COST ESTIMATING HANDBOOK

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Submitted by:

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Submitted to:

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

U.S. Department of Interior
Bureau of Land Management
National Science and
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FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE

U.S. Department of Agriculture
Forest Service
Southwest Region

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ACRONYMS AND ABBREVIATIONS

ACBMs	Asbestos Containing Building Materials
ACM	Asbestos Containing Material
AHERA	Asbestos Hazard Emergency Response Act
AML	Abandoned Mine Land
AMD	Acid mine drainage
APFO	Aerial Photography Field Office
APSRS	Aerial Photography Summary Record System
ARARs	Applicable or relevant and appropriate requirements
ARD	Acid rock drainage
ASTM	American Society of Testing and Materials
B&P	Bid and proposal
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
BOR	Bureau of Reclamation
CAA	Clean Air Act
CAB	Cartographic and Architectural Branch
CAD	Computer Aided Design
CASHE	Compliance Assessment - Safety, Health, and the Environment
CBD	Commerce Business Daily
CEQA	California Environmental Quality Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CHF	Central HazMat Fund
CLP	Contract Laboratory Program
CPT	Cone Penetration Test
COR	Contracting Officer's Representative
CRP	Community Relations Plan
CWA	Clean Water Act
CY	Cubic yard
DEA	Drug Enforcement Agency
DM	Departmental Manual
DoD	Department of Defense
DOI	U.S. Department of Interior
DQO	Data Quality Objectives
DOT	Department of Transportation
DTSC	Department of Toxic Substances Control
EE/CA	Engineering Evaluation/Cost Analysis
EM	Electromagnetic methods
EPA	U.S. Environmental Protection Agency
ERG	Emergency Response Guidelines
EROS	Earth Resources Observation System
Phase I ESA	Environmental Site Assessment
ESA	Endangered Species Act
ESIC	Earth Science Information Center (USGS)
FBO	FedBizOpps
FFCA	Federal Facilities Compliance Act
FFER	Federal Facilities Environmental Restoration
FS	Forest Service
G&A	General and administrative
GC	Gas chromatography
GPS	Global Positioning System
GSA	General Services Administration
GPO	Government Printing Office

ACRONYMS AND ABBREVIATIONS (continued)

HASP	Health and Safety Plan
HazMat	Hazardous Materials
HAZWOPER	Hazardous waste operator
HELP	Hydrologic Evaluation of Landfill Performance
HRS	Hazard Ranking System
HSO	Health and Safety Officer
HVAC	Heating, ventilation and air conditioning
IA	Interagency Agreement
I-A	Intra-agency Agreement
IDEAS	Interior Department Electronic Acquisition System
IDW	Investigation-derived waste
LOC	Library of Congress
LOE	Level of Effort
MOU	Memorandum of understanding
NABMP	North American Bats and Mines Project
NAPP	National Aerial Photography Program
NARA	National Archives and Records Administration
NCP	National Contingency Plan aka - National Oil and Hazardous Substances Pollution Contingency Plan
NEPA	National Environmental Policy Act
NESHAP	National Emission Standard for Hazardous Air Pollutants
NHAP	National High Altitude Photography
NIOSH	National Institute of Occupational Safety and Health
NOAA	National Oceanic and Atmospheric Administration
NPL	National Priorities List
NPS	National Park Service
NRC	Nuclear Regulatory Commission
NSTC	National Science and Technology Center
NTIS	National Technology Information Service
O&F	Operational and functional
O&M	Operation and maintenance
OSHA	Occupational Safety and Health Administration
OSWER	Office of Solild Waste and Emergency Response
PA	Preliminary Assessment
PAH	Polycyclic aromatic hydrocarbon
PBSC	Performance-based service contract
PCB	Polychlorinated biphenyls
PCOC	Potential contaminants of concern
PLM	Polarized Light Microscopy
PPE	Personal protection equipment
PRP	Potentially Responsible Party
PVC	Polyvinyl chloride
QAPP	Quality assurance project plan
QA/QC	Quality Assurance/Quality Control
RA	Remedial Action Plan
RAP	Remedial Action Plan
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RPA	Removal Preliminary Assessment
RQ	Reportable quantity

ACRONYMS AND ABBREVIATIONS (continued)

RSI	Removal Site Inspection
SBA	Small Business Administration
SAP	Sampling and analysis plan
SARA	Superfund Amendments and Reauthorization Act
SAS	Special analytical services
SCA	Service Contract Act
SCBA	Self-contained breathing apparatus
SDWA	Safe Drinking Water Act
SI	Site Inspection
SOW	Statement of Work
SPB	Still Picture Branch
SSAB	Site-specific advisory board
ST-133	Science and Technology Center, Branch of Environmental Compliance
SVOC	Semi-Volatile Organic Compounds
TAG	Technical Assistance Grants
TAL	Target Analyte List
TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
TPH	Total petroleum hydrocarbons
TRS	Township, Range and Section
TSCA	Toxic Substances Control Act
TSD	Treatment, Storage, and Disposal
TSDF	Treatment, Storage and Disposal Facility
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
UST	Underground storage tank
VOC	Volatile organic compounds
XRF	X-ray fluorescence

1.0 Introduction

The purpose of this handbook is to give Bureau of Land Management (BLM) and U.S. Department of Agriculture (USDA) Forest Service (Forest Service) employees a general overview of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process and provide data so that the costs involved with the investigation, removal or remediation of wastes, and reclamation of sites on BLM and Forest Service property can be estimated. This handbook also addresses investigation and remediation activities associated with Abandoned Mine Land Sites (AML).

The objectives of this Cost Estimating Handbook are to provide the information to assist the users in:

- Preparing project cost estimates;
- Developing budget estimates prior to requesting funding;
- Evaluating cost proposals for contract award;
- Evaluating removal and remedial proposals; and
- Preparing bonding estimates.

In addition, the handbook provides general discussions of various reclamation and waste issues and processes intended to assist the field specialist with the analysis of projects. The Cost Estimating Handbook is not intended to be a complete and comprehensive discussion of all aspects of removal and reclamation, but rather one of many tools to be used by agency staff in preparing cost estimates.

In addition to this Cost Estimating Handbook, the CD-ROM includes cost data tables, cost estimating examples, samples of statement of work (SOW), and additional reference materials.

The examples provided on the CD-ROM may not be completely appropriate to each user's current site; site specific considerations, and other agency or public concerns can significantly alter cost estimates. The Cost Estimating Handbook is not intended to be an official source of agency guidance on any issue. It has been prepared by Dynamac Corporation, under the direction of Ken Smith, Bureau of Land Management and Maria McGaha, USDA Forest Service. Comments on the content of this handbook should be forwarded to the Contracting Officer's Representatives (COR):

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The handbook is divided into five major sections with each section containing references to sources of additional information. This first section, Section 1.0, Introduction, presents an overview of the handbook. Section 2.0, Preparing Cost Estimates, provides an introduction to the CD-ROM, and presents an overview of the cost estimating process, the components of a cost estimate, the steps for preparing a cost estimate, and a discussion on how to go about procuring services. Section 3.0, Activities Requiring a Cost Estimate, presents the range of activities from investigation projects to removal actions for which cost estimates can be developed. In addition, this section provides an overview of the CERCLA process as it relates to BLM and Forest Service, beginning with pre-removal activities and concluding with remedial design and remedial action. Section 4.0, Examples of Typical Sites, depicts seven typical sites, and the professional services, construction services, and analytical services that each site may require for removal, remediation, or reclamation activities. Section 5.0, Costing Information, delineates the current costs for the services, equipment, and personnel typically used for BLM and Forest Service removal and reclamation.

The costs provided in this handbook are based on various sources and are representative for 2002. The cost data sources include: R.S. Means Building Construction Cost Data, 60th edition (2002); R.S. Means Environmental Remediation Cost data, 7th edition (2001); vendor quotes; vendor catalogues; Internet cost databases; and guidance documents. To the extent feasible, Dynamac used 2002 cost data sources. When costs were only available for previous years, they were escalated to 2002 as described in Section

2.0, Preparing Cost Estimates. That section also shows how to escalate the 2002 costs for following years up to 2007. However, costs may vary due to many reasons, including general economic conditions, season of the year, size of the project, and location. For this reason, this handbook should be used for estimation purposes only.

2.0 Preparing Cost Estimates

This section provides an overview of the cost estimating process, including the need for and use of cost estimates, and the steps for preparing cost estimates. The Cost Estimating Handbook CD-ROM contains the cost data tables of Appendix A and the cost estimating example in Appendix B in MicroSoft Excel®. The Excel® spreadsheets can be copied to a diskette or hard drive and used multiple times in developing cost estimates.

Cost estimates can be developed for a wide range of projects. The handbook focuses on two general types of projects, Investigative and Removal/Remedial. Below is an overview of the types of projects that fall into each category.

2.0.1 Investigation Projects

CERCLA and Abandoned Mine Land (AML) investigation projects include Preliminary Assessments (PAs), Site Inspections (SIs), Removal Preliminary Assessments (RPA), Removal Site Inspections (RSI), Engineering Evaluation/Cost Analysis (EE/CA), and Remedial Investigation/Feasibility Studies (RI/FSs). Depending on the type of contaminants and affected environmental media, any or all of the following tasks may be required for an environmental investigation:

- Geophysical investigations, including electromagnetic, gravity, and seismic surveys.
- Drilling of boreholes and installation of monitoring wells for soil and/or groundwater sampling, measurement of the water table, and/or determining aquifer and soil properties.
- Collection and analysis of environmental samples from groundwater, soil, surface water, sediment, air, vegetation/biota, and/or waste sources.
- Generation and disposal of contaminated media (investigation-derived waste [IDW]), including personal protective equipment (PPE) and contaminated soil and water.
- Decontamination of drilling and other equipment.
- Health and safety monitoring of contaminants.
- Professional and technician time for developing required work plans, conducting field sampling and other investigation activities, performing analysis of the data (including development and analysis of remedial alternatives), providing community relations activities, volume calculations, and writing reports.
- Mapping, global positioning system (GPS), and ground surveys.

2.0.2 Removal/Remediation Projects

CERCLA removal and remediation projects and AML projects are extremely variable in size and scope, and can only briefly be summarized here. Typical activities that are expected for a removal action or remediation project include:

- Any or all of the investigation tasks discussed above. Even for simple removal actions, where contaminants have been removed, most removal and remediation projects are expected to require some level of additional investigation including installation of wells, confirmation sampling and analysis, health and safety monitoring, and/or post-removal monitoring. Post cleanup sampling and analysis is often critical and should not be left out of the cost estimate.

- Soil excavation, earth moving, and other heavy construction activities.

- Containment, treatment, transportation, and/or disposal of contaminated material.

- Professional and technician time for developing required work plans, conducting field sampling and other investigation activities, performing analysis of the data (including development and analysis of remedial alternatives), providing community relations activities, and writing reports.

2.1 Uses of Cost Estimates

Cost estimates need to be developed for AML and CERCLA investigation and remediation projects for three primary reasons:

1. Budgeting;
2. Evaluating cost proposals for contract awards; and
3. Evaluating removal and remedial alternatives.

2.1.1 Budgeting

The allocation of funds for specific environmental projects is based on estimates of the costs of those projects. Major cost under- or over-estimates can be disruptive because:

- Underfunded projects can be delayed while additional sources of funding are identified. For Hazardous Materials (HazMat) projects, this can result in possible regulatory penalties and/or needless threats to human health or the environment.

- Over funded projects can be needlessly blocked because they appear to be more costly than they actually are.

2.1.2 Evaluating Cost Proposals for Contract Awards

In many cases, the primary decision factor in selecting services and products is cost. The cost is the easiest element to evaluate when several proposals are compared. However, the apparent simplicity of comparing bidders' final costs may hide differences in project approach, understanding of the scope of work, the agency's liability exposure, and contractor's work quality. Some things you can do to make these less obvious factors more apparent is:

- Developing a good understanding of the project requirements. The agency Project Manager must understand all of the individual work elements which will be required for completion of the project.

- Writing a detailed scope of work. The more detailed a scope of work that is developed, the more likely it is that all of the bidders will be providing costs based on the same tasks, numbers and volumes of environmental media involved, and performance standards required. Regulators, agency counterparts, and Environmental Protection Agency (EPA) publications are sources of detailed statements of work and assistance in preparing a SOW. The bibliography at the end of this section contains additional sources.

- Developing a detailed bid schedule that the bidders are required to fill out. This provides several advantages: a) it will lay out all of the work elements that are required, so that the bidders are including all work tasks in their bids; b) it requires the bidders to break down their bids into components, so that the Project Manager can understand the reasons for differences in the bids; and c) it will provide unit costs that can be used to price the actual field-measured quantities for payment purposes during the performance of the project.

2.1.3 Evaluating Removal and Remedial Alternatives

Cost estimates need to be developed for numerous possible scenarios for any CERCLA investigation or remediation project for several reasons:

- To provide an investigation, removal action, or remediation project that provides the most protection for the cost. In many cases, the budget is not developed based on the needs of the project, but the project is designed around the available funding. In these cases, cost estimating of various project elements will allow the agency Project Manager to modify the number of samples, the types of analytes, or volumes of removed material to identify the optimal acquisition of data or scope of remedial action available within the available funding.

- To make Risk Management decisions. Risk Management decisions require the development of several potential scenarios, and then evaluation of the scenarios for several factors, including technical implementability, short- and long-term effectiveness, public acceptability, and cost.

- To comply with CERCLA. The CERCLA removal action and remedial action procedures require the consideration of cost in the evaluation of alternatives in EE/CAs and RI/FSs.

2.2 Components of a Cost Estimate

Presented below is a multi-step guide for developing a cost estimate.

2.2.1 Step 1 - Develop Detailed Scope for Project

The cost estimate is only as good as the scope is accurate. The first step in completing the cost estimate is to develop a detailed project scope. One key component to an accurate scope of work is making sure that the level of detail is sufficient to developing the cost estimate. Scoping of a project to the level of detail needed for an accurate cost estimate includes:

- Identify project goals.
- Identify the main work tasks required to meet the project goals.
- Break each work task down into its components for individual costing.

2.2.1.1 Identify Project Goals

The first step in scoping is identifying the goals and objectives of the project. Examples of common goals for CERCLA investigation projects include:

- Identifying the nature of the contaminants on the site.
- Determining the extent of contamination, both horizontally and vertically (basically, the volume of contamination).
- Identifying routes of migration, routes of exposure, and potential receptors.

- Identifying site properties that affect choices of remedial options (aquifer characteristics, soil characteristics).
- Collecting data of the type and quality that can be used for cost recovery purposes.

- Protecting the health and safety of site workers and nearby residents/workers during the project.
- Complying with environmental regulations.

Examples of common goals for CERCLA removal action or remediation projects include:

- Removing the contaminated material from the site.
- Treating or containing the contaminated material so that it no longer presents a threat.
- Collecting data of the type and quality that can be used for cost recovery purposes.
- Protecting the health and safety of site workers and nearby residents/workers during the project.
- Complying with environmental regulations.

2.2.1.2 Identify the Main Work Tasks Required to Meet the Project Goals

Ultimately, the entire project will have to be broken down into its smallest individual components to develop an accurate cost estimate. The first step in doing this is identifying the main tasks. For the actual field activities, this will include broad items such as:

- Collection and analysis of samples;
- Installation of monitoring wells;
- Excavation of contaminated soil;
- Removal of onsite waste sources (such as drums); and
- Installation of onsite treatment systems.

2.2.1.3 Break Each Work Task into its Components for Individual Costing

The next step is to break every task down into its components. For investigation projects, this will include breaking down the investigation with respect to:

- Materials required for purchase, and number of each.
- Professional and technical disciplines needed, with number of hours required for each.
- Number of analyses for each media, including the analytical suite, data quality needs, and required turnaround times.
- Volumes of IDW that will be generated, and how they will be disposed. This may require detailed calculations based on borehole diameters, for jobs requiring monitoring well installation.
- Travel and per diem for Contractor's field personnel.
- Mobilization and demobilization of field equipment, such as drill rig, GeoProbe, or mobile laboratory.

Please note that this is the first of several steps that will require the making of numerous assumptions. Cost estimating will require you to make assumptions based on your knowledge and experience.

For removal/remediation projects, the breakdown will include:

- All of the items mentioned for investigation projects.
- The volume or area of contaminated media involved.
- The distance and mode of transportation to a disposal or treatment facility.

For each field activity, a variety of office-based planning and analysis tasks are required, and often forgotten. These include:

- Review of existing data, maps, and reports.

- Development of work plans, sampling plans, health and safety plans, and quality assurance plans.

- Procurement of field and laboratory contractors, ranging from simple phone contacts and purchase orders to development of design specifications and bid packages.
- Acquisition and/or maintenance of field sampling and health and safety monitoring equipment.
- Data analysis activities, including contaminant mapping and modeling, data validation, and risk assessment calculation.
- Attendance at all project meetings, and meetings with regulators.
- Development of final reports and/or designs.

Scoping the project correctly, and in great detail, is the most difficult step in the cost estimating process. Once all of the required materials, times, analyses, and other components of the project have been completely identified, Step 1 is complete.

2.2.2 Step 2 - Determine the Purpose of the Cost Estimate

The next step is to determine what cost it is you are trying to estimate, and why you are trying to estimate it. Things you want to consider before proceeding include:

- Required accuracy and detail. Before proceeding, you need to determine the level of detail and accuracy you need for the cost estimate. For instance, If you are doing budget estimates for five years in advance, then you can be less detailed. If you are developing an internal cost estimate for a job you are putting out for bid, you will need a more detailed and accurate cost estimate.
- Significant factors affecting the cost estimate. Often, a rough cut at the cost estimate before going into detail will show that one factor significantly drives the cost. For instance, for removal actions, hazardous waste disposal costs may be so large as to make all other costs insignificant. If this is true, then your time should be spent on refining your volume calculations, and you should spend less time figuring out how the size of the backhoe required will affect the costs.

2.2.2.1 Estimating Volumes: Waste Piles and Surface Impoundments

During the process of investigating hazardous waste sites or abandoned mine lands, it is becoming increasingly important to precisely estimate the volume of waste materials located on site. This is driven by the need to develop cost estimates that accurately reflect the funding required to cleanup or remove contaminated material. There are several methods available to develop volume estimates including photogrammetric and field surveying. The intent of this section is to discuss field surveying methods that are commonly employed to generate the information required to develop volume estimates. Photogrammetric analysis is very specialized and, consequently, will not be addressed in this section. However, photogrammetric assistance is available through the BLM National Science and Technology Center (NSTC), Division of Geographic Sciences (Contact: Fred Batson, Division Chief (303) 236-6376).

There are several field methods available to estimate volumes, but all work on the principle of defining the area and height, or thickness, of the waste pile or tailings impoundment. In general, the field methods used to develop the volume estimates will dictate the level of precision that the evaluator can hope to obtain. For example, if the evaluator employs GPS hardware in the field or has a cadastral survey conducted, the volume can be measured very precisely. Once the area and thickness measurements have been collected, these data can easily be manipulated by a number of software programs designed to perform volume calculations. A few of these programs include AutoCAD Land Development Desktop and Surfer®.

2.2.2.2 Field Methods for Estimating Waste Piles and Surface Impoundments

One of the simplest, and least precise, methods to calculate volumes is by pacing off the dimensions of the waste pile or surface impoundment. Typically these areas are irregularly shaped and the evaluator will be required to select a geometric form (e.g., parallelogram, rectangle, circle, triangle, etc.) that best matches the area that is covered. For complex polygons, the evaluator can subdivide the area into several smaller simpler shapes. Once the geometric form has been established, the sides are then paced off and the pace count converted into lengths. The height of a waste pile can be estimated either by using nearby points of reference (e.g., trees, structures, known topographic elevations, etc.) or by pacing the slope and estimating the angle of repose.

Estimating the depth of a surface impoundment presents a greater challenge, but a reasonable estimate can be obtained by making several assumptions. Typically, surface impoundments at abandoned mine lands are located in a drainage. The assumption can then be made that the bottom of the impoundment has the shape of the drainage channel (e.g., v-shaped). In the case of v-shaped drainage channels, a line can be drawn down the center axis (i.e., length) of the impoundment and the impoundment divided into two halves. Right triangles can then be established to represent the vertical profile of each half. At the dam face, the height of the dam will represent one length of the triangle and the distance from the center line to the edge of the impoundment another. The third length can be calculated with the following formula:

$$c = \mathrm{sqrt}\,(a^2 + b^2)$$

Since the thickness of the impoundment will decrease away from the dam face, each half would be subdivided, or sliced into sections, and multiple triangles would be established to cover the entire length of the impoundment.

Precision will increase with the degree of accuracy of the measurements that are made. The dimensions of a waste pile or impoundment can be paced or measured with tape measures. Clinometers can be used to measure slope, as well as distances. However, when precise volumes need to be determined, a GPS or cadastral survey should be conducted. Either survey will provide very accurate measurements of area, as well as heights when evaluating waste piles. Surface impoundments present a different challenge, since the majority of material will be below grade and not visible. When investigating surface impoundments, several techniques can be used to accurately determine the depth. The most common method is to use a drill rig or hydraulic punch (See Section 5.2.3) to core through the impoundment to determine the depth to the interface between the indigenous soil and the impoundment material. Multiple holes need to be drilled or punched along the entire periphery of the impoundment, as well as within the impoundment. As a minimum, a number of holes should be cored along the center axis and parallel to the center axis, between the center axis and the outer boundary of the impoundment. For large impoundments, hydraulic punches are preferable due to their speed and ease of use. Another method to determine the depth of a surface impoundment is to use surface geophysics, such as electromagnetic or electrical resistivity surveys. A more detailed description of these techniques is provided in Sections 5.2.2.1.1 and 5.2.2.1.2, respectively. When applied correctly, surface geophysics can paint a picture of the subsurface topography and provide a great deal of detail on the depth of a surface impoundment.

2.2.3 Step 3 - Estimate Cost of Individual Line Items

To estimate the costs of each line item the following substeps are required:

- Obtain unit costs for each line item identified.
- Convert the units of your line item estimates into the units of the cost data source available.
- Add indirect costs, if necessary.
- Escalate costs where appropriate.
- Multiply the fully loaded, escalated, unit costs by the number of items.

2.2.3.1 Obtain Unit Costs for Each Line Item Identified

There are several ways to obtain unit costs for each of the project components identified:

- Use this Cost Estimating Handbook.
- Conduct market research (see Section 2.4.5, Market Research).
- Use a variety of other available resources.

As soon as you start to compile your unit costs, you will probably realize that the scope you developed is not nearly as detailed as you thought it was. For instance, you have done an excellent calculation of the volume of contaminated soil to be removed, and then turned to your Cost Estimating Handbook to find unit costs for about 100 different sizes and types of backhoes, bucket loaders, graders, rollers, scrapers, tractors, dump trucks, and cranes. There are several ways to approach this issue:

- Use your detailed knowledge of engineering and earthmoving equipment to determine exactly what type and size of equipment to use, and exactly how long it will take.

- Call a contractor, and ask them to give you some guidance - they'll usually be glad to help you out.

- Make some fast assumptions, and go with them.

- Look at the amount of time available for the job and back calculate the sizes of equipment needed to do the job.

- Derive several answers and look at the budget available.

2.2.3.2 Convert the Units of Line Item Estimates into the Units of the Cost Data Source Available

It is possible that no converting of units will be necessary for developing a simple cost estimate for investigation projects. Examples of instances where conversions, extrapolations, and assumptions will be necessary include:

- You will probably have to convert your time assumptions into the same units as the costs that are supplied to you, such as converting hours to weeks.

- For materials or services where costs are quoted per week or month (many of the costs in the Cost Estimating Handbook are listed this way), you will probably have to extrapolate up or down to match the time frame of your project. This extrapolation will usually not be direct. For instance, the daily rental cost of equipment will not be equal to 1/5 of the weekly cost, it will be more. Examination of this issue by Dynamac found that daily equipment rental costs are typically about 1/3 of the weekly cost.

- You may need to make conversions between volumes and weights, especially for removal jobs. For instance, you may have calculated a volume of contaminated soil to be removed, but your unit cost is in dollars per ton. Conversions between metric and U.S. units may also be necessary. A metric to U.S. units conversion table is included in Appendix C.

- For soil excavation jobs, you may have to make assumptions about the amount of soil that can be moved per day.

2.2.3.3 Add Indirect Costs Where Necessary

When using a cost data source to populate your cost estimate it is important to understand if the data source lists costs that include both direct and indirect costs or just the former. The difference between direct and indirect costs is described in the following two subsections. The cost data tables in Appendix A of this handbook indicate whether the costs include the indirect cost component (i.e., the costs are fully loaded) or not. When a cost item is retrieved from a data source that only includes direct costs you need to estimate and add the indirect costs. Sometimes, a cost source does not clearly indicate if the costs are direct or fully loaded costs. In those cases, use judgment and make quick comparisons to known costs to determine if a cost is loaded or not.

2.2.3.3.1 Direct Costs

Direct costs include material/equipment rental and/or purchase, costs for professional and field technician salaries, travel costs, waste treatment/disposal costs, and analytical costs.

Material and equipment costs typically include:

- Purchase of project planning materials (maps, reports, aerial photographs), PPE (boots, gloves, coveralls), sampling equipment (bailers, sample jars, decontamination fluids), well materials (polyvinyl chloride [PVC], bentonite, pumps), monitoring equipment (HNu, pH meters), drums for waste storage, and construction materials (backfill soil, capping soil, fencing, riprap).

- Rental of drilling or construction equipment, including GeoProbe or Cone Penetrometer equipment; drill rig; pumps, generators, and tanks for well testing; geophysical equipment; and backhoes, bulldozers, graders, and other earthmoving equipment. These costs are usually supplied per hour, day, or week, but may also be combined with cost for crews and operators.

Costs for professional and technician time typically include:

- Labor costs associated with the time for engineers, geologists, and other professionals to develop project plans (work plans, health and safety plans, quality assurance plans), procure and manage field and analytical subcontractors, conduct and/or oversee field activities, provide data analysis (contaminant mapping, data validation, risk assessment, computer modeling, cost estimating, and remedial alternatives analysis), provide community relations support, attend project planning and status meetings with the client and regulators, and writing reports. The direct labor costs consist only of the salaries payed to personnel, typically provided on a per hour basis.

- Labor costs associated with the time for field technicians involved in field sampling, well installation, geophysical survey, and construction activities. These costs are either shown as direct hourly costs or combined as part of the total rental cost for equipment.

Costs for travel typically include:

- Hotel and per diem for field personnel. These costs are sometimes included in bids for field crews. Many government contracts call for use of the government schedule. The government schedule may be an adequate substitute for estimating contractor costs.

- Air travel, rental car, and/or car mileage costs. Remember that air travel costs can vary widely depending on the amount of notice provided.

Estimating these costs depends on accurate determination of the number of field personnel, vehicles, rental equipment (amount and types), and the length of time they will be in the field.

Costs for waste treatment and/or disposal may include transportation of contaminated media offsite and disposal of: IDW; contaminated PPE; decontamination fluids; well purging or development water; drill cuttings; and waste materials (e.g., drums, contaminated soils, and contaminated groundwater). Estimating these costs depends on the reasonableness of the estimate of the volumes of material to be disposed of.

It should be noted that the offsite disposal of contaminated materials represents, in many cases, the largest portion of the remediation costs. As a result, it is very important not only to develop a reasonable estimate of these costs but also to examine any applicable options of lowering them. A common way to reduce disposal costs is to perform waste segregation. For example, a quick characterization of an old landfill may document a few samples that fail the Toxicity Characteristic Leaching Procedure (TCLP), which means that they classify as characteristic hazardous waste. A superficial analysis of a those results may conclude that all of the wastes contained in the landfill are hazardous and must be disposed of in an offsite permitted Subtitle C RCRA landfill. However, a more thorough interpretation of the analytical results may show that the hazardous samples are only representative of a discrete area of the landfill, whereas the rest of the wastes are non-hazardous solid wastes that may be disposed of in an offsite RCRA Subtitle D landfill (at a fraction of the Subtitle C landfill disposal costs). Based on this understanding, the follow-on remedial design may include procedures, during waste excavation, for the sampling and segregation of hazardous waste materials from the rest of the wastes contained in the landfill. Using waste segregation throughout the performance of a remediation project may result in significant cost savings.

Costs for sample analyses typically include:

- Analyses of environmental media for identification and delineation of contamination during investigation. This could include samples from surface and subsurface soil, groundwater, surface water, sediment, air, vegetation/biota, or waste sources.

- Analyses of waste, contaminated soils, decontamination fluids, monitoring well development water, and other media for hazardous waste characterization. This will usually involve Toxicity Characteristic Leaching Procedure (TCLP) analyses.

- Analyses of samples from the walls of an excavation and/or from soils beneath a waste source to verify removal of the contaminated portion of the material.

- Analyses of surface water or groundwater as part of long-term monitoring in place of or following a remedial action.

- Analyses of appropriate background and Quality Assurance/Quality Control (QA/QC) samples.

- Rental of x-ray fluorescence (XRF) or ownership of other in site testing equipment.

Analytical costs will vary widely based on:

- Numbers of samples, which may be difficult to estimate. Be sure to remember numbers of background and QA/QC samples required when costing a project (typically 10 percent of the total sample set). See Section 3.2.3, Sampling and Analysis Plan (SAP), for factors to consider.

- Suite of analytes. Costs can be limited by only running a limited suite, such as just volatile organic compounds (VOCs), a select analyte, such as benzene, rather than a full analysis for VOCs, semi-VOCs, pesticides/polychlorinated biphenyls (PCBs), and metals.

- Data quality needs versus timely results. Field screening analyses which provide real-time information on the presence or absence of a contaminant are usually costed per sample, and are inexpensive. Mobile laboratories which can provide full analyses in a limited amount of time are commonly available at a per day or week charge. Greater precision can be obtained from fixed laboratories, but requires a two week turn around for regular price schedule. Quicker turn around times on fixed lab results increase the standard cost anywhere from 10 - 25 percent. Turn around times of two weeks and one week are available for greatly enhanced prices. Expedited results are available for significantly increased costs.

- In general, analytical costs are a significant portion of the budget of an investigation, and are also a cost that can be limited by reducing numbers of samples, range of analytes, and required QA/QC. However, it is also easy to receive sample results and find that background has not been defined, or that contamination has not been delineated, and that additional rounds of sampling are required. Reducing analytical costs are the most common method of limiting the costs of an investigation, and are also probably the most common cause of cost and schedule overruns by requiring additional sampling rounds for an investigation.

2.2.3.3.2 Indirect Costs

Indirect costs are costs that are added to the direct costs and consist of overhead charges, insurance and bonding, general and administrative (G&A) rates, contractor profit and others. Indirect costs are an allowable cost under Federal government contracting regulations. The indirect portion of a fully loaded rate ranges approximately from 80 to 200 percent of the direct costs for professional services.

The components of indirect costs may include:

- Contractor overhead charges. This includes the contractor’s costs for office space and other facilities, contract administration, management, computers, marketing, insurance, and other costs of staying in business. The charges generally range from 30 percent to 150 percent; a reasonable value to use in cost estimates is 50 percent.

- Contractor G&A rates. These costs are attributable to the contractor’s administrative support, such as accounting and contracting. G&A can consist of a multitude of different items ranging from taxes, depreciation, legal fees, conferences, to bid and proposal (B&P) expenses. It differs for every company or organization. G&A rates usually range from 30 to 50 percent.

- Contractor procurement and handling costs. In virtually all cases, contractors add a separate fee (commonly 10 percent) onto the direct cost of items or materials that are purchased for a specific job.

- Contractor profit. This will typically range from 5 to 15 percent of the total cost.

2.2.3.4 Escalate Costs Where Appropriate

At this point, the items which require escalation for inflation should be adjusted accordingly. For purposes of considering cost escalation for inflation, projects can be separated into two types:

- One-stage, short time frame projects. This includes most or all investigation projects, and remedial jobs such as soil removal, where all contamination is removed from the site. Most of these jobs are expected to last less than a year, so escalation of the costs of different parts of the project is not required. For these projects, the cost for the entire project needs to be escalated based on the date of the beginning of the project versus the date that the cost estimate was prepared.

- Multi-stage or very long time frame projects. This includes remediation projects which will take a very long time (such as groundwater remediation), or projects which require periodic monitoring activities over a period of years. For these projects, different parts of the project need to be escalated using different escalation factors.

For single cost items, such as lab costs, the costs are usually good for a specified period of time. You need to determine the typical time period that the costs are valid, which usually range from 30 days to 6 months. The costs included in this Cost Estimating Handbook are representative for 2002. The cost escalation coefficients in the table below allow the escalation of the costs in this handbook to any year and month between 2002 and 2007. The cost escalation coefficients included in this table were generated by the Department of Defense (DoD) based on accepted economic forecasts.

Table 2.1: Cost Escalation Based on DoD Forecasts

Year	Factor
2002	100
2003	101.6
2004	103
2005	104.8
2006	106.7
2007	108.7

The procedure for using the cost escalation table consists of the following steps:

1. Select the year for the project cost estimate.
   Example: 2004.

2. Calculate the cost escalation factor. The cost escalation factor is the ratio between the cost escalation coefficient for the date selected for the cost estimate and the 2002 cost escalation coefficient (the denominator is always the 2002 coefficient because the costs in this document are dated 2002).

   Cost escalation factor = 103.0 (2004) / 100 (2002) = 1.03.

3. Multiply each cost retrieved from this document by the cost escalation factor.

   Example: Gamma-gamma geophysical logging. Cost per foot is $0.70 for 2002. Escalated for 2004 the cost becomes 1.03 X $0.70 = $0.72.

2.2.3.5 Multiply the Fully Loaded, Escalated, Unit Costs by the Number of Items

Once you have completed the processing of a unit cost, the estimate of that cost line item is obtained by multiplying the unit cost by the number of items.

2.2.4 Step 4 - Apply Contingency to Total Project Cost

Once the cost estimate is complete and a total project cost is obtained, you need to consider the level of accuracy of the estimate. Generally, the numerous assumptions that are used to fill data gaps when developing an estimate contribute to lowering the accuracy of the result. In order to address this limitation, a contingency factor is applied to account for possible variations in actual project conditions. Typical contingency values are 10-25 percent and are applied to the total estimate result in order to derive the “grand total” value.

2.3 Difficulties in Developing Cost Estimates

The primary issues which present difficulties in developing accurate cost estimates are:

- Incomplete or inaccurate project scoping.
- Lack of understanding of applicable regulations.
- Lack of reliable cost data sources.
- Over reliance on verbal cost estimates developed by contractors based on insufficient site information.
- Inaccurate extrapolation of costs.
- Use of cost data from completed projects that are not directly comparable.

2.3.1 Incomplete or Inaccurate Project Scoping

The key to developing an accurate cost estimate is to ensure that the project scope is accurate, detailed, and has been completely defined. Examples of items that are typically forgotten or otherwise misjudged include:

- Underestimating professional time required to develop and write work plans, attend meetings, do data analyses, and write reports.

- Using inaccurate/ inadequate site data. These may include poor estimates of waste volumes (see Section 2.2.2.1, Estimating Volumes: Waste Piles and Surface Impoundments), of rate of flow from adits (see Sections 4.1.2.1. acid Drainage and 4.1.2.2 Closure of Adits, Pits and Shafts), or other field characteristics of great consequence on the total cost estimate.

- Forgetting to include appropriate numbers of background and QA/QC samples in the project.

- Underestimating field mobilization and demobilization times and costs.

- Failing to include detailed costs for PPE, sampling equipment, field notebooks, and other small items.

- Forgetting to include the full range of field decontamination issues, including construction of a decontamination pad, decontamination time, and collection and offsite disposal of decontamination water.

- Forgetting to include items required for restoration of a site after a removal action or excavation project has been completed.

2.3.2 Lack of Understanding of Applicable Regulations

Environmental investigations, removal actions, and remedial activities require compliance with a wide range of Federal, State, and local environmental regulations. The direct consequence of many of these activities is the offsite treatment or disposal of hazardous waste. Section 5.5, Hazardous Waste Treatment and Disposal, discusses these costs. In addition, other regulations also may apply that affect the cost estimate in two ways:

- Direct costs of compliance. These regulations require some costs to be expended for the project to be in compliance. This can include professional time spent to develop regulatory permits or management documents, changes in the design of some field features to account for compliance issues, and/or construction of additional facilities required for compliance.

- Indirect costs of compliance. Failing to identify and address these compliance issues before beginning the project will often lead to delays in implementation of the project, and will adversely affect the costs.

Environmental regulations which commonly must be complied with during investigations, removal actions, and remedial activities, but which are often forgotten or underestimated, include:

- Clean Air Act (CAA) and related State and local air regulations. Remedial actions which will release VOC emissions (such as VOC stripping of contaminated groundwater), or which will release particulates (such as soil excavation jobs), may require permits to be completed, changes in the design of the project, and/or additional health and safety precautions.

- Clean Water Act and related State and local water regulations. If cleanup involves discharge to local sewer systems a permit may be required. In addition, most soil excavation jobs are expected to have to comply with State or local regulations which require a Sedimentation and Erosion Control Plan and/or permits. This issue may require costly modifications in the excavation plans.

- The National Historic Preservation Act, Archaeological Resource Protection Act, and other State and local regulations applying to preservation of historical and archeological resources. These regulations may require, for instance, the conduct of historical or archeological surveys before excavation or other ground disturbance can begin.

- Endangered Species Act, which provides a program for the conservation of threatened and endangered plants and animals and the habitats in which they are found, may greatly impact the options available for the remediation of a site, for example.

2.3.3 Lack of Reliable Cost Data Sources

This can be one of the most frustrating barriers to completing an accurate cost estimate. The Cost Estimating Handbook was specifically designed to include all items which could be thought of that would be relevant to investigation, removal, or remediation jobs, but it is surely not complete. In general, it is expected that cost data is eventually available for any item you can think of. If you can buy it or build it, then there is someone who wants to sell it to you or build it for you. The market research techniques discussed in Section 2.4.5 may help you fill in the cost data gaps in your estimate.

2.3.4 It Is Improper to Rely on Verbal Cost Estimates Developed by Contractors

Under the FAR 10.002, relying on verbal cost estimates provided by contractors is not permitted. However, market research (see Section 2.4.5) is allowed and schedules can be reviewed for comparable work.

2.3.5 Inaccurate Extrapolation of Costs

There are two primary ways this can occur:

- Rental costs cannot be extrapolated from one time period to another directly. For example, daily rental costs will always be more than 1/5 of the quoted weekly cost, and weekly rental cost will be more than 1/4 of the quoted monthly cost. If weekly rental quotes are used for a job that will take one or two days, and are extrapolated directly, the cost estimate will underestimate the actual cost of the project.

- Quotes based on the size or volume of the job cannot be directly extrapolated if the size of the job changes. Contractor quotes for field activities, such as quotes on a per volume basis, are commonly directly extrapolated if the size of the project changes. For instance, a contractor may provide a quote for removal and disposal of 100 cubic yards (CY) of contaminated soil. If the scope is subsequently changed to 200 cubic yards, the cost cannot just be doubled. This is because the quote will include mobilization and demobilization costs, health and safety equipment costs, construction of a decontamination pad, installation of sediment and erosion control structures, and other costs which will not change based on the size of the project. Because these fixed costs may be a significant portion of total costs, the contractor should be contacted before extrapolating costs. If the size of a job is increased after quotes are received, and the quote is extrapolated directly, then the cost estimate will probably overestimate the actual cost.

2.3.6 Use of Cost Data from Projects That Are Not Directly Comparable

One very common method of cost estimating is to compare the project to another similar project completed somewhere else. This has obvious advantages in that it is fast, and is based on actual data. However, it has obvious risks if not done carefully. For small, simple investigation or removal jobs, this may be appropriate, but the larger and more complex the projects become, the more difficult it is to ensure that the projects are comparable. Since the price range for an EE/CA project can range from tens of thousands of dollars to a few million dollars, no simple comparison of one to another is possible.

Quantity discounting can effect the cost of work. Therefore, when using cost data from completed projects, make sure that any discounting that was applied to it be taken into account.

2.4 Hiring a Contractor

The BLM has developed a web-based site with information regarding Procurement Tools: http://www.blm.gov/natacq/tools/indextool.html The following information was gleaned from that web site and adapted for this Cost Estimating Handbook.

2.4.1 Government Purchase Card and Convenience Checks

The Government purchase card and convenience checks allow Federal employees to purchase commercially available goods and services. The purchase card is a preferred method of payment for purchases. If the purchase card is not accepted by a merchant, a convenience check may be issued.

Bureau policy for employees needing to purchase supplies or services under $2,500 is stated in WO IM 97-47, Establishment of Purchase Card (VISA) Use Goal. The convenience check program policies are provided in WO IM 98-86, Implementation of Convenience Check Program.

To receive a purchase card and convenience checks (optional), your supervisor must authorize the action, you must complete the on-line self-study course ***Using Government Purchase Cards***, located at http://www.ntc.blm.gov/purchase/, take the test, and submit it to your purchase card program coordinator. A card and checks will be ordered in your name. Only the cardholder named on the card or check is authorized to use it. The card may be used only for purchases that are otherwise authorized by law or regulation.

Use of the purchase card or convenience check provides the following benefits:

- It significantly streamlines the procurement process thereby generating substantial savings in administrative time and expenses.
- It allows employees the flexibility to shop for competitive prices and purchase goods and services from a full range of vendors or order from existing contracts at discount prices.
- It enables managers to track and control expenses with detailed monthly statements.

- It may allow you to make payments for purchases against existing contracts.
- It permits you to purchase most of the 300,000 items currently on GSA Advantage! Web site.

2.4.2 Over Micro-Purchase Threshold

Micro-purchase means an acquisition of supplies or services, the aggregate amount of which does not exceed $2,500, except that in the case of construction, the limit is $2,000. Only those employees who have been delegated authority, such as contracting officers, may obligate funds over the micro-purchase threshold. Generally, all purchases that exceed this threshold must be competed. When you need to buy something that exceeds the micro-purchase threshold, you must submit a requisition to the procurement office. Early planning and coordination with your procurement analyst or contracting officer will make the process much easier.

The purchasing authority of contracting officers vary as does the level of procurement authority for a specific office. Typically, the state office procurement authority is $100,000, the field office is $25,000 or under, and the National Business Center is unlimited. Oregon has unlimited authority within the state with limited exceptions.

2.4.3 Award on Factors Other than Price

If it is important to consider factors other than price when selecting a study or cleanup contractor, information on past performance can be used. Information from previous contracts as well as requested references from past and current projects from contractors can be reviewed. Guidance and best practices for use of past performance in obtaining best value awards is given in WO IM 97-91, A Guide to Best Practices for Past Performance.

Technical capability can also be considered. Evaluation information is provided by the requisitioner, who also participates in the evaluation process. New procedures allow government employees to perform this type of evaluation in a much more streamlined process that is appealing to both the Government and the contracting community.

2.4.4 Requisition/IDEAS

A requisition is an internal document, prepared by program personnel, providing authorization to spend program funds to meet the required need. The requisition should contain a description of the need (i.e., supplies, services, or construction) and other necessary information to initiate a procurement. Only the contracting officer is authorized to commit the government to purchase supplies or services over the micro-purchase threshold.

Any acquisition involving the participation of your procurement office requires entry of requisition data into the Interior Department Electronic Acquisition System (IDEAS). In the IDEAS Procurement Desktop the Purchase Request Form accumulates the same data as the Requisition including fund code, estimated cost, required delivery date, any special requirements, instructions or approvals. There is no requirement in IDEAS to include the details of your Statement of Work to the program. However, a Word Document can be tied to the Purchase Request Form through the utility menu and will speed your procurement. For assistance in completion of your purchase, see your staff assistant or procurement personnel.

2.4.4.1 Description of Need

Complex supply and service acquisitions require the development of a description of need, which may consist of specifications and drawings, functions to be performed, performance required, or essential physical characteristics, to present a clear description of the government's requirements. Describe what is needed in enough detail so both the contracting officer and the contractors can understand the requirement. Overly restrictive descriptions may limit competition and increase costs. Since the written words translate into cost and profit, every word must be scrutinized.

Specifications may be written in the form of performance requirements or design requirements, or a combination of both. Performance specifications encourage innovation and efficiency from the competitive marketplace.

2.4.4.2 Solicitation

Various methods may be used by the contracting officer to solicit pricing for the items or services you request. Depending on the complexity of the need, time frames to complete the procurement vary from a few days to several months.

There may already be contracts in place that can provide the types of services needed. For instance, BLM has an agency wide contract for environmental services. In addition, there are other contract vehicles that can be accessed by agency personnel, such as the General Services Administration (GSA) environmental services schedule, and the U.S. Army Corps of Engineers services.

2.4.4.3 FedBizOpps/Commerce Business Daily

Issued by the U.S. Government Printing Office (GPO), and published on the Web by Community of Science, the FedBizOpps (FBO) /Commerce Business Daily (CBD) lists notices of proposed government procurement actions, contract awards, sales of government property, and other procurement information over $25,000, all updated daily. The contracting officer is required to announce proposed contract actions expected to exceed $25,000 by publishing a synopsis in the CBD. The notice may add at least 15 days lead time to your procurement. Some exceptions apply when purchasing commercial items.

2.4.4.4 Contract Award

An order placed by a contracting officer committing the government to purchase the supplies or services. Orders may be oral, written, or electronic and include terms and conditions binding on both parties.

2.4.4.5 Types of Contracts

Supply

When ordering a commercial item, you may describe the item you have selected through market research. Attach all documentation supporting the market research to the requisition.

Service

Service contract means a contract that directly engages the time and effort of a contractor whose primary purpose is to perform an identifiable task rather than to furnish an end item of supply. It can cover services performed by either professional or nonprofessional personnel whether on an individual or organizational basis. Some of the areas in which service contracts are found include the following:

- Maintenance, overhaul, repair, servicing, rehabilitation, salvage, modernization, or modification of supplies, systems, or equipment.

- Advisory and assistance services.

- Operation of Government-owned equipment facilities and systems.

- Architect-Engineering.
- Studies, research and development.
- Professional and technical support services supporting programs such as Information Resources Management and Hazardous Materials Management.

Service - Performance-Based Service Contracting

To ensure that performance-based contracting methods are used to the maximum extent practicable when acquiring services, guidance is provided in WO IM 98-06, PBSCs.

Construction Project Specification

All construction projects more than $2,000 require use of engineering guide specifications and/or drawings. Early involvement of your engineering staff will ensure timely development of the specifications for your project.

Service Contract Act (SCA)

In accordance with the SCA, service contracts more than $2,500 will contain mandatory provisions regarding minimum wages and fringe benefits, safe and sanitary working conditions, notification to employees of the minimum allowable compensation, and equivalent Federal employee classifications and wage rates. Minimum wages and fringe benefits are determined by issuance of a wage determination from the Secretary of Labor. Wage determinations must be requested by the contracting officer for each service project and it may take 30 to 60 days to receive a response.

If you have plans to issue a service contract, contact the procurement office early so they can request a wage determination and have it available when your procurement request is received in the procurement office.

Construction

Construction means construction, alteration, or repair (including dredging, excavating, and painting) of buildings, structures, or other real property. For purposes of this definition, the terms "buildings, structures, or other real property" include but are not limited to improvements of all types, such as bridges, dams, highways, streets, sewers, power lines, pumping stations, airport facilities, docks, lighthouses, canals, channels, and temporary roads. Also included in the definition of construction are reclamation and remediation activities. Construction does not include the manufacture, production, furnishing, construction, alteration, repair, processing, or assembling of vessels, aircraft, or other kinds of personal property.

Solicitations and contract awards for construction contracts must be in writing. All construction projects more than $2,000 require use of engineering guide specifications and/or drawings. Early involvement of your engineering staff will ensure timely development of the specifications for your project.

2.4.5 Market Research

Market research is used to determine the availability of commercial items to meet our needs for supplies or services. Market research identifies customary terms and conditions of the commercial marketplace such as warranties, acceptance, inspection, financing, and maintenance support.

Depending on the size, complexity, and value of the item or service to be acquired, market research is conducted by the requisitioner, the contracting officer, or together as a team. Market research is an essential element of building an effective strategy for the acquisition of commercial items and establishes the foundation for the description of need, the solicitation, and resulting contract. The results of market research should be documented.

Techniques for conducting market research may include:

- Contacting specialists in your agency or in other Federal agencies who may have experience relevant to your information needs.
- Reviewing the results of recent market research undertaken to meet similar or identical requirements.
- Publishing formal requests for information in appropriate technical or scientific journals or business publications.
- Querying government data bases that provide information relevant to agency acquisitions including Internet searches.
- Contacting your existing HazMat or AML Technical Assistance Contractor to gather data for you. Directly contacting contractors that provide the services you are interested in is prohibited because it interferes with competition.
- Participating in interactive, on-line communication among industry, acquisition personnel, and customers.
- Obtaining source lists of similar items from other contracting activities or agencies, trade associations or other sources.
- Reviewing catalogs and other generally available product literature published by manufacturers, distributors, and dealers or available on-line.
- Conducting interchange meetings or holding pre-solicitation conferences to involve potential offerors early in the acquisition process.

8(a) Small Business Administration (SBA) Procurement Goals

Federal agencies can now count orders with 8(a) firms on multiple award schedules toward their 8(a) procurement goals. This is the result of a Memorandum of Understanding between SBA and GSA, signed on June 7, 2000.

2.4.6 The General Services Administration Federal Supply Schedule

http://www.fss.gsa.gov/schedules/

Under the schedules program, GSA enters into contracts with commercial firms to provide supplies and services at stated prices for given periods of time. Orders are placed directly with the schedule contractor, and deliveries are made directly to the customer.

The Federal Supply Schedules Program mirrors commercial buying practices more than any other procurement process in the Federal Government today. It provides customers with literally millions of state-of-the-art, high-quality commercial products and related services at volume discount pricing on a direct delivery basis.

2.4.7 Other Means of Procuring Services

Interagency Agreement (IA). Is an agreement between the BLM (or Forest Service) and another Federal Agency(ies) outside the U.S. Department of the Interior (DOI) (USDA) used to reimburse that Agency for goods or services provided to the BLM (Forest Service).

Intra-agency Agreement (I-A). An agreement between the BLM (or Forest Service) and another Bureau(s) within the DOI (USDA) used to reimburse that Bureau for goods or services provided to the BLM (or Forest Service).

The BLM (or Forest Service) enters into an IA/I-A with another Agency/Bureau to reimburse them for goods or services which that Agency/Bureau provides and the BLM (or Forest Service) needs. The Agency/Bureau receiving funds (Servicing Agency/Bureau) for its goods and/or services is under the same limitations for the use of the funds as is the Agency/Bureau to whom the funds were appropriated (Requesting Agency/Bureau)

Funds obligated for an IA/I-A may include a surcharge which will be paid to the Servicing Agency/Bureau in addition to the services performed. An IA/I-A is effective the date that the last Agency/Bureau signatory official signs the IA/I-A, and may cover a period not to exceed 5 years.

Memorandum of Understanding (MOU). A written agreement between the BLM or Forest Service and another entity(ies) that confirms the use of cooperative policies or procedures to promote mutual endeavors.

An MOU documents a “handshake” agreement by the MOU’s entities to use cooperative management policies or procedures, to provide mutual assistance, or to exchange results for the promotion of common endeavors. An MOU is not intended to be a detailed working document. It may be an “umbrella” agreement that provides a basis for more detailed sub-agreements, but it does not provide authority to enter into contracts or agency agreement It may not commit to future noncompetitive contracts with the MOU’s entities or subvert any of the procurement laws and regulations. An MOU does not obligate or exchange private or Federal funds, supplies, equipment, or services; share or exchange data with non-Federal entities; or serve as a substitute for covenants or reservations in land or mineral patents. An MOU may be the appropriate way to document the agency’s commitment to participate in a so called “Watershed Agreement” that sets a working group consisting of Federal, State, Tribal, and local Governments; private citizens; and other interests to address impacts of human activities on biotic resources within a watershed and proposes collaborative solutions to problems identified.

Forest Service/USDA

The Office of Procurement and Property Management, Procurement Policy Division, guided the procurement modernization effort within USDA. The Acquisition Toolkit encompasses many of the guiding principles. These guiding principles were established and are driving the modernization effort. Some of the guiding principles are:

- Offer one-stop Electronic Service Center.
- Create one-time data entry systems.
- Reduce procurement action lead times.
- Permit USDA personnel to take better advantage of flexibilities allowed by recent procurement reforms.
- Provide modern integrated procurement automation tools.

The Procurement Modernization Team, comprised of departmental and agency level personnel, is leading the integrated modernization effort. Information on additional planned phases is presented below.

2.5 Factors to Consider when Using Contractors

When utilizing a contractor to perform work, the following factors should be considered:

- The contractor's ability to perform the necessary work - this can be based on past performance doing the same or similar work.
- Developing a SOW that is clear and detailed as to site conditions, task description, expectations, milestones and date of completion.
- Lead times for contracting - allow between 6 months to a year for a new contract to be put in place.
- Negotiating the contract.
- Understanding the bill submitted, the manner in which costs are presented can be part of the SOW.
- On-site supervision at all possible times to ensure that the contractor:
  - Arrives on time;
  - Arrives ready to perform;
  - Has equipment that functions; and
  - Has personnel with the experience required under the contract.
- Providing oversight of the contractor while work is being performed.

2.6 Do You Really Want to Write Your Own Contract?

As described in the previous subsections, there are many different contracts available to you that may be used to deal with your site. You may check with your State Office or Regional Office to see what contracts are current and available, including:

- State Office or Regional Office removal contractor
- IA with the Corp of Engineers
- IA with the Bureau of Reclamation
- GSA Contract

You may also check with Science and Technology Center, Branch of Environmental Compliance (ST-133) to see what contracts are current and available. These currently include:

- Technical Assistance Contract for HazMat, AML and Physical Hazards
- IA with the Bureau of Reclamation
- IA with the Corp of Engineers
- IA with the Argonne National Laboratory
- IA with the Army Technical Service Center, Aberdeen Proving Grounds
- GSA Contract

Your contracting officer should be contacted for GSA contracting. Note that if you go straight to GSA, GSA may add overhead charges to your contract. For HazMat and AML purposes, separate GSA contracts should exceed $100,000. It is not generally worth the administrative costs and effort for a smaller contract. ST-133 will have a Technical Assistance contract with multiple contractors available after January 1, 2003.

3.0 Activities Requiring a Cost Estimate

This section provides an overview of the types of activities for which cost estimates can be developed. Activities are presented in a manner following the National Contingency Plan (NCP) and the CERCLA processes. Since agencies are more likely to participate in removal actions, these activities are presented first.

For each activity, where available, the usual types of personnel needed and an estimate of hours required to accomplish the work (where available) are provided in a **Cost Discussion Section**. In addition, sources of additional information are provided in a **Reference Section** for each activity. Section 4.0, presents examples of typical sites requiring removals and cleanup.

3.1 Regulatory Background

3.1.1 National Contingency Plan Requirements

Following the passage of Superfund legislation in 1980, the NCP was broadened to cover releases at hazardous waste sites requiring emergency removal actions. Over the years, additional revisions have been made to the NCP to keep pace with the enactment of legislation. The latest revisions to the NCP were finalized in 1994 to reflect the oil spill provisions of the Oil Pollution Act of 1990.

The NCP establishes methods and criteria for determining whether a CERCLA response action is appropriate, and the extent of such response action when there is a release of a hazardous substance into the environment. The BLM and Forest Service are responsible for making these determinations at their facilities and taking response action under CERCLA when appropriate.

The BLM and Forest Service must follow the process in the NCP (40 CFR Part 300) to conduct investigations and cleanup action, including pursuing potentially responsible parties to contribute to cleanup actions. Hazardous substance sites on agency lands may include abandoned landfills and mines, oil and gas exploration sites, drug labs, illegal dumps, and similar sites.

3.1.2 CERCLA

The BLM and Forest Service may take response action under CERCLA to address the release or threatened release of a hazardous substance in to the environment when such action is necessary to protect public health or welfare or the environment.

A release site may be discovered by:

- Investigation by agency personnel under CERCLA or other statutory authority.
- Survey efforts, observations, interviews, annual or periodic site visits, SIs.
- Notification of a release by Federal or state permit holder or reports submitted to National Response Center or EPA under CERCLA section 103.
- Reports by visitors or citizen petitions.

There are a variety of indications that a release may have occurred, including fish kills, soil or water discoloration, vegetative stress, abandoned drums, mine tailings, or other visual evidence.

3.1.2.1 CERCLA Requirements

Under CERCLA Section 104 the President is authorized to take response action when necessary to protect public health, welfare, or the environment whenever there is a release or substantial threat of release of a hazardous substance into the environment.

This response authority has been delegated to agencies for non-emergency situations for facilities not on the National Priorities List (NPL). The BLM has the authority to act as the lead agency on lands it administers, and has authority from EPA to respond, pursue violations of CERCLA and recover costs for incidents occurring on lands under its jurisdiction.

Similarly, the USDA was delegated certain CERCLA responsibilities, which it in turn delegated to the Forest Service. The Forest Service has the authority to act as the lead agency on lands that it administers, and is responsible for oversight of all investigations and cleanups on Forest Service lands, with the exception of emergency response actions. The EPA or the U.S. Coast Guard are the lead agencies for CERCLA emergency response actions on agency lands.

In order to determine whether a site triggers CERCLA reporting requirements, agency personnel must evaluate whether a release or threat of release exists, whether the release is of a hazardous substance, and the quantity of hazardous substances involved in any release.

A “release” **does not** include:

- A release that results only in exposure to persons solely within a workplace.
- Engine exhaust from a motor vehicle.
- Release of source, byproduct or special nuclear material from a nuclear incident defined by the Atomic Energy Act.
- Normal application of fertilizer.

3.1.2.2 CERCLA Hazardous Substances

CERCLA defines the term hazardous substance by incorporating by reference specific substances regulated by other environmental statutes, including Resource Conservation and Recovery Act (RCRA), Toxic Substance Control Act (TSCA), CAA, and Clean Water Act (CWA). CERCLA hazardous substances include:

- Toxic pollutants and hazardous substances regulated by the CWA.
- Hazardous air pollutants regulated by the CAA.
- Hazardous waste regulated by RCRA.
- Imminently hazardous chemicals regulated by TSCA.
- Substances designated by the EPA under section 102 of CERCLA.

Hazardous substances commonly found at CERCLA sites include heavy metals, solvents, polycyclic aromatic hydrocarbons (PAHs), dioxin, and PCBs.

There are **exclusions to the list** of CERCLA hazardous substances that must be considered when evaluating a potential release site. Petroleum, natural gas, natural gas liquids, and synthetic gas usable as fuel are not CERCLA hazardous substances.

3.2 Pre-Removal/Pre-Investigation Activities

A site with a potential release is often discovered by agency staff through random observation, periodic SIs and from reports of resource users such as recreationists. Agency personnel usually perform the initial scoping investigation to confirm whether a release has taken place or a threat of a release is present.

3.2.1 Initial Scoping Activities

Initial scoping activities include collecting available information to confirm or refute the presence of a release, determining whether a release of a hazardous substance equals or exceeds the substance's reportable quantity (RQ), and to gather information for planning a proper and safe entry onto the site for removal or cleanup.

The appropriate level of initial scoping depends on the nature of the site. An emergency spill may only require a visual observation to confirm the hazardous substances present; however, an historic site, such as an inactive mine or tailings pile, may require additional investigation. Initial scoping may include review of existing site information, such as use applications, and affidavits of labor; interviews with individuals; and a site visit by trained personnel. Sampling is usually done in the PA/SI phase.

Cost Discussion

Personnel conducting initial scoping activities that involve exposure to a potential release must have at a minimum, hazardous waste operator (HAZWOPER) 24-hour training. Costs associated with initial scoping of pre-removal, pre-investigation activities can include: up to 60 hours of site reconnaissance, file review, interviews and writing a findings report conducted by junior staff and up to 20 hours of review by senior staff.

3.2.2 Health and Safety Plan

Occupational Safety and Health Administration (OSHA) standard 1910.120 requires that a Health and Safety Plan (HASP) be written for any activities involving possible hazardous waste. HASPs are designed to provide safe procedures and practices for personnel engaged in field activities by identifying possible hazards that may exist at the site and the methods used to avoid those hazards.

Typically, a contractor generates a HASP from site and local area information. Much of the information comes from the Work Plan and communication with persons who have direct knowledge about the site and surrounding environment. Although not a deliverable, agency personnel may be required to review the HASP for content and applicability.

A review of the HASP will involve reading the document, editing the content if necessary and forwarding comments to the contractor. The contents of a HASP provide background information about the site including a site history and a site description. It should also contain a Statement of Work (SOW) or list the principal tasks to be accomplished and the key personnel involved.

The main focus of the HASP is to identify potential hazards and risks associated with the site and to outline safety measures to follow to avoid these potential hazards. Potential hazards could include chemical, physical, biological, radiological, environmental, and task specific hazards. Safety measures should include establishing minimum PPE requirements for the specific task to be performed at the site. The PPE requirements must be appropriate for the potential constituents of concern (PCOCs) that may exist at the site. Decontamination procedures for personnel and equipment are outlined in the HASP. The training requirements that each site worker must have prior to entering the site are addressed in the HASP. Also included are the medical surveillance program enforced by the contractor and an Emergency Response and Contingency Plan, which includes medical facilities, and emergency standard operating procedure. For sites where airborne contaminants may pose a health hazard, the HASP includes a section on air monitoring procedures to ensure that adequate respiratory protection is worn by the site workers. The PPE level and decontamination requirements in the HASP will impact the cost estimate for the project.

Although the HASP is developed as an internal document for the contractor, agency personnel participating in the field activity should adopt the HASP for use while on the site. An example of a typical HASP is included on the CD-ROM accompanying this handbook (CEH 12 2002\03 All Documents\102 Sample Documents\HASP).

Cost Discussion

Health and Safety Plans are typically prepared by senior technical level staff with oversight and review by a senior staff member, project manager or program manager. Technical experts in health and safety issues such as Industrial Hygienists or a Health and Safety Officers (HSO) are utilized in preparing the health and safety information. A typical HASP takes approximately 32 hours to prepare. Approximately 95 percent of that time is for writing (health expert), 5 percent for review.

3.2.3 Sampling and Analysis Plan

Sampling investigations are conducted to obtain data necessary to further characterize a site and the extent of contamination. They can be conducted in conjunction with a PA, SI, RPA, EE/CA, and RI/FS. SAPs are produced to propose field work necessary to fill data gaps. Before completion of a sampling plan, site reconnaissance should be performed to verify the current site conditions and the practicality of the proposed sampling strategy.

In addition to a description of sampling locations, a sampling plan needs to state the purpose of the sampling activity, outline the sampling and analysis strategies, describe the procedures for collecting samples and lay out quality assurance methods (which should be delineated in the investigator's Quality Assurance Project Plan [QAPP]). The sampling plan must be delivered to the BLM/FS for review and approval prior to the contractor commencing work.

SAPs should be reviewed for the following basic information:

- An introduction that states the purpose of the sampling activity.
- A site history and site description that includes site location, structures/topography, geology/soil information, surrounding land use and populations, sensitive ecosystems, meteorology, surface water, groundwater, site waste characteristics and any information from previous investigations.
- Sampling and analysis strategies should include the sampling objectives outlining the type of samples to be collected (such as grab or composite), media to be collected, sampling locations, and the number of samples to be collected. It should also list the constituents of concern or target analytes and the test methods proposed to analyze the samples. It is important to review the information in this section for completeness and accuracy (ensure the types and numbers of samples are correct). This is the heart of the SAP.
- Sampling procedures should detail in a step-by-step process the collection of samples. It should also include equipment and personnel decontamination procedures and investigation derived waste management procedures.
- Field QA/QC methods that include QA/QC samples (duplicates and rinsates), field books, records, and sample collection, handling and identification protocols (labels, Chain-of-Custody forms, etc.).
- Laboratory QA/QC methods that include sample receipt, analytical procedures, QA/QC objectives for measurement data, data reduction (changing raw data to proper reporting units), validation, and reporting.

In addition to reviewing SAPs for the basic information listed above, the reviewer needs to ensure that site and/or investigation specific information is appropriate for the sampling conditions and that all sampling issues have been addressed. For example, as part of an investigation of a mine site, air sampling is required in a fire restricted area. A gas-powered generator, which is restricted from the area, is needed to collect the air samples. The sampling team is required to provide around-the-clock fire prevention surveillance in order to use the generator. The sampling plan for this investigation would require an additional section detailing fire protection measures and procedures that would take place during the air sampling. The reviewer should confirm that the fire protection measures would be adequate and appropriate for the location and conditions of the site.

Cost Discussion

SAPs are typically generated by junior- to mid-level support staff with oversight and review by a more senior staff member, project manager, or program manager. A broad range of technical disciplines can be utilized in the completion of the sampling plan. It is not uncommon for engineers, geologists, environmental scientists, chemists, biologists, geographers, etc. to be involved. A SAP can require between 45 to 90 hours to prepare depending on the complexity of the sampling investigation. Approximately 5 percent of that time is used by the senior level manager for review; the remaining hours are used by the junior to mid-level staff.

Reference

Safety and Health Management, BLM Handbook H-1112-1.

Safety and Health for Field Operations, BLM Handbook H-1112-2.

A sample SAP is included on the CD-ROM accompanying this handbook (CEH 12 2002\03 All Documents\102 Sample Documents\SAP).

3.3 Removal Actions

Removal actions are relatively short-term responses taken to prevent, minimize, or mitigate risks to public health, welfare, or the environment that might otherwise result from a release or threatened release. Typical removal activities include the removal of leaking drums or other containers, restricting public access to a site, engineering controls to contain contamination and excavation of contaminated soils.

Removal actions are used to eliminate the source of contamination from a site or effectively contain it on-site so that continuing releases of contaminants are prevented or reduced to acceptable levels. **Removal actions may be implemented in any phase of the site assessment process.** They may occur following a visual inspection of the site, or following a more detailed collection of site data through a Removal PA or Removal SI. Guidelines for conducting hazardous waste removal actions are provided in the NCP (40 CFR 300.410 through 300.415). Removal actions should be cost effective and should attain and meet Federal and State applicable or relevant and appropriate requirements (ARARs). If the situation is immediately dangerous to human health and/or the environment, requiring an immediate removal action, the method selected need not achieve the above standards.

In general there are three types of removal actions:

- Emergency Removal Actions
- Time Critical Removal Actions
- Non-Time Critical Removal Actions

Removal PA/SIs (RPA, RSI) are the evaluations used to determine if a removal action is necessary on a recently discovered site. The formats and procedures developed were specifically intended to guide the removal decision process, and not intended to cover the planning or design of removal actions (such as an EE/CA).

In the removal process, the PA and SI are conducted to determine the need for removal and then an EE/CA is performed to both characterize the site and evaluate the removal options. Similarly, if remedial action is necessary, the Remedial Investigation is conducted to characterize the site, and the Feasibility Study is done to evaluate and document the choice of remedial alternatives.

A PA is a process by which readily available existing records, information, and other data concerning site conditions are reviewed to evaluate the potential risks presented by the release site. Sometimes a PA is followed by an SI. An SI may be performed when it is necessary to obtain additional information in order to characterize site conditions and evaluate whether further response is appropriate. An SI does not need to be completed in every instance; it is appropriate when additional data are needed to make a determination regarding the need for a response action. An SI may be conducted through on-site investigations, sampling of environmental media or the contents of containers, receptacles and sumps at the site. Before conducting any sampling a site specific HASP and a SAP must be prepared (see Sections 3.2.2, and 3.2.3 respectively, above). Once the PA or PA/SI is completed the result should be documented and presented in a report which summarizes the results of the review of data.

3.3.1 Removal Preliminary Assessment

Upon discovery of site conditions that appear to require immediate action to mitigate a present threat, or avoid a more serious future problem, a removal PA may be conducted to ascertain the need for immediate action. Some examples of conditions that may warrant a removal include co-disposal of incompatible hazardous wastes, unrestricted public access to contaminated areas, and waste sources with leaking or otherwise ineffective containment. A removal PA is based on readily available information and may include, but is not limited to, the following:

- Identification of the source and nature of the release or threat of release.
- Evaluation by Federal or State public health agencies of the threat to public health.
- Evaluation of the magnitude of the potential threat.
- Evaluation of factors necessary to make a determination of whether a removal is necessary.
- Determination of whether a non-federal party is undertaking an adequate response.
- Collection and review of data such as:
  - Site management practices
  - Generator information
  - Photographs, and current and historical aerial imagery
  - Literature searches
  - Personal interviews

3.3.2 Removal Site Inspection

A removal site inspection (RSI) is performed if additional information is needed. This inspection may include a perimeter (off-site) survey or an on-site inspection if such an inspection can be performed safely. Environmental and waste media samples may also be collected for laboratory analysis. Section 300.410 of the NCP identifies the conditions under which a removal site evaluation may be terminated. Following a removal PA and, if warranted, a removal SI, the agency conducting the investigation must document all findings, conclusions, and recommendations in a written report.

The report should contain the following elements:

- Identification of the source and nature of the release or threatened release, including any specific hazardous substances present.
- Evaluation of the threat posed to human health, welfare, and ecological resources.
- Evaluation of whether any removal or remedial action should be taken.
- Conclude one of the following: removal action is appropriate, remedial action is appropriate, or no further response action is necessary.

Cost Discussion

According to the EPA Guidance a typical PA requires an average of 120 hours to complete. Depending on site complexity, size, location, and the need for a defensible recommendation regarding site disposition, additional hours may be required. Conversely, fewer hours may be necessary for relatively straightforward sites that clearly warrant no further investigation, sites with extensive existing file information, and sites ineligible for CERCLA remedial action.

PA Activity	Typical Range of Hours
Collect information	60 to 80 hours
Reconnaissance	10 to 20 hours
Scoring	5 to 15 hours
Reporting	20 to 30 hours
Average Total	**120 hours**

The EPA Guidance contains an estimate of 400 hours to complete "focused" SI tasks, and 620 hours to complete "expanded" SI tasks. Please note that an expanded SI is performed **AFTER** a focused SI is completed.

The EPA Guidance contains an example SI Sample Plan that depicts a cost summary to perform the SI. EPA estimates in the example that it will require 440 hours to complete the SI and an additional $25,200 (1992 dollars) for lab analysis of samples gathered.

Reference

Environmental Pollution, Prevention, Control and Abatement Manual, USDA DM 5600-001. http://www.usda.gov:80/ocio/directives/DM/DM5600-001.htm

Guidance for Performing Preliminary Assessments Under CERCLA, EPA, September 1991, (NTIS PB92-963303, EPA 9345.0-01A) and the electronic scoring program PA-Score provide more information on conducting PAs. Both the PA Guidance and the PA Score software are provided on the CD-ROM accompanying this handbook (CEH 12 2002\03 All Documents\103 Reference Materials\PA Guidance and CEH 12 2002\03 All Documents\103 Reference Materials\PA Score).

A sample RPA SOW is included on the CD-ROM accompanying this handbook (CEH 12 2002\03 All Documents\102 Sample Documents\RPA SOW).

Guidance for Performing Site Inspections Under CERCLA; Interim Final, EPA, September 1992, (NTIS PB92-963375, EPA 9345.1-05) provides more information on conducting SIs. The SI Guidance is included on the CD-ROM (CEH 12 2002\03 All Documents\103 Reference Materials\SI Guidance).

A sample RSI SOW is included on the CD-ROM accompanying this handbook (CEH 12 2002\03 All Documents\102 Sample Documents\RSI SOW).

CERCLA Handbook, Hazardous Waste Program SOPs, National Park Service, 1998.

CERCLA Response Actions Handbook, BLM Manual H-1703-1

3.3.3 Engineering Evaluation/Cost Analysis

An EE/CA is written for a non-time-critical removal and its purpose is to evaluate removal action options in terms of how each option addresses risks of human and environmental exposure, and migration of hazardous substances at the site. Each option is evaluated in terms of effectiveness in addressing risks, implementability, and cost. In general, an EE/CA does not need to be as elaborate or detailed as a comprehensive Feasibility Study. The information in this handbook can assist in developing the cost estimates required by the EE/CA.

In addition, the decision for conducting a removal is based on a determination that a threat exists, while the decision to perform remedial action is based on the comparatively rigid Hazard Ranking System (HRS) score.

Cost Discussion

Removal actions should be performed by contractors experienced in handling hazardous substances. In addition, the removal action must satisfy the NCP requirements in 40 CFR section 300.415. EE/CAs can range in cost from approximately $35,000 to $250,000 depending on the project, and may go as high as $2 million. Costs will vary depending on the size, severity, and complexity of the site.

Reference

Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA, (OSWER Directive 9360-32, August 1993, NTIS#PB 93-963402). The EE/CA Guidance is included on the CD-ROM accompanying this handbook (CEH 12 2002\03 All Documents\103 Reference Materials\EPA Guidance on Removal Actions).

A sample EE/CA SOW is included on the CD-ROM accompanying this handbook (CEH 12 2002\03 All Documents\102 Sample Documents\EE/CA SOW).

3.4 HRS Scoring

The HRS is the scoring system used by EPA's Superfund program to assess the relative threat associated with actual or potential releases of hazardous substances. Information collected during the PA and SI is used to calculate an HRS score. Sites with an HRS score of 28.50 or greater are eligible for listing on the NPL and require the preparation of an HRS scoring package.

The HRS uses a structured analysis approach to scoring sites. This approach assigns numerical values to factors that relate to risk based on conditions at the site. The factors are grouped into three categories:

- Likelihood that a site has released or has the potential to release hazardous substances into the environment.
- Characteristics of the waste (e.g. toxicity and waste quantity).
- People or sensitive environments (targets) affected by the release.

Four pathways can be scored under the HRS:

- Groundwater migration (drinking water).
- Surface water migration (drinking water, human food chain, sensitive environments).
- Soil exposure (resident population, nearby population, sensitive environments).
- Air migration (population, sensitive environments).

After scores are calculated for one or more pathways, they are combined using a root-mean-square equation to determine the overall site score.

The electronic scoring system, PREScore, can be used to do the scoring calculations. If all pathway scores are low, the site score is low. However, the site score can be relatively high even if only one pathway score is high. This is an important requirement for HRS scoring, because some extremely dangerous sites pose threats through only one pathway.

Cost Discussion

Once the data is collected, developing an estimated HRS using the EPA PREScore system should entail minimal costs. Junior-level staff may be able to complete the score sheet, with oversight and review by senior level staff.

Reference

The Hazard Ranking System Guidance Manual; Interim Final, November 1992, (NTIS PB92-963377, EPA 9345.1-07) and the December 14, 1990 *Federal Register*, Hazard Ranking System; Final Rule (55 FR 51532). HRS training is available on a limited basis.

PREScore Version 4.1, which runs on a DOS platform, and is included on the CD-ROM accompanying this handbook (CEH 12 2002\03 All Documents\103 Reference Materials\PRE Score).
PREScore website: http://www.epa.gov/superfund/resources/prescore/index.htm

3.5 Potentially Responsible Party Process

A potentially responsible party (PRP) search is a structured mechanism for identifying the parties associated with a site over time, and obtaining information about the site's environmental and operational history. Once parties are identified, their relationship to the site and the hazardous substances released on the site can be determined. This information forms the basis for seeking recovery of agency response costs and cost sharing for remediation process.

The process of identifying PRPs entails gathering relevant facts concerning the hazardous substance release or threat of release at the site, and analyzing those facts in light of the PRP categories established by CERCLA. The development of an accurate site history will identify parties that have been associated with the site over time, and establish the time frame during which hazardous substances were used, generated, or disposed of at the site.

The typical tasks comprising a baseline PRP search are:

- Record collection and review.
- Title search/ownership history.
- Interviews.
- Site operation history.
- Corporate and financial status research.

The BLM and Forest Service policies are to exercise fully their delegated CERCLA authorities to ensure that PRPs undertake response action, or reimburse the agency for response costs incurred to cleanup hazardous substance releases affecting agency lands or resources for which the PRP is liable. This policy is in accordance with Departmental Manual requirements.

3.5.1 What is a Potentially Responsible Party?

Under CERCLA, a PRP is a person or entity that was a significant contributor to the hazardous substance problem being remediated. The law provides that such parties can be held responsible for the remediation action or the cost of the remediation conducted by the government. BLM and the FS have been given authority under CERCLA to pursue PRPs and recover the costs expended by the agency or require the PRP to conduct the remediation. BLM and the FS are actively pursuing this option where AML problems fall under CERCLA. A PRP can be anyone of the following:

- Current owner or operator - a person that currently owns the land or operates the facility where the hazardous substances are located (regardless of whether mining activity has occurred during the current owner or operator's involvement at the site).
- Past owner or operator - a person who owned or operated the land or facility at the time hazardous substances were disposed of at the site (requires proof that disposal occurred during the person's ownership or operation).
- Generator - a person that "arranged for" the disposal or treatment of the hazardous substances at the site (commonly known as the "generator" of the hazardous substances).
- Transporter - a person that transported the hazardous substances to the site.

Any person that qualifies as a PRP (as defined above) may be held liable for some portion of, or all of the costs incurred by BLM, the Department of the Interior (DOI), Forest Service, USDA or other entities of the United States Government, a State, or Indian tribes for cleaning up the site. These costs include all monies spent for site investigations, sampling, engineering evaluations, pilot studies, alternative remedy analyses, contractor costs, labor costs, enforcement costs, and other activities (not inconsistent with the process outlined in the NCP) undertaken to address the release site.

3.5.2 Why do Potentially Responsible Party Searches?

In order to implement the DOI/BLM and USDA/Forest Service policies of identifying viable PRPs to cleanup the contamination of public lands or facilities, and/or to recover the costs of a cleanup, it is necessary to conduct a PRP search. DOI/BLM policy on providing funding for a site cleanup requires the completion of a PRP search which will identify a viable PRP, or will find no viable PRP for the site. There are several situations in which the identification of PRPs is very important:

- Where the agency faces significant expenditures for response costs at a site and the identification of PRPs would allow the agency to bring other parties into the cleanup process.
- Where the agency has already incurred cleanup costs, the agency may recover costs from a PRP through cost recovery actions.
- Where the agency faces liability at a site not operated or managed by the agency, identification of PRPs may be important in minimizing the agency's contribution.
- Where the agency administered lands have incurred natural resource damages as a result of the hazardous substances.

3.5.3 Levels of Potentially Responsible Party Searches

A PRP search can be a screening tool to determine whether there are any viable parties associated with the site, a baseline search that is focused on discerning the financial viability of identified parties or a comprehensive and detailed investigation ("full-blown" PRP search).

The type of PRP search performed should be based on the nature of the site contamination, the extent of contamination, anticipated expenses and length of time to respond to the release, and the likelihood of identifying other PRPs. Under most circumstances, a baseline PRP search is appropriate to identify a preliminary list of PRPs and their respective financial status. A more comprehensive follow-up investigation may then be warranted if additional information is needed to establish a party as a PRP, or to identify other PRPs.

3.5.3.1 Screening (Evaluation) Search

The objectives of a Screening Search are to identify the PRPs, to compile data that documents a party as a PRP, and to identify any data gaps. A Screening Search should be conducted if you plan to request funding from the Central HazMat Fund (CHF) administered by DOI, or if you plan to "move dirt" (spend BLM funds).

In planning a Screening Search, agency personnel must develop a plan which summarizes the activities to be conducted, identifies the roles and responsibilities of the individuals involved, identifies time frames for the work, and develops a system for managing the data collected.

Begin your search early, as soon as a project is funded. Most of the tasks for a screening search can be completed by agency personnel. If the site is large and had numerous operators, you may want to hire a contractor. However, for most sites, the initial phase can be completed by agency personnel. For a more exhaustive discussion of any of these tasks, refer to the reference material at the end of this guide. Since PRP searches are site specific, there is no one method or single format that fits all sites. It is helpful to use personal contacts and data from other sites that may apply to the site you are working on.

Cost Discussion

Agency personnel will conduct most Screening Searches. However, if a contractor is needed to conduct a Screening Search because of conflicting work priorities, the requesting office will be responsible for the funding, which may range from $2,000 to $3,500 per site. The Screening (Evaluation) Search is performed by junior staff with oversight by senior staff and usually requires 45 to 60 hours to complete.

3.5.3.2 Baseline Search

A Baseline Search may be conducted, if necessary, after the Screening Search has been completed and the results indicate the possibility of a PRP which will require a greater effort to locate. This type of search is often accomplished by a contractor in cooperation with the appropriate Solicitor's Office or the Office of the Regional Counsel.

If the decision is made to hire a contractor to do a more thorough Baseline Search based on the results of the Screening (Evaluation) Search, clearly identify data needs and prepare a specific SOW. It is very critical to work closely with the contractor during the entire contracted search process. Provide the contractor with all of the information that has been collected to date to prevent duplication of efforts. If the site is large or very complex with a history of many PRPs, a Baseline Search may be needed.

Regardless of which PRP search is followed, the final decision on the data collected and the findings report must be sent to the appropriate Solicitor's Office or the Office of the Regional Counsel for concurrence.

Cost Discussion

Baseline Searches cost between $12,500 and $25,000, and are usually performed by junior research staff with oversight and review by senior staff. These searches can require anywhere from 180 hours to well over 300 hours to complete. It is very important to develop an estimated site cleanup cost for the site before doing a Baseline Search to ensure that the cost of cleanup justifies the expenditure of funds on the Baseline Search.

Reference

Potentially Responsible Party Searches, DOI, February 25, 1994, 75 pp.

Procedure to Obtain Potentially Responsible Party Cleanup of Acid Mine Drainage or Other Hazardous Substances/Wastes at Mine Sites on BLM Lands September 27, 1996, NARSC

Hazardous Substance Releases, CERCLA/NCP Process (Draft), NARSC

Forest Service PRP Search Manual (Draft), USDA Forest Service

Cost Recovery, BLM Handbook H-1270-2

EPA Office of Solid Waste and Emergency Response (OSWER) Directive 9834.6, August 1987
BLM website http://www.blm.gov/narsc/aml/refmenuset.htm

BLM Contacts for PRP Training or Consultation:

Janet Youngdahl, BLM -NARSC, (303) 236-6282
Casey Padgett, DOI, Office of the Solicitor, (303) 231-5353 ext. 223

3.6 Remedial Actions

Remedial action includes any action consistent with permanent remedy taken instead of, or in addition to, removal action. Remedial action is generally a longer, more complex response action than removal action, and often requires millions of dollars and several years to complete. Remedial action sites often have multimedia contamination involving a combination of soil, surface water, and groundwater contamination. Sites, which may encompass several acres or square miles, are often broken down into smaller components called “operable units.” The cleanup requirements of each operable unit may differ and, accordingly, different remedial actions will be selected for each operable unit. Removal actions usually can be completed at less expense and less time than remedial actions.

A RI/FS is similar to, but more extensive than, an EE/CA conducted for a non-time critical removal action. An RI/FS is conducted when there is a determination that a remedial action is necessary to address fully the risks posed by a release.

The RI/FS develops data in order to assess site conditions, identify remedial action alternatives, and evaluate such alternatives through a detailed, comparative analysis. In general, RI/FS is only conducted when it is determined that a removal action is not appropriate to address site conditions.

3.6.1 Remedial Investigation/Feasability Study

When appropriate (such as after a site is listed on the NPL), a RI/FS is performed. The remedial investigation serves as the mechanism for collecting data to:

- Characterize site conditions.

- Determine the nature of the waste.
- Assess risk to human health and the environment.
- Conduct treatability testing to evaluate the potential performance and cost of the treatment technologies that are being considered.

The Feasibility Study is the mechanism for the development, screening, and detailed evaluation of alternative remedial actions.

The Remedial Investigation and Feasibility Study are conducted concurrently — data collected in the Remedial Investigation influence the development of remedial alternatives in the Feasibility Study, which in turn affect the data needs and scope of treatability studies and additional field investigations. This phased approach encourages the continual scoping of the site characterization effort, which minimizes the collection of unnecessary data and maximizes data quality.

The RI/FS process includes these phases:

- Scoping.
- Site Characterization.
- Development and Screening of Alternatives.
- Treatability Investigations.
- Detailed Analysis.

Fieldwork support activities that may need to be performed prior to initiating field work include:

- Assuring access to the site is possible, including obtaining access across non-federal lands, if needed.
- Assuring that the contractor has procured subcontractors, equipment and coordinated with analytical laboratories.
- Assuring onsite facilities for office and laboratory space decontamination equipment and vehicle.

Cost Discussion

RI/FS costs are site specific; however, the typical types of staff that are required to successfully complete the necessary studies are: engineers, geologists, and environmental scientists, with assistance from specialists, such as aerial photography analysts, and groundwater modelers.

Reference

Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA; Interim Final, EPA, October 1988, (NTIS PB89-184626, EPA 9355.3-01).

3.6.2 Remedial Design

Remedial Design (RD) is the phase in a site cleanup where the technical specifications for cleanup remedies and technologies are designed. Remedial Action (RA) follows the RD phase and involves the actual construction or implementation phase of site cleanup. The RD/RA is based on the specifications described in the Record of Decision (ROD).

Cost Discussion

The costs associated with the RD phase of site cleanup is site specific and is highly variable. The types of staff that are usually involved with developing RD for sites are engineers and geologists with an equal balance between junior and senior staff.

3.6.3 Record of Decision

The ROD is the official instrument by which the agency documents its decision and includes background information on the site, a description of the chosen remedy and why it was selected.

Cost Discussion

In addition to the cost of compiling the actual ROD, other associated costs are the publication of notices that the ROD is available for public review prior to initiating remedial action.

3.6.4 Operation and Maintenance Activities

O&M activities protect the integrity of the selected remedy for a site. O&M measures are initiated after the remedy has achieved the remedial action objectives and remediation goals outlined in the ROD, and is determined to be operational and functional (O&F) based on State and Federal agreement. For EPA/NPL lead sites, remedies are considered O&F either one year after construction is complete or when the remedy is functioning properly and performing as designed — whichever is earlier. Remedies requiring O&M measures include landfill caps, gas collection systems, groundwater extraction treatment, groundwater monitoring, or surface water treatment.

Once the O&M period begins, the State or PRP is responsible for maintaining the effectiveness of the remedy. O&M monitoring includes four components:

- Inspection
- Sampling and analysis
- Routine maintenance
- Reporting

O&M activities are usually required for sites where cleanup proceeded through landfill/capping activities, groundwater activities, or through natural attenuation.

Cost Discussion

Costs for O&M activities vary greatly and are site specific. When estimating O&M costs it is important to take into consideration that certain costs may escalate over time due to inflation, and that other costs may be only occasional — such as periodic sampling or equipment maintenance or replacement.

3.7 Community Relations

The objective of community relations, community involvement or public participation is to inform and involve the public in activities and decisions related to the cleanup of hazardous waste sites. This two-way communication provides useful information to the community, ensures that the lead agency addresses community issues in a timely manner, and ensures that community concerns are considered when decisions are made regarding a site. Failure to involve the community may cause the public to mistrust the agency, to question an agency's actions and the secrecy of those actions. This almost always results in lengthy and costly delays late in the process.

The following sections list the minimum community relations requirements and suggested activities for public participation at hazardous waste sites. Following the outlined activities there is a discussion of the associated technical level of effort (LOE) and costs. Section 3.7.1 discusses the community relations requirements under Federal programs. Section 3.7.2 discusses additional Federal policies or guidance. Section 3.7.3 discusses State requirements, and Section 3.7.4 provides an estimate of the LOE and costs associated with each required activity. The CD-ROM accompanying this handbook contains an example of a Community Relations Plan (CRP) (CEH 12 2002\02 All Documents\102 Sample Documents\ Community Relations Plan) developed for sites that involves multiple Federal agencies and a private party. Interacting with the media is generally considered to be separate from community relations and is not considered here.

3.7.1 Community Relations Requirements at Hazardous Waste Sites

The community relations requirements may differ depending on the type of site and regulating agency involved. Community relations at hazardous waste sites are primarily governed by CERCLA, Superfund Amendments and Reauthorization Act (SARA), the NCP, Federal policies and an individual State's Superfund regulations.

RCRA, Safe Drinking Water Act (SDWA), CWA - The Federal Facilities Compliance Act (FFCA) amended RCRA in 1992 to waive Federal facilities' sovereign immunity and ensure that Federal facilities are subject to the requirements of RCRA to the same extent as private parties. However, a review of the public participation requirements under RCRA, the SDWA and the CWA indicates that these laws will apply only to facilities that are operated by BLM or FS and are either RCRA permitted or are applying for a RCRA permit for the treatment, storage or disposal of hazardous wastes. Similarly, community relations requirements for oil and mineral development are not considered since these are not activities which a BLM or FS Hazardous Materials Coordinator is expected to face.

CERCLA, SARA and the NCP - Several community relations activities are required under the NCP for Removal Actions and for Remedial Activities, regardless of whether the site is EPA, State or Federal Facility-Lead. It is EPA's policy that these community relations requirements are the minimum requirements and serve as the foundation for more comprehensive and effective activities. According to EPA's *Community Relations Handbook*, "The requirements have been kept to a minimum to allow for a flexible community relations approach that can take into account the needs of different communities."

Requirements for All Removal Actions - Designate an agency spokesperson to inform the public about the release and actions taken, respond to questions, and immediately notify affected citizens, state and local officials, and emergency management agencies. Establish an Administrative Record available to the public at a central location and at a location near the site.

Requirements for Removal Actions with Planning Periods Less Than 6 Months - Within 60 days of the start of on-site removal activity, make the Administrative Record available to the public and issue a notice of availability in a major local newspaper. Provide a public comment period within 30 days of making the Administrative Record available to the public. The agency must prepare a written response to significant comments regarding the removal action.

Requirements for Removal Actions Expected to Extend Beyond 120 Days - Within 120 days of the start of on-site removal activity, conduct interviews with local officials, public interest groups, or other interested parties to determine their concerns and information needs, and to learn how citizens would like to be involved in the Superfund process. By the end of the 120-day period, prepare a formal CRP based on community interviews and other information that specifies the community relations activities the agency plans to undertake. Within 120 days of the start of on-site removal activity, establish at least one Information Repository at or near the site and inform the public of its availability.

Requirements for Removal Actions with a Planning Period of at Least Six Months - Complete a CRP prior to completion of the EE/CA. Establish the Information Repository and Administrative Record no later than the signing of the EE/CA approval memorandum. Publish a notice of availability and a brief description of the EE/CA in a major local newspaper. Upon completion of the EE/CA, provide a public comment period of at least 30 days. The agency must extend this comment period by at least 15 days upon timely request. The agency must prepare a written response to significant comments and make this responsiveness summary available to the public in the Information Repository.

Requirements for Remedial Responses Prior to the Remedial Investigation - Conduct community interviews. Complete the CRP before Remedial Investigation field activities start. Establish an

Information Repository and inform the public of its availability. Inform the public of the availability of Technical Assistance Grants (TAGs) (for NPL sites) and the application process.

Requirements after Completion of the Remedial Investigation - Establish an Administrative Record and inform the public of its availability.

Requirements after Completion of the Feasibility Study and Proposed Plan - Publish in a major local newspaper a notice of the availability of the RI/FS and proposed plan, including a brief summary of the proposed plan and the public comment period. Provide a public comment period on the RI/FS of at least 30 days. The agency must extend this comment period by at least 30 days upon timely request. Hold a public meeting at or near the site at the beginning of the comment period. Prepare a transcript of the public meeting and make it available to the public. The agency must prepare a written response to significant comments, criticisms and new data submitted on the proposed plan and RI/FS and include this responsiveness summary with the ROD.

Requirements for Pre-ROD Significant Changes - If such changes could be reasonably anticipated by the public, the agency must include in the ROD a discussion of significant changes and the reasons for such changes. If the public could not have reasonably anticipated such changes, the agency must issue a revised proposed plan that includes a discussion of the significant changes and the reasons for such changes. The agency must also seek additional public comment on the revised proposed plan.

Requirements After the ROD Is Signed - The agency must publish in a major, local newspaper a notice of the ROD's availability, including the basis and purpose of the selected remedy. The ROD must also be made available at or near the site prior to any remedial action. Prior to the RD, the agency should revise the CRP to reflect community issues pertaining to the RD and construction phase.

Requirements for Post-ROD Significant Changes - When the remedial action or the consent decree differs significantly from the remedy selected in the ROD with respect to scope, performance or cost, the agency must publish in a major local newspaper a notice that summarizes the explanation of significant differences and the reasons for such differences. The agency must also make the explanation of significant differences and supporting information available to the public in the Administrative Record and Information Repository. When the remedial action or the consent decree fundamentally alters the basic features of the selected remedy with respect to scope, performance or cost, the agency must propose an amendment to the ROD and publish in a major local newspaper a notice of availability and a description of the proposed amendment. The agency must follow the same procedures as that required for completion of the Feasibility Study and proposed plan.

Requirements for RD - Upon completion of the final engineering design, the agency must issue a fact sheet and provide a public briefing prior to beginning remedial action.

3.7.2 Additional Federal Policies and Guidance

In April 1992, EPA established the Federal Facilities Environmental Restoration (FFER) Dialogue Committee as an advisory committee under the Federal Advisory Committee Act. (The Committee has sometimes been referred to as the Keystone Group.) The Committee includes 40 representatives of Federal agencies (including the Department of Interior), tribal and state governments and associations, and local and national environmental, community and labor organizations. The phrase "Federal Facility Environmental Restoration" refers to the cleanup of contaminated sites at currently and previously used or owned Federal facilities that are conducted under CERCLA, RCRA, Federal Facility Agreements, and other State and Federal regulatory requirements.

The FFER Dialogue Committee was established to develop recommendations for improving the FFER decision-making process and to ensure that cleanup decisions reflect the priorities and concerns of all stakeholders. In February 1993, the Committee issued an interim report which included recommendations for improving public participation and stakeholder involvement in key FFER decisions. The Committee recommended the creation and use of site-specific advisory boards (SSABs). The role of the SSABs is to share information and actively involve representatives of the local community and others in the cleanup decision-making process. SSABs complement, but do not replace, other community relations activities. The Committee recommended that the agency support the SSAB by providing administrative support.

3.7.3 State Community Relations Requirements

In addition to Federal requirements and guidance, many states have enacted their own Superfund legislation. These laws generally apply to Removal Actions or Remedial Actions at hazardous waste sites not on the NPL. As stated previously, the Federal Facilities Compliance Act requires the facility to comply with applicable state regulations regarding hazardous waste sites. These laws generally require some form of community relations.

For the purposes of this handbook, the community relations requirements for hazardous waste sites in California have been selected to serve as a model. California's Public Participation Policy and Procedures Manual is currently undergoing final legal review. Any changes in the final document will be reflected in the final version of this handbook. The California EPA, Department of Toxic Substances Control (DTSC), requires that public participation activities be conducted during Removal Actions and during each phase of the site mitigation process. The California Environmental Quality Act (CEQA) also seeks to identify the potential environmental impacts of proposed site mitigation and hazardous waste management activities, and weigh these against the social and environmental benefits of the proposed action. CEQA then seeks to eliminate, mitigate or off-set identified negative environmental impacts by either altering or eliminating certain proposed activities. The DTSC has primary responsibility for CEQA compliance at hazardous waste sites, but may request agency support.

It is unlikely that the community relations requirements for other states will be more stringent and are probably less than that of California. In all cases, the agency Project Manager should consult with the state agency to determine the applicable state requirements.

Requirements during PA - Develop a Community Profile. No PA report can be approved without a Community Profile.

Requirements for Removal Actions and Interim Remedial Actions - Develop a Community Profile which evaluates whether public involvement activities are warranted at a given time and to identify sites with high community interest or concerns. Develop a site mailing list. Prepare fact sheets discussing the proposed actions. Provide public notice of the impending action and a public comment period. The state may require these additional activities, if determined to be necessary: Prepare a CRP. Hold a community meeting. Hold small group meetings.

Requirements during RI/FS - Conduct community interviews. Prepare CRP prior to any on-site work. Prepare a "Kick-off" fact sheet. Hold an initial community meeting. Establish Information Repositories. Develop mailing lists.

Requirements at Time of Draft Remedial Action Plan (RAP) - Notify local and affected agencies of the RAP. Provide public notice of the availability of the draft RAP and the CEQA requirements in a newspaper of general circulation. Hold a 30-day minimum public comment period. Prepare and distribute a fact sheet. Post notices at the site location. Notify by direct mailing the owners of property adjacent to the site, and local and affected agencies. Hold at least one public meeting to discuss and receive public comments on the draft RAP.

Requirements at Final RAP - Prepare written response to comments. Reevaluate the need for further public participation. If necessary, update the Community Relations Plan.

Requirements at Design and Implementation - Notify persons on project mailing list prior to construction activities. Issue fact sheets. Hold a community meeting. Initiate other activities to inform the community of progress at the site. Send final letter at completion of remediation or certification, describing the final remediation and any ongoing operations or maintenance.

3.7.4 LOE and Cost Estimates

Community relations requires manpower and resources to meet the required and suggested activities outlined above. The technical LOE, the expected staff hours and material costs associated with specific tasks are listed below. See the professional services section for personnel salary ranges (**Section 5.1**). Many of these efforts could be done in-house by existing agency staff.

3.7.4.1 Public Meetings

The following are activities and costs typically associated with planning and holding a public meeting:

- Publicize Public Meetings. Prepare and distribute flyers, mail meeting announcements to general public and local officials; a news release and/or advertisement may also be used; Junior-level staff member. 2 staff days and $1,000 material/postage costs.

- Room Rental Charge. Public meetings are typically held in public buildings such as a school or library. Rental charges in public buildings are usually $100 or less per meeting. Private meeting facilities can be considerably more.

- Plan public meetings, briefings for local officials, Technical Review Committees or SSABs. Prepare signs, fact sheets and other handouts, meeting graphics, slides or overhead transparencies, rehearse presentation. Mid-level staff familiar with the site. 3 staff days and $500 to $1,000 material costs.

- Meeting Transcript. Costs typically include an attendance fee ($35 per hour) and a transcription fee ($3 per page). A travel fee may be required if a local Court Reporter is not available. A three-hour meeting will produce a 100 page transcript. Total cost is $500.

3.7.4.2 Community Relations Plan Activities

The following activities and costs are typically associated with preparing a CRP:

- Prepare Community Profile. Junior level staff member. 5 staff days.

- Conduct Community Interviews. The number of interviews varies depending on the size of the site and the community, but should not be less than 12. Mid- to senior-level staff member. 4 staff days.

- Compile Mailing List. Junior-level staff member. 3 staff days.

- Prepare Community Relations Plan (includes interviews). Mid- to senior-level staff member. 15 staff days.

- Revise Community Relations Plan. Mid- to senior-level staff member. 7 staff days.

3.7.4.3 Making Information Available

The Contract Laboratory Program (CLP) will identify appropriate methods to make site investigation and cleanup information available to the community. Expected activities include:

- Designate Agency Spokesperson. Senior staff member, project manager or program manager. Staff time is variable.

- Publish Notice in Local Newspaper. Notices are display ads, not classified legal notices. A typical notice will require a one-quarter page ad. Ad rates can vary widely, from $10,000 for a major city daily to $500 for a small town daily. Junior-level staff member with senior level oversight. ½ staff day.

- Establish and Maintain Information Repository and Administrative Record. Staff time and costs are variable. Requires an inventory and one copy of most documents. Mid-level to senior-level staff member with legal review. 10 days staff time initially plus one day per month to maintain. Initial material (photo copies) costs $1,000.

3.7.4.4 Prepare Written Materials

Additional methods of providing information to the community may include any or all of the following:

- Respond to Significant Comments and Prepare Responsiveness Summary. Senior staff member, project manager or program manager. Staff time is variable.

- Issue Proposed Plan. Summarize proposed plan. Senior staff member, project manager or program manager. Staff time 5 days.

- Prepare Fact Sheets. Junior-to mid-level staff member familiar with site. Staff time 7 days. Material/postage costs $1,000.

Reference

A sample CRP is included on the CD-ROM accompanying this handbook (CEH 12 2002\03 All Documents\102 Sample Documents\Community Relations Plan).
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Community Relations during Enforcement Activities and Development of the Administrative Record, EPA Guidance, OSWER Directive.

Community Relations in Superfund: A Handbook, EPA-OSWER, EPA/540/R-92/009, January 1992.

3.8 Environmental Site Assessment

All acquisitions or transfers of real property, whether discretionary or nondiscretionary require an ESA prior to acquisition or transfer. The purpose of an ESA is to assess the risks of liability for hazardous substances or other environmental cleanup costs and damages associated with property prior to its acquisition or transfer by the agency.

There are five levels to the ESA process. The appropriate level at which to initiate the process will vary depending on circumstances. Each level has specific criteria for completion and may require differing types of expertise to complete successfully. In addition, the size, location, and past use of the site may affect the types of expertise needed to complete the ESA. The five levels are as follows:

1. Preliminary Analysis
2. Initial Assessment
3. Phase I ESA
4. Phase II Site Investigation
5. Phase III Cleanup

The typical Phase I ESA has four components: records review; site reconnaissance; interviews; and a report. The first three tasks are intended to be used in conjunction with each other in order to develop the report. Ordinarily a Phase I ESA does not include sampling.

A Phase I ESA accomplishes the following:

- Evaluates the potential environmental liability associated with acquisition.
- Requires the line manager to consider the potential liability in making an acquisition decision.
- Estimates the cost of remediation and assures that appropriated funds are not used without required approvals.
- Provides documentation to enable the agency to assert an innocent landowner defense.
- Provides information to agency management on risks and liability associated with proposed acquisitions.

Cost Discussion

An ESA is usually conducted by junior staff with oversight and review by senior level professionals. A "typical" Phase I ESA can take 120 hours of junior-level staff and 60 hours of senior-level staff. For example, a small administrative facility comprising 20 acres or less and four or fewer buildings can be completed in the aforementioned time frame.

The Phase II ESA is conducted to assess the potential presence of hazardous substances. Typically, the Phase II EAS includes a review of the Phase I, and based on the findings, the development of a tailored Sampling and Analytical Plan, field sampling and preparation of the Phase II report. The cost and LOE required for a Phase II ESA is variable and dependent on the size and complexity of the site, hazardous materials that may be present, and level of professional expertise required to assess potential problems

Phase II cleanup involves preparing remedial plans and cost estimates. Again, costs depend on the size and complexity of the site, nature and extent of contamination and design of the remedial action.

Reference

BLM Departmental Manual (DM) 602.

Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process; ASTM document E 1528-00.

Standard Guide for Environmental Site Assessments: Phase II Environmental Site Assessment Process, ASTM document E 1903-97.

Draft Pre-Acquisition Environmental Site Assessments, BLM Handbook H-2101-4.

4.0 Examples of Typical Sites

This section presents a series of "typical" sites that are encountered by agency personnel. Hazardous substance sites on agency lands include abandoned landfills and mines, oil and gas exploration sites, and drug lab or other illegal dumps.

For each example the types of professional services, construction services, and analytical services most often associated with the site are presented. Costs for these services can be found in Section 5.0, Costing Information, and used in the cost estimating process. In addition, the CD-ROM accompanying this handbook has electronic worksheets that can be used to perform cost estimating calculations.

4.1 Abandoned Mine Lands Sites

There are literally thousands of abandoned mine sites on public lands throughout the United States. Physical and environmental hazards such as open shafts and acid drainage on AML can pose serious threats to human health and the environment. As Federal land managers, BLM and the FS are tasked with identifying the abandoned mine sites on the public lands they supervise that could cause considerable harm. Once these sites are identified, the proper regulatory corrective action can be taken.

Adits, pits/shafts, waste rock piles/tailing piles, and old milling and processing operations are the most common types of features found at AML sites that require corrective actions. This section of the handbook presents information on the types of studies associated with the reclamation and rehabilitation of these typical AML site features. In addition, equipment and services requirements usually needed to accomplish the actions are presented. Costs for services and equipment are depicted in Section 5.0; however, representative costs are also included in this chapter.

The AML process has equivalent activities to the PA/SI and RI/FS activities of the CERCLA process. The inventory phase, is analogous to the combined PA/SI and the site characterization phase is analogous to the RI/FS. Remediation is the same for both processes.

4.1.1 Common Studies for AML Sites

In 1995, a Federal interdepartmental strategy was developed that changed the AML program strategy from an inventorying process to a watershed approach. This streamlined approach was adopted in an effort to expedite the restoration of abandoned mine sites that had already been identified as hazardous in nature, and to identify and restore other sites that also pose serious dangers. The watershed approach requires a site assessment and may involve a removal action or remediation action.

4.1.1.1 Site Assessment

Once a contaminated site has been identified, pre-remedial site assessments are conducted to collect data and determine whether or not a site poses a threat to human health and the environment and if the site is eligible for remedial funding under the CERCLA Superfund Program. The site assessment process is outlined in 40 CFR 300.420, and includes a PA, SI, the calculation of the HRS screening score, and a recommendation for further studies or actions. An assessment or investigation may stop at any point when it is determined that the onsite hazards do not pose a significant threat to human health and the environment.

4.1.1.2 Removal Actions

Removal actions are used to eliminate the source of contamination from a site or effectively contain it on-site so that continuing releases of contaminants are prevented or reduced to acceptable levels. **Removal actions may be implemented in any phase of the site assessment process.** They may occur following a visual inspection of the site, or following a more detailed collection of site data through a Removal PA or Removal SI. Guidelines for conducting hazardous waste removal actions are provided in the NCP (40 CFR 300.410 through 300.415). Removal actions should be cost effective and should attain and meet Federal and State applicable or relevant and appropriate requirements (ARARs). If the situation is immediately dangerous to human health and/or the environment, requiring an immediate removal action, the method selected need not achieve the above standards.

For some AML sites a removal action may be all that is needed. Specifically, waste rock piles and tailings piles can be excavated, moved to a more stable location and capped to protect it from spring run off and/or precipitation. Typical equipment used in removal actions can include excavators, bulldozers, front-end loaders, dump trucks and pickup trucks. A removal action will require laborers, equipment operators, truck drivers and a foreman with oversight by agency personnel. The length of the project will depend on the location, topography of the site and the volume of waste. As with most remediation actions, mobilization, overnight lodging and meal expenses must be included for equipment and personnel where appropriate.

4.1.1.3 Preliminary Assessment

A PA is a limited-scope investigation in which readily available information is reviewed to distinguish between sites which pose little or no threat to human health and the environment and those which require further investigation or action. A PA may also include a limited field investigation. The assessment should provide information necessary for emergency response, removal activities, and for informing the community about the site. If the results of a PA indicate that further investigation is needed, an SI is performed.

Typically, PAs are conducted by junior- to mid-level support staff from a broad range of technical disciplines including engineers, geologists, environmental scientists, chemists, biologists and geologists with oversight and review by a more senior staff member. A typical PA should require approximately 120 hours to complete. Section 3.3.2, above presents typical project hours break-out.

4.1.1.4 Site Inspection

The purpose of an SI is to collect the additional data necessary to complete an HRS screening score. The HRS is the principal mechanism used by EPA to place waste sites on the NPL or list of Superfund sites. It is a numerically based screening system that uses information from PAs and SIs to assess the relative potential of sites to pose a threat to human health or the environment. This scoring system can be used to eliminate sites which do not qualify for remedial action under the CERCLA process. There are several types of SIs which can be performed: focused SIs, screening SIs, and expanded SIs. Choosing which SI to perform depends on the quality of previous investigations and the information needed to fill data gaps to fulfill HRS needs.

The LOE required for an SI will vary, depending on the quality and quantity of preexisting information and its applicability to HRS requirements. The EPA *Guidance for Performing Site Inspections Under CERCLA* (CEH 12 2002\03 All Documents\103 Reference Materials\SI Guidance) presents an estimate of 400 hours for a Focused SI, and up to 620 hours for an Expanded SI. Typically, the written portion of an SI is prepared by mid- to senior-level technical staff with general support from junior staff. Field sampling activities are usually conducted by junior and mid-level staff under the direct supervision of experienced mid- to senior-level staff. A broad range of technical disciplines similar to a PA can be utilized in the completion of the project. A more detailed discussion of PA and SI activities can be found in Section 3.3. EPA estimates in the example that it will require 440 hours to complete the SI and an additional $25,200 (1992 dollars) for lab analysis of samples gathered.

4.1.1.5 ARARS

ARARs are State, local and Federal standards that are directly applicable to or may be considered relevant and appropriate to the circumstances on the site. The standards must be considered throughout the project from initial scoping to possible long term remediation. They are particularly applicable in land use regulations that involve wetlands, flood plains, endangered and threatened species/critical habitat, cultural resources, coastal zones, wild and scenic rivers and wilderness areas.

4.1.1.6 Engineering Evaluation/Cost Analysis

Non-time critical removal actions which allow more than six months for investigation and analysis are required (under the NCP) to have an EE/CA. The purpose of an EE/CA is to generate and evaluate the costs and effectiveness of various removal options. EE/CAs can range in cost from approximately $35,000 to $250,000 depending on the project, and may go as high as $2 million. Costs will vary depending on the size, severity, and complexity of the site. See Section 3.3 for additional information regarding EE/CAs. It is important to note that by following CERCLA/NCP removal process requirements, National Environmental Policy Act (NEPA) requirements are met and it is not necessary to produce a separate NEPA document.

4.1.1.7 Remediation Actions

A removal may or may not be the final action for a site. If it is unclear whether contaminants remain or pose a sufficient threat to warrant continued action, the site may require remediation. The site assessment will develop an HRS score for a site to determine whether or not it will be placed on the NPL for remediation as part of the CERCLA (Superfund) program. Remedial actions involve conducting a RI/FS or a long term monitoring program may be initiated to address these uncertainties.

4.1.1.8 Remedial Investigation/Feasibility Study

After a site is listed on the NPL and becomes part of the CERCLA/Superfund program, a RI/FS is performed at the site. The Remedial Investigation serves as the mechanism for collecting data. The Feasibility Study is the mechanism for the development, screening, and detailed evaluation of alternative remedial actions. Both components are conducted concurrently. However, data collected in the Remedial Investigation influences the development of remedial alternatives in the Feasibility Study. This in turn affects the data needs and scope of treatability studies and additional field investigations. See Section 3.6 for further details on the RI/FS process.

4.1.1.9 Sampling and Analysis Plans

Sampling and analysis will likely be required as part of the investigation and remediation process. A sampling and analysis work plan can be prepared prior to sampling in an effort to adequately fill data gaps and to characterize the contamination of a site. It should be noted that not all projects require a full work plan. See also, Sections 2 and 5.3.

The most important preliminary step of preparing a work plan is to define the data quality objectives (DQO). The DQO process is a means to plan field investigations so that the quality of data collected can be evaluated with respect to its intended use. The work plan is a document that specifies the process for collecting environmental samples to effectively meet the project objectives. A work plan is made up of three parts, the QAPP, the SAP and the HASP. The QAPP describes the policy, organizational and functional activities for collecting data that will stand up under legal and scientific scrutiny. SAPs describe the number, type and location of samples to collect as well as the laboratory analyses to be performed. HASPs are designed to provide safe procedures and practices for personnel engaged in field activities by identifying possible hazards that may exist at the site and the precautions used to avoid those hazards. A more detailed discussion of HASPs and SAPs can be found in Sections 3.2.2 and 3.2.3.

Typically, sampling and analysis work plans are prepared by mid- to senior-level support staff from a broad range of technical disciplines including engineers, geologists, environmental scientists, chemists, biologists and geologists with oversight and review by a more senior staff member or project manager. A typical work plan can require approximately 150 to 200 hours to complete with 95 percent of the effort used to write the document and five percent for review. The CD-ROM accompanying the handbook contains samples of HASP and SAP.

Each project site is unique and will require a unique sampling strategy depending on the mining history, data gaps and PCOC. Sampling of waste sources at an AML site will involve the collection, packaging and shipping of samples to an analytical laboratory for analysis. Potential waste sources can include acid mine drainage (AMD), contaminated soils, tailings and ore piles, sediments, as well as surface water and groundwaters targets. Environmental samples from AML sites are most frequently analyzed for metals, but may also be tested for volatiles, semivolatiles, pesticides, herbicides, acid/base accounting, TCLP and SPLP based on site conditions.

The cost of sampling will be based on the number of samples collected and the analyses performed. The number of samples collected will be determined by the size and scope of the project and the extent of contamination at the site. Field sampling activities are generally conducted by junior and mid-level staff under the direct supervision of experienced mid- to senior-level staff. Sampling costs will also typically include dedicated sampling equipment expenses, sample shipping costs, and travel, housing and per diem expenses for sampling personnel. There may be a need for field investigation equipment and operators to run the equipment. These costs should include mobilization/demobilization and downtime. Section 5.2 provides a more detailed list of sampling methods and associated costs.

The analyses required for field samples will be based on the PCOC and the DQO. **Appendix A, Table 4.1** lists the costs for typical analytical tests run on environmental samples collected from AML sites. See Section 5.3 for greater detail on the costs of laboratory analyses performed.

Reference

Abandoned Mine Land Inventory and Hazard Evaluation Handbook, U.S. Department of the Interior, Bureau of Mines, May 1994. This document is included on the CD-ROM accompanying this handbook (CEH 12 2002\03 All Documents\103 Reference Materials\Abandoned Mines Handbook\Bureau of Mines AML Handbook).

4.1.2 Reclamation Activities

The following describes some of the typical reclamation activities performed at AML sites. These activities may be employed during site rehabilitation.

4.1.2.1 Acid Drainage

Water draining from abandoned mines, overburden piles, waste rock piles, tailings piles and ore piles are often acidified and contaminated with dissolved metals. AMD, acidified water draining from adits and shafts, and acid rock drainage (ARD), acidified water draining from tailings piles and ore piles, are a major problem facing the mining industry today. They also comprise the leading source of surface water and groundwater contamination coming from AML sites. Acid drainage is generated when sulfide minerals are exposed to the air (oxidized) and the resultant sulfur ions are dissolved and mobilized in water. The formation of sulfuric acid is typically a slow process and does not pose much of a threat to the environment when the minerals are left in their natural state. Mining operations, however, remove vast amounts of sulfide minerals from the ground and expose them to air and water thereby increasing the rate at which acid drainage (sulfuric acid) is produced. The formation of acid lowers the pH of the infiltrating water and increases the rate at which metals from the surrounding environment are dissolved and mobilized. Water contaminated with elevated concentrations of metals can become unsuitable for human consumption or aquatic habitat. As contaminated, metal laden water enters the environment, the pH begins to increase due to dilution and natural buffering, and the dissolved metals precipitate out of solution, often coating the stream bottoms and beds. Quite often these metal laden materials are fixed by bacterial slimes to stream bottoms. This coating of precipitated metal oxide can have a devastating impact on stream biota.

Acid drainage is typically studied as part of an AML study. Those studies include PA, SI, EE/CA, and RI/FS studies as discussed previously. Both active treatment and passive treatment of acid drainage is evaluated for remediation purposes.

The remediation of acid drainage at an AML site prevents contamination from entering the environment. This is normally accomplished by one or more of the following methods: controlling water to and from the source, exclusion of oxygen to the source, and neutralization of acidified water. Remediation and treatment options for acid drainage are site specific and will depend on the site characteristics. Treatment options can range from simply moving a waste rock pile to an area of less environmental exposure and capping it, to designing, constructing and operating a large water treatment plant. The cost of treatment will vary depending on the site and project specific goals.

The preferred method for remediating ARD is to prevent water from contacting the source of contamination. Managing water contact with a waste rock, overburden or tailings pile can be accomplished by the following methods.

Diversion of Surface Waters: The diversion of surface waters away from waste piles can be accomplished by constructing berms or ditches to divert the water away from an ARD source. Berms and ditches typically act as a short term solution, however, more permanent solutions can be designed to control erosion and debris accumulation. Diversion structures also typically require periodic inspection and maintenance. These structures are also used to divert water flow around landfill caps. Additional information is provided in Sections 4.2 and 5.4.

The costs associated with diverting water for a waste pile will include the expenses for contracting equipment such as bulldozers, front-end loaders, vibratory compactors, and water tank trucks. A foreman, equipment operator, and possibly unskilled laborers will be needed depending on the size of the project. Other items that may require consideration include the construction of access roads or bridges capable of handling heavy equipment, seeding disturbed areas, and the installation of silt fences.

Precipitation/Run-off Protection: Waste piles can be shielded from precipitation or spring run-off by covering the pile with a low permeability cap or liner. Covering an overburden pile, tailings pile or other waste rock pile may range from constructing a simple cap to designing, constructing and operating a complex enclosure system that meets RCRA Subtitle D specifications. Simple cap construction typically consists of applying a thick layer of topsoil to a waste pile. A Subtitle D encapsulation system may consist of placing a liner (clay or synthetic) below the waste pile to prevent groundwater from seeping up into the contamination source or contamination draining down through the waste pile into the groundwater. A subtitle D system would also consist of several protective layers on top of the waste pile to prevent precipitation from percolating down through the contaminated material and protecting the cap from erosion. See, also, Section 4.1.3 below.

A typical procedure used to protect a waste pile from precipitation or run-off is to excavate and move the contaminated media to a stable location, cap the material with soil, clay or compost, recontour the excavated site and reseed both areas. Direct treatment of AMD to keep the constituents of concern from leaching out of the waste, usually involves the addition of alkaline reagents such as lime, soda ash, briquettes, or sodium hydroxide, however, lime is not a preferred method. Hay bales are often strategically placed around newly seeded areas to provide erosion control. In addition, mulched organic material, especially in dry areas, can increase success of seeding by 70 percent.

The type of equipment used often includes an excavator, bulldozer, front-end loader, dump trucks, water truck and seeding equipment. A working crew will consist of equipment operators, truck drivers, laborers and a crew foreman. The costs associated with this type of removal action include mobilization and demobilization of equipment, equipment rental, personnel salaries, transportation, material costs, and possibly hotel and food costs. It may be necessary to truck in topsoil amendments if no close sources are available, costs of which must be added into material transportation costs. See **Appendix A, Table 4.2** for a list of typical costs applicable to waste pile protection. Also, see Section 5.4 for general construction costs.

Controlled Placement: The controlled and engineered placement of waste rock piles such as cellular pile construction (gabion structures) combined with compacting and mixing soils with low permeability material can also be used to control ARD formation. This method should be considered in conjunction with other control measures such as using a cap (see discussion above). Spreading and compacting a large area of waste would involve using a bulldozer to move material around and a towable sheeps foot or other type of compaction device.

AMD can contaminate both surface and groundwater. It is typically associated with a single point source coming from an adit or shaft of lowest elevation. The most practical and cost effective way to deal with AMD contamination is to minimize and control the discharge of water. This can be achieved a number of ways including:

- Diversion of surface and groundwater around the waste piles.
- Installation of under drains.
- Integrating a settling pond into the water flow prior to its going into a stream.

It is important to review data concerning the seasonality of water flow for the specific site. In many cases the fluctuations may be significant and may impact the pH and chemistry of the flow. For this reason, the data should include both volumes and chemical constituents of the water, and should be for a minimum of one year, but preferable for five or more years.

Other treatments include lime precipitation, evaporation, biological (aerobic and anaerobic bacteria) methods and construction of wetlands. Construction costs are proportional to the volume of the AMD and the volume of surface and/or groundwater. In most cases, the smaller the flow (amount of contamination) out of the mine and over the area, the lower the cost of remediation.

AML sites with small flows may be treated by evaporation, ponds or constructed wetlands. This involves constructing an impoundment, installation of plumbing, peat beds, aquatic plants, monitoring, and maintenance. Typical construction costs for flows up to five gallons per minute are $10,000 or less. Operating costs are about 10 percent of construction costs. The use of a constructed wetland as a treatment solution is highly dependant on the climate and topography.

Wetlands do not usually thrive in cold arid climates. The topography of the surrounding area such as slope of the terrain and available surface area for treatment systems are also critical in determining a treatment solution. A wetland requires a fairly large, open, flat area, and also requires periodic replacement of vegetation.

AML sites with large flows can require the use of a water treatment plant. Treatment options can include limestone channels or drains, hydrated lime or soda ash. Lime precipitation is the most common type of water treatment. Equipment and system requirements include receiving ponds, lime storage bins, mixing tanks, thickening tanks, dewatering equipment, pH adjustment and discharge. Engineering includes grading site, pond construction, purchase of tanks and process equipment and fabrication of set up. The plant is designed to site characteristics. Construction costs are proportional to the volume of the AMD and the amount of contaminants in the water to be treated and can range from $50,000 to over $20 million. Operating costs range between $100 to $1,500 per day.

Section 5.1, Professional Services, **Appendix A, Table 5.1**, Staffing Rates, contains costs associated with the types of personnel required to ARD/AMD treatments.

Reference

Costs of Remediation at Mine Sites, EPA, January 1997.

Design and Construction of RCRA/CERCLA Final Covers, EPA, May 1991.

4.1.2.2 Closure of Adits, Pits, Shafts

The reclamation of abandoned mines may involve the closure of adits, shafts and other underground mine openings. An experienced underground mining engineer should review any plans for closing underground mine workings. A biological survey of the mine should be conducted by an experienced biologist prior to closure to identify bats and other wildlife that may inhabit the mine. The reclamation costs associated with appropriate closures can range widely. It may be fairly inexpensive to install a grate or cover in an adit, but it can be quite expensive to stabilize underground workings.

Closures can be temporary (less than one year) or permanent. Temporary closures typically involve a combination of covers and enclosures. Permanent closures of adits and shafts can include covers, caps, enclosures, controlled filling, shaft plugs, and roadway stops and dams.

Covers: Covers are typically designed to provide temporary closure measures to prevent unauthorized access and illegal dumping in shafts and adits. They may also be used as a permanent closure solution depending on the site location and dangers associated with site. Covers should be clearly visible and self draining. Mine access covers for shafts are divided into two categories, light duty and heavy duty. Light duty covers can be made of polyurethane foam, timber, steel, or concrete. They are required to support a uniformly distributed load of 270 lb/ft^2. Heavy duty covers should be constructed with reinforced concrete no less than 12 inches thick and are required to support a uniformly distributed load of 700 lb/ft^2. The heavy duty covers must also have a strong central monument on top that identifies the mine access with a reference number, position of shaft center and diameter and depth of the shaft. Mine covers are often coupled with an enclosure such as a fence.

A cover for an adit usually consists of walling the entrance or fitting it with a strong steel door and securing the roof against intrusion. An adit cover may need a gas ventilation pipe with a flame arrester to allow the escape of gases. Regular inspection and maintenance are required for all types of covers. See Field Investigations (Section 5.2) and General Construction (Section 5.4) for more details on costs.

Caps: Caps are used to permanently close a mine shaft. They should be designed to maintain integrity even in the event of the loss of shaft fill or the collapse of shaft walls. They are to be constructed of reinforced concrete (4350 lb/in^2) at least 18 inches thick and be able to support the weight of the overburden and a uniformly distributed superimposed load of 700 lb/ft^2. The length or diameter of a cap should be no less than twice that of the internal shaft diameter. It should be founded on competent material, or where possible, solid rock. A gas ventilation pipe with flame arrester should be installed if the production of mine gas is expected. Finally, a cap should be marked with the shaft reference number and the center, diameter, and depth of the shaft. See Field Investigations (Section 5.2) and General Construction (Section 5.4) for details on costs.

Enclosures: Enclosures such as fencing and walling are used as security measures to prevent unauthorized access to project sites. They are typically used during remediation activities and at sites where access to a site is a big factor. A maintained enclosure and light shaft cover can provide an adequate temporary closure measure. Enclosures can require regular inspection and maintenance. Costs for closures can be found below in **Appendix A, Table 4.3.**

Controlled Filling: Controlled filling of a shaft with shallow sumps should begin with hardcore fill followed by a general fill material. Hardcore material can include broken stone, brick or concrete demolition rubble, or other granular materials. It must be free draining, water insoluble and resistant to chemical attack. The hard core material is filled into the shaft up to a height of at least five times that of the shaft diameter for the first 650 feet of shaft. **(Note:** material excavated from the mine operation is frequently not suitable for this role.) An additional height of one quarter of the shaft diameter is required for each additional 650 feet. Settling must be taken into account when filling up the remainder of the shaft with general fill material. General fill should be of granular nature with no toxicity, combustibles or poor engineering properties. This can include mining wastes if it meets these criteria. Bulkheads should be installed just inside the inner mine workings close to the shaft tunnel to prevent the general fill and hardcore material from settling out of the shaft into underground passages. A layer of clay can be used to prevent water or gases from moving up and down through the fill material. The clay seal should be installed below the water table so that it does not dry out and crack and it should be 3 feet thick for every 300 feet of head water it has to support. See General Construction (Section 5.4) for more details on equipment costs.

Shaft Plugs: Concrete plugs are intended to prevent the loss of fill from a mine shaft or to protect underground workings. Plugs are normally used only when underground workings that are accessible, such as in mines, are being shut. There are three types of shaft plugs: conical plugs, parallel plugs and inset plugs. The design and construction of concrete plugs includes a bottom form that can support the wet weight of the concrete. This bottom form is typically made of steel beams hitched into the sidewalls of the shaft and a 0.25 inch steel plate thrown over the top. Sandbags or clay can be used to line the edge of the form to prevent wet concrete from seeping around edges. Concrete is then poured into the form in one continuous operation to the desired depth. A shaft plug should have a minimum height equal to the shaft diameter. Clay or grout may be used to keep the plug water tight. See General Construction (Section 5.4) for more details on equipment costs.

Roadway Stops and Dams: Roadway stops and dams are used to permanently seal adits. Roadway stops are used to retain solid fill material. Dams are designed to be water tight. Stops are constructed of hard sandstone from the mine or hardcore material that is packed floor to ceiling, side to side and between end retaining walls. The length of the stops for level roadways should be at least three times the height or width, whichever is greater. The end retaining wall should be constructed of gabions filled with rocks. The adit opening should be filled with rock fill. Dams should be constructed out of concrete similar to shaft plugs and be no less than the roadway height or width, whichever is greater, in length. See General Construction (Section 5.4) for more details on equipment costs.

Reference

Polyurethane Foam Applications in the Closure of Abandoned Mine Openings, National Park Service, Mining and Minerals Branch, August 1994. This document is included on the CD-ROM accompanying this handbook (CEH 12 2002\03 All Documents\103 Reference Materials\Abandoned Mines Handbook).

Solid Minerals Reclamation Handbook, BLM Manual Handbook H-3042-1, 4/8/1992. This document is included on the CD-ROM accompanying this handbook (CEH 12 2002\03 All Documents\103 Reference Materials\Solid Minerals Handbook).

4.1.2.3 Other Concerns

Other concerns to be taken into account by Federal land managers during site remediation of AML sites include mine gas and bat protection measures.

Mine Gas: Gases can accumulate in underground mines that have been closed and where normal ventilation has been changed due to site remediation. Most mine gases are grouped into two categories, firedamp and blackdamp. Methane gas (firedamp) is lighter than air and is emitted from strata surrounding a mine. Carbon dioxide and nitrogen (blackdamp) are heavier than air and settle in the bottom of old shafts and adits. Both firedamp and blackdamp gases can present potential hazards to site workers. Handheld hazardous gas detection devices should be used to determine gas levels in underground workings and around mine openings (see **Appendix A, Table 4.3** for costs). Ignition sources should be eliminated when conducting remediation activities in and around mines where firedamp is present. Respirators and other precautions should be used in underground mine workings, particularly mine shafts, when blackdamp is present. When mine openings are closed it may be necessary to install vent pipes equipped with flame arresters and lightning conductors or the opening may be sealed with gypsum, cement and other types of grouts.

Bat Protection: Federal land managers must consider bat protection while remediating AML sites. The increase in urban development, deforestation and exploitation of caves is threatening natural habitat used by bats. Abandoned mines have been found to provide a source of roosting, hibernation and migration rest stops for a number of bats species. Closing an abandoned mine without conducting a biological survey of bat populations may trap and kill an entire colony. The North American Bats and Mines Project (NABMP) was founded by Bat Conservation International and the Bureau of Land Management.

The primary goal of the project is to provide national leadership and coordination to minimize the loss of mine-roosting bats during mining and mine land reclamation.

The most common bat protection measures taken at AML sites are the implementation of bat gates. Bat gates are designed to keep humans out of the abandoned mines, maintain air flow and provide access for bats. Hundreds of bat gates have been constructed and installed since the AML program began. The type of gate installed depends on the size of the opening, the location and the species of bats using the mine. Bat gates are typically designed and constructed in adits, although some have been used with vertical shafts. Rebar, manganese steel, angle iron and even wire cable can be used in the construction of bat gates. Typically the metal bar or wire cable is crisscrossed and anchored into the mine walls. The openings in between cross member bars are typically 5¾" with at least a 24" wide space between vertical supports. A popular bat gate designed by Roy Powers uses 4"x4" angle iron for structural members and cross member supports with 1½"x1½"x½" angle iron stiffeners welded inside the cross members to increase integrity and stiffness.

The Utah State Abandoned Mine Land Program requires the use of manganese steel in bat gate construction. Manganese steel bat gates can not be cut with a hacksaw and require less welding than the Powers bat gate. Some gates are also constructed with a locked hatch or lockable bar to allow future access to the mine. Taking measurements of the mine opening and prefabricating the gate in a shop reduces installation difficulties and costs. The costs of construction and installation of a bat gate can range from a few hundred dollars to nearly $20,000, with an average of less than $5,000 depending on the size and material of construction.

It is important to establish a pre- and post-installation monitoring program of the acceptance of a gate. The installation of a bat gate can cause roosting bats to abandon a mine. A qualified biologist should be consulted to help identify all species that utilize an AML site and to recommend a design. Also, gates may not work with some species of bats. It may be necessary to construct another type of protection such as a concrete wall with a horizontal opening at the top to allow bats access. Posting signs just inside a gate to explain the purpose of the bat protection program and warning of the dangers of abandoned mines can help to prevent vandalism.

Reference

http://www.batcon.org/mines/index.html July 15, 2000

Bat-Compatible Closure of Abandoned Underground Mines in National Park System Units, Burghardt, John E., National Park Service.

Memorandum on Jail Bar Bat Grate Designs for Specific Uses, Amodt, Louis A., State of Utah Department of Natural Resources, Division of Oil, Gas and Mining, January 26, 1995.

Bats and Mines, Tutle, Merlin D., Daniel A.R. Taylor, Bat Conservation International. This document is included on the CD-ROM accompanying this handbook (CEH 12 2002\03 All Documents\103 Reference Materials\Abandoned Mines Handbook).

4.1.3 Site Rehabilitation Measures

The goal of site reclamation, ultimately, is to stabilize a site and return it to productive post-mining use. The planned use of the reclaimed AML site will dictate what site rehabilitation steps are to be taken. AML site rehabilitation can include revegetation of reclaimed areas, stream and fishery reconstruction and riparian eco-system reconstruction.

4.1.3.1 Revegetation

After removal and disposal have taken place, a site is typically backfilled, contoured and re-vegetated. Before grasses, trees, shrubs or other native and non-native vegetation can be planted, the land must be backfilled and re-contoured to match the surrounding environment. Earth moving equipment such as bulldozers, backhoes and front-end loaders are utilized to excavate and grade the site. Dump trucks may needed to haul in topsoil or other borrow material if the materials can not be found on-site. Once the general contour of the land has been established the revegetation process begins. Seeding and planting are most successful if they are completed immediately after the seed bed is prepared and just prior to a long season of precipitation.

Soil Management: Topsoil or some other replacement material is mandatory to achieve good vegetation growth in reconstructing an AML site. The quality and the amount of topsoil will have a large effect on revegetation success. Some things to consider in soil management are topsoil layer thickness, volume of soil needed, whether or not direct placement is feasible and availability of other growth media. This typically requires a soil survey (National Cooperative Soil Survey SCA USDA Handbooks 430 and 436) of the surrounding location. The survey should indicate soil properties and qualities, giving a soil baseline for future actions. Topsoil should be salvaged where possible before remediation starts typically by piling it and providing erosion protection such as seeding. It should be noted that soils stored rapidly lose quality. Reapplied topsoil should be tested for nutrients, pH and toxicity factors prior to planting. Bulldozers are often used in piling topsoil for future use. This will also require a heavy equipment operator experienced with topsoil stockpiling and spreading. Seeding of a topsoil pile to prevent erosion can be accomplished by a mechanical or hydro seeder. See **Appendix A, Table 4.4** for more details on associated costs. It should be noted that it is often difficult to find good sources of topsoil, riprap, and other materials necessary to achieve good vegetation growth.

Seed Bed Preparation: The layer of soil deposited must be prepared before seeding and planting. The soil needs to be conditioned in order to absorb and hold water and be loose enough that vegetation roots can penetrate it. Equipment used to condition seed beds include rippers, discs, chisel plows, spring tooth harrows and rakes. It may be necessary to rip the surface mantle to break up subsurface compacted ground. Medium equipment operators should be capable of handling most of these types of equipment. See **Appendix A, Table 4.4** for more cost details.

BLM's Vale District in Oregon maintains a fleet of rangeland drills and plows for site preparation and seeding. The equipment may be used by private individuals upon a signed agreement arranged through the BLM NSTC. A maintenance fee of $1 per acre is charged for drills used by state, other Federal and private facilities. If transportation of the equipment is requested, a charge code and project number is required.

Fertilization: It may be necessary to add additional natural or man-made nutrients to the soil. This can be done prior to, during, or after seeding. Typically fertilizers are added prior to seeding. Equipment used to apply chemical fertilizers include broadcast spreaders for dry of granular fertilizers, subsoil injectors for liquid fertilizers and hydro seeders for applying fertilizer slurries. Special equipment is required to apply biologic fertilizers such as manure or compost. Harrow or drill fertilizer into soil prior to planting for best results. Other amendments to the soil can be included to abate some of the impacts of remediation activities. Amendments also help mitigate compaction problems, improve water infiltration, neutralize acidic/alkaline conditions, modify soil structure and enhance water holding capacity with improving drainage. Soil amendments may include wood chips, calcium chloride, various organic mulches, gypsum and lime. Also see **Appendix A, Table 4.4** for more details on related equipment costs.

Soil Amendments: The use of soil amendments is often an important part of preparing disturbed areas for revegetation. Most disturbed sites exhibit soils that have received impacts to their chemical and/or physical characteristics (e.g., compaction). These impacts affect the ability of the soil to function effectively as a growth medium for vegetation and generally increase the likelihood of soil surface instability. Soil amendments are natural or man-made materials incorporated into the soil to improve the soil-water or soil-air relationships in the soil profile by altering the chemical or physical properties of the disturbed soils. Soil amendments help provide a suitable environment for vegetation establishment. Soil amendments include, but are not limited to: wood chips, calcium chloride, various organic mulches, gypsum, and lime. When incorporated into the soil, these materials help mitigate compaction problems, improve water infiltration, neutralize acidic or alkaline conditions, modify soil structure, an enhance water holding capacity while improving drainage.

Seed Selection: The local county extension service, the Forest Service Ranger District Office or the BLM Field Office may have information concerning the types of seed stock available in the area. The selection of seeds is an important step in the successful revegetation of a site. A seed specialist with experience in the geographic area of the project site should be contacted to recommend a good mixture of seeds. Agency personnel may contact the Regional Seed Warehouse located at the Lower Snake District Office in Boise, Idaho. Forest Service personnel may contact range/seed managers. Native species from the vicinity of the project site and/or other adaptable species from a similar climate zone and soil type are most likely to survive. Minimum moisture requirements and the availability of seed from commercial seed suppliers or regional seed warehouses will also determine the species of seed to choose. Select a mixture of five or six species that are diverse and when practical should include grasses, forbs and shrubs. The mixture should include seeds for warm and cool season growth, provide quick cover and contain a balance that will meet the post-mining objectives (i.e. grazing, wildlife habitat, etc.). The Forest Service uses only native seeds for revegetation. The BLM typically uses native seed but may utilize non-native seeds as well.

Seed Acquisition: Seeds should be purchased from local dealers or agency seed warehouses with experience in the geographic area of the project site. All seed purchased should be tested for purity, germinations and noxious weeds. BLM maintains a Regional Seed Warehouse located at the Lower Snake District Office in Boise, Idaho that purchases, tests and stores a wide variety of seed species. The seed warehouse will purchase and store seed for other states under a formal agreement known as a MOU. See Section 2.4, Hiring a Contractor, for additional information on contracting devices. Requests for seeds from the warehouse typically require a one year advanced notice. This gives the seed warehouse time to find the seeds requested and to buy them at the best prices. Seed reserved under a MOU is held until September 1. After that time all seed not requisitioned is available for other state or district use. Seed prices can be highly variable depending on their availability and the species. Seed prices typically range from $2 per pound to $10 per pound.

Seeding: Seeding and planting are most successful if they are completed immediately after the seed bed is prepared and just prior to a long season of precipitation. Seeding in the late fall, prior to snowfall, can also enhance germination success in the spring. It is important to use a proper seeding rate. Over-seeding will result in dense stands with slow growth. Insufficient seeding will result in sparse plants unable to stabilize a site. Seeding rates should be based on pure live seed percentages and seeds per square foot or pure live seed per acre. Other seeding considerations include planting depth and equipment use. Most seeds should be planted 1/8 to ½ inch deep. Smaller seeds should be planted closer to the surface than larger seed. Seeding can be conducted using a number of techniques and equipment. Rangeland drill seeding works well when the terrain is rough and rocky. A cultipacker type seeder is effective at evenly distributing seed over areas that are fairly smooth and free of large rocks. Broadcast seeding can be divided into ground seeding, aerial seeding and hydro seeding. Seed spread by broadcasting should be raked in order to cover the seed and to provide good soil-seed contact, otherwise seeding success suffers. Broadcasting only, is not recommended. **See Appendix A, Table 4.4** for more details on seeding costs.

Planting and Mulching: Shrubs, trees and other transplantable species can play a crucial role in meeting the post-mining objectives of a site. Planting techniques can include hand planting, sprigging and transplanting. The preferred method of transplanting shrubs and trees is to use containerized or bare root stock. When transplanting, consider what sources are available such as local or Federal nurseries, the care and hardening of plants prior to planting, the time of year to plant, the methods of planting, spacing, watering, maintenance and any follow up planting. Check with local BLM and Forest Service offices as they may have lists of nurseries stocking preferred species.

When planting shrubs and trees, select species from a climate zone similar to the project site. For instance, willow trees are especially suited for use in riparian zones. Also consider site conditions and preparation, methods of planting, spacing, fertilizers to use, watering, post-planting care and mulching. A good layer of mulch will help protect a seeded and planted area against environmental extremes and helps to stabilize a site until plant growth is established. Mulches include straw, native hay, jute, wood chips, other woody materials, crushed rock and synthetic biodegradable fibers and blankets. Hay and straw should be applied at a rate of ½ to 1½ tons per acre. Synthetic fiber mulches should be applied at a rate of 1 ton per acre. Seeded blankets may be used as viable options to seeding and mulching. Mulches can be applied as part of the hydro-seeding process, by hand or machine. Equipment for machine mulching can include power mulchers and tractor spreaders. The costs for spreading mulch by hand will depend on the size of the site, the type of mulch to spread and the required depth. Aged barks, wood chips and compost are the most expensive and difficult mulches to spread. Hay and straw are typically less expensive and easier to distribute. See **Appendix A, Table 4.4** and General Construction (Section 5.4) for more details on costs.

4.1.3.2 Stream and Fishery Restoration

Reestablishing stream and fishery resources is an important consideration in the site rehabilitation process. The Endangered Species Act of 1973 (16 U.S.C. 1531 *et seq*.) provides for the protection of threatened and endangered species and their habitat. The intent of stream corridor restoration is to allow the stream to reach a natural equilibrium and become self sustaining. There are a wide range of measures that can be utilized in accomplishing this including passive measures (i.e. removal of persistent hazard) to active measures (i.e. remove hazards and repair damage to stream corridors). Stream channel reconstruction can involve the excavation of a channel, backfilling a streambed with stream gravels, and reconstruction of habitat elements including plant life, pools, riffles and installment of large rocks and woody debris. There are many different options for stabilizing and reconstructing stream embankments. Those options can be categorized into two major groups, hard engineering treatments and soft bio-engineered treatments. Hard engineering treatments include the use of riprap, grouted riprap, concrete revetments, bulkheads, gabion baskets and blankets, etc. The hard engineering treatments can be used in a wide variety of locations and variable flow situations but do not provide habitat or other biological benefits of soft bioengineered treatments.

Examples of soft bioengineered treatments can include but are not limited to brush layering, wattling, and terracing of willow cuttings. Construction of soft stabilization treatments require the assembling of materials and equipment prior to work, streambed work, and maintenance during the first full growth season. Materials for reconstruction can include boulders, willows and erosion control fabric. The natural materials, willows and boulders, can be located on site or imported. Erosion control fabric can be purchased in fifty meter rolls. Willows should be harvested near ground level, bundled in groups of ten, soaked in water for three or more days and stored if necessary in a cool dark place before being planted. One person with heavy-duty brush cutters or a light weight chain saw should be able to harvest one hundred thirty bundles per eight hour day. Streambed work consists of placing of a row of stabilizing boulders at the toe of the streambed slope, planting willow stems individually (layering) or in groups (wattling) immediately behind the boulders, contouring the stream bank and covering the embankment with an erosion control fabric. A terracing technique uses the same steps as above and applies them to a double terraced stream bank reconstruction supporting eight to fourteen foot stream banks. Maintenance requirements for these bioengineered treatments include watering and weeding. Willows should be watered daily if possible. Weeding is best during the spring and just after it rains. Weeding is best conducted during the spring. See **Appendix A, Table 4.4** for more details on costs.

4.1.3.3 Riparian Ecosystem Reconstruction

Riparian ecosystems are the transitional wetlands located between permanently saturated wetlands and upland areas. They exist as the vegetated zones along rivers, streams, lakes, and springs. The typical riparian eco-systems on agency lands found throughout the western U.S. are located in arid and semi-arid regions. These transitional wetland areas filter and purify water, reduce sediment loads, control run-off water volume, enhance soil stability, provide micro-climate moderation and increase groundwater recharge and base flow. The goal of riparian/wetland reclamation is to minimize disturbance and to restore and preserve their natural functions. Specific reclamation activities should include flood energy dissipation, bank building, sediment filtering, water storage and aquifer recharge. The soft engineered stream bank treatments outlined above provide appropriate reconstruction of riparian eco-systems. The reestablishment of riparian plants along streams can be paramount if the ecosystem is to regain a foothold and thrive.

Riparian wetland areas are among the most productive and important ecosystems, comprising nearly one percent of the public lands. Characteristically, these areas display a greater diversity of plant and animal life and vegetation structure than adjoining ecosystems.

Minimizing impacts to the wildlife and fisheries resources is an important consideration in reconstruction. Protection of threatened and endangered species and their habitat is provided for under the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*). Baseline data of the wildlife and fisheries use will provide a valuable reference for development of the reclamation plan.

For restoration to provide wildlife habitat, emphasis should be placed upon habitat features that promote maximum vegetative species diversity and value following operations. Target wildlife species may be selected as the primary focus of revegetation efforts. Target wildlife species should occur in the area, or have the potential to occur, if provided with the proper forage (or other habitat elements). For common or well-studied species, food habit information may be available in publications from State or Federal wildlife agencies.

References

Handbook of Western Reclamation Techniques, The Office of Technology Transfer, Western Regional Coordinating Center, Office of Surface Mining Reclamation and Enforcement, 1996.

Solid Minerals Reclamation Handbook, BLM Manual Handbook H-3042-1. This document is provided on the CD-ROM accompanying this handbook (CEH 12 2002\03 All Documents\103 Reference Materials\Solid Minerals Handbook).

Stream Corridor Restoration Principles, Processes, and Practices, Federal Interagency Stream Restoration Working Group, 10/98, http://www.usda.gov/stream_restoration/newtofc.htm
This document presents information on how to develop and apply a stream corridor restoration plan.

Four Bioengineered Stabilization Treatments, Windell, Jay, and Gurnee, Grant,. Bioengineering. March/April 1999.

4.2 Landfills

Landfills located on agency lands can pose a danger to human health and the environment if they are not properly constructed and maintained. The most complex sites often investigated by the Agencies involve a series of removal and remedial actions including: reactive walls; pump and treat; frequent sampling and monitoring. All of this occurs in a frequently hostile regulatory and public environment. Except for very simple, small landfills, a full work plan is appropriate including groundwater investigations.

The remediation and cleanup of a landfill site will include characterizing site contamination, implementing the appropriate remediation option and returning the landfill area to a natural state. Remediation options for landfills will vary depending on the conditions at the site. They may be as simple as covering the material with a simple earthen cap or it may be as complex as constructing and placing the material in a lined, capped repository complete with monitoring wells and a leachate collection system. The cost to cleanup a landfill site will ultimately depend on the remediation option chosen. This section will focus on the use a cap.

4.2.1 Site Characterization

In order to characterize a landfill site, a determination of the onsite contamination and the associated hazards they pose to human health and the surrounding environment must be made. The characterization of onsite contamination involves collecting all available data about the site, sending a team to collect samples, analyzing the samples, compiling and reviewing all appropriate data and then making an assessment. This characterization is accomplished by conducting a study such as a RPA or an EE/CA. More information can be found on characterization studies by reviewing Sections 3.2 through 3.6. Also see Section 3.2.2 concerning HASPs.

One of the major tasks associated with characterizing a landfill is the collection and analysis of samples. Soil and waste samples are typically collected from the buried refuse and from the bottom of the landfill at the waste/soil interface. The typical compounds screened through analyses include TAL metals, VOCs, Semi-Volatile Organic Compounds (SVOCs), pesticides/PCB and herbicides, and methane. The samples should be tested for any other constituents of concern based on available data gathered. Initially, very few samples (10 - 15 samples) are required to quickly determine whether or not a landfill contains potentially hazardous material. A typical sample crew consists of two or three OSHA-trained members. The leader of the sampling crew is generally a mid- or junior-level geologist or engineer, and the rest of the members are junior level geologists or engineers, or experienced technicians. Normally, a backhoe is used during the sampling activities to excavate trenches into the buried waste. This provides access to collect samples and provides an opportunity to observe the contents of the buried refuse. For more cost estimation information see the Analytical Services Section 5.3.

4.2.2 Capping Considerations

There are several considerations that must be taken into account when cleaning up a landfill site. The first consideration that should be made is whether a cap will be the best remediation option. Appropriate cleanup options will be proposed and analyzed as part of the Site Characterization study or studies. Typically, the constructing of a cap over landfill material provides an option that is economical and provides adequate protection to human health and the environment.

In order to design a cap that would provide adequate protection to human health and the environment there are several capping considerations that must be taken into account. First, the characteristics of the site, such as the size of the landfill, the topography and climate of the surrounding area, the constituents of concern in the landfill, whether these constituents will leach and mobilize to contaminate groundwater, the depth of the water table, the proximity of surface water, run-off and the proximity to and access of public to the site must be considered in determining the design parameters of the cap. The design parameters that will need to be determined are the number of layers, the material in each layer, thickness of each layer and the type of cap stabilization (revegetation). Potential landfill cover designs for the site can be developed and analyzed with the assistance of the Hydrologic Evaluation of Landfill Performance (HELP) computer model developed by USEPA. This "quasi-two-dimensional hydrologic model was issued to conduct water balance analysis for landfills, cover systems, and other containment facilities" The model assists in the determination of appropriate waste disposal cover and liner design elements for a particular application.

4.2.3 Cap Construction

A simple soil cap formed of two feet of silty loam is often considered for landfill sites. In general, this method may reduce the leachate produced by percolation to an acceptable level. A multi-media cap with a geosynthetic liner may be required to prevent percolation through the waste materials, but represents additional costs for the installation and management of the liner.

Construction of the cap over the surface area of the landfill will involve the excavation and hauling of cap material, dumping it in place, and then spreading and compaction the material. Earth moving equipment such as bulldozers and front-end loaders are typical equipment used to excavate borrow materials. Often cap materials can be found either on-site or in the local area on agency land and will be free of charge. Dump trucks and dump trailers can be used to haul and dump the cap material in place. Bulldozers are most often used to spread the dumped material. Compaction using a sheep foot compactor helps to prevent surface water from penetrating the cap.

4.2.4 Revegetation

The goal of site reclamation, ultimately, is to stabilize a site and return it to a natural state. After capping has taken place, a site is typically revegetated. A layer of topsoil or seed bed may need to be hauled in from a local nursery to promote proper vegetation growth. Dump trucks can be used to haul the topsoil. The revegetation process will consists of seeding and planting grasses, trees, shrubs or other native and non-native vegetation. Broadcast seeding can be divided into ground seeding, aerial seeding and hydro seeding. Seed spread by broadcasting should be raked to cover and provide good soil-seed contact. Revegetation is the most successful if it is completed immediately after the seed bed is prepared and just prior to a long season of precipitation.

4.2.5 Erosion Control

Proper grading, vegetation, surface armoring, and riprap on the soil cover surface protects it from gullying, riling and being scoured by surface water, and thereby minimizes erosion. Silt fencing can be used to prevent sediment and soil erosion during vegetation growth period. The cover should be sloped to allow for good lateral drainage within the cover section, and to limit erosive velocities of local runoff on the cap. In addition, if erosion matting is not used, then the slope should be roughened to prevent rill erosion. See **Appendix A, Table 4.5** for details on costs. For cost estimation purposes see heavy equipment rates found in the General Construction Section 5.4 and the Site Rehabilitation Subsection 4.1.3.

The operation and maintenance activities for a capping strategy could include long term watering and other care required for the success of the new vegetation, additional placement of seed in areas of unsuccessful revegetation and other needed repairs to the surface of the cap. It may also include monitoring of the repository if monitoring wells are part of the remediation design. If this is the case long term monitoring may involve the collection of quarterly groundwater samples.

4.3 Illegal Dumping

Illegal dumping is disposal of waste in a non-permitted area. It is also referred to as “open dumping,” “fly dumping,” and “midnight dumping” because materials are often dumped in open areas, from vehicles along roadsides, and late at night. Illegally dumped wastes are primarily nonhazardous materials that are dumped to avoid either disposal fees or the time and effort required for proper disposal. These materials typically include:

- Construction and demolition waste such as drywall, roofing shingles, lumber, bricks, concrete, and siding.
- Abandoned automobiles, auto parts, and scrap tires.
- Appliances or “white goods.”
- Furniture.

- Yard waste.
- Household trash.
- Medical waste.

Wastes such as scrap tires, bulky items, and yard waste may be illegally dumped because they are banned from landfills and their proper management can be costly. Residential and commercial wastes may be illegally dumped in areas that lack or have costly pickup service.

Sites used for illegal dumping vary but may include abandoned industrial, residential, or commercial buildings; vacant lots on public or private property; and infrequently used alleys or roadways. Because of their accessibility and poor lighting, areas along rural roads and railways are particularly vulnerable. Illegal dumping can occur at any time of day but is more common at night or in the early morning hours during warmer months.

If not addressed, illegal dumps often attract more waste, potentially including hazardous wastes such as asbestos, household chemicals and paints, automotive fluids, and commercial or industrial wastes.

The health risks associated with illegal dumping are significant. Areas used for illegal dumping may be easily accessible to people, especially children, who are vulnerable to the physical (protruding nails or sharp edges) and chemical (harmful fluids or dust) hazards posed by wastes. Rodents, insects, and other vermin attracted to dump sites may also pose health risks. Dump sites with scrap tires provide an ideal breeding ground for mosquitoes, which can multiply 100 times faster than normal in the warm, stagnant water standing in scrap tire casings. Severe illnesses, including encephalitis and dengue fever, have been attributed to disease-carrying mosquitoes originating from scrap tire piles.

In rural areas, open burning at dump sites can cause forest fires and severe erosion as fires burn away trees and undergrowth. Dumping activities in such areas can also have a negative impact on plants and wildlife. Additionally, runoff from dump sites containing chemicals may contaminate wells and surface water used as sources of drinking water.

Reference

http://www.epa.gov/reg5rcra/wptdiv/illegal_dumping/downloads/il-dmpng.pdf Illegal Dumping Prevention Guidebook EPA publication.

4.4 Illegal Labs

In recent years illegal drug manufacturers have discovered and taken advantage of the remoteness and existence of AML site buildings and other abandoned structures on agency lands. The hazards of entering such buildings extend beyond the exposure to chemical reagents. Operations are frequently protected by armed guards and/or booby traps. Illegal methamphetamine laboratories present a danger to anyone who happens to cross them or personnel involved in the emergency cleanup. State police typically escort personnel during activities at the site.

According to the U.S. Department of Justice, clandestine laboratories present significant environmental and public health challenges. While active labs pose a greater risk of chemical exposure than do sites where drugs were formerly produced, both environments should be considered hazardous waste sites and should be treated as such by law enforcement, environmental, and health agencies.

Once all necessary evidence samples are collected at the clandestine laboratory site, remaining chemicals, laboratory glassware, and equipment should be considered contaminated and disposed of properly. States vary in how hazardous chemicals may be destroyed. For example, the California Health and Safety Code allows, with specific requirements, for the destruction of chemicals used in the manufacture of controlled substances. The State of Washington allows a “destruct order” to be issued in conjunction with the search warrant for the laboratory site, enabling law enforcement officers to “destroy or arrange for the destruction of any item suspected of being dangerous or hazardous, such as chemicals, residue, contaminated lab equipment, containers for such items, or other suspected hazardous substance." Although law enforcement personnel should be present to provide security for the disposal operation, the actual procedures should be performed by a qualified disposal contractor. The contractor should remove, transport, store, and dispose of all chemicals and associated glassware, equipment, and contaminated materials from the site, and prepare manifests. In so doing, the contractor should be familiar with and comply with applicable Department of Transportation (DOT), EPA, and State regulations:

- EPA and required State identification numbers.
- Controlled substances registration (if State mandated).
- Appropriate vehicles, material, and personnel available.
- Reasonable response time.
- Use of an RCRA-permitted treatment, storage, and disposal (TSD) facility.
- Knowledge and experience necessary to manage and dispose of hazardous materials properly.

Selection of the disposal contractor may require input from health and environmental officials as well as law enforcement officials to review contractor qualifications in light of State and local needs. Jurisdictions vary in how they select and use disposal contractors. For example, in California, both the Bureau of Narcotic Enforcement and Drug Enforcement Agency (DEA) have disposal contractors; decisions about which contractor to call are most often predicated on which is the "lead" investigative agency.

4.4.1 PPE

One of the most important decisions involves the selection of and requirement for staff use of PPE. The diversity of known and potential health hazards at the clandestine laboratory scene requires that all responding personnel be protected to the fullest extent possible. See Section 5.2.1, for cost information concerning PPE.

Three principal elements go into equipment choice : (1) PPE, (2) respiratory protection, and (3) air monitoring equipment.

The type and degree of protection required for clandestine laboratory response is dependent on the type and degree of hazards to be encountered, type and duration of work to be performed, and clothing and equipment use limitations. The PPE component should delineate specific levels of protective equipment to be worn for the varying hazardous chemical and physical environments associated with clandestine laboratory responses. For example, the Washington State Patrol policy mandates the use of self-contained breathing equipment when dealing with certain hazardous labs, such as an LSD or fentanyl site. (Several Federal agencies have recommended minimum levels of PPE for varying hazardous environmental levels.)

To select the appropriate level of PPE, the working conditions should be assessed, including airborne concentrations of contaminants and other environmental factors. Selection criteria for PPE fall into three general areas:

- Hazard assessment
- Performance requirements
- Chemical resistance

4.4.2 Hazard Assessment

Examples of hazard information that should be assessed include:

- Chemical hazards (each chemical's physical and toxicological properties).
- Physical hazards (hot temperatures).
- Degree of hazard (grade, strength, quantity of chemicals present).
- Work function, duration, and probability of exposure.

4.4.3 Performance Requirements

Protective clothing and equipment should be selected with specific use requirements in mind. Products may be manufactured from a variety of materials that provide varying levels of protection and performance. The following are several factors to consider in assessing PPE performance requirements:

- Strength (degree to which it withstands tears, abrasions, and punctures).
- Flexibility (degree to which it allows freedom of movement).
- Temperature resistance (degree of protection in extreme temperatures).
- Cleanability (whether it can be washed and decontaminated routinely).
- Durability (degree to which it resists aging and maintains protective capacity over time).

4.4.4 Chemical Resistance

The PPE's chemical resistance (the degree of protection against specific chemical hazards) requires special consideration since no single material will provide proper protection against all chemical hazards. All materials used in protective clothing and equipment are susceptible to attack by various chemicals; therefore, it is important to know which material will protect against which chemicals.

4.4.5 Equipment

Specialized air monitoring equipment is needed to evaluate chemical hazards by testing for explosive atmosphere and oxygen deficient atmosphere at clandestine laboratory sites prior to collecting evidence and dismantling the laboratory. Combustible gas indicators are used to measure the concentration of flammable vapors or gases in the air. The advantage of using this type of instrument are: (1) immediate reading; (2) simple to operate; (3) portable; and (4) built-in audible alarms. The limitations of using this type of instrument are: (1) combustible gas indicators are intended for use only in normal oxygen atmospheres; (2) oxygen deficient or enriched atmospheres can produce false readings; and (3) certain substances (i.e., leaded gas vapors) can affect the meter's ability to respond correctly.

4.5 Shooting Ranges

The cleanup and remediation of an abandoned shooting range consists of characterizing the site, removing projectiles, casings and contaminated soil and returning the shooting range to a natural state. Typically, remediation oversight for the project will consist of a two-member team that could include Project Managers, HSOs, Senior Engineers or Scientists. There will also be a construction oversight team that include a Project Foreman, HSO and possibly additional supervisors depending on the size of the project.

4.5.1 Site Characterization

In order to characterize the site, a determination of the onsite contamination and the associated hazards they pose to human health and the surrounding environment must be made. The characterization of onsite contamination involves collecting all available data about the site, sending a team to collect samples, analyzing the samples, compiling and reviewing all appropriate data and then making an assessment. This characterization is accomplished by conducting a study such as a RPA or an EE/CA. More information can be found on characterization studies by reviewing sections 3.1 through 3.5.

One of the major tasks associated with site characterization is the collection and analysis of samples. Projectile, casing, soil, air, surface water and groundwater samples are collected from firing lines, ranges, berms, and overshot areas. Air, surface water and groundwater can also be collected from areas adjacent to the shooting range if contamination is noted off-site. The samples typically are analyzed using TCLP and Totals analysis for heavy metals, volatiles and semi-volatiles. A typical sample crew consists of two or three OSHA-trained members. The leader of the crew is generally a mid- or junior-level geologist or engineer, and the rest of the members are junior-level geologists or engineers or experienced technicians. For more cost estimation information, see the Analytical Services Section 5.3.

4.5.2 Removal

Projectiles, casings and contaminated soils are typically removed from the firing lines, ranges, berms and overshot areas. Heavy equipment such as bulldozers, front-end loaders and backhoes can be used for excavation where appropriate. Large containers such as hoppers or roll-off bins can be used to hold the materials until disposal. Sometimes it is necessary to minimize the impact of remediation on the surrounding environment. In such cases hand excavation or vacuum trucks can be used. The projectiles and casings can then be separated from the contaminated soil and recycled to help defer the cost of remediation.

Projectiles and casings are typically separated from soil using sieves or vibrating screens. The sifted projectiles and casings can be sent to a lead recycler. The soil should be tested in the field to determine if it is hazardous. An XRF can be used as a rough guide for distinguishing between hazardous and non-hazardous levels of heavy metals in soil. If hazardous, it should disposed of in a RCRA Subtitle C hazardous waste landfill, if non-hazardous, it should disposed of in a Subtitle D industrial waste landfill. For cost estimating purposes see the earth moving equipment rates in the General Construction Section 5.4.

4.5.3 Disposal

After the contaminates have been excavated they need to be transferred and recycled or disposed of properly. Various size dump trucks, dump trailers, and trucks to transport large containers such as hoppers and roll-off bins are used to transfer materials. The costs for trucks include equipment rental and labor by the day and milage. It is important to note that hazardous waste manifests, labels, placards and applicable permits are required for hazardous wastes transportation.

By recycling the projectiles and casing, a portion of the remediation costs may be recouped. The amount of return, if any, on the recycled lead depends on the lead content and its current market value. The cost to landfill hazardous wastes depends on the contaminates, their concentration and whether they need pre-treatment. Disposal costs include profiling costs, disposal charges and applicable taxes. Transportation and disposal costs for hazardous and non-hazardous wastes can often comprise a large portion of the total remediation cost. For general landfill disposal cost estimate information see the **Appendix A** tables and the Hazardous Waste Treatment and Disposal, Section 5.5.

4.5.4 Revegetation

Before grasses, trees or shrubs can be planted, the land should be recontoured to match the surrounding environment. Earth moving equipment such as bulldozers, backhoes and front-end loaders are utilized to excavate and grade the site. Once the general contour of the land has been established the revegetation process begins. This includes soil management, seed bed preparation, fertilization, soil amendments, seed selection, seed acquisition, seeding, planting and mulching. See **Appendix A, Table 4.6** for details on costs. Costs for professional services and equipment are described in more detail in Sections 5.1 and 5.4 respectively.

4.6 Underground Storage Tanks

Congress directed the EPA, under Subtitle I of the RCRA, to establish regulatory programs that would prevent, detect, and cleanup releases from USTs containing petroleum or hazardous substances. The UST regulations that EPA issued in 1988 established a number of corrective action requirements for UST owners and operators including operation, closure, and installation requirements as well as the requirement to cleanup soil and groundwater as needed to protect human health and the environment.

4.6.1 Temporary Closure

Tank closure is one way to help protect human health and the environment, particularly groundwater, from the threats posed by many older USTs. An UST can be closed temporarily (up to 12 months) or permanently.

A temporary closure must meet the following requirements:

- Continue to monitor for leaks using leak detection if the UST is not empty.
- Monitor and maintain any corrosion protection systems.
- Take appropriate action to cleanup any releases.

If the UST remains temporarily closed for more than 3 months, leave vent lines open, but cap and secure all other lines, pumps, man ways, and ancillary equipment.

After 12 months of temporary closure, one of three options available must be chosen. These options include permanent closure if it doesn't meet the applicable requirements for new or upgraded USTs (except for spill and overfill); getting an extension beyond 12 months, if an assessment is provided that determines whether contamination is present at the site; or maintaining a temporary closure without needing an extension granted by the regulatory authority if the UST meets the applicable requirements for new or upgraded USTs (except for spill and overfill) and the requirements noted above for temporary closure.

4.6.2 Permanent Closure

Permanent closure of a UST can be more involved than a temporary closure but provides a permanent solution and, therefore, may be more appealing to agency offices. A permanent closure must meet the following requirements:

1. Notify the regulatory authority at least 30 days before the UST is closed.

2. Determine if contamination from the UST is present in the surrounding environment. If so, it may be necessary to take corrective action. Keep a record of the actions you take for at least 3 years to determine if contamination is present at the site (or you can mail this record to your regulatory authority). It is often cost effective to remove the tanks, lines, pumps, and ancillary equipment while testing for soil and water contamination; soil removal may be appropriate.

3. Either remove the UST from the ground or leave it in the ground. In both cases, the tank must be emptied and cleaned by removing all liquids, dangerous vapor levels, and accumulated sludge. The removal of USTs should be carried out by trained professionals who follow standard safety practices. If the UST is left in the ground, fill it with a harmless, chemically inactive solid, like sand.

The samples collected as part of a permanent closure will determine the presence and extent of contamination. The number of samples and the analyses conducted will vary from site to site. The samples should be collected from the contents of the tank, underneath the tank and anywhere where leaking is visible. Samples should be analyzed for those contaminates contained within the tank as well as TAL metals, VOCs, SVOCs, Pesticides/PCB and Herbicides. It is important to check state and/or local regulations for the sampling and analysis associated with the permanent closure of a UST. Upon completion of the sampling and analysis the tank may either be removed or left in place. This decision is typically based on the use of the land after remediation and if cleanup of the soil beneath the tank is necessary. In either case the tank must be emptied and cleaned. Liquid materials can be pumped from the UST to a tanker truck for transfer and disposal. Sludges and solids that have formed in tanks may need to be excavated. In order to excavate solid material an access hole may need to be cut in the tank. The UST should be flushed to remove waste residues. All wastes removed from the tank must be disposed of properly. If the tank is removed it must be disposed of properly and the existing hole must be backfilled with appropriate borrow material. See **Appendix A, Table 4.7** for cost information.

4.6.3 Operating/Upgrading

To operate or upgrade a UST system, it is important that the system meet the current UST regulations. The main idea of operating or upgrading is to ensure there is some type of corrosion protection, and to install devices necessary to protect against spills and overfills. Without the protection provided by upgrading, your UST is more likely to leak, damage the environment and require costly cleanups. Before operating or installing a tank the integrity must be checked. Some common corrosion protection measures for tanks include cathodic protection, interior lining or a combination or the two. Spill protection should include installing catchment basins and following correct filling practices. The three main types of overfill devices include automatic shutoff devices, overfill alarms and ball float valves. Damaged tanks and piping can not be repaired and must be replaced.

4.6.4 Installation

To install an UST system after December 22, 1998, it must meet the Federal requirements for correct installation, leak detection, and spill, overfill, and corrosion protection. Some states may have further requirements such as UST installers be certified (in addition to being qualified) to conduct this type of work. The state or territorial UST program should be checked to ensure that the appropriate regulations are followed. Federal regulations for installation of tanks and piping (40 CFR Part 280.20 (d) and (e)) require that:

1. [paragraph (d)] all tanks and piping must be properly installed in accordance with a code of practice developed by a nationally recognized association of independent testing laboratories and in accordance with manufacturer's instructions.

2. [paragraph (e)] certify on a notification form that one or more of the listed methods of certification, testing, or inspection is used to demonstrate compliance with part (d), above.

Cost Discussion

Tank RACER is a windows-based PC software for very large removals that provides fast, accurate, and comprehensive cost estimates for cleanups at petroleum and UST sites. However, RACER may not be applicable to smaller removals, such as a 250-gallon underground tank in the middle of the desert environment. It was produced through an Interagency Agreement between the U.S. Air Force and the U.S. Environmental Protection Agency. Several Government agencies, including eight state agencies, EPA, and DoD, have participated in the validation of the system.

Tank RACER is an UST removal Cost Estimation Software: http://www.epa.gov/swerust1/tnkracr1.htm

4.7 Facilities

4.7.1 Hazardous Waste Spills/Expired Products

See Section 5.5, Hazardous Waste Treatment and Disposal. In addition, depending on the materials involved, the appropriate action in responding to a spill of hazardous waste, substances or materials is similar to that of pre-removal actions. However, it is important to note that ALL suspected spills of hazardous waste, etc., should only involve staff with proper training, such as 24-hour HAZWOPER or 40-Hour HAZMAT worker training.

4.7.2 Asbestos

There are several types of asbestos fibers, of which three have been used for commercial applications:

1. Chrysotile, or white asbestos, comes mainly from Canada, and has been very widely used in the U.S. It is white-gray in color in its natural state and found in serpentine rock.

2. Amosite, or brown asbestos, comes from southern Africa.

3. Crocidolite, or blue asbestos, comes from southern Africa and Australia.

Asbestos-containing products are commonly used for their thermal insulating properties. Some of the more common asbestos-containing products include pipe insulation, insulating cement, insulating block, asbestos cloth, gaskets, packing materials, thermal seals, refractory and boiler insulation materials, transite board, asbestos cement pipe, fireproofing spray, joint compound, vinyl floor tile, ceiling tile, mastics, adhesives, coatings, acoustical textures, duct insulation for heating, ventilation and air conditioning (HVAC) systems, roofing products, insulated electrical wire and panels, and brake and clutch assemblies.

Asbestos-containing materials (ACMs) in buildings do not always pose a threat to occupants and workers. Intact, undisturbed ACMs generally do not pose health risks. However, they may become hazardous and pose increased risk when they are damaged, disturbed, or deteriorate over time and thus release asbestos fibers into building air.

4.7.2.1 Air and Bulk Sampling

Air and bulk sampling for asbestos requires a building inspection and involves several elements. These elements include: investigating site records, performing a site visit, and developing a sampling plan. Before conducting the site visit, an investigation of building records which may indicate locations of ACMs should be made. This research may include architectural drawings, floor plans, or work-order forms. Once copies of these documents have been obtained, a site visit can take place. This site visit should include bulk and air sampling as well as a visual inspection of all building spaces to assess the condition and location of ACMs. A sampling plan should be prepared based on the location and quantity of ACMs present and according to the specifications presented in the Asbestos Hazard Emergency Response Act (AHERA). Bulk and air samples, once collected, should be analyzed by an accredited laboratory using appropriate microscopic techniques. OSHA recommends that bulk sample analysis be done by Polarized Light Microscopy (PLM). Bulk analysis results will likely apply to both OSHA and EPA regulations.

Once sample results have been obtained, a hazard assessment should be made considering the physical condition and location of all ACMs as well as any other building characteristics which may affect the probability of disturbance or damage to the materials, leading to a fiber release. With this information in hand, a management plan, possibly including abatement may be composed.

4.7.2.2 Sampling Team

A typical sampling team should consist of at least two inspectors, with at least one member of the team being AHERA certified. The time required to perform an asbestos inspection is highly variable from one building to another. Factors of particular influence in determining the length of time it will require to survey a building are: building square footage, building age, building use or classification, number of homogeneous sampling areas present, and accessibility. Most often, a larger building will require longer sampling time than a smaller one; however, some situations exist in which a large number of suspect materials are present in a very small area. Building use may also help in estimation of inspection time. For example, an office building will tend to have fewer suspect materials than a boiler plant. Older buildings will generally be more time consuming when sampling, often due to the presence of a larger number of sampling areas. In addition to the fact that ACMs were used far more frequently some time ago, patching and replacement of damaged materials over time will bring more sample areas into the building.

Perhaps the most overlooked factor in determining the amount of sample time required is building accessibility. Since AHERA requires inspection of all building areas, preparations must be made prior to the inspection to gain access to mechanical rooms, crawl spaces, restricted areas, and other locations not of public access. Under average conditions, an experienced team should be capable of sampling approximately 3,500 square feet per hour, or nearly 30,000 square feet in a typical eight hour work day. **Appendix A, Table 4.8**, lists a number of factors that can have an effect on the time it takes to perform an inspection.

Air sampling often takes place concurrently with the bulk sample collection. Air sampling requires approximately four hours to obtain the appropriate volume of air. Advanced planning will prevent lost waiting or down time. **Appendix A, Table 4.9** presents cost information.

Some projects require reports of greater complexity than others, such as those which require Computer Aided Design (CAD) drawings. These types of projects will often require as much as 50 percent more computer time.

4.7.3 Environmental and Safety Audits - CASHE Process

The purpose of Environmental and Safety Audits is to assist BLM and Forest Service managers in identifying compliance issues that may exist at their facilities and determining the resources necessary to correct them. This type of audits is based on the Compliance Assessment - Safety, Health, and the Environment (CASHE) Protocol Manual developed by BLM. The CASHE process contains 22 protocols that provide detailed discussions of regulatory requirements and their applicability to typical BLM facilities. These protocols are divided into 16 environmental protocols (e.g., air, hazardous materials/hazardous waste transporter, PCBs, SARA Title III, solid waste, and wastewater) and six OSHA protocols (e.g., asbestos, hazardous materials, and material handling and storage).

A CASHE audit includes a visit of the subject facility (e.g., BLM or Forest Services offices, visitor centers, and recreation areas), consisting of the evaluation of hazardous material business practices, work areas, structures, a review of facility records for compliance evaluation, and interviews with facility personnel; and the preparation and submittal of a CASHE Report. In addition to the description of the findings, the report includes correction action alternatives for each deficiency. The typical follow-up procedure consists of developing a Corrective Action Plan to provide guidance for the implementation of the corrective actions and estimate the associated implementation costs. The following are examples of statements of work developed during a CASHE audit that address specific needs of the audited facility:

Sample Statement of Work for Packing, Transporting, and Treating of Hazardous Waste

1.0 Inventory of Hazardous Waste to be Treated

Below are three examples of how the inventory can be listed.

First Example

1. Five 5-gallon spent silver recovery canisters. The canisters are plastic and have some free liquid in them. The contents exhibit EPA Hazardous Waste Number D011 (silver).

2. One 15-gallon spent silver recovery canister. The canister is plastic and has some free liquid it. The contents exhibit EPA Hazardous Waste Number D011 (silver).

3. Approximately 40 gallons of spent photo processing chemistry. The liquid exhibits EPA Hazardous Waste Number D011 (silver).

Second Example

An inventory of the hazardous waste to be treated under this contract is provided as Attachment 1.

Note to user: The inventory must provide the following information:

4. hazardous waste accumulation points;
5. types of hazardous waste (e.g., ignitable, corrosive);
6. number of 55-, 5-, and 1-gallon containers of each waste type;
7. number of aerosol cans; and
8. number of miscellaneous containers of each waste type (i.e., containers smaller than one gallon). For example, the number of small containers of flammable paint products and number of small containers of acids must be listed.

Third Example

The hazardous waste is accumulated at _______________. Bidders must come to the site, and inventory it prior to submitting a bid.

2.0 Bulking of Hazardous Waste

1. All containers of hazardous waste one gallon and larger shall be emptied into 55-gallon drums with other compatible wastes. Aerosol cans shall be collected in open head drums. The drums shall comply with the requirements of 49 CFR 173. Each drum shall be shipped full, minus an allowance for outage as defined in 49 CFR 173.24(h), with the exception of the last drum used to collect each type of compatible waste stream. The size of this last drum can be selected by the contractor.

2. The contractor may overpack, as opposed to emptying each one gallon and larger container of hazardous waste, if the contractor can show the over packing everything is cost beneficial to the Bureau. The Bureau must approve the documentation from the contractor which supports his claim that over packing everything is more cost effective prior to this action being taken.

3. Adhesives or other products which are too viscous to flow out of a container and render it empty in accordance with 40 CFR 261.7 shall be over packed.

4. A container smaller than or equal to 110 gallons is empty and therefore solid waste if commonly employed practices are used to render it empty (e.g., pouring, pumping) and there is less than one inch of residue remaining in the container. Empty containers 5 gallons or larger shall be rendered unusable by being crushed or cut vertically in half. Containers of acute hazardous waste or pesticides shall be tripled rinsed and the rinsate disposed of as a hazardous waste prior to destroying the container.

5. The contractor may bulk the hazardous waste inside a Bureau structure provided the location is approved in advance prior to the contractor bulking the waste. Otherwise the waste shall be bulked outside. The contractor is responsible for moving of the waste from its accumulation areas to the location(s) chosen for bulking of the waste. The contractor shall receive approval from the Bureau for any areas used to bulk the hazardous waste prior to taking any action.

3.0 Over Packing of Hazardous Waste

All containers of hazardous waste smaller than one gallon can be over packed or bulked with other compatible wastes at the contractor's discretion. The over-packed container must comply with the requirements of 40 CFR 173.25.

4.0 Safety and Spill Cleanup

The contractor shall provide their personnel with all Personal Protective Equipment necessary to allow the wastes to be safely handled and bulked. The contractors shall provide and stage spill cleanup equipment and supplies at each location were hazardous waste are bulked or over packed. The contractor is totally responsible for cleaning up any spills and disposing of the cleanup debris at no additional cost to the government.

5.0 Labeling, Marking, and Placarding

1. The contractor shall label and mark each drum and overpack in accordance with U.S. Environmental Protection Agency (EPA) regulations 40 CFR 262.31 and 40 CFR 262.32, and all applicable State of ___________ regulations.

2. The contractor shall provide the appropriate types and numbers of placards and securely affix them to the transportation vehicles. The placards shall comply with and be secured in accordance with U.S. Department of Transportation regulations 49 CFR 172, Subpart F.

6.0 Manifests and Land Disposal Restriction Notifications

1. The contractor shall prepare all manifests in accordance with EPA and State of __________ regulations. The Bureau's EPA ID# is __________________. The manifests shall be prepared in accordance with EPA regulation, 40 CFR 262, Subpart B.

2. The contractor shall prepare all Land Disposal Restriction Notifications in accordance with EPA and State of ___________ regulations. The notifications shall be prepared in accordance with EPA regulation or applicable state regulation, 40 CFR 268.7

3. The manifests and notifications shall be signed by Bureau personnel and copies retained by the same personnel prior to the hazardous waste being transported off site by the contractor for treatment and disposal.

4. Manifests signed by the treatment facility designated on the manifests must be received by the Bureau's representative within 45 days to avoid having the Bureau file an Exception Report with the EPA and state in accordance with 40 CFR 262.42(a)(2). The manifest with the original signatures of the generator, transporter, and designated facility is the manifest which must be received within 45 days. A copy or facsimile is not acceptable.

7.0 Emergency Response Information

1. The contractor shall furnish the 24-hour emergency response number required on each manifest. The contractor is responsible for ensuring that the emergency response number is staffed 24 hours a day and that the personnel staffing the phone are familiar with the wastes being transported from the Bureau.

2. Each contractor vehicle transporting hazardous waste shall have a copy of the Department of Transportation's Emergency Response Guidelines (ERG) in the vehicle readily accessible to the driver.

8.0 Treatment Requirements

1. All hazardous waste taken from Bureau facilities shall be sent to a hazardous waste incinerator or landfill that is permitted under EPA or appropriate state regulation 40 CFR 264.

2. All hazardous waste may be treated or disposed of in another manner only if approved of, in advance by the Bureau.

3. The incinerator(s) or landfill to which the Bureau's hazardous waste will be sent for treatment shall be identified in the contractor's proposal.

4. Hazardous waste from Bureau facilities cannot be sent to an incinerator facility which is under investigation by the EPA or state for improper operation.

5.0 Costing Information

This section of the handbook presents current costs for various services, equipment, and personnel often utilized to perform the activities described in Sections 3 and 4. The tables are for guidance in developing cost estimates and due to space limitations may not contain ALL services, equipment, or personnel required for every activity for which a cost estimate might be prepared.

5.1 Professional Services

The following section presents unburdened, direct labor salary ranges for the types of personnel typically involved in environmental projects. The overhead and profit associated with the following salaries was due to the wide range of overhead and profits depending on the size of the company and project. Small companies typically have less overhead than larger companies. Government projects are billed lower than private sector projects. Much of the overhead and profit can be associated with the direct labor that goes into a project. It also depends on the size of the project. A small project will require a larger percentage of overhead and profit as compared to a large project.

Program manager labor should not be more than 5 to 10 percent of the project. The number of years of experience associated with the technical levels of effort are: Junior 0-3 years, Mid 4-7 years and Senior 8+ years experience. The salary information is based on 2002 National data from www.salarysurvey.com and from the 2000 Scientific Salaries Survey published by Dietrich Associates, Inc. Salaries for personnel associated with small, rural establishments may be lower. A college degree is typically required for mid- to senior-level professional positions, often with an M.S. or Ph.D. preferred. Staffing rates are provided in **Appendix A, Table 5.1**.

5.2 Field Investigations

5.2.1 Personal Protective Equipment

The selection of the appropriate PPE is a complex process which should take into consideration a variety of factors. Key factors involved in this process are identification of the hazards or suspected hazards; their routes of potential hazard to employees (inhalation, skin absorption, ingestion, and eye or skin contact); and the performance of the PPE materials and seams in providing a barrier to these hazards. The following are guidelines to help the selection of the appropriate PPE. The site information may suggest the use of combinations of PPE selected from the different protection levels (i.e., A, B, C, or D) as being more suitable to the hazards of the particular work site.

The PPE is divided into four categories based on the degree of protection, with Level D offering the least protection and Level A the most degree of protection. PPE should be fully discussed in the HASP and enforced on the site (see Section 3.2.2).

Level D: A work uniform affording minimal protection, used for nuisance contamination only. The following constitute Level D equipment:

- Coveralls.
- Gloves[1].
- Boots/shoes, chemical-resistant steel toe and shank.
- Boots, outer, chemical-resistant (disposable)[1].
- Safety glasses or chemical splash goggles[1].
- Hard hat[1].
- Escape mask[1].
- Face shield[1].

Note: [1]Optional, as applicable.

Level C: The concentration(s) and type(s) of airborne substance(s) is known and the criteria for using air purifying respirators are met. The following constitute Level C equipment:

- Full-face or half-mask, air purifying respirators (National Institute of Occupational Safety and Health [NIOSH] approved).
- Hooded chemical-resistant clothing (overalls; two-piece chemical suit; disposable chemical-resistant overalls).
- Coveralls[1].
- Gloves, outer, chemical-resistant.
- Gloves, inner, chemical-resistant.
- Boots (outer), chemical resistant steel toe and shank[1].
- Boot-covers, outer, chemical-resistant (disposable)[1].
- Hard hat[1].
- Escape mask[1].
- Face shield[1].

Note: [1]Optional, as applicable.

Level B: The highest level of respiratory protection is necessary but a lesser level of skin protection is needed. The following constitute Level B equipment:

- Positive pressure, full-face piece self-contained breathing apparatus (SCBA), or positive pressure supplied air respirator with escape SCBA (NIOSH approved).
- Hooded chemical-resistant clothing (overalls and long-sleeved jacket; coveralls; one or two-piece chemical-splash suit; disposable chemical-resistant overalls).
- Coveralls[1].
- Gloves, outer, chemical-resistant.
- Gloves, inner, chemical-resistant.
- Boots, outer, chemical resistant steel toe and shank.
- Boot-covers, outer, chemical-resistant (disposable)[1].
- Hard hat[1].
- Face shield[1].

Note: [1]Optional, as applicable.

Level A: To be selected when the greatest level of skin, respiratory, and eye protection is required. The following constitute Level A equipment:

- Positive pressure, full-face piece SCBA, or positive pressure supplied air respirator with escape SCBA (NIOSH approved).
- Totally-encapsulating chemical-protective suit.
- Coveralls[1].
- Long underwear[1].
- Gloves, outer, chemical-resistant.
- Gloves, inner, chemical-resistant.
- Boots, outer, chemical resistant steel toe and shank.
- Hard hat (under suit).
- Disposable protective suit, gloves and boots (depending on suit construction, may be worn over totally-encapsulating suit).

Note: [1]Optional, as applicable.

The costs for PPE are provided in **Appendix A, Table 5.2**.

5.2.2 Geophysical Investigation Methods

The following schedules of rates reflect the market prices for geophysical methods that may be required in environmental investigations. Due to the variety and complexity of the geophysical methods and equipment, each company has its own way of costing its services. Significant differences in cost estimates may derive from:

- Wide ranges of minimum charges for using the equipment.
- Some initial footage costs included in the mobilization or daily crew costs in borehole geophysics.
- Mobilization costs may increase up to ten times for sites farther than a certain distance (sometimes set between 150 and 200 miles) from the contractor's office.
- Level of PPE Required.

Please note that BLM owns various types of geophysical equipment that may be accessed by contacting Mr. Brent Lewis at the National Science and Technology Center, telephone (303) 236-0550.

5.2.2.1 Surface Geophysics

5.2.2.1.1 Electromagnetics

Electromagnetic methods (EM) are geophysical techniques that are based on the physical principle of inducing and detecting electrical current flow within geologic strata. EM induction surveys work by inducing time-varying magnetic fields into the ground from a transmitter coil, creating a magnetic field which is then measured at receiver coils. EM methods are useful to locate, delineate, and map landfill boundaries and cells, groundwater contaminant plumes, buried objects (e.g., metal objects such as drums, USTs, pipes, and metallic utilities), and previously excavated and backfilled areas. Some of the advantages of using EM methods include the ability to collect a large amount of data over a large area rather quickly, the ability to work in uneven highly vegetated terrain, and that the equipment is lightweight and easily transportable. The limitations include interference caused by surface or near surface metallic objects. An equipment list of available EM systems is provided in **Appendix A, Table 5.3**.

5.2.2.1.2 Electrical Resistivity

Electrical or direct current methods measure the bulk resistivity of the subsurface to determine the geologic structure and/or physical properties (e.g., clay, gravel, or sand) of the geologic materials. Resistivity methods work by introducing an electrical current directly into the ground through current electrodes. The resulting difference in voltage potential is subsequently measured between a pair of potential electrodes, which are typically arranged in a linear pattern. There is a small margin of error associated with depth, therefore, depending on the level of precision required, it may be necessary to perform confirmatory drilling or auguring along the resistivity survey lines.

The apparent resistivity is the bulk average resistivity of all soils and rock influencing the flow of current. Resistivity methods are useful in the characterizing and mapping of the subsurface hydrogeology, stratigraphy, depth to groundwater, and presence of clay aquitards. Some practical applications include defining the depth of tailings impoundments, depth of landfills or landfill cells, and the depth and extent of contaminant plumes. Some of the advantages of using resistivity methods include the ability to provide substantial quantitative data that can be used in computer modeling to provide accurate estimates of depth for volume estimation and the ability to provide surveys up to several hundred feet deep. The disadvantages include interference problems caused by overhead power lines and grounded metallic structures, and intensive labor requirements setting up the linear survey lines. An equipment list of available Electrical Resistivity systems is provided in **Appendix A, Table 5.4**.

5.2.2.1.3 Seismic Reflection

Seismic reflection methods involve the introduction of a sound wave from an acoustic source. The acoustic source will vary depending on the target depth. For example, deep surveys require a powerful source, such as a trailer or truck-mounted accelerated weight drop, to generate a low frequency wave. For shallow high resolution applications, a down-hole shotgun is used to generate a high frequency wave. The reflection of the sound wave is recorded by geophones. The geophones are typically placed along a line at equal intervals. The shallower the investigation, the closer the spacing of the geophones. Conversely, the deeper the investigation, the farther the geophones are spaced. Seismic reflection is a method extensively used in deep oil and gas explorations and which may, in principle, be used in environmental investigations. However, seismic reflection is less suitable for shallow depth surveys (which include essentially all environmental projects focused on soil and groundwater contamination) than seismic refraction, discussed below. None of the geophysical companies contacted to provide quotes for this cost estimating handbook offered seismic reflection services.

5.2.2.1.4 Seismic Refraction

In practice, seismic refraction methods are similar to seismic reflection techniques. The principle difference is in how the wave is recorded at the surface. The difference consists of measuring the travel times of compressional waves that are critically refracted from subsurface refraction interfaces. Practical applications of seismic refraction in the environmental field would involve the need to know information about the subsurface geology. Equipment and costs are provided in **Appendix A, Table 5.5**.

5.2.2.2 Borehole Geophysics

There are a number of borehole geophysical methods available that generally fall into one of five categories: electrical, magnetic, nuclear, seismic, and thermal. In general, borehole geophysical techniques are used to provide information on the physical or chemical makeup of the subsurface geology. Borehole geophysics can also be used in groundwater investigations. Typically, borehole geophysics are used to provide data delineating mineralized zones, in mapping alteration zones associated with mineralization, providing hole-to-hole lithologic correlation, detecting groundwater flow patterns within the holes, and determining in-situ physical properties for use in the interpretation of ground and airborne geophysical data. Borehole geophysics are commonly used during the use of groundwater study and well abandonment projects. In general, borehole geophysical instruments are quick and versatile. Most instruments can easily log between 250 and 500 feet per day and have the ability to combine specialized probes during single runs. It should be noted, however, that probes using nuclear sources may require Nuclear Regulatory Commission (NRC) or State radioactive licenses. **Appendix A, Table 5.6** provides a list of methods and average costs.

Reference

Appalachian Geophysical Surveys, 276 PA Route 366-Mamont, Apollo, PA 15613; Telephone: (412) 327-8119.

COLOG, Inc., 17301 W. Colfax, Suite 265, Golden, CO 80401; Telephone: (303) 279-0171.

Century Geophysical Corp., 7517 East Pine, Tulsa, OK 74115, Telephone: (918) 838-98141.

Vibra-Tech, 109-E First Street, P.O. Box 577, Hazleton, PA 18201; Telephone: (717) 455-5861.

5.2.3 Geologic Drilling

A two-man drilling crew, consisting of a driller and a helper, can handle most augering drilling projects, if work can be performed in Level D PPE. The addition of a second helper does not significantly improve the productivity of an average auger drilling job. However, the addition of a third drilling crew member in difficult projects (deep holes - more than 100 feet, difficult access, hard fractured rock, etc.), may generally help maintain the average daily footage listed in this section. Drilling crews of three or more are required for work in Levels A and B PPE and advisable for Level C PPE.

The costs in this section reflect work performed in Level D PPE. A 10 to 25 percent increase generally applies for upgrading to Level C PPE. The rates for projects requiring Levels A or B PPE are negotiated based on the specifics of each project.

Soil Drilling: The average productivity of a two-man drilling crew is 100 to 200 feet of soil drilling per day, depending on accessibility, drilling method, sampling requirements, experience, etc.

Rock Drilling: The average productivity of a two-man drilling crew is 50 to 100 feet of rock drilling per day, depending on accessibility, drilling method, sampling requirements, experience, etc.

5.2.4 Groundwater Monitoring

5.2.4.1 Monitoring Well Installation

Predrilled Boreholes, Including Labor and Materials

A two-man drilling crew, consisting of a master driller and a helper, can handle most well installation projects if work can be performed in Level D PPE (a driller with a Master Driller license is required in many states to certify the installation of a well). The addition of a third crew member increases the productivity significantly in only the most demanding projects. Drilling crews of three or more are required for work in Levels A and B PPE and advisable for Level C PPE.

The costs in this section reflect work performed in Level D PPE. A 10 to 25 percent increase generally applies for upgrading to Level C PPE. The rates for projects requiring Levels A or B PPE are negotiated based on the specifics of each project. The average productivity of a two-man drilling crew is 50 to 100 feet of monitoring well installed per day, depending on accessibility, well depth and diameter, well construction materials, well design, surface completion, experience, etc.

At sites with very limited hydrogeological information it is possible to have no indication of groundwater during the drilling operations for a monitoring well. This situation is due either to the boring being too shallow respective to the aquifer or to the aquifer having a very low specific discharge. Since the presence of groundwater is generally required for the installation of a monitoring well, a positive determination of whether the boring is dry or not is necessary. A preferred method to make that determination consists of placing a piezometer in the borehole, leaving the boring open (covered but not backfilled) overnight and taking water measurements the next day. The charges associated with these operations may consist of stand-by time (**Appendix A, Table 5.7**), and the cost of materials for the piezometer (a five or ten foot section of PVC screen of minimum diameter (i.e. cheapest) available and the length of riser necessary to complete the piezometer to ground surface). **Appendix A, Table 5.8** provides the installation cost, plus materials, for several different riser and screen sizes made from different materials.

5.2.4.2 Monitoring Well Construction Materials

Appendix A, Table 5.9 provides a list of materials and products that can be used during the construction of a monitoring well. After selection of the riser and screen I.D. size, practically every item listed in **Appendix A, Table 5.9** is used in the construction of a monitoring well.

5.2.5 Sampling Methods and Equipment

5.2.5.1 Environmental Field Instrumentation

There are a wide variety of sampling methods each governed by the media being sampled. Regardless, **Appendix A, Table 5.10** provides a list of instruments typically used in the environmental industry.

5.2.5.2 Groundwater Level Measurement Devices

Appendix A, Table 5.11 provides a list of equipment that is used during groundwater investigations.

5.2.5.3 Soil and Rock Sampling Techniques

Subsurface soil and rock samples are typically collected using a drill rig or via GeoProbe. With the exception of rock coring and soil cuttings, the methods listed in **Appendix A, Table 5.12** can be collected via GeoProbe.

5.2.5.4 Groundwater Sampling

Groundwater sampling operations consist of well purging and sample collection. Well purging is performed to increase the representativeness of the samples and consists of removing a minimum of three volumes of stagnant water from the well. A common procedure is to pump or bail the well until the required volume has been removed. A more reliable method is to pump or bail until the measurements of pH, temperature, and electrical conductivity have stabilized within some predetermined intervals. Samples are then collected by a low flow pump or by bailers.

A typical sampling team consists of two or three OSHA-trained members. The leader of the crew is generally a mid or junior level geologist or engineer, and the rest of the members are junior-level geologists or engineers, or experienced technicians. The time required to purge and sample a well varies in a large range depending on the depth and diameter of the well, accessibility, type of pumps or bailers, number of samples, availability of power, and well recharge (or recovery). For an "average" job, with shallow wells (no deeper than 20 to 25 feet below ground), good accessibility, and using bailers, purging and sampling operations may require 1.5 to 2.5 hours per well. Necessary equipment may include bailers or pumps (and a generator if power is not available), water level indicator, photo ionization detector, pH, temperature, and conductivity meters, graded buckets, latex gloves, etc. For cost estimating purposes see personnel rates in Section 5.1, Professional Services, and equipment costs, in Sections 5.2, Field Investigations.

5.2.5.5 Other Soil and Groundwater Testing and Sampling Methods

5.2.5.5.1 Dilatometer

The dilatometer is a spade-shaped stainless steel device with a circular pressure membrane on one side. The dilatometer is attached to the drilling rods of a drill rig and pushed into the ground. Readings are made every 0.2 to 0.5 meters of depth. With some computer processing and engineering interpretation, the results of a dilatometer survey provide estimates of in-situ pore pressure, overburden pressure, grain size distribution, in situ lateral pressure, and lateral strain-stress modulus. The dilatometer is not suitable for testing hard soils or layers mostly consisting of gravel, due to the incapacity of the blade to penetrate them. Sometimes this limitation can be overcome by alternating the use of the dilatometer with conventional auger drilling methods. The productivity of the method is in the range of 150 to 250 feet per day. Costs are provided in **Appendix A, Table 5.13**.

5.2.5.5.2 Cone Penetration Test

This method is similar to the dilatometer testing in that the probe is pushed into the ground to test in-situ soil properties. The penetration limitations of the two methods are also similar: the cone is not usable in hard or highly granular soils. The CPT consists of pushing continuously a cone-probe into the ground at a rate of 15 to 20 mm/sec and recording the cone resistance versus depth. The method is less complex than dilatometer testing and can be performed by drillers or technicians. The CPT is typically performed in conjunction with soil gas sampling or with shallow groundwater sampling. A disadvantage of the CPT is that the evaluation of the soil types producing the recorded cone resistance requires either considerable experience or recovery of soil samples for correlation testing.

5.2.5.5.3 Soil Gas Survey

Soil gas surveys are used for the detection of VOCs in the subsurface. Soil gas surveys are a method of initially assessing potential causes of concern in the subsurface of a site by extracting samples of the vapors in the soil and analyzing them through state-of-the-art gas chromatography.

The method consists of driving 3/4 inch OD hollow steel rods into the ground and collecting soil gas samples with a vacuum pump. Due to the small diameter of the rods, the driving equipment is small enough to allow its installation on dedicated pick-up trucks or vans. The rods can be driven to depths of approximately 40 feet, depending on soil conditions. As with any push/drive method, the hardness of soils is a limiting factor as is gravel. The advantages are lower costs (a drill rig is not required), the absence of investigation-derived waste, and the possibility to analyze the samples in the field. One of the main disadvantages of the method is that soil gas results are a secondary indicator of other media (soil and water) contamination. The productivity is in the range of 15 to 25 samples per day. The daily rates for the probe truck and a hydrogeologist are $1,200 to $1,500 for a 10-hour work day. Mobilization costs are estimated based on the number of hours required for a one-way trip to the site, multiplied by $125 per hour. The daily rates for a mobile laboratory trailer and a chemist, to perform the sample analysis in the field, are $1500 to $1,800 per day, including the gas chromatography (GC) analysis of all samples collected during the day plus 10 percent duplicate samples.

5.2.5.5.4 Shallow Groundwater Survey

This method is used to obtain groundwater samples without monitoring wells and is generally similar to the soil gas surveys; specifically, the samples are collected using the same equipment. The sampling and mobile laboratory costs are also similar.

5.2.5.5.5 Hydro-Punch Sampling

In cases when the hardness of the soil may prevent the use of the previous method, a drill rig may be used to pre-drill a hole to just above the depth of interest. The sampling probe can then be attached to the drilling rods and pushed into the ground to the required depth. One of the most used probes is Hydro-Punch. The method requires a junior or mid-level geologist or engineer to coordinate sample collection. Costs are provided in **Appendix A, Table 5.14**.

5.2.6 Air and Bulk Asbestos Sampling

Section 4.7.2, Asbestos, discusses in detail the requirements associated with asbestos sampling. Please refer to that section.

5.2.7 Aerial Photography

Aerial photography can be used by trained interpreters to determine land-use and environmental conditions, among other things. By comparing the aerial imagery, photo interpreters can detect old waste pits, lagoons, landfills, chemical spill evidence and other pollutants, and develop habitat analyses. It is important to note that none of the sources of aerial photographs have the photographs “in stock” so project planning is important to plan enough lead time into the project schedule to ensure that the photographs are obtained in a timely manner.

5.2.7.1 Where to Obtain Aerial Photographs

There are a number of sources of aerial photographs, including: U.S. Geological Survey (USGS); National Archives and Records Administration (NARA, archives); National Oceanic and Atmospheric Administration (NOAA); USDA, Forest District Offices; Denver and BLM State Offices; State highway administrations; and the Defense Mapping Administration. It is important to note that each agency has its own coordinate system.

USGS maintains the Earth Science Information Center (ESIC) to sell aerial photographs, remotely sensed images from satellites, a wide array of digital geographic and cartographic data, as well as the topographic and geologic maps. Declassified photographs from early spy satellites were recently added to the ESIC offerings of historical images.

The USGS Aerial Photography Summary Record System (APSRS) describes aerial photography projects that meet specified criteria over a given geographic area of the United States and its territories. The USGS maintains an inventory of over 600,000 aerial photographs for the entire country. The APSRS data base can be used to locate imagery in the collections of other Federal agencies and, in some cases, those of private companies that specialize in esoteric products. Each listing is a summary of aerial photography projects within an area, corresponding to the USGS 7.5-minute map series. Entries are sorted by project date and describe the scale, project code, film type, cloud cover, and camera focal length. The entries also give the name of the holding agency or firm. The APSRS (sometime in the future will be available on the website) data base and contributor data base are available on CD-ROM for $57, plus a $5 handling fee. The USGS can be contacted directly to take orders. Costs are provided in **Appendix A, Table 5.17**.

5.2.7.2 Historical Photographs

The Earth Resources Observation System (EROS) Data Center of the USGS maintains the National Land Remote Sensing Data Archive, including, 49 million satellite images and some 8 million aerial photographs of the United States. In addition, EROS contains aerial photography from the Bureau of Indian Affairs (BIA), the Bureau of Reclamation (BOR), EPA, National Park Service (NPS), the U.S. Air Force, the U.S. Army, the U.S. Navy and from various USGS programs. Originally, the photographs were acquired for a variety of agency projects, thus, providing irregular coverage over the conterminous United States, Alaska, Hawaii, and Micronesia. The film types, scales, acquisition schedules, and available end products differ according to individual agency project requirements. Low-, middle-, and high-altitude photographs using a variety of film types were collected. Some of them date to the 1940's.

Most aerial mapping photographs of the United States taken for Federal agencies before 1941 have been assembled at the Cartographic and Architectural Branch (CAB) of the National Archives. These photographs date from the mid-1930's and cover approximately 80 percent of the land area of the conterminous United States. The CAB also maintains a collection of American military photographs of the United States from the 1940's-1960's and some German military photographs of Eastern Europe and Russia flown during World War II.

In general USDA's (and its agencies) original film pre-1955 is stored at the NARA; 1955 to the present film is stored at Salt Lake City. For USGS, more recent film is stored at EROS, while the older film is stored at the NARA.

The Library of Congress (LOC) maintains a large collection of historical photographs, some of which are aerial photographs dating from 1900 to the 1940's, a series of panoramic views of U.S. cities taken between 1906-1908. The Library will perform a limited number of searches (less than 10) for a single mail inquiry, but visitors to Washington, D.C., are welcome to examine their research files. An important note, however, is that the LOC on-line catalog does not list aerial photographs nor does it list prices for obtaining copies.

5.2.7.3 Contemporary Photographs

The National Aerial Photography Program (NAPP) collects aerial photographs of the 48 conterminous United States on a 5-year cycle for multiple Federal agencies. More recent products are standardized under the NAPP in which the entire country has been photographed every five to seven years beginning in 1980.

In 1935 USDA began to use rectified-to-scale aerial photography to more efficiently measure acreage. Today, the Farm Service Agency, Aerial Photography Field Office (APFO) has aerial photographs which cover all the Nation's major crop land. Aerial photography taken for APFO dating from 1955 to the present is currently available through APFO, including much of the conterminous United States.

The National High Altitude Photography (NHAP) program, in operation from 1980-89, and coordinated by USGS, was an interagency project to eliminate duplicate photography in various Government programs, there is one cycle of coverage only in most cases, in the following scales: 1 to 58,000 CIR (color), and 1 to 8,000 B&W. These aerial photographs are available through the USGS.

The Still Picture Branch (SPB) of the National Archives has a large collection of photographs taken from the air. These date from the early 20th century to the present. Both the CAB and the SPB maintain search rooms where visitors can search the files for the photographs they want. For mail inquiries, be specific in describing area locations and time eras. Also, include your name, address, and daytime telephone number in each inquiry. The National Archives office will return a research report and a price list for prints. The SPB will also send electrostatic copies of appropriate photographs.

5.2.7.4 What to Obtain

In general, aerial photographs consists of one set of black and white paper print for proofing and two sets of titled prints. When searching for and ordering aerial photography, the following information will expedite locating the appropriate products: detailed maps clearly outlining the site limits; brief geographic description of the site including where possible, state, county, geographic coordinates ([Latitude/Longitude] and Township, Range and, Section [TRS]), different spellings of the site name, and relative location of the site with nearby, well-known geographic locales.

5.2.7.5 Creating Aerial Photographs (flying the site)

The Forest Service owns and operates aircraft, cameras, and sensor systems to acquire information for program activities with critical specifications for resource protection and monitoring.

If it is necessary for the agencies to hire a private contractor to take current aerial photographs, the cost is approximate (minimal base costs for flying a very small area are $2,000 ; $10 per square mile for black and white; CIR color infra red, normal color $13 per square mile CIR is $15 per square mile). These costs reflect photography of large areas (i.e., approximately 1/3 of a state 1,500 square miles or larger, 12,000 feet altitude, at a scale of 1:24,000).

Conventional oblique and vertical aerial photography services are obtained through the use of a fixed-wing airplane and/or helicopter. This type of photography can be taken anywhere from 500 to 15,000 feet. Vertical photos are taken at a 90 degree angle or looking straight down. They have the appearance of maps. While light is essential to all photography, timing is critical to the accuracy of an aerial photograph. Some aerial photography companies do not photograph any earlier than three hours after sunrise, or later that three hours prior to sunset, because if the shadows are too long, detail is lost. The minimum sun angle required is between 35 and 40 degrees, depending on terrain.

An exception is when looking for vegetation patterns in the water. Then, companies often capture vertical photography during the period from two or three hours after sunrise. This prevents direct solar reflection into the camera, and sun glint on the images.

The following information are the standards that USGS applies to aerial photography it accepts into its collections. This information is included here for general guidance.

Flight specifications for the NHAP/NAPP program require that all photographs meet certain standards regardless of the geographic area involved. The sun angle is 30 percent or higher to reduce potential shadow effects on the ground. Cloud cover must be absent, and atmospheric haze must be minimal. Even seasonal factors such as the presence of snow on the ground, flooding, or the amount of foliage are considered prior to accepting the photography. The center point of each photograph must also fall within a 1,000 foot radius of a pre-determined position within the north-south flight lines. Camera tilt shall not exceed four degrees, nor average more than two degrees in any ten mile section of a flight, nor average more than one degree for the entire flight contract.

The NAPP photographs are acquired over pre-determined exposure points within a 7.5 minute quadrangle map. The principal points of exposure divide the quad into quarter sections. Each section involves a 3.75 minute sub-quadrangle. The NAPP flight lines run north-south down the middle of these quarter-quads.

An alternate to fix-wing overflights is the LTA-Kamm™ which employs an 18-foot helium blimp that suspends a high-quality, professional camera above your subject while the operator composes and shoots the photo from the ground. Unlike conventional aerial photography, LTA-Kamm™ Photography is not subject to vibration. This means sharper images, without the need for costly enlargements. This service is less expensive than conventional aerial photography and may be appropriate for certain projects, such as: very low-level photography; restricted airspace; and noise-sensitive environs, such as wildlife areas. LTA-Kamm™ Photography can be taken between 10 and 500 feet above the ground, and requires no air traffic clearance.

In order to ensure that the correct area is recorded by the aerial photography, panels need to be secured to the ground to mark the site. The panels should be secured so they will remain in place until after the fly over. This task is often performed by the BLM District and Forest Service Regional custodial staff.

5.2.7.6 Interpretation

The ultimate product of aerial photography acquisition and analysis is a formal interpretation of the aerial photographs. The interpretation should consist of text, maps and the aerial photographs themselves. The interpretation can be performed by in-house staff, by USGS personnel, and by contractors. In addition to the interpretation, an independent QA/QC of the product should be performed. Finally, successful aerial interpretation requires a close working relationship between the project manager and the person doing the interpretation.

References

For background information about the basic elements of aerial photo interpretation, please check the University of Texas website at: http://www.utexas.edu/depts/grg/gcraft/notes/remote/remote.html.

BLM contact: Larry Cunningham at NSTC, (303) 236-6382; alternate contact at BLM Connie Slusser (303) 236-7991.

For information on USGS products and services, call 1-888- 275-8747, or Mr. Don Light (find new contact), Director of the USGS NAPP at (703) 648-5106, to discuss specific areas, or the USGS EROS Data Center at (605) 594-6151 or by e-mail: custserv@edcmail.cr.usgs.gov.

Library of Congress, Prints and Photographs Division (202) 707-6394.

National Archives and Records Administration Cartographic and Architectural Branch for information about obtaining aerial photographs from the CAB and the SPB at (301)713-7040.

5.3 Analytical Services

Sampling and analysis will likely be required as part of most investigations and/or remediation processes. The purpose of collecting samples and sending them to a laboratory for analysis is to gain information about a site to fill data gaps and to characterize site contamination. It is important that the data collected be representative of the site and that the quality of data meet the objectives of the project.

DQO are developed to plan field investigations so that the quality of data collected can be evaluated with respect to its intended use. Sampling procedures and analytical procedures are developed based on the PCOC, and by the DQO. A sampling and analysis work plan or other type of sampling document should be prepared prior to sampling to specify the process for collecting and analyzing environmental samples. (See Section 3.2.3 for additional information concerning Sampling Plans.)

Analytical results are sometimes measured in parts per billion. Proper QA/QC practices are essential to maintain this level of accuracy. QA/QC checks to be taken during sampling activities should include using clean equipment, collecting QA/QC samples (equipment blanks, field blanks, trip blanks and field duplicates), maintaining proper custody of samples and chain of custody, documentation, and recording all observations in a field notebook. The laboratory should also have, and follow, a QA/QC plan for conducting analyses.

Generally, all analytical data should be evaluated for validity and applicability. The objective of performing data validation is to assess the degree of data usability. Data validation assesses overall sample collection, transferral, and analytical performance, considering both the sampling methods and the laboratory methods.

Each project site is unique and will require different sampling and analysis strategies. Sampling can involve collecting samples from potential sources such as contaminated soils, waste rock piles, sediments, surface waters and groundwaters. The size of the project and the extent of contamination will determine the number of samples collected. There are a large number or tests and analyses that can be performed on environmental samples. Often a group or suite of test methods are run on samples. The UDSAI suite of analysis include the following: TAL metals; target compound list (TCL) organics (volatiles, semivolatiles and pesticides/PCBs); and Total petroleum hydrocarbons (TPHs) and diesel range / gasoline range organics.

The cost of sampling and analysis will be based on the number of samples collected and the analyses performed on the samples. The cost of sampling will also be related to the field activities and other associated costs such as sample shipping, disposable sampling equipment used, sample bottles, rental of field equipment and, personnel protective equipment. The costs associated with laboratory analysis can be determined from the **Appendix A** tables.

5.3.1 Target Analyte List

The TALs were originally derived from the EPA Priority Pollutant List. In the years since the inception of the CLP, analytes have been added to and deleted from this list, based on advances in analytical methods, evaluation of method performance data, and the needs of the Superfund Program.

Laboratory costs presented below for TAL analyses are based on standard two-week turn-around. Analytical results can be obtained on an expedited schedule at an increased cost. For shorter turn-around times, the costs are generally increased with the following percentages:

If standard 2-week turn-around is assumed 100 percent

- 1-week turn-around = 100 % + 25 %
- 72-hour turn-around = 100 % + 50 %
- 48-hour turn-around = 100 % + 75 %

Example: Standard turn-around = $275
1 week turn-around = $275 X 125 % = $343.75

EPA Methods that are given in **Appendix A, Table 5.18** are the same for either water or solid matrices.

Prices quoted in **Appendix A, Table 5.19** are for the analysis of the full suite of TAL metals, which are individually presented in **Appendix A, Table 5.18.** Special Analytical Services (SAS) can also be requested when the full analytical suite of TAL metals is not required. For TAL metals SAS requests, the average cost per compound is $35, while the average cost for two compounds is $50. SAS requests involving three or more compounds average $50 for the first two and $10 for each additional metal. **Appendix A, Table 5.19** provides a list of the TAL metals and CLP analytical method.

The CLP analytical method used by the EPA follows very strict, detailed analysis and reporting procedures. However, it is typically used only when cost recovery is anticipated. More often, a laboratory can perform a CLP-like program to provide a full data package. An additional 10 percent to 20 percent must normally be added to the cost for CLP or CLP-like data packages. A CLP-like package can be performed by a laboratory that is not a participant in the EPA program, and may result in lower overall costs.

5.3.2 Target Compound List

TCLs were originally derived from the EPA Priority Pollutant List. In the years since the inception of the CLP, compounds have been added to and deleted from this list, based on advances in analytical methods, evaluation of method performance data, and the needs of the Superfund Program.

Laboratory costs for TCL analyses presented in this section are based on standard two-week turn-around. Analytical results can be obtained on an expedited schedule at an increased cost. SAS requests can be submitted for TCL compounds, as well. For TCL SAS requests, the average cost per compound is $120. **Appendix A, Tables 5.21, 5.24, and 5.26** provide a list of the TCL compounds and the CLP analytical methods.

The costs in **Appendix A, Table 5.20, 5.22, 5.23, and 5.25** are based on a routine turnaround time.

EPA Methods that are given in these tables are the same for either water or solid matrixes.

Prices quoted in **Appendix A, Table 5.20** are given for CLP Analysis performed on the entire TCL list presented below. If the entire list of compounds is not required, the cost is going to be $110 for each individual compound.

5.3.3 Field Screening Tests

Field screening tests are used to detect metals in soil, and VOCs in water, soil, waste sources, and soil gas. They provide in situ, fast analysis to help direct the characterization effort, which saves money. There are both cost and time saving advantages of operating a field screening lab over sending samples off site for analysis. Results obtained in real time can be input immediately into the sampling optimization methodology to determine the optimal location and number of additional samples to be collected. This will potentially reduce the total number of samples required to adequately delineate the contaminant plume and speed up the characterization effort.

The costs in **Appendix A, Table 5.27** represent only the equipment costs for the specified tests. Labor costs should be added when developing a cost estimate. Average time to perform one of the following tests is 15 to 30 minutes. Typically, sampling work is performed by technicians. However, in cases when the field screening tests are incidental to other work performed at the site and requiring higher level personnel, the tests may be performed by an engineer or geologist.

5.4 General Construction

Appendix A, Table 5.28 presents Rental Equipment Rental **without** Operators (per each piece of equipment unless otherwise specified). For periods of less than one week, operated equipment is usually more economical to rent than renting bare equipment and hiring an operator. Equipment moving and mobilization costs must be added to rental rates where applicable. For instance, a crane may take 2 days to erect and 2 days to dismantle.

Reference

RS Means Building Construction Cost Data 60th edition (2002).

5.5 Hazardous Waste Treatment and Disposal

This section presents the ranges of costs for treating and disposing of non-hazardous and hazardous wastes (**Appendix A, Table 5.29**). The costs presented here will be lower for larger volumes of waste, and will generally be higher with increasing contaminant concentrations. BLM and Forest Service personnel should contact the specific treatment, storage, and disposal facility (TSDF) to get exact price quotes.

Several steps are required in the process of disposing of hazardous and non-hazardous wastes. **Figure 5.5** contains a flow diagram of the process.

5.5.1 Waste Characterization Profile

Once the need for a removal has been identified, and in the absence of generator knowledge that would determine the waste is not hazardous, the waste will generally require a waste characterization profile. A waste profile may include a full inorganic (TAL), organic (TCL), TCLP, reactivity, corrosivity, and ignitability analyses before it can be approved for disposal. The generator can either send a sample to a TSDF or an independent laboratory for waste characterization. Prior to shipping a sample to an independent laboratory, the agency personnel should consult with TSDF to ensure that the analytical program will satisfy the TSDF waste pre-acceptance requirements.

Treatment and disposal costs are highly variable depending on the waste constituents and their concentrations. A TSDF cannot provide an accurate quote for disposal before reviewing the waste characterization data. The characteristics identified in the analysis will determine whether the waste is hazardous or non-hazardous, and whether it requires incineration, stabilization, neutralization, solidification, encapsulation, or some other form of treatment prior to disposal.

Compatibility Criteria:

In general, waste must be compatible with:

- The original contents of the container which it is stored, transported, and disposed.
- The container itself.
- Other wastes in the container.

Some general recommendations regarding disposal containers:

- Hydrofluoric acid in glass.
- Strong solvents in plastic.
- Strong acids in metal.
- Chem waste in red bio waste bag.
- Put primary containers in secondary containers, segregated by storage group.
- Wastes in all primary containers that are stored in a common secondary container.
- Put acids and mixtures of acids and metals in separate primary and secondary containers.

Reference

Hazardous Waste Management Reference Guide for Laboratories, Department of Environmental Health and Safety, Stanford University,1998, http://www.stanford.edu/dept/EHS/waste/guide/refguide.pdf.

5.5.2 Choose a Treatment, Storage and Disposal Facility

Current BLM policy requires that field/district offices use only those facilities which have been formally audited in the past year. The scope of the audits include an evaluation of facilities' compliance with solid and hazardous waste regulations, design and operations standards, waste treatment and disposal technologies, records management, financial assurance, and relationship with state regulators. For those field district offices that would like to use a disposal facility that has not been audited but do not have enough time or enough money to complete a formal audit before the end of the year may apply for an informal exclusion or informal audit by contacting Ken Smith. One of the main purposes of the BLM audit program is to limit DOTs liability exposure by allowing personnel to make educated decisions when choosing a facility for waste disposal.

At the end of each year, all audit reports prepared during that year are consolidated into a compilation which is mailed to all BLM State offices. A summary of that compilation is sent annually to all BLM district/field offices. Additional copies of individual reports, annual compilation, or compilation summary are available by request (contact Ken Smith). District/field offices are also encouraged to actively participate in the program by specifying those sites which they would like to see audited. In addition, field offices are encouraged to join the audit team and visit the sites.

5.5.3 Choose a Transportation Company

The generating agency maintains ultimate responsibility for the waste during shipment and disposal. A transportation company should be selected that will meet EPA and DOT regulations. Other important factors to consider when selecting a transportation company include type of services available, regulatory violations, and pricing. Some TSDF typically subcontract with a transportation company to transfer the wastes from the site of generation to their facility; therefore, it is wise to inquire with the selected TSD facility before selecting a waste hauler.

Wastes can be transported on a large quantity/truck load basis or small quantity/milk run basis. TSDF charge a minimum disposal fee per truck load. There are a number of companies that provide "milk run" services throughout the country stopping to pick up small quantities of hazardous waste. Those companies that operate their own incinerators and other disposal services have much lower "milk run" prices. The transportation costs from these companies are typically 30 percent lower than that of a waste broker. A list of phone numbers of transportation facilities providing "milk run" services is provided below:

Company	**Phone Number / Web Site**
Teris (formerly ENSCO)	1-870-863-7170 www.terisna.com
Clean Harbors	1-800-444-4244 www.cleanharbors.com

5.5.4 Oversee Proper Waste Removal and Disposal

The contracting agency will hire a contractor and provide oversight during waste removal and disposal. A copy of a generic hazardous waste contract can be found at the end of the hazardous waste treatment, disposal, and incineration section. The contractor will provide the technical work which may include providing the waste drums, preparing all the paperwork, labeling, and bulking the waste if necessary. Typically when working with individually containerized hazardous wastes, 20 to 25 one-gallon containers will fit in an overpack and can be disposed of as a lab pack. Disposal of an overpack requires extra disposal costs. Usually it is more economical to bulk all containers one gallon and larger. Bulking consists of opening the containers, pouring their contents into an open head 55-gallon drum, sealing the drums and disposing of the empty containers.

The generating agency is encouraged to inquire into and verify the type of treatment and the ultimate disposal site for the waste. Sometimes, landfills and incinerators only perform acceptance and consolidation of certain wastes at their sites and ship the wastes to other facilities for disposal. In other cases, a hazardous waste landfill may treat a characteristic hazardous waste, de-characterize it (i.e., remove the characteristic that rendered the waste hazardous), and ship it to a non-hazardous waste landfill for ultimate disposal. In these cases, the generator may be mislead into believing that the disposal of the waste occurred at the facility that initially accepted the waste.

5.5.5 Save All Relevant Paperwork

The generating agency has a liability for all hazardous wastes. It is imperative that all relevant paperwork is acquired and maintained. The paperwork could include a manifest signed by the generator at the time of off-site shipment. The manifest is also signed by the transporter and the facility that receives the wastes. All permits and approvals must also be kept for future records.

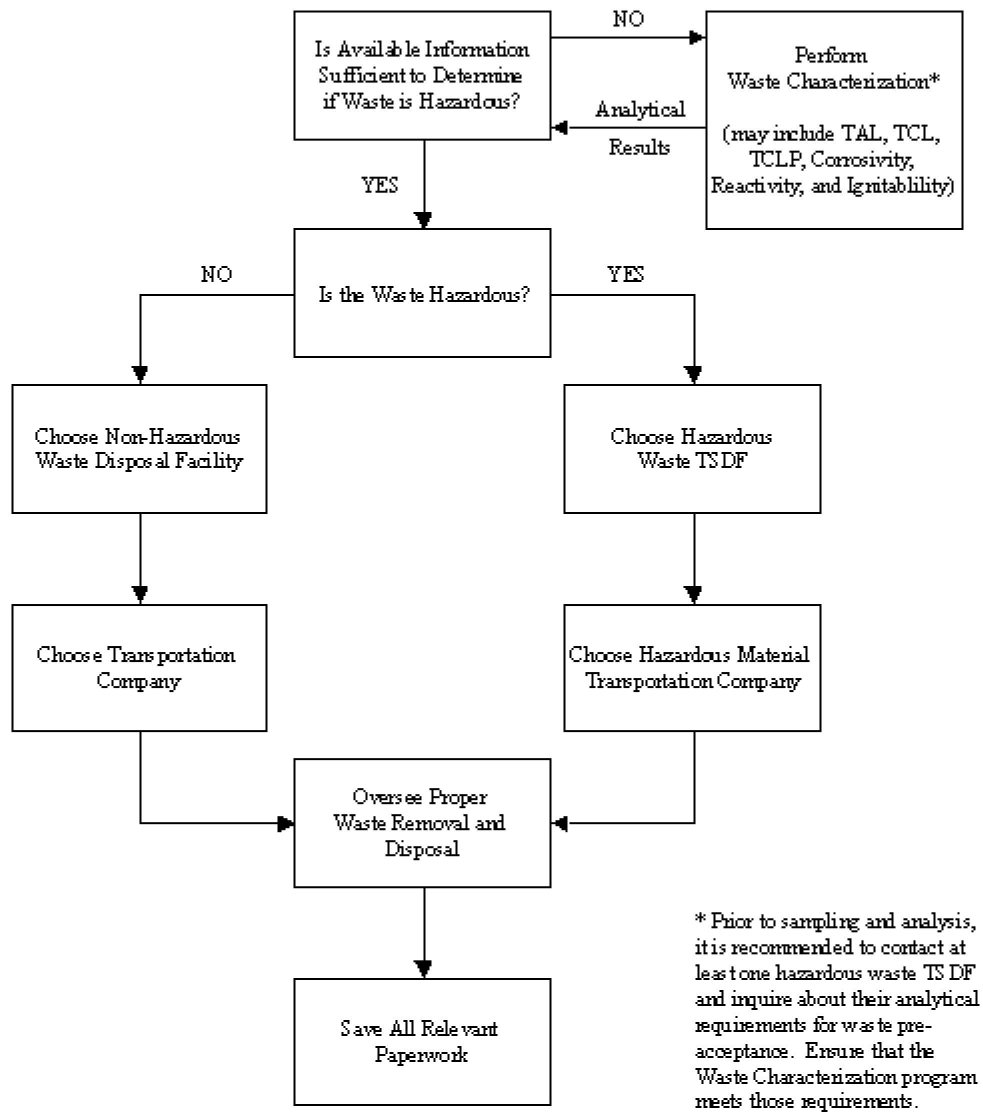
Reference

Information on EPA's asbestos regulations, interpretive documents, and guidance materials are available to the public and the regulated community through a variety of sources. The TSCA Assistance Information Service, (202) 554-1404, provides TSCA regulation (including asbestos) information, copies of regulations, Agency guidance documents, and referrals to more specific sources of information (for example, Regional Asbestos/National Emission Standard for Hazardous Air Pollutants [NESHAP] Coordinators), as needed.

Asbestos calls about asbestos-related renovation or demolition in buildings other than schools, transport and disposal of asbestos waste, and other questions related to EPA's asbestos NESHAP (Clean Air Act) regulations should be directed to the EPA SBA Asbestos Ombudsman, at 1-800-368-5888 if outside Metro Washington DC. Or, contact the appropriate EPA Regional NESHAP Coordinator for the state in which you live.

In addition, each State has its own rules and training programs that agency personnel should be aware of prior to engaging in any cleanup activity. Agency personnel may be eligible to participate in State sponsored training programs.

Figure 5.5 - Waste Disposal Flow Diagram



APPENDIX A
COST DATA TABLES

Table 2.1: Cost Escalation Based on DoD Forecasts

Year	Factor
1999	95.7
2000	96.8
2001	98.3
2002	100
2003	101.6
2004	103.0
2005	104.8
2006	106.7
2007	108.7

Table 4.1: Analytical Costs

Rates do not include Overhead, General and Administrative, and Profit costs

Water Analysis	Cost	
Target Analyte List (TAL) Metals (EPA 6010/7000s 200 series 1631 for Hg)	$303.59	EA
Cyanide (EPA 335.1)	$49.70	EA
Volatiles (8260B)	$192.14	EA
Semivolatiles (8270C)	$365.51	EA
Pesticides/PCBs (608, 8081, 8082)	$161.14	EA
Herbicides (8151A)	$222.91	EA
Acid/Base Accounting (EPA 305.1/310.1)	$24.01	EA
Soil Analysis		
Target Analyte List (TAL) Metals (EPA 6010/7000s)	$327.65	EA
Volatiles (8260B)	$192.14	EA
Semivolatiles (8270C)	$365.51	EA
	$282.98	EA
Pesticides/PCBs (SW 3550B/SW 8081/8082)	$161.14	EA
Herbicides (SW 3550B/SW 8151A)	$242.80	EA
TCLP (toxicity characteristic leaching procedure) (EPA 1311)	$579.23	EA
TCLP (extraction: volatiles) (EPA 1311)	$136.25	EA
SPLP (synthetic precipitation leaching procedure)	$154.91	EA

Table 4.2: ARD/AMD Treatment Costs

Rates include Overhead, General and Administrative, and Profit costs

Activity	Cost			
Grass Ditching, 3' Bottom, 3' Deep, 2:1 Side Slopes	$17.44			/LF
Grass Ditching, 5' Bottom, 5' Deep, 4:1 Side Slopes	$45.95			/LF
Riprap Ditching, 3' Bottom, 3' Deep, 2:1 Side Slopes	$18.96			/LF
Concrete Ditching, 3' Bottom, 3' Deep, 2:1 Side Slopes	$52.37			/LF
2' High Earthen Berm	$5.84			$/yd^3$
Excavation, Excavator, 1 yd^3 (backhoe), 6 to 10 ft deep	$3.33			$/yd^3$
Excavation, Front End Loader, wheeled, 2 1/4 yd^3	$1.55			$/yd^3$
Earthwork, Dozer, 300 hp, 50 ft to 300 ft haul	$1.01	to	$4.05	$/yd^3$
Hauling, 12 yd^3 Dump Truck, 1 to 3 mile round trip	$3.92	to	$4.84	$/yd^3$
Spread Topsoil from pile to rough, Front End loader	$4.14			$/yd^3$
Compaction Water ($.005/gal), Water Truck, (3000 gal)	$0.86			$/yd^3$
Hay Bales (placed and removed)	$405			/ton
Seeding, hydro or air, including seed and fertilizer, hydro spreading of mulch	$0.35			/acre
with wood fiber mulch added	$0.47			/acre
Clay Liner - 6" lifts	$16.86	to	$20.23	$/yd^2$ installed
Soil/Bentonite liner - 6" lifts	$1.53			$/ft^2$ installed
Polymeric Liner, Anchor Trench, 3' x 1.5'	$0.92			/LF
Polymeric Liner, PVC (20 mil - 100 mil)	$0.87	to	$4.62	$/ft^2$
Gabions, galvanized steel mesh, stone filled, 18" to 36" deep	$61.50	to	$104	$/yd^2$

Table 4.3: Adits, Pits, Shafts Closure Costs

Rates include Overhead, General and Administrative, and Profit costs (except for monitor rental)

Material	Cost			
Galvanized Chain-link Fence, 6' to 8' high	$21.00	to	$32.50	/LF (installed)
Barbed-wire Fencing, 3-Strand	$2.23			/LF (installed)
Swing Gate, 12' two swinging gates 6' to 8' high	$1,125	to	$ 1,725	installed
4500 psi Concrete (no trucking included)	$83.00			/yd^3
Backfilling Dozer, 200 H.P., 300' haul, no compaction	$1.94			/yd^3
Bat gates (installed)	$1,033			installed
Sign, installed	$69			EA
Portable CO_2 Monitor, Monthly Rental	$382			/month
Portable Combustible Gas/Oxygen Indicator, Monthly Rental	$385			/month

Table 4.4: Site Rehabilitation

Rates include Overhead, General and Administrative, and Profit costs

Material/Activity	Cost			
Earthwork, Dozer, 300 hp, 50 ft to 300 ft haul	$1.01	to	$4.05	$/yd^3$
Hauling, 12 yd^3 Dump Truck, 1 to 3 mile round trip	$3.92	to	$4.84	$/yd^3$
Spread Topsoil from pile to rough, Front End loader	$4.14			$/yd^3$
Seeding, hydro or air, including seed and fertilizer,	$0.35			$/yd^2$
with wood fiber mulch added	$0.47			$/yd^2$
Plowing and Discing				
Rangeland Drills				
Mechanical Seeding, 215 lb/acre	$905			/acre
Planting Trees, 7' to 8' high (includes costs of trees)	$11,746			/acre
Guying trees, 2" to 4"	$1,098			/acre
Guying trees, 6" to 8"	$2,473			/acre
Planting Shrubs 15" to 18" spread, 24" to 30" spread	$917.18	and	$699.29	/acre
Power Mulching, Large (oat straw 1" deep)	$38.50			/thousand ft^2
Tractor Spreader	$203	to	$258	/thousand ft^2
Spreading Mulch by Hand, 1" to 3" deep (hay, straw, compost, wood chips, aged bark)	$0.94	to	$5.50	$/yd^2$
Hay Bales (placed and/or removed)	$405			/ton
Slope Protection, Rip-Rap, machine placed	$34			$/yd^3$
Dumped Rip-Rap, 50 lb average	$16.80			/ton
Dumped Rip-Rap, 100 lb average	$23.50			/ton
Dumped Rip-Rap, 300 lb average	$27.00			/ton
Gabions, galvanized steel mesh, stone filled, 18" to 36" deep	$61.50	to	$104	$/yd^2$
Native hay (seed source) (native grass hay)	$20.65			per bale

Table 4.5: Landfill Rehabilitation

Rates include Overhead, General and Administrative, and Profit costs

Item	Description	Cost	
Remediation and Construction Oversight	Refer to section 5.1		
Labor	PM and Staff Scientist	$1,250	/day
Labor	Foreman and HSO	$1,575	/day
Per Diem	Lodging and food	$108	/day/person
Car Rental	Mid size car	$60	/day
Site Characterization	Refer to section 3.1 - 3.5		
Mobilization	Refer to section 5.4		
Excavation	Refer to section 5.4		
Dozer	200 H.P.	$1,073	/day
Front End Loader	2 yd^3 capacity	$677	/day
Transportation	Refer to section 5.4		
Dump Truck	12 yd^3 capacity	$358	/day
Dump Truck - Off-highway rear dump	25 yd^3 capacity	$1,100	/day
Spread Dumped Cap Material	Refer to section 5.4		
Dozer	200 H.P.	$1,073	/day
Front End Loader	2 yd^3 capacity	$677	/day
Revegetation	Refer to section 4.1.3		
Mechanical Seeding	215 lbs of seeds per acre	$905	/acre
Planting Shrubs	15" to 18" spread	$917.18	/acre
Planting Shrubs	24" to 30" spread	$699.29	/acre
Sediment/Erosion Control	Refer to Section 5.4 for costs		
Silt Fencing	Propylene, 3' high	$0.69 to $0.93	/LF

Table 4.6: Revegetation Activities

Rates include Overhead, General and Administrative, and Profit costs (Except for Disposal Rates)

Item	Description	Cost	
Remediation and Construction Oversight	Refer to section 5.1		
Labor	PM and Staff Scientist	$1,125	/day
Labor	Foreman and HSO	$1,400	/day
Per Diem	Lodging and food	$108	/day/person
Car Rental	Mid size car	$60	/day
Sediment/Erosion Control	Refer to Section 5.4 for costs		
Silt Fencing	Propylene, 3' high	$0.69 to $0.93	/LF
Site Characterization	Refer to section 3.1 - 3.5		
Mobilization	Refer to section 5.4		
Excavation	Refer to section 5.4		
Dozer	200 H.P.	$1,073	/day
Front End Loader	2 yd^3 capacity	$677	/day
Hand	Heavy soil	$26.50	/yd^3
Separation	Refer to section 5.4		
Vibrating Screen	110 H.P. w/5' by 10' screen	$407.00	/day
Regrade/Backfill	Refer to section 5.4		
Dozer	200 H.P.	$1,073	/day
Front End Loader	2 yd^3 capacity	$677	/day
Revegetation	Refer to section 4.1.3		
Mechanical Seeding	215 lbs of seeds per acre	$905	/acre
Planting Shrubs	15" to 18" spread	$917.18	/acre
Planting Shrubs	24" to 30" spread	$699.29	/acre
Transportation	Refer to section 5.4		
Dump Truck	12 yd^3 capacity	$358	/day
Dump Truck - Off-highway rear dump	25 yd^3 capacity	$1,100	/day
Disposal	Refer to section 5.5		
Non-Hazardous Waste Treatment and Landfill Disposal	Contaminated soil - bulk (direct disposal)	$92.76	/yd^3
Hazardous (RCRA) Waste Landfill Disposal	Bulk solids (not requiring stabilization)	$164	/ton
	Bulk solids (with stabilization)	$318	/ton

Table 4.7: UST Activities

Rates include Overhead, General and Administrative, and Profit costs

Item	Description	Cost
Site Characterization	Refer to section 3.2 - 3.6	
Mobilization	Refer to section 5.4	
Excavation	Refer to section 5.4	
Backhoe, wheel mounted	3/4 yd^3 capacity	$226 /day
Transportation	Refer to section 5.4	
Vacuum Truck	5000 gallon hazardous waste	$451 /day
Dump Truck	12 yd^3 capacity	$358 /day
Dump Truck - Off-highway rear dump	25 yd^3 capacity	$1,100 /day
Spread Dumped Cap Material	Refer to section 5.4	
Dozer	200 H.P.	$1,073 /day
Front End Loader	2 yd^3 capacity	$677 /day
Revegetation	Refer to section 4.1.3	
Mechanical Seeding	215 lbs of seeds per acre	$905 /acre
Planting Shrubs	15" to 18" spread	$917.18 /acre
Planting Shrubs	24" to 30" spread	$699.29 /acre
Sediment/Erosion Control	Refer to section 5.4	
Silt Fencing	Propylene, 3' high	$0.69 to $0.93 /LF

Table 4.8: Asbestos Inspection

	Approximate Inspection Time Adjustment	
Characteristic	Below Average	Above Average
Building Accessibility	+10 percent	-10 percent
Building Age	-15 percent	+15 percent
Amount of Carpeting with Underlying Floor Tiles	-5 percent	+5 percent
Homogeneity of Materials	+20 percent	-20 percent
Mechanical Spaces	+5 percent (for each more than 1)	-
Piping in Sub-Ceiling	-10 percent	+10 percent
Steam Piping Present	-15 percent	+15 percent

Table 4.9: Asbestos Inspection Costs

Rates include Overhead, General and Administrative, and Profit costs

Item	Description	Costs			
Mileage	Round trip to site	$0.365			/mile
Junior-Level Inspector	Not necessarily AHERA certified.	$440			/day
Mid-Level Inspector	AHERA certified.	$520			/day
Computer Time and Report Generation	Approximately 2 hours per 1 hour of sampling time	$60			/hour
Per Diem	When overnight lodging required	$100	to	$120	/day per individual
Air Sample Analysis	TEM	$100			per sample
Bulk Sample Analysis	PLM	$30			per sample
Disposable Sampling Equipment	Sample bags, Tyvek Suits, film, batteries, air sampling cartridges	$81			/day of sampling per team

Table 5.1: Staffing Rates

Rates do not include Overhead, General and Administrative, and Profit costs

Title	Level	Salary ($/Hour)		
		Low	Average	High
PROFESSIONAL POSITIONS				
Project/Program/Senior Manager	Senior	$32.25	$36.00	$40.75
Civil Engineers	Junior	$19.00	$20.50	$26.00
	Mid	$27.00	$33.50	$34.50
Engineers, P.E. Registration	Senior	$38.25	$41.00	$44.50
Environmental Engineer	Junior/Mid	$24.50	$29.75	$36.00
	Senior	$36.50	$38.75	$43.00
Geologists	Junior	$16.50	$18.50	$21.00
	Mid	$21.00	$28.50	$31.00
Hydrogeologists	Junior	$16.50	$18.50	$21.00
	Mid	$21.00	$28.50	$31.00
	Senior	$29.50	$35.25	$41.00
Chemist	Junior	$16.75	$18.50	$20.75
	Mid	$20.75	$28.00	$33.00
	Senior	$33.00	$36.50	$39.00
Toxicologist	Mid	$22.75	$27.50	$33.00
Health Physicist	Mid	$28.50	$30.50	$37.75
	Senior	$35.50	$37.75	$47.00
Industrial Hygienist	Junior	$20.00	$22.00	$24.00
Industrial Hygienist, CIH	Mid	$23.50	$26.50	$31.50
	Senior	$35.00	$39.00	$43.00
Environmental Scientist	Junior	$15.25	$17.25	$19.00
	Mid	$20.75	$25.25	$30.75
	Senior	$24.75	$31.25	$36.75
Biologist	Junior	$14.75	$16.25	$21.00
	Mid	$21.00	$24.00	$28.75
	Senior	$27.25	$35.00	$42.25
Community Relations Specialist	Junior	$16.75	$19.75	$22.00
	Mid/Senior	$20.25	$24.00	$28.00
FIELD OPERATIONS/TECHNICAL POSITIONS				
Field Chemist	Junior/Mid	$16.75	$18.50	$20.75
Technician, Engineering	Junior	$15.50	$16.75	$20.00
	Mid	$18.75	$20.75	$23.00
Technician, Environmental Sciences	---	$16.00	$18.25	$22.00
Remediation Supervisor/ Foreman		---	$31.45	---
Equipment Operator	---	$26.65	$30.00	$32.80
Remediation Technician/ Laborer	---	---	$23.45	---
Truck Driver	---	$24.30	---	$25.00

Title	Level	Salary ($/Hour)		
		Low	Average	High
CLERICAL/ADMINISTRATIVE SUPPORT				
Word Processing	---	$13.00	$14.25	$16.00
Secretary	---	$11.50	$12.75	$15.50
Administrative Assistant	---	$15.00	$17.00	$19.25
Drafting/AutoCAD	Junior/Mid	$13.75	$16.00	$18.25
	Senior	$15.50	$17.50	$19.50
Computer Science Programmer/Analyst	Junior	$18.75	$21.00	$23.75
	Mid	$23.75	$27.25	$31.00
	Senior	$27.50	$31.00	$35.75

Table 5.2: PPE Equipment

Rates do not include Overhead, General and Administrative, and Profit costs

Item	Description	Costs			
Coveralls	Level D	$4.25	to	$6.18	/Each
	Level C	$17.00	to	$21.00	/Each
	Level B	$50.00	to	$171.40	/Each
	Level A	$342.89	to	$1,606.69	/Each
Gloves	Inner	$5.31	to	$28.67	/Pair
	Outer	$14.00	to	$40.00	/Pair
Boots	Safety Work Boots, Leather	$75.00	to	$100.00	/Pair
	Neoprene, PVC, Polyblend Boots	$22.00	to	$57.00	/Pair
Boot-Covers and Overboots	Vinyl, Latex, Polyethylene, Rubber, Butyl, Neoprene, PVC	$5.25	to	$55.00	/Pair
Hard Hats		$8.20	to	$18.00	/Each
Face Shields		$13.00	to	$19.48	/Each
Escape Masks	5-minute unit	$405.57	to	$500.00	/Each
Full-Face Respirators		$138.00	to	$197.46	/Each
Half-Mask Respirators		$25.52	to	$37.87	/Each
Chemical Cartridge Elements	Various chemical characteristics	$5.00	to	$70.00	/Each
Self-Contained Breathing Apparatus (SCBA) (Includes air cylinder, face piece, harness, airline, and regulator)	Purchase:	$1,500	to	$3,000	/Unit
	Rental:	$50.00			/Day
		$145.00			/Week

Table 5.3: Electromagnetics Equipment

Rates include Overhead, General and Administrative, and Profit costs

Equipment [Make and Model]	Mobilization One-way Basis ($ per Mile)	Average Coverage [Range, in Linear Feet]	Distance Between Measurement Stations [ft.]	Geophysical Crew, Per Day [$]	Additional Costs [$]
GEONICS EM-31-MK2	$2.50	3500 to 5000	3 to 50	1 Man @ $450 /day	Equipment: $65 /day Shipping: $500 Office: $450 /day
GEONICS EM-34-3	$4.00	2000 to 5000	10 to 50	2 Men @ $750 /day	Equipment: $400 /week Shipping: $600 Office: $450 /day
GEONICS EM-61	$2.50	2000 to 10000	1	1 Man @ $450 /day	Equipment: $400 /week Shipping: $805 Office: $450 /day
GEM GSM-19	$2.50	3500 to 5000	3 to 50	1 Man @ $450 /day	Equipment: $90 /day Shipping: $450 Office: $450 /day

Table 5.4: Electrical Resistivity Equipment

Rates include Overhead, General and Administrative, and Profit costs

Equipment [Make and Model]	Mobilization One-way Basis ($ per Mile)	Average Coverage [Range, in Linear Feet]	Number of Soundings	Geophysical Crew, Per Day (Specif. No. of Members) [$]	Additional Costs (Specify the Add. Items) [$]
ABEM Terrameter SAS-300C	$3.50	500 to 2500	5 to 10	3 Men @ $2,600 /day	Equipment: $55 /Day Shipping: $650 Office: $450 /Day
Megger DET2/2	$3.50	500 to 1500	4	2 Men @ $2,150 /day	Equipment: $125 /Day Shipping: $550 Office: $450 /Day

Table 5.5: Seismic Refraction Equipment Costs

Rates include Overhead, General and Administrative, and Profit costs

Equipment [Make and Model]	Mobilization One-way ($ per Mile)	Average Coverage (Range in Linear Feet)	Distance Between Measurement Stations [ft.]	Geophysical Crew, Per Day [$]	Additional Costs
EG&G 1225	$4.00	1000 to 3500	5 to 30	4 Men @ $2,500 /day	Equipment: $125 /Day Explosives: $7.00 /Shot Office: $450 /Day
OYO GEOSPACE MX-160	$4.00	1000 to 3500	5 to 30	4 Men @ $2,500 /day	Equipment: $200 /Day Explosives: $7.00 /Shot Shipping: $500 Office: $450 /Day

Table 5.6: Borehole Geophysics

Rates include Overhead, General and Administrative, and Profit costs

Method/Item	Normal Vertical Sampling Interval [ft.]	Cost of Logging [$ per foot]			
Electrical (minimum $175.00 per day):					
Spontaneous Potential	0.1	$0.35			
Single-Point Resistance	0.1	$0.35			
Fluid Conductivity	0.1	$0.35			
Nuclear (minimum $350 per day):					
Natural Gamma	0.1	$0.70			
Gamma-Gamma	0.05	$0.70			
Neutron	0.1	$0.70			
Mechanical:					
Caliper	0.1	Included			
Thermal:					
Temperature	0.1	$0.60			
Acoustic					
Sonic	0.2	$1.15	minimum	$500	/day
Acoustic Borehole Televiewer		$3.50	minimum	$1,500	/day
Borehole Geophysics/ Miscellaneous					
Item	**Description**	**Costs**			
Mobilization/Mileage	Within 150 - 200 miles	$0.00	to	$3.50	/mile (one way basis)
	More than 150 - 200 miles	$1.00	to	$3.50	/mile (additional fees may be required - ex: $2,500 for mobilization)
OSHA Trained Geophysical Crew (10 Hour Working Day)	1 person crew	$1,175.00			/day
	2 person crew	$1,500.00			/day
Computer Time	1 hr. per hole minimum	$60.00			/hour
Standby	Not due to contractor	$60.00			/hour
Per Diem	When overnight lodging required	$100.00	to	$150.00	/day per individual
Travel Expenses		Actual fare round-trip			
Set-up and Decontamination		$60.00			/hole
Reprocessing and/or Report Preparation	By Logging Engineer	$80.00			/hour

Table 5.7: Drilling Equipment

Rates do not include Overhead, General and Administrative, and Profit costs

Method	Description		Costs (per foot)
			(Sampling Not Included)
Hollow Stem Auger	3.75 i.d. auger	0-50 ft. deep	$10 to $14
		50-100 ft. deep	$12 to $17
		>100 ft. deep	$14 to $20
	6.25" i.d. auger	0-50 ft. deep	$14 to $18
		50-100 ft. deep	$15 to $20
		>100 ft. deep	$18 to $25
	8.25" i.d. auger	0-50 ft. deep	$18 to $23
		50-100 ft. deep	$20 to $25
		>100 ft. deep	$30 to $35
Solid Stem Auger	Same range of costs as drilling with hollow stem augers		
Cable Tool (percussion drilling)		0-100 ft. deep	$23 to $28
		>100 ft. deep	$25 to $28
Air Rotary		0-100 ft. deep	$30 to $50
		>100 ft. deep	$30 to $60
Drive and Wash		0-100 ft. deep	$23
		>100 ft. deep	$25
Rock Drilling			
Rock Coring (NQ, HQ)		0-50 ft. deep	$44 to $60
		50-100 ft. deep	$44 to $60
		>100 ft. deep	$44 to $60
Cable Tool		0-50 ft. deep	$28 to $34
		50-100 ft. deep	$28 to $39
		>100 ft. deep	$28 to $45

Other Costs Associated with Drilling		
Item	**Description**	**Cost**
Mobilization	Truck-Mounted Drill Rig	$420 to $1,000
	All-Terrain Vehicle Mounted Drill Rig	$1,000 to $1,800
Mileage (One Way Basis)[a]	Less than 50 miles from office	$0 to $6 /mile
	More than 50 miles from office	$4 to $6 /mile
Out of Town Living Expenses	2-man crew	$200 to $250 /day
Decontamination (Level D PPE) - Requires Steam Cleaner		$160 to $180 /hour
Steam Cleaner/Generator Rental		$134 to $196 /day
Water Truck Rental		$163 to $230 /day
55-Gallon Drum		$60 to $75 /each
Well Development		$160 to $180 /hour
Stand-By Time, 2-Man Crew (Not Due to the Drilling Company)		$150 to $175 /hour

[a] - Some companies incorporate mileage costs into mobilization charges. Other companies do not charge mileage if the distance to the job site is below a cut off distance, generally set around 100 miles.

Table 5.8: Monitoring Well Installation

Rates do not include Overhead, General and Administrative, and Profit costs

Item (Includes Parts and Labor)	Description	Costs
PVC Schedule 40/80 Monitoring Well	1" i.d.	$15 to $22 /foot
	2" i.d.	$21 to $23 /foot
	4" i.d.	$35 to $38 /foot
Stainless Steel Monitoring Well	2" i.d.	$44 to $70 /foot
	4" i.d.	$75 to $150 /foot
Protective Cover	6" diam., flush-mount	$60 to $160 /each
	8" diam., flush-mount	$60 to $185 /each
	10" diam., flush-mount	$80 to $210 /each
	4" X 4" X 5', stand-up	$175 to $300 /each
	6" X 6" X 5', stand-up	$190 to $325 /each
	8" X 8" X 5', stand-up	$210 to $390 /each
Well Head Protector	3 steel posts	$150 to $250
	4 steel posts	$200 to $300
Concrete Well Pad	2' X 2' X 4"	$105 to $170 /each
	4' X 4' X 4"	$170 to $200 /each
	2' X 2' X 2'	$300 to $500 /each
Dewatering		
Excavate drainage trench with backhoe loader	2' wide x 2' deep	$9.65 /$yd^3$
	2' wide x 3' deep	$6.40 /$yd^3$
Pumping 8 hrs, attended 2 hours per day including 20 L.F. of suction hose and 100 L.F. of discharge hose	2" diaphragm pump	$144 /day
	4" diaphragm pump	$157 /day
Pumping 8 hrs, attended 8 hours per day including 20 L.F. of suction hose and 100 L.F. of discharge hose	2" diaphragm pump	$575 /day
	3" centrifugal pump	$590 /day
	4" diaphragm pump	$630 /day
	6" centrifugal pump	$805 /day
Sump hole construction, incl excavation and gravel, pit		$1.65 /$ft^3$
with 12" gravel collar	12" pipe, corrugated, 16 ga	$30 /LF
	15" pipe, corrugated, 16 ga	$38 /LF
	18" pipe, corrugated, 16 ga	$43 /LF
	24" pipe, corrugated, 14 ga	$53 /LF
Wood lining, up to 4' by 4', add		$17 /$ft^2$ contact area

Table 5.9: Monitoring Well Construction Materials

Rates do not include Overhead, General and Administrative, and Profit costs

I.D.	Description	Schedule 40/80 Costs
PVC Pipe and Screen		
2"	5' Screen	$13.50 to $18.00
	5' Riser	$8.00 to $10.00
	10' Screen	$22.50 to $28.00
	10' Riser	$11.50 to $16.25
4"	5' Screen	$29.50 to $39.50
	5' Riser	$19.25 to $30.50
	10' Screen	$48.50 to $68.00
	10' Riser	$29.50 to $51.00
Stainless Steel Monitor Pipe and Screen		
2"	5' Screen	$148 to $198
	5' Riser	$73 to $99
	10' Screen	$260 to $345
	10' Riser	$104 to $141
4"	5' Screen	$167 to $225
	5' Riser	$130 to $173
	10' Screen	$305 to $395
	10' Riser	$202 to $270
Miscellaneous		
Bottom Plug	Schedule 40, 2" i.d.	$3.50
	Schedule 40, 4" i.d.	$5.75
	Schedule 80, 2" i.d.	$5.75
	Schedule 80, 4" i.d.	$13.50
Locking Cap	2" i.d.	$31.00
	4" i.d.	$37.00
Flush-Mount, Leak Proof Manhole	8" i.d., 12" skirt	$57.50
	12" i.d., 12" skirt	$102
Stainless Steel Centralizer	For 2" wells	$14.75
	For 4" wells	$17.00
Lockable, Stand-up Protective Cover	4" X 4" X 5'	$50 to $300
	6" X 6" X 5'	$70 to $325
Type II Portland Cement (for the Grout Mix)	94 lb. bag	$8.00 to $11.50
Bentonite Powder (for the Grout Mix)	50 lb. bag (Rec. mix: 4-5 lb. bent. per 94 lb. sack cement)	$9.00 to $10.00
Bentonite Pellets (for the Seal)	5 gal. bucket	$35.00
Filter Sand	50 lb. bag	$5.75

Table 5.10: Field Instruments

Rates do not include Overhead, General and Administrative, and Profit costs

Item	Model	Rental Costs		Recalibration/	Purchase	
		Daily	Weekly	Maintenance	COST	
Ultraviolet (UV) Photo Ionization Detector (PID)	HNu PI-101	$90	$325	$170	$5,100	
	Photovac Micro TIP	$90	$325	$170	----	
Portable Gas Chromatographs		$497	$1,092	$198	----	/with analysis
Flame Ionization Detector	Foxboro OVA 128	$100	$300	$170	----	
Combustible Gas Indicator	AIM 3250	----	----	----	$2,712	
	AIM 3000	----	----	----	$1,978	
	GasTech GX-86	----	----	----	$3,390	
	MSA MicroGard	$50	$150	$70	$2,531	
	MSA Passport	$70	$180	$70	$3,164	
Oxygen Meter	MSA 246 RA	$51	$153	----	$669	
	Lab Service Supply	----	----	----	$565	
Detector Tubes	Drager HazMat Kit	----	----	----	$1,237	
pH/mV/°C Meter	Oakton	$32	$79	$226	$425	
pH/°F/DO/Turbidity/Salinity Meter	Horiba U-10	$70	$210	----	$2,720	
Lab In A Bag Package	In-Situ, Inc. field screening system for VOCs	----	----	----	$1,124	
Glass Drum Sampler	Drum Thief - 75 ml	----	----	----	$44.33	/case of 25
Disposable Ball Check Valve Drum Sampler	Coliwasa - 200 ml	----	----	----	$78.93	/case of 12
250 ml Teflon Bomb Sampler	Sampler	----	----	----	$627	
	50 ft suspension cord	----	----	----	$71	
12 ft. Grab Sampler		----	----	----	$495	
6 ft. Polyethylene Dipper		----	----	----	$46	
12" Interface Sampler		----	----	----	$63	
Teflon Bailer	1 ft. - Norwell	----	----	----	$221	
	3 ft. - Norwell	----	----	----	$385	
PVC Bailer	1.7 in. OD	----	----	----	$24	
	3.5 in. OD	----	----	----	$40	
Disposable Polyethylene Bailer	1.7 in. OD	----	----	----	$130	/case of 24
Hand Auger	Handgrip	----	----	----	$93	
	Head	----	----	----	$235	
	34 in. auger extension	----	----	----	$81	
Submersible Pump with 100 ft. Motor Lead	Grundfos Redi-Flo2	----	$210	----	$868	
Converter for the Subm. Pump	Redi-Flo2 Converter	----	$135	----	$1,424	
50 ft. Reinforced Hose	½" ID	----	----	----	$1.25	/foot
Gasoline Generator	3.5 kW	$50	$150	$500		
Conductivity/°C/salinity Meter		----	----	----	$872	

Table 5.11: Groundwater Level Measurement Devices

Rates do not include Overhead, General and Administrative, and Profit costs

Item	Description	Costs
Steel Tape, water level indicator, electric, light, horn	100 feet	$884
Air/Product and Water/Product Interface Meter - Phase Detector	100 feet	$1,200 to $1,880 /Each
Float Recorders	Records continuously on chart paper	$4,100 /Unit
Pressure Transducers	Requires data logger and accessories	$1,125 to $1,700 /Sensor and 150' cable
Data Logger	4 channel	$2,600 to $6,800 /Unit

Table 5.12: Soil and Rock Sampling

Rates do not include Overhead, General and Administrative, and Profit costs

Method	Description	Costs ($)
Soil - Split Spoon Sampling (includes decontamination of sampler between sampling events) - per sample	Based on ASTM 1586 (4 samples within top 10 ft., one sample every 5 ft. below 10 ft.)	$17.00 to $28.00
	Continuous split spoon sampling	$17.00 to $23.00
Soil - Shelby Tube Sampling - per sample	"Undisturbed" sample, 3 in. diameter	$28.00 to $40.00
Soil - Auger Cuttings and Wash Samples	Poor quality soil samples are obtained as part of the drilling process	No additional cost to the respective drilling methods
Rock - Coring - per foot	Rock samples are obtained as part of the drilling process	$44.00 to $60.00 (0 - 50 ft. deep)
		$44.00 to $60.00 (50 - 100 ft. deep)
		$44.00 to $60.00 (>100 ft. deep)

Table 5.13: Dilatometer

Rates do not include Overhead, General and Administrative, and Profit costs

Item	Description	Costs			
Mobilization	Truck-Mounted Drill Rig	$420.00	to	$800.00	
	All-Terrain Vehicle Mounted Drill Rig	$600.00	to	$1,800.00	
Mileage (One Way Basis) can be incorporated in mobilization cost	Less than 50 miles from office	$0.00	to	$6.00	/mile
	More than 50 miles from office	$3.50	to	$6.00	/mile
Dilatometer Rental		$1,150.00			/week
Mid-Level Engineer	Operate the dilatometer during field activities	$27.00	to	$34.00	/hour plus overhead
Mid-Level Engineer	Computer processing. Requires 25 percent to 50 percent of the field time	$27.00	to	$34.00	/hour plus overhead
Dilatometer Soil Testing		$11.25	to	$13.50	/foot

Table 5.14: Hydro-Punch Sampling

Rates do not include Overhead, General and Administrative, and Profit costs

Item	Description	Costs
Mobilization	Truck-Mounted Drill Rig	$420.00 to $800.00
	All-Terrain Vehicle Mounted Drill Rig	$600.00 to $1,800.00
Mileage (One Way Basis) can be incorporated in mobilization cost	Less than 50 miles from office	$0.00 to $6.00 /mile
	More than 50 miles from office	$3.50 to $6.00 /mile
Geologist/Engineer	Coordinate groundwater sampling	See Professional Services hourly salaries and add overhead
Hydro-Punch Rental		$1,150.00 /week
Disposable Rings, Points, and Screens for Hydro-Punch		$450.00 /LS
Hydro-Punch Sampling		$125.00 /location
Soil Drilling		$12.50 to $25.00 /foot

Table 5.15: Air and Bulk Asbestos Sampling

	Approximate Inspection Time Adjustment	
Characteristic	**Below Average**	**Above Average**
Building Accessibility	+10 percent	-10 percent
Building Age	+15 percent	-15 percent
Amount of Carpeting with Underlying Floor Tiles	-5 percent	+5 percent
Homogeneity of Materials	+20 percent	-20 percent
Mechanical Spaces	+5 percent (for each more than 1)	-5 percent (for each less than 1)
Piping in Sub-Ceiling	-10 percent	+10 percent
Steam Piping Present	-15 percent	+15 percent

Table 5.16: Additional Air and Bulk Asbestos Sampling Costs

Rates do not include Overhead, General and Administrative, and Profit costs (Except for personnel rates)

Item	Description	Costs			
Mileage	Round trip to site	$0.365			/mile
Junior-Level Inspector	Not necessarily AHERA certified.	$440.00			/day
Mid-Level Inspector	AHERA certified.	$520.00			/day
Computer Time and Report Generation	Approximately 2 hours per 1 hour of sampling time	$60			/hour
Per Diem	When overnight lodging required	$100	to	$120	/day per individual
Air Sample Analysis	Transmission Electron Microscopy (TEM)	$100			/per sample
Bulk Sample Analysis	Polarized Light Microscopy (PLM)	$30			/per sample
Disposable Sampling Equipment	Sample bags, Tyvek Suits, film, batteries, air sampling cartridges	$81			/day of sampling per team

Table 5.17: Aerial Photography

Rates do not include Overhead, General and Administrative, and Profit costs

Source	Type of photographs	Cost
USGS - NAPP/NHAP all 9x9 film at USGS EROS www.edc.usgs.gov	Paper print 9"x9"	
	infra red	$16.00
	black and white	$10.00
	Film positive	
	infra red	$24.00
	black and white	$10.00
	Handling Fee	$5.00
National Archives and Records Administration (NARA) - CAB and Still Picture Branch	digital, photographic, and oversize electrostatic reproductions	All reproductions are made to order for a fee(for all photo labs); CAB staff does not maintain a stock of copies.
Library of Congress	not listed	not listed

Table 5.18: List of TAL Metals

Analyte	EPA Method		Analyte	EPA Method
Aluminum	202.1/202.1		Magnesium	242.1
Antimony	204.1/204.2		Manganese	243.1/243.2
Arsenic	206.2/206.3/206.4/206.5		Nickel	249.1/249.2
Barium	208.1/208.2		Potassium	258.1
Beryllium	210.1/210.2		Selenium	270.3
Cadmium	213.1/213.2		Silver	272.1/272.2
Calcium	215.1		Sodium	273.1
Chromium	218.1/218.2/218.3		Thallium	279.1/279.2
Cobalt	219.1/219.2		Vanadium	286.1/286.2
Copper	220.1/220.2		Zinc	289.1/289.2
Iron	236.12/236.2			
Lead	239.1/239.2		Cyanide	(9010B) included if requested

Table 5.19: TAL Full Suite

Rates do not include Overhead, General and Administrative, and Profit costs

Analyte	Matrix	Method	Costs ($)
TAL Metals	Soil	SW-846/ 6010/7000/SOW-390	$327.65
TAL Metals	Water	SW-846/200 series and 1631 for Hg	$303.59

Table 5.20: List of TCL Analytes

Rates do not include Overhead, General and Administrative, and Profit costs

Analyte	Matrix	Method	Costs ($)	
Alkalinity	Water	310.1/310.2	$24.01	
Aluminum	Water	202.1/7020/200.7/6010	$41.03 to	$60.09
	Soil	7020/6010	$13.97	
Antimony	Water	204.1/7040/6010/7041/204.2/200.7	$41.03 to	$60.09
	Soil	7040/6010/7041	$13.97 to	$34.07
Arsenic	Water	206.2/206/3/7060/7061	$31.44	
BOD, 5-day	Water	Standard Methods	$34.68	
Barium	Water	208.1/7080/6010/200.7	$13.97 to	$60.09
	Soil	7080/6010	$13.97	
Beryllium	Water	210.1/7090/6010/200.7	$13.97 to	$60.09
	Soil	7090/6010	$13.97	
Cadmium	Water	213.1/7130/6010/200.7	$13.97 to	$60.09
	Soil	7130/6010	$13.97	
Calcium	Water	215.1/7140/6010/200.7	$13.97 to	$60.09
	Soil	7140/6010	$13.97	
Chemical Oxygen Demand	Water	410	$26.55	
Chloride	Water	300	$18.08	
	Soil	9253	$19.26	
Chlorophyll A	Water	Standard Methods	$34.08	
CrIV-Colorimetric	Water	7196	$22.71	
	Soil	7196	$22.71	
CrIV-Coprecip.	Water	7195	$34.24	
	Soil	7195	$34.24	
CrIV-Chelation/Extract	Water	7197	$43.37	
	Soil	7197	$43.37	
Chromium	Water	218.1/7190/200.7/6010	$13.62 to	$60.09
	Soil	7190/6010	$24.62	
Cobalt	Water	219.1/7200/200.7/6010	$13.97 to	$60.09
	Soil	7200/6010	$13.97	
Color	Water	110.2/110.3	$14.85	
Conductivity	Water	120.1	$10.83	
	Soil	9050	$17.82	
Copper	Water	220.1/7210/200.7/6010	$13.97 to	$60.09
	Soil	7210/6010	$13.97	
Corrosivity:pH	Water	9045	$7.93	
	Soil	9045	$7.93	
Corrosivity: NACE	Waste	1110	$48.56	
Cyanide	Water	335.3	$49.70	
	Soil	9010	$55.89	
Dissolved Oxygen	Water	360.1/360.2 (Winkler)	$24.28	
F List: (See following 4 rows)				
VOAs, BNAs, Alcohols	Liquid	8240/8270/In-house	$309.81	
Volatiles only, GC/MS	Liquid	8240	$192.14	
BNAs only, GC/MS	Liquid	8270	$309.81	
Alcohols only, GC	Liquid	In-house	$154.91	

Analyte	Matrix	Method	Costs ($)	
Flashpoint, Setaflash	Oil	1010/1020	$31.44	
	Soil	1010/1020	$31.44	
Fluoride	Water	300.00/340.2	$24.01 to	$67.08
Hardness	Water	130.2/2340B	$15.28	
Herbicides	Water	8150	$222.91	
	Soil	8151A	$242.80	
Iron	Water	236.1/7380/200.7/6010	$13.97 to	$81.40
	Soil	7380/6010	$13.97	
Langlier Index	Water	Combination	$50.60	
Lead	Water	239.1/7420/200.7/6010	$43.03	
	Soil	7420/6010	$13.97	
MBAS	Water	425.1	$38.38	
Magnesium	Water	242.1/7450/200.7/6010	$13.97 to	$60.09
	Soil	7450/6010	$13.97	
Manganese	Water	243.1/7460/200.7/6010	$13.97 to	$60.09
	Soil	7460/6010	$13.97	
Mercury	Water	1631	$41.92	
	Soil	7471	$41.92	
Metal Scans: (See following 4 rows)				
23 metals, all by ICP	Water	SW-846 (6010)	$303.59	
	Soil	SW-846 (6010)	$327.65	
13 PP metals, all by ICP	Water	200.7/6010	$181.62	
	Soil	6010	$181.62	
13 metals, PP methods	Water	SOW-390/SW-846 (6010)	$237.52	
	Soil	SOW-390/SW-846 (6010)	$237.52	
Moisture	Soil	Standard Methods	$22.56	
Molybdenum	Water	246.1/7480/6010	$13.97 to	$60.09
	Soil	7480/6010	$13.97	
Nickel	Water	249.1/7520/200.7/6010	$13.97 to	$60.09
	Soil	7520/6010	$13.97	
Nitrogen Forms: (See following 5 rows)				
Ammonia	Water	350.2	$35.29	
	Soil	350.2 on water leach	$28.03	
Kjeldahl (Total)	Water	351.2	$31.57	
	Soil	351.2 on water leach	$31.57	
Nitrate-N	Water	300	$30.98	
	Soil	300.00 on water leach	$31.77	
Nitrite-N	Water	351.4	$31.57	
	Soil	351.4 on water leach	$31.57	
Nitrate + Nitrite-N	Water	353.2/353.3	$62.56	
	Soil	353.2 on water leach	$62.56	
Oil & Grease-Grav-Total	Water	413.1	$49.78	
Oil & Grease-Grav	Soil	9071A	$52.40	
Oil & Grease-Grav/Polar	Water	413.1	$49.78	
Oil & Grease-Grav/Nonpolar	Water	413.1	$49.78	
Oil & Grease-IR-Total	Water	413.2	$57.64	
	Soil	413.2	$57.64	
Oil & Grease-IR-TPH	Water	418.1	$62.03	
	Soil	418.1	$62.03	
Oil & Grease-IR-TRPH	Soil	SW 3540/EP 418.1	$112.79	

Analyte	Matrix	Method	Costs ($)	
Ordnance (Explosives): (11 compounds)				
Nitoraromatics and Nitramines	Water	8330A	$314.81	
	Soil	8330	$314.81	
PCB-Arochlors	Water	617	$163.50	
	Soil	8080	$163.50	
Phenols	Water	604	$108.21	
	Soil	8041	$78.95	
Pesticides (Organophosphorous)	Water	614/8140A	$161.32	
	Soil	614/8141A	$161.32	
Pesticides/PCB (OC)	Water	608/8081/8082	$161.14	
	Soil	608/8081/8082	$161.14	
Pesticides/Herb-(6 cmpds)	Water	608/8080/8150	$222.91	
PH	Water	9045	$7.93	
	Soil	9045	$7.93	
Phenols, Total	Water	9066	$39.69	
	Soil	9066	$39.69	
Phosphate, Total	Water	365.2/365.4	$31.05	
Phosphate, ortho	Water	365.1/365.2	$26.33	
Phosphate, sol reactive	Water	365.2	$26.33	
PAHs	Water	610/8310/8100	$112.79	
	Soil	8310/8100	$112.79	
Potassium	Water	258.1/7610/200.7/6010	$13.97 to	$60.09
	Soil	7610/6010	$13.97	
Priority Pollutants:				
Priority Pollutant, Full	Water	Combination	$1,239.25	
	Soil	Combination	$1,342.52	
Priority Pollutant, Inorganic	Water	Combination	$324.27	
	Soil	Combination	$454.39	
Priority Pollutant, metals	Water	Combination	$185.89	
	Soil	Combination	$201.38	
Priority Pollutant, Pest/PCB	Water	608/8080	$161.14 to	$227.20
	Soil	8080	$161.14 to	$273.67
Priority Pollutant, VOA	Water	624/8240	$192.14 to	$258.18
	Soil	8240	$192.14 to	$232.36
Priority Pollutant, BNA	Water	625/8270	$365.51 to	$557.66
	Soil	8270	$365.51 to	$619.62
Reactivity	Water	SW 846	$88.64	
	Soil	SW 846	$88.64	
Regulated/Unreg VOAs	Water	524.2	$253.01 to	$361.45
Reports: (See following 4 rows)				
CLP Data Package: Inorganics, per sample	----	----	$51.64	
CLP Data Package: Volatiles, per sample	----	----	$51.64	
CLP Data Package: Semi-Volatiles, per sample	----	----	$51.64	
CLP Data Package: Semi-Volatiles, per sample	----	----	$51.64	

Analyte	Matrix	Method	Costs ($)	
Salinity	Water	Standard Methods	$16.52	
Selenium	Water	270.2/270.3/7740.7741	$34.93	
	Soil	7740/7741	$24.82	
Silica	Water	370.1	$31.44	
Silver	Water	272.1/7760/200.7/6010	$13.97 to	$60.09
	Soil	7760/6010	$13.97	
Sodium	Water	273.1/7760/200.7/6010	$13.97 to	$60.09
	Soil	7760/6010	$13.97	
Solids: (See the following 7 rows)				
Total	Water	160.3	$12.43	
	Soil	Standard Methods	$12.43	
Total, performed w/WTPH	Soil	Standard Methods	$10.33	
Total Dissolved	Water	160.1	$12.95	
Total Suspended	Water	160.4	$12.95	
Total Volatile	Sediment	Standard Methods	$15.84	
	Water	160.2	$15.84	
Settleable, by weight	Water	Standard Methods	$12.90	
Settleable, by vol (Imhoff)	Water	160.5	$12.90	
Sulfate	Water	300.0/375.4	$18.08	
	Soil	300.0 on water leach/375.4	$18.08	
Sulfide	Water	Standard Methods/376.1	$26.47	
	Soil	PSDDA Mod	$26.47	
TCLP: (See following eight rows)				
TCLP-Package Total	Liquid	40CFR 268	$1,239.25 to	$1,652.33
	Solid	40CFR 268	$1,239.25 to	$1,652.33
TCLP Extraction	Soil/Water	1311	$136.25	
TCLP Zero Head space Extraction	Soil/Water	1311	$136.25	
TCLP 8 metals	Soil/Water	Combo of 6010 and 7000 series	$180.72	
TCLP 11 metals	Soil/Water	Combo of 6010 and 7000 series	$209.64	
TCLP Volatiles	Soil/Water	8240	$260.00	
TCLP Semi-Volatiles	Soil/Water	8270	$422.71	
TCLP Pest/Herb	Soil/Water	8080 and 8150	$335.63	
TPH Method 418.1	Water	418.1	$62.03	
	Soil	418.1	$112.79	
Tannis and Lignins	Water	Standard Methods	$26.85	
Thallium	Water	279.2/7841	$26.20	
	Soil	7841	$26.20	
Tin	Water	282.1/7870/200.7/6010	$13.97 to	$60.09
	Soil	7870/6010	$13.97	
Titanium	Water	283.1/283.2	$18.59	
	Soil	283.1/283.2	$22.72	
Total Organic Carbon	Water	415.2/415.1	$27.76	
	Soil	9060	$27.35	
Total Organic Halogens (TOX)	Water	9022	$79.52	
Trihalomethanes	Water	501.3	$110.05	
Turbidity	Water	180.1	$12.18	
Vanadium	Water	286.1/7910/200.7/6010	$144.58	
	Soil	7910/6010	$13.97	

Analyte	Matrix	Method	Costs ($)
Volatiles, GC	Water	601/8021B	$104.07
	Water	602/8021B	$77.88
	Soil	601/8021B	$104.07
	Soil	602/8021B	$77.88
Volatile Organics, GC/MS	Water	524.2	$192.14
	Water	624/8240	$192.14
	Soil	8240	$192.14
WTPH-HCID	Water	8015	$71.62
	Soil	8015	$71.62
WTPH-G (inc. BTEX.)	Water	8015	$71.62
	Soil	8015	$99.57
WTPH-D	Water	8015	$71.62
	Soil	8015	$129.26
WTPH-418.1	Water	418.1	$62.03
	Soil	418.1	$112.79
WTPH-TS	Soil	Standard Methods	$10.33
Zinc	Water	289.1/7950/200.7/6010	$13.97 to $60.09
	Soil	7950/6010	$13.97

Table 5.21: List of VOC Compounds

Volatile Organic Compounds	EPA Method		Volatile Organic Compounds	EPA Method
Acetone	8260		1,2-Dichloropropane	8260
Benzene	8260		cis-1,3-Dichloropropene	8260
Bromodichloromethane	8260		trans-1,3-Dichloropropene	8260
Bromoform	8260		Ethyl Benzene	8260
Bromomethane	8260		2-Hexanone	8260
2-Butanone	8260		Methylene Chloride	8260
Carbon Disulfide	8260		4-Methyl-2-Pentanone	8260
Carbon Tetrachloride	8260		Styrene	8260
Chlorobenzene	8260		1,1,2,2-Tetrachloroethane	8260
Cloroethane	8260		Tetrachloroethene	8260
Cloroform	8260		Toluene	8260
Chloromethane	8260		1,1,1-Trichloroethane	8260
Dibromochloromethane	8260		1,1,2-Trichloroethane	8260
1,1-Dichloroethane	8260		Trichloroethene	8260
1,2-Dichloroethane	8260		Vinyl Chloride	8260
1,1-Dichloroethene	8260		Xylenes (total)	8260
trans-1,2-Dichloroethene	8260			

Table 5.22: TCL Organics

Rates do not include Overhead, General and Administrative, and Profit costs

Analyte	Matrix	Protocol	Costs ($)
VOCs	Soil	ILM 03.0	$ 192.14
VOCs	Water	ILM 03.0	$ 192.14

Table 5.23: SVOC Suite

Rates do not include Overhead, General and Administrative, and Profit costs

Analyte	Matrix	Protocol	Costs ($)
SVOCs	Soil	ILM 03.0	$ 282.98
SVOCs	Water	ILM 03.0	$ 365.51

Table 5.24: List of SVOC Compounds

SVOCs	EPA Method		SVOCs	EPA Method
Phenol	8270		Acenaphthene	8270
bis(2-Chloroethyl)ether	8270		2,4-Dinitrophenol	8270
2-Chlorophenol	8270		4-Nitrophenol	8270
1,3-Dichlorobenzene	8270		Dibenzofuran	8270
1,4-Dichlorobenzene	8270		2,4-Dinitrotoluene	8270
1,2-Dichlorobenzene	8270		Diethylphthalate	8270
2-Metylphenol	8270		4-Chlorophenyl-phenyl ether	8270
4-Metylphenol	8270		Fluorene	8270
N-Nitroso-di-n-dipropylamine	8270		4-Nitroaniline	8270
Hexachloroethane	8270		4,6-Dinitro-2-Methylphenol	8270
Nitrobenzene	8270		N-nitrosodiphenylamine	8270
Isophorone	8270		4-Bromophenyl-phenylether	8270
2-Nitrophenol	8270		Hexachlorobenzene	8270
2,4-Dimethylphenol	8270		Pentachlorophenol	8270
bis(2-Chloroethoxy) methane	8270		Phenanthrene	8270
2,4-Dichlorophenol	8270		Anthracene	8270
1,2,4-Trichlorobenzene	8270		Di-n-butylphthalate	8270
Naphthalene	8270		Fluoranthene	8270
4-Chloroaniline	8270		Pyrene	8270
Hexachlorobutadiene	8270		Butylbenzylphthalate	8270
4-Chloro-3-methylphenol (para-chloro-meta-cresol)	8270		3,3'-Dichlorobenzidine	8270
2-Methylnaphthalene	8270		Benzo(a)anthracene	8270
Hexachlorocyclopentadiene	8270		Chrysene	8270
2,4,6-Trichlorophenol	8270		bis(2-Ethylhexyl) phthalate	8270
2,4,5-Trichlorophenol	8270		Di-n-octylphthalate	8270
2-Chloronaphthalene	8270		Benzo(b)fluoranthene	8270
2-Nitroaniline	8270		Benzo(k)fluoranthene	8270
Dimethylphthalate	8270		Benzo(a) pyrene	8270
Acenaphthylene	8270		Indeno(1,2,3-cd) pyrene	8270
2,6-Dinitrotoluene	8270		Dibenz(a,h)anthracene	8270
3-Nitroaniline	8270		Benzo(g,h,i)perylene	8270

Table 5.25: Pesticide Suites

Rates do not include Overhead, General and Administrative, and Profit costs

Analyte	Matrix	Protocol	Costs ($)
Pesticides/PCBs	Soil	ILM 03.0	$ 161.14
Pesticides/PCBs	Water	ILM 03.0	$ 161.14

Table 5.26: List of Pesticide/PCB Compounds

Pesticides/PCBs	EPA Method		Pesticides/PCBs	EPA Method
alpha-BHC	8080/8081		4,4'-DDT	8080/8081
beta-BHC	8080/8081		Methoxychlor	8080/8081
delta-BHC	8080/8081		Endrin ketone	8080/8081
gamma-BHC (Lindane)	8080/8081		Endrin aldehyde	8080/8081
Heptachlor	8080/8081		alpha-Chlordane	8080/8081
Aldrin	8080/8081		gamma-Chlordane	8080/8081
Heptachlor Epoxide	8080/8081		Toxaphene	8080/8081
Endosulfan I	8080/8081		Aroclor-1016	8080/8081
Dieldrin	8080/8081		Aroclor-1221	8080/8081
4,4'-DDE	8080/8081		Aroclor-1232	8080/8081
Endrin	8080/8081		Aroclor-1242	8080/8081
Endosulfan II	8080/8081		Aroclor-1248	8080/8081
4,4'-DDD	8080/8081		Aroclor-1254	8080/8081
Endosulfan sulfate	8080/8081		Aroclor-1260	8080/8081

Table 5.27: Field Screening Tests

Rates do not include Overhead, General and Administrative, and Profit costs

Test	Matrix	Analyte	Costs ($)
Amino Assay Field Screening Test Kit	Soils	PCB	$35.61
	Soils	TPH	$26.46
	Soils	Selected Pesticides/ Herbicides	$37.65 per pesticide/herbicide
	Soils	Mercury	$23.59
Draeger Test Kit	Air	Over 160 Volatiles and Semi-Volatiles	$13.96 per analyte
HAZCAT Field Kit	Soils, Liquids, and Drums	Over 1000 of hazardous and non-hazardous substances	$83.73 per analyte or test kit
Portable XRF	Soils	metals	BLM owns several contact Karl Ford 303-236-6622 for availability. Rentable or available through contractors

Table 5.28: General Construction Rental Equipment

Rates do not include Overhead, General and Administrative, and Profit costs

R.S. Means Line Number			Item	Description	Reference	Hourly Operating Cost	Rent/Day	Rent/Week	Rent/Month	Equipment Cost/Day*
1590	200	40	Aggregate Spreader	Push Type, 8-12 ft wide	R01590-100	$1.25	$86.50	$260.00	$780.00	$62.00
		75	Auger, truck mounted	vertical drilling to 25 feet	R02315-450	$71.60	$2,375.00	$7,100.00	$21,300.00	$1,993.00
		100	Excavator (Backhoe), crawler mtd	Diesel Hydraulic ½ yd^3	R02455-900	$10.60	$390.00	$1,175.00	$3,525.00	$319.80
		150		1 yd^3		$20.05	$670.00	$2,015.00	$6,050.00	$563.40
		300		2 yd^3		$33.90	$1,150.00	$3,455.00	$10,400.00	$962.20
		340		3 ½ yd^3		$75.70	$2,475.00	$7,440.00	$22,300.00	$2,094.00
		350	Backhoe, Gradall	Truck mtd, 3 ton, @ 15 ft radius 5/8 yd^3	R02315-300	$24.80	$895.00	$2,690.00	$8,075.00	$736.40
		370		1 yd^3		$28.95	$1,050.00	$3,185.00	$9,550.00	$868.60
		400	Backhoe, Loader, wheel type	45 hp, 5/8 yd^3	R02315-400	$5.35	$188.00	$565.00	$1,700.00	$155.80
		460		80 hp, 1 1/4 yd^3	R02315-450	$9.20	$237.00	$710.00	$2,125.00	$215.60
		470		112 hp 1 ½ yd^3		$12.80	$415.00	$1,240.00	$3,725.00	$350.40
		550	Brush Chipper, gas	12 inch cutter head, 130 hp		$7.20	$208.00	$625.00	$1,875.00	$182.60
		750	Bucket, Clamshell, general purpose	3/8 yd^3		$0.70	$53.50	$160.00	$480.00	$37.60
		900		1 yd^3		$0.95	$90.00	$270.00	$810.00	$61.60
		1000		2 yd^3		$1.60	$140.00	$420.00	$1,250.00	$96.80
		1010	Bucket, Dragline, medium duty	½ yd^3		$0.40	$23.00	$69.00	$207.00	$17.00
		1030		1 yd^3		$0.45	$26.00	$78.00	$234.00	$19.20
		1050		2 yd^3		$0.75	$55.00	$165.00	$495.00	$39.00
		1070		3 yd^3		$1.10	$93.50	$280.00	$840.00	$64.80
		1200	Compactor, roller	2 drum, 200 lb, operator walking		$4.65	$143.00	$430.00	$1,300.00	$123.20
		1250	Compactor, rammer	gas, 1000 lb blow		$0.95	$40.00	$120.00	$360.00	$31.60

R.S. Means Line Number	Item	Description	Reference	Hourly Operating Cost	Rent/Day	Rent/Week	Rent/Month	Equipment Cost/Day*
1300	Compactor, vibratory plate, gas	13 in plate, 1000 lb blow		$0.75	$38.50	$115.00	$345.00	$29.00
1350		24 in plate, 5000 lb blow		$1.95	$66.50	$200.00	$600.00	$55.60
1860	Grader, self- propelled	25,000 lb		$15.30	$420.00	$1,265.00	$3,800.00	$375.40
1920		40,000 lb		$25.95	$740.00	$2,225.00	$6,675.00	$652.60
1930		55,000 lb		$34.65	$1,050.00	$3,130.00	$9,400.00	$903.20
1950	Hammer, pavement	gas, 1000-1250 lb		$12.55	$415.00	$1,245.00	$3,725.00	$349.40
2000	demolition, hydraulic, self-	diesel, 1300-1500 lb		$18.75	$555.00	$1,670.00	$5,000.00	$484.00
2050	Hammer, pile driving, steam	4150 ft-lb @225 BPM		$1.55	$282.00	$845.00	$2,525.00	$181.40
2150	or air	15000 ft-lb @ 60 BPM		$2.20	$505.00	$1,515.00	$4,550.00	$320.60
2200		24450 ft-lb @ 111 BPM		$2.90	$550.00	$1,645.00	$4,925.00	$352.20
2250	Hammer Leads *(per linear*	15000 ft-lb hammers		$0.45	$6.65	$20.00	$60.00	$7.60
2300	*foot)*	>=24450 ft-lb hammers		$0.65	$10.65	$32.00	$96.00	$11.60
2350	Hammer, Diesel	22,400 ft-lb		$13.25	$585.00	$1,760.00	$5,275.00	$458.00
2400		41,300 ft-lb		$20.10	$690.00	$2,070.00	$6,200.00	$574.80
2450		141,000 ft-lb		$33.10	$1,550.00	$4,625.00	$13,900.00	$1,190.00
2500	Vibrating Electric	34 hp		$21.10	$700.00	$2,095.00	$6,275.00	$587.80
2550	Hammer/Extractor, 200 kW	80 hp		$39.05	$1,025.00	$3,110.00	$9,325.00	$934.40
2600	diesel generator	150 hp		$56.40	$1,575.00	$4,700.00	$14,100.00	$1,391.00
2700	Extractor, steam or air	700 ft-lb		$1.70	$217.00	$650.00	$1,950.00	$143.60
2750		1000 ft-lb		$1.95	$315.00	$945.00	$2,825.00	$204.60
3000	Roller, tandem	gas, 3-5 tons		$5.15	$127.00	$380.00	$1,150.00	$117.20
3050		diesel, 8-12 tons		$4.30	$223.00	$670.00	$2,000.00	$168.40
3100	Roller, towed type	Vibratory gas, 12.5 hp, 2 ton		$2.70	$255.00	$765.00	$2,300.00	$174.60
3150		Sheepsfoot Double 60 in x 60 in		$0.85	$110.00	$330.00	$990.00	$72.80
3200	Roller, pneumatic tire, diesel	12 ton	R01590-100	$6.10	$315.00	$945.00	$2,825.00	$237.80
3250		21-25 ton		$10.25	$590.00	$1,775.00	$5,325.00	$437.00
3300	Roller, sheepsfoot, self	130 hp	R02315-300	$29.80	$875.00	$2,630.00	$7,900.00	$764.40
3320	propelled, 4 wheel	300 hp		$41.55	$975.00	$2,930.00	$8,800.00	$918.40

R.S. Means Line Number			Item	Description	Reference	Hourly Operating Cost	Rent/Day	Rent/Week	Rent/Month	Equipment Cost/Day*
		3350	Roller, vibratory steel drum	18,000 lb	R02315-400	$11.30	$355.00	$1,065.00	$3,200.00	$303.40
		3400	and Pneumatic tire, diesel	29,000 lb		$18.95	$470.00	$1,415.00	$4,250.00	$434.60
		3450	Scrapers, towed type	9-12 yd^3	R02315-450	$3.37	$161.00	$482.00	$1,450.00	$123.35
		3500		12-17 yd^3		$3.58	$214.00	$643.00	$1,925.00	$157.25
		3550	Scrapers, self propelled, 4x4	2 engine, 14 yd^3	R02455-900	$69.40	$1,450.00	$4,320.00	$13,000.00	$1,419.00
		3600	drive	2 engine, 24 yd^3		$101.35	$2,275.00	$6,815.00	$20,400.00	$2,174.00
		3650	Scrapers, self loading	11 yd^3		$31.35	$825.00	$2,470.00	$7,400.00	$744.80
		3700		22 yd^3		$61.35	$1,475.00	$4,410.00	$13,200.00	$1,373.00
		3860	Shovel/Backhoe bucket (front	½ yd^3		$0.85	$53.50	$160.00	$480.00	$38.80
		3880	end, mechanical attach)	1 yd^3		$0.90	$71.50	$215.00	$645.00	$50.20
		3890		1 ½ yd^3		$1.00	$170.00	$510.00	$1,525.00	$110.00
		3910		3 yd^3		$1.15	$305.00	$920.00	$2,750.00	$193.20
		4110	Tractor, crawler, with	75 hp		$12.15	$325.00	$970.00	$2,900.00	$291.20
		4150	bulldozer, torque converter,	105 hp		$17.20	$490.00	$1,475.00	$4,425.00	$432.60
		4200	diesel	140 hp		$19.80	$510.00	$1,530.00	$4,600.00	$464.40
		4260		200 hp		$29.80	$975.00	$2,925.00	$8,775.00	$823.40
		4310		300 hp		$39.20	$1,200.00	$3,600.00	$10,800.00	$1,034.00
		4360		410 hp		$53.65	$1,575.00	$4,725.00	$14,200.00	$1,374.00
		4380		700 hp		$109.65	$3,400.00	$10,235.00	$30,700.00	$2,924.00
		4400	Tractor, crawler with loader,	1 ½ yd^3, 80 hp		$9.70	$310.00	$930.00	$2,800.00	$263.60
		4450	torque conv., diesel	1 ½-1 3/4 yd^3, 95 hp		$11.70	$380.00	$1,145.00	$3,425.00	$322.60
		4510		1 3/4-2 1/4 yd^3, 130 hp		$16.05	$615.00	$1,850.00	$5,550.00	$498.40
		4530		2 ½-3 1/4 yd^3, 190 hp		$23.20	$840.00	$2,525.00	$7,575.00	$690.60
		4560		3 ½-5 yd^3, 275 hp		$31.15	$1,200.00	$3,610.00	$10,800.00	$971.20

R.S. Means Line Number			Item	Description	Reference	Hourly Operating Cost	Rent/Day	Rent/Week	Rent/Month	Equipment Cost/Day*
		4610	Tractor, wheeled with loader, torque conv., 4x4	1-1 1/4 yd^3, 65 hp		$10.05	$223.00	$670.00	$2,000.00	$214.40
		4620		1 ½-1 3/4 yd^3, 80 hp		$11.05	$315.00	$940.00	$2,825.00	$276.40
		4650		1 3/4-2 yd^3, 100 hp		$11.55	$335.00	$1,000.00	$3,000.00	$292.40
		4710		2 ½-3 ½ yd^3, 130 hp		$14.55	$425.00	$1,270.00	$3,800.00	$370.40
		4730		3-4 ½ yd^3, 170 hp		$18.10	$565.00	$1,700.00	$5,100.00	$484.80
		4760		5 1/4-5 3/4 yd^3, 270 hp		$32.95	$855.00	$2,570.00	$7,700.00	$777.60
		4810		7-8 yd^3, 375 hp		$50.20	$1,100.00	$3,305.00	$9,925.00	$1,063.00
		4870		12 ½ yd^3, 690 hp		$93.50	$2,350.00	$7,015.00	$21,000.00	$2,151.00
		4880	Tractor, wheeled skid steer	10 ft^3, 30 hp, gas		$5.85	$140.00	$420.00	$1,250.00	$130.80
		4890		1 yd^3, 78 hp, diesel		$7.60	$223.00	$670.00	$2,000.00	$194.80
		4900	Trencher, chain, boom type, gas	operator walking, 12 hp		$2.00	$117.00	$350.00	$1,050.00	$86.00
		4910		operator riding, 40 hp		$5.75	$245.00	$735.00	$2,200.00	$193.00
		5000	Trencher, wheel type, diesel	4 ft deep x 12 in wide		$12.80	$645.00	$1,930.00	$5,800.00	$488.40
		5100		6 ft deep x 20 in wide		$23.70	$940.00	$2,820.00	$8,450.00	$753.60
		5150	Trencher, ladder type, diesel	5 ft deep x 8 in wide		$14.80	$505.00	$1,510.00	$4,525.00	$420.40
		5200		8 ft deep x 16 in wide		$32.45	$985.00	$2,950.00	$8,850.00	$849.60
		5250	Truck, dump, tandem	12 ton payload		$19.90	$325.00	$970.00	$2,900.00	$353.20
		5300	Truck, 3-axle dump	16 ton payload	R01590-100	$27.20	$420.00	$1,265.00	$3,800.00	$470.60
		5350	Dump Trailer only, rear dump	16 ½ yd^3	R01590-100	$4.05	$145.00	$435.00	$1,300.00	$119.40
		5400		20 yd^3	R02315-300	$4.50	$155.00	$465.00	$1,400.00	$129.00
		5450	Flatbed, single axle	1 ½ ton rating	R02315-300	$11.45	$107.00	$320.00	$960.00	$155.60
		5500		3 ton rating	R02315-400	$14.55	$110.00	$330.00	$990.00	$182.40
		5550	Truck, off highway, rear dump	25 ton capacity	R02315-400	$40.45	$1,000.00	$3,020.00	$9,050.00	$927.60
		5600		35 ton capacity	R02315-450	$41.50	$1,050.00	$3,165.00	$9,500.00	$965.00
1590	400	4020	Paver, bituminous, rubber tires, 8 ft wide	52 hp, gas		$14.45	$770.00	$2,315.00	$6,950.00	$578.60
		4030		64 hp, diesel		$23.20	$1,150.00	$3,455.00	$10,400.00	$876.60
		4050	Paver, bituminous, crawler, 10 ft wide	78 hp, gas		$25.95	$1,375.00	$4,105.00	$12,300.00	$1,029.00
		4060		87 hp, diesel		$32.70	$1,725.00	$5,140.00	$15,400.00	$1,290.00
		4070	Paver, concrete, 12 to 24 ft wide	250 hp		$35.20	$1,275.00	$3,815.00	$11,400.00	$1,045.00

R.S. Means Line Number			Item	Description	Reference	Hourly Operating Cost	Rent/Day	Rent/Week	Rent/Month	Equipment Cost/Day*
		7020	Transit with tripod (builder's level)		R02315-300	$0.09	$21.50	$65.00	$195.00	$13.70
		7050	Trench Box	8000 lbs, 8 x 16 ft	R02315-300	$0.85	$142.00	$426.00	$1,275.00	$92.00
		7070		12,000 lbs, 10 x 20 ft	R02315-300	$2.55	$340.00	$1,025.00	$3,075.00	$225.40
		7100	Truck, pickup. 3/4 ton	2-wheel drive	R02250-400	$5.50	$66.50	$200.00	$600.00	$84.00
		7200		4-wheel drive	R02250-400	$5.65	$75.00	$225.00	$675.00	$90.20
		7300	Tractor, 4x2, 30 ton capacity	195 hp		$13.85	$300.00	$905.00	$2,725.00	$291.80
		7410		250 hp		$18.85	$380.00	$1,140.00	$3,425.00	$378.80
		7500	Tractor 6x2, 40 ton capacity	240 hp		$17.45	$405.00	$1,220.00	$3,650.00	$383.60
		7600	Tractor 6x4, 45 ton capacity	240 hp		$21.15	$475.00	$1,430.00	$4,300.00	$455.20
1590	600	600	Crane, crawler, cable	½ yd^3, 15 tons @ 12 ft radius	R02315-450	$4.97	$455.00	$1,360.00	$4,075.00	$311.75
		700		3/4 yd^3, 20 tons @ 12 ft radius	R02315-450	$22.76	$535.00	$1,600.00	$4,800.00	$502.10
		800		1 yd3, 25 tons @ 12 ft radius	R02315-450	$30.35	$665.00	$1,990.00	$5,975.00	$640.80
		900	Crane, crawler mounted, lattice boom	1 ½ yd^3, 40 tons @ 12 ft radius	R02315-450	$31.15	$935.00	$2,800.00	$8,400.00	$809.20
		1000		2 yd3, 50 tons @ 12 ft radius	R02315-450	$41.90	$1,150.00	$3,460.00	$10,400.00	$1,027.00
		1100		3 yd^3, 75 tons @ 12 ft radius	R02315-450	$45.10	$1,125.00	$3,710.00	$11,100.00	$1,103.00
		1200		100 ton capacity, standard boom	R02315-450	$54.40	$1,575.00	$4,740.00	$14,200.00	$1,383.00
		1300		165 ton capacity, standard boom	R02315-450	$79.70	$2,700.00	$8,115.00	$24,300.00	$2,261.00
		1400		200 ton capacity, 150 ft boom	R02315-450	$81.45	$2,800.00	$8,400.00	$25,200.00	$2,332.00
		1500		200 ton capacity, 450 ft boom	R02315-450	$119.60	$3,825.00	$11,440.00	$34,300.00	$3,245.00
		1600	Crane, truck mounted, cable	20 tons @ 10 ft radius	R02315-450	$19.32	$725.00	$2,170.00	$6,500.00	$588.55
		1700	operated, 6x4	25 tons @ 10 ft radius	R02315-450	$24.63	$965.00	$2,890.00	$8,675.00	$775.05

R.S. Means Line Number			Item	Description	Reference	Hourly Operating Cost	Rent/Day	Rent/Week	Rent/Month	Equipment Cost/Day*
		1800	Crane, truck mounted, cable operated, 8x4	30 tons @ 10 ft radius	R02315-450	$29.10	$760.00	$2,280.00	$6,850.00	$688.80
		1900		40 tons @ 12 ft radius	R02315-450	$34.95	$945.00	$2,840.00	$8,525.00	$847.60
		2000		60 tons @ 15 ft radius	R02315-450	$39.56	$1,175.00	$3,540.00	$10,600.00	$1,024.00
		2050		82 tons @ 15 ft radius	R02315-450	$42.83	$1,650.00	$4,940.00	$14,800.00	$1,331.00
		2100		90 tons @ 15 ft radius	R02315-450	$46.38	$1,750.00	$5,250.00	$15,800.00	$1,421.00
		2200		115 tons @ 15 ft radius	R02315-450	$51.75	$1,875.00	$5,590.00	$16,800.00	$1,532.00
		2300		150 tons @ 18 ft radius	R02315-450	$56.90	$2,050.00	$6,175.00	$18,500.00	$1,690.00
		2350		165 tons @ 18 ft radius	R02315-450	$64.15	$2,400.00	$7,225.00	$21,700.00	$1,958.00
		2400	Crane, truck mounted, hydraulic	12 ton capacity	R02315-450	$31.70	$590.00	$1,770.00	$5,300.00	$607.60
		2500		25 ton capacity	R02315-450	$33.10	$765.00	$2,300.00	$6,900.00	$724.80
		2550		33 ton capacity	R02315-450	$35.80	$950.00	$2,855.00	$8,575.00	$857.40
		2600		55 ton capacity	R02315-450	$41.55	$1,075.00	$3,200.00	$9,600.00	$972.40
		2700		80 ton capacity	R02315-450	$55.70	$1,525.00	$4,550.00	$13,700.00	$1,356.00
		2800	Crane, self propelled, 4x4, with telescoping boom	5 ton capacity	R02315-450	$13.55	$345.00	$1,035.00	$3,100.00	$315.40
		2900		12 ½ ton capacity	R01590-150	$20.15	$520.00	$1,560.00	$4,675.00	$473.20
		3050		20 ton capacity	R01590-150	$22.80	$645.00	$1,930.00	$5,800.00	$568.40
		3100		25 ton capacity	R01590-100	$24.80	$720.00	$2,155.00	$6,475.00	$629.40
		3150		40 ton capacity	R01590-100	$44.10	$1,050.00	$3,140.00	$9,425.00	$980.80
1590	400	1930	Floodlight, mercury, vapor, or quartz, on tripod	1000 watt	R02315-300	$0.28	$20.00	$60.00	$180.00	$14.25
		1940		2000 watt	R02315-300	$0.48	$35.00	$105.00	$315.00	$24.85
		1960	Floodlights, trailer mounted with generator	2-1000 watt lights	R02315-300	$1.90	$108.00	$325.00	$975.00	$80.20
		2100	Generator, electric, gas engine	1.5 - 3 kW	R02315-300	$1.30	$33.50	$100.00	$300.00	$30.40
		2200		5 kW	R02315-300	$1.90	$50.00	$150.00	$450.00	$45.20
		2300		10 kW	R02315-300	$2.35	$112.00	$335.00	$1,000.00	$85.80
		2400		25 kW	R02315-300	$6.70	$133.00	$400.00	$1,200.00	$133.60
		2500	Generator, diesel engine	20 kW	R02315-300	$4.40	$96.50	$290.00	$870.00	$93.20
		2600		50 kW	R02315-300	$9.55	$113.00	$340.00	$1,025.00	$144.40
		2700		100 kW	R02315-300	$14.00	$157.00	$470.00	$1,400.00	$206.00
		2800		250kW	R02315-300	$43.45	$277.00	$830.00	$2,500.00	$513.60

* Equipment Cost per Day represents the rental rate used in determining the daily cost of equipment in a crew. It is calculated by dividing the weekly rental rate by five days and adding the hourly operating cost multiplied by eight hours.

Table 5.29: Hazardous Waste Costs (Treatment, Disposal)

Rates do not include Overhead, General and Administrative, and Profit costs

Item	Description	Cost ($)
Non-Hazardous Waste Treatment and Landfill Disposal	Contaminated soil - drums (direct disposal)	$92.76 /drum
	Contaminated soil - bulk (direct disposal)	$92.76 /$yd^3$
	Contaminated soil - bulk (requires treatment before disposal)	$225.33 /$yd^3$
	Wastewater (solidification and disposal)	$289.97 /drum
	Asbestos-containing materials (disposal)	$45.12 to $171.88 /$yd^3$
Hazardous (RCRA) Waste Treatment	Wastewater (runoff water, purge water, other slightly contaminated waters)	$0.13 to $0.77 /gal.
	Wastewater (neutralization of corrosives)	$1.03 to $3.10 /gal.
	Bulk PCB dechlorination	$0.98 to $1.08 /gal.
	Drummed PCB dechlorination	$79.52 to $89.85 /drum
Hazardous (RCRA) Waste Landfill Disposal	Bulk solids (not requiring stabilization)	$164.20 /ton
	Bulk solids (with stabilization)	$318.44 /ton
	Drummed solids	$99.04 /drum
	Transformer carcass disposal	$4.65 /$ft^3$
	TSCA (PCB) liquids	$511.19 /drum
	TSCA (PCB) solids	$113.60 /ton
	Deep well injection (aqueous liquids)	$0.50 /gal. (surcharges for dilution, high TDS)
Hazardous (RCRA) Waste Incineration	Bulk solids	$1.03 /lb.
	Drummed solids	$864.65 /drum
	Drummed sludges	$510.94 /drum
	Bulk aqueous wastes	$1.18 /lb.
	Drummed aqueous wastes	$786.05 /drum
	Bulk non-aqueous wastes	$0.36 /lb.
	Drummed non-aqueous wastes	$283.99 /drum
	Bulk liquid meeting fuel parameters	$1.34 /gal.
	Drummed liquid meeting fuel parameters	$542.17 /drum
	TSCA solids	$622.21 /drum
	Bulk TSCA (PCB) liquids	$6.00 /gal.
	Drummed TSCA (PCB) liquids	$471.63 to $550.23 /drum
	Corrosive or Reactive wastes	$17.82 /gal.
	Fluorinated Aerosol cans	$4.03 /lb.
	Non-fluorinated Aerosol cans	$3.04 /lb.
Hazardous waste packaging and loading costs	Loading of bulk solids into truck	$2.01 /$yd^3$
	Loading of bulk solids into drums	$26.28 /drum
	Re-containerize leaking 55- gallon drums	$46.90 /drum
Hazardous waste transportation costs	Drummed/bulk waste - minimum charge	$2,306
	Transport 55-gallon drums (up to 80 drums)	$1.73 /mile
	Transport bulk solid waste (up to 20 cu. yds.)	$1.73 /mile
	Transport bulk liquid/ sludge (up to 5,000 gals)	$1.73 /mile
	Transport bulk solid waste in dump truck	$2.26 to $2.56 /mile

Item	Description	Cost ($)
Miscellaneous hazardous waste costs	Profile a Waste	$1,337 to $1,549
	Extra fee for 85 gal. overpack landfill disposal	$74.24 /drum
	Extra fee for 85 gal. overpack incineration disposal	$87.65 to $196.52 /drum
	Extra fee for leaking drums	$209.61 /drum
	Extra fee for drums less than 90 percent full	$15.72 /drum
	Minimum charge for drum shipments	$235.81
	Minimum charge for bulk shipments	$1,965
	Truck washout	$152.63 each
	Manifest discrepancy	$50.88 each
	Waste stream evaluation	$404.03
	Priority waste stream evaluation	$786.05
	Lab pack profile evaluation	$393.02 each

Table 5.30: Earthwork

Rates include Overhead, General and Administrative, and Profit costs

Item	Description	Cost	
Mobilization (up to 50 miles)			
Dozer , loader, backhoe, or excavator	70 H.P. to 250 H.P.	$180.00	/Each
	Above 250 H.P.	$270.00	/Each
Scraper, towed type (incl. Tractor)	6 yd^3 capacity	$289.00	/Each
	10 yd^3	$310.00	/Each
Self-propelled scraper	15 yd^3	$330.00	/Each
	24 yd^3	$360.00	/Each
Shovel or dragline	3/4 yd^3	$300.00	/Each
	1 1/2 yd^3	$360.00	/Each
Delivery Charge for small equipment	on flatbed trailer	$40.00 to $100.00	/Each
Structural Compaction			
Steel wheel tandem roller	5 tons	$81.50	/hr
	10 tons	$88.50	/hr
Sheepsfoot or wobbly wheel roller	8" lifts, common fill	$1.05	/yd^3
	8" lifts, select fill	$0.91	/yd^3
Vibratory plate	8" lifts, common fill	$1.79	/yd^3
	8" lifts, select fill	$1.66	/yd^3
Excavating, Bulk Bank Measure			
Backhoe, hydraulic, crawler mounted	1 yd^3 cap - 75 yd^3/hr	$2.22	/yd^3
	1 1/2 yd^3 cap - 100 yd^3/hr	$1.86	/yd^3
	2 yd^3 cap - 130 yd^3/hr	$1.71	/yd^3
	3 yd^3 cap - 160 yd^3/hr	$2.36	/yd^3
Backhoe, hydraulic, wheel mounted	1/2 yd^3 cap - 30 yd^3/hr	$4.44	/yd^3
	3/4 yd^3 cap - 60 yd^3/hr	$3.38	/yd^3
Clamshell	1/2 yd^3 cap - 20 yd^3/hr	$6.90	/yd^3
	1 yd^3 cap - 35 yd^3/hr	$5.30	/yd^3
Dragline	1/2 yd^3 cap - 30 yd^3/hr	$5.35	/yd^3
	1 yd^3 cap - 35 yd^3/hr	$4.59	/yd^3
	1 1/2 yd^3 cap - 65 yd^3/hr	$3.14	/yd^3
Front end loader, track mounted	1 1/2 yd^3 cap - 70 yd^3/hr	$1.45	/yd^3
	2 1/2 yd^3 cap - 95 yd^3/hr	$1.41	/yd^3
	3 yd^3 cap - 130 yd^3/hr	$1.23	/yd^3
	5 yd^3 cap - 160 yd^3/hr	$1.25	/yd^3
Front end loader, wheel mounted	3/4 yd^3 cap - 45 yd^3/hr	$2.10	/yd^3
	1 1/2 yd^3 cap - 80 yd^3/hr	$1.30	/yd^3
	2 1/4 yd^3 cap - 100 yd^3/hr	$1.16	/yd^3
	5 yd^3 cap - 185 yd^3/hr	$0.93	/yd^3
Hydraulic excavator, truck mounted	1/2 yd^3 cap - 30 yd^3/hr	$6.35	/yd^3
	48" bucket, 1 yd^3 cap - 45 yd^3/hr	$4.63	/yd^3

Item	Description	Cost	
Shovel	1/2 yd^3 cap - 55 yd^3/hr	$2.50	/yd^3
	3/4 yd^3 cap - 85 yd^3/hr	$1.93	/yd^3
	1 yd^3 cap - 120 yd^3/hr	$1.53	/yd^3
	1 1/2 yd^3 cap - 160 yd^3/hr	$1.35	/yd^3
	3 yd^3 cap - 250 yd^3/hr	$1.07	/yd^3
Excavating, Bulk, Dozer open site			
75 H.P. 50' haul	Sand and gravel	$1.84	/yd^3
	Common earth	$2.11	/yd^3
	Clay	$3.37	/yd^3
75 H.P. 150' haul	Sand and gravel	$3.66	/yd^3
	Common earth	$4.22	/yd^3
	Clay	$6.75	/yd^3
75 H.P. 300' haul	Sand and gravel	$7.05	/yd^3
	Common earth	$8.45	/yd^3
	Clay	$13.00	/yd^3
105 H.P. 50' haul	Sand and gravel	$1.43	/yd^3
	Common earth	$1.64	/yd^3
	Clay	$2.60	/yd^3
105 H.P. 150' haul	Sand and gravel	$3.23	/yd^3
	Common earth	$3.70	/yd^3
	Clay	$5.90	/yd^3
105 H.P. 300' haul	Sand and gravel	$7.15	/yd^3
	Common earth	$8.35	/yd^3
	Clay	$10.00	/yd^3
200 H.P. 50' haul	Sand and gravel	$1.02	/yd^3
	Common earth	$1.17	/yd^3
	Clay	$1.86	/yd^3
200 H.P. 150' haul	Sand and gravel	$2.40	/yd^3
	Common earth	$2.77	/yd^3
	Clay	$4.40	/yd^3
200 H.P. 300' haul	Sand and gravel	$4.61	/yd^3
	Common earth	$5.30	/yd^3
	Clay	$8.45	/yd^3
300 H.P. 50' haul	Sand and gravel	$0.88	/yd^3
	Common earth	$1.01	/yd^3
	Clay	$1.62	/yd^3
300 H.P. 150' haul	Sand and gravel	$1.81	/yd^3
	Common earth	$2.07	/yd^3
	Clay	$3.32	/yd^3
300 H.P. 300' haul	Sand and gravel	$3.53	/yd^3
	Common earth	$4.05	/yd^3
	Clay	$6.65	/yd^3

Item	Description	Cost	
460 H.P. 50' haul	Sand and gravel	$1.05	/yd^3
	Common earth	$1.21	/yd^3
	Clay	$1.94	/yd^3
460 H.P. 150' haul	Sand and gravel	$1.58	/yd^3
	Common earth	$1.82	/yd^3
	Clay	$2.91	/yd^3
460 H.P. 300' haul	Sand and gravel	$3.08	/yd^3
	Common earth	$3.54	/yd^3
	Clay	$5.80	/yd^3
700 H.P. 50' haul	Sand and gravel	$1.07	/yd^3
	Common earth	$1.23	/yd^3
	Clay	$1.94	/yd^3
700 H.P. 150' haul	Sand and gravel	$1.85	/yd^3
	Common earth	$2.14	/yd^3
	Clay	$3.40	/yd^3
700 H.P. 300' haul	Sand and gravel	$3.63	/yd^3
	Common earth	$4.15	/yd^3
	Clay	$6.80	/yd^3
Excavating, Bulk, Scrapers			
Elevating scraper, 11 yd^3	sand & gravel, 1500' haul	$2.50	/yd^3
	sand & gravel, 3000' haul	$2.82	/yd^3
	sand & gravel, 5000' haul	$3.41	/yd^3
	common earth, 1500' haul	$2.87	/yd^3
	common earth, 3000' haul	$3.25	/yd^3
	common earth, 5000' haul	$3.91	/yd^3
	clay, 1500' haul	$4.59	/yd^3
	clay, 3000' haul	$5.20	/yd^3
	clay, 5000' haul	$6.25	/yd^3
Self propelled scraper, 14 yd^3, 1/4 push dozer	sand & gravel, 1500' haul	$2.68	/yd^3
	sand & gravel, 3000' haul	$3.06	/yd^3
	sand & gravel, 5000' haul	$3.83	/yd^3
	common earth, 1500' haul	$3.08	/yd^3
	common earth, 3000' haul	$3.52	/yd^3
	common earth, 5000' haul	$4.40	/yd^3
	clay, 1500' haul	$4.93	/yd^3
	clay, 3000' haul	$5.60	/yd^3
	clay, 5000' haul	$7.00	/yd^3

Item	Description	Cost	
Self propelled scraper, 21 yd^3, 1/4 push dozer	sand & gravel, 1500' haul	$2.79	$/yd^3$
	sand & gravel, 3000' haul	$3.62	$/yd^3$
	sand & gravel, 5000' haul	$4.39	$/yd^3$
	common earth, 1500' haul	$3.20	$/yd^3$
	common earth, 3000' haul	$4.17	$/yd^3$
	common earth, 5000' haul	$5.05	$/yd^3$
	clay, 1500' haul	$5.10	$/yd^3$
	clay, 3000' haul	$6.65	$/yd^3$
	clay, 5000' haul	$8.10	$/yd^3$
Towed, 10 yd^3, 1/4 push dozer	sand & gravel, 1500' haul	$3.95	$/yd^3$
	sand & gravel, 3000' haul	$4.91	$/yd^3$
	sand & gravel, 5000' haul	$6.05	$/yd^3$
	common earth, 1500' haul	$5.25	$/yd^3$
	common earth, 3000' haul	$5.55	$/yd^3$
	common earth, 5000' haul	$7.15	$/yd^3$
	clay, 1500' haul	$7.00	$/yd^3$
	clay, 3000' haul	$7.35	$/yd^3$
	clay, 5000' haul	$9.85	$/yd^3$
Towed, 15 yd^3, 1/4 push dozer	sand & gravel, 1500' haul	$2.76	$/yd^3$
	sand & gravel, 3000' haul	$3.46	$/yd^3$
	sand & gravel, 5000' haul	$4.26	$/yd^3$
	common earth, 1500' haul	$3.69	$/yd^3$
	common earth, 3000' haul	$3.95	$/yd^3$
	common earth, 5000' haul	$5.00	$/yd^3$
	clay, 1500' haul	$4.91	$/yd^3$
	clay, 3000' haul	$5.25	$/yd^3$
	clay, 5000' haul	$6.90	$/yd^3$
Excavating, Trench or continuous footing, common earth, no sheeting or dewatering included			
1' to 4' deep	3/8 yd^3 tractor loader/backhoe	$5.75	$/yd^3$
	1/2 yd^3 tractor loader/backhoe	$4.54	$/yd^3$
4' to 6' deep	1/2 yd^3 tractor loader/backhoe	$4.54	$/yd^3$
	5/8 yd^3 hydraulic backhoe	$4.58	$/yd^3$
	3/4 yd^3 hydraulic backhoe	$4.06	$/yd^3$
	1/2 yd^3 hydraulic excavator, truck mounted	$7.06	$/yd^3$
6' to 10' deep	3/4 yd^3 hydraulic backhoe	$5.40	$/yd^3$
	1 yd^3 hydraulic backhoe	$3.33	$/yd^3$
	1 yd^3 hydraulic excavator, truck mounted	$4.17	$/yd^3$
	1 1/2 yd^3 hydraulic excavator	$2.48	$/yd^3$
10' to 14' deep	3/4 yd^3 hydraulic backhoe	$6.10	$/yd^3$
	1 yd^3 hydraulic backhoe	$3.70	$/yd^3$
	1 1/2 yd^3 hydraulic backhoe	$2.76	$/yd^3$

Item	Description	Cost	
14' to 20' deep	1 yd^3 hydraulic backhoe	$4.17	/yd^3
	1 1/2 yd3 hydraulic backhoe	$3.11	/yd^3
	2 1/2 yd^3 hydraulic backhoe	$3.04	/yd^3
By hand with pick and shovel	2' to 6' deep, light soil	$36.50	/yd^3
	2' to 6' deep, heavy soil	$73.00	/yd^3
Backfill trench, front end loader, wheel mounted	1 yd^3 bucket, minimal haul	$1.90	/yd^3
	1 yd^3 bucket, 100' haul	$3.80	/yd^3
	2 1/4 yd^3 bucket, minimal haul	$1.55	/yd^3
	2 1/4 yd^3 bucket, 100' haul	$3.10	/yd^3
Fill			
Spread dumped material	by dozer, no compaction	$1.43	/yd^3
	by hand	$24.50	/yd^3
Gravel fill, compacted, under floor slabs	4" deep	$0.36	/ft^2
	6" deep	$0.49	/ft^2
	9" deep	$0.72	/ft^2
	12" deep	$0.94	/ft^2
Gravel fill, compacted, under floor slabs, alternate pricing method	4" deep	$29.50	/yd^3
	6" deep	$25.50	/yd^3
	9" deep	$23.00	/yd^3
	12" deep	$22.00	/yd^3

APPENDIX B
COST ESTIMATING EXAMPLE

COST ESTIMATING EXAMPLE

Assumptions:

Site contaminated by old releases from gasoline UST. The UST was removed by owner several years ago.
The State Environmental Agency requires the site to be characterized and remediated.

Steps:

1. Prepare pre-field work submittals: Work Plan and Safety and Health Plan
2. Perform field investigation work
3. Prepare Site Characterization Report, including remedial alternative evaluation and proposed groundwater and soil cleanup standards
4. Meet with State Agency to determine the preferred remedial alternative
5. Conclude site characterization phase
6. Develop Remedial Design Specifications (in BLM's Service Contract format), drawings, cost estimate and bid schedule
7. Issue Request for Bid, evaluate bids, and award remedial contract
8. Prepare pre-field work submittals: Remedial Work Plan and Safety and Health Plan
9. Conduct field remediation work, consisting of: excavation and segregation of contaminated and clean soil; removal of free product; confirmation analysis by onsite mobile laboratory; QA/QC analysis by fixed laboratory; placement of oxygen release compound (ORC) in the excavation; backfilling of excavation; and shipment of contaminated soils to treatment and disposal facility.
10. Assume that 1,000 cubic yards will be excavated and that half of that volume is contaminated soil
11. Develop Site Remediation Close-Out Report
12. Conduct quarterly groundwater monitoring for two years
13. Document that COCs are below clean-up standards and obtain closure letter from State Environmental Agency

DESCRIPTION	QTY	UNIT	UNIT PRICE AT LEVEL D PPE	OVERHEAD GENERAL AND ADMINSTRATIVE, & PROFIT	UNIT PRICE W/ OVERHEAD G&A, & PROFIT	TOTAL COSTS	DATA SOURCE
Prepare pre-field work submittals (by BLM Contractor)							
Site Specific Work Plan							
Engineer/Geologist, mid-level	40	Hr	$28.50	110%	$59.85	$2,394.00	Table 5.1
Engineer/Geologist, senior review	8	Hr	$41.00	110%	$86.10	$688.80	Table 5.1
Site Safety and Health Plan							
Scientist/Geologist, mid-level	32	Hr	$28.50	110%	$59.85	$1,915.20	Table 5.1
Scientist/Geologist, senior, review	6	Hr	$36.00	110%	$75.60	$453.60	Table 5.1
Subtotal						$5,451.60	
Perform field investigation work (by BLM Contractor and Subcontractror)							
Mobilization/Demobilization (drill rig and support vehicle)	1	LS	$1,500.00	0%	$1,500.00	$1,500.00	Table 5.7
Drilling	250	Ft	$17.00	0%	$17.00	$4,250.00	Table 5.7
2 inch ID PVC well installation	250	Ft	$22.00	0%	$22.00	$5,500.00	Table 5.8
Protective well cover and concrete pad	5	Ea	$300.00	0%	$300.00	$1,500.00	Table 5.8
Equipment decontamination	5	Ea	$300.00	0%	$300.00	$1,500.00	Table 5.7
Sampling (including 1 QA/QC sample for each type of analysis)							
TPH-Gasoline and BTEX (soil)	11	Ea	$100.00	40%	$140.00	$1,540.00	Table 5.20
TPH-Gasoline and BTEX (water)	6	Ea	$72.00	40%	$100.80	$604.80	Table 5.20
TPH-Diesel (soil)	11	Ea	$130.00	40%	$182.00	$2,002.00	Table 5.20
TPH-Diesel (water)	6	Ea	$72.00	40%	$100.80	$604.80	Table 5.20
VOC, including MTBE (soil)	11	Ea	$192.00	40%	$268.80	$2,956.80	Table 5.20
VOC, including MTBE (water)	6	Ea	$192.00	40%	$268.80	$1,612.80	Table 5.20
TAL - metals (soil)	11	Ea	$328.00	40%	$459.20	$5,051.20	Table 5.19
TAL - metals (water)	6	Ea	$304.00	40%	$425.60	$2,553.60	Table 5.19
Field coordination and sample collection (including hiring of drilling subcontractor)							
Engineer/Geologist/Scientist, senior	80	Hr	$41.00	110%	$86.10	$6,888.00	Table 5.1
Engineer/Geologist/Scientist, junior	80	Hr	$20.00	110%	$42.00	$3,360.00	Table 5.1
Other Direct Costs							
Travel	2	Airfare	$500.00	30%	$650.00	$1,300.00	Internet
Per diem (2 people for 5 days, $85 per day per person)	10	Day	$85.00	30%	$110.50	$1,105.00	CONUS
Rental car, gas and parking	5	Day	$80.00	30%	$104.00	$520.00	Internet
Sampling supplies and sample shipping	1	LS	$300.00	30%	$390.00	$390.00	Dynamac
Topographic Survey	1	LS	$2,000.00	30%	$2,600.00	$2,600.00	Dynamac
Subtotal						$47,339.00	

DESCRIPTION	QTY	UNIT	UNIT PRICE AT LEVEL D PPE	OVERHEAD GENERAL AND ADMINSTRATIVE, & PROFIT	UNIT PRICE W/ OVERHEAD G&A, & PROFIT	TOTAL COSTS	DATA SOURCE
Site Characterization Report (by BLM Contractor)							
Draft 100% Report							
Engineer/Geologist/Scientist, junior	40	Hr	$20.00	110%	$42.00	$1,680.00	Table 5.1
Engineer/Geologist/Scientist, mid-level	64	Hr	$28.50	110%	$59.85	$3,830.40	Table 5.1
Engineer/Geologist/Scientist, senior	16	Hr	$41.00	110%	$86.10	$1,377.60	Table 5.1
Draftperson	24	Hr	$17.00	110%	$35.70	$856.80	Table 5.1
Clerical	4	Hr	$14.00	110%	$29.40	$117.60	Table 5.1
Final 100% Report							
Engineer/Geologist/Scientist, junior	16	Hr	$20.00	110%	$42.00	$672.00	Table 5.1
Engineer/Geologist/Scientist, mid-level	16	Hr	$28.50	110%	$59.85	$957.60	Table 5.1
Engineer/Geologist/Scientist, senior	8	Hr	$41.00	110%	$86.10	$688.80	Table 5.1
Draftperson	4	Hr	$17.00	110%	$35.70	$142.80	Table 5.1
Clerical	4	Hr	$14.00	110%	$29.40	$117.60	Table 5.1
Subtotal						$10,441.20	
Meet with BLM and State Environmental Agency (includes preparation of presentation materials - by BLM Contractor)							
Engineer/Geologist, mid-level	32	Hr	$28.50	110%	$59.85	$1,915.20	Table 5.1
Engineer/Geologist, senior	40	Hr	$41.00	110%	$86.10	$3,444.00	Table 5.1
Travel	2	Airfare	$500.00	30%	$650.00	$1,300.00	Internet
Per diem (two people for 3 days, $85 per day per person)	6	Day	$85.00	30%	$110.50	$663.00	CONUS
Rental car, gas and parking	5	Day	$80.00	30%	$104.00	$520.00	Internet
Subtotal						$7,842.20	
Develop Remedial Design Specifications (in BLM's Service Contract format), drawings, cost estimate and bid schedule - by BLM Contractor							
Draft 100% Report							
Engineer/Geologist, junior	40	Hr	$20.00	110%	$42.00	$1,680.00	Table 5.1
Engineer, mid-level	80	Hr	$28.50	110%	$59.85	$4,788.00	Table 5.1
Engineer, senior	120	Hr	$41.00	110%	$86.10	$10,332.00	Table 5.1
Draftperson	32	Hr	$17.00	110%	$35.70	$1,142.40	Table 5.1
Clerical	16	Hr	$14.00	110%	$29.40	$470.40	Table 5.1
Final 100% Report							
Engineer/Geologist, junior	8	Hr	$20.00	110%	$42.00	$336.00	Table 5.1
Engineer, mid-level	24	Hr	$28.50	110%	$59.85	$1,436.40	Table 5.1
Engineer, senior	40	Hr	$41.00	110%	$86.10	$3,444.00	Table 5.1
Draftperson	8	Hr	$17.00	110%	$35.70	$285.60	Table 5.1
Clerical	16	Hr	$14.00	110%	$29.40	$470.40	Table 5.1
Subtotal						$24,385.20	
Send Request for Bid, evaluate bids, and award remedial subcontract (by BLM Contractor)							
Engineer/Geologist, senior	100	Hr	$41.00	110%	$86.10	$8,610.00	Table 5.1
Clerical	4	Hr	$14.00	110%	$29.40	$117.60	Table 5.1
Subtotal						$8,727.60	

DESCRIPTION	QTY	UNIT	UNIT PRICE AT LEVEL D PPE	OVERHEAD GENERAL AND ADMINSTRATIVE, & PROFIT	UNIT PRICE W/ OVERHEAD G&A, & PROFIT	TOTAL COSTS	DATA SOURCE
Prepare pre-remedial work submittals (by Subcontractor)							
Site Remediation Work Plan							
Engineer/Geologist, mid-level	40	Hr	$28.50	110%	$59.85	$2,394.00	Table 5.1
Engineer/Geologist, senior review	8	Hr	$41.00	110%	$86.10	$688.80	Table 5.1
Site Remediation Safety and Health Plan							
Scientist/Geologist, mid-level	32	Hr	$28.50	110%	$59.85	$1,915.20	Table 5.1
Scientist/Geologist, senior, review	6	Hr	$36.00	110%	$75.60	$453.60	Table 5.1
Submittal review by BLM Contractor; engineer/Geologist/, senior	12	Hr	$41.00	110%	$86.10	$1,033.20	Table 5.1
Subtotal						$6,484.80	
Preconstruction site meeting (includes one representative from the BLM Contractor and 2 representatives from subcontractor)							
BLM Contractor							
Engineer/Geologist, senior	24	Hr	$41.00	110%	$86.10	$2,066.40	Table 5.1
Travel	1	Airfare	$500.00	30%	$650.00	$650.00	Internet
Per Diem ($85 per day per person)	3	Day	$85.00	30%	$110.50	$331.50	CONUS
Rental car, gas and parking	3	Day	$80.00	30%	$104.00	$312.00	Internet
Subcontractor							
Engineer/Geologist, senior	24	Hr	$41.00	110%	$86.10	$2,066.40	Table 5.1
Engineer/Geologist, mid-level	24	Hr	$28.50	110%	$59.85	$1,436.40	Table 5.1
Per Diem ($85 per day per person)	6	Day	$85.00	30%	$110.50	$663.00	CONUS
Rental car, gas and parking	3	Day	$80.00	30%	$104.00	$312.00	Internet
Subtotal						$7,837.70	
Remediation contractor field team (by subcontractor)							
Site Manager	80	Hr	$36.00	110%	$75.60	$6,048.00	Table 5.1
Health and Safety Officer	80	Hr	$36.00	110%	$75.60	$6,048.00	Table 5.1
Per Diem ($85 per day per person)	24	Day	$85.00	30%	$110.50	$2,652.00	CONUS
Rental car, gas and parking	2	Wk	$300.00	30%	$390.00	$780.00	Internet
Subtotal						$15,528.00	
Field oversight and coordination (by BLM Contractor)							
Engineer/Geologist, mid-level	80	Hr	$28.50	110%	$59.85	$4,788.00	Table 5.1
Travel	1	Airfare	$500.00	30%	$650.00	$650.00	Internet
Per Diem ($85 per day per person)	12	Day	$85.00	30%	$110.50	$1,326.00	CONUS
Rental car, gas and parking	2	Wk	$300.00	30%	$390.00	$780.00	Internet
Subtotal						$7,544.00	
Pre-excavation field activities							
Construct contaminated soil staging area, HDPE liner and hay bales	1	Ea	$1,182.00	0%	$1,182.00	$1,182.00	Dynamac
Construct 30'X50' decon. pad, HDPE liner with 2"x4" frame	1	Ea	$1,279.00	0%	$1,279.00	$1,279.00	Dynamac
Install sediment and erosion control devices							
Silt fences	100	LF	$0.80	30%	$1.04	$104.00	Table 4.7
Hay bales	100	LF	$2.66	30%	$3.46	$345.80	m/c, 02370 550 1250
Subtotal						$2,910.80	

DESCRIPTION	QTY	UNIT	UNIT PRICE AT LEVEL D PPE	OVERHEAD GENERAL AND ADMINSTRATIVE, & PROFIT	UNIT PRICE W/ OVERHEAD G&A, & PROFIT	TOTAL COSTS	DATA SOURCE
Excavation activities							
Excavator, crawler, 1-1/2 CY	1,000	CY	$1.45	110%	$3.05	$3,045.00	Table 5.30
2-1/4 CY Front end loader, wheeled	1,000	CY	$1.16	110%	$2.44	$2,436.00	Table 5.30
Decontamination (excav, loader, mobile lab)	3	Ea	$146.00	110%	$306.60	$919.80	m/e, 33 17 0802
ORD placement	500	lb	$10.00	10%	$11.00	$5,500.00	Regenesis web site
Free product recovery and disposal	1	LS	$2,000.00	0%	$2,000.00	$2,000.00	Dynamac
Subtotal						$13,900.80	
Analytical work (for constituents of concern only)							
Mobile laboratory (with chemist)	5	day	$750.00	0%	$750.00	$3,750.00	
Fixed laboratory (QA/QC)							
TPH-Gasoline and BTEX (soil)	10	Ea	$100.00	40%	$140.00	$1,400.00	Table 5.20
TPH-Gasoline and BTEX (water)	2	Ea	$72.00	40%	$100.80	$201.60	Table 5.20
VOC, including MTBE (soil)	10	Ea	$192.00	40%	$268.80	$2,688.00	Table 5.20
VOC, including MTBE (water)	2	Ea	$192.00	40%	$268.80	$537.60	Table 5.20
Lead (soil)	10	Ea	$14.00	40%	$19.60	$196.00	Table 5.20
Lead (water)	2	Ea	$43.00	40%	$60.20	$120.40	Table 5.20
Subtotal						$8,893.60	
Backfill activities							
Excavator, crawler, 1-1/2 CY	1,000	CY	$1.45	110%	$3.05	$3,045.00	Table 5.30
2-1/4 CY Front end loader, wheeled	1,000	CY	$1.16	110%	$2.44	$2,436.00	Table 5.30
Dump truck (to bring 500 CY backfill from onsite sources)	500	CY	$2.32	10%	$2.55	$1,276.00	m/c, 02320 200 0310
Backfill compaction	1,000	CY	$1.17	10%	$1.29	$1,287.00	m/c, R02315-300
Subtotal						$8,044.00	
Offsite treatment and disposal							
Transportation of contaminated soil to landfill							
2 CY Front end loader, wheeled	1	WK	$1,462.00	110%	$3,070.20	$3,070.20	Table 5.28
2-20 CY trucks, 2 R/T per day each, 7 days of waste hauling to landfill by 2 trucks (landfill is located 60 miles from the site)	3	WK	$645.00	0%	$645.00	$1,935.00	Table 5.28
	28	Shipment	$740.00	0%	$740.00	$20,720.00	m/e 33 19 0209
	3,360	Mile	$1.73	0%	$1.73	$5,812.80	Table 5.29
Low temperature thermal desorption (Assume 1.1 ton per CY) and landfilling	550	Ton	$161.00	10%	$177.10	$97,405.00	m/e 33 14 0235
Subtotal						$128,943.00	
Preparation of Close-Out Report (by Subcontractor)							
Engineer/Geologist, mid-level	40	Hr	$28.50	110%	$59.85	$2,394.00	Table 5.1
Engineer/Geologist, senior review	8	Hr	$41.00	110%	$86.10	$688.80	Table 5.1
Submittal review by BLM Contractor; engineer/Geologist/, senior	8	Hr	$41.00	110%	$86.10	$688.80	Table 5.1
Subtotal						$3,771.60	

DESCRIPTION	QTY	UNIT	UNIT PRICE AT LEVEL D PPE	OVERHEAD GENERAL AND ADMINSTRATIVE, & PROFIT	UNIT PRICE W/ OVERHEAD G&A, & PROFIT	TOTAL COSTS	DATA SOURCE
Quarterly groundwater monitoring (eight sampling rounds - by subcontractor)							
Engineer/Geologist/Scientist, mid-level	128	Hr	$28.50	110%	$59.85	$7,660.80	Table 5.1
Engineer/Geologist/Scientist, junior	128	Hr	$41.00	110%	$86.10	$11,020.80	Table 5.1
Per diem	32	Day	$85.00	30%	$110.50	$3,536.00	CONUS
Rental car, gas and parking	16	Day	$80.00	30%	$104.00	$1,664.00	Internet
Sampling supplies and sample shipping	1	LS	$300.00	30%	$390.00	$390.00	Dynamac
Laboratory analyses							
TPH-Gasoline and BTEX (water)	6	Ea	$72.00	40%	$100.80	$604.80	Table 5.20
VOC, including MTBE (water)	6	Ea	$192.00	40%	$268.80	$1,612.80	Table 5.20
Lead (water)	6	Ea	$43.00	40%	$60.20	$361.20	Table 5.20
Summary Reports							
Engineer/Geologist/Scientist, mid-level	192	Hr	$28.50	110%	$59.85	$11,491.20	Table 5.1
Engineer/Geologist/Scientist, senior, review	64	Hr	$41.00	110%	$86.10	$5,510.40	Table 5.1
Subtotal						$43,852.00	

TOTAL ESTIMATE	$351,897.10
CONTINGENCY (10% of total estimate)	$35,189.71
GRAND TOTAL	$387,086.81

Notes:

Table x.x = Table from the Cost Estimating Handbook, Appendix A
m/e = R.S. Means 2001 Environmental Remediation Cost Data Unit Price Book, escalated
m/c = R.S. Means 2002 Building Construction Cost Data Book

APPENDIX C
METRIC CONVERSION FACTORS

METRIC CONVERSION FACTORS

(From Washington State Department of Transportation)
http://www.wsdot.wa.gov/Metrics/factors.htm

Length

To convert from	to	multiply by
mile (US Statute)	kilometer (km)	1.609347
inch (in)	millimeter (mm)	25.4
inch (in)	centimeter (cm)	2.54
inch (in)	meter (m)	0.0254
foot (ft)	meter (m)	0.3048
yard (yd)	meter (m)	0.9144

Area

To convert from	to	multiply by
square foot (sq ft)	square meter (sq m)	0.09290304 E
square inch (sq in)	square meter (sq m)	0.00064516 E
square yard (sq yd)	square meter (sq m)	0.83612736 E
acre (ac)	hectare (ha)	0.4047

Volume

To convert from	to	multiply by
cubic inch (cu in)	cubic meter (cu m)	0.00001639
cubic foot (cu ft)	cubic meter (cu m)	0.02831685
cubic yard (cu yd)	cubic meter (cu m)	0.7645549
gallon (gal) Canada liquid	liter	4.546
gallon (gal) Canada liquid	cubic meter (cu m)	0.004546
gallon (gal) U.S. liquid	liter	3.7854118
gallon (gal) U.S. liquid	cubic meter (cu m)	0.00378541
fluid ounce (fl oz)	milliliters (ml)	29.57353
fluid ounce (fl oz)	cubic meter (cu m)	0.00002957

Force

To convert from	to	multiply by
kip (1000 lb)	kilogram (kg)	453.6
kip (1000 lb)	newton (N)	4,448.222
pound (lb) avoirdupois	kilogram (kg)	0.4535924
pound (lb)	newton (N)	4.448222

Pressure or stress

To convert from	to	multiply by
kip per square inch (ksi)	megapascal (MPa)	6.894757
pound per square foot (psf)	kilogram per square meter (kg/sq m)	4.8824
pound per square foot (psf)	pascal (Pa)	47.88
pound per square inch (psi)	pascal (Pa)	6,894.757
pound per square	megapascal (MPa)	0.00689476

inch (psi)

To convert from	to	multiply by
Mass (weight)		
pound (lb) avoirdupois	kilogram (kg)	0.4535924
ton, 2000 lb	kilogram (kg)	907.1848
grain	kilogram (kg)	0.0000648
Mass (weight) per length		
kip per linear foot (klf)	kilogram per meter (kg/m)	0.001488
pound per linear foot (plf)	kilogram per meter (kg/m)	1.488
Mass per volume (density)		
pound per cubic foot (pcf)	kilogram per cubic meter (kg/cu m)	16.01846
pound per cubic yard (lb/cu yd)	kilogram per cubic meter (kg/cu m)	0.5933

Temperature		
degree Fahrenheit (F)	degree Celsius (C)	tc=(tF-32)/1.8
degree Fahrenheit (F)	kelvin (K)	tk = (tF+459.7)/1.8
kelvin (K)	degree Celsius (C)	tc=tk-273.15
Energy and heat		
British thermal unit(Btu)	joule (J)	1055.056
calorie (cal)	joule (J)	4.1868E
Btu/degree	F x hr x ft2 W/m2 - degree K	5.678263
kilowatt-hour (kwh)	joule (J)	3,600,000E
British thermal unit per pound (Btu/lb)	calories per gram (cal/g)	0.55556
British thermal unit per hour (Btu/hr)	watt (W)	0.2930711

Power		
horsepower (hp) (550 ft-lb/sec)	watt (W)	745.6999 E
Velocity		
mile per hour (mph)	kilometer per hour(km/hr)	1.60934
mile per hour (mph)	meter per second (m/s)	0.44704
Permeability		
darcy	centimeter per second (cm/sec)	0.000968
feet per day (ft/day)	centimeter per second (cm/sec)	0.000352

Note:

One U.S. gallon of water weighs 8.34 pounds (U.S.) at 60 degrees F.

One cubic foot of water weighs 62.4 pounds (U.S.).

One milliliter of water has a mass of 1 gram and has a volume of one cubic centimeter.

One U.S. bag of cement weighs 94 lbs.

FREQUENTLY USED CONVERSION FACTORS

Quantity	From English Units	To Metric Units	Multiply by
Length	mile	km	1.609347
	yard	m	0.9144
	foot	m	0.3048
	inch	mm	25.40
Area	square mile	km 2	2.590
	acre	m 2	4047
	acre	hectare	0.4047
	square yard	m 2	0.8361
	square foot	m 2	0.092 90
	square inch	mm 2	645.2
Volume	acre foot	m 3	1 233
	cubic yard	m 3	0.7646
	cubic foot	m 3	0.02832
	cubic foot	L (1000 cm 3)	28.32
	100 board feet	m 3	0.2360
	gallon	L (1000 cm 3)	3.785
Mass	lb	kg	0.4536
	kip (1000 lb)	metric ton (1000kg)	0.4536
Mass/unit length	plf	kg/m	1.488
Mass/unit area	psf	kg/m 2	4.882
Mass density	pcf	kg/m 3	16.02
Force	lb	N	4.448
	kip	kN	4.448