

# Heterogeneous Site Characterization Through Incremental Sampling Methodology (ISM)

*Sample with a plan, process for purpose, decide with confidence.*

## **Saving Money with ISM**

Better data provided by ISM sampling and processing can reduce total cost by focusing remediation effort and cost where contaminant concentrations exceed action limits. Highly variable data from heterogeneous sites sometimes has so much uncertainty that the consultant can't demonstrate that a particular decision unit doesn't warrant remediation even when the average concentration is below the action limit.

In the traditional approach to characterization of a site, an environmental testing laboratory receives a discrete field collected soil sample. The labs subsequently subsample a small aliquot from the container to analyze for the constituents requested by the client.

*The data users often look at the concentration obtained from the laboratory [using the traditional approach] as being 'the concentration' in the soil without realizing that the number generated from the laboratory is the end point of an entire process, extending from the design of the sampling, through collection, handling, processing, analysis, quality evaluation and reporting.<sup>1</sup>*

Over the years, there has been a growing awareness that there are potential deficiencies and limitations in the traditional approach. ISM had been developed and is evolving to address some of these limitations.

*Incremental Sampling Methodology is a structured composite sampling and processing protocol having specific elements designed to reduce data variability and increase sampling representativeness for a specific volume of soil under investigation.<sup>1</sup>*

## **TestAmerica's ISM Program Support**

Since 2003, TestAmerica has been at the forefront in the evaluation and implementation of ISM at our laboratories. Our involvement started in working with the U.S. Army Corps of Engineers Louisville District and continued with our collaboration and discussions with the U.S. ACE Cold Regions Laboratory related to ISM for surface soil sampling for munitions constituents and metals at Military Munitions Response Program projects. TestAmerica continued its ISM support during the development of the state specific guidance in Hawai'i and Alaska. Starting in 2009, TestAmerica actively participated with Interstate Technology and Regulatory

Council [ITRC] in the development of its ISM technical and regulatory guidance and continues as one of the ITRC ISM trainers.

TestAmerica has designed its ISM services as a turnkey solution for our clients to provide the single source solution. TestAmerica is uniquely qualified and committed to provide ISM support to our clients. Our services include:

- Technical support to the investigative team from our senior, ISM experienced analytical chemists during the development of the ISM plan.
- Comprehensive ISM sample processing for sample conditioning, particle size selection particle size reduction, and analytical splitting and subsampling to support the project goals
- Comprehensive organic and inorganic laboratory testing services.

## **TestAmerica Solutions to ISM Testing Challenges**

The delivery of reliable data for our clients requires the laboratory to have a keen understanding of ISM practices and the variety of sample processing options available to support project goals. To that end, TestAmerica has an internal ISM Best Practices Group which has a senior analytical chemist from each of its ISM facilities who work collaboratively to develop our best practices. TestAmerica's ISM Best Practices Group has developed our **ISM Program Standard**. This standard identifies systematic laboratory sample handling and processing procedures including quality control procedures to address the complexities and challenges associated with ISM projects. This standard provides the technical framework for TestAmerica's ISM facilities to deliver the highest level of performance in our industry. TestAmerica's ISM facilities are committed to providing detailed technical support during the ISM development process, outstanding client services, the appropriate sampling processing, subsampling, analytical methods and detection limits, the highest integrity, and the fastest turnarounds with the best accuracy and precision at a competitive price

### **Footnote:**

1. ITRC .2012. Incremental Sampling Methodology. ISM-1 Washington D.C.:Interstate Technology & Regulatory Council, Incremental Sampling Methodology Team. [www.itrcweb.org/ISM-1](http://www.itrcweb.org/ISM-1).

TestAmerica understands that: **Incremental Sampling Methodology [ISM] is...**

...a method to provide an unbiased, statistically valid estimate of the mean value of an analyte within a decision unit.	...NOT appropriate for all sampling programs.
...a process which addresses the major sources of sampling error in a systematic fashion and increases sample representativeness.	...NOT the same process for all constituents of concern.
...a process where by all the members of the investigative team, which are the consultants, regulators, geologists, analytical chemists, risk assessors and toxicologist are involved in the entire ISM planning and implementation process.	...NOT making sampling and processing decisions without considering the end use of the data.
...a process which addresses the common errors associated with sampling and subsampling rather than focusing only on the QA/QC procedures of sample preparation and analysis.	...NOT intended to measure small scale heterogeneity.

**ISM is structured compositing BUT not all compositing is ISM.**

## TestAmerica’s Comprehensive ISM Laboratory Sample Processing Support

Incremental Sampling requires the development of a well-conceived sampling plan developed by the entire investigative team which consists of consultants, regulators, geologists, analytical chemists, and risk assessors . The incremental samples consist of at least 30 increments totaling a kilogram or more. Multiple sample processing options must be available to the investigative team to achieve the project specific goals. TestAmerica has designed our services to be able to support the wide variety of sample processing options that may be required for any project.

TestAmerica supports the following:

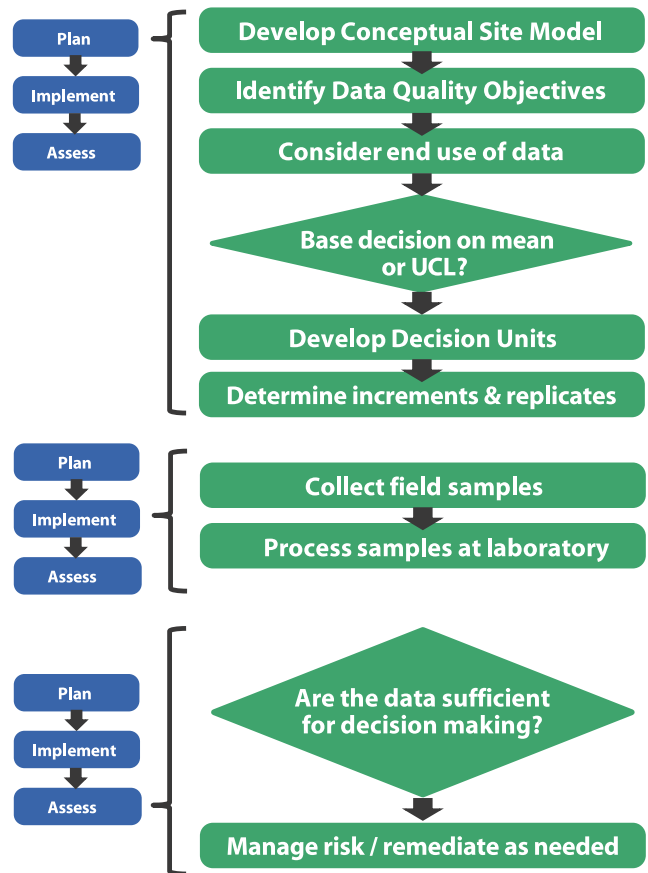
### Volatile Organic Compounds ISM Samples

Volatile Organic Compounds are collected using U.S. EPA Method 5035A. The volatile increments are collected using a coring device and combined in a sample bottle with a methanol volume appropriate for the increments. The use of En Core® samplers and laboratory preservation is also an option.

The shipment of large volumes of methanol can be problematic. TestAmerica’s laboratories can work with the investigative team to determine the best approach and to ensure compliance with all federal shipping regulations

### Semivolatile Organic and Inorganic ISM Samples

The specific laboratory processing and subsampling is determined by the investigative team and is based on the objectives of the sampling program and specific constituents of concern.



## Sample Conditioning

Sample conditioning is needed before particle size selection or particle size reduction since these steps requires a flowable sample. The volatility and the thermal stability of the constituents of concern do effect the options for sample conditioning.

<b>Air Drying</b>	Ambient temperature with air flow, one or more days.
<b>Sample Disaggregation</b>	Gentle grinding used on dry, crushable soil which breaks up soil agglomerate but does not mill hard crystalline particles into smaller particles like the particle size reduction techniques.

## Particle Size Reduction

Particle size reduction can facilitate more representative subsampling. A mill which contains constituents of interest should be avoided. The objectives of the risk assessment influences the choices related to particle size reduction.

<b>Milling</b>	Milling is recommended for ISM metals analysis. Extended high speed milling can elevate temperatures due to friction. It is not recommended for organics [except explosives in Method 8330B].
<b>Mortar and Pestle</b>	Sample is crushed between the bowl and pestle, the process can be manual or automatic.
<b>Ball Mill</b>	Sample is placed in a container with grinding medium (steel, ceramic or agate ball) and tumbled.
<b>Puck Mill</b>	Sample is placed in a dish with the puck and milled to the appropriate particle size or for a selected duration.

## Analytical Splitting and Subsampling

After the sample is dried, disaggregated, and otherwise prepared, there are multiple techniques which can be used for splitting and subsampling. The final subsample mass must be used completely in the analytical preparation step. Therefore, the final mass needed for the analysis must be considered when choosing a process.

<b>Sectorial Sample Splitting</b>	Requires the laboratory to have a rotating sectorial sample splitter. The devices have a rotating head with several chutes. Sample is placed into the hopper, which delivers sample to the splitter. Increments go down the chute and are delivered in equal portion to the subsample jars.
<b>One Dimensional Slabcake</b>	Sample is poured into a line using 20 passes back and forth to evenly distribute sample particles over the line. A square scoop cuts across the line to collect sample aliquots which are then combined.
<b>Two-Dimensional Slabcake</b>	Entire sample is spread across a 2D surface. A square scoop collects at least 30 increments in a systematic random fashion which are then combined in a subsample.
<b>Riffle Splitting</b>	Samples are divided into two equal portions by directing the sample through alternate chutes into two different pans.

## Particle Size Selection

Particle size selection, via sieving, can occur at several different points in the ISM process. It can be used as a part of the disaggregation stage or to determine if the milling of the sample is complete. The samples are passed through the appropriate size sieve to select the designated particle size. The routine particle size fraction is  $< 2$  mm but other particle sizes can be selected based on the project goal.

## TestAmerica Supports the Following Environmental Testing for ISM:

TestAmerica follows U.S. EPA, ASTM, Standard Methods and other approved methods in support of ISM projects. TestAmerica's ISM facilities typically utilize larger subsamples which are more representative for sample preparation and analysis. TestAmerica's ISM experience includes the following parameters:

- Cyanide
- Dioxins/Furans
- Energetics including Explosives & Perchlorate
- Glycols
- Herbicides
- Metals including Mercury
- Organochlorine Pesticides
- PCB Aroclors
- Radionuclides
- Semivolatile Organics
- TPH/DRO
- Volatile Organics

## Additional Single Source Solutions Offered by TestAmerica:

**Senior, Experienced ISM Analytical Chemists** – who support the investigative team during the development of the ISM plan.

**Dedicated ISM Project Manager** – provides a single point of contact with experience on ISM projects.

**Comprehensive Certification** – including DOD QSM, NELAP as well as other national and state certifications to support ISM projects.

**Capacity** – of eight dedicated ISM facilities offering the largest environmental testing capacity in the U.S. providing timely data delivery to all our clients.

**All Coolers, Bottles and Sampling Supplies** – are provided via our couriers or from any of our laboratories and service center locations.

**Dedicated Courier Service** – provides delivery service from project or office locations and delivers the samples directly to our laboratories either the same day or for next day A.M. delivery.

**Data Reports** – provided in the client requested format ranging from data only to comprehensive reports with all laboratory quality control data. All reports can be provided in a searchable PDF electronic format for easy electronic long-term storage.

**Electronic Data Deliverables (EDDs)** – provided in any client requested format including Excel, client specific formats to Earth Soft EQulS 4 or 5 deliverables. EDDs can be for company data management systems as well as ultimate upload into regional data management systems.

**Online Data Access through TotalAccess 4.0** – secure, 24/7 access to all project-related information via no-charge internet portal. TotalAccess users get Rapid Data Access, User Customized Data Reporting Functionality (EDDs), Project Status Updates, electronic deliverables and other documents generated for each project.

TestAmerica's ISM facilities are committed to providing detailed technical support during the ISM development process, outstanding client services, the appropriate sampling processing, subsampling, analytical methods and detection limits, the highest integrity, and the fastest turnarounds with the best accuracy and precision at a competitive price.

### TestAmerica Locations Supporting ISM:

Burlington 802.660.1990	Canton 330.497.9396	St. Louis 314.298.8566
Denver 303.736.0100	Seattle 253.922.2310	Sacramento 916.373.5600



For additional resources, news and Incremental Sampling Methodology specifics, visit:  
[www.testamericainc.com/ISM](http://www.testamericainc.com/ISM)

## TestAmerica Leadership:

- TestAmerica was recruited to join the Interstate Technology and Regulatory Council (ITRC) in January 2009. Dr. Mark Bruce (TestAmerica Corporate Technical Director, Canton, OH) was one of the primary authors and editors of Section 6 that provides guidance for laboratory processing options for ISM samples. He received the ISM team Industry Recognition Award in October 2009.
- Mr. Larry Penfold, TestAmerica Quality Compliance Director, has been involved with the development of the ISM from its inception at the U.S. Army Corps of Engineers Cold Regions Research and Engineering Laboratory since 2003.
- TestAmerica was contracted by ADEC to perform the initial study which compared ISM to traditional grab samples and was the first lab in Alaska to commercially support ISM.
- TestAmerica laboratory has worked with the State of Hawai'i Department of Health in establishing and optimizing ISM processes since 2005. Over the years, the laboratory has processed over 10,000 samples using an ISM approach.

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