- Excavation sites, pits, or trenches;
- Secondary containments or berms;
- Valve vaults;
- Electrical vaults;
- Steam pits and other utility pits;
- Utility manholes;
- Other natural or manmade depressions that must be dewatered; or
- Discharges from a fire suppression system that has been breached within a radiological buffer area or a contamination area" (DOE 1999b).

If incidental water is encountered during characterization, dewatering of the area may be necessary to maintain a safe working environment. If dewatering of the area is necessary, a temporary sump will be installed to transfer the water into a temporary storage container(s). The water will then be sampled and managed in accordance with the Site's Incidental Water Program, 1-C91-EPR-SW.01, *Control and Disposition of Incidental Water*.

Incidental water is sampled to determine whether it may be discharged to the environment, or treatment is required. Process knowledge, field pH, appearance, field nitrate, and field conductivity are the initial screening criteria. Compliance staff may direct or perform additional sampling and analysis, when known or suspected contamination is present.

5.0 DATA ANALYSIS PROCEDURES

The characterization team will aggregate and evaluate data generated as part of IASAP activities in accordance with the IASAP DQOs. This will include the following:

- Aggregation according to IASAP DQOs for comparison to RFCA Tier I and Tier II ALs;
- Use of geostatistical or standard statistical techniques to determine whether additional sampling is required to reach specified confidence levels that an IHSS, PAC, or UBC Site has been adequately characterized;
- Use of verification sampling techniques to ensure the accuracy of data generated from field instrumentation;
- Use of geostatistical or standard statistical techniques to determine whether RFCA ALs have been exceeded;

- Aggregation of remediation confirmation data according to IASAP DQOs for comparison to RFCA Tier I and Tier II ALs to determine whether remediation was successful; and

- Aggregation and evaluation according to IASAP DQOs for use in the CRA.

5.1 VERIFICATION OF FIELD ANALYTICAL DATA

Data generated from field instrumentation will be correlated with analytical laboratory data. The following techniques will verify the accuracy of field analytical data:

1. Evaluation of linear regression based on data developed during the 903 Pad characterization for HPGe correlation (Appendix I);

2. Initial verification study to compare new field analytical instruments to laboratory analytical data;

3. Ongoing verification sampling of field analytical results at a rate of 5 to 10 percent (i.e., 5 to 10 laboratory analytical samples for every 100 field analytical samples); and

4. Confirmation sampling.

5.1.1 Linear Regression Analysis

The QA staff will evaluate the accuracy of HPGe, and other field instrument methods, not only through standard, periodic QC specifications (such as daily source checks and annual full-scale calibrations), but also by regressing field measurements against associated laboratory measurements. Regression analysis provides a means of "normalizing," or standardizing, field measurements to laboratory measurements. The general linear model that relates a response to a set of indefinite variables will be used.

Successful regression analyses of HPGe data have been performed at RFETS, and other DOE sites (DOE 2000b). Regression analysis has also been successfully used in the quantification of metals (Sackett and Martin 1998), and is recommended by EPA to correct for low biases inherent in the field methods.

Optimization of sample homogeneity is a key factor in producing usable field/laboratory correlations (Sackett and Martin 1998), where relatively large and variable grain sizes are thought to cause a low bias (in field methods). Samples will be homogenized and sieved, and each sample will be split for field and laboratory analysis.

A general linear model (Equation 5-1) that relates a response to a set of indefinite variables may be used.

$$y = B_0 + B_1 x_1 + B_2 x_2 + ... B_k x_k + E \qquad \text{(Equation 5-1)}$$

Where:

$x_1, x_2 ... x_k$	=	independent variables
$B_1, B_2 ... B_k$	=	unknown parameters
E	=	random error term

Consistent with calibration curves constructed for laboratory analytical methodologies (EPA SW846), where full-range curves are constituted by four (e.g., metals, SW6010) to five (e.g., VOCs, SW8260) sequentially increasing values, regression analyses will be initiated with a minimum of five values through the measurement range of interest. Additional values will be added to the curves as the project progresses.

Based on previous experience and related publications (Sackett and Martin 1998), a linear relationship is expected between field and laboratory results. Acceptability of a linear regression will be based on a correlation coefficient (R^2) of greater than 0.90, and use of an Analysis of Variance (ANOVA) and corresponding F Test to determine both "goodness-of-fit" and appropriateness of the model. The regression will be rejected if the measurements are too variable or the model is incorrect. If a linear model is inappropriate, a curvilinear regression may be evaluated (including confidence intervals or limits), and if used, will be evaluated using an ANOVA to determine the significance of adding terms to the regression. Polynomial expansion beyond a quadratic is not anticipated for correlating field results with laboratory results.

5.1.2 Initial Verification Study

An initial verification study will be conducted to confirm the accuracy of field analytical equipment. Soil samples will be collocated with field analytical readings and sent to an offsite analytical laboratory for analysis.

The underlying assumption for the verification study is that a linear relationship exists between the laboratory analytical data and field analytical data. The field analytical data may be standardized using the following equation (Gilbert 1987):

$$\bar{x}_{lr} = \bar{x}_A + b(\bar{x}_{n'} - \bar{x}_F) \qquad \text{(Equation 5-2)}$$

Where

$\bar{x}_{lr}$	=	standardized estimate of μ
$\bar{x}_A$	=	mean of the n laboratory measurements
b	=	slope of the estimated linear regression
$\bar{x}_{n'}$	=	mean of the n' field measurements
$\bar{x}_F$	=	mean of the n field measurements

5.1.3 Ongoing Verification

As stated previously, accuracy of several field methods will be evaluated, not only through standard, periodic QC specifications (such as daily source checks and annual full-scale calibrations), but also by regressing field measurements against associated laboratory measurements. Regression analysis provides a means of normalizing, or standardizing, field measurements to laboratory measurements.

Verification of field analytical methods will continue throughout IA characterization and remediation activities. The frequency of split samples for the ongoing field analytical equipment verification sampling will be based on the following:

- Initial verification study;
- Results of previous verification; and
- Field duplicate frequency (5 to 10 percent) as discussed in Section 5.1.4.

5.1.4 Verification Sampling

Environmental projects may use a variety of QC samples, depending on the needs and goals of the project. The QC samples could include blanks (e.g., preparation blanks and trip blanks), duplicates, splits, blind performance evaluation (PE) samples, etc. Typically, each type of QC sample has only one use; for example, field duplicates are used to evaluate sampling precision. The QC samples required for the IA sampling and analysis effort are presented in Appendix H.

To increase efficiency and reliability of the project, one type of QC sample, the duplicate, will serve several purposes:

1. To evaluate sampling precision (its typical use);
2. To confirm that methods are sufficiently comparable with laboratory methods; and
3. As “confirmation samples” to confirm the results in the AOC.

This approach will eliminate the time and cost of performing a separate phase of verification sampling and will be performed in parallel with field sampling and analysis. This approach will be implemented by sending a duplicate sample, after it is analyzed for its first purpose, to the laboratory for verification analysis. The duplicate sample, initially used for field precision purposes, effectively becomes a replicate when used for verification purposes. Acceptable verification will be determined through use of a percent difference value; specifically, this is the laboratory value compared with the normalized field value (i.e., field value based on the regression analysis).

In certain cases where field analytical methods (or onsite laboratories) do not provide adequate quality, such as unacceptable detection limits or field/laboratory correlations, verification sampling must be more aggressive than described above. More rigor could include the original grid spacing and number of samples used for characterization purposes, which consider hot spot size and contaminant boundaries. The term

"verification sample," in the context of the IASAP, is reserved for those specific samples whose sole purpose is to confirm (or contradict) results of samples already collected. Because of this narrow purpose, the number of samples needed is much less than the previous number of samples required to characterize the site of interest. If an aggressive design for verification sampling is required, it indicates that characterization sampling (and field analysis), relative to a specific COC and applicable ALs, was inadequate for cleanup decisions.

5.2 TIER I AND TIER II ACTION LEVELS AND DATA EVALUATION

In accordance with the IASAP DQOs, the extent of contamination must be delineated to RFCA Tier I and Tier II ALs. Designation of hot spots and subsequent remediation and/or closure decisions will be based on comparisons to RFCA Tier I and Tier II ALs. A phased statistical evaluation will be conducted that consists of the following steps:

1. Data aggregation;
2. Comparison of data to Tier I and Tier II ALs;
3. Geostatistical analyses, if appropriate data are available; and
4. EMC (if necessary).

The flow chart presented on Figure 31 displays the steps and decision points used for this phased statistical evaluation. The null (Ho) and alternative (Ha) hypotheses used during the statistical analyses are as follows:

Ho: Analyte concentrations/activities within the AOC are significantly greater than the Tier I and Tier II ALs.

Ha: Analyte concentrations/activities within the AOC are not significantly greater than the Tier I and Tier II ALs.

5.2.1 Data Aggregation

Data aggregation will be based on media type (e.g., surface or subsurface soil), AOC, and purpose of evaluation (e.g., characterization, confirmation, or CRA). To perform a valid statistical evaluation, data must meet the criteria that all observations are independent but comparable (i.e., collected and analyzed using similar methods). Furthermore, data from various soil horizons need to be aggregated by subgroups before conducting statistical comparisons. These aggregated subgroups must represent a single population characterized by a fixed population mean and variance. Table 8 summarizes the data aggregation and appropriate subdivisions of each group.

Figure 31
Data Evaluation Flow Chart

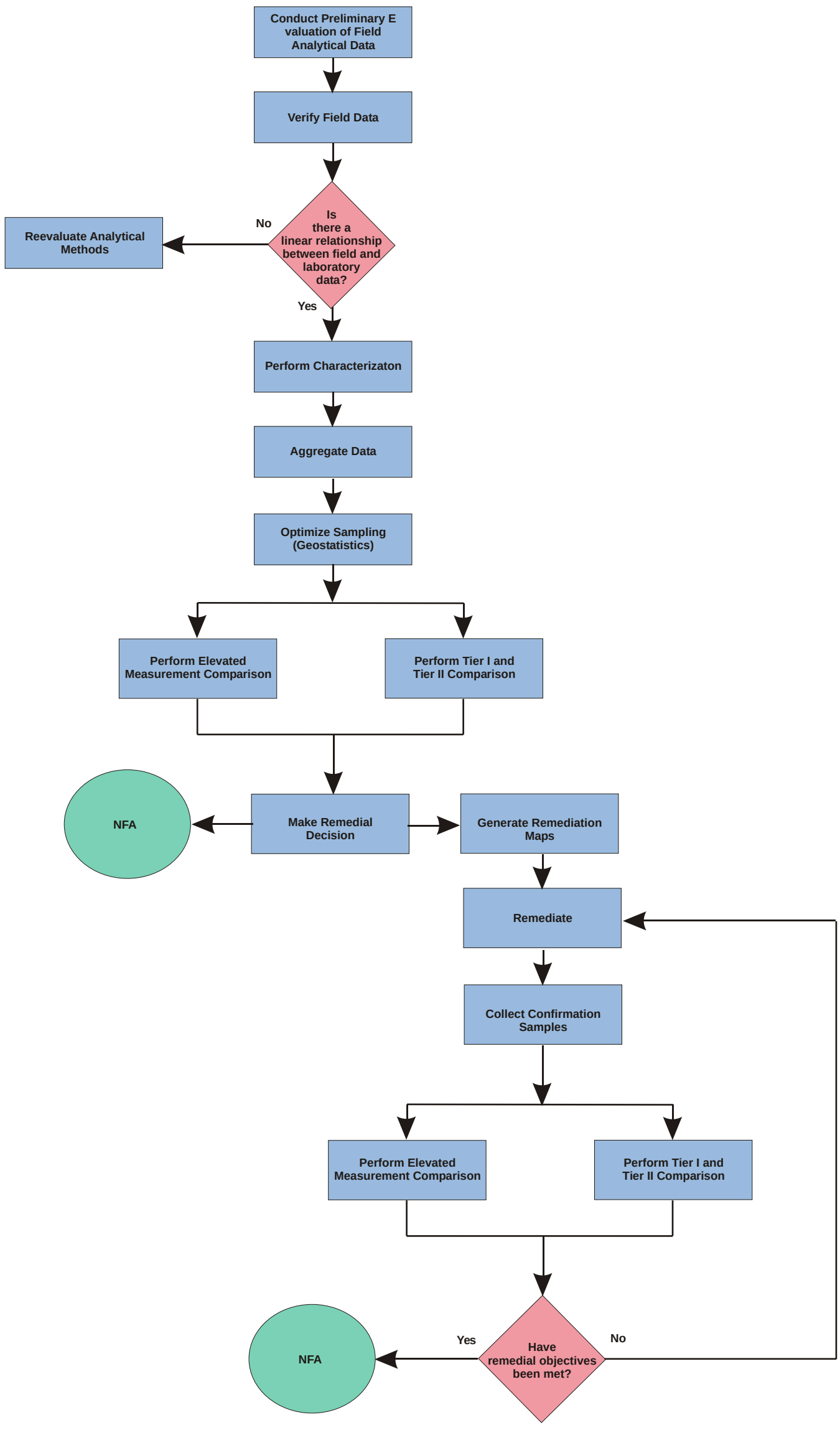


Table 8
Data Aggregation Framework

Soil Horizon	Depth Interval[1] (ft)	Subgroups		
		Characterization[2]	Confirmation (Excavation Remedy)	CRA
Surface Soil	0.0 to 0.5	Area of Concern	Floor and Sidewalls	Exposure Unit
Subsurface Soil	0.5 to 2.5	Area of Concern		
	2.5 to 4.5	Area of Concern		
	4.5 to 6.5	Area of Concern		
	6.5 to 8.5	Area of Concern		
	8.5 to Bedrock	Area of Concern		

[1] Actual depth intervals will be based on the depth to bedrock contact or depth to water.
[2] The AOC is based on IHSS, PAC, UBC Site, and White Space Area boundaries as defined by the project team.

The first step in the data evaluation process is to group the data by soil horizons. For example, surface soil samples collected from 0 to 6 inches bgs will be grouped as a single soil horizon, and subsurface soil samples from 6 to 30 and 30 to 54 inches bgs will be grouped into second and third horizons, respectively, so that each depth interval is grouped as a unique sample population. Although different subsurface soil horizons may have similar geologic and physical properties, the aggregation of distinct soil horizons will conform to remediation excavation techniques. Subsurface soil samples with similar geologic properties may be aggregated into a single group for the CRA.

Data aggregation for remediation confirmation will be based on samples collected within the excavated or remediated area. For excavations, samples from the floor and sidewalls of the excavation will be consolidated into a single subgroup. Data aggregation for the CRA will be based on the size of the EUs (DOE 2000c).

5.2.2 Elevated Measurement Test

Individual measurement values will be compared to corresponding Tier I and Tier II ALs for delineating hot spot areas and making remediation decisions. This elevated measurement test identifies measurements that may normally be overlooked using more robust inferential statistical test procedures. Measurements of a given analyte that are greater than or equal to the elevated measurement value (Tier I or Tier II AL) may indicate potential contamination. However, some Tier I and Tier II ALs may be less than mean background concentrations or activities. Therefore, data will be prescreened to filter out those that are below background levels (mean plus two standard deviations) and MDLs.

5.2.3 Confirmation Samples

The characterization team will evaluate confirmation sampling measurements to determine whether residual soil is clean with respect to remediation goals. Measurements

of a given analyte that exceed remediation goals may require additional evaluation. Flexibility in the decision process includes statistically comparing means of populations to the corresponding ALs.

5.2.4 Spatial Evaluation – Geostatistics

In addition to defining optimal sampling locations for characterization purposes, the characterization team will also use geostatistical analysis to define areas above RFCA ALs. The geostatistical approach incorporates probabilistic and risk-based outcomes relative to the AL thresholds and decision error rates. The geostatistical methodology is an unbiased geostatistical tool that will be used to optimize characterization and remediation within the IA. Specifically, geostatistical analysis will be used to:

- Optimize the number and locations of characterization samples;
- Develop maps of the areas with concentrations above RFCA ALs at a given level of probability;
- Optimize the number and locations of confirmation samples; and
- Link onsite analysis with sampling to allow near real-time remedial decisions.

Geostatistical Procedures

Geostatistical analysis is a spatial correlation modeling approach that uses several evaluative steps. Descriptions and applications of the SmartSampling geostatistical technique are presented in reports published by SNL (1998), Rautman (1996), and McKenna (1997). The following describes the ordered process of the geostatistical approach:

1. *Exploratory Analysis* - The first step in the geostatistical evaluation is to determine the distribution of the data set by evaluating descriptive statistics and plotting the data on a histogram. Data found to depart from the normal distribution function should be normalized prior to performing the geostatistical evaluation.
2. *Structural Analysis* - Variograms (Myers 1997), which describe the geostatistical spatial correlation between samples, are generated. This procedure defines the spatial variance between data points. Three important parameters defined by the variogram include (1) the range (distance at which samples are spatially correlated), (2) sill (similar to the variance of the data set), and (3) nugget effect (departure from the origin, which indicates microscale sampling variability or imprecision of the data set).
3. *Kriging* - The spatial correlation model derived from the variogram analysis is used in the kriging simulation. Kriging is the process of simulating predicted values in unsampled areas by calculating a weighted least-squares mean of the surrounding data points. The weighted values account for not only the distance between known observations and points of predicted values, but also the correlation of clustered observations. For example, clustered data may provide redundancy and are weighted less than a single observation at an equal distance in a different direction. The kriging

simulations are processed to produce maps defining the spatial distribution of the contaminants and uncertainty in the spatial distribution.

4. *Probability Kriging* - Probability maps that describe the likelihood a contaminant value at any unsampled location exceeds the AL are generated. Probability kriging is based on multiple simulations of the contaminant concentration. The outcome of each simulation reflects the actual observations within the area. The multiple simulations of the concentrations provide the basis for determining the relative uncertainty so that the probability of exceeding a specified threshold value (e.g., RFCA ALs) at any point within the area can be estimated. The simulations are processed to produce maps defining the spatial distribution of the contaminants and the inherent uncertainty in spatial distribution.

5. *Probability Calculation* - The probabilities are calculated from the estimated value from each realization and a cumulative distribution function at each point of estimation is developed. For example, assume 100 realizations are performed for the area of interest. If the threshold value is 10 pCi/g and 20 of the 100 realizations exceed the threshold value at a given point, the probability of exceedance is 20 percent at that point.

6. *Uncertainty Mapping* - A map with optimal locations for additional sampling is developed. These locations are optimized to produce the greatest decrease in the spatial uncertainty of the contaminant distribution with respect to ALs. That is, areas with the greatest uncertainty of exceeding the ALs are identified and targeted for additional sampling and analysis.

7. *Sample Optimization* - Data are collected and added to the geostatistical program.

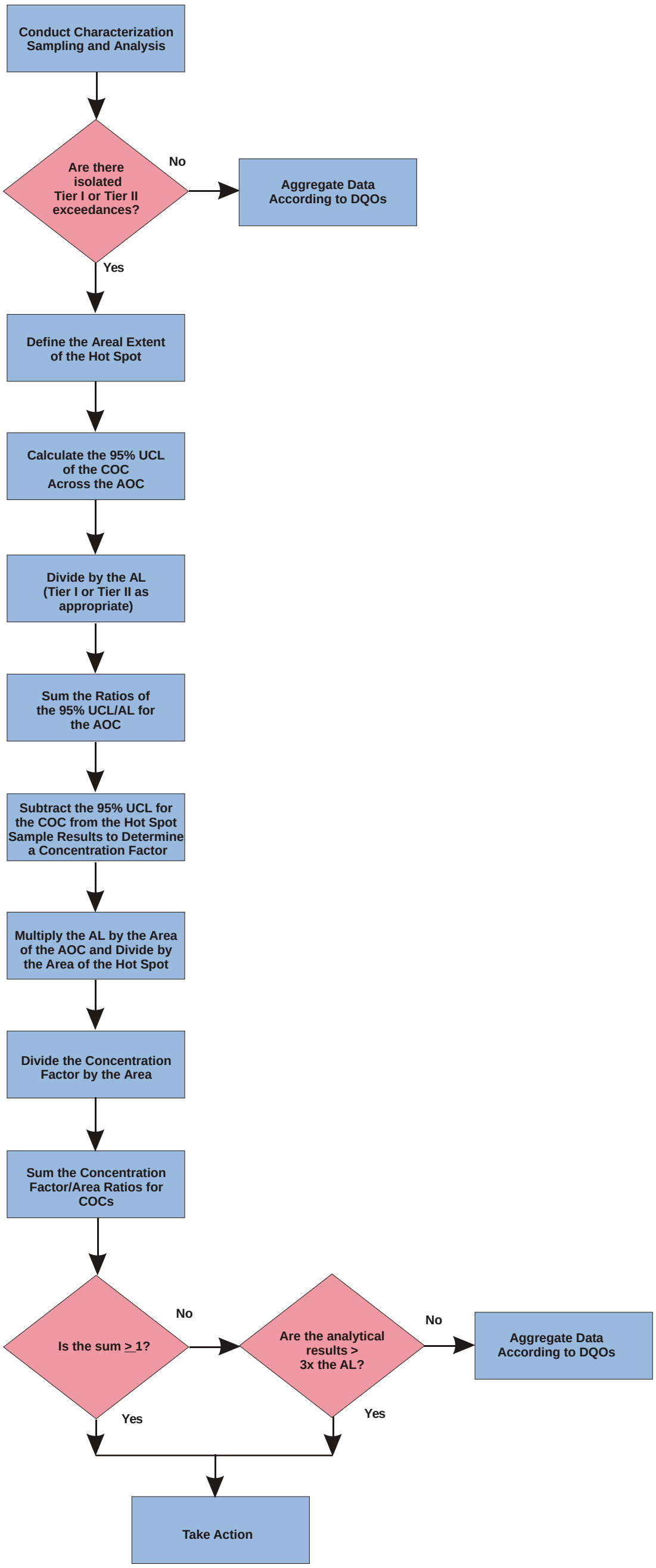
8. Steps 2 through 5 are repeated as necessary.

9. *Excavation Mapping* - Excavation maps are developed from the probability kriging. These maps are based on the probability of exceeding a specified AL as described in Step 4. An excavation map requires that an acceptable reliability of remediation is determined. This is similar to the process of specifying an acceptable level of false positive errors in the traditional DQO procedure. For example, if the Type I error rate is specified at 10 percent, then all remediation units exceeding 10 percent would be targeted for remediation.

5.3 ELEVATED MEASUREMENT COMPARISON

The EMC (MYAPC 1999) comparison, illustrated on Figure 32, includes an equation that depends on several variables: AL, measured value, size of the hot spot, and size of the

Figure 32
Elevated Measurement Comparison Flow Chart



AOC. The EMC is applicable to all sample results or hot spots that are above RFCA Tier I or Tier II ALs. In AOCs where all sample results are less than ALs, the EMC is not required. The EMC for nonradionuclides is shown in Equation 5-3. If the EMC is greater than or equal to 1, action is indicated.

(Equation 5-3)

$$\text{If}: \sum_{i=1}^{n}\left[\frac{95\%\text{UCL}_{\text{AOC}}}{\text{AL}}\right]_i + \sum_{j=1}^{n}\left[\frac{\left(\text{SampleResult}_{\text{hs}} - 95\%\text{UCL}_{\text{AOC}}\right)}{\left(\frac{\text{AL} * \text{Area}_{\text{AOC}}}{\text{Area}_{\text{hs}}}\right)}\right]_j \geq 1 \text{ Then}: \text{Action is Indicated}$$

Where

$(95\%UCL)_{AOC}$	=	95% UCL of the mean concentration in the AOC
AL	=	Tier I or Tier II soil AL
$(Sample\ Result)_{hs}$	=	hot spot sample result
$(Area)_{AOC}$	=	area of the AOC
$(Area)_{hs}$	=	hot spot area (based on the area surrounding the elevated sample result)
i	=	number of COCs
j	=	number of hot spots for a particular COC

The first term "i" of Equation 5-3 will be applied to each COC separately. This term will be used for all observations less than Tier I or Tier II ALs within the AOC. As shown in Equation 5-3, the first term is defined as the ratio of the 95% UCL of the mean to the RFCA Tier I or Tier II AL for the AOC. Observations greater than the ALs will be excluded from the 95% UCL calculations, because this type of censorship will ensure the data set complies with normality assumptions required for calculating the 95% UCL.

The second term "j" of Equation 5-3 will be applied to each sample result that exceeds the RFCA Tier I or Tier II AL separately, so that these results can be evaluated as a function of the hot spot size relative to the AOC and magnitude of the AL. Because human health risks are based on an individual's exposure across an area, the incremental risk due to a small, elevated COC sample result (hot spot) needs to be determined. The second term of Equation 5-3 is defined as the difference between the 95% UCL of the mean concentration and the sample result divided by the RFCA Tier I or Tier II AL for a given COC. The AL is area-weighted, which is appropriate because exposure to contamination is random across an area.

For radionuclides, an area factor consistent with MARSSIM (EPA 1997) guidance is applied to the AL as shown in Equation 5-4. Radionuclide-specific area factors are based on exposure pathway models, which can be estimated from RESRAD simulations.

(Equation 5-4)

$$\text{If}: \sum_{i=1}^{n}\left[\frac{95\%\text{UCL}_{\text{AOC}}}{\text{AL}}\right]_i + \sum_{j=1}^{n}\left[\frac{\left(\text{Sample Result}_{\text{hs}} - 95\%\text{UCL}_{\text{AOC}}\right)}{\left(\text{AL} * \text{AF}\right)}\right]_j \geq 1 \text{ Then}: \text{Action is Indicated}$$

Where

$(95\%UCL)_{AOC}$	=	95% UCL of the mean concentration in the AOC
AL	=	Tier I or Tier II soil AL
$(Sample\ Result)_{hs}$	=	hot spot sample result
AF	=	area factor (for radionuclides)
i	=	number of COCs
j	=	number of hot spots for a particular COC

The product of Equations 5-3 and 5-4 is the summation of EMCs for all COCs and each hot spot within a given AOC. Results of the equation greater than 1 indicate action may be necessary and results less than 1 indicate action is not necessary. Because the EMC includes an area-weighting component, results for very small hot spots may indicate action is not necessary for very high contaminant concentrations. To reduce this effect, when the concentration of the contaminant at a hot spot is three times the Tier I AL, action is indicated. If the hot spot is remediated, the confirmation sample values will be used in the equation. Using a value of three times the AL as an upper limit for re-evaluation is consistent with RESRAD's release criteria. The "three times the AL" concept will not apply to ALs that are based on acute toxicity. An example data set (Appendix J) shows how the EMC is applied.

6.0 DATA MANAGEMENT

A variety of data types will be generated during IA characterization and remediation to support data analysis and reporting requirements. ER will manage in-process field analytical data so that the characterization staff can evaluate these data on a daily basis. All field analytical data will be transferred to ASD for long-term data management. All offsite analytical data will be managed by ASD.

Data generated during IA characterization and remediation will include, but not be limited to, the following:

- Sampling location data;
- Field parameters (depth, sample interval, field instrument readings, etc);
- Surface and subsurface soil analytical data; and
- Investigative-derived materials data (e.g., stockpiles and drill cuttings).

All data collected during these activities will meet RFETS data quality requirements and project DQOs. IA investigation data will be used for the following purposes:

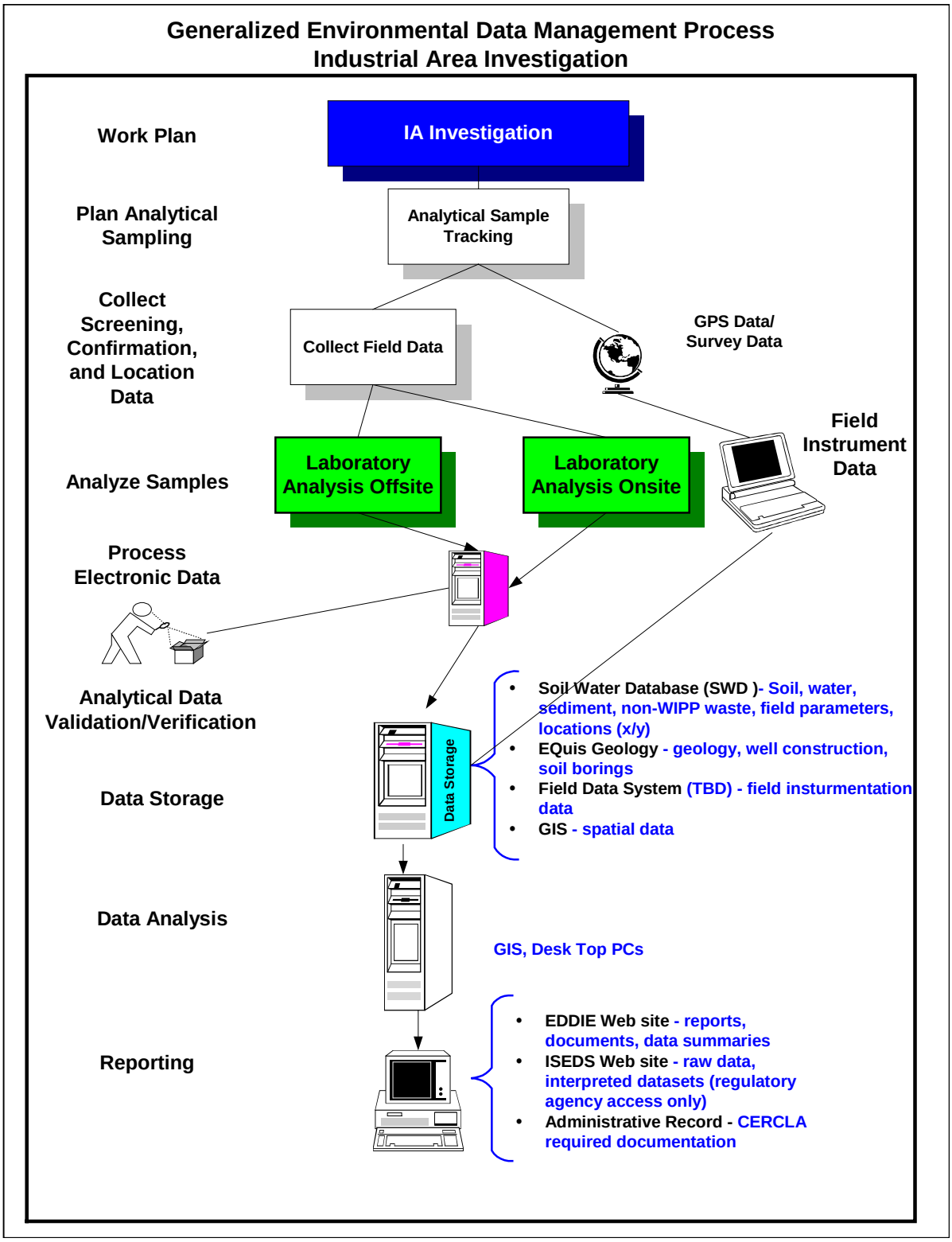
- Document IA investigation activities and decisions;
- Provide final characterization of all residuals left in the IA;
- Provide data for the CRA; and
- Support the CAD/ROD and post-closure monitoring.

A generalized overview of the IA investigation environmental data management process is shown on Figure 33. This diagram also identifies where electronic and hard copy data may be located. The majority of data collected will be available electronically and stored in shared data systems accessible to all project team members. Current environmental data systems are summarized in Table 9. The data systems used to support the IA investigation are in common RFETS standard platforms to facilitate integration of data and information among media and make data easily available to users.

Table 9
Current Environmental Data Systems at RFETS

Environmental Data System	Software Platform in FY00	Typical Data
Air Database (AIR)	Oracle V8.0	Effluent air, ambient air, meteorology
Soil Water Database (SWD)	Oracle V8.0	Laboratory analytical data for soil, groundwater, surface water, non-WIPP waste, sediment, and miscellaneous media; field parameters for environmental sampling; sampling locations (x/y)
Flow	Oracle V8.0	Surface water flow measurements
Ecology Database (SED)	Access	Ecological species, ecological sampling locations
Administrative Record (AR)	Oracle V8.0	Index of AR documents
Integrated Sitewide Environmental Data System (ISEDS)	Internet (regulatory agency access only)	Uninterpreted analytical data (all media), electronic field measurements, interpreted data sets, “residual” data sets
Environmental Data Dynamic Information Exchange (EDDIE)	Internet	Final environmental reports, photos, data summaries, and update information on environmental programs
Geographic Information System (GIS)	ArcInfo V.8	Spatial data coverages for base features (topography, roads, buildings, etc.) and interpreted spatial data for extent of chemical contamination
Remedial Action Decision Management System (RADMS)	Access	Database for ER characterization and remediation data
Waste Environmental Management System (WEMS)	Oracle V.8	Waste drum tracking
Analytical Services Toolkit (AST)/EDDProPlus(BIG EDD)	Access/Oracle V8.0	Laboratory analyses tracking, electronic laboratory analyses (EDD) processing

Figure 33


Generalized Environmental Data Management Process
Industrial Area Investigation
Work Plan
IA Investigation
Plan Analytical Sampling
Analytical Sample Tracking
Collect Screening, Confirmation, and Location Data
Collect Field Data
GPS Data/ Survey Data
Field Instrument Data
Analyze Samples
Laboratory Analysis Offsite
Laboratory Analysis Onsite
Process Electronic Data
Analytical Data Validation/Verification
Data Storage
Data Storage
Soil Water Database (SWD)- Soil, water, sediment, non-WIPP waste, field parameters, locations (x/y)
EQuis Geology - geology, well construction, soil borings
Field Data System (TBD) - field insturmentation data
GIS - spatial data
Data Analysis
GIS, Desk Top PCs
Reporting
EDDIE Web site - reports, documents, data summaries
ISEDS Web site - raw data, interpreted datasets (regulatory agency access only)
Administrative Record - CERCLA required documentation

6.1 DATA MANAGEMENT REQUIREMENTS

Surface and subsurface soil data collected as part of the IA investigations will be stored in the applicable database listed in Table 9. All data collected and/or information generated as part of the IA investigation will be managed in accordance with the requirements presented below.

6.1.1 Sample Tracking Information

Laboratory Analytical Sample Tracking

All offsite laboratory analytical samples will be tracked using the Analytical Services Toolkit (AST) or equivalent system, which tracks the entire lifecycle of a sample request and provides a chain-of-custody. Samples will be numbered in accordance with ASD-003, *Identification System for Reports and Samples.*

Field Analytical Sample Tracking

All field analytical samples will be given an AST tracking number that will be used for the entire life cycle of the sample request. The AST tracking number will ensure that data generated during IA characterization activities will be consistent with AST requirements and formats for transfer to SWD. Samples will be numbered in accordance with ASD-003, *Identification System for Reports and Samples.* Field analytical data will be tracked in the Remedial Action Decision Management System (RADMS) and transferred to SWD.

6.1.2 Sampling Locations

Sampling Location Codes and Names

Sampling location codes and names used to support data analysis and GIS analysis will be created following requirements specified in PRO-1058-ASD-005, *Environmental Data Management Procedure.*

Location Spatial Coordinates

Spatial coordinates will be collected at all sampling locations in accordance with OPS-PRO-947, *Location/Surveying.* Final approved coordinates will be stored in the SWD Master Location Table.

6.1.3 Analytical Laboratory Data

Electronic Analytical Data

Offsite laboratory analytical data collected during IA sampling activities will be processed, subjected to QC review and tracked through RADMS and EDDPRo Plus, and entered into SWD. Electronic analytical data packages in a portable document format

(PDF) file will be managed by K-H ASD according to PRO-1058-ASD-005, *Environmental Data Management Procedure.*

Field Analytical Data

Field analytical data generated from instrument-specific software will be controlled, and data will be backed up daily on an RFETS server to ensure no loss of data occurs prior to transfer to ASD.

Hard Copy Analytical Data

Hard copy laboratory analytical data will be managed according to PRO-1058-ASD-005, *Environmental Data Management Procedure.*

6.1.4 Nonanalytical Field Data

Field Parameter Data

Field parameter data will be entered into RADMS and stored in SWD in accordance with PRO-1058-ASD-005, *Environmental Data Management Procedure*.

6.1.5 Maps

Geographic Information System Maps

GIS maps will be created using the RFETS GIS. All GIS files will be labeled and stored in the GIS tracking system following GIS Department SOPs. Map presentation will adhere to PRO-1130-ASD-006, *Spatial Data Map Control*.

6.1.6 Samples/Data of Special Significance

Confirmation Soil Sampling/Excavation Boundary Samples

Confirmation/excavation boundary soil samples collected to demonstrate performance will be labeled in SWD in accordance with PRO-1058-ASD-005, *Environmental Data Management Procedure*. Any excavation boundary samples representing material removed from the site will be labeled as no longer representative (NLR) in SWD within 10 days of determination.

No Longer Representative Data

If during IA activities, data are determined to be NLR of site conditions (i.e., source material has been removed and shipped from the site, or otherwise made not representative), they will be coded NLR in SWD within 10 days of determination in accordance with PRO-1058-ASD-005, *Environmental Data Management Procedure*.

Stockpile Sampling

Where treated or untreated soil has been stockpiled and sampled prior to returning it to an excavated location (put back), any sample results representative of the stockpile and thus the returned soil, will be labeled with the appropriate final location in SWD.

Waste

All waste sample analyses and waste drums are tracked through the Waste and Environmental Management System (WEMS).

6.1.7 Final Decision Documents, Reports, and Data Sets

Final Reports – Electronic Version

All final reports and/or decision documents will be provided in electronic format to the RFETS Environmental Data Dynamic Information Exchange (EDDIE) Web site for dissemination to the public.

Final Reports – Hard Copy

All final reports and/or decision documents will be provided in hard copy to the CERCLA Administrative Record (AR) staff for inclusion into the RFETS AR.

Interpreted Report Data

The IA investigation will generate sets of subject matter expert (SME)-interpreted data to document decisions. These data sets will be created using RFETS standard software (such as Microsoft Excel, ArcInfo, or Microsoft Access) and will be stored electronically on the Integrated Sitewide Environmental Data System (ISEDS) Web site. Files will be clearly labeled to identify project and data set, and a text file describing the data set will be created and stored on the ISEDS site. Interpreted data sets will be provided to ISEDS within 10 days of submission of final approved report or decision document.

6.1.8 Field Analytical Data Management

Field analytical data generated during IA sampling activities will be managed so that data are easily configured and transferred to the appropriate Site databases. Field analytical data will be generated by several field instruments (Section 4.9). All field instrumentation will be equipped with instrument-specific software that will record and report all relevant environmental and QC data generated. Field measurements will be downloaded daily, or at the end of the sampling event if it is less than 1 day. Data will be configured for the following uses:

- ER data evaluation according to DQOs;
- Geostatistical analysis;

- AST; and
- SWD.

6.1.9 Environmental Restoration Data Evaluation

The ER data evaluation will include the following information for samples collected in each IHSS, PAC, and UBC Site:

- Location code;
- Project identification;
- Sample date;
- X-coordinate (latitude);
- Y-coordinate (longitude);
- Elevation;
- Depth interval;
- Soil horizon;
- Sample type;
- Analyte;
- Results;
- Result units;
- Detection limit;
- Dilution factor (if applicable); and
- QC partners.

Geostatistical Evaluation

Geostatistical evaluation will include the following information:

- Location code;
- X-coordinate (latitude);
- Y-coordinate (longitude);

- Elevation;
- Depth interval;
- Soil horizon;
- Sample type; and
- Sum of ratios per location code for radionuclides and nonradionuclides relative to Tier I and Tier II ALs.

6.1.10 Field Instrument Data Definition

EDDs will be produced for all field sampling events through the RADMS. EDDs will be consistent with ASD EDDs, but may include additional fields relevant only to the IASAP DQOs. If these additional fields are of archival value for future Site needs, SWD will be modified to accommodate the additional information.

Files will be in space delimited text format that is easily portable to Microsoft Access or Microsoft Excel. The format may vary from the template displayed below; however, all records will include, at a minimum, the fields specified in Table 10.

6.1.11 Sample Handling and Documentation

Soil samples will be handled and containerized according to OPS-PRO.069, *Containerizing, Preserving, Handling, and Shipping of Soil and Water Samples.* Transferring and shipping samples will be performed according to PRO-908-ASD-004, *On-Site Transfer and Off-Site Shipment of Samples.*

Samples sent offsite for analysis will require evaluation under 49 Code of Federal Regulations (CFR) 173, the U.S. Department of Transportation (DOT) radioactive materials criteria of 2,000 pCi/g total radioactivity. If radiological screening indicates levels above this threshold, samples may be analyzed onsite or transported to offsite laboratories in accordance with hazardous materials transportation shipping requirements. DOT radiological screening samples will be collected and assigned a unique sample designation as described in Section 6.1.12. In addition, radiological screening samples collected under the IASAP will be sufficient to support DOT shipping and offsite laboratory license requirements.

6.1.12 Sample Numbering

Unique sample numbers will be generated for each IA Group sampling effort. A report identification number (RIN) will be generated through the AST system. The unique sample number consists of the RIN, event number, and, if necessary, a bottle number. The event number is the sampling event at a given location and time. The bottle number is the numbers of bottles for multiple analyses from the same event.

Table 10
Electronic Digital Data Format

Field Type	Field Name	Description	Definition
general lab	LAB_CODE	Laboratory Code	Coded value identifying the analytical laboratory
project-specific	PROJECT_ID	Project Name	Project description/unique identification
project-specific	CUST_SAMP_NUM	Customer Sample Number	Text field used by the sample team that identifies the sample
general lab	LAB_SAMPLE_NUM	Laboratory Sample Number	Laboratory's unique sample identifier, assigned by the laboratory
general lab	LAB_SAMPLE_RECEIPT_DATE	Laboratory Sample Receipt Date	Date laboratory received the sample
general lab	LAB_BATCH_ID	Laboratory Batch ID	Laboratory's unique numerical identifier relating a group of samples to a given laboratory batch
general lab	SAMPLE_VOLUME	Sample Volume	Volumetric amount of sample for analysis
general lab	SAMPLE_VOLUME_UNIT_CODE	Sample Volume Unit Code	Coded value representing the volumetric units
general lab	ALIQUOT	Aliquot Size	Volume or mass of aliquot analyzed
general lab	ALIQUOT_UNITS	Units of Measure for the Aliquot	Units of measure for the volume or mass of the aliquot
general lab	EXTR_METH_CODE	Code Denoting an Approved Sample preparation/extraction method	Specific laboratory preparation or extraction procedure used to digest the sample prior to analysis
general lab	ANAL_METH_NAME	Name of the approved test method	Specific laboratory test methods used to analyze the sample
general lab	% MOISTURE	Percent moisture	Mass percentage of moisture in the sample; allows correction of result to dry weight basis
general lab	LAB_EXTRACTION_DATE	Laboratory Extraction Date	Date the sample was extracted
general lab	LAB_EXTRACTION_TIME	Laboratory Extraction Time	Time the sample was extracted
general lab	LAB_ANALYSIS_DATE	Laboratory Analysis Date	Date of analysis
general lab	LAB_ANALYSIS_TIME	Laboratory Analysis Time	Time of analysis
general lab	INSTRUMENT_ID	Identification of Instrument	Unique ID number of the measurement system used to measure the sample
general lab	CAS_NO	CAS Number	Code that identifies the analyte tested
general lab	ANALYTE_NAME	Analyte Name	Name of the analyte
general lab	RESULT	The measured numerical analytical result	Analytical numeric result
general lab	SIG_FIGS	Significant Figures	Number of significant figures for the result
general lab	UNIT_CODE	Unit Code	Units used at the laboratory
general lab	RESULT_TYPE_CODE	Result Type	Coded value identifying the type of sample, including all QC types (target, matrix spike, etc.)
general lab	DETECTION_LIMIT	Detection Limit	Numeric value representing the MDL or minimum detectable activity with same units as result

Field Type	Field Name	Description	Definition
general lab	DETECTION_LIMIT_TYPE_CODE	Detection Limit Type Code	Coded value indicating which detection limit was used (MDL, instrument detection, etc.)
general lab	BASIS	Wet or Dry Basis	Mass basis for reported concentration of a solid sample; typically, results are reported on a dry basis
general lab	DILUTION_FACTOR	Serial Dilution Factor	Numeric factor when a sample was diluted prior to analysis
general lab	RESULT_SEQUENCE_ID	Result Sequence Identifier	Unique record-level sequential identifier for the datum
general lab	COMMENTS	Comment	Any comment that relates to the record
QC	SPIKE_AMOUNT	Amount of spike concentration or reference standard value	Spike concentration of analyte or activity value for radioactive standards
QC	%_RECOVERY	Percent recovery	Measured recovery, expressed as percentage, of a spike or reference standard value
QC	LCL	Lower Control Limit	Lower control limit on a measurement relative to a spike or reference standard amount
QC	UCL	Upper Control Limit	Upper control limit on a measurement relative to a spike or reference standard amount
QC	RPD	Relative Percent Difference	Relative percent difference between an original sample and its corresponding duplicate or replicate sample
QC	LAB_RESULT_QUALIFIER_CODES	Laboratory Result Qualifier Codes	Coded value indicating a laboratory qualifier or flag
QC	VALIDATION_QUALIFIER_CODE	Validation Qualifier Code	Coded value representing the validation qualifier or flag
QC	VALIDATION_REASON_CODES	Validation Reason Codes	Numeric value describing the reason for the validation qualifier
QC	VALIDATION_DATE	Validation Date	Date validation was performed on the laboratory batch
QC- RAD-specific	COUNT_TIME	Counting time for radioactivity	Amount of time, in minutes, that sample was counted; for radiological measurements only
QC- RAD-specific	DETECTOR_EFF	Detector Efficiency	Efficiency of the detector used for radiological measurement of the sample; unitless
QC- RAD-specific	BACKGROUND	Radiological Background	Numerical background value
QC- RAD-specific	CHEM_YIELD	Chemical Yield	Chemical yield of the tracer (radiometric) or carrier (gravimetric)
QC- RAD-specific	BKGRD_UNITS	Background Units of Measure	Unit of measure for radiological background values, typically in pCi/g
QC- RAD-specific	DUPLICATE_EQUIVALENCY	Duplicate Equivalency	Measure of precision using duplicate samples
QC- RAD-specific	COUNT_ERROR	Counting Error	Measure of random error in the measurement based on the stochastic nature of radioactive decay
QC- RAD-specific	TOTAL_ERROR	Total Error	Total error of the measurement, which includes random (e.g., counting) and systematic error

Note: All parameter fields are left-justified and padded to the right with blanks. File Name field may be omitted if all records are provided as one file.

The unique sample number format is presented below.

Format: YYNXXXX-EVT.BOT
RIN, seven digits, three parts YYNXXXX
YY= FY
N= use code
XXXX = sequential number

Each sample will be assigned a unique number in accordance with procedure, ASD-003, *Identification System for Reports and Samples*. The RIN is used by ASD to track and file analytical data and will be designated by ASD prior to sampling activities. The unique sample number is broken down into the following three parts:

- RIN;
- Event number; and
- Bottle number.

As presented above, the RIN is a seven-digit alphanumeric code starting with the FY (e.g., "00" for the year 2000). The RIN is followed by a dash, and then by the event number. The event number is a three-digit code, starting with "001" under the RIN, and is sequential. Each typical sampling location will have a unique event number under the RIN. QC samples will have unique event numbers to support a "blind" submittal to the analytical laboratories. The event number will be followed by a period, and then by the sequential bottle number. The bottle number is a three-digit sequential code, starting with "001," and is used to identify individual sample containers collected at the same location and same event number.

In addition to the sample numbering scheme above, additional information will be collected with respect to each sample and recorded on the project logsheets. This includes:

- Sample type; and
- QC code.

QC codes will include the following, as appropriate:

- REAL: regular sample; and
- DUP: duplicate sample.

A sample number will also be assigned to each sample collected for internal sample tracking. The block of sample numbers will be of sufficient size to include the entire number of possible samples (including QA samples) and location codes. In preparation for the final report, the ASD and project sample numbers will be cross-referenced with location codes.

6.2 REMEDIAL ACTION DECISION MANAGEMENT SYSTEM

The ER RADMS is a system that generates, verifies, validates, and delivers environmental data products to ER staff in complete and timely maps and reports in conformance with requirements described in Section 6.1. The ER RADMS is a tool for accessing and evaluating environmental data produced within 24 to 48 hours of sample analysis (coupled with historical data as needed), during both characterization and remediation activities. Figure 34 illustrates the general data flow and system configuration.

Detailed specifications of the ER RADMS are described in the data management plan, which describes data generation, aggregation, QC, archival, and access policies. Field and analytical data are organized in Microsoft Access and linked with a GIS, specifically ArcView, to provide users with contaminant data by geographic location and the ability to perform spatial analyses as needed. The ER RADMS will interface with existing site databases, including ASD and SWD, to ensure data consistency and retrievability.

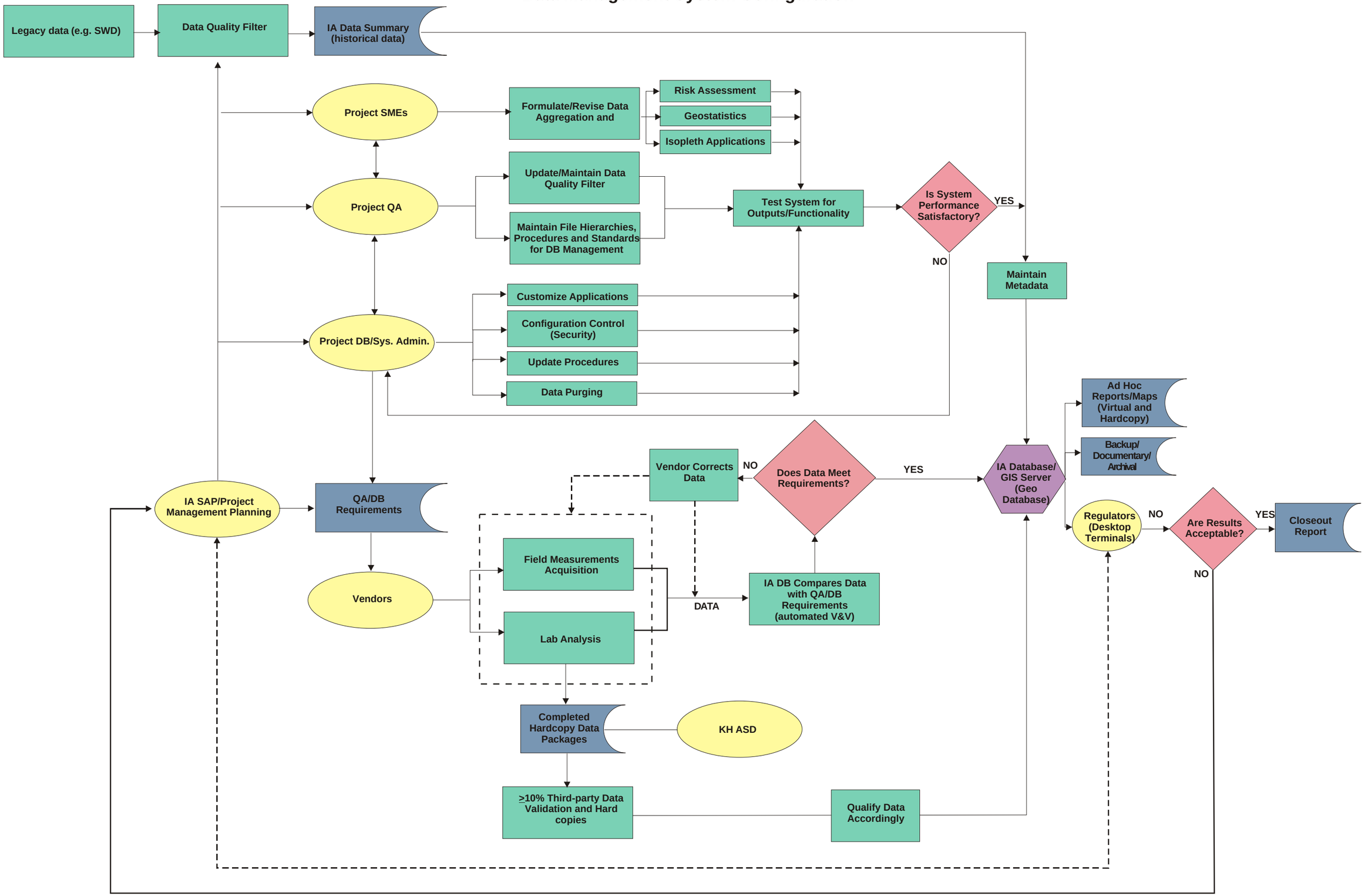
The ER staff will use RADMS to:

- Evaluate analytical data;
- Track environmental samples and maintain chain-of-custody;
- Assess the quality of analytical results;
- Determine characterization sampling locations;
- Determine remediation areas;
- Determine confirmation sampling locations;
- Estimate risk from residual contamination;
- Track closure of RCRA units;
- Track waste volumes and composition; and,
- Produce reports.

Additionally, RADMS will be available to CDPHE and EPA. ER staff will work interactively with the regulatory agencies to:

- View existing data;
- Determine proposed characterization sampling locations;
- Determine remediation areas;
- Determine confirmation sampling locations; and,

Figure 34
Data Management System Configuration



- Accelerate the review and approval process by working with virtual data and graphics prior to submittal of Closeout Reports.

The RADMS includes several modules customized for ER program requirements. The modules include the following:

- Sample tracking;
- Data analysis
  - Data verification and validation,
  - Spatial analysis (contaminant-concentration isopleths), and
  - Risk screen;
- RCRA closure;
- Waste management; and
- Reporting.

6.2.1 Sample Tracking

All characterization and remediation samples will be tracked through the RADMS field data collection management module. Sample tracking will be keyed to the ASD sample numbering system, and will include a variety of field parameters (e.g., those currently required by ASD, as well as sample depth, test method, collection time, and field QC information). Chain-of-custody forms and sample labels may also be printed from this module.

6.2.2 Data Analysis

Data will be analyzed through several different modules as described below. Routine statistical, verification and validation, and spatial analysis will be automated. The algorithms and data analysis sequences are consistent with project DQOs (Section 3.0) and data evaluation (Section 5.0). Data analysis will be performed with verified and validated data after characterization sampling is complete, and again after remediation confirmation sampling.

6.2.3 Verification and Validation

All data collected during ER characterization and remediation sampling will be verified and validated according to QA requirements. Verification will consist of ensuring that all data received from the analytical vendor(s) are complete and correctly formatted. Validation will consist of a systematic comparison of all QC requirements with results reported by the vendor (e.g., relative to laboratory control samples [LCSs], matrix spikes [MSs], matrix-spike duplicates [MSDs], and blanks). The verification and validation

process will establish usability of the data by determining, reporting, and archiving the following criteria relative to each measurement set or batch:

- Precision;
- Accuracy;
- Bias;
- Sensitivity; and,
- Completeness.

6.2.4 Spatial Analysis

Several data aggregation and evaluation options will be available in the spatial analysis module, including inverse distance weighting (IDW), kriging, Monte Carlo simulations, and other geostatistical techniques. Spatial analysis will allow determination of contaminant-concentration boundaries as defined by RFCA Tier I, Tier II, and background values. This analysis will also be used to determine additional sampling locations, remediation areas, and associated confidences in the values/decisions.

6.2.5 Risk Screen

The risk screening module is used to determine whether human health risks are acceptable in remediated areas. Algorithms in the risk screening module are consistent with DQOs in the Draft CRA Methodology (DOE 2000c) and the IASAP. The risk screening module includes estimation of external and internal exposures on an IA Group basis.

6.2.6 RCRA Closure

The RCRA closure module allows a user to archive all pertinent location, analytical, and remediation information about RCRA units. This will be used to track closure of sections of the OPWL and NPWL.

6.2.7 Waste Management

Location, volume, characteristics, classification, and container type will be tracked for all ER remediation waste, and will allow links with other RFETS waste management databases.

6.2.8 Reporting

RADMS is configured to produce reports from all of the customized modules. Hardcopy reports will typically consist of data tables (queries), isopleth maps (e.g., Tier I, Tier II, and background concentration boundaries, and risk), and combinations of tables and maps tailored to specific needs. Hardcopy reports will be minimized through the routine use of desktop “workstations” dedicated to specific locations and/or personnel within the project, DOE, EPA, and CDPHE.

7.0 PROJECT ORGANIZATION

The overall IA project organization is shown on Figure 35 and the general IA Group characterization project organization is shown on Figure 36.

The overall IA project organization is designed to provide support to the project manager by ensuring the various support functions are consistent across the IA characterization program and available to the project. These support functions will include, but not necessarily be limited to, the following:

- H&S;
- QA;
- Field instrumentation and mobile laboratory services;
- Data configuration;
- Data analysis procedures;
- Interactions with ASD and SWD;
- Data management; and
- Reporting procedures.

The IA Group characterization organization shown on Figure 36 illustrates the characterization team functions. Individuals assigned to each specific IA Group characterization will be identified in the appropriate IASAP Addenda.

8.0 QUALITY ASSURANCE AND QUALITY CONTROL

QA requirements defined in this IASAP are consistent with quality requirements as defined in DOE (Order 414.1A, *Quality Assurance*) and EPA (QA/R-5, EPA *Requirements for Quality Assurance Project Plans for Environmental Data Operations*, 1997). These requirements are also consistent with RFETS-specific quality requirements as described in the Kaiser-Hill Team *Quality Assurance Program*, PADC-1996-00051 (K-H 1999).

The applicable QC categories include the following:

Management

- Quality Program;
- Training;
- Quality Improvement;

Figure 35
Industrial Area Characterization Project Organization

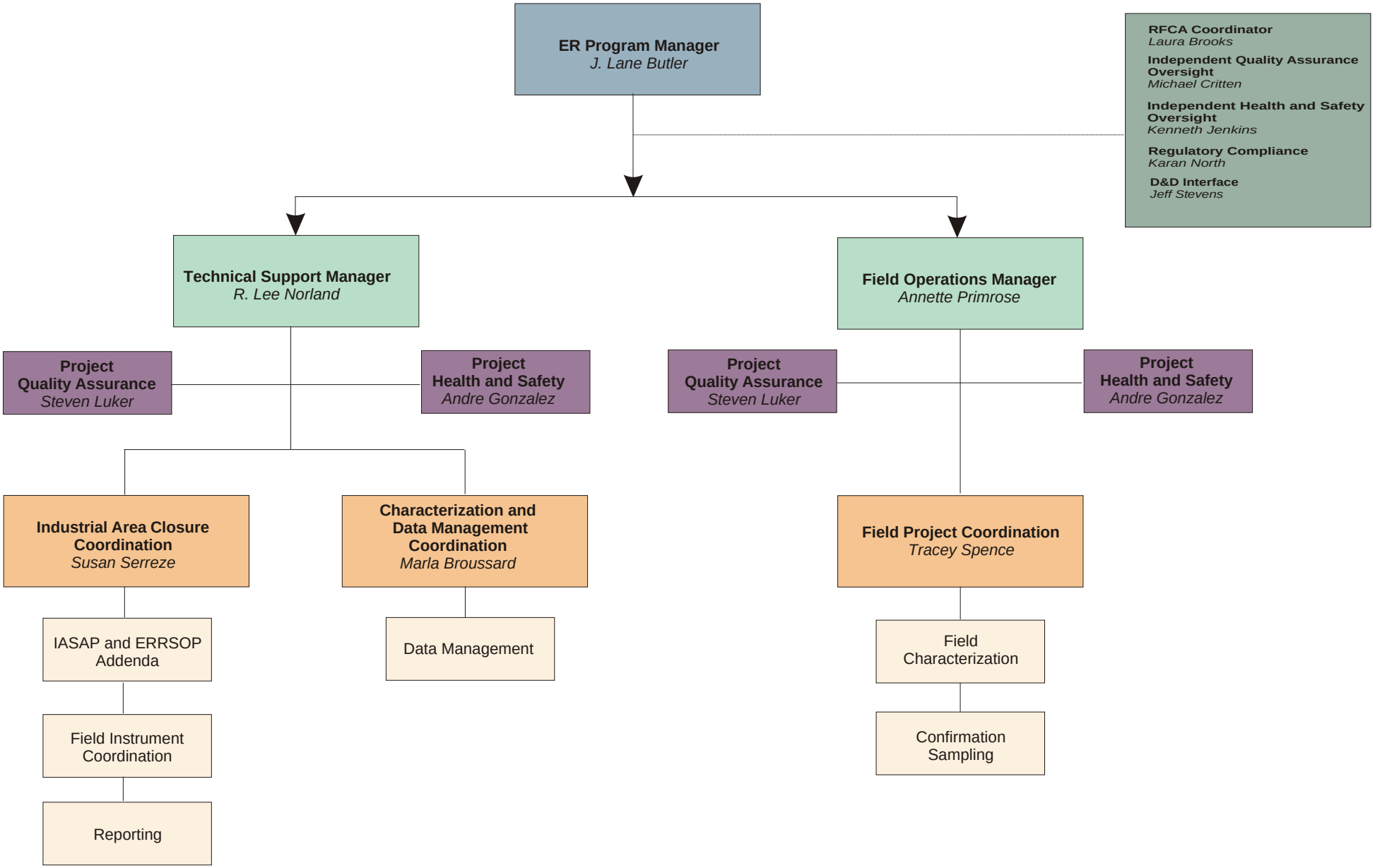
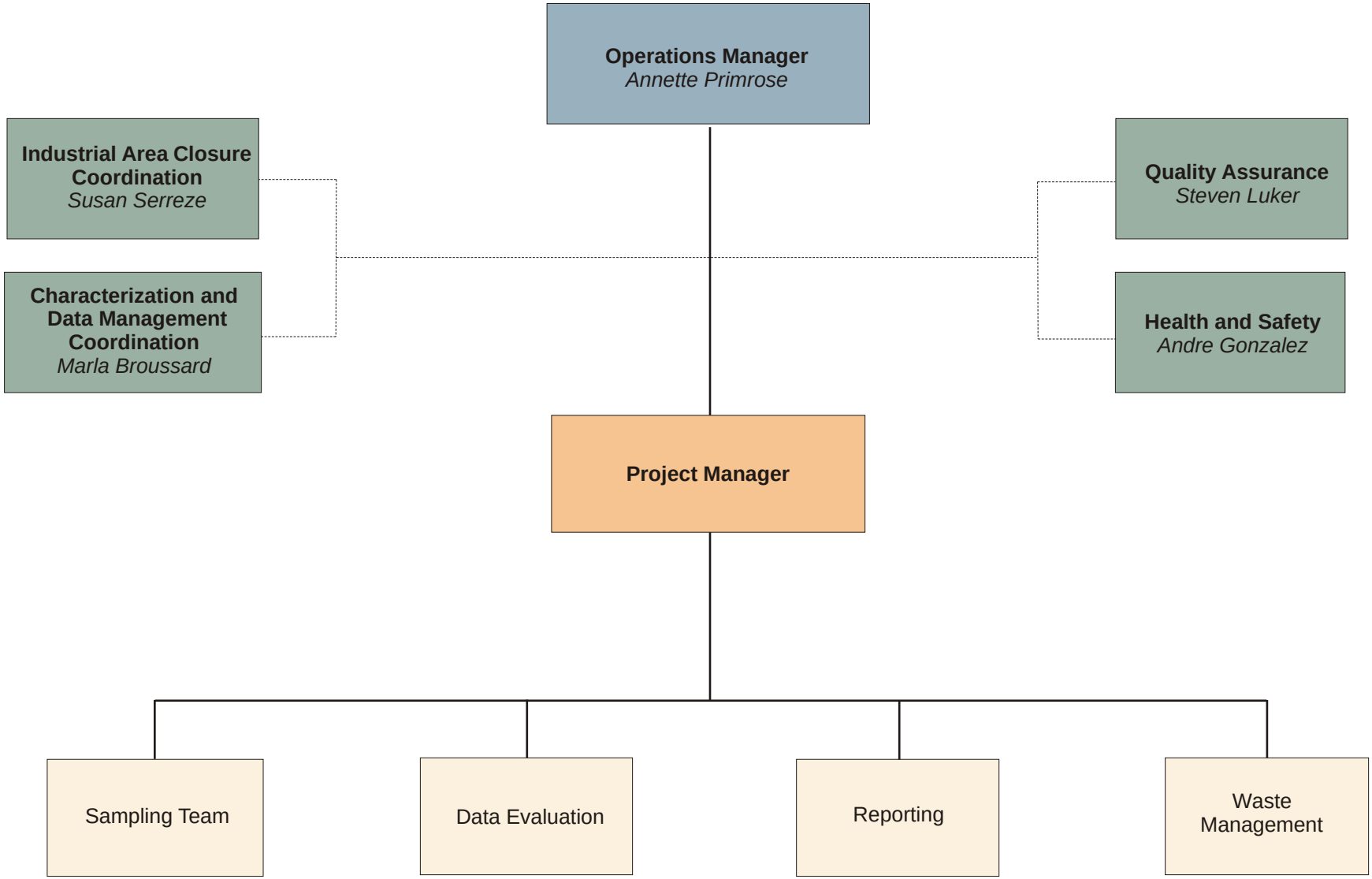


Figure 36
Industrial Area General IA Group
Characterization Project Organization



- Documents/Records;

Performance

- Work Processes;
- Design;
- Procurement;
- Inspection/Acceptance Testing;

Assessments

- Management Assessments; and
- Independent Assessments.

The QAPjP (Appendix H) discusses in detail how these criteria will be implemented. The project manager will be in direct contact with the QA manager to identify and correct potential quality-affecting issues. Oversight of field sampling and analysis will be conducted to ensure data comply with quality requirements. The confidence levels of the data will be maintained by the collection of QC samples and implementation of the DQO process.

Data verification and validation will be performed according to ASD procedures. Analytical laboratories supporting this task undergo annual technical and QA audits performed by ASD.

Data quality will be measured in terms of the precision, accuracy, representativeness, completeness, and comparability (PARCC) parameters. Data collected during IA sampling activities will be evaluated using the PARCC parameters (Appendix H). Measurement sensitivity and bias will also be addressed.

9.0 HEALTH AND SAFETY

All necessary H&S protocols will be followed in accordance with the specifications in the IASAP Addenda and Integrated Work Control Program (IWCP), as appropriate. In addition, work will be conducted under Radiological Work Permits (RWPs), as applicable. A readiness review will be conducted before the start of fieldwork for all IA Groups. The IASAP Addenda will include H&S requirements for the specific PCOCs, hazards, and emergency response protocols associated with the IA activities.

The Occupational Safety and Health Administration (OSHA) construction standard for Hazardous Waste Operations and Emergency Response, 29 CFR 1926.65, is followed at RFETS. Under this standard, a H&S plan that addresses the safety and health hazards of each phase of the project and specifies the requirements and procedures for employee protection will be developed. In addition, the DOE Order for Construction Project Safety

and Health Management, 5480.9A, applies to this project. This order requires the preparation of AHAs to identify each task, hazards associated with each task, and cautions necessary to mitigate the hazards. These requirements will be integrated wherever appropriate.

IASAP activities could expose workers to physical, chemical, and low levels of radiological hazards. Physical hazards include those associated with excavation activities, drilling, use of heavy equipment, noise, heat stress, cold stress, and work on uneven surfaces. Physical hazards will be mitigated by appropriate use of PPE, engineering, and administrative controls. Chemical hazards will be mitigated by use of PPE and administrative controls. Appropriate skin and respiratory PPE will be worn throughout the project.

VOC monitoring will be conducted with an organic vapor monitor for any employees who must work near suspected VOC-contaminated soil (e.g., soil sampling or excavation personnel). Based on employee exposure evaluations, the Site H&S officer may downgrade PPE requirements, if appropriate.

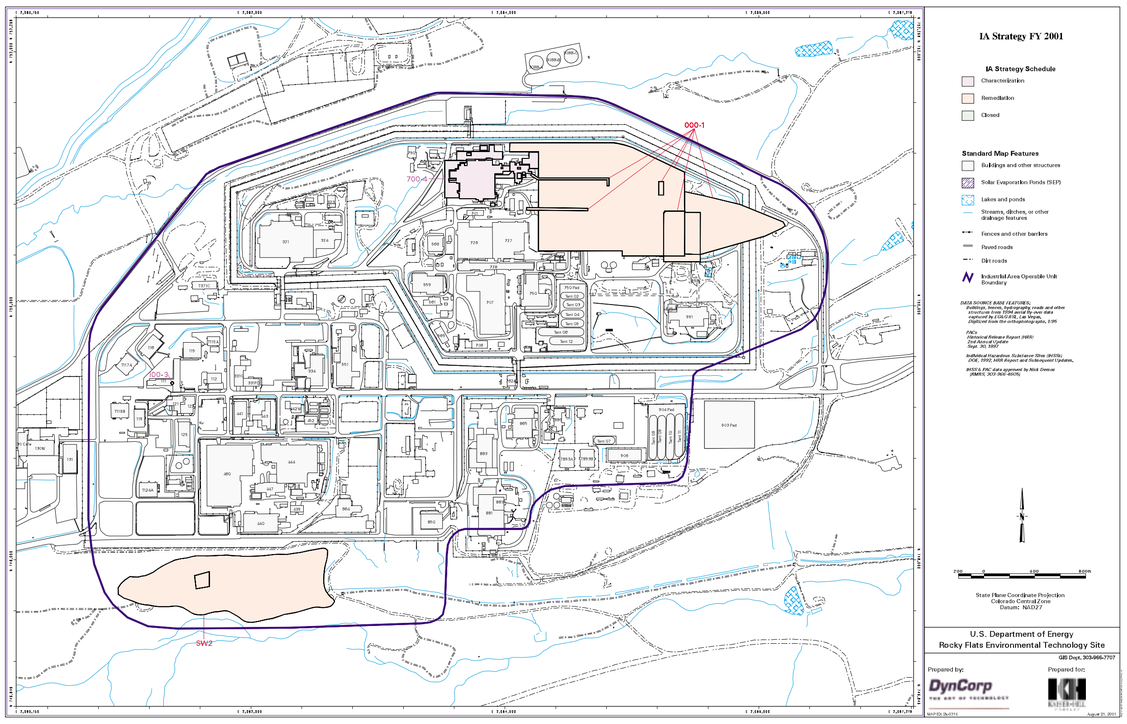
H&S data and controls will be continually evaluated. Field radiological screening will be conducted using radiological instruments appropriate to detect surface contamination and airborne radioactivity. As stated in 10 CFR 835, Radiation Protection of Occupational Workers, all applicable implementing procedures will be followed to ensure protection of workers. Dust minimization techniques will be used to minimize suspension of contaminated soil.

10.0 SCHEDULE

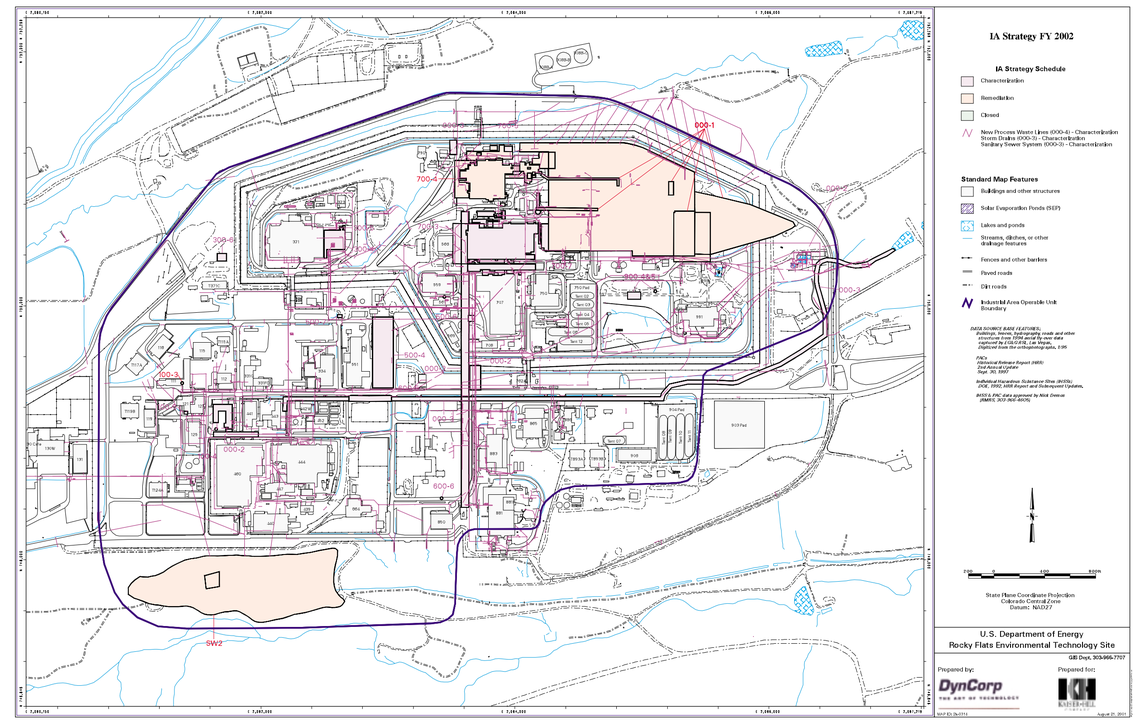
The schedule for characterization of the IA Groups is shown on Figure 37. This figure illustrates the 2005 Working Schedule for RFETS Closure, but may change based on the decommissioning schedule and characterization acceleration opportunities.

Figure 37
Industrial Area Schedule

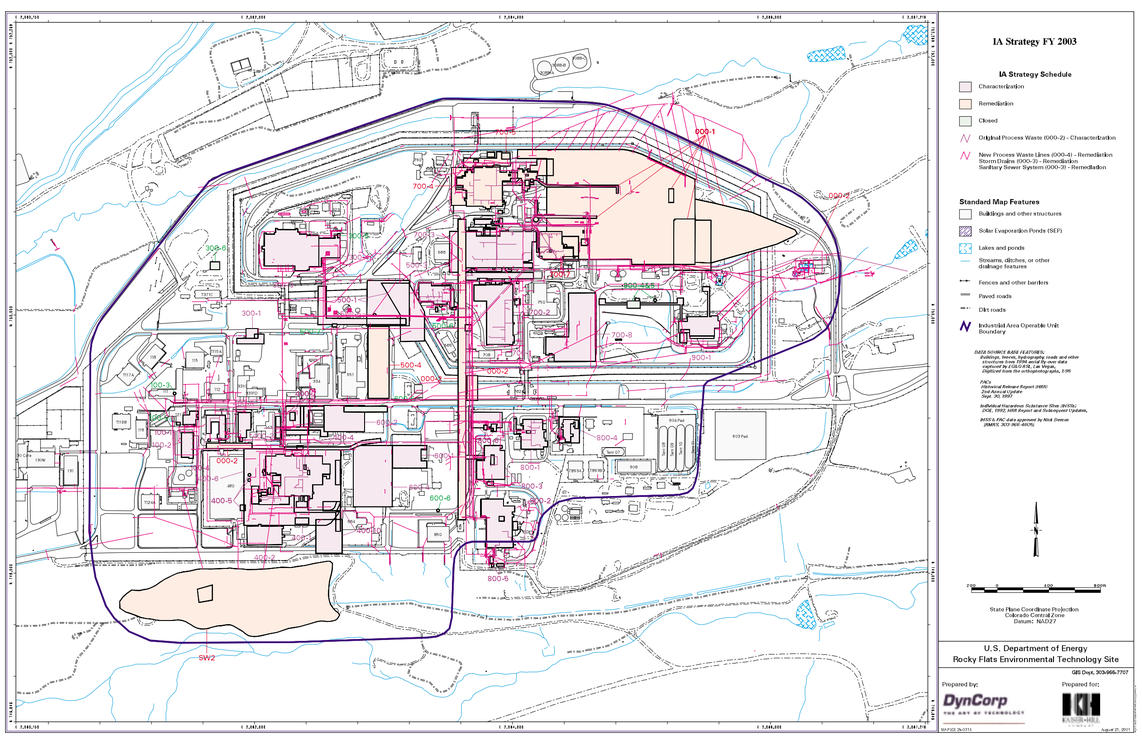
FY 2001



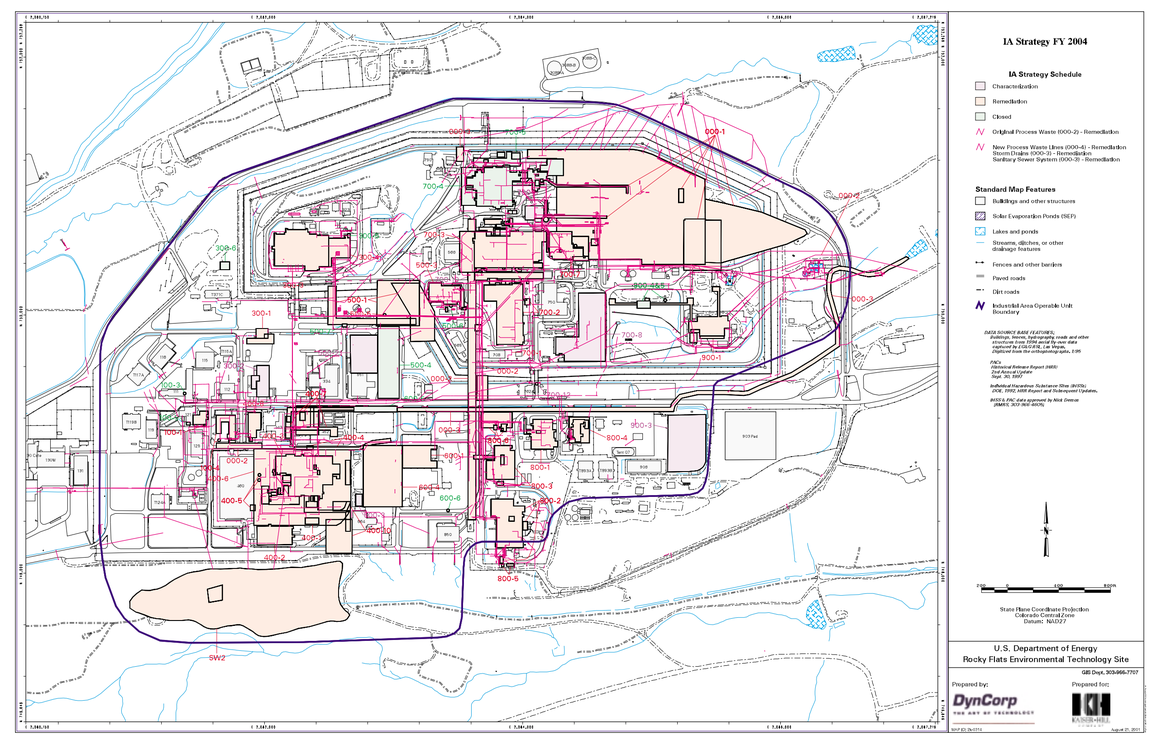
FY 2002



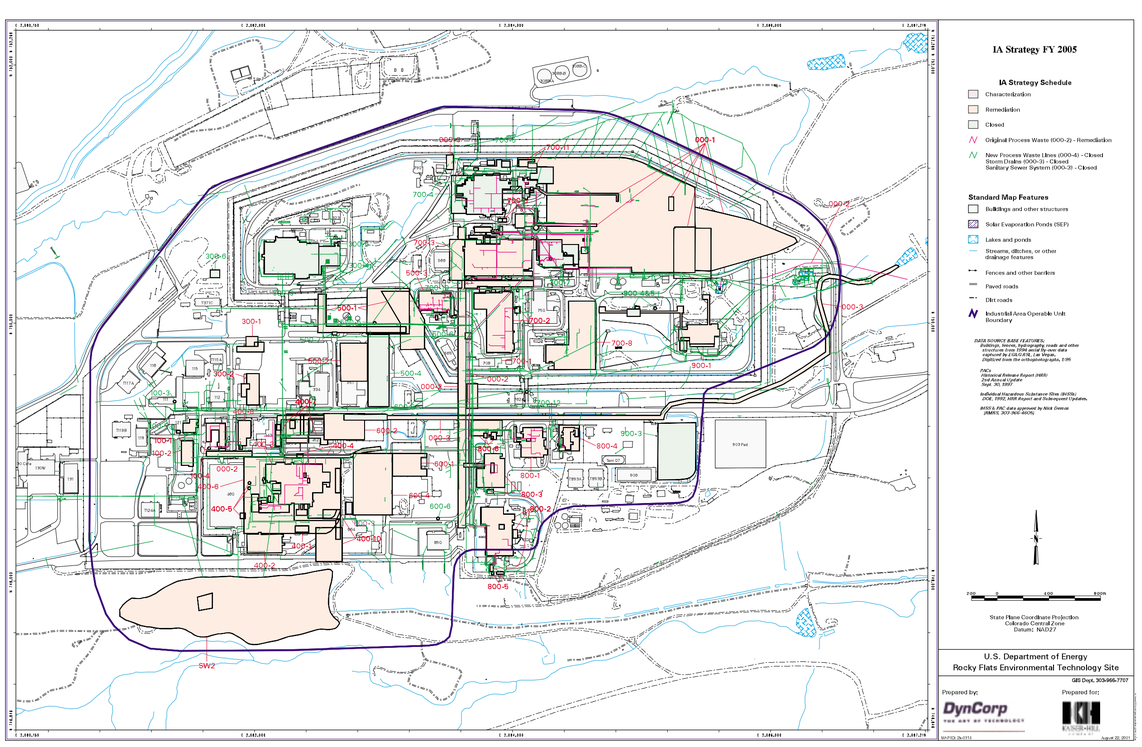
FY 2003



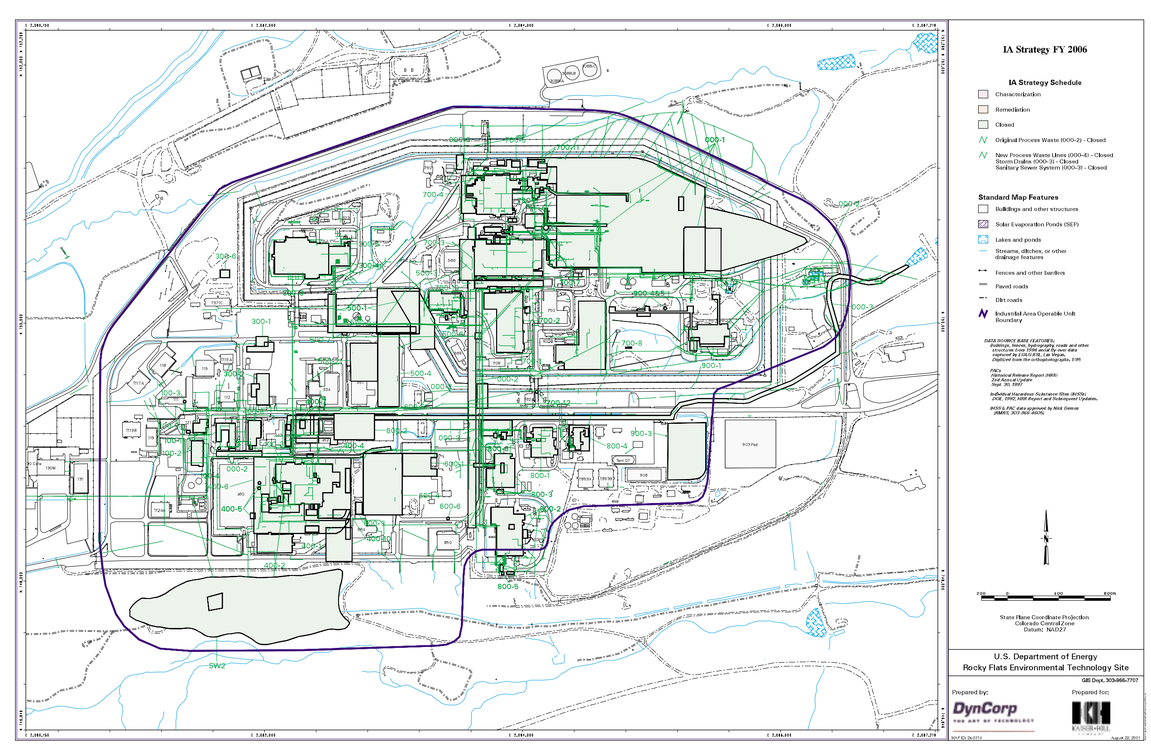
FY 2004



FY 2005



FY 2006



NT_svr w:/projects/fy2k/0314/poster_fig37.aml

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LIST OF APPLICABLE STANDARD OPERATING PROCEDURES

Identification Number	Procedure Title
1-C91-EPR-SW.01	*Control and Disposition of Incidental Waters*
1-PRO-079-WGI-001	*Waste Characterization, Generation, and Packaging*
1-PRO-573-SWODP	*Sanitary Waste Offsite Disposal Procedure*
3-PRO-112-RSP-02.01	*Radiological Instrumentation*
4-S01-ENV-OPS-FO.03	*Field Decontamination Operations*
4-F99-ENV-OPS-FO.23	*Management of Soil and Sediment Investigative Derived Materials*
ASD-003	*Identification System for Reports and Samples*
OPS-PRO.069	*Containerizing, Preserving, Handling and Shipping of Soil and Water Samples*
OPS-PRO.070	*Equipment Decontamination at Decontamination Facilities*
OPS-PRO.102	*Borehole Clearing*
OPS-PRO.112	*Handling of Field Decontamination Water*
OPS-PRO.114	*Drilling and Sampling Using Hollow-Stem Auger and Rotary Drilling and Rock Coring Techniques*
OPS-PRO.117	*Plugging and Abandonment of Boreholes*
OPS-PRO.121	*Soil Gas Sampling and Field Analysis*
OPS-PRO.124	*Push Subsurface Soil Sampling*
OPS-PRO-947	*Location/Surveying*
PRO-1058-ASD-005	*Environmental Data Management Procedure*
PRO-1130-ASD-006	*Spatial Data Map Control*
PRO-908-ASD-004	*On-Site Transfer and Off-Site Shipment of Samples*
RF/RMRS-98-200	*Evaluation of Data for Usability in Final Reports*