APPENDIX H

COMPARATIVE COST ESTIMATE

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APPENDIX H

COMPARATIVE COST ESTIMATE

H1.0 INTRODUCTION

The feasibility study (FS) provides a logical progression for evaluating sites that require remedial action. During the detailed analysis portion of the FS, nine factors (two threshold, five balancing, and two modifying) are evaluated. This FS evaluated the two threshold criteria and five balancing criteria. The remaining two factors are assessed during the review and comment period. One of the balancing criteria is the cost to implement the various alternative remedial actions.

Cost estimates for the FS have an accuracy of +50 percent, -30 percent, which is the accuracy specified in EPA/540/R-00/002, *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study*. The cost estimates provide a discriminator for deciding between similar protective and implemental alternatives for a specific waste site. Therefore, the costs are relational and not absolute for the evaluation of the alternatives. Cost estimates by waste site were developed using the MAESTRO cost models developed by the Fluor Hanford, Inc. (FH) Project Controls Estimating department.

The various cost elements are taken from EPA/540/R-00/002; the FH contract with the U.S. Department of Energy (DE-AC06-96RL13200, *Contract Between the U.S. Department of Energy, Richland Operations Office, and Fluor Daniel Hanford, Inc.*); R. S. Means; and technical and historical site information. Contingency is applied to the cost estimate to cover potential cost overruns. Contingency covers two types, scope and bid. Scope covers the unknown elements of the alternative as remedial design proceeds, while bid contingency covers the unknown elements of remedial action and operations and maintenance as they proceed. A contingency of 25 percent is applied based on the level of engineering information available at this time. This FS does not evaluate the economies associated with implementing multiple sites or groups with a common alternative or aggregated remediation. They will be considered in the future as part of long-range planning and through the post record of decision activities, such as remedial design. Potential areas of cost sharing to reduce overall remediation costs include the following:

- Remediating all waste sites with a common preferred alternative at the same time
- Sharing mobilization/demobilization costs
- Sharing surveillance and maintenance costs
- Sharing barrier performance monitoring costs
- Sharing training costs.

Present net worth costs were estimated using the real discount rate published in Appendix C of the Office of Management and Budget Circular No. A-94, *Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs*, which is effective through the end of January 2007. Programs with durations longer than 30 years use the 30-year interest rate of

3.0 percent. Present net worth costs are discussed for each alternative in the following subsections.

Non-discounted costs were calculated because of recommendations presented in EPA/540/R-00/002. Non-discounted constant dollar costs demonstrate the impact of a discount rate on the total present-value cost. The non-discounted costs are presented for comparison purposes only.

Major assumptions are covered in section H3.0. These assumptions are necessary to provide the level of detail necessary for independent review.

H2.0 ALTERNATIVE COST ESTIMATES

This section describes the cost estimates based on the remedial alternatives developed in Chapter 6.0 of the FS. This section also summarizes the alternatives considered and the total present-worth costs, and provides summary and backup information for costs by waste site or group.

H2.1 ALTERNATIVE 1 – NO-ACTION

The no-action alternative represents a situation where no legal restrictions, access controls, or active remedial measures are applied to the waste site. No action is justified by a site condition where no COC exceeds a concentration level within a depth and extent envelope that requires a response for the protection of human health and the environment. No maintenance or other activities would be instituted or continued. The concentration value and envelope are determined by the site characterization and risk assessment presented in Chapter 3.0. Chapter 6.0 of the FS describes the no-action alternative.

Because the no-action alternative assumes no further actions will be taken at a waste site, costs are assumed to be zero.

H2.2 ALTERNATIVE 2 – MAINTAIN EXISTING SOIL COVER AND MONITORED NATURAL ATTENUATION

Chapter 6.0 of the FS provides a description of the *Maintain Existing Soil Cover and Monitored Natural Attenuation* alternative. The cost model for each of the sites is discussed in detail in Section H3.2. The primary annual/periodic costs associated with this alternative are surveillance and maintenance of the existing covers and natural attenuation. This alternative also includes the cost of long term groundwater monitoring. The costs for these annual/periodic activities were estimated based on the area and existing conditions of the individual waste sites or groups. Table H2-1 provides site details used as the basis for the capital and annual/periodic cost estimates.

The unit cost for site surveillance and maintenance was assumed to be the same as the current unit cost for similar activities at other sites. The unit cost accounts for such activities as site radiation surveys and existing soil cover repair. Because the existing soil cover is maintained

annually, costs for replacing all or large portions of the existing cover at specified intervals (i.e., every 20 years) are considered unnecessary.

The costs associated with natural attenuation monitoring are divided into three components: radiological surveys of surface soils, spectral gamma logging of vadose zone boreholes, and groundwater monitoring. The costs to perform radiological surveys of surface soils at the study sites are assumed to be similar to those for current survey practices at the other sites and are included in the surveillance and maintenance costs.

Vadose zone monitoring costs assume spectral gamma logging of one borehole per waste site to a 15 m (50 ft) depth once every 5 years until the site meets all preliminary remediation goals. This monitoring is considered for sites with high concentrations of contaminants in the shallow zone or near the bottom of crib and trench structures. It also assumes that the service life of vadose zone boreholes is 30 years. Costs are included for logging and periodic replacement of these boreholes until all preliminary remediation goals are met for the site (assume 150 years).

Groundwater monitoring costs likely will be incurred for sites that have high concentrations of mobile contaminants deep within the vadose zone and/or where groundwater contamination is known to have occurred. However, for the purpose of this FS the groundwater sampling activity will be considered as a periodic cost.

Institutional controls, which can have one-time or recurring costs (capital, annual operation and maintenance, or periodic), are non-engineering or legal/administrative measures to reduce or minimize the potential for exposure to site contamination or hazards by limiting or restricting site access. Examples include institutional controls plan, restrictive covenants, property easements, zoning, deed notices, advisories, groundwater use restrictions, and site information database.

An institutional controls plan would describe site controls and how to implement them. A site information database would provide a system for managing data necessary to characterize the current nature and extent of contamination. Institutional controls are project-specific costs that can be an important component of a remedial alternative and, as such, should generally be estimated separately from other costs, usually on a sub-element basis. Institutional controls may need to be updated or maintained, either annually or periodically.

The institutional control cost model used for this alternative was developed by the FH Project Controls and Estimating Department. The duration for institutional controls only considers the initial, “Year-one” period. The annual/periodic activities were based on the length of time required to reach the preliminary remediation goals of 150 years. The combined present net worth costs for surveillance and maintenance, natural attenuation monitoring, and institutional control activities represent the present-worth cost for this alternative. The real discount rate of 3.0 percent is used for discounting real (constant dollar) flows for the duration until all preliminary remediation goals are reached at each site (assume 150 years). The non-discounted cost for the 150 year project duration is presented for comparison purposes.

H2.3 ALTERNATIVE 3 – REMOVAL, TREATMENT, AND DISPOSAL

Chapter 6.0 of this FS describes the removal, treatment, and disposal (RTD) alternative. The cost model for each of the sites is discussed in detail in Section H3.3. Table H2-2 lists the excavation depths for this alternative. Capital Cost estimates for the RTD alternative are provided in Table H2-3. Annual/periodic and institutional control costs were not added to the removal, treatment, and disposal alternative because the contaminants are assumed to be removed to concentrations at or below the preliminary remediation goals. This alternative removes the human health and ecological risks associated with the contaminated soils at each site evaluated in this FS.

The RTD construction activities represent the present-worth cost for this alternative. The real discount rate of 3.0 percent is used for discounting real (constant dollar) flows for the duration until all preliminary remediation goals are reached at each site (assume 150 years). The non-discounted cost for the 150 year project duration is presented for comparison purposes. For this alternative, the present worth cost and non-discounted cost are zeroed out once the RTD activities are complete.

H2.4 ALTERNATIVE 4 – ENGINEERED BARRIER

Chapter 6.0 of this FS provides a description of the barrier alternative. The cost model used for each site is discussed in detail in Section H3.4 Engineered Barrier. The Capital Cost estimates for the capping alternative are included in Table H2-4. Table H2-5 lists the barrier dimensions for this alternative. Figure F-1 shows details of the assumed barrier design for the Evapotranspiration (ET) Monofill Barrier.

Operation and maintenance costs for the barrier alternative include barrier performance monitoring and repair costs. For purposes of this FS, all sites will assume annual repairs to the barrier (replacement of 60.8 cm [2 ft] of topsoil layer and revegetation over 10 percent of the barrier area). This is considered a conservative estimate because the barrier has been designed to require minimal maintenance, particularly after vegetation has been established.

Institutional controls are an integral component of the barrier alternative and would be required to prevent both intrusion to the barrier area and activities that might alter the integrity and effectiveness of the barrier. Groundwater monitoring likely would be a part of the barrier alternative. However, the cost estimate considers groundwater sampling periodic costs. Therefore, they are not considered in the capital cost estimates.

The institutional control cost model used for this alternative was developed by the FH Project Controls and Estimating Department. The duration for institutional controls only considers the initial, “Year-one” period. The Annual/Periodic activities were based on the length of time required to reach the preliminary remediation goals (assume 150 years).

The combined present net worth costs for removal and disposal construction activities, surveillance and maintenance; natural attenuation monitoring and institutional control activities represent the present-worth cost for this alternative. The real discount rate of 3.0 percent is used for discounting real (constant dollar) flows for the duration until all

preliminary remediation goals are reached at each site (assume 150 years). The non-discounted cost for the 150-year project duration is presented for comparison purposes.

H2.5 COST SUMMARY

The capital, periodic, non-discounted, and present-worth costs for each alternative by site are in Table H2-5, H2-6, and H2-7 for alternatives 2, 3, and 4, respectively. Table H2-8 compares the present worth and non-discounted costs for all of the alternatives.

H3.0 ASSUMPTIONS

Assumptions used for Alternatives 3 and 4 are discussed in the following sections.

H3.1 GLOBAL ASSUMPTIONS

H3.1.1 Labor

Fixed price construction craft labor rates are those listed in Appendix A to the Hanford Site Stabilization Agreement. The Hanford Site Stabilization Agreement rates include base wage, fringe benefits, and other compensation as negotiated between FH and the National Building and Construction Trades Department AFL-CIO. Other factors to cover additional costs for Workman's Compensation, FICA, state and federal unemployment insurance to develop a fully burdened rate by craft have been incorporated. The labor rates used are for 2007.

FH labor rates for management, engineering, safety oversight, and technical support are based on the FH approved planning rates for fiscal year 2007.

H3.1.2 Markups

Direct Cost Factors.

- Sales tax has been applied to all materials and equipment purchases at 8.3 percent.
- Construction consumables are estimated at 3.5 percent of fixed price (FP) direct craft labor costs to allow for small tools, tape, plastics, gloves, etc.
- General foreman factor of three percent has been applied to FP craft labor hours.

Indirect Cost Factors.

- FP contractor overhead, profit, bond and insurance costs have been applied at 26.5 percent on FP labor, materials, and equipment.
- FH General and Administration of 16.5 percent has been applied to all FH labor, material and equipment. The General and Administration is also applied to the FP contractor costs.

H3.1.3 General Assumptions

- FH Cost Estimating Templates for site remediation were used as the basis for each waste site. Standard templates used include RTD (trench/ ditch/ pond) and ET Monofill Barrier.

- Construction labor, material and equipment units have been estimated based upon standard commercial estimating resources and databases: R. S. Means, Richardson's Process Plant Construction Estimating Standards, and the Rental Rate Blue Book Database. The units may have been factored or adjusted by the estimator as appropriate to reflect influences by contract, work site, or other identified project or special conditions.

- Quotes from local commercial sources have been used for materials that need to be acquired for the construction of barriers or temporary improvements.

- Equipment Rates are based on 21 working days per month.

- Equipment operation is based on one shift of eight hours per day.

- One work week equals five days per week.

- Work stoppages or shut downs due to inclement weather are not factored into the estimates or planning schedules for this study.

- Work delays or stoppages caused by waiting for lab results or approval for backfilling waste site excavations are not factored into the estimates or planning schedules for this study.

- The cost estimates do include costs for design, work plan preparation, or any other preparation costs normally associated with activities occurring before field mobilization.

- Remedial Design Capital Costs are based on EPA/540/R-00/002 Exhibit 5-8. The following guide is used in this study.

  - For projects with construction costs less than $100K – Remedial design is planned at 20 percent of construction costs.

  - For projects with construction costs from $100K to $500K – Remedial design is planned at 15 percent of construction costs.

  - For projects with construction costs from $500K to $2M – Remedial design is planned at 12 percent of construction costs.

  - For projects with construction costs from $2M to $10M – Remedial design is planned at eight percent of construction costs.

  - For projects with construction costs greater than $10M – Remedial design is planned at six percent of construction costs.

- Escalation has not been included in the calculations. All costs are present day (fiscal year 2007).
- Contingency Rates are based on Section 5.4 of EPA/540/R-00/002.

H3.1.4 Long-Term Groundwater Monitoring Costs

Under each alternative that includes annual inspections and maintenance costs (Alternatives 2 and 4) there will be a cost for periodic groundwater monitoring. The cost associated with periodic groundwater monitoring is distributed equally over applicable closure zones. The following is a description of the periodic groundwater costs.

Periodic groundwater sampling will be performed in each closure zone. Each closure zone will contain three monitoring wells that will be sampled during the periodic sampling event. The present-worth cost for the periodic groundwater monitoring program will be the same for each closure zone. That cost then will be divided equally among all the waste sites within that closure zone. A summary of the facility closure zones associated with this FS is presented below.

Closure Zone	Number of Sites in Each Closure Zone
200-E Ponds	50
200-W Ponds	26
Solid Waste	29

Based on historical information from similar Hanford Site planning, the cost to install a compliant monitoring well is approximately $180,000[1] per well. It is assumed that this cost includes all required labor and material. In addition, each of the wells will need to be replaced every 30 years.

Cost to install wells (3 wells)	= $180,000/well x 3 wells
	= $540,000
Replacement costs (3 wells)	= $180,000/well x 3 wells

[1] Installation/replacement, as well as maintenance and sampling, costs have been rounded-off to facilitate explanation of long-term groundwater program costs.

= $540,000 every 30 years

Maintenance will need to be performed on each of the wells every five years during the 150-year active monitoring period.

Maintenance costs (3 wells) = $5,000/well x 3 wells

= $15,000 every 5 years

During each sampling event, three groundwater samples will be collected for analysis.

Total analytical cost per sampling event = $1,599

The labor cost of doing all the paper work, labeling, monitoring, and delivery to the laboratory is approximately $300 per well sampled.

Total labor cost = $300/well x 3 wells

= $900/sampling event

Total cost to collect and analyze samples per sampling event = $2,499

Sampling events will occur at the following frequencies:

Year 1	Quarterly (4 sampling events)
Year 2	Semi-annually (2 sampling events)
Years 3 through 5	Annually (3 sampling events)
Years 6 through 10	Every 2 years (3 sampling events)
Years 11 through 50	Every 5 years (8 sampling events)
Years 51 through 150	Every 10 years (10 sampling events).

The present-worth cost to conduct a periodic groundwater monitoring program for each closure zone for 150 years was calculated.

Present-worth cost for long-term groundwater program = $557,583/closure zone.

As a comparison, the non-discounted present worth cost for long-term groundwater program was calculated to compare the effect of a discount rate on the total project cost.

Present-worth non-discounted costs for long-term groundwater program = $3,089,808/closure zone.

The present-worth cost, on a per site basis, will be added to the calculated costs. Because there are a different number of sites in each closure zone, the following list presents the

long-term groundwater monitoring cost per site for each closure zone and the sites included in this FS. The non-discounted long-term groundwater monitoring cost per site is presented in parentheses.

Closure Zone	Number of Sites in Each Closure Zone	Cost Per Site
200-E Ponds	50	$11,152 ($61,796)
200-W Ponds	26	$21,445 ($118,839)
Solid Waste	29	$19,227 ($106,545)

Lastly, the following lists the sites included in this cost estimate, their associated closure zone, and the cost that will be added into the costs for Alternatives 2 and 4. Non-discounted costs are presented in parentheses.

Closure Zone	Cost Per Site
200-E Ponds 216-A-29 Ditch	$11,152($61,796)
Solid Waste Zone 216-B-63	$19,227 ($106,545)
200-W Ponds 216-S-10 Ditch 216-S-10 Pond 216-S-11 Pond	$21,445 ($118,839)

H3.2 ALTERNATIVE 2 – MAINTAIN EXISTING SOIL COVER AND MONITORED NATURAL ATTENUATION

H3.2.1 General Assumptions

The general assumptions for Alternative 2 are as follows.

Alternative 2 costs were calculated for each of the sites using a similar methodology as estimates for Alternatives 3 and 4. Cost calculation methodologies were consistent for each site and presented later in this appendix.

Typical site areas range from under 9.3 m^2 (100 ft^2) to 92,903 m^2 (1,000,000 ft^2). Because of this difference, larger construction crews will be used for sites larger than 9,290 m^2 (100,000 ft^2). For example, existing cover maintenance will use five trucks to haul material to the site for areas greater than 9,290 m^2 (100,000 ft^2) and one truck for sites less than 9,290 m^2 (100,000 ft^2).

Fencing and monuments/signs for institutional controls and fencing maintenance are considered institutional costs and are considered in this cost estimate.

Periodic groundwater monitoring costs will be added to long-term monitoring costs as indicated in Section H3.1.4.

Alternative 2 consists of seven general activities: institutional controls, site inspection and surveillance, existing cover maintenance, natural attenuation monitoring, reporting, site reviews and monitoring. These activities are described for the representative sites in the following sections.

Cost estimate prices were obtained from one of the following sources:

- ECHOS Environmental Remediation Cost Data – Unit Price, 7th Annual Edition (Means 2001a)
- *Facility Construction Cost Data*, 19th Annual Edition (Means 2007)
- Experience on similar projects.

H3.2.2 Typical Waste Site

Institutional Controls Implementation: Preparing and implementing institutional controls is a capital cost and includes office or administrative costs to implement deed restrictions, land-use restrictions, and groundwater-use restrictions. Costs presented in the cost estimates are based on the following:

- Time to produce institutional controls = 200 hours (assumption) x3
- Labor rate = $56/h (assumption).

Site Inspection and Surveillance: The cost associated with site inspection and surveillance is an operation and maintenance cost. This cost is incurred annually as long as the alternative is being used. The activities performed under site inspection and surveillance includes radiation surveys of surface soil and physical site inspection. Activities may include control of deeply burrowing animals and deep rooted plants by using herbicide or by physical removal (cost for these items are not included).

Site radiation surveys: For costing purposes, sites 0.4 ha (1 a.) or smaller are assumed to cost $8,712 for every surveying event. An additional $1,000 will be required for site radiation surveys for every additional 465 m^2 (5,000 ft^2) of site area above 0.4 ha (1 a.).

Physical site inspection: For costing purposes, sites 0.4 ha (1 a.) or smaller are assumed to require a team of two inspectors to perform the activities associated with site inspection and surveillance. An additional crew time will be needed for site inspection and surveillance for site areas larger than 0.4 ha (1 a.).

The cost for site inspection and surveillance for 0.4 ha (1 a.) is $781 and $896 for each additional 4,645 m^2 (50,000 ft^2) of waste area.

Existing Cover Maintenance: The cost associated with existing cover maintenance is an operation and maintenance cost. This cost will be incurred annually as long as the alternative

is being used. Because cover maintenance is performed annually, including costs for replacing all or large portions of the existing cover at specified intervals is unnecessary. Rather, cover maintenance is assumed to include replacing cover soils over 10 percent of the area to a depth of 0.61 m (2 ft). The soil used to repair the existing cover is a silt loam and pea gravel mixture. The pea gravel is used to make the soil resistant to wind erosion.

For costing purposes, it is assumed that the silt loam can be acquired for no material cost from an on site borrow source (Area C) and that pea gravel must be purchased at an offsite location. Both materials (silt loam and pea gravel) must be mixed before being transported and placed at the site. It is assumed that periodically a large volume of silt and pea gravel will be mixed and stockpiled by a subcontractor at Area C. This mixture will be for the repair of barrier surfaces. The material and transportation cost of pea gravel, excavation, hauling of the silt, and the blending and stockpiling by the subcontractor are estimated to cost \$8.95/0.76 m^3 (\$8.95/yd^3) for the mixture in stockpile at Area C.

For waste sites with areas greater than 9,290 m^2 (100,000 ft^2), it is assumed for transporting the silt loam/pea gravel mixture to the waste site, that one front end loader, with operator will load dump trucks for transportation to the site. To transport the silt loam to the site, it is assumed that five dump trucks and five drivers will be used and each dump truck will be able to make two trips an hour to the site carrying 9.2 m^3 (12 yd^3) per trip. For waste sites less than 9,290 m^2 (100,000 ft^2) in size, one front end loader with one operator will directly load two dump trucks making two trips an hour to the site.

Once the material is at the waste site it is assumed that the silt loam/pea gravel mixture will be unloaded at the repair area and spread with a Low Ground Pressure dozer over the area. An 11,356 – 15,142 L (3,000 - 4,000 gal) water truck will be used for dust control during the spreading process. For sites with areas less than 9,290 m^2 (100,000 ft^2), one Low Ground Pressure dozer will be used. For sites with areas greater than 9,290 m^2 (100,000 ft^2), two Low Ground Pressure dozers will be used. Once the silt loam and pea gravel is in place these areas will need to be revegetated. It is assumed that a revegetation crew can reseed 0.4 ha (1 a.) in an hour.

In addition to the transportation, spreading, and revegetation costs, it is assumed that FH will have a site engineer on site during cover maintenance activities to provide oversight.

For planning purposes, the repair of a 0.4 ha (1 a.) waste site will require 247 m^3 (323 yd^3) of silt loam/pea gravel mixture, three hours to load and transport, four hours to spread, and one hour to reseed. With supervisory over site the cost per 0.4 hectare (1 acre) is \$5,728. Waste sites less than 0.4 hectare (1 acre) in size are assumed to cost the same.

Weed and Pest Control: The cost associated with weed and pest control is an operation and maintenance cost and will happen monthly or as required for as long as the alternative is being used. The work involves controlling weeds by spraying and removal or trapping of animals from the waste site. Radiological Control Technician (RCT) time is included in the cost for this work. For costing purposes, sites 0.4 ha (1 a.) or smaller are assumed to cost \$1,036 per year. For sites larger than 0.4 hectare (1 acre), the cost will increase by \$248 per 0.4 hectare (1 acre) over the initial \$1,036/0.4 ha (\$1,036/a.).

Waste Site/Fence Maintenance: The cost associated with waste site/fence maintenance is an operation and maintenance cost and will occur four times per year for as long as the alternative is being used. The work involves removal of wind blown trash/weeds and repair of the existing perimeter fences and signs. RCT time is included in the cost for this work. It is expected that a crew can maintain a two hectares (five acres) site per day. The costs are assumed to be $2,135 per 0.4 hectare per year ($2,135/acre per year).

Natural Attenuation Monitoring: The cost associated with natural attenuation monitoring is an operation and maintenance cost. This cost will be incurred annually as long as the alternative is being used. The cost for natural attenuation monitoring includes spectral gamma logging of vadose zone boreholes.

Vadose zone monitoring costs assume spectral gamma logging of one borehole per waste site to a depth of 15 m (50 ft) once every five years. The service life of a vadose zone borehole is assumed to be 30 years. Therefore, every 30 years a replacement borehole will be drilled. Costs are based on the following:

- Unit cost for vadose zone monitoring = $75 per 0.30 m (1 ft) of borehole
- Length of borehole drilling = 15 m (50 ft)
- Cost of vadose zone monitoring = $75 per 0.30 m x 15 m (1 ft x 50 ft)
- Total cost of vadose zone monitoring = $3,750
- Installation cost of borehole = $50 per 0.30 m (1 ft) of borehole
- Length of borehole installation = 15 m (50 ft)
- Cost of borehole installation =$50 per 0.30 m x 15 m) (1 ft x 50 ft)
- Total cost of borehole installation = $2,500
- Oversight (assumption) = 1 day = 8 hours ($56/h).

Other costs associated with installing replacement boreholes are included on the cost estimate sheets. These items include, but are not limited to, mobilization of a drill rig, decontamination of a drill rig, and handling of investigation derived waste.

Reporting: Annual and periodic activities will be recorded in an annual report. The report will contain descriptions of activities that occurred during the year. Reports will contain all appropriate/required backup and material purchase information. The cost for the annual reports is based on the following assumption:

- Annual reports = $10,000/report.

Site Reviews: The cost associated with site reviews is an operation-and-maintenance cost. This cost will be incurred every five years as long as the alternative is being used. Site reviews will be conducted to assess site conditions and to evaluate the selected alternative and determine whether additional steps toward remediation are required. The cost for the five year site reviews is based on the following assumption:

- Five year site review = $20,000/review.

Monitoring: Monitoring includes collecting groundwater samples from down-gradient wells to evaluate the performance of the barrier system. Refer to Section H3.1.4.

H3.3 ALTERNATIVE 3 – REMOVAL, TREATMENT, AND DISPOSAL

Ditches and Ponds are excavated to the required depth and contaminated material is then removed to the Environmental Restoration Disposal Facility (ERDF) for disposal. The sites are then backfilled and reseeded.

H3.3.1 General Description and Assumptions

The general assumptions for Alternative 3 are as follows.

The field work such as mobilization/demobilization, excavation, backfill, revegetation, and some of the post construction work will be contracted to a FP Contractor. The Project Management, RCT support, field sampling, sampling analysis, and safety oversight will be performed by FH. The waste disposal work involved with hauling from the waste site to ERDF and the disposal work at ERDF will be performed by the Environmental Restoration Contractor responsible for the operation of ERDF.

Mobilization and Start Up include site training, mobilization of equipment and personnel, installing temporary construction fences, construction of staging/container storage areas and access roads, setting up office, change, and storage trailers with utilities, temporary survey buildings, and decontamination areas. Ten days are planned for this activity. The contractor will setup office trailers, change trailer, and storage container. The setup costs are considered part of the rental costs. The rental cost of the trailers and utilities will also include and are based on the duration of the work. A temporary staging area will be constructed at a lump sum cost of $40,014. The contractor will construct a temporary survey building and decontamination areas at a lump sum cost of $22,868 for the building and $13,752 for the decontamination area. Site access roads will be constructed at a cost of $11,785.

Demobilization shall include demobilization of equipment and personnel, removing temporary construction fences, access roads, and office/storage trailers. This activity is planned for 10 days. The staging area and roads will be scarified as part of demobilization and the planning costs is $505. The office trailers, storage containers will be removed by contractor or off site vender and are considered a part of the rental cost. The temporary survey building and decontamination area will be removed at a lump sum cost of $17,217.

Typical heavy equipment mobilized to and demobilized from the site are:

- One large dozer
- One 1.5-2.3 m^3 (2-3 yd^3) excavator
- One 3.8 m^3 (5 yd^3) wheel loader
- Backhoe loader
- Two farm tractors
- Motor grader
- One soil compactor with blade

- Five highway 12 m^3 (16 yd^3) end dump trucks with 12 m^3 (16 yd^3) end dump trailers
- Two 15,142 to 22,712 L (4,000 to 6,000 gal) water trucks
- One flatbed truck
- Three trucks with tilt container beds
- Revegetation equipment-seed drill, mulcher, and tiller.

The cost of moving equipment 56 km (35 mi) from a commercial storage yard to the waste site is planned at $14,147 to mobilize. The cost to demobilize is planned at $23,923, which also includes the decontamination of the equipment, along with moving the equipment to the storage yard. This includes the FP labor to clean the equipment. The FH RCT labor hours support to decontamination of the construction equipment is 40 hours, which is planned at $2,636.

Contractor personnel are given hazardous waste worker, radiological and other required site training before the start of work at the site. The cost of training is planned at $189,734, which includes the crew time and tuition costs. The training will meet site requirements to work at a Hanford waste site. The four typical crews were used to calculate the cost of training.

A temporary fence is constructed around the waste site work area. It will be a steel post with orange mesh fabric. During demobilization, the fence will be removed. The planning cost for this site is the linear footage around the waste site plus 15 m (50 ft) of construction zone on all sides of the site.

Before remediation work starts at the waste site, the contractor performs a boundary/topographic/location survey. The planning cost for this work is based on the area of the waste site.

For excavation sites that will have contaminated waste removed to a maximum depth of 4.6 m (15 ft). The sides of the excavation will be sloped at 1.5:1 to the bottom of the excavation; except for those sites that were originally constructed using 2:1 slopes. For sites were the total depth of excavation is less than 1.5 m (5 ft) the sloping of the sides of the excavation is not required. During the waste removal process, heavy equipment will be kept out of the contaminated areas of the excavation site.

For excavation sites overburden will be removed with a 1.5-2.3 m^3 (2-3 yd^3) excavator, and two haul trucks. The soil will be stockpiled near by the waste site. A 15,142 L (4,000 gal) water truck is used to control dust during this activity. The production rate for one crew is 112 m^3/h (146 yd^3/h).

Contaminated waste will be removed using a 1.5-2.3 m^3 (2-3 yd^3) hydraulic crawler excavator. The contaminated soil will be directly placed into lined ERDF Containers and hauled from the excavation site. A highway truck with water tank trailer is used to control dust during this activity. Depending on the volume of waste to be removed, one to four crews can be working at a site. Crew labor consists of one operator, one laborer, and one truck driver. The production rate for one crew is 46 m^3/h (60 yd^3/h). An FH RCT supports the work at 1.5 hours per excavation crew hour.

Air sampling will occur during the excavation of contaminated soil. A minimum of two samples will be collected per day. Planning cost per sample is $520/each. The sampling crew will consist of one sampler and RCT.

Soil samples will be taken of the overburden, from ERDF containers, and for verification that the requirements for waste removal have been met. The soil sampling cost developed as follows:

- Non Contaminated Soil sampling:
  - Maximum of six samples or one sample per yd^3 which ever is less
  - Quality Assurance (QA) sample required is one
  - The planning cost per sample is $1,262/sample
  - The soil being sampled is the overburden that is uncontaminated and will not be removed from the site.
- Sampling required for waste going to ERDF:
  - One sample is required for every 70 containers
  - There will be a minimum of six samples per site
  - QA samples required are either a minimum of one or five percent of total of ERDF samples which ever is greater
  - The planning cost per sample is $452/sample.
- Pre – Verification Process sampling:
  - One sample will be required per 2500 m^2 (50m x 50m)(26899 f^2)
  - There will be a minimum of six samples per site
  - QA samples required are either a minimum of two or five percent of the total samples which ever is greater
  - The planning cost per sample is $2,227/sample
  - These samples are the preliminary samples needed to see if all of the required waste has been removed from a site being excavated
  - This process is expected to happen twice during the excavation process

  - If the samples show that the site has met the requirement then the Verification Process will start.

- Verification Process Sampling:
  - One sample will be required per 625 m^2 (25m x 25m)(6724 f^2)
  - There will be a minimum of six samples per site
  - QA samples required are a minimum of either two or five percent of the total samples which ever is greater
  - The planning cost per sample is $7,856/sample for onsite lab analysis and $1,458 for offsite lab analysis and shipping, a total of $9,314/sample
  - These samples are the final samples needed to see if all of the required waste has been removed from a site being excavated
  - This process happens once during the excavation process.

- Sampling Crews:
  - Verification Sampling – two hours for each sample taken by a crew made up of one FH RCT and sampler technician
  - Other sampling (Air, ERDF, Non Contaminated) – one hour for each sample taken by a crew made up of one FH RCT and sampler technician.

The ERDF Container handling and loading process starts with a site haul truck picking up an empty container at the staging area. The container is moved to a preparation area where laborers install a bed liner and it is inspected by a half-time RCT. The haul truck and container proceed to the loading area. After loading the liner is sealed and the container is secured by laborers. The container is moved to the survey building where a team of three RCTs inspect and survey the container and truck for contamination. From there the haul truck is driven to the storage area and the container is unloaded from the truck. Three trucks are required to support each contaminated excavation crew.

ERDF disposal fee, transportation, and handling costs are estimated at $1,005 per container. An Environmental Restoration Contractor driver and truck/trailer will move a loaded container from the storage area to ERDF and place an empty container in the storage area. The estimated costs include the rental of the containers used. For planning purposes, the capacity of an ERDF container is 9.9 m^3 (13 yd^3) of contaminated waste.

Backfilling is performed by three different operations.

- The moving of the stockpiled overburden back to the excavation site will require one crew. The equipment used by a crew is one 3.1-3.8 m^3 (4-5 yd^3) loader, and

two haul trucks. Labor is one operator, and two truck drivers. The production rate for one crew is 210 m^3/h (275 yd^3/h).

- The moving of borrow material to the excavation site is typically performed by one crew hauling from an on site pit source. The equipment used by a crew is one 3.8 m^3 (5 yd^3) loader, five 12 m^3 (16 yd^3) highway end dump truck with 12 m^3 (16 yd^3) end dump trailers and one water truck. Labor is one operator and six truck drivers. The production rate for one crew is 141 m^3/h (185 yd^3/h).

- One crew performs spreading and compacting backfill at the site. The equipment used per crew is one 300-hp dozer and one water truck. The crew consists of one operator, one truck driver, and one laborer. The production rate for one crew is 141 m^3/h (185 yd^3/h).

Revegetation of the waste site includes planting native dry land grass using tractors with seed drills and hand broadcasting, hand planting sage brush seedlings, and irrigation four times in the spring or early summer. All disturbed areas such as the waste site, stockpile, staging areas and access roads are to be replanted.

The FH Project Management team is made up of a part time project manager, with a full time field supervisor, and part time engineering support. QA, Rad Con, and Safety also provide oversight along with other support for contract management, and project controls. Total hours for this staff are planned at 22.5 hours per day. The duration of this work is based on total project duration.

The FP Contractor field supervisory team is made up of a full time construction manager and field supervisor, along with part time QA, construction safety, and clerical support. Two pickup trucks are included in the cost. Total hours for this staff are planned at 21 hours per day. The duration of this work is based on total project duration.

Demobilization includes demobilization of equipment and personnel, removing temporary construction fences, construction of staging/container storage areas, access roads, office/change/storage trailers, truck scales, temporary survey buildings, and decontamination areas.

Excavation and backfill quantities listed below are based on loose or truck cubic yards. The swell factor used is 15 percent.

Miscellaneous site cleanup covers the labor and equipment to cover a work area cleanup on a weekly basis

H3.3.2 Annual Cost

No annual costs are associated with Alternative 3. No site monitoring is required because all of the contaminated waste will be removed.

H3.3.3 Special Site Conditions

H3.3.3.1 Site 216-A-29 Ditch

The site will require 1,100 m^3 (1,440 yd^3) of additional backfill to bring the low areas level with the surrounding topography. The low areas are due to the terraces built during the last work performed at the site. The volume of pre-level material required is based on field observations.

H3.3.3.2 Site 216-S-10 Ditch

The northern 296 m (970 ft) of ditch currently was not been filled in during the last work performed at the ditch. The site will require 4,022 m^3 (5,260 yd^3) of additional backfill to bring the site level with the surrounding area after the remediation excavation has been completed. The volume of additional backfill material required is based on field observation.

H3.4 ALTERNATIVE 4 – ENGINEERED BARRIER

ET Monofill Barriers are planned to be constructed over the waste sites. For planning purposes the side overlap for all types of barriers will be 6.1 m (20 ft) for all exterior sides.

H3.4.1 General Description and Assumptions

The work involved for Alternative 4 is as follows.

The field work such as mobilization/demobilization, borrow site excavation, barrier fill, revegetation, and some for the post construction work will be contracted to a FP Contractor. The Project Management, RCT support, sampling, and Safety oversight will be performed by FH.

Mobilization and Start Up include site training, mobilization of equipment and personnel, installing temporary construction fences, construction of an access road, setting up office, and storage trailers with utilities. Fifteen days are planned for this activity. The contractor will setup or construct a temporary staging area, office trailers, change trailer, and storage container, at a lump sum cost of $1,823. The rental cost of the trailers, and utilities are also included and are based on the duration of the work. Site access roads will also be constructed at a cost of $9,475.

Typical heavy equipment mobilized to and demobilized from the site is:

- Large dozer
- Two low ground pressure dozers
- Two 3.8 m^3 (5 yd^3) wheel loaders
- One small loader
- Motor grader
- Two 12-ton vib single drum roller
- Pug Mill with hoppers and belt loaders

- Two farm tractors
- Five highway 12 m^3 (16 yd^3) end dump trucks and 12 m^3 (16 yd^3) end dump trailers
- Two 15,142 to 22,712 L (4,000 to 6,000 gal) water trucks
- Flatbed truck
- Revegetation equipment - seed drill, mulcher, and tiller

The cost of moving equipment 56 km (35 mi) from a commercial storage yard to the waste site is planned at $11,975 to mobilize and $11,975 to demobilize.

Contractor personnel are given training before the start of work at the site. The cost of training is planned at $8,225. The training will meet site requirements to work at a waste site.

A temporary fence is constructed around the waste site work area. It will be a steel post with orange mesh fabric. The fence will be removed as part of demobilization.

Before remediation work starts at the waste site, a boundary /topographic /location survey is performed by the FP contractor. The planning cost for this work is based on the area of the waste site.

Industrial air sampling will be performed during the construction of the first layer of the barrier. A minimum of two samples will be taken per day. Environmental air sampling will be performed at the start, end of work and on a quarterly basis. Planning cost per air sample is $520/each. FH will perform all sampling required. The sampling crew is made up of one sampler and RCT.

Revegetation of the waste site barrier includes planting native dry land grass using tractors with seed drills and hand broadcasting, hand planting sage brush seedlings, and irrigation four times in the spring or early summer. All disturbed areas such as the around the barrier, stockpile, staging areas and access roads are to be replanted.

The FH Project Management team is made up of a part time project manager, with a full time field supervisor, and part time engineering support. QA, Rad Con, and Safety also provide oversight along with other support for contract management, and project controls. Total hours for this staff are planned at 22.5 hours per day. The duration of this work is based on total project duration. As part of the final reports required for a barrier construction is the FH survey crew's final mapping and the D&D Report. The cost of the final mapping is based on the final area of the barrier while the cost for Final D&D Report is a lump sum cost $2,450.

The FP Contractor field supervisory team is made up of a full time construction manager and field supervisor, along with part time QA, construction safety, and clerical support. Two pickup trucks are included in the cost. Total hours for this staff are planned at 21 hours per day. The duration of this work is based on total project duration. A field engineer prepares Final D&D Report covers the cost of the contractor to turn over submittals required to close out the work. The activity is a lump sum cost of $9,440.

Demobilization shall include demobilization of equipment and personnel, removing temporary construction fences, access roads, and office/storage trailers. This activity is

planned for 10 days. The staging area and roads will be scarified as part of demobilization and the planning costs is $711. The office trailers, storage containers will be removed by contractor or off site vender and are considered part to the rental cost.

There are two on site sources for the fill materials to construct the three soil/fill layers. The source for engineered fill is located at Pit 30 approximately halfway between 200 East Areas and 200 West Areas. This pit is assumed to have the sufficient quantity for this project. The source for the silt required for Layers 1 and 2 is located at Area C about 3.2 km (2 mi) south of 200 West Area.

The crushed ballast, crushed base course, and fractured basalt, and will be supplied by off site vendors or from commercial gravel pits. These materials are delivered to the waste site by the vendor.

All barrier sites are considered to have settled and are compacted enough to support construction of a barrier without further settling. Dynamic Compaction is not used for group of barriers.

Sites that will get an ET Barrier will be required to be level before the constructing the barrier. The pre-leveling construction process is the same as the bottom layer of a barrier.

At waste sites where the top of the contamination layer is less than 5.2 m (17 ft) from the ground surface, a bio intrusion barrier will be constructed. This layer is constructed of 30 cm (12 in.) of crushed road ballast topped with 10 cm (4 in.) of 1½ crushed surfacing base course rock for a total depth of 41 cm (16 in.). The rock is from a commercial source and is delivered to the waste site by the supplier's trucks. The spreading and compaction equipment used at the bio-barrier is a 3.8 m^3 (5 yd^3) loader to haul /place the rock, 250-300-hp Dozer with a U-blade to spread the rock and one 12 ton vibratory rollers. Dust control is by a 15,142 L (4,000 gal) water truck. One laborer supports the placement work.

The ET Monofill Barrier is constructed of three different layers. The bottom layer will be constructed of engineered or screened fill material, which has a minimum thickness of 20 cm (8 in.). The construction of the engineered fill requires the excavation of suitable borrow from an on-site pit source. The estimated time to complete the fill is based on the production rate of a of a 3.8 m^3 (5 yd^3) loader excavating at a borrow pit. All material is screened with a grizzly mounted on a surge bin to remove 10 cm (4 in.) or larger rocks. The five highway end dump trucks with 12 m^3 (16 yd^3) end dump trailers are needed to keep up with the loader. A 15,142 L (4,000 gal) water truck provides dust control at the pit. The Production rate for this work is 141 m^3/h (185 yd^3/h). The spreading and compaction equipment used at the barrier is a 250-300-hp Dozer with a U-blade to spread fill and two 12 ton vib single drum rollers. Dust control is by a 15,142 L (4,000 gal) water truck. To produce a smooth surface to prevent low areas and have a cross slope of two percent, the surface of engineered fill is fine graded. Work involves a small dozer with laser controls, 3.8 m^3 (5 yd^3) loader, one 12-ton vibratory single drum roller, and water truck. The production rate is 4181 m^2/day (5,000 yd^2/day) for the engineered fill surface area. One laborer supports the dozer and loader operators. Two engineer technicians set up the grade and elevation control.

The second layer will be constructed of 69 cm (27 in.) of silt fill. The construction of this layer involves excavating and hauling the silt from the on site pit to the barrier. The production rate is based on a 3.8 m^3 (5 yd^3) loader excavating and loading at the pit. There are five highway 12 m^3 (16 yd^3) end dump trucks with 12 m^3 (16 yd^3) end dump trailers. The Production rate for this work is 141 m^3/h (185 yd^3/h) based on the production of the loader. At the barrier the silt is spread with two small low ground pressure dozers. The silt is scarified to prevent over compaction. One laborer supports the two dozers. Dust control at the pit and the barrier uses a 15,142 L (4,000 gal) water truck.

The top layer will be constructed of 31.8 cm (12.5 in.) of silt/pea gravel fill. The fill material is made up of silt with 15 percent pea gravel added by weight. The silt is excavated with a 3.8 m^3 (5 yd^3) loader and hauled from the site silt source by two dump trucks to a process area near the pit. The Pea gravel will come from an off site commercial source and will be stockpiled at the silt process area. A 3.8 m^3 (5 yd^3) loader and a pug mill with belt loader are used to mix the silt and gravel. The hauling from the process area and the spreading of the material is the same as described for the second layer.

The side slopes of the barrier will be covered with fractured basalt 0.3 m (1 ft) deep with silt filling the voids in the rock. The side slopes of the barrier are graded before placing any fractured basalt. The work involves a 100-150-hp dozer with laser controls, 3.8 m^3 (5 yd^3) loader, one 12-ton vib single drum roller, and water truck. The production rate is 2,090 m^2/h (2,500 yd^2/h) for the engineered fill surface area. One laborer supports the dozer operator and water truck. Two engineer technicians set up the grade and elevation control.

A non-woven geotextile is placed on top of side slopes. This work covers the placement of needle punched 120 mil polypropylene geotextile over the prepared surface of the slopes. The production rate is 125 m^2/h (150 yd^2/h). Three laborers place and splice the fabric. An operator with a small loader and a teamster with a flatbed truck support this work.

The fractured basalt with silt layer is the last layer of the barrier to be constructed. The fractured basalt will come from a commercial source and will be delivered and stockpiled at the construction site. The delivered cost of the rock is based on vendor quotes of \$21.61/0.79 m^3 (\$21.61/yd^3). The silt will come from the same source as Layer 2. The silt will be delivered and stockpiled at the barrier site when the silt for Layer 2 is being hauled. One loader and 300-hp dozer are used to place the basalt on the fill slope. One laborers support the work. The production rate is 54 m^3/h (70 yd^3/h). A quarter time water truck and driver are used for dust control.

Instrumentation is not included for this series of barriers.

After completion of the barrier construction work a 1.2 m (4 ft) steel post with chain fence is constructed around the site. The fence location is at the toe of the barrier slope.

During the construction of the barrier compaction testing will be performed on the three layers of fill. The lower level will require that a minimum level of compaction has been reached. While the top two layers will be tested to ensure that the fill does not become over compacted.

Miscellaneous site cleanup covers the labor and equipment to cover a work area cleanup on a weekly basis.

H3.4.2 Surveillance and Cap Maintenance:

The costs associated with surveillance and cap maintenance are operation and maintenance costs and are incurred annually. The activities performed during surveillance and cap maintenance are expected to be the same as those described for site inspection/surveillance and existing cover maintenance cost items under Alterative 2. Refer to the Alternative 2 assumptions for these cost items.

H3.4.3 Monitoring:

Monitoring includes collecting groundwater samples from down-gradient wells to evaluate the performance of the cap system. Refer to Section H3.1.4.

H3.4.4 Special Site Conditions

H3.4.4.1 Site 216-A-29 Ditch

The site will require 1,100 m^3 (1,440 yd^3) pre-leveling before the start of construction of the barrier due to the terraces built during the last work performed at the site. The volume of pre-level material required is base on field observations.

H3.4.4.2 Site 216-S-10 Ditch

The site will require 4,022 m^3 (5,260 yd^3) pre-leveling before the start of construction of the barrier because the northern 296 m (970 ft) of ditch is still open and has not been backfilled. The volume of pre-level material required is base on field observations.

Figure H-1. Monofill Evapotranspiration Barrier Design.

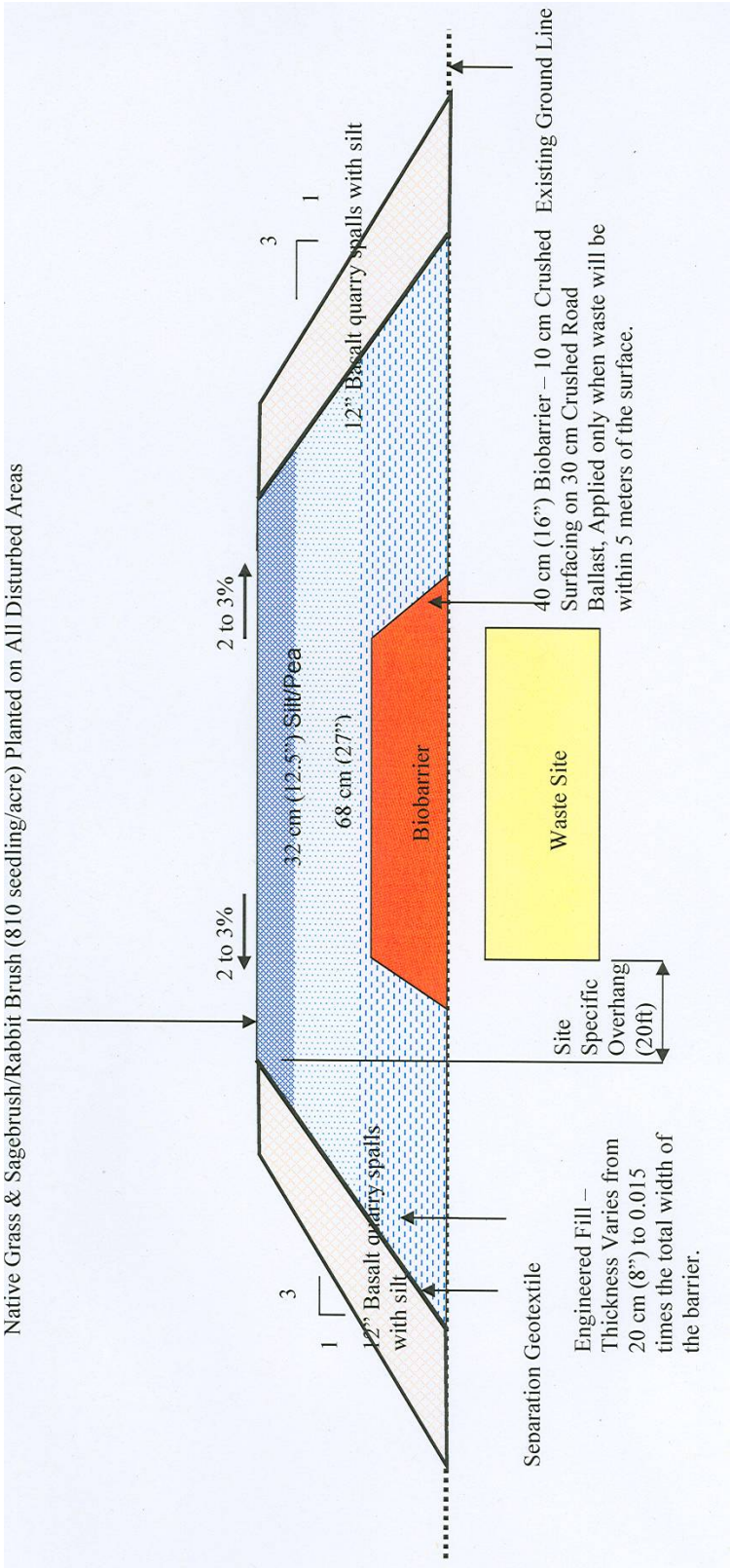

Table H-1. Alternative 2 Site Information.

OU 200-CS-1, Hanford Site, Richland, Washington.								
Waste Site	**Site Description**	**Alternative 2**						
		Site Dimensions (m [ft])						
		Length (Bottom) (m [ft])	**Width (Bottom) (m [ft])**	**Ground Water Depth (bgs)**	**Clean Soil Depth (bgs)**	**Side Slope[a]**	**End Slope[a]**	**Surface Area (ha [a.])**
216-A-29	**Ditch**							
Segment 1	AD-2 to AD-3	1,500 [4,920]	1.8 [6]	86.9 [285]	0.61 [2]	1.5	1.5	0.27 [0.68]
Segment 2	AD-3 to AD-1	482 [1,580]	1.8 [6]	86.9 [285]	0.61 [2]	1.5	1.5	0.089 [0.22]
Complete site		1,982 [6,500]						0.369 [0.90]
216-B-63	**Trench**	426.7 [1,400]	1.2 [4]	79.2 [260]	0.91 [3]	1.5	1.5	0.053 [0.13]
216-S-10	**Ditch**							
Covered part	SD-1 to SP-1	180 [590]	1.8 [6]	73.2 [240]	1.8 [6]	1.5	1.5	0.032 [0.08]
Uncovered Segment 1[b]	SD-1 to SD-3	210 [690]	1.8 [6]	73.2 [240]	0.0 [0]	1.5	1.5	0.040 [0.10]
Uncovered Segment 2[b]	SD-3 to SD-2	296 [970]	1.8 [6]	73.2 [240]	0.0 [0]	1.5	1.5	0.053 [0.13]
Complete site		686 [2250]						0.13 [0.31]
216-S-10								
First	Pond	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Second	Pond	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Complete site								
216-S-11								
First	Pond	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Second	Pond	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Complete site								

[a] Slope measurements is assumed

[b]Uncovered Ditch is 3 m (10 ft) deep by 1.8 m (6 ft) wide at bottom

Table H-2. Alternative 3 Site Information.

OU 200-CS-1, Hanford Site, Richland, Washington.															
		Site Dimensions (m [ft])				Excavation Dimensions (m [ft])									
Waste Site	**Site Description**	**Length (Bottom) (m [ft])**	**Width (Bottom) (m [ft])**	**Side Slope[a]**	**End Slope[a]**	**Length (Top) (m [ft])**	**Width (Top) (m [ft])**	**Excavation Depth (m [ft])**	**Clean Overburden Depth (m [ft])**	**Contam. Soil Volume (m^3 [yd^3])**	**Contam. Debris (m^3 [yd^3])**	**Excav. Volume (m^3 [yd^3])**	**Overburden Soil Volume (m^3 [yd^3])**	**Backfill (m^3 [yd^3])**	**Duration (days)**
216-A-29	**Ditch**														
Segment 1	AD-2 to AD-3	1,500 [4,920]	1.8 [6]	1.5	1.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Segment 2	AD-3 to AD-1	482 [1,580]	1.8 [6]	1.5	1.5	489 [1,606]	9.7 [32]	2.6 [8.5]	0.61 [2]	1,745 [2,282]	0.0 [0]	7,227 [9,453]	5,483 [7,171]	2,846 [3,722]	
Complete Site		1,982 [6,500]	1.8 [6]	1.5	1.5	489 [1,606]	9.7 [32]			1,745 [2,282]	0.0 [0]	7,227 [9,453]	5,483 [7,171]	2,846 [3,722]	49
216-S-10	**Ditch**														
Covered part	SD-1 to SP-1	180 [590]	1.8 [6]	1.5	1.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Uncovered Segment 1[b]	SD-1 to SD-3	210 [690]	1.8 [6]	1.5	1.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Uncovered Segment 1[b]	SD-3 to SD-2	296 [970]	1.8 [6]	1.5	1.5	309 [1,015]	16 [51]	4.6 [15]	0.0 [0]	2,472 [3,233]	0.0 [0]	12,230 [15,996]	5,736 [7,503]	6,493 [8,493]	
Complete site		685.8 [2,250]				309.3 [1,015]	16 [51]			2,472 [3,233]	0.0 [0]	12,230 [15,996]	5,736 [7,503]	6,493 [8,493]	49
216-B-63	**Trench**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
216-S-10	**Pond**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
216-S-11	**Pond**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

[a] Slope measurement is assumed
[b] Uncovered Ditch is 3 m (10 ft) deep by 1.8 m (6 ft) wide at bottom
Contam. = Contaminant
Excav. = Excavation

Table H-3. Alternative 3 Capital-Cost Breakdown.

OU 200-CS-1, Hanford Site, Richland, Washington.					
ALTERNATIVE 3 - REMOVAL, TREATMENT, AND DISPOSAL					
	216-A-29	**216-S-10**	**216-B-63**	**216-S-10**	**216-S-11**
	Ditch	**Ditch**	**Trench**	**Pond**	**Pond**
Mobilization/ Demobilization	$409,724	$376,171	$0	$0	$0
Monitoring & Sampling	$418,810	$328,198	$0	$0	$0
Site Work	$239,859	$177,023	$0	$0	$0
Soil Excavation	$441,893	$597,947	$0	$0	$0
Cap	$0	$0	$0	$0	$0
Construction Staff	$143,480	$143,480	$0	$0	$0
Project Management	$96,098	$95,190	$0	$0	$0
Sub Total	$1,749,864	$1,718,009	$0	$0	$0
Contingency (25%)	$437,466	$429,502	$0	$0	$0
Remedial Design *	$174,986	$171,801	$0	$0	$0
Total Project	$2,362,316	$2,319,312	$0	$0	$0

* Remedial Design Capital Costs are based on EPA/540/R-00/002 Exhibit 5-8
- For projects with construction costs from $2M to $10M – Remedial design is planned at 8% of construction costs.
- For projects with construction costs greater than $10M – Remedial design is planned at 6% of construction costs.

Table H-4. Alternative 4 Capital-Cost Breakdown.

OU 200-CS-1, Hanford Site, Richland, Washington.					
ALTERNATIVE 4 – ENGINEERED BARRIER					
	216-A-29	**216-S-10**	**216-B-63**	**216-S-10**	**216-S-11**
	Ditch	**Ditch**	**Trench**	**Pond**	**Pond**
Mobilization/ Demobilization	$273,628	$264,757	$0	$0	$0
Monitoring & Sampling	$4,797	$4,797	$0	$0	$0
Site Work	$75,807	$53,065	$0	$0	$0
Soil Excavation	$0	$0	$0	$0	$0
Cap	$532,276	$384,165	$0	$0	$0
Construction Staff	$154,296	$142,934	$0	$0	$0
Project Management	$103,342	$94,302	$0	$0	$0
Sub Total	$1,144,146	$944,020	$0	$0	$0
Contingency (25%)	$286,037	$236,005	$0	$0	$0
Remedial Design *	$171,622	$141,603	$0	$0	$0
Total Project	$1,601,805	$1,321,628	$0	$0	$0

* Remedial Design Capital Costs are based on EPA/540/R-00/002 Exhibit 5-8
- For projects with construction costs from $500K to $20M – Remedial design is planned at 12% of construction costs.
- For projects with construction costs from $2M to $10M – Remedial design is planned at 8% of construction costs.

Table H-5. Alternative 4 Site Information.

OU 200-CS-1, Hanford Site, Richland, Washington.										
					Alternative 4 Engineered Barrier					
		Site Dimensions (m [ft])			Capping Dimensions (m [ft])					
Waste Site	**Site Description**	**Length (Bottom) (m [ft])**	**Width (Bottom) (m [ft])**	**Clean Soil Depth (bgs)**	**Length (m [ft])**	**Width (m [ft])**	**Hectares [Acres] of Capping**	**Preleveling Fill (m^3 [yd^3])**	**Duration (days)**	**Cap Type**
216-A-29	**Ditch**									
Segment 1	AD-2 to AD-3	1,500 [4,920]	1.8 [6]	0.61 [2]	N/A	N/A	N/A		N/A	N/A
Segment 2	AD-3 to AD-1	482 [1,580]	1.8 [6]	0.61 [2]	504 [1,652]	26 [85]	1.3 [3.2]	1,101 [1,440]		ET Monofill
Complete Site		1,982 [6,500]	1.8 [6]	0.61 [2]	504 [1,652]	26 [85]	1.3 [3.2]	1,101 [1,440]	51	
216-S-10	**Ditch**									
Covered part	SD-1 to SP-1	180 [590]	1.8 [6]	1.8 [6]	N/A	N/A	N/A	N/A	N/A	N/A
Uncovered Segment 1*	SD-1 to SD-3	210 [690]	1.8 [6]	0.0 [0]	N/A	N/A	N/A	N/A	N/A	N/A
Uncovered Segment 2*	SD-3 to SD-2	296 [970]	1.8 [6]	0.0 [0]	320 [1,049]	26 [85]	0.8 [2.0]	4,022 [5,260]	47	ET Monofill
Complete site		686 [2,250]	1.8 [6]	0.0 [0]	320 [1,049]	26 [85]	0.8 [2.0]	4,022 [5,260]	47	
216-B-63	**Trench**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
216-S-10	**Pond**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
216-S-11	**Pond**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

* Uncovered Ditch is 3 m (10 ft) deep by 1.8 m (6 ft) wide at bottom

Table H-6. Alternative 2 Site Summary Sheet - Trench, Ditch, Pond - Capital Costs, Periodic Costs, Non-Discounted Costs and Present Worth Costs

200-CS-1 Feasibility Cost Study					
Site	**Alternative**	**Total Capital Cost**	**Non-Discounted Annual and Periodic Cost**	**Non-Discounted Cost**	**Total Present Worth Cost**
216-A-29 Ditch	Alt 2 - Maintenance Existing Cover and IC	$35,400	$4,734,310	$4,769,710	$1,057,090
216-B-63 Trench	Alt 2 - Maintenance Existing Cover and IC	$35,400	$4,772,541	$4,807,941	$1,064,146
216-S-10 Ditch	Alt 2 - Maintenance Existing Cover and IC	$35,400	$4,783,044	$4,818,444	$1,066,084
216-S-10 Pond	Alt 2 - Maintenance Existing Cover and IC	N/A	$0	$0	$0
216-S-11 Pond	Alt 2 - Maintenance Existing Cover and IC	N/A	$0	$0	$0

Table H-7. Alternative 3 Site Summary Sheet - Trench, Ditch, Pond - Capital Costs, Periodic Costs, Non-Discounted Costs and Present Worth Costs

200-CS-1 Feasibility Cost Study					
Site	**Alternative**	**Total Capital Cost**	**Non-Discounted Annual and Periodic Cost**	**Non-Discounted Cost**	**Total Present Worth Cost**
216-A-29 Ditch	Alt 3 - RTD	$2,362,316	$0	$2,362,316	$2,362,316
216-B-63 Trench	Alt 3 - RTD	$0	$0	$0	$0
216-S-10 Ditch	Alt 3 - RTD	$2,319,312	$0	$2,319,312	$2,319,312
216-S-10 Pond	Alt 3 - RTD	$0	$0	$0	$0
216-S-11 Pond	Alt 3 - RTD	$0	$0	$0	$0

Table H-8. Alternative 4 Site Summary Sheet - Trench, Ditch, Pond - Capital Costs, Periodic Costs, Non-Discounted Costs and Present Worth Costs

200-CS-1 Feasibility Cost Study					
Site	**Alternative**	**Total Capital Cost**	**Non-Discounted Annual and Periodic Cost**	**Non-Discounted Cost**	**Total Present Worth Cost**
216-A-29 Ditch	Alt 4 - ET Monofill Barrier and IC	$1,601,804	$12,547,189	$14,148,993	$4,339,088
216-B-63 Trench	Alt 4 - ET Monofill Barrier and IC	$0	$0	$0	$0
216-S-10 Ditch	Alt 4 - ET Monofill Barrier and IC	$1,321,628	$7,350,240	$8,671,868	$2,916,031
216-S-10 Pond	Alt 4 - ET Monofill Barrier and IC	$0	$0	$0	$0
216-S-11 Pond	Alt 4 - ET Monofill Barrier and IC	$0	$0	$0	$0

Table H-9. Alternatives 1, 2, 3, and 4 Present Net Worth and Non-Discounted Comparison Costs

200-CS-1 Feasibility Cost Study, Hanford Site, Richland, Washington				
Net Present Worth Cost Estimates.				
WASTE SITE/GROUP	**ALTERNATIVE 1: No Action**	**ALTERNATIVE 2: Maintain Existing Soil Cover and Monitored Natural Attenuation**	**ALTERNATIVE 3: Removal, Treatment, and Disposal**	**ALTERNATIVE 4: Engineered Barrier**
216-A-29 Ditch	$0	$1,057,090	$2,362,316	$4,339,088
(Non-discounted cost)		$4,769,710	$2,362,316	$14,148,993
216-B-63 Trench	$0	$1,064,146	$0	$0
(Non-discounted cost)		$4,807,941	$0	$0
216-S-10 Ditch	$0	$1,066,084	$2,319,312	$2,916,031
(Non-discounted cost)		$4,818,444	$2,319,312	$8,671,868
216-S-10 Pond	$0	$0	$0	$0
(Non-discounted cost)		$0	$0	$0
216-S-11 Pond	$0	$0	$0	$0
(Non-discounted cost)		$0	$0	$0

H4.0 REFERENCES

DE-AC06-96RL13200, 1996, *Contract Between the U.S. Department of Energy, Richland Operations Office, and Fluor Daniel Hanford, Inc.*, U.S. Department of Energy, Richland Operations Office, Richland, Washington, as amended.

EPA/540/R-00/002, 2000, *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study*, OSWER 9355.0-75, U.S. Environmental Protection Agency, Washington, D.C.

OMB Circular No. A-94, 2002, *Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs*, Office of Management and Budget, Washington, D.C., as revised.

Means, R.S., 2001a, *ECHOS Environmental Remediation Cost Data – Unit Price*, 7th Annual Edition, Robert S. Means Company, Kingston, Massachusetts.

Means, R.S., 2006, *Facility Construction Cost Data*, 19th Annual Edition, Robert S. Means Company, Kingston, Massachusetts.

Rental Rate Blue Book for Construction Equipment 2007, Equipment Watch, San Jose, California.

Process Plant Construction Estimating Standards Volume 1, Richardson Engineering Services Inc., Mesa, Arizona.

Site Stabilization Agreement for All Construction Work for the U.S. Department of Energy at the Hanford Site, 1984, as amended, commonly known as the Hanford Site Stabilization Agreement (original title, *Site Stabilization Agreement, Hanford Site, between J. A. Jones Construction Services Company and Morrison-Knudsen Company, Inc., and the Building and Construction Trades Department of the AFL-CIO and its affiliated international unions, and the International Brotherhood of Teamsters, Chauffeurs, Warehousemen, and Helpers of America.*