Chapter 3
Develop Data Collection Options (Phase III)

This chapter offers guidance to sampling and analysis data implementors for their detailed planning efforts. Phase III (see Figure 3-1) of the Technical Project Planning (TPP) process is designed for planning sampling and analysis approaches that will satisfy the data needs identified during Phase II. Data collection options are also developed during Phase III to ensure the customer has adequate information during Phase IV for business decisions related to a project's data collection program.

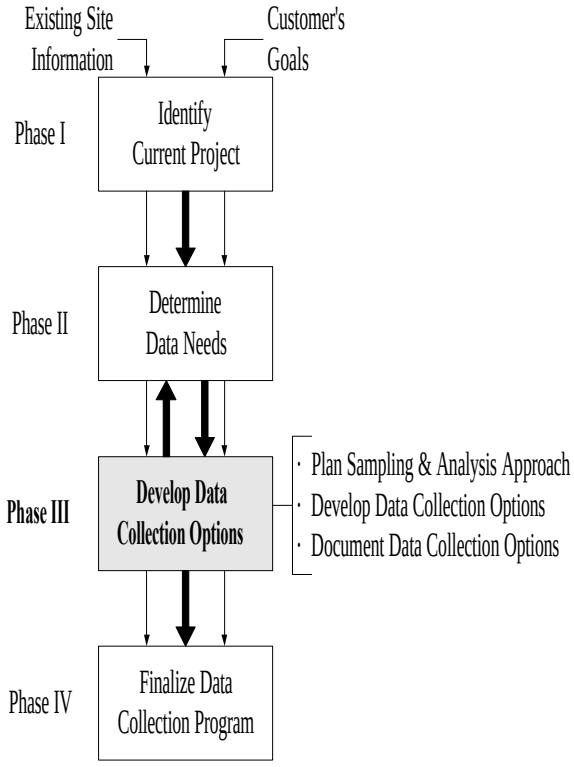

Figure 3-1
Phase III of Four-Phase TPP Process

> The PM and technical personnel will find that Phase III activities are iterative with Phase II activities as data needs tend to be clarified and refined. Therefore, data implementors will find communication with the data users to be invaluable during this phase of TPP activities.

Data implementors will find guidance in this chapter to help them document both the appropriate sampling and analysis methods and the data collection options. Although this chapter supports efforts to plan sampling and analysis approaches, it is not an exhaustive reference or resource.

3.1 PLAN SAMPLING AND ANALYSIS APPROACH.

Planning the most appropriate sampling and analysis approaches for a site is an iterative thought process. As presented in this manual, many technical personnel must collaborate to determine suitable sampling and analysis methods and develop data collection options for a site.

3.1.1 Review Phase I and Phase II Information.

The project manager (PM) should distribute copies of the Phase I memorandum for record (MFR) and any corresponding project objective worksheets, and Phase II data need worksheets to all personnel involved in Phase III. Efforts to plan sampling and analysis approaches should begin with review of the earlier TPP information. Review of Phase I and Phase II information is particularly critical for those personnel not involved in those efforts, and for the entire team when some time has passed since Phase I and Phase II efforts were completed.

3.1.1.1 Review Phase I MFR.

Review of the Phase I MFR and any project objective worksheets will refresh technical personnel of the site approach, project objectives, current project focus, and any site constraints and dependencies.

Although the data implementors may have been involved in Phase I activities, the Phase I MFR may contain revised constraint information including the finalized acquisition strategy, a modified budget, and updated schedule information. For example, schedule and site physical constraints may now preclude use of a proposed sampling method, while new budget and regulatory constraints may dictate the selection of analytical options. The MFR may also contain or reference useful site background information including analytical data from previous studies, site physical characteristics, aerial photographs, topographic maps, site cross-sections, site boring logs, etc. The preliminary conceptual site model prepared during Phase I can also acquaint data implementors with the physical and chemical features of a site in relation to possible sampling strategies.

3.1.1.2 Review Phase II Data Needs.

Data implementors should review the range of data needs identified during Phase II by the data users. Documentation prepared at the end of Phase II should communicate the intended data uses, the required number of samples, the contaminant concentrations of interest, and the necessary sampling areas or locations and depths. The Phase II documentation should also designate each of the data needs as "basic," "optimum," or "excessive," as well as any opportunities for use of field screening or field analytical methods and expedited site characterization approaches.

As data implementors review the Phase II data needs, they should begin to recognize both similar and unique data needs to ensure that all of the data needs are understood. Although data implementors may have been consulted during Phase II by data users, data need worksheets or other Phase II documentation may introduce new or refined data needs developed by each data user perspective. Data implementors will probably find it necessary to contact data users when trying to interpret data needs or to obtain additional information regarding data quality requirements.

3.1.2 Plan Sampling and Analysis Approaches.

The sampling data implementor should generally lead efforts to first sort and then combine the data needs prior to developing and documenting sampling strategies. The analysis data implementor should then proceed to develop and document field and laboratory analysis strategies. And finally, technical personnel representing both the sampling and analysis data implementor perspectives should refine their plans within cost and schedule constraints of the project. Data implementors will find Step 7 of the U.S. Environmental Protection Agency's 7-Step Data Quality Objective Process useful during these TPP efforts.[1]

While planning sampling and analysis approaches, data implementors are expected to consider both analytical and field sources of error to ensure the data will be useable for the intended data use(s). Detailed planning by data implementors can further minimize analytical error and significantly reduce potential sources of field error. Proper management of analytical and field sources of error requires that both the sampling and analysis data implementors employ the most current accepted methods for sampling and analyzing all types of media.[15, 16]

Data implementors must address site-specific sampling and analysis requirements rather than merely planning to implement sampling or analysis activities that were developed for a previous project or similar site.

3.1.2.1 Sort and Combine Data Needs. Data implementors should first sort and then combine data needs by media and location. It is important to identify overlapping data needs at a particular location and unique data needs from common locations at a site. Similar data needs should be combined to the extent possible to ensure sampling and analysis efforts are minimized. The efforts of data implementors to carefully sort and combine data needs can make a project very successful and efficient. When sorting and combining data needs, it is intended that some of the efforts include the following.

- **Balancing Sensitivity Requirements**
  When combining similar data needs, data implementors are cautioned to only apply the most stringent or lowest concentrations of interest requirements to those locations designated by the data users based on the intended data use. Typically, data used to characterize risk must meet more stringent sensitivity requirements than data used to evaluate, design, implement, and operate remedial technologies. The data required to identify potentially responsible parties may also require a greater degree of confidence, or number of samples, than other data needs. An example of overlapping data needs is a risk perspective data need for groundwater contaminant concentrations from an existing drinking water well and a remedy perspective data need for groundwater contaminant concentrations from the same vicinity. Both data needs could be satisfied simultaneously as long as the analytical sensitivity meets the more stringent of the two requirements. In this case, the risk data need requirements for lower analytical quantitation limits is likely the most stringent requirement. However, if additional groundwater contaminant concentration information was required from adjacent wells for only the remedy perspective, the more stringent risk sensitivity requirements should not be applied. When balancing sensitivity requirements, data implementors must be sure to effectively communicate and involve the appropriate laboratory personnel to prevent misunderstandings during sample analysis.

- **Meeting Sampling Depth Requirements**
  Data implementors may recognize similar data needs in a particular area of a site or even overlapping data needs at a common site location. In those instances where some data needs directly overlap each other in location and depths, data implementors should be sure to meet the discrete sampling depth requirements of any data users with unique sampling depth needs.

- **Evaluating Data Need Trade-Offs**
  Data need trade-off situations may be discovered where an alternate adjacent sampling location may be acceptable and representative for several data user perspectives instead of merely collecting data from several individual but adjacent sampling locations. After consultation with data users, they may agree to reduce the number of samples or increase their concentrations of interest on some data needs to help meet project cost or schedule constraints. Such trade-offs may enable the

data implementors to decrease the overall uncertainty of site decisions by using the available funds for conducting other required field screening or field analytical work at a site. Still another data need trade-off may involve the use of composite sampling where it can be appropriate for the intended data use(s). This trade-off may help to meet project constraints while decreasing the uncertainty of some site decisions.

Although the greatest cost savings can be achieved when the data needs of several data user perspectives overlap (e.g., contaminants of concern, soil chemical or physical characteristics), overlooking a unique data need from a common site location could result in costly remobilization to the site to re-sample the location. Another common opportunity for cost savings is ensuring that management decisions regarding investigation and remediation derived wastes can be made using the analytical results from corresponding matrix sampling locations.

3.1.2.2 Develop and Document Sampling Strategies.

Developing the sampling strategy requires a thorough understanding of a site, and all the information generated during TPP Phases I and II. In particular, the sampling data implementor should understand the team's preliminary conceptual site model and consider its use while developing sampling strategies for a site. Data implementors should also be sure to follow any state-specific guidance on sampling design that is applicable to a site. Based on initial efforts to work with this information, the sampling data implementor may consider involving some of the other technical personnel to determine the best sampling strategy to meet the data needs, develop the data collection options, and apply field screening or field analytical and expedited site characterization approaches whenever appropriate.

3.1.2.2.1 Sampling Strategy Constraints.

The total sampling time and costs should be estimated based on site access considerations, proximity of multiple sampling locations, seasonal weather conditions, mobilization/ demobilization efforts, equipment decontamination measures, sample management activities, concurrent site operations, and the total number of samples associated with each data collection event. The sampling data implementor should work to ensure that the entire field sampling activity can be conducted within the time allotted on the project schedule and within the project's budget constraints.

Because it is often necessary to sample property adjacent to a customer's property, the team should be proactive to obtain an access agreement and sensitive to minimizing disruption to the properties of adjacent owners. It can also be very time consuming to get appropriate site access agreements in place. Therefore, a common sampling strategy is to develop a sample collection design that involves only a one-time offsite sampling effort, rather than multiple or periodic sampling events that may require a costly real estate acquisition.

For each sample collection design alternative, the sampling data implementor should select the optimal number of samples and the most resource-effective data collection design that satisfies all of corresponding data needs. Sampling design approaches for designating sampling locations include both probabilistic and

non-probabilistic methods and must correspond to the type of decision to be made as discussed in Paragraph 2.1.4.1.

> When evaluating sample collection designs, the sampling data implementor must remember to include appropriate quality assurance/quality control measures.

3.1.2.2.2 Probabilistic Sampling.
If decision error quantification is required, probabilistic sampling must be performed. For those investigations when litigation with another potentially responsible party is anticipated, a probabilistic or random sampling approach may be desired for extrapolating results from a set of samples to larger portions of a site. By combining an efficient probabilistic sampling design with a statistical hypothesis test, data implementors can optimize resources (e.g., personnel, equipment, funding, site access, temporal constraints) and provide data of an acceptable quality for the intended data use(s). Planning for statistical analysis before sample collection is crucial so data support the intended data use(s). Other guidance should be used for establishing tolerable limits on decision errors and statistically determining the number of samples to be collected based on the hypothesis test and random data collection design.[1]

3.1.2.2.3 Non-Probabilistic Sampling.
Non-probabilistic or judgmental sampling locations are selected by the data user based on site knowledge of contaminant distribution and the intended data use. With judgmental sampling, it is not possible to quantify decision errors related to the number of samples, and the sample is only as good as the conceptual model used to define the target population.

3.1.2.2.4 Field Screening and Analysis.
Field screening and field analytical methods can be useful tools for satisfying some data need requirements while reducing costs. Data implementors could also plan to conduct some field screening or field analytical activities during these Phase III TPP efforts to refine the team's understanding of the site prior to designing a data collection program for the current executable stage of site activities. Further discussion about the use of field screening methods is provided in Paragraph 3.1.2.3.1.

3.1.2.2.5 Expedited Site Characterization (ESC) Techniques.
Another sampling and analysis execution option that should be considered and re-visited at this step in the TPP process is the use of ESC techniques. ESC is a methodology that utilizes in-field decision making, dynamic work plans, and real-time data acquisition and interpretation.[12]

In the case of the TPP process, ESC encourages the data users and data implementors to plan a data collection program in the office and then those same key personnel implement the data collection program in the field. In instances where the data users and data implementors believe ESC techniques are appropriate, dynamic work plans should be used by the team to provide some decision logic in advance of field activities. It will also provide sufficient flexibility for field modifications based on on-site decision making. By having established decision logic and providing on-site decision making authority, field work can be suspended whenever conditions deviate from what was planned or anticipated.

If at this step in the TPP process the team believes some ESC techniques should be applied at a site, the team should review Phase I TPP activities to ensure ESC is appropriate within the site approach and the current project. As the team proceeds with integrating ESC techniques, the technical personnel should also review Phase II TPP activities to identify and redefine the data needs that could be adequately fulfilled using ESC techniques.

> The sampling data implementor should not hesitate to obtain clarifications from the data users to ensure the sampling methods will meet Phase II data needs.

3.1.2.3 Develop and Document Analysis Strategies.
The analysis data implementor should evaluate the testing requirements, media to be sampled, and chemical and physical characteristics of the contaminants to select the analytical strategy. By involving the appropriate laboratory personnel during these efforts, the analysis data implementor will be more successful in identifying and communicating project specific analytical requirements.

The analysis data implementor must incorporate a comprehensive and multifaceted approach to quality assurance/quality control in order to achieve and document that data quality requirements have been attained for the intended data usage.[16] They should also refer to Engineer Manual 200-1-6 concerning compliance monitoring activities that may be applied to ensure adequate chemical data quality management is achieved on a project.

The anticipated analytical costs and turnaround time associated with each analytical method and the related quality assurance/quality control requirements must be considered. In all cases, the costs and turnaround times should be compared to the project's analytical budget and schedule, and the analytical strategies adjusted to fit within the project constraints.

The generation of screening data versus definitive data should always be considered. Whenever appropriate or potentially viable, performance based measurement systems should also be evaluated. By being less prescriptive about the laboratory analysis to be performed, performance based measurement systems can be tailored for application at a site and can enable optimization of cost and schedule expenditures.

3.1.2.3.1 Screening Data.
Field screening activities can be used during the TPP process (e.g., during a site visit) to refine sampling and analysis approaches or to provide additional site characterization data to data users. Various types of field screening analyses should be considered to gather preliminary information, reduce errors associated with spatial heterogeneity, or to prepare preliminary maps as guides for further sampling. Field screening analyses can be conducted to determine worker protection levels; extent of contamination or hot spots; presence of underground contamination; and the potential applicability of presumptive remedies or innovative technologies. For many sites, field screening analyses can also provide useful data for a risk assessment because they can be used quantitatively if confirmed with definitive data. In general, field screening data intended for quantitative use should be confirmed with at least 10 percent replicate samples analyzed using definitive methods.

Effective planning for the use of field measurement technologies involves consideration of at least the following factors:

- Knowledge of site contaminants and what may be encountered that could affect performance of the field measurement technology;
- Determining whether the measurement sensitivity is sufficient for the contaminant concentration(s) of interest;
- Understanding exactly what the field analysis technology measures;
- Understanding the factors controlling the performance of the field analysis technology; and
- Establishing a site-specific correlation between the screening and definitive measurement techniques.

Data users must be consulted for their concurrence regarding the use of field screening methods to meet their intended data uses. Collaboration between the analysis and sampling data implementors is crucial when the team plans to use field screening and field analytical methods. The team also needs to establish how field decisions will be made and communicated across the team.

3.1.2.3.2 Definitive Data.

Definitive data are generated using rigorous, analyte-specific methods where analyte identifications and quantitations are confirmed, and quality assurance/quality control requirements are satisfied. Definitive data can be generated from standardized analytical methods (e.g., EPA reference methods) or non-standardized methods in which the analytical or total measurement error has been determined. The potential analytical methods should be selected based upon the intended data use(s). Analytical method selection should be based on the chemicals of concern, the anticipated range of concentrations for the individual chemical contaminants and the media type and complexity. Other critical, site-specific considerations include regulatory agency method preferences and quantitation limit requirements; chemical quantitation and identification requirements; cleanup capabilities; quality assurance/quality control requirements; and turnaround time needed. There may also be a need for future proof of data results for compliance, responsibility, or cost allocation disputes.

The analysis data implementor should not hesitate to obtain clarifications from the data users to ensure the analytical methods will meet Phase II data needs.

3.1.2.4 Refine Plans Within Project Constraints.

Data implementors should generate order-of-magnitude cost estimates to determine if the proposed sampling and analysis scheme can be executed within the budget constraints. Data implementors may find that the number of samples, sampling methods, or analysis methods need to be changed to remain within budget constraints. Archiving samples for subsequent analysis may also contribute to balancing the sampling design within project constraints.

Data implementors should also evaluate effects of schedule and any temporal constraints that apply to site activities. An extremely short schedule may require some sampling events to be concurrent rather than phased activities. The level of effort associated with the entire data collection plan could exceed the scheduled duration of field activities. Temporal conditions may be such that some data needs could only be fulfilled during a seasonally dry or warm period of time.

In all instances, data implementors should be careful to recognize and develop data collection strategies for obtaining "basic," "optimum," and "excessive" data needs.

3.2 DEVELOP DATA COLLECTION OPTIONS.

After planning sampling and analysis activities, data implementors should work with data users to group the data needs into data collection options for consideration during Phase IV activities. Data collection options provide a simple mechanism to document the "basic" data needed for the current project; "optimum" data that is cost-effective and prudent to collect for future executable stages; and any "excessive" data that is imposed or mandated by others in excess of the data needed by data users.

3.2.1 Basic Data Collection Option.

The "basic" data collection option is the data set needed to satisfy the current project objectives (e.g., remedial investigation data). The data collection efforts would produce data that generally meets all the data quality requirements of the data users for only the current project.

If data quality requirements cannot be met for the data users, the technical personnel need to clearly communicate this information to the PM. For example, the PM should be advised if planning compromises have been incorporated by the technical personnel when existing sampling or analysis methods cannot achieve action levels or concentrations of interest required by the data users. If all the basic data needs for the current project cannot be obtained within budget or schedule constraints, technical personnel should prioritize the data needs within this basic group of data needs, but not eliminate data needs at this step in the TPP process.

3.2.2 Optimum Data Collection Option.

The "optimum" data collection option highlights opportunities to collect data needed to satisfy future project objectives at the site, during the current project. This grouping includes the portion of data needed for future executable stages that would be cost-effective and prudent to obtain during the current project. The optimum data collection option includes only those future data needs that technical personnel believe are good current investments toward future executable stages at a site.

A typical optimum data collection option would be to include the feasibility study and remedial design data that can be cost-effectively obtained during the remedial investigation at a site. Even if the current project budget cannot afford optimal data collection, data implementors should still develop an optimum data collection option to be considered by the customer during Phase IV.

3.2.3 Excessive Data Collection Option.

This unique group of data needs are those data needs that data users believe are excessive for the purposes of satisfying both current and future project objectives. The data needs classified as "excessive" will be those specifically requested, imposed, or mandated by others and not needed by the data users.

Examples of excessive data collection options would include planning to have full suite laboratory analysis of all samples when full suite analysis of select samples would meet the project objectives; or planning to install additional groundwater monitoring wells when the data users can use the existing monitoring wells for meeting the project objectives.

All data needs within the excessive data collection option exceed the data needs or data quality requirements of the data users for the current and future executable phases of the project. The excessive data collection option should not be misused to represent the data needs that cannot be collected within cost or schedule constraints of the project.

Development or recommendation of all three types of data collection options may not be possible or appropriate on some sites. For example, if no data needs were requested, imposed, or mandated above the data need or data quality requirements of the data users, then the excessive data collection option is not necessary. Although development of an optimum data collection option should always be pursued, recommendation of an optimum data collection option may be deemed inappropriate if the data needed to satisfy current project objectives already exceeds project cost and schedule constraints.

3.3 DOCUMENT DATA COLLECTION OPTIONS.

Data implementors are responsible for communicating data collection options for further consideration during Phase IV. Data implementors' efforts to document project specific requirements for the basic, optimum, and excessive data collection options are critical for the success of TPP activities and continued progress to site closeout. Data implementors should consider recording the appropriate sampling and analysis methods and the data collection options using the sampling and analysis planning worksheet and the summary table of data collection options provided in Appendix F or similar methods. Use of standardized worksheets and tables will allow quick and easy quality assurance/quality control review of the data collection and analysis plans.

Critical aspects of documenting the appropriate sampling and analysis methods and data collection options are as follows:

- What data needs are being met;
- What project objectives will be satisfied;
- How many samples need to be collected;
- Where do the samples need to be collected;
- What sample collection methods need to be used (e.g., discrete or composite samples; sampling equipment and technique; quality assurance/quality control samples);
- What sample analysis methods need to be used (e.g., sample preparation; laboratory analysis; method detection limit and quantitation limit; laboratory quality assurance/quality control); and
- What technical limitations, cost benefits, and imposed requirements are associated with each applicable data collection option.

Data implementors should also develop order-of-magnitude costs for preliminary estimates and prepare draft figures representing planned sampling locations or areas. The data collection tables, preliminary cost estimates, and draft figures will be used during Phase IV activities.

Sampling and analysis planning worksheets offer a concise yet complete means of communicating the sampling and analysis methods to obtain data that satisfies the data requirements associated with the intended data uses. Well prepared sampling and analysis worksheets can be inserted directly into appropriate scope of work or work plan sections.

3.4 COMPLETE PHASE III ACTIVITIES.

The technical personnel should review the sampling and analysis planning worksheets to ensure that all data needs were appropriately incorporated within a data collection option. In accordance with the applicable quality management plan, the PM should also have independent technical resources review the sampling and analysis planning worksheets. (An example of a sampling and analysis planning worksheet is provided in Appendix F and may be useful during independent review efforts.) In any case, all projects will be periodically evaluated by the project team to ensure baseline requirements of scope, schedule, and cost are being met.[2] If it appears that some data needs were omitted from grouping within a data collection option, the PM should meet with the data implementors to correct the apparent omission. After the technical personnel complete quality control confirmation that the data collection tables are complete, they should document in the project file if any data needs were not grouped within the data collection options to be considered during Phase IV.

The PM should review any site information worksheets or lists of site information data needs that were identified by the data implementors. It is the PM's responsibility, working with the technical personnel, to decide how and when the additional site information data needs will be fulfilled (e.g., discussions with the customer, site visits, incorporated within appropriate scope of work or work plan sections).

At the conclusion of Phase III, the PM should distribute copies of all sampling and analysis planning worksheets and attach related illustrations to all appropriate TPP team members.