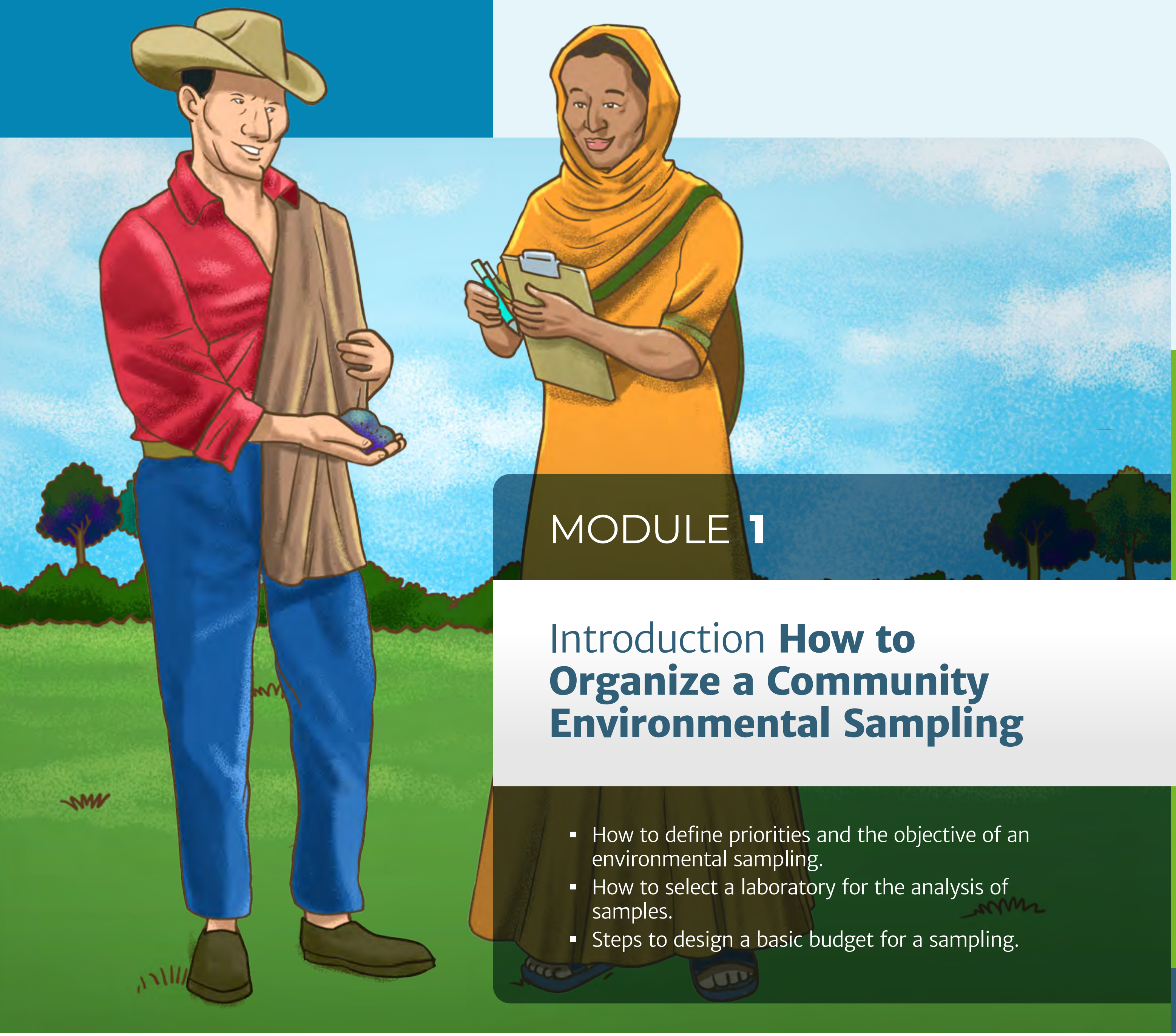
GUIDE

ENVIRONMENTAL
SAMPLING
GUIDE

MODULE 1



MODULE 1

Introduction **How to Organize a Community Environmental Sampling**

- How to define priorities and the objective of an environmental sampling.
- How to select a laboratory for the analysis of samples.
- Steps to design a basic budget for a sampling.

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Environmental Law Alliance Worldwide

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Acknowledgements

This guide is part of the ***Guide to Environmental Sampling for Communities (ELAW)***, which is composed of four modules:

- **Module 1**. General Considerations for Community Environmental Sampling
- **Module 2.** Water Sampling – A Basic Guide for Communities
- **Module 3.** Air Sampling – A Basic Guide for Communities
- **Module 4.** Soil Sampling – A Basic Guide for Communities

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This Guide has been made possible thanks to the support of the **Philip Stoddard and Adele Smith Brown Foundation** and has the objective to help citizens and grassroots organizations interested in community-based environmental monitoring initiatives to defend the right to a healthy environment. This guide contains basic information and does not include analytical aspects of sample processing in a laboratory.

The Environmental Law Alliance Worldwide (ELAW) supports environmental and public interest advocates in their efforts to defend the right to a healthy environment. ELAW supports environmental advocates and the communities they represent with legal and scientific information to protect the air, water, soil, and ecosystems in their countries.

Additional information on ELAW and the three modules of the **Basic Guide to Environmental Sampling for Communities** are available free of charge on the ELAW website: www.elaw.org.

Environmental Law Alliance Worldwide

ENVIRONMENTAL SAMPLING GUIDE

MODULE 1

Introduction **How to Organize a Community Environmental Sampling**

Content

Introduction

Environmental sampling is key to assess and quantify the presence of pollutants in the environment (water, air, soil). It is fundamental to determine if the concentration of pollutants exceed environmental quality guidelines or standards for the protection of public health and ecosystems.

Today an increasing number of organized citizen groups and participatory monitoring programs are interested in taking environmental samples to reliably analyze them and determine if there are risks to the environment and/or health in their communities. These efforts can demand substantial effort, time, and money. Errors in sampling and handling may completely ruin these efforts, which in turn could affect a community or a civil society organization with limited resources. Therefore, every effort to make a sampling effort effective is crucial to obtain evidence of contamination as reliably as possible and make good use of funds, personnel, and time.

While each location has different environmental characteristics, there are some basic procedures, principles, and techniques for collecting and handling samples that are key for the reliability of laboratory analysis.

Often civil society organizations face difficulties in setting priorities and planning effective environmental sampling. Module 1 Basic Concepts for Environmental Sampling provides general concepts and tips to solve basic problems to plan an environmental sampling, define the objectives of a sampling plan, and organize a community to conduct an environmental sampling. Modules 2, 3 and 4 develop the techniques of sampling, handling, and storage of water, air, and soil samples respectively.

1 Scope of These Guidelines

The scope of this document is limited to basic principles of simple and manual environmental sampling, and is aimed at citizen groups and organizations that have limited economic resources and technical capabilities. It does not address sampling with expensive and mechanized equipment. It also does not develop analytical methods or address regulatory aspects, although some general parameters and concepts are reviewed. This guide does not provide a complete catalogue of possible environmental sampling designs used by environmental authorities worldwide and the sampling methods suggested in Modules 1, 2, 3 and 4 do not replace regulatory requirements for specific types of sampling design, nor regional or state environmental guidance. Rather, they are intended to guide local populations in analyzing potential sources of pollution, identifying priorities, and designing a basic environmental sampling.

In addition, there are sampling plans that could be used in the collection of environmental data that are not included in the four Modules of this Guide. For example, double sampling, sequential sampling, quota sampling, and multi-stage sampling are all designs that are used for environmental data collection. Information about these can be found in other resources on environmental sampling.

2. How the ELAW Environmental Sampling Guide is Organized

ELAW's Environmental Sampling Guide has four modules that can be managed jointly or individually depending on the needs of the local communities or civil society organizations interested in carrying out an environmental sampling:

Module 1 Basic Concepts for Environmental Sampling

Module 2 Community Guide to Water Sampling

Module 3 Community Guide to Air Sampling

Module 4 Community Guide to Soil Sampling

These four Modules are intended to be used as a reference individually instead of being read sequentially. It is highly recommended to review module 1 prior to designing an environmental sampling and to read each Module according to the user's needs. Module 1 has important concepts and terms; it guides users on how to organize, define priorities, and then proceed to design the samples.

Each of the other modules contains more specific information on different sampling designs or protocols, priority parameters, and quality standards. The information is presented in as accessible terms as possible for easy comprehension with a glossary and a section of additional information resources.

3 Objectives of Module 1

Provide basic concepts and guidelines for communities and grassroots organizations interested in designing an environmental sampling plan. Users should be able to:

- Set priorities for environmental sampling.
- Define the objectives of an environmental sampling.
- Select an analysis laboratory.
- Develop a basic budget.

4. What is Environmental Sampling?

Sampling is the process by which a small portion of material is selected in a volume sufficient enough to be transported and analyzed in a laboratory. In the case of environmental samples, this process involves the careful collection of a sample of water, air, soil or biological material for analysis.

Sampling differs from monitoring in that the latter is a continuous process of recording observations, measurements and evaluations of the environment over a given period of time in order to track observed changes. Therefore, sampling can be an important part of an environmental quality monitoring initiative.

Why should we do Environmental Sampling?

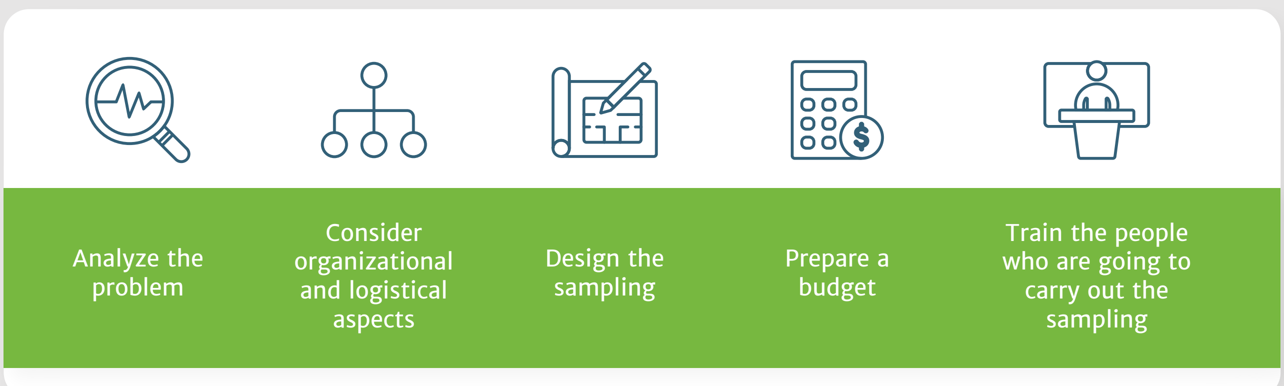
- It characterizes the sources of contamination and / or a record of changes in the physical and biological components of our environment.
- It provides crucial information for community environmental monitoring initiatives, strengthening the organization and awareness of stakeholders.
- It produces information that can be compared with national and international environmental quality standards or guidelines and historical records of the state of the environment.
- It strengthens the arguments of the communities that participate in the decision-making processes and in the defense of a healthy environment.
- It helps identify contaminated areas, map areas possibly affected by pollution, and set priorities for intervention.

5. Planning Environmental Sampling: How to Start?

Needs vary according to the environmental problem(s) in each case. A good place to start is to assess the problem, prioritize the issues of concern, decide how the information would be used, and assess our capabilities and limitations. Here is a list of issues to consider:

- Analyze the problem: define the objectives and scope of sampling
- Consider organizational and logistical aspects
- Design and implement sampling
- Prepare a budget
- Train the people who will carry out the collection on the sampling techniques, handling, and storage of the samples (see Module 2: Water, Module 3: Air, and Module 4: Soil for more information).

The **participation of interested people is key in every step of the process.**



Analyze the problem: define the objectives and scope of a sampling

The first step for all environmental sampling is to understand the problem you want to address. Oftentimes, the affected communities want to do a broad and comprehensive environmental sampling and analysis all at one time. However, this goal may be limited due to the lack of economic, logistical, time, or staff, and secondly, a complex assessment could be too overwhelming or difficult to accomplish. Therefore, it could be preferable to initially set priorities and collect a small number of samples. Lessons learned from an initial sampling experience can be very useful for subsequent samplings.

Initial steps:

- ***Identify the problem.*** This step must involve the affected populations and serves to establish priorities and make decisions regarding the scope of sampling, the parameter to be analyzed and the design of sampling.
- ***Define sampling limits.*** In this step, the community or organization defines spatial and temporal boundaries and identifies any practical constraints on data collection.
- ***Define priorities.*** Prioritizing is important; if you focus solely on one to three priorities, your organization will be able to organize better and to use resources more efficiently instead of covering a lot and doing little.

NO PRIORIZATION	***WITH PRIORIZATION***
▪ Very limited resources (staff, funds, time) to assess a wide variety of pollution sources or has too many issues to address at the same time. ▪ Fewer resources available to address each issue. ▪ Risk of ineffective use of time, energy, and resources.	▪ Defining few priorities allows us to distribute resources better for each source of pollution identify the question or issue that we want to solve. ▪ Giving more resources, attention and energy to fewer issues contributes to better results.

Prioritizing helps to focus the working team and contributes to the best achievement of their objctives.

Useful questions for defining priorities in Environmental Sampling

- What are the possible causes/sources of the environmental problem we wish to address?
- Could this problem be attributed to different causes/sources? If so, what are they?
- What are the observed effects? Which one of them do we want to address first? Why?

It may be helpful to first analyze the easiest problem to address. If you are trying to find evidence to support a claim made to the authorities or private sector, you may consider these questions:

- What are the legal arguments of a lawsuit or claim, and what is the type of evidence is there?
- What laws or regulations would be invoked in that claim? Do these norms refer to national or international environmental quality standards or guidelines? What are those standards?
- What potential arguments or issues could hinder your claims or affect you from obtaining the evidence that you need?

Scientific experts can provide valuable input and advice to local communities throughout the process. It is highly recommended to consider organizing meetings, workshops, or schedule calls with these groups to obtain feedback during all the phases of an environmental sampling process.

Other helpful considerations are:

- Try to find out if environmental studies, analyses, or assessments have already been done in the area. Other useful sources include environmental monitoring reports required by law. Sometimes, it is necessary to spend time and resources requesting reports from the authorities, but this information can ultimately be of great help.
- Ask local people about their perspectives and priorities. This can greatly facilitate the analysis of the problem and can contribute to the sampling process. It is also advisable to be very careful with the generation of high expectations about obtaining fast solutions for the environmental problem in question. Addressing environmental problems is often complex and requires sustained effort over time. Obtaining information through sampling can contribute to the search for solutions, and at the very least, this is an opportunity to inform the affected populations about the possibilities and limitations of environmental sampling.

6. Design and Implementation of Sampling

Identify the inputs needed for sampling and a list of the parameters to analyze. See Modules 2, 3 and 4 for specific guidance on respective sampling.

Identify certified and trustworthy laboratories. You can contact local experts, universities, research centers or allies who can guide you. If possible, select a certified laboratory, one that has the necessary accreditations to process the type of samples and determine the parameters considered a priority for your needs. If possible, request quotes from more than one laboratory to compare prices. Some laboratories offer bottles, materials and equipment, as well as sample collection services. Check with the laboratory for details about their services.

Develop a list of factors to guide your decision-making process. Once the problem, priorities and laboratory budget have been defined, other expenses such as transportation, storage, equipment, and materials for sampling can also be identified. These elements can help you make decisions (based on a factual basis) for choosing between the alternatives, considering the parameters of interest, and the intended use of to the sampling results.

For more specific guidance to design the collection, handling, and storage of samples see Modules 2, 3 and 4 for the design of water, air, and soil sampling. Follow the instructions in the mentioned modules, especially:

- How to select priority parameters according to the specific case.
- How to avoid contamination of samples and secure their integrity by keeping them in the appropriate conditions until they are delivered to the laboratory.
- Transport the samples to the laboratory as soon as possible.
- Document the sampling process using a chain of custody (see above modules for details).

How can problems with sampling be avoided?

Problems can be avoided by following theseprecautions:

- Representativeness of the sample: Depending on each situation, the sample must adequately represents the characteristics of the element of the environment in question (body of water, air and soil sampling area) and the conditions of the environment in which it is located.

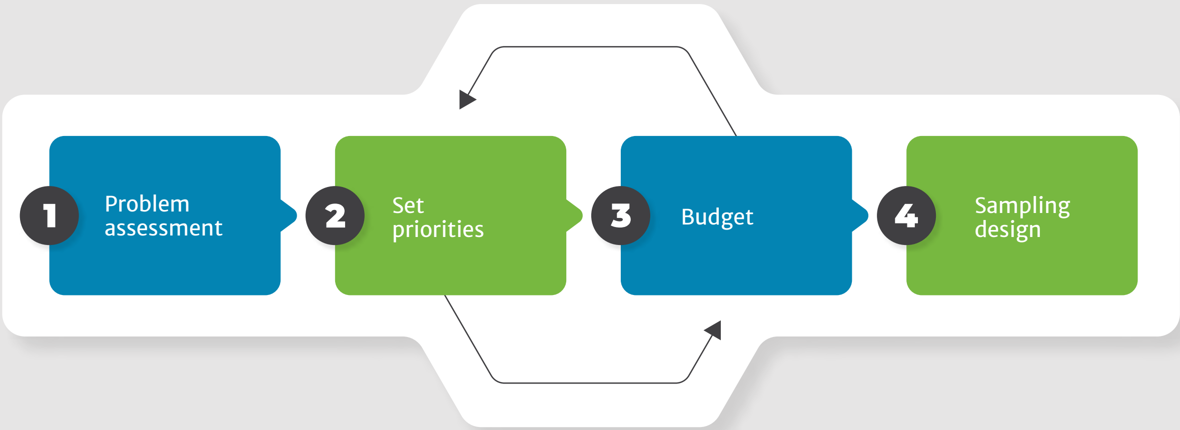
- Properly select the laboratory and the methods of analysis.
- Ensure that the method(s) of sampling, handling and storage are appropriate. Label the samples properly and take the coordinates or clearly note the precise location of the sampling points. Keep track of a chain of custody of the sampling. These points are developed in greater detail in Modules 2, 3 and 4 on water, air and soil sampling, respectively.
- Ensure the safety of the people involved in the sampling. Samples may contain toxic or dangerous elements and substances. For that reason, it is necessary to wear appropriate gloves, footwear and clothing. Sometimes it may be necessary to wear masks. Access to sample sites can be difficult so all necessary precautions must be taken to avoid accidents or risks to personal safety.
- If possible, try to take one or more control samples that allow comparing the results of the areas of interest with other (s) that have not been exposed to the source of contamination.

7. How to prepare a budget for Environmental Sampling?

Budgeting and setting priorities are two aspects of all environmental sampling that go hand in hand. Analyzing available resources can refine the process of setting priorities. In addition, a budget is necessary to seek financial support to cover the costs of sampling.

Many times, the definition of priorities and the budget are iterative processes. That is, they can be adjusted repeatedly, one depending on the other.

Each budget is different and depends on the conditions of each case, including the



accessibility to the sampling points, the parameters to be analyzed, the number of people involved, etc. Usually, a sampling budget is divided into the following items:

- Staff costs
- Material and equipment costs
- Transportation costs and other logistical requirements
- Cost of laboratory analysis

As for personnel costs, some issues to consider are:

The time and availability of people with experience in sampling, and occasionally a notary or witnesses may be necessary.

Details about the necessary materials are detailed in Modules 2, 3 and 4. Include the cost of the equipment for collecting and storing samples (jars, containers, bags), labels and markers for labelling, twine, or other necessary implements when sampling of river water, spatulas for soil sampling, and other materials such as coolers, dry ice, tape, boots, gloves, safety masks, and other protective equipment. Follow the recommendations for handling and transport detailed in the modules and include these costs in the budget.

- Include adequate packing and shipping expenses and possible administrative costs.

As for laboratory costs, as much as possible it is best to have at least two quotes from certified laboratories for the selected parameters whenever possible. See the Water, Air and Soil Sampling Modules for more information on how to select some basic parameters.

8. Training of Personnel In Charge of Environmental Sampling

Developing environmental sampling skills is a continuous learning process. These skills can be acquired by anyone in the community. The most important thing is to have the will to acquire knowledge and develop experience. Capacity building should be a priority in any community or group of people who share a goal. Each person has much to contribute, and the people who are acquiring experience and knowledge are able to multiply their knowledge through sharing it with the rest of society. They are key actors for strengthening society and can contribute to the development and improvement of local environmental management.

How to conduct training for Environmental Sampling

Training for sampling could be part of community capacity building on environmental issues by encouraging participation in participatory environmental management and governance. Alternatively, training a group of people, volunteers or community leaders could also be the best option, depending on the circumstances.

Once the priorities and scope of sampling have been defined with the help of community members, strengthening technical capacities can begin by convening the people who will participate in environmental sampling to exchange ideas on sampling objectives, identification of sampling points, logistical details and sampling techniques.

Sampling techniques will depend on the medium to be analysed (water, air, and soil) and are further developed in Module 2: Water; Module 3: Air and Module 4: Soil. Some general recommendations applicable to all cases are:

- Identify possible sampling points and access routes on a map prior to collecting the samples.
- If possible, make a preliminary tour of the area to identify probable transportation or access problems.
- Rehearse using the sample collection techniques before going to the field to collect the samples.
- Verify that the person responsible for the sample collection is aware of labelling and the chain of custody form as well as how to properly store and transport the samples.

9. How to Select a Laboratory for Environmental Analysis

The selection of a laboratory for the sample analysis depends on the kind of samples, the contaminants to be analyzed, the location of the area where the samples are to be taken, the available funds, etc.

Whenever possible we recommend choosing a certified laboratory which has experience and an accreditation that recognizes its testing competency. Accreditation is based on assessments according to standards of a national or international entity (e.g., ISO standards) that verifies the technical competence and reliability of the laboratory, as well as that the facilities are adequate. This includes an evaluation not only of the equipment (calibrated, proper maintenance programs) and analytical methods, but also the technical competence of the personnel in charge of the analyses. Laboratories may be accredited for one or more specific tests or analyses. This ensures that the results are accurate and reliable.

Certification is granted by an authorized entity and may be different from accreditation. For example, the ISO 9001 certification of a laboratory only focuses on the laboratory's quality control system, but not on analytical methods, while ISO/IEC 17025 and ISO 15189 standards do assess the technical competence and reliability of analytical procedures and equipment, personnel, laboratory facilities.

Some ways to find certified labs are:

- Consult the directories of laboratories accredited by the national accreditation agency. Often there are lists of these laboratories on the internet.
- Ask organizations and partners who have performed analysis of environmental samples previously.
- Consult with universities and other academic centers.

Recommendations for contacting an environmental analysis laboratory:

- Keep a list of the priorities you have identified. The lab may be able to give you guidance on the parameters to analyze. We recommend that you consult Modules 2, 3 and 4 for the selection of water, air and soil analysis parameters, respectively.
- Remember that analyzing "all" possible parameters is not necessarily the best decision in economic and logistical terms for your organization.
- Try to check with at least two labs and compare prices.
- Ask if the laboratory can give you the necessary containers, jars, and thermal boxes (water analysis) or other necessary materials.
- Inquire about the sample volume needed, whether it requires the use of preservatives, and other important information for sample handling and transportation.
- Ask if the laboratory provides sample collecting.

Glossary

Acid	For the context of this sampling guide, acid is a compound which has a pH less than 7.0 when dissolved in water.
Acute toxicity	An immediate toxic response resulting from a single short-term exposure to an agent or substance. (See: Chronic toxicity, Toxicity).
Air pollutant	Any agent or combination of such agents, including any physical, chemical, biological, radioactive (including source material, special nuclear material, and byproduct material) substance or matter which is emitted into or otherwise enters the ambient air and may harm humans, animals, or vegetation. Pollutants include almost any natural or synthetic airborne matter. A pollutant may consist of particles, liquid droplets, gases, or a combination of these. In general, an air pollutant is generated from: point or non-point sources or are created de novo in the air by the interaction of two or more primary pollutants, from reaction with normal atmospheric constituents, with or without photoactivation. In addition to pollen, fog, and dust, which are of natural origin, around 100 airborne contaminants have been identified. Environmental regulation often groups air pollutants in categories such as particulate matter, sulfur compounds, volatile organic substances, and others such as nitrogen, oxygen, halogen compounds, radioactive, and odors.
Alkali	Any base substance or hydroxide soluble in water, that neutralizes acids and forms salts with them and turns red litmus blue. The condition of water or soil containing enough alkaline substance to raise the pH to more than 7.0.
Ambient air	Any unbounded portion of the atmosphere: open air or air in its natural state, not contaminated by air-borne pollutants. Ambient air is typically 78% nitrogen and 21% oxygen. The extra 1% is made up of a combination of carbon, helium, methane, argon, and hydrogen.
Analysis	The process of determining the composition or presence of a chemical element, substance, microorganism, or characteristic to assess qualitatively and/or quantitatively the presence of internal and/or external elements.

Chronic toxicity	The development of adverse effects as result of long-term exposure to a harmful substance or other stressor.
Composite Sampling	A sampling method used when a mixture of several individual grab samples are combined in their entirety or in part to form a new sample. The entire composite sample can be measured to obtain the desired information, or one or more random subsamples can be measured individually. In general, the individual samples that are combined must have the same size or volume and the composite sample must be completely mixed.
Contaminant	1. Any physical, chemical, biological, or radiological substance or matter that has an adverse effect on air, water, or soil. 2. In general, any substance introduced into the environment with adverse consequences for the usefulness of a resource or for the health of humans, animals, or ecosystems.
Dermal toxicity	The ability of a substance to cause harmful effects by their contact with the skin.
Drinking water	Drinking water is water that is used in drink or food preparation; potable water is water that is safe to be used as drinking water. It should not represent any significant risk to health over a lifetime of consumption.
Ecosystem	A biological community and its system of ecological relationships in a local environment, including relationships between organisms and between the organisms and the environment itself.
Effluent	Wastewater – with or without treatment – discharged from treatment plants, sewers, or industries. It usually refers to waste discharged into the environment.
Emission	A term used to describe the gases and particles which are put into the air or emitted by various sources (such as vents residential stacks or from the exhausts of motor vehicles, trains or aircrafts).

Erosion	The gradual wearing away of soil and rocks by the combined action of the wind water, ice, or gravity.
Fugitive emissions	Those emissions which could not reasonably pass through a stack, chimney, vent or other functionally equivalent opening.
Greenhouse effect	The trapping of heat within the Earth's atmosphere by "greenhouse gases." These heat-trapping gases include water vapor, carbon dioxide, methane, and certain other gases in the air.
Grey water	Household wastewater composed of wastewater from kitchens, bathrooms, sinks, bathtubs and washing machines.
Groundwater	Water that flows or seeps downward and saturates soil or rock, supplying springs and wells. Groundwater is freshwater reserves located below the earth's surface, usually in aquifers, which feed wells and springs. Because groundwater is a major source of drinking water, there is growing concern about contamination with agricultural leachate, industrial contaminants, and leaking from underground storage tanks.
Monitoring	Periodic or continuous process of measuring or collecting environmental data. It could be used for decision-making or to determine the level of compliance with legal requirements and/or levels of contaminants in various media or in humans, animals, and plants.
Pollution [environmental]	The addition of any substance (solid, liquid gas, micro-organisms, energy, sound, heat, radioactivity) to the environment at a level that can damage the quality of air, water, land and/or negatively affect the balance and health of natural life processes and organisms. Under the Clean Water Act, the term has been defined as follows: alterations made or caused by human beings to the physical, biological, chemical, and radiological integrity of water and other media.

Process wastewater	Any water which, during manufacturing or processing, comes into direct contact with or results from the production or use of any raw material, product, byproduct, or waste product.
Repreentative sample	An amount of material or water that is almost identical in content and consistency to the larger mass of material or water being studied.
Representativeness	A measure of the degree to which data accurately represents the characteristics of a population, variations in parameters at a sampling point, a process condition, or an environmental condition. Representativeness is also the correspondence between the analytical result and the actual environmental quality or condition experienced by a pollutant receiver.
Route of exposure	An exposure route is the way a chemical enters an organism upon contact. It is a point of contact/entry of a stressor from the environment into an ecological receptor (e.g., via ingestion, dermal absorption, or inhalation).
Runoff	The part of the water from precipitation, thaw, or irrigation that runs through the land into streams and other surface waters. Runoff can carry pollutants from air and land to receiving waters.
Sample	A set of units or elements selected from a larger population, which are usually observed to make inferences regarding that population.
Sampling design	Waste produced by residences and commercial sources and discarded in sewers. A description of the sample collection plan that specifies the number, type, and location (spatial or temporal) of the sampling units to be selected for measurement.
Sewer wastewater	Waste produced by residences and commercial sources discarded in sewers.

Simple Sampling	A sampling method in which samples are collected at random times or locations throughout the sampling period or study area.
Subchronic toxicity	It is the ability of a substance to cause effects for more than a year, but for less than the life of the exposed organism.
Surface waters	All water naturally open to the atmosphere (rivers, lakes, reservoirs, ponds, streams, seas, estuaries, etc.).
Toxic	A substance or agent that can harm an exposed organism.
Toxicity	The degree to which a substance or mixture of substances can harm humans or animals. Acute toxicity refers to dangerous effects on an organism through a single exposure or short-term exposure. Chronic toxicity refers to the ability of a substance or mixture of substances to cause harmful effects over an extended period, usually through continuous or repeated exposures sometimes throughout the life of the exposed organism.
Treated wastewater	Wastewater that has been treated with one or more physical, chemical or biological processes to reduce its potential of being a health threat.
Untreated wastewater	Sewage that has not gone through treatment and its contents.
Water pollution	The presence of harmful or unacceptable materials in the water in sufficient quantity to affect the quality of the water for drinking, cooking, and recreational use. Harmful substances could include bacteria, organic and/or inorganic chemical substances, viruses, parasites, and other pathogenic microorganisms.
Watershed	A land area that channels rainfall and/or snowmelt to creek, streams, and rivers and eventually to outflow points such as reservoirs, bays and the ocean.

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Environmental Law Alliance Worldwide (ELAW) helps communities speak out for clean air, clean water, and a healthy planet. We are a global alliance of attorneys, scientists and other advocates collaborating across borders to promote grassroots efforts to build a sustainable, just future.