Appendix C. Data Quality Objectives and Data Usability Assessment Process

C.1. The Data Quality Objective Process

The data quality objective (DQO) process is a systematic planning tool based on the scientific method for establishing criteria for data quality and for developing data collection designs (EPA 1994). The process provides a systematic procedure for defining the criteria that a data collection design should satisfy, including when to collect samples, where to collect samples, the acceptable level of decision errors for the study, and how many samples to collect. The US Environmental Protection Agency (EPA) developed the DQO process as an important tool for project managers and planners to determine the type, quantity, and quality of data needed to support recommendations and decisions. Using the DQO process, the project team ensures that the type, quantity, and quality of environmental data used in decision-making will be appropriate for the intended application and the opportunities for making an incorrect decision are minimized accordingly. The DQO process is applicable to all projects where the objective of the study is to collect environmental data in support of an EPA program and the results of the study will be used to make a specific decision.

The DQOs are the result of the DQO process. DQOs are qualitative and quantitative statements that translate non-technical project goals into technical project-specific goals and guide the development of sampling and analysis plans able to cost-effectively produce the 'right kind of data' (Crumbling 2001). DQOs are goal-oriented statements that establish the minimum for overall decision quality or tolerable decision error in accordance with the non-technical objectives driving the project, and are intended to clarify the study objective, define the most appropriate type of data to collect, determine the appropriate conditions from which to collect the data , and specify the acceptable limits on decision errors that will serve as the basis for establishing the quantity and quality of data needed to support the decision. DQOs express the purpose for which the data will be used, but not how the data are generated (EPA 1998).

The DQO process consists of six iterative steps used to develop the decision performance criteria (i.e., the DQOs) that are in turn used to develop the data collection design, and a seventh step for optimizing the design. These seven steps are described below:

- Step One. The Problem Statement — Concisely describe the problem to be studied. Review prior studies and existing information to gain a sufficient understanding to define the problem.

- Step Two. Identify the Decision — Identify the questions the study will attempt to resolve and the resulting actions.

- Step Three. Identify the Inputs to the Decision — Identify the information that needs to be obtained and the measurements that need to be taken to resolve the decision statement.

- Step Four. Define the Study Boundaries — Specify the time periods and spatial area to which the decisions apply. Determine when and where data should be collected.

- Step Five. Develop a Decision Rule — Define the statistical parameter of interest, specify the action level, and integrate the previous DQO outputs into a single statement that describes the logical basis for choosing among alternative actions.

- Step Six. Specify Tolerable Limits on Decision Errors — Define the decision maker's tolerable decision error rates based on a consideration of the consequences of making an incorrect decision.

- Step Seven. Optimize the Design — Evaluate information from the previous steps and generate alternative data collection designs. Choose the most resource-effective design that meets all DQOs.

C.1.1 Steps One and Two: Problem Statement and Decision Development

Scoping for the Palos Verdes (PV) Shelf Pilot Capping Study was based on the Waterways Experiment Station (WES) in situ capping options report (Palermo, et al, 1999). The WES in situ capping options report (Palermo, et al, 1999) evaluated potential cap designs, developed an equipment selection and operations plan for cap placement, developed a monitoring and management plan to ensure successful cap placement and long-term cap effectiveness, and developed preliminary cost estimates. The WES in situ capping options report (Palermo, et al, 1999) also developed the initial project problem statement: how to construct an in situ cap that would 1) physically stabilize (i.e., prevent any further erosion and transport) the contaminated EA sediments, 2) reduce bioaccumulation and movement of contaminants into the food chain, and 3) reduce the flux of dissolved contaminants into the water column. The WES in situ capping options report (Palermo, et al, 1999) identified two approaches: 1) placement of a thin cap that would isolate the contaminated material from shallow burrowing benthic organisms, which would provide a reduction in both the surficial sediment concentration and contaminant flux; and 2) placement of an isolation cap that is sufficiently thick to effectively isolate benthic organisms from the contaminated sediments, prevent bioaccumulation of contaminants, and effectively prevent long term contaminant flux. Based on the WES in situ capping options report (Palermo, et al, 1999), the *Field Pilot Study of In-Situ Capping of Palos Verdes Shelf Contaminated Sediments – Operations and Monitoring Plan* (Palermo 2000) developed the pilot study cap monitoring decision questions presented below.

- Can a uniform cap be constructed?

- Can disturbance to in place sediments be limited?

- Does the cap remain clean?

- Does the cap remain stable?

- Does the cap placement occur as modeled?

The results of the pilot study cap study will be used by EPA to scope a long-term pilot study cap monitoring program and evaluate the effectiveness, implementability, and cost of a full-scale in situ sediment cap.

C.1.2 Step Three: Inputs to the Decision

Inputs are defined as the methods, including environmental measurements, used and the information generated that will be used to address the problem statements. The *Field Pilot Study of In-Situ Capping of Palos Verdes Shelf Contaminated Sediments-Operations and Monitoring Plan* (Palermo, 2000) identified the following inputs into the monitoring decision questions:

Can a uniform cap be constructed? This question involves the ability to place multiple loads of sediment over an area without creating many areas that are too thick and others that are too thin. The ability to control placement will be assessed both during the series of placements and once the placements are complete. Data inputs include determining cap material presence, location, thickness, and in situ physical characteristics and comparing the results of different placement methods and materials. These inputs are defined in the PV Shelf Pilot Capping Project Monitoring Scope of Work ([SOW], Fredette 2000) and in the Supplemental Monitoring SOW (Fredette 2001).

Can disturbance to in place sediments be limited? (Will negative impacts to the environment occur in the course of constructing the cap?) Sediments released from the placement vessel will fall through the water column, impact the bottom, and then spread laterally. This process has the potential to disturb the in-place sediments both at the direct point of impact, and to a lesser degree in the area where lateral spread occurs. Data inputs include baseline 2,2-bis(p-chlorophenyl) 1,1-dichloroethylene (p,p' DDE) concentrations in the pilot study cells effluent affected (EA) sediments, p,p' DDE concentrations in the pilot study cells after the initial placement, and after the last placements, and evidence of EA sediment reworking.

Sediments released from the placement vessel will impact the water quality throughout the water column from the point of release, and the finer particles may remain suspended in the water column for a long time before settling to the ocean floor. Data requirements for decisions include water quality measurements in the water column during and after placement, surface, subsurface, and bottom current direction and speed to determine the intensity of the plume and potential of the plume to impact water quality in locations removed from the placement sites. Of particular concern are the kelp beds that are located near the pilot study area. The monitoring methods to be used to collect these data were defined in the Monitoring SOW (Fredette 2000) and in the Supplemental Monitoring SOW (Fredette 2001).

Does the cap remain clean? This question addresses the concern that the clean cap material may potentially become contaminated by the EA sediment through resuspension or by advection. To address this concern, the cap material must be distinguished from the EA sediments and effective monitoring methods must be available and implemented to provide an accurate picture of the EA sediment condition before placement and after the cap sediments are placed. The pilot study cells are located in water depths from 40 to 70 meters (m) and have bottom slopes of up to two degrees. Monitoring methods will be required to provide data that will be used to determine EA sediment physical and chemical characteristics; cap material presence, location, and physical and chemical characteristics; and benthic organism presence and post cap-colonization. The monitoring methods to be used to collect these data were defined in the Monitoring SOW (Fredette 2000) and in the Supplemental Monitoring SOW (Fredette 2001).

Does the cap remain stable? This question address the concern that the cap material as placed would become unstable or that the placement of the cap material would destabilize the existing EA sediments to the extent that the cap and EA sediment would slide off the shelf at the shelf break particularly in Cell SU where the bottom slope is greatest. Monitoring methods will be required to provide data that will be used to determine the EA sediment thickness and extent in the pilot study cells before cap placement begins and location and thickness of the cap after construction for a period of two years after construction. Bottom mounted arrays will document changes in bottom lateral surge speeds that occur during the placement process. Side-scan sonar, sediment profile photography, and coring will all be used to map the actual extent of the deposit. Side-scan sonar, in particular, will be useful for assessing the down slope spread of material and the potential for turbidity flow. The monitoring methods to be used to collect these data were defined in the Monitoring SOW (Fredette 2000) and in the Supplemental Monitoring SOW (Fredette 2001).

Does the cap placement occur as modeled? This question and its associated monitoring will incorporate several concerns that have been raised about the placement of sediments from vessels at the ocean surface onto the seafloor below. These concerns include:

- Sediment spread
- Material thickness once it comes to rest on the bottom
- Effect of depth, slope, and material type
- Potential for the creation of turbidity flows or mudwaves.

Inputs to this decision include the physical characteristics of the in-hopper cap material, the volume of cap material placed, the cap material release rate, and the hopper dredge speed and direction during placement, as well as characteristics and location of the cap sediments on the pilot study cells. The monitoring methods to be used to collect these data were defined in the Monitoring SOW (Fredette 2000) and in the Supplemental Monitoring SOW (Fredette 2001). Inputs from the numerical models during initial and interim placements will be required for comparison to the in-place sediment cap data.

C.1.3 Step Four: The Pilot Cap Study Boundary

Project boundaries specify the time periods and spatial area to which the decisions apply, and determine when and where data should be collected. The *Field Pilot Study of In-Situ Capping of Palos Verdes Shelf Contaminated Sediments-Operations and Monitoring Plan* (Palermo, 2000) evaluated selected geographic and physical constraints in developing the pilot study capping project boundaries. These boundaries, as well as design feasibility, temporal, and cost considerations, are presented below:

Pilot cell representativeness — The pilot study cells selected should be representative of the overall range of conditions, such as bottom slopes and water depth, within the total anticipated capping prism for a full-scale remediation.

Placement Cell Location — 1) Placement cell areal extent should be sufficiently geographically diverse to demonstrate the effect of water depth, bottom slope, and placement method on cap thickness and sediment resuspension; 2) The pilot study cells should be located to minimize any impact to the Los Angeles County Sanitation Districts (LACSD) outfalls until the nature of cap accumulation is demonstrated; 3) The pilot study cell locations should be located to minimize the potential for recontamination of the pilot study cap both during and following cap placement; 4) The distance between cells should be sufficiently large to avoid interference between intentionally separate placements using different options and to allow for demonstrating the effect of adjacent placements in building the desired cap thickness; 5) The pilot study cells should be located where placement and placement monitoring are possible.

EA Sediment Characteristics — 1) EA sediment composition should distinguishable from the proposed capping material; 2) EA sediment layer thickness should be sufficient to allow measurement of the degree of mixing of cap and contaminated sediment and the effects of advection due to consolidation; 3) EA surficial sediment contaminant concentrations in the upper few cm should be sufficiently high to allow effective measurement of contaminant resuspension and water column contaminant release.

Temporal boundaries — The pilot study in situ capping study should be initiated and completed concurrently with the Queen's Gate Deepening Project, which would result in cost savings to the project.

Cap Material Types — The cap material types used for the in situ capping study should be 1) sufficiently different in physical characteristics to be distinguishable from the EA sediment, 2) be locally available in

sufficient quantities to complete the pilot study, and 3) be representative of the cap material type to potentially be used during the full scale capping.

Cost boundaries — The pilot study in situ capping project should be designed to complete the baseline monitoring activities, place the cap materials, and conduct the interim and post-cap monitoring activities within the EPA-established a budget of $5,000,000.

Design Feasibility Boundaries — The data collected during the pilot in situ capping study should demonstrate the constructability of an in situ cap using various capping material and placement methods under different environmental conditions. To the extent possible, these pilot study data also should indicate the degree to which the pilot study in situ caps, as constructed, minimize recontamination by benthic organisms.

C.1.4 Step Five: Develop a Decision Rule

The decision rule summarizes the attributes the decision maker (i.e., EPA) wants to know about the population (i.e., data collected before, during, and for the near term, after the pilot study cap construction) and how that knowledge would guide the selection of a course of action (i.e., full scale cap construction methods) to solve the problem. The decision rule step combines criteria from the previous steps with the parameter of interest (i.e., p,p' DDE and suspended solids) and the action level (e.g., baseline concentration of p,p' DDE, water quality standards, and the sediment quality guideline standards) to provide a concise description of what action will be taken based on the results of the data collection. For the PV Shelf, action levels generally were not applicable because the remedy (i.e., full scale capping) had already been selected, and purpose of the pilot study was to determine whether the pilot study cap construction methods chosen were applicable to a full scale cap construction, and modifications, if any, to those methods. Instead, historical p,p' DDE concentrations and sediment and water quality standards were used as guideline values for comparison in order to determine whether construction modifications applicable to the full scale cap were necessary to minimize resuspension of the EA sediment and migration of suspended solids.

The four main elements of the decision rule are presented below:

- The parameters of interest (i.e., p,p' DDE and suspended solids).
- The scale of the decision making, as defined in the study boundaries.
- The comparison guidelines, which are defined as the measurement threshold values (e.g., any DDE detected in the water column and cap material at concentrations greater than the baseline concentration, water quality standards, the sediment quality guideline standards, and the laboratory method and reporting limits) of the parameter of interest (i.e., p,p' DDE) that will provide the criteria for evaluating the constructability of the pilot study cap as applicable to the full scale cap.
- The alternative actions are defined as the actions the decision maker (i.e., EPA) would take depending on the true value of the parameter of interest (i.e., p,p' DDE). These actions were defined as part of the decision identification.

<u>Parameter of Interest</u> ─ The Operations and Monitoring Plan ([OMP] Palermo 2000), Monitoring SOW (Fredette 2000), and the Supplemental Monitoring SOW (Fredette 2001) defined p,p'-DDE and suspended

solids as the parameters of interest for the pilot study capping study. p,p'-DDE is the most toxic of the p,p'-DDT metabolites and occurs at significant concentrations (i.e., greater than 10 milligram per kilogram [mg/kg]) in the EA sediments in the target placement cells. p,p'-DDE does not occur in the Queen's Gate or borrow site materials at concentrations greater than the laboratory method detection limit (i.e., 0.048 µg/Kg). The p,p'-DDE concentration will be used to evaluate the degree of impact of cap placement on resuspension of EA sediments into the cap material during placement and through advection, and into the water column. Additionally, p,p'-DDE will be measured in the plume to the extent possible as it travels away from the placement site. These measurements will be used to evaluate the impact of placement on locations removed from the placement site.

In addition to p,p' DDE concentrations, the suspended sediment plume (i.e., particulates and turbidity) created by the placement events will be monitored for plume migration direction, duration (as measured by the ability to detect and track the plume), and changes in turbidity with respect to the kelp beds in the vicinity of the pilot study cells and the LACSD sewer outfalls located to the south east.

Scale of Decision Making ─ The pilot study cap study boundaries were defined in the OMP (Palermo 2000) as pilot study cap representativeness, pilot study cell location, EA sediment characteristics, time-orientation, cost, and design feasibility. These boundaries are discussed in the section above.

Comparison Values for the Pilot Study ─ Quantitative action levels were developed for the pilot study based on published water quality criteria and sediment quality guideline values, and approved method detection limits and laboratory reporting limits for p,p' DDE. These limits are described in the *Project Work Plan for the Palos Verdes Pilot Capping Project: Baseline Monitoring Activities, Revision 2.0 (SAIC, 2000a)* and *Project Work Plan for the Palos Verdes Pilot Capping Project: Interim and Post-Cap Monitoring Volume I (SAIC, 2000b)*.

Alternative Actions ─ Using the data collected as part of the pilot study and the recommendations derived from those data, EPA will develop a long-term monitoring strategy for the near term and evaluate the effectiveness, implementability, and cost of a full-scale in situ sediment cap.

C.1.5 Step Six: Decision Error Tolerances

The purpose of establishing decision error tolerances is to set a limit (i.e., control) the degree of uncertainty with which the decision is made and avoid, to the extent possible, the consequences of making an incorrect decision. To determine decision error tolerances, potential sources of error must be identified and evaluated for the likelihood that an incorrect decision may result. Decision error can be minimized and controlled, but never totally eliminated. That is, decisions are made based on known, reliable, and reproducible data where the opportunities for introducing unpredicted error are minimized to the degree possible. Establishing acceptable decision error tolerances minimizes the three types of error listed below:

- Sampling design error occurs when the sampling design does not account for the natural variability in the true state of the environment (i.e., does not produce representative data).

- Measurement error occurs as a result of random and systematic errors that are inherent in the each step of the data production process, including sample collection, preparation and analysis; and data reduction, handling, and reporting.

- Total study error is a function of both sampling design and measurement error combined.

The objectives of establishing error tolerances are to create limits for which data can be used, which will minimize the opportunity for introducing manageable error in the decision-making process and to limit the consequences of implementing an incorrect decision, which for the purposes of the pilot study capping study, would be a decision based on data that cannot be reproduced or for which quality cannot be documented. The consequences of implementing a full-scale cap based on data for which decision errors were not developed potentially could result in a cap that might not isolate receptors from the contaminated sediments, might increase the availability of the contaminants to the environment, and/or might contribute to the destabilization of the EA sediments on the PV shelf.

Opportunities for decision error were identified and evaluated in two types of documents developed for the pilot study capping project, including the Monitoring SOW, Supplemental Coring SOW, and the Project Work Plans (PWPs). The Monitoring SOW (Fredette 2000) and Supplemental Monitoring SOW (Fredette 2001) defined the sampling design that would be used to monitor each cell before, during, and after construction. This design was based on the expected behavior of the cap materials, as described in the WES in situ capping options report (Palermo 1999), and included the elements listed below:

- Placement cells to be monitored
- Types of data to be collected
- Monitoring instruments required to produce those data
- Study phases (i.e., baseline, construction and post construction) during which the data were to be collected.

The Baseline and Interim and Post Cap Monitoring PWPs and standard operating procedures (SOPs) (SAIC 2000a and 2000b) defined the sampling and analysis methods required to effectively monitor the placement cells as directed by the Monitoring SOW (Fredette 2000) and the Supplemental Monitoring SOW (Fredette 2001). The PWPs developed the detailed technical project goals (i.e., measurement quality objectives [MQOs]) required to ensure that all opportunities for measurement error (i.e., uncertainty) were minimized and established limits for which the data could be used in the decision making process.

Measurement Quality Objectives (MQOs) ─ MQOs are project-specific, analytical parameters derived from project-specific DQOs. MQOs include the QA activities that will be conducted during the project, and quality control (QC) acceptance criteria for the data quality indicators (DQIs) applicable to the PV Shelf pilot study capping project. MQOs establish the minimum for analytical performance parameters (i.e., serve to specify "how good" data must be) derived from the level of performance needed to achieve the project goals (as expressed in the DQOs). Project MQOs are not intended to be technology- or method-specific, and generally will not specify the methods by which the data are generated. MQOs consist of quality assurance (QA) activities (i.e., calibration, data assessment and reporting, preventive maintenance, and corrective action), DQIs, and QC acceptance criteria. MQOs are presented in Sections 2 through 10 of the baseline and interim and post cap PWP DQOs.

Data Quality Indicators (DQIs) ─ DQIs are analytical method-specific qualitative and quantitative descriptors used in interpreting the degree of acceptability or utility of the data collected. Principal DQIs include precision, accuracy (bias), representativeness, comparability, and completeness. Secondary DQIs include sensitivity, recovery, memory effects, limit of quantitation, repeatability, and reproducibility. Establishing QC acceptance criteria for the DQIs sets quantitative goals for the quality of data generated

in the analytical measurement process or measurement systems (EPA 1998). DQIs are presented in the Baseline and Interim and Post Cap PWP Sampling and Analysis Plans (SAPs).

QC Acceptance Criteria — QC acceptance criteria are method- and technology-specific protocols and specifications that demonstrate that data of known and sufficient quality are generated. QC acceptance criteria include specific limits for sensitivity, recovery, memory effects, limit of quantitation, repeatability, and reproducibility, and are designed such that if consistent met, the project MQOs will be achieved, and the resulting data will be sufficient to meet the project DQOs and support the project decisions (Crumbling 2001). Acceptance criteria are presented in the Baseline and Interim and Post Cap PWPs.

C.1.6 Step Seven: Optimize the Data Collection Design

The objective of optimizing the study design is to identify the most resource-effective data collection design for generating sufficient data of known and verifiable quality to satisfy the DQOs. Reviewing and evaluating the effectiveness of the data collection design is conducted by any of the methods listed below.

- Reviewing the previous DQO products
- Incorporating historical data into the DQO products created as a result of the previous six steps
- Developing alternatives to the data collection design
- Formulating mathematical expressions to solve the design problem for each data collection design alternative, which include methods for testing statistical hypotheses and defining the optimum sample size formula, statistical models that describes the relationship of the measured value to the "true value," and a cost function that relates the number of samples to the total cost of sampling and analysis.
- Selecting the optimal sample size that satisfies the DQOs for each data collection design alternative.
- Selecting the most resource-effective data collection design that satisfies all DQOs.
- Documenting the operational detail and theoretical assumptions of the selected design in the PWP.

For the purposes of the PV Shelf pilot study capping project, the data collection design alternatives that included bullet items 3 through 5 listed above were described in the WES in situ capping options report (TR-EL-99-2, 1999). The *Field Pilot Study of In-Situ Capping of Palos Verdes Shelf Contaminated Sediments – Operations and Monitoring Plan* (Palermo 2000), the Monitoring SOW (Fredette 2000), and the Supplemental Monitoring SOW (Fredette 2001) incorporated this design optimization analysis into the specifications and requirements for the pilot study cap operations and monitoring events. These guidelines and specifications were used to develop and were documented in the baseline and interim and post cap PWPs (SAIC 2000a and 2000b). The PWPs also incorporated data from previous LASCD, US Geological Survey (USGS), and National Oceanographic and Atmospheric Administration (NOAA) study data to optimize data collection locations and collection methods.

As the pilot study project planning and cost estimating evolved, funding constraints required a re-evaluation of the initial project scope in relation to the budget established by EPA. The Team re-evaluated the construction monitoring design to determine the minimum amount of data required to answer the study questions. As a result of this effort, four tasks were eliminated from the sampling design to complete the pilot study within the budget established by EPA. These tasks are listed below.

- All placements and placement monitoring activities at Cell Seaward downstream (SD) were eliminated
- All interim placement surveys at Cell Landward Downstream (LD) were eliminated
- Post cap gravity core surveys at Cell LD were eliminated
- Bathymetric surveys were eliminated.

One cell was created during the pilot study. Cell Landward Center ([LC] i.e., between Cells landward upstream [LU] and LD) was created to evaluate the impacts of spreading Queen's Gate material using the pump-out method on EA sediment.

C.2. Chemical Data Validation and Usability Assessment

C.2.1 Introduction

Data validation is defined as those procedures used to determine whether the sample analysis met the pre-determined performance criteria for the analytical method used. The impact of the specific performance acceptance criteria is noted by appending qualifiers on each data point, as required. These qualifiers indicate that the data may be considered estimated (i.e., 'J'), rejected (i.e., 'R'), and not detected ('U'). A data point also may be considered an estimated non-detect (i.e., 'UJ').

Data usability is the process of evaluating the data validation results and determining the confidence with which any data point may be used. Usability is determined by evaluating the data validation qualifier applied and the laboratory QC results. The concentration values may be considered to have a high degree of confidence because the method performance criteria were achieved. The concentration values considered estimates, are evaluated with respect to the bias contributed to the value by the QC result. Bias is considered to be high or low, which means that the concentration result is likely higher or lower than the actual laboratory result indicates. Bias direction can be estimated for data quality impacts due to surrogate recoveries, matrix spike recoveries, and laboratory control sample recoveries. However, for most laboratory QC results, the degree to which bias impacts the concentration result cannot be estimated. Sample concentration results that are rejected during data validation are not used in the decision-making process and are not reported.

The PV Shelf pilot study capping project data usability assessment is prepared in conjunction with the data validation assessment report prepared by Science Applications International Corporation (SAIC) and presented in Appendix B of the monitoring report. Data usability is evaluated with respect to the monitoring questions (i.e., can a uniform cap be constructed, will negative impacts to the environment occur in the course of constructing the cap, and does the cap remain clean and stable [i.e., can the cap be effectively monitored to determine actual cap placement and behavior in the near- and long-term]?) to ensure that the opportunity for incorporating unacceptable and manageable error into the decision-making process is minimized to the extent possible.

The data usability assessment conducted for the PV Shelf Pilot Capping Study consisted of data validation and data usability evaluation. Data validation was conducted using procedures described in the October 1999, *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review* (EPA 1999), and in the *Project Work Plan for the Palos Verdes Pilot Capping Project: Baseline Monitoring Activities, Revision 2.0 (SAIC, 2000a)* and *Project Work Plan for the Palos Verdes Pilot Capping Project: Interim and Post-Cap Monitoring Volume I (SAIC, 2000b).*

C.2.2 Data Validation Summary

Fifty-one sample delivery groups reported by the Woods Hole Group were validated by SAIC, located in Reston, Virginia. The data validation results summary is presented in Appendix B of the SAIC monitoring report. All analytical results are in the Dredging Analysis Network (DAN-LA) geographic information system (GIS) as reported by the Woods Hole Group, located in Falmouth, Massachusetts, except for the data qualifiers that were applied as a result of the data validation process. These qualified values are limited to those considered to be estimated (i.e., qualified with a 'J'), but are considered fully usable for the intended purpose of the data collection.

C.2.3 Data Usability Summary

All analytical data, data validation qualifiers, and QC results were evaluated to determine the confidence with which the sediment and marine water data could be used in the PV Shelf pilot study capping project decision-making process. The criteria used in the data usability summary are presented in the following sections.

Data Quality Indicators

Data quality indicators (DQIs) are qualitative and quantitative measures of data quality "attributes," which are descriptors (i.e., the words) used to express various properties of analytical data. Thus, DQIs are the various measures of the individual data characteristics that collectively comprise the general, all-encompassing term "data quality" (Crumbling 2001).

Quality attributes (and the facets of data quality that they describe) include (but are not limited to) the following quality properties:

- Method selectivity/specificity
- Method sensitivity
- Precision
- Accuracy (bias)
- Representativeness
- Comparability
- Completeness.

Method Selectivity/Specificity

Method selectivity/specificity is defined as the compound type or class that can be detected by the instrument or detector. Instruments that are used to detect a compound class (i.e., hydrocarbons) are said to be selective. Instruments that are used to detect a specific element group (e.g., halogens) are said to be specific. All marine waters and sediments, as well as field QC blanks, were analyzed using EPA solid waste method SW 8081A (EPA 1996) modified by laboratory standard operating procedure (SOP), as required by the *Project Work Plan for the Palos Verdes Pilot Capping Project: Baseline Monitoring Activities, Revision 2.0 (SAIC, 2000a)* and *Project Work Plan for the Palos Verdes Pilot Capping Project: Interim and Post-Cap Monitoring Volumes I and 2 (SAIC, 2000b)*. Samples are analyzed using gas chromatographs (GCs) equipped with an electron capture detector (ECD), which is a selective detector to any electron rich compound, such as those having a chlorine, nitrogen, or oxygen group attached. Because the ECD is only selective and not specific for halogenated compounds (i.e., chlorinated pesticides in general and p,p ' DDE in particular), analytical certainty is increased by using two dissimilar chromatography columns. A compound is considered detected if it responds in a manner similar to that of the compound standard on both columns. Detected p,p' DDE was further confirmed using a GC/mass spectrometer (GC/MS) to maximize data certainty. The GC/MS quantifies the compound based on compound retention time in the same manner as the GC. However the mass spectrometer fragments the compound into ions. Each compound fragments in known ion and known ion ratios, which are then compared to known fragments and fragment ratios for the compound of interest (i.e., p,p' DDE) contained in the GC/MS data system library. If the fragments and the fragment rations of the sample match that contained in the library, the compound is considered confirmed. GC/MS confirmation is discussed in Appendix B of the SAIC monitoring report.

Method Sensitivity

Method sensitivity is defined as the degree to which any compound can be detected within specific confidence criteria. Specific method detection limits (i.e., 0.8 micrograms per liter [µg/L] and 0.048 micrograms per kilograms [µg/Kg] in marine water and sediment, respectively) and laboratory reporting limits were required during the pilot study capping study to ensure that potential impact from resuspension of the contaminated sediment in the capping materials and the immediate water column could effectively be assessed. Method sensitivity was a key analytical parameter to address for providing data to characterize ambient marine water conditions and to demonstrate that resuspension of contaminated sediment was minimized to the extent possible and that the recently placed cap material remained clean. All laboratory reporting limits were consistent with the reporting limits (i.e., 1 µg/L and 0.001 µg/Kg dry weight for marine water and sediment, respectively) presented in the *Project Work Plan for the Palos Verdes Pilot Capping Project: Baseline Monitoring Activities, Revision 2.0 (SAIC, 2000a)* and *Project Work Plan for the Palos Verdes Pilot Capping Project: Interim and Post-Cap Monitoring Volume I (SAIC, 2000b)*. In addition, field QC blanks were evaluated for interference potentially contributed by the sample collection methods and sample containers used. Some interference was anticipated from the plastic Niskin® bottles and the sample containers in the marine water field blanks because of the ultra-low sensitivity analyses required; however, p,p'-DDE was detected in the two field QC blank samples associated with the two marine water samples. Although the sample results associated with LU-3D BTD4 and 6 were considered not detected by the data validators, these concentrations were similar to that detected in the remaining water samples in this sample delivery group, and should be considered detected, but estimated in the decision-making process. p,p'-DDE was detected in selected field QC blanks collected with marine sediment samples, however the concentrations detected were at least 10 times less than the p,p'-DDE concentration detected in the environmental samples.

Precision

Precision is defined as the degree of agreement between or among independent, similar, or repeated measures. Precision is expressed in terms of analytical variability. For this project, analytical variability was measured as the relative percent difference (RPD) or coefficient of variation between analytical laboratory duplicates and between the matrix spike (MS) and matrix spike duplicate (MSD) analyses, and sample collection variability was measured by analysis of blind field duplicate samples

Based on the validation results, analytical precision was within the criteria specified for the pilot study capping study, except for two RPD values. Sixty-nine marine waters and 17 field QC blanks associated with the marine waters were collected and analyzed for p,p'-DDE. Five MS/MSD analyses were conducted using marine water samples. All RPD values were within the control limits (i.e., 30 percent) described in the PWPs, except for one value (i.e., 70 percent) associated with SU-1D-BTD 1. This value has not impact on the overall analytical precision. Three hundred eight sediment samples and 20 field QC blanks associated with the sediment samples were collected and analyzed for p,p'-DDE. Eighteen MS/MSD analyses were conducted. One RPD value (i.e., 32 percent) was outside the control limit (i.e., 30 percent). This value has no impact on the overall analytical precision.

Marine sediment and water variability was assessed by collecting one field duplicate sample for every 10 samples collected, as described in the Baseline and Interim and Post-Cap PWPs. Field duplicates were collected to assess the variability that could be expected in the EA sediment, the cap material as placed, and the cap material plume following placement. RPD values of up to 50 percent initially were anticipated. Six marine water duplicates were collected during the interim and post-cap monitoring study, and all calculated RPD values were less than 28 percent. Twenty-seven marine sediment duplicates were collected during the baseline, interim and post-cap, and supplemental monitoring study. All calculated RPD values were less than 50 percent, except for three sediment duplicates collected during the baseline monitoring study. These data are considered to be representative of the variability in the EA sediments and are not due to sampling or analytical error.

Accuracy

Accuracy is defined as the amount of agreement between a measured value and the true value, and, for the purpose of this project, was measured as the p,p' DDE percent recovery in the MS/MSD, laboratory control sample (LCS), and marine reference material analyses, as well as organic surrogate compounds. Additional potential bias was evaluated by the analysis of blank samples (e.g., analytical method and field QC blanks).

Based on the data quality analysis presented in Appendix B of the SAIC monitoring report, all accuracy acceptance criteria were met, except for selected percent recovery values. Where the MS/MSD and LCS percent recoveries were less than the lower recovery control limit (i.e., 75 percent), the reported p,p' DDE values were qualified as estimated (i.e., 'J'). These data are considered usable, but should be considered potentially lower in concentration than sediments representative of the site and time collected. Four field QC blank sample data were rejected because the LCS recoveries were slightly (i.e., 73 percent) outside the control limits (i.e., 75 percent); however, these results are not considered to have adversely impacted the environmental data quality, since other field QC blank data indicate that sample collection methods contributed very little interference to the environmental data results. One marine water sample was qualified as estimated (i.e., "J") due a surrogate recovery that was less than the lower control limit (i.e., 30 percent) but greater than 10 percent. Surrogate recoveries in four sediment samples were greater than the

upper control limit (i.e., 150 percent). These data were qualified as estimated (i.e., 'J') where required. The direction of bias with respect to surrogate recoveries cannot be determined. Seventeen regional reference material (RRM) samples were analyzed with each marine sediment sample group received by the laboratory. All recoveries were within the consensus concentration range (i.e., 6,560 to 15,300 µg/Kg), except one result (i.e., 6,500 µg/Kg) that was slightly less than the lower consensus limit. This result is not considered to have adversely impacted the accuracy of the environmental data.

Based on the analysis of all accuracy criteria, all data reported met the accuracy goal described in the Baseline and Interim and Post Cap PWPs.

Representativeness

Representativeness is the degree to which sample results represent the system under study. This component is an integral component of the design phase of a data collection program (i.e., the PV Shelf Pilot Capping Study). The PV Shelf Pilot Capping Study used the results of all analyses to evaluate the constructability and effectiveness of the cap and impact of cap placement on the surrounding environment. Pilot cap cell locations were placed using a biased approach presented in the in situ capping options report (Palermo, et al., 1999). The rationale supporting the numbers of samples prepared for chemical analysis is described in the Monitoring SOW (Fredette, 1999a) and the Supplemental Monitoring SOW (Fredette 2001). The sampling and analysis program design rationale is described in the *Project Work Plan for the Palos Verdes Pilot Capping Project: Baseline Monitoring Activities, Revision 2.0 (SAIC, 2000a)* and *Project Work Plan for the Palos Verdes Pilot Capping Project: Interim and Post-Cap Monitoring Volume I (SAIC, 2000b)*.

Representativeness also was assessed by evaluating all data quality and analytical data results as these data relate to marine sediment and marine water condition in and around the pilot study cells. Based on the data quality analysis presented in Appendix B of the SAIC monitoring report, all QC criteria described in the PWPs for the analysis of marine sediments and water during the pilot study capping project were met; however, some uncertainty has been noted in the sediment core data. Visual and grain size distribution data indicate that some sampling error may have been introduced by artifacts created by the gravity coring method. These potential artifacts are discussed in Chapter 3 and in the SAIC monitoring report. Supplemental studies are planned to evaluate whether other coring methods may minimize the artifacts observed in the gravity core data.

Comparability

Comparability is the degree to which data from one study can be compared with data from other similar studies, reference values (such as background), reference materials, and screening values. This goal was achieved by using standard techniques to collect and analyze representative samples and reporting analytical results in appropriate units. The sample collection methods used were based on standard operating procedures presented in the *Project Work Plan for the Palos Verdes Pilot Capping Project: Interim and Post-Cap Monitoring Volume I (SAIC, 2000b)*. The analytical methods used were modified for marine sediments and waters from EPA solid waste method SW 8081A (EPA, 1996) and contained in the laboratory SOP. In addition, 17 RRM samples from the PV Shelf were analyzed with the marine sediment samples to demonstrate that the EPA analytical methods used, as modified for marine matrices, generated concentration values consistent with concentrations expected in other marine samples. All recoveries were within the consensus range (i.e., 6,560 to 15,300 µg/Kg), except one result that was slight less (i.e., 6,500 µg/Kg) than the lower control limit. This result is not considered to adversely impact the data usability.

Based on this data quality analysis and the data quality analysis presented in Appendix B of the SAIC monitoring report, all data are considered comparable to other marine sediment and water data collected as part of other dredged material and in situ sediment cap evaluation programs.

Completeness

Completeness is defined as the percentage of usable data in the total data population generated. Because the number of samples collected exceeded that required for the analysis, 100 percent completeness was anticipated with respect to sample collection. The number of samples planned was expected to provide sufficient data to satisfy the objective defined in the in situ capping options report (Palermo et al, 1999), and in the Baseline and Interim and Post-Cap Monitoring PWPs (SAIC 2000 and 2000a). The volume of sample collected was sufficient to reanalyze the sample had the initial results not met QC requirements.

Based on this data quality assessment and the data validation assessment presented in Appendix B of the SAIC monitoring report, the analytical data set completeness was calculated to be 99.0 percent. Of the 414 data points collected, four data points (i.e., field QC blanks) were rejected because the QC results were unacceptably outside the method performance criteria. These blank samples are considered to have no adverse impact on the environmental data quality, and as such all environmental data collected were used as the basis in the pilot study cap effectiveness and impact evaluation and recommendations to EPA by SAIC and USACE.

C.3 References

Crumbling, Deanna. 2001. 'Clarifying DQO Terminology Usage to Support Modernization of Site Cleanup Practice.' USEPA Technology Innovation Office, Washington D.C. March 30, 2001. http://www.clu-in.org/chartext_edu.htm#stats.

EPA 1996: Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, Third Update

EPA 1998: February 1998, EPA Guidance for Quality Assurance Project Plans, EPA QA/G-5, United States Environmental Protection Agency Office of Research and Development, EPA/600/R-98/018

EPA 1999: October 1999, USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review, EPA 540/R-99/008

EPA 1994: September 1994, Guidance for the Data Quality Objectives Process, EPA QA/G-4, United States Environmental Protection Agency Quality Assurance Management Staff, EPA/600/R-96/055

Fredette 2000: Palos Verdes Shelf Pilot Project Monitoring Scope of Work, version 4.2, Thomas Fredette, USACE New England District. Need to add final dates to Fredette SOWs

Fredette 2001: Supplemental Palos Verdes Shelf Pilot Project Monitoring Scope of Work, version 3.21, Thomas Fredette, USACE New England District

Palermo, et al, 1999: Options for In Situ Capping of Palos Verdes Shelf Contaminated Sediments, Technical Report EL-99-2, 1999.

SAIC 2000a: Project Work Plan for the Palos Verdes Pilot Capping Project: Baseline Monitoring Activities, Revision 2.0

SAIC 2000b: Project Work Plan for the Palos Verdes Pilot Capping Project: Interim and Post-Cap Monitoring Volumes I and 2 (Standard Operating Procedures)