Vista Technologies, Inc.
Radiation Safety Program

PROCEDURE - 17

SOIL, WATER AND SEDIMENT SAMPLING TECHNIQUES

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ABBREVIATIONS AND ACRONYMS

α	-	Alpha
ß	-	Beta
γ	-	Gamma
μ	-	Micro
^{241}Am	-	Americium-241
^{137}Ce	-	Cesium-137
^{234}Pa	-	Protactinium-234
^{210}Pb	-	Lead-210
^{210}Po	-	Polonium-210
^{214}Po	-	Polonium-214
^{218}Po	-	Polonium-218
^{232}Pu	-	Plutonium-232
^{226}Ra	-	Radium-226
^{228}Ra	-	Radium-228
^{219}Rn	-	Radon-219 (Actinium Series)
^{220}Rn	-	Radon-220 (Thorium Series)
^{222}Rn	-	Radon-222 (Uranium Series)
^{89}Sr	-	Strontium-89
^{90}Sr	-	Strontium-90
^{230}Th	-	Thorium-230
^{232}Th	-	Natural Thorium
^{238}U	-	Uranium-238
μCi	-	MicroCurie
μCi/hr	-	MicroCuries per hour
μCi/ml	-	MicroCuries per milliliter
μM	-	Micrometer
μR/hr	-	MicroRoentgen per hour
μg/mg	-	Microgram per milligram
ALARA	-	As low as reasonably achievable
ALI	-	Annual limit on intake
ANSI	-	American National Standards Institute
APR	-	Air-purifying respirator
Bq	-	Becquerel
Bq/m^3	-	Becquerels per cubic meter of air
BZ	-	Breathing Zone
C	-	Coulomb
C/kg	-	Coulombs per kilogram
CDE	-	Committed Dose Equivalent
CEDE	-	Committed Effective Dose Equivalent

CFR	-	Code of Federal Regulations
Ci	-	Curie
CIH	-	Certified Industrial Hygienist
CFM	-	Cubic feet per minute
CLIA	-	Clinical Laboratories Improvement Act
CLP	-	Contract Laboratory Program
cm	-	Centimeter
cm/sec	-	Centimeters per second
cpm	-	Counts per minute
CPR	-	Cardiopulmonary resuscitation
CSE	-	Certified Safety Executive
(D)	-	Duplicate count
DAC	-	Derived air concentration
DAC-h	-	DAC hours
DCA	-	Double Contingency Analysis
DDE	-	Deep Dose Equivalent
DI	-	De-ionized water
DOT	-	U.S. Department of Transportation
dm^2	-	Square Decimeter; one square decimeter equals 100 square centimeters
dpm	-	Disintegrations per minute
dpm/cm^2	-	Disintegrations per minute per square centimeter
dpm/dm^2	-	Disintegrations per minute per square decimeter
dps	-	Disintegrations per second
DRD	-	Direct reading dosimeter
DU	-	Depleted uranium
EPA	-	U.S. Environmental Protection Agency
eV	-	Electronvolt
FE	-	Feces sample
FIDLER	-	Field instrument for detection of low energy radiation
FR	-	Filter ratio
FSP	-	Field Sampling Plan
ft^2	-	Square foot
γ	-	Gamma ray
GA	-	General area
GeLi	-	Germanium - Lithium
G-M	-	Geiger-Mueller
GMC-H	-	Mine Safety Appliances Company, full-facepiece, dual ..combination filter cartridges for an APR
GPD	-	Gaseous Diffusion Plang
h	-	hours
He-3	-	Helium Three (3)

HEPA	-	High efficiency particulate air
HNO_3	-	Nitric acid
HP	-	Health Physics
hr	-	Hour
HS	-	Hot spot (radiation)
HSP	-	Site-specific Health and Safety Plan
HWP	-	Hazardous Work Permit
ICRP	-	International Commission on Radiological Protection
ID	-	Identification
IDLH	-	Immediately dangerous to life or health
IDW	-	Investigation derived waste
IP	-	Ionization potential
IVC	-	Independent verification contractor
keV	-	Kiloelectronvolt
kg	-	Kilogram
LANL	-	Los Alamos National Laboratory
lpm	-	Liters Per Minute
MCA	-	Multi-channel analyzer
MDA	-	Minimum detectable activity
meV	-	Millielectronvolt
m	-	Meter
m^2	-	Squared Meters
m^3	-	Cubic meters
mCi	-	MilliCurie
MSHP	-	Manager, Vista Safety and Health Program
mil	-	1/1000 inch
ml	-	Milliliter
mm	-	Millimeter
mR	-	MilliRoentgen
mR/hr	-	MilliRoentgens per hour
mrem	-	Millirem
mrem/hr	-	Millirems per hour
MSA	-	Mine Safety Appliances Company
MSDS	-	Material Safety Data Sheet
MSHA	-	Mine Safety and Health Administration
NaI	-	Sodium iodide
NCA	-	Nuclear Criticality Analysis
NCS	-	Nuclear Criticality Safety
NCRP	-	National Council on Radiation Protection and Measurements
NEA	-	Nuclear Energy Agency
NIST	-	National Institute of Science and Technology

NIOSH	-	National Institute for Occupational Safety and Health
n. o. s.	-	Not otherwise specified
NPDES	-	National Pollutant Discharge Elimination System
NRC	-	U.S. Nuclear Regulatory Commission
NS	-	Nose swipe
NTIS	-	National Technical Information Service
NVLAP	-	National Voluntary Laboratory Accreditation Program
OHSO	-	On-Site Health and Safety Officer
ORNL	-	Oak Ridge National Laboratory
ORPO	-	On-Site Ionizing Radiation Protection Officer
OSHA	-	U.S. Occupational Safety and Health Administration
pCi	-	PicoCurie
pCi/gm	-	PicoCuries per gram
pCi/l	-	PicoCuries per liter
P.E.	-	Professional Engineer
PF	-	Protection Factor
PIC	-	Pocket Ionization Chamber
PM	-	Project Manager
PMT	-	Photomultiplier Tube
PPE	-	Personal Protective Equipment
PRP	-	Potentially Responsible Party
PRS	-	Portable ratemeter/scaler
PVC	-	Polyvinyl chloride
QA	-	Quality assurance
QC	-	Quality control
R	-	Roentgen
RA	-	Restricted (radiation) area
rad	-	Radiation absorbed dose
RAS-1	-	Kurz air sampling pump flow calibration kit
REM	-	Roentgen equivalent man
RHSC	-	Radiation Health and Safety Committee
RSO	-	VISTA Radiation Safety Officer
RWP	-	Radiation work permit
SAP	-	Sampling and Analysis Plan
SCBA	-	Self-contained breathing apparatus
SRD	-	Self-reading dosimeter
TODE	-	Total Organ Dose Equivalent
TLD	-	Thermoluminescent dosimeter
TWA	-	Time-weighted average

U^{nat}	-	Natural uranium
UR	-	Urine sample
U.S.	-	United States
VISTA	-	Vista Technologies, Inc.
VSHP	-	VISTA Safety and Health Program
VRSP	-	VISTA Radiation Safety Program
WL	-	Working Level
WP	-	Work Plan

SOIL, WATER, AND SEDIMENT SAMPLING TECHNIQUES

The following sections discuss systematic and biased surface soil radiological sampling, subsurface soil radiological sampling, and water and sediment sampling.

1. SYSTEMATIC AND BIASED SURFACE SOIL RADIOLOGICAL SAMPLING

The purpose of these procedures for systematic and biased surface soil radiological sampling is to establish radiological systematic and biased surface soil sampling techniques for collecting surface soil during remedial action, characterization or other activities at Vista project work sites. These procedures supplement the Field Sampling Plan (FSP) or Sampling and Analysis Plan (SAP) for a specific Vista project work site.

This procedure describes the systematic and biased surface soil radiological sampling techniques, applicable forms, sample labels, radioactive decontamination of sampling equipment and identification of sampling locations. Additional guidance is provided for requirements as specified within NUREG Nuclear Regulatory Guide) and Environmental Protection Agency (EPA) documents.

The applicable references are:

- NUREG/CR 5849, "Manual for Conducting Radiological Surveys in Support of License Termination;
- NUREG/CR-5512, "Residual Radioactive Contamination From Decommissioning;"
- "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods," SW-846, Third Edition, Proposed Update Package,
- "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods," SW-846, Third Edition Revised,
- "A Compendium of Super-fund Field Operations Methods," EPA 540 P-87 001
- Vista's RSP Procedure 15 "Monitoring and Surveying."

1.1. Necessary Supplies

- Sample containers (500 ml Nalgene® jars, etc);
- Sampling equipment as required;
- Labels;
- "Field Sample Collection Form," shown as Attachment 29;
- Measuring tape;
- "Custody Seal," shown as Attachment 30;
- Alconox® or Liquinox® (or standard brand of phosphate-free detergent), De-Ionized (DI) water, spray bottles, 5-gallon plastic buckets (3), and soft bristle brushes (3); and
- Radiological field sample collection logbook(s)
- Ground Penetrating Radar (GPR)
- Facility area diagram;
- Flags to mark sample locations;

Note: For the purposes of this document, Ionizing Radiation includes certain types of Non-Ionizing Radiation

- Clipboard and pen

1.2. Specific Instructions

Sample collection for radiological analysis on Vista project work sites requires that samples be collected consistent with the guidance specified in NUREG and EPA documents. This includes sampling technique, sampling equipment radioactive decontamination, and documentation.

The frequency and number of systematic surface soil samples usually will be specified in the FSP or SAP. The number of samples collected will depend on site-specific information such as elevated γ ray readings as detected from γ ray scans conducted in accordance with Vista's RSP Procedure 15, "Monitoring and Surveying - Gamma Ray Exposure Rate Surveys at One Meter in Open and Enclosed Areas, and Walkover Gamma Ray Scan." Direction from instruction guides, FSPs, SAPs, or other written instruction are required for all sampling events.

Prior to initial sampling, tools and equipment must be cleaned as specified below:

- Sampling tools for radioactive materials must be washed using a solution of Alconox® or Liquinox® and water. A soft bristle brush should be used to remove any visible material from sampling tools and equipment. Sampling tools will be rinsed with DI water and allowed to air dry. After drying, tools should be covered with aluminum foil or wrapped in plastic to preclude their radioactive contamination until used.

Prior to initial sampling, a bound, page-numbered sample logbook will be established, and during sampling the information below will be entered:

- Purpose of sampling (e.g., characterization, remedial action, and so forth);
- Coordinates of sampling point, and depth of sampling;
- Name of field technician doing the sampling;
- Type of sample (e.g., soil, water, and so forth); and
- Number of samples and volume taken.
- Description of sampling point and sampling methodology;
- Date and time of collection;
- Sample identification number(s);
- Sample distribution and method of transportation (e.g., cooler, United Parcel Service or Federal Express);
- Name of analytical laboratory;
- References such as maps or photographs of the sampling site;
- Field observations such as weather conditions, wind direction, wind speed, and relative humidity must be entered into the sample logbook;
- Any measurements taken (e.g.,, pH, soil density, flammability, explosivity);
- Signatures of field technician who took the sample or made any observations;
- Method used for radioactive decontamination of sampling equipment; and
- For composite samples, method of compositing.

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1.Note: All entries into the sample

2.logbook must be made in black ink.

All information must be included in the field sampling logbook to adequately reconstruct the sampling event. A custody seal, shown as Attachment 30, will be placed on sample containers by Vista field technical staff taking samples prior to turning these samples over to other field technicians for shipment. Custody seals must be dated and signed by Vista field technical staff collecting the sample.

A sample is considered to be under a person's custody if: (1) it is in a person's physical possession; (2) in view of the person after he has taken possession; (3) secured by that person so that no one can tamper with the sample; or (4) secured by that person in an area that is restricted to authorized personnel.

1.3. Sampling Techniques

Radiological sampling may be conducted on commercial, residential, government, or other private property. Every effort will be made to minimize damage to a property during sampling events.

General considerations for sampling include the following:

- On properties with grass or sod areas, soil samples will be taken in a manner as to not damage the physical appearance of the property. Therefore, when collecting a soil sample, the trowel must first penetrate the ground just under the grass roots, and then be lifted vertically up and away from the sampling area so that the sod may be replaced. This will minimize damage to a lawn. Before the cut plug portion is returned to the lawn, soil that has been slightly compacted and wet with water should be replaced in the sampling location. Next, the plug should be placed on the sampling location and the roots compressed into the mud. This will assure that no air remains around the roots that will kill the sod plug;
- To collect the sample, the trowel should penetrate the soil vertically to the specified depth (usually 15 cm, or 6 inches). This procedure will continue until the plug of soil is encircled. The plug is then lifted and placed into the sample container. The sample quantity should contain enough material to completely fill the sample container. Should additional material be required to fill the sampling container, the trowel will again penetrate the soil vertically to the specified depth around the circumference of the sampling area. Rocks and other debris should remain with the sample if they represent typical soil configuration. This will be determined by Vista field technical staff doing the sampling based on visual observation of the soil; and
- The hole will be backfilled with clean soil, tamped to the root depth, and the sod replaced as described previously. All attempts will be made to restore the property to its original condition.
- For radiological characterization surveys, the frequency of systematic sampling will follow the characterization plan. Biased soil radiological sampling locations will be identified from elevated γ ray readings that indicate that radioactive contamination

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exists. In areas where a ray-emitting contamination is not present, Vista field technical staff will have to determine biased sample locations based on site characteristics (i.e., runoff areas, sumps, and so forth).

1.4. Documentation

Using the Field Sample Collection Form each soil sample collected will be assigned a sequential number and recorded in the field sample collection logbook. Sample information should then be documented on the form shown as "Field Sample Collection Form," Attachment 29. Documentation on the Field Sample Collection Form should contain the following information:

- Results of contamination survey;
- Site number;
- Site name;
- Activity support (job) number;
- Name of Vista field technical staff doing the sampling;
- Sample identification number;
- Sample grid points;
- Sample type;
- Time sample was collected;
- Date sample was collected;
- Sample preservative used;
- Purpose;
- Depth (in centimeters or feet);
- Analysis required;
- Remarks;
- Chain-of-custody information;
- Recorded by;
- Results of excessive removable contamination scan;
- Date and time form was completed;
- Number of samples in each shipping container;
- Total number of samples in shipment; and
- Total number of boxes in shipment.

The names of field technician who collected the samples should be recorded in the field sample collection logbook. Document all facts about the sample on the Field Sample Collection Form and enclose the original Field Sample Collection Form with the samples to be shipped to the analytical laboratory.

To help ensure that each sample has been properly handled, a chain-of-custody procedure must be followed. For chain-of-custody reporting, enter the following information in the appropriate box of the Field Sample Collection Form:

- Survey for excessive radioactive material prior to transportation;

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- Reason the sample is being scanned is for assuring there is no excessive radioactive material, prior to transportation released from the site (i.e., shipment, archival, analysis, and so forth);
- Person physically relinquishing the sample to the carrier (consignee);
- Person or consignor (e.g., United Parcel Service or Federal Express);
- Date and approximate time the sample was released to the consignor (time the sample leaves the site or is delivered to the consignor); and
- Personnel at the analytical laboratory (or location that receives the sample) will acknowledge receipt of the sample on the next line of the chain-of-custody box by their signature in the "received by" column, and by entering the date and time the sample was received.

A copy of the Field Sample Collection Form should be provided to the Vista Project Manager (PM) and the Vista Radiation Safety Officer (RSO) by the Vista On-site Radiation Protection Officer (ORPO). A copy should be retained for the on-site records by the Vista ORPO.
Upon receipt of samples in the analytical laboratory, receiving personnel should acknowledge the shipment by completion of appropriate information in the chain-of-custody section of the Field Sample Collection Form. The laboratory must also note within the remarks section of this form if custody seals have been violated.

1.5. Post-Remedial Action Survey

Upon completion of excavation, a 10 m by 10 m grid will be established inside the excavated area. The surface area inside the grid block will be scanned using an unshielded γ ray scintillation detector. The detector is held near the ground surface, and is slowly moved from side to side as the surveyor advances. This procedure is conducted over the entire excavation and documented on the form shown as "Walkover Gamma Ray Scan Data Sheet Form," Attachment 23.

To reach this step within this procedure, all γ ray-emitting contamination, including hot spots, should have been removed. To further confirm or document the radiological status of the excavation, shielded γ ray (cone shield) apparatus scintillation detector readings should be conducted at locations as specified by the work plan. This information may be used to infer actual radionuclide concentration by cross calibration of cpm to pCi/g. This does not replace actual soil sample requirements as specified within the Vista procedures for post-remedial action sampling. Detection of any residual radioactive contamination during cone-shield apparatus surveys will require additional excavation and repetition of steps of the Post-Remedial Action Survey.

Gamma ray exposure rate measurements will be obtained at 1 meter above the ground as described in Procedure 15 "Monitoring and Surveying,". The final step in confirming compliance with regulatory remedial action guidelines for soil is to collect soil samples. The samples provide documented evidence supporting the certification of the property for release for unrestricted use. Soil samples should, therefore, be representative of the entire sampled grid block(s) to demonstrate that a 100 m^2 area meets the averaging criteria as specified in the protocol.

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1.6. Obtaining Representative Samples

A series of 2.5 cm diameter plugs, 15 cm deep will be collected from 25 equally spaced locations within each 100-m^2-grid block. The samples will be placed in a plastic bag and blended (wet). The wet sample will then be placed in a 2-liter Marinelli beaker and shipped to the analytical laboratory for initial wet count screening by γ ray spectroscopy. Additional biased hot spot samples will be acquired in areas where γ survey data may be subject to Independent Verification Contractor (IVC) scrutiny with respect to meeting criteria. The samples will be noted as "biased" and may be taken in 500-ml Nalgene® jars.

After the initial γ ray and neutron count, the entire soil sample will be dried and pulverized. After samples have been pulverized and thoroughly blended, an aliquot that completely fills a 500 ml Marinelli beaker will be taken from the blended sample. The remaining soil will be placed in a container, identified, and archived.

The 500-ml Marinelli beaker will be sealed and allowed to equilibrate if Ra-226 analyses are required. The results obtained from counting the "dry" sample will be transmitted to Vista for inclusion on post remedial action reports.

2. SUBSURFACE SOIL RADIOLOGICAL SAMPLING

The purpose of this procedure is to establish radiological sampling techniques for collecting subsurface soil samples during remedial action, characterization or other activities at Vista project work sites. This procedure describes subsurface soil sampling techniques, applicable forms, sample labels, radioactive decontamination of sampling equipment and identification of sampling locations. Additional guidance is provided for requirements as specified within NUREG and EPA documents.

Applicable references are:

- "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods," SW-846 - Third Edition, Proposed Update Package;
- "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods," SW-846, Third Edition Revised, November;
- "A Compendium Of Super-fund Field Operations Methods," EPA 540 P-87 001,

2.1. Necessary Supplies

- Sample containers - 500 ml Nalgene® jars;
- Sampling equipment as required;
- Labels;
- "Field Sample Collection Form," shown as Attachment 29;
- "Custody Seal," shown as Attachment 30;
- Measuring tape;
- Alconox® or Liquinox® (or standard brand phosphate-free detergent, De-Ionized (DI) water, spray bottles, 5-gallon plastic buckets (3), and soft bristle brushes (3); and

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- Radiological Field Sample Collection Logbook(s)
- Ground Penetrating Radar (GPR)
- Facility area diagram;
- Flags to mark sample locations;
- Clipboard and pen.

2.2. Specific Instructions

Sample collection for radiological analysis on Vista project work sites requires that samples be collected as specified within NUREG and EPA documents. This includes sampling technique, sampling equipment radioactive decontamination, and documentation.

- The frequency and number of subsurface soil samples will be determined by the site characterization plan, or by written guidance provided by the Vista PM. If the Vista PM makes decisions about the number or frequency of samples, he or she must advise the team leader for that site. The number of samples collected will depend on site-specific information such as elevated γ ray readings and direction from project management personnel to assure the property is adequately covered.
- Instruction guides, FSPs, SAPs, or other written instruction are required for all sampling events. The Vista PM will provide necessary guidance documents.
- Prior to initial sampling, tools and equipment must be thoroughly cleaned. Sampling tools will be washed using a solution of Alconox® or Liquinox® and water. A soft bristle brush will be used to remove any visible material from sampling tools and equipment. Sampling tools will be rinsed with DI water and allowed to air dry. After drying, tools will be covered with aluminum foil or wrapped in plastic to prevent radioactive contamination until used.
- Prior to initial sampling, a bound, page-numbered sample logbook will be used. During sampling the following information should be recorded in the logbook:

  - Purpose of sampling (e.g., characterization, remedial action, and so forth);
  - Release survey of material to be transported;
  - Coordinates of sampling point, and depth of sampling;
  - Names of field technician doing the sampling;
  - Sample matrix (e.g., soil, water, and so forth);
  - Number of samples and volume taken;
  - Description of sampling point and sampling methodology;
  - Date and time of collection;
  - Release scan;
  - Sample identification number(s);
  - Sample distribution and method of transportation (e.g., cooler, United Parcel Service or Federal Express);
  - Name of analytical laboratory; and
  - References such as maps or photographs of the sampling site.

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- Field observations such as weather conditions, wind direction, wind speed, and relative humidity must be entered into the sample logbook even when work is conducted inside a building or structure:

  - Any measurements made (e.g., pH, soil density, flammability, explosiveness, and so forth);
  - Signatures of personnel who sample or make any observations;
  - Method used for radioactive decontamination of sampling equipment; and
  - For composite samples, method of composting.

3.	Note: All entries into the sample logbook must be done in black ink.

All information must be included in the field-sampling logbook to adequately reconstruct the sampling event. Custody seals, shown as Attachment 30, will be placed on sample containers by the field technician taking the samples prior to turning these samples over to other field technicians for shipment. Custody seals must be dated and signed by the field technician collecting the sample.

A sample is considered to be under a person's custody if: (1) it is in a person's physical possession; (2) in view of the person after he has taken possession; (3) secured by that person so that no one can tamper with the sample; or (4) secured by that person in an area that is restricted to authorized personnel.

2.3. Sampling Techniques

Subsurface soil samples can be collected using hand augers, split spoons, Shelby tubes, power augers, or other techniques dependent upon soil conditions and site characteristics.

2.4. Hand Auger Samples

Various types of hand augers and sample extraction tools are available for subsurface sampling applications, before use be aware of underground hazards. The use of a GPR is advised and should be used. Hand augers are typically made of a short cutting barrel with extension handles. The hand auger is limited in use because soil must be fine enough to avoid clogging the intake area. Hand augers will not work well in soil where rock or debris exceed 1 inch (2.5 cm) in diameter.

- Specific instructions:

  - Prior to sampling, personnel involved should be briefed on the piping and structural obstacles which may be encountered (i.e. explosive chemicals, gas lines, etc.).
  - Assemble the hand auger and mark depth increments on the auger handle.

Note: If samples are required from specific depths, it may be advantageous to drill with a power drill to just above the sampling point.

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- Drill to depth of sample removing excess soil from hole.

Note: Place contaminated soil in a stainless steel bowl or pan for homogenization.

- Drill and obtain samples from auger barrel as required for sampling plan.
- Decontaminate hand auger after each sampling effort.

2.5. Split-Spoon Samples

Split-spoon samples are often the best method for obtaining subsurface soil samples when soil conditions are rocky or wet. Split-spoon samplers vary in size. Typical split spoons have 1.5- to 3-inch (4 to 8 cm) inner diameter. Samples are pushed up into the spoon when the spoon is driven/hammered into the ground. Spoons have a steel or plastic basket that works as a check valve to keep sample material from falling out during removal of the spoon from the hole.

Split spoons have threaded ends and screwed-on caps used to hold the sampler parts together. The caps are unthreaded after sampling. The spoon comes apart so that the enclosed sample can be obtained.

2.5.1. Specific instructions:

- Assemble the split-spoon sampler with steel or plastic basket (radiological only) in place.
- Typical spoons are made with cap ends as a matched set (i.e., end caps only fit the spoon for which they were made as a set).
- Assemble extension rods as required, and drive the spoon to the depth as specified in the FSP or SAP.
- After the spoon has passed through the required sampling depth, remove the spoon from the hole.
- Place the spoon on a clean piece of plastic and remove the threaded end caps.
- Open the spoon by prying it apart. Measure the amount of material inside the spoon and note the percent recovery. Typical spoon lengths are 24 inches long (61 cm). Example: 24 inches of sample equals 100 percent recovery; 12 inches of sample equals 50 percent recovery.
- Loosely reassemble the split spoon for radioactive decontamination. It is important to keep the matched ends with the manufactured set.
- Continue sampling as required.

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- Should the field technician be required to drive split spoons, an impact rod must be constructed. The rod may be made from a piece of drill steel that has the split-spoon thread. A section of the drill steel is cut off to a length of 1 foot and screwed into the spoon threads. This will prevent the split spoon from being damaged by hammer impact.
- When the field technician is required to drive split spoons with a sledge hammer, it will be difficult to remove the spoon from the hole. One method used is to place a pipe wrench on the steel extending from the hole at a point high enough to place a hydraulic jack under the pipe wrench, and jack the spoons out.

2.6. Shelby Tube Samples

A Shelby Tube is a hollow pipe which is used to push into the ground to force material up into the tube. Shelby tubes range in size, but most commonly used is 30 inches long (76 cm) by 3 inches (8 cm) inner diameter. Shelby tubes are not suitable if soil is rocky or extremely wet.

Note that it is very difficult to push Shelby tubes without the assistance of a drilling rig. However, in some cases Shelby tubes may be pushed by heavy equipment such as a backhoe to acquire a good sample.

2.6.1. Specific instructions include the following:

The drilling contractor will auger to the required sampling depth. The contractor will push and extract the Shelby tube sample. The contractor places plastic caps over the ends of the sampling tube and the tube is then turned over to the field technician for identification, extraction (if required) and shipment.

- Estimate the percent recovery as discussed in the split-spoon sampling procedure. If the sample enclosed in the Shelby tube is to be extracted, an extraction tool will be required.
- Record all pertinent data on a metal sampling label. Clean the exterior of the tube, and attach completed sampling label to the tube.
- Seal the end caps of the Shelby tube with duct tape or paraffin if sample is to be sent intact. If the sample is to be extracted, remove end caps and place the tube into the extractor. Extract sample increments as required, homogenize the sample in a stainless steel bowl or pan, and place into Nalgene® jars and correctly label. Ship the samples to the laboratory for analysis.

2.7. Power Augering

It is possible to acquire information samples during and after auguring bore holes. This method should be used for information samples only. The sample obtained from the sampling method described below will, in general, be biased by soil mixing and subsequent dilution. A Ground

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Penetrating Radar Should always be used before any augering is done. Use of a GPR will aid in avoiding damage to underground plumbing, gas,. electrical systems or any other possible hazard

2.7.1. Specific instructions include the following:

- Use a GPR and site specific documents to help identify any possible underground hazards.
- Assemble power auger for drilling. As with any power equipment check the oil level prior to using the equipment. Routine ß particle and γ ray surveys of soils may assist in bias sampling.
- Screw the auger in to the required depth and remove. It is important to minimize soil extraction from the hole by auger rotation.
- Obtain sample from auger and decontaminate the auger.
- Repeat the above steps as required to obtain additional samples.

2.8. Other Sampling Techniques

Other techniques include any method by which subsurface soil samples can be obtained. The methods described below may assist the field technician in collecting samples when other sampling tools are not available.

- Technique No. 1

Post hole digger samples can be obtained from two sources. Source No. 1 is to use the post hole digger to dig a hole acquiring samples at the required depths as the hole is dug. Source No. 2 is used after power auguring. This method utilizes the open bore hole drilled by a rig or other source. The post hole digger is used on the side of the hole to collect samples at the required depths. This technique is easier because of the pre-opened hole.

- Technique No. 2

Side wall samples can be obtained from an open bore hole. Fabrication of a sampling tool is required to obtain these types of samples. Typical side wall samplers consist of a can or cup attached to a pipe or piece of wood. Samples are obtained from existing bore holes by scraping the side of the bore hole at the required depths.

- Technique No. 3

Test pit sampling can be done with the assistance of a backhoe. Holes are dug to the required depth and samples are then cut from the side of the hole. As in any open hole, be sure that adequate shoring, sloping, or shielding is in place prior to any work inside the hole. USE CAUTION and a GPR!

- Technique No. 4

Note: For the purposes of this document, Ionizing Radiation includes certain types of Non-Ionizing Radiation

Hollow nail pipe samplers are sections of pipe that are 3 or 4 inches in diameter and connected together with couplings at 1-foot increments. The pipe is pushed into the ground with a backhoe and then removed. The pipe is then taken apart to obtain the samples needed at the required depths. This method requires the use of heavy equipment to push and extract the hollow nail pipe.

2.9 Documentation

Each subsurface soil sample collected should be assigned a sequential number and recorded in the field sample collection logbook. Sample information should then be documented on the form shown as Attachment 29. Documentation on the form should contain the following information:

- Site number;
- Activity support (job) number;
- Name of field technician staff the sampling;
- Sample identification number;
- Sample grid points;
- Time sample was collected;
- Sample preservative used;
- Analyses required;
- Chain-of-custody information;
- Date and time form was completed;
- Number of samples in each shipping container;
- Total number of samples in shipment; and
- Total number of boxes in shipment.
- GPR I.D.
- Scan survey results of samples
- Site name;
- Purpose;
- Sample type;
- Date sample was collected;
- Depth (in centimeters or feet);
- Remarks;
- Recorded by;

NOTE: Samples should be surveyed for possible contamination before packaging to be sent to the laboratory. If external contamination is detected, do not send the samples to the laboratory and immediately contact the Vista ORPO for further directions.

Record in the field sample collection logbook the names of field technician who collected the samples. Document all facts about the sample on the Field Sample Collection Form and enclose the original Field Sample Collection Form with samples to be shipped to the laboratory.

To help ensure that each sample has been properly handled, a chain-of-custody procedure must be followed. For chain-of-custody reporting, enter the following information in the appropriate box of the Field Sample Collection Form:

Note: For the purposes of this document, Ionizing Radiation includes certain types of Non-Ionizing Radiation

- Reason the sample is being released from the site (i.e., shipment, archival, analysis, and so forth);
- Person physically relinquishing the sample to the carrier (consignee);
- Person or consignor (e.g., United Parcel Service or Federal Express);
- Date and approximate time the sample was released to the consignor (time the sample leaves the site or is delivered to the consignor); and
- Personnel at the laboratory (or location that receives the sample) will acknowledge receipt of the sample on the next line of the chain-of-custody box by their signature in the "received by" column, and entering the date and time the sample was received.

A copy should be retained for the on-site records by the Vista ORPO.

Upon receipt of the samples in the analytical laboratory, receiving personnel should acknowledge the shipment by completing appropriate information in the chain-of-custody section of the Field Sample Collection Form. The laboratory should also note within the remarks section of the form if custody seals have been violated.

3. WATER AND SEDIMENT SAMPLING

The purpose of this procedure is to establish a systematic sampling technique for the collection of water or sediment samples at Vista project work sites. This procedure describes sample acquisition, filtration and preservation. This procedure also describes how to complete the required paperwork for these samples.

The applicable reference is:

"Standard Methods for the Examination of Water and Waste Water," American Public Health Association.

3.1. Introduction

In general, water samples are acquired from areas where the potential of radioactive contamination is suspected. Sediment samples are collected at sedimentation areas. When collecting water and sediment samples, be aware of the possibility of soluble or insoluble radioactive contamination in the area of concern. All samples should be representative of the sample matrix.

3.2. Necessary Supplies

- Sample containers;
- Sampling tools (bailer, depth sampler, and so forth);
- Nitric acid (HNO_3) 70 percent;
- 0.45 µM filters; and
- Filtering funnels and apparatus.
- Ground Penetrating Radar (GPR)
- Facility area diagram;

Note: For the purposes of this document, Ionizing Radiation includes certain types of Non-Ionizing Radiation

- Flags to mark sample locations;
- Clipboard and pen

3.3. Specific Instructions

The frequency, number, and type of samples must follow the site-specific FSP or SAP. The FSP or SAP will be completed prior to any on-site sampling effort, and will be reviewed by the Vista RSO and Vista ORPO prior to any sampling unless the sampling effort is minimal.

Sample collection may start after the following check list has been completed.

- Pre-release Survey of package;
- FSP is completed (if required);
- SAP is completed (if required);
- Equipment and materials are ready;
- Sample containers are labeled;
- Sampling tools decontaminated (as per the FSP or SAP); and
- Filtration and preservation are ready.

Samples should be acquired from required location as per the FSP or SAP. If pH or temperature is to be determined, the measurements must be made when the sample is first drawn from the sampling point. Water should be transferred into the sample container if required by the FSP or SAP.

If suspended and dissolved fractions are to be determined, filtration will be required. For the dissolved fraction, filter 1 to 2 liters of water through a 0.45 µM filter. Preserve the filtered sample with approximately 10 ml of 70 percent HNO_3, and note such preservation on the exterior of the sample container. Document all sample information on the sample label and the form "Field Sample Collection Form," Attachment 29, including time, date, temperature, and so forth.

If samples are suspected of containing agents that may be reactive with acid, do not preserve. Consult with individuals who are knowledgeable about the characteristics of the area to be sampled. Samples will be packaged to help assure that no leakage occurs during transportation. Complete the Field Sample Collection Forms. The Field Sample Collection Form must include any special hazards the samples may pose to analytical laboratory personnel.

3.4. Suspended Fraction

If the suspended fraction of a water sample is required for analysis, it must be filtered in the field at collection time because temperature and dissolved oxygen concentration can cause changes in the sample. If this is not possible, return to the sample filtering area as soon as possible and conduct the following steps:

- Assemble the filter apparatus in preparation of filtering water samples. Place a 0.45-µM filter in the filter holder and wet with DI water. Shake the water sample to suspend all

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insoluble material in the sample and quickly pour a measured volume (1 to 2 liters) into a volumetric flask or graduated cylinder. The volume to the ml must be known and marked on the Field Sample Collection Form and the sample label. Filter the measured volume through the filter.

- If the sample contains a substantial amount of insoluble or fine suspended particles, filtering may be difficult. The use of a pre-filter Whatman 41 paper may help.
- Once filtering has been completed, place filter in a sample container, label and ship to the laboratory. Mark on the sample label SUSPENDED FRACTION and the total volume (ml) filtered.
- Send three (3) unused filters to the laboratory to be analyzed as blanks.

3.5. Sediment Samples

The sampling frequency, number and type of sediment samples must follow the FSP or SAP. The SAP should be written prior to the sampling effort. Prepare all sampling equipment and containers prior to collection of samples.

Sediment samples may be collected by several methods. These include the use of clam-shell, split-spoon, and dredge samplers. The method used will be dependent upon sampling conditions. A combination of methods may be required to obtain sediment samples for a project. Samples should contain at least 500 grams of sediment. Sampling techniques will be discussed with the sample requester. The agreed methods will be used for specific sampling areas.

Samples should be collected as required by the FSP or SAP and placed in sample containers. Complete the sample container label and the Field Sample Collection Form. This information should include any special considerations such as the potential of toxic materials present in the samples. Package and ship all samples to the laboratory for analysis.

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ATTACHMENTS

Attachment 23

WALKOVER GAMMA RAY SCAN DATA SHEET FORM

Site:_____ Date: _____ Technician: _____

Scaler: _____ Probe: _____ Serial No. _____ Conversion _____

Background: Indicates Maximum Gamma Rate on Grid Key

X-Grid Y-Grid	Grid Key	Gamma Range	Remarks/Coordinates of Biased Soil Samples (If Taken)

Attachment 29

FIELD SAMPLE COLLECTION FORM

SITE ACTIVITY SAMPLES

Site No. | Site Name: | Activity Support (Job) No.: | Samplers:

Sample I.D. No. / Sample Grid Point	Sample Type (1)	Sample Time	Date of Sample	Preservative	Purpose (2)	Depth cm [ ] ft [ ]	Analysis Required	Remarks

Sample Type (1)
SS –Surface Soil
BS – Bias Soil
PS – Profile Soil
SD – Sediment Silt
OR – Other
VE – Vegetation
GW – Ground Water
SW – Surface Water

Purpose (2)
RC – Rad Character
VR – Verification
QC – Quality Control
HS – Hot Spot
RS – Resample
BG – Background
RT – Routine
SP – Special

Note: Scan Samples Prior to Release

"This package conforms to the conditions and limitations specified in 49 CFR 173.421 for excepted radioactive material, limited quantity, n..a., UN 2910"

CHAIN OF CUSTODY

REASON	RELNQ BY	REC'D BY	DATE	TIME

Recorded By: _____

Date/Time: _____

No. of sample in box _____

Total No. of samples in shipment: _____

Total No. of boxes in shipment: _____

ATTACHMENT 30

CUSTODY SEAL

Vista Technologies, Inc.

_____
Date

CUSTODY SEAL

_____
Signature