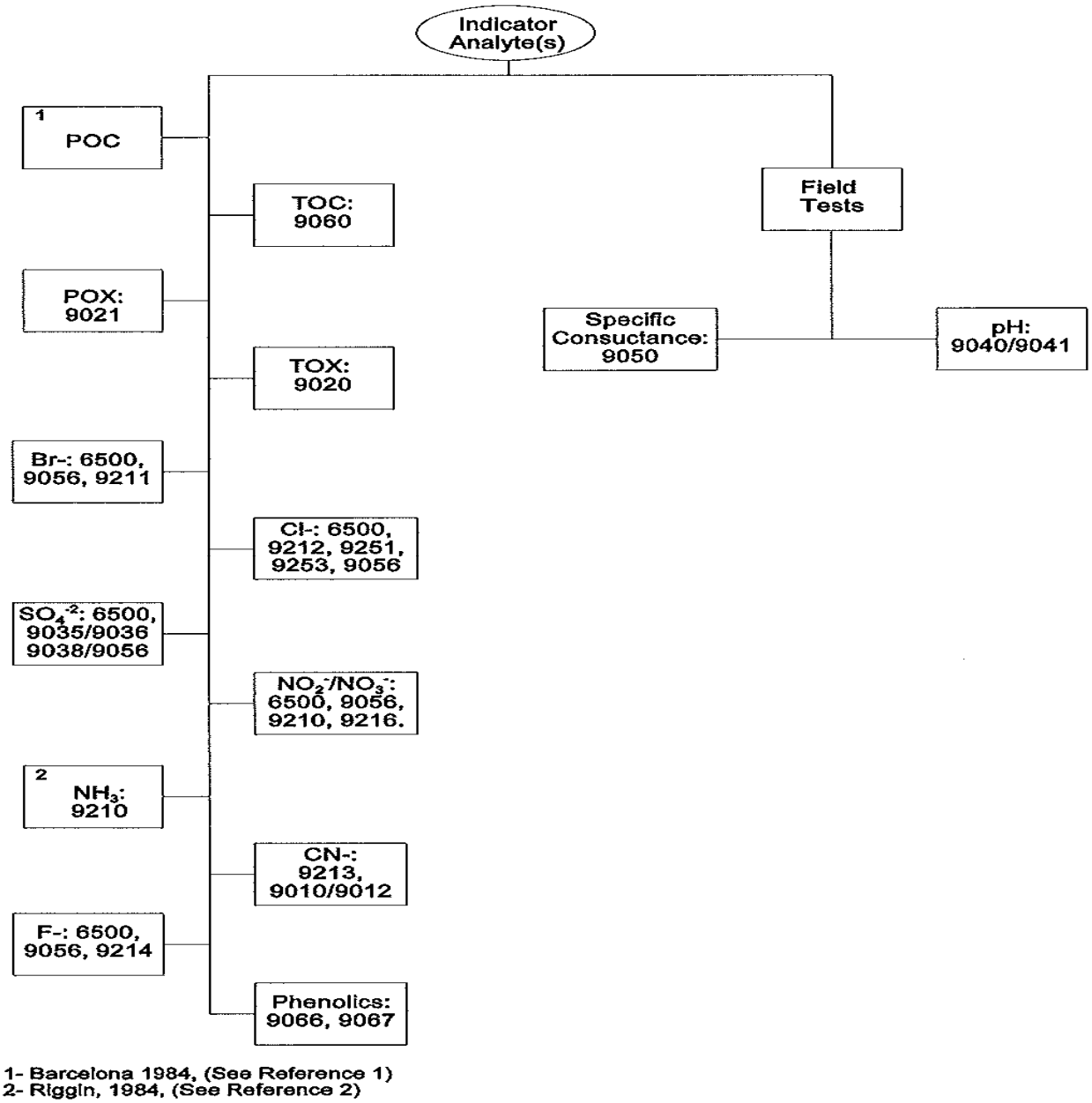


FIGURE 2-4A
GROUNDWATER ANALYSIS - ORGANIC ANALYTES



For illustrative purposes only.
See the disclaimer and Sec. 2.1 for information on the flexibility inherent in SW-846 methods.

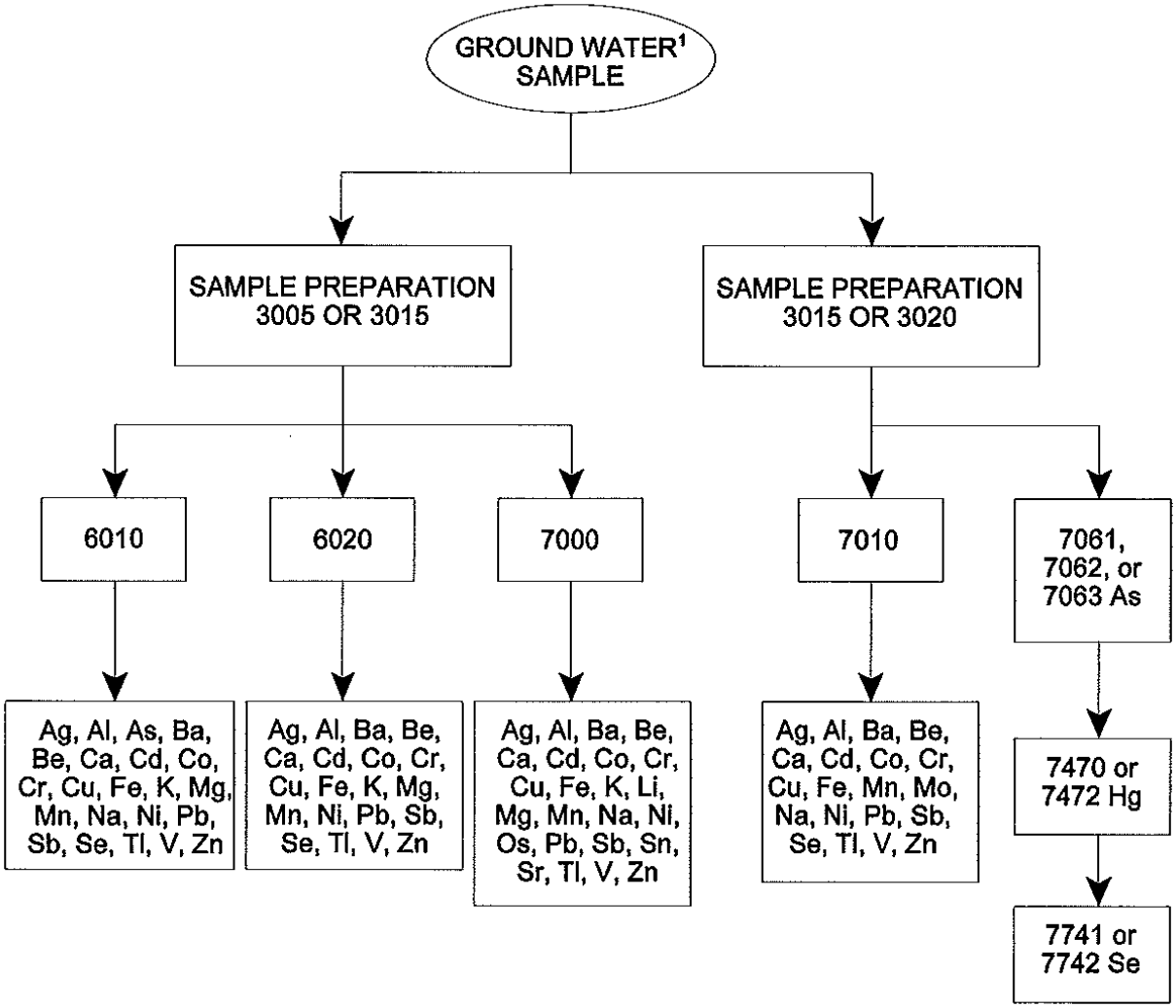
FIGURE 2-4B
GROUNDWATER ANALYSIS - INDICATOR ANALYTES



For illustrative purposes only. See the disclaimer and Sec. 2.1 regarding the flexibility inherent in SW-846 methods.

FIGURE 2-4C

GROUNDWATER ANALYSIS - INORGANIC ANALYTES



For illustrative purposes only. See the disclaimer and Sec. 2.1 regarding the flexibility inherent in SW-846 methods.

Appendix A: Summary of Updates/Changes in Chapter 2

1. Improved overall method formatting for consistency with new SW-846 methods style guidance. The entire document was reformatted in Microsoft Word.docx format from the original .WPD and .PDF files.
2. The revision number was changed to five and the published date to July 2014.
3. A Table of Contents was compiled and added to make finding information easier.
4. Minor editorial and grammatical changes (e.g., removing extra spaces between words, adding commas, etc.) were made throughout Sections 1.0 to 2.7. The disclaimer statement in Section 1.0 was numbered to keep the format consistent, as it started at Section 2.0 originally.
5. Graphics in the Figures Section were modified from Corel Drawing Objects V.10 to .jpg graphical images where needed to remove artifacts from the conversion process. The text titles of each figure was centered and formatted.
6. This appendix was added to document non-significant changes made during the editorial process.
7. Bis(2-chloroisopropyl) ether was corrected to Bis(2-chloro-1-methylethyl) ether in Tables 2-1, 2-4, 2-15, 2-22, and 2-34.
8. Revised Table 2-40A to reflect current sample preservation guidance for styrene and vinyl chloride in aqueous samples (i.e., deletion of previously recommended practice of collecting a second set of samples without acid preservatives and analyze immediately, if styrene and vinyl chloride are analytes of interest).
9. Revised Table 2-41.
10. Revised Table 2-45 to include Methods 1313 and 1316.
11. Added Table 2-46.
12. Added Figure(s) for new leaching procedure(s).
13. Revised Table 2-40B to include Mercury Speciation hold times in addition to totals.
14. All other tables were updated with the target compound list in the current published methods.