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Jennifer L. Pepe
Environmental Restoration Division
DOE, RFO

DATA QUALITY OBJECTIVES (DQO) FOR THE BACKGROUND SOILS CHARACTERIZATION PROJECT (BSCP) – SRJ-009-93

Enclosed please find a draft copy of the Data Quality Objectives for the Background Soils Characterization Project. This draft section will be incorporated into the workplan for this project which is under development. The DQO section was written following the Environmental Protection Agency (EPA) guidelines (Data Quality Objectives for Remedial Response Activities; USEPA, 1987) for DQO development in the Remedial Investigation/Feasibility Studies (RI/FS) process. The purpose of the DQO section was to involve data users early on in the project and to verify that project objectives were in line with the needs of the operable unit (OU) managers. A summary table titled, "Comparison of BSCP Goals With OU Data Uses and DQOs" is attached and was used in the DQO process.

The attached DQO section will comprise Section 4 of the workplan based on a tentative outline for the eight planned sections of the workplan. In Section 4, decision types were identified and data users were surveyed as part of Stage 1 of the DQO process. Data uses, types, and needs were evaluated as part of Stage 2. Stage 3 of the process involves the actual design of the data collection program, which will be performed during workplan development (Section 5 of the workplan).

The BSCP supports the RI/FS activities currently underway in the OUs, however, it is not a RI/FS. Consequently, several aspects of the formal DQO process are not applicable to the BSCP (such as identifying potential receptors). Nevertheless, the DQO process was followed as closely as practicable.

A new DQO guidance document was recently released by EPA (Guidance for Planning for Data Collection in Support of Environmental Decision Making Using the Data Quality Objectives Process; USEPA, October, 1993) and was received here on November 22, 1993. There was not sufficient time to incorporate the new guidelines into this DQO section. EG&G is currently reviewing the new guidelines and will address them in the workplan. The new DQO guidelines are attached to this letter.

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Your thoughts and comments are needed to finalize the DQO section and we would welcome a discussion concerning the new DQO guidelines as well. Once an approved DQO section is finalized, the next step is to make a presentation to the agencies to get their input. EG&G is in the final stages of procuring the services of a subcontractor for assistance in this project and efforts on the workplan should begin immediately after the contract is in place.

If there are any questions concerning the DQOs or other aspects of the project, please contact me at extension 8567 or Jim Whiting at extension 8799.

Sigurd R. Jaunarajs
Environmental Engineer
Geosciences Division
EG&G Rocky Flats, Inc.

jlm

Orig. and 1 cc – J. L. Pepe

Attachments:
As Stated (3)

COMPARISON OF BACKGROUND SOILS CHARACTERIZATION PROJECT (BSCP) PROJECT GOALS WITH OPERABLE UNIT DATA USES AND DQOs

(sheet 1 of 3)

The following is a summary of comparisons between the BSCP project goals and the Operable Unit DQOs. The Operable Unit data uses and other DQOs were summarized by 1) examining each OU's most recent work plans, technical memoranda, and/or reports, 2) responses from data use questionnaires circulated to each of the OU managers, 3) interviews and meetings between BSCP personnel and OU managers, 4) pertinent regulatory guidelines. Other data users on the staff of EG&G which were identified and interviewed included air modelers (AM), ground water modelers (GWM), surface water modelers (SWM), geochemical modelers (GCM), risk assessment personnel (RA), ecologists/environmental evaluation personnel (EA)and remedial design engineers (RD).

PHASE	DATA OBJECTIVE	DATA TYPE	DATA USE	DATA USER	COMMENT
1 (0-5cm)	Determine background means and variances in the surficial soils for selected analytes Also: Test hypothesis Ho: Rock Creek Data Set is within the range for "background"	• Radiological analyses • TAL metals • TCL semi-volatiles • Pesticides/PCBs	Site Characterization Nature and extent of contamination Risk assessment Environmental evaluation Preliminary remediation goals (PRGs)	OU1 OU2 OU3 OU4 OU5 OU6 OU7 OU8 OU9 OU10 0U11 OU12 OU13 OU14 OU15 OU16 AM GWM SWM GCM RA	Phase III RI/RFI is complete; Rock Creek data set was used for background; BSCP goals should address future corrective and remedial action needs RI/RFI is complete; used Rock Creek data set; BSCP goals should address corrective and remedial needs RI/RFI is nearing completion. Data (but not report from BSCP) may be timely to bolster data set for comparisons with background; otherwise, uses Rock Creek data; BSCP shall have minimal effect on OU3. OU3 analyzed only for radionuclides Phase I RI/RFI is nearing completion; however, IM/IRA is in progress; Phase II RI/RFI , CMS/FS, and corrective action/remedial design is forthcoming. BSCP goals should address present and future OU4 needs RI/RFI in progress. Draft due Nov93, Final May94. Data (but not report from BSCP) may be timely to bolster data set for comparisons with background; otherwise, uses Rock Creek data. Future needs addressed. RI/RFI in progress. Draft Jun94, Final Dec94 . BSCP goals may be in time for present OU5 needs RI/RFI is nearing completion. Data from BSCP may not be in time for some of present OU 7 needs. RI/RFI in progress. BSCP goals should fit present and future OU8 needs Phase 1 not likely to be applicable to OU9 (pipelines) needs, but Phase 2 of BSCP can support needs RI/RFI in progress. BSCP goals should fit present and future OU10 needs RI/RFI is nearing completion. Data from BSCP may not be in time for some of present OU 11 needs. RI/RFI in progress. BSCP goals should fit present and future OU12needs RI/RFI in progress. BSCP goals should fit present and future OU13needs RI/RFI in progress. BSCP goals should fit OU14 needs Soils data may not be applicable to inside building closures data needs Expect a Record of Decision soon for no further action. No data needs anticipated. Concentrations of analytes support modeling needs for the 0-5 cm environment for all modelers Comparison of concentrations with background determines PCOC's for Risk Assessment

COMPARISON OF BACKGROUND SOILS CHARACTERIZATION PROJECT (BSCP) PROJECT GOALS WITH OPERABLE UNIT DATA USES AND DQOs (cont'd)

(sheet 2 of 3)

PHASE	DATA OBJECTIVE	DATA TYPE	DATA USE	DATA USER	COMMENT
1 (0-5cm)	Determine background means and variances in the surficial soils for a set of additional chemical and physical parameters.	• Total organic carbon • Bulk density • Particle size analysis • pH (lab) • Nitrate/nitrite • Specific conductance	Fate and transport model Environmental evaluation	OU1-OU15 AM GWM SWM GCM RA EA RD	Comments are similar to above Data types for Phase 1 shall supplement modeling needs. Additional data more specific to general modeling needs shall be available from Phase 2. Risk assessment employs data types for fate and transport of contaminant modeling of inhalation pathway. Additional data shall be available from Phase 2. The bulk of environmental evaluation data types shall come from Phase 2. The bulk of remedial design/alternative selection/remedial monitoring data types shall come from Phase 2.
2 (0-4ft)	Determine background means and variances in soil horizons for each major soil group for selected analytes	• Radiological analyses • TAL metals • TCL semi-volatiles • Pesticides/PCBs	Site Characterization Nature and extent of contamination Risk assessment	OU1 OU2 OU3 OU4 OU5 OU6 OU7 OU8 OU9 OU10 0U11 OU12 OU13 OU14 OU15 OU16 AM GWM SWM GCM RA	RI/RFI is complete; soil profile data may support further research such as the soil profiling and vertical distribution of actinides done for OU1 by M.I. Litaor Same as OU1 comment RI/RFI is nearing completion. Otherwise, same as OU1 comment Phase I RI/RFI is nearing completion; however, IM/IRA is in progress; Phase II RFIRFI, CMS/FS, and Corrective action/remedial design is forthcoming. BSCP goals should address present and future OU4 needs RI/RFI in progress. Draft due Nov94, Final May95. Concentrations of materials in soil profiles are not at this time measured in OU5, but data types should support modeling and remedial action monitoring RI/RFI in progress. Draft Jun94, Final Dec94 . Otherwise, comment similar to OU5. RI/RFI is nearing completion. Data from BSCP may not be in time for some of present OU 7 needs; however shoud be useful for future OU7 needs RI/RFI in progress. Soil profiling may be included in OU8 field sampling. BSCP data may be timely. Trenching near pipelines should be able to use natural soils data from Phase 2 for comparisons, for modeling, and for remedial action during feasibility study. RI/RFI in progress. BSCP goals should fit present and future OU10 needs RI/RFI is nearing completion. Data from BSCP may not be in time for some of present OU 7 needs; however shoud be useful for future OU11 needs RI/RFI in progress. BSCP goals should fit present and future OU12 needs RI/RFI in progress. BSCP goals should fit present and future OU13 needs; soil profiling may be included in OU13 field sampling. Soil profiling may be included in OU14 field sampling. Soils data may not be applicable to inside building closures data needs Expect a Record of Decision soon for no further action. No data needs expected from BSCP. Concentrations of analytes in major soil horizons for each major soil group should support modeling needs for all modelers Risk assessment modeling and future potential comparisons with concentrations in each major soil horizon may benefit from Phase 2 data

COMPARISON OF BACKGROUND SOILS CHARACTERIZATION PROJECT (BSCP) PROJECT GOALS WITH OPERABLE UNIT DATA USES AND DQOs (cont'd)

(sheet 3 of 3)

PHASE	DATA OBJECTIVE	DATA TYPE	DATA USE	DATA USER	COMMENT
2 (0-4ft)	Determine background means and variances for a set of additional chemical and physical parameters for each soil horizon for each major soil group. Data intended for modeling purposes and engineering purposes.	• Bulk density • Soil pH • Texture-particle size anal. • Porosity • Total organic carbon • Cation exchange capacity • Clay mineralogy • Anions	Fate and transport model Evaluation of remedial alternatives Engineering design of alternatives Monitoring during remedial action Site characterization Post closure monitoring	OU1-OU15 AM GWM SWM GCM RA RD	Comments are similar to the comments for Phase 2 above. These additional data types in Phase 2 shall support fate and transport models for all uncompleted RI/RFI investigations. All OUs and data users shall be able to use these data for corrective measure/remedial action studies, decisions, and actions.
2 (0-4ft)	Coordinate soil pit sampling activities with soil scientists/ecologists for the purposes of ecological and environmental investigations	• Vegetation data • Soil nutrient data • Soil microorganism data	Environmental evaluation	EA	Nutrient pools, microorganism counts, and vegetation data are expected to be data types which ecologists shall collect.

4.0 DATA NEEDS AND THE DATA QUALITY OBJECTIVES (DQO) PROCESS

4.1 Data Needs

Most environmental regulations establish as a fundamental principle the need for collecting baseline information from background soils data . Baseline soils information from background soils characterization provides data types required for decision making in three distinct RI/FS tasks:

1. Determination of the nature and extent of contamination
   - Establishment of the spatial extent of plutonium contamination as an indicator of the "boundary" of background areas located upgradient and upwind of RFP activities
   - Establishment of background concentrations of contaminants of concern to use as comparisons with concentrations found in affected areas
2. Risk assessment and determination of risk-based soil cleanup levels
   - Development of fate and transport of contaminant models
   - Establishment of background concentrations of contaminants of concern for a determination of "background" risk assessment for comparison purposes
3. Helping to determine the potential effectiveness of soil remediation alternatives
   - Evaluation of alternatives
   - Development of fate and transport of contaminant models
   - Engineering design of alternatives
   - Monitoring during remedial action

(References for the above include: Characterizing Soils for Hazardous Waste Site Assessments, Breckenridge, et. al., EPA 540/4-91/003, March 1991, US EPA, Wash. D.C; Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, SW-846, Supplement 1990 EPA-600/4-79-019, US EPA, Wash. D.C.; Methods for Evaluating the Attainment of Cleanup Standards, Volume 1: Soils and Solid Media, EPA 230/02-89-042, 1989, US EPA, Wash. D.C)

Soils characterization provided by the BSCP also supports these additional tasks:

4. Site characterization for site-wide physical features (soil)
   - refining and/or validating existing soil maps by photo-interpretation and soil profile analysis
   - characterizing soil physical and chemical parameters
   - focusing field investigation activities
   - focusing sample analytical parameters
5. Environmental evaluations
   - coordinating soil pit analysis with ecological/environmental investigators
6. Assessment of the health and safety of workers during the BSCP
7. Any other activities involving or requiring the use of the characteristics and natural composition of the soils

In order to meet the present and future background soils data needs most effectively, every aspect of the plan for the Rocky Flats Plant (RFP) Background Soils Characterization Project (BSCP) - the project objectives, the field sampling design and process, the lab and data analysis, quality control/quality assurance, etc.- has been built upon the framework of the Data Quality Objectives (DQOs) process as outlined in Data Quality Objectives for Remedial Response Activities (U.S. EPA 1987). This section of the work plan (Section 4) outlines the rational for development of the BSCP work plan using the DQOs as a guideline. A full description of the resulting Sampling and Analysis Plan can be found in Section 5 of this work plan.

4.2 Data Quality Objective Process

The Data Quality Objective process is a starting point for the detailed design of a data collection effort. Data Quality Objectives are qualitative and quantitative statements which specify the quality of the data needed to support specific decisions or regulatory actions. DQOs are the basis for specifying the quality assurance and quality control activities and requirements associated with the data collection process.

Data quality objectives are developed through a three stage process, as illustrated in Figure 4-1. The process is not as sequential as the figure might suggest; rather, all DQO elements are continually reviewed in an iterative and interactive manner. The DQOs and the sampling and analysis plan are revised, as necessary, as results of each data collection effort indicate. (Barth, et. al., Soil Sampling Quality Assurance User's Guide, Second Edition, March 1989, EPA/600/8-89/046, US EPA, Las Vegas, Nevada, p.16.; and US EPA, 1987, Data Quality Objectives for Remedial Response Activities: Development Process, EPA/540/G-87/003, March 1987, US EPA, Wash. D.C.).

4.2.1 Stage 1 - Identification of Decision Types (Figure 4-2)

The purpose of Stage 1 of the DQO process is to identify the individuals responsible for decisions regarding use of background soils characterization data, to identify and involve data users, and to define the types of decisions which will be made by those using the data.

4.2.1.1 Identification and Involvement of Data Users

In general, users of data from the Background Soils Characterization project are likely to be primarily those who are involved with the RI/FS process at Rocky Flats Plant who shall use the data: 1) to compare background with non-background contaminant concentrations in order to monitor and assess environmental degradation and the risk to human health that may have resulted from past work practices at Rocky Flats Plant, and, 2) to use physical and chemical data from natural soils to model the fate and transport characteristics of contaminants and to assess and design remedial action alternatives, if necessary. Although comparisons of contaminant concentrations between affected areas and background, risk assessment determinations, and remedial action decisions are beyond the scope of this work, the background data necessary for making those decisions comprise the bulk of this work. The potential data users for this project are identified in the following paragraphs.

Data users for RI/FS projects fall into one of the following categories; decision makers, primary data users, secondary data users, and technical support/review groups. The decision makers' roles include deciding on the nature of contamination (the contaminants of concern), assessing the risks to human health and the environment posed by Rocky Flats Plant contaminants, delineating the extent of the contaminated areas, deciding on acceptable cleanup levels, and choosing feasible alternatives for cleanup operations. The primary data users role is to provide technical information and guidance to the decision makers, to delineate which concentrations constitute contamination and which are variations in background.

After identifying the data users, an interactive program was initiated in order to involve them in the development of the objectives for the study and the design of the sampling and analysis plan. Questionnaires and informal conversations as well as reviews of work plans, reports, regulatory guidelines, and technical literature were utilized to solicit data user involvement. The results of that interaction provide much of the information for developing BSCP DQOs.

- Decision Makers:
  - Remediation Project Managers (OU managers) for each of the 16 designated Operable Units (OUs) at Rocky Flats Plant
  - Personnel from EG&G, DOE, EPA, and CDH who are involved in decision making through management and regulatory oversight
  - Rocky Flats Technical Review Group

- Primary Data Users are those individuals from EG&G and its subcontractor(s) involved in the Background Soils Characterization project and ongoing RI/FS activities at Rocky Flats Plant: (listed by task)
  - Characterizing site physical features (soil): geoscientists, soil scientists, and ecologists on the staff of EG&G and its subcontractors as well as on DOE, EPA, and CDH staffs
  - Determining the nature and extent of contamination: statisticians, chemists and those listed above for site characterization
  - Risk Assessment: risk assessors, health and safety personnel, fate and transport of contaminant modelers, and those listed above for defining the nature and extent of contamination

- Helping to determine the potential effectiveness of soil remediation alternatives: design engineers, contaminant fate and transport modelers, geoscientists, statisticians
-Environmental evaluations: soil scientists, ecologists, biologists
-Health and safety personnel

- Secondary Data Users:
  - RCRA/CERCLA investigations at other sites and scientific investigations (the BSCP shall add to the body of data regarding baseline soil characterizations for selected analytes and selected soil physical parameters for regional and worldwide comparisons)
  - Public (Citizen's groups, neighboring municipalities, business community, etc.)
  - ongoing and future soil monitoring programs at and near RFP
  - land managers

- Support Group: (includes personnel from EG&G and its subcontractors and EPA, DOE, CDH)
  -laboratory management
  -database management
  -quality assurance
  -records control
  -compliance monitoring

4.2.1.2 Evaluation of Available Information

DESCRIPTION OF THE CURRENT SITUATION

A description of the site physical features and a brief historical background of activities at Rocky Flats Plant can be found in the introductory section (Section 1) of this work plan. Previous investigations (Section 2) and a compilation of several conceptual models from various Operable Units (Section 3 and Section 4.2.1.3) suggest that soils which are upwind and upgradient (generally south through west to north) of known activities at the Rocky Flats Plant (see figures 4-3a through 4-3c) represent "background", or natural, soils. The term "background", however, must be carefully defined, especially with respect to the "surficial soil" environment (upper 5 cm of soil). The U.S. Environmental Protection

Agency (EPA) defines natural background as ambient concentrations of chemicals present in the environment uninfluenced by human activities; while anthropogenic background is defined as concentrations of chemicals consistently present in the environment because of human-made, non-site-specific sources (i.e. agriculture, automobiles, world-wide fallout levels, etc.).

A recent study (Chem-Risk, Task 6 Draft Report for Phase I Dose Reconstruction Study, May 1993) has indicated that twelve materials have been identified as potential materials of concern for off-site human health hazard, although approximately 8,000 materials have been used at Rocky Flats Plant. Those twelve materials include six solvents used in operations (carbon tetrachloride, chloroform, methylene chloride, tetrachloroethylene, 1,1,1-trichloroethane, and trichloroethylene), one non-radioactive metal (beryllium), three radioactive metals (plutonium- 238,239,240,241,242; uranium-233,234,235,238, and americum-241), and tritium, the radioactive isotope of hydrogen. The volatile solvents mentioned above are not likely to remain in surface soil which indicates that, as a minimum, radionuclides and beryllium are of principal concern as contaminants off-site.

BSCP Phase 1 and Phase 2 investigations shall not limit analysis to these few analytes; rather, a suite of radionuclides, metals, and semi-volatile organic compounds shall comprise the list of analytes in order to provide data for assessment of site specific contaminant comparisons with sampling which has been and will be conducted in the Operable Units. The need to distinguish contaminants, notably the radionuclides mentioned above, which were produced by activities at Rocky Flats Plant from contaminants present due to widespread human contamination, requires that we use "anthropogenic background" as our definition for background concentrations of materials in natural soils.

Since the isotopes of plutonium and americium-241 are not naturally occurring in detectable amounts in naturally occurring soils or their parent materials, their presence shall be due to fallout from atmospheric testing or due to atmospheric deposition and/or runoff from activities at RFP. Uranium and its daughter products, on the other hand, can be found in natural soils at varying amounts, depending upon the parent material. The

challenge for establishing true means and variances for some of the materials of concern can be illustrated by the following examples:

Example 1: Uranium and its daughter products exist in detectable amounts in naturally occurring soils, but the relative concentrations vary depending on the geologic parent material. Although the upper 5 cm of soil may be comprised partly of organic matter and windblown loess transported from distant sources, the underlying soil parent material may influence the relative abundance of uranium and its daughters. In order to partially account for variability of the amounts of uranium due to natural background, therefore, it is prudent to sample several soil groups similar to those which exist at Rocky Flats Plant. Since the Flatirons soil is a major soil series found at Rocky Flats Plant and is found only in regions fairly proximal to RFP, sampling for uranium and its daughters should be designed in areas thought to be unimpacted by RFP, but nearby. Variance of concentrations of uranium in background soils may also be due to worldwide fallout, as discussed in the next example.

Example 2: Although the sampling program shall be designed generally upwind and upgradient from RFP activities, it may be difficult, if not impossible, to distinguish whether very low levels of plutonium-239/240 ($<.10$ pci/g) are due to variances in fallout levels for this region, are due to the influence of activities at Rocky Flats Plant, are due to analytical errors including statistical counting errors while measuring low concentrations of plutonium, or are due to sampling error. The literature suggests that during the decades of above ground nuclear weapons testing, plutonium, uranium, and other radionuclides were transported by winds and air movements globally and removed by in-cloud scavenging - called rainout and snowout - and by washout from precipitation below clouds. (Holloman, et. al., Worldwide Fallout of Plutonium from Nuclear weapons Tests, ORNL, March 1987, p.6). A study of plutonium-239/240 concentrations in southern Colorado and northern New Mexico (Purtyman, et. al. Plutonium Deposition and Distribution from Worldwide Fallout in Northern New Mexico and Southern Colorado, Los Alamos National Labs, August 1990) has found that Pu-239 levels in soils varies from .001 to .08 pci/g, depending on regional and local weather patterns, differences in particle sizes of the plutonium, and differences due to varying erosion and transport conditions. Since fallout plutonium in snow may have been

transported into snowdrifts which may have accumulated in the lee of topographical features and micro-topographical features during the years of above ground nuclear testing, it is not unreasonable to propose that variation in certain radionuclides may exist due to topographical and micro-topographical features. Since plutonium seems to exhibit little downward vertical mobility in soils (Litaor), the variability of plutonium concentrations due to world-wide fallout should still be evident in the surficial soil environment.

Other offsite sources of widespread contaminants, besides atmospheric fallout, include atmospheric deposition of uranium from the burning of uranium-rich coal in western power plants and atmospheric deposition of trace metals and other contaminants in airborne pollution from industrial sources along the Front Range. Since the intent of the sampling program is to determine as nearly as possible the makeup of background soils, sampling locations nearby potential off-site point sources such as Highways 128 and 93 and the railroad spur west of the plant shall be avoided.

REVIEW OF AVAILABLE DATA

Previous studies and existing data regarding background investigation of soils and other media, and of non-background soil sampling data have been organized into the following categories in order to be more useful for this study.

Background Investigations of other media:

- Background Geochemical Characterization (EG&G, Background Geochemical Characterization Report, 9/93)

Upwind/upgradient surficial soils sampling CDH method

- Western Aggregates
- Colorado Dept. of Health
- OU3

Upwind/upgradient surficial soils sampling RFP method

- RFP Environmental Monitoring program
- OU3
- Rock Creek
- Hammond
- Rockwell/Dow
- Illsley/law suit

Upwind/upgradient soils other methods

- Poet and Martell (1 cm)
- Krey and Hardy 1970 (0-20)
- Krey, et. al. 1976 (0-20)
- CSU (3 cm)

Remote background surficial soils sampling CDH method

- Colorado Dept. of Health
- OU3

Remote background surficial soils sampling RFP method

- OU3
- Rick Lawton- Rockwell/Dow
- Hammond
- Rockwell/Dow
- Illsley/law suit

Remote background soils sampling other methods

- Poet and Martell (1 cm)
- Krey and Hardy 1970 (0-20)
- Krey, et. al. 1976 (0-20)
- CSU (3 cm)
- ORNL
- Purtyman et. al. 1990
- Fallout studies
- OU3 trenches (Litaor)
- Shacklette
- Savannah River

Non-background surficial soils sampling CDH method

- OU1
- OU2
- OU3
- CDH

Non-background surficial soils sampling RFP method

- OU1
- OU2
- OU3
- OU4
- OU5
- OU6
- OU7
- Dow/Rockwell
- Hammond
- Environmental monitoring

Non-background soils sampling other methods

- Poet and Martell (1 cm)
- Krey and Hardy 1970 (0-20)
- Krey, et. al. 1976 (0-20)
- CSU (3 cm)
- Purtyman et. al. 1990
- OU 2 and OU3 trenches (Litaor)
- Gamma emission surveys (Reimann)
- Alpha emission surveys

Other Pertinent data

- Mass spec isotope ratios- Krey, CSU
- Soil Survey of Golden Area, Colorado as a general soil map for the area
- Soil Survey of Boulder County Area, Colorado
- Aerial color and color infrared photographs of RFP and surrounding region for photo-interpretation and re-mapping, where necessary, of soil map units and similar soil groupings
- Borehole logs from OUs to use for classification of soils in OUs
- Existing maps, GIS data sets, 2 foot contour maps, 20 foot contour maps

ASSESSMENT OF THE ADEQUACY OF THE DATA

Use of non-validated data

Only the Rock Creek data and the data, both remote background and non-background data, collected for each of the OUs has been validated.

However, a considerable body of non-validated information, particularly for Pu-239/240 can be utilized by geostatistical analysis to determine whether historical upwind/upgradient sampling sites exhibit spatial distribution from the plant site. If the data is not sufficient for a complete geostatistical analysis, the data can serve to design semi-variograms for a more complete geostatistical analysis requiring more samples. The purpose of the geostatistical analysis in part is to ascertain the so called "boundary" outside of which background concentrations are thought to exist.

Remote background data, together with upwind/upgradient data from historical sampling sites, can be combined and analyzed to estimate the population mean and variance for some of the radionuclides. These estimates can then be used to determine the number of samples required to meet pre-specified statistical parameters such as confidence interval and power of statistics for the sampling plan for Phase 1.

Data comparability

Although samples to determine plutonium contamination of soil have been collected periodically in and around RFP since it was built in 1952, no large scale sampling occurred until 1969 (p. 58 Task 6 Draft Report, Chem Risk). From 1969 until 1990 most soil sampling efforts have been designed to determine the extent of plutonium contamination in the surficial soil. Since 1990, sampling efforts have included analyzing for a broader suite of radionuclides as well as for a suite of metals. The Rock Creek background study added suites of semi-volatile and volatile organic compounds to metals and radionuclides.

Over the years, several methods were employed to sample soil for plutonium contamination. Initially, Krey and others with the Health and Safety Lab of the Atomic Energy Commission (predecessor to DOE), sampled to a depth of 20 centimeters (cm) in order to determine a complete inventory of plutonium in the soil. The Colorado Department of Health (CDH) developed a method which sampled to a depth of 0.64 cm in order to assess the risk of plutonium to human health which is potentially respirable by resuspension of dust from soils. Poet and Martell obtained samples in 1972 to a depth of 1 cm for examining plutonium

contamination. Krey, Poet and Martel, and, more recently, M. Z.. Litaor, sampled to greater depths (up to a meter or more) in order to assess the vertical distribution of actinides in soil.

The so-called RFP method has been used at the Rocky Flats Plant site for the ongoing environmental monitoring soil sampling program as well as other extensive sampling programs. The RFP method samples to a depth of 5 cm and is considered a compromise between determining total plutonium inventories in the soil and providing information for assessing human health risk through the inhalation pathway. The RFP sampling method is evaluated later in Section 4.2.2.5.

Comparisons of data sets which have been collected at different times and by different methods require assumptions which may or may not be altogether valid. Where it is possible, data sets employing similar methods collected within a reasonably similar time period shall be used for BSCP geostatistical analysis and design. A comparison of sampling methods (between the CDH method and the RFP method which were both collected at each sampling location for OU2 and OU3 sampling programs) may be useful to determine the degree of correlation between those methods for geostatistical purposes. Although comparisons between data collected for determination of the nature and extent of contamination in the various OUs with data to be collected by the BSCP is beyond the scope of this work, the data comparability requirements shall be addressed below under the Stage 2 DQO process, "Review of PARCC Parameters".

Rock Creek data set

Samples from eighteen locations in the Rock Creek drainage in the northwest quadrant of the buffer zone of Rocky Flats Plant were collected utilizing the RFP method in 1992 and 1993. Those data were collected in support of RCRA/CERCLA investigations for OU1 and OU2 regarding the need to establish a background basis for determining the nature and extent of contamination and for providing background data for human health risk assessment purposes. The sample locations were selected to represent soil types found in OU1 and OU2, but upwind and upgradient of suspected contaminant sources. Samples were analyzed for 9 radionuclide analytes (Am-241, gross alpha particle activity, gross beta particle activity,

plutonium-239/240, Ra-226, Ra-228, U-233/234, U-235, and U-238), 8 "water quality parameters" (% solids, ammonia, bicarbonate as CaCO3, carbonate, nitrate/nitrite, oil and grease, total organic carbon, total solids), 30 heavy metals on the total analyte list (TAL) for metals, 68 semi-volatile organic compounds, and 27 pesticide/pcb compounds.

Criticisms for using the Rock Creek data set as representative background for surficial soil contaminant concentrations include:

1. the sample sites may not have been located in a true "background" area
2. the small number of sample locations may not provide an adequate sample size for determining means and variances of contaminant concentrations
3. the sample sites may not completely represent all soil types found in all other operable units

The objectives of Phase 1 (outlined in paragraph 4.2.1.4 below) shall address those criticisms with its sampling design. Phase 2 shall address potential additional data needs at soil depths from the surface to four feet.

4.2.1.3 Development Of Conceptual Site Model

(Figures 4-3a through 4-3c)

Conceptual Model

A preliminary conceptual model was developed for addressing data needs and to illustrate the rationale for choosing the general locations for potential background soil areas for Phase 1 and Phase 2. The conceptual model incorporates the following elements: 1) the measurable analytes of concern that the soils may contain; 2) the sources, both RFP and offsite, of those analytes; and 3) the pathways of analyte migration leading from sources to the background soils. Several considerations were made in developing the conceptual model. A background soils area is one which is located close enough to RFP contaminant sources such that soil types, climate and weather considerations, landforms and physiography, and potential off-site contaminant sources, pathways, and concentrations are all similar enough to those found in the RFP operable units; then the

background soils area represents a reasonable analog. However, the area chosen cannot be so close to RFP sources such that contaminant releases from RFP contribute to measurable concentrations, which in effect renders it a non-background area.

The basic elements of a conceptual model for RI/FS work as proposed by the EPA include a source, pathway and receptors for contaminants. These elements were used in developing this preliminary conceptual model, although the "receptors" of contaminants in this case are the background soils. Figure 4-3a depicts the basic elements of the conceptual model. Both offsite and RFP sources are considered.

Offsite sources include atmospheric testing conducted in the northern hemisphere which produced radionuclides. These radionuclides were entrained in the atmosphere, transported downwind by prevailing winds, and deposited on the surficial soils via precipitation and dry depostion. A second major offsite source of metals and certain radionuclides are naturally occurring rocks, mineral deposits, and sediments. The mountains to the west of RFP are the source of a portion of potential contaminants of concern occurring in background soils, as well as in quaternary geologic materials on which soils have formed. Transport of contaminants has occurred through several mechanisms such as wind erosion, stream sediment transport, and transport of dissolved constituents via ground water and surface water. Another potential source of radionuclides, metals, and semi-volatile compounds are numerous offsite activities. Activities capable of contributing contaminants to background soils in the RFP area include: industrial operations in the Denver metropolitan area; mining operations in the mountains; automobile and rail traffic in the vicinity; and small businesses/light industry in the immediate vicinity. A schematic representation of offsite sources of potential contaminants of concern and pathways leading to potential background soils areas is presented in Figure 4-3b.

RFP also may have contributed contaminants to potential nearby background soil areas. With the exception of plutonium, the source terms for other contaminants (other radionuclides, metals, and semi-volatile compounds) are considered too small to have affected concentrations in background surficial soils. Despite this observation, all potential source

terms which may have had an influence on background soils are addressed here. Radionuclides from the 903 Pad (IHSS 112) are generally considered to have been moved by wind dispersion to the east/southeast, however, they may have also affected potential background areas to the west of RFP. Activities and incidents within the industrial areas of RFP such as the '57 and '69 fires are also potential sources of contaminants in background areas. This scenario is unlikely when prevailing wind direction and wind velocities necessary to exceed resuspension "threshold" levels are considered. Metals and radionuclides may have been dispersed to potential nearby background areas as a result of waste management practices at the Ash Pits (IHSS 133). Spraying operations at the West Spray Field (IHSS 168) may have contributed metal and radionuclides to background surficial soils via overspray and surface runoff; however, the effect of surface runoff is thought to be minimal because surface drainage occurs predominantly to the east and away from potential background areas. A schematic representation of potential RFP sources and pathways is presented in Figure 4-3c. All technically feasible RFP sources of contamination, associated pathways, and transport mechanisms must be considered when assessing potential areas for background soil sampling.

The preliminary conceptual model of background soils focuses on areas generally to the west, northwest, and southwest of RFP as potential background areas. They share similarities with soils found within RFP OUs in terms of parameters affecting soils. These areas are located generally upwind of RFP, with respect to the prevailing winds in the area, and are upgradient with respect to surface water and ground water flow. Soils in these areas are comprised of naturally occurring potential contaminants of concern and have the potential for containing contaminants from other offsite sources. Their close proximity to RFP contaminant sources makes it plausible that contaminants from RFP operations may have affected some areas, in which case those areas are ineligible for consideration as background soil sampling locations.

4.2.1.4 Specify Study Objectives

The BSCP shall employ a two-phased approach to meet the objectives of the project. Simply stated, Phase 1 shall sample the "surficial" soil environment, i.e., the upper 5 cm (2 inches) of the soil surface. Phase 2 shall sample major soil horizons at selected locations to a depth of 4 feet by the use of back hoe excavated pits. Phase 2 shall collect hand augered core samples in areas delineated as wetlands rather than utilizing back hoe excavated pits in order to minimize impacts to those sensitive areas. Detailed sampling and analysis plans for each phase are described in Section 5 of the work plan. Overall objectives are outlined below and listed by task in Table 4-1. Specific objectives for each phase and their associated data needs, based on existing data and the background conceptual model, are outlined in Table 4-2.

Phase 1 objectives

The main objectives for Phase 1 support the need to compare background with non-background contaminant concentrations in order to monitor and assess environmental degradation and the risk to human health that may have resulted from past work practices at Rocky Flats Plant. A secondary objective is to test the hypothesis that the Rock Creek data set is located in a true background location and that the concentrations of chemicals from the Rock Creek data set represent background values. This secondary objective is included here in order to validate, qualify, or disqualify the Rock Creek data set as background for OUs 1, 2, and 3. Those Operable Units require some level of background values for reports which are completed or shall be completed before the final report from the BSCP is made available.

Phase 2 objectives

The main objectives for Phase 2 are to support the need to use physical and chemical data from natural soils to model the fate and transport characteristics of contaminants and to assess and design remedial action alternatives, if necessary. A secondary objective is to provide data to support the need to compare background with non-background contaminant concentrations in the soil solum (i.e., the upper soil layers, often the A and

B horizons which lay above the parent material and support most of the living roots and other living plant and animal activity). Other objectives include supporting environmental evaluations, ecological studies, and any other activities involving or requiring the use of the characteristics and natural composition of the soils.

4.2.1.5 Determine Need For Additional Data

Available data

The available surficial soils data from Operable Units 1,2,3,4,5,6, and 7 serve to identify sources, contamination migration pathways, and potential receptors for a variety of potential contaminants of concern. Some of the validated data from OU3 and from the Rock Creek study may prove to be located in background areas and may therefore be included as data points for the BSCP. Other surficial soils data which have not been validated and which come from locations upwind and upgradient from activities at RFP shall serve as data for a geostatistical determination of the spatial distribution of plutonium upwind and upgradient. The purpose of geostatistics is to attempt to determine the extent of contamination from known sources at RFP and thereby identify areas proximal to RFP which may be considered "background" for plutonium. Plutonium shall be considered to be the indicator for the spatial extent of contamination of all analytes of concern. Surficial soils data which has not been validated and comes from locations remote to RFP, but not located upwind and upgradient, may be used, along with compilations from literature sources, as data points for establishing means and variances of plutonium for the Front Range regional area. Soils data collected from pit/trenches in OU1, OU2, and OU3 may be used to help characterize site-wide soils and indicate potential contaminants of concern in the soil profile. Soil cores taken from various locations may be used to help characterize site-wide soils.

Need for additional data

Existing surficial soils data (from the surface to 5 cm or less) are not adequate to:

1. Geostatistically determine the location of "background" areas upwind/upgradient from RFP
2. Establish statistically defensible means and variances of potential contaminants of concern in "background" areas

Background soils data from the surface to four feet has not been collected. That data is needed to:

1. further characterize the site by describing major soil types found at and nearby RFP
2. characterize baseline chemical and physical parameters of each soil type for each horizon for fate and transport modeling and engineering properties
3. serve as baseline for vertical extent of potential contaminants through the soil "solum"
4. aid environmental evaluation investigations

Therefore, collection of additional soils data is warranted. Stage 2 of the DQO process assesses data uses and data needs.

4.2.2 Stage 2 - Identification of Data Uses/Needs (Figure 4-4)

4.2.2.1 Identify Data Uses

Data collected by the BSCP for surficial soils and soils to a depth of four feet shall serve as background concentration data and baseline physical and chemical data for the following data uses:

1. Determination of the nature and extent of contamination including site characterization for site-wide physical features (soil)
2. Risk assessment and determination of risk-based soil cleanup levels
3. Helping to determine the potential effectiveness of soil remediation alternatives
4. Environmental evaluations

5. Assessment of the health and safety of workers during the BSCP
6. Any other activities involving or requiring the use of the characteristics and natural composition of the soils

The BSCP data collection effort is designed to be used by those concerned with present RI/RFI activities at Rocky Flats Plant; however, it also anticipates future use by those concerned with remedial action feasibility studies and implementation, by the scientific community, and others who have an interest in background soils information. Data uses specific to the BSCP are listed in table 4-1.

4.2.2.2 Identify Data Types

Data types needed to meet each objective of the BSCP are outlined in Table 4-2. These data types fall into 5 broad categories: pre-sampling data types, field survey data types, chemical parameters (contaminants), physical parameters, and spatial data. Specific data types for each phase are summarized in Table 4-3.

4.2.2.3 Identify Data Quality Needs

Table 4-2 lists the analytical levels appropriate to intended data uses. Data quality will be achieved by adhering to the data collection and analysis protocols provided in agency-approved EG&G Rocky Flats Environmental Management Department Operating Procedures (Volumes I through VI) and the General Radiochemistry and Routine Analytical Services Protocol (GRRASP), Parts A and B.

The EPA defines five levels of analytical data (EPA, 1987c from OU3 work plan) associated with data quality:

Level I-Field screening or analysis using portable instruments. Results are often not compound specific or quantitative, but results are available in real-time. Level I is the least costly analytical option. Level I is typically used for initial site characterization.

Level II-Field analyses using more sophisticated portable analytical instruments. In some cases, the instruments may be set up in a mobile laboratory on-site. There is a wide range in the quality of data that can be generated. Quality depends on using suitable calibration standards, reference materials, and sample preparation procedures; and training the operator. Results are available in real time or several hours later. Level II is typically used for site characterization and evaluation of alternatives.

Level III-These analyses are performed in an off-site analytical laboratory. Level III analyses may or may not use contract laboratory program (CLP) procedures, but do not usually use the validation or documentation procedures required of CLP Level IV analyses. The laboratory may or may not be a CLP laboratory. Level III is typically used for site characterization, evaluation of alternatives, and risk assessment.

Level IV-CLP routine analytical services (RAS). All analyses are performed in an off-site CLP analytical laboratory following CLP protocols. Level IV is characterized by rigorous QA/QC protocols and documentation. Level IV is typically used for risk assessment and evaluation of alternatives.

Level V-Analyses by nonstandard methods. All analyses are performed in an off-site analytical laboratory that may or may not be a CLP laboratory. Method development or method modification may be required for specific constituents (such as for radionuclides) or detection limits. CLP special analytical services (SAS) are level V. Level V is typically used for risk assessments.

4.2.2.4 Identify Data Quantity Needs

Phase 1 data quantity needs

A determination of the data quantity needs for determining the spatial extent of contaminants of concern as indicated by the spatial extent of plutonium contamination from the RFP plant source awaits a geostatistical analysis of existing data as explained earlier in section 4.2.1.4 and in Table 4-2. Data quantity for Phase 1 shall then depend on the number of samples needed to establish the "boundary" of background areas and the number of

samples necessary to determine, with a 95% confidence interval, the background mean of plutonium 239/240 (Note: the confidence interval and the analyte(s) of concern is(are) subject to change as development of the work plan proceeds.)

Phase 2 data quantity needs

The primary objective of Phase 2 is to provide baseline soils characterization of natural soils similar to those found in affected areas at Rocky Flats Plant. The major use of the data is to provide information for deriving fate and transport models in and through the upper four feet of the soil for risk assessment and for remedial alternative purposes. Secondary uses of the data include engineering properties for remedial design and, of lower priority, background contaminant data for major soil horizons in each of the major soil groups. Characterizations similar to Phase 2 at other DOE facilities (Oak Ridge, Hanford, Savannah River Site) have generally employed a limited number of sampling locations for each of the major soil groups . In order to provide cost-effective, useful baseline soil characterization data, The BSCP shall collect samples from back hoe excavated pits or hand augered cores from an estimated 4 to 8 sampling locations for each of 4 or 5 major soil groups. The number of samples to be collected shall depend somewhat on the variance of the highest priority analytical parameter(s). If the variance(s) of priority parameter(s) is(are) unacceptable and an increased number of samples can be obtained to decrease the variance(s) in a cost-effective manner, then additional locations will be sampled; if not, then additional sampling shall await subsequent investigations, if warranted.

4.2.2.5 Evaluate Sampling/Analysis Options

Phase 1 sampling options (depth and compositing techniques)

Several surficial soil sampling methods have been used at Rocky Flats Plant and vicinity and EPA Region VIII for radionuclide, organic, and inorganic compound sampling. A brief outline of commonly used methods follow:

METHOD	USED BY	OBJECTIVE	DEPTH	COMPOSITE
CDH (Colorado Dept. of Health)	CDH, OUs, other investigations	Primary: assess potential for resuspension of radionuclides by inhalation Secondary: indicator of radionuclide inventory in soil	0-.64 cm (0-2 inches)	25 subsamples from large areas (usually 10 acre plots)
EPA (Environmental Protection Agency)	?	Primary: assess potential for resuspension of radionuclides by inhalation Secondary: indicator of radionuclide inventory in soil	0-1 cm	?
Poet and Martell	Colorado Committee on Environmental Information (CCEI) report	Primary: assess potential for resuspension of radionuclides by inhalation Secondary: indicator of radionuclide inventory in soil	0-1 cm	?

METHOD	USED BY	OBJECTIVE	DEPTH	COMPOSITE
CSU (Colorado State University)	CSU	Compromise between assessing potential for resuspension and radionuclide inventory in soil	0-3 cm	?
grab sample	OUs, other investigations	assess contamination under pavement. quick sampling at other areas to assess potential contamination	variable	?
old RFP	OUs, other investigations	Compromise between assessing potential for resuspension and radionuclide inventory in	0-5 cm	10 subsamples from 2 square meters
RFP	OUs, other investigations	Compromise between assessing potential for resuspension and radionuclide inventory in soil	0-5 cm	5 subsamples from 1 square meter
Remote sensing (in situ alpha and gamma)	OUs, site wide	Field screening for radionuclides	?	NA

These various methods were evaluated to meet the main objectives of Phase 1 which include 1) providing data for comparing inventories of certain analytes of concern between background and impacted areas, 2) providing data for risk assessment determinations, 3) testing the hypothesis that the Rock Creek data set represents background. The RFP method was chosen as a cost effective method which a) meets the comparability DQO objective (outlined in the next section), b) provides the required information for assessing inventory levels of contaminants and risk assessment data, and c) was the method used by the Rock Creek study.

Phase 1 sampling design (selection of sampling locations)

Sampling location options for areas thought to be unimpacted by RFP activities include:

- locations generally upwind from potential atmospheric deposition of radionuclides and other contaminants due to resuspension of contaminants in the soils and due to stack emissions or burning from sources at RFP
- locations generally upgradient from contaminants in soil, ground water, or surface water from sources at RFP
- locations on-site at Rocky Flats Plant
- locations off-site but in the local region
- locations remote from the RFP region

Selecting suitable background sampling locations for Phase 1 presents several challenges, each of which must answer the question, "Is this location truly background? In other words, is this location in an area unimpacted by activities at Rocky Flats Plant?" Some of these challenges include:

1. Variance of low level fallout radionuclide concentrations in global fallout.
   - influence of local and regional winds and weather
   - influence of accumulation in snow (snowdrifts) and subsequent removal by melting
   - influence of local transport mechanisms (resuspension, re-deposition, surface runoff, etc.)

2. Variance of low level fallout radionuclide concentrations due to sampling error.

3. Variance of low level fallout radionuclide concentrations due to analytical error (statistical counting error, instrument error, and other potential error due to radiological analysis techniques)).
   - The mean "true" values reported in the literature do not often report the counting error or the detection limit for the method.

4. Possible variance of naturally occurring radionuclides and metals due to geologic parent material.

5. Varying methods for reporting global fallout in soil from the literature.

6. Other sources of radionuclides and/or other contaminants (from highways, railroads, etc.) from activities not linked to RFP activities.
7. Problems of off-site access

8. Cost effectiveness

Consideration of these challenges leads to the selection of sampling locations outlined in the Sampling and Analysis Plan. These locations have been chosen using professional judgment and geostatistical techniques.

Phase 1 analysis options

(Note: This section needs further input regarding selection of specific analytes, in particular, a final selection of "indicators" for semi-vols, pesticides/pcbs, and any adjustments to potential contaminant of concern. This section may also need a discussion regarding whether physical/chemical parameters like ph, bulk soil density, particle size data for soil types are better addressed in Phase 2.)

Phase 2 Sampling/Analysis options

Precedent for a soil pit/trench sampling technique has been set by M. Z. Litaor in studies for OU1, Ou2, and OU3 regarding the vertical distribution of actinides in soil and is outlined in EMD-OP Volume III GT.7. This sampling technique is generally consistent with USDA soil profile description techniques and shall meet the requirements for meeting Phase 2 objectives.

Phase 2 sampling locations will be selected after the geostatistical analysis of historic data for Phase 1 indicates acceptable locations. Sampling design options include judgmental, random, stratified, systematic, and geostatistical. The sampling design will be a combination of judgmental and stratified random sampling statistical designs in order to utilize professional judgment for selecting soil types in background similar to soil types in affected areas.

Phase 2 analysis (Note: this section needs further input regarding selection of specific analytes. in particular, a final selection of "indicators" for semi-vols, pesticides/pcbs, and any adjustments to potential contaminant of concern. Also adjustments regarding whether physical/chemical parameters like ph, bulk soil density, particle size data for soil types are better addressed in phase 2.

4.2.2.6 Review of PARCC Parameter Information

PARCC parameters are indicators of data quality. Precision, accuracy, and completeness goals are established for this Work Plan according to the data types and the analytical levels. PARCC goals shall be specified in the Quality Assurance section (Section 7) of this work plan.

Background soils information is designed to be in support of OU activities at RFP, therefore the PARCC requirements for the BSCP are modeled after those for the OUs. The GRRASP provides a listing of the CLP analytes and detection/quantification limits for Target Compound List (TCL) semi-volatile organics, Target Analyte List (TAL) metals, radionuclides, and inorganic parameters. These analytical methods are appropriate for meeting the data quality requirements for analytical Levels I through V. The precision, accuracy, and completeness parameters for analytical Levels I through V are discussed below, along with the completeness and representativeness for all analytical levels.

Precision is a measure of the variability in repeated measurements of the same sample compared to the average value for all samples. Accuracy measures the bias or source of error in a group of measurements; bias is an indication of the systematic error within an analytical technique. Precision and accuracy objectives for the analytical data collected for the BSCP will

be evaluated according to the control limits specified in the referenced analytical method and/or in data validation guidelines. For the radionuclide analyses, the accuracy objectives specified in GRRASP will be followed. The specified criteria for precision and accuracy are described in the Quality Assurance section (Section 7) of this work plan. Precision and accuracy for non-analytical data will be achieved through protocols outlined in agency-approved operating procedures and Document Change Notices (DCNs) to those procedures, where appropriate.

Completeness is defined as the percentage of measurements made that are judged to be valid. The target completeness objective for the BSCP field and analytical data is 100 percent, although 90 percent will be the minimum acceptable level.

Comparability is a qualitative parameter that expresses the confidence with which one data set can be compared with another. As stated above in this work plan, comparability between historic surficial soil data sets may be dependent on the sampling method used and the time between sampling periods. (Note: A comparison of results between the CDH sampling method and the RFP sampling method for OUs 2 and 3 is being considered [conversation with M. I. Litaor] and may be finished in time to be included as a part of the sampling and analysis plan.) In order to achieve comparability with surficial soils data utilizing the RFP method, work will be performed in accordance with approved sampling and analysis plans, standard analytical protocols, and approved standard operating procedures (SOPs) for data collection. Consistent units of measurement will be used for data reporting.

Representativeness expresses the degree to which sample data accurately and precisely represent the characteristics of a particular site or population, parameter variations at a sampling point, or an environmental condition. Representativeness is a qualitative parameter related to the proper design of the sampling and analysis program. As outlined in the Sampling and Analysis section (Section 5) of this work plan, sample location selection has been designed to represent soil types and environmental conditions found in the affected areas at Rocky Flats Plant. The Sampling and Analysis Plan described in Section XX of this work plan, as well as the referenced SOPs, describe the rationale for the sample program to provide

for representative samples. In designing the field sampling program, statistical considerations shall be given when selecting sample locations and sample numbers.

4.2.3 Stage 3 - Design Data Collection Program (figure 4-5)

The purpose of Stage 3 of the DQO process is to design the specific data collection program for the BSCP. To accomplish this, the elements identified in Stages 1 and 2 shall be assembled and the Sampling and Analysis Plan (SAP) prepared. The SAP consists of (1) a Quality Assurance Project Plan (QAPjP) that describes the policy, organization, functional activities, and QA/QC protocols necessary to achieve the DQOs dictated by the intended use of the data and (2) a field sampling plan (FSP) that provides guidance for all fieldwork by defining in detail the sampling and data collection methods to be used in the BSCP. These two components are presented in other sections of this work plan. A detailed discussion of all samples to be collected is presented in the Sampling and Analysis Plan for each phase and includes sample type, number of samples, sample location, analytical methods, and QA/QC samples.

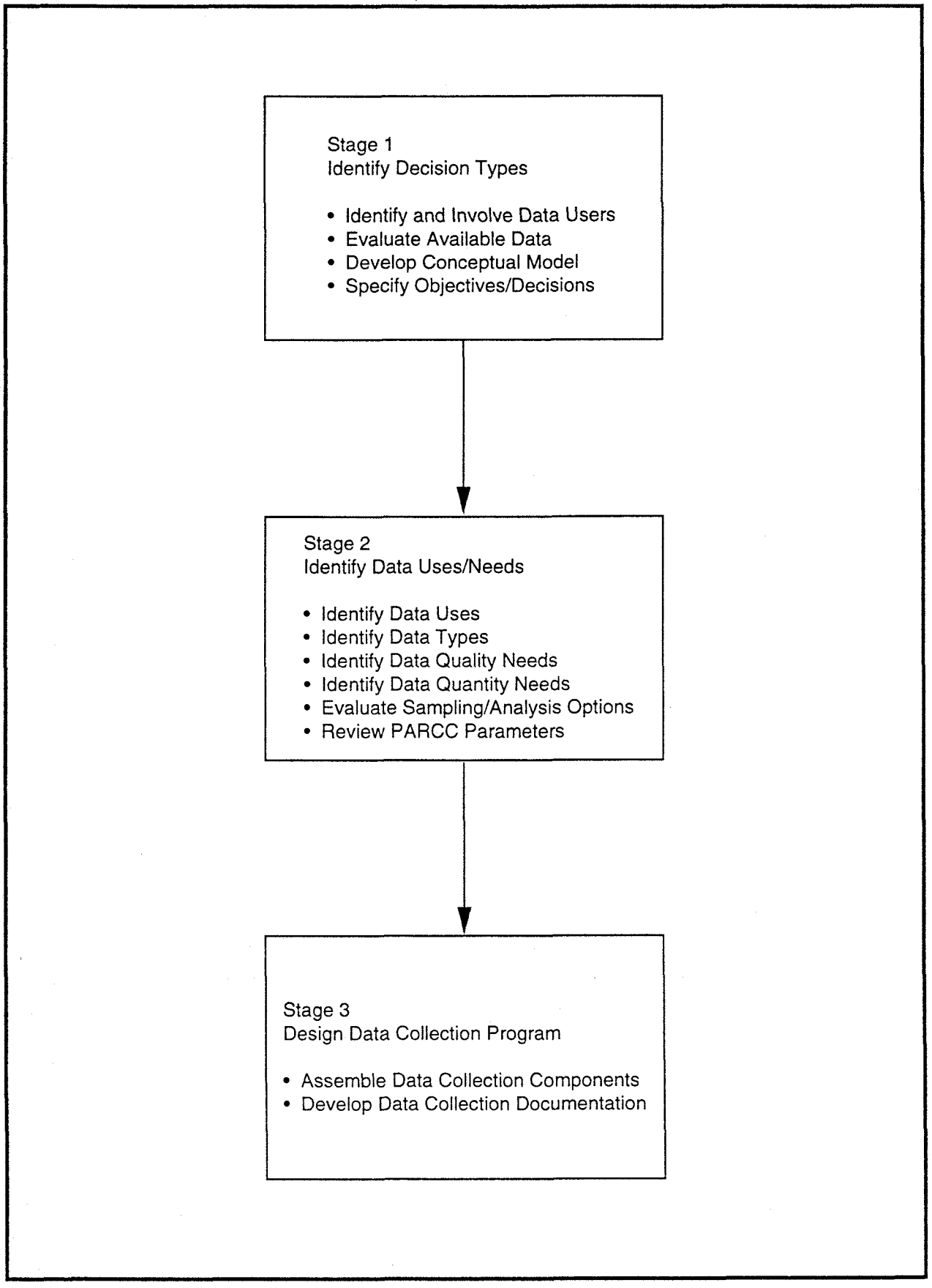

Figure 4-1 DQO Three-Stage Process

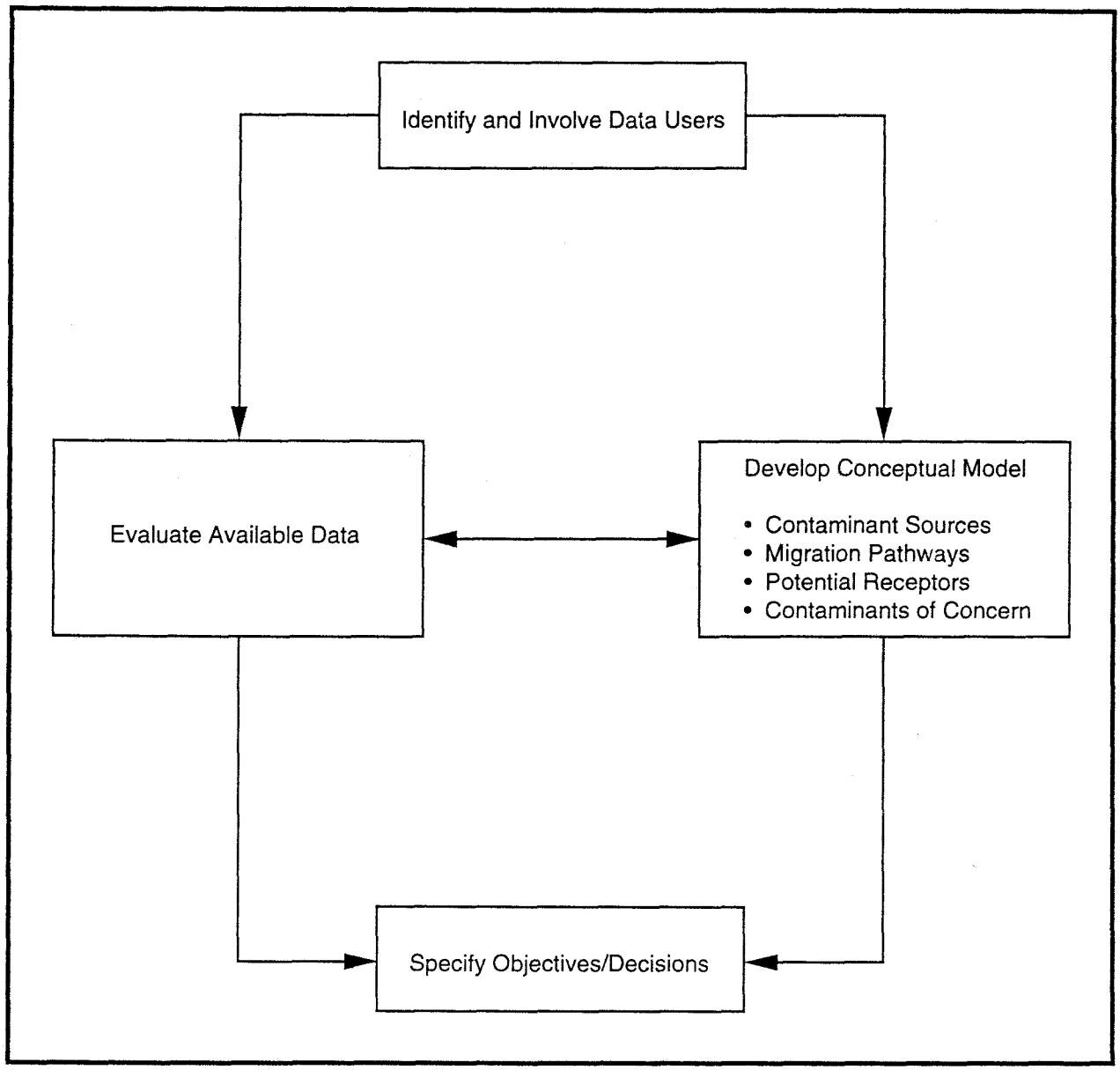

Figure 4-2 DQO Stage 1 Elements

Figure 4-3a Elements of the Conceptual Model

Source	Pathways	Receptor
Offsite		
Radionuclides from Atmospheric Testing	Air	*Soils in the Vicinity of RFP*
Radionuclides and Metals That are Naturally Occurring in Soils and Geologic Materials	Air, Surface Water, Groundwater, and *in Situ*	Soils in the Vicinity of RFP
Metals, Radionuclides, and Semi-VOAs from Point-Specific Offsite Locations	Air, Surface Water, and Groundwater	Soils in the Vicinity of RFP
RFP		
Radionuclides from the 903 Pad	Air (Secondary Surface Water)	Soils in the Vicinity of RFP
Radionuclides from the '57 and '69 Fires	Air (Secondary Surface Water)	Soils in the Vicinity of RFP
Metals and Radionuclides from Activities in the Ash Pits	Air (Secondary Surface Water)	Soils in the Vicinity of RFP
Metals and Radionuclides from Activities at the West Spray Field	Air and Surface Water	*Soils in the Vicinity of RFP*
Contaminants from Other IHSSs	Air	Soils in the Vicinity of RFP

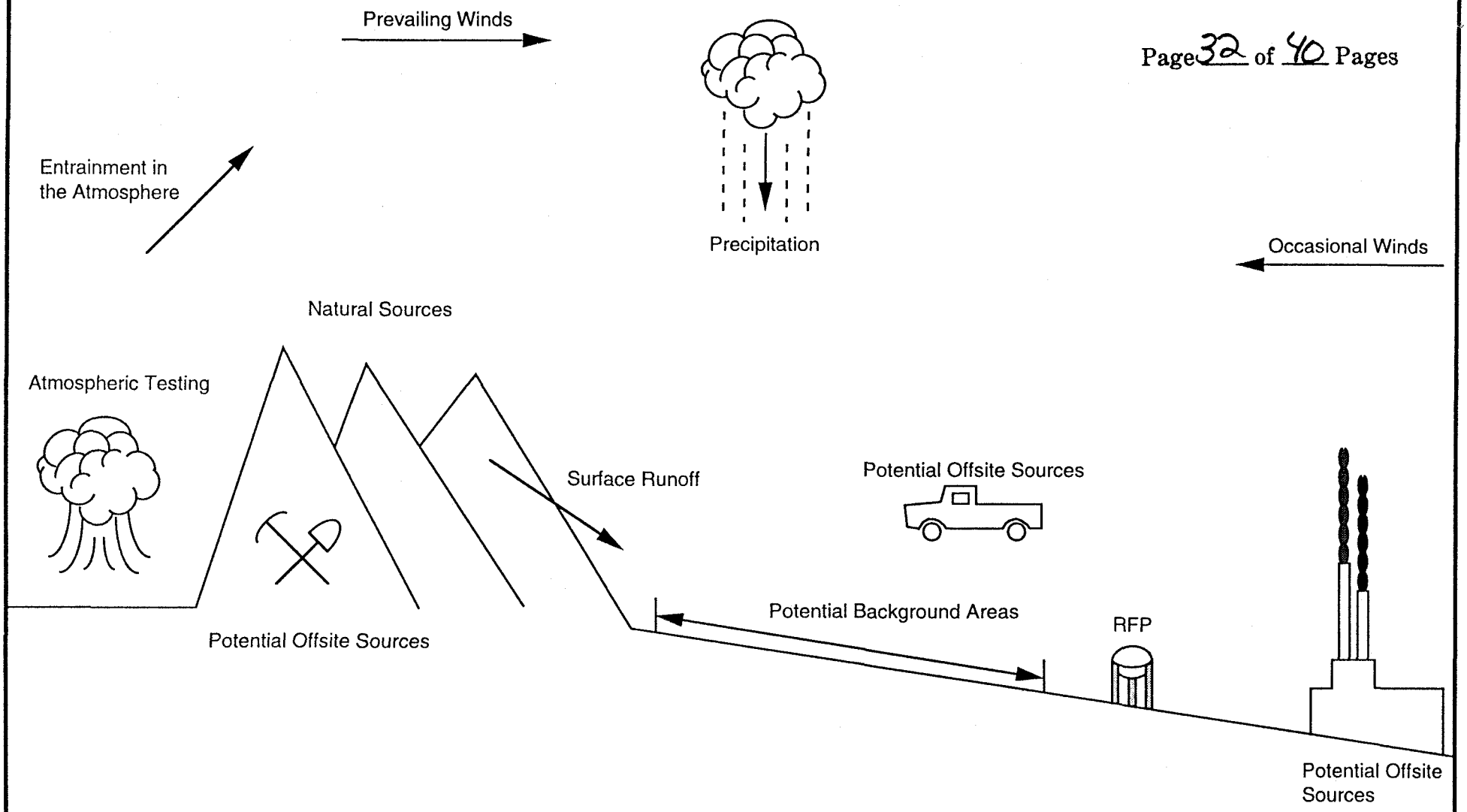

Figure 4-3b Schematic Conceptual Model – Background Areas and Offsite Sources of Potential Contaminants of Concern

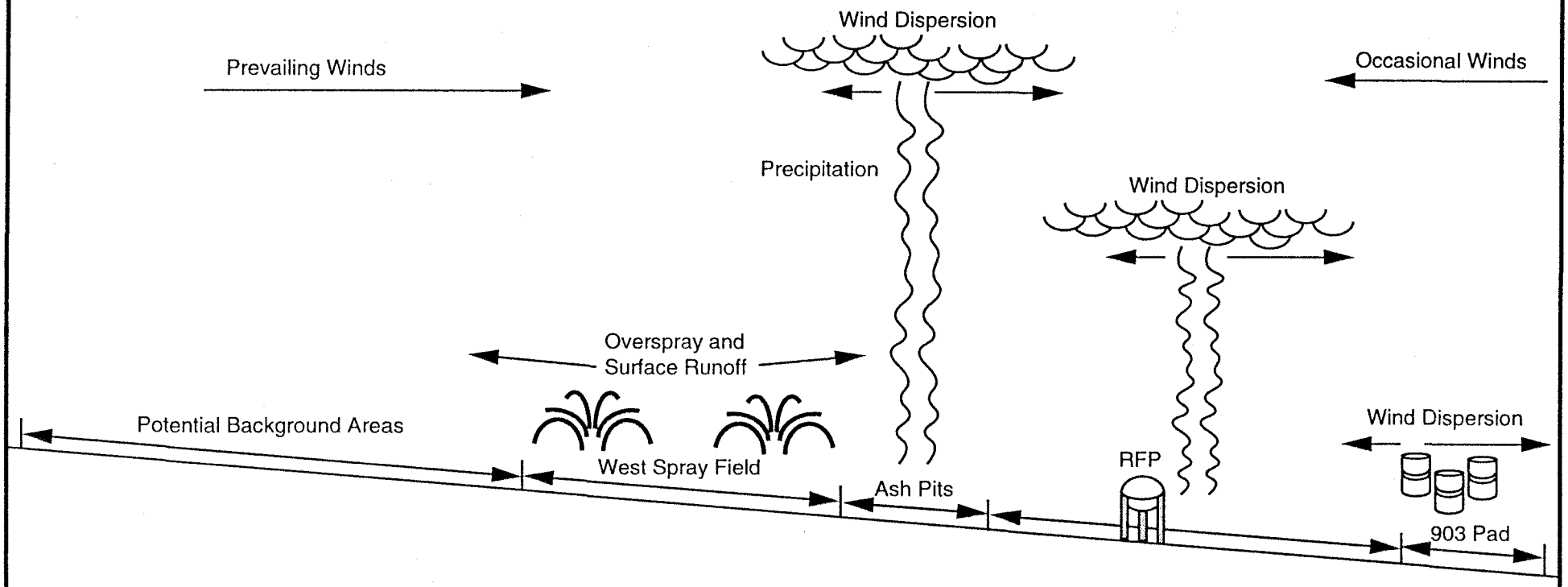

Figure 4-3c Schematic Conceptual Model – Background Areas and RFP Sources of Potential Contaminants of Concern

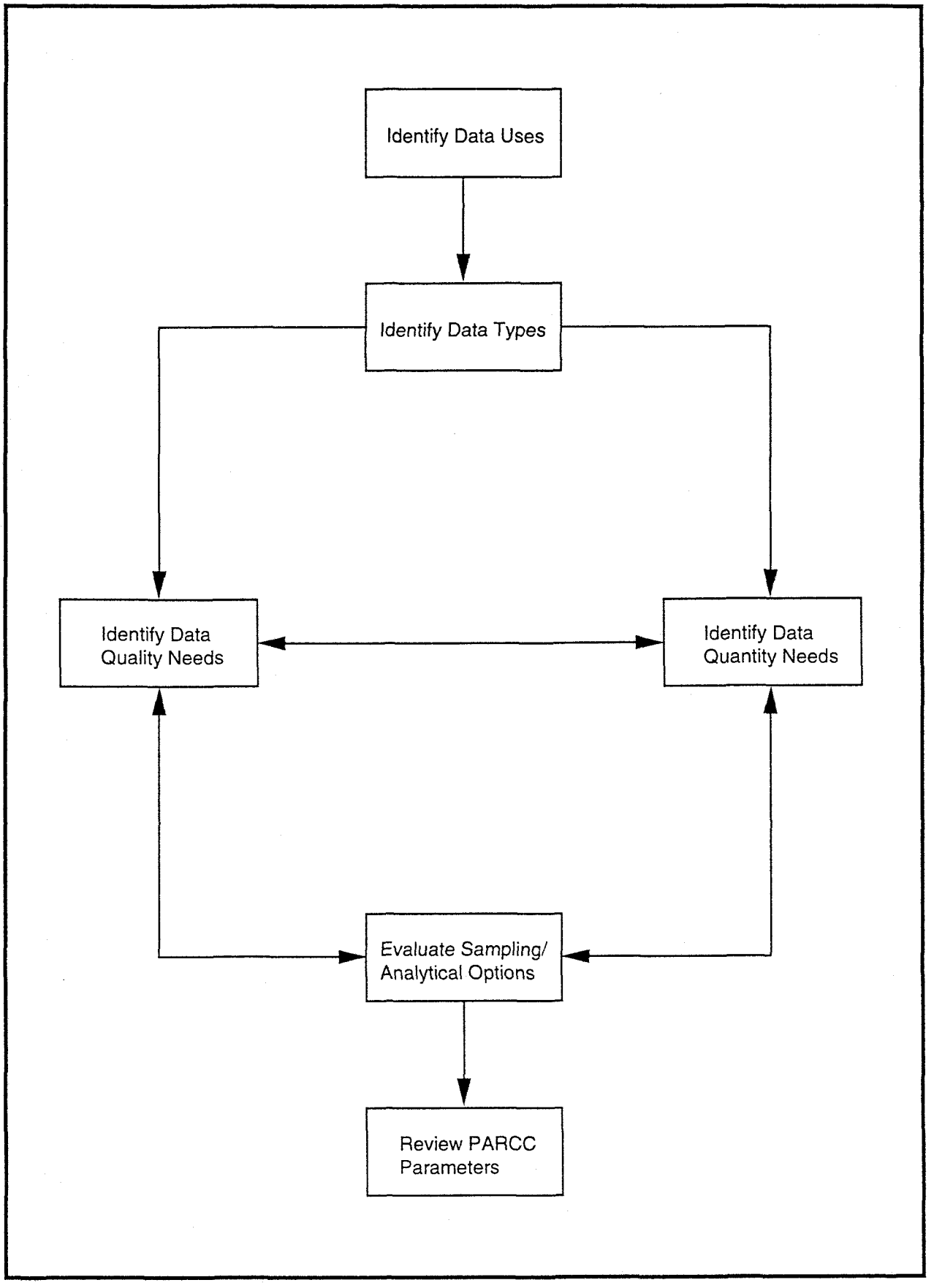

Figure 4-4 DQO Stage 2 Elements

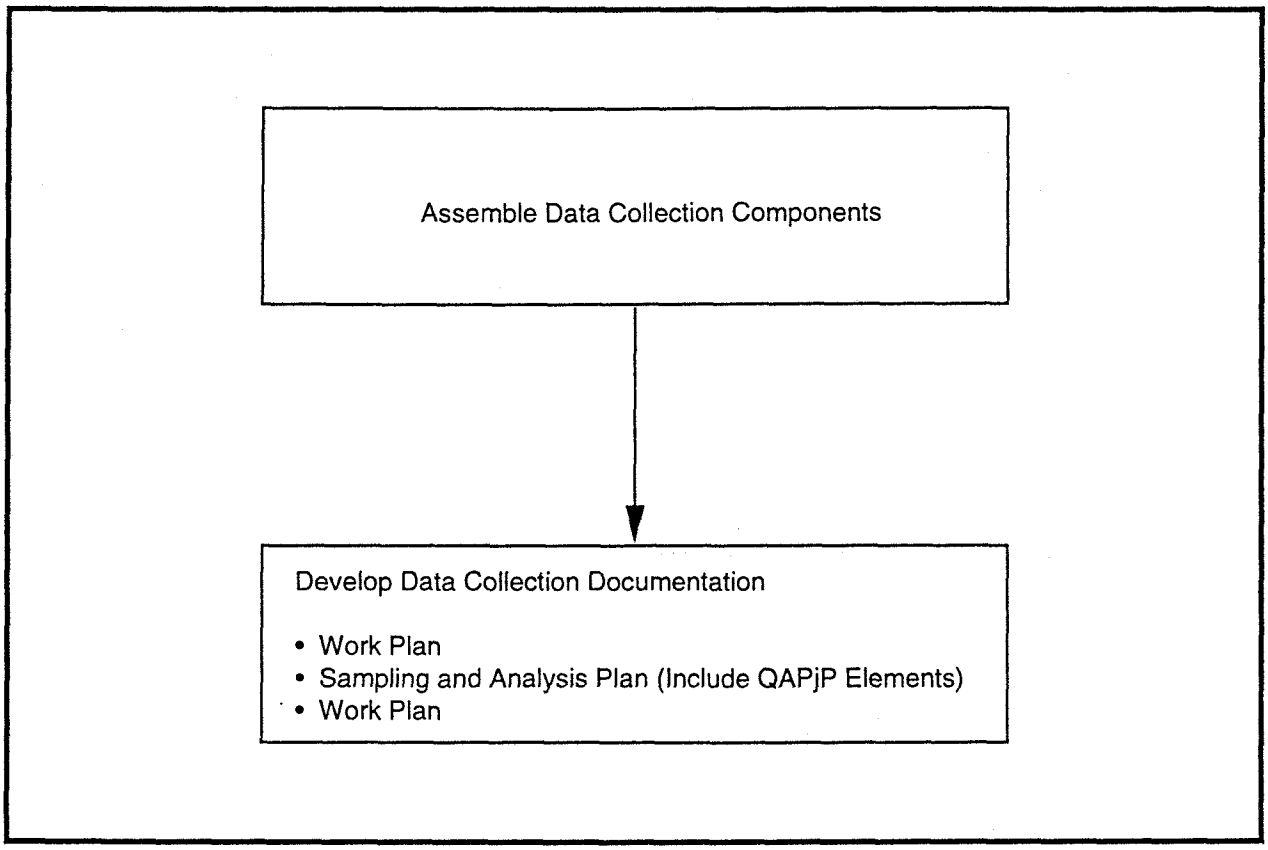

Figure 4-5 DQO Stage 3 Elements

TABLE 4-1
OBJECTIVES OF THE BACKGROUND SOILS CHARACTERIZATION PROJECT
(Listed by Task)

TASK	OBJECTIVE
1. Determination of the nature and extent of contamination	• Establishment of the spatial extent of plutonium contamination as an indicator of the "boundary" of background areas located upgradient and upwind of RFP activities. • Establishment of background concentrations of contaminants of concern to use as comparisons with concentrations found in affected areas
2. Risk assessment and determination of risk-based soil cleanup levels	• Development of fate and transport of contaminant models • Establishment of background concentrations of contaminants of concern to use as comparisons with concentrations found in affected areas
3. Helping to determine the potential effectiveness of soil remediation alternatives	• Evaluation of alternatives • Development of fate and transport of contaminant models • Engineering design of alternatives • Monitoring during remedial action
4. Site characterization for site-wide physical features (soil)	• Refining and/or validating existing soil maps by photo-interpretation and soil profile analysis • Characterizing soil physical and chemical parameters • Focusing field investigation activities • Focusing sample analytical parameters
5. Environmental evaluations	• Coordinating soil pit analysis with ecological/environmental investigators
6. Assessment of the health and safety of workers during the BSCP	
7. Any other activities involving or requiring the use of the characteristics and natural composition of the soils	

TABLE 4-2 (SHEET 1 OF 3)
OBJECTIVES OF THE BACKGROUND SOILS CHARACTERIZATION PROJECT
SUMMARY

PHASE	DATA NEED/OBJECTIVE	ACTIVITY	DATA TYPE	ANALYTICAL LEVEL	DATA USE
1 and 2	1) Identify soil map units which are common to both the potential background areas and OUs	Review aerial photographs	• photo interpretation of stereo photos and transfer map unit delineations to GIS and maps	• I & II	Site Characterization Focus field investigation activities
2	2) Refine and/or validate the Golden Area Soil Survey map based on soil types. Extend Golden Area Soil Survey map unit design into portions of Boulder County.	Examine selected bore hole cores in OUs. Log cores in order to classify soils into USDA taxonomic groupings at the family level. Identify soil types.	• soil horizon analysis (Munsell colors, review particle size distribution for soil textures and coarse fragment phases • Field observation	• I & II • I	Site Characterization Focus field investigation activities
1 and 2	3) First approximation to determine spatial extent of plutonium contamination upwind/up-gradient of RFP activities as an indicator of background area boundary for all potential contaminants of concern.	Review historical data sets. Perform geostatistical analysis on selected historical data sets. Design semi-variograms from the data. If more data is needed for determining spatial extent of plutonium, choose locations for sampling effort.	• Review of surface soil data for plutonium concentrations	• I	Site Characterization Nature and extent of contamination Focus field investigation activities
1	4)Determine spatial extent of radionuclide contamination upwind/up-gradient of source areas of RFP.	Collect surficial soil samples using RFP method in locations determined by first approximation. Analyze samples for plutonium, americium, and uranium. This activity may be concurrent with determining means and variances of contaminants of concern for background described in objective 6) below.	• Radiological analyses	• V	Nature and extent of contamination Risk assessment Focus field investigation activities
1 and 2	5) Select list of analytes to include in soils analysis.	Review historical reports, surface soil data, and other documents regarding site-wide chemical use, disposal, and contamination in soils.	• Data review	• I	Focus sample analytical parameters

TABLE 4-2 (SHEET 2 OF 3)
OBJECTIVES OF THE BACKGROUND SOILS CHARACTERIZATION PROJECT
SUMMARY

PHASE	DATA NEED/OBJECTIVE	ACTIVITY	DATA TYPE	ANALYTICAL LEVEL	DATA USE
1	6) Determine background means and variances in the surficial soils for selected analytes.	Collect surficial soil samples using RFP method in background locations. Geostatistics and stratified sampling methods shall be utilized to include each of the major soil groups in the sampling design. Analyze samples for plutonium, americium, uranium, TAL metals, some TCL semi-volatiles, pesticides/PCBs.	• Radiological analyses • TAL metals • TCL semi-volatiles • pesticides/PCBs	• V • IV • IV • V	Site Characterization Nature and extent of contamination Risk assessment Environmental evaluation Preliminary Remediation Goals (PRGs)
1	7) Determine background means and variances in the surficial soils for a set of additional chemical and physical parameters.	Analyze a subset of the above samples for additional chemical and physical parameters.	• Total organic carbon • Bulk density • Particle size analysis • pH (lab) • anions • Specific conductance	• III • III • III • II • III • II	Fate and transport model Environmental evaluation
2	8) Determine background means and variances in the major soil horizons for each soil group (except in designated wetlands) for selected analytes.	Collect soil samples from each major soil horizon in each major soil group from pit walls exposed by back hoe excavated soil pits. Collect composite samples from each major horizon; i.e., at the minimum, a composite of the A horizon(s), composite of the B horizon(s), composite of the C horizon (if encountered). Analyze samples for plutonium, americium, uranium, TAL metals, some TCL semi-volatiles pesticides/PCBs.	• Radiological analyses • TAL metals • TCL semi-volatiles • pesticides/PCBs	• V • IV • IV • V	Site Characterization Nature and extent of contamination Risk assessment
2	9) Determine background means and variances for a set of additional chemical and physical parameters for each major horizon for each soil group (except in designated wetlands). Data intended for modeling purposes and engineering purposes.	Collect soil samples from each major soil horizon from pit walls exposed by back hoe excavated soil pits. Collect composite samples from each major horizon; i.e., at the minimum, a composite of the A horizon(s), composite of the B horizon(s), composite of the C horizon (if encountered).	• Bulk density • Soil pH • Texture-particle size anal. • Porosity • Total organic carbon • Cation exchange capacity • Clay mineralogy • Anions • Infiltration rate ? • Moisture content ?	• III • II • III • III • III • II • III • III	Fate and transport model Evaluation of remedial alternatives Engineering design of alternatives Monitoring during remedial action Site characterization Post closure monitoring

TABLE 4-2 (SHEET 3 OF 3)
OBJECTIVES OF THE BACKGROUND SOILS CHARACTERIZATION PROJECT
SUMMARY

PHASE	DATA NEED/OBJECTIVE	ACTIVITY	DATA TYPE	ANALYTICAL LEVEL	DATA USE
2	10) Coordinate soil pit sampling activities with soil scientists/ecologists for the purposes of ecological and environmental investigations	Soil scientists and ecologists working on environmental/ecological investigations shall have the opportunity to collect samples and make observations for their purposes while the soil pits are open.	• Vegetation data • Soil nutrient data • Soil microorganism data		Environmental evaluation
2	11) Determine background means and variances of selected analytes in the major soil horizons for soil groups in designated wetlands. A secondary objective is to obtain acceptable data with minimal impact in ecologically sensitive areas by employing low impact sampling methodology	Collect soil samples from each major soil horizon from hand-augered cores in designated wetland areas. Collect composite samples from each major horizon; i.e., at the minimum, a composite of the A horizon(s), composite of the B horizon(s), composite of the C horizon (if encountered).	• Radiological analyses • TAL metals • TCL semi-volatiles • pesticides/PCBs	• V • IV • IV • V	Site Characterization Nature and extent of contamination Risk assessment
2	12) Determine background means and variancesfor additional chemical and physical parameters in the major soil horizons for soil groups in designated wetlands. A secondary objective is to obtain acceptable data with minimal impact in ecologically sensitive areas by employing low impact sampling methodology	Collect soil samples from each major soil horizon from hand-augered cores in designated wetland areas. Collect composite samples from each major horizon; i.e., at the minimum, a composite of the A horizon(s), composite of the B horizon(s), composite of the C horizon (if encountered).	• Bulk density • Soil pH • Texture-particle size anal. • Porosity • Total organic carbon • Cation exchange capacity • Clay mineralogy • Anions • Infiltration rate ? • Moisture content ?	• III • II • III • III • III • II • III • III	Fate and transport model Evaluation of remedial alternatives Engineering design of alternatives Monitoring during remedial action Site characterization Post closure monitoring
2	13) Coordinate wetland sampling activities with soil scientists/ecologists for the purposes of ecological and environmental investigations	Soil scientists and ecologists working on environmental/ecological investigations shall have the opportunity to collect samples and make observations for their purposes while the soil pits are open.	• Vegetation data • Soil nutrient data • Soil microorganism data		Environmental evaluation

TABLE 4-3

BSCP DATA TYPES

DATA TYPES	PHASE I (SURFICIAL)	PHASE II (0-4 FEET)
1) Pre-sampling		
historical data review	X	
aerial photos	X	X
maps	X	X
literature search	X	X
existing data review	X	X
examine OU borehole cores (soil horizons, textures)		X
2)Field survey		
soil horizon description		X
vegetation data/description		X
soil classification		X
3) Chemical		
radionuclides	X	X
metals (TAL)	X	X
semivolatile (indicator?)	X	X
pesticides/PCBs?	X	X
nitrate/nitrite	X?	X
total organic carbon	X?	X
pH		X
cation exchange capacity		X
anions		X
calcium carbonate content		X
4) Physical		
Bulk density		X
Particle size (texture)	X?	X
specific conductance	X?	X
porosity		X
clay mineralogy		X
other (permeability, infiltration, etc.)		X