6.0 ALARA ANALYSIS

PURPOSE OF THIS SECTION

The purpose of this section is to describe how DOE will achieve a decommissioning goal below the 25 mrem per year dose limit in those areas remediated during Phase 1 of the decommissioning and describe quantitative cost-benefit analyses to demonstrate that potential future doses from residual radioactivity in surface soil, subsurface soil, and streambed sediment will be as low as reasonably achievable (ALARA).

INFORMATION IN THIS SECTION

This section provides the following information:

- In Section 6.1, brief summaries of relevant NRC requirements and guidance and the planned remediation approach, along with a discussion of the derived concentration guideline levels (DCGLs);
- In Section 6.2, a brief summary of how DOE will achieve a decommissioning goal below the dose limit; and
- In Section 6.3, a description of the ALARA analysis process, which focuses on the DCGLs, and the results of preliminary ALARA analyses which indicate that remediation of contaminated surface soil, subsurface soil, and streambed sediment below DCGLs for 25 mrem per year would not be cost-effective.

RELATIONSHIP TO OTHER PLAN SECTIONS

To put into perspective the information in this section, one must consider the information in Section 1 on the project background and those facilities and areas within the scope of the DP. Useful background information is also provided in Section 2 on site history, in Section 3 on the facilities of interest, and in Section 4 and Appendix B on the radiological status of the project premises.

Section 5 describes the DCGLs that are the primary focus of the analysis process described in this section and summarizes how they were developed. Section 7 describes the Phase 1 decommissioning activities.

6.1 Introduction

To put into context the ALARA process described below, it is useful to consider the applicable requirements and guidance, the planned remediation activities, and the DCGLs on which the ALARA process focuses.

After an area has been remediated to meet the cleanup criteria, additional remediation actions could be taken to further reduce the level of residual radioactivity. An ALARA analysis compares the benefits and costs of those additional remediation actions to determine whether or not it would be cost effective to implement any of them.

6.1.1 Applicable Requirements and Guidance

The NRC's Final Policy Statement on Decommissioning Criteria for the WVDP (NRC 2002) prescribed the NRC's License Termination Rule (10 CFR 20, Subpart E) as the decommissioning criteria for the WVDP. As explained in Section 1, certain areas of the project premises are being remediated in Phase 1 of the decommissioning to NRC's unrestricted release criteria of the License Termination Rule. These criteria, which appear in 10 CFR 20.1402, state that:

> "A site will be considered acceptable for unrestricted use if the residual radioactivity that is distinguishable from background radiation results in a TEDE [total effective dose equivalent] to an average member of the critical group that does not exceed 25 mrem per year, including that from groundwater sources of drinking water, and the residual radioactivity has been reduced to levels that are as low as reasonably achievable (ALARA). Determination of the levels which are ALARA must take into account consideration of any detriments, such as deaths from transportation accidents, expected to potentially result from decontamination and waste disposal."[1]

Appendix N of NUREG-1757, Volume 2 (NRC 2006) "describes methods acceptable to NRC staff for determining when it is feasible to further reduce the concentrations of residual radioactivity to below the concentrations necessary to meet the dose criteria", i.e., methods for performance of an ALARA analysis. NUREG/BR-0058 (NRC 2004) recommends use of a value of $2,000 per person-rem for ALARA analyses.

[1] In 10 CFR 20.1003, NRC defines ALARA as follows: *ALARA* (acronym for "as low as is reasonably achievable") means making every reasonable effort to maintain exposures to radiation as far below the dose limits in this part [10 CFR 20] as is practical consistent with the purpose for which the licensed activity is undertaken, taking into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and licensed materials in the public interest.

DOE defines ALARA in DOE Order 5400.5 as follows: "an approach to radiation protection to control or manage exposures (both individual and collective to the work force and the general public) and releases of radioactive material to the environment as low as social, technical, economic, practical, and public policy considerations permit. ... ALARA is not a dose limit, but rather it is a process that has as its objective the attainment of dose levels as far below the applicable limits of the Order as practicable."

How the ALARA process is applied for the subject analysis is discussed in Section 6.3.1.

As explained in Section 1.7 of this plan, the ALARA process is an integral part of DOE radiation control procedures applicable to Phase 1 of the decommissioning. The ALARA process has been incorporated into the remediation strategy for the Phase 1 decommissioning work as explained below.

6.1.2 Remediation Activities of Interest

Section 1.10.2 of this plan identifies the facilities within the scope of Phase 1 decommissioning activities and explains that a soil and sediment characterization program will be undertaken before the decommissioning to better define the nature and extent of radioactive contamination in surface soil, subsurface soil, and streambed sediment on the project premises. This section also explains that radioactively contaminated subsurface soil in excess of DCGLs will be removed from large areas to be excavated in WMA 1, the Process Building and Vitrification Facility area, and WMA 2, the Low-Level Waste Treatment Facility area. Figure 1-2 shows these areas.

Section 1.10.2 also explains that remediation of environmental media during Phase 1 of the decommissioning will focus on soil within these large excavations and that surface soil in selected areas of the project premises may also be remediated based on the results of the characterization program and on available funding.

Section 7 of this plan provides additional details of Phase 1 decommissioning activities including conceptual drawings showing the two major excavations and the methods for contaminated soil removal.

6.1.3 The DCGLs Involved

As explained in Section 5, three sets of DCGLs have been developed for Phase 1 of the decommissioning. These DCGLs apply to (1) surface soil, (2) subsurface soil in the large WMA 1 and WMA 2 excavations, and (3) streambed sediment in Erdman Brook and Franks Creek.

The DCGLs were based on the unrestricted release dose limit of 25 mrem per year to the average member of the critical group of interest. Section 5 identifies the DCGLs and describes the conceptual models and the primary mathematic model (RESRAD) used in their development. Section 5 also describes additional dose assessments performed to ensure that remediation criteria used in Phase 1 do not limit potential options for Phase 2 of the decommissioning and the resulting cleanup goals, which are provided in Table 5-13.

6.2 Achieving a Decommissioning Goal Below the Dose Limits

DOE's plans to ensure that doses from residual radioactivity at the conclusion of the WVDP Phase 1 decommissioning are ALARA include:

- A Phase 1 decommissioning strategy that promotes ALARA,
- Conservatism inherent in development of DCGLs and the lower cleanup goals that will guide the decontamination efforts, and

- Use of remediation processes that are conservative by nature.

Cost-benefit analyses will be performed during Phase 1 of the decommissioning to determine whether residual radioactivity levels should be decreased to further reduce future potential doses. The cost-benefit analysis process is described in Section 6.3.

Upon completion of Phase 1 of the decommissioning and in preparation for Phase 2, additional dose evaluations will be performed utilizing Phase 1 final status survey data as a further demonstration that potential future doses from residual radioactivity in those areas remediated in Phase 1 are ALARA.

6.2.1 Phase 1 Decommissioning Strategy Promotes ALARA

As summarized in Section 1.10.2 and detailed in Section 7, DOE's Phase 1 decommissioning strategy for the WVDP has been designed to reduce risk from residual radioactivity consistent with the ALARA process. For example:

- A new Canister Interim Storage Facility will be built on the south plateau and the vitrified HLW canisters moved there to allow removal of the contaminated Process Building.
- Most other contaminated surface structures will also be completely removed, including the Vitrification Facility, a process that will significantly reduce risk by reducing residual radioactivity on the project premises.
- The source area of the north plateau groundwater plume beneath the Process Building will be completely removed, a process that will also significantly reduce risk from residual radioactivity on the project premises.
- Vertical hydraulic barrier walls installed to support the WMA 1 and WMA 2 excavations will be left in place after Phase 1 of the decommissioning to minimize the potential for contaminant migration though groundwater among different parts of the project premises, including the potential for recontamination of the remediated WMA 1 and WMA 2 excavated areas.[2]
- All radioactive waste generated in Phase 1 decommissioning activities will be disposed of offsite.
- Potentially contaminated soil and sediments within the project premises will be characterized to better define potential risk from residual radioactivity in these media, and surface soil exceeding DCGLs may be remediated in Phase 1, which will effectively eliminate the risk associated with this environmental media contamination.
- Essentially all radioactive material that will remain after the Phase 1 activities have been completed will be located underground, primarily in the underground waste

[2] If the site-wide removal alternative were to be selected for Phase 2 of the decommissioning, the hydraulic barrier walls would be removed during Phase 2.

tanks and in the NDA[3]. Controlled access to the WVDP will continue during the Phase 1 institutional control period, which will prevent access to this underground radioactivity.

6.2.2 Good Practices that Promote ALARA

The DOE radiological controls requirements identified in Section 1.7 and the supplemental technical standards associated with those requirements will be followed during the decommissioning activities as specified in Section 7. DOE Policy 441.1, *Department of Energy Radiological Health and Safety Policy*, and the associated implementation guidance, DOE Guide 441.1-2, *Occupational ALARA Program Guide*, include provisions for good practices that promote ALARA. Among these good practices will be:

- The use of spray fixatives or fog sprays during building demolition to reduce the potential spread of airborne contamination;
- The use of engineered surface water run-off controls during building demolition to reduce the potential spread of contamination by precipitation;
- The use of radiological containment to avoid spreading radioactive material during equipment removal, such as removal of piping in the HLW transfer trench and cutting and capping contaminated lines that remain when infrastructure such as the concrete floor slab of the LLW2 Building is removed;
- The use of airborne contamination controls to ensure that doses to workers will be below federally allowed limits;
- The use of personal protective equipment, such as respirators and anti-contamination clothing, in contaminated areas;
- Removal of all demolition debris that may fall within the footprints of removed infrastructure, such as the two-foot deep excavation made to remove the Equipment Shelter;
- Removal of debris remaining in the HLW transfer trench after contaminated piping removal and removal of any radioactive contamination spread to the trench during this work to the extent practicable[4];
- Requiring that the large excavations in WMA 1 and WMA 2 extend at least one foot into the unweathered Lavery till, a geologic unit that is relatively impervious to radionuclide migration;

[3] There may also be residual radioactivity above cleanup goals in surface soil and sediment, but this amount would be a small fraction of residual radioactivity below the surface.

[4] The HLW transfer trench is the only facility within the scope of the Phase 1 of the WVDP decommissioning that will remain in place. It is not expected to be radioactively contaminated when the piping removal begins. Even though radiological containment will be used in removal of the piping, spills during this work are possible.

- Removing easily removable contaminated soil in the large WMA 1 and WMA 2 excavations; and
- Installation of infiltration and surface water run-off controls such as liners, drainage collection systems, and berms below and around excavated soil laydown areas to prevent migration of contaminants into underlying groundwater and nearby surface waters.

Additional guidance in DOE-STD-ALARA1draft will also be considered.

6.2.3 Conservatism in DCGL Development

The process for developing DCGLs for Phase 1 of the decommissioning as described in Section 5 was conservative in several respects. Section 5 provides examples of this conservatism. (As explained in Section 5, a probabilistic uncertainty analysis was performed to evaluate whether key input parameters used in DCGL development were sufficiently conservative and probabilistic peak-of-the-mean DCGLs are being used as the basis for surface soil and streambed sediment cleanup goals.)

6.2.4 Conservatism from the Decontamination and Final Status Survey Processes

As explained in Section 7, bulk soil removal techniques using equipment such as tracked excavators and backhoes will be used to remove contaminated soil. These techniques are not precision processes, but remove soil (and its associated contamination) in discrete increments. Typically, they remove more soil than necessary so that the remaining concentration falls well below the DCGL. This inherent characteristic will result in average residual contamination in decontaminated areas generally being well below the $DCGL_W$ value.

NRC recognizes in NUREG-1496 (NRC 1997) that the soil remediation process will result in residual contamination below the DCGLs by stating:

> "In actual situations, it is likely that even if no specific analysis of ALARA were required for soil removal that the actual dose will be reduced to below 25 mrem/y because of the nature of the removal process. For example, the process of soil excavation is a coarse removal process that is likely to remove large fractions of the remaining radioactivity."

Another factor that adds conservation is the final status survey process, which is described in Section 9. This process follows guidance in NUREG-1575, *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)* (NRC 2000) and the MARSSIM statistical techniques require the average residual radioactivity concentrations to be less than the $DCGL_W$ values. (In the case of this plan, the average residual radioactivity concentrations will be less than the cleanup goals or CG_W values.)

6.3 DCGL ALARA Analysis

This section describes the ALARA analysis process as a cost-benefit process as recommended by NRC (NRC 2006) and then provides the results of preliminary ALARA analyses for DCGLs for surface soil, subsurface soil, and streambed sediment.

6.3.1 ALARA Analysis Guidance

NRC guidance on ALARA analysis for remediation actions is found in Appendix N to NUREG-1757, Volume 2 (NRC 2006). The guidance discusses possible costs and benefits that may be considered as indicated in Table 6-1.

Table 6-1. Possible Benefits and Costs Related to Decommissioning(1)

Possible Benefits	Possible Costs
Collective dose averted(2)	Remediation costs
Regulatory costs avoided	Additional occupational/public dose
Changes in land values	Occupational nonradiological risks
Esthetics	Transportation direct costs and implied risks
Reduction in public opposition	Environmental impacts
	Loss of economic use of site/facility

NOTES: (1) From Table N-1 of NUREG-1757, Volume 2 (NRC 2006).
(2) Collective dose averted is the primary possible benefit as discussed below.

The NRC guidance includes additional discussion of monetary costs that may be considered in the analysis, explaining that the costs associated with remediation beyond the cleanup goals (the remediation action) "generally include the monetary costs of: (1) the remediation action being evaluated, (2) transportation and disposal of the waste generated by the action, (3) workplace accidents that occur because of the remediation action, (4) traffic fatalities resulting from transporting the waste generated by the action, (5) doses received by workers performing the remediation action, and (6) doses to the public from excavation, transport, and disposal of the waste." (NRC 2006)

The NRC guidance also includes the following guidance related to limiting the scope of a preliminary analysis:

- "The primary benefit from a remediation action is the collective dose averted in the future, i.e., the sum over time of the annual doses received by the exposed population."
- "In the simplest form of the [ALARA] analysis, the only benefit estimated from a reduction in the level of residual radioactivity is the monetary value of the collective averted dose to future occupants of the site."

Consistent with this guidance, the only benefit considered in the preliminary ALARA analysis for the DCGLs is the collective dose averted by the action. The primary quantifiable cost is the disposal of the waste generated by the action, and that is the cost considered in this preliminary ALARA analysis.

> **NOTE**
>
> DOE has performed a preliminary ALARA analysis and provided for a later, more detailed ALARA analysis that will be performed during the remediation work. This approach is appropriate for Phase 1 of the decommissioning since information used in the analyses may change between the time of Decommissioning Plan issue and the time when remediation of the large excavations – the activity for which the analyses are most important – takes place. For example, waste disposal costs could increase significantly and possibly change the outcome of the analyses.
>
> The results of the preliminary analysis provide useful information for planning purposes, even though it is possible that the later, more detailed analysis will produce different results. This two-step approach is consistent with guidance in Appendix N of NUREG-1757, Volume 2 (NRC 2006)

6.3.2 Calculating Benefits and Costs

As defined in Section N.1.3 of NUREG-1757, Volume 2 (NRC 2006), the "residual radioactivity level that is ALARA is the concentration, Conc, at which the benefit from removal equals the cost of removal." The benefit from removal, i.e., the present worth of a future collective averted dose, can be calculated via NUREG-1757, Volume 2 (NRC 2006), Equations N-1 and N-2, combined below:

$$B_{AD} = \$2000 \times P_D \times A \times 0.025 \times F \times \frac{Conc}{DCGL_W} \times \frac{1 - e^{-(r+\lambda)N}}{r + \lambda}$$

where:

B_{AD}	=	benefit from an averted dose for a remediation action (\$),
\$2000	=	value in dollars of a person-rem averted (NRC 2004) (\$/person-rem),
P_D	=	population density for the critical group scenario (persons/m^2),
A	=	area being evaluated (m^2),
0.025	=	annual dose to an average member of the critical group from residual radioactivity at the $DCGL_W$ (rem/y),
F	=	effectiveness, or fraction of the residual radioactivity removed by the remediation action (unit-less),
Conc	=	average concentration of residual radioactivity in the area being evaluated (pCi/g),

$DCGL_W$ = derived concentration guideline equivalent to the average concentration of residual radioactivity that would give an annual dose of 25 mrem to the average member of the critical group (pCi/g),[5]

r = monetary discount rate (per year),

λ = radiological decay constant (per year), and

N = number of years over which the collective dose was calculated (years).

Setting the benefit from removal, B_{AD}, equal to the cost of the remediation, $Cost_T$, and solving for the ratio of the concentration, Conc, to the $DCGL_W$ gives NUREG-1757, Equation N-8:

$$\frac{\text{Conc}}{\text{DCGL}_W} = \frac{\text{Cost}_T}{\$2000 \times P_D \times 0.025 \times F \times A} \times \frac{r+\lambda}{1-e^{-(r+\lambda)N}}$$

Where all parameters are as previously defined.

For convenience in the following discussion, the ratio of the concentration, Conc, to the $DCGL_W$ is defined as R.

When R is 1 or greater, the residual concentration (Conc) that is ALARA is equal to or greater than the $DCGL_W$, and no further remediation is needed to reduce the concentration to below the $DCGL_W$ level. When R is less than 1, then the concentration that is ALARA is less than the $DCGL_W$, and further remediation should be undertaken to reduce the residual concentration. For example, if R is equal to 0.5 for a particular remediation action, and the measured surface concentration is below the $DCGL_W$ value, but above 0.5 times the $DCGL_W$ value, then in order to meet the ALARA criterion that particular remediation action should be implemented.

6.3.3 Surface Soil Preliminary ALARA Analysis

For surface soil, the NUREG-1757, Volume 2 (NRC 2006), Table N.2 generic parameters are P_D = 0.0004 person/m^2, r = 0.03/y, and N = 1000 y. Also since surface soil remediation usually involves total removal of the soil, the remediation action efficiency (F) has been conservatively set to 1.0. Using these values to calculate the soil Conc to $DCGL_w$ ratio (R) gives:

$$R = \frac{C_{Tu}}{\$2000 \times 0.0004 \times 0.025 \times 1.0} \times \frac{0.03+\lambda}{1-e^{-(0.03+\lambda)1000}}$$

In the above equation the total cost of remediation ($Cost_T$) divided by the total area to be remediated (A) has been replaced by the total unit cost of remediation (C_{Tu}, \$/m^2).

[5] The DCGL applicable to the average concentration over a survey unit is called the $DCGL_W$ (W = Wilcoxon Rank Sum), whereas the DCGL applicable to limited areas of elevated concentrations within a survey unit is called the $DCGL_{EMC}$ (EMC = Elevated Measurement Comparison). (NRC, 2006).

If the surface soil concentration is set equal to the $DCGL_W$ (i.e., R = 1) then the above equation can be solved to determine the maximum remediation unit cost that would be ALARA. This is shown in the equation below, which has conservatively removed the radiological decay term.[6]

$$C_{Tu} = \$2000 \times 0.0004 \times 0.025 \times 1.0 \times \frac{1 - e^{-(0.03)1000}}{0.03}$$

Solving the above equation for C_{Tu} gives the maximum ALARA unit cost of $\$0.67/m^2$. In other words, if surface soil can be removed and disposed of for $\$0.67/m^2$, or less, then it will be consistent with the ALARA process to do so, but if it costs more than $\$0.67/m^2$ to remove and dispose of surface soil, then no further remediation below the $DCGL_W$ is necessary.

Removing six inches of soil will result in waste volumes of 5.38 cubic feet per square meter remediated. With a LLW disposal cost of $6.76 per cubic foot (URS 2008, Table 3-16), the soil disposal component of the total remediation cost alone is about $\$36.38/m^2$. Consequently, residual radioactivity in surface soil at the $DCGL_W$ at the WVDP is ALARA, *and soil remediation below the surface soil $DCGL_W$ is not necessary.*

This result is consistent with NUREG-1496 (NRC 1997, page 7-6), which states: "there appears to be a strong indication that removing and transporting soil to waste burial facilities to achieve exposure levels at the site at or below a 25 mrem/y unrestricted use dose criterion is generally not cost-effective". It is also consistent with the surface soil example given in NUREG-1757, Section N.1.4, which states: "the dose limit [25 mrem/y] would be limiting by a considerable margin. Based on these results, it would rarely be necessary to ship soil to a waste disposal facility to meet the ALARA requirement. The licensee could use this [NUREG-1757] evaluation to justify not removing soil." (NRC 2006, page N-12).

6.3.4 Subsurface Soil Preliminary ALARA Analysis

For subsurface soil, it is appropriate to use the same parameter values to determine the Conc to $DCGL_W$ ratio (R) as were used for surface soil. Therefore, if subsurface soil can be removed and disposed of for $\$0.67/m^2$, or less, then it is consistent with the ALARA process to do so, but if it costs more than $\$0.67/m^2$ to remove and dispose of subsurface soil, then no further remediation below the $DCGL_W$ is necessary.

While the disposal unit cost for surface soil and subsurface soil will be the same, the cost to remediate subsurface soil will likely be higher than the cost for surface soil removal because removal of soil from the bottom or sides of the excavation will likely be more difficult than removal of surface soil.

Therefore, since for subsurface soil: (1) the Conc to $DCGL_W$ ratio (R) will be the same as for surface soil, (2) the cost to remediate will likely be higher than for surface soil, and

[6] Omitting the decay constant is conservative for shorter-lived radionuclides. For example, including a 30-year decay constant for Cs-137 or Sr-90 would result in a maximum ALARA unit cost of approximately $\$0.38/m^2$ for those radionuclides. The value of $\$0.67/m^2$ for long-lived radionuclides is not changed by omission of the decay constant in the equation.

(3) surface soil at the $DCGL_W$ is ALARA, it is concluded that remediation below the subsurface soil $DCGL_W$ is similarly not necessary, and that subsurface soil at the $DCGL_W$ satisfies the ALARA criteria.

6.3.5 Streambed Sediment Preliminary ALARA Analysis

Likewise, for streambed sediment it is appropriate to use the same parameter values to determine the Conc to $DCGL_W$ ratio (R) as were used for surface and subsurface soils.[7] Therefore, if streambed sediment can be removed and disposed of for $0.67/m^2, or less, then it is consistent with the ALARA process to do so, but if it costs more than $0.67/m^2 to remove and dispose of streambed sediment, then no further remediation below the $DCGL_W$ is necessary.

The cost to remediate and dispose of streambed sediment will be similar to the cost for surface soil removal, except that streambed sediments of interest are located in Erdman Brook and the portion of Franks Creek on the project premises and are likely to be wet. Both of these factors will complicate the removal process – that is, managing the wet contaminated soil and the difficultly in providing equipment access owing to the steep stream banks – with the result that the remediation of streambed sediments will likely be more costly than the remediation of an equivalent amount of surface soil.

Therefore, since for streambed sediments: (1) the Conc to $DCGL_W$ ratio (R) will be the same as for surface soil, (2) the cost to remediate will likely be higher than surface soil, and (3) surface soil at the $DCGL_W$ is ALARA, it is concluded that remediation below the streambed sediment $DCGL_W$ is similarly not necessary, and that streambed sediment at the $DCGL_W$ is ALARA.

6.3.6 Addressing Intergenerational Concerns

The consequences (i.e., doses) of the remediation that will take place during Phase 1 of the decommissioning could occur over a lengthy period, especially if Phase 2 of the decommissioning were to involve a site-wide removal approach resulting in unrestricted release of the property. (In a Phase 2 site-wide close-in-place approach, the potential future doses from the remediated Phase 1 areas would be small compared to those from the Phase 2 source areas.) The impact of intergenerational doses on the cost-benefit analysis can be evaluated by considering the impact of lower discount rates.[8]

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[7] One parameter that would be appropriately different for streambed sediment is the population density. The steep slopes in the areas of Erdman Brook and Franks Creek would reasonably be expected to preclude building residences in the area of these streams. However, use of the 0.0004 persons/m^2 value (about 1040 persons per square mile) is conservative because a more realistic smaller value would produce a higher R value. The population density in Cattaraugus County in 2000 was 64 persons per square mile using the total population figure in Table 3-6.

[8] Based on Office of Management and Budget guidance, present worth calculations are normally performed using both three and seven percent real discount rates. These discount rates are used to calculate the present worth of averted health effects regardless of when these effects are adverted. The three percent rate (as used in Section 6.3.3) approximates the real rate of return on long-term government debt, which serves as proxy for the real rate of return on savings. (NRC 2004)

Figure 6-1 shows the unit cost of remediation (C_{Tu}) as a function of the discount rate. It shows that with a discount rate of zero, the cost of remediation would be approximately $20/m^2. Because this unit cost is less than the $36.38/m^2 disposal component of the total remediation cost in the preliminary analysis (Section 6.3.3), the DCGLs result in intergenerational doses that are ALARA and further remediation would not be necessary.

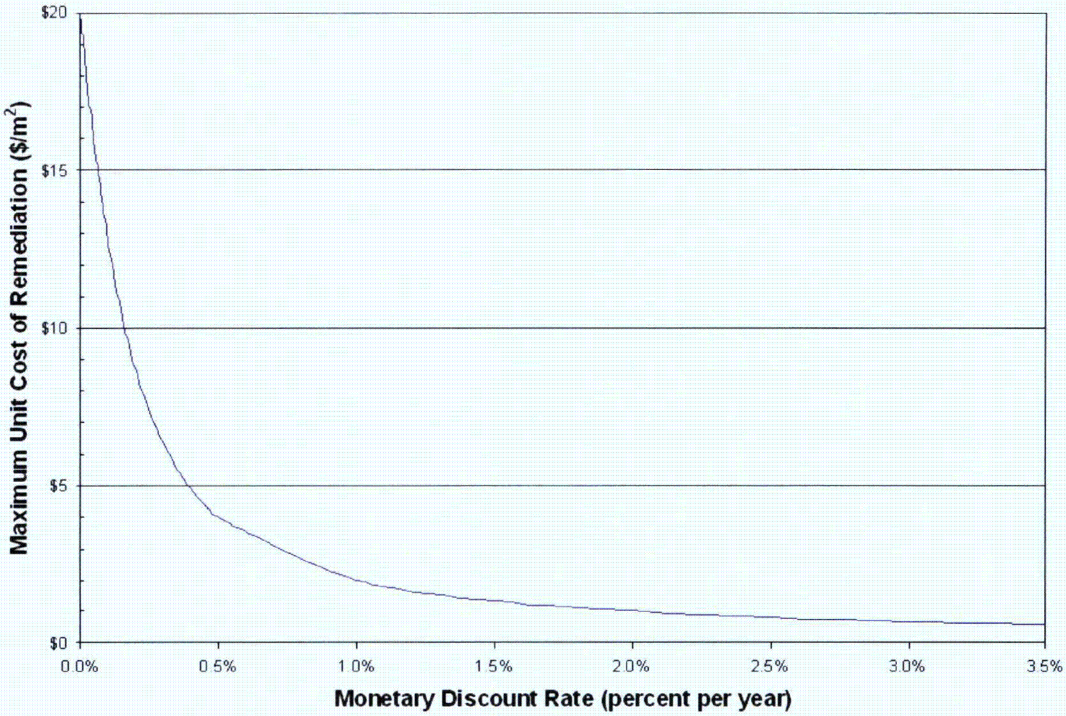

Figure 6-1. Unit Remediation Costs vs. Monetary Discount Rate

6.4 Additional Analyses

Additional ALARA analyses will be performed in connection with remediation of the WMA 1 and WMA 2 excavations. These analyses will make use of updated values for parameters such as LLW disposal costs, as well as in-process survey results for radioactivity in soil at the base of the excavation during soil removal activities.

Factors not included in the simple preliminary analyses such as other societal and socioeconomic considerations, the costs related to occupational risks, and transportation of additional waste will be taken into account in the additional ALARA analyses. Consideration will also be given in these analyses as to whether remediation of the WMA 1 and WMA 2 excavations to DCGLs (actually to the cleanup goals) for surface soil, rather than for subsurface soil, will be cost-effective. Consideration will be given as well to the effects of using lower discount rates on the estimated cost of remediation so that intergenerational concerns are taken into account.

NOTE

As mentioned previously, DOE has already established cleanup goals below the DCGLs calculated for 25 mrem per year for surface soil, subsurface soil and streambed sediment as explained in Section 5, based on considerations such as the complexity of the site and its different source areas, to ensure that cleanup criteria used in Phase 1 of the decommissioning will support all potential options for Phase 2.

Also, as described in Section 5, a final dose analysis will be performed using Phase 1 final status survey data from the WMA 1 and WMA 2 excavations to estimate potential doses from residual radioactivity from these areas assuming that the entire project premises were to be remediated to the License Termination Rule criteria for unrestricted release.

6.5 References

Code of Federal Regulations

10 CFR 20.1003, *Definitions.*

10 CFR 20, Subpart E, *Radiological Criteria For License Termination (LTR).*

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