Guidelines For Contamination Reduction And Sampling At Illegal Drug Manufacturing Sites

Revised June 1996

Office of Toxic Substances

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1.0 INTRODUCTION

In 1989, the Washington State Legislature passed the Omnibus Drug Lab Law [Title 69.50 and 64.44 Revised Code of Washington (RCW)] in response to the growing concern over drugs and the illegal manufacture of drugs (Appendix A). Under Title 64.44 RCW, the health department is responsible for posting the property and determining whether the property is contaminated. If the health department determines the property is contaminated, the property is found "unfit for use." When the health department determines the property is "unfit for use," the property owner is responsible for assessing the level of contamination and decontaminating (cleanup) the property. The property owner must hire a state certified cleanup contractor. Under the provisions of Title 64.44 RCW, the Washington State Department of Health (DOH) and the Washington State Board of Health promulgated Chapter 246-205 Washington Administrative Code (Appendix A). Under the provisions of Chapter 246-205, local health departments, property owners, and contractors must follow these standard operating procedures (SOP) during the cleanup process at labs.

These SOP represent a concerted effort to provide the most up-to-date information for use during the contamination reduction (cleanup) process at illegal drug manufacturing sites (labs). They are compiled from information and data collected from library references, and other state and federal agencies. These SOP have been peer reviewed by local health departments, cleanup contractors, and technical experts for applicability and technical accuracy. When these cleanup SOP are followed, the site will be considered fit for use, if there is no scientific evidence to suggest a continuing human health risk after cleanup. The basis for this conclusion is current knowledge and the known physical properties of the chemicals associated with drug production.

When following these SOP, you must remember that the methods of manufacturing change, and the chemical hazards associated with this activity will change. The effects of the many byproducts resulting from the manufacture of these drugs are unknown. Illegal drug manufacturing is changing dynamically and there are no absolute guarantees that chronic health effects will be completely eliminated by cleaning these contaminated residences.

1.1 Purpose

The purpose of this manual is to provide local health officials, property owners, and contractors with uniform procedures and standards for reducing the contamination at illegal drug manufacturing sites. The intent of SOP is to give the users a standard plan of action. Each site and incident is different and the user should modify the procedures as necessary. Changes must be made in writing to the local health department prior to implementation.

The goal of cleaning a site is to reduce the levels of contaminants so the site may be reoccupied.

1.2 Background

The illegal manufacture of drugs has become a significant public health problem during the past several years. Nationally in 1988, 810 illegal drug manufacturing labs were seized, and these figures only account for 25 percent of existing labs. Twenty-five methamphetamine manufacturing labs were seized in Washington State alone. Law enforcement and health agency officials estimate that it is likely there were about 100 labs in Washington State in 1988.

Because of the number of illegal drug manufacturing labs and the potential public health threat, a clandestine drug lab response steering committee was formed. The goal of the committee was to increase coordination and communication between the responding agencies. Committee members included representatives from local and state law enforcement, local hazardous materials response teams, state and federal environmental agencies, state and local health departments, private contractors, the Washington State Department of Labor and Industry, and the Washington State Board of Pharmacy.

The committee addressed the issues of on-scene roles/responsibilities, needed legislation, hazardous material response, hazardous material removal, property owner liability, public health risk, among others. The committee produced several documents, including: "Model Local Fire Department and Hazardous Materials Team Response to Illegal Methamphetamine Drug Labs," "Clandestine Laboratory Policy Manual for Law Enforcement Agencies," and "Model Local Health Department Response to Illegal Methamphetamine Drug Labs."

In 1988, the Washington State Controlled Substances Act (Chapter 69.50.511 of the Revised Code of Washington) was amended, setting forth the principles of a coordinated, cooperative response effort at illegal drug lab sites (Appendix A). Under this law, law enforcement officials/agencies are responsible for arresting suspects and notifying environmental and local/state health agencies. The Washington State Department of Ecology's role is to remove, transport, and dispose of bulk hazardous materials, and to conduct an environmental risk assessment. The roles and responsibilities of the state and local health departments and the interior contamination of residences and buildings were not addressed.

In 1989, the Washington State Legislature created Chapter 64.44 RCW (Appendix A), which addresses properties contaminated by illegal drug manufacturing activities and defines the roles and responsibilities of DOH and local health departments. DOH is responsible for: training, testing, and certifying illegal drug lab site cleanup contractors and workers; maintaining a list of illegal drug lab sites; maintaining a list of certified illegal drug lab site cleanup contractors; providing technical assistance to local health departments; developing cleanup guidelines; and developing sampling and testing methods for surface water, groundwater, soil, and septic tanks.

The roles and responsibilities of the local health department are: posting the property; notifying the property owner and others with an interest in the property; inspecting the property; determining contamination; prohibiting use until cleanup is completed; overseeing cleanup of the property; and authorizing reoccupation.

The focus of this manual is to describe the process required to reduce contamination (cleanup) of the interiors of lab sites. While the main emphasis is on methamphetamine manufacture, numerous other drugs can be and are manufactured illegally (i.e., MDA, MDMA, LSD, PCP, and others). The generic

methodologies for MDA, MDMA, and LSD are shown in Appendix B (Tables 15B - 27B). An incident involving LSD requires close cooperation among all agencies to ensure it is handled safely. Because LSD presents acute health risks to humans, this type of drug lab will require the utmost care during all phases of investigation and cleanup.

The manual is laid out as follows: pre-cleanup screen, workplan, gross and residual cleanup, encapsulation (painting the interior walls with a non-porous paint), post cleanup assessment, and reoccupation. Recommended sampling and testing methods for air, surface water, groundwater, soil, and septic tanks are included in Appendix C.

1.3 Methods of Manufacture

The manufacture of methamphetamine is fairly simple and does not require a college chemistry degree. Generally, methamphetamine is made by using a recipe, which may be handwritten or obtained from a publication. The person manufacturing the drug literally "cooks" the ingredients. Hence these people are called "cooks." While it is possible to use a number of methods to produce this drug, two methods are most commonly used: amalgam and ephedrine. The basic synthesis methods are shown in Appendix B (Tables 1B - 4B, 10B, and 11B).

1.3.1 Amalgam Method

The amalgam method is presently the least common method for manufacturing methamphetamine in Washington State. This method primarily uses phenyl-2-propanone (P-2-P) and methylamine as precursors (substances used to manufacture drugs) (Appendix B, Tables 1B - 4B). Mercuric chloride, aluminum, hydrochloric acid (HCl), alcohols, ethers, and benzene are used as catalysts, reagents, and solvents as part of this manufacturing method (ibid).

1.3.2 Ephedrine Method

The ephedrine method is more common than the amalgam method, and several sites in Washington State have been found where this method has been used to manufacture methamphetamine. This method primarily uses ephedrine, and pressurized hydrogen as precursors (Appendix B, Tables 10B - 11B). Sodium hydroxide, red phosphorous, sulfuric acid, lithium, aluminum hydride, chloroform, alcohols, ethers, acetone, and other chemicals are used as catalysts, reagents, and solvents as part of this manufacturing method (ibid).

1.3.3 Precursor Manufacture

As public agencies have attempted to control the illegal manufacture of drugs by regulating the sale of precursors, the cooks have found methods to manufacture the precursors. The common methods for producing P-2-P, methylamine, ephedrine, and other precursors and pre-precursors are shown in Appendix B (Tables 5B - 9B and 12B). The reagents are also shown in those tables.

1.3.4 Byproducts and Contaminants

Production of methamphetamine in pharmaceutical laboratories under ideal controlled conditions results in the production of byproducts and contaminants which are removed. But in a clandestine laboratory those conditions do not exist. In addition to the normal byproducts, other unwanted byproducts may be produced during less than ideal conditions (e.g., overheating, underheating, and improper mixing). Some of those byproducts are shown in Appendix B (Tables 13B and 14B). The human health risk becomes a concern when the contaminants, sludge, and byproducts are discharged into the environment (air, septic tanks, streams, and soil).

1.4 Implications for Human Health

Some chemicals used in methamphetamine production present a danger of injury from fire or explosion. In addition, at the lab site there are possible risks of exposure to infectious disease (e.g., AIDS, hepatitis B) in the event of skin puncture by drug paraphernalia. Risk of injury or toxicity from chemical exposure is present, depending on the toxic properties of the chemicals, quantity and form, concentration, duration, and route of exposure. Systemic absorption of chemicals or injury may occur by one or more of the following routes of exposure:

1. Inhalation
2. Skin exposure
3. Ingestion (swallowing)
4. Injection

Inhalation and/or skin exposure are the most likely routes of exposure for persons exposed to the drug lab environment. The cook has the potential of toxicity from all routes of exposure; i.e., ingestion and injection of the drug, spill of chemicals onto the skin, and inhalation of vapors. Children living in the drug lab environment typically are in contact with the floor, thus have a higher potential for exposure because of the possibility of ingesting chemicals (e.g., mercury and lead) in addition to inhalation or skin exposure.

Inhalation or skin exposure may result in injury from corrosive substances, with symptoms ranging from shortness of breath, cough, chest pain, to burns to the skin. Many solvents are absorbed into the body through the lungs and if the dose is sufficient may cause symptoms of intoxication, dizziness, lack of coordination, nausea, and disorientation. The skin, to a lesser extent, may also absorb some solvents if chemicals remain in direct contact. Ingestion of chemicals will result in the greatest risk of toxicity. However, except in a suicide attempt or a child accidentally ingesting these chemicals, toxicity by ingestion is a remote possibility.

The final methamphetamine product has considerable potential for adverse effects in the drug user. Toxic properties of the drug may cause agitation, psychosis, seizures, respiratory arrest, and death. In addition, drugs produced in drug labs contain an abundance of contaminants and byproducts which do not have predictable effects on the drug user. Impurities found in some drugs produced in drug labs have resulted in severe and permanent neurologic disability following intravenous injection. As state and federal agencies reduce the availability of precursors by regulation and enforcement, it can be anticipated that the cook will resort to more exotic methods of production, resulting in the creation of contaminants and byproducts with unexpected and potentially serious adverse effects to the drug user.

1.5 Exposure Risk

The risk of human exposure varies considerably depending on the lab process, quantity, and form of chemicals. Also, there is greater risk of chemical exposure at a site where a lab is actively producing drugs than at a site where drugs were formerly produced.

1.5.1 Active Lab

A functioning drug lab presents the greatest risk of adverse health effects for occupants. If a site found to be an illegal drug manufacturing site is supplied with chemicals and lab hardware, it should be considered unsafe for entry except by trained personnel using appropriate personal protective equipment.

Danger of fire and explosion comprises the greatest risk due to the relatively large amounts of solvents normally found at these sites. A chemical spill could result in air concentrations strong enough to produce symptoms from inhalation of solvents, corrosives, or cyanide. The drug cooking process could also generate sufficient amounts of toxic gases to produce symptoms. The levels of airborne chemicals will vary considerably depending on the cooking method, quantity of chemicals present, size of the room, and ventilation. Another potential risk of toxic exposure occurs as a result of the cook setting "booby traps." For example, a tripwire can be set that drops sodium cyanide into acid when a door is opened, resulting in the release of highly toxic hydrogen cyanide gas.

Acute injury with immediate onset of symptoms from a massive chemical exposure is the most significant health risk related to illegal methamphetamine manufacture. Routes of exposure and possible health effects of chemicals likely to be encountered at illegal methamphetamine manufacturing sites are summarized in Appendix B (Tables 28B-32B).

Although the risk of acute injury is possible from exposure to chemicals at an active lab site, risk of chronic toxicity or cancer is remote.

1.5.2 Former Lab

After removal of the illicit laboratory equipment and chemicals, residual amounts of some substances may persist on building surfaces and furnishings prior to cleanup. Substances present in the active lab as gases or volatile solvents should dissipate rapidly with ventilation, unless there has been a significant spill and a residual pool of liquid remains.

1.5.3 Cleanup

In addition to the cooks, members of the household, and law enforcement and state agency personnel making the initial site assessment, health effects could also occur in cleanup crews or persons reoccupying the house before cleanup. Cleanup personnel may be exposed to high concentrations of toxic chemicals for short periods of time (acute exposure) and should be aware of symptoms of acute exposures from solvents, cyanides, corrosives, and irritants and metals and their salts (Tables 15B - 19B). When symptoms of acute exposure are experienced, appropriate action must be taken to leave the source, or to remove the source from the exposed person. For instance, when a person begins to feel symptoms of

acute solvent intoxication (headache, lethargy, disorientation, respiratory difficulty, and eye irritation), he/she should immediately leave the interior of the house being cleaned and get out into fresh air. Re-entry should not occur unless adequate ventilation has reduced the airborne contaminant to safe levels or unless he/she wears self-contained breathing apparatus. Appropriate personal protection equipment (PPE) must be worn at all times.

2.0 METHODS

2.1 Preliminary Assessment

A preliminary assessment should determine what chemicals are involved, the manufacturing method, and whether the property is fit or unfit for use as is. This assessment occurs after potential contamination has been identified and the property has been posted under the provisions of RCW 64.44.020.

The local health department should conduct a preliminary assessment to determine the manufacturing method used and the chemicals involved. The first step in this process is to obtain copies of the law enforcement report and the Department of Ecology hazardous material transportation manifest. The police report will contain invaluable historical and drug manufacturing method information. From this information, a lab site chemical inventory can be developed. The chemical inventory will help to identify potential chemical hazards and the manufacturing method used.

The preliminary assessment must be reviewed by the local health department to evaluate the potential contamination and health risk. Under the provisions of RCW 64.44.020, the local health department shall determine whether the property is fit or unfit for use.

It is recommended that the local health department use the data in Appendices B - D, Section 1.4 Implications for Human Health and other appropriate sources to aid in making the determination.

If the local health department determines the property is fit for use, the preliminary findings should be documented and archived for future use. The documentation should include: findings, conclusions, the name of the owner of record, his/her mailing and street address, legal description of the property, and clear directions for locating the property.

If the local health department determines the property is unfit for use, the local health department must post the site and a site-specific written work plan must be developed and submitted to the local health department by the landowner for approval prior to starting cleanup (RCW 64.44.030).

2.2 Work Plan

When the preliminary assessment indicates the property is unfit for use, it is required that the property owner hire a state authorized illegal drug lab cleanup contractor to cleanup the site (RCW 64.44.050). The contractor is responsible for but not limited to conducting a pre-cleanup site assessment, writing a workplan, cleaning the site, proper disposal of waste under the provisions of Chapter 173-303 WAC, and writing the final report.

2.2.1 Pre-cleanup Site Assessment

The purpose of the pre-cleanup site assessment is to review the data collected during the preliminary assessment, familiarize the contractor with the site, identify and test for target chemicals (chemicals used during the manufacturing process), and to find the best cleanup method. This assessment must come prior to preparing the workplan. The pre-cleanup site assessment must contain the following elements:

1. A review of the information collected during the preliminary assessment by law enforcement agencies, the Department of Ecology, and other appropriate documentation regarding the evidence and extent of the illegal drug manufacturing activity.

2. A site survey to determine the nature and extent of observable damage and contamination.

3. Pre-cleanup testing including: testing the indoor air for total volatile organic compounds (VOC's) and airborne mercury, and surface lead.

4. The possibility of obtaining false positives for lead and mercury exists. These materials were commonly added to paints. Bear in mind, that homes built before 1978 will show positive for lead and homes built before 1990 will show positive for mercury. To minimize this possibility: If the amaglam method was not used, **do not** test for either lead or mercury. If there is no clear indication which method was used, or in cases where multiple methods were used and also where precursors were manufactured, specifically P2P and methylamine, **test** for lead and mercury. If the amalgam method was clearly used, **test** for lead and mercury.

2.2.2 The Written Workplan

The written workplan shall include:

Timeline - The timeline should identify the key work elements below, indicate the estimated time to complete each element, and show start-end time estimates for each element.

Location - Street address and mailing address of the contaminated property, owner of record and his/her mailing address, legal description, and clear directions for locating the property.

Site Map - A diagram of the contaminated property including floor plans of affected buildings, local drinking water wells and nearby streams drawn to a reasonable scale as determined by the local health department. The diagram shall show the location of damage and contamination and the location of sampling points used in the site assessment.

Preliminary Assessment Summary - A summary of the information obtained from the appropriate agency(ies) such as law enforcement, Department of Ecology, and the local health department, including a discussion of the information's relevance to the contamination.

Pre-cleanup Testing Summary - A summary of all tests to be performed by the contractor during the pre-cleanup site assessment, sampling locations, and results.

Cleanup Procedures - Specific cleanup procedures will include a list of any and all materials to be removed, removal procedures, any proposed cleanup process and appropriate disposal of contaminated materials under the provisions of the Washington State Dangerous Waste Regulations (WAC 173-303).

Waste Disposal Plan - A waste disposal plan shall be included in the workplan. Materials (building structures, clothes, furniture, etc.) inside the drug lab and the structure housing the lab may have been contaminated by the process of manufacturing drugs. The contractor must determine whether or not the waste generated during the cleanup is ***dangerous waste*** under the provisions of WAC.173-303.

Knowledge obtained from the pre-cleanup screen and/or pre-cleanup site assessment may be used to help designate the waste generated during the cleanup. Under the plan, waste should be segregated into two groups: visibly stained/contaminated and visibly clean. A representative sample must be taken from each group. The plan shall include a detailed description of the sampling method. These samples shall be tested and analyzed following the protocols under WAC 173-303.

The plan shall identify the **permitted** "Temporary Storage and Disposal" (TSD) facility that will be used in the event ***dangerous waste*** is generated. The ***dangerous waste*** must be manifested and transported to the TSD under the provisions of WAC 173-303.

If the waste is not designated as ***dangerous waste***, it is **solid waste** and may be disposed of at a **permitted** solid waste landfill. The local health department must be contacted prior to disposal of this solid waste to determine if a specific permit is required for disposal at landfills under its jurisdiction. The **permitted** landfill shall be identified.

If the contractor proposes to dispose of the structure by burning, permission must be obtained in writing from the local health department, local air pollution control authority, and local fire department.

Post-cleanup Site Assessment Plan - The post-cleanup site assessment plan should include, but not be limited to: air, non-porous surface, soil and water sampling. Sampling and testing should be performed using recognized standards and written procedures designed to ensure accuracy, reproducibility, and relevance to onsite contamination (Sections 2.3 and 2.4).

Indoor air will be tested for volatile organic compounds (VOC's), and airborne mercury. Horizontal surfaces will be tested for lead. Other compounds may be tested for, as deemed necessary by the local health department.

The testing components of the assessment should include:

1. The exact location within the property where each test sample was or will be collected;

2. The materials, equipment and techniques used or proposed for sampling at each location;

3. The amount of area, and/or volume of material collected for each test sample;

4. All control samples taken or to be taken, including the location, materials, techniques and results;

5. All sample test results must be reported in parts per million (ppm) or parts per billion, e.g., weight/weight (mg/kg) or weight/volume (ñg/m^3) units consistent with the kind of sample tested;

6. Surface sample test results must be reported as total weight of contaminant per appropriate unit of area, e.g., weight/surface area (µg/ft^2);

7. During each sample collection, identical methods must be used; and

8. The name, location, mailing address, and the licenses, registrations, or certifications of laboratories performing the work.

Portions of all samples or duplicate samples and all sample reports should be retained by the contractor and stored for a period of not less than one calendar year from the date of collection.

The sampling and analytical methods will follow the procedures outlined in Appendices C and D. When applicable, laboratory tests will be performed by a laboratory having both a U.S. Drug Enforcement Administration registration and either a certification from the Washington State Department of Health, the Washington State Department of Ecology, or equivalent.

Selection of chemicals to be analyzed will be determined by:

1. Chemicals found on site (labeled containers, detected analytically);

2. Chemicals implied by reference (e.g., methods of manufacture indicate high probability of presence); and

3. Long-term health effects (e.g., mercury vapor).

Contractor Statement of Qualifications - The statement of qualifications must include a listing of all on-site personnel qualifications, state drug lab cleanup certification, and training under applicable Occupational Safety and Health Administration (OSHA) and Washington Industrial Safety and Health Administration (WISHA) Rules (29 CFR 1910.120 and WAC 296-62-300).

Worker Health and Safety Plan - The worker health and safety plan must conform to applicable WISHA rules (WAC 296-62-300).

Under the provisions of RCW 64.44.050, the workplan must be submitted to the local health department for review and approval. **The contractor must have written approval from the local health department prior to implementation of the workplan**.

If during the cleanup it becomes necessary to modify the approved plan, written application must be made to the local health department. **The contractor must have written approval from the local health department before proceeding with the modified work plan** (ibid).

2.3 Gross Cleanup

Powders and liquids should be tested to determine their corrosivity, toxicity, and flammability. When the tests are complete, those materials should be neutralized if possible (acids with baking soda and bases with citric or acetic acid). Solids should be scooped up and packaged for disposal. Liquids can be absorbed with clay (kitty litter or floor sweep) or another non-reactive material and packaged for disposal.

Visibly contaminated (etched or stained) sinks, bathtubs, and toilets should be removed. Carpets should be removed, tested and disposed of properly. Generally, cleaning costs for the above items exceed replacement costs.

If the residence is on a septic tank system, the tank liquid should be tested and disposed of properly.

Once again, it cannot be overemphasized that appropriate personal protection equipment (PPE) must be worn at all times during the cleanup.

2.4 Residual Cleanup

The interior should be scrubbed using a standard detergent solution. The immediate area where the chemical reaction was conducted and other areas deemed appropriate should be cleaned with the solution. The wash water should be tested and disposed of properly.

2.5 Encapsulation

The interior should be painted with an oil-based paint (e.g., walls, wood flooring, ceilings, and paneling). Complete coverage may require more than one coat of paint. The paint should be allowed to dry according to the manufacturer's instructions.

2.6 Post Cleanup Assessment

This assessment should be conducted after residual cleanup and/or the encapsulant has cured. Prior to this assessment, the indoor air temperature must have been returned to about 70 degrees Fahrenheit for a minimum of 24 hours. The interior will be sampled as described in the approved workplan and in accordance with Appendices C and D. If a prior assessment was conducted and the test results indicate some contaminants were reduced to acceptable levels (e.g., VOC's), tests for those contaminants should be dropped from this assessment.

2.7 Final Report

The contractor must submit to the local health department written documentation (Final Report) showing that the cleanup has been completed according to the approved plan and an affidavit of compliance with the approved work plan (ibid).

The local health department shall review the report and determine whether the property is "Fit for Use." If the information in the final report indicate the property meets the reoccupancy standards, the property shall be determined "Fit for Use" under RCW 64.44.

The final report is a technical document, summarizing the work performed under the workplan and presenting the data collected during the post cleanup assessment. The recommended report outline follows:

I. Introduction
   A. Case Narrative
   B. Site Description
   C. Site Assessment

II. Methods
   A. Sampling and Analysis
   B. Cleanup
   C. Disposal

III. Results
   A. Chemical Analysis
   B. Cleanup
   C. Disposal

APPENDICES
Building/Site Diagram
Sampling Grid
Analytical Data Lab Reports

Note: Data must be reported as ppm for VOCs, µg/ft^2 for surface samples and ng/m^3 for air samples.

Sampling methodology must reference standard U.S. Environmental Protection Agency (EPA) methods or equivalent established methods used to analyze the samples. The analytical method must be detailed (e.g., lead - EPA method 239.2 and mercury - EPA method 245.2)

2.8 Reoccupancy

After complete cleanup and encapsulation, only small amounts of residual chemicals should remain. Reoccupancy of the house presents the potential for chronic exposure to low levels of chemicals. The primary chemicals of concern are the drug "cooked," solvents, lead, and mercury.

After ventilation, solvents must be reduced to less than 1 ppm total hydrocarbons threshold limit value, 8-hour time weighted average (TLV). Lead must be less than 20 ug/ft^2 (one square foot wipe sample, total lead). Mercury must be less than 50 ng/m^3 of air. The lead and mercury measurements are background levels for average houses.

The following methodology should be used for estimating the hazard for those chemicals measured in clandestine drug labs for which no standards have been set.

1. The suspect chemical should be searched out on a toxicological data base, such as "Toxline," or "Hazardous Substance Data Base" (HSDB) to obtain references which might aid in identifying a critical study on which a hazard estimation can be based.

   Studies which indicate health effects from human exposures at low levels should be identified.

   Animal studies which indicate effects at the lowest exposure level possible should be identified.

   Critical studies need to identify both a LOAEL (Lowest Observed Adverse Effect Level) and a NOAEL (No Observed Adverse Effect Level).

   Critical studies should be studies which use the same exposure route or routes of the suspect chemical.

2. For a rough estimate, the NOAEL identified in a critical study can be divided by a safety or uncertainty factor of at least 100 (for inter- and intra-species differences) to arrive at a level which could indicate harm to an exposed human being.

3. The level derived from the critical study by the application of uncertainty factors should be compared with the concentration measured of that chemical in the suspect clandestine drug lab. If the level measured in the lab is higher than that calculated from the critical study, a judgment can be made that the level existing in the suspect lab constitutes a potential danger to occupants. Route of exposure must be taken into consideration.

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APPENDICES

APPENDIX A

Laws Pertaining To The Cleanup Of Illegal Drug Manufacturing Sites

APPENDIX B

Methods Of Manufacturing, Chemical Toxicity And Routes Of Exposure Tables For Methamphetamine, MDA, MDMA, And LSD And Their Precursors, And Pre-precursors

Table 1B. Methamphetamine Manufacture: Phenyl-2-Propanone Amalgam Method	
Phenyl-2-Propanone + Methylamine ----------→ Methamphetamine	
Reagents	**Solvents**
Aluminum (foil, wire, pellets) Mercuric Chloride Hydrochloric Acid	Methanol Ethanol Isopropyl Alcohol Acetone Chloroform Ether Benzene

Table 2B. Methamphetamine Manufacture: Phenyl-2-Propanone Alternative No. 1 Method	
Phenyl-2-Propanone + Methylamine ----------→ Methamphetamine	
Reagents	**Solvents**
Hydrochloric Acid Sodium Cyanotrihyborate Sodium Hydroxide Magnesium Sulfate	Methanol Ether

Table 3B. Methamphetamine Manufacture: Phenyl-2-Propanone Alternative No. 2 Method	
Phenyl-2-Propanone + Methylamine ----------→ Methamphetamine	
Reagents	**Solvents**
Sodium Hydrogen Gas Copper Sulfate Calcium Hydroxide Platinum Oxide	Methanol Ethanol Acetone

Table 4B. Methamphetamine Manufacture: Phenyl-2-Propanone Leukart Reaction Method	
Phenyl-2-Propanone + N-Methylformamide ----------→ Methamphetamine or Phenyl-2-Propanone + Methylamine + Formic Acid ---------→ Methamphetamine	
Reagents	**Solvents**
Hydrochloric Acid Sodium Hydroxide Magnesium Sulfate	Ether

Table 5B. Precursor Manufacture: Phenyl-2-Propanone Manufacture Method No. 1	
Phenylacetic Acid ----------→ Phenyl-2-Propanone	
Reagents	**Solvents**
1. Lead Acetate 2. Pyridine or Sodium Acetate or Potassium Acetate + Acetic Anhydride Thorium Oxide 3. Acetic Acid + or Lime Hydrate or Platinum or Platinum Chloride or Lithium Aluminum Hydride	Ether

Table 6B. Precursor Manufacture: Phenyl-2-Propanone Manufacture Method No. 2

Benzene + Chloroacetone ----------→ Phenyl-2-Propanone

Reagents	Solvents
Aluminum Chloride	N/A

Table 7B. Precursor Manufacture: Methylamine Manufacture

Acetamide + Chlorine + Carbon Dioxide ----------→ Methylamine

or

Methanol + Ammonia ----------→ Methylamine

Table 8B. Pre-Precursor Manufacture: Phenylacetic Acid Manufacture

Benzylchloride + Potassium Cyanide ----------→ Benzylcyanide

sodium metal

Benzylcyanide + Ethylacetate ----------→ Phenylacetic Acid

Table 9B. Pre-Precursor Manufacture: Benzylchloride Manufacture

Toluene + Chlorine ----------→ Benzylchloride

Table 10B. Methamphetamine Manufacture: Ephedrine Method - Red Phosphorous Method

Ephedrine + Hydroiodic Acid + Red Phosphorous ----------→ Methamphetamine

Reagents	Solvents
Hydrochloric Acid	Ether
Sodium Hydroxide	Freon
Sodium Chloride	Acetone
Sodium Thiosulfate	
Sulfuric Acid	

Table 11B. Methamphetamine Manufacture: Ephedrine Method - Hydrogenation Method

Ephedrine + Pressurized Hydrogen ----------→ Methamphetamine

Reagents	Solvents
1. Thionylchloride or Perchloric Acid or Phosphorous Pentachloride	Methanol Ethanol Ether Acetic Acid Chloroform
2. Palladium Black or Sodium Acetate or Platinum or Platinum Chloride or Lithium Aluminum Hydride	
3. Sulfuric Acid and Lead Anode and Cathode	

Table 12B. Precursor Manufacture: Ephedrine Manufacture

Propiophenone + Methylamine + Hydrogen ----------→ Ephedrine

Reagents	Solvents
Platinum Oxide	N/A

Table 13B. Byproducts and Contaminants Associated with the Phenyl-2-Propanone Methods for Synthesizing Methamphetamine
Dibenzyl Ketone Enol Acetate of Phenyl-2-Propanone Lead Oxides Aluminum Oxides Aluminum Hydroxide Mercury Vapor Acetic Acid a-Benzyl-N-Methylphenethylamine N,N-dimethylamphetamine Amphetamine Di-(1-phenylisopropyl) Amine Di-(1-phenylisopropyl) Methylamine Tri-(1-phenylisopropyl) Amine Benzyl Methyl Ketone Phenylisopropylamine Benzyl Methyl Ketone Benzylamine 2,4-Dihydrozyl-1,5-Diphenyl-4-Methylpentone

Table 14B. Byproducts and Contaminants Associated with the Ephedrine Methods for Synthesizing Methamphetamine
Iodine Chloropseudoephedrine Phosphine (produced from overheating) Yellow Phosphorus (produced from overheating)

Table 15B. Manufacture of 3,4 Methylenedioxyamphetamine (MDA): Method 1	
Isosafrole + Formamide ---------→ MDA	
Reagents	**Solvents**
Acetic Acid	Ethanol
Ammonium Formate	Acetone
Formic Acid	Methanol
Hydrochloric Acid	Ether
Hydrogen Peroxide	Benzene
Sulfuric Acid	

Table 16B. MDA Method 2	
Piperonal + Nitroethane ---------→ MDA	
Reagents	**Solvents**
Acetic Acid	Ether
Ammonium Acetate	Ethanol
Lithium Aluminum Hydride	

Table 17B. MDA: Method 3	
Safrole + Hydrobromic Acid ---------→ MDA	
Reagents	**Solvents**
Acetic Acid	Ether
Ammonium Acetate	Ethanol
Cuprous Oxide	
Mercuric Chloride	
Sodium Carbonate	
Sodium Hydroxide	

Table 18B. MDA Precursor Manufacture: Isosafrole
Safrole + Potassium Hydroxide ---------→ Isosafrole

Table 19B. MDA Precursor Manufacture: Piperonal	
Isosafrole + Sodium Dichromate ---------→ Piperonal	
Reagents	**Solvents**
Sulfuric Acid Sodium Carbonate	Toluene

Table 20B. Manufacture of 3,4 Methylenedioxymethamphetamine (MDMA): Method 1	
Isosafrole + N, Methylformamide ---------→ MDMA	
Reagents	**Solvents**
Ammonium Formate Hydrochloric Acid Hydrogen Peroxide Acetic Acid Sulfuric Acid Formic Acid Lithium Aluminum Hydride	Acetone Methanol Ether Benzene Ethanol

Table 21B. Manufacture of MDMA: Method 2	
Piperonal + Nitroethane ---------→ MDMA	
Reagents	**Solvents**
Acetic Acid	Benzene

Lithium Aluminum Hydride

Table 22B. Manufacture of MDMA: Method 3	
Safrole + Hydrobromic Acid ---------→ MDMA	
Reagents	**Solvents**
Acetic Acid Methylamine Cuprous Oxide Mercuric Chloride Sodium Carbonate Sodium Hydroxide	Ether Ethanol

Table 23B. Other Reagents Used in MDA and MDMA Manufacture
Reagents
Ammonium Acetate Hydroxylamine Sodium Borohydride Sodium Cyanoborohydride Raney Nickel

Table 24B: Manufacture of Methcathinone	
Ephedrine + (Sodium or Potassium Dichromate) > "CAT" or Ephedrine + Chromium Trioxide + Sulfuric Acid > "CAT" or Ephedrine + Potassium Permanganate > "CAT"	
Reagents	**Solvents**
Sodium Dichromate Potassium Dichromate Potassium Permanganate Hydrochloric Acid HCL Gas Sodium Hydroxide	Toluene

Table 25B. Manufacture of Lysergic Acid Diethylamide (LSD): Method 1

Lysergic Acid + Lithium Hydroxide + Diethylamine ------→ LSD

Reagents	Solvents
Sulfur Trioxide	Dimethylformamide (DMF)
Sodium Chloride	Ether
Sodium Sulfate	Methanol
Alumina	Methylene Dichloride
Activated Carbon	Chloroform
Tartaric Acid	Benzene
	Acetone
	Ethanol

Table 26B. Manufacture of LSD: Method 2

Lysergic Acid + N,N-carbonyldiimidazole + Diethylamine ------→ LSD

Reagents	Solvents
Tartaric Acid	DMF
Sodium Sulfate	Ether
Celite 545	Methanol
Alumina	Methylene Dichloride
Activated Carbon	Chloroform
	Benzene
	Acetone
	Methylene Chloride
	Ethanol

Table 27B. Manufacture of LSD: Method 3

Lysergic Acid + Trifluoracetic Acid + Diethylamine -------→ LSD

Reagents	**Solvents**
Tartaric Acid	DMF
Alumina	Ether
Activated Carbon	Methanol
	Methylene Dichloride
	Chloroform
	Benzene
	Acetone
	Methylene Chloride
	Acetonitrile
	Ethanol

Table 28B. Manufacture of LSD: Method 4

Ergot Alkaloid or Ergotamine Tartarte + Hydrazine + Diethylamine → LSD

Reagents	**Solvents**
Tartaric Acid	Methylene Dichloride
Alumina	Methanol
Activated Carbon	Chloroform
Sodium Nitrate	Benzene
Sodium Bicarbonate	Ethanol
Hydrochloric Acid	Ethylene Dichloride
	Acetone

Table 29B. Chemical Toxicity and Routes of Exposure (Skin and Respiratory) for Solvents

Solvent	Form	Exposure
Acetone	Liquid	Eyes, Inhalation, Skin
Benzene	Liquid	Eyes, Inhalation, Skin
Benzylchloride	Liquid	Eyes, Inhalation, Skin
Chloroform	Liquid	Eyes, Inhalation, Skin
Ethanol	Liquid	Eyes, Inhalation, Skin
Ethyl Ether	Liquid	Eyes, Inhalation, Skin
Freon	Liquid	Eyes, Inhalation, Skin
Hexane	Liquid	Eyes, Inhalation, Skin
Isopropanol	Liquid	Eyes, Inhalation, Skin
Methanol	Liquid	Eyes, Inhalation, Skin
Petroleum Ether	Liquid	Eyes, Inhalation, Skin
Pyridine	Liquid	Skin, Eyes, Inhalation

Health Effects:

Inhalation of vapors at low concentration may result in mild eye, nose, and throat irritation. Symptoms of intoxication (drowsiness and lack of coordination) or loss of consciousness may occur at high doses.

Freon spilled onto the skin may result in freezing injury to the skin.

Table 30B. Chemical Toxicity and Routes of Exposure (Skin and Respiratory) for Cyanide

Substance	Form	Exposure
Sodium Cyanide	Solid	Skin, Eyes
Potassium Cyanide	Solid	Skin, Eyes
Benzyl Cyanide	Liquid	Skin, Eyes, Inhalation
Hydrogen Cyanide	Gas	Inhalation

Health Effects:

Cyanides are highly toxic substances. If solid salt forms are mixed with acid, hydrogen cyanide gas will be released. Inhalation of hydrogen cyanide may result in rapid progression of symptoms to coma, respiratory failure and death.

Table 31B. Chemical Toxicity and Routes of Exposure (Skin and Respiratory) for Corrosives and Irritants

Substance	Form	Exposure
Acetic Acid	Liquid	Skin, Eyes, Inhalation
Acetic Anhydride	Liquid	Skin, Eyes, Inhalation
Benzylchloride	Liquid	Skin, Eyes, Inhalation
Hydroiodic Acid	Liquid	Skin, Eyes, Inhalation
Mercuric Chloride	Powder, Solid	Skin, Eyes, Inhalation
Methylamine	Gas, Liquid, Solid	Skin, Eyes, Inhalation
Perchloric Acid	Liquid	Skin, Eyes, Inhalation
Phosphine	Gas	Eyes, Inhalation
Sodium Metal	Solid	Skin, Eyes
Sodium Hydroxide	Liquid, Solid	Skin, Eyes
Thionyl Chloride	Liquid	Skin, Eyes, Inhalation

Health Effects:

Vapors of volatile corrosives may cause eye irritation, heavy tearing, conjunctivitis, and corneal injury. Inhalation may cause irritation of mucous membranes of the nose and throat, and lung irritation resulting in cough, chest pain, shortness of breath. Pulmonary edema and hemoptysis may occur in severe cases. High concentrations of vapor may cause skin irritation. Additional symptoms of vapor inhalation may include headache, nausea, dizziness, and anxiety.

Direct contact with corrosives may result in severe eye or skin burns.

Table 32B. Chemical Toxicity and Routes of Exposure (Skin and Respiratory) for Metal/Salts

Substance	Form	Exposure
Aluminum	Solid	Skin, Eyes
Magnesium	Solid	Skin, Eyes
Red Phosphorous	Solid	Skin, Eyes
Iodine	Solid	Skin, Eyes
Mercuric Chloride	Solid	Skin, Eyes
Mercury Vapor	Liquid, Vapor	Inhalation
Lead Acetate	Solid	Skin, Eyes
Lithium Aluminum Hydride	Solid	Skin, Eyes
Sodium Acetate	Solid	Skin, Eyes
Sodium Hydroxide	Solid	Skin, Eyes
Sodium Metal	Solid in Kerosine	Skin, Eyes
Potassium Metal	Solid in Kerosine	Skin, Eyes
Thorium	Solid	Skin, Eyes

Health Effects:

Most metals and salts are stable solids with minimal potential for exposure unless ingested or the metal is present in the air as a dust or fumes, when heated. Sodium and potassium metal and sodium hydroxide are extremely corrosive in the presence of moisture (water). Lithium aluminum hydride is extremely reactive. Thorium is an alpha particle emitting radioactive material. Mercury vapor is of utmost concern because of its neurotoxic effects.

Table 33B. Chemical Toxicity and Routes of Exposure (Skin and Respiratory) for Precursors

Substance	Form	Exposure
Phenylacetic Acid	Solid	Skin, Eyes
Phenyl-2-Propanone	Solid	Skin, Eyes
Methylamine	Gas, Liquid, Solid	Skin, Eyes

Health Effects:

Phenylacetic acid may produce irritation upon direct contact. Specific toxicity on Phenyl-2-Propanone is lacking. Similar compounds are used in fragrances and pharmaceuticals. Methylamine is an irritant and a corrosive (see Table 30B).

Table 34B. Chemical Toxicity and Routes of Exposure (Skin and Respiratory) for Chemicals associated with the Manufacture of LSD, MDA, and MDMA

Name	Form	Route	Health Affects
Acetonitrile	Liquid/Vapor	Inhalation, Ingestion	Headaches-Convulsions, possible cyanide poisoning
Alumina	Solid	Inhalation	Irritation
Ammonium Acetate	Liquid/Vapor	Eyes, Skin, Inhalation	Mucous Membrane, Skin Irritation
Ammonium Formate	Liquid/Vapor	Eyes, Skin, Inhalation	Mucous Membranes, Skin Irritation
Cuprous Oxide	Solid/Dust	Eyes, Inhalation	Mucous Membrane Irritation
Diethylamine	Liquid/Vapors	Eyes, Skin, Inhalation	Corrosive
Dimethylformamide	Liquid/Vapors	Inhalation, Skin	Irritation, @ Higher doses Central Nervous System Effects
Ergot Alkaloid	Solid/Powder	Eyes, Inhalation, Skin, Ingestion	Severe Arterial Spasm/gangrene - Small Doses Lethal
Ergotamine Tartarte	Solid/Powder	Eyes, Inhalation, Skin, Ingestion	Severe Arterial Spasm/gangrene - Small Doses Lethal
Ethylene Dichloride	Liquid/Vapor	Eyes, Inhalation, Skin	Irritation, Central Nervous System Effects
Formamide	Liquid/Vapor	Eyes, Inhalation, Skin	Irritation
Formic Acid	Liquid/Vapor	Eyes, Inhalation, Skin	Irritation
Isosafrole	Liquid	Eyes, Inhalation, Skin	Carcinogenic
Hydrazine	Liquid	NA	EXPLOSIVE!!!
Hydrobromic Acid	Liquid/Vapor	Eyes, Inhalation, Skin	Irritation

Table 34B. (cont'd) Chemical Toxicity and Routes of Exposure (Skin and Respiratory) for Chemicals associated with the Manufacture of LSD, MDA, and MDMA

Hydrogen Peroxide	Liquid	Eyes, Inhalation, Skin	Irritation
Hydroxyamine	Liquid/Vapor	Eyes, Inhalation, skin	Irritation
Lithium Aluminum Hydride	Solid/Powder	Eyes, Inhalation, Skin	Corrosive, Potentially Explosive
Lithium Hydroxide	Solid/Powder	Inhalation	Central Nervous System Effects
Lysergic Acid	Solid/Powder	Eyes, Inhalation, Skin, Ingestion	Severe Central Nervous System Effects
N, Methylformamide	Liquid/Vapors	Eyes, Inhalation, Skin, Ingestion	Irritation
Methylene Chloride	Liquid/Vapors	Inhalation, Skin	Irritation, Central Nervous System Effects, Carcinogen
Piperonal	Liquid/Vapors	Eyes, Inhalation, Skin, Ingestion	Irritation
Potassium Hydroxide	Liquid/Vapors	Inhalation, Skin	Irritation
Raney Nickel	Solid/Powder	Inhalation	Irritation/Allergen
Safrole	Liquid/Oil	Ingestion	Carcinogen
Sodium Dichromate	Solid/Powder	Eyes, Inhalation, Skin, Ingestion	Severe Irritation/Corrosive
Sodium Borohydride	Solid/Powder	NA	Flammable/Explosive
Sodium Nitrate	Solid/Powder	NA	Flammable/Explosive
Sodium Sulfate	Solid/Powder	NA	Little Effect
Sulfur Trioxide	Gas	Eyes, Inhalation	Mucous Membrane Irritation, Corrosive
Tartaric Acid	Solid/Powder	Eyes, Inhalation, Skin, Ingestion	Corrosive Irritation to Mucous Membranes and G.I. Tract
Toluene	Liquid/Vapors	Eyes, Inhalation, Skin	Mucous Membrane Irritant, Central Nervous System Effects

APPENDIX C

Field And Sampling Guidelines

1.0 OVERVIEW

The purpose of Appendix C is to cover the needs of all the user groups. The chain-of-custody procedures are intended for local health departments, and the remaining testing and analytical procedures should be used by all the user groups, but are generally unnecessary for landowners.

It can not be overstated that it is essential to follow the guidelines for sample collection and documentation. A documented link must be shown between the samples taken and the analytical results reported. This link is maintained with: (1) custody procedures that identify and accompany a sample from collection through analysis, and (2) document control that ensures all documents for a specific project are accounted for when the project is complete. Documents include field notebooks (xerox copies of appropriate pages may be included in the file in lieu of the entire notebook), custody forms and photographs. Each document should be identified with a number and placed in the project file. Permanent, waterproof ink should be used to record all data in documents.

1.1 Field Notebook

All field activities should be documented in a bound notebook. The name of the person who collected the sample and the specific piece of sampling equipment used to collect the sample should be included. Field activities should be recorded in sequentially numbered pages, using non-erasable, waterproof ink.

The following information should be recorded for each sampling location:

- Date and time of day
- Name of person collecting sample
- Name of any other persons present and tasks they performed
- Project name and/or ID number
- Sampling location (address and specific site where the sample was collected)
- Sample volume
- Field measurements
- Document numbers
- Sample numbers
- Method of sample preservation
- Documentation of any photography
- Other pertinent information such as sample color, time and method of calibration of field instruments, and comments or description of conditions at the site.

Field instruments should be described and identified by model and serial number. Such identification need only be entered once for each instrument if the same equipment is used for each trip into the field.

If initials are used they should be identified in the field notebook or on file with the person's signature to clearly distinguish persons with similar initials. If anyone other than the person to whom the field notebook was assigned makes an entry, that person should date and sign the entry.

Errors should be corrected with a single line drawn through the error, the correct data filled in, and the correction initialed and dated. Any deviations from the sampling guidelines should be documented, and the reason for the change noted. If relevant, the deviation should be communicated to the laboratory with the samples.

1.2 Photo Documentation

It is useful to photograph the sample location and any visible signs of contamination.

Photographs should be taken with a data-back camera. The lens system should have a perspective similar to that of the naked eye and should present a fair and accurate representation of the situation.

A description of all photographs taken in the field should be recorded in the field notebook. Entries should be made at the time photographs are taken. Exposures should be numerically identified so that prints can be numbered correctly. Entries should include the following information:

- Name and signature of the photographer
- Date and time of day
- Exposure number
- Site location
- Diagram showing the compass direction and orientation of photographer and subject
- Brief description of the subject photographed

The following information should be recorded on the back of each print:

- Name, agency, and signature of the photographer
- Date and time of day
- Site location
- Diagram showing the compass direction and orientation of photographer and subject
- Brief description of the subject photographed
- Project name and ID. number

1.3 Sample labels

Samples should be labeled immediately upon collection. The following information should be included on the label:

- Sample number
- Preservative used
- Desired analyses
- Date and time of day
- Name of the person who collected the sample
- Remarks, such as color, odor, presence of sediment or other pertinent characteristics

1.4 Chain of Custody Seals

Chain of custody seals should be secured to the container so that tampering will be evident. Covering the custody seal with filament tape will help ensure that tampering cannot go undetected.

The following information should be recorded on each seal and recorded in the field notebook:

- Sample number. If applying the custody seal to a shipping container, rather than to individual samples, indicate the number of samples enclosed (Example: "10 samples, list enclosed")
- Date and time of day
- Name, title, and signature of the person affixing the seal

The person breaking the seal should initial and date the seal.

If the container is to be resealed after opening, a new custody seal should be affixed.

1.5 Transfer of Custody and Shipment

All samples should be accompanied by a custody form. This form documents transfer of samples from the field investigator to another person, to the laboratory or other appropriate entity. When transferring samples, the person relinquishing the samples and the person receiving them should sign the custody form, noting the time and date that the transfer was made.

Samples should be properly packaged for shipment to the laboratory for analysis. Shipping containers should be secured with strapping tape and a custody seal.

If split samples are sent to another agency or analytical lab, it should be noted on the custody form and the representative of both entities should sign the form.

The original custody and analysis forms should be placed in a waterproof bag inside the secured shipping container. A copy of these forms should be placed in the project file.

If sent by common carrier, the shipping receipt should be retained. If sent by registered mail, the return receipt should be included. The shipping documents should be retained as part of the documentation, and the documentation numbers recorded on the custody form.

The person receiving the samples at the laboratory should open the sealed container and complete the custody form with his or her signature, date and time in the appropriate space. Sample containers should not be opened by the common carrier.

2.0 QUALITY ASSURANCE: SAMPLE BLANKS AND DUPLICATES

2.1 Sample Blanks

Trip Sample Blank - This blank is used for checking contamination introduced during handling and transport of samples. As a guide, the sampler should include one blank per sampling method per field trip.

The procedure is: an empty sample container is filled with reagent grade distilled water and carried into the field, handled, and transported similarly to the samples collected in the field. The blank is returned to the lab and analyzed for the same parameters as the field samples. Note: for volatile organic compound samples (VOC), two VOC blank sample containers should be filled.

Sample Collection Blank - This blank is used for checking contamination introduced during collection of water samples. As a guide, a collection blank should be included per sampling method per field trip or any time it is suspected that a sample has become contaminated.

The procedure is: an empty sample container is filled in the field with reagent grade distilled water and preservative (where applicable), labeled, and transported to the lab for testing. This blank is tested for the same parameters as the field samples. Note: for VOC, two VOC containers should be filled.

Rinsate Blank - A rinsate blank is collected by rinsing the inside of a sampling device with reagent grade distilled water and pouring the water into a sample bottle. The blank is used for checking contamination introduced from sampling devices (e.g., well samplers, dip buckets). As a guide, a blank should be taken per sampling method each time a sampling devise is used (not necessary when filling sample bottles directly from the source).

The procedure is: the sampling device is filled or rinsed with reagent grade distilled water. Then an empty sample bottle is filled with this water using the sampling device. The blank is returned to the lab and analyzed for the same parameters as the field samples. Note: for VOC, two VOC containers should be filled.

2.2 Field Duplicates

A duplicate field sample should be collected for each sampling method. These duplicates should be taken at the same place and time. The purpose is to check both sampling and laboratory variability. Fill twice as

many containers as are normally required, but number them as separate samples. Document this procedure for reference. The laboratory should not know that they are duplicates.

2.3 Matrix Spike and Matrix Spike Duplicates

For the purposes of these guidelines, matrix is defined as the substance or media (water, soil, carpet, and paneling) that is contaminated. Adequate sample volume or mass should be collected to insure the laboratory can run matrix spikes and matrix spike duplicates. Matrix spike and matrix spike duplicates are explained in Section 4.2.3.

The following numbers of bottles should be filled for each sampling method to provide sufficient quantities of sample:

VOC - Four 40 milliliter (ml) vials per sample should provide sufficient sample for the analysis, matrix spike and matrix spike duplicate. Remember, VOC sample vials must be filled to the top.

Inorganics, Metals and Organics - Sampling containers should be filled with sufficient sample for the analysis, matrix spike, and matrix spike duplicate. Check with laboratory for container size required for the media to be tested.

Table 1C. Recommended Quality Assurance/Quality Control (QA/QC) Methods for Water Sample Blanks: Trip, Transfer, Rinsate, and Field Duplicates			
Parameter	Container	Preservation Method	Maximum Holding Time
VOC	2-40 ml glass vial	Cool, 4^0C	18 days
Organics	1 liter glass	Cool, 4^0C	18 days
Inorganics	1 liter glass or plastic	Cool, 4^0C	28 days
Mercury	1 liter glass or plastic	HNO^3 to pH <2	28 days
Metals	1 liter glass or plastic	HNO^3 to pH <2	180 days

Table 2C. Recommended Quality Assurance/Quality Control (QA/QC) Methods for Sediment, Soil, and Wipe Sample Field Duplicates			
Parameter	Container	Preservation Method	Maximum Holding Time
Organics	1 pint glass	Cool, 4^0C	28 days
Inorganics	1 pint glass	Cool, 4^0C	28 days
Mercury	1 pint glass	Cool, 4^0C	28 days
Metals	1 pint glass	Cool, 4^0C	180 days

Table 3C. Recommended Quality Assurance/Quality Control (QA/QC) Methods for Air Sample Trip Blanks			
Parameter	Container	Preservation Method	Maximum Holding Time
VOC	Follow Standard Methods	Cool, 4^0C	28 days
Organics	Follow Standard Methods	Cool, 4^0C	28 days
Inorganics	Follow Standard Methods	Cool, 4^0C	28 days
Mercury	Follow Standard Methods	Cool, 4^0C	28 days
Metals	Follow Standard Methods	Cool, 4^0C	180 days

3.0 SAMPLE COLLECTION

The collection of surface, indoor air, water, soil, and septic system samples should be conducted by qualified personnel using acceptable standards and protocols to ensure accuracy, and the ability to produce similar results with repeated sampling (e.g., re-sample the site and have similar analytical results).

To maximize the integrity of the sample, as few people as possible should handle the sample or physical evidence. Sample labels should be completed for each sample with waterproof, non-erasable ink. Samples should be sealed immediately upon collection. It is permissible to seal the shipping container only, in lieu of sealing individual samples. Any time a seal is broken on a shipping container, that fact should be noted on the laboratory sheet and the seal replaced. All samples should be documented in the field notebook. A laboratory sheet should be completed for all samples or physical evidence collected. Each shipping container should have its own laboratory sheet identifying and documenting the samples or physical evidence it contains. Unused sampling containers should be stored in a limited access area until used. Open boxes containing unused containers should be resealed.

3.1 Planning the Sampling Sites

A visual inspection of the building and outside premises should be done to locate areas of contamination and potential sampling sites. Pathways from "cooking" areas to other rooms need to be inspected for stains and debris on floors, carpets and walls. Closets, crawl spaces and attics may have been used for storage. Inspection of the outside premises should include outbuildings, "dumping" areas, well houses and surface water. Drainfields also need to be assessed.

3.2 Sampling Procedures

3.2.1. Non-porous Surface Samples

To determine the extent of contamination on non-porous surfaces (tile, linoleum and formica), a technique known as "wipe" or "swab" sampling is used. Blotting versus wiping or rubbing with a absorbent pad is recommended to minimize collection of unwanted debris and maximize collection of the contaminant.

Non-porous areas, such as tile, linoleum, metal, or glass are blotted with an absorbent pad treated with a solvent to remove the residue from the surface. **On porous areas, such as carpet or drapes, this sampling technique is only satisfactory for a qualitative (absence or presence) identification of the chemical**. Absorbent pads should be handled with stainless steel forceps.

It is possible that dirt or finishes; such as wax, paint, lacquer, or other debris; could confuse test results.

The following procedure is recommended for collecting swab samples:

1. Fold an 11 cm filter paper (Whatman 40 ashless or equivalent) or gauze pad into a 2.5 cm square.

2. Grasp the pad with the forceps or fresh gloved hand. Glove should be changed between samples and one blank sample should be taken per sample set to determine any contamination as a result of the glove.

3. Wet the surfaces of the pad with methanol for organic samples and 3% nanograde nitric acid for metals samples.

4. Place 10-by-10 cm square template (usually made of teflon or other material that will not contaminate the sample and is resistant to the solvent) on the surface to be sampled.

5. Blot the 100 square cm area horizontally with one side of the wet swab and then vertically with the other side. Blot uniformly at least five times in each direction.

6. Carefully roll the pad into a cylinder and place in a glass jar and secure with a Teflon-lined lid.

7. Label jar, attach custody seal and prepare sample for transport to the laboratory.

3.3 Composite Sampling

It may be productive and cost effective to composite (combine) samples. For example, instead of taking multiple samples for analysis from a soil site, these samples could be pooled, mixed and sub-sampled into a single sample at the lab. To reduce bias, it is important that the samples to be pooled are of equal size. Composite sampling in the field for VOC is not recommended because of the potential loss through volatilization.

3.4 Grid Sampling

When a contaminated site covers a large area or there is no obvious staining, the area should be sampled using patterns or grids. The individual sampling locations can be selected randomly or systematically. The samples can be combined. The locations must be identified on the site map. The sample locations should be tied to a permanent landmark (e.g., building corner, door jamb, etc.).

3.5 Air Samples

To collect air samples, constant flow air sampler pumps, absorbent tubes, impingers, filters and polyurethane foam are used. Calibration of pumps are necessary before and after sampling. This is of major importance when the internal battery is used as the power source. Enough time should be allowed to obtain an adequate sample of the chemical for analysis. Sampling time and flow rate will be determined by the method and chemical of interest. Tubing, glassware and other materials should be free from contamination. Next, label the sample container, attach custody seal and prepare sample for transport to the laboratory.

3.6 Sediment Samples

Residues often accumulate in lake and stream sediments. These residues and their degradation products (products created as the residues break down) can be re-released into the water or air during sampling. Therefore, great care should be taken to minimize stirring or agitating the sample.

Directly scooping sediment into a glass jar avoids the cost and use of sampling devices. This procedure is recommended for sampling in shallow water. In deeper water, the core tube technique or the use of a commercial sediment collecting device is recommended.

1. Carefully lower core tube or other sampling device through the water and into the sediment.

2. Collect approximately 1 pint of sediment, removing rocks, leaves, and other debris.

3. Transfer into a glass jar and secure with a Teflon-lined lid.

4. Label jar, attach custody seal and prepare sample for transport to the laboratory.

3.7 Septic Tank Samples

Septic tank contents are layered into: sludge at the bottom, liquid in the middle, and scum at the top. Each layer needs to be sampled. Sampling methods are the same as for sediments and water.

3.8 Soil Samples

The following procedure is for collecting soil within the top inch of the surface. This procedure can be used for collecting deeper soil samples after digging to the desired depth. However, residues in the topsoil layer can contaminate deeper layers, if the topsoil layer is not removed carefully.

1. Scrape to a depth of one inch and collect about one pint of topsoil with a clean stainless steel spatula or spoon. Minimize the collection of rocks, sticks, leaves, and debris.

2. Place the sample into a glass jar, filling the jar to the top (no head space) and secure with a Teflon-lined lid.

3. Label jar, attach custody seal, and prepare sample for transport to the laboratory.

3.9 Water (Lakes, Streams and Other Surface Water Samples)

A common method for collecting water from ponds, lakes and streams is by dipping the sample bottle to obtain water at or near the surface. This technique is effective because many chemicals remain on the water surface. If physical conditions preclude the dip method or if subsurface samples are needed, alternate methods are available using a sampling jar attached to a telescoping pole, hand pumps, or weighted water samplers.

1. Collect at least one liter of water into a certified clean glass jar and secure with a Teflon-lined lid. When sampling for VOC use the procedures described in that section.

2. Avoid collecting sediments.

3. Label jar, attach custody seal, and prepare sample for transport to the laboratory.

3.10 Water (Surface Slick Samples)

If water depth prevents dipping a bottle to collect a slick on the water surface, the preferred method is the "saturation" pad technique. It may be appropriate to composite several pads for a single sample. Do not re-dip a pad or use both sides to collect a surface slick. Collected material can be washed away if the pad is re-dipped.

Fold an 11 cm filter paper (Whatman 40 ashless or equivalent) or gauze pad into a 2.5 cm square.

1. Grasp the pad firmly with stainless steel forceps and saturate the pad with the slick.

2. Roll the pad into a cylinder and place into a glass jar and secure with a Teflon-lined lid.

3. Label jar, attach custody seal, and prepare sample for transport to the laboratory.

3.11 Water (Well Water Samples)

Purging the Well - "Purging the well" means removing the volume of water standing in the well casing and/or in the water distribution system and replacing that water with new water from the aquifer. The purpose is to insure that a representative sample of the aquifer is collected.

If there is no tap at the well head, use the closest tap to the well head.

Purging is not necessary on wells which are pumped continuously, but measurements of temperature, conductivity (the ability to conduct an electric current) and pH should still be recorded. If a well is pumped dry during the purging process, it may be considered adequately purged and the sample can be collected as soon as the well casing is recharged.

Flow may be diverted with a hose during the purging process, but the hose must be removed before samples are collected.

One of the following methods should be used:

Method A

Open the tap all the way and allow water to flow into a catch bucket. Water should flow for approximately five minutes before readings are taken for conductivity, temperature, and pH. After five minutes and while water continues to flow, conductivity, temperature and pH should be measured at approximate one minute intervals until three consecutive readings indicate that parameters have stabilized. Readings may be considered stable when temperature measurements vary by no more than $\pm$ 0.5^0C, conductivity readings vary by no more than $\pm$ 1% and pH readings vary by no more than $\pm$ 0.1 pH unit. It may be assumed that the source is adequately purged when stable readings for two parameters are obtained. After readings have stabilized, remove the hose and begin sampling.

Method B

Three to five well casing water volumes (storage volumes) should be purged from the well.

The storage volume is calculated as follows:

1. Volume (V) = 3.14 x R^2 x D x 7.48 gal/ft^3
   V = Borehole volume (gallons)
   R = Radius of the well bore (feet)
   D = Depth of well (feet)

2. Flow should be measured using a five-gallon bucket and a stopwatch. Record readings in the field notebook.

3. Calculate the amount of time (in minutes) that the well should be purged in order to remove the required 3-5 times the well volume:

   Time = $\frac{\text{3 (or 5) x Volume of borehole (in gal)}}{\text{required flow rate (in gal/min)}}$ in minutes

4. After the required minimum volume has been purged and while water continues to flow, conductivity, temperature and pH should be measured at approximately one minute intervals until three consecutive readings indicate that parameters have stabilized. These measurements should be recorded in the field notebook. Samples should be collected after the required well volume has been purged and readings for conductivity, temperature, and pH have stabilized.

3.12 Field Measurements

Specific conductivity, pH and temperature should be measured on-site and during purging of the well. Well water should be pumped continuously into a bucket or other container until three consecutive readings taken at one minute intervals indicate the three parameters have stabilized.

1. Conductivity - The conductivity of a water sample gives an indication of the concentration of dissolved solids in the water.

   Conductivity should be measured with a temperature-compensated instrument, reading directly in micromhos/cm at 25°C. The cell should be checked before initial use and unless otherwise stated by the manufacture. The instrument should be calibrated daily during regular use against a 0.00702 N potassium chloride (KCl) solution with a specific conductivity of 1,000 micromhos/cm at 25°C. Routine checks are made by using a standard solution within the anticipated conductivity range of the sample at ambient temperature.

2. Temperature - Temperature should be recorded by an electronic reading thermometer or mercury thermometer accurate to $\pm$0.5°C.

3. Hydrogen Ion Concentration (pH) - The pH of a solution is a measure of the effective hydrogen ion concentration. It should be measured with an instrument having an accuracy of 0.1 units.

   Since pH is temperature sensitive, it is important that pH calibration standards be within $\pm$1°C of the sample solution for precise determinations.

3.13 Sample Collection

Samples should be collected as close to the well as possible, from a tap located before the water has passed through any pressure or water storage tanks or treatment systems. If it is not possible to collect a sample from the water system before the well water storage tank, then the volume of water in the storage tank must be taken into account when purging the system.

There should be sufficient space to place the bottle under the tap without grazing the neck interior against the faucet.

Leaking taps which allow water to flow out from around the stem of the valve handle and down the outside of the faucet, or taps in which water tends to run up on the outside of the lip, should be avoided as sampling locations.

Aerator, strainer, and hose attachments on the tap should be removed before sampling. If a steady stream of water cannot be obtained from the tap after removing such devices, a more suitable tap should be sought.

Water flow should be steady to avoid dislodging material lining the inside of the pipe. A smooth-flowing stream at moderate pressure without splashing should be obtained. Water flow should not be adjusted immediately prior to or during actual sample collection.

Excessive flow and the resulting turbulence can affect metals, volatile organics, and many other chemicals. Samples should be disturbed as little as possible (e.g., turbulence, agitation, and exposure of water sample and containers to the atmosphere).

During sample collection, the bottle cap should not be placed on the ground or in a pocket. The bottle should be held in one hand and the cap in the other, keeping the bottle cap right side up (threads down) using care not to touch the inside of the cap. Be careful to avoid losing the Teflon liner in certain bottle caps. Avoid contaminating the sample bottle with fingers or permitting the faucet to touch the inside of the bottle. When filling any container, care should be taken that splashing drops of water from the ground or sink do not enter either the bottle or cap.

A clean polyethylene sheet placed on the ground may be helpful in maintaining a clean work area.

Samples should be labeled and held on ice, if required, immediately after collection.

Samples should be collected in the following order:

1. Volatile Organic Compounds (VOC)
2. Other Organic Compounds, Metals and Inorganics

Volatile Organic Compounds (VOC) - Samples to be analyzed for purgeable organic compounds should be taken in 40 ml vials and secured with screw caps containing a Teflon septum.

Two vials should be filled for each sample.

The investigator should determine if the water to be sampled contains chlorine. If the water contains no chlorine, two 40 ml vials, each containing 2 drops of 1:1 HCl, should be filled with the sample and labeled. If the sample contains no chlorine **and only if** the sample will be analyzed within 24 hours, preservation with HCl is not necessary.

Samples should be collected before chlorination or other pre-treatment if at all possible. If this is not possible and the sample contains chlorine, the following procedure for sample collection and preservation should be followed:

Fill a 40 ml vial, containing 10 mg sodium thiosulfate, to the shoulder (where the vial necks down to the top) with sample, add 2 drops of 1:1 HCl, then fill completely with sample. Label the vial.

NOTE: Sodium thiosulfate and acid preservatives should be added in this order and in two separate steps because HCl reacts with sodium thiosulfate.

Vials should be completely filled, no air bubbles. Extreme caution should be exercised when filling a vial, to avoid any turbulence which could also produce volatilization. The sample should be carefully poured down the side of the vial to minimize turbulence. As a rule, it is best to gently pour the last few drops into the vial so that surface tension holds the water in a “convex meniscus.” The cap is then applied and some overflow may be lost, but air space in the bottle is eliminated. After capping, turn the bottle over and tap it

to check for bubbles; if any are present, discard the sample and sample bottle and repeat the procedure with a new bottle.

Other Organic Compounds, Metals, and Inorganics - All containers and tubing, used for collection of samples for other organic compounds, metals and inorganic analysis, should be prepared as provided by standard cleaning procedures.

When possible, the sample should be collected directly into the appropriate sample container. If this cannot be physically accomplished, an intermediate collection device may be used, such as a smaller sampling bottle, which has been cleaned according to standard procedures.

APPENDIX D

Laboratory Analytical Methods And Reporting Tables

INTRODUCTION

The purpose of Appendix D is to ensure that data generated for the illegal drug manufacturing program is accurate. It is important that laboratories testing samples follow accepted laboratory practices. This section is intended as a guide for analytical laboratories, contractors, and local health departments to help in identifying and following good laboratory practices.

Because many of the chemicals of interest do not have standard analytical methods, laboratories will be responsible for selecting an appropriate method capable of meeting the desired reporting limits. Government publications and scientific journals are good sources of general information about methods (see bibliography for suggested publications). The chemist may have to modify the published methods for adaptation to different types of samples. Laboratories should use standard government methods where they are available. A list of standard methods for specific types of samples is included in the section of this manual on methodology.

Although laboratories will not be required to use specific methodology, they will be required to follow specific quality assurance procedures (QA). This is necessary to ensure that laboratories produce high quality data and that data generated by different laboratories is comparable. The quality assurance requirements are listed in Section 4.2.

I. Laboratory Requirements

Participating analytical laboratories should meet the following minimum requirements:

1. Laboratories should be certified under appropriate state, federal, or professional certification programs. In Washington State, labs testing soil, sewage, or surface samples should be certified by the Washington State Department of Ecology accreditation program. Labs testing water should be certified by the Washington State Department of Health. Labs testing air should be certified by Washington State Department of Ecology or the American Industrial Hygiene Association. Out-of-state labs should hold comparable certifications within their own state.

   Although, these certification programs do not cover all of the chemicals of interest in the Clandestine Drug Lab Program, they do certify for similar methodology. If labs demonstrate their proficiency in similar methods through these certification programs, they are more likely to produce quality data for the chemicals included in the Clandestine Drug Lab Program.

2. Any lab testing drug precursors (chemicals from which drugs are made) should obtain a Drug Enforcement Agency controlled substance number. Without this number, the lab will be unable to purchase necessary drug precursor standards to use in calibrating the analytical methods.

3. Where applicable, all chemicals identified by gas chromatography (GC) methods should be verified by gas chromatography/mass spectrometry (GC/MS). All GC/MS systems used should be operated by a data system which includes a library specific for drugs and drug precursors. The standard NBS/Wiley libraries available on most GC/MS systems do not contain all of the compounds of interest.

II. Quality Assurance

To ensure high quality data, quality assurance (QA) measures should be applied both at the time of sample collection and during laboratory analysis. The QA necessary during sample collection is discussed under the Field and Sampling Guidelines for the Clandestine Drug Lab Program. This section only deals with laboratory QA and QC measures.

Each lab should have an established quality assurance program. The program should include a QA manual which discusses internal lab policies on sample handling (sample preservation and holding times), method verification (detection limits and control charts), data review, and troubleshooting. The program should also include a designated QA officer who conducts final review of lab data. In large labs it may be impossible for the QA officer to review all data, but he or she should review at least ten percent of all data generated. The QA officer should also be consulted whenever QC limits are exceeded.

The following discussion describes QC parameters which are applicable to all chemicals of interest and all types of samples. Recommended control limits for each QC parameter are also included. If a laboratory exceeds a control limit for any method, every effort should be made to determine the cause of the problem, correct it and reanalyze the sample. If the problem cannot be corrected, or the sample cannot be reanalyzed, the lab should include a discussion in the case narrative on the probable cause of the problem and its effect on the data for that method.

A. Method Blank

A lab method blank (a reagent grade distilled water sample) should be included with each batch of samples for each sampling method. The blank should be carried through the entire sample preparation and analysis process and should be treated as a sample. Blank results are used to eliminate the possibility of lab sources of sample contamination. Method blanks should be completely below detection limits for each chemical of interest.

B. Standard Reference Material or QC Standard

For each chemical and each method a quality control standard or standard reference sample should be prepared and analyzed. Testing material of known concentration allows the chemist and data reviewer to verify the accuracy of the analysis and the efficiency of the sample preparation process. It is preferable to use certified reference material wherever possible. The National Institute of Standards and Technology (NIST, formerly NBS) has a large selection of reference material in a variety of sample types, including soil, sludge and tissue. The EPA has certified standards for water and waste. Some commercial vendors also have standard reference materials available. There are very few reference materials for air methods, so labs should rely on matrix spikes. Manufacturers of certified reference material provide expected control limits for each chemical within that sample type.

If a reference material is unavailable for a particular chemical, labs should prepare a quality control standard. This is an independent standard at a concentration other than that used for method calibration, but within the calibration range. An independent standard is composed of chemicals from a different source than those used in the standards for the method calibration (i.e., a different lot number or manufacturer of a particular chemical). The laboratory should be capable of determining the true value of the quality control standards to within $\pm$20percent.

All reference materials or quality control standards should be analyzed at the beginning of each analytical run for each method. They should also be tested during the analytical sequence at a frequency of ten percent (the reference material should be retested after every tenth sample). If the reference material or quality control sample falls outside the control limits at any point in the analytical run, the cause should be determined and corrected. Any samples tested in the analytical sequence where the control limits were exceeded should be reanalyzed. New sample preparation is not necessary.

C. Matrix Spikes/Duplicate Matrix Spikes

For every chemical and every type of sample (also called a matrix), spikes, and duplicate spikes should be performed to verify the analytical recovery and precision of the method. The spikes are performed by analyzing the samples, then adding a known amount of standard material to a sample and testing it again. Spikes are added to a subsample of the sample before any sample preparation takes place. The recovery for the known material is calculated by comparing the quantity of chemical found in the sample before and after spiking. The spike is performed in duplicate to check the precision of the sample preparation process and the analysis and to determine how well the analytical method picks up the chemical of interest.

Spikes and duplicate spikes should be performed at a frequency of ten percent (a spike and duplicate spike should be tested after every tenth sample). For air analysis, the testing of spikes and duplicate spikes may not be possible at such a high frequency. Air samples should have a spike and duplicate spike tested for each method and chemical of interest at least once per batch.

The percentage of the spike recovered will vary according to chemical and sample type. For relatively clean materials (water, air, surface wipes) the percent recovered should be at least 80 to 120 percent. For more difficult types of samples such as soil and sewage, the percent recovered, particularly for organic compounds, will be lower. Under EPA's SW-846 and CLP methods, some organic chemicals in soil typically have recoveries of 30 percent. Because there are no established recovery limits for many of these chemicals, each laboratory will have to determine typical recovery limits for the methods which they use. Those recovery limits will have to be included in each data report. As data is collected for the Clandestine Drug Lab Program, the Washington State Department of Health will develop recovery guidelines for as many chemicals of interest as possible.

III. Analytical Methods

Appendix D is a list of suggested analytical methods or techniques and desired reporting limits for each of the chemicals of interest. Labs are encouraged to use standard methodology where available. Where standard methods are not available, the labs are responsible for the selection or development of methods that will produce the required reporting limits. Labs are also responsible for utilizing all of the QC parameters outlined above. Without the use of these QC parameters, data reviewers will not be able to accurately assess the quality of the test results and will be forced to reject those results.

IV. Reporting Format

In order to allow for data review and evaluation all data reports should include the following information:

1. Laboratory contact name and telephone number

2. Case narrative - overall discussion of samples and analysis: condition of samples on arrival and any problems during sample preparation or analysis
3. Methods - List of standard method numbers, if used, with a description of any modification to the methods. If a standard method was unavailable, include a complete description of the methods used and pertinent references in the literature
4. Blank results and detection limits
5. Certified reference material or quality control standards and control limits
6. Sample results and detection limits
7. Matrix Spike/Matrix Spike Duplicate results (recovery and relative standard deviation)
8. Copies of chain-of-custody information

Table 1D. Analytical Methods and Reporting Limits (RL) for Chemicals Found at Illegal Drug Manufacturing Sites.
Washington State Department of Health, Office of Toxic Substances, August 1995.

CASE #	CHEMICAL	AIR		WATER		SOLIDS (Soil, Wipes, Sewage)	
		RL	METHODS	RL	METHODS	RL	METHODS
60355	ACETAMIDE	***	OSHA/IMIS 625 GC/NPD	***	GC/NPD LC	***	GC/NPD LC
108247	ACETIC ANHYDRIDE	***	NIOSH 3(S170) CLR	***	CLR	***	CLR
67641	ACETONE	***	NIOSH 1300 GC/FID	***	EPA 624	***	SW846-8240
7429905	ALUMINUM	***	NIOSH 7300 ICP NIOSH 7013	***	EPA 202.2(AA) EPA 200.7(ICP)	***	AA or ICP
7446700	ALUMINUM CHLORIDE (For Aluminum)	***	OSHA/IMIS 100 AA	***	AA or ICP	***	AA or ICP
7664417	AMMONIA	***	NIOSH 5(S347) SPI NIOSH 6701	***	EPA 350.1,.2,.3 CLR	***	CLR
71432	BENZENE	***	NIOSH 1501 GC/FID	***	EPA 524.1,.2 EPA 502.2 GC/MS or GC/PID	***	SW846-8240 GC/MS or GC/PID
100-44-7	BENZYL CHLORIDE	***	NIOSH 1003 GC/FID	***	GC/FID	***	GC/FID
140-29-4	BENZYL CYANIDE (For Cyanides)	***	NIOSH 7904 SPI	***	EPA 335.2 CLR	***	CLR
1305620	CALCIUM HYDROXIDE	***	NIOSH 0500 (Total Nuisance Dust) NIOSH 0600 (Total Respirable Dust) GR	***	For Calcium EPA 215.1 or ICP	***	For Calcium SW846-7140 or ICP
124389	CARBON DIOXIDE	***	NIOSH 3(S249) GC	***		***	
7782505	CHLORINE	***	NIOSH 1(209) CLR	***	Total Residual Chlorine EPA 330.5 CLR or IC	***	

Table 1D. (cont'd). Analytical Methods and Reporting Limits (RL) for Chemicals Found at Illegal Drug Manufacturing Sites.
Washington State Department of Health, Office of Toxic Substances, August 1995.

CASE #	CHEMICAL	AIR		WATER		SOLIDS (Soil, Wipes, Sewage)	
		RL	METHODS	RL	METHODS	RL	METHODS
78955	CHLOROA CETONE	***	GC/MS	***	GC/MS	***	GC/MS
67663	CHLOROFORM	***	NIOSH 1003 GC/FID	***	EPA 524.1,.2 EPA 502.1,.2 GC/MS, GC/HALL	***	SW846-8240 GC/MS
7758987	COPPER SULFATE (For Copper)	***	NIOSH 7300	***	EPA 220.1 OR ICP	***	SW846-7210 OR ICP
299423	EPHEDRINE	1µg/m^3	IR or GC or GC/MS	1µg/L	GC/MS	1µgft^2	GC/MS
64175	ETHANOL	***	NIOSH 1400 GC/FID	***	GC/FID	***	GC/FID
141786	ETHYL ACETATE	***	NIOSH 2(S49) GC	***	GC	***	GC
60297	ETHYL ETHER	***	NIOSH 1610 NIOSH 2(S80) GC	***	GC	***	GC
64186	FORMIC ACID	***	NIOSH 5(S173) IC/ECN	***	IC	***	IC
110543	HEXANE	***	NIOSH 2(S90) NIOSH 1500	***	GC HPLC	***	GC HPLC
7647010	HYDROCHLORIC ACID	***	NIOSH 7903 IC	***	IC	***	IC
1333740	HYDROGEN	***	GC/TH.CON.DET.	***	GC/TCD or Hydrogen Specific Instrument	***	GC/TCD or Hydrogen Specific Instrument
10034-85-2	HYDROIODIC ACID	***	CLR IC	***	ICP/MS CLR IC	***	ICP/MS CLR IC
7439921	LEAD	***	NIOSH 7082(AA) NIOSH 7300(ICP)	***	EPA 239.2	20 µg/ft^2	SW846-7421
301042	LEAD ACETATE (For Lead)	***	NIOSH 7082 AA	***	EPA 239.2	***	SW846-7421

Table 1D. (cont'd). Analytical Methods and Reporting Limits (RL) for Chemicals Found at Illegal Drug Manufacturing Sites.
Washington State Department of Health, Office of Toxic Substances, August 1995.

CASE #	CHEMICAL	AIR		WATER		SOLIDS (Soil, Wipes, Sewage)	
		RL	METHODS	RL	METHODS	RL	METHODS
1305-62-0	LIME HYDRATE (Same as methods for Calcium Hydroxide)	***		***		***	
16853-85-3	LITHIUM ALUMINUM HYDRIDE (For Lithium)	***	NIOSH 7300	***	ICP	***	ICP
7487889	MAGNESIUM SULFATE (For Magnesium)	***	NIOSH 7300	***	EPA 242.1 OR ICP	***	SW846-7450
7439-97-6	MERCURY	50 ng/m^3	Modified NIOSH 6009	***	EPA 245.2,.1 For $HgCl_2$-HPLC	***	SW846-7470
7487-94-7	MERCURIC CHLORIDE (For Mercury)	***	Modified NIOSH 6009	***	EPA 245.2,.1 For $HgCl_2$-HPLC	***	SW846-7470
	METHAMPHETAMINE	***	GC/MS	***	GC/FID	1 $\mu g/ft^2$	GC/MS GC/FID
67561	METHANOL	***	NIOSH 2000 GC/FID	***	GC/FID	***	GC/FID
62577	METHYLAMINE	***	NIOSH 4(S77) GC NIOSH 6(S148) IC or IR	***	GC/MS	***	GC/MS
123397	N-METHYL-FORMAMIDE (No valid methods)	***	GC/MS	***	GC/MS	***	GC/MS
	PALLADIUM BLACK (For Palladium)	***	AA or ICP	***	EPA 253.2 OR ICP	***	AA or ICP
7601903	PERCHLORIC ACID	***	OSHA/MISA 1981 CLR	***	CLR	***	CLR
103-82-2	PHENYLACETIC ACID	***	GC or IR	***	GC GC/MS	***	GC GC/MS
103-79-7	1-PHENYL-2-PROPANONE	***	GC/MS GC/FID	***	GC/MS GC/FID	1 $\mu g/ft^2$	GC/MS GC/FID
10026138	PHOSPHORUS PENTACHLORIDE	***	NIOSH 5(S257)	***	For Phosphorous ICP	***	ICP
74400064	PLATINUM	***	NIOSH 7300 ICP	***	EPA 255.2 OR ICP	***	ICP
	PLATINUM BLACK (For Platinum)	***	AA or ICP	***	AA or ICP	***	AA or ICP
	PLATINUM OXIDE (For Platinum)	***	AA or ICP	***	AA or ICP	***	AA or ICP

Table 1D. (cont'd). Analytical Methods and Reporting Limits (RL) for Chemicals Found at Illegal Drug Manufacturing Sites.
Washington State Department of Health, Office of Toxic Substances, August 1995.

CASE #	CHEMICAL	AIR		WATER		SOLIDS (Soil, Wipes, Sewage)	
		RL	METHODS	RL	METHODS	RL	METHODS
127082	POTASSIUM ACETATE (For Potassium)	***	OSHA ID 121	***	EPA 258.1 OR ICP	***	SW846-7610 OR ICP
151508	POTASSIUM CYANIDE	***	NIOSH 7904	***	For Cyanide EPA 335.2 CLR	***	CLR
	PRIOPIOPHENONE	***		***		***	
110861	PYRIDINE	***	NIOSH 3(S161) GC GC/FID	***	GC/FID	***	GC/FID
7723140	RED PHOSPHORUS (Total Phosphorous)	***	CLR	***	EPA 365.1,.2 EPA 365.3,.4 CLR	***	CLR
7440235	SODIUM	***	NIOSH 7300	***	EPA 273.1 OR ICP	***	SW846-7770 OR ICP
127093	SODIUM ACETATE (Same as Sodium methods)	***		***		***	
7647145	SODIUM CHLORIDE (Same as Sodium methods)	***		***		***	
143339	SODIUM CYANIDE (Same as Cyanide methods)	***		***		***	
	SODIUM CYANOTRIHYDROBORATE (Same as Cyanide methods)	***		***		***	
1310732	SODIUM HYDROXIDE	***	NIOSH 4(S381) TITR. NIOSH 7401	***	TITR.	***	TITR.
7772987	SODIUM THIOSULFATE (For Sulfur)	***	ICP	***	ICP	***	ICP
7664939	SULFURIC ACID	***	NIOSH 3(S174) TITR. NIOSH 5(267) CLR	***	TITR. or CLR	***	TITR. or CLR

Table 1D. (cont'd). Analytical Methods and Reporting Limits (RL) for Chemicals Found at Illegal Drug Manufacturing Sites.
Washington State Department of Health, Office of Toxic Substances, August 1995.

CASE #	CHEMICAL	AIR		WATER		SOLIDS (Soil, Wipes, Sewage)	
		RL	METHODS	RL	METHODS	RL	METHODS
7719097	THIONYL CHLORIDE (For Sulfur)	***	ICP		ICP		ICP
1314201	THORIUM DIOXIDE (For Thorium)	***	GAMMA COUNTER		GAMMA COUNTER ION EXCHANGE-ABSORBANCE		GAMMA COUNTER
13823-29-5	THORIUM NITRATE (Same as Thorium methods)	***					
108883	TOLUENE	***	NIOSH 4000 GC/FID NIOSH 1500 or 1501	±	EPA 524.1,.2 EPA 502.2	±	SW846-8240

*** = TLV, Washington State Drinking Water Standard, or Qualitative Analysis (absence or presence)
AA = ATOMIC ABSORPTION
CLR = COLORIMETRIC
GC/FID = GAS CHROMATOGRAPH/FLAME IONIZATION DETECTOR
GC/MS = GAS CHROMATOGRAPH/MASS SPECTROMETRY
GC/NPD = GAS CHROMATOGRAPH/NITROGEN-PHOSPHOROUS DETECTOR
GC/PID = GAS CHROMATOGRAPH/PHOTOIONIZATION DETECTOR
GC/TCD = GAS CHROMATOGRAPH/THERMAL CONDUCTIVITY DETECTOR
GR = GRAVIMETRIC
HPLC = HIGH PERFORMANCE LIQUID CHROMATOGRAPHY
IC = ION CHROMATOGRAPHY
IC/ECN = ION CHROMATOGRAPHY/ELECTROLYTIC CONDUCTIVITY DETECTOR
ICP = INDUCTIVELY COUPLED PLASMA SPECTROMETER
ICP/MS = INDUCTIVELY COUPLED PLASMA SPECTROMETER/MASS SPECTROMETRY
IR = INFRARED
LC = LIQUID CHROMATOGRAPHY
LC/MS = LIQUID CHROMATOGRAPHY/MASS SPECTROMETRY
LC/UV/FLUOR = LIQUID CHROMATOGRAPHY WITH DUAL UV AND FLUORESCENCE DETECTORS
SPI = SPECIFIC ION ELECTRODE
TITR = TITRATION