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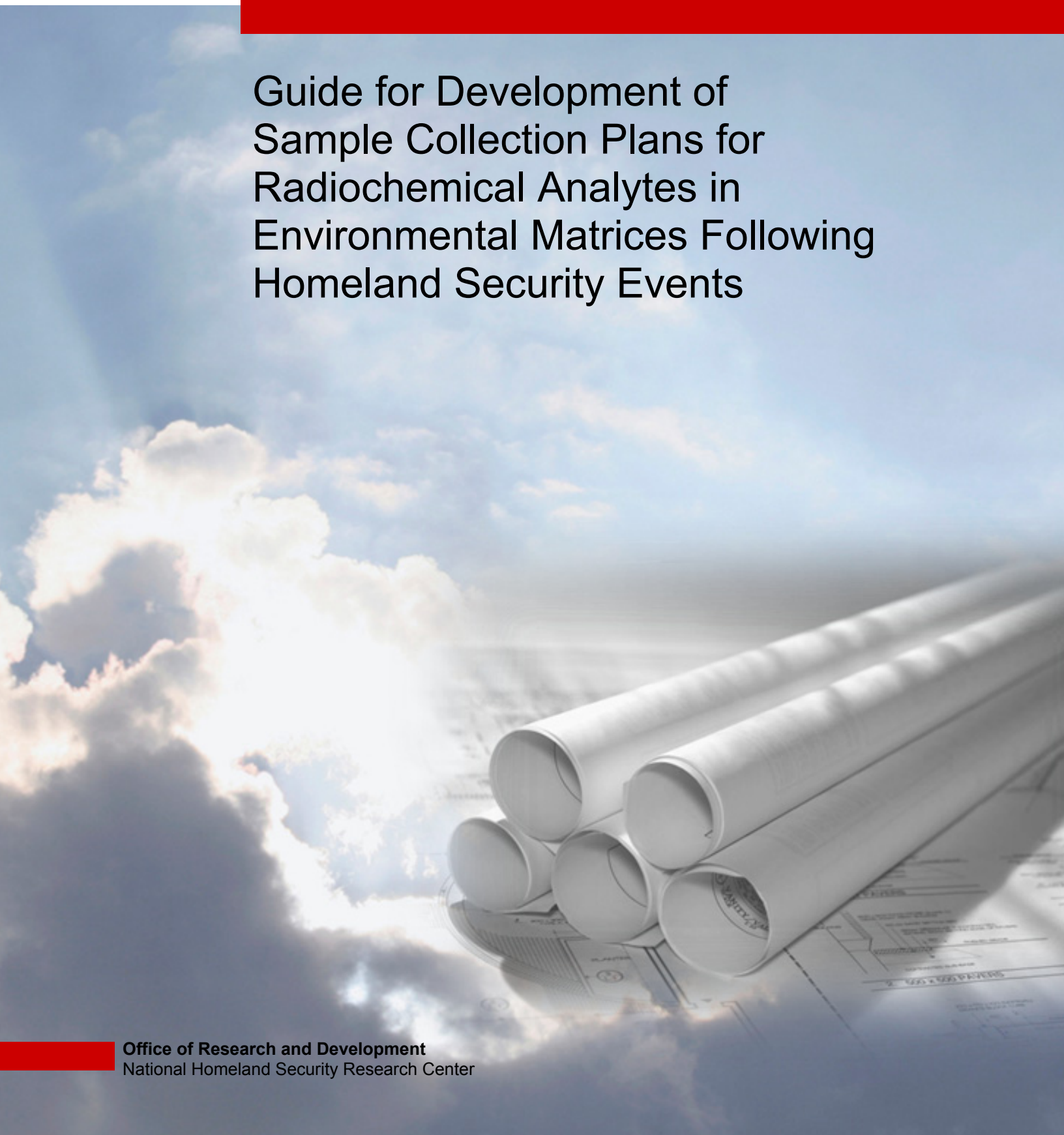
United States
Environmental Protection
Agency

Guide for Development of Sample Collection Plans for Radiochemical Analytes in Environmental Matrices Following Homeland Security Events



Office of Research and Development
National Homeland Security Research Center

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Guide for Development of Sample Collection Plans for Radiochemical Analytes in Environmental Matrices Following Homeland Security Events

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Office of Research and Development, National Homeland Security Research Center,
Cincinnati, Ohio 45268

Office of Radiation and Indoor Air, National Air and Radiation Environmental Laboratory,
Montgomery, Alabama 36115

Office of Emergency Management, National Decontamination Team,
Erlanger, Kentucky 41018

COMPUTER SCIENCES CORPORATION
Alexandria, Virginia 22304-3540

Office of Research and Development
National Homeland Security Research Center

Disclaimer

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Abbreviations and Acronyms

CFR	Code of Federal Regulations
COC	Chain of Custody
D&D	Decontamination and Decommissioning
DCGL	Derived Concentration Guideline Level
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
DQO	Data Quality Objective
ERLN	Environmental Response Laboratory Network
EPA	U.S. Environmental Protection Agency
FRMAC	Federal Radiological Monitoring and Assessment Center
HASP	Health and Safety Plan
HSA	Historical Site Assessment
IATA	International Air Transportation Association
IMAT	Incident Management Assistance Team
MARLAP	Multi-Agency Radiological Laboratory Analytical Protocols Manual
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MDC	Minimum Detectable Concentration
MQO	Measurement Quality Objective
NIST	National Institute of Standards and Technology
PAG	Protective Action Guides
PE	Performance Evaluation
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RPG	Radiation Protection Group
RSP	Radiation Safety Plan
SAM	Standardized Analytical Methods for Environmental Restoration Following Homeland Security Events (U.S. EPA)
SCP	Sample Collection Plan
SHO	Safety and Health Officer
SOP	Standard Operating Procedure
SOW	Statement of Work

1.0 Introduction

The purpose of this document is to provide a framework to assist incident commanders, project managers, state and local authorities, contractors, and enforcement divisions in developing and implementing an approach for sample collection during the cleanup of an urban environment after a radiological homeland security event. Information in this document can be used to develop a systematic and integrated methodology to sample collection, which will meet data use needs and site disposition objectives. This document incorporates site-specific optimization processes to include quantitative and qualitative assessments applied at each stage of site cleanup decision making: from initial scoping and stakeholder outreach, to evaluation of cleanup options, to implementation of the chosen alternative.

It is projected that, following initial site investigation and response, contaminated sites will be turned over by the U.S. Department of Energy's (DOE) Federal Radiological Monitoring and Assessment Center (FRMAC) to the U.S. Environmental Protection Agency (EPA) for cleanup. Traditional radiological site cleanup processes may not be completely followed after a homeland security event because of the urgency to resume use of the affected area as soon as possible.

The elements in this document are intended to provide a general guide for preparation of homeland security event-specific sample collection plans (SCPs) for the collection of environmental data in compliance with EPA requirements regarding quality assurance (QA), quality control (QC), and data quality objectives (DQOs). Additional guides may be issued to clarify or amend the traditional cleanup protocols. The elements can be used for developing SCPs for site investigation, characterization, cleanup, final status surveys to release a site, or to support decision making for the final disposition of the site following a homeland security radiological event. It is assumed that the number of SCPs required, and the details contained within each, is dependent on the size and complexity of the specific event site.

This document does not provide information and instructions that are included in the following documents, which must be developed for each project/site in addition to an SCP:

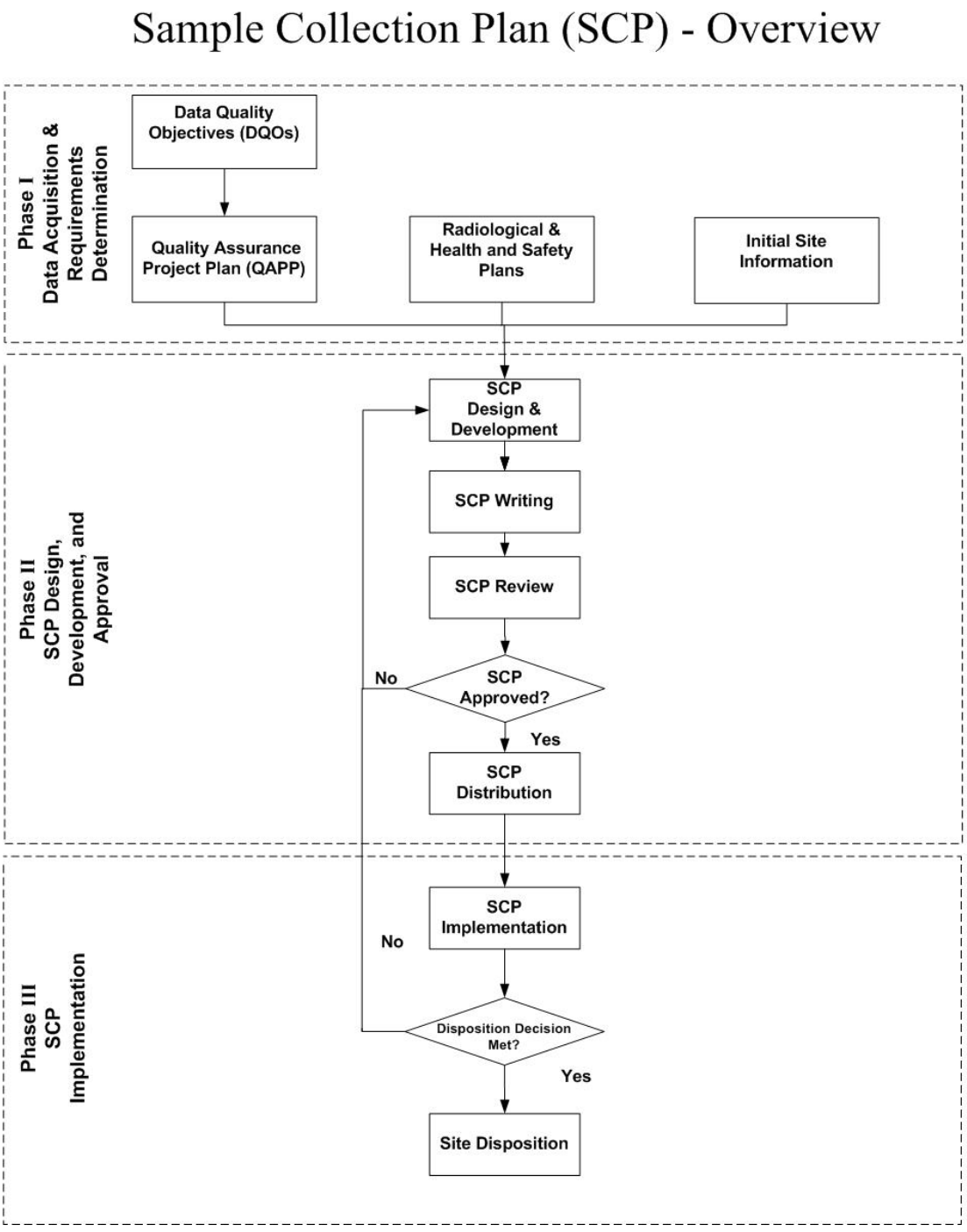
- Quality assurance project plan
- Radiation safety plans and associated procedures
- Health and safety plan and associated procedures

The information in this document is intended to apply only to the development of SCPs for cleanup of real property sites contaminated with radioactive materials from a homeland security event. EPA's *Standardized Analytical Methods for Environmental Restoration Following Homeland Security Events* (SAM) should be reviewed for analytical methods to be used during laboratory analysis of specific radionuclides. EPA's *Sample Collection Procedures for Radiochemical Analytes in Environmental Matrices* (EPA/600/S-07/001) should be reviewed for information regarding sample collection procedures and equipment. If additional contamination is present (e.g., unexploded ordnance, chemical warfare agents, biological wastes, hazardous chemical waste, and/or mixed waste), additional direction will be required. It will be necessary to develop an SCP that includes information on how to handle these materials.

2.0 Overview of the SCP Development Process

Figure 2.1 provides a flowchart of major SCP developmental elements and the general processes of project needs determination through development of sample collection plans and eventual site disposition. The general phases of this process are presented in Figure 2.1, specific SCP elements are described in this document for each phase. The user is encouraged to review the flowchart for each phase. Other elements, as determined in relevant documents listed in Section 6.0, may also be included in the SCP development process.

Figure 2.1



2.1 Phase I – Data Acquisition and Requirements Determination

Before preparing an SCP the project should assemble a core SCP design team. Team members may include, but are not limited to:

- Risk assessors
- Statisticians
- Technical planners
- Health physicists
- Radiochemists
- Civil engineers
- Radiological engineers
- Health and safety specialists
- Construction specialists
- Public and media relations specialists
- Regulatory specialists
- State and local subject matter experts
- Legal specialists
- Incident commanders
- On-scene coordinators

The SCP design team must review the information provided in the Phase I section (see Section 3.0), and perform a thorough review of all appropriate documents, including any statements of work (SOWs), quality assurance project plans (QAPPs), DQOs, health and safety plans (HASPs), radiation safety plans (RSPs), or specifications regarding the impending cleanup effort and disposition decision.

2.2 Phase II – SCP Design and Development

The SCP design team gathers the important site information obtained in Phase I and prepares the SCP prior to any field activities. The SCP will likely be amended or revised several times during cleanup. For each SCP developed, the format and content should be consistent with this document, regardless of the size of the project. Section 4.0 describes the general format and content considerations for an SCP. A good working knowledge of these elements is necessary to understand the type of information required and to determine if additional sources of information are needed. Appendix A lists the typical elements that should appear in the SCP. Specific elements that should be included will depend on the size and/or complexity of the cleanup project, and the SCP format should be modified as appropriate.

2.3 Phase III – SCP Implementation

An EPA approved and cleared SCP, from the Phase II process, must be in place before data collection activities commence. All SCP activities must be performed in compliance with the approved/cleared SCP and should be monitored and verified throughout implementation (See Section 5.0).

While data collection activities are being performed, SCP compliance is monitored by conducting field, desk, and laboratory audits. SCP defined QA elements (i.e., field control samples, QA laboratory analyses, data assessment procedures) are also monitored to ensure SCP compliance. QA audits of the SCP must conform to requirements set in the QAPP.

When all of the SCP activities are completed, an evaluation is made to determine if the site cleanup sampling goals and objectives have been met. If the goals and objectives have not been met, the SCP is reevaluated by returning to Phase II.

3.0 Phase I - SCP Data Acquisition and Requirements Determination

To prepare an SCP, it is necessary to understand all requirements included in the project DQOs, QAPPs, and the site-specific requirements included in the project's HASP and RSP as shown in Figure 3.1. SCP developers also must consider all available existing information regarding the specific site and project, including data collected during the initial response phase of the event.

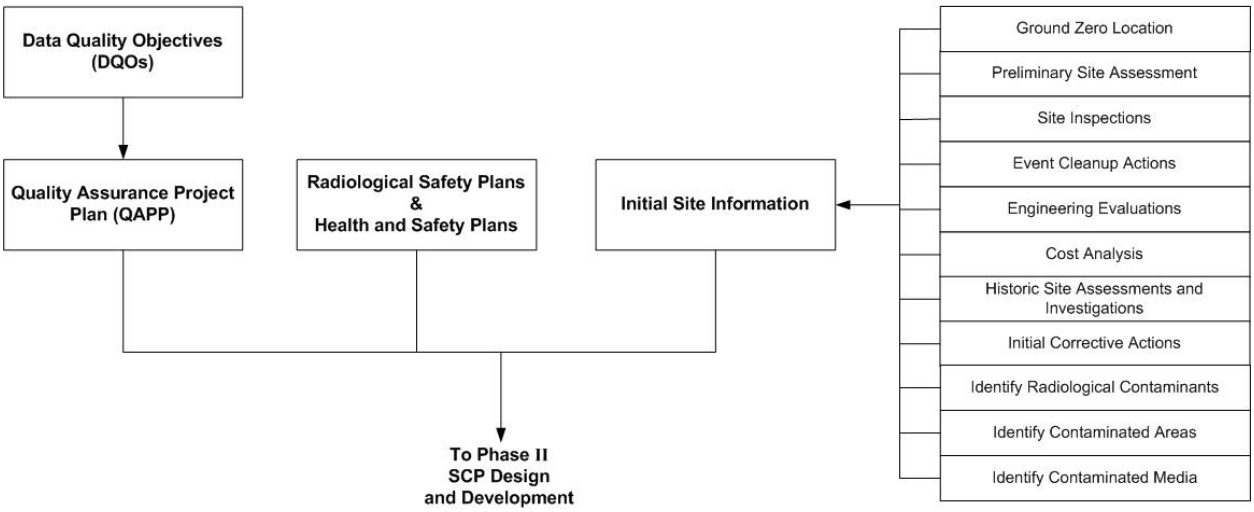
SCP developers should consult with the response team to obtain information collected during the initial phase of the event. As time permits, the team should review data from previous investigations, and/or information regarding site constraints. Before preparing an SCP, developers should perform a thorough review of all appropriate project documents, including any SOWs, QAPPs, DQOs, HASPs, RSPs, or specifications regarding the project or containing project planning results.

The level of specificity outlined within these project documents may vary from outlining general project goals to specifying sampling and analytical requirements to meet project DQOs. Project documents should identify additional applicable references that might be required for obtaining background information, including (but not limited to):

- Engineering regulations and guidance documents
- Regulatory program and status reports from previous investigations
- Construction data
- Ownership/operational histories
- Site maps and photographs
- Information on regional and site geology, hydrogeology, hydrology, topography, ecology, climatology, demographics
- Current and future land use

Figure 3.1

Phase I - SCP Data Acquisition & Requirements Determination



3.1 Data Quality Objectives (DQOs) and Quality Assurance Project Plan (QAPP)

According to EPA policy, systematic planning must be used to develop acceptance or performance criteria for collection, evaluation, or use of environmental data. Systematic planning identifies the expected outcome of the project, technical goals, cost and schedule, and the acceptance criteria for the final result, which must be documented in a QAPP. As defined in the Code of Federal Regulations at 40 CFR 300.430, the QAPP describes policy, organization, and functional activities, as well as the DQOs and measures necessary to achieve adequate data. The QAPP is a plan that provides a process for obtaining data of sufficient quality and quantity to satisfy data needs.

The development of a QAPP is separate from the SCP, but is essential in defining project DQOs and activities needed to ensure that project quality criteria are met. A site-specific QAPP is usually developed in parallel with the development of an SCP. Information pertaining to the preparation of a project-specific QAPP can be found in EPA QA/G-5, *Guidance for Quality Assurance Project Plans*, December 2002. Project managers and planners should also review information regarding the DQO process provided in *Guidance for Systematic Planning Using the Data Quality Objectives Process*, EPA QA/G-4, EPA/240/B-06/001, February 2006; and *Multi-Agency Radiation Survey and Site Investigation Manual*, NUREG-1575, Rev. 1; EPA 402-R-97-016, Rev. 1; DOE/EH-0624, Rev. 1; August 2000 (MARSSIM).

Specific QAPP DQO elements related to collection of environmental data include:

- Measurement quality objectives (MQO)
- Cleanup goals, cleanup options, and establishment of derived concentration guideline levels (DCGLs). [**NOTE:** MARSSIM should be consulted to gain a thorough knowledge of DCGLs and how they are interconnected to the SCP and the DQOs of the QAPP.]
- Survey units identification
- Data assessment including data quality indicators for precision, bias, completeness, representativeness, reproducibility, comparability, sensitivity, and statistical confidence
- Data verification
- Data validation

3.2 Radiological and Industrial Health and Safety Plans

Safety is a primary consideration in any sampling event, and is a critical consideration during development of an SCP. Personnel safety requirements and considerations for a particular site may extend beyond radiological concerns, and may include physical hazards and chemicals that are toxic, corrosive, emit harmful or explosive vapors, or are incompatible when mixed. The SCP must be consistent with all radiation and industrial safety requirements and procedures associated with a site. The SCP also must include or reference site-specific personnel safety and protection plans for radiation and industrial health/safety.

Radiation protection requirements included in the site RSP are developed and implemented by the site radiation protection group (RPG), which is responsible for:

- Developing and implementing a RSP and radiation work plans for individuals working at the site
- Taking measurements of the radiation levels of all sampling sites and associated activities
- Dictating the radiation protection requirements for entering and working in a radioactively contaminated sampling area
- Stopping any activity to protect personnel from overexposure to radiation or from radioactive material contamination

Industrial safety requirements included in the site HASP are developed and instituted by a designated safety individual (e.g., safety and health officer, SHO), who is responsible for:

- Developing and implementing a HASP and safety work plans
- Assessing all site activities for potential safety concerns
- Ensuring that personnel are informed as to the potential hazards in a sampling area and dictating the requirements for safely working at the site
- Stopping any job or activity to protect personnel from a dangerous situation

3.3 Initial Site Information

When FRMAC turns a site over to the EPA for cleanup, FRMAC typically will provide detailed response-stage investigation data for review and use in planning the site cleanup. In general, the information will detail how the investigation was conducted, identify contamination boundaries and grid systems, and detail contamination gradients. This information is critical for designing an appropriate and successful SCP that is consistent with the site investigation. The detailed information provided by FRMAC should include:

- Location of ground zero
- Preliminary site assessment information and data
- Site inspections
- Event cleanup actions
- Historical site assessments and investigations
- Any initial corrective cleanup actions performed to secure and control the effected site
- Identification of radiological contaminants, contaminated areas, and contaminated media
- Meteorological data

In addition to the information typically provided by FRMAC, but that is also important in designing a SCP includes information and data generated during engineering evaluations and cost analyses.

If detailed response data/information is not available when the site is turned over to the EPA, as might be the case following a homeland security incident, the information provided in this document will enable the planning team to develop an SCP for site investigation and characterization, site cleanup, final status surveys, and site disposition. A historical site assessment (HSA) or operational history, if applicable, can also be performed to identify areas of environmental concern or liability from historical or current use of radiological substances (see MARSSIM Chapter 3). Information tracking these uses should be collected, and includes:

Existing Radiation Data Prior to the Homeland Security Contamination Event - Review of applicable documents and records to determine if any information is available, via public records, regarding potential pre-existing radiological contamination.

Interviews - Interviews with current owner(s), building management companies, manager(s) or other responsible parties, local government officials, and residents to obtain as much information as possible regarding the site and any operations and activities that occurred on it. Included in this inquiry would be past and present environmental practices, improvements or alterations, site operations, and plans for future use.

Site Reconnaissance - A site visit or inspection to observe current uses (and evidence of past uses, whenever possible), including those likely to involve the use, treatment, storage, disposal, or generation of radioactive materials.

Evaluation of Data - A written report to document initial investigation phase findings, observations, and recommendations, including suspected or identified areas of radiological concern or liability and what sampling and analyses activities were conducted to verify the suspected areas of contamination. This report should demonstrate that inquiries were sufficient to ascertain site ownership and uses prior to the event. and to minimize any future liability in the event that radiological contamination is found after cleanup or the detection threshold is lowered after the site is turn over for cleanup.

3.4 Identify Real Property Radiological Contaminants

Once potential areas of concern or contamination are identified and evaluated, an SCP strategy is developed so that sufficient data can be obtained to allow a designated individual or group to conclude that the contaminant(s) of concern:

- Is present at levels above the cleanup goals and cleanup is necessary, or
- Is present at levels below the cleanup goals and no further action is required, or
- Is not present above specified detection limits and no further action is required.

If contamination is present at levels above the cleanup goals risk-based release limits, the SCP should ensure that sufficient data are generated to characterize the extent of contamination.

3.5 Identify Contaminated Areas

Prior to cleanup following initial response to a homeland security event, affected and unaffected real property areas will need to be assessed to identify the extent of contamination. Sample collection and analysis will be required to assess the type, degree and extent of contamination. This assessment, as defined by FRMAC[1], is the evaluation and interpretation of environmental radiological data obtained during or following a radiological emergency. The primary products of the FRMAC assessment include interpretation of the post-event radiological situation in terms of the Protective Action Guides (PAGs).

Assessment of the area for cleanup actions will rely on initial post-event measurements and model predictions. Initial field measurements from the Incident Management Assistance Team (IMAT) first responders and FRMAC teams will be used in SCP development effort to identify the areas of contamination. This information includes:

- Field survey measurements
- Aerial radiological surveys
- Laboratory analyses of various samples, such as soil, air, water, vegetation, and foods
- Meteorological information
- Models (plume dispersion area, deposition rates, and re-suspension probabilities)

It should be noted that the initial assessment models and cleanup goals might be enhanced and/or changed after the results of detailed radiological characterization are gathered.

Prior to cleanup actions, information garnered from FRMAC assessments are coupled with data obtained from historic information (local public, corporate, and governmental information). This

[1] FRMAC Assessment Manual Methods, Volume 1, SAND2003-1071P

information is used to identify areas where contamination could have spread or areas that may affect the actions for cleanup of the area. Examples of historic information to examine include:

- Infrastructure data (water, cable, electric, and sewer systems, underground transport or other types of pipe chases or transport facilities)
- Geological and geographical data (water table information, soil composition, bedrock strata)
- Documentation of facilities, businesses, or dwellings where radioactive materials used, stored, or disposed of prior to the radiological emergency (radioisotopes used by medical professionals, radiological sources used by industries, contaminated backfill material, etc.)
- Records, such as news articles or local emergency responder reports, that indicate spills, discharges, or other unusual occurrences that could have resulted in the additional spread of contamination. (These should include spills of solvents or other materials that may influence transport mechanisms in ground water and soil.)

Areas immediately surrounding, or adjacent to, the affected area are included in the identification of contaminated areas because of the potential for inadvertent spread of contamination from airborne re-suspension, meteorological conditions, wildlife movements, etc. (See MARSSIM Chapter 3.)

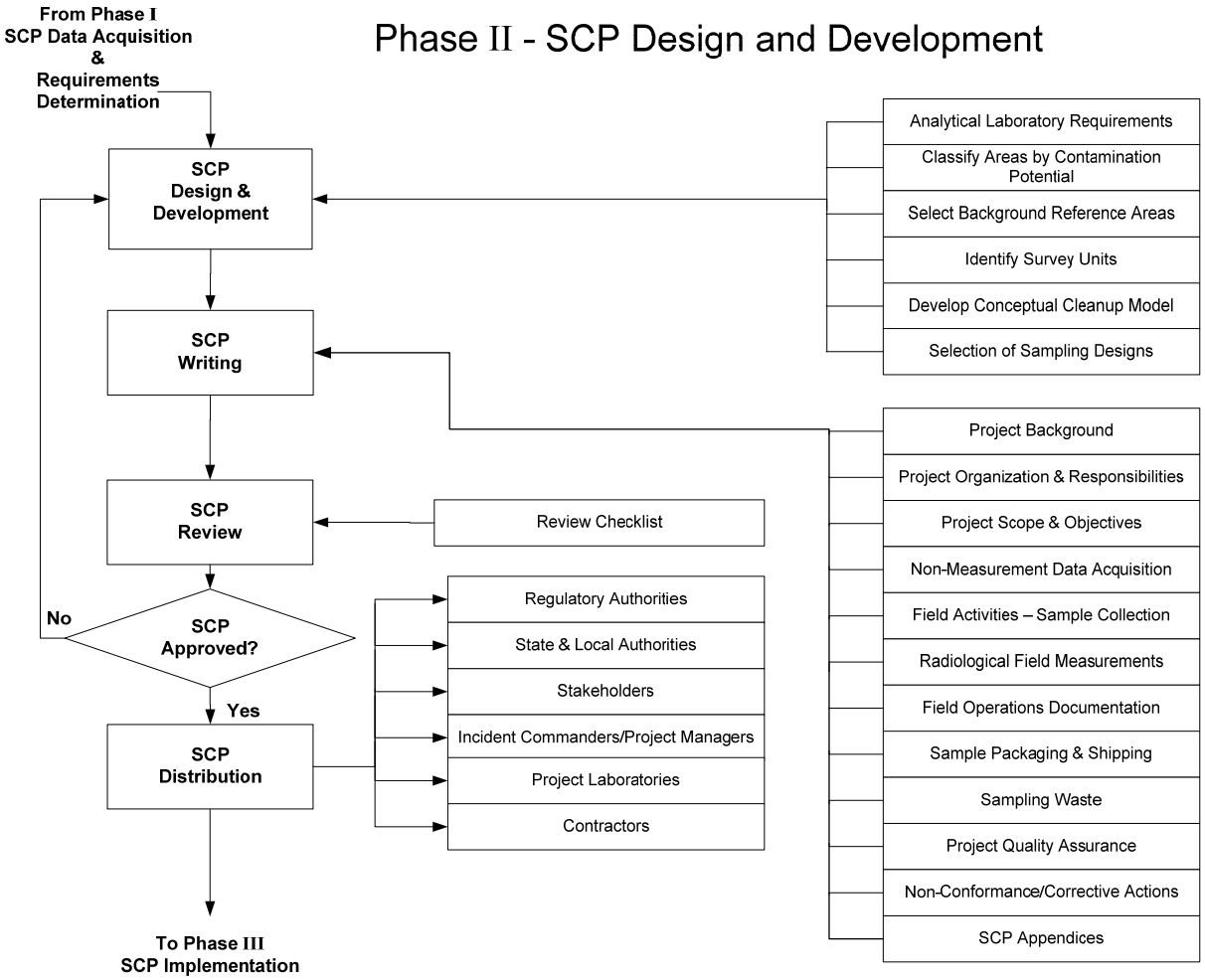
3.6 Identify Contaminated Media

The next step in evaluating the data gathered is to identify potentially contaminated media. Identification of media that have the potential to contain, or that do not contain residual contamination, is used for preliminary classification and for planning subsequent SCP sampling activities. MARSSIM Section 3.3.6 provides guidelines on evaluating the likelihood for release of radioactivity into the following environmental media: surface soil, subsurface soil, sediment, surface water, ground water, air, and buildings. The evaluation will result in a finding of either "Suspected Contamination" or "No Suspected Contamination," which may be based on analytical data, professional judgment, or a combination of the two.

4.0 Phase II - SCP Design and Development

The information and documents gathered and generated during Phase I are used to design and develop the project SCP as shown in Figure 4.1. SCPs are designed to layout and describe project requirements for conducting and completing all field sampling activities, corresponding data assessment activities, and reporting requirements. Elements that are included in an SCP are listed in Appendix A and described in detail in this section. Specific elements that should be included will depend on the size and/or complexity of the cleanup project, and the SCP format should be modified as appropriate. The SCP is prepared and approved prior to initiation of any field activities and is expected to be amended or revised several times during cleanup.

Figure 4.1



Prior to initiation of SCP design, the decision maker(s) and sample collection planning team should review the QAPP and corresponding DQOs, from Phase I, to identify the data needs and purpose for sample collection(s), including:

- Sample collection locations and frequencies
- Types of samples to be collected or measurements to be performed
- Target radionuclide(s)

- Potential interfering radionuclides and chemical contaminants
- Radiological field measurements and instrumentation to support sample collection
- DCGL for each radionuclide of interest
- MQOs for each radionuclide (e.g., required method uncertainty, required Minimum Detectable Concentration (MDC))
- Analytical or screening methods that will be used in the field and laboratory to assay samples
- Analytical bias and precision (e.g., quantitative or qualitative)
- Number of samples to be collected
- Type and frequency of field QC samples to be collected
- Amount of material to be collected for each sample
- Sample tracking requirements
- Sample preservation, filtration, and shipping requirements
- Additional standard operating procedures (SOPs) to be followed or developed
- Cost of the methods being used (cost per analysis as well as total cost)
- Where possible, the use of surrogate measurements should be considered to expedite the field sampling activities and reduce analytical costs.
- Site-specific background (from background reference areas) for the radionuclide(s) of interest
- Turnaround time required for sample results to maintain project schedules
- Analytical measurement documentation requirements

For projects that encompass several sub-sites or involve a long-term effort, it may be beneficial to generate a comprehensive SCP that includes addendums to cover all aspects of sampling and analytical requirements. These addendums to the SCP must clearly identify the DQOs that are specific to a given sub-site(s), applicable matrices, site-specific sampling and analysis requirements, and any deviations from the comprehensive SCP. Information addressed in the comprehensive SCP may be referenced in the SCP addendums. When this approach is used, all addendum references to the comprehensive SCP must be verified by the project technical planning team during the document review process. Preparatory phase inspections (field audits) must ensure that all appropriate plans (comprehensive and addendum SCPs) are available on site, and that field personnel are familiar with procedures included in both.

A separate SCP may be developed for the final status survey. Final status surveys are performed after cleanup is complete to demonstrate that residual radioactivity levels satisfy criteria for site disposition. These surveys provide data to demonstrate that radiological parameters do not exceed the established DCGLs and that DQOs have been met. Final status survey SCPs are designed based on these objectives and the known or anticipated radiological conditions at the site. The SCP must include an appropriate number and location of measurement and sampling points to demonstrate compliance with the release criterion. Planning for a final status survey SCP should include early discussions with the appropriate agencies concerning logistics for confirmatory surveys and sampling. Confirmatory activities are usually limited in scope to include checking conditions at selected locations, comparing findings with those of the final status survey, and performing independent statistical evaluations of the data developed from the final status survey. An independent verification survey may be performed to provide data to substantiate results of the final status survey. Independent evaluations of final site conditions are more extensive than the confirmatory activity listed above, and involve validation of the cleanup final status survey procedures, results, and documentation. The independent verification survey is not a replacement or supplement to the final status survey, but it serves to validate the final status survey prior to releasing the effected lands/facilities for public use.

4.1 Review of Successful Sampling Plans

When preparing an SCP, the design should match the needs of a given project with the resources available. Project needs generally consist of the cleanup objectives and tolerable limits of uncertainty. Project resources may include personnel, time, and equipment. The goal of the SCP should be to acquire and use all of the information available so that the data collected meet the needs of the data user (i.e., decision maker).

The following is a list of some site-specific sampling plans that have been used successfully in support of site disposition. These sampling plans range from complex site characterization plans to smaller sub-site project plans.

- Rocky Flats Environmental Technology Site, The D&D Characterization Protocol, MAN-007-DDCP, July 2002, can be downloaded at: http://rockyflats.apps.em.doe.gov/references/027-D&D%20Char%20Protocol-Reduced.pdf

- NASA Plum Brook Reactor Facility, Characterization Plan, MW-PL-02-004, September 2002, can be downloaded at: http://www.lerc.nasa.gov/WWW/pbrf/documents-records/char_plan/characterization_plan_MW-PL-02-004.pdf

- 105+ Basin Sediment Disposition Phase Two Sampling and Analysis Plan - Bechtel Hanford, Inc., BHI-00984, Rev 0, March 1997, can be downloaded at: http://www.osti.gov/energycitations/servlets/purl/16071-NoYaHn/webviewable/16071.pdf

4.2 Defining Radioanalytical Laboratory Requirements for SCP Sample Analysis

Early consideration of analytical capability is essential to the success of the SCP. Prior to defining radioanalytical laboratory requirements, SCP designers should review the *Multi-Agency Radiological Laboratory Analytical Protocols Manual*, NUREG-1576; EPA 402-B-04-001A; July 2004 (MARLAP), Volume 1, Chapters 5 and 7, for a detailed discussion on obtaining laboratory services. The methods listed in SAM should be reviewed to aid in discussions with the laboratory. The radioanalytical laboratory(s) that will perform the analyses should be selected early in the planning process, so that they may be consulted regarding the analytical methods to be used and to ensure sampling activities will address the analytical needs. Designers and planners should focus on choosing a laboratory that is a member of the Environmental Response Laboratory Network (ERLN). Designers must select the methods that will be used to analyze samples, and design the SCP to meet the analytical needs of those methods.

SCP designers should also consider the use of mobile laboratories to provide on-site analytical capability and minimize off-site sample transportation. The SCP must identify:

- ERLN member laboratories
- Communications protocols between the project management, field personnel, and laboratory personnel
- Chain-of-custody requirements
- Numbers of samples each the laboratory(s) are expect to receive
- Project requirements for analytical result turnaround times
- SAM approved analytical procedures that the laboratory will follow
- Corrective action processes for suspect analytical data
- Documentation, reporting, and project deliverables requirements

Procurement of laboratory services usually requires a SOW describing the analytical services needed. Careful preparation of the SOW is essential to ensuring the laboratory performs the

required services in a technically competent and timely manner (consult MARLAP, Volume 1, Chapters 5 and 7, for expanded details). SOWs must be reviewed by personnel familiar with radioanalytical laboratory operations. For complicated sites requiring a large number of analyses, it is recommended that a portion of this evaluation take the form of an audit. For smaller sites or facilities, the decision maker(s) may decide that a review of the laboratory's qualifications is sufficient. There are eight criteria that should be reviewed during this evaluation:

1. The laboratory should possess appropriate well-documented procedures, instrumentation, and trained personnel to perform the analyses required to address the DQOs (e.g., radionuclide(s) of interest and target detection limits).
2. The laboratory should be experienced in performing the same or similar analyses.
3. The laboratory should have satisfactory performance evaluation results from formal monitoring or accreditation programs, and should be able to provide a summary of QA audits and proof of participation in inter-laboratory cross-check programs. Equipment calibrations should be performed using National Institute of Standards and Technology (NIST) traceable reference radionuclide standards whenever possible.
4. The laboratory should have adequate capacity to perform all analyses within the desired timeframe to meet project required turnaround times.
5. The laboratory possesses a radioactive materials handling license or permit for the samples to be analyzed. SCPs for large projects may indicate that more than one analytical laboratory is necessary to meet the SCP objectives.
6. The laboratory should provide an internal quality control review of all generated data. The reviewers must be independent of the data generators.
7. The laboratory should have an active and fully documented QA program in place, and the QA program comply with the project DQOs.
8. The laboratory should have adequate protocols for method performance documentation and sample security.

4.3 Classify Areas by Contamination Potential

After a radiological homeland security event, areas of the event site will have differing potential for contamination and, accordingly, will not need the same level of sampling to demonstrate compliance with established cleanup goals. The sampling process will be more efficient if the SCP is designed so that areas with higher potential for contamination (based in part on results of the Phase I assessment) receive a higher degree of sampling.

Site classification is a critical step in designing the SCP. The working hypothesis of MARSSIM is that all impacted areas that are being evaluated for release have a reasonable potential for radioactive contamination above the DCGL. This initial assumption means that all areas are initially considered to be Class 1 areas[2] unless some basis for reclassification as non-impacted, Class 3, or Class 2 is provided.

Areas that have no reasonable potential for residual contamination may not need any level of sampling, and may be designated as non-impacted areas. These areas have no radiological impact from the homeland security event and are typically identified during Phase I. Background reference areas are normally selected from these non-impacted areas.

4.4 Select Background Reference Areas

The SCP should clearly identify background reference areas. Typically, these are non-impacted areas, and should have physical, chemical, geological, radiological, and biological characteristics

[2] As defined by MARSSIM

that are similar to the site being evaluated. In some situations, a reference area may be associated with the survey unit being evaluated, but cannot be contaminated by the homeland security event. Generally, reference areas should not be part of the survey unit being evaluated. (See MARSSIM Chapter 4.)

4.5 Identify Survey Units

Each survey unit is a physical area consisting of structures or land areas of specified size and shape for which a separate decision will be made as to whether or not that area exceeds the release criterion. This decision is made as a result of the final status survey, and the survey unit is the primary entity for demonstrating compliance with the release criterion. The SCP must clearly define each survey unit in the site. (See MARSSIM Chapter 4.)

To facilitate sample collection design and ensure that the numbers of sampling points for a specific site are relatively uniformly distributed among areas of similar contamination potential, the site is divided into survey units that share a common history or other characteristics, or are naturally distinguishable from other portions of the site. A survey unit should not include areas that have different contamination classifications; however, depending on the size of the survey units, it may be advantageous to combine dissimilar areas into one survey unit to conform to dose models and minimize sampling densities. (See NUREG-1505 Chapter 12.)

4.6 Develop a Conceptual Cleanup Model of the Site for SCP Planning

A site model serves as the basis for defining sample collection needs during development of the SCP to support site cleanup goals. Project planners should gather and analyze available information to develop a conceptual site model that shows locations of known contamination, areas of suspected contamination, types and concentrations of radionuclides in impacted areas, potentially contaminated media, and locations of potential reference (background) areas. The diagram should include the general layout of the affected area including schools, public parks, business centers, transportation infrastructure, water treatment facilities, lakes, streams, drainage and sewer systems, buildings, and roads.

4.7 Selection of Sampling Designs

The main goal in the development of the SCP is to collect samples that are representative of the site conditions. An accurate assessment of contamination can minimize the number of samples required to achieve cleanup DQOs. Using the conceptual cleanup model, crucial pathways and media requiring assessment are identified for possible sampling. Sampling strategies can be grouped into either statistical or non-statistical methods. To ensure that samples are as representative as possible, statistics are often used to design an appropriate sampling strategy and to provide a sound basis for supporting project decisions. In selecting the sampling design for the project, use an environmental statistician is recommended to ensure the sampling design provides the data needed to support project decisions.

EPA's *Guidance on Choosing a Sampling Design for Environmental Data Collection for Use in Developing a Quality Assurance Project Plan* (EPA QA/G-5S, EPA/240/R-02/005) is a tool-box of statistical designs for sample collection that can be consulted during development of the SCP. An SCP may contain some or all of the designs. However, it is important that the design(s) selected meet the objectives of the QAPP and can support the DQOs and DCGLs of the project. Sample collection designs can be based on, but not limited to:

Judgmental or Bias Sampling - In judgmental or bias sampling, selection of sampling units (i.e., the amount and location and/or timing of sample collection) is based on knowledge of the

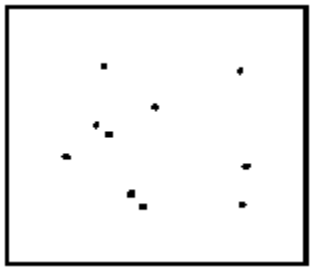
feature or condition under investigation and on professional judgment. This type of sampling, based on professional judgment, differs from statistical scientific theory probability-based sampling. Therefore, conclusions are limited and depend entirely on the validity and accuracy of professional judgment. Expert judgment may also be used in conjunction with other sampling designs to produce effective sampling for defensible decisions.

Simple Random Sampling - In simple random sampling, particular sampling units (e.g., locations and/or times) are selected using random numbers, and all possible selections of a given number of units are equally likely. For example, a simple random sample of a set of drums can be taken by numbering all the drums and randomly selecting numbers or by sampling an area using pairs of random coordinates. This method is easy to understand, and the equations for determining sample population size are relatively straightforward. Simple random sampling is most useful when the population of interest is homogeneous (e.g., no major patterns of contamination or hot spots are expected). Advantages of this design include:

- Provides statistically unbiased estimates of the mean, proportions, and variability
- Relatively easy to understand and implement
- Sample size calculations and data analysis are straightforward

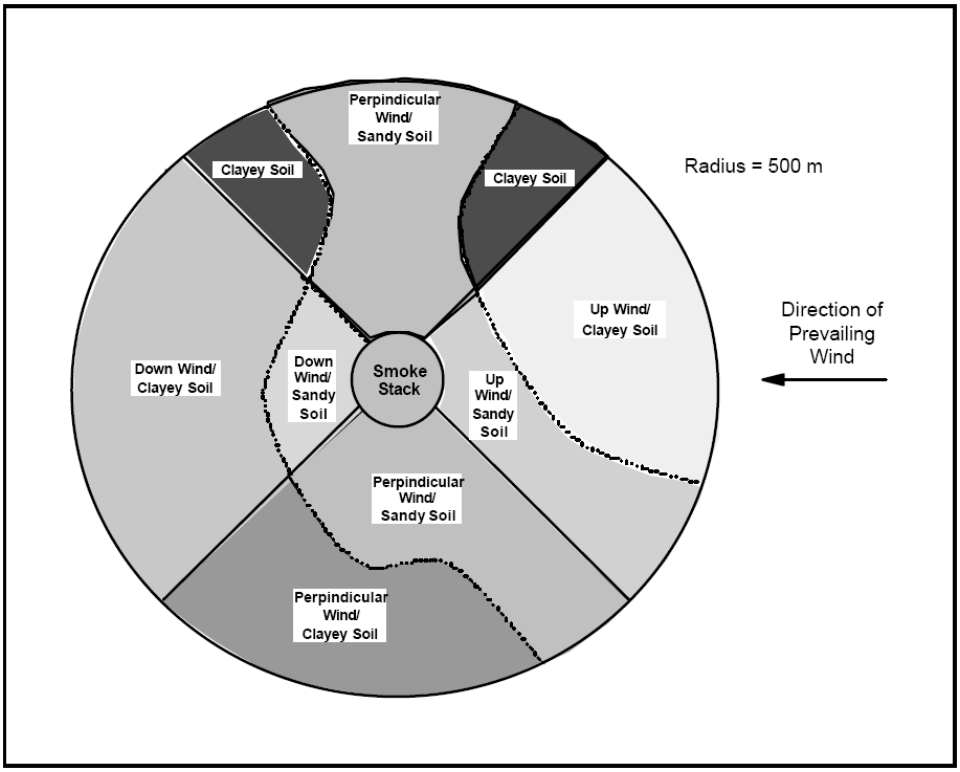
An example is shown in Figure 4.2.

Figure 4.2
Simple Random Sampling
(*from EPA QA/G-5S, EPA/240/R-02/005*)



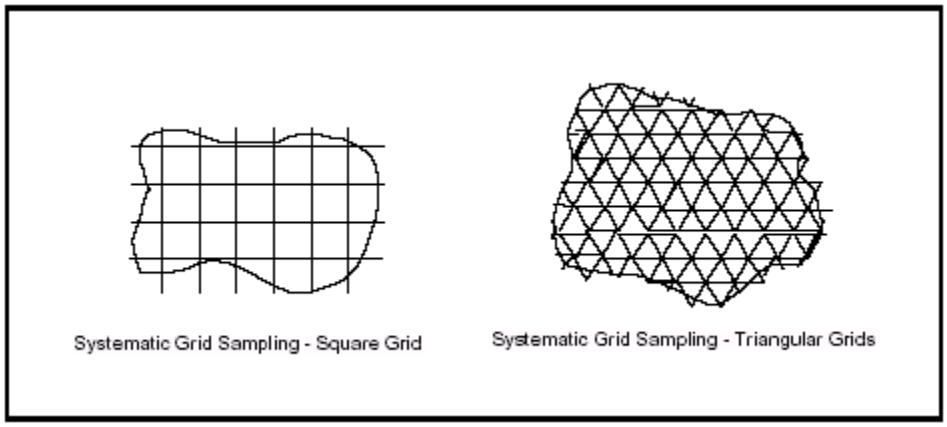
Stratified Sampling - In stratified sampling, the target population is separated into non-overlapping strata, or subpopulations that are known or thought to be more homogeneous (relative to the environmental medium or the contaminant), so that there tends to be less variation among sampling units. Strata may be chosen on the basis of spatial or temporal proximity, or on the basis of preexisting information or professional judgment. This design is useful when the target population is heterogeneous and the area can be subdivided based on expected contamination levels. Advantages of this sampling design are that it has potential for achieving greater precision in estimates of the mean and variance, and that it allows computation of reliable estimates for population subgroups of special interest. Greater precision can be obtained if the measurement of interest is strongly correlated with the variable used to make the strata. An example is shown in Figure 4.3.

Figure 4.3
Stratified Sampling
(*from EPA QA/G-5S, EPA/240/R-02/005*)



Systematic and Grid Sampling - In systematic and grid sampling, samples are taken at regularly spaced intervals over space or time. An initial location and/or time is chosen at random. The remaining sampling locations are defined so that all locations are at regular intervals over an area (grid) or time (systematic). Examples of systematic grids include square, rectangular, triangular, or radial. In random systematic sampling, an initial sampling location (or time) is chosen at random and the remaining sampling sites are specified so that they are located according to a regular pattern (e.g., at the points identified by the intersection of each line in one of the grids). Systematic and grid sampling is used to search for hot spots and to infer means, percentiles, or other parameters. It is also useful for estimating spatial patterns or trends over time. This design provides a practical and easy method for designating sample locations and ensures uniform coverage of a site, unit, or process. An example is shown in Figure 4.4.

Figure 4.4
Systematic/Grid Sampling
(*from EPA QA/G-5S, EPA/240/R-02/005*)

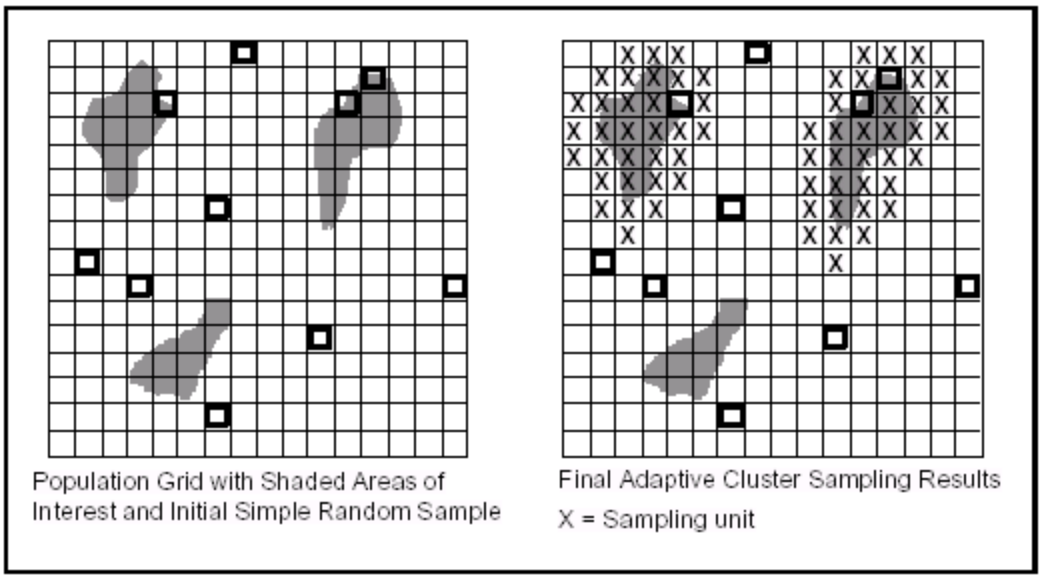


Ranked Set Sampling - In ranked set sampling, *m* sets (each of size *r*) of field locations are identified using simple random selection. The locations are ranked independently within each set using professional judgment or inexpensive, fast, or surrogate measurements. One sampling unit from each set is selected (based on the observed ranks) for subsequent measurement using a more accurate and reliable (hence, more expensive) method for the contaminant of interest. Relative to simple random sampling, this design results in more representative samples and so leads to more precise estimates of the population parameters.

Ranked set sampling is useful when the cost of locating and ranking locations in the field is low compared to laboratory measurements. It is also appropriate when an inexpensive auxiliary variable (based on expert knowledge or measurement) is available to rank population units with respect to the variable of interest. To use this design effectively, it is important that the ranking method and analytical method are strongly correlated.

Adaptive Cluster Sampling - In adaptive cluster sampling, initial measurements are made of randomly selected primary sampling units using simple random sampling. Whenever a sampling unit is found to show a characteristic of interest, additional sampling units adjacent to the original unit are selected and measurements are made. Several additional rounds of sampling and analysis may be needed. Adaptive cluster sampling also tracks selection probabilities for later phases of sampling so that an unbiased estimate of the population mean can be calculated. An example application of adaptive cluster sampling is delineating the borders of a plume of contamination. It is useful for estimating or searching for rare characteristics in a population, and is appropriate for inexpensive, rapid measurements. It enables delineating the boundaries of hot spots, while also using all data collected with appropriate weighting to give unbiased estimates of the population mean. An example is shown in Figure 4.5.

Figure 4.5
Adaptive Cluster Sampling
(*from EPA QA/G-5S, EPA/240/R-02/005*)



Composite Sampling - In composite sampling, volumes of material from several selected sampling units are physically combined and mixed to form a single homogeneous sample. Compositing can be very cost effective because it reduces the number of radiochemical analyses needed. It is most cost effective when analytical costs are large relative to sampling costs; it demands, however, that there are no safety hazards or potential biases (e.g., increased radiological dose rates or radioanalyte cross contamination) associated with the compositing process. Compositing is often used in conjunction with other sampling designs when the goal is to estimate the population mean and when information on spatial or temporal variability is not needed. It can also be used to estimate the prevalence of a rare trait. An example is shown in Figure 4.6.

Figure 4.6
Composite Sampling
(*from EPA QA/G-5S, EPA/240/R-02/005*)

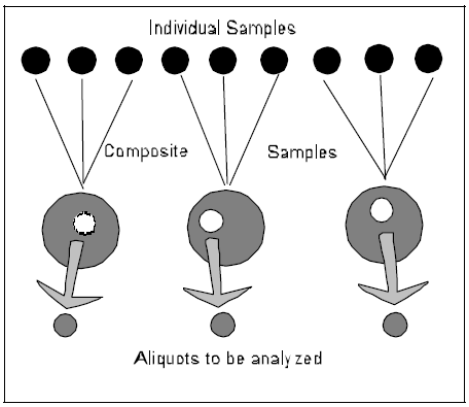


Table 4-1 provides a comparison of advantages and disadvantages for each of the sampling designs listed above.

Table 4-1 Comparison of Sampling Designs

Sampling Design	Statistical or Non-Statistical	Application	Advantage	Disadvantage
Judgmental or Bias Sampling	Non-Statistical	An individual subjectively selects sampling locations that appear to be representative of average conditions.	Good for homogeneous, well-defined sites	Not usually recommended. Conclusions are limited and depend entirely on the validity and accuracy of professional judgment.
Simple Random Sampling	Statistical	Representative sampling locations are chosen using the theory of random chance probabilities.	Good for sites where background information is not available and no visible signs of contamination are present.	May not be cost-effective for samples located too close together. Does not take into account spatial variability of media.
Stratified Sampling	Statistical	Site is divided into several sampling areas (strata) based on background or site survey information; each stratum is evaluated using a separate random sampling strategy.	Good for large sites characterized by a number of soil types, topographic features, past/present uses, or manufacturing/storage areas.	Often more cost-effective than random sampling. More difficult to implement in the field and analyze results. Does not take into account spatial variability of media.
Systematic and Grid Sampling	Statistical	Most common statistical strategy; involves collecting samples at predetermined, regular intervals within a grid pattern.	Best strategy for minimizing bias and providing complete site coverage. Can be used effectively at sites where no background information exists. Ensures that samples will not be taken too close together.	Does not take into account spatial variability of media.
Ranked Set Sampling	Statistical	In ranked set sampling, sets of field locations are identified using simple random sampling. The locations are ranked independently within each set using professional judgment or inexpensive, fast, or surrogate measurements.	More efficient than simple random sampling. Ranked set sampling is useful when the cost of locating and ranking locations in the field is low compared to laboratory measurements.	Does not take into account spatial variability of media.
Adaptive Cluster Sampling	Statistical	Sampling designs in which the procedure for selecting sites or units to be included in the sample may depend upon values of the variable of interest observed during the survey.	Takes advantage of population characteristics so as to obtain more precise estimates of population values for a given sample size.	Coefficients of variation for the adaptive sampling may be rather large compared to other designs.
Composite Sampling	Statistical	A composite sample is made from a number of discrete samples which have been collected from a body of material and combined into a single sample with the intention that this single sample is representative of the components of that body of material.	Analytical cost savings.	Limitations include aspects of false negatives or positives and loss of information regarding any relationships between radionuclides in individual samples.

Listed below are several commercially available software tools that can be used to aid designers in the development of SCPs.

NOTE: Mention of company names, trade names, or commercial products in this document does not constitute endorsement or recommendation for use.

- **COMPASS** software was designed to facilitate the use of MARSSIM and to guide the user into making informed decisions in designing final status surveys. COMPASS also simplifies the application of statistical tests by performing the calculations and providing prospective power curves that help determine what level of confidence the user is willing to accept for a particular number of measurements or samples in a survey unit. After performing the final status survey, COMPASS assesses the data for comparison to the cleanup goals. COMPASS is available for download at http://orise.orau.gov/ieav/survey-projects/marssim.htm#compass

- **COMPLY** is a computerized screening tool for evaluating radiation exposure from atmospheric releases of radionuclides. The tool may be used for demonstrating compliance with some EPA and Nuclear Regulatory Commission regulations. COMPLY is available for download at http://www.epa.gov/radiation/assessment/comply.html

- **Cumulative Probability Plot** can be used to plot empirical data on cumulative probability distribution graphs. The software computes parametric statistics and a "test statistic" based on "sampling by variables." It is useful for visual presentation of characterization and final status surveys. Cumulative Probability Plot is available for download at http://www.radprocalculator.com/Probability.aspx

- **Elipgrid-PC Hot Spot Probability Calculations** is used for design and analysis of sampling grids for locating elliptical targets (e.g., contamination hot spots). It computes the probability of success in locating targets based on the assumed size, shape, and orientation of the targets, and on the specified grid spacing. It can also be used to compute a grid spacing from a specified success probability, compute cost information associated with specified sampling grids, determine the size of the smallest hot spot detected given a particular grid, and create graphs of the results. ELIPGRID-PC is available for download at http://dqo.pnl.gov/software/elipgrid.htm

- **GENII-NESHAPS** provides a set of software for calculating radiation dose and risk from radionuclides released to the environment. The GENII-NESHAPS Edition is specifically designed to help site managers plan and improve compliance with 40 CFR 61, subparts H and I. GENII-NESHAPS is available for download at http://www.epa.gov/radiation/assessment/genii.html

- **MARSSIMPower2000** implements the final status survey designs described in the MARSSIM manual. MARSSIMPower2000 is available for download at http://cvg.homestead.com/marssimpower2000.html

- **RESRAD** is a DOE-developed code used for calculation of dose from all pathways from radioactively contaminated sites. Developed by Argonne National Laboratory, RESRAD codes are available for download at http://web.ead.anl.gov/resrad/home2/

- **Spatial Analysis and Decision Assistance** (SADA) is University of Tennessee developed and incorporates tools from environmental assessment fields. These tools include integrated

modules for visualization, geospatial analysis, statistical analysis, human health risk assessment, ecological risk assessment, cost/benefit analysis, sampling design, and decision analysis. SADA is available for download at http://www.tiem.utk.edu/~sada/index.shtml

- **Visual Sample Plan** provides statistical solutions to sampling design (how many samples to take and where to take them) and provides mathematical and statistical algorithms. Visual Sample Plan is available for download at http://dqo.pnl.gov/vsp/

4.8 Writing the SCP - Content of Major Elements

When all of the appropriate site information is gathered, the SCP designers take the information and assemble the SCP. Appendix A provides a checklist of elements that may be used as a template for writing a site-specific SCP. The specific elements that would be appropriate to include in an SCP will depend on site conditions (e.g., the extent and type of the contamination, site size, project needs, and DQOs).

4.8.1 Project Background

With the information gathered during Phase I, including response information turned over by FRMAC, the SCP should provide both a site history, including descriptions of the use of the site, permits, and the use of chemicals and radioisotopes and radiological event information. The historical and response data from any investigation and event sampling efforts should be identified and summarized. An assessment of the quality of the data should be included, as well as a discussion of any problems encountered during initial site assessment and event response. The SCP should include a description and a map of the location, size, and important physical features of the affected area, such as schools, public parks, business centers, transportation infrastructure, water treatment facilities, lakes, streams, drainage and sewer systems, buildings, and roads.

This section of the SCP should also describe the initial investigation radiological issues and the project's planned approach toward resolution.

4.8.2 Project Organization and Responsibilities

This element of the SCP identifies key field personnel or organizations responsible for each field activity during the clean up and remediation. A chart showing project organization and lines of authority should be included. The chart should identify QC management organizations and identify their appropriate independent reporting chain outside project management. This section of the SCP should describe the responsibilities of all project field personnel, including subcontractor roles and their key points of contact, sampling personnel, and liaison personnel between field, laboratory, and QC managers.

This section of the SCP should also identify organizations responsible for:

- Project planning
- Project coordination
- Sample collection
- Disposal of sampling waste
- Sample custody

This section should also identify any special training requirements and/or personnel certifications necessary to perform the project work.

4.8.3 Project Scope and Objectives

The SCP must describe specific project objectives of the sampling effort. It should identify the planned project activities, QA procedures to be implemented to support project activities, relevant regulatory standards, and the project schedule. The intended use of data should be stated and should satisfy the intended uses of the data for meeting identified regulatory requirements and project specific clean up criteria. An outline should be included of the project schedule to include project plan review periods, fieldwork, sample analysis, data management and validation, and project report writing.

4.8.4 Non-Measurement Data Acquisition

The SCP should describe data needed from non-measurement sources, such as databases, literature, handbooks, and local authorities. Information of this type may be needed to support assessment of:

- Data supporting modeling activities
- Public transportation infrastructure
- Street and highway uses
- Land uses (residential, recreational, agriculture, etc.)
- Meteorological data
- Hydrogeological data (local or regional aquifers)
- Geological data (site bedrock formations, soil series)
- Well surveys
- Local relevant or significant habitats
- Endangered species

4.8.5 Field Activities – Project Sample Collection Procedures

The SCP should provide detailed site-specific instructions and requirements that are to be used in conjunction with the sample collection procedures described in EPA's *Sample Collection Procedures for Radiochemical Analytes in Environmental Matrices* (EPA/600/S-07/001, December 2006). The design team should refer to these sample collection procedures for detailed information on how the samples required under the SCP are to be collected. The SCP must provide details to describe the field activities to be performed, including but not limited to, information regarding:

- Sampling and field data-gathering procedures and methods to be used to collect environmental matrix specific field measurements and samples for:
  - Soil and sediment
  - Aqueous and liquid-phase
  - Ground water/drinking water
  - Air
  - Surfaces
  - Building materials
- Collection of geophysical data
- Drilling or borings
- Installation of ground water monitoring wells
- Sample sizes required, for each matrix, to meet DQOs and MQOs
- Number of samples to be collected for each sampling location
- Sample container types and sizes
- QC requirements (e.g., field control QC samples)
- Specific sample collection equipment to be used

- Considerations for sample filtration in the field (if required)
- Sample preservation requirements
- In situ field measurements (if any)

4.8.6 Radiological Field Measurements and Instrumentation

Many site cleanup projects will include on-site screening for detection and/or measurement of contamination. This screening can assist with project planning and reduce the burden of sample collection and analyses. Site RSP requirements for the sampling efforts to be performed should be identified, along with the support function interface between the RPG and the sample collection personnel. A listing of site-specific matrices, the expected radionuclides present in the matrices, and the appropriate instrumentation and measurement techniques to be used for each matrix should be detailed.

4.8.7 Field Operations Documentation

The SCP should identify requirements regarding the records that will be used to document all field operations, and should also identify the records and schedule for those which require periodic submittal. The SCP also should include proposed documentation forms. Corrections to documentation entries must be defined in the SCP according to the requirements of the QAPP and corrective action procedures. Field operations documents may include but are not limited to:

- Daily QC reports
- Field logbooks
- Field work forms
- Boring logs
- Well installation and development forms
- Photographic records
- Field analytical records

This section should also address the sample documentation records, such as:

- Sample numbering system
- Sample labels and tags
- Field sampling logs
- Chain-of-custody forms and custody seals
- Lab notification documentation forms

Sample custody requirements should be defined for:

- Field sample collection
- Sample transfer to the laboratory(s)
- Laboratory custody control

The SCP should also define project records custody requirements for originals of field documentation and laboratory reports. It should define records management practices for but not limited to:

- SOPs
- SOP review documentation and record retention requirements

- Corrective action reports
- Shipment manifesting and bills of lading
- Waste profile forms
- Test logs
- Drum logs, etc.

4.8.8 Sample Packaging and Shipping Requirements

The SCP should include a discussion of sample packaging and shipping requirements in accordance with appropriate federal and state regulations (e.g., Department of Transportation [DOT] regulations found at 49 CFR 171–178; International Air Transportation Association [IATA] regulations). It should identify:

- Appropriate laboratory(s)
- Laboratory(s) addresses and points of contact
- Sample submittal schedule
- Mode of sample transportation (e.g., overnight courier)
- Manifesting requirements for the shipment.

It is recommended that the receiving laboratories also document the condition of field samples upon receipt at the laboratory. This enables verification of correct sample volumes, sample preservation, chain-of-custody completeness and accuracy, and overall packaging techniques.

Sample packaging and shipping procedures described in Module I, Section 7.0, of EPA's *Sample Collection Procedures for Radiochemical Analytes in Environmental Matrices* (EPA/600/S-07/001, December 2006) should also be reviewed before completing this section of the SCP.

4.8.9 Sampling Waste

The SCP should describe procedures that will be used for collecting, labeling, storing, and disposing of the sampling waste. The SCP should detail procedures for assessing corresponding sample results or sampling the waste to determine whether it is hazardous. The SCP should address how the sample results will be evaluated to determine disposal options for the sampling waste. Disposal actions must be conducted with the concurrence of appropriate project technical personnel and management.

4.8.10 Project Quality Assurance (QA)

The SCP must include QA/QC elements that are consistent with the QAPP and are applied throughout the project to ensure proper execution of the SCP and appropriate data generation. The project assessment activities should be discussed as they pertain to the QA objectives identified in the QAPP. In general, the SCP should provide specifications for QA activities by defining in detail:

- Project schedules
- Proper technical review/approval of project documents
- Radiochemical DQOs and MQOs identified in the QAPP, and their respective data quality indicators
- QA/QC protocols necessary to achieve the DQOs and MQOs
- Analytical methods and measurements
- Evaluation of laboratories

- QA samples and sample handling procedures/verification
- QA sample analysis
- Use of single- and double-blind performance evaluation (PE) samples
- Equipment calibration and maintenance documentation
- SCP QA implementation protocols
- Establishing key field personnel experience requirements
- Level of decision making empowered to key field personnel
- Communication protocols between the field and project stakeholders
- Data assessment procedures for the evaluation and the identification of any data limitations, including data review, validation, and reporting
- Generation of required quality reports
- Sampling requirements to support the final status survey

EPA or EPA contract audit personnel should conduct a variety of audits (field, laboratory, office) to identify procedures that could cause problems with sampling and analytical results. The audits should be scheduled as early as possible, and should cover project activities from initial investigation to post closure monitoring to include but not be limited to:

- Sample collection from all media (i.e., air, ground water, surface water, soil, sediment, and waste)
- Placement of sampling devices
- Decontamination of equipment or activities that could cause cross-contamination
- Post sample collection activities (packaging/shipping)
- Laboratory activities
- Data reporting, including electronic media
- Chain-of-custody procedures and documentation
- Field logs
- Well installation and development (if deemed necessary based on the event)

4.8.11 Non-Conformance/Corrective Actions

The SCP must address notification and corrective actions that should be followed by field and laboratory personnel if there are deviations from the SCP or problems with samples upon receipt at the laboratory. Typical problems or deviations include, but are not limited to:

- Improperly preserved samples
- Improper chain-of-custody documentation
- Broken sample containers or questionable sample integrity
- Sample relocation
- Insufficient sample amount

Corrective action procedures must address:

- Corrective actions required if field and/or analytical procedures are found to deviate from the requirements in the SCP
- Re-sampling with additional analysis of new samples
- Reanalysis of existing field or QC samples
- Proper data qualification
- Corrective action protocols necessary in the event of deficiency or failure

- Notification processes
- Contingencies

The SCP must state that significant changes to or deviations from the approved SCP will not be made without the written approval of EPA project management.

4.8.12 SCP Appendices

The SCP appendices should include, but not limited to, the following items:

- References
- List of abbreviations and acronyms
- Standard project forms to be used
  - Chain-of-custody forms
  - Sample labels
  - Shipping manifest
  - Audit forms
  - Non-conformance reporting forms
  - QA report forms
- Summary tables
  - Data quality objectives summary
  - Site cleanup objectives
  - Proposed monitoring well information
  - Sample container preservation and holding time requirements
  - Names and addresses of owners of property near the site
  - Sample container types and quantities
  - Summary of sample matrices and locations
  - Summary of number of samples and analyses
  - Listing of approved analytical laboratories and contact information
- List of figures
  - Project organization
  - Sampling schedule
  - Proposed on-site and off-site sampling locations
  - Proposed monitoring well locations and construction

4.9 SCP Review and Approval

The SCP should be reviewed to determine whether it will provide data that satisfy regulatory requirements, data use needs and DQOs, and whether it is compatible with all site constraints. As a guide, reviewers should use a checklist that contains general information that typically should be included in an SCP. Review checklists can be prepared by reviewing Appendix A and identifying project specific variations.

NOTE: Due to the complexity that each site-specific SCP may require, a detailed checklist is beyond the scope of this document.

Once an SCP has been approved, appropriate personnel sign the signature page. Personnel signing the SCP are determined on a project-specific basis. It is recommended that the incident commander/project manager sign the title page of the SCP, and that the technical manager sign the title page of the associated QAPP. Deviations from the approved SCP must receive written approval. In addition, there may be significant changes in the project that necessitate appending or modifying the SCP. Similar procedures of review and approval for those modified sections are necessary prior to execution of the modifications.

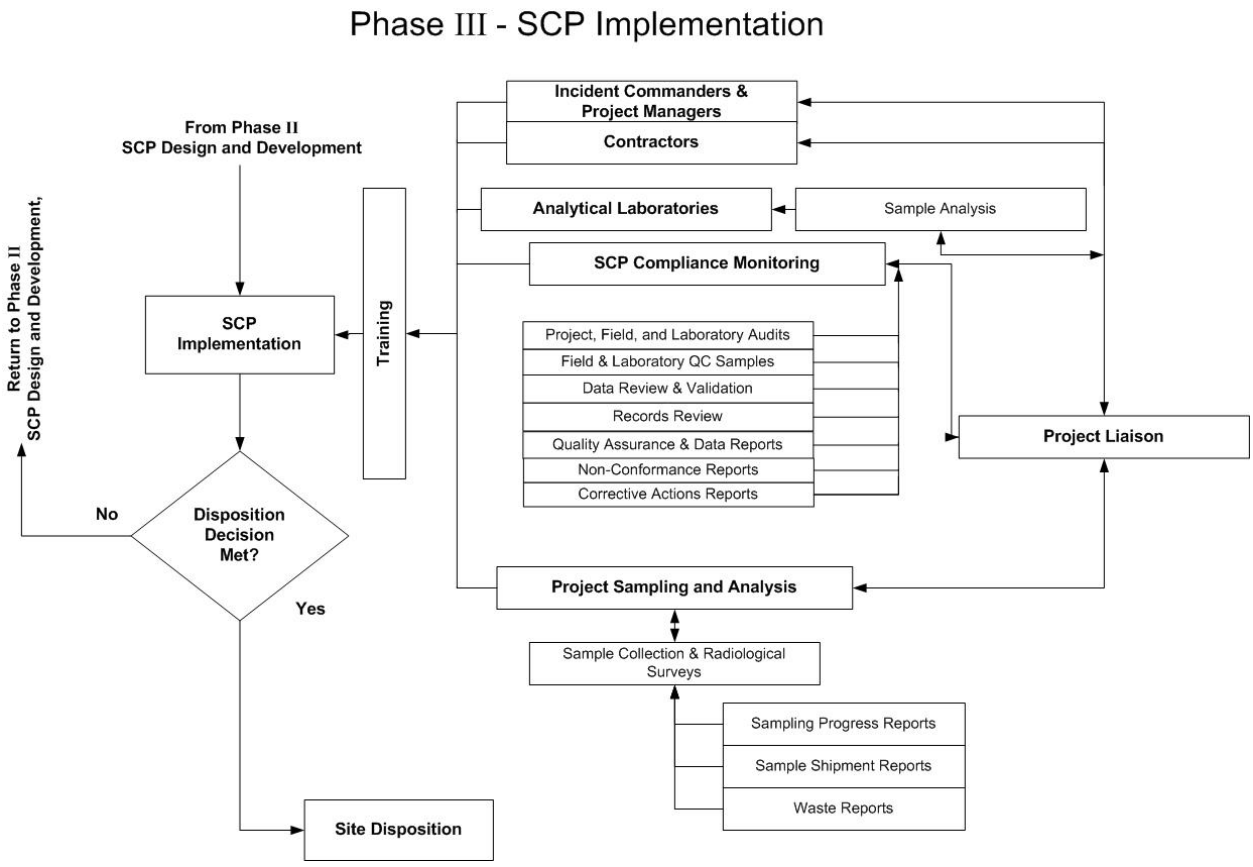
4.10 SCP Distribution

Once approved, the final SCP and/or its approved modifications must be distributed to all appropriate parties, including project and technical managers, primary and QA laboratory(s), appropriate regulatory authorities, stake holders, and subcontractors (i.e., drilling or sampling firms, data validation firms, etc.).

5.0 Phase III - SCP Implementation

An approved SCP must be in place before implementing the SCP activities. Figure 5.1 outlines the SCP implementation elements.

Figure 5.1



5.1 Personnel Training

Prior to implementation of the SCP, project personnel must be adequately trained for their specific duties and possess a full understanding of all aspects of the SCP. Training must include safety and health requirements and practices as defined in the HASP and RSP.

5.2 Field Sample Collection

Prior to performing sample collection, sampling personnel should ensure that proper field equipment is available and in good condition, and sample collection and handling procedures (including sample preservation) are performed in accordance with the SCP and following specifications provided in EPA's *Sample Collection Procedures for Radiochemical Analytes in Environmental Matrices*, EPA/600/S-07/001, December 2006).

5.3 Project Liaison

A liaison between project management, field, and laboratory personnel should be identified to ensure smooth transition of all samples from the field to the laboratory or laboratories. Liaison

duties also may include implementation of proper sample documentation, packaging, and shipping procedures.

5.4 SCP Compliance Monitoring

Before data collection activities are implemented, an approved SCP must be in place and execution must be performed in compliance with the approved SCP. There are several QA elements that may be applied to the project to ensure proper SCP compliance. These include, but are not limited to:

- Field and laboratory audits
- Field and laboratory quality control samples
- Equipment calibration and maintenance documentation
- QA sample handling verification
- QA sample analysis using of single- and double-blind performance evaluation samples
- Data review and/or data validation
- Electronic media audits
- Generation of QA reports and data quality assessment reports

5.4.1 Project, Field, and Laboratory Audits

During implementation of the SCP, field activity audits should be performed for any phase of field work, from initial investigation and data collection, to post closure monitoring. Field audits should be scheduled as early in the activity as possible to identify procedures that could cause problems with the sampling and analytical results. This oversight is necessary to ensure that approved procedures, as specified in the SCP, are used. Field audits include monitoring critical activities such as well installation and development (if deemed necessary based on the event), placement of other sampling devices (e.g., composite), decontamination of equipment or activities that could cause cross-contamination, sample collection from all media (i.e., air, ground water, surface water, soil, sediment, and waste), and post sample collection activities (packaging/ shipping). Laboratory audits must also be performed to ensure that procedures for proper communication, proper documentation, and awareness of project DQOs are in place and that these procedures are in compliance with the analytical SOW.

5.4.2 Project Activity Reports

While data collection activities are being performed, the sampling team should communicate daily with appropriate project personnel regarding project status by submitting at least, but not limited to, the following:

- Field sampling progress reports in relationship to project schedules including field work forms, boring logs, well installation and development forms, photographic records, field analytical records
- Sample shipment reports
- Waste accumulation reports
- Other project required field reports

Project quality assurance monitoring of data collection activities must include all of the applicable QA/QC requirements identified in the SCP and the QA group should communicate daily with appropriate project personnel regarding project status by submitting at least, but not limited to, the following:

- Field and laboratory DQO and MQO evaluation reports
- QA samples and sample handling procedures/verification reports
- QA sample analysis reports
- Non-conformance reports
- Corrective action reports

5.5 Site Disposition

For most sites, following review of data results generated during one or more surveys, a disposition decision is based on a demonstration of compliance with site cleanup goals. When survey results are used to support a decision, the decision maker(s) needs to ensure that the data will support that decision with satisfactory confidence. Actions must be taken to manage the uncertainty in the survey results, so that sound, defensible decisions may be made. These actions include design and implementation of proper survey and sampling plans to control known causes of uncertainty, proper application of QC procedures to detect and control significant sources of error, and careful analysis of uncertainty before the data are used to support decision making.

If the decision maker(s) determine that the cleanup goals have not been met to satisfy the site QAPP due to a sample collection issue, then the SCP will be re-optimized through reevaluation and redesigned. Additional sampling and analysis may be required to satisfy compliance demonstration and site disposition.

6.0 Additional Resources

In addition to the information provided in this document, the following documents are recommended as resources for generating an SCP that clearly identifies project goals, associated data needs, and application of QA elements based upon the QAPP project goals designed to reach site release:

- *Multi-Agency Radiological Laboratory Analytical Protocols Manual*, NUREG-1576; EPA 402-B-04-001A; July 2004 (MARLAP)
- *Multi-Agency Radiation Survey and Site Investigation Manual*, NUREG-1575, Rev. 1; EPA 402-R-97-016, Rev. 1; DOE/EH-0624, Rev. 1; August 2000 (MARSSIM)
- *Guidance for Developing Quality Systems for Environmental Programs*, EPA QA/G-1, EPA/240/R-02/008, November 2002
- *Guidance on Assessing Quality Systems*, EPA QA/G-3, EPA/240/R-03/002, March 2003
- *Guidance on Systemic Planning Using the Data Quality Objectives Process*, EPA QA/G-4, EPA/240/B-06/001, February 2006
- *Guidance for Quality Assurance Project Plans*, EPA QA/G-5, EPA/240/R-02/009, December 2002
- *Guidance on Choosing a Sampling Design for Environmental Data Collection for Use in Developing a Quality Assurance Project Plan*, EPA QA/G-5S, EPA/240/R-02/005, December 2002
- *Guidance on Technical Audits and Related Assessments for Environmental Data Operations*, EPA QA/G-7, EPA/600/R-99/080, January 2000
- *Guidance on Environmental Data Verification and Data Validation*, EPA QA/G-8, EPA/240/R-02/004, November 2002
- *Sample Collection Procedures for Radiochemical Analytes in Environmental Matrices*, EPA/600/S-07/001, December 2006
- *EPA Requirements for Quality Assurance Project Plans*, EPA QA/R-5, EPA/240/B-01/003, March 2001

7.0 References

U.S. Army Corps of Engineers, *Requirements for the Preparation of Sampling and Analysis Plans,* EM 200-1-3, February 2001.

U.S. Department of Energy, *Decommissioning Handbook* (DOE/EM-0383), January 2000.

U.S. Department of Energy, *Statistical and Cost-Benefit Enhancements for the DQO Process for Characterization Decisions (DOE/EM-0316),* September 12, 1996.

U.S. Department of Homeland Security, Federal Emergency Management Agency, Planning Guidance for Protection and Recovery Following Radiological Dispersal Device (RDD) and Improvised Nuclear Device (IND) Incidents, FR Doc E8-17645, Federal Register: (Volume 73, Number 149) [Page 45029-45048], August 1, 2008.

U.S. Environmental Protection Agency, *Guidance for Developing Quality Systems for Environmental Programs,* EPA QA/G-1, EPA/240/R-02/008, November 2002.

U.S. Environmental Protection Agency, *Guidance on Assessing Quality Systems*, EPA QA/G-3, EPA/240/R-03/002, March 2003.

U.S. Environmental Protection Agency, *Guidance on Systemic Planning Using the Data Quality Objectives Process,* EPA QA/G-4, EPA/240/B-06/001, February 2006.

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U.S. Environmental Protection Agency, *Guidance on Choosing a Sampling Design for Environmental Data Collection for Use in Developing a Quality Assurance Project Plan,* EPA QA/G-5S, EPA/240/R-02/005, December 2002.

U.S. Environmental Protection Agency, *Guidance on Technical Audits and Related Assessments for Environmental Data Operations,* EPA QA/G-7, EPA/600/R-99/080, January 2000.

U.S. Environmental Protection Agency, *Guidance on Environmental Data Verification and Data Validation,* EPA QA/G-8, EPA/240/R-02/004, November 2002.

U.S. Environmental Protection Agency, *Data Quality Assessment: A Reviewers Guide*, EPA QA/G-9R, EPA/240/B-06/002, February 2006.

U.S. Environmental Protection Agency, *Data Quality Assessment: Statistical Methods for Practitioners,* EPA QA/G-9S, EPA/240/B-06/003, February 2006.

U.S. Environmental Protection Agency, *Guidance on Quality Assurance for Environmental*

Technology Design, Construction, and Operation, EPA QA/G-11, EPA/240/B-05/001, January 2005.

U.S. Environmental Protection Agency, *EPA Requirements for Quality Assurance Project Plans,* EPA QA/R-5, EPA/240/B-01/003, March 2001.

U.S. Environmental Protection Agency, *Sample Collection Procedures for Radiochemical Analytes in Environmental Matrices*, EPA/600/S-07/001, December 2006.

U.S. Nuclear Regulatory Commission, *A Nonparametric Statistical Methodology for the Design and Analysis of Final Status Decommissioning Surveys*, NUREG-1505, June 1998.

U.S. Nuclear Regulatory Commission, *Multi-Agency Radiation Survey and Site Investigation Manual,* NUREG-1575, Rev. 1; EPA 402-R-97-016, Rev. 1; DOE/EH-0624, Rev. 1; August 2000.

U.S. Nuclear Regulatory Commission, *Multi-Agency Radiation Survey and Assessment of Materials and Equipment (Draft Report for Comment),* NUREG-1575, Supp. 1; EPA 402-R-06-002; DOE/EH-707, December 2006.

U.S. Nuclear Regulatory Commission, *Multi-Agency Radiological Laboratory Analytical Protocols Manual,* NUREG-1576 EPA 402-B-04-001A, July 2004.

U.S. Nuclear Regulatory Commission, *Manual for Conducting Radiological Surveys in Support of License Termination* (NUREG/CR-5849), Draft Report for Comment, June 1992.

Appendix A
Sample Collection Plan Design Elements and Development Checklist

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