Appendix I The Columbia River Treaty and Return of the Canadian Entitlement

Return of Canadian Entitlement

Upon ratification of the Columbia River Treaty in 1964, Canada built three large storage dams (Duncan, Arrow and Mica) on the Canadian side of the border, to facilitate flood control protection in both Canada and the U.S., and to increase power generated on the U.S. side at U.S. dams. This increased power was called the "downstream power benefits," and the U.S. and Canada share in those benefits equally. The Canadian half is called the "Canadian Entitlement," and is owned by the Province of British Columbia. The U.S. and Canada both have the option to terminate most elements of the Treaty after 2024 with 10 years advanced notice.

Canadian Entitlement to downstream power benefits was sold to a nonprofit organization, the Columbia Storage Power Exchange (CSPE, a consortium of 41 U.S. Northwest utilities) under a contract called the Canadian Entitlement Purchase Agreement (CEPA) for a period of 30 years following the Treaty-specified required completion date for each Canadian storage project. Purchase of Entitlement under CEPA expired 31 March 1998 for Duncan, and 31 March 1999 for Arrow, and will expire 31 March 2003 for Mica.

On 1 April 1998 Entitlement power began returning to Canada at the U.S.-Canada border, over existing power lines, as established by international agreement. For the period 1 August 2001 through 31 July 2002, the amount returned for Duncan and Arrow is 292.1 average annual megawatts of energy, scheduled at rates up to 783 megawatts ("peak," or capacity). Together with the Canadian Entitlement power sold to CSPE utilities, total Canadian Entitlement currently stands at about 533 average annual megawatts, scheduled at rates up to 1427 megawatts. At the same time, an equal amount of power ("American Entitlement," if you will) is used as a part of the resource stack of Bonneville and mid-Columbia project owners to serve their customers.

The amount of power that makes up the Canadian Entitlement is determined 6 years in advance, through a series of hydroelectric power studies jointly called the Assured Operating Plan and the Determination of Downstream Power Benefits. Once agreed to by the Canadian and U.S. Entities, who together oversee the Treaty, the Canadian Entitlement power for 6 years out becomes fixed and must be delivered – regardless of actual operating benefits which are affected by rainfall, snowpack, river constraints, generator or transmission line outages, and deratings of transmission paths for reliability or other reasons (which sometimes happens at the interconnection between the U.S. and Canada).

The U.S. Government is obligated by the Treaty to acquire sufficient generating and transmission resources to deliver the Canadian Entitlement, either to the border or to CSPE utilities, with a level of reliability equivalent to firm service provided any of Bonneville's firm customers in the Northwest. Under the 29 March 1999 Entity Agreement and Exchange of Notes, the Canadian Entitlement is returned to the border in the ratio of 11/14 on the West side (Blaine) and 3/14 on the East side (Nelway) of the Cascade Mountains.

Future Entitlement Obligations

The following Canadian Entitlement delivery obligations are based on Assured Operating Plans for the 1997-98 through 2005-06 operating years which have been agreed upon and signed by the U.S. and Canadian Entities. The Entities' staff are currently working on preparing the 2006-07, 07-08, and 08-09 AOP's. For detailed monthly schedules see the Entitlement Schedule on the next page. While the specific amounts of delivery obligations cannot be determined beyond the last AOP, the capacity is expected to fluctuate between 1100 MW and 1500 MW as described in footnote 8 on the next page.

CANADIAN ENTITLEMENT AMOUNTS DELIVERED TO THE BORDER
(Energy in average MW and Capacity in MW)

Start Date	AOP/ DDPB	Total Energy Entitlement	Energy Entitlement Owed 1/	Energy 2/ Delivered to Border	Total Capacity Entitlement	Capacity Entitlement Owed 1/	Capacity 3/ Delivered to Border
Apr 1, 1998	1998-99	553.3	50.0	48.26	1229.6	111.1	109
Aug 1, 1998	1998-99	562.7	50.8	49.03	1514.7	136.8	134
Apr 1, 1999	1998-99	562.7	308.6	297.88	1514.7	830.6	815
Aug 1, 1999	1999-00	559.5	306.8	296.14	1461.9	801.7	787
Aug 1, 2000	2000-01 /4	508.4	277.4 4/	267.76	1447.3	793.7	779
Aug 1, 2001	2001-02	532.6	292.1	281.58	1427.1	782.6	768
Aug 1, 2002	2002-03	534.5	293.1	282.55	1170.7	642.0	630
Apr 1, 2003	2002-03	534.5	534.5	516.33	1170.7	1170.7	1149
Aug 1, 2003	2003-04	537.3	537.3	519.03	1176.4	1176.4	1154
Aug 1, 2004	2004-05 /5	537.3	537.3	519.03	1176.4	1176.4	1154
Aug 1, 2005	2005-06	535.1	535.1	516.91	1218.0	1218.0	1195
Aug 1, 2006	2006-07 6/	7/	7/	7/	8/	8/	8/

Notes:

1. The Energy and Capacity Entitlement amounts owed to Canada ramps up to the full amount of the Entitlement in 2003 based on the ratio of storage benefits no longer sold to CSPE compared to the total Canadian Treaty storage. For April 1, 1998, first delivery of Entitlement was based on a 1.4/15.5 portion of the computed entitlement. On April 1, 1999, the ratio increased to 8.5/15.5, and April 1, 2003, the ratio increases to the full amount. The 2000-01 Energy Entitlement includes a reduction of 2.5 aMW by the 4/5/95 Entity Agreement.
2. The Entities have agreed to reduce Energy amounts delivered to BC/U.S. border by 3.4% for U.S. transmission losses, plus an additional 0.2% for the 1997-98 through 2002-03 AOP's that don't include step-up transformer losses, for a total of 3.6% losses.
   Disposal of the Entitlement directly in the U.S. has been approved by the March 29, 1999, Entity Agreement and Exchange of Notes.
   Amounts delivered within the U.S. will include standard TBL 1.9% transmission losses plus, plus the 0.2% step-up transformer losses prior to August 1, 2003, for a total reduction of 2.1%.
   Amounts delivered to the border will be based on the monthly rate of energy owed times the monthly hours, rounded to the nearest MWh, then reduced by the transmission loss and rounded to the nearest MWh. Beginning Aug. 1, 2001, the loss calculation was changed to be a percent of the total obligation instead of a percent of the net amount delivered.
3. The Entities have agreed to reduce Capacity amounts delivered to the BC/U.S. border by standard BPA system transmission losses (currently 1.9%). The Operating Committee has agreed to round Capacity values to the nearest whole MW.
4. The 2000-01 Energy Entitlement includes a 2.5 aMW reduction from the calculated value due to an April 5, 1995, Entity agreement on nonpower requirements.
5. 2004-05 AOP/DDPB values are the same as the 2003-04 AOP/DDPB.
6. Study not yet completed. Expect slight decline in energy, little change in capacity.
7. Expect slow decline of 2-3 aMW per year, although + or - >50 MW is remotely possible.
8. Likely to fluctuate between about 1100 MW and 1500 MW, in future years, with a very small chance of values greater than 1500 MW

Appendix J Kangley Echo Lake Economic Screening and Sensitivity Analysis Report

Kangley Echo Lake
Economic Screening and Sensitivity Analysis Report

Energy and Environmental Economics, Inc. (E3)
San Francisco, CA

Awad & Singer
Oakland, CA

Nexant, Inc.
San Francisco, CA

Tom Foley
Consultant
Portland, OR

November 8, 2002

Prepared for:
The Energy Efficiency Group & Transmission Business Line
Bonneville Power Administration
Portland, Oregon

Section 1. Executive Summary

Bonneville Power Administration (BPA) proposed the Kangley-Echo Lake transmission line to meet system reliability threats brought about by load growth in the Puget Sound region and treaty obligations to return energy to Canada. These conditions create the possibility of a blackout in the Puget Sound area if certain contingencies, such as a transmission line outage, were to occur during extreme cold weather.

The proposed 500kV line would connect the existing Schultz-Raver 500 kV line with BPA's Echo Lake substation in the Maple Valley area. The proposed route may cross the Cedar River watershed, which provides drinking water for the City of Seattle. BPA funded this study to explore the feasibility of pursuing alternatives to building the Kangley-Echo Lake (KEL) line.

The study team consisted of experts from Energy and Environmental Economics (E3), Awad & Singer, Nexant, Inc., and Tom Foley Consultants. The goals of this evaluation were to:

1. Identify technologies that would be cost effective alternatives to KEL.
2. Evaluate the sensitivity of the cost effectiveness analysis to variations in key input assumptions.
3. Estimate whether achievable load reduction from those cost effective alternatives would be sufficient to defer the line.

1.1 Summary of Approach

We analyzed the cost effectiveness of a broad range of alternatives including Demand-Side Management (DSM), Distributed Generation (DG), large scale Generation (G), and Demand Response and Direct Load Control (DR-DLC). Our analysis estimated the costs and benefits of each alternative from six stakeholder perspectives:

1. BPA TBL Ratepayers (RIM)
2. BPA TBL Revenue Requirement (Utility Cost Test)
3. Total Resource Cost
4. Societal Cost
5. Participants
6. Local Distribution Company (LDC) Ratepayers (RIM)

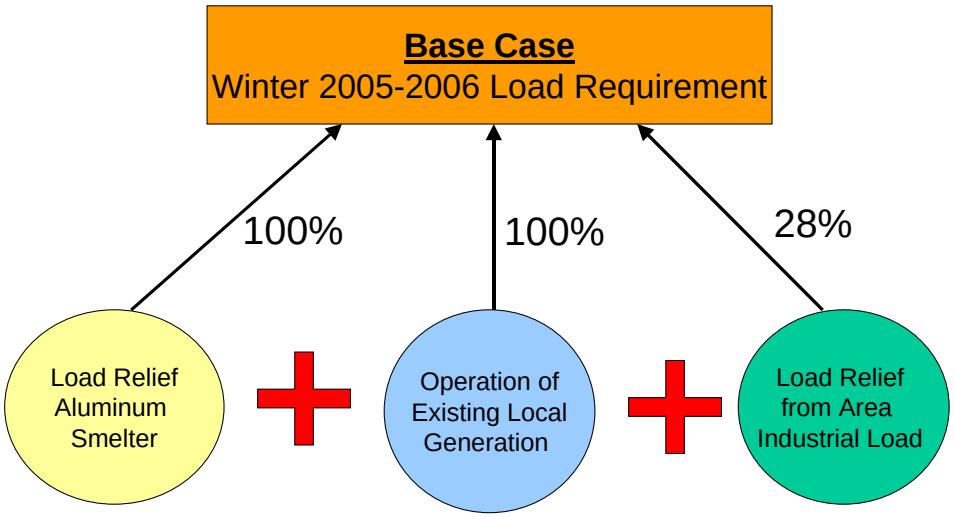
Our analyses of the economics and the required penetration of alternatives were based on BPA system planning information on the transmission system, the proposed KEL line and the conditions requiring additional capacity. In addition, BPA provided general economic assumptions and system characteristics. The team developed the list of alternatives and their cost and performance characteristics from third party sources including the Northwest Power Planning Council DSM database.

1.2 Summary of Findings

A high level of load reduction or additional generation is required to defer KEL. Based on the planning assumptions provided, the level of load reduction required to prevent an overload on the transmission system and to maintain system reliability during a major system outage is approximately 122 megawatts (MW) at the Covington transmission substation during the winter of 2003-2004. This load reduction requirement amount increases every year thereafter. The analysis of the load requirement in Section 4 provides a thorough description of the load forecasting process.

The Puget Sound Area peak load is approximately 12,000MW. Because of the way that power flows over the network of transmission facilities, each MW of load reduction or additional in-area generation only reduces the flows across the Covington transformer by a fraction of a MW. For example, a 100MW load reduction in downtown Seattle will only reduce loadings on the Covington transformers by 42MW, while the same reduction in Tacoma would only achieve a 20MW reduction at Covington. The ratio of the MW change at Covington to the MW change at the source is called the load flow distribution factor (or distribution factor). When applying these factors, the 122MW that are required to bring the peak load of Covington below overload levels in the first year translates to approximately 381MW of load reduction or additional generation within the Puget Sound Area assuming a distribution factor of 32%[1]. Thereafter, the amount of load reduction or additional generation needed to prevent an overload increases annually. By the winter of 2005-2006 the needed amount grows to 269MW at Covington, or 841MW within the Puget Sound Area. As illustrated in Figure 1, a 3-year deferral of the line would require 100% of the available load relief from the large aluminum smelter in the area, plus operation of all existing generation not expected to be on-line, plus load relief from 28% of industrial load in the area. To put the 28% industrial participation rate in perspective, we reviewed information from 13 utility DR programs, and found only four with participation rates above 5%.

Figure 1: Load Relief and Generation Requirements for a 3-Year Deferral of the KEL Line (Base Case Assumptions)



[1] 32% is the load weighted average distribution factor across the Puget Sound study area.

Transmission avoided costs are low. The avoided cost of the KEL project, assuming a cost of $25 million and annual operations and maintenance (O&M) costs of $50,000 for the line, is approximately $1.49 million per year (as calculated using the differential revenue requirement method described in Section 3.2 of this report). Therefore, in order to prevent increasing TBL's revenue requirement, 122MW of demand reduction at Covington would have to be purchased for $1.49 million or less. This equates to approximately $12.25 per kW at Covington per year or $3.92 per kW-year in the Puget Sound Area based on average load flow distribution factors.

Furthermore, TBL estimates that construction of the KEL line would reduce peak losses on the transmission system by 11MW. This would result in annual energy savings of 48,180MWh, valued at nearly $2 million dollars.[2] Therefore, the economic value of the energy savings is greater than the benefit of deferring the line.

Incentive Levels are low compared to other programs. The likelihood of achieving significant penetration in the area with incentive levels calculated from the avoided cost of deferring the KEL line cannot be determined precisely without a detailed customer assessment. To provide BPA with some general indication, however, we compared incentive levels and penetration rates for 19 demand response programs across the United States with the incentive levels and penetration rates required for cost-effective deferral of the KEL line. From this comparison we conclude that it is unlikely the available incentive payments based on the value of deferring the KEL line would be sufficient to achieve the significant penetration required in this case. Any DR-DLC program designed to meet the load relief needs at Covington would need to achieve higher penetration with a lower incentive level than the programs we observed in our survey.

Demand response is the most cost-effective alternative from a TBL rate perspective. Of the alternatives considered, we found that demand response programs are most likely to be cost-effective from the utility rate perspective and to participants. Demand response is well suited to solving the capacity problem without causing significant revenue loss since it focuses load reduction on only the hours when needed for system reliability. We found, however, that demand response is not cost effective from the TRC perspective because deferral of the line would eliminate the significant loss savings BPA expects the line to achieve. DSM is cost-effective from a TRC perspective, but is not likely to produce win-win outcomes because there would be increased pressure on rates due to increased efficiency, and subsequently reduced utility sales throughout the year or season. We found that DSM programs would need to reduce energy each year from half to one and a half times the annual energy growth. Also, DSM efforts would either have to be funded externally to BPA or the additional costs would have to be passed through to TBL's ratepayers, because the DSM measures do not pass TBL's RIM test.

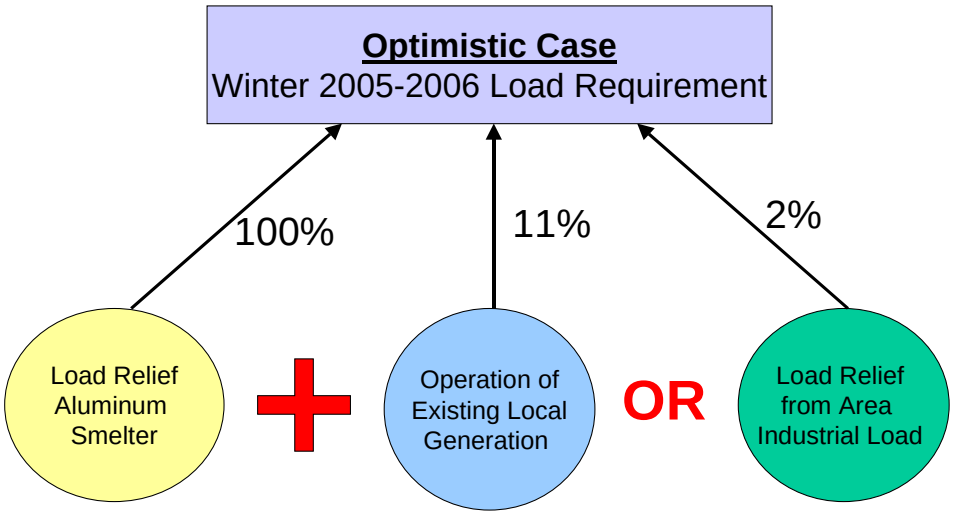
Scenario analysis indicates alternatives could be cost effective if demand is lower than forecast. To provide BPA with a comprehensive assessment of the potential for cost effective alternatives to the KEL line, we conducted a scenario analysis. The purpose of the analysis was to evaluate the sensitivity of cost effectiveness results to changes in key economic inputs. We tested the entire range of alternative technologies under three sets of economic assumptions. These included the base case which we largely derived from BPA's transmission planning work, an 'optimistic' case that improves the cost-effectiveness and penetration requirements of alternatives, and a 'pessimistic' case that reduces the cost-effectiveness of alternatives. The base case represents our best estimate of the future, and the 'optimistic' and 'pessimistic' cases represent extremes that have a low probability of occurring. We found the KEL line was the most

[2] Assumes the 'base case' market price of $40.03 /MWh.

cost-effective solution to capacity constraints in both the base and pessimistic cases. In the optimistic case, we found DR and generation were cost effective from both the ratepayer and participant perspectives.

In this optimistic case we estimated that BPA would require 82MW of load reduction at the Covington substation to defer the line for 3 years or 256MW within the Puget Sound Area. As illustrated in Figure 2, this can be achieved through 100% of available load relief from the large aluminum smelter in the area, plus either operation of 11% of existing generation not expected to be on-line or load relief from 2% of industrial load in the area.

Figure 2: Load Relief and Generation Requirements for a 3-Year Deferral of the KEL Line (Optimistic Assumptions)



1.3 Summary

The decision whether to build the line or defer the line depends on expectations of demand and the availability of funds for alternatives. Three scenarios were examined to provide insight into this decision. If demand increases at the forecasted rates and funds for alternatives are limited to the value of deferring the line, then the KEL line is the most cost effective and feasible solution. However, if demand were to be significantly lower than expected, then sufficient load reduction potential of alternatives exists to mitigate the need for the line. In this case, the economics of alternatives would also be improved, and it might be possible to defer the line for up to 3 years with demand response programs and contracts with existing generation in the area. Likewise, if additional benefits of alternatives were to be found to offset the costs (for example, through partnering with local distribution utilities), the cost-effectiveness of alternatives could be improved. On the other hand, if demand were to increase at a higher rate than forecasted, then the KEL would again be the most cost-effective and feasible solution.

There are competing views of the appropriate criterion for cost effectiveness. The principal debate is between the Ratepayer Impact Measure (RIM) and the Total Resource Cost test (TRC). RIM compares the effect on TBL's rates of the cost of alternatives versus the capital and maintenance costs of a proposed solution. TRC compares the costs and benefits of alternatives with all the costs and benefits of a proposed solution. TRC includes energy and generation benefits. An alternative deemed cost effective under TRC could cause rates to be higher. While

our analysis provides information to evaluate these two criteria, it was not intended to provide guidance as to the appropriateness of one over the other.

Independent of BPA's decision regarding the KEL line, the distribution system benefit of alternatives is an avenue of additional investigation that was not within the scope of this project, but should be pursued. If distribution benefits are significant, they would increase the value of alternative measures and should provide additional sources of funding. The incorporation of distribution benefits involves institutional and policy considerations that are beyond the scope of this analysis and will require more time for resolution than is available for the KEL line decision process.

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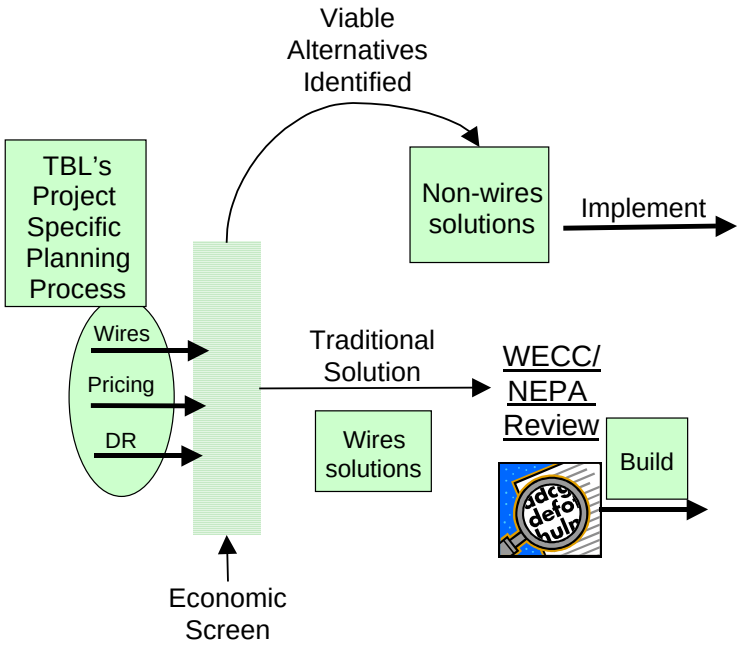
Section 2. Introduction

2.1 Background

Prior to proceeding with the construction of transmission projects, Bonneville Power Administration's (BPA) Transmission Business Line (TBL) is obligated to ensure that there is a clear and compelling demonstration of project need, and that the proposed project provides the most cost-effective solution to the region's transmission problems from an engineering, economic, and environmental standpoint. As part of its evaluation, BPA must consider whether non-transmission options can be employed as viable alternatives to transmission expansion. Non-transmission solutions include, but are not limited to: pricing strategies, demand reducing strategies, and strategic placement of generators. BPA retained the team of Energy and Environmental Economics, Inc. (E3), Awad & Singer, Nexant, Inc., and Tom Foley to conduct an economic screening of non-transmission alternatives to their proposed construction of the Kangley – Echo Lake (KEL) transmission line.

BPA commissioned this study with the intent of setting a precedent for the evaluation of alternatives for future transmission projects in keeping with the 'Expansion of BPA Transmission Planning Capabilities' document issued in November 2001. The goal is to make the planning process more proactive and expansive in identifying and resolving transmission problems at the lowest cost to the transmission system. It is TBL's intent that transmission projects, for which viable alternatives might exist, will be screened against the costs of strategically located and operated generation, demand management, and transmission-pricing programs (see Figure 3).

Figure 3: Economic Screening of Non-Wires Alternatives



2.2 The Kangley-Echo Lake Transmission Project

The need for the KEL Transmission Project is based on BPA TBL's projected overloads for winter 2003-2004. This projected overload is the product of a variety of factors that result in higher flows of energy northbound into the Puget Sound area. Factors contributing to the overload include: the projected growth of peak loads in the Puget Sound area, increased power return obligations to Canada under the Columbia River Treaty (the Canadian Entitlement Return), and the anticipated effect of extremely cold weather on Puget Sound area peak loads. One factor that can actually *reduce* transmission demand is the amount of local generation that is operating during peak periods. These factors are used as inputs to a BPA TBL load flow analysis that projects the loading on critical elements in the Puget Sound area under various system contingencies such as generator or transmission line outages. If the projected loading under specified contingencies exceeds equipment ratings on any critical elements, BPA TBL must take action to avoid being in violation of Western Electricity Coordinating Council (WECC) reliability criteria.

BPA studies show that, under certain contingencies, overloads can occur on a variety of elements in the Puget Sound area, including two 500 kV transformer banks at BPA's Covington substation near Enumclaw. At the direction of BPA, our study focused on the loading at the Covington transformer banks. Alternatives that reduce loading on these transformer banks to below their emergency limit will also prevent overloads on the other elements of the transmission system. The Covington transformers have a combined rating of 2,850 MVA. BPA conducted load flow studies for heavy load conditions in winter 2003-2004, and concluded that certain contingencies would cause an overload of 122 MW on the Covington transformer banks. We used BPA's load projections in conjunction with load duration curves from historical years in which extreme cold weather events occurred to develop MW and duration targets for transmission alternatives. The projected overloads, and number of hours during which overloads occur, are presented below in Table 1.

Any alternatives to construction of the KEL transmission line must maintain WECC reliability criteria. Therefore, measures that mitigate the overloads on the Covington transformers must be in place before the winter of 2003/2004 for the KEL line to be deferred or replaced.

Table 1: Projected Covington Transformer Bank Overloads, 2004-2013

Year	Maximum Overload (MW)	Number of Hours Overload Occurs
2004	122	10
2005	190	17
2006	269	30
2007	397	51
2008	449	61
2009	505	70
2010	558	86
2011	611	102
2012	664	119
2013	714	135

2.3 Project Goals

The team conducted an economic screen of non-transmission alternatives to the construction of the KEL transmission line that entailed: 1) Identifying any technologies or measures that would be cost-effective non-wires alternatives to the construction of the transmission line; 2) Estimating whether the achievable load reduction from those cost effective alternatives would be sufficient to defer construction of the line; and 3) Identifying and describing the scenarios and input assumptions under which there would be potential for line deferral.

In order to be successful, the combined load impact of the alternatives would have to satisfy the BPA TBL mandate to maintain transmission reliability based on WECC standards. If the combined impact falls short of the peak load requirements, then the line will have to be constructed to maintain reliability and there will be no capacity value to the alternatives in delaying the line. The load requirement to maintain reliability is based on the same forecasts that BPA TBL transmission planners have used to develop the proposed design of the new KEL line. In addition, we have explored alternative levels of load reduction using scenario analysis in order to develop more robust conclusions on the potential for KEL deferral.

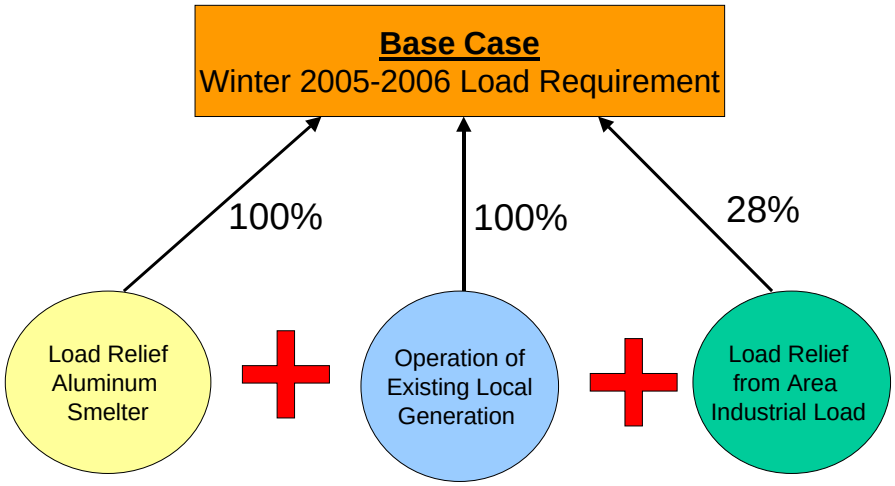
2.4 Summary of Results

A high level of load reduction or additional generation is required to defer KEL. Based on the planning assumptions provided, the level of load reduction required to prevent an overload on the transmission system and to maintain system reliability during a major system outage is approximately 122 megawatts (MW) at the Covington transmission substation during the winter of 2003-2004. This load reduction requirement amount increases every year thereafter. The analysis of the load requirement in Section 4 provides a thorough description of the load forecasting process.

The Puget Sound Area peak load is approximately 12,000MW. Because of the way that power flows over the network of transmission facilities, each MW of load reduction or additional in-area generation only reduces the flows across the Covington transformer by a fraction of a MW. For example, a 100MW load reduction in downtown Seattle will only reduce loadings on the Covington transformers by 42MW, while the same reduction in Tacoma would only achieve a 20MW reduction at Covington. The ratio of the MW change at Covington to the MW change at the source is called the load flow distribution factor (or distribution factor). When applying these factors, the 122MW that are required to bring the peak load of Covington below overload levels in the first year translates to approximately 381MW of load reduction or additional generation within the Puget Sound Area assuming a distribution factor of 32%[3]. Thereafter, the amount of load reduction or additional generation needed to prevent an overload increases annually. By the winter of 2005-2006 the needed amount grows to 269MW at Covington, or 841MW within the Puget Sound Area. As illustrated in Figure 4, a 3-year deferral of the line would require 100% of the available load relief from the large aluminum smelter in the area, plus operation of all existing generation not expected to be on-line, plus load relief from 28% of industrial load in the area. To put the 28% industrial participation rate in perspective, we reviewed information from 13 utility DR programs, and found only four with participation rates above 5%.

[3] 32% is the load weighted average distribution factor across the Puget Sound study area.

Figure 4: Load Relief and Generation Requirements for a 3-Year Deferral of the KEL Line (Base Case Assumptions)



Transmission avoided costs are low. The avoided cost of the KEL project, assuming a cost of $25 million and annual operations and maintenance (O&M) costs of $50,000 for the line, is approximately $1.49 million per year (as calculated using the differential revenue requirement method described in Section 3.2 of this report). Therefore, in order to prevent increasing TBL's revenue requirement, 122MW of demand reduction at Covington would have to be purchased for $1.49 million or less. This equates to approximately $12.25 per kW at Covington per year or $3.92 per kW-year in the Puget Sound Area based on average load flow distribution factors.

Furthermore, TBL estimates that construction of the KEL line would reduce peak losses on the transmission system by 11MW. This would result in annual energy savings of 48,180MWh, valued at nearly $2 million dollars.[4] Therefore, the economic value of the energy savings is greater than the benefit of deferring the line.

Incentive Levels are low compared to other programs. The likelihood of achieving significant penetration in the area with incentive levels calculated from the avoided cost of deferring the KEL line cannot be determined precisely without a detailed customer assessment. To provide BPA with some general indication, however, we compared incentive levels and penetration rates for 19 demand response programs across the United States with the incentive levels and penetration rates required for cost-effective deferral of the KEL line. From this comparison we conclude that it is unlikely the available incentive payments based on the value of deferring the KEL line would be sufficient to achieve the significant penetration required in this case. Any DR-DLC program designed to meet the load relief needs at Covington would need to achieve higher penetration with a lower incentive level than the programs we observed in our survey.

Demand response is the most cost-effective alternative from a TBL rate perspective. Of the alternatives considered, we found that demand response programs are most likely to be cost-effective from the utility rate perspective and to participants. Demand response is well suited to solving the capacity problem without causing significant revenue loss since it focuses load

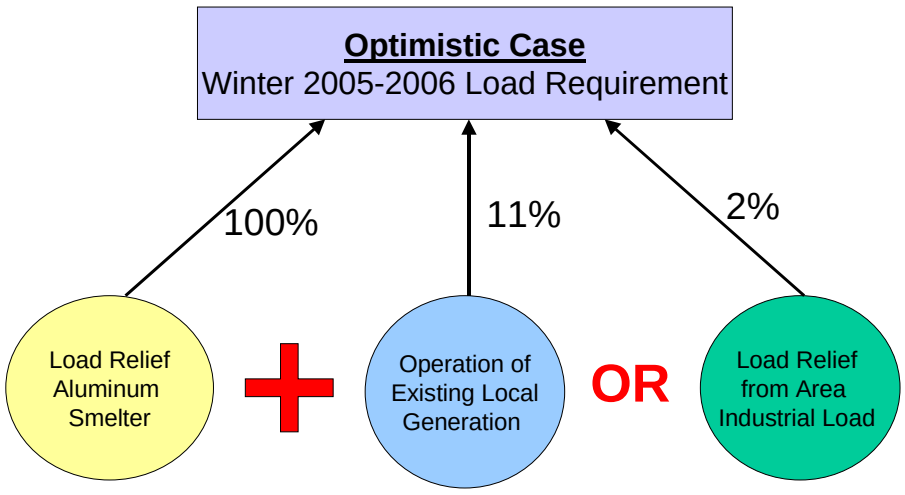
[4] Assumes the 'base case' market price of $40.03 /MWh.

reduction on only the hours when needed for system reliability. We found, however, that demand response is not cost effective from the TRC perspective because deferral of the line would eliminate the significant loss savings BPA expects the line to achieve. DSM is cost-effective from a TRC perspective, but is not likely to produce win-win outcomes because there would be increased pressure on rates due to increased efficiency, and subsequently reduced utility sales throughout the year or season. We found that DSM programs would need to reduce energy each year from half to one and a half times the annual energy growth. Also, DSM efforts would either have to be funded externally to BPA or the additional costs would have to be passed through to TBL's ratepayers, because the DSM measures do not pass TBL's RIM test.

Scenario analysis indicates alternatives could be cost effective if demand is lower than forecast. To provide BPA with a comprehensive assessment of the potential for cost effective alternatives to the KEL line, we conducted a scenario analysis. The purpose of the analysis was to evaluate the sensitivity of cost effectiveness results to changes in key economic inputs. We tested the entire range of alternative technologies under three sets of economic assumptions. These included the base case which we largely derived from BPA's transmission planning work, an 'optimistic' case that improves the cost-effectiveness and penetration requirements of alternatives, and a 'pessimistic' case that reduces the cost-effectiveness of alternatives. The base case represents our best estimate of the future, and the 'optimistic' and 'pessimistic' cases represent extremes that have a low probability of occurring. We found the KEL line was the most cost effective solution to capacity constraints in both the base and pessimistic cases. In the optimistic case, we found DR and generation were cost effective from both the ratepayer and participant perspectives.

In this optimistic case we estimated that BPA would require 82MW of load reduction at the Covington substation to defer the line for 3 years or 256MW within the Puget Sound Area. As illustrated in Figure 5, this can be achieved through 100% of available load relief from the large aluminum smelter in the area, plus either operation of 11% of existing generation not expected to be on-line or load relief from 2% of industrial load in the area.

Figure 5: Load Relief and Generation Requirements for a 3-Year Deferral of the KEL Line (Optimistic Assumptions)



2.5 Report Organization

In Section 3 of this report we discuss the analysis methods that we have employed in the economic screen of alternatives to the KEL line. This screen is a forward-looking economic analysis that uses the benefit/cost (B/C) ratio of alternatives as the primary indicator of cost-effective solutions. A B/C ratio greater than one indicates that the benefit of a non-transmission alternative is greater than its cost, and therefore it is a potentially cost-effective alternative to the transmission line. One of the primary benefits of line deferral to TBL and their ratepayers is the reduction in TBL's future revenue requirement that can be achieved by a deferral of the line.

As described in Section 4, the first step of our analysis is an investigation of area load growth and the duration and level of projected overloads. This is fundamental to our study as it shows us when and at what level demand reduction is required from the non-wires alternatives.

Next we conducted a simple evaluation using base-case assumptions about the cost-effectiveness of non-wires options to allow TBL to look at as wide a set of alternatives as possible. The technologies and programs that we included in the economic screen are described in Section 5. We describe the results of the base case analysis in Section 6.

Finally we applied scenario analysis (described in Section 7), and benchmarking techniques to estimate the market penetration potential for promising alternative (described in Section 8) to develop a more robust picture of the alternatives.

Section 3. Methodology

We screened for cost-effective alternatives by calculating the benefit/cost (B/C) ratios for a variety of non-wires technologies and programs. A B/C ratio greater than one indicates that the non-wires alternative has a benefit greater than its cost, and therefore is a potentially cost-effective alternative to the transmission line. Suggesting that a measure is "cost-effective" however, immediately raises the question, "cost effective to whom?"

If TBL's goal is to resolve transmission problems at the lowest cost to its ratepayers, the appropriate B/C measure for TBL is the Ratepayer Impact Measure (RIM test), which measures the impact on TBL's rates. The benefits include the change in BPA-TBL's revenue requirement that can be achieved by the deferral of the KEL transmission line (or other wires) investment. The costs included in the RIM test are the direct program costs that will be included in the revenue requirement (i.e., incentive payments paid by TBL to the providers of the non-wires solution(s) to the transmission problem and TBL's administrative costs) and TBL's lost revenues due to reduced sales. Lost revenues are included in the RIM test because these lost revenues are collected from remaining sales thereby increasing the per unit rate. If a non-wires alternative's RIM-B/C ratio is greater than one (1.00), then this alternative would tend to decrease per unit rates that TBL would charge to collect its revenue requirement. The potential "savings" from lower the revenue requirement can be used to "buy" a non-wires alternative.[5]

Measures that do not pass the RIM test could be used if they pass the TRC or the Distribution Utility RIM test. However, this would increase TBL's revenue requirement relative to building the line. There are three basic options for dealing with the increased revenue requirement. First, the additional cost could be borne by TBL's transmission ratepayers. Second, the additional cost could be spread across all of BPA's rates. Third, the additional cost could be reflected in the rates of distribution utility customers. These are institutional and policy considerations that are beyond the scope of this analysis and will require more time for resolution than is available relative to the KEL line decision process.

There are competing views of the appropriate criterion for cost-effectiveness. The principal debate is between the Ratepayer Impact Measure (RIM) and the Total Resource Cost test (TRC). RIM compares the effect on TBL's rates of the cost of alternatives versus the capital and maintenance costs of a proposed solution. TRC compares the costs and benefits of alternatives with all the costs and benefits of a proposed solution. TRC includes energy and generation benefits. An alternative deemed cost effective under TRC could cause rates to be higher. While our analysis provides information to use in evaluating these two criteria, it was not intended to provide guidance as to the appropriateness of one over the other.

3.1 Cost-Effectiveness Tests

TBL's ratepayers are not the only stakeholders in a transmission line expansion. We also evaluate cost-effectiveness from a number of different perspectives: Total resource cost, societal, participant, and local utility. The purpose of including all perspectives is to find solutions that are

[5] A deferral of a wires investment that resulted in increased O&M costs could potentially increase the revenue requirement

cost-effective or "winners" for all stakeholders. Looking at all perspectives also aids in program design. For example, one of the costs for the RIM test is the incentive paid by TBL to the provider of the non-wires solution, which could be the contractual payments to a local generator to be available to operate during the heavy load hours or to an industrial customer to curtail their load during such hours. A win-win program design is one that would set the incentive level payment such that both TBL's ratepayers and the program participant are better off, i.e., the RIM and Participant B/C ratios are both greater than one. If we can find such a balance, this is a program that warrants further investigation as a potential alternative to the transmission line.

Table 2 outlines the program costs and program benefits that are attributed to cost test perspective, which are described below.

Table 2: Costs & Benefits for Each B/C Test Perspective

Tests and Perspective	Program Costs	Program Benefits
RIM Test **BPA TBL**	TBL Incentive TBL Revenue Loss Admin Costs	T Avoided Cost
Utility Cost Test **BPA TBL**	TBL Incentive Admin Costs	T Avoided Cost
TRC Cost Test	Measure / Program Costs Admin Costs Avoided Loss Savings	Gen Capacity Savings Energy Savings T Avoided Cost D Avoided Cost
Societal Cost Test	Measure / Program Costs Admin Costs Avoided Loss Savings Environmental Externalities	Gen Capacity Savings Energy Savings T Avoided Cost D Avoided Cost
Participant Cost Test **Distribution Utility Customers**	Participant Measure / Program Costs	TBL Incentive Dist. Utility Incentive Dist. Revenue Loss
RIM Test **Distribution Utility**	Dist. Utility Incentive Dist. Revenue Loss Utility Admin	Gen Capacity Savings Energy Savings TBL Revenue Loss D Avoided Cost

3.1.1 Ratepayer Impact Measure (RIM) - Transmission Company

This benefit/cost test measures the impacts on TBL's rates. The benefits included are the transmission cost savings from the deferral of the line and changes in O&M costs. The costs included are the incentive payments paid by TBL to the providers of the non-wires solution(s), TBL's administrative costs, and TBL's lost revenues due to reduced sales. If the program benefit/cost ratio is less than one, this program would tend to increase the per unit rates that TBL would charge to collect its revenue requirement. Measures that have a high reduction in sales relative to peak load reductions, such as conservation, are generally not cost-effective from the RIM perspective.

3.1.2 Utility Cost Test - Transmission Company

This test measures the impacts on BPA's revenue requirement. The benefits included for this test are the transmission avoided costs including O&M savings. The costs included are the TBL incentive payments and TBL administrative costs. If the program benefit/cost ratio is less than one, the program will increase the revenue requirement. This test is different than the RIM test because the lost sales due to any measures that reduce BPA sales will generally not alter the transmission company revenue requirement.

3.1.3 Total Resource Cost Test (TRC)

The TRC test measures the costs and benefits from a broader perspective and includes all of the direct cash costs associated with the non-wires alternative. The benefits include the avoided costs of transmission, distribution, generation capacity and energy, including losses. The costs include the lifecycle costs of the measure, O&M costs, program administrative costs, and the lost opportunity to realize a reduction in transmission losses from building the line. Transfers such as incentive payments between BPA and its customers, as well as bill savings, are not included from this perspective since the net cost of transfers between BPA and customers is zero.

3.1.4 Societal Cost Test

The societal cost test includes the broadest set of costs and benefits. In addition to the direct cash costs accounted for in the TRC test, any environmental externalities such as reduced air emissions are included as a benefit.

3.1.5 Participant Cost Test

The participant cost test measures the lifecycle net benefits for the participant. The participant is the customer that installs the DSM, curtails their load, or owns the DG. The benefits included in this test are the incentives paid to the customer and the customer's bill savings due to the measure. The costs included are the life-cycle costs of the measure to the participant. This cost test is a good indicator of how acceptable a program will be to individual customers who might participate in the program.

3.1.6 Ratepayer Impact Measure (RIM) - Distribution Company

This benefit/cost test measures the impacts on the rates of the distribution utilities that BPA TBL serves with their transmission system. The benefits included for this test are the transmission avoided costs, and the costs included are the incentive payments paid by the utility to the providers of the non-wires solution(s) to the transmission problem, the utility's administrative costs and the utility's lost revenues due to reduced sales. If the program benefit/cost ratio is less than one, this program would tend to increase the per unit rates that the utility charges to meet its revenue requirement. Measures that significantly reduce sales relative to peak demand reductions, such as conservation, generally are not cost-effective from the RIM perspective.

3.2 Transmission Avoided Cost Definition

As we state above, the basic benefits of non-traditional alternatives on the transmission system are measured as the change in BPA-TBL's revenue requirement that can be achieved by the deferral of the KEL transmission line (or other wires) investment. In calculating the avoided

costs of this project, we are estimating the forward-looking incremental cost of building the KEL line. If this transmission line can be avoided or deferred for a year or longer, then this will result in a reduction of TBL's future revenue requirements. The avoided transmission cost is just one component of the total system benefits of implementing an alternative solution; however, from the BPA-TBL perspective, it is the only benefit of reducing peak loads. Therefore, we focus in this section on the calculation of the transmission avoided cost component; however the method is similar for the other components of avoided cost.[6]

This method of calculating the long run incremental costs is also referred to as the 'differential revenue requirement' method because it is based on the difference in revenue requirements before and after deferral of the transmission project.

Step 1: Estimate the Revenue Requirement and Timing of the Planned Transmission Investment.

Table 3 shows the revenue requirements for the planned KEL transmission line project. The costs are shown at revenue requirement levels (direct investment dollars have been scaled up to account for administrative and general costs, debt repayment, tax effects, and operations and maintenance expenses) so that the economic savings to the BPA rate base can be estimated.

Table 3: Revenue Requirement of Planned Expenditures

A	*B*	*C*	*D*	*E*
Year	Investment	Constant Base Year Dollars ($1000s)	Base Year	Revenue Requirement in Nominal Dollars ($1000s)
Investment data from BPA				
2002				
2003	KEL Y1	25,000	2003	25,000
2004			2004	0

Step 2: Evaluate the Load Reduction Required on the Transmission Path to Defer the Project

Table 4 shows the forecast of load reduction requirements on the Covington transformers based on the needs assessment described later in Section 4. If this amount of load reduction can be achieved during the critical load periods, BPA-TBL can maintain its system reliability criteria and defer the project. Note that the actual amount of load reduction required is several times greater than the Covington transformers' overload due to the way that power flows over the transmission network. (See Section 4.4).

The base case load scenarios in this analysis identify a need for 122 MW of load reduction at the Covington transformers in the winter of 2003/2004 in order to defer the KEL transmission line.

[6] For more detail, see *Costing Methodology for Electric Distribution System Planning*, prepared by E3 and Fred Gordon of Pacific Energy Associates for the Energy Foundation.

The method the team employed to arrive at this initial base case load reduction target is described in Section 4.

Table 4: Overload of the Covington Transformers

A	*B*
Year	Peak Load Reduction Required (MW)
2002	-
2003	122
2004	190
2005	269
2006	397
2007	449
2008	505
2009	558
2010	611
2011	664
2012	714
2013	766
2014	818
2015	870

Step 3: Calculate the Change in Revenue Requirement per kW of Load Reduction

Table 5 shows the calculation of the reduction in revenue requirement from postponing the KEL transmission line project if the alternatives can achieve the required amount of load reduction.[7] Column A shows the revenue requirement of the expenditures (from Table 3). Column B is the required annual load reduction from Table 4. Column C shows the assumed amount of load reduction, which has been set to equal the annual load growth from 2002/3 to 2014/15.

The assumption on the amount of load reduction is important but subtle. We are estimating the value of load reduction at the constrained location for a **meaningful** decrement of load[8]. Column D shows the deferral length in years achieved by the load reductions in column C. This deferral length can vary by year depending on the load growth in each year. Column E shows the value of the deferral for each year. The deferral value is calculated as the difference in the present value of revenue requirement under the original and deferred schedule. [9]

[7] This load reduction could be due to distributed generation, curtailable load, DSM or other strategy.

[8] For systems that have a radial configuration, the amount of load reduction at the constraint will be the same as the total resource that is implemented (adjusted for losses). In network systems, flow distribution factors can be used to estimate load reduction achieved at the constraint from a reduction at a particular point on the system.

[9] The inflation rate and weighted average cost of capital (WACC) used in the calculation of Column E are 2.7% and 9%, respectively.

The method for calculating the deferral value is based on the concept that the value of a load change is equal to the difference between the present value of the original investment plan and the present value of the deferred plan.[10] The cost of a deferred investment increases with the inflation rate but decreases by the cost of capital (discount rate). Since the discount rate is higher than the inflation rate, this results in a net present value savings:

$$\text{Deferral Value} = \text{Nominal Cost in Year(i)} \times (1 - ((1+\textit{Inflation Rate})/(1+\textit{Discount Rate}))^{\wedge}\Delta t)$$

Where Δt is the deferral length in years.

For example, the 122 MW of load reduction prior to 2003 results in a savings of $1.445 million dollars in TBL's revenue requirement.

Table 5: Calculation of Transmission Deferral Value at Covington

	A	*B*	*C*	*D*	*E*	*F*
Year	Scaled Nominal Cost ($000)	Incremental Load Reduction Required (MW)	Load Reduction (MW)	Deferral Length (yrs)	Deferral Value ($000)	Marginal Cost ($/kW)
	(see prior table)			*(Col C / Col B)*	*(A * (1-((1+inflation)/(1+WACC))^D))*	*(Col E / Col D)*
2003	25,000	122.0	122.0	1.00	1,445	11.84
2004	0	67.9	67.9	1.00	0	0.00
2005	0	79.3	79.3	1.00	0	0.00
2006	0	128.0	128.0	1.00	0	0.00
2007	0	52.2	52.2	1.00	0	0.00
2008	0	55.3	55.3	1.00	0	0.00
2009	0	53.5	53.5	1.00	0	0.00
2010	0	52.9	52.9	1.00	0	0.00
2011	0	52.6	52.6	1.00	0	0.00
2012	0	50.2	50.2	1.00	0	0.00
2013	0	52.0	52.0	1.00	0	0.00
2014	0	52.0	52.0	1.00	0	0.00
2015	0	52.0	52.0	1.00	0	0.00

Step 4: Adjust for Changes in O&M Costs

The avoided O&M costs associated with deferring the KEL transmission line are added to the total deferral value prior to calculating the total transmission marginal cost in $/kW. For example in this base case scenario the avoided O&M costs of $50,000 are added to the $1.445 million dollars calculated in Column F to yield an adjusted total deferral value of $1.495 million. When the total deferral value is divided by the amount of load reduction required, we get the value per kW of load reduction. In the base case scenario this gives us a marginal cost of $12.25/kW in 2003. This means that each kW of the 122 MW of total reduction in 2003 is worth $12.25/kW because of the value of deferring the expenditures in that year. However, this value only holds if

[10] See Area Specific Marginal Costing for Electric Utilities: "A Case Study of Transmission and Distribution Costs", R. Orans Ph.D. Dissertation, 1989.

the full 122 MW of load reduction is achieved. If the load reduction is less than 122 MW, then the value equals zero.

Step 5: Calculate the Total Transmission Avoided Costs

These calculations suggest that the maximum that BPA –TBL could pay without increasing the revenue requirement is $12.25/kW for a program that cut demand by 122 MW in 2003. Table 6 shows the value of additional load reduction to achieve additional years of deferral.

Table 6: Base Case Incentive Levels Using $25M Dollar Avoided Investment Cost

Minimum Contract Length	1 Year	2 Year	3 Year	4 Year	5 Year	6 Year	7 Year
Minimum Total MW Required	122.00	189.93	269.20	397.20	449.39	504.73	558.19
Maximum Incentive	$ 1,494,954	$ 2,906,393	$ 4,236,252	$ 5,489,249	$ 6,669,824	$ 7,782,165	$ 8,830,214
$/kW (PV Contract Payments)	$ 12.25	$ 15.30	$ 15.74	$ 13.82	$ 14.84	$ 15.42	$ 15.82
$/kW-yr (Level Annual Payments)	$ 12.25	$ 7.98	$ 5.70	$ 3.91	$ 3.50	$ 3.15	$ 2.88

This equates to a total value of $1,494,954 that would be economical to offer in order to achieve the required load reduction for one year. Looking out into future years, on average, there would be a maximum of approximately $1 million dollars of avoided costs per year available for programs or technologies to defer the transmission line investment. For each consecutive year after the initial expenditure would be made, the incentive level in present value terms is discounted further because the inflation rate is lower than the discount rate.

3.3 Avoided Loss Savings

With the addition of the KEL line, TBL estimates line losses will be reduced by approximately 48,180MWh per year due to improvements in the efficiency of the transmission system. This estimate is based on 11MW peak loss savings, and a loss factor of 50%. The loss factor measures the relationship between peak losses to average annual losses. Therefore, 11MW at a 50% loss factor implies 5.5aMW per year, or 48,180MWh per year.

The KEL line provides significant energy savings. Using the market price forecast developed in this study that shows a long-run marginal cost of electricity of $40.03/MWh, the reduction in losses attributable to the construction of the KEL line results in an annual savings to transmission users of approximately $1,928,645 per year of energy that would not have to be generated.

The team analyzed the unattained loss savings as one of the costs of deferring the line from the TRC and Societal cost test perspectives. For consistency of terminology, we refer to this foregone loss savings as "avoided loss savings." For each year that the line is not built, the transmission system does not gain from the efficiency improvements the KEL line would provide. This cost is offset by the financing benefit of deferring the line and the team calculated the avoided line loss savings with an approach very similar to the transmission avoided costs described in Section 3.2. The same calculation is made as described in the transmission avoided costs except that instead of a benefit of approximately $1,400,000 per year of deferral, the avoided line loss savings is treated as a cost of approximately $2,000,000. The energy savings from the reduction in losses if the KEL line is built is greater than the benefit of deferring the line.

Table 7 shows the avoided loss savings from deferral of the KEL line on a per kW-year basis for a 3, 5, and 10-year deferral of the line. For each kW of load reduction at Covington substation

that a transmission alternative achieves, the share of avoided line loss savings per kW is added as a cost of the program. For example, if the line is deferred for 3 years, the cost in avoided loss savings is $7.34/kW-year.

Table 7: Avoided Loss Savings from Deferral of the KEL Line

Deferral Length	3 Years	5 Years	10 Years
Avoided Losses ($/kW-year at Covington)	$ 7.34	$ 4.51	$ 2.99

Not all of the stakeholders benefit from a reduction in losses on the system. Most notably, a change in losses does not impact the BPA TBL revenue requirement or transmission rates since the losses on the system are collected directly from transmission users, and not through rates. Therefore, from the TBL RIM perspective avoided loss savings are not included.

From a distribution utility RIM perspective, a reduction in losses would be a benefit since lower losses would lower the price of purchased energy on the system. However, since losses are paid on a system average basis by all transmission users for all sales, the 5.5aMW change compared to the total losses on the system would have an extremely small impact on the price for energy and therefore the avoided line loss savings is ignored from the distribution utility RIM perspective.

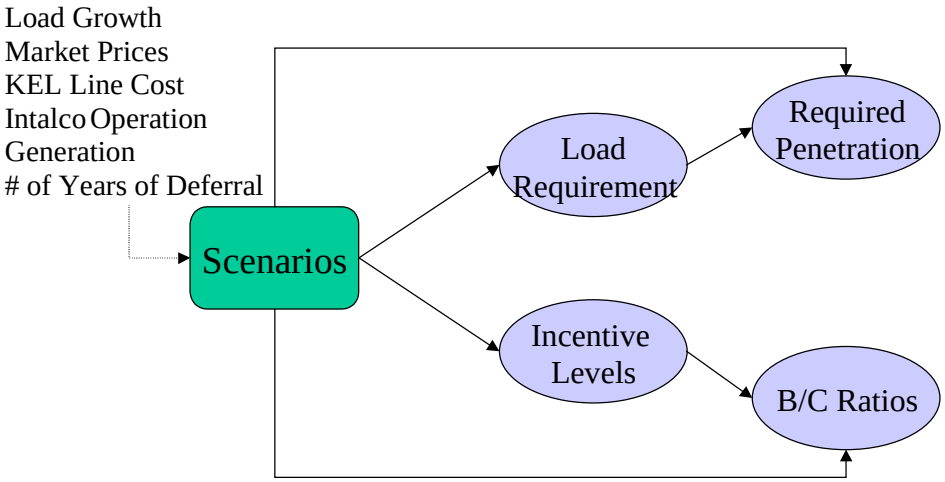
From a participant perspective installing a distributed generator, or energy efficiency, the impact of the avoided line losses is also too small to be significant. The cost of energy for the participant is based on the utility tariff that will not change significantly due to the avoided KEL line losses.

The team did include the avoided line loss savings in the calculation of the Total Resource Cost (TRC) and Societal Cost tests since the region would save these losses if the KEL line were built.

3.4 Scenario Analysis

In the base case analysis we include assumptions about: future market prices for electric energy; the cost of the KEL line; load growth in the Puget Sound area; the amount of generation operating in the area; the years of deferral that can be achieved for the KEL line; and the likely participation of large industrial customers in load control programs. These are all uncertain variables and different assumptions about these variables will alter the cost-effectiveness of non-wires alternatives to the KEL line. Referring to Figure 6 we see how these uncertain variables influence load requirement and incentive levels, which in turn impact the required market penetration from cost effective measures and the results of the B/C tests. For example, if we assume high market prices for the years 2003 and 2004 then merchant generation plants are more likely to be built independently of TBL incentives, thereby lowering the potential overload on the Covington transformer banks and resulting in higher incentives that can be applied to “buying” other solutions for the remaining overload problem. Therefore, as part of the analysis we also consider a range of possible scenarios for the Puget Sound area. We present the results of the scenario analysis in Section 7.

Figure 6: Overview of the Scenario Analysis



3.5 Program Benchmarking

In order to ascertain what are reasonable assumptions for the implementation of Demand Reduction/Direct Load Control (DR/DLC) programs, the team conducted a benchmarking survey of relevant utility programs. BPA provided the team with a draft research report on demand response programs that was used as the primary source of pertinent program information.[11] In addition to this source, we obtained supplemental DR/DLC program information through an extensive search of utility websites and the Energy Information Administration's publicly available database.[12] For confidentiality reasons, the specific names of the utilities conducting DR/DLC programs are not provided in this report.

In total, the team collected program information from 19 different programs that were targeted to industrial and/or commercial customers and operated by utilities throughout the United States. We did not include residential demand response programs in this analysis because these types of programs are not consistent with the high level of reduction that BPA would need to achieve in an extremely short time period. Given a longer implementation timeline, BPA could potentially leverage or support its utilities' load reduction programs within a more dispersed customer segment.

The team collected data on the pricing (incentive level), duration (hours, months, and years), and energy (MW) either reduced, or available for demand reduction, for each of the 19 programs. We applied this information in two analyses. First, we included the pricing levels and duration of each program in our cost/benefit analysis to determine whether similar programs would yield a favorable result (more benefits than costs) from the ratepayer's perspective if a particular program was implemented. Second, we included information regarding the level of load reduction that is available under each program and applied these levels in our penetration analysis discussed below.

[11] "BPA Demand Response Program Research Report" Xenergy, Inc. September 2002, DRAFT, pp. 1-124.
[12] Energy Information Administration website: www.eia.doe.gov

3.6 Penetration Analysis

The team conducted a penetration analysis to gauge what level of penetration is achievable at varying incentive payment levels. We measured levels of penetration as the percentage of MW reduced within the targeted segment. In order to do this, we compared programs with fixed incentive levels with the total MW subscribed or committed for reduction at the incentive level offered. We converted the total MW into a percentage of utility demand in the commercial/industrial sector to get an appropriate penetration level percentage. While overall penetration targets established by the utility managing the program are not included in this analysis, the results provide a clear view as to the feasible range for DR/DLC programs. The results of this analysis are described in Section 8.

Section 4. Area Load Growth Factors and Implications

In order to conduct an effective screening process for potential alternatives to the construction of the KEL transmission line, it is important to understand the characteristics of the Puget Sound Area electrical system that contribute to the need for the additional capacity. The need for the KEL Transmission Project derives from projected overloads that could arise during the winter of 2003-2004 if a transmission outage occurs during a 1-in-20 year 'Arctic Express' weather event.

TBL projects loadings on critical transmission system elements by aggregating load growth forecasts submitted by large utilities in the area, developing forecasts for the smaller utilities and adding transmission contracts with Direct Service Industries (DSIs). The team used these projections in conjunction with load duration curves from historical years in which extreme cold weather events occurred to develop capacity and duration targets for transmission alternatives.

4.1 Determinants of Peak Demand Forecast

The projected overload results from a variety of factors, including projected growth of peak loads in the Puget Sound area, power delivery obligations to Canada under the Columbia River Treaty, assumptions about system conditions such as the operation of local generators, and a projection of the effect of extremely cold weather on Puget Sound area peak loads. These factors serve as inputs to a load flow analysis that projects the loadings on the critical elements under various system contingencies such as generator or transmission line outages. If the projected loadings under certain contingencies exceed equipment ratings, BPA must take action to avoid being in violation of WECC reliability criteria.

4.1.1 Utility Load Forecasts

For large utilities, including investor-owned utilities and larger public utilities, BPA requests "average" (i.e., 50% probability of being higher or lower) forecasts of peak demand. These forecasts are accepted as submitted. The loads of smaller publicly owned utilities are forecast by BPA Transmission and added to the large utility forecasts. BPA then adjusts these forecasts to reflect 1-in-20 year "extreme cold" or heavy load conditions with factors developed by the larger utilities or by BPA. Utility peak loads are assumed to be coincident, based on an 'Arctic Express' weather event.

4.1.2 Direct Service Industries (DSIs)

DSIs are industrial customers, such as aluminum smelters, that take transmission service directly from BPA. They are generally served on a contract demand basis, meaning they have a right to use transmission up to the contracted amount. For these customers, BPA assumes that peak load is equal to 100% of contract demand. Currently, there is only one large DSI operating in the Puget Sound area. Intalco, an aluminum smelter located in Ferndale, Whatcom County, has a transmission contract for 468 MW.[13]

[13] Kaiser Aluminum, in Tacoma, previously had an historical peak load of 152 MW, but currently has no firm transmission contract with BPA.

4.1.3 Canadian Entitlement

Another source of demand for transmission in the Puget Sound area is the return of the "Canadian Entitlement", an obligation to deliver energy and capacity to Canada that stems from the Columbia River Treaty. The Canadian Entitlement is calculated annually according to the terms of the Treaty and subsequent implementation agreements. BPA returned a maximum of 600MW in 2002, and expects to return 907 MW of capacity in 2004, increasing to 1,179MW in 2007.

4.1.4 Local Generation

One factor that can *reduce* transmission demand is the amount of local generation that is operating. There are approximately 2,500MW of generating capacity in the Puget Sound area north of Tacoma. Approximately 60% of this capacity, or 1,600MW, is gas-fired thermal generation. Most of the thermal generation is composed either of peaking plants owned and operated by Puget Sound Energy (800MW) or industrial cogeneration (700MW). The remainder is largely hydroelectric. Large hydro projects include Seattle City Light's Skagit River projects (650MW), Puget Sound Energy's Baker River projects (162MW), and Snohomish PUD's Henry M. Jackson project on the Sultan River (112MW).

BPA's load flow studies assume that most generation in the area, some 2000 MW, is running at or near maximum capacity. The team used this level of generation operating as a baseline for incorporation into the study of alternatives. However, there are a few plants that may have additional generating capacity beyond what BPA is assuming, capacity that potentially could be enlisted to defer the Kangley-Echo Lake line if gas is available. The impact of additional available generation is discussed in the Penetration Analysis Section 8.

4.2 Projected Overloads and Alternatives Targets

4.2.1 Load Flow Analysis

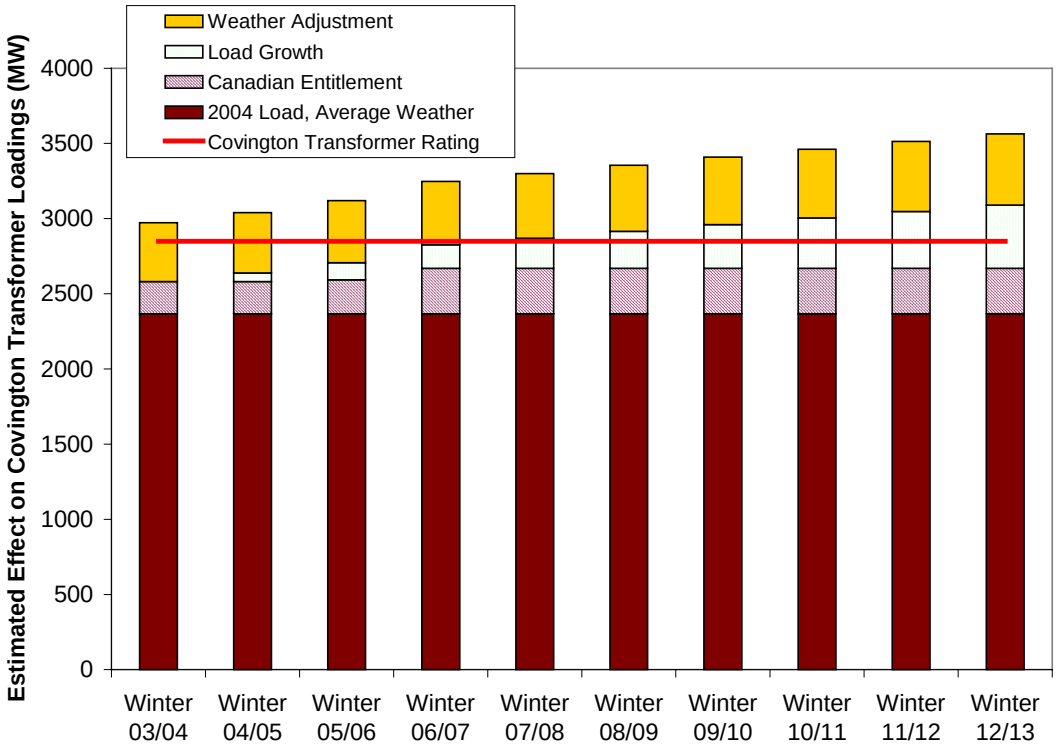
BPA uses local load and resource forecasts as inputs to a load flow analysis, which is a computer model that projects loadings on critical elements under a variety of contingency conditions. BPA studies show that, under certain contingencies, overloads can occur on a variety of elements in the Puget Sound area, including two 500 kV transformer banks at BPA's Covington substation near Enumclaw, the Covington-Creston and Covington-Duwamish 230 kV circuits, and Tacoma Power's 115 kV system. At the direction of BPA, the team focused on the loadings on the Covington transformer banks. Transmission alternatives that reduce loadings on the transformer banks below the limit will also prevent outages on the other elements. The Covington transformers have a combined emergency rating of 2,850 MVA. BPA conducted load flow studies for heavy load conditions in winter 2003/2004, and concluded that an outage would cause an overload of 122 MVA on the transformer banks (See Table 8.).

Table 8: Projected 2004 Overload on Covington 500 kV Transformers

Inputs	
Total Utility Load (MW)	11,149
Direct-Service Industry Load (MW)	468
Exports under Canadian Entitlement (MW)	907
Total Local Generation (MW)	2,036
Results	
Covington Transformer Bank Loading, Outage Case (MVA)	2,972
Covington Transformer Rating (MVA)	2,850
Overload (MVA)	122

Figure 7 presents a graphical view of the factors that contribute to the need for the Kangley-Echo Lake Transmission Project. Forecasts of 2004 utility average weather (1-in-2 year) peak loads would contribute approximately 2,350 MW of loading to the Covington transformer banks, in the event of an outage. Return of the Canadian Entitlement adds 215 MW in 2004, while adjustment of utility forecasts to reflect 1-in-20 year severe weather conditions adds another 390 MW. As loads grow in the years after 2004, the need for the line becomes more pronounced. The average annual growth forecasted for the Puget Sound Area for 'normal weather' over the next 10 years equals 1.5% or 173 MW. By 2008, the combination of load growth and increases in the Canadian Entitlement return mean that new capacity is needed to serve peak loads during an average weather year.

Figure 7: Factors Contributing to the Need for the Kangley-Echo Lake Project



4.2.2 Targets for Alternatives

To identify load reduction targets, the team projected Covington transformer loadings based upon BPA's forecast. Our results are portrayed graphically in the charts below. Overloads are projected for every year after 2004, jumping in 2007 with the next installment of the Canadian Entitlement, and growing steadily thereafter. By 2010, the potential overload reaches nearly 600 MW.

The projected peak loadings and the annual load shapes provide the criteria that define success for transmission alternatives. In order to be successful, a transmission alternative must be able to supply the needed capacity to the system at the appropriate time. The maximum capacity needed in a given year is the highest projected overload in that year, based on the 1-in-20 year adjustment to utility load forecasts described above. However, not all overload hours require that much capacity.

The shape of the load curve is a critical parameter for the success of transmission alternatives. Unfortunately, the shape cannot be known with any certainty in advance. The most appropriate load shape is the one that best reflects the conditions that are likely to occur during a year with a 1-in-20 year event, since this is the event that leads to the maximum loadings the transmission system must be planned to accommodate. Such a year is likely to have a somewhat lower load factor than a normal year, as the peak loads will be relatively higher regardless of the level of the base load. Based on feedback from BPA, the team developed a load shape using a combination of the 1988-89 and 1990-91 winter seasons.

Figure 8 presents projected overloads in 2004 and 2010 based on this load curve and the load forecasts described above. Based on this load shape, 2004 is projected to have 10 hours in which an outage would lead to an overload on the Covington transformer bank. By 2010, an overload could occur for 86 hours.

Figure 8: Projected Post-Contingency Loadings on Covington Transformer Banks

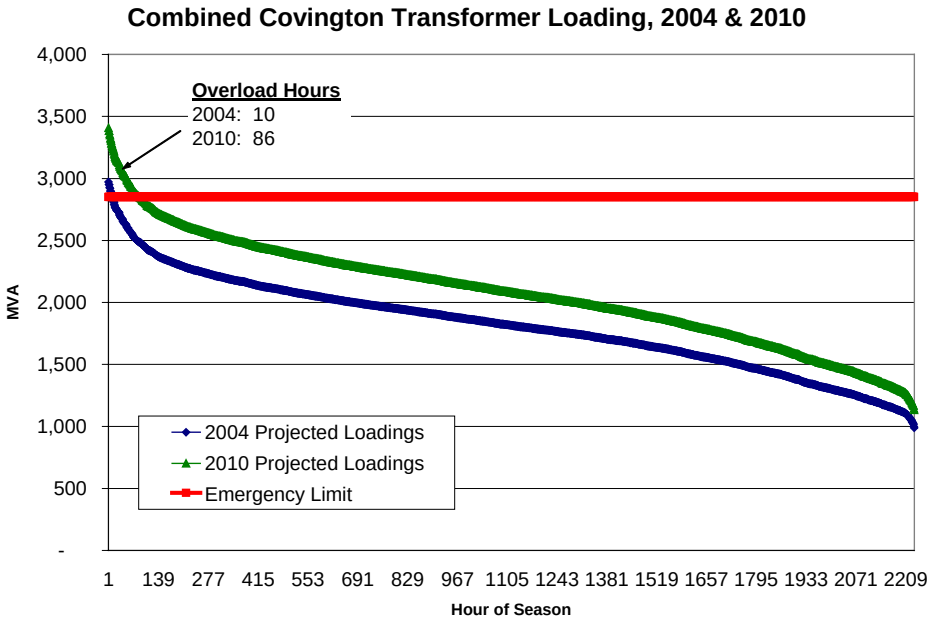


Figure 9 and Figure 10 present another view of the projected overloads. These figures depict a vertical view of a three-dimensional surface in which the horizontal axis is days of the year, from the 1990-91 season,[14] the vertical axis is hours of the day, and the Covington transformer loadings are indicated by the color on the figure. In these figures, the red area represents overload conditions (transformer bank loadings above 2,850 MVA) and the orange area represents hours of concern (loadings between 2,350 and 2,850 MVA). The 2004 overloads occur only during the December 19-23 period that featured the 1990 'Arctic Express' event. There are only scattered periods in which loadings creep over 2,350 MVA. By 2010, the period in which post-contingency loadings exceeds 2350 MW encompasses nearly all the daytime hours from mid-December to mid-January. The mid-December overloads have extended to a week, and overloads appear during several other morning and evening peak periods.

[14] For illustrative purposes, the ordered hours from the load curve constructed by the team are collated with the hours from 1990-91, so that the highest load hour from the constructed curve occurs on the same day and hour as the highest load hour from the 1990-91 season, the second-highest load hour occurs on the same day and hour as the second-highest load from 1990-91, etc. Thus, the overloads can be shown occurring in their natural pattern, i.e., in an extreme cold weather event that lasts for several days. Whether such an event will occur in December, January or February, of course, cannot be known in advance.

Figure 9: 2004 Covington Transformer Bank Loadings by Day and Hour

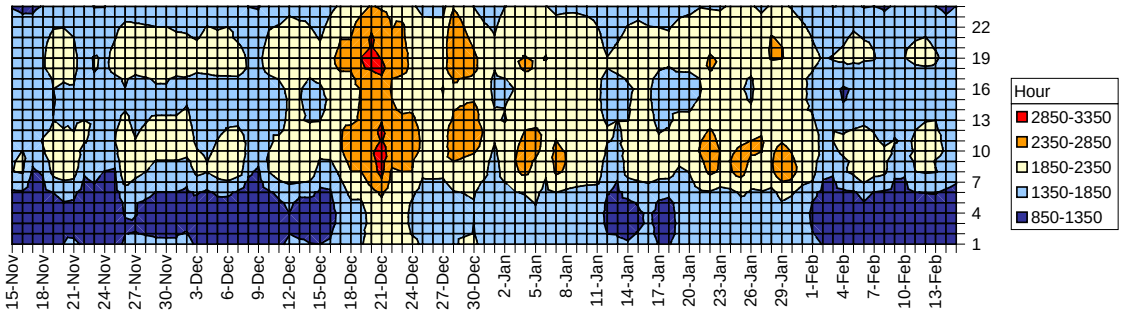
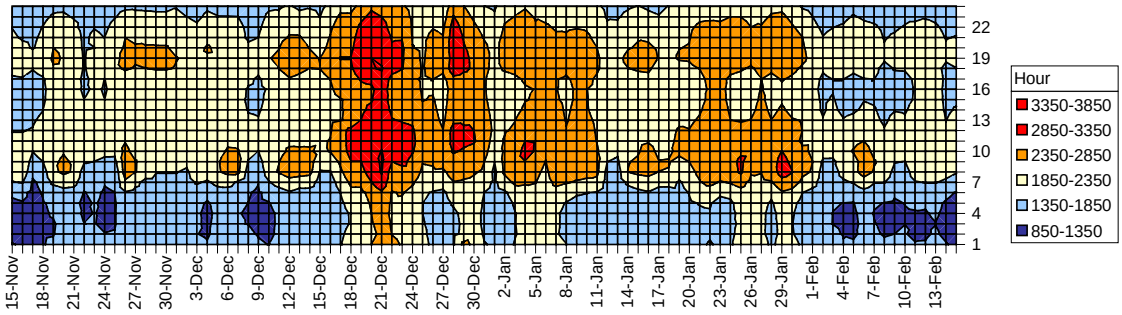


Figure 10: 2010 Covington Transformer Bank Loadings by Day and Hour

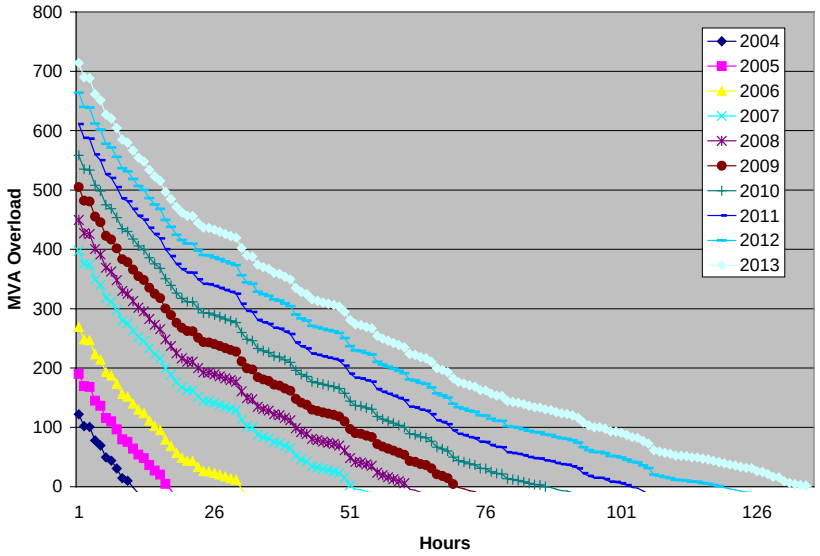


The maximum capacity targets, and the number of hours in which capacity is needed, are presented in the following table. Table 9 shows the projected overloads in 2004 and 2010 by hour of the day. In 2004, overloads occur variably during the 6 AM to 10 PM peak period. As expected, more overloads occur during the late morning and early evening periods. By 2010, overloads occur on 11 days during the 10 AM hour and 9 days during the 6 PM hour.

Table 9: Projected Transformer Bank Overloads by Hour of Day, 2004 and 2010

Hour of Day	2004	2010
12:00 – 5:59 AM	0	0
6:00 – 6:59 AM	0	1
7:00 – 7:59 AM	1	5
8:00 – 8:59 AM	1	6
9:00 – 9:59 AM	1	10
10:00 – 10:59 AM	1	11
11:00 – 11:59 AM	1	9
12:00 – 12:59 PM	0	4
1:00 – 1:59 PM	0	2
2:00 – 2:59 PM	0	1
3:00 – 3:59 PM	0	1
4:00 – 4:59 PM	0	3
5:00 – 5:59 PM	2	7
6:00 – 6:59 PM	1	9
7:00 – 7:59 PM	1	7
8:00 – 8:59 PM	1	4
9:00 – 9:59 PM	0	4
10:00 – 10:59 PM	0	2
11:00 – 11:59 PM	0	0
Total Overload Hours	*10*	*86*

Figure 11: Transmission Alternative Targets, 2004-2013



4.3 Other Factors Affecting Projected Overloads

The potential for deferral of the KEL line is driven by the forecasted need to meet system overloads. However, the factors that determine the overall load in the Puget Sound Area have elements of uncertainty and variation. Factors that have an effect on area load estimates and, thus potential alternatives to KEL line construction include the Canadian Entitlement return and the sensitivity to the adjustments made for weather. The relevant issues around these factors are described below.

4.3.1 Canadian Entitlement Return

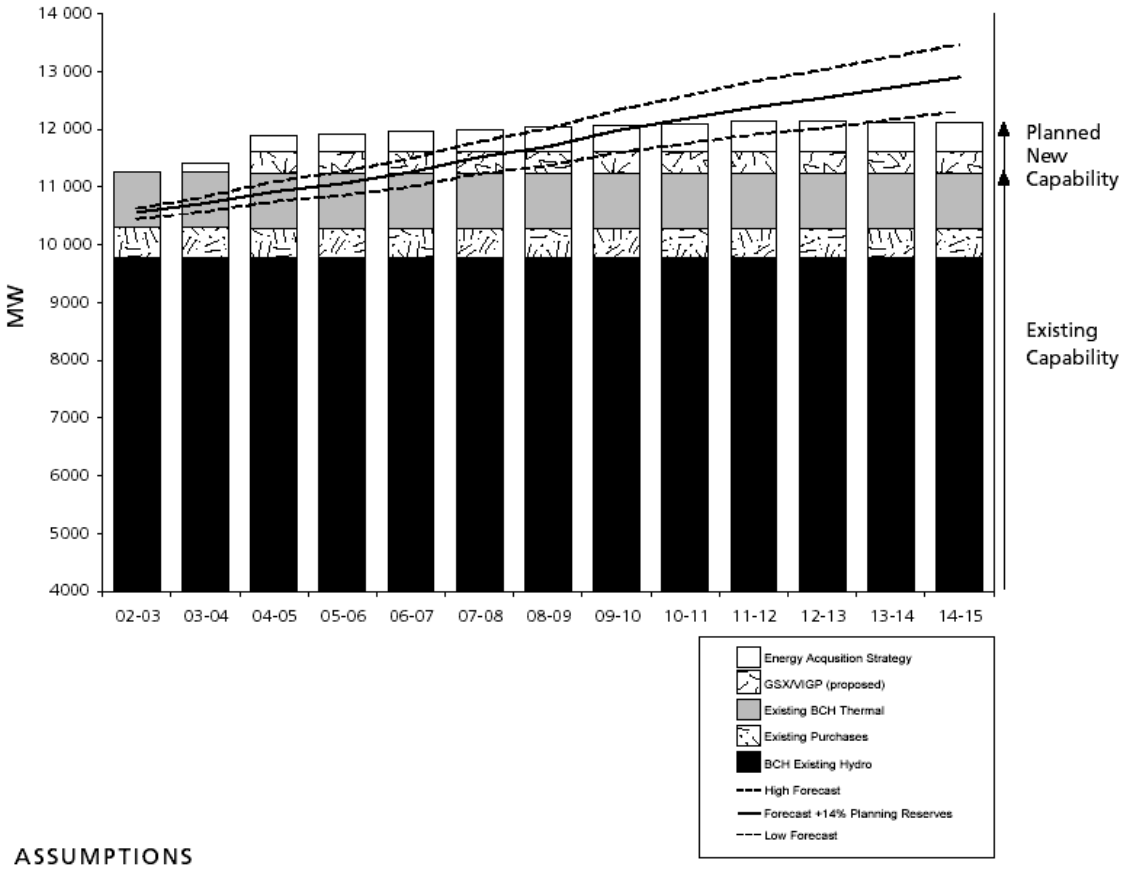
The return of the Canadian Entitlement comprises approximately 7.5% of the total projected loading on the Covington transformer banks in 2004, rising to 10% in 2007. While the Canadian Entitlement is clearly a significant contributor to the need for the KEL transmission line, Puget Sound area load growth would require new transmission by 2006 even without the Entitlement.

Canadian Entitlement power is delivered to the British Columbia Hydro and Power Authority (BC Hydro). BC Hydro is a Crown Corporation acting as the agent of the government of Canada in implementing the terms of the Columbia River Treaty, much as BPA acts as the agent for the United States. Under the original terms of the treaty, Entitlement power was to be returned to Canada at the border near Oliver, in the Okanogan Valley. As BPA and BC Hydro negotiated the implementation of the Entitlement in the late 1990s, an agreement was reached instead to deliver the power to Canada over the existing 500 kV system in Puget Sound area and the existing 230 kV system near Boundary Dam in eastern Washington.

BPA treats power deliveries to Canada under the terms of the treaty as a firm transmission obligation, just as it does deliveries to loads in the United States. Like U.S. utilities, BC Hydro relies on the firm power and transmission capacity that BPA is providing to meet peak loads on its own system.

While BC Hydro may request the power to be delivered elsewhere in the United States, the power is generally being used to serve load on BC Hydro's system during winter peaks. BC Hydro is currently very close to supply-demand balance. At expected rates of growth, BC Hydro will need new resources beyond existing generation and purchases by 2006. Figure 12 portrays BC Hydro's projected supply-demand balance through 2014.

Figure 12: Demand and Supply Balance for BC Hydro



(Source: BC Hydro's 2002 Annual Report)

4.3.2 Weather Sensitivities

As described above, utilities provide BPA with "average" winter peak loads, i.e., peak loads that would be expected in an average weather year. BPA then adjusts these loads upward to reflect a 1-in-20 year 'Arctic Express' weather event, using adjustment factors either provided by the utilities or based on a study done by Battelle for BPA. The adjustment factor is different for each utility, depending on the types of loads in each utility's service territory, and changes with the composition of loads during the forecast period. The adjustment factor averages approximately 17%.

In order to determine how sensitive the need for the project is to this parameter, the team calculated the maximum weather sensitivity factor that would avoid an overload during each year of the forecast period. The results are presented in Table 10.

Table 10: Maximum Weather Adjustment Factors to Avoid Overload

	2004	2005	2006	2007	2008	2009
Average Year Load	2,582	2,626	2,681	2,791	2,825	2,861
Rating	2,850	2,850	2,850	2,850	2,850	2,850
Maximum Adjustment	10.4%	8.5%	6.3%	2.1%	0.9%	-0.4%

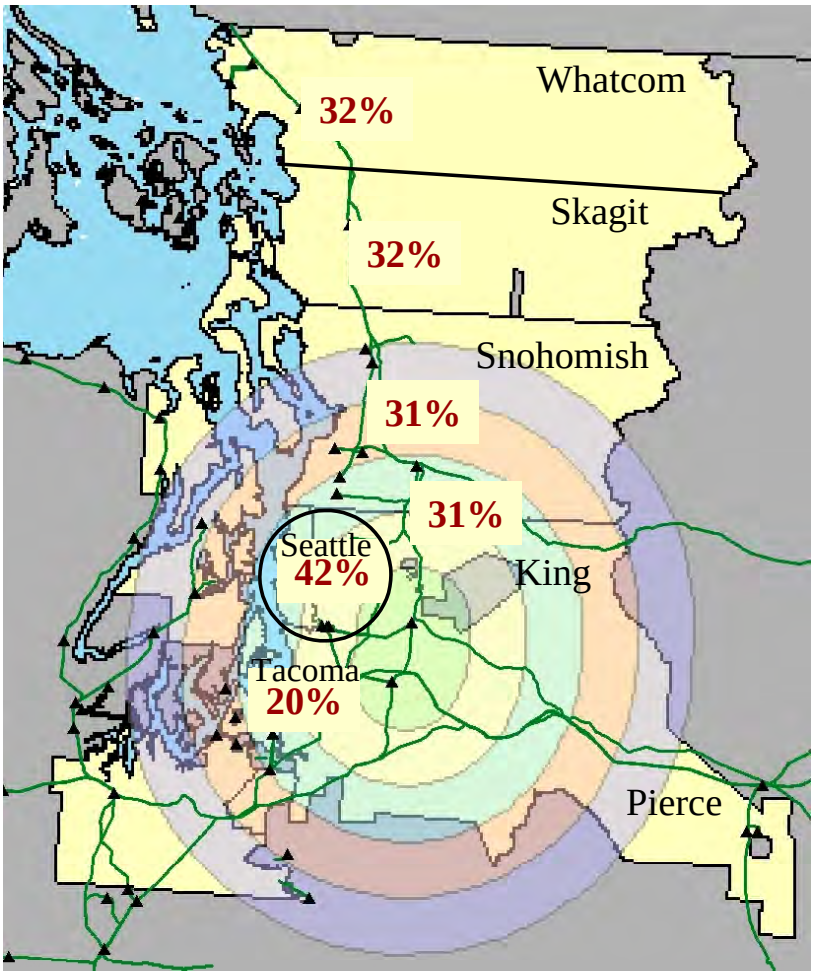
In 2004, a cold weather adjustment factor of 10.4%, instead of 17.3%, would result in a loading of 2850 MVA at the Covington substation. By 2007, the maximum weather adjustment is only 2.1%. While the cold weather adjustment does help drive the need for the line in the early years, in the long run the line is needed to serve peak loads even during an average winter.

4.4 Puget Sound Area Transmission Network

The load forecasts described in this section represent total load in the Puget Sound area, from Tacoma in the south to the Canadian border in the north. However, load reduction at different locations will have a different effect on Covington transformer loadings due to network power flow interactions. For example, the 230 kV Covington-Duwamish line connects the Covington substation directly with the heavy industrial area south of downtown Seattle. A 100 MW load change in this area changes loadings on the Covington transformers by 42 MW. Load changes in other areas have a lesser effect. This means that the effectiveness of any load reduction or distributed generation program will vary by location. Figure 13 shows the area and the load-flow distribution factors for load reduction in different parts of the Puget Sound Area.

The factors measure the effect of a change in *net* load on the Covington transformers. This means that they apply equally to both changes in generation and load. Adding generation in the Seattle load center by 100 MW would have the same effect on the transformer loading (reducing it by 42 MW) as reducing the load by 100 MW.

Figure 13: Map of the Study Area and Load-Flow Distribution Factors



Section 5. Alternatives to Transmission Expansion

A broad range of alternatives was included in the economic screen: Demand-Side Management (DSM); Distributed Generation (DG); large scale Generation (G); and Demand Response (DR). We give an overview of the measures and technologies in the following sub-sections, details about specific measures can be found in the Appendices.

5.1 Overview of the Types of Demand Response (DR) Programs

DR programs are a potential source of load reduction that could be exercised during an 'Arctic Express' event to prevent overloads on the Covington transformers. These options include Direct Load Control (DLC), interruptible / curtailable (non-firm) rates, and demand bidding (i.e. the Demand Exchange) to reduce loads when needed during system peaks. These types of solutions are an effective approach to achieve load reductions because they directly address the capacity nature of the problem.

DR programs can be categorized into two major types: 1) Price-based dispatch programs that offer customers incentives to voluntarily curtail load during the peak; and 2) Pre-arranged contracts with customers (such as interruptible / curtailable rates or direct load control) that would require a customer to reduce loads during the system peak for a fixed price at BPA's request. These programs differ in their implementation and potential for providing load relief as discussed below. In this analysis we evaluate both 'price-based dispatch' and 'interruptible/curtailable' for their capability to provide the needed capacity to BPA.

5.1.1 Price-Based Dispatch

Price-based dispatch programs are voluntary programs in which the price for curtailment or interruption is determined through a price convergence mechanism (i.e. auction, bidding system, etc.) between load serving entities and customers. Customers can choose the point at which the price available to them is high enough to offset their productivity losses from reducing or shutting-off their load. If the price offered by the load serving entity is high enough, then sufficient load reduction can in, all probability, be purchased at that price. While price-based dispatch programs result in a particularly efficient process of load reduction they do not provide firm or guaranteed reductions in system load when needed.

It is particularly important with regard to the KEL project to factor in the probability of achieving load reduction during 'Arctic Express' conditions. For example, during an extreme weather condition, it is unlikely that residential, commercial, and retail customers would curtail their heating load. Additionally, because there is no guarantee that the customer will reduce load, BPA-TBL cannot be certain that their demand reduction targets, required for reliability, will be met through a price-based dispatch program. More experience with these types of program in achieving peak load relief in a targeted area may reduce this uncertainty.

The curtailment period can be specified for any appropriate period of time, e.g. real-time, day-ahead when curtailment is required. These are flexible, market-based programs that allow for efficient load reduction during peak periods, emergencies, or when costs are highest for the load serving entities.

Price-based dispatch programs have low utility transaction costs once the initial program implementation is completed. A large number of customers can participate because the marginal cost of including additional customers is also low. Additionally, the higher the penetration throughout the customer base, the more likely the load serving entity would be able to operate an efficient market that matched customer participation with available incentive payments, thereby targeting the programs so as to achieve highest participation.

5.1.2 Interruptible / Curtailable and Demand Response Contracts

Interruptible / curtailable contracts differ from the price-based dispatch programs because the terms (i.e., number of times/year the customer can be curtailed, maximum hours per interruption, and notification period for interruption) and the price (fixed component) are pre-determined and bound with an enforceable contract. By securing a contract for the load reduction, the available peak load relief is more certain for planning purposes. This type of program is better suited for the type of system conditions driving the need for the KEL transmission line, where extreme but infrequent weather conditions result in high levels of load relief required over relatively few hours of the year.

As with the price-based dispatch programs, the curtailment period varies with the contract. Also, the notification time frame for curtailment or service interruption is variable. The price paid for interruption or curtailment is typically higher when there is less notification time prior to load reduction or interruption. The notification period and other contract terms can be tailored to the needs of both the load serving entity and the customer for reducing load. The transaction costs for these contracts are higher than the price-based dispatch contracts and thus these contracts are better applied to customers with larger loads.

For our analysis we consider contracts of existing generators to generate during the 'Arctic Express' as a form of demand response. These are contracts with owners of existing generators to call on them to dispatch during hours requiring peak load relief. Similar to other interruptible/curtailable contracts, the contract terms will specify the number of hours and frequency that the generator can be called on as well as the price.

5.2 Overview of Demand-Side Management Measures

DSM measures are typically considered energy efficiency measures rather than peak shaving programs. However, certain measures such as heating efficiency and weatherization will reduce heating loads and have an impact on peak demand reduction so we have included them in the economic screen. We used DSM cost and performance measures from the Northwest Power Planning Council (NWPPC) Database (http://www.nwppc.org/comments/default.asp). The analysis calculated the benefit/cost ratio of each measure with the inclusion of the specific avoided costs associated with the KEL line. Although the focus for the DSM screening was to find winter peak shaving programs, all DSM measures available from the NWPPC database were screened. In Table 11 we summarize the number of DSM measures by sector (residential, commercial, etc.) and end-use (heating, lighting, appliances, etc.). In total we screened 1533 measures from the NWPPC database.

Table 11: Summary of DSM Measures

End Use	Residential	Commercial	Industrial	Other	TOTAL
Heating	108 (plus 16 AC Measures)	2			126
Envelope	23	8			31
Lighting	21	652			673
Water Heating	16				16
Appliances	7	4			11
Exit Signs		7			7
Motors			657		657
Traffic Signals				10	10
Vending Machines				2	2
TOTAL	191	673	657	12	1,533

5.3 Overview of Generation and Distributed Generation

There are a variety of generation options that could help to defer the KEL transmission line, including both existing and new generation. In the course of this study we identified 277MW of additional capacity that could potentially be available from existing generators in the Puget Sound area.[15] An additional 270MWs of capacity are currently under construction. Together, these plants could provide up to 170MW of relief at the Covington substation. Another 2,700MW of capacity are either permitted or planned, although it is uncertain how much, if any, of this capacity will eventually be constructed.

In order to be successful in deferring the need for the project, a generator would have to be available to operate during the heavy load hours when an outage would cause an overload on the Covington transformer banks. The contractual disposition of the power supply is irrelevant; the generator need only be operating and feeding power into the grid in order to reduce the power flow across the transformer banks. However, BPA would need to be able to rely on the generator being able to provide the energy whenever required. Because the potential consequences for failing to deliver could be a widespread blackout in the Puget Sound area, BPA would need a fairly ironclad guarantee that the generator would be ready when called upon.

5.3.1 Existing Generation

BPA makes assumptions about the disposition of existing generators when it conducts its studies of the power flows across critical transmission system elements. BPA generally assumes that all generators in the Puget Sound area would be running in order to meet the extremely heavy loads during an Arctic Express event. However, this analysis uncovered approximately 390MW of

[15] Most of the generation capacity numbers in this section came from the Northwest Power Planning Council databases available at http://www.nwcouncil.org/energy/powersupply/Default.htm. These include the *Existing Generating Projects* and *Generating Project Development Activity* databases, which were last updated on 6/18/02.

capacity at several generating stations in the area that is not running for BPA's load flow studies. This capacity could potentially be called upon by BPA during the target hours.

Plants that are not running at full capacity for BPA's studies include Ross Dam, a hydroelectric project owned by Seattle City Light; Pierce Power, a gas-fired peaker owned by TransAlta, and a number of smaller gas turbines that were installed in 2001 during the height of the electricity crisis. A complete list of these facilities is presented below in Table 12.

Table 12: Existing and Potential Large Generators in the Puget Sound Area

Project	Location	Type	Available Capacity (Local MW)*	Effective MW at Covington
In service			*277*	*70*
Pierce Power	Frederickson	Gas turbine	154	31
Ross Dam**	Skagit River	Hydroelectric	109	46
BP Cherry Point GTs	Blaine	Gas turbine	73	23
Equilon GTs	Anacortes	Gas turbine	39	12
Georgia-Pacific GT	Bellingham	Gas turbine	11	4
Construction (Phase 1)			*268*	*56*
Frederickson Power 1	Frederickson	Combined-cycle	249	50
Tesoro (Permanent ICs)	Anacortes	Reciprocating engine	19	6
Permitted (Phase 2)			*1,156*	*365*
Sumas Energy 2	Sumas	Combined-cycle	660	211
Everett Delta I	Everett	Combined-cycle	248	77
Everett Delta II	Everett	Combined-cycle	248	77
Potential (Phase 3)			*1,643*	*460*
BP Cherry Point Cogen.	Blaine	Cogeneration	720	230
U.S. Electric Cherry Point	Blaine	Coal–Steam	349	112
Frederickson Power 2	Frederickson	Combined-cycle	280	56
Tahoma Energy Center	Frederickson	Combined-cycle	270	54
Cedar Hills	Cedar Hills Landfill	Landfill Gas	24	7
Maximum Available Puget Sound Area Generation			***3,344***	***950***

* Includes only capacity that is not already assumed to be operating in BPA's load flow studies.
** Ross Dam is unlikely to be available during a multi-day Arctic Express event.

There is no certainty that these plants are actually available to be dispatched during the target hours. Ross Dam has environmental or water availability constraints that prevent a sustained dispatch above the level assumed by BPA. The smaller gas turbines that were installed during the electricity crisis may have been retired in the months since wholesale electricity prices receded to

historic levels. Still, these facilities represent a potential resource that could be investigated for their ability to serve as a transmission alternative.

If the generators are available, BPA could contract with the facility owners to provide capacity during the target hours. This option might be relatively inexpensive, as the generators would already have a strong incentive to operate because wholesale energy prices are likely to be high during an Arctic Express event.

5.3.2 New Large-Scale Generation

In addition to the existing facilities, a number of new, large power plants have been proposed for the Puget Sound area since the late 1990s. Nearly all of these plants would be large natural gas-fired, combined-cycle combustion turbine plants. Together, these plants would add approximately 3,000MW of generating capacity. Of course, many if not most of these projects will never be built. Still, even one of the larger projects could significantly reduce the need for the KEL Transmission Project.

Two projects are already under construction in the Puget Sound area: Frederickson Power 1, a 249MW combined cycle combustion turbine facility in Pierce County, and 19MW of natural gas-fired reciprocating engines under construction at the Tesoro refinery in Anacortes. If both of these plants come on line, they could provide approximately 50MW of loading relief at Covington. If these projects are on line before the winter of 2004, BPA might be able to obtain a commitment to operate during the target hours for a minimal cost.

Plants that already have all of the necessary permits but have not yet begun construction include the 660MW Sumas Energy 2 project in Whatcom County and the two 248MW Everett Delta projects. These projects could provide 450MW of relief at Covington. Projects that are either in the permitting process or are planned could provide an additional 1,000MW of relief.

The disposition of these plants is much more speculative. The analysis undertaken for this high-level screening project indicates that new power plants not already in the construction stage are not economic at this time. However, this conclusion is heavily influenced by the assumptions and methodologies used to forecast electricity and natural gas prices. The forecasts indicate that, for the next few years, the revenue available from the wholesale electricity market is insufficient to recover both the fixed and variable costs of a natural gas-fired, combined-cycle combustion turbine power plant. By 2006, electricity prices are forecast to rise to a level that would support the development of new power plants.

Because new plants are uneconomic on their own, they would probably need incentive payments from BPA in order to be available before the latter half of the decade. As a consequence, this option is likely to be more expensive than contracting with existing facilities to provide capacity during the next few years. Under the assumptions used for this analysis, the incentive needed for the 2003-2005 period would be approximately $25 per kW, or $12.5 million for a 500MW plant.

5.3.3 Regional Availability of Natural Gas

One issue that arose during the course of this study is the availability of natural gas, and the ability of the region's natural gas system to deliver the gas to all of the existing and new natural gas-fired generators in the Puget Sound area. As generating capacity would be needed by BPA during the highest loads of an Arctic Express event, this time period would almost certainly experience extremely high coincident demand for natural gas. Like electricity transmission, the

natural gas delivery system has a fixed peak delivery capacity; once the limits of the system are reached, there is very little that can be done on short notice to increase deliveries. BPA relies on gas-fired generators to operate in order to avoid a Puget Sound-area blackout during an Arctic Express event. Therefore, the relevant question is: How can BPA be sure that the generators will be able to obtain fuel supplies?

A comprehensive answer to this question would require analysis of: the physical delivery capability of the interstate pipeline system, including the likely direction of flows on the bi-directional Northwest Pipeline (which is highly sensitive to price differences between the Canadian and Rocky Mountain producing regions); the take away delivery capability of distribution systems operated by local natural gas utilities, for a number of potential distributed generation sites; existing claims on such capacity, including the extent to which industrial sector demand is interruptible; and the availability of capacity at underground storage facilities, among other things. This analysis would need to be dynamic, incorporating likely and possible changes to the existing infrastructure, such as the Northwest Pipeline's Evergreen Expansion project, expected to be complete by November 2003. Such an analysis is beyond the scope of this report.

Nevertheless, the natural gas system has in place mechanisms for managing gas use during times of peak demand. For example, many large industrial customers, including some electric generators, have the ability to switch to diesel fuel. These customers typically take interruptible service, freeing up delivery capacity for firm customers during system peaks. For dual-fuel generators, natural gas supplies should not be an issue as long as the generators have the ability to obtain sufficient supplies of distillate oil in the event that gas service is curtailed. For single fuel generators, BPA might be able to obtain the certainty it needs by requiring generators to demonstrate that they have access to firm supplies of natural gas. If there were any question that the existing mechanisms would be unable to sufficiently ration access to natural gas, such that curtailment of firm customers became necessary, BPA might be able to work with the pipeline operators and local distribution companies to avoid curtailing the generators due to the importance of that generating capacity to the stability of the electricity grid.

While such an approach might not give BPA 100% certainty, less that 100% certainty is the reality for all elements that feed into the projected need for the KEL project, including the accuracy of utility load growth forecasts, the appropriateness of the weather adjustments, assumptions about utility-owned generation being online, etc. Whether generators would be able to obtain firm gas supplies with the incentive level BPA can offer might not be known until the implementation phase.

5.3.4 Existing Distributed Generation

In addition to the existing large generation discussed above, there are also small-scale distributed generators in the Puget Sound region. According to BPA's estimates, existing idle DG at local industrial sites, banks, hospitals etc., amounts to approximately 60MW in the region. This translates to less than 20MW available at Covington after applying the appropriate load flow factors. This idle capacity could potentially be called upon by BPA during the target hours. However, because of the low levels of available capacity from these generators, we excluded them from further analysis in this high-level economic screen.

5.3.5 New Distributed Generation

Small-scale, distributed generation can often serve as a substitute for investment in transmission or distribution circuit. However, in this case, the potential overload is sufficiently large and the

load area sufficiently diverse such that distributed generation does not appear to be a viable alternative given the available dollars from deferring the KEL.

The distributed generation technologies that were considered in this analysis are listed in Table 13, below. The extremely low capacity factors at which these units are projected to operate make them uneconomic if considered solely as a transmission alternative. However, some of the technologies, particularly behind-the-meter technologies such as diesel generators, reciprocating engines, or small gas turbines, might provide additional benefits such as backup power to their owners, defraying some of the costs of the units. In addition, the project owners might be able to sell the energy to their local utilities or into the wholesale power market. However, it is unlikely that sufficient capacity could be built with the relative low incentive that BPA can offer.

Table 13: Generation Technologies Considered for High-Level Screening

	Combined Cycle Combustion Turbine	Simple Cycle Combustion Turbine	Cummins ORU Genset	Generic Diesel Engine	Gas Spark Ignition	Low Temp (PEM) Fuel Cell	High Temp Fuel Cell
Operating Data							
Heat rate	7,618	11,380	8,000	10,000	9,000	9,000	7,000
Lifetime (yrs)	25	25	25	25	25	25	25
Fuel	Gas	Gas	Diesel	Diesel	Gas	Gas	Gas
Avg. Fuel Cost	$3.90	$3.90	$6.09	$6.09	$3.90	$3.90	$3.90
Capacity Factor	90%	10%	10%	10%	10%	90%	90%
Smallest (kW)	50,000	500	1,000	500	300	1	1
Largest (kW)	750,000	50,000	5,000	10,000	5,000	250	250
Plant Costs							
Initial Cost ($/kW)	$523.06	$369.90	$558.32	$550.00	$550.00	$3,000.00	$4,000.00
Total Fixed Annual	$23.23	$11.14	$16.69	$16.61	$16.61	$16.61	$16.61
Fixed O&M ($/kW-yr.)	$18.00	$7.44	$11.11	$11.11	$11.11	$11.11	$11.11
Property Tax ($/kW-yr.)	$5.23	$3.70	$5.58	$5.50	$5.50	$30.00	$40.00
Variable O&M ($/MWh)	$0.60	$0.12	$3.50	$20.00	$15.00	$15.00	$10.00

5.3.6 Renewable Generation and Emerging Technologies

Renewable generation such as wind and solar were not considered for this study, because their resource characteristics are a poor match for BPA's needs to defer the KEL project. Wind energy was excluded because the Puget Sound Area is not home to a commercial-grade wind resource. Solar was excluded because the critical hours occur during the winter months when solar radiation is scarce, and many of the target hours occur during the evening. Fuel cells do not suffer from these disadvantages, and were considered for the high-level screen. However, their extremely high cost makes them unattractive as a substitute for the KEL project.

Section 6. Base Case Economic Screening Analysis

In the first stage of the economic screen we use base-case input assumptions for the cost-effectiveness tests of non-wires options. In this base case analysis we include assumptions about:

1. Fuel price forecasts
2. Operations and maintenance costs
3. Inflation, discount, and financing rates
4. Utility rates and average customer costs by customer
5. Environmental externality costs
6. Load reduction requirements
7. KEL revenue requirement (all-in-cost of the KEL transmission line)
8. Transmission avoided costs
9. Avoided line loss savings
10. Electricity market prices

Items one through five are considered fixed input assumptions, but later in Section 7 we look at alternative scenarios for items six through ten to test the sensitivity of the cost-effectiveness results to these highly variable inputs.

6.1 Fixed Input Assumptions

6.1.1 Natural Gas and Distillate Oil Price Forecasts

Natural gas and distillate oil prices are inputs to the running costs of DG and other generation resources. These prices are also used in our forecasts of electricity market prices. For the purposes of our analysis we used fuel forecasts from the Northwest Power Planning Council. The Council published draft natural gas and distillate oil price forecasts for its 5th Power Plan in April of 2002.[16] The Council forecasts U.S. wellhead prices through 2025, and then adjusts these prices to reflect the costs of delivering power to end-users. This study uses the Council's forecast of delivered natural gas prices for Westside electricity generators and utility distillate oil prices, adjusted for inflation to 2002 dollars. Fuel price forecasts are shown graphically in Figure 14 and Figure 15 below.

[16] Northwest Power Planning Council, *Draft Fuel Price Forecasts for the 5th Northwest Conservation and Electric Power Plan*, April 25, 2002, p. F-1.

Figure 14: Natural Gas Price Forecast

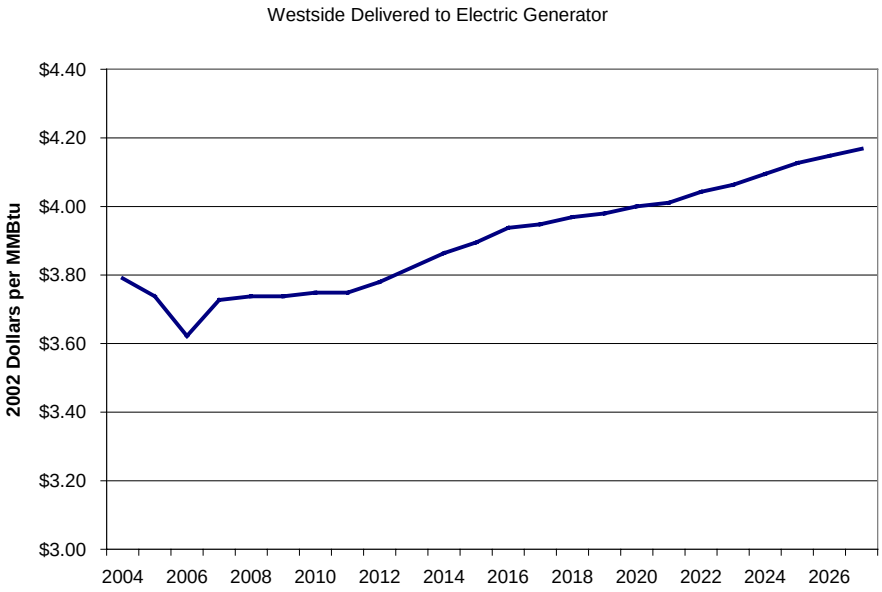
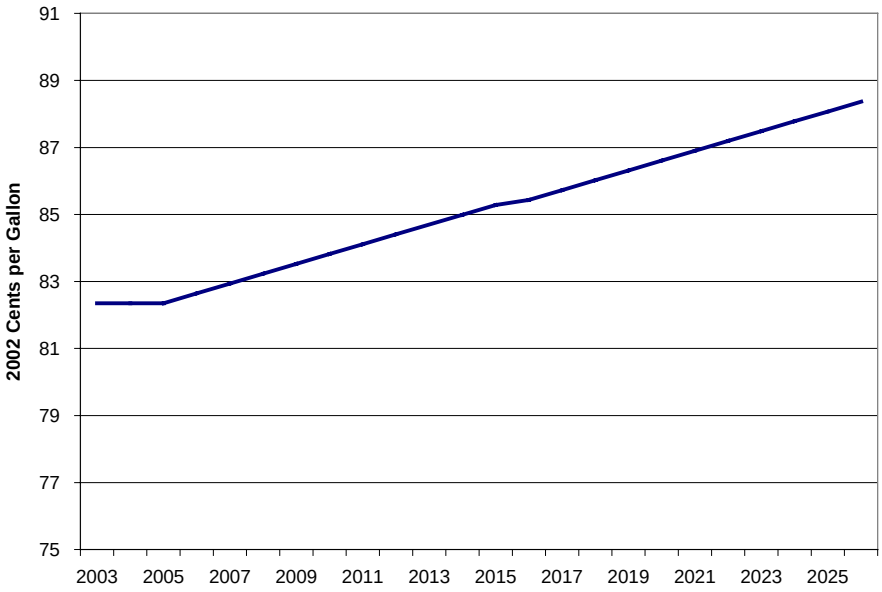


Figure 15: Distillate Oil Price Forecasts



6.1.2 Operations and Maintenance (O&M) Cost Assumptions

For the purposes of this analysis, we applied an O&M cost value of $50,000 per year. This is the annual O&M cost associated with the maintenance of the KEL line if it were built. TBL provided this value based upon expenses for similar projects. While these types of costs can vary significantly for different projects, this value is a comparatively small portion of the overall costs of the construction of the KEL transmission line. Therefore, even though it is important to include this cost in the overall analysis, it is kept constant throughout and the entire amount is added to the maximum annual incentive payment calculated during the avoided cost analysis.

6.1.3 Inflation and Discount Rate

The inflation, discount, and financing rates applied throughout the economic screening analysis were provided by BPA and are shown in Table 14.

Table 14: Discount and Inflation Rate Assumptions

Financial Input	Value
Real Utility Discount Rate (9% nominal, 2.7% inflation)	6.1%
Real Societal Discount Rate	3.0%
Financing Rate for Generators/DG	12.5%

6.1.4 Utility Rates and Average Customer Costs by Customer Type

For the purposes of the economic screening analysis, we used average rates for the three major customer classes: residential, commercial, and industrial. While average rates do not exactly match the rates in each distribution utility's territory, they do provide a reasonable approximation for a screening study. A more detailed program design (for implementing a cost-effective program) would use the utility-specific rates. Table 15 outlines the average $/ kWh rates for the four local distribution utilities included in the analysis. The rates used in the screening analysis (column two) are intended to be representative of current posted rate schedules and are not intended to accurately reflect billing rates for particular customers.

Table 15: Average per kWh rates for Local Distribution Utilities

	Average Used in Screen	Tacoma Power	Seattle City Light	Snohomish	Puget Sound Energy
Residential	$0.065/kWh	$0.06	$0.06	$0.08	$0.07
Commercial	$0.055/kWh	$0.03	$0.05	$0.07	$0.06
Industrial (Contract)	$0.050/kWh	$0.02	$0.05	$0.05	$0.04
Distribution Utility Distribution Rate	$0.030/kWh				
Transmission Average Rate	$2.56/kW-month				

6.1.5 Environmental Effects

Throughout the economic analysis, only tangible financial impacts that are applicable to each measure are included in the benefit-cost model. An estimation of tangible financial impacts for environmental externality effects is not readily available for this region. However, many of the alternatives we analyzed have positive environmental effects for each measure within the Societal Cost Test perspective. Consequently, to reflect the environmental benefits of the measures tested, we used the Regional Technical Forum's (RTF) recommended environmental monetary estimate of $15/ton of carbon dioxide emissions.[17] This estimate stems from the conclusion by the RTF that there exists "a risk that serious damage will result from continued increases in greenhouse gas concentrations in the atmosphere." Thus, the monetary value of $15/ton of carbon dioxide represents the reduction in this risk.

The environmental externality value is only used during the calculation of the Societal Cost Test and is not applied to any other Cost Test perspectives in the economic analysis.

6.2 Base Case Assumptions for Variable Inputs

6.2.1 Load Reduction Requirement

The base case for the required load reduction is taken from the forecast compiled by TBL and the project team's load duration curve estimation as described in Section 4. Our analysis indicates a deficiency of 122MW during the winter of 2003 / 2004. In Table 16 we show the maximum overload and number of overload hours per year for the years 2004 through 2013.

Table 16: Projected Covington Transformer Bank Overloads, 2004-2013

Year	Maximum Overload (MW)	Number of Hours Overload Occurs
2004	122	10
2005	190	17
2006	269	30
2007	397	51
2008	449	61
2009	505	70
2010	558	86
2011	611	102
2012	664	119
2013	714	135

[17] "The Regional Technical Forum's Recommendations to the Bonneville Power Administration Regarding Conservation and Renewable Resources Eligible for the Conservation and Renewable Resources Rate Discount and Related Matters" Regional Technical Forum, September 1, 2000, pp. 27-28.

6.2.2 KEL Revenue Requirement (Cost of Line)

We assume a base case revenue requirement of $25 million for the line including construction, mitigation and other costs, plus O&M costs of $50,000/year.

6.2.3 Transmission Avoided Costs

In Table 17 we show the base case transmission avoided costs as calculated in the methodology section. These avoided costs include the increased O&M costs once the new line is built. For example, if the KEL line is deferred for 3 years, the transmission avoided costs would be $5.70 per kW of load reduction at Covington substation. Transmission avoided costs are used to set the maximum incentive levels in the economic analysis.

Table 17: Net Transmission Avoided Costs

Years of Deferral	3	5	10
Net T Avoided Cost ($/kW-year)	$ 5.70	$ 3.50	$ 2.33

6.2.4 Avoided Line Loss Savings

Table 18 provides the avoided line loss savings if the KEL line is deferred for 3, 5, and 10 years. If the KEL line is deferred, the line loss savings that could be achieved if the new line is built would also be delayed. For example, if the line is deferred for 3 years, each kW of load reduction costs $7.34/kW-year in avoided savings.

Table 18: Base Case Avoided Loss Factors

Years of Deferral	3 Years	5 Years	10 Years
Avoided Loss Factor ($/kW-year)	$ 7.34	$ 4.51	$ 2.99

6.2.5 Electricity Price Forecasts

The team developed a methodology to forecast future electricity market prices using data from Platts' *Electricity Daily*, assumptions about the long-run marginal cost of a new combined-cycle, combustion turbine power plant, and the Northwest Power Planning Council's draft natural gas price forecasts.

Electricity Daily reports prices for "Forward Assessments" for each calendar year through 2005 for various locations, including Mid-Columbia. These quotes reflect the expected price of a flat block of power delivered daily to Mid-Columbia over the course of a year. As of September 16, 2002, the Mid-Columbia Forward Assessments were $38 for calendar year 2003, $39 for 2004, and $40 for 2005. These prices are for delivery to Mid-Columbia. Ideally, an adjustment would be applied to reflect the different, presumably higher, value of energy on the west side of the Cascades due to transmission system congestion. However, in the absence of meaningful congestion price data, no such adjustment is possible.

For 2006 and beyond, the market price of electricity is assumed to be equal to the fully allocated cost of a natural gas-fired, combined-cycle, combustion turbine power plant. This cost is based on the generation cost data developed by E3 for this study. The fully allocated capital cost of

such a plant is calculated to be $10.90 per MWh. This cost stays constant throughout the forecast period. The plant operating cost varies from $29 in the early years to $32 per MWh toward the end of the forecast, based on rising natural gas prices in the NWPC forecast. Using this approach, the team developed a base case market price forecast for electricity averaging $40.03 per MWh through 2027.

The base case forecast is consistent with a scenario in which reduced load due to the 2000-2001 western energy crisis leads to a surplus of electricity on the wholesale market in the short-term. As loads recover, the surplus shrinks and prices begin to rise until they reach the level at which it becomes economic to build new power plants. By 2006, when loads have recovered fully, the region is in resource balance and prices reach equilibrium at the cost of a natural gas-fired power plant. This methodology assumes that long-term prices above this level will lead to the construction of new plants, driving prices down, while prices below this level would lead to the retirement of existing plants that are uneconomic, driving prices up. Of course, actual market prices could be either higher or lower than this benchmark in any given year, and are likely to be quite volatile. These situations are addressed in the sensitivity analysis described in Section 7.

6.3 Results from Technologies/Measures Analyzed

With the base case assumptions, we find that there are no alternative measures that are cost-effective from both the TBL RIM perspective and the Participant Cost test. If the Participant Cost Test has a B/C ratio less than one, the participant is worse off from participation in the program versus non-participation. It is difficult to get significant participation for these types of programs. This means that there are no programs that make BPA rates lower relative to construction of the KEL line and leave the participant (either the generation owner, the recipient of the DSM, or participant in a DR program) better off (a win-win situation).

The team also calculated results using cost tests focused on the other stakeholders. These perspectives are important to evaluate as well since they indicate the relative impact on other interested parties such as the distribution utilities, and a broader societal perspective of the alternative relative to the KEL line.

In Table 19 we show the benefit cost ratios for one of each of the DSM, DG, DR, and G alternatives. The alternatives shown were chosen as the measure or technology with the highest B/C ratio from the RIM-BPA/TBL perspective. The relationship of the B/C ratios for the other measures and technologies are similar for each type. Detailed calculation of B/C ratios is included in the appendices.

The DSM measures evaluated are not cost-effective from the BPA TBL/RIM, or Utility Cost Test, but are cost-effective from the Total Resource Cost Test, Societal Cost test, and Participant Cost Test. The poor performance with RIM is typical for efficiency measures. Since the only impact of the measure on TBL rates is the capacity load relief, the costs of efficiency measures are relatively high compared to the benefits. In addition, lost sales are a cost from the RIM perspective and in the case of the KEL line, the transmission rate of $2.56/kW-mo or $10.24/kW-year (assuming 4 heating months) is much higher than the transmission avoided costs of $1.70/kW-year ($5.30 times a load distribution factor of 32%).

We analyzed the distributed generation technologies using an incentive payment equal to the full value of avoided transmission costs. Therefore, from the utility cost test perspective the benefits and costs are equal and there is a BC ratio of 1.0. The additional cost of revenue loss that a behind-the-meter generator will cause makes DG not cost-effective from the TBL BPA RIM

perspective. DG is not cost-effective from the TRC or Societal perspectives due to the relatively higher cost of generating energy with small-scale generation and the energy savings associated with building the KEL line.

For generation (G) technologies, the incentive level was set equal to the transmission avoided cost, resulting in a RIM and Utility Cost Test BC ratio of 1.00. Since there is no revenue loss associated with large-scale generation connected to the BPA transmission system, these cost tests result in the same answer. The participant cost test for the generation owner is very close to 1.0 indicating that a new central station plant would be nearly cost-effective with the base case assumptions. This finding for the merchant plant is very sensitive to the assumptions made in the market price forecast.

The team estimated the BC ratios for a conceptual BPA demand response program with an incentive payment equal to the transmission-avoided costs. At this incentive level, the RIM and Utility Cost Test BC ratio is 1.0. The measure is not cost-effective to the participant because the incentive level is less than the value assumed for the foregone load (Assumed to be $150/MWh) in the base case. The results are very sensitive to this assumption and are described in more detail in Section 7, which describes the sensitivity analysis. Demand response programs are not cost-effective from the TRC and Societal perspectives because the energy savings associated with building the line are greater than the financial benefits of deferring the line.

Table 19: Benefit Cost Ratio of Alternative with the Highest BPA TBL RIM BC Ratio

	DSM	DG	DR	G
Alternative	Single Family Heating	Gas Spark Ignition	BPA (Conceptual)	Combined Cycle Combustion Turbine
RIM-BPA/TBL	0.0004	0.01	1.00	1.00
Utility Cost	0.02	1.00	1.00	1.00
TRC Cost	1.94	0.56	0.56	1.56
Societal Cost	2.40	0.50	0.60	1.10
Participant Cost	2.20	0.56	0.78	0.99
RIM-LDC	0.71	1.03	0.80	Not Effected

(1) Program NWPC Description: Post79/Pre93 Single Family Construction Convert FAF w/o CAC to HP w/PTCS - Heat Pump rated HSPF 8.0 or higher and SEER 12 or higher w PTCS

In Table 20 we show the number of the 1,533 DSM measures that were cost-effective from each of the cost-test perspectives under the base case assumptions. None of the measures were cost-effective from the TBL RIM or Utility Cost Test; however, most were cost-effective from the TRC, Societal, and Participant cost tests.

Table 20: Number of Cost Effective DSM Measures from Each Perspective

	RIM-BPA/TBL	Utility Cost	TRC Cost	Societal Cost	Participant Cost	RIM-LDC	Total # of Measures
DSM	0	0	1034	1179	1523	1	1533

6.4 Summary of DSM Demand and Energy Savings

As part of the economic screening for cost-effective non-wires alternatives to the KEL transmission project, the team explored the penetration potential of cost-effective alternatives as discussed in Section 8. We did not investigate the penetration potential of DSM programs because these measures failed to pass the RIM test from TBL's perspective. However, over two thirds of the 1533 DSM measures examined did pass the TRC test perspective (See Table 20). While a DSM penetration potential analysis is beyond the scope of this project, from our DSM results we estimated the size of the energy efficiency program that would be necessary to achieve the demand reduction that is required to defer the KEL line.

Of the 1,533 DSM measures examined 1,034 passed the TRC cost test under our base case assumptions. From these 1,034 measures, the average coincident system-peak demand saving per program is 0.33 kW, and the average annual kWh saving is 3,933 kWh. So for each kW saving during the system peak period we would expect 11,950 kWh of annual energy savings.[18] If the 381 MW[19] reduction required to defer the KEL line for one year was to be achieved through an average mix of cost-effective DSM programs,[20] we would expect to see a corresponding annual energy reduction of roughly 4,556,000 MWh.

Lastly, if we were to focus the DSM efforts on the ten measures with the lowest kWh/kW ratios (i.e., the measures that provide the highest system peak demand reduction for the least amount of energy sales reduction),[21] for each kW saving we would expect 3,376 kWh of energy savings. With those focused programs, we would see only about 1,287,000 MWh of energy reduction in attaining the 381 MW of required load reduction.

If instead, we were to focus on the ten most cost effective programs (from the TRC perspective) in terms of either $/kWh net benefit or $/kW net benefit, the associated energy savings would be about 4,800,000 MWh per year. This range of 1,287,000 MWh to 4,800,000 MWh of energy reduction provides an indication of the magnitude of the DSM effort that would be required to meet the line deferral requirements. This is summarized in Table 21 below.

Table 21: DSM Program Energy Savings

	System KW Savings	Annual kWh Savings	kWh/kW	Load Reduction Requirement for Year 1 (MW)	Expected Annual MWh Savings
All Programs	0.3291	3,933	11,950	122 MW at Covington or 381 MW within the Puget Sound Area	4,556,115
Top 10 for lowest kWh/kW ratio (1)	1.9771	6,674	3,376		1,287,005
Top 10 for $/kW (2)	4.8442	60,016	12,389		4,723,424
Top 10 for $/kWh (3)	4.8228	61,335	12,718		4,848,650

(1) Residential and small commercial heating programs
(2) Industrial efficient motors plus one residential heating measure

[18] This comparison is made based on system peak savings to reflect the impact at the Covington substation. The coincident system peak savings will be lower than the customer's peak load savings.
[19] Under the base case assumptions 122 MW of load reduction is required at Covington, which translates to 381 MW within the Puget Sound Area, assuming an average distribution factor of 32%
[20] Cost effective from TRC perspective
[21] These tend to be small commercial and residential heating programs.

(3) Industrial efficient motors

The range of 412,000 MWh to 1,500,000 MWh of required energy reduction is high compared to the level of annual growth in the Puget Sound Area of approximately 1,000,000 MWh.[22] The DSM programs would need to reduce energy each year from half to one and a half times the annual energy growth. Also, DSM efforts would either have to be funded externally to BPA or the additional costs passed through to TBL's ratepayers, because they do not pass TBL's RIM test.

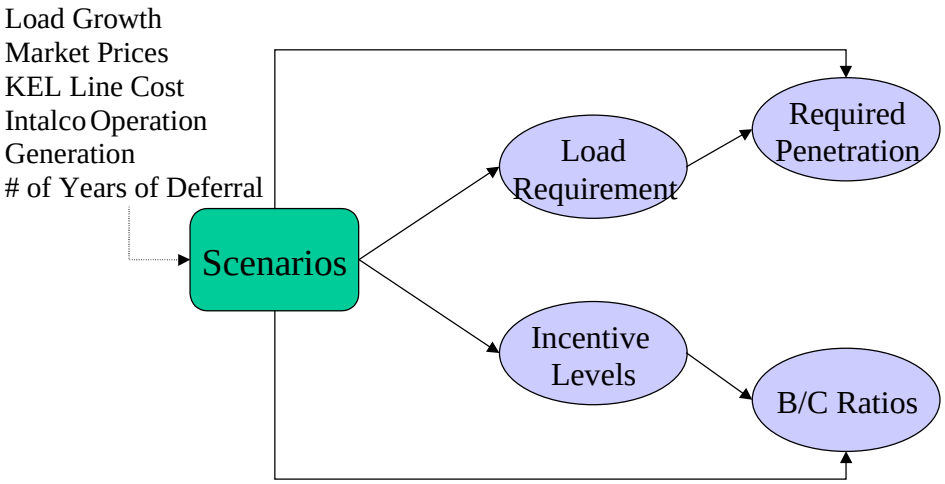
[22] Based on the average annual growth forecasted for the Puget Sound Area for 'normal weather' over the next 10 years of 173 MW and a 65% regional load factor.

Section 7. Sensitivity Analysis

The team evaluated a number of scenarios in which key economic inputs were systematically tested to determine if changes from the base case assumptions would change the conclusions. This section describes the development of alternative scenarios and describes the cost-effectiveness of transmission alternatives with assumptions more 'optimistic' and 'pessimistic' to alternatives than the base case we describe in Section 6.

In Figure 16 below, we summarize how we developed the scenarios. From the base case scenarios, we constructed high and low case scenarios for load growth, market prices, KEL line cost, and in-area generation operation. We then recalculated the load requirement and incentive levels using the same approach described in Section 3 and Section 4. In order to reduce the number of variations, we calculated B/C Ratios and penetration levels only for the more extreme 'optimistic' and 'pessimistic' combinations of inputs since this fully illustrates the range of results from the scenario analysis.

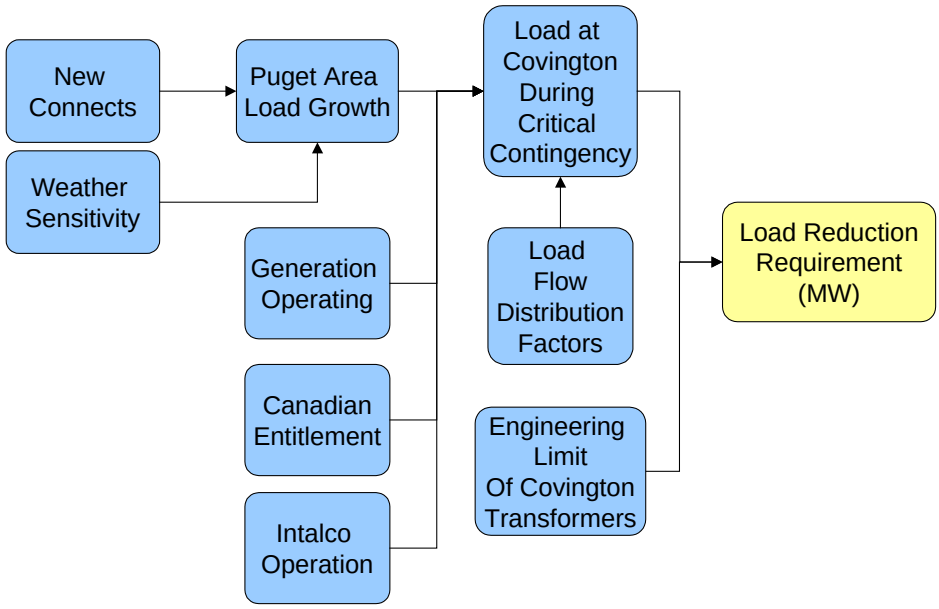
Figure 16: Scenario Analysis



7.1 Load Requirements

In Section 4, the numerous variables that contribute to the determination of load requirements are discussed in detail. Figure 17 is a flow diagram illustrating the analysis we used to calculate the load reduction required at the Covington substation. The base case variables used in the initial economic screening analysis are those variables that TBL currently uses in their planning. However, for the purposes of the load requirement sensitivity analysis, the input variables we modified are load growth and local generation operating during the critical 'Arctic Express' conditions.

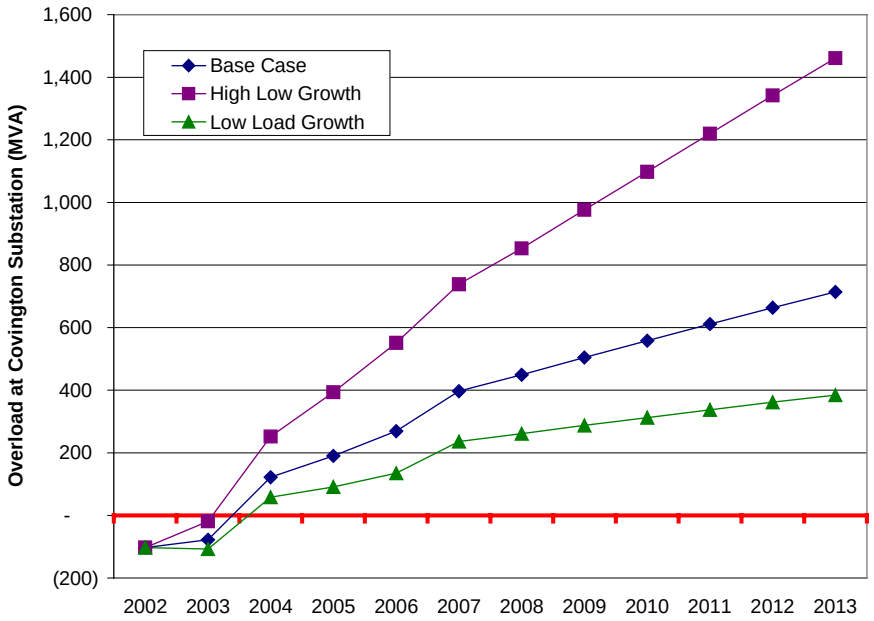
Figure 17: Simplified Flow Diagram of Load Reduction Requirement Calculation



7.1.1 Load Reduction Requirement Scenarios

The high load growth case was constructed by assuming that, beginning with the winter of 2002-2003, utility loads grow at twice the rate reported by local utilities (i.e., approximately 3%, vs. 1.5% in the base case); the low load case assumed a growth rate of half that reported by utilities (or 0.8%). The results of these sensitivity cases are presented in Figure 18, below.

Figure 18: Load Growth Sensitivity Cases



In addition to load growth, we used the amount of local generation operating as an additional sensitivity to the required load reduction. In the base case we assume that most, but not all generators are running at full capacity. This results in approximately 2,000MW of local generation. BPA also provided the team with high and low generation cases. In the high case, local generation was approximately 2,200MW. This case would reduce the overload at the Covington transformer banks by 53MW relative to the base case. In the low case, BPA assumed only 1,700MW of local generation. This case would increase the Covington overload by 93MW.

Table 22 summarizes the load growth and generation scenarios we used to develop load reduction requirement scenarios.

Table 22: Load and Generation Scenario Inputs

	Load Growth	Generation Operating
Base	1.5% growth	2,000 MW
Low	0.8% growth	1,700 MW
High	3% growth	2,200 MW

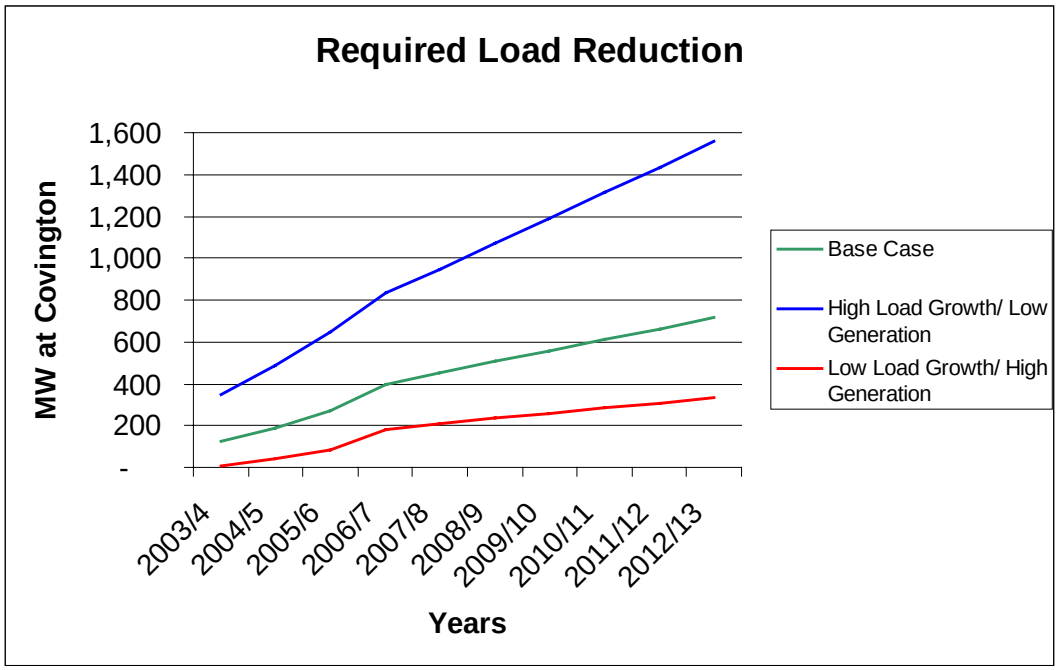
7.1.2 Scenario Results of Required Load Reduction

Applying the scenarios described in the previous section, we developed two scenarios around the base case to illustrate the effects of load growth and operating generation on the required load reduction. Table 23 summarizes the three scenarios shown in Figure 19 (base case plus two variations).

Table 23: Required Load Reduction at Covington (MW)

Scenario	2003/4	2004/5	2005/6	2006/7	2007/8	2008/9	2009/10	2010/11	2011/12	2012/13
Base Case	122	190	269	397	449	505	558	611	664	714
High Load Growth/ Low Generation	346	488	645	832	947	1,071	1,192	1,313	1,436	1,555
Low Load Growth/ High Generation	5	39	82	184	209	235	260	284	309	332

Figure 19: Required Load Reduction at Covington



Even the low load case with high levels of generation operating would not, by itself, defer the need for the Kangley-Echo Lake project. We used this case as the 'optimistic' combination of factors for the required load reduction. The requirement begins at 5MW in the winter of 2003-2004 and increases to 82MW by the third year. Conversely, we used the case with high load growth and low generation to estimate the 'pessimistic' combination. In this scenario 346MW of load reduction at Covington is required in the first year and 551MW is required by the third year.

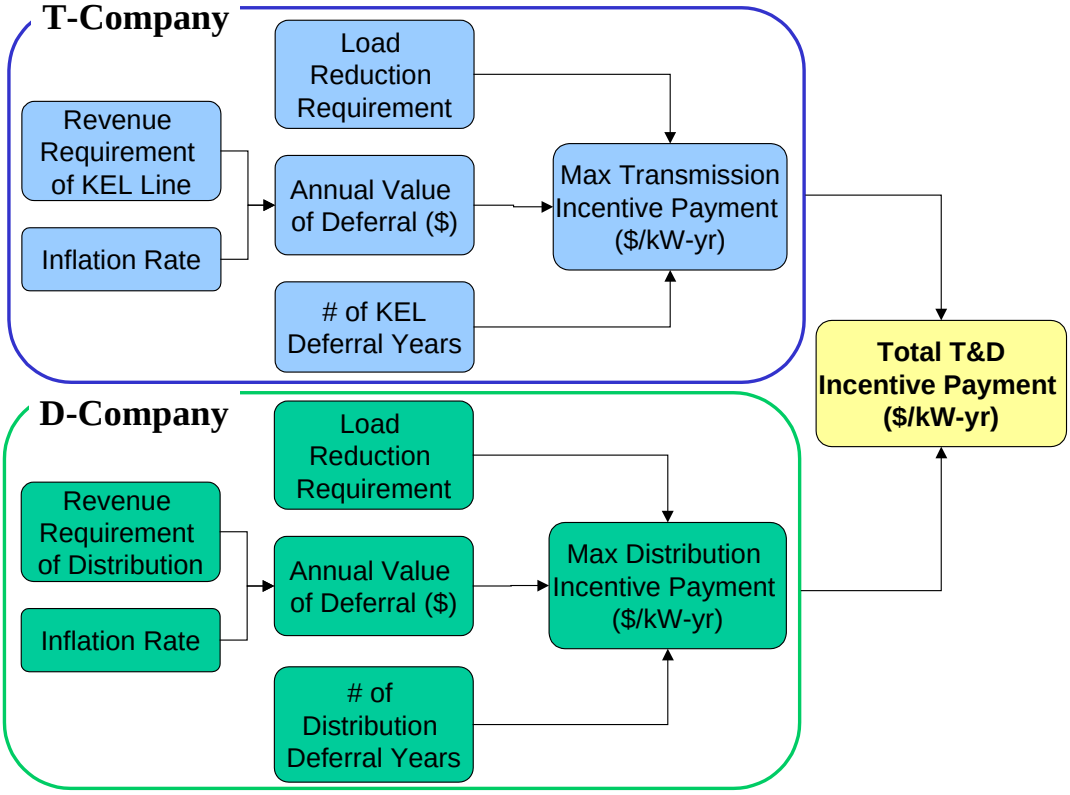
7.2 Incentive Payments

As described previously in Section 3.2, the revenue requirement of the KEL transmission line and the capacity required to defer it are the primary determinants in our estimation of the maximum incentive payments for TBL. However, other stakeholders may see deferred costs from the load reduction that is required to defer the KEL line. We describe in Section 3 the other benefits that are accrued in the TRC and distribution utility cost-effectiveness tests. These include avoided distribution capacity costs, avoided generation capacity costs, and avoided energy costs. If all stakeholders contribute to the program incentive payments up to the level of the net benefits they receive from the resulting load reduction, then this can result in increased incentive levels and higher program penetration. Our analysis sets the distribution system avoided cost to zero. Distribution avoided costs are area specific and experiences with utilities throughout North America have shown that the majority of distribution areas have excess distribution capacity and thus zero avoided capacity costs. Should a distribution company identify an area within the Puget Sound region with avoided distribution capacity costs then this would present an opportunity for a combined TBL/Distribution Company program whereby both companies would contribute to the program incentive payments.

We summarize pictorially the calculation of total incentive payments from the Transmission Company (TBL) and the Distribution Company in Figure 20. The maximum incentive payment

on a $/kW-year basis is calculated by determining the total avoided cost per year and then dividing by the required load reduction over the number of years for project deferral. In this section, we develop scenarios of both the KEL revenue requirement and the required load reduction levels, and then calculate ranges of potential incentive levels.

Figure 20: Maximum T&D Incentive Payment Calculation



7.2.1 Maximum Incentive Payment Scenarios

7.2.1.1 Revenue Requirement Scenarios

TBL provided estimates of the revenue requirement under several construction scenarios, which are shown in Table 45. We assume a base case revenue requirement of $25 million for construction, mitigation and other costs. The low cost scenario has a revenue requirement of $18.5 million and the high cost scenario is estimated to be $36 million. The scenarios encompass a range of 25% below and 44% above the base case.

In Table 45 we also provide the approximate annual value of deferring the KEL line given the respective revenue requirement. We calculated these values using the methodology described in Section 3.2. For example, in the base case, the annual benefit of line deferral is approximately $1.49 million in present value revenue requirement. The values shown are the maximum possible incentive levels on a $/year basis for year one and are based upon the KEL avoided costs. In each

subsequent year of deferral, we reduce the maximum incentive levels by the discount rate to account for the decreasing impact of additional deferrals on the present value revenue requirement.

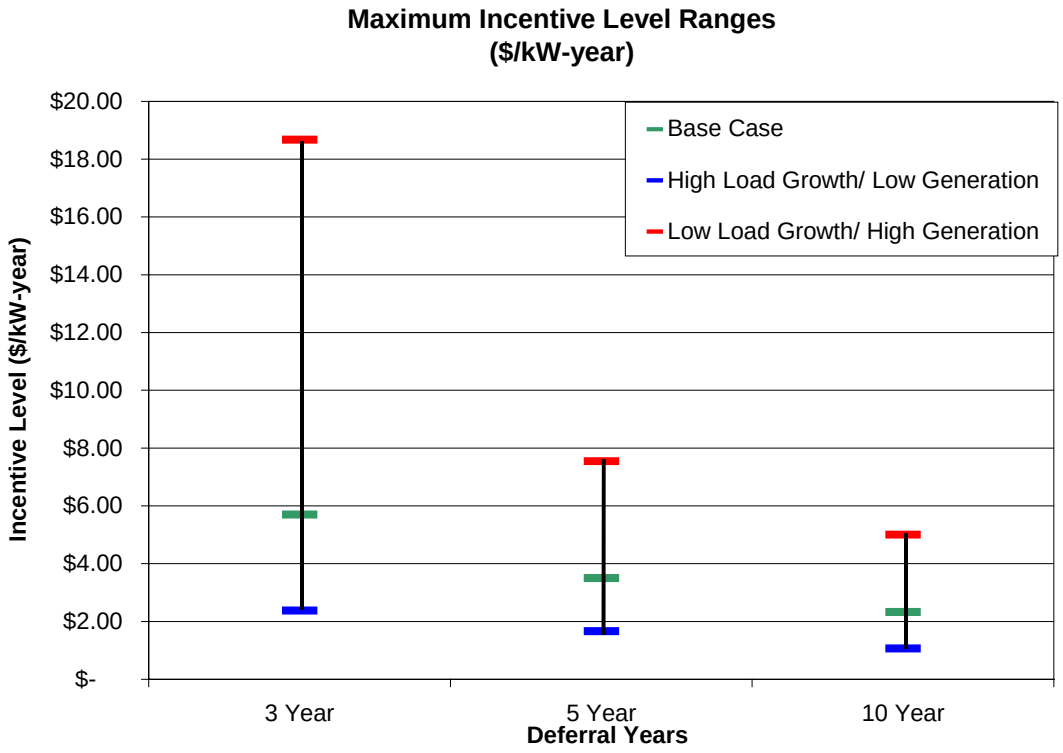
Table 24: Revenue Requirement Scenarios

Scenario	Revenue Requirement	Annual Deferral Benefit PV Revenue Requirement
Base Case	$25 million	$1.5 million
Low Cost	$18.5 million	$1.1 million
High Cost	$36 million	$2.1 million

7.2.2 Scenario Results for Incentive Payments

We calculated the maximum incentive level scenarios by combining the base case deferral value (based on a $25 million KEL cost) with the load reduction requirement scenarios using the avoided cost methodology described in Section 3.2. The resulting incentive level scenario ranges for the base case KEL line revenue requirements are shown in Figure 21.

Figure 21: Maximum Incentive Level Ranges with Required Load Reduction Scenarios



In Table 25, we show the range of maximum incentive payments for the complete range of sensitivities of load growth, generation operating, and KEL construction revenue requirement.

Table 25: Transmission Avoided Costs ($/kW at Covington)

Cost	Load	Generation	3 Year Deferral	5 Year Deferral	10 Year Deferral
B	B	B	$ 5.70	$ 3.50	$ 2.33
H	B	B	$ 8.13	$ 4.99	$ 3.32
L	B	B	$ 4.27	$ 2.62	$ 1.74
B	H	L	$ 2.38	$ 1.66	$ 1.07
B	H	B	$ 2.79	$ 1.84	$ 1.14
B	L	B	$ 11.38	$ 6.02	$ 4.32
B	L	H	$ 18.68	$ 7.54	$ 5.01
H	L	H	$ 26.61	$ 10.75	$ 7.13
L	H	L	$ 1.78	$ 1.24	$ 0.80

B=Base, H=High, L=Low

In addition to the incentive levels, we calculated the avoided line loss savings for all of the load reduction scenarios using the approach described in Section 3.3 (Table 26). This cost of deferring the line only applies to the Total Resource Cost (TRC) and Societal Cost Test. In the base and low cases of KEL revenue requirement scenarios, the avoided line losses are higher than the associated benefit of deferral. In the high case for KEL line revenue requirement, the avoided line losses are lower.

Table 26: Avoided Loss Savings for Each Load Reduction Scenario ($/kW at Covington)

Cost	Load	Generation	3 Year Deferral	5 Year Deferral	10 Year Deferral
B	B	B	$ 7.34	$ 4.51	$ 2.99
H	B	B	$ 7.34	$ 4.51	$ 2.99
L	B	B	$ 7.34	$ 4.51	$ 2.99
B	H	L	$ 3.06	$ 2.14	$ 1.38
B	H	B	$ 3.59	$ 2.37	$ 1.46
B	L	B	$ 14.65	$ 7.75	$ 5.56
B	L	H	$ 24.04	$ 9.71	$ 6.44
H	L	H	$ 24.04	$ 9.71	$ 6.44
L	H	L	$ 3.06	$ 2.14	$ 1.38

B=Base, H=High, L=Low

7.3 Market Price Sensitivity

To test the sensitivity of the cost-effectiveness results to market electricity prices, we developed low and high market electricity forecasts with natural gas prices unchanged at $3.81 per MMBtu. Varying the market price without changing the assumption of natural gas price results in a sensitivity to the 'spark spread' for natural gas-fired generation. A larger 'spark-spread' makes central station generation relatively more cost-effective. Even though these markets generally

move together, we did not vary the fuel cost and the electricity price together because these scenarios would not materially change the results.

In Table 27 we list the assumptions used to develop the base, high, and low electricity price scenarios. Under the low forecast we assume that wholesale electricity prices are equal to the marginal operating costs (fuel costs and variable O&M) of a large-scale combined cycle power plant fueled by natural gas and a heat rate of 7,618 HHV MMBtu per kWh. This case results in a levelized market electricity price of $29.07 per MWh over the forecast period. This case is unlikely to persist in the long term since these electricity prices do not allow any margin to recover fixed operating costs.

Under the high forecast we assume that electricity prices are equal to the fully allocated cost of a simple cycle combustion turbine fueled by natural gas with a heat rate of 11,380 HHV MMBtu per kWh. This assumption results in a levelized electricity price of $52.26 per MWh during the forecast period.

Table 27: Electricity Price Scenario Assumptions

	Base Case	**Low Case**	**High Case**
Technology	Combined Cycle Combustion Turbine	Combined Cycle Combustion Turbine	Simple Cycle Combustion Turbine
Lifetime (yrs)	25	25	10
Fuel	Gas	Gas	Gas
Avg. Fuel Cost	$3.81	$3.81	$3.81
Capacity Factor	90%	90%	90%
Plant Costs Recovered in Power Prices			
Initial Cost ($/kW)	$523.06	$523.06	$369.90
Heat rate	7,618	7,618	11,380
Total Fixed Annual	$23.23	$0.00	$11.14
Fixed O&M ($/kW-yr.)	$18.00	$0.00	$7.44
Property Tax ($/kW-yr.)	$5.23	$0.00	$3.70
Variable O&M ($/MWh)	$0.60	$0.60	$0.12
Levelized Electricity Price	$40.03	$29.07	$52.26

7.4 Benefit/Cost Tests for Optimistic and Pessimistic Cases

The team recalculated the cost-effective of KEL alternatives for the 'optimistic' and 'pessimistic' scenarios. In Table 28, we show the combinations of input sensitivities we used to develop these cases. In the 'optimistic' case we assume a low growth forecast and high generation operating during the peak and the base case KEL revenue requirement which results in high avoided costs. In addition, we assume high market prices relative to the natural gas price that was held fixed during the scenario analysis. This is an 'optimistic' assumption since high electricity prices tend

to make conservation measures more cost-effective and high electricity prices relative to natural gas prices tend to make generation more cost-effective.

In the 'pessimistic' case, we assume input sensitivities that tend to make KEL alternatives less cost-effective. In each case, we made the opposite assumption from the 'optimistic' case. Since there were no cost-effective measures in the base case, a set of more pessimistic assumptions does not change the fundamental results. However, we include the 'pessimistic' scenario to illustrate the relative impact of the input sensitivities to the cost-effectiveness of alternatives.

Table 28: Assumptions for 'Optimistic' and 'Pessimistic' Case

	'Optimistic' Case	'Pessimistic' Case
Load Forecast	Low	High
Generation Operating	High	Low
KEL Line Cost	Base	Base
Avoided Costs	High	Low
Market Price	High	Low

In addition to the load reduction requirements and the avoided cost sensitivities we describe above, we changed assumptions with respect to DSM and DR cost-effectiveness in the scenario analysis. In Table 29, we summarize the assumptions made for the DSM analysis. In each case we assume that participants are paid the full incremental cost of an efficiency improvement as an incentive. In the base case we assume that BPA pays 50% of the incentive, and that the local distribution utility pays the other 50%. In the 'optimistic' case we assume that the distribution utility pays the full incentive, and in the 'pessimistic' case we assume that BPA pays 100%. In addition, in the 'optimistic' case we assume that the impact of capacity reduction at the Covington substation is equal to the local distribution system impact rather than the capacity reduction on the system level adjusted by the load flow distribution factors.

Table 29: DSM Assumptions for Sensitivity Analysis

	Base	Optimistic	Pessimistic
Incentive Basis	100%	100%	100%
BPA % of Incentive	50%	0%	100%
Basis of kW Load Reduction	System	Local	System

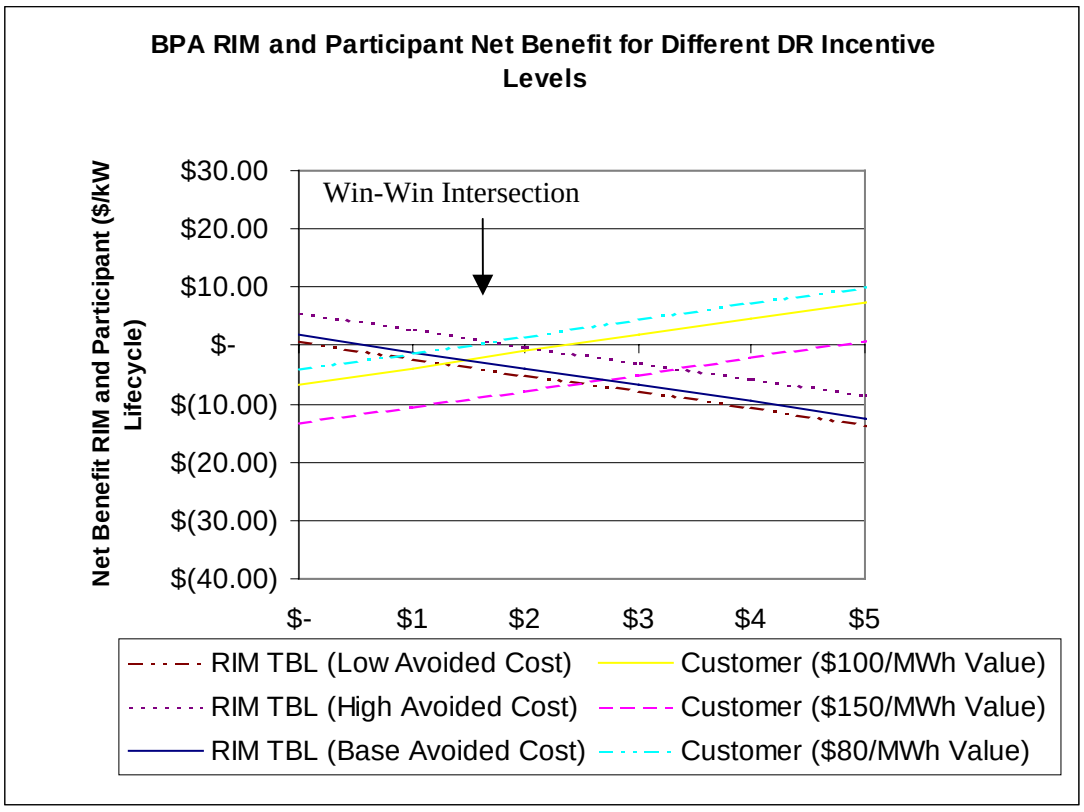
We computed the BC Ratios of each of the 1,533 DSM measures with the scenarios. The number of DSM measures that are cost-effective for each cost test is shown in Table 30. Even in the 'optimistic' case, there are no DSM measures that are cost-effective from the RIM BPA-TBL perspective. From this we conclude that even under extremely optimistic inputs, a conservation approach using DSM to defer the KEL line will raise TBL rates relative to construction of the new line. From a social perspective captured in the TRC and Societal cost tests, there are numerous measures that are cost-effective even under the 'pessimistic' scenario. From this we conclude that DSM is cost-effective to the region as a whole and should be pursued for reasons other than deferral of the KEL line.

Table 30: Number of DSM Programs that Are Cost Effective from Each Perspective

	RIM-BPA/TBL	Utility Cost	TRC Cost	Societal Cost	Participant Cost	RIM-LDC
Base	0	0	1034	1179	1523	1
Optimistic	0	0	1151	1263	1523	53
Pessimistic	0	0	929	1063	1523	0

The team also completed scenario analysis of demand response measures as an alternative to the KEL line. In Figure 22, below, we show the net benefit of demand response from the BPA TBL RIM and Participant cost tests for a range of scenarios.

Figure 22: BPA TBL Rim and Participant Net Benefit at Different DR Incentive Levels



If a DR program is cost-effective from both perspectives it should be possible to develop a DR program to contract for capacity reductions that lead to a relative reduction in TBL rates relative to the KEL line, and is attractive to potential customers. On the horizontal axis we show the incentive level paid to customers in $/kW-year, and on the vertical axis we show the net benefit of the program over the assumed 3-year life of the DR program. As the incentive payments are increased, the benefit to TBL rates decreases and the benefit to the participants increase. Any intersection of the two perspectives above the zero net benefit line demonstrates potential for DR. Across the range of scenarios that we examined, this 'win-win' intersection occurs with the avoided costs developed for the 'optimistic' scenario and a low value to the participating customer of reduced energy consumption during the program of $80/MWh. In the base and 'pessimistic' cases we did not find a 'win-win' intersection for DR.

We developed Table 31 and Table 32 to summarize our analysis of BC ratios for each of the alternatives. The tables show the BC ratios, from each of the stakeholder perspectives, for the measure with the highest RIM BPA-TBL level. As discussed above, we did not find any cost-effective DSM measures from the TBL RIM perspective in either case. Similarly, we did not find any DG technology that was cost-effective from the TBL RIM perspective in either scenario. However, as we illustrated above, DR can be cost-effective from both the RIM and Participant cost levels in the 'optimistic' case. This finding for DR is very sensitive to the assumed loss in value for a customer to participate in the program. In addition, because of the avoided line loss savings, DR is not cost-effective from the TRC and societal cost tests. Large-scale generation is cost-effective in the 'optimistic' case because of the assumption of high electricity market prices.

Table 31: Benefit Cost Ratio of Alternative with the Highest TBL RIM BC Ratio: 'Optimistic' Case

	DSM	DG	DR	G
Alternative	HEATING - Single Family Heat Pump - PTCS System O&M	Gas Spark Ignition	BPA (Conceptual)	Combined Cycle Combustion Turbine
RIM-BPA/TBL	0.12	0.02	1.00	1.00
Utility Cost	No Utility Costs	1.00	1.00	1.00
TRC Cost	1.13	0.73	0.70	2.03
Societal Cost	1.33	0.66	0.73	1.44
Participant Cost	2.27	0.56	1.14	1.30
RIM-LDC	0.54	1.28	1.05	Not Effected

In Table 32 we provide the BC ratios for the 'pessimistic' case. As discussed earlier, none of the alternatives are cost-effective from the TBL RIM perspective in this scenario. However, even in the pessimistic scenario, we find that DSM measures are cost-effective from the TRC and societal cost perspectives.

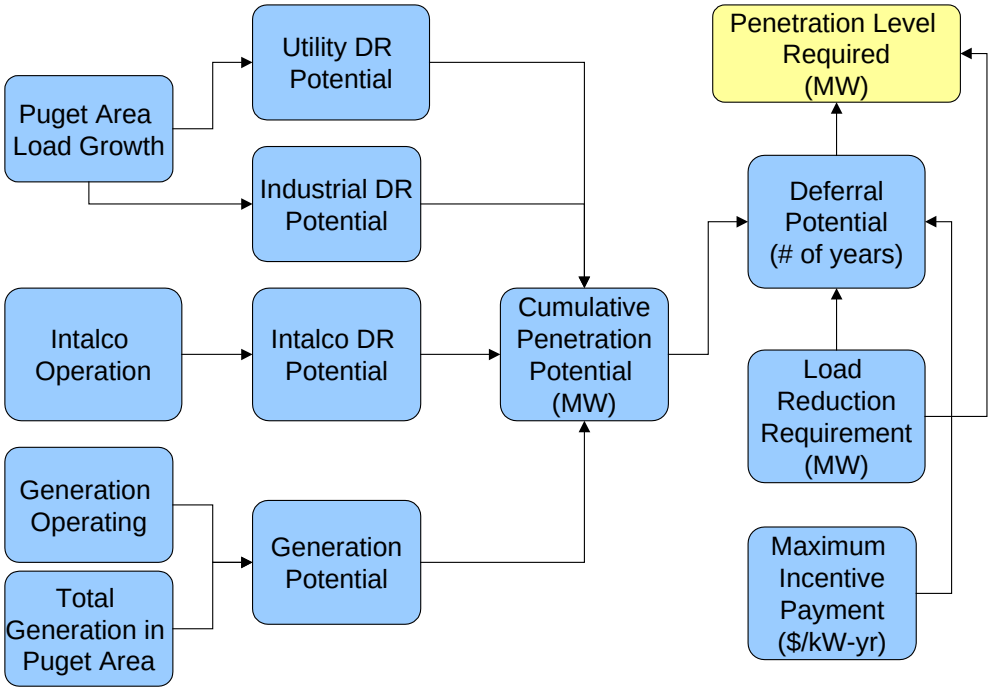
Table 32: Benefit Cost Ratio of Alternative with the Highest TBL RIM BC Ratio: 'Pessimistic' Case

	DSM	DG	DR	G
Alternative	HEATING	Gas Spark Ignition	BPA (Conceptual)	Combined Cycle Combustion Turbine
RIM-BPA/TBL	0.00	0.00	1.00	1.00
Utility Cost	0.00	1.00	1.00	1.00
TRC Cost	1.65	0.41	0.23	1.13
Societal Cost	2.04	0.37	0.25	0.80
Participant Cost	2.20	0.56	0.37	0.72
RIM-LDC	0.56	0.82	0.58	Not Effected

Section 8. Penetration Analysis

The team conducted a penetration analysis to determine whether or not the alternatives could meet the required level of load reduction within the necessary time frame. Figure 23 shows the relationships of the factors we incorporated into the penetration analysis. After estimating the cumulative penetration potential for the Puget Sound area, we calculated the required penetration level to achieve the required load reduction required for each year. This was completed for each of the scenarios described in Section 7.

Figure 23: Required Penetration Level Calculation Process Flow



8.1 Total Potential Market of Potentially Economic Alternatives

8.1.1 Estimate of Potential Penetration of DR/DLC Alternatives

The overall estimate of the potential market for industrial DR/DLC is shown below in Table 33. We did not include the commercial and residential sectors in this penetration analysis. Given the short time frame, which requires implementation prior to the winter of 2003-2004, targeting the less dispersed and larger industrial customers would likely yield better results for BPA's load reduction goal at Covington. There are approximately 1,380MWs of industrial Puget Sound area load that could be targeted with a DR/DLC program. However, this potential is reduced to a 444MW reduction at Covington when load flow effects are applied using the load flow distribution factors. Given the same load flow factor, Intalco could contribute up to 150MW of load relief at Covington if it were able to curtail its entire load. However, due to its operational characteristics, Intalco can only curtail approximately 50% of its load, thus Intalco is capable of

providing 75MW of load relief. The maximum potential penetration level from the DR/DLC alternatives we analyzed in the industrial sector is estimated to be 519MW. This value is based upon area industrial customers and the Intalco facility.

Table 33: Base Case Potential Market for DR/DLC Measures

Sector	Puget Sound Area Peak Load	Covington Load Flow Factors	Approx. Covington Transformer Peak Contribution
	MW	*%*	*MW*
Industrial Customers	1,380	32	444
Intalco	468	32	75
Total MW			**519**

8.1.2 Estimate of Potential Penetration of Generation Alternatives

In Table 34, we provide the base case potential for operation of large-scale generation to reduce loads on the Covington transformer. To develop a penetration estimate of existing generation, we assumed that all existing generators would be available, except for Ross Dam, which is likely to provide additional output during a sustained extreme weather event. Thus, a total of 277MW of generation would be available, yielding a 70MW reduction on the Covington transformer banks by applying the load flow distribution factors. Generators that are not yet online and producing energy were excluded from the base case. Phase 1 generation refers to those that are under construction. Phase 2 refers to those generators that have been permitted.

Table 34: Base Case Penetration Market for Generation

	Puget Sound Area Maximum Availability	Approx. Covington Transformer Peak Contribution	Penetration Achieved	Potential MW for Covington Load Reduction
	MW	MW	%	MW
Existing G	277	70	100%	70
Phase 1 G	268	56	0%	-
Phase 2 G	1,156	365	0%	-
Total				**70**

8.2 Range of Required Penetration across Scenarios

8.2.1 DR/DLC Program Required Penetration

Table 35 shows the penetration required from DR/DLC measures (including an Intalco curtailment contract) to meet the potential overloads for each of the five scenarios of load growth described in Section 7.1. The total MW reductions required for each scenario are shaded gray. In

each case, we allocated load relief between Intalco and industrial customers in order to reach this target. We assumed that any MWs reduced from either the Industrial segment or Intalco are additive, thus for the base case in Year 1 the combined reduction of 47MW plus 75MW would reach the 122MW required reduction.

Table 35 indicates that by Year 3, there is not enough existing industrial load impact at Covington in the high load growth scenarios. However, in the low load growth scenarios, the Year 1 required penetration levels appear achievable if a contract is signed with Intalco to commit to curtail the maximum level they are able to achieve.

Table 35: Required DR/DLC Penetration Levels for Load Growth Scenarios[23]

Scenario	DR Penetration	Year 1		Year 2		Year 3	
		% Penetration Required	MW	% Penetration Required	MW	% Penetration Required	MW
Base Case		**122**		**190**		**269**	
	Industrial	11%	47	26%	115	44%	194
	Intalco	100%	75	100%	75	100%	75
High Load Growth/ Low Generation		**346**		**488**		**645**	
	Industrial	61%	271	93%	413	Not Enough Available	
	Intalco	100%	75	100%	75		
					488		
High Load Growth/ Base Generation		**252**		**394**		**551**	
	Industrial	40%	177	72%	319	Not Enough Available	
	Intalco	100%	75	100%	75		
Low Load Growth/ Base Generation		**58**		**91**		**135**	
	Industrial	0%	-	4%	16	14%	60
	Intalco	100%	75	100%	75	100%	75
Low Load Growth/ High Generation		**5**		**39**		**82**	
	Industrial	0%	-	0%	-	2%	7
	Intalco	100%	75	100%	75	100%	75

8.2.2 DR/DLC Program and Existing Generation Required Penetration

Reviewing deferral possibilities with DR/DLC programs only represents a single alternative solution for the deferral and is not a comprehensive method for evaluating all of the potential alternative solutions. A combined solution would incorporate a combination of demand response and generation measures. Therefore, we looked into the possibility of achieving the load reduction targets by employing a combination of existing generation and DR/DLC programs. Table 36 displays the penetration levels required of generation and DR/DLC for the five load scenarios analyzed. Load reduction at Intalco is assumed to be phased in first, followed by existing generation, and then demand response programs. This approach utilizes the 'chunks' of

[23] Intalco contributions do not vary because BPA would either have a contract with Intalco or not. If a contract is secured, we assume that it would be for the maximum level for which Intalco can reduce its load, equal to 75 MW of effective load reduction at Covington.

capacity from largest to smallest. For example, Intalco is assumed to contribute all of its available effective load reduction at Covington before the available existing generation would be targeted. Once the existing generation resources reach their maximum contribution of 70MW at Covington, DR-DLC programs would be implemented. Realistically, these three resources would be simultaneously implemented; however, the phased-in approach shown here is useful conceptually.

Table 36: Required DR/DLC and Existing Generation Penetration Levels for Load Growth Scenarios

Scenario	DR & Generation Penetration	Year 1		Year 2		Year 3	
		% Penetration Required	MW	% Penetration Required	MW	% Penetration Required	MW
Base Case		**122**		**190**		**269**	
	Industrial	0%	-	10%	45	28%	125
	Intalco	100%	75	100%	75	100%	75
	Generation	68%	47	100%	70	100%	70
High Load Growth/ Low Generation		**346**		**488**		**645**	
	Industrial	45%	201	77%	343	Not Enough Available	
	Intalco	100%	75	100%	75		
	Generation	100%	70	100%	70		
High Load Growth/ Base Generation		**252**		**394**		**551**	
	Industrial	24%	107	56%	249	92%	406
	Intalco	100%	75	100%	75	100%	75
	Generation	100%	70	100%	70	100%	70
Low Load Growth/ Base Generation		**58**		**91**		**135**	
	Industrial	0%	-	0%	-	0%	-
	Intalco	100%	75	100%	75	100%	75
	Generation	0%	-	24%	16	86%	60
Low Load Growth/ High Generation		**5**		**39**		**82**	
	Industrial	0%	-	0%	-	0%	-
	Intalco	100%	75	100%	75	100%	75
	Generation	0%	-	0%	-	11%	7

Combining the G and DR/DLC resources does appear to provide enough potential penetration for deferral in Year 1, as well as sufficient load reduction in the low load growth scenarios. While this is an improvement upon the DR/DLC single-resource penetration estimates shown in Table 35, by Year 2 of the base case, BPA would need to secure Intalco's total load reduction contribution, all available existing generation in the area, and achieve a 10% penetration level with DR/DLC programs.

8.3 Penetration Feasibility

8.3.1 Benchmarking Utility DR/DLC Programs

In order to ascertain whether the required penetration levels are reasonable for BPA to achieve, the team conducted a high-level benchmark study of utility DR/DLC programs targeted toward the commercial and industrial sectors. The first four data columns in Table 37 below list name, incentive, number of months, and hours per year of current or historical utility DR/DLC programs. The hours per year column indicates the maximum hours for which the program was designed to operate or the total number of hours that curtailment/interruption was achieved. In some cases, such as price-dispatched programs like BPA's Demand Exchange, no upper bound was indicated. For these programs, we assumed an average of 100 hours per year.

In all cases the duration of the program (number of months or hours per year required) differed from BPA's estimated duration of 3 months and only 10 hours in Year 1 of potential required load relief. The last column in this table shows what the incentive levels would look like if the BPA duration characteristics were applied to each program. We estimated that since the program would be required for fewer hours, BPA may be able to achieve their required reduction with lower incentive payments.

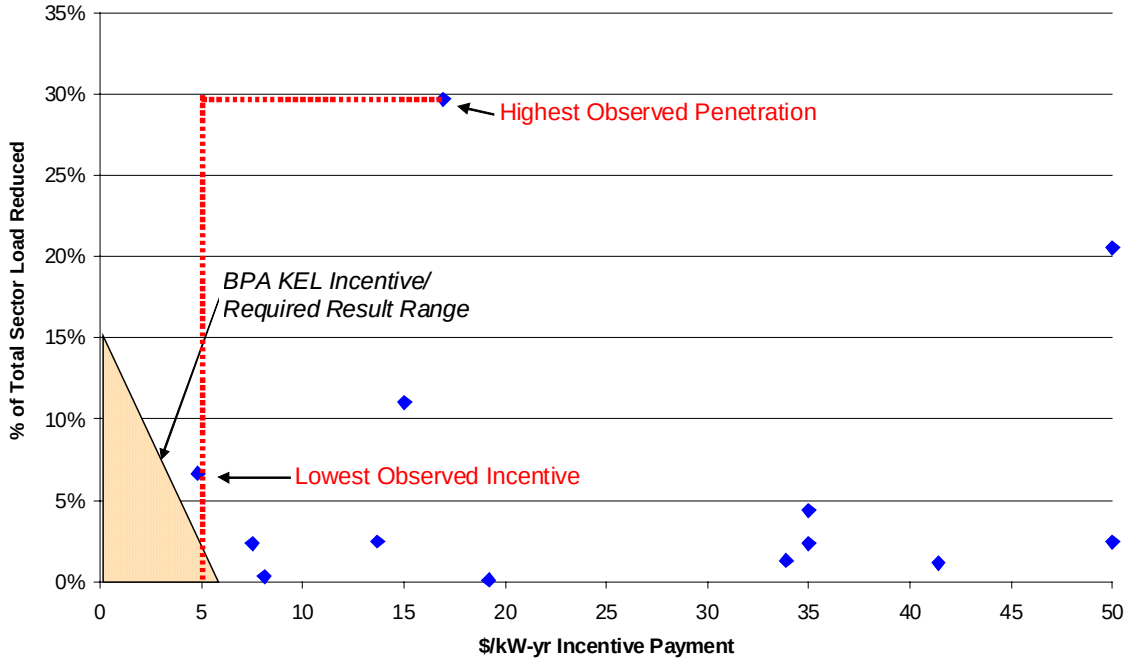
Table 37: Survey of Utility DR/DLC Program Characteristics

Program Type	Program Incentive ($/kW-yr)	# Months	# Hours /Year	Calculated BPA Incentive ($/kW-yr)*
1 Demand Buy Back	16.95	12	113	1.5
2 Energy Exchange Program	4.8	12	48	1
3 Voluntary Load Reduction	15	4	100	1.5
4 Interruptible Option	41.68	4	100	24.3
5 Curtailable Option	32.4	4	75	20.7
6 Curtailable Option	27.6	4	75	35
7 Curtailment Service Cooperative	35	3	120	30
8 Interruptible Service	120	12	300	65
9 Demand Relief Program	128	4	96	5
10 Emergency Demand Response Program	50	6	100	0.81
11 Day-Ahead Demand Response Program	8.1	6	100	3.5
12 Demand Bidding Program	35	12	100	21
13 Com/Ind. Base Interruptible Program	84	12	120	1
14 Scheduled Load Reduction Program	19.2	4	192	5
15 Emergency Response Program	50	12	100	10.35
16 Capacity Program - Interruptible Tariff	41.4	12	300	10.35
17 Economy Program - Interruptible Tariff	41.4	12	300	4.75
18 Reliability Program	63	12	150	1.37
19 Demand Exchange	13.7	6	100	0.0

Figure 24 illustrates the levels of load reduction other utilities achieved through their DR/DLC programs as a percentage of the sector they were targeting and the incentive levels they were offering. The triangle in the lower left-hand corner represents the range of incentives that BPA would be able to offer to obtain the required load penetration. The penetration targets are unknown and each program has its own unique goals, but we conclude from the clustering of the programs below the 5% penetration range that DR/DLC programs would not achieve high penetration levels with very low incentives. If this were possible for BPA, the capacity program would be unique among this set of similar programs.

Since the incentive levels that BPA is able to offer are so low, it would be difficult to implement an effective DR/DLC program relying solely on incentive payments as motivation for participation. Any DR-DLC program designed to meet the load relief needs at Covington would need to achieve higher penetration with a lower incentive level than the programs we observed in our survey.

Figure 24: Penetration and Incentive Ranges of 13 Utility DR Programs



8.3.2 Generation Penetration Feasibility

Table 38 lists both the existing and potential large generators in the Puget Sound area. Only the existing facilities shown in this table were included in the penetration analysis. The Ross Dam is not included in the overall estimates of available generation because it is unlikely that in the event of a multi-day Arctic Express weather system this facility would be able to generate. With the exclusion of the Ross Dam, there are four remaining facilities that could contribute additional generation and provide load relief during the extreme peak period in question.

In the above analysis, we assumed that it would be possible to put generation contracts in place up to the maximum potential generation level for these facilities. However, there is uncertainty with regard to how firm the available capacity values listed in Table 38 are in both the short and long-term. For example, it was recently announced by TransAlta that the largest potential contributing plant, Pierce Power, is scheduled to be removed from service. This plant was originally commissioned in 2001 to improve the power shortage in the Pacific Northwest.[24]

[24] "TransAlta decommissions temporary Pacific Northwest plant" News Release at www.transalta.com

Table 38: Existing and Potential Large Generators in the Puget Sound Area

Project	Location	Type	Available Capacity (Local MW)*	Effective MW at Covington
In service			*277*	*70*
Pierce Power	Frederickson	Gas turbine	154	31
Ross Dam**	Skagit River	Hydroelectric	109	46
BP Cherry Point GTs	Blaine	Gas turbine	73	23
Equilon GTs	Anacortes	Gas turbine	39	12
Georgia-Pacific GT	Bellingham	Gas turbine	11	4
Construction (Phase 1)			*268*	*56*
Frederickson Power 1	Frederickson	Combined-cycle	249	50
Tesoro (Permanent ICs)	Anacortes	Reciprocating engine	19	6
Permitted (Phase 2)			*1,156*	*365*
Sumas Energy 2	Sumas	Combined-cycle	660	211
Everett Delta I	Everett	Combined-cycle	248	77
Everett Delta II	Everett	Combined-cycle	248	77
Potential (Phase 3)			*1,643*	*460*
BP Cherry Point Cogen.	Blaine	Cogeneration	720	230
U.S. Electric Cherry Point	Blaine	Coal–Steam	349	112
Frederickson Power 2	Frederickson	Combined-cycle	280	56
Tahoma Energy Center	Frederickson	Combined-cycle	270	54
Cedar Hills	Cedar Hills Landfill	Landfill Gas	24	7
Maximum Available Puget Sound Area Generation			***3,453***	***950***

* Includes only capacity that is not already assumed to be operating in BPA's load flow studies.
** Ross Dam is unlikely to be available during a multi-day Arctic Express event.

For three of the five scenarios, securing the potential generation resources currently available, combined with DR/DLC program load relief, would enable BPA to defer the KEL line construction for at least one year. Obtaining a contract with Intalco would be the primary determining factor in the success of any deferral effort. If BPA were able acquire 50% of the available generation and achieve a 2% penetration within the industrial sector, line construction could be deferred for the first year in the base case. Beyond Year 1, however, it would be difficult for BPA to achieve the levels of penetration necessary to reach the load reduction targets in the base case due to the low incentive levels BPA is able to offer for DR/DLC and the limited generation resources available in the area.

Section 9. Conclusion

This study provides a high-level economic screening analysis of potential alternatives to the KEL transmission line. The analysis consisted of a pre-assessment of the load reductions required from alternatives in order to defer or replace the KEL line. Following the pre-assessment of performance requirements, the economic screen comprised three steps. Step 1 was an assessment of the cost-effectiveness of alternatives given the potential avoided costs of deferring the line and estimates of the cost of alternatives. Step 2 was a scenario analysis to test the sensitivity of cost effectiveness results to changes in key economic input assumptions. Step 3 was to estimate the potential penetration of alternatives to determine whether or not sufficient load reduction could be obtained.

An assessment of the transmission capacity requirements to reliably serve the Puget Sound Area, carried out in conjunction with the BPA Transmission Business Line (BPA TBL) team, gave an estimate of 122MW of load reduction required at the Covington substation for approximately 10 hours during the 2003-2004 winter. The required load reduction and the number of forecasted hours of Covington Transformer overload increases in each year thereafter. Our estimate of the base-case load reductions and number of hours required are provided in Table 39, below. These overload forecasts depend on the load growth forecasts, the generation operating in the area, and the requirements of the Canadian Entitlement Return.

Table 39: Projected Covington Transformer Bank Overloads, 2004-2013

Year	Maximum Overload (MW)	Number of Hours Overload Occurs
2004	122	10
2005	190	17
2006	269	30
2007	397	51
2008	449	61
2009	505	70
2010	558	86
2011	611	102
2012	664	119
2013	714	135

A large number of potential alternatives were evaluated including a wide range of DSM measures, small-scale generation, large-scale generation, demand response, and direct load control. The economics of each approach were evaluated from the perspective of each of the major stakeholders including BPA TBL, the participant in the program, the local distribution utility, as well as the more social perspectives provided by the Total Resource Cost test and the Societal Cost Test.

Under base case economic assumptions and using the criterion, the same or lower rates, the KEL line is the most cost-effective solution to regional capacity constraints. In addition, we analyzed the cost-effectiveness and penetration potential with combinations of 'optimistic' and 'pessimistic' assumptions. The KEL line remained the most cost-effective alternative in the 'pessimistic' case. In the 'optimistic' case, our analysis concludes that demand-response type programs and contracting with existing in-area generators to operate during the critical peak loads would be cost-effective. In addition, our penetration analysis of these technologies in the 'optimistic' scenario demonstrates that it would be feasible to achieve sufficient penetrations to defer the line for at least three years. Therefore, there is potential for alternatives in the 'optimistic' case.

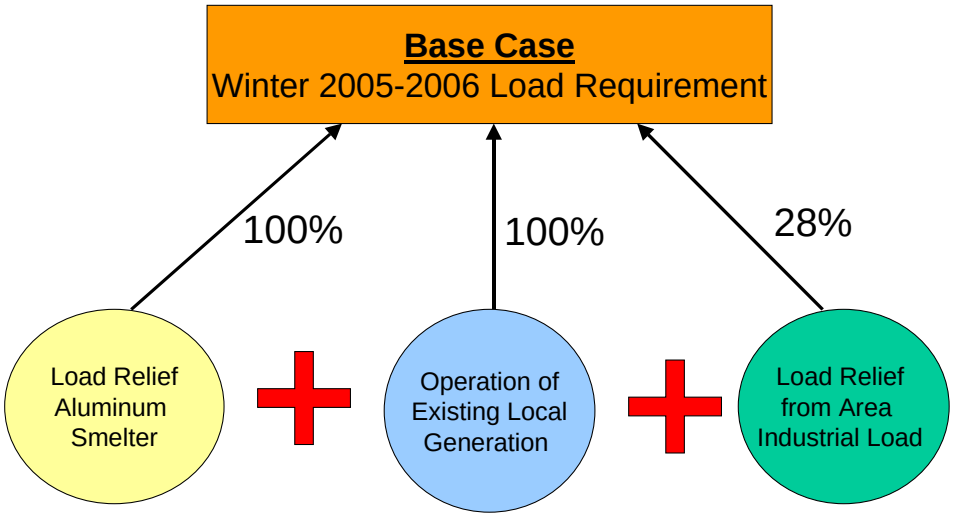
Based on our analysis we make the following findings:

A high level of load reduction or additional generation is required to defer KEL. Based on the planning assumptions provided, the level of load reduction required to prevent an overload on the transmission system and to maintain system reliability during a major system outage is approximately 122 megawatts (MW) at the Covington transmission substation during the winter of 2003-2004. This load reduction requirement amount increases every year thereafter. The analysis of the load requirement in Section 4 provides a thorough description of the load forecasting process.

The Puget Sound Area peak load is approximately 12,000MW. Because of the way that power flows over the network of transmission facilities, each MW of load reduction or additional in-area generation only reduces the flows across the Covington transformer by a fraction of a MW. For example, a 100MW load reduction in downtown Seattle will only reduce loadings on the Covington transformers by 42MW, while the same reduction in Tacoma would only achieve a 20MW reduction at Covington. The ratio of the MW change at Covington to the MW change at the source is called the load flow distribution factor (or distribution factor). When applying these factors, the 122MW that are required to bring the peak load of Covington below overload levels in the first year translates to approximately 381MW of load reduction or additional generation within the Puget Sound Area assuming a distribution factor of 32%[25]. Thereafter, the amount of load reduction or additional generation needed to prevent an overload increases annually. By the winter of 2005-2006 the needed amount grows to 269MW at Covington, or 841MW within the Puget Sound Area. As illustrated in Figure 1, a 3-year deferral of the line would require 100% of the available load relief from the large aluminum smelter in the area, plus operation of all existing generation not expected to be on-line, plus load relief from 28% of industrial load in the area. To put the 28% industrial participation rate in perspective, we reviewed information from 13 utility DR programs, and found only four with participation rates above 5%.

[25] 32% is the load weighted average distribution factor across the Puget Sound study area.

Figure 25: Load Relief and Generation Requirements for a 3-Year Deferral of the KEL Line (Base Case Assumptions)



Transmission avoided costs are low. The avoided cost of the KEL project, assuming a cost of $25 million and annual operations and maintenance (O&M) costs of $50,000 for the line, is approximately $1.49 million per year (as calculated using the differential revenue requirement method described in Section 3.2 of this report). Therefore, in order to prevent increasing TBL's revenue requirement, 122MW of demand reduction at Covington would have to be purchased for $1.49 million or less. This equates to approximately $12.25 per kW at Covington per year or $3.92 per kW-year in the Puget Sound Area based on average load flow distribution factors.

Furthermore, TBL estimates that construction of the KEL line would reduce peak losses on the transmission system by 11MW. This would result in annual energy savings of 48,180MWh, valued at nearly $2 million dollars.[26] Therefore, the economic value of the energy savings is greater than the benefit of deferring the line.

Incentive Levels are low compared to other programs. The likelihood of achieving significant penetration in the area with incentive levels calculated from the avoided cost of deferring the KEL line cannot be determined precisely without a detailed customer assessment. To provide BPA with some general indication, however, we compared incentive levels and penetration rates for 19 demand response programs across the United States with the incentive levels and penetration rates required for cost-effective deferral of the KEL line. From this comparison we conclude that it is unlikely the available incentive payments based on the value of deferring the KEL line would be sufficient to achieve the significant penetration required in this case. Any DR-DLC program designed to meet the load relief needs at Covington would need to achieve higher penetration with a lower incentive level than the programs we observed in our survey.

Demand response is the most cost-effective alternative from a TBL rate perspective. Of the alternatives considered, we found that demand response programs are most likely to be cost-effective from the utility rate perspective and to participants. Demand response is well suited to

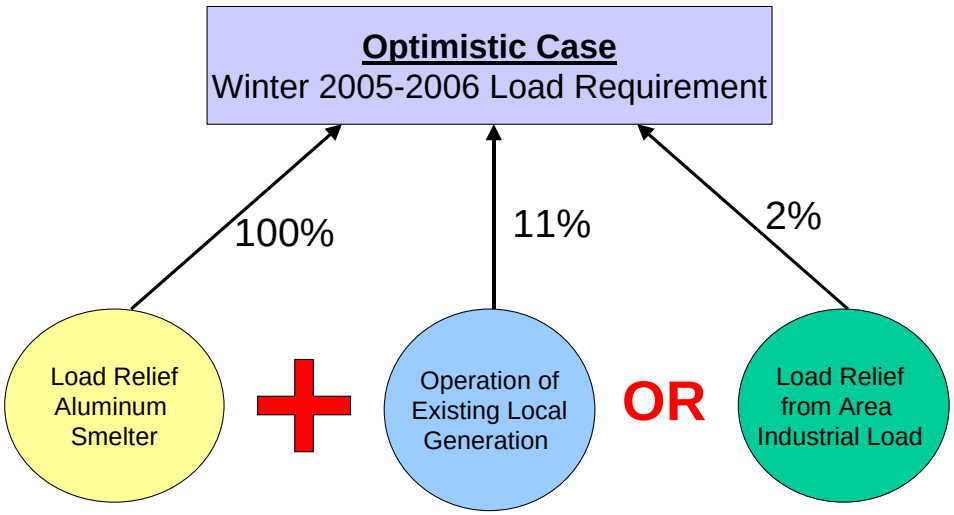
[26] Assumes the 'base case' market price of $40.03 /MWh.

solving the capacity problem without causing significant revenue loss since it focuses load reduction on only the hours when needed for system reliability. We found, however, that demand response is not cost effective from the TRC perspective because deferral of the line would eliminate the significant loss savings BPA expects the line to achieve. DSM is cost-effective from a TRC perspective, but is not likely to produce win-win outcomes because there would be increased pressure on rates due to increased efficiency, and subsequently reduced utility sales throughout the year or season. We found that DSM programs would need to reduce energy each year from half to one and a half times the annual energy growth. Also, DSM efforts would either have to be funded externally to BPA or the additional costs would have to be passed through to TBL's ratepayers, because the DSM measures do not pass TBL's RIM test.

Scenario analysis indicates alternatives could be cost effective if demand is lower than forecast. To provide BPA with a comprehensive assessment of the potential for cost effective alternatives to the KEL line, we conducted a scenario analysis. The purpose of the analysis was to evaluate the sensitivity of cost effectiveness results to changes in key economic inputs. We tested the entire range of alternative technologies under three sets of economic assumptions. These included the base case which we largely derived from BPA's transmission planning work, an 'optimistic' case that improves the cost-effectiveness and penetration requirements of alternatives, and a 'pessimistic' case that reduces the cost-effectiveness of alternatives. The base case represents our best estimate of the future, and the 'optimistic' and 'pessimistic' cases represent extremes that have a low probability of occurring. We found the KEL line was the most cost-effective solution to capacity constraints in both the base and pessimistic cases. In the optimistic case, we found DR and generation were cost effective from both the ratepayer and participant perspectives.

In this optimistic case we estimated that BPA would require 82MW of load reduction at the Covington substation to defer the line for 3 years or 256MW within the Puget Sound Area. As illustrated in Figure 2, this can be achieved through 100% of available load relief from the large aluminum smelter in the area, plus either operation of 11% of existing generation not expected to be on-line or load relief from 2% of industrial load in the area.

Figure 26: Load Relief and Generation Requirements for a 3-Year Deferral of the KEL Line (Optimistic Assumptions)



9.1 Summary

The decision whether to build the line or defer the line depends on expectations of demand and the availability of funds for alternatives. Three scenarios were examined to provide insight into this decision. If demand increases at the forecasted rates and funds for alternatives are limited to the value of deferring the line, then the KEL line is the most cost effective and feasible solution. However, if demand is significantly lower than expected, then sufficient load reduction potential of alternatives exists to mitigate the need for the line. In this case, the economics of alternatives are also improved, and it may be possible to defer the line for up to 3 years with demand response programs and contracts with existing generation in the area. Likewise, if additional benefits of alternatives can be found to offset the costs such as through partnering with local distribution utilities, the cost-effectiveness of alternatives can be improved. On the other hand, if demand increases at a higher rate than forecasted, then the KEL is again the most cost effective and feasible solution.

There are competing views of the appropriate criterion for cost effectiveness. The principal debate is between the Ratepayer Impact Measure (RIM) and the Total Resource Cost test (TRC). RIM compares the effect on TBL's rates of the cost of alternatives versus the capital and maintenance costs of a proposed solution. TRC compares the costs and benefits of alternatives with all the costs and benefits of a proposed solution. TRC includes energy and generation benefits. An alternative deemed cost effective under TRC could cause rates to be higher. While our analysis provides information to use in evaluating these two criteria, it was not intended to provide guidance as to the appropriateness of one over the other.

Independent of BPA's decision regarding the KEL line, the distribution system benefit of alternatives is an avenue of additional investigation that was not within the scope of this project, but should be pursued. If distribution benefits are significant, they would increase the value of alternative measures and should provide an additional source of funding. The above are institutional and policy considerations that are beyond the scope of this analysis and will require more time for resolution than is available relative to the KEL line decision process.

Section 10. Appendix 1: DSM Results

Table 40: Base Case Results: Best RIM-BPA/TBL BC Ratio Measure for Each Sector and End Use

Sector	End Use	RIM-BPA/TBL	Utility Cost	TRC Cost	Societal Cost	Participant Cost	RIM-LDC
Single Family	Heating	0.0042	0.02	1.94	2.40	2.20	0.71
Commercial	Heating	0.0039	0.01	1.17	1.28	1.25	0.77
Industrial	Motors	0.0033	0.09	146.16	202.18	142.95	0.87
Grocery	Lighting	0.0032	0.01	1.67	1.91	1.70	0.86
Restaurant	Lighting	0.0024	0.01	1.60	1.83	1.71	0.80
Single Family	Lighting	0.0022	0.01	5.03	6.15	8.18	0.71
Multifamily	Envelope	0.0019	0.00	3.65	7.38	4.14	0.66
Single Family	Appliances	0.0019	0.01	1.05	1.07	1.09	0.76
Other	Traffic Signals	0.0019	0.00	1.60	1.93	2.82	0.70
Other	Vending Machines	0.0013	0.00	2.11	2.75	3.12	1.02
Single Family	Water Heating	0.0013	0.00	1.12	1.19	1.29	0.71
Other	Exit Signs	0.0011	0.00	1.73	2.25	2.91	0.65
Office	Envelope	0.0010	0.00	2.22	4.00	2.70	0.66
Multifamily	Appliances	0.0002	0.00	1.05	1.18	1.56	0.76

- HEATING - Post79/Pre93 Single Family Construction Convert FAF w/o CAC to HP w/PTCS - Heat Pump rated HSPF 8.0 or higher and SEER 12 or higher w PTCS
- HEATING - Commercial Small Heat Pump - Heat pump rated HSPF 8.0 and SEER 13 or higher
- MOTORS - New Premium Efficiency Open Drip-Proof (ODP) Industrial Motors, 100 - 250 HP - Premium Efficiency 15 HP 1800 RPM ODP
- LIGHTING - Grocery, HtPmp Heat - 2-F32T8 32watt T8 lamp(s) w/ IS Elect. ballast
- LIGHTING - Restaurant, Gas Heat - 2-F32T8 32watt T8 lamp(s) w/ IS Elect. ballast
- LIGHTING - Residential Lighting - Energy Star CFL Exterior - 26 Watt
- ENVELOPE - New Low Rise (Less than 5 Stories) Multifamily Dwellings w/Electric Heat - Long Term Super Good Cents Program & Specifications
- APPLIANCES - Single Family Residence w/Electric Water Heat - Energy Star Dishwasher - Electric DHW
- TRAFFIC SIGNALS - Existing and new traffic signals - LED Traffic Signals - Replace 12 inch Red Incandescent Left Turn Bay with 12 inch Red LED module
- VENDING MACHINES - Existing and new vending machines with illuminated fronts - Vending Machine Controller-Large Machine w/Illuminated Front

- WATER HEATING - Residence w/Electric Water Heat - EF- 0.91 Domestic Water Heater w/80 gallon rated capacity and minimum 10 year warranty
- EXIT SIGNS - Building or structure where exit signs are required - Energy Star Light Emitting Diode (LED) Exit Sign - Incandescent Exit Sign Base Case Fixture
- ENVELOPE - Small Office Weatherization Floor Insulation - R0 > R19 batt
- APPLIANCES - Multifamily common area or commercial Laundromat w/Electric Dryer and Electric Water Heat - Energy Star Clothes Washer - Commercial Laundry - Electric Water Heater & Dryer

Table 41: High Case Results: Best RIM-BPA/TBL BC Ratio Measure for Each Sector and End Use

Sector	End Use	RIM-BPA/TBL	Utility Cost	TRC Cost	Societal Cost	Participant Cost	RIM-LDC
Residential	HEATING	0.12182	No Costs	1.1263918	1.32622	2.271919	0.537287
Residential	ENVELOPE	0.0756	No Costs	0.7734072	0.778167	1.019761	0.081233
Retail	LIGHTING	0.05242	No Costs	1.4190025	1.644883	2.264875	0.643189
Commercial	ENVELOPE	0.04769	No Costs	1.3346391	1.499764	1.313166	0.903818
Residential	AC	0.04505	No Costs	0.9596437	1.359056	1.808506	0.484423
Other	TRAFFIC SIGNALS	0.03756	No Costs	2.671951	3.157824	3.917702	0.732854
Commercial	APPLIANCES	0.03366	No Costs	2.4164582	4.216765	2.417784	0.714741
Residential	WATER HEATING	0.02759	No Costs	0.7051603	0.737292	1.123673	0.298116
Residential	LIGHTING	0.0252	No Costs	1.0666137	1.085855	1.079922	0.88704
Commercial	HEATING	0.0233	No Costs	1.187743	1.263433	1.289272	0.77522
Commercial	EXIT SIGNS	0.0233	No Costs	1.358093	1.712916	2.148293	0.5969
Industrial	MOTORS	0.0233	No Costs	2.6907709	3.388458	3.118524	1.057349
Residential	APPLIANCES	0.02048	No Costs	7.188171	8.40871	27.19212	0.19031
Other	VENDING MACHINES	0.02048	No Costs	6.7119553	7.790815	26.51209	0.172715
Commercial	LIGHTING	0.0177	No Costs	19.347523	25.94088	14.94159	1.059835

- HEATING - Single Family Heat Pump - PTCS System O&M
- AC - Residential Dwellings - Energy Star Window Air Conditioner - 16000 Btu/hr
- TRAFFIC SIGNALS - Existing and new traffic signals - LED Traffic Signals - Replace Large Pedestrian Incandescent " Don't Walk" with Large LED Module
- HEATING - Retail Small Heat Pump - Heat pump rated HSPF 8.0 and SEER 13 or higher
- ENVELOPE - Single Family Weatherization - Infiltration Control (Cost and Savings per sq. ft. of floor area for each 0.1 ach reduction) - Mechanical ventilation systems must be installed in substantial compliance with Appendix T, Part 2 in all homes for which verified reductions in air infiltration/exfiltration are claimed.
- LIGHTING - Residential Lighting - Energy Star CFL Exterior - 23 Watt
- ENVELOPE - Small Retail Weatherization Wall Insulation - R0> R11 blown

- APPLIANCES - Multifamily common area or commercial Laundromat w/Gas Water Heat and Electric Dryer - Energy Star Clothes Washer - Commercial Laundry - Electric Dryer/Gas Water Heater
- APPLIANCES - Single Family Residence - Unknown DHW Energy Source - Energy Star Dishwasher - Gas DHW
- WATER HEATING - Residence w/Electric Water Heat - EF- 0.91 Domestic Water Heater w/80 gallon rated capacity and minimum 10 year warranty
- EXIT SIGNS - Building or structure where exit signs are required - Energy Star Electro-luminescence (EL) Exit Sign - Incandescent Exit Sign Base Case Fixture
- VENDING MACHINES - Existing and new vending machines with illuminated fronts - Vending Machine Controller-Large Machine w/Illuminated Front
- LIGHTING - Large (>20,000 ft2) Office, HtPmp Heat - 2-F32T8 32watt T8 lamp(s) w/ IS Elect. ballast
- LIGHTING - Small (<=20,000 ft2) Retail, HtPmp Heat - 2-F32T8 32watt T8 lamp(s) w/ IS Elect. ballast
- MOTORS - Replace rather than Rewind Open Drip-Proof (ODP) Industrial Motors, 10 HP and smaller - Replace instead of Rewind 7.5 HP 1800 RPM ODP with new, Premium Efficiency motor of same size and type

Table 42: Low Case Results: Best RIM-BPA/TBL BC Ratio Measure for Each Sector and End Use

Sector	End Use	RIM-BPA/TBL	Utility Cost	TRC Cost	Societal Cost	Participant Cost	RIM-LDC
Residential	HEATING	0.00142	0.00381	1.6516604	2.03743	2.197138	0.561501
Commercial	ENVELOPE	0.00135	0.019691	110.06131	159.7317	142.9525	0.651537
Residential	APPLIANCES	0.00111	0.001712	1.0959389	1.189491	1.245551	0.667924
Commercial	EXIT SIGNS	0.00105	0.002373	1.4681869	1.68	1.702181	0.666012
Other	TRAFFIC SIGNALS	0.00079	0.001895	1.4224507	1.615965	1.705642	0.623158
Commercial	HEATING	0.00072	0.001575	3.6863316	4.717233	8.178473	0.58211
Residential	LIGHTING	0.00065	0.001789	1.0366544	1.053436	1.088397	0.63562
Industrial	MOTORS	0.00056	0.000891	2.6538877	5.633757	4.13539	0.548264
Commercial	APPLIANCES	0.00044	0.000502	1.1612056	1.474298	2.815976	0.651537
Residential	AC	0.00042	0.000874	1.534259	2.094447	3.118524	0.993971
Retail	LIGHTING	0.00038	0.000633	1.0600986	1.119003	1.289272	0.635872
Residential	WATER HEATING	0.00025	0.000288	1.2550009	1.713382	2.905316	0.592306
Residential	ENVELOPE	0.00024	0.000271	1.6130093	3.047789	2.695395	0.573109
Other	VENDING MACHINES	4.3E-05	6.2E-05	0.9175291	1.034029	1.558949	0.806447
Commercial	LIGHTING	0	0	0.7648173	0.768569	1.019761	0.553018

- HEATING - Post79/Pre93 Single Family Construction Convert FAF w/o CAC to HP w/PTCS - Heat Pump rated HSPF 8.0 or higher and SEER 12 or higher w PTCS

- MOTORS - New Premium Efficiency Open Drip-Proof (ODP) Industrial Motors, 100 - 250 HP - Premium Efficiency 15 HP 1800 RPM ODP
- HEATING - Commercial Small Heat Pump - Heat pump rated HSPF 8.0 and SEER 13 or higher
- LIGHTING - Grocery, HtPmp Heat - 2-F32T8 32watt T8 lamp(s) w/ IS Elect. ballast
- LIGHTING - Restaurant, Gas Heat - 2-F32T8 32watt T8 lamp(s) w/ IS Elect. ballast
- LIGHTING - Residential Lighting - Energy Star CFL Exterior - 26 Watt
- APPLIANCES - Single Family Residence w/Electric Water Heat - Energy Star Dishwasher - Electric DHW
- ENVELOPE - New Low Rise (Less than 5 Stories) Multifamily Dwellings w/Electric Heat - Long Term Super Good Cents Program & Specifications
- TRAFFIC SIGNALS - Existing and new traffic signals - LED Traffic Signals - Replace 12 inch Red Incandescent Left Turn Bay with 12 inch Red LED module
- VENDING MACHINES - Existing and new vending machines with illuminated fronts - Vending Machine Controller-Large Machine w/Illuminated Front
- WATER HEATING - Residence w/Electric Water Heat - EF- 0.91 Domestic Water Heater w/80 gallon rated capacity and minimum 10 year warranty
- EXIT SIGNS - Building or structure where exit signs are required - Energy Star Light Emitting Diode (LED) Exit Sign - Incandescent Exit Sign Base Case Fixture
- ENVELOPE - Small Office Weatherization Floor Insulation - R0 > R19 batt
- APPLIANCES - Multifamily common area or commercial Laundromat w/Electric Dryer and Electric Water Heat - Energy Star Clothes Washer - Commercial Laundry - Electric Water Heater & Dryer
- AC - Residential Dwellings - Energy Star Window Air Conditioner - 19000 Btu/hr

Table 43: Detailed DSM Calculation of Best Base Case Measure: Base Case

		DSM Measure
1	Name	HEATING - Post79/Pre93 Single Family Construction Convert FAF w/oCAC to HP w/PTCS - Heat Pump rated HSPF 8.0 or higher and SEER 12 or higher w PTCS
2	Sector: Res(1) / Com(2) / Retail(3) / Ind(4) / Other(5)	1
3	End Use: Heating(1) Envelope(2) Lighting(3) Water Heating(4) AC (5) Appliances (6) Exit Signs (7) Motors (8) Traffic Signals (9) Vending Machines (10)	1
4	Original Device (Name)	Forced Air Furnace without Cental AC
5	Replacement Device	Heat Pump rated HSPF 8.0 or higher and SEER 12 or higher w PTCS
6	Cost of Original Device	$3,868.94
7	Cost of Replacement Device	$4,381.97
8	Measure Life (Years)	18
9	Incentive Basis (Enter 1 for Early Replacement, 2 for Failure Replacement, 3 for Either)	3
10	Incentive as % of Incremental Cost	100%
11	BPA % of incentive	50%
12	BPA Admin Cost $/measure one time cost	$0.00
13	Distribution Utility Admin Cost $/measure one time cost	$0.00
	Annual Demand and Energy Impacts	
14	System Coincident Peak Reduction (KW)	2.7596
15	Local Distribution System Peak Load Reduction (kW)	7.3915
16	Annual Savings @ Site (kwh/yr)	9,468
17	Annual Savings @ Busbar (kwh/yr)	10,190
18	T&D Line Loss Factor	7.625%
19	kW Savings Basis (Enter 1 for System Coincident, 2 for Local Distribution)	1
20	Demand Reduction for Billing Determinants (Enter 1 for System Coincident, 2 for Local Distribution)	2
21	# of Months of Demand Reduction	4
22	Load Distribution Factor	32%
	Lifecycle Avoided Costs per kW or kWh	
23	Peak Period kW Savings (for Gen capacity savings)	2.7596
24	Peak Period kW Savings (for T capacity savings)	0.88
25	Peak Period kW Savings (for Distribution Capacity Savings)	7.39
26	Annual kWh/measure	10190
27	Monthly Peak Demand Reduction (kW) (for billing determinants)	7.39
28	Generation Capacity $/kW	$0.00
29	Transmission $/kW (total 3-yr marginal cost discounted at utility discount rate)	$5.70
30	Avoided Loss Savings $/kW (total 3-year avoided losses)	$7.34
31	Local Distribution Company $/kW (local distr. marginal cost accruing over 10 years, discounted at utility discount rate)	$0.00
32	Local Distribution Company $/kW (local distr. marginal cost accruing over 10 years, discounted at societal discount rate)	$0.00
33	Energy $/kWh ($MWh marg. cost accruing over 10 yrs discounted at utility disc. rate / 1000)	$0.46
34	Energy (discounted at societal disc. rate) + Environmental Adder $/kWh (energy per unit cost [33] + {$MWh env. adder cost accruing over 10 yrs discounted at societal disc. rate} / 1000)	$0.65
	BPA Rates and Lost Revenue	
35	Transmission Average Rate $/kW-month	$2.5600
36	Transmission Revenue Loss $/year (trans avg rate [35] * monthly peak demand reduction [27] * months of demand reduction [21])	$75.69
	Distribtuion Utility Rates and Lost Revenue	
37	Total Average Rate $/kWh	$0.0650
38	Total Electricity Revenue Loss $/year (total avg rate [37] * annual kWh/measure [26])	$662.37
	Lifecycle Avoided Costs, Revenue, Incentive per measure	
39	Generation Avoided Cost (gen. capacity per unit cost [28] * peak period kW savings [23])	$0.00
40	Transmission Avoided Cost (trans. per unit cost [29] * Peak Period kW savings [24])	$5.04
41	Avoided Loss Savings $/kW [30] * Peak Period kW Savings [24])	$6.48
42	Local Distribution Company (local distr. per unit cost [31] * peak period kW savings [25])	$0.00
43	Societal Local Distribution Company (local distr. per unit cost [32] * peak period kW savings [25])	$0.00
44	Energy (energy per unit cost [33] * annual kWh/measure [26])	$4,642.08
45	Energy w/ Environment (energy & env. adder per unit cost [34] * annual kWh/measure [26])	$6,644.72
46	Total Electricity Revenue Loss (discounted at utility discount rate)	$7,537.72
47	Total Distribution Utility Rates Avoided (discounted at generator discount rate)	$5,245.82
48	Transmission Revenue Loss	$861.34
49	Lifecycle BPA Incentive Payment	$256.52
50	Lifecycle BPA Admin Cost	$0.00
51	Lifecycle Distribution Utility Incentive Payment	$256.52
52	Lifecycle Distribution Utility Admin Cost	$0.00

Table 44: Detailed DSM Results of Best DSM Measure: Base Case

		HEATING - Post79/Pre93 Single Family Construction Convert FAF w/oCAC to HP w/PTCS - Heat Pump rated HSPF 8.0 or higher and SEER 12 or higher w PTCS
	RIM Test - BPA TBL	
53	Program Cost (BPA Incentive+Trans. Rev. Loss+ BPA Admin)	$1,117.85
54	Program Benefit (Trans Savings)	$5.04
55	Net Savings	($1,112.82)
56	BC Ratio	0.00
	Utility Cost Test - BPA TBl	
57	Program Cost (Incentive + Admin)	$256.52
58	Program Benefit (Trans Savings)	$5.04
59	Net Savings	($251.48)
60	BC Ratio	0.02
	TRC Cost Test	
61	Program Cost (Measure Cost + Admin Costs + Avoided Loss Savings)	$4,388.45
62	Program Benefit (Gen Savings + T Savings + D Savings)	$8,516.05
63	Net Savings	$4,127.60
64	BC Ratio	1.94
	Societal Cost Test	
65	Program Cost (Measure Cost + Admin Costs + Avoided Loss Savings)	$4,388.45
66	Program Benefit (Electric Gen Savings + Trans Savings + Environment)	$10,518.69
67	Net Savings	$6,130.24
68	BC Ratio	2.40
	Participant Cost Test	
69	Program Cost (Buy Device)	$4,381.97
70	Program Benefit (Incentive + Electricity Bill Reduction+ Replace Conv. Device)	$9,627.78
71	Net Savings	$5,245.82
72	BC Ratio	2.20
	RIM Test - Distribution Utility	
73	Program Cost (Dist. Utility Incentive + Dist. Revenue Loss + Utility Admin)	$7,794.23
74	Program Benefit (Trans. Bill Reduction + D Savings + Gen Savings)	$5,503.41
75	Net Savings	($2,290.82)
76	BC Ratio	0.71

Section 11 Appendix 2: DG Results

Table 45: Base Case Results: BC Ratio for Each DG Technology

	RIM-BPA/TBL	Utility Cost	TRC Cost	Societal Cost	Participant Cost	RIM-LDC
Gas Spark Ignition	0.01	1.00	0.56	0.50	0.56	1.03
Cummins Genset	0.01	1.00	0.54	0.48	0.54	1.03
Low Temp (PEM) Fuel Cell	0.01	1.00	0.44	0.49	0.44	0.88
High Temp Fuel Cell	0.01	1.00	0.42	0.48	0.42	0.88
Generic Diesel Engine	0.01	1.00	0.41	0.36	0.41	1.03

Table 46: High Case Results: BC Ratio for Each DG Technology

	RIM-BPA/TBL	Utility Cost	TRC Cost	Societal Cost	Participant Cost	RIM-LDC
Gas Spark Ignition	0.02	1.00	0.73	0.66	0.56	1.28
Cummins Genset	0.02	1.00	0.70	0.63	0.54	1.28
Low Temp (PEM) Fuel Cell	0.02	1.00	0.58	0.62	0.45	1.12
High Temp Fuel Cell	0.02	1.00	0.54	0.60	0.42	1.12
Generic Diesel Engine	0.02	1.00	0.54	0.47	0.42	1.28

Table 47: Low Case Results: BC Ratio for Each DG Technology

	RIM-BPA/TBL	Utility Cost	TRC Cost	Societal Cost	Participant Cost	RIM-LDC
Gas Spark Ignition	0.00	1.00	0.41	0.37	0.56	0.82
Cummins Genset	0.00	1.00	0.39	0.35	0.54	0.82
Low Temp (PEM) Fuel Cell	0.00	1.00	0.32	0.37	0.44	0.66
High Temp Fuel Cell	0.00	1.00	0.30	0.36	0.42	0.66
Generic Diesel Engine	0.00	1.00	0.30	0.26	0.41	0.82

Table 48: Detailed Calculation of DG Results: Base Case

	Calculation	DG Customer Bypass (includes lost retail revenue)
1	DG Device	Gas Spark Ignition
2	BPA Incentive Cost $/kW	$1.83
3	Distribution Utility Incentive Cost $/kW	$0.00
4	Generator Life (Years)	10
5	Fuel Cost $/MMBtu	$3.81
6	Heat Rate Btu/kWh	9,000
7	Capital Cost $/kW	$550.00
8	Install Cost $/kW	$0.00
9	Fixed O&M $/kW-yr	$16.61
10	Variable O&M $/kWh	$0.015
11	Lifecycle BPA Admin Cost	$0.00
12	Lifecycle Distribution Utility Admin Cost	$0.00
	Generator Operating Assumptions	
13	Peak Period kW Savings (at T Constraint)	0.32
14	Annual Load Factor	30%
15	Monthly Peak Demand Reduction (kW) (for billing determinants)	1.00
16	Environmental Externality Benefit? 0=no, 1=yes	0.00
17	Market Energy Price ($/kWh)	$0.040
	Generator Cost Calculations	
18	Fuel Cost $/kWh ($/MMBtu [5] * Heat Rate [6] / 10^6)	$0.03
19	Annual Fuel and O&M Costs $/kW ({fuel cost [18] + var. O&M [10]} * annual load factor [14] * 8760 hrs in a yr + fixed O&M [9])	$146.14
	Lifecycle Generator Costs	
20	Lifecycle Capital Cost ($/kW) (cap. cost [7] + install cost [8])	$550.00
21	Lifecycle Fuel and O&M Cost ($/kW) (Discounted at Generator WACC)	$910.26
22	Total Lifecycle Cost ($/kW)	$1,460.26
23	Lifecycle Fuel and O&M Cost ($/kW) (Discounted at Societal Discount Rate)	$1,284.04
	Per Unit Lifecycle Avoided Costs	
24	Generation Capacity $/kW	$0.00
25	Transmission $/kW (total 10-year trans. marginal cost discounted at utility discount rate)	$5.70
26	Avoided Loss Savings $/kW (total 3-year avoided losses)	$7.34
27	Local Distribution Company $/kW (local distr. marginal cost accruing over 10 years, discounted at utility discount rate)	$0.00
28	Local Distribution Company $/kW (local distr. marginal cost accruing over 10 years, discounted at societal discount rate)	$0.00
29	Energy $/kWh ($MWh marg. cost accruing over 10 yrs discounted at utility disc. rate / 1000)	$0.31
30	Energy (discounted at Societal Discount Rate) + Environmental Adder (If Clean Generation) $/kWh (energy per unit cost discounted at Societal Discount Rate + {$MWh env. adder cost accruing over 10 yrs discounted at Societal Discount Rate} / 1000)	$0.35
31	Energy $/kWh ($MWh marg. cost accruing over 10 yrs discounted at generator disc. rate/1000)	$0.25
	Rates and Lost Revenue	
32	Total Average Rate $/kWh	$0.0500
33	Transmission Average Rate $/kW-month	$2.5600
34	Total Electricity Revenue Loss $/year (total avg rate [32] * annual load factor [14] * 8760 hrs in a yr)	$131.40
35	Transmission Revenue Loss $/year (trans. avg. rate [33] * monthly peak demand reduction [15] * annual load factor [14] * 12 months)	$30.72
	Lifecycle Avoided Costs per kW, Revenue per kW, Incentive per kW	
36	Generation Avoided Cost (gen. capacity per unit cost [24] * peak period kW savings [13])	$0.00
37	Transmission Avoided Cost (trans. per unit cost [25] * peak period kW savings [13])	$1.83
38	Avoided Loss Savings $/kW [26] * Peak Period kW Savings[13])	$2.35
39	Local Distribution Company (local distr. per unit cost [27] * peak period kW savings [13])	$0.00
40	Local Distribution Company (local distr. per unit cost [28] * peak period kW savings [13])	$0.00
41	Energy (energy per unit cost [29] * annual load factor [14] * 8760 hrs in a yr)	$816.70
42	Energy w/ Environment (energy & env. adder per unit cost [30] * annual load factor [14] * 8760 hrs in a yr)	$924.29
43	Total Electricity Revenue Loss (total annual loss [34] accruing over 10 years, discounted at utility discount rate)	$1,020.11
44	Total Distribution Utility Rates Avoided (total distribution utility annual loss [34] accruing over 10 years, discounted at financing rate of generator)	$818.42
45	Sales of Energy (energy per unit cost [31] * annual load factor [14] * 8760 hours in a yr)	$0.00
46	Transmission Revenue Loss (total annual loss [35] accruing over 10 years, discounted at utility discount rate)	$238.49
47	Lifecycle BPA Incentive Payment	$1.83
48	Lifecycle Distribution Utility Incentive Payment	$0.00
49	Lifecycle BPA Admin Cost	$0.00
50	Lifecycle Distribution Utility Admin Cost	$0.00

Table 49: Detailed Results of Best DG Measure: Base Case

		DG Customer Bypass (includes lost retail revenue)
	RIM Test - BPA TBL	
51	Program Cost (Incentive[47] + T Rev. Loss[46] + Admin[49])	$240.32
52	Program Benefit (T Savings[37])	$1.83
53	Net Savings	($238.49)
54	BC Ratio	0.01
	Utility Cost Test - BPA TBL	
55	Program Cost (Incentive[47] + Admin[49])	$1.83
56	Program Benefit (T Savings[37])	$1.83
57	Net Savings	$0.00
58	BC Ratio	1.00
	TRC Cost Test	
59	Program Cost (DG Cost[22] + Admin Costs[49,50]+Avoided Loss Savings[38])	$1,462.61
60	Program Benefit (Gen Cap Savings[36] + Energy [41] + T Savings[37] + D Savings[39])	$818.52
61	Net Savings	($644.08)
62	BC Ratio	0.56
	Societal Cost Test	
63	Program Cost (DG Cost[20,23] + Admin Costs[49,50] +Avoided Loss Savings[38])	$1,836.39
64	Program Benefit (Gen Cap Savings [36 Energy w/ Environment [42] + T Savings[37] + D Savings[40])	$926.11
65	Net Savings	($910.27)
66	BC Ratio	0.50
	Participant Cost Test	
67	Program Cost (DG Costs[22])	$1,460.26
68	Program Benefit (Incentive[47,48] + Electricity Bill Reduction or Energy sales[44 or 45])	$820.25
69	Net Savings	($640.01)
70	BC Ratio	0.56
	RIM Test - Distribution Utility	
71	Program Cost (Incentive[48] + Dist. Revenue Loss[43] + Utility Admin[50])	$1,020.11
72	Program Benefit (Trans. Bill Reduction[46] + D Savings[27] + Gen Savings[41] in bypass scenario)	$1,055.19
73	Net Savings	$35.08
74	BC Ratio	1.03

Section 11. Appendix 3: G Results

Table 50: Base Case Results: BC Ratio for Each Large Scale Generation Technology

	RIM-BPA/TBL	Utility Cost	TRC Cost	Societal Cost	Participant Cost	RIM-LDC
Combined Cycle Combustion Turbine	1.00	1.00	1.56	1.10	0.99	Not Effected
Simple Cycle Combustion Turbine	1.00	1.00	0.71	0.63	0.57	Not Effected

Table 51: High Case Results: BC Ratio for Each Large Scale Generation Technology

	RIM-BPA/TBL	Utility Cost	TRC Cost	Societal Cost	Participant Cost	RIM-LDC
Combined Cycle Combustion Turbine	1.00	1.00	2.03	1.44	1.30	Not Effected
Simple Cycle Combustion Turbine	1.00	1.00	0.93	0.82	0.75	Not Effected

Table 52: Low Case Results: BC Ratio for Each Large Scale Generation Technology

	RIM-BPA/TBL	Utility Cost	TRC Cost	Societal Cost	Participant Cost	RIM-LDC
Combined Cycle Combustion Turbine	1.00	1.00	1.13	0.80	0.72	Not Effected
Simple Cycle Combustion Turbine	1.00	1.00	0.52	0.46	0.41	Not Effected

Table 53: Detailed Calculation of G Results: Base Case

	Calculation	DG Merchant Plant (Connected to BPA)
1	DG Device	Combined Cycle Combustion Turbine
2	BPA Incentive Cost $/kW	$1.83
3	Distribution Utility Incentive Cost $/kW	$0.00
4	Generator Life (Years)	25
5	Fuel Cost $/MMBtu	$3.81
6	Heat Rate Btu/kWh	7,618
7	Capital Cost $/kW	$523.06
8	Install Cost $/kW	$0.00
9	Fixed O&M $/kW-yr	$23.23
10	Variable O&M $/kWh	$0.001
11	Lifecycle BPA Admin Cost	$0.00
12	Lifecycle Distribution Utility Admin Cost	$0.00
	Generator Operating Assumptions	
13	Peak Period kW Savings (at T Constraint)	0.32
14	Annual Load Factor	90%
15	Monthly Peak Demand Reduction (kW) (for billing determinants)	0.00
16	Environmental Externality Benefit? 0=no, 1=yes	0.00
17	Market Energy Price ($/kWh)	$0.040
	Generator Cost Calculations	
18	Fuel Cost $/kWh ($/MMBtu [5] * Heat Rate [6] / 10^6)	$0.03
19	Annual Fuel and O&M Costs $/kW ({fuel cost [18] + var. O&M [10]} * annual load factor [14] * 8760 hrs in a yr + fixed O&M [9])	$256.79
	Lifecycle Generator Costs	
20	Lifecycle Capital Cost ($/kW) (cap. cost [7] + install cost [8])	$523.06
21	Lifecycle Fuel and O&M Cost ($/kW) (Discounted at Generator WACC)	$2,189.46
22	Total Lifecycle Cost ($/kW)	$2,712.52
23	Lifecycle Fuel and O&M Cost ($/kW) (Discounted at Societal Discount Rate)	$4,605.61
	Per Unit Lifecycle Avoided Costs	
24	Generation Capacity $/kW	$0.00
25	Transmission $/kW (total 10-year trans. marginal cost discounted at utility discount rate)	$5.70
26	Avoided Loss Savings $/kW (total 3-year avoided losses)	$7.34
27	Local Distribution Company $/kW (local distr. marginal cost accruing over 10 years, discounted at utility discount rate)	$0.00
28	Local Distribution Company $/kW (local distr. marginal cost accruing over 10 years, discounted at societal discount rate)	$0.00
29	Energy $/kWh ($MWh marg. cost accruing over 10 yrs discounted at utility disc. rate / 1000)	$0.54
30	Energy (discounted at Societal Discount Rate) + Environmental Adder (If Clean Generation) $/kWh (energy per unit cost discounted at Societal Discount Rate + {$MWh env. adder cost accruing over 10 yrs discounted at Societal Discount Rate} / 1000)	$0.72
31	Energy $/kWh ($MWh marg. cost accruing over 10 yrs discounted at generator disc. rate/1000)	$0.34
	Rates and Lost Revenue	
32	Total Average Rate $/kWh	$0.0500
33	Transmission Average Rate $/kW-month	$2.5600
34	Total Electricity Revenue Loss $/year (total avg rate [32] * annual load factor [14] * 8760 hrs in a yr)	$0.00
35	Transmission Revenue Loss $/year (trans. avg. rate [33] * monthly peak demand reduction [15] * annual load factor [14] * 12 months)	$0.00
	Lifecycle Avoided Costs per kW, Revenue per kW, Incentive per kW	
36	Generation Avoided Cost (gen. capacity per unit cost [24] * peak period kW savings [13])	$0.00
37	Transmission Avoided Cost (trans. per unit cost [25] * peak period kW savings [13])	$1.83
38	Avoided Loss Savings $/kW [26] * Peak Period kW Savings[13])	$2.35
39	Local Distribution Company (local distr. per unit cost [27] * peak period kW savings [13])	$0.00
40	Local Distribution Company (local distr. per unit cost [28] * peak period kW savings [13])	$0.00
41	Energy (energy per unit cost [29] * annual load factor [14] * 8760 hrs in a yr)	$4,229.31
42	Energy w/ Environment (energy & env. adder per unit cost [30] * annual load factor [14] * 8760 hrs in a yr)	$5,660.39
43	Total Electricity Revenue Loss (total annual loss [34] accruing over 10 years, discounted at utility discount rate)	$0.00
44	Total Distribution Utility Rates Avoided (total distribution utility annual loss [34] accruing over 10 years, discounted at financing rate of generator)	$0.00
45	Sales of Energy (energy per unit cost [31] * annual load factor [14] * 8760 hours in a yr)	$2,690.90
46	Transmission Revenue Loss (total annual loss [35] accruing over 10 years, discounted at utility discount rate)	$0.00
47	Lifecycle BPA Incentive Payment	$1.83
48	Lifecycle Distribution Utility Incentive Payment	$0.00
49	Lifecycle BPA Admin Cost	$0.00
50	Lifecycle Distribution Utility Admin Cost	$0.00

Table 54: Detailed Results of Best G Measure: Base Case

		DG Merchant Plant (Connected to BPA)
	RIM Test - BPA TBL	
51	Program Cost (Incentive[47] + T Rev. Loss[46] + Admin[49])	$1.83
52	Program Benefit (T Savings[37])	$1.83
53	Net Savings	$0.00
54	BC Ratio	1.00
	Utility Cost Test - BPA TBL	
55	Program Cost (Incentive[47] + Admin[49])	$1.83
56	Program Benefit (T Savings[37])	$1.83
57	Net Savings	$0.00
58	BC Ratio	1.00
	TRC Cost Test	
59	Program Cost (DG Cost[22] + Admin Costs[49,50]+Avoided Loss Savings[38])	$2,714.87
60	Program Benefit (Gen Cap Savings[36] + Energy [41] + T Savings[37] + D Savings[39])	$4,231.13
61	Net Savings	$1,516.26
62	BC Ratio	1.56
	Societal Cost Test	
63	Program Cost (DG Cost[20,23] + Admin Costs[49,50] +Avoided Loss Savings[38])	$5,131.02
64	Program Benefit (Gen Cap Savings [36 Energy w/ Environment [42] + T Savings[37] + D Savings[40])	$5,662.22
65	Net Savings	$531.20
66	BC Ratio	1.10
	Participant Cost Test	
67	Program Cost (DG Costs[22])	$2,712.52
68	Program Benefit (Incentive[47,48] + Electricity Bill Reduction or Energy sales[44 or 45])	$2,692.72
69	Net Savings	($19.80)
70	BC Ratio	0.99

Section 12. Appendix 4: DR Results

Table 55: Base Case Results: BC Ratio for Each DR Measure

	RIM-BPA/TBL	Utility Cost	TRC Cost	Societal Cost	Participant Cost	RIM-LDC
BPA (Conceptual)	1.00	1.00	0.33	0.35	0.42	0.80
Day-Ahead Demand Response Program	0.21	0.21	0.33	0.36	0.87	0.80
Energy Exchange Program	0.12	0.12	0.33	0.35	1.04	0.80
Demand Exchange	0.12	0.12	0.33	0.36	1.25	0.80
Voluntary Load Reduction	0.04	0.04	0.31	0.33	1.39	0.80
Demand Buy Back	0.04	0.04	0.30	0.33	1.39	0.80
Emergency Demand Response Program	0.03	0.03	0.33	0.36	3.67	0.80
Emergency Response Program	0.03	0.03	0.33	0.36	3.67	0.80
Scheduled Load Reduction Program	0.03	0.03	0.29	0.32	1.04	0.80
Reliability Program Rider	0.03	0.03	0.31	0.35	3.13	0.80
Demand Bidding Program	0.02	0.02	0.31	0.33	2.80	0.80
Capacity Program - Interruptible Tariff	0.01	0.01	0.29	0.31	1.31	0.80
Economy Program - Interruptible Tariff	0.01	0.01	0.29	0.31	1.31	0.80
Energy Cooperative (Curtailment Service Cooperative)	0.01	0.01	0.31	0.32	2.50	0.80
Com/Ind. Base Interruptible Program	0.01	0.01	0.30	0.32	5.26	0.80
Interruptible Service	0.00	0.00	0.29	0.31	3.15	0.80
Demand Relief Program	0.00	0.00	0.31	0.33	9.72	0.80
The Alliance Option C - Curtailable	0.00	0.00	0.00	0.00	2.86	0.80
The Alliance Option B - Curtailable	0.00	0.00	0.00	0.00	3.29	0.80
The Alliance Option A - Interruptible	0.00	0.00	0.00	0.00	3.19	0.80

Table 56: High Case Results: BC Ratio for Each DR Measure

	RIM-BPA/TBL	Utility Cost	TRC Cost	Societal Cost	Participant Cost	RIM-LDC
BPA (Conceptual)	1.00	1.00	0.70	0.73	1.14	1.05
Day-Ahead Demand Response Program	0.69	0.69	0.69	0.73	1.64	1.05
Energy Exchange Program	0.41	0.41	0.70	0.73	1.95	1.05
Demand Exchange	0.41	0.41	0.69	0.73	2.34	1.05
Voluntary Load Reduction	0.13	0.13	0.70	0.73	2.61	1.05
Demand Buy Back	0.12	0.12	0.70	0.73	2.61	1.05
Emergency Demand Response Program	0.11	0.11	0.69	0.73	6.87	1.05
Emergency Response Program	0.11	0.11	0.69	0.73	6.87	1.05
Scheduled Load Reduction Program	0.10	0.10	0.70	0.73	1.95	1.05
Reliability Program Rider	0.09	0.09	0.68	0.73	5.87	1.05
Demand Bidding Program	0.06	0.06	0.70	0.73	5.25	1.05
Capacity Program - Interruptible Tariff	0.05	0.05	0.69	0.73	2.45	1.05
Economy Program - Interruptible Tariff	0.05	0.05	0.69	0.73	2.45	1.05
Energy Cooperative (Curtailment Service Cooperative)	0.04	0.04	0.73	0.73	4.68	1.05
Com/Ind. Base Interruptible Program	0.02	0.02	0.70	0.73	9.87	1.05
Interruptible Service	0.02	0.02	0.69	0.73	5.91	1.05
Demand Relief Program	0.02	0.02	0.70	0.73	18.23	1.05
The Alliance Option C - Curtailable	0.00	0.00	0.00	0.00	5.35	1.05
The Alliance Option B - Curtailable	0.00	0.00	0.00	0.00	6.18	1.05
The Alliance Option A - Interruptible	0.00	0.00	0.00	0.00	5.98	1.05

Table 57: Low Case Results: BC Ratio for Each DR Measure

	RIM-BPA/TBL	Utility Cost	TRC Cost	Societal Cost	Participant Cost	RIM-LDC
BPA (Conceptual)	1.00	1.00	0.23	0.25	0.37	0.58
Day-Ahead Demand Response Program	0.09	0.09	0.23	0.26	0.87	0.58
Energy Exchange Program	0.05	0.05	0.23	0.26	1.04	0.58
Demand Exchange	0.05	0.05	0.23	0.26	1.25	0.58
Voluntary Load Reduction	0.02	0.02	0.22	0.24	1.39	0.58
Demand Buy Back	0.01	0.01	0.22	0.24	1.39	0.58
Emergency Demand Response Program	0.01	0.01	0.23	0.26	3.67	0.58
Emergency Response Program	0.01	0.01	0.23	0.26	3.67	0.58
Scheduled Load Reduction Program	0.01	0.01	0.21	0.24	1.04	0.58
Reliability Program Rider	0.01	0.01	0.22	0.25	3.13	0.58
Demand Bidding Program	0.01	0.01	0.22	0.24	2.80	0.58
Capacity Program - Interruptible Tariff	0.01	0.01	0.21	0.24	1.31	0.58
Economy Program - Interruptible Tariff	0.01	0.01	0.21	0.24	1.31	0.58
Energy Cooperative (Curtailment Service Cooperative)	0.00	0.00	0.22	0.24	2.50	0.58
Com/Ind. Base Interruptible Program	0.00	0.00	0.22	0.24	5.26	0.58
Interruptible Service	0.00	0.00	0.21	0.24	3.15	0.58
Demand Relief Program	0.00	0.00	0.22	0.24	9.72	0.58
The Alliance Option C - Curtailable	0.00	0.00	0.00	0.00	2.86	0.58
The Alliance Option B - Curtailable	0.00	0.00	0.00	0.00	3.29	0.58
The Alliance Option A - Interruptible	0.00	0.00	0.00	0.00	3.19	0.58

Table 58: Detailed Calculation of DR Results: Base Case

		DR-DLC Measure
1	DR-DLC Program Company	Conceptual DR Program
2	DR-DLC Program Name	BPA (Conceptual)
3	Customer Cost of Dropped Load ($/kWh) (Lost Productivity)	$0.15
4	BPA Incentive Cost $/kW-year	$0.64
5	Distribution Utility Incentive Cost $/kW-year	$0.00
6	Measure Life (Years)	3
	Annual Demand and Energy Impacts	
7	Peak Period kW Savings (for T&D capacity savings)	0.32
8	Number of hours per year	50
9	Monthly Peak Demand Reduction (kW) (for billing determinants)	0.00
10	Months in Peak Load Season for Curtailment	3
11	BPA Admin Cost $/measure one time cost	$0.00
12	Distribution Utility Admin Cost $/measure one time cost	$0.00
13	Customer Cost of Dropped Load ($/kW lifecycle) ([3] accruing over 3 yrs, discounted at generator rates)	$20.09
14	Customer Cost of Dropped Load ($/kW lifecycle) ([3] accruing over 3 yrs, discounted at societal disc. rates)	$21.85
15	BPA Incentive Cost $/kW lifecycle ([4] accruing over program life, discounted at utility discount rate)	$1.83
16	Distribution Utility Incentive Cost $/kW lifecycle ([5] accruing over program life, discounted at utility discount rate)	$0.00
	Lifecycle Avoided Costs per kW or kWh	
17	Generation Capacity $/kW (discounted at utility discount rate)	$0.00
18	Transmission $/kW (total 3-year marginal cost discounted at utility discount rate)	$5.70
19	Avoided Loss Savings $/kW (total 3-year avoided losses)	$7.34
20	Local Distribution Company $/kW (local distr. marginal cost accruing over 3 years, discounted at utility discount rate)	$0.00
21	Local Distribution Company $/kW (local distr. marginal cost accruing over 3 years, discounted at societal discount rate)	$0.00
22	Energy $/kWh ($MWh wholesale energy cost accruing over 3 yrs discounted at utility disc. rate / 1000)	$0.11
23	Energy $/kWh (discounted at societal disc. rate) + Environmental Adder $/kWh (discounted at societal disc. Rate)	$0.13
	Rates, Administration Costs, and Lost Revenue	
24	Total Average Rate $/kWh	$0.0500
25	Transmission Average Rate $/kW-month	$2.5600
26	Distribution Utility Electricity Revenue Loss $/year (total avg rate [24] * annual kWh/measure [8])	$2.50
27	Transmission Revenue Loss $/year (trans avg rate [25] * monthly peak demand reduction [9] * months in peak load season [10])	$0.00
	Lifecycle Avoided Costs, Revenue, Incentive per measure	
28	Generation Avoided Cost (gen. capacity per unit cost [17] * peak period kW savings [7])	$0.00
29	Transmission Avoided Cost (trans. per unit cost [18] * peak period kW savings [7])	$1.83
30	Avoided Loss Savings $/kW [19] * Peak Period kW Savings[7])	$2.35
31	Distribution Avoided Cost (local distr. per unit cost [20] * peak period kW savings [7])	$0.00
32	Distribution Avoided Cost (local distr. per unit cost [21] * peak period kW savings [7])	$0.00
33	Energy (energy per unit cost [22] * annual kWh/measure [8])	$5.66
34	Energy w/ Environment (energy & env. adder per unit cost [23] * annual kWh/measure [8])	$6.71
35	Total Electricity Revenue Loss [26] (discounted at utility rates)	$7.08
36	Total Distribution Utility Rates Avoided [26] (discounted at generator rates)	$6.70
37	Transmission Revenue Loss [27] (discounted at utility rates)	$0.00
38	Lifecycle BPA Incentive Payment [15]	$1.83
39	Lifecycle Distribution Utility Incentive Payment [16]	$0.00
40	Lifecycle BPA Admin Cost [11]	$0.00
41	Lifecycle Distribution Utility Admin Cost [12]	$0.00

Table 59: Detailed Results of Best DR Measure: Base Case

		DR-DLC Measure
	RIM Test - BPA TBL	
42	Program Cost (Incentive [38] + Trans. Rev. Loss [37] + Admin [40])	$1.83
43	Program Benefit (Trans Savings [29])	$1.83
44	Net Savings	$0.00
45	BC Ratio	1.00
	Utility Cost Test - BPA TBL	
46	Program Cost (Incentive [38] + Admin [40])	$1.83
47	Program Benefit (Trans Savings [29])	$1.83
48	Net Savings	$0.00
49	BC Ratio	1.00
	TRC Cost Test	
50	Program Cost (Cost of Dropped Load [13] + Admin Costs [40,41])+Avoided Loss Savings[30]	$22.44
51	Program Benefit (Gen Savings [28,33] + T Savings [29] + D Savings [31])	$7.49
52	Net Savings	($14.95)
53	BC Ratio	0.33
	Societal Cost Test	
54	Program Cost (Cost of Dropped Load [14] + Admin Costs [40,41])+Avoided Loss Savings[30]	$24.20
55	Program Benefit (Gen Savings [28,34] + T Savings [29] + D Savings [32])	$8.53
56	Net Savings	($15.67)
57	BC Ratio	0.35
	Participant Cost Test	
58	Program Cost (Cost of Dropped Load [13])	$20.09
59	Program Benefit (Incentives [38,39] + Electricity Bill Reduction [36])	$8.52
60	Net Savings	($11.57)
61	BC Ratio	0.42
	RIM Test - Distribution Utility	
62	Program Cost (Dist. Utility Incentive [16] + Dist. Revenue Loss [35] + Utility Admin [12])	$7.08
63	Program Benefit (Trans. Bill Reduction [37] + D Savings [31] + Gen Savings [28,33])	$5.66
64	Net Savings	($1.41)
65	BC Ratio	0.80

Section 13. Appendix 5: Glossary

'Arctic Express' weather event

A 1-in-20 year extreme cold temperatures resulting from the southern flow of northern Arctic air into the United States.

Avoided Loss Savings

Lost savings from an avoided reduction of electricity losses on the transmission system that occur because the transmission system upgrades are deferred.

B/C ratios

Benefit / Cost ratio is a measure of cost-effectiveness calculated as the ratio of benefits of a particular measure to the costs of the measure. The benefits and costs included depend upon the particular cost test, but in all cases a measure is cost-effective under a particular cost test if the B/C ratio is greater than one.

BPA

Bonneville Power Administration.

Canadian Entitlement

Canada's one half share of the additional power produced on the Columbia River in the western United States as a result of the 1961 Columbia River Treaty. Canada sold its share of the power benefits for a 30-year period to a consortium of United States utilities and delivery of the Canadian Entitlement began in 1998.

Columbia River Treaty

A United States/Canadian treaty signed in 1961, which led to the construction of three storage dams on the Columbia River system in Canada and one in the United States. Under the Treaty, Canada and the United States equally share the benefits of the additional power that can be generated at dams downstream in the United States because of the storage at the upstream Treaty reservoirs. Canada's half of the downstream power benefits are called the Canadian Entitlement (Entitlement).

Cost Test

A cost test is the approach used to evaluate the cost-effectiveness of a measure. Each cost test evaluates the cost-effectiveness from a different perspective, i.e. ratepayer, utility, participant, societal.

Demand Reduction Programs

Programs implemented by a utility to influence the level or timing of customers' energy demand in order to optimize the use of available utility resources

Demand Response Program

Programs implemented by a utility to reduce customer loads during system peaks. Demand response programs addressed by this study include Direct Load Control (DLC), interruptible/curtailable rates, and demand bidding (i.e. the Demand Exchange).

Direct Load Control

A method of insuring a proper balance of supply and demand, usually through the use of direct measures designed to decrease demand; the application of direct control over system load. Examples of direct load control include rolling blackouts and brownouts, mandatory service interruptions during peak demand periods, and at the most drastic stage, manual disconnection of customer equipment by the utility.

Demand Side Management (DSM)

Measures taken by a utility to influence the level or timing of customers' energy demand in order to optimize the use of available utility resources.

Direct Service Industries (DSIs)

Industrial customers that take transmission service directly from BPA.

Distribution Factor

See 'Load Flow Distribution Factor'

Distributed Generation (DG)

Generation equipment that is placed in the system to benefit the transmission and distribution delivery system in addition to providing capability of generating energy. Typically, distributed generation is sized smaller than conventional central station generation.

Environmental Adder

The societal cost on the environment of any activity. This cost is not a direct cost to, but is an externality born by society.

Environmental Externality

A non-monetary cost to society of environmental degradation.

FERC

Federal Energy Regulatory Commission.

Firm Transmission Capacity

Firm transmission capacity is the amount of transmission capacity that can be (and in many cases must be) guaranteed to be available at a given time.

Generation Avoided Costs

The cost savings achieved by reducing the need for generation. This savings does not include savings that may result in the transmission and distribution system.

Heat Rate

Measure of the amount of thermal energy needed to generate a given amount of electrical energy.

Interruptible/Curtailable Contracts

Contracts between utilities and customers that allow utilities to reduce customers' loads under predetermined terms and conditions.

ISO

Independent System Operator

KEL

Kangley Echo Lake

Lifecycle Costs/Benefits

The present value of the costs or benefits over the life of the alternative.

Load Duration Curve

A graph showing all levels of demand (or load) on an electric utility's system, sorted by decreasing size, and the amount of time (or % of time) that any given demand level equaled or exceeded that demand.

Load Flow Distribution Factor

The ratio of the MW change at the constraint on the system (ie. Covington substation) to the MW change at the source (ie. downtown Seattle).

Loss Factor

Measures the relationship between peak capacity losses and average annual losses. To calculate the MWh losses associated with peak capacity losses, the following formula is used:

Total MWh losses = Peak Capacity Loss x Loss Factor x 8,760 (number of hours in a year)

LRIC

Long-run incremental cost.

Measure

A method of reducing demand on the system such as an incentive to a customer to install more efficient air conditioning or switch to an alternative fuel.

Merchant Plant

Merchant plants are electric generating plants that sell power competitively on the wholesale market. They produce only wholesale power for which the price and supply of the power is not regulated by state or local authorities. Merchant power plants are not considered utilities because they do not sell any of their power to retail electric customers.

NEPA

National Environmental Policy Act

NWPPC

Northwest Power Planning Council, or 'The Council'

NWPP

Northwest Power Pool

Overload

A condition in any circuit in which actual current flow exceeds either the expected load or the rated load. Both conditions are potentially hazardous to devices attached to the circuit.

PBL

BPA's Power Business Line

Peak Loss Savings

The reduction in capacity losses during system peak times

Penetration Potential

The potential number of customers or the percentage of a particular market segment that can adopt a DSM/DR/DLC measure.

Price Based Dispatch Program

Voluntary participation programs where the price for curtailment or interruption is determined through a price convergence mechanism (i.e. auction, real-time pricing, etc.)

Ratepayer Impact Measure (RIM Test)

A perspective to evaluate program cost-effectiveness. The RIM test measures what happens to customer bills or rates due to changes in utility revenues and operating costs caused by the program.

Revenue Requirement

Total amount of money that must be collected from customers to pay all operating and capital costs.

RTO

Regional Transmission Operator

Societal Cost Test

A perspective to evaluate program cost-effectiveness. The Societal Cost Test is similar to the Total Resources Cost Test, but includes savings due to environmental externalities.

TBL

BPA's Transmission Business Line

Total Resource Cost Test (TRC test)

A perspective to evaluate program cost-effectiveness. The TRC test evaluates measures from a societal perspective, but does not include externality effects.

Transmission Avoided Cost

The costs avoided by not making transmission upgrades. In this study, transmission avoided costs are calculated as the value of deferring the transmission upgrades:

Deferral Value = Nominal Cost in Year (i) x (1- ((1+Inflation Rate)/(1+Discount Rate))^Δt)

Utility Cost Test

A perspective to evaluate program cost-effectiveness. The utility cost test evaluates measures from the perspective from all ratepayers (both participants and non-participants).

VOS

Value of service

WECC

Western Electricity Coordinating Council

Appendix K Transmission System Vegetation Management Program Summary

Transmission System Vegetation Management Program - Summary

Bonneville Power Administration

Background

Bonneville is responsible for maintaining a network of 15,000 miles (mi.) of electric transmission lines, 350 substations, and other related facilities. This electric transmission system operates in seven states of the Pacific Northwest (Oregon, Washington, Idaho, western Montana, and small portions of northwest Wyoming, northern California and Utah).

The Pacific Northwest offers a great diversity of vegetation. As that vegetation grows near or into our electrical facilities, or hampers access roads leading to those facilities, it can interfere with electric power flow, pose safety problems for us and neighboring members of the public, and interfere with our ability to carry out both routine and emergency maintenance of these facilities. We need to keep vegetation a safe distance away from our electric power facilities and to control noxious weeds at our facilities. **Bonneville's transmission system vegetation management program is the policy and direction for managing vegetation at our facilities throughout our service area.**

Our facilities include the following:

- **rights-of-way** (transmission lines—including trees just outside of the right-of-way, access roads, and microwave beam paths),
- **electric yards** (substations and switching stations), and
- **non-electric** facilities (maintenance work yards, landscaping around buildings, microwave sites).

Integrated Vegetation Management

Bonneville uses an integrated vegetation management strategy for controlling vegetation at our facilities where possible. Integrated vegetation management is a strategy to cost effectively control vegetation with the most benign overall long-term effect on public health and safety and the environment (ecosystem). Methods are chosen, based on the vegetation needing control and the environmental conditions present. We use our planning steps (describe later) to determine the appropriate methods and mitigation measures to use for vegetation control given the type of vegetation needing control, land ownership, land uses, and natural resources present.

Below are the four **general control methods** we have as tools for managing vegetation at our facilities**:**

- manual (chainsaws, pulling, etc.),
- mechanical (heavy equipment such as mowers and choppers),
- biological control agents (the use of insects to control noxious weeds), and
- herbicides (the use of chemicals to control vegetation).

The herbicide method can be further divided into 4 **application techniques:**

- spot (targeting a single plant, such as cut-stump treatments or injection treatments),
- localized (targeting a small clump of plants such as the use of a backpack sprayer),
- broadcast (treating an area with a hydraulic sprayer attached to a truck or tractor), and
- aerial (treatment of an area with the use of a plane or helicopter).

Bonneville presently has 23 different herbicides that could be used if appropriate (some are used only for controlling vegetation in substations).

2,4-D	Fosamine ammonium	Oryzalin
Azafenidin	Glyphosate	Paclobutrazol
Bromacil	Halosulfuron-methyl	Picloram
Chlorsulfuron	Hexazinone	Sulfometuron-methyl
Clopyralid	Imazpyr	Tebuthiuron
Dicamba	Isoxaben	Triclopyr
Dichlobenil	Mefluidide	Trinexapac-ethyl

Planning Steps Overview

Bonneville has seven planning steps that we use for site-specific vegetation management projects including rights-of-way (transmission lines, danger trees, access roads, and microwave beam paths), electric yards, and non-electric facilities. The Planning Steps are a tool for ensuring that environmental aspects are considered as part of an integrated vegetation management strategy and under NEPA.

The **Planning Steps** are as follows:

1. **Identify facility and the vegetation management need.**
2. **Identify surrounding land use and landowners/managers.**
3. **Identify natural resources.**
4. **Determine vegetation control methods.**
5. **Determine debris disposal and revegetation methods, if necessary.**
6. **Determine monitoring needs.**
7. **Prepare appropriate environmental documentation.**

Note: These steps apply to *planned* maintenance, not to *emergency* maintenance.

Each Planning Step has a set of **mitigation measures** used to avoid or reduce potential impacts on the environment, and to allow for safe operation and maintenance of the transmission system.

The Planning Steps and mitigation measures provide a consistent and efficient process for ensuring that NEPA compliance is achieved and environmental and landowner concerns are considered when making decisions about vegetation control.

The Project Manager—the person responsible for the vegetation management at a particular facility—would ensure that these steps are carried out.

In the discussion below, Federal laws are stated in shaded boxes within the text.

1. Identify facility and the vegetation management need.

In this step, Project Managers would do the following:

- Identify the facility needing vegetation control (e.g., right-of-way, access road, electric yard) and the safety and electrical clearance requirements that need to be met.
- Identify the types of vegetation needing control (e.g., tall-growing vegetation, noxious weeds) and the density of the growth.

For rights-of-way, Project Managers apply the following mitigation measures, as appropriate (in addition to measures in Steps2 through 7).

Rights-of-way

As defined here, rights-of-way include danger tree clearing, access roads and microwave beam paths.

- *With the use of applicable mitigation measures,* methods that may be appropriate for controlling vegetation on rights-of-way include manual, mechanical, herbicide (spot, localized, broadcast, and aerial), and biological controls (for noxious weeds).
- *Around transmission structure*s, control all tree and brush species within about 9 m (30 ft.) of structures. Cut stumps are not to be taller than 5 – 10 cm (2 – 4 in.). These species include blackberries, poison oak, scotch broom, and other vegetation that, by size or density, might hinder routine inspection and maintenance work or make it more hazardous.
- Pull all debris and slash out of the 9-m (30-ft.) area around transmission structures.
- *On the right-of-way*, control all tall-growing species that are now or would be a hazard to the line. Cut stumps are not to be taller than 10 – 15 cm (4 – 6 in.).
- *On access roads,* control all vegetation except grasses, to enable safe driving.
    - ✶ The access road is 4 to 8 m wide (14 to 25 ft. wide) and requires a 5-m- (15-ft.-) high clearance. Limbs should not hang down into the access road.
    - ✶ Cut stumps are not to be taller than 5 – 10 cm (2 – 4 in.) in the roadbed.

- ✶ Stumps will be cut horizontal to the ground to prevent personal injuries and tire puncture.
- ✶ Limbs are to be trimmed back as flush to the trunk as possible when trees are rooted outside of the access road.
- ✶ All debris is to be pulled back from the access road as prescribed.

- *For danger trees*, remove all off-right-of-way trees that are potentially unstable and would fall within a minimum distance or into the safety zone of the power line, as well as trees that could blow into that zone or enter into the zone when the conductor swings. Tree growth within the treatment cycle should be taken into consideration when selecting trees. (See **Appendix E** for danger tree clearance criteria.)
- *For microwave beam paths*, cut trees when they have grown into the beam path, disrupting the signal.

Promoting Low-growing Plant Communities

Consider the following steps or mitigation measures to promote a semi-stable low-growing plant community:

1. Remove existing tall-growing vegetation. If using manual methods to eliminate deciduous (resprouting-type) species, carry out follow-up herbicide treatments to ensure that the roots are killed.
2. Replant or reseed with ground cover if none exists or if there is a low potential for natural revegetation by low-growing species (and a high potential for natural revegetation by tall-growing species).
3. Maintain, by selectively eliminating tall-growing vegetation before it reaches a height or density to begin competing with low-growing species.
4. As much as practical, be careful not to disturb low-growing plants. When possible, use only selective vegetation control methods (such as spot/localized herbicide applications) that have little potential to harm non-target vegetation.

Electric Yards

For electric yards, Project Managers apply the following mitigation measures, as appropriate, in addition to those in Steps 2 - 7.

Electric yards are defined as substations, switching stations, and electric yards (including a 3-m or 10-ft. bare-ground buffer zone outside the fenced area).

- *With the use of applicable mitigation measures,* methods that may be appropriate for controlling vegetation in and around electric yards are herbicide (spot, localized, and broadcast) applications, with very selective use of weed burners, steamers, and hand-pulling.
- Use only herbicides that (1) will not corrode ground mats, underground facilities, or other metals on site; (2) are non-combustible; and (3) are non-conductive.
- Select and rotate the use of herbicide products to prevent weeds from developing resistance to herbicides.
- For electric yards within 100 m (328 ft.) of wells, streams, rivers, or wetlands, determine whether the water body should be monitored for potential herbicide contamination.

Non-electric Facilities

For non-electric facilities, Project Managers apply the following mitigation measures, as appropriate, in addition to those in Steps 2 - 7.

Non-electric facilities are defined as microwaves, maintenance yards, and the grounds surrounding electric yards or maintenance facilities.

Guidance for Environmentally and Economically Beneficial Practices on Federal Landscaped Grounds *(1995; 60 FR 40837) directs Federal agencies to incorporate, to the extent practicable, guidance for environmentally and economically beneficial practices into their landscaping programs and practices.*

- *With the use of applicable mitigation measures,* methods that may be appropriate for controlling vegetation at non-electric facilities include manual, mechanical, and herbicide (spot, localized, and broadcast).
- *Where cost-effective and to the extent practicable,* use regionally native plants for landscaping.
- *Where cost-effective and to the extent practicable,* seek to prevent pollution by, among other things, reducing fertilizer and pesticide use, using integrated pest management techniques, recycling green waste, and minimizing runoff.
- *Where cost-effective and to the extent practicable,* implement water-efficient practices, such as the use of mulches, efficient irrigation systems, audits to determine exact landscaping water-use

needs, recycled or reclaimed water, and the selecting and siting of plants in a manner that conserves water and controls soil erosion.

Noxious Weeds

For noxious weeds, Project Managers apply the following mitigation measures, as appropriate.

> *The **Federal Noxious Weed Act** (amended 1990) directs Federal agencies to develop and implement Integrated Pest Management Noxious Weed Programs.*

- *With the use of applicable mitigation measures*, methods that may be appropriate for controlling noxious weeds include the use of biological controls and herbicides (spot, localized, broadcast, and aerial applications).
- Take full responsibility for controlling noxious weeds on fee-owned property.
- Enter into active noxious weed control programs with land owners/managers or county weed control districts where Bonneville activities may have caused or aggravated an infestation.
- *Where appropriate*, provide herbicides or biological control agents to landowners.
- *When possible*, wash vehicles that have been in weed-infested areas (removing as much weed seed as possible) before entering areas of no known infestations.
- *Consider, if appropriate*, reseeding after noxious weed treatments.
- *When reseeding is needed*, use approved weed-free seed.

2. Identify surrounding land use and landowners/ managers.

In this step, Project Mangers do the following:

- Evaluate, generally, existing land uses (e.g., agriculture, residential) along a right-of-way or surrounding a facility needing vegetation control to determine any constraints on vegetation control.

- *To the extent practicable,* identify casual informal use of the right-of-way by non-owner publics to determine any constraints on vegetation control.
- Determine, generally, landowners or land managers (e.g., private residential, timber company, Federal, state) in or around the facility needing vegetation control.
- Determine whether there are any existing landowner agreements with provisions that need to be followed regarding the vegetation maintenance of a specific portion of line.
- *During planning for vegetation control activities,* use an appropriate method (i.e., doorhanger, letter, phone call, e-mail, and/or meeting) to 1) notify landowners where Bonneville has a right-of-way easement to inform them of upcoming activities, 2) request any information that needs to be considered.
- Determine whether there are *other* potentially affected people or agencies that need to be notified or coordinated with; determine appropriate method(s) of notification and coordination.
- (Please see **Tribal Lands** and **Cultural Resources** for information on necessary contacts with Tribes.)

Agriculture

For agricultural areas, Project Managers apply the following mitigation measures, as appropriate.

*The **Farmland Protection Policy Act** (7 USC 4201 et seq.) directs Federal agencies to identify and quantify adverse impacts of Federal programs on farmlands. Vegetation management activities will not contribute to irreversible conversion of agricultural land to non-agricultural uses.*

- *With the use of applicable mitigation measures,* methods that may be appropriate for controlling vegetation in agricultural areas include manual, mechanical, biological (for noxious weeds), and herbicide (spot, localized applications, and [potentially] broadcast and aerial applications).
- Prevent the spread of noxious weeds by cleaning seeds from equipment before entering cropland.
- *If on grazing lands and there is potential for pine needle poisoning,* do not lop and scatter pine tree vegetative debris—machine-chip or haul debris off-site.
- *If using herbicides on grazing lands,* comply with grazing restrictions as required per herbicide label.

- *If using herbicides near crops for consumption*, comply with pesticide-free buffer zones, if any, as per label instructions.
- *For rights-of-way adjacent to agricultural fields*, observe appropriate buffer zones necessary to ensure that no drift will affect crops.
- *For rights-of-way near organic farms*, determine appropriate no-herbicide or spot-herbicide-only buffer zones, or provide for the owner to maintain the right-of-way, by way of a vegetation management agreement.
- *If reseeding*, determine whether any of the adjacent properties are being, or will in the immediate future be, used for growing grass seed, especially high-purity strains.
- *If reseeding near grass-seed fields*, consult with the area seed certification and registration authority to determine whether buffer zones are necessary, appropriate grass mixtures allowed, and appropriate modes of seeding used.

Residential/ Commercial

For residential or commercial areas, Project Managers apply the following mitigation measures, as appropriate.

> ***The Federal Noise Control Act of 1972*** *(42 U.S.C. 4903) requires that Federal entities such as Bonneville comply with state and local noise requirements.*

- *With the use of applicable mitigation measures*, methods that may be appropriate for controlling vegetation in residential/ commercial areas include manual, mechanical, biological (for noxious weeds), and herbicide (spot, localized applications and [potentially] broadcast applications).
- *Where appropriate*, assign responsibility for tall-growing species on the rights-of-way to underlying property owner (e.g., to owners of orchards or Christmas tree farms).
- *If appropriate*, offer to replace trees (with a low-growing species), or use tree growth regulators instead of removing a tree.
- *If using herbicides*, ensure that treated areas are posted and reentry intervals are specified and enforced in accordance with label instructions.

FS-managed Lands

For FS-managed lands, Project Managers apply the following mitigation measures, as appropriate.

*The **Federal Land Policy and Management Act** (1976) provides guidance for the uniform, periodic, and systematic inventories of Federal public lands and their resources.*

- Use, update, or develop site-specific vegetation management plans for rights-of-way that cross FS-managed lands.
- Review existing site-specific vegetation management plans for consistency with this EIS (including measures specific to Forest Service-managed lands). This EIS does not supercede or revoke any existing agreements or site-specific vegetation management plans. However, if appropriate, work with local Forest Officer in revising existing plans to achieve consistency.
- Develop site-specific vegetation management plans (where they do not already exist) using the Planning Steps and mitigation measures in this EIS (including measures specific to Forest Service managed lands). Conduct appropriate NEPA analysis and documentation (see Planning Step #7).
- Contact the local Forest Supervisor's or District Ranger's office, in advance of any proposed vegetation management activity (non-emergency) on national Forest System lands (or follow direction in site-specific vegetation management plans for notification procedures). Notification should be made as far in advance of the planned date of on-the-ground implementation as is reasonably possible, in order for appropriate environmental compliance to be conducted.
- *If expecting the FS to conduct environmental data collection or analysis*, allow more than one year for completion, and be prepared to reimburse the FS for the costs in conducting such activities.
- *With the use of applicable mitigation measures*, methods that may be appropriate for controlling vegetation on FS-managed lands include manual, mechanical, biological (for noxious weeds), and herbicide (spot, localized applications, and [potentially] broadcast and aerial applications).
- Comment on and engage in Forest Service proposals to revise or amend Forest Land and Resource Management Plans, to assure that the designation and management of utility corridors are adequately addressed wherever appropriate.

- See **Appendix F** of the Transmission System Vegetation Management Program Final EIS (May 2000) for additional mitigation measures specific to FS-managed lands.

BLM-managed Lands

For BLM-managed lands, Project Managers would the following mitigation measures, as appropriate.

- Use, update, or develop site-specific vegetation management plans for rights-of-way that cross BLM-managed lands.
- Contact the local BLM office, before implementing vegetation management activities on BLM lands (or follow direction in site-specific vegetation management plans for notification procedures). Notification should be made as far in advance of the planned date of on-the-ground implementation as is reasonably possible.
- *For NEPA compliance on BLM-managed lands,* use the Planning Steps and mitigation measures in this EIS, including the BLM-specific mitigation measures and appropriate NEPA analysis and documentation (see Planning Step #7*)*.
- Consult with appropriate BLM office regarding presence of natural resources and features and appropriate buffers or other mitigation measures.
- *With the use of applicable mitigation measures*, methods that may be appropriate for controlling vegetation on BLM-managed lands include manual, mechanical, biological (for noxious weeds), and herbicide (spot, localized applications, and [potentially] broadcast and aerial applications).
- See **Appendix G** of the Transmission System Vegetation Management Program Final EIS (May 2000) for additional mitigation measures specific to BLM-managed lands.

Other Federal Lands

For facilities that are on other Federal lands, Project Managers apply the following mitigation measures, as appropriate.

- *With the use of applicable mitigation measures*, methods that may be appropriate for controlling vegetation on other Federal lands include manual, mechanical, biological (for noxious weeds), and herbicide (spot, localized, broadcast, and aerial applications).
- Notify, consult, and cooperate with other Federal agencies when scheduling vegetation control activities on rights-of-way over their lands.

State and Local Lands

For facilities that are on state or county/city lands, Project Managers apply the following mitigation measures, as appropriate.

- *With the use of applicable mitigation measures,* methods that may be appropriate for controlling vegetation on state or local lands include manual, mechanical, biological (for noxious weeds), and herbicide (spot, localized, broadcast, and aerial applications).

- *When facilities cross state or local agency lands,* notify, and cooperate with those entities (such as State Parks or county lands) prior to vegetation control activities, as appropriate.

Tribal Reservations

For facilities that are on Tribal reservations, Project Managers apply the following mitigation measures, as appropriate.

***Bonneville's Tribal Policy** (April 1996) follows the **Department of Energy's American Indian Policy** (DOE Order No. 1230.2) for Bonneville's Trust responsibility as a Federal agency; it provides a framework for a government-to-government relationship with the thirteen Federally recognized Columbia Basin Tribes. Notify, consult, and cooperate with Tribal representatives when scheduling right-of-way vegetation control activities that may affect Tribal Trust, Treaty, or cultural resources.*

- If possible and practical, develop a cooperatively written right-of-way vegetation management plan with the Tribe. The plan should address specific land-use or environmental resources along the corridor that need consideration, including appropriate mitigation measures identified in this EIS.
- If possible, consider working with the Tribes on replanting of traditional-use plants. Low-growing traditional-use plants may include blue camas, bitter root, wild celery, biscuit root, Canby's desert parsley, Indian carrot/false caraway, field mint, blue huckleberries.
- *With the use of applicable mitigation measures,* methods that *may* be appropriate for controlling vegetation on Tribal reservations include manual, mechanical, biological (for noxious weeds), and herbicide (spot, localized applications and [potentially] broadcast and aerial applications).

See **Cultural Resources** discussion, later in this discussion, for additional coordination/consultation with Tribes regarding cultural resources.

3. Identify natural resources.

In this step, Project Managers do the following:

- Identify natural resources, or the potential for the presence of natural resources, that could be affected by vegetation management activities. These resources might include wetlands, springs, and threatened or endangered species, etc. Any consultations or contacts made through Step 2, above, could be used to help identify the natural resources along a given right-of-way or site.
- Determine whether mitigation measures should be applied or specific control methods should be used, based on the presence or potential presence of those resources.

Water Resources

For water resources (streams, rivers, lakes, wetlands, wells), Project Managers apply the following mitigation measures, as appropriate.

*Discharge Permits under the **Clean Water Act** regulate discharges into waters of the United States, including wetlands.*

***Section 401** of the Clean Water Act regulates discharges into navigable waters.*

***Section 402** of the Clean Water Act regulates storm water discharges associated with industrial activities under the National Pollutant Discharge Elimination System (NPDES). The regulation includes a general permit authorizing Federal facilities to discharge storm water from construction activities (that can include tree clearing) disturbing land of 2 or more ha (5 or more ac.) into waters of the U.S. The conditions for the permit include preparation of a Storm Water Pollution Prevention (SWPP) plan.*

***Section 404** of the Clean Water Act requires permits from the U.S. Army Corps of Engineers to discharge dredged or fill material into waters of the U.S.*

*The Department of Energy (Bonneville's parent agency) has regulations for environmental review to be in compliance with **Floodplains/ Wetlands** requirements (10 CFR 1022.12, and Executive Orders 11988 and 11990).*

*The **Safe Drinking Water Act** (42 U.S.C. sec 300f et seq.) is designed to protect the quality of public drinking water and its sources. State and local public drinking water regulations including sole-source aquifers.*

- *With the use of applicable mitigation measures*, methods that may be appropriate for controlling vegetation near water resources

  include manual, biological (for noxious weeds), some mechanical methods, and potentially some herbicides (see Tables III-1, -2, and -3 for Buffer Zones and Herbicide-free Zones).

- Use selective control methods and take care not to affect non-target vegetation.
- Leave vegetation intact, where possible.
- Recognize that any discharge of material (displaced soils, and in certain circumstances, vegetation debris) within a water of the U.S. may be subject to Corps regulations under the Clean Water Act.
- Notify inspector and the State of any amount of herbicide spill in or near water.
- Consider climate, geology, and soil types in selecting the herbicide/adjuvant with lowest relative risk of migrating to water resources.
- *When using herbicides/adjuvants*, apply appropriate buffer zones to preclude the possibility of herbicide movement from the application site to adjoining water bodies. See Tables III-1, III-2, and III-3.
- The buffers in tables III-1, III-2, and III-3 are to be used unless other agencies, local authorities, or T&E consultations require more strict buffers. In cases of more strict local buffers, those would apply.
- For noxious weed treatment, try to apply buffer zones, recognizing that treatment may be necessary within zones for control in compliance with local weed boards and Federal noxious weed laws.

Table III-1: Buffer Widths to Minimize Impacts on Non-target Resources

Herbicide & Adjuvant Ecological Toxicities and Characteristics	Buffer Width from Habitat Source per Application Method (i.e., stream, wetland, or sensitive habitat)				
	Spot	Localized	Broadcast[1]	Aerial[2]	Mixing, Loading, Cleaning
Practically Non-Toxic to Slightly Toxic	Up to Edge[3,4]	Up to Edge[3,4]	10.7m[3,4] (35 ft.)	30.5m[4] (100 ft.)	30.5m[5] (100 ft.)
Moderately Toxic, or if Label Advisory for Ground/ Surface Water	7.6m[3,4] (25 ft.)	10.7m[3,4] (35 ft.)	30.5m[3,4] (100 ft.)	76.2m[4] (250 ft.)	76.2m[5] (250 ft.)
Highly Toxic to Very Highly Toxic	10.7 m[3,4] (35 ft.)	30.5m[3,4] (100 ft.)	Noxious weed control only. Buffer as per local ordinance	Noxious weed control only. Buffer as per local ordinance	76.2m[5] (250 ft.)

[1] Using ultra low volume (ULV) nozzles with orifice size and spray pressure set to produce droplets at a minimum of 150 microns, boom or nozzle heights at the lowest possible height, and cross-wind speed of less than 10 mph.[3]

[2] Using ULV nozzles with orifice size and spray pressure set to produce droplets at a minimum of 150 microns, minimizing air shear relative to nozzle angle and aircraft speed, boom length at 70% or less of wingspan/rotor, swath adjustment not to exceed 60 feet based on maximum cross-wind speed of less than 10 mph, minimum safety clearance application height, and herbicide tank mixture dynamic surface tension is less than 50 dynes/cm.[3]

[3] Goodrich-Mahoney, J.W., Determination of the Effectiveness of Herbicide Buffer Zones in Protecting Water Quality, Electric Power Research Institute, Report No. TR-113160, September 1999

[4] Calculated from: A Summary of Ground Application Studies, Spray Drift Task Force, 1997

[5] BPA Best Management Practice

Table III-2: Herbicide-free Zones for Rights-of-way, Substations, Electric Yards, and Non-electric Facilities

Zone	Buffer Width
Agricultural Irrigation Source of Any Kind (Wet or Dry)	15m (50 ft.) from each bank (linear) or well (radius) for any herbicide.
Domestic/Public Drinking Water Well	50m (164 ft.) radius for any herbicide having a ground/surface water advisory* 15m (50 ft.) radius for any other herbicide
Domestic/Public Drinking Water Intakes/Spring Developments	For slopes <10% 50-m (164- ft.) radius for any herbicide having a ground/surface water advisory* 15-m (50-ft.) radius for any other herbicide For Slopes >10% <30% 150-m (492-ft.) radius for any herbicide having a ground/surface water advisory* 50-m (164-ft.) radius for any other herbicide For slopes >30% 300-m (984-ft.) radius for any herbicide having a ground/surface water advisory* 100-m (328-ft.) radius for any other herbicide
Sole Source Aquifers	As per local aquifer management plan.

*as stated on the label

Table III-3: Additional Herbicide-free Zones for Substations, Electric Yards, and Non-electric Facilities

Zone	Buffer Width
Secondary Containment Liners, Vaults, and Lagoons	2-m (6-ft.) radius for any herbicide having a ground/surface water advisory* Up to edge of containment feature for any other herbicide
Storm Drains that Discharge Offsite	2-m (6-ft.) radius for any herbicide having a ground/surface water advisory*, or, if moderately/highly/very highly toxic to any aquatic vertebrate or invertebrate Up to edge of drainage feature for any other herbicide

Table III- 4: Mechanical Buffer Zones

Ground-disturbing Mechanical Methods	Buffer Width From Habitat Source, i.e., Stream or Wetland
Slopes under 20%	10.7 m (35 ft.)*
Slopes over 20%	No disturbance

* USDA, Natural Resources Conservation Service (NRCS), Conservation Practice Standard, Riparian Forest Buffer, Code 391A, 1997

Threatened or Endangered Species and Critical Habitat

For threatened or endangered (T&E) plant or animal species, Project Managers apply the following mitigation measures, as appropriate.

*The **Endangered Species Act (ESA)** (16 USC 1536) provides for conserving endangered and threatened species of fish, wildlife and plants. Federal agencies must determine whether proposed actions would adversely affect any endangered or threatened species.*

- With the use of applicable mitigation measures, methods that may be appropriate for controlling vegetation in places that potentially have sensitive or threatened and endangered (T&E) species include manual, biological (for noxious weeds), mechanical (except in areas of T&E plants), and herbicide (spot and localized applications.
- Determine whether any T&E species or designated T&E critical habitats are potentially present in the project area (through the use of T&E maps, specialist's determination, or T&E list from the U.S. Fish and Wildlife Service (USFWS) and/or National Marine Fisheries Service (NMFS)).
- *If T&E species or designated critical habitats are potentially present in the project area*, determine whether they are likely to be affected. If project is likely to affect but not *adversely* affect T&E species, obtain concurrence from the USFWS and/or NMFS.
- *If it is determined that the project is likely to adversely affect T&E species or their designated critical habitats,* initiate formal consultation with the USFWS and/or NMFS and prepare a Biological Assessment according to 40CFR Part 402 or follow measures developed through existing programmatic considerations.

- Apply mitigation measures (such as timing restrictions, or specific method use) resulting from determinations or consultations.
- (Bonneville is currently in consultation with NMFS and the USF&W Service for T&E anadromous and resident fish species. Protocols developed through this consultation shall be applied to vegetation management activities.)

Marbled Murrelet

The specifications below are based on Bonneville consultation with USFWS (1995) on our maintenance program, which includes vegetation management. These specifications apply in areas determined to be suitable marbled murrelet habitat (Peterson, 1995). These measures are appropriate for manual and mechanical tree removal and noise disturbance from all vegetation control activities. Herbicide use will require further consultation.

- *If a tree needing removal is greater than 80 cm (32 in.) in diameter at breast height and has suitable nest tree characteristics,* initiate formal consultation with the USFWS.
- *During core breeding season, from April 1- August 5,* do not carry out maintenance activities (e.g., chainsaw work) that produce noise above ambient noise levels, within 0.4 km (0.25 mi.) of known marbled murrelet habitat or occupancy (based on marbled murrelet maps).
- *During the late breeding season, from August 6 - September 15,* do not carry out maintenance activities using motorized equipment within 0.4 km (0.25 mi.) of marbled murrelet habitat or occupancy within two hours after sunrise or within two hours before sunset.

Spotted Owl

The suitable spotted owl habitat specifications below are based on Bonneville consultation with USFWS (1992) on Bonneville's maintenance program, which includes vegetation management. (USFWS, 1992). Theses measures are appropriate for manual and mechanical tree removal and noise disturbance from all vegetation control activities. Herbicide use will require further consultation.

- *Where opportunity exists,* suspend vegetation management activities within 0.4 km (0.25 mi.) of spotted owl critical habitat between March 1 and June 30, unless the owls are shown not to be nesting.

- Examine any large trees (greater than 20.3 cm [8 in.] in diameter at breast height east of the Cascades, or 28 cm [11 in.] in diameter at breast height west of the Cascades) that need to be removed in spotted-owl habitat for evidence of owls. If a tree has evidence of owl nesting activity, conduct formal consultation with the USFWS.
- *In case of an emergency danger tree removal—a tree suddenly becoming an imminent threat to the line, posing a danger to life and property*—immediately examine the felled tree for evidence of owl nesting. If such evidence is found, start emergency consultation with the USFWS, or, if the situation occurs during off-duty hours, conduct after-the-fact emergency consultation the next business day.

Other Species

*The **Fish and Wildlife Conservation Act of 1980** (16 USC 2901 et seq.) encourages Federal agencies to conserve and promote conservation of non-game fish and wildlife species and their habitats. In addition, the Fish and Wildlife Coordination Act (16 USC 661 et seq.) requires Federal agencies undertaking projects affecting water resources to consult with the USFWS and the state agency responsible for fish and wildlife resources.*

For other fish, wildlife, or protected plant species, Project Managers apply the following mitigation measures, as appropriate.

- Through coordination with the state department of fish and wildlife or appropriate Federal agency, determine whether any other locally listed (state, FS, BLM) endangered, threatened, or sensitive species or habitats are potentially present in the project area.
- *If listed species or habitats are potentially present in the project area,* determine whether they are likely to be affected and what appropriate mitigation measures should be applied to lessen potential impacts (such as timing restrictions, or specific method use).
- Where possible and appropriate, leave brush piles for small animal habitats.
- Where possible and appropriate, top and leave tall dead trees (snags) in place for wildlife habitat.

Visual Resources

In visually sensitive areas, Project Managers apply the following mitigation measures, as appropriate.

- *With the use of applicable mitigation measures,* methods that may be appropriate for controlling vegetation in visually sensitive areas include manual, mechanical, biological (for noxious weeds), and herbicide (spot and localized applications).

- Limit use of broadcast foliar application of herbicide to reduce the creation of large areas of browned vegetation.
- *At road crossings, highways/visual overlooks*, leave sufficient vegetation, where possible, to screen view of right-of-way.
- *If the area is a very sensitive visual resource,* consider (1) planting low-growing tree seedlings adjacent to the right-of-way (or providing low-growing seedlings to landowner for planting); (2) softening the straight line of corridor edge by cutting some additional trees outside the right-of-way; or (3) if possible, leaving some low-growing trees within the right-of-way.

Cultural Resources

For cultural resources, Project Managers apply the following mitigation measures, as appropriate.

National Historic Preservation Act (1966, 16 U.S.C. 470) *requires Federal agencies to take into account the potential effects of their undertakings on properties on or eligible for the National Register of Historic Places.*

Archeological Resources Protection Act *prohibits excavation, removal, damage, or other alteration or defacement of archeological resources on Federal or Indian lands without a properly issued permit.*

American Indian Religious Freedom Act *requires Federal land managers to include consultation with traditional Native American religious leaders in their management plans and guarantees First Amendment rights for traditional religions.*

The Historic Sites Act of 1935*, the basis for the National Historic Landmarks Program, provides for the preservation of historic American sites, buildings, objects and antiquities of national significance.*

Native American Graves Protection and Repatriation Act of 1990 (PL101-601) *recognizes the property rights of Native Americans in certain cultural items, including Native American human remains, funerary objects, sacred objects, and items of cultural patrimony. In cases involving the inadvertent discovery of Native American human remains or defined cultural items during activities occurring on Federal or Tribal lands, the activity must be halted temporarily, the items protected, and the appropriate Federal agency and Tribal authority notified of the discovery.*

- *With the use of applicable mitigation measures,* methods that may be appropriate for controlling vegetation in areas with potential cultural resources include manual, biological (for noxious weeds),

  non-soil-disturbing mechanical, and (potentially) herbicide (spot, localized, broadcast and aerial applications).
- Contact Tribes with traditional-use areas of Trust or Treaty resources in the project area (even when not crossing reservation

lands) to determine the potential presence of traditional-use plants or other cultural resources and to determine the desired level of Tribal involvement in planning efforts. (Restrictions such as seasonal constraints for vegetation control, avoidance of certain areas, or using methods that do not affect non-target plants may be required.)

- *If potentially affecting cultural resources (especially if proposing mechanical ground-disturbing methods*) consult with the appropriate State Historic Preservation Officer or Tribal Historic Preservation Officer (THPO) if on reservation lands with designated THPO.

Steep Slopes/ Unstable Slopes

For steep or unstable slopes, Project Managers apply the following mitigation measures, as appropriate.

- *With the use of applicable mitigation measures*, methods that may be appropriate for controlling vegetation in areas of steep slopes or unstable soils include manual, biological (for noxious weeds), non-soil-disturbing mechanical, and herbicide (spot, localized, broadcast and aerial applications).
- Do not using ground-disturbing mechanical equipment to clear on slopes over 20%.
- Avoid using granular or total vegetation management (non-selective) herbicides on slopes over 10%.
- Do not use herbicides with a high potential for surface runoff.
- Perform mechanical clearing when the ground is dry enough to sustain heavy equipment.
- Reseed or replant seedlings on slopes with potential erosion problems and/or take other erosion control measures as necessary.

Spanned Canyons

For spanned canyons, Project Managers apply the following mitigation measures, as appropriate

- Avoid removing vegetation where it will not grow up into the safety zones for the transmission line.

4. Determine vegetation control methods.

In this step, Project Managers do the following:

- Determine the appropriate control method or combination of methods to be used for a specific facility or right-of-way, based on the three steps above: 1) facility and vegetation control needs, 2) type of land-uses and contacts with land owners/managers, and 3) natural resources present.
- *For all methods using machinery or vehicles (i.e. chainsaws, trucks, graders),* keep the equipment in good operating condition to eliminate oil or fuel spills or excess exhaust.
- Do not wash equipment or vehicles at a stream.

Manual

For the use of manual methods, Project Managers apply the following mitigation measures, as appropriate.

Manual control methods include the following: pulling weeds; cutting with shears, clippers, chainsaws, brush saws, or axes; steaming with a hand-held hot steam device (electric yards); burning plants with propane burners (electric yards); and girdling by cutting a ring around the trunk of the tree.

- *When crews are working during the fire season*[1], each crew shall have the proper fire-suppression tools and materials, as required by the responsible fire control agency.
- Equip power-cutting tools with approved spark arresters.
- Cut conifers below the lowest live limb to eliminate the continued growth of lateral branches.
- *If planning follow-up herbicide stump treatment,* cut stumps flat for application of the chemical.
- *If planning follow-up herbicide stump treatment in rights-of-way,* cut deciduous brush about 15.2 cm to 20.3 cm (6 to 8 in.) above the ground line.
- *If planning follow-up herbicide stump treatment in access roads,* cut deciduous stumps 5 to 10 cm (2 to 4 in.) above the ground line.
- *If planning follow-up herbicide stump treatment,* apply herbicides as soon as possible after cutting. (If herbicide is not applied soon after the vegetation has been cut, it may be best to wait until resprouting has occurred and then spray by foliar technique.)
- *For safety,* cut all brush stumps flat where possible. (Angular cuts leave a sharp point that could cause injuries if fallen upon.)
- *For cutting trees close to "live" power lines,* use only qualified personnel.

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[1] Fire season is defined by the fire protection district that has jurisdiction in that area.

Mechanical

For the use of mechanical methods, Project Managers apply the following mitigation measures, as appropriate.

Mechanical methods include the use of chopper/shredders, walking brush controllers, mowers, feller-buncher machines, roller-choppers, and blading.

- Do not use ground-disturbing mechanical equipment to clear on slopes over 20%.
- Perform soil-disturbing or heavy mechanical clearing when the ground is sufficiently dry to sustain heavy equipment.
- Use measures to control the spread of noxious weeds.
- Do not use ground-disturbing mechanical methods in areas with T&E plant species unless determined appropriate through consultations.
- Do not use ground-disturbing mechanical methods in areas with cultural resources unless determined appropriate through consultations.

Biological Controls

For the use of biological controls, Project Managers apply the following mitigation measures, as appropriate.

- Use only those biological control agents (insects) that have been tested to ensure they are host-specific.

Herbicides

For the use of herbicide methods, Project Managers apply the following mitigation measures, as appropriate.

*The **Federal Insecticide, Fungicide and Rodenticide Act (FIFRA)** regulates all herbicides and herbicides labels; classifies herbicides as "general" or "restricted" use; describes written records certified applicators must keep; and may give fines of up to $25,000 and jail sentences of up to one year for misapplication of herbicides and violation of FIFRA standards.*

***Resource Conservation and Recovery Act (RCRA)** regulates the disposal of toxic wastes (including the disposal of unused herbicides).*

***Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)** regulates how to clean up spills of hazardous materials and when to notify agencies of spills.*

***Superfund Amendments and Reauthorizations Act (SARA)**, also known as the Emergency Planning and Community Right-to-Know Act (EPCRA), sets up emergency response committees, requires industrial facilities to provide written plans in the event of a "chemical emergency," and requires annual inventory of all chemicals.*

***Toxic Substance Control Act (TSCA)** provides authority for EPA to secure information on all new and existing chemical substances.*

Federal Occupational, Safety and Health Administration (OSHA) *protects worker health and safety, including requiring that workers be provided with a Material Safety Data Sheet (MSDS) for hazardous materials including herbicides.*

Food, Agriculture, Conservation, and Trade (FACT) *Act of 1990, and amended in 1995, addresses restricted-use pesticide record-keeping.*

- Follow product label directions, as required by FIFRA, including "mandatory" statements (such as registered uses, maximum use rates, application restrictions, worker safety standards, restricted entry intervals, environmental hazards, weather restrictions, and equipment cleaning).
- Follow all product label "advisory" statements (such as techniques for mixing, applying and cleaning within the mandatory requirements, recommendations for protection clothing, guidelines for differing soil types, etc).
- Always have a copy of the herbicide label and Material Safety Data Sheets (MSDS) at work sites during all mixing and applications.
- Ensure that all herbicide applications are conducted in the presence of a licensed applicator valid for the state where the work is located.
- Keep records of each application, including the active ingredient, formulation, application rate, date, time, location, etc. Records must be available to state and Federal inspectors.
- Ensure the use of EPA-approved herbicides that have been reviewed by Bonneville for effectiveness and environmental considerations.
- See **Water Resources** for herbicide mitigation measures near wetlands, streams, rivers, ponds, and wells.
- *Before application*, thoroughly review the right-of-way to identify and mark, if necessary, the buffer requirements.
- Observe restricted entry intervals specified by the herbicide label and post public warning signs where required.

Bonneville is proposing to use the following 23 herbicide active ingredients:

2,4-D	Fosamine ammonium	Oryzalin
Azafenidin*	Glyphosate	Paclobutrazol

Bromacil	Halosulfuron-methyl	Picloram
Chlorsulfuron	Hexazinone	Sulfometuron-methyl
Clopyralid	Imazapyr	Tebuthiuron
Dicamba	Isoxaben	Triclopyr
Dichlobenil	Mefluidide	Trinexapac-ethyl
Diuron	Metsulfuron-methyl	

* Pending registration by EPA

Each herbicide has information on the label that must be followed. The information given below is not intended to replace reading the labels.

Drift and Leach Reduction

- Use drift reduction agents, as appropriate, to reduce the drift hazard when applying herbicides as broadcast, aerial, or localized foliar treatments.
- *When trying to reach the upper foliage of tall brush*, take care to prevent drift or spraying of non-target species.
- When selecting herbicides/adjuvants, consider climate, geology, and soil types when using formulations with ground- or surface water advisories or restrictions.
- Avoid application (with herbicides that could damage subsequent crops) to ground that is to be planted later.

- Pay close attention to present weather and changing weather:
  - ✶ **wind** (may blow dry or wet spray applications away from treatment site),
  - ✶ **humidity** (if humidity is too low, herbicide effectiveness may be reduced due to volatilization and closed pores on surface of vegetation),
  - ✶ **temperature inversions** (may cause movement of evaporated "clouds" of herbicide formula to non-target vegetation or evaporation of carrier, reducing drop size and increasing drift potential), and/or
  - ✶ **heavy rainfall** (may wash herbicide off plants or soil and move away from treated area).

Table III-5, below, identifies Bonneville's minimum weather restrictions (to be used in the absence of more stringent label instructions and restrictions.)

Table III-5: General Climate Restrictions for Herbicide Applications (restrictions may vary according to label instructions and state or local requirements)

Control Method	Max. Temp*	Min. Humidity	Precipi-tation	Wind	Season
Stump	____	_____	Minimal	_____	frost-free (wood must not be frozen for penetration)
Foliar	75°F	30%	None	0-5 mph	spring/summer (or as specified on herbicide label)
Basal	75°F	30%	Minimal	0-10 mph	frost-free (wood must not be frozen for penetration)
Pellet	____	_____	Moderate required	_____	frost-free
Aerial	70°F	50%	None	0-5mph	growing season

* Evaporation (volatilization) of some herbicides occurs with higher temperatures, causing drift and potential damage to non-target plants. Volatilization is more likely a problem with ester formulations than amine formulations**.**

Spot Stump Application

A spot application is treatment of individual plant(s) with the least amount of chemicals possible. Stump treatments are done by hand (squirt bottle or canister) or by backpack.

- *For spot treatment*, cut stumps flat, 15.2 – 20.3 cm (6 – 8 in.) above ground (except for access roads and around structures sites which should be 5 – 10 cm (2 – 4 in.) above ground) to facilitate treatment and reduce trip and fall hazards. Treatment should occur within 8 hours to prevent resprouting.
- Directly spray the root collar area, sides of the stump, and/or the outer portion of the cut surface, including the cambium, until thoroughly wet, but not to the point of runoff. This would avoid, or minimize, deposition to surrounding surfaces.

Localized Basal Application

Localized herbicide application is the treatment of individual or small groupings of plants. Basal is the treatment of the base—bark or stem—of a plant.

- Apply basal treatments at any time during the year except when snow or water prevent application to the groundline. However, in general, treatments are more effective during the spring (when plants are leafing out) and less effective in the fall (when they are dropping their leaves).
- Use basal bark treatments to control woody plants with stems less than 15.2 cm (6 in.) in diameter.

Localized Foliar Application

Foliar treatment is the treatment of the leaves of the plant.

- Do not apply when rain is imminent (better plant penetration is obtained when herbicide dries and is absorbed; rain may wash herbicide off).
- Apply foliar treatments during active growing and after leaves have developed.

Localized and Broadcast Pellet Application

This is the application of granular or pellet herbicides, treating either small groupings of plants by hand or large areas with dispersing machines.

- Observe buffer zones and maintain recommended buffer widths.
- Do not broadcast pellets where there is danger of contaminating water supplies.

- Apply pelletized or granular herbicides as recommended by label instructions regarding adequate rainfall/irrigation following application to ensure pellets dissolve and the herbicide can be carried into the root system.
- Do not apply pellet herbicides within three times (3X) the crown width (or dripline) of an off-right-of-way tree.
    - ✶ *When soils are rocky or shallow, the slope is away from the right-of-way, or the size and age of the off-right-of-way vegetation may indicate that part of the root system may be within the right-of-way,* consider observing greater pellet edge distances.

Broadcast Application (Liquid Herbicide)

This is the application of herbicides by use of tractors or trucks that treat a large area.

- Observe buffer zones and maintain recommended buffer widths (see Tables III-1, -2, and -3 on pages 64, and 65).
- Do not use broadcast application where there is danger of contaminating water supplies (see Tables III-1, -2, and -3).
- Do not use the broadcast method where there are adjoining susceptible crops and ornamental bushes.

Aerial

This is the application of herbicides with a helicopter or airplane.

- Use only those herbicides/adjuvants registered for aerial application and apply according to all label instructions and restrictions.
- Consider surrounding land use before assigning aerial spraying as method. Aerial spraying may be limited by incompatible adjacent land use, such as domestic water sources, some agricultural areas, and densely populated areas. Observe buffer zones and maintain recommended buffer widths (see Tables III-1, -2, and -3 on pages 64 and 65).
- Do not use aerial application where areas of browned vegetation are not acceptable.
- Use drift reduction agents, if applicable, to minimize drift. The use of a microfoil boom may preclude need of drift reduction agents.

- Do not make aerial application when the wind velocity exceeds 5 mph. (See weather requirements.)
- Fly no higher than necessary to achieve appropriate application, reduce drift potential, and maintain flight safety.

Mixing

- Prepare spray mixture in accordance with the label(s) instructions (do not exceed the amount of herbicide per acre specified on the label).
- Perform mixing on rights-of-way, within electric yards, or other suitable locations and with respect to buffer zones and recommended buffer widths.
- Mix aerial applications only at a heliport (permanent or temporary).
- Always use siphon prevention devices/methods when filling herbicide tanks from domestic water supplies.

Spills and Misapplications

Most herbicide accidents and spills occur during mixing, loading and washing of equipment. The key to prevention is to ensure all equipment and vehicles are well-maintained and that personnel are well-trained and equipped.

- Refer to MSDSs for emergency response information.
- Report spills and misapplications to EPA in accordance with the Government Agency Plan (GAP). In addition, report spills and misapplications and clean-up according to various state and Federal laws and regulations. At a minimum:
  - ✶ Contain spill or leak, or halt misapplication;
  - ✶ Isolate area;
  - ✶ Request help and make appropriate notifications to Bonneville and state officials;
  - ✶ As soon as possible, notify the owner of the land, whether the spill occurs on or off right-of-way.
  - ✶ Clean up the spill;
  - ✶ Cleanup equipment and vehicles;
  - ✶ Dispose of cleanup materials, and
  - ✶ Follow up with appropriate cleanup documentation.

Handling

- *During transportation*, secure herbicide containers to prevent movement within the vehicle or loss from the vehicle during the operation of the vehicle.
- Do not store herbicides in passenger compartment of vehicles.
- *When spray equipment is not being used*, all valves and tank covers shall be closed during any movement of the vehicle.
- Firmly secure to the frame of the vehicle any portable tanks used for herbicide application.

Safety

- *On jobs where herbicide splash may occur*, always use suitable goggles or face shield as required.
- Always use personal protective gear listed on the herbicide label.
- Do not permit workers with a known allergy to herbicides to participate in herbicide applications.
- Provide applicators with an on-site hand washing facility.
- Wash hands before eating, drinking, or smoking after applying herbicides and take a hot shower at the conclusion of work.
- Do not smoke or consume food or drinks during the application of herbicides.
- Promptly change any clothing substantially contaminated by a herbicide if the material contacts the skin and the herbicide cannot be adequately removed. Each worker is to have one complete change of work clothes on the site.
- Use self-contained[2] herbicide handling equipment when appropriate and available to reduce worker exposure during herbicide mixing and handling.

Storage of Herbicides, Containers, and Equipment

- Follow label requirements for storage.
- Permanent storage facilities will meet the following requirements:

---

[2] Self-contained herbicide handling equipment is equipment designed to limit worker exposure to herbicides. Examples: premixed herbicide containers that can be attached to a backpack sprayer (to limit the pouring and addition of water or other carriers to common container); canisters that are injected into the base of a tree and that open to release herbicide, once injected.

- ✶ dry;
- ✶ protected from freezing or excessive heat;
- ✶ well-ventilated;
- ✶ locked and, where possible, secured by gates and/or a climb-proof fence;
- ✶ impervious flooring;
- ✶ all doors on storage areas properly posted to identify the use of the building for herbicide storage;
- ✶ spill containment measures or devices;
- ✶ a fully developed and maintained Spill Prevention and Countermeasure Plan;
- ✶ maintained ABC-type fire extinguisher, and
- ✶ meeting any additional standards set by State or local law.

- Store containers with labels plainly visible. Group together all containers of the same product.
- Inform local fire department, in writing, of the amounts, kinds, and locations of stored herbicides.
- Stack herbicide containers on stable pallets and out of the way, to prevent container damage by other traffic.
- Store containers upright. Seal all containers appropriately. If containers are not in good condition, repackage and label with a copy of the label and the relabeling date.
- Do not store herbicides in empty food or drink containers.
- *Where practicable*[3], maintain a complete inventory indicating number and identity of containers in storage unit.
- Label "contaminated with herbicides" any items used for handling herbicides at the storage site that might be used for other purposes. Do not remove item from site without thorough decontamination.
- Do not transfer herbicides to unmarked containers except for immediate use. Do not return unmarked containers back to a storage area.

---

[3] In some states, this is a requirement.

- Store herbicide containers in such a way that the oldest batch is used first and that partially used containers are used first.
- Clean spilled areas immediately. Inspect storage areas frequently for leakage.
- Store only minimum amounts of chemicals at field and temporary locations; order out no more chemicals than necessary.
- Dispose of unwanted or unusable products promptly and correctly.
- *In temporary locations, such as the field,* store all chemicals in buildings or vehicles that can be locked up.
- *During transportation,* do not leave vehicles transporting chemicals unattended unless the chemical is being carried in a closed van.

Disposals

- Use water-soluble packaging (WSP) when available, to eliminate the need for container disposal.
- Do not burn paper and carton-type containers unless so stated on the label.
- Dispose of containers or cartons in one of three ways:
  - ✶ **Triple rinse** containers of liquid herbicides before disposal. The rinse solution will be poured into the mix-tank and *used for treatment.* Each rinse solution shall be equal to at least 10 percent of the container volume. Dispose of the empty containers as noncontaminated waste, at any legal landfill dump.
  - ✶ Use a **rinsing nozzle** (instead of triple rinsing). A rinsing nozzle has a sharp point that can puncture a plastic or metal empty herbicide container and flush the container's contents into the mix tank.
  - ✶ Return **returnable** "mini-bulk" type containers to the distributor for refill.
- Dispose of unwanted or unusable herbicide products as contaminated waste at an approved waste facility.
- Dispose of contaminated materials (including contaminated soil) resulting from cleanup procedures according to agency directives.

- Place any contaminated materials to be transported in watertight containers.

5. Determine debris disposal and revegetation methods, if necessary.

In this step, Project Managers do the following:

- Determine the appropriate debris disposal methods to be used, based on the four steps above: 1) facility and vegetation control needs, 2) type of land-uses and contacts with land owners/ managers, 3) natural resources present, and 4) control methods used.
- Determine whether reseeding or replanting is necessary for erosion control, preventing noxious weed infestation, establishing and promoting low-growing plants, or promoting wildlife habitat.

Vegetative Debris Disposal

For vegetative debris disposal, Project Managers would apply the following mitigation measures, as appropriate.

*The **Federal Clean Air Act**, as revised in 1990 (PL 101-542, 42 USC 7401), requires the EPA and states to carry out programs intended to assure attainment of the National Ambient Air Quality Standards.*

*Section 404 of the **Clean Water Act** requires permits from the U.S. Army Corps of Engineers to discharge dredged or fill material into waters of the U.S. (Vegetation debris left in a stream or wetland could be considered fill material.)*

- Do not permit debris from tree falling, cutting, or disposal to fall into or be placed in any watercourse, spring, pond, lake, or reservoir, *unless* there is approval from the appropriate authorities for stream habitat projects.
- *Where the scattering method of disposal is used,* perform in accordance with specific requirements or agreement with the responsible fire control agency.
- *If on grazing lands and there is potential for pine needle poisoning,* do not lop and scatter pine tree vegetative debris—machine-chip or haul debris off-site.
- *If using heavy equipment for piling debris,* perform when the ground is able to support equipment, and excessive rutting will not occur.

- Reduce vegetation debris accumulation that can produce a fire hazard along the right-of-way.
- *If debris is removed from site,* take debris to an approved dumpsite.
- *If burning vegetation debris piles*, burn off the right-of-way. Do not burn debris close enough to the right-of-way or facility where smoke could provide a conductive path from the transmission lines or electric equipment to the ground.
- *Before pile burning is attempted off the right-of-way,* secure from the applicable fire control agency any required permits for burning.
- *If burning vegetative debris piles*, keep piles relatively small to keep intense and prolonged heat from damaging the soil horizons.
- *If burning*, do not pile burn in or next to watercourses.
- *If burning*, do not use oil, diesel, or rubber to start pile burn fires.

Reseeding/ replanting

If reseeding or replanting is determined to be necessary, Project Managers apply the following mitigation measures, as appropriate.

- Use seeds, seedlings, or plants that are consistent with management objectives and adapted to climatic conditions, soils, landscape position, and the site itself.
- Use native seed/plants if the species meet the objectives of the revegetation project, if the costs are reasonable, and if the seeds/plants are readily available in the quantity and quality needed to perform the project.
- *If native seed mixes are not reasonably priced or available in needed quantities,* consider a seed mix with some percentage of native seeds.
- Use high-purity seed; take actions to prevent purchase of seed contaminated with noxious weeds.
- Prepare seedbed properly.
- Use proper planting time and dates to ensure enough moisture for germination and growth before frosts.
- Use effective planting methods; drill seeding is most effective, broadcast methods are appropriate when drill method is impractical.
- Consider increasing seeding rates for critical erosion areas by 150% of recommended drill seeding rates.

- *For wildlife forage,* consider adding legumes.
- *For creating shrub cover,* consider adding shrub species.
- Plant tree and shrub stock according to local standard.
- Follow recommendations for applying appropriate soil amendments and fertilizers.
- If practical, control weed growth during seed or seedling establishment.
- *If possible,* protect the site from grazing for 1-2 years until establishment.
- See mitigation measures for seeding near agricultural areas.

6. Determine monitoring needs.

In this step, Project Managers do the following:

- Determine what steps are needed to evaluate whether treatments or mitigation measures are working properly and to ensure that other resources are not being adversely affected.
- Visit rights-of-way shortly after treatment (at least within a year of treatment) to determine effectiveness:
  - ✶ Was target vegetation controlled?
- Visit rights-of-way within a year of treatment to determine whether any other impacts occurred:
  - ✶ Were non-targeted plants affected?
  - ✶ Were there any environmental impacts (e.g., erosion, water contamination, debris in wetlands)?
  - ✶ Were desired results for environmental resources achieved (water, fish, soil, scenic, cultural).

- Monitor to determine whether follow-up treatments or mitigation measures are necessary (e.g., erosion control measures such as mulching, hydroseeding, coconut blankets).
- Use monitoring to help determine methods/issues for next treatment cycle.

7. Prepare appropriate environmental documentation.

In this step, Project Managers do the following for NEPA environmental compliance, as appropriate:

*This Draft EIS was prepared according to the **National Environmental Policy Act** (NEPA, 42 USC 4321 et seq.). NEPA is a national law that protects the environment. NEPA applies to all Federal projects or projects that require Federal involvement.*

- Document the outcome of the Planning Steps through the use of a checklist; attach any T&E species consultations or other supplemental information as appropriate.
- Develop a Supplement Analysis (a NEPA analysis tiered to this program-wide EIS) that compares the project-specific potential impacts with those disclosed in the EIS.
- Conduct further NEPA environmental review if anticipated impacts or site-specific work are *substantially different* from those evaluated in EIS, or if significant new circumstances or information relevant to environmental concerns are found. If further NEPA review is needed, it would be in the form of an EA or an EIS, depending on the extent of the substantially different impacts.

Appendix L Land Use, Transportation, and Recreation Technical Report

Land Use, Transportation, and Recreation Technical Report

Prepared for

Bonneville Power Administration
Portland, Oregon

September 2002

Prepared by

CH2MHILL



Printed on Recycled and Recyclable Paper

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1.0 Introduction

1.1 Background

The Bonneville Power Administration (BPA) is committed to providing reliable power to the Northwest region. BPA is proposing to build new infrastructure projects to improve the reliability of the transmission system and to meet future power needs. The Kangley-Echo Lake Transmission Line Project is the most critical of these infrastructure projects.

1.1.1 Proposal

The proposed 500-kilovolt (kV) transmission line would connect an existing line with BPA's Echo Lake Substation in the Maple Valley area of Washington. The proposed line is needed to improve system reliability in the King County area and to enhance the return of power to Canada as required by the Columbia River Treaty. Without system improvements, an outage on an existing BPA line in the area coupled with cold winter weather could cause voltage instability and a loss of power in the Puget Sound area as early as winter 2002-03.

BPA is considering a broad range of alternatives for this project. Project alternatives are described in Appendix A (as provided by BPA). Alternative routes considered in this technical study report and the report's overall purpose are described below.

1.1.2 Alternative Routes

BPA studied several alternative routes for the Kangley-Echo Lake Project in 2000 and 2001. These are described and analyzed in the Draft Environmental Impact Statement (DEIS) issued in June 2001 and are identified as the Preferred Route (Alternative 1), Alternative 2, Alternative 3, Alternative 4A, and Alternative 4B. Alternatives dropped from further analysis earlier due to costs and other considerations were resurfaced by BPA in early 2002 to address potential routes around the Cedar River Municipal Watershed. These routes are identified as Alternative A, Alternative B, Alternative C (Options C1 and C2), and Alternative D (Options D1 and D2). A description of these new alternatives is provided in Section 2 of this report.

1.1.3 Purpose of this Report

BPA plans to issue a supplemental DEIS (SDEIS) in early 2003. The SDEIS will include analysis of the original routes evaluated in the DEIS (Routes 1 through 4) and the new alternatives identified in early 2002 (Routes A through D). This Technical Report describes the impacts of the new alternative routes so that they can be considered along with the original routes in the SDEIS. This report provides the supporting technical material to be extracted and summarized in the SDEIS.

1.2 Project Area and Resources Studied

Direct and indirect impacts on land use, transportation, and recreation resources are considered in this report. The direct impact area for this project covers the width of the existing right-of-way (ROW) plus proposed additional ROW along the alternative transmission line alignments, except for Alternative C. The study corridor for Alternative C encompasses a 250-foot-wide corridor along the potential alignment currently identified by

BPA. A wider corridor is considered for Alternative C because the alignment of the transmission line in this area does not follow any existing alignment and has not yet been selected with the specificity necessary to consider only a 150-foot-wide corridor. As discussed in Section 2, the proposed actual ROW width for Alternative C is 150 feet, which is consistent with the ROW widths for other alternatives.

Impacts to land use, transportation, and recreation facilities in the vicinity of the project are described in this report. Figure 1 presents the project area or vicinity and identifies the more detailed map areas that will be used to illustrate existing conditions and locate potential impacts as they are discussed in this report.

1.3 Methods Used

Data were gathered remotely where possible. A geographic information system (GIS) was used to collect and process all available mapped data, while management plans, comprehensive land use plans, and zoning ordinances were collected in hard copy or electronic formats. All documents and electronic data were reviewed and contacts were made by phone or in person to provide a context for plan review and to allow for project-specific input from representatives of affected agencies.

Ground and aerial reconnaissance were performed. Mapped sites of apparent conflicts and areas mentioned by representatives of affected agencies as key areas of concern were visited wherever possible to ensure an accurate understanding of potential conflicts. The general area was toured to ensure a broad understanding of the project surroundings.

2.0 Description of Added Alternatives

The additional alternatives identified by BPA are labeled A through D. They are shown in Figure 1 and described in Table 1. Schematics depicting the tower and right-of-way configurations for the existing and proposed conditions along each of these alternatives are presented in Appendix B.

3.0 Affected Environment

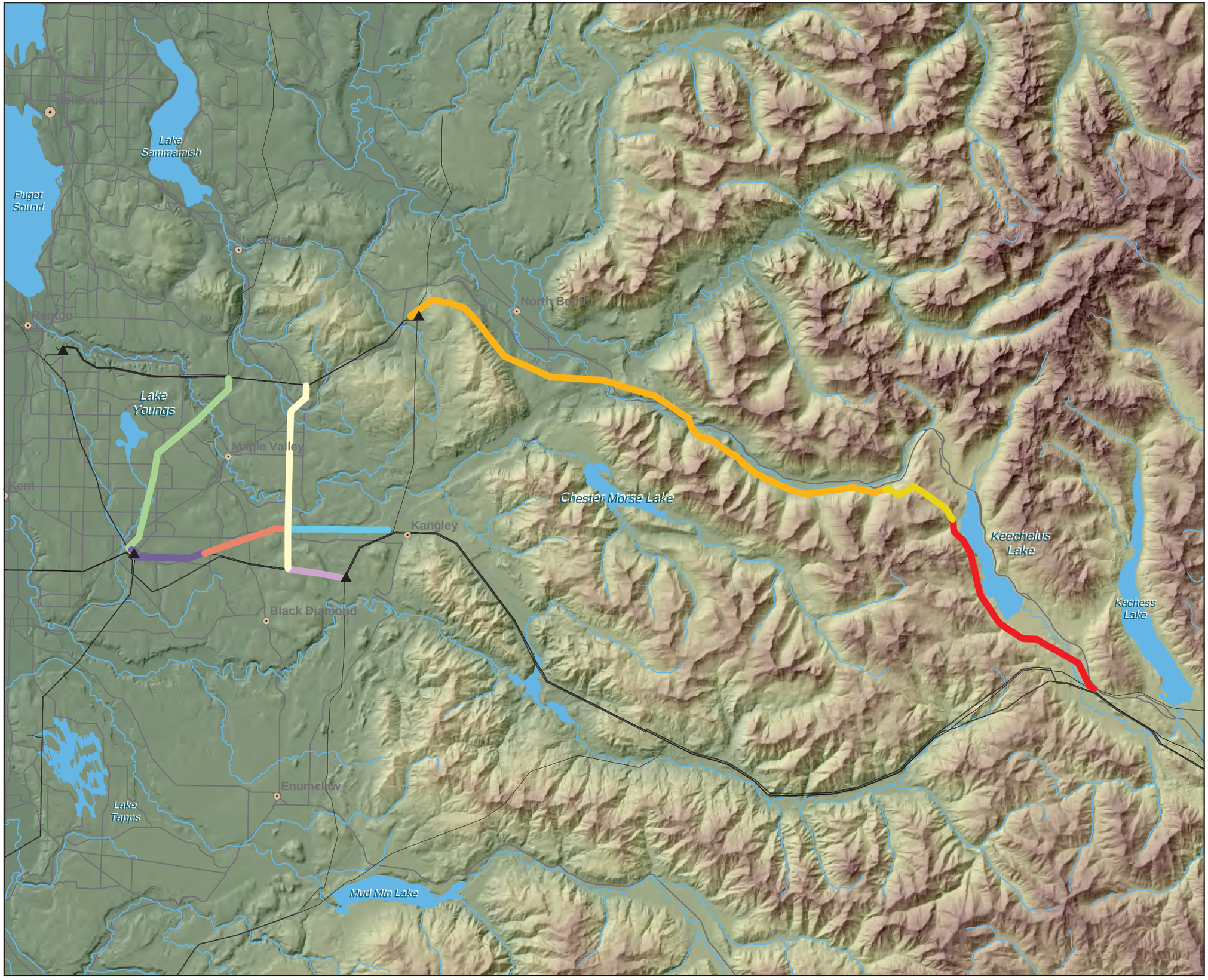
3.1 Land Use

All alternatives are located east of or on the eastern edge of King County's major urban areas. The general land uses in this area shift from small urban and rural residential uses along Highway 18, from Hobart south to Black Diamond, to forest uses where lands are managed for commercial production, habitat, and recreation values east of the rural residential areas toward Snoqualmie Pass. Some forestland occurs in the rural residential areas, but farther east, rural residential uses become much less dense and forest uses become the typical land use east of North Bend.

Figure 1
Project Vicinity

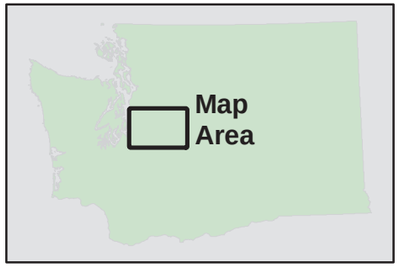
Kangley - Echo Lake Transmission Line Project

Legend



Land Use Impact Area

- A1
- A2
- A3
- C
- C1
- C2
- B-1, D1-1, D2-1
- B-2, D1-2, D2-2
- B-3, D1-2, D2-3
- BPA Substations
- Existing BPA Lines
- Highways/Interstates



N

0 2.5 5

Miles

Alternatives A and C are located in or near small urban areas characterized by a rural residential development pattern. Approximately 83 percent of the full length of Alternative A (including segment C2 as necessary to make the Kangley connection) crosses unincorporated land. The remainder crosses the recently incorporated cities of Covington and Maple Valley. Alternative C does not cross any incorporated cities. Both Alternative C and the unincorporated portions of Alternative A are located in areas zoned primarily for rural residential use with a range of permitted parcel sizes from 2.5 acres to 10. The predominant residential parcel size allowed is 5 acres.

Table 1. Description of New Alternatives

Alternative A	Construct a new single-circuit 500-kV line in an existing right-of-way from a tap along the Schultz-Raver No. 2 line near Kangley to BPA's Covington Substation near Covington. New ROW would be needed around the northeast side of the Covington Substation to where the new line would intersect the Covington-Maple Valley ROW. From Covington, rebuild a portion of BPA's existing Covington-Maple Valley single-circuit 230-kV transmission line with a double-circuit 500-kV line, operating one side at 500-kV and the other at 230-kV. The 500-kV circuit would terminate at Echo Lake Substation via a vacant circuit of the Maple Valley-Echo Lake double-circuit 500-kV transmission line. New double-circuit towers, about 175 feet tall, would support both circuits. With the exception of the new right-of-way that would need to be acquired around the Covington Substation, the new transmission lines would be built on existing rights-of-way. Alternative A consists of segments A1, A2, A3, and C2, as shown in Figure 1. Segment C2 is common to a portion of Alternative C2 west of Kangley Substation.
Alternative B	Rebuild about 38 miles of a portion of BPA's Rocky Reach-Maple Valley 345-kV transmission line between Stampede Pass and the Echo Lake Substation to a double-circuit 500-kV line. The new towers would be about 180 feet tall. The new 500-kV line would be connected to the existing Schultz–Raver No. 2 500-kV transmission line just east of Stampede Pass and to Echo Lake Substation at the west end. The line would cross I-90 twice. Almost all of this route would be on existing right-of-way. Alternative B consists of segments B1, B2, and B3, as shown in Figure 1.
Alternative C (Option C1)	Construct a new single-circuit 500-kV line from BPA's Raver Substation in a new 150-foot right-of-way adjacent to an existing right-of-way on segment C1 as shown in Figure 1. The remainder of this alternative, segment C as shown in Figure 1, would be on a new 150-foot-wide right-of-way. New towers would be about 135 feet tall. The new line would pass through the Ravensdale and Hobart areas and would be connected to an existing vacant (unused) circuit of the Maple Valley-Echo Lake double-circuit 500-kV line. The vacant circuit would then need to be connected to a new bay in the Echo Lake Substation. This option would require the purchase of new right–of-way. Alternative C (Option C1) consists of segments C and C1 as shown in Figure 1.

Table 1. Description of New Alternatives

Alternative C (Option C2)	Construct a new single-circuit 500-kV line from near the community of Kangley within an existing right-of-way to a point just west of the Cedar River Municipal Watershed. From here, the proposed route turns north and would require a new 150-foot-wide right-of-way. New towers would be about 135 feet tall. The new line would pass through the Ravensdale and Hobart areas and would be connected to an existing vacant (unused) circuit of the Maple Valley-Echo Lake 500-kV line. The vacant circuit would then need to be connected to a new bay in the Echo Lake Substation. This option would require the purchase of new right–of-way. Alternative C (Option C2) includes the route segments identified as C and C2 in Figure 1.
Alternative D	Construct a new single-circuit 500-kV transmission line from east of Stampede Pass to Echo Lake Substation, a distance of approximately 38 miles. The new line would be adjacent to a portion of the Rocky Reach-Maple Valley 345-kV line. New towers would be about 135 feet tall. The line would cross I-90 twice. A new 150-foot-wide right-of-way would need to be acquired. There are two options for Alternative D. Option D1 proposes to build the new line on the south side of the existing Rocky Reach-Maple Valley 345-kV line. Option D2 proposes to construct the new line on the north side of the existing Rocky Reach-Maple Valley 345-kV line. These routes are shown as segments D1, D2, and D3 in Figure 1 (DV: Figure 1 shows two D1-2s but no D1-3).

Alternatives B and D are located along the Interstate 90 (I-90) corridor. These alternatives cross lands predominantly designated for forest use with some small pockets of rural residential and other uses. Rural residential uses are present just south of North Bend , near Lake Keechelus, and near the recreational development at Snoqualmie Pass. About 63 percent of the length of these alternatives is located within the boundaries of the Mt. Baker-Snoqualmie and Okanogan-Wenatchee National Forests. About two-thirds of the length of these alternatives is located in King County. The remaining third is located in Kittitas County. The full length of the alternatives in Kittitas County is zoned for forest use (White, 2002). All but the small rural residential area just south of North Bend in King County is zoned for forest use (Sandin, 2002).

Table 2 and Figure 1 show land use of areas crossed by the additional Alternatives A, B, C (Options C1 and C2), and D (Options D1 and D2).

Table 2. Land Uses Crossed by Alternatives (in miles)

	Urban Area	Rural Residential	Forest	Mineral	Total
Alternative A	3.6	13.8	None	1.6	19
Alternative B	None	6.2	28.8	None*	35.0
Alternative C (Option C1)	None	6.4	3.6	None	10.1
Alternative C (Option C2)	None	8.9	0.7	1	10.6
Alternative D (Option D1)	None	6.2	28.8	None *	35.0
Alternative D (Option D2)	None	6.2	28.8	None *	35.0
* Though not currently reflected on the King County Land Use map, Alternatives B and D (Options D1 and D2) will cross the proposed Cadman Northbend Gravel Site just east of North Bend. Approximately 1 mile of the existing and proposed ROW along the route will cross property included in the current proposal.					

3.1.1 Land Use and Ownership by Alternative

3.1.1.1 Alternative A

Unincorporated Areas. Alternative A requires segment C2 to make the connection near Kangley (Figure 2). Segment C2 crosses alongside two existing unincorporated subdivisions east of Maple Valley and through the Kangley Pit. Alternative A then passes north of another small subdivision and crosses the City of Kent's Clark Springs parcel before entering the City of Maple Valley. The unincorporated area along the existing ROW between Covington and Maple Valley is an area of established subdivisions. At the Covington Substation, Alternative A turns north and enters the City of Covington. The rural residential area north of Covington consists of a mix of parcel sizes. These properties are privately owned and larger than lots in the unincorporated subdivisions between Covington and Kangley. Equestrian uses and small-scale farming, such as Christmas tree farms and pumpkin patches, are evident on some of the larger rural residential lots.

Incorporated Areas. The two incorporated areas crossed by Alternative A contain established and proposed commercial areas, existing and proposed subdivisions, apartments, and park spaces. Both Covington and Maple Valley are growing rapidly.

Maple Valley. Within 0.25 mile of Alternative A, in Maple Valley, at least nine new subdivisions (approximately 1,050 new residential units) are planned or permitted. These units include the 300-lot Rock Creek Meadows Subdivision, which has not yet submitted a completed application, and the 575-lot Maple Ridge Highland Subdivision, which is proposed for annexation. The closest three subdivisions are Shanlemar (35 lots), and Elk Run #6 and #7, which have a combined total of about 50 lots. Commercial uses immediately affected include Les Schwab Tire, Safeway Plaza I and II, and Four Corners

Storage (Figure 3). Private and public recreation sites also are located along Alternative A in Maple Valley. These sites are discussed in Section 3.3.

Covington. The portion of Alternative A that passes through Covington crosses through the city's commercial area near the State Route (SR) 18, Kent-Kangley interchange. The exact route Alternative A would take around the Covington Substation has not been decided, but it likely would be routed around the east and north sides of the substation and pass through the existing residential subdivisions at the intersection of SE Wax Road and Covington Way SE. Other existing developments include a composting and topsoil business, and a commercial plaza anchored by Safeway. The Covington Apartments and Covington Retail are under construction along the existing right-of-way. Other proposed and planned commercial uses include a "big box" regional commercial center and interest from two other large, well-known retailers in specific properties along the ROW. The existing ROW is used to accommodate the primary access to existing and planned commercial uses in the commercial area. North of SR 18 the land uses along Alternative A in Covington are residential. Three pending subdivisions or short plats (216 units) are located within 0.25 mile of Alternative A. The four-lot short plat called Fox Wood is the only proposed project in this area located along the ROW (see Figure 4).

Though the predominant use outside incorporated areas is rural residential, much of the land is forested. Figure 5 shows the forest stands by age throughout this area for reference, though commercial forest activities are not the typical land use around Alternatives A and C (Options C1 and C2).

3.1.1.2 Alternatives B and D (Options D1 and D2)

Alternatives B and D do not cross any incorporated areas, but do cross primarily forestland managed for commercial forestry, recreational, and habitat values. Three areas that have rural residential use include an area south of North Bend, an area near Lake Keechelus, and the recreation areas at Snoqualmie Pass.

Alternatives B and D cross through some areas of rural residential subdivision south of North Bend between where the alternatives cross back to the south side of I-90 and where the alternatives meet the edge of the Rattlesnake Mountain Recreation area. These view-lots are zoned for rural residential uses (Sandin, 2002) and the parcels are predominantly privately owned.

The rural residential uses, primarily cabins, evident near Lake Keechelus are located on private land surrounded by National Forest land. The cabins are on land zoned for forest use (White, 2002) (see Figures 6 and 7) in a development known as Roaring Creek.

The cabins and rural residential use near Snoqualmie Pass are also potentially affected because these alternatives pass within one-half mile to the south of some of the development.

Recreational resources, sites, and facilities along the forested lengths of Alternatives B and D are discussed in Section 3.3. Most of Alternatives B and D pass through the Mt. Baker-Snoqualmie and Okanogan-Wenatchee National Forests. Land allocations for federally owned land in these areas guide the management of these lands. Land allocations are defined in the Northwest Forest Plan, adopted in 1994. Additional plans that guide

Figure 2
Land Use Alternatives A, C, C1, and C2
Kangley - Echo Lake Transmission Line Project

Legend

- Alternatives
- BPA Substations
- Existing BPA Lines
- Trails
- Highways/Interstates
- Arterial Roads
- City Boundary

Land Use

- Missing
- Commercial
- Industrial
- Mining
- Agriculture
- Forest
- Green Spaces
- Rural Communites
- Rural Residential
- Urban Residential

Seattle

Map Area

N

0 1 2

Miles

Maple Valley
Cedar River Trail
SE JONES RD
Issaquah Creek
SE 156TH ST
TIGER MT RD SE
Taylor Mtn State Forest
Raging River
Rock Creek
Carey Creek
Cedar River Watershed
Walsh Lake
SE 104TH ST
SE 176TH ST
SE PETROVITSKY RD
140TH AVE SE
Lake Desire
Lake Youngs Trail
Plum Creek
196TH AVE SE
SE 192ND ST
124TH AVE SE
Shady Lake
SE 200TH ST
Lake Youngs
SE 208TH ST
148TH AVE SE
PETROVITSKY RD SE
244TH AVE SE
SE 216TH ST
SWEENEY RD SE
SE 231ST ST
276TH AVE SE
Shadow Lake
SE 224TH ST
132ND AVE SE
190TH AVE SE
SE 240TH ST
SE 244TH ST
SE 240TH ST
SE 256TH ST
Covington
164TH AVE SE
SE 262ND PL
Pipe Lake
224TH AVE SE
Lake Meridian
STATE HWY 516
SE KENT KANGLEY RD
284TH AVE SE
Selleck
Kangley
SE WAX RD
Brunner Park
216TH AVE SE
Plum Creek
Raver
132ND WAY SE
STATE HWY 18
Lake Sawyer
THOMAS RD SE
STATE HWY 169
SE 312TH ST
STATE HWY 58
Covington Creek
Green River
Black Diamond
HILL RD
A
C
C1
C2

Figure 3
City of Maple Valley
Land Use

Kangley - Echo Lake
Transmission Line Project

Legend

- Alternatives
- BPA Substations
- Existing BPA Lines
- Maple Valley Boundary

Land Use

- Commercial
- Industrial
- Mining
- Agriculture
- Forest
- Green Spaces
- Rural Communites
- Rural Residential
- Urban Residential
- Other

Seattle

Map Area

N

0 0.25 0.5

Miles

Cedar River

Wilderness Lake

Rock Creek Meadows

Pipe Lake

Four Corners Commericial

City of Kent

Eastwood Forest

A

Maple Ridge Highland

Elk Run Golf Course

Lake Sawyer

Figure 4
City of Covington
Land Use

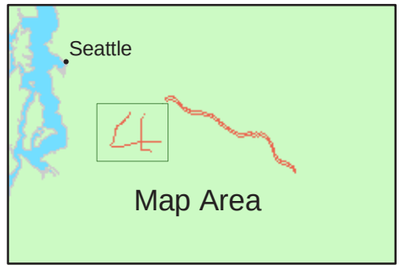
Kangley - Echo Lake
Transmission Line Project

Legend

- Alternatives
- BPA Substations
- Existing BPA Lines
- Covington Boundary

Land Use

- Commercial
- Industrial
- Mining
- Agriculture
- Forest
- Green Spaces
- Rural Communites
- Rural Residential
- Urban Residential
- Other



N

0 0.25 0.5

Miles

A

256th

Jenkins Creek

Lake Meridian

SR 18

Kent-Kangley Rd

Safeway

SE Wax Rd

Covington Rd

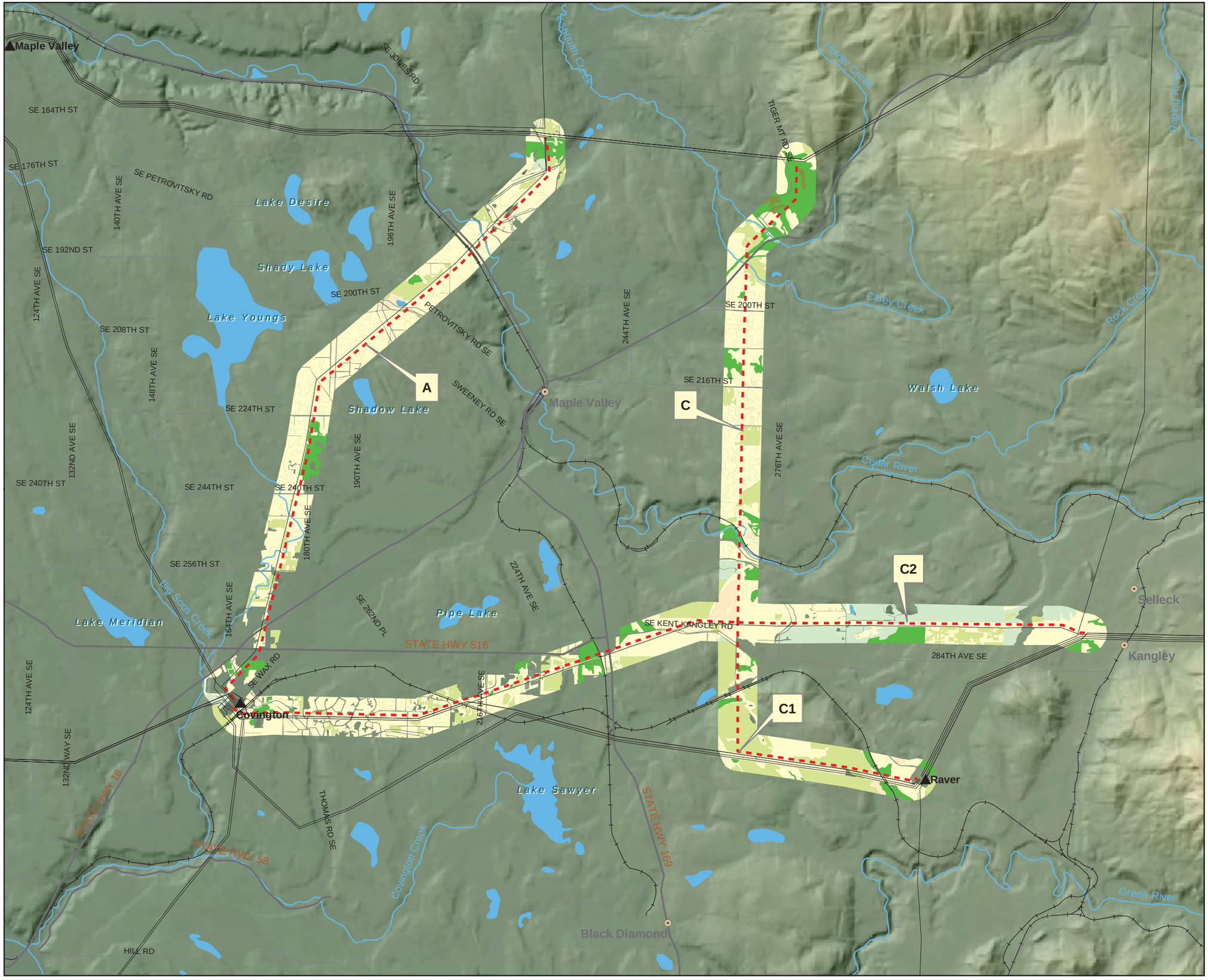
Covington

Big Soos Creek

Pipe Lake

A

Figure 5
Forest Stand by Age Alternatives A, C, C1, and C2
Kangley - Echo Lake Transmission Line Project

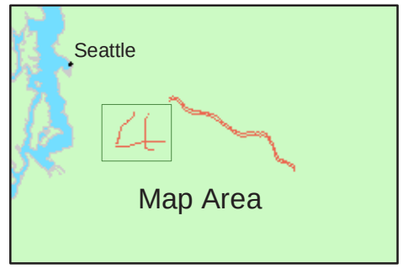


Legend

- Alternatives
- BPA Substations
- Existing BPA Lines
- Highways/Interstates
- Arterial Roads
- Railroads

Forest Stand by Age

- < 35 years
- 36 - 75 years
- 76 - 250 years
- > 250 years
- Other Forest
- Non Forest

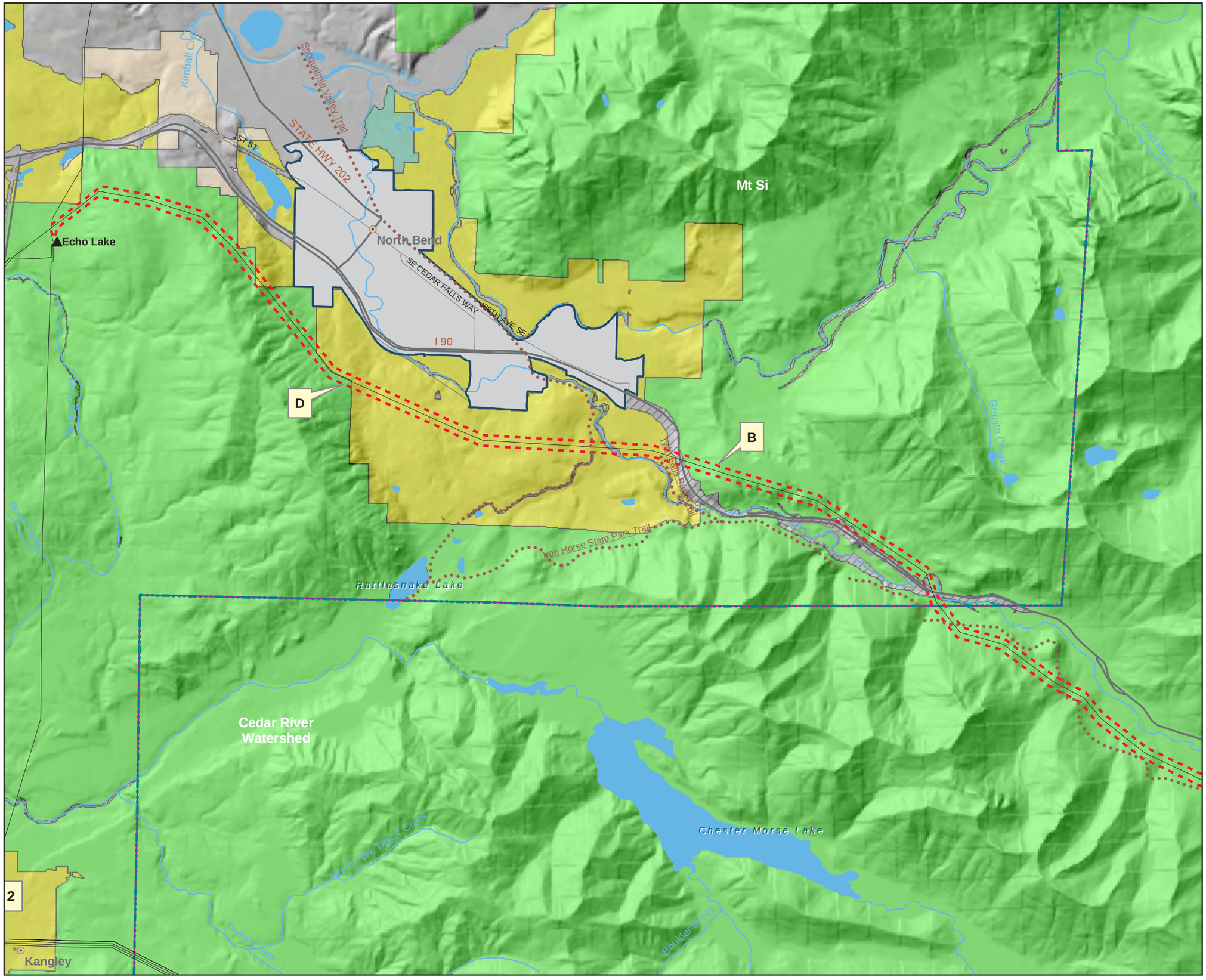


N

0 1 2

Miles

Figure 6
Land Use
Alternatives B and D, West Half
Kangley - Echo Lake Transmission Line Project

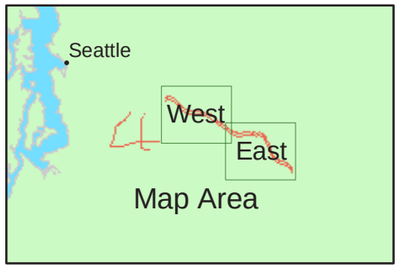


Legend

- Alternatives
- BPA Substations
- Existing BPA Lines
- Trails
- Highways/Interstates
- Arterial Roads
- City Boundary
- National Forest

Land Use

- Missing
- Commercial
- Industrial
- Mining
- Agriculture
- Forest
- Green Spaces
- Rural Communites
- Rural Residential
- Urban Residential



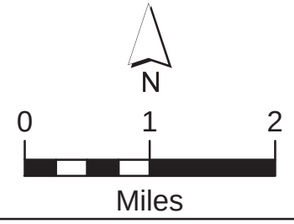
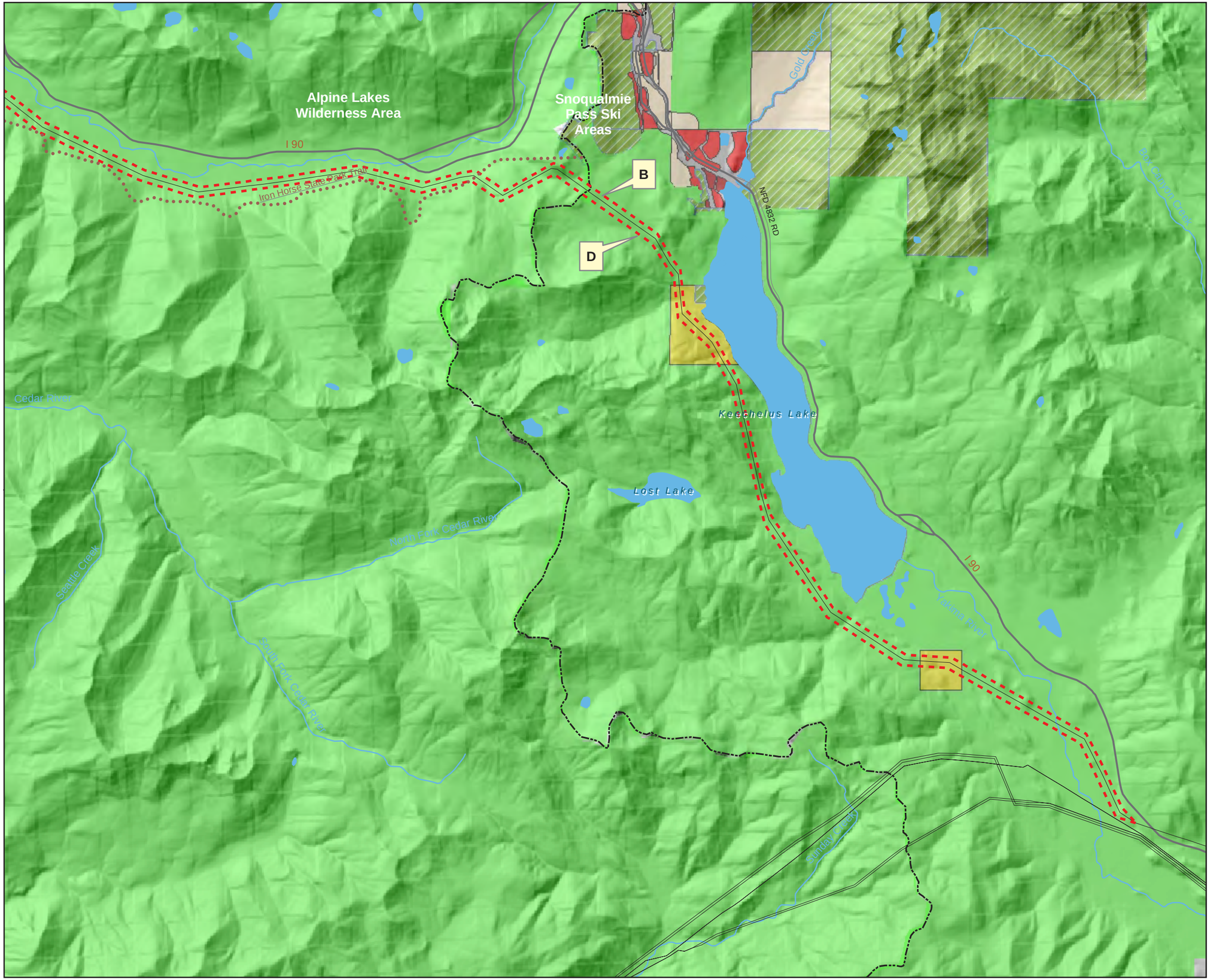


Figure 7
Land Use
Alternatives B and D, East Half
Kangley - Echo Lake Transmission Line Project

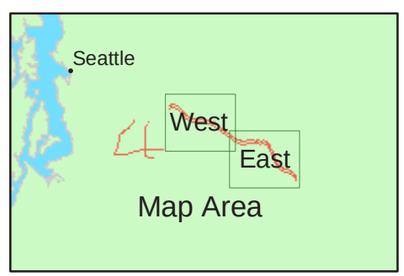


Legend

- Alternatives
- BPA Substations
- Existing BPA Lines
- Trails
- Highways/Interstates
- Arterial Roads
- wa_cnty arc

Land Use

- Missing
- Commercial
- Industrial
- Mining
- Agriculture
- Forest
- Green Spaces
- Rural Communites
- Rural Residential
- Urban Residential



N

0 1 2

Miles

management include the Mt. Baker-Snoqualmie National Forest Land Management Plan, Wenatchee National Forest Land Management Plan, and the Snoqualmie Pass Adaptive Management Area Plan, completed in 1997. As a result, land management on National Forest lands is complex. Some newly acquired properties have not yet been assigned an allocation. In these instances, the U.S. Forest Service would work with BPA on a site-specific basis to determine the appropriate allocation for affected land after a route is selected.

Northwest Forest Plan land allocations along Alternatives B and D include Late-Successional Reserve, Adaptive Management Area, Riparian Reserves, and Matrix. Individual Forest Land Management Plan allocations include General Forest, Deer and Elk Winter Range, Mountain Goat Habitat, Dispersed Recreation, and Scenic Travel Retention. The management objectives along the length of the right-of-way are all forest related with an emphasis on maintaining scenic quality, preserving the recreational experience, and maintaining and enhancing late-successional forests and their habitat values. A key element in the management objectives is the prohibition on timber harvest within forest stands more than 80 years old west of the Cascade Crest. East of the Cascade Crest there is no age limit on timber harvest, but timber stand treatments would focus on younger stands and must be beneficial to the maintenance and enhancement of late-successional forests. Figures 8 and 9 show forest stands by age.

3.1.1.3 Alternative C1

Alternative C can be completed by including either Option C1 to the Raver Substation (Alternative C1) or by including Option C2 to Kangley (Alternative C2). Land uses affected by Option C2 were discussed as part of Alternative A. Land uses affected by Option C1 are discussed in this section. Option C1 runs through a privately owned area zoned for forest use. There are large blocks of forestland currently managed as commercial forest.

Segment C, common to both Alternatives C1 and C2, turns north along the east side of the Plum Creek mineral site. Land on the west side of the proposed ROW is designated for mineral use and land on the east side is designated forest as far north as Ravensdale Way. North of Ravensdale Way, Alternative C runs through rural residential land similar to the land north of Covington along Alternative A. Parcel sizes vary greatly, but are generally larger than in areas characterized by rural residential subdivisions. Equestrian uses and small-scale farm and forest uses such as Christmas tree farms and pumpkin patches are evident. Many of the larger lots are wooded. At the intersection of Ravensdale Way and 268th Avenue SE, there is a short row of older homes on small parcels. This area is an exception to the large lot rural residential ownership pattern predominant in the area.

The northern section of Alternative C re-enters forestland at Tiger Mountain State Forest, near the SR 18 and Issaquah Hobart Road interchange. Tiger Mountain State Forest is a publicly owned, managed forest offering recreational opportunities. Land uses along this alternative are depicted in Figure 2 and forest stands by age are depicted in Figure 5.

3.1.2 Large Landowners and Managers in the Vicinity

Large private landowners in the vicinity include Weyerhaeuser Company (inclusive of Weyerhaeuser Real Estate Company), Fruit Growers Supply Company, Plum Creek Timber Company, Trillium Corporation, and Palmer Coking Coal Company (Figures 10, 11, and 12).

The original draft EIS addressed recreational uses allowed on property near the Echo Lake Substation, owned by the Fruit Growers Supply Company, Weyerhaeuser Real Estate Company, and Trillium. Contacts made to confirm land management and recreational use of land around the additional alternatives do not alter earlier statements appearing in the draft EIS regarding management of large parcels or tracts of land near Echo Lake.

3.1.2.1 Palmer Coking Coal

There is no management plan for Palmer Coking Coal land near Alternative C (Options C1 and C2). Approximately 310 acres are owned and managed for forestry and mineral extraction near Landsburg. Development is planned for the area. A total of 25 planned lots are located along segment C as it is currently depicted.

Public access to Palmer Coking Coal land is allowed by permission only. Recreation uses include horseback riding, hiking, walking, and jogging on informal paths (Kombol, 2002). There are abandoned mine shafts in this area.

3.1.2.2 Plum Creek Timber Company

There is no management plan for Plum Creek land in the vicinity of the additional alternatives. Generally, properties are managed for timber harvest on a 50-year rotation. Most stands are 15 to 25 years old. Some mining sites owned by Plum Creek also are located in the area. Two mineral extraction sites are located at the northern end of Alternative A and another is located at the southern end of segment C, where it joins segment C1.

Public access occurs informally on Plum Creek property. It is not a permitted system. Hikers, horseback riders, and mountain bikers all use the trails. Jeeps and motorcycles also drive trails in the vicinity of existing transmission lines (Johnson, 2002).

3.1.2.3 Weyerhaeuser Company

Land owned by Weyerhaeuser around Alternatives B, C (segments 1 and 2), and D (Options D1 and D2) is managed for timber production. Weyerhaeuser also owns the parcel east of North Bend just north of I-90 that is permitted for expanded mineral extraction. Cadman will be the operator of the North Bend Gravel Mine where extraction is expected to start in July 2002 and run for approximately 20 years.

Public access is not allowed and locked gates secure the Weyerhaeuser properties (Stangle, 2002).

3.1.2.4 Other Landmark Ownerships

The Landsburg Mine on Kent-Kangley near Black Diamond and the Hobart Landfill at approximately 24041 276th Ave are also located near Alternative C. The Landsburg Mine site is an archived Superfund site. Its status as an archived site means that to the best of EPA's knowledge all necessary steps have been taken and no further steps will be taken to list the site on the National Priority List. The Hobart Landfill has been closed and no longer accepts waste.

Figure 8
Forest Stand by Age
Alternatives B and D, West Half

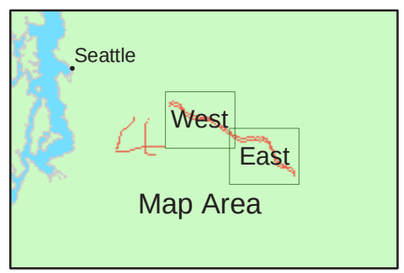
Kangley - Echo Lake Transmission Line Project

Legend

- Alternatives
- BPA Substations
- Existing BPA Lines
- Highways/Interstates
- Arterial Roads
- Railroads

Forest Stand by Age

- < 35 years
- 36 - 75 years
- 76 - 250 years
- > 250 years
- Other Forest
- Non Forest



N

0 1 2

Miles

Figure 9
Forest Stand by Age
Alternatives B and D, East Half
Kangley - Echo Lake Transmission Line Project

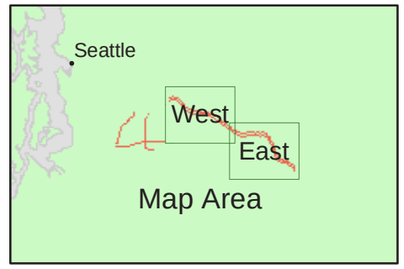


Legend

- Alternatives
- BPA Substations
- Existing BPA Lines
- Highways/Interstates
- Arterial Roads
- Railroads

Forest Stand by Age

- < 35 years
- 36 - 75 years
- 76 - 250 years
- > 250 years
- Other Forest
- Non Forest



N

0 1 2

Miles

Figure 10
Recreation and Major Land Owners Alternatives A, C, C1, and C2

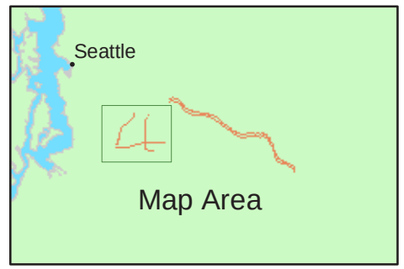
Kangley - Echo Lake Transmission Line Project

Legend

- Alternatives
- BPA Substations
- Existing BPA Lines
- Trails
- Highways/Interstates
- Arterial Roads
- Parks & Wilderness
- Watershed
- Other Public

Large Land Owners

- Palmer Coking Coal Co
- Plum Creek Timber Co
- Weyerhauser Co



N

0 1 2

Miles

Figure 11
Recreation and Major Land Owners Alternatives B and D, West Half

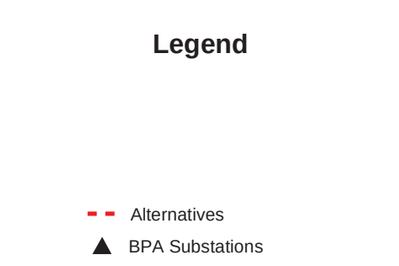
Kangley - Echo Lake Transmission Line Project

Legend

- Alternatives
- BPA Substations
- Existing BPA Lines
- Trails
- Highways/Interstates
- Arterial Roads
- National Forest
- Parks and Wilderness
- Watershed
- Other Public

Large Land Owners

- Palmer Coking Coal Co
- Plum Creek Timber Co
- Weyerhauser Co

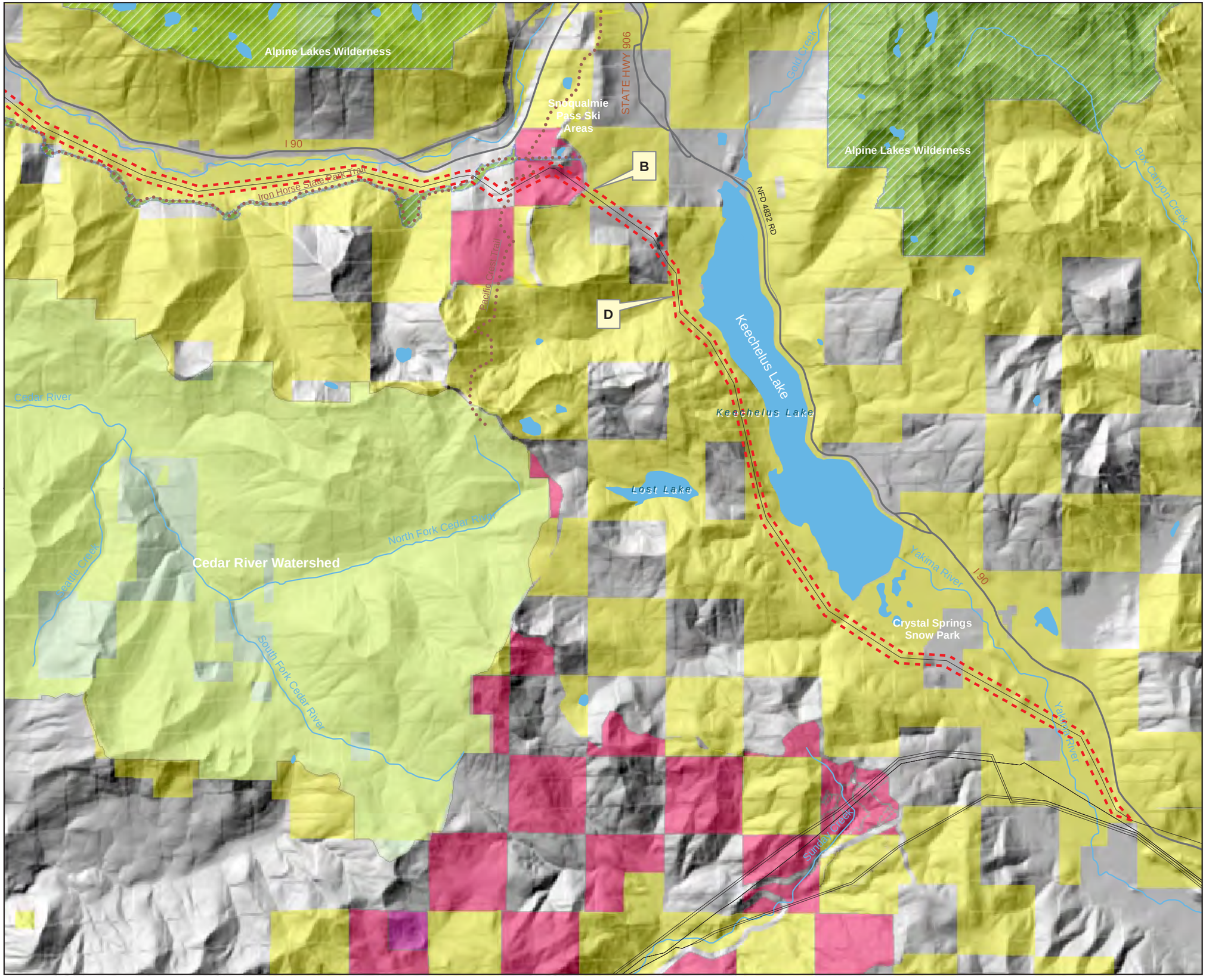


N

0 1 2

Miles

Figure 12
Recreation and Major Land Owners Alternatives B and D, East Half
Kangley - Echo Lake Transmission Line Project

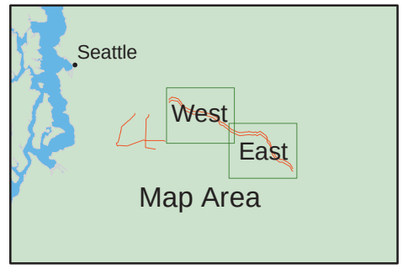


Legend

- Alternatives
- BPA Substations
- Existing BPA Lines
- Trails
- Highways/Interstates
- Arterial Roads
- Parks and Wilderness
- Watershed
- Other Public

Large Land Owners

- Palmer Coking Coal Co
- Plum Creek Timber Co
- Weyerhauser Co



N

0 1 2

Miles

3.2 Transportation

3.2.1 Existing Transportation Roads, Rail Lines, and Airports

Interstate and State Roadways and Bridges. I-90 is intersected twice by Alternatives B and D. Alternative A intersects SR 169, SR 18, and SR 516. Alternative C also intersects SR 18 and SR 516. These state routes provide access to the cities of Covington and Maple Valley, and serve as links to Interstates 90 and 405, as well as to the larger incorporated areas of Kent and Renton, among others. They are under the jurisdiction of the Washington State Department of Transportation (WSDOT).

Primary Local Roadways and Bridges. Primary local roadways and related bridges adjacent to or intersected by Alternative A, include 164th Avenue SE, 190th Avenue SE, 196th Avenue SE, 216th Avenue SE, SE 256th Street, SE 240th Street, Cedar Grove Road, Lake Francis Road, Petrovitsky Road, Kent-Kangley Road, and Covington/Sawyer Road. These roads primarily provide access, either directly or via subdivision streets, to homes and to the central business districts of Covington and Maple Valley. Land use in the project area adjacent to these roadways primarily is zoned rural residential, with some urban residential, and smaller areas of commercial, industrial, and mining. The roads are maintained and improved under the jurisdiction of King County. Within the City of Covington, Kent-Kangley Road (SR 516), Covington Way SE, SR 18, and 164th Avenue SE are the primary roadways adjacent to or intersected by Alternative A. This includes the portion of the easement now covered by paved ingress and egress routes and landscaped parking lots in the Covington Square Shopping Center.

Local roadways adjacent to or intersected by Alternative C include 276th Avenue SE, SE 200th Street, SE 216th Street, Cedar River Pipeline Road, Kent-Kangley Road, Tiger Mountain Road, and the Issaquah-Hobart Road. These roads primarily provide access, either directly or via subdivision streets, to homes in Covington and Maple Valley. Land use in the project area adjacent to these roads primarily is zoned rural residential, with some forestry and mining uses.

Roadways adjacent to or intersected by Alternatives B and D, other than I-90, include unpaved access roads on National Forest land used to service the existing transmission lines and provide recreation and resource management access to National Forest land south of I-90 and private forestlands north of I-90. On the west end of Alternatives B and D, several local roadways which provide access to homes and subdivisions south of North Bend are intersected.

Rail Lines. The Burlington Northern Santa Fe Railway (BNSF) is the only active rail line adjacent to or intersected by any of the alternatives. Alternatives B and D intersect the BNSF line southeast of North Bend. Alternative A intersects the BNSF at two locations: west of Covington and within the city limits of Covington. Alternatives C (segments C1 and C2) intersect the BNSF at one location to the southwest of Maple Valley.

There are also several abandoned railroad rights-of-ways in the area that previously belonged to the Chicago, Milwaukee, St. Paul, and Pacific Railroad (CMSP&P). Some of them have been converted to recreational trails through the Rails to Trails program.

Airports. Two small landing strips, North Bend and Bandera, and one airport, Crest Airpark, exist within the project area. The landing strips are near Alternatives B and D near I-90. The airport is south of Alternative A near Covington.

Figures 13, 14, and 15 show major transportation infrastructure in the area, including roads, rail lines and airports.

3.2.2 Planned Transportation Elements and Major Works Underway

The 2002-2007 Maple Valley Transportation Improvement Program shows no planned future improvements in the area adjacent to the project area.

The Transportation Element of the City of Covington's Comprehensive Plan indicates two future projects that could overlap in timing and construction with the proposed Alternative A alignment. First, the city plans to widen SR 18 to four lanes spanning Covington Way to 180th Avenue SE. A portion of the proposed Alternative A crosses over SR 18. This project is a high priority and is state-funded. It is estimated to occur between 2002 and 2006. Second, the city plans to construct a new downtown Collector Arterial System, which would consist of SR 516, SR 18, Covington Way SE, and Wax Road. This city project, which is just west of the proposed Alternative A alignment, is privately funded and estimated to be constructed between 2002 and 2006. This project currently is rated as a medium priority.

The King County Transportation Plan and the Cedar River Watershed Management Plan do not show any significant projects or future work in the areas adjacent to the alternatives.

WSDOT is in the design phase of widening I-90 at Snoqualmie Pass East from a four-lane to a six-lane highway. An EIS is scheduled for 2003 and construction is scheduled for summer of 2004. The proposed transmission line project and WSDOT project are not anticipated to conflict.

3.3 Recreation

3.3.1 Recreation Resources

Many recreational resources are located in and around the added alternatives. King County is developing a regional trail system that provides commuting options and is connecting communities to recreational destinations. The cities of Covington and Maple Valley have raised recreation issues related to Alternative A and potential impacts, both positive and negative, on local and regional recreation resources. Alternatives B and D (Options 1 and 2) extend along the I-90 corridor and run through an area focused on providing scenic quality and recreational opportunities. The land acquisition and trail development activities of public agencies and the Mountains to Sound Greenway Trust signify the priority placed on recreation in the vicinity of Alternatives B and D (Options D1 and D2) and the northern end of Alternative C (segments C1 and C2). The distinction of the 100-mile section of I-90, the Mountains to Sound Greenway, as the first interstate highway to be designated a National Scenic Byway confirms the priority placed on maintaining and enhancing scenic qualities and recreational opportunities along the I-90 corridor.

Informal recreation uses that occur on lands managed by large private landowners in the vicinity were discussed earlier in this section.

Figure 13
Transportation Features
Alternatives A, C, C1, and C2

Kangley - Echo Lake Transmission Line Project

Legend

- Alternatives
- BPA Substations
- Existing BPA Lines
- Highways/Interstates
- Arterial Roads
- Railroads
- Airfields

Map Area

Seattle

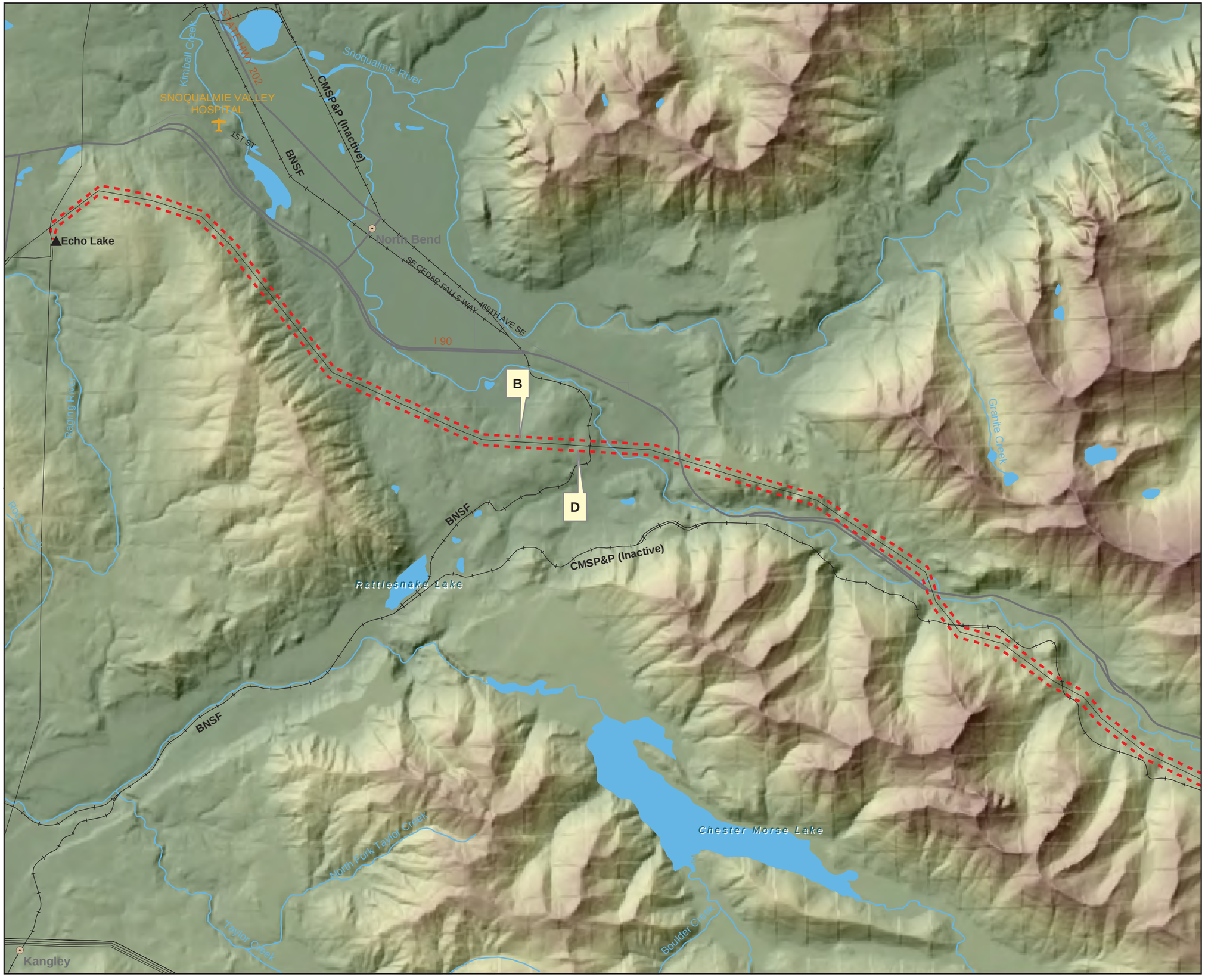
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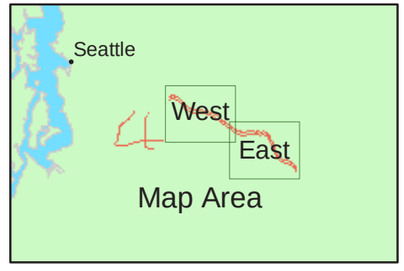
Figure 14
Transportation Features
Alternatives B and D, West Half

Kangley - Echo Lake Transmission Line Project



Legend

- Alternatives
- BPA Substations
- Existing BPA Lines
- Highways/Interstates
- Arterial Roads
- Railroads
- Airfields



N

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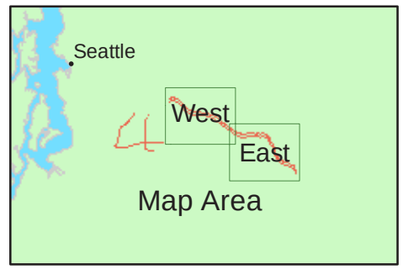
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Figure 15
Transportation Features
Alternatives B and D, East Half
Kangley - Echo Lake Transmission Line Project



Legend

- Alternatives
- BPA Substations
- Existing BPA Lines
- Highways/Interstates
- Arterial Roads
- Railroads



N

0 1 2

Miles

3.3.2 Recreational Resources by Alternative

3.3.2.1 Alternative A

Recreational resources along the full route of Alternative A are discussed here. The easternmost portion of Alternative A passes just south of the Cedar River Watershed and through the City of Kent's Clark Springs property. Neither of these publicly owned areas is open to the public for recreational use. Alternative A continues through Maple Valley. The existing right-of-way crosses Elk Run Golf Course, which is a public golf course located on private land and land leased from King County. It is estimated that approximately 50,000 rounds of golf are played annually at the course (Humphreys, 2002). There is a planned active recreation area including ballfields, and bus barn development on land immediately under the right-of-way and existing line. Maple Valley recently completed design for this facility and plans to start construction soon. Plans include a perimeter trail that would connect to the Cedar River and planned Cedar to Green River Trails (Starbord, 2002). As Alternative A turns north at the Covington Substation, it passes through the City of Covington between Gas Line Right-of-Way Park, which is currently being developed, and the Soos Creek Park and Trail, which is planned to extend into Covington. North of Covington, Alternative A passes between Lake Youngs Watershed and Shadow Lake, then crosses through the Peterson Lake Natural Area and the Cedar River Trail, which connects Maple Valley and Renton along Highway 169 and the Cedar River.

3.3.2.2 Alternatives B and D (Options D1 and D2)

Approximately 22 miles of Alternatives B and D (Options D1 and D2) cross through National Forest land from the Yakima River east of Keechelus Lake to about midway between exits 38 and 42 on the I-90 corridor. As discussed earlier in the land use section, the land allocations assigned to public land in this area show maintenance of recreational opportunities is a primary objective in this area of both National Forests. Acquisition and exchange of land have occurred recently, but there are no plans to add to existing recreational facilities (Rogalski, 2002). Federal recreational resources of note in the vicinity include:

- **Alpine Lakes Wilderness Area,** located north of I-90 near Snoqualmie Pass
- **Pacific Crest Trail**, which crosses the existing BPA right-of-way west of Surveyors Lake and east of the Iron Horse State Park Gate
- **Tinkham Campground,** located between existing BPA right-of-way and I-90, east of exit 42
- **McClellen Butte Trail,** with its trailhead at exit 42

The remainder of the length of Alternatives B and D (Options 1 and 2) (approximately 14 miles) crosses a mix of public and private land. Though outside the National Forest, this length of the alternatives is located within the Mountains to Sound Greenway Trust and a mix of state, federal, and privately funded recreational resources has been established. Recreational resources outside the National Forest boundary include the following:

- **Iron Horse State Park and John Wayne Pioneer Trail**, which parallel the I-90 corridor from Rattlesnake Lake to Lake Keechelus and the Yakima River. Parts of this converted

railroad line trail parallel the BPA right-of-way and the proposed alternatives cross the trail in four locations.

- **Ollalie State Park,** located east of the Upper Twin Falls Trailhead
- **Upper and Lower Twin Falls Trailhead, Twin Falls Natural Area, and Twin Falls Trail,** located east of exit 34, along the south side of I-90
- **Camp Waskowitz, with** approximately 40 acres north of the South Fork along I-90 accessed off of 150th and approximately 330 acres south of the South Fork. A portion of the 330 acres extends up to the existing line. Most of the property is used for hiking and outdoor educational sites. Outhouses and "infrequently used shelter houses" are located along the existing line and Christmas trees have been planted under the existing line.
- **Snoqualmie Valley Trail** extends from the John Wayne Pioneer Trail and Rattlesnake Lake recreation area down the Snoqualmie River valley
- **Rattlesnake Mountain Scenic Area, Rattlesnake Mountain Trail, and Rattlesnake Lake Recreation Area.** Rattlesnake Lake Recreation Area is more than 1.5 miles south of the existing BPA right-of-way on Cedar Falls Road off exit 32. The existing BPA right-of-way runs along the east side, then passes through the northern end of the Rattlesnake Mountain Scenic Area approximately 0.75 mile south of Snoqualmie Point Trailhead where it crosses the Rattlesnake Mountain Trail.

West of the Rattlesnake Mountain Scenic Area, the existing BPA right-of-way turns southwest toward the Echo Lake Substation after crossing the Rattlesnake Mountain Trail. Here it crosses Weyerhaeuser Real Estate Company land that has been identified for a planned trail connection between the Tiger Mountain State Forest and Rattlesnake Mountain Scenic Area (Konigsmark, 2002).

3.3.2.3 Alternative C (Segments 1 and 2)

Alternative C (segment 1) crosses no public recreation areas. Segment C, common to both C1 and C2, passes just west of Ravensdale Park and along the east side of Big Bend along the Cedar River just north of Kent-Kangley Road. At its north end, this segment crosses Tiger Mountain State Forest. (Refer to Figure 8.)

Segment C2 of Alternative C is described under Alternative A.

4.0 Environmental Consequences

4.1 Land Use

4.1.1 Impact Levels

Table 3 summarizes Land Use, Transportation, and Recreation impact levels. The impact levels for each of type of environmental consequence are defined at the beginning of each section. Land use impact levels are defined below.

Land use impacts would be considered **high** where transmission facilities would:

- Require acquisition of new right-of-way and installation of new structures that would preclude existing or planned use of the land outside existing electrical transmission corridors in an area not previously directly affected by the presence of electrical transmission lines
- Displace five or more residences

Impacts would be considered **moderate** where transmission facilities would:

- Require acquisition of new right-of-way and installation of new structures that would preclude existing or planned use of the land outside existing right-of-way, but immediately adjacent to an existing electrical transmission corridor in an area currently affected by the presence of transmission lines
- Displace one to four residences

Impacts would be considered **low** where transmission facilities would:

- Occupy existing right-of-way and require the rebuilding or replacement of existing structures or the installation of new structures that may necessitate adjustment of established or planned use of land within existing right-of-way
- Displace no residences

Table 3 summarizes the line miles associated with each of the alternatives and the levels of land use, recreation, and transportation impact (high, moderate, low, or no) during project operation.

Table 3. Summary of Land Use, Recreation, and Transportation Impact Levels by Alternative

Alternative	Total Miles	High		Moderate		Low or No	
Land Use Impact Levels							
A with C2	19.0	X					
C with C1	10.1	X					
C with C2	10.6	X					
B	38.0					X	
D (Option 1)	38.0	X					
D (Option 2)	38.0	X					
Transportation Impact Levels							
A with C2	19.0					X	
C with C1	10.1					X	
C with C2	10.6					X	
B	38.0					X	
D1	38.0					X	
D2	38.0					X	
Recreation Impact Levels							
		Experiential	**Functional**	**Experiential**	**Functional**	**Experiential**	**Functional**
A with C2	19.0					X	X
C with C1	10.1					X	X
C with C2	10.6					X	X
B	35.0					X	X
D1	35.0			X			X
D2	35.0			X			X

Note:

Recreational resources were assigned a moderate rating for experiential impact as a result of the high level of experiential impact Alternative D (Options 1 and 2) would have on Lower Twin Falls Trailhead balanced against the low level of impacts on other recreational resources in the area. Cumulative experiential impacts in the area were also considered.

4.1.2 Potential Long-Term and Short-Term Impacts

4.1.2.1 Long-Term Conversion Impacts

No comprehensive plan or zone changes would be required in order to site any of the proposed alternatives. Utility facilities are permitted outright or conditionally in all land use zones currently crossed. The presence of BPA right-of-way and transmission lines has

varied impacts on lands accommodating or planned for different uses. Land currently managed for timber production would be converted from that use within the entire right-of-way. Other uses would be accommodated within the cleared areas of the rights-of-way when timber management for commercial harvest is no longer possible. The same would be true for land managed for the protection or enhancement of late-successional forests or old-growth timber stands. However, land used for large lot residential or even urban commercial or industrial uses may, with careful planning, continue to be used in much the same way within the right-of-way as it would be if the right-of-way did not exist. Visual impacts or disturbance related to noise created by transmission lines is possible, but the actual conversion of the land would occur only in those areas occupied by tower structures or access roads.

Rights-of-way may accommodate circulation and parking or rural pasture areas that are necessary or desirable in rural residential, commercial, or industrial areas. Potential for recreational open space also may be created by the presence of a transmission line easement through an urban area. When new rights-of-way are acquired in established development areas, it is not always possible to avoid all existing structures. Some residences or other uses may have to be displaced.

4.1.2.2 Short-Term Construction Impacts

Short-term construction-related impacts often are referred to as nuisance impacts and would be similar for all alternatives. Noise and erosion can be controlled through employment of noise mitigation measures, erosion, and dust control, and prompt revegetation of disturbed areas. Less clearing activity would be necessary where existing rights-of-way are used and less construction time spent to create new access roads where an existing system of access roads exists. Employing best management practices (BMPs) would minimize environmental construction impacts in both populated and unpopulated areas. However, alternatives located near or in rural residential areas would inconvenience a greater number of individuals during the construction period.

4.1.2.3 Alternative A

Most of the length of Alternative A would be accommodated within existing rights-of-way. Table 4 shows the existing and proposed configurations of the facilities along the route. The transmission line would need to be routed around the Covington Substation, but the route the line would take in this area is not known. It is assumed, for this discussion, that the line would need to be located on new right-of-way beyond the eastern edge of the substation property, which is owned in fee by BPA.

Table 4. Description of Impacts by Alternative

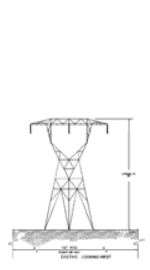
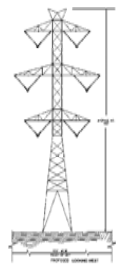
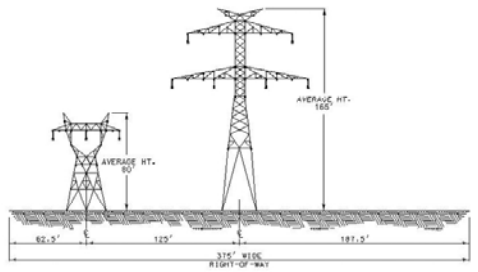
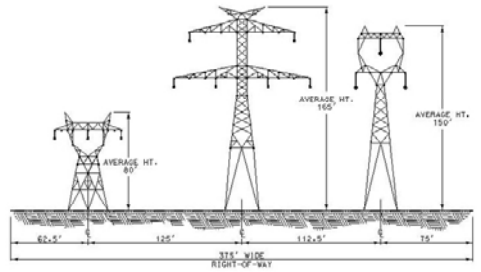
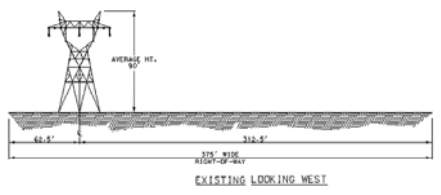
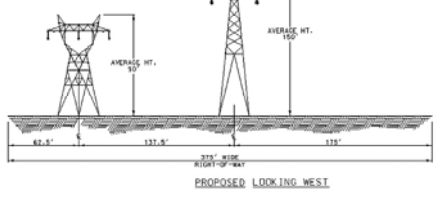
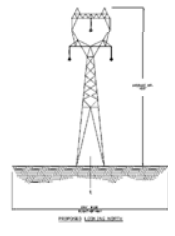
Land Use Impact Area	Existing	Proposed	Area of New or Expanded ROW (acres)	Area of New Access Road (acres)	Length of Line (miles)	Tax Lots Crossed	Developed Tax Lots Crossed	Homes Displaced (approximate)
Alternative A								
A-1 Covington-Maple Valley Corridor Alternative "A"			None	5	8.9	181	105	None Existing ROW
A-2 Corridor East of Covington Alternative "A"			None	6	3.2	133	103	Note: The route Alternative A takes around Covington Substation is not illustrated here. If, as anticipated, this routing cannot be accommodated on existing BPA property, as many as 25 homes and two tax lots may be displaced or purchased to accommodate new ROW.
A-3 Corridor from Kangley West Toward Covington Alternatives "C2" and "A"			None	2	3.5	55	24	None Existing ROW
Alternative C								
C Alternative "C" to "C1" Proposed 500-kV Addition			142	20	7.8	120	53	30-35 houses within a 250-foot corridor. Note: Actual ROW will be 150 feet wide.
Alternative "C" to "C2" Proposed 500-kV Addition			112	18	6.2	102	46	23-28 houses within a 250-foot corridor. Note: Actual ROW will be 150 feet wide.

Table 4. Description of Impacts by Alternative

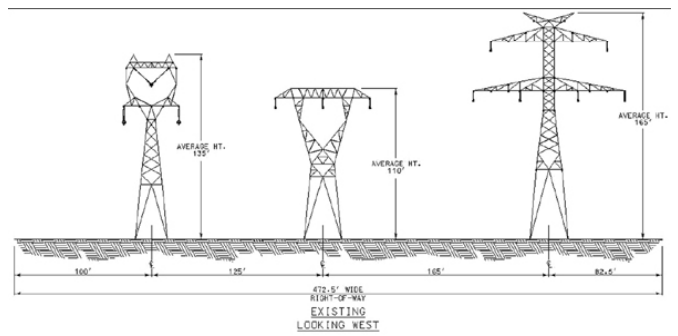
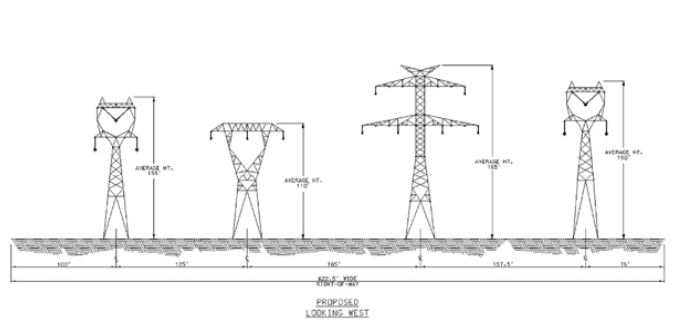
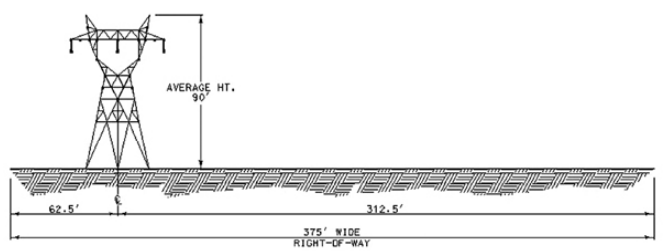
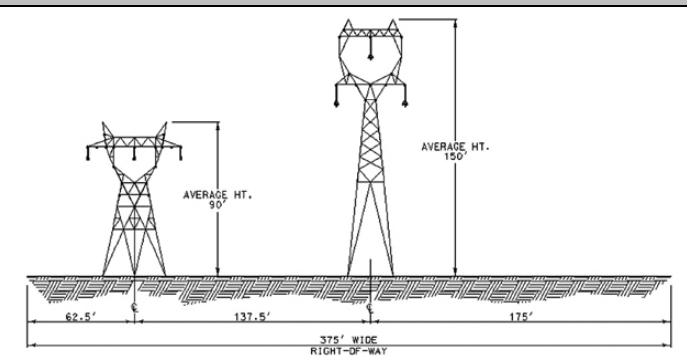
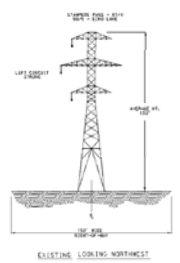
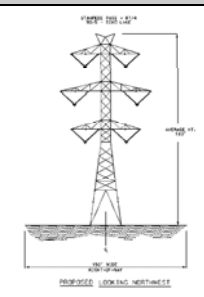
Land Use Impact Area	Existing	Proposed	Area of New or Expanded ROW (acres)	Area of New Access Road (acres)	Length of Line (miles)	Tax Lots Crossed	Developed Tax Lots Crossed	Homes Displaced (approximate)
Alternative C1								
C1 Corridor West of Raver Alternative "C1"			41	1	2.3	8	1	0
Alternative C2								
C2 Alternative "C2" Proposed 500-kV Addition Corridor from Kangley West Toward Covington Alternatives "C2" and "A"			None	3	4.2	32	10	None Existing ROW
Alternative B								
B-1 Rocky Reach-Maple Valley Corridor Alternative "B" Proposed Double Circuit			None	2	9.8	Tax lot count not available for Kittitas County*	Developed tax lot count not available for Kittitas County*	None Existing ROW

Table 4. Description of Impacts by Alternative

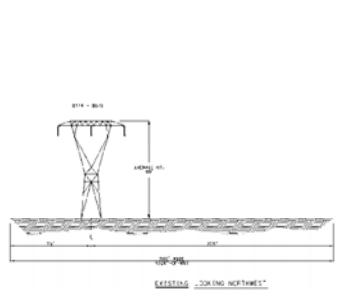
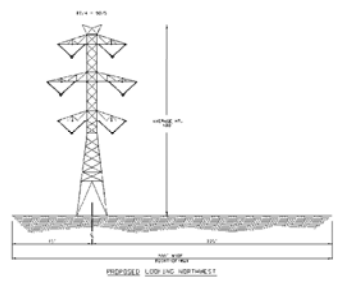
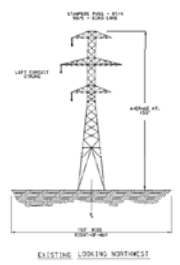
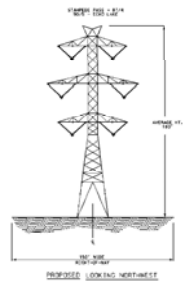
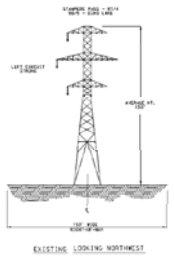
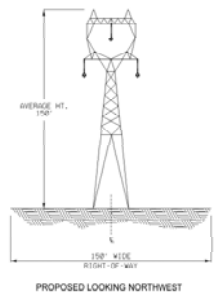
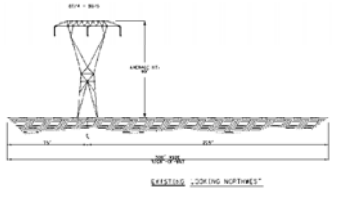
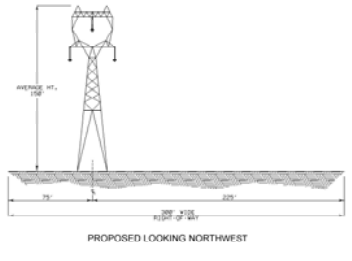
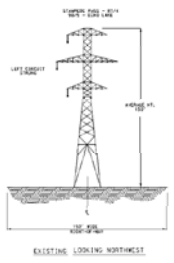
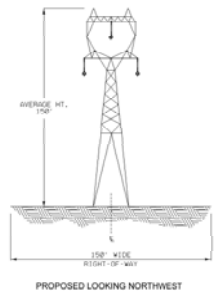
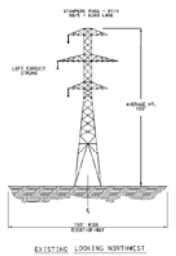
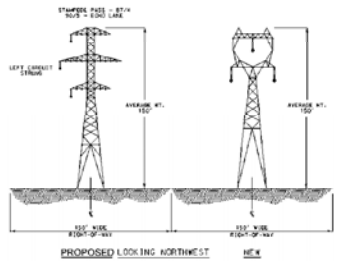
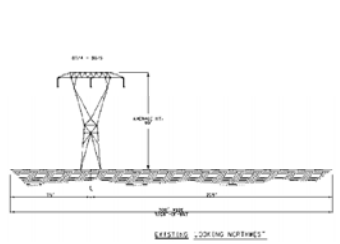
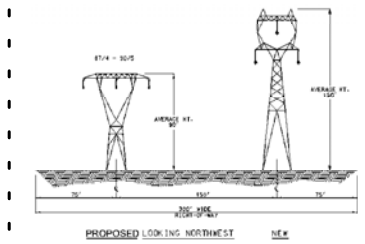
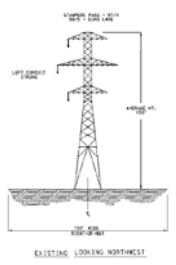
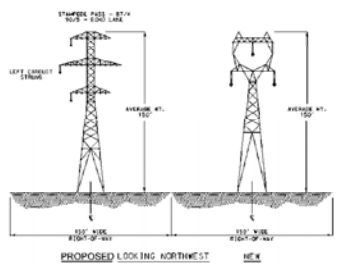
Land Use Impact Area	Existing	Proposed	Area of New or Expanded ROW (acres)	Area of New Access Road (acres)	Length of Line (miles)	Tax Lots Crossed	Developed Tax Lots Crossed	Homes Displaced (approximate)
B-2 Rocky Reach-Maple Valley Corridor Alternative "B" Proposed Double Circuit Replacing Existing Single-Circuit Structures from Tower 87/4 to Tower 90/5			None	0	3.5	7 King County portion only	0 King County portion only	None Existing ROW
B-3 Rocky Reach-Maple Valley Corridor Alternative "B" Proposed Double Circuit Replacing Existing Double-Circuit Structures from Tower 90/5 to Echo Lake			None	3	22.5	103	20	None Existing ROW
Alternative D1								
D1-1 Rocky Reach-Maple Valley Corridor Alternative "D" Proposed Single Circuit			178	8	9.8	Tax lot count not available for Kittitas County	Developed tax lot count not available for Kittitas County	None
D1-2 Rocky Reach-Maple Valley Corridor Alternative "D" Proposed Single Circuit			63	3	3.5	7 King County portion only*	0 King County portion only*	None Existing ROW

Table 4. Description of Impacts by Alternative

Land Use Impact Area	Existing	Proposed	Area of New or Expanded ROW (acres)	Area of New Access Road (acres)	Length of Line (miles)	Tax Lots Crossed	Developed Tax Lots Crossed	Homes Displaced (approximate)
D1-3 Rocky Reach-Maple Valley Corridor Alternative "D" Proposed Single Circuit			410	22	22.5	127	32	11-14 houses + 5 additional tax lots
Alternative D2								
D2-1 Rocky Reach-Maple Valley Corridor Alternative "D" Proposed Single Circuit			178	9	9.8	Tax lot count not available for Kittitas County	Developed tax lot count not available for Kittitas County	None
D2-2 Rocky Reach-Maple Valley Corridor Alternative "D" Proposed Single Circuit			None	3	3.5	8 King County portion only*	0 King County portion only*	None Existing ROW
D2-3 Rocky Reach-Maple Valley Corridor Alternative "D" Proposed Single Circuit			410	20	22.5	113	22	8 houses

* Land in Kittitas County is predominantly National Forest, with few parcels and limited development.
Source Data: Refer to Section 8 (References) in this report.

Location of the transmission line outside existing right-of-way in this location would affect as many as 27 tax lots in the subdivision located at the corner of SE Wax Road and Covington Way, and would potentially displace homes on as many as 25 of those tax lots according to assessor records. For this reason alone, Alternative A would be considered to have a **high** land use impact. No other portion of this alternative would require new right-of-way. This alternative also would directly affect more than 400 tax lots along its length. As many as 240 of these tax lots are developed.

Impacts along this alternative would not be limited to displaced residents. Careful coordination would be required to maintain the circulation pattern in and out of the commercial development in Covington and the parking area at the new Covington Apartments now under construction. Though specific location of towers through the proposed ballfields and bus barn in Maple Valley will be planned to create the least disruption possible to existing plans and to ensure impacts to proposed land uses are minimized, concerns about build-up of static electricity under the proposed lines may cause the city to relocate the school bus parking to another site.

4.1.2.4 Alternative B

Alternative B would require rebuilding the existing facility within existing right-of-way. This alternative would not displace any dwellings and would not require the acquisition of additional right-of-way. Alternative B would be considered to have **low** land use impact. The approximate 38-mile length of Alternative B does cross more than 110 tax lots, at least 20 of which are developed.

4.1.2.5 Alternative C (Option C1)

Proposed transmission line segment C is common to Alternative C (Options C1 and C2). The impact of Option C1 would be similar to Option C2, primarily because of the impacts of segment C. Segment C would require new construction in a new right-of-way. It is estimated that between 23 and 28 dwellings would be displaced to allow for this construction. The impact resulting from segment C alone would cause a **high** land use impact. In total, Option C1 would displace approximately 30 to 35 homes, seven more than Option C2. The 10-mile length of Option C1 would cross 128 tax lots, at least 54 of which are developed.

4.1.2.6 Alternative C (Option C2)

This discussion considers land use impacts along the total length of Alternative C, segments C and C2. More than 4 miles of the approximate 10.6-mile length of Option C2 would require installing new facilities in existing right-of-way. Table 4 illustrates the existing structures and right-of-way and the proposed configuration. Segment C2 would cross approximately eight tax lots, only one of which is classified as developed by the county assessor. This option would cause between 23 and 28 dwelling units to be displaced. Option C2 would have a **high** land use impact based both on the requirement for a new right-of-way and the number of homes to be displaced. This option directly affects land use by crossing at least 134 tax lots, 56 of which are developed.

4.1.2.7 Alternative D (Option D1)

Alternative D (Options D1 and D2)would require the acquisition of additional right-of-way. Clearing of the rights-of-way required by both of these options would conflict with National Forest land management goals outlined for the area by the Northwest Forest Plan and Snoqualmie Pass Adaptive Management Area Plan.

Although expansion of this right-of-way along an existing corridor would have a moderate land use impact on its own, Option D1 would displace between 11 and 14 homes. It is also possible that up to five additional tax lots that appear to be currently vacant may become undevelopable as a result of easement expansion south of the existing line. This alternative would likely have **high** land use impact. In its 38-mile length, this alternative would cross more than 134 tax lots, at least 32 of which are developed.

Additional land use concerns along this alternative include the potential impacts to cabins and lots at Roaring Creek west of Lake Keechelus and the new North Bend Gravel Mine that is proposed by Cadman on Weyerhaeuser land east of North Bend.

4.1.2.8 Alternative D (Option D2)

Land use impacts related to Option D2 would be similar to Alternative D, Option D1. Although less new right-of-way would be required for this alternative, the undeveloped area where adequate right-of-way already exists is located near the pass. Alternative D (Option D2) would displace about eight homes and would have **high** land use impact. If the transmission line were to be placed on the north side of the existing right-of-way rather than on the south side, it would cross a minimum of 121 tax lots, at least 22 of which are developed.

4.1.2.9 No Action Alternative

There would be no impact to land use from the No Action Alternative.

4.1.3 Mitigation Measures

Actual design and siting of the lines has not yet been completed. BPA may want to consider adjusting the tower locations to minimize impacts on existing and designed uses allowed within the right-of-way.

- Segment C, common to Options C1 and C2, would be located wholly within new right-of-way. This segment would pose a threat to the greatest number of dwellings, but also have the greatest siting flexibility because the dwellings do not follow an existing line. Adjusting the alignment within the 250-foot-wide study corridor could save some dwellings. A route also would be located as far away from remaining residences as would be practical to avoid potential damage to private water systems and wells and other existing improvements.
- New access roads would be constructed along the edge of clearings, pastures, or small farm fields as much as possible to minimize disturbance to these spaces.
- BPA would need to coordinate closely with landowners or land managers on any alternative and to consider scheduling impacts.

- Gates and fences would be left closed to ensure that horses, cattle, or other livestock remain onsite.
- BPA may want to consider special agreements with landowners to allow the growing of ornamental and orchard trees or other crops.
- BPA would compensate owners of displaced homes and others affected by the creation of new or expanded rights-of-way.

4.1.4 Cumulative Impacts

Cumulative impacts would result from any of the additional alternatives considered. Alternative B is the only alternative that would be accommodated wholly within existing right-of-way and, therefore, poses the least cumulative long-term impact. All other alternatives would either increase the width of an existing disturbance or create a new disturbance through land not previously affected by a transmission corridor. The primary cumulative impacts along Alternatives A and C (Options C1 and C2) would be the increased urbanization of rural residential areas along with some loss of vegetation and wildlife habitat. The primary cumulative impacts along Alternatives B and D (Options D1 and D2) would be the conversion of forestland and the loss of vegetation and wildlife habitat.

4.2 Transportation

4.2.1 Impact Levels

The potential for conflicts between transmission lines and transportation facilities occurs where the facilities are parallel and in proximity, or where the transmission line crosses a transportation facility. A **high** impact on a roadway, bridge, or rail facility would be where the placement of a transmission tower precludes future expansion or realignment of the facility. **No impact** would occur where the towers are placed a sufficient distance from the right-of-way, so that future planned expansion within a right–of–way, or even future acquisition of right-of-way, is not affected by the line.

4.2.2 Potential Long-Term and Short-Term Impacts

4.2.2.1 Highways and Bridges

BPA has a minimum clearance of 47.5 feet over highways and county roads for 500-kilovolt (kV) lines supported by lattice steel towers. The BPA minimum clearance over railroad rights-of-way is 37 feet for 500-kV lines supported by lattice steel towers. BPA's minimum clearances are sufficient to clear any objects that would be carried by rail or truck, with the possible exception of military items. Because of the mandatory minimum clearances, no transportation impacts would occur under Alternatives B, C, or D. Alternative A would have **no** impacts as a result of insufficient clearance. However, it would have a **low** long-term impact on the urbanized area of Covington as a result of conversion of a portion of the easement now covered by paved ingress and egress routes in the Covington Square Shopping Center area to transmission line use.

There would be **no** long- or short-term impacts to bridges because they would not be used except when transporting construction materials, which would be within acceptable load limits. Other long-term impacts to roadways would be related to new access roads

constructed for the project. In general, the level of impact would depend on the total amount of new roads that would be built.

4.2.2.2 Railroads

There would be **no long- or short–term impacts to railroad operations** in the project area, because transmission lines, which cross rail lines, would provide sufficient clearance for transport of most cargo.

4.2.2.3 Airports

According to Federal Aviation Administration (FAA) guidelines, any project-related structures, wires, or cranes that permanently or temporarily are higher than 200 feet above ground would intrude into navigable airspace. The towers would be less than 200 feet and would not enter navigable airspace. Therefore, there would be **no long-term impact to air operations** in the project area. BPA will seek FAA review and approval for any construction activities that might require cranes or other equipment to extend above the 200-foot line. Therefore, there would be little or no short-term impact to air operations in the project area.

4.2.3 No Action Alternative

No impacts on existing transportation facilities would occur.

4.2.4 Cumulative Impacts

Cumulative impacts on transportation would be **low;** however, construction of the transmission line where there is no existing line would result in an increased number of access roads. Impacts resulting from construction of new access roads are discussed in the land use section. Presence of new lines would result in some increase in operation and maintenance traffic and four-wheel drive access. Direct impacts to transportation are projected to be low enough that the cumulative impacts should be negligible.

4.3 Recreation

4.3.1 Impact Levels

Impacts on recreational resources fall into two general categories: functional and experiential. Functional impacts are those that prevent, interfere with, or limit the use of a site or area for recreational purposes. Experiential impacts are those project elements that detract from the expectations of the user when recreating in a given area (those that would alter viewsheds).

A **high functional** impact would preclude the use of or access to a recreation facility or preclude a particular recreational activity. A **low functional** impact would limit the use of or access to a recreation facility or limit a recreational activity.

A **high experiential** impact would negatively affect a substantial portion of an experience, for example, a transmission line paralleling a trail for more than half its length would be a high impact to the hiking experience. A **low experiential** impact would negatively impact a small portion of an experience, for example, a transmission line crossing a trail.

The experiential impacts on recreational resources in this area are tied to the visual and aesthetic qualities of the environment in which the recreational activity takes place**.** The technical report on aesthetic impacts qualifies and quantifies the nature of the impacts on recreational resources in the area. This land use, transportation, and recreation report focuses primarily on functional and experiential impacts other than the impacts reviewed in the aesthetic impact report. Recreation impacts apply to existing and planned recreation facilities. Additional impacts may occur where the proposed project would conflict with the general recreation plans and policies of a responsible agency or jurisdiction.

4.3.2 Potential Impacts by Alternative

Recreational impacts specific to each alternative are discussed below.

4.3.2.1 Alternative A

Segment C2 of this alternative crosses the City of Kent's Clark Springs property and parallels the Cedar River Watershed on its southern side. No recreational activity would be taking place in the Cedar River Municipal Watershed along the north side of the existing right-of-way. Neither of these areas is open for public recreation so no short- or long-term impact on recreation would occur as a result of this portion of Alternative A or segment C2.

Alternative A continues through Maple Valley, crossing the city's planned bus barn and recreational field complex and the Elk Run Golf Course. The current plans for the city's recreation fields and bus parking take into account the existing transmission line, but do not anticipate accommodation of an additional line and support structures. There likely would be a need to redesign the proposed facilities if Alternative A is selected. While this would create a short-term complication, if BPA is able to coordinate with the city before construction of the recreational facilities, long-term conflicts with recreational use may be avoided. The golf course has developed around existing transmission structures. The open nature of a golf course is not incompatible with transmission line rights-of-way. However, coordination would be necessary to ensure that no long-term incompatibilities result from an additional line being located in the existing right-of-way.

No public recreational resources are located along the existing BPA right-of-way between Maple Valley and the Covington Substation. It is worth noting, however, that private play areas are sometimes located in transmission line rights-of-way. Two such instances include the play area in the Eastwood Forest Subdivision on the west side of Maple Valley and Ryan Brunner Park, south of Covington, that serves the Winterwood residents. As long as the play areas are constructed in compliance with the terms of the BPA easement, construction of Alternative A would not preclude use of this type of play area. It may, however, require relocation of facilities and parents may be concerned about their children's safety if new transmission lines pass directly over structures that were once under open air. No direct recreational impacts would result from replacement of the existing transmission line in the existing right-of-way along Alternative A through Covington. The city does not favor selection of Alternative A, but does recognize the potential benefits to the city's trail system that could be afforded by alterations to the existing BPA right-of-way (Korve, 2002). This objective is supported by the city's comprehensive plan, as discussed in Chapter 5.

North of Covington, Alternative A passes between Lake Youngs and Shadow Lake, then crosses the Peterson Lake Natural Area and the Cedar River Trail. Visual impacts related to

taller towers are discussed in the technical report addressing aesthetic impacts. Replacement of an existing line in the existing right-of-way as it currently crosses these areas would cause some temporary construction impacts, but would not alter the ability to use or enjoy either of these amenities long term.

Functional Impacts. There would be **no** long-term functional impacts to recreational resources along Alternative A. There would be temporary low functional impact to the golf course while construction of the additional line limits access to specific areas of the Elk Run Golf Course.

Experiential Impacts. There would be **no or low** permanent experiential impacts to recreation at the Elk Run Golf Course or the Maple Valley recreation site after construction is complete. Construction of an additional transmission line and replacement of the existing line would present some temporary experiential impacts.

4.3.2.2 Mitigation Measures

Alternative A. BPA would coordinate with Elk Run Golf Course, Maple Valley, and Covington to ensure short-term construction impacts to recreation are limited, long-term impacts are avoided, and opportunities for trail enhancement are explored.

BPA would coordinate with homeowners associations where possible to ensure that impacts on private community playgrounds are minimized and that any risks related to the location of new transmission lines in the existing right-of-way is clearly understood by parents.

Mitigation suggested in the technical report on aesthetic impacts would be used to ensure impacts to recreational experiences are minimized.

General Mitigation. Some general mitigation steps would be taken for all alternatives:

- Final siting decisions would be made with recreational users and their patterns of use in mind to avoid disruption where possible. Structure locations would be selected in consultation with the landowners.
- Disruption of recreation caused by installation and maintenance would be minimized and installation plans would include adequate public notice and communication. Public notice would include notice of any rerouting of trails and the nature of construction impacts so that recreationists could alter their plans if desirable. Communication would include notice to off-road vehicle groups, hunters, and visitors associations.
- BPA would coordinate with landowners and managers to ensure appropriate specifications for installation and restoration following installation are complied with and any increased maintenance anticipated from BPA would be considered.

4.3.2.3 Cumulative Impacts

Cumulative impacts would occur if an additional transmission line were to be constructed in existing right-of-way. Though the right-of-way exists, additional or taller structures could be more visible. For the portion of the alternative where an additional line would be added, line noise would be increased and additional tower supports would occupy land within the right-of-way that was previously available for recreational use. The effects of this

cumulative impact would need to be weighed against the effects of alternatives requiring new right-of-way or affecting other recreational resources.

4.3.3 Alternative B

Alternative B would rebuild the existing line within the existing corridor on existing right-of-way. Converting the line to a double-circuit 500-kV line would require towers about 180 feet tall. The visual and aesthetic impacts of increased tower heights on recreation users are considered in the technical report evaluating aesthetic impacts. The primary experiential impacts to recreation along the I-90 corridor posed by this alternative are related to visual impacts. Non-visual impacts are primarily functional and are discussed below by resource.

4.3.3.1 In the National Forest

Alpine Lakes Wilderness Area. The Alpine Lakes Wilderness area is located on the north side of I-90. Alternative B is located on the south side of I-90 in this area and does not cross the wilderness area. Alternative B poses **low or no** functional impact or experiential impacts, other than visual impacts, on the Alpine Lakes Wilderness Area.

Snow Parks south of Lake Keechelus. Heavy snowmobile use takes place south and west of Lake Keechelus. Existing rights-of-way provide access to and between areas frequented by snowmobiling. Concerns have been raised regarding the increased voltage of the lines and increased hazards to snowmobilers operating their equipment under the lines. Because the lines would be a higher voltage, a higher ground clearance is required. This higher clearance ensures the same level of safety afforded by the current ground clearance required for the existing lines.

Pacific Crest Trail. The Pacific Crest Trail passes under the existing line for approximately 0.5 mile near Surveyors Lake. This single trail crossing would not be functionally altered by replacement of the existing towers to upgrade the existing line. Experiential impacts other than visual impacts would be limited primarily to noise from the overhead lines. This line noise would not be increased substantially by implementation of Alternative B. The area surrounding the trail crossing appears to have been harvested, so experiential impacts related to vegetative management also would be negligible. Alternative B poses **low or no** functional impact or experiential impact, other than visual impacts, to the Pacific Crest Trail.

Tinkham Campground. This campground is located 0.75 mile off the right-of-way, on the opposite side of the existing U.S. Forest Service Road in a forested area. Alternative B poses **low or no** functional impact or experiential impact to the Tinkham Campground.

McClellen Butte Trail. This trail passes under Alternative B once between the trailhead and the Snoqualmie River. The surrounding area is predominantly wooded. In this setting, rebuilding the existing line as stated in Alternative B would not substantially alter the recreational experience beyond that of the current conditions. Alternative B poses **low or no** functional impact and experiential impact, other than visual impacts, to the McClellen Butte Trail.

Downhill ski areas at Snoqualmie Pass. Hyak is one of three downhill ski areas located on the south west side of the I-90 corridor at Snoqualmie Pass. One chairlift at the area does run up to and apparently under the existing transmission line. Nordic ski trails, which are also used for mountain biking and hiking trails during the summer months at The Summit

ski area, utilize existing access roads and right-of-way tied to the existing transmission line. Rebuilding the existing transmission facilities poses no functional or experiential impact on this recreational use, other than the short-term impacts of the construction itself.

4.3.3.2 Outside the National Forest Boundary

Iron Horse State Park and John Wayne Pioneer Trail. Alternative B crosses the John Wayne Pioneer Trail at four locations in a length of more than 20 miles. Alternative B also parallels the trail and park for much of its length. This trail is a rails-to-trails project and the area is recognized for its utility as well as recreational use. The primary impacts to the trail and park would be visual and are discussed in the technical report addressing aesthetic impacts (Person, 2002). Alternative B would pose **no** functional limitations to trail or park use. The only experiential impacts might be related to increased visibility because of increased tower heights, as discussed in the technical report on aesthetic impacts.

Ollalie State Park. The Ollalie Area Mountain Bike Study is underway. This area has many abandoned logging roads that could be linked to create multiple use loop trails. Trails identified in the study thus far are primarily located up hill from the railroad grade (typically above 2,000 feet elevation) and are not near the existing transmission line right-of-way (Person, 2002). **No** functional impacts or experiential impacts, other than possible visual impacts, would result from implementation of Alternative B through Ollalie State Park.

Upper and Lower Twin Falls Trailhead, Twin Falls Natural Area, and Twin Falls Trail. Access to or activities supported by the Twin Falls recreational facilities would not be altered by implementation of Alternative B. The most noticeable experiential impact would result from rebuilding the existing line along the entry road providing access to the Lower Twin Falls Trailhead. Aesthetic impacts of this action are addressed in the technical report on aesthetic impacts. The access road appears to be frequented by vehicles rather than pedestrians; therefore, line noise or other experiential impacts would not be substantial. **No** functional impacts or experiential impacts, other than possible visual impacts, would result from implementation of Alternative B near the Twin Falls Area.

Camp Waskowitz. Other than construction impacts, Alternative B would pose little impact on the camp or its activities in the area of the existing line. No functional or experiential impacts other than possible visual impacts would result from implementation of Alternative B through the upper reaches of Camp Waskowitz.

Snoqualmie Valley Trail. The Snoqualmie Valley Tail crosses the existing right-of-way that would accommodate Alternative B in one location south of I-90. The area is wooded and this trail continues under I-90 and through North Bend, which is not a wilderness experience. **No** functional impacts or experiential impacts, other than possible visual impacts, would result from implementation of Alternative B where it crosses the Snoqualmie Valley Trail.

Rattlesnake Mountain Scenic Area, Rattlesnake Mountain Trail, and Rattlesnake Lake Recreational Area. The Rattlesnake Mountain Trail follows the ridge of Rattlesnake Mountain and is crossed by the existing right-of-way in a single location. Rebuilding the existing line with taller tower supports would not limit access to the trail or scenic area and

would pose **no** functional or experiential impacts to use and enjoyment of these resources, other than possible visual impacts.

4.3.3.3 Mitigation Measures

BPA would coordinate with land managers in the area regarding the timing and duration of construction activities within the existing right-of-way, to ensure that short-term construction impacts to recreation are limited.

The removal of Danger Trees beyond the right-of-way and along the alternatives passing through the National Forest and the Mountains to Sound Greenway would be minimized to the greatest extent possible while ensuring the safe construction and operation of the lines.

Mitigation suggested in the technical report on aesthetic impacts would also be used along Alternative B to ensure that aesthetic impacts are minimized and existing visual impacts are decreased where possible.

4.3.3.4 Cumulative Impacts

Cumulative impacts resulting from rebuilding the existing line in existing right-of-way in Alternative B would be minimal. Although the right-of-way exists, taller structures can be more visible. Cumulative aesthetic impacts are addressed in the technical report on aesthetic impacts. There would be some cumulative impact to the recreational experience of additional construction noise and traffic, which could detract from a recreational experience in the short term. The proposed widening of I-90 in the same time frame as this project is an example of this cumulative impact, which may also hinder access to some trails and recreational facilities locally for short periods of time.

4.3.4 Alternative C (Options C1 and C2)

Segment C1 of Alternative C crosses no recreational areas. Some informal recreation, such as hiking or horseback riding, likely occurs on the large parcels crossed by this alternative, but expanding the existing right-of-way and constructing an additional line in expanded right-of-way on large forest zoned parcels would not result in substantial adverse impacts. Recreational impacts related to segment C2 of Alternative C were addressed in Section 4.3.2.1.

Segment C, common to Alternative C, Options C1 and C2, would not limit access to Ravensdale or Big Bend Park. The southern end of Tiger Mountain is classified as an unmodified area and is managed primarily to protect sensitive plant communities (DNR, 1997). Segment C2 is described under Alternative A. Alternative C (Options C1 and C2) would pose **no** functional and **low** or no experiential impact, other than visual impacts, to use and enjoyment of these resources.

4.3.4.1 Mitigation Measures

Mitigation suggested in the technical report on aesthetic impacts would be used along Alternative C (Options C1 and C2) to ensure that aesthetic impacts are minimized and existing visual impacts are decreased where possible.

4.3.4.2 Cumulative Impacts

Other transmission lines and corridors pass through the surrounding rural residential area. Other construction and development projects, such as the proposed widening of Highway 18 and other road construction projects, as well as development of additional subdivisions and housing, cumulatively increase the amount of use on surrounding recreation resources. These developments also change the character of the landscape and limit future options for recreational development. Addition of a new right-of-way and transmission line along Alternative C (Options C1 and C2) would add to the impacts of existing corridors by creating a new corridor in an area not previously affected by the presence of a transmission line. However, Alternative C (Options C1 and C2) would not directly affect a great number of recreational resource sites.

4.3.5 Alternative D (Options D1 and D2)

Alternative D (Options D1 and D2) would have similar impacts on recreational resources. Distinctions between D1 and D2 are identified in this text. Otherwise, the impacts of expansion of the corridor to the north or to the south should be considered equivalent.

The types of recreational areas affected would be the same as those affected by Alternative B. The impacts would be similar in nature to those discussed in Section 4.3.3, but greater in extent.

4.3.5.1 In the National Forest

Alpine Lakes Wilderness Area. Access to the wilderness area would not be affected by creation of additional right-of-way and addition of another transmission line. The primary experiential impacts would be related to increased visual impacts resulting from a wider transmission corridor. Alternative D (Options D1 and D2) would pose **low or no** functional impact or experiential impacts, other than visual impacts, on the Alpine Lakes Wilderness Area.

Snow Parks south of Lake Keechelus. Heavy snowmobile use occurs south and west of Lake Keechelus. Existing rights-of-way provide access to and between areas frequented by snowmobiling. Additional width of right-of-way in this area would not affect snowmobilers.

Pacific Crest Trail. An additional line would increase the disturbance at the trail crossing, but the trail and lines still would cross at a single location. It is also worth noting that the trail crossing is near the area where the Pacific Crest Trail passes other disturbances, including the summit area development and ski areas and I-90. Although Alternative D (Option D2) would be accommodated in existing right-of-way in this area, this factor alone does not distinguish the impacts of Alternative D (Options D1 and D2). Both options would pose **no** functional impact and **low** experiential impact, other than visual impacts, to the Pacific Crest Trail.

Tinkham Campground. Distance and vegetation ensure that Alternative D (Options D1 and D2) would pose similar impacts to Alternative B.

McClellen Butte Trail. An additional line would increase the disturbance at the trail crossing and the broader cleared area (150 feet expanded to 300 feet) would double a trail

user's exposure to the transmission line corridor, but the trail and lines still would cross at a single location. Alternative D (Options D1 and D2) would pose **no** functional impact and a **low** experiential impact to the McClellen Butte Trail.

Downhill ski areas at Snoqualmie Pass. Hyak is one of three downhill ski areas located on the southwest side of the I-90 corridor at Snoqualmie Pass. One chairlift at the area does run up to and apparently under the existing transmission line. Downhill skiing is not a wilderness activity. Access roads and rights-of-way available for mountain biking and hiking use would be slightly increased by these alternatives. The presence or expansion of the existing right-of-way and transmission facilities would not detract greatly from the surrounding recreational environment. Alternative D (Options D1 and D2) pose no functional and low experiential impact on this recreational use.

4.3.5.2 Outside the National Forest Boundary

Iron Horse State Park and John Wayne Pioneer Trail. Alternative D (Options D1 and D2) would have the same general location relative to Iron Horse State Park and the John Wayne Trail as Alternative B. The distinction among visual impacts from Alternatives D (Options 1 and 2) and B are discussed in the technical report addressing aesthetic impacts. Neither Alternative D (Options D1 and D2) would limit or prevent access to any portion of the trail or park. As with other trail crossings, the wider right-of-way and additional line would extend the trail user's exposure to the transmission corridor. Alternative D (Options D1 and D2) would pose **no** functional impact and only **low** experiential impact, other than visual impacts, to the park and trail.

Ollalie State Park. Alternative D (Options D1 and D2) would have the same general location relative to Ollalie State Park as Alternative B. Neither Alternative D (Option D1 or D2) would present any barriers to access to Ollalie State Park or its planned uses. Therefore, Alternative D (Options D1 and D2) would pose **no** functional impact and only **low** experiential impact, other than visual impacts, to the park and trail.

Upper and Lower Twin Falls Trailhead, Twin Falls Natural Area, and Twin Falls Trail. Access to or activities supported by the Twin Falls recreational facilities would not be altered by implementation of Alternative D (Options D1 and D2) . The experiential impact of Alternative D (Option D1) would be distinctly higher than that of Alternative D (Option D2). As mentioned in the discussion of Alternative B, the impacts of Alternatives B and D (Options D1 and D2) would be most noticeable along the entry road providing access to the Lower Twin Falls Trailhead. Aesthetic impacts of this action are addressed in the technical report on aesthetic impacts. Alternative D (Option D1) would place the entry drive into the trailhead between the two transmission lines and pose greater impact on the experience of reaching the trailhead than Alternative D (Option D2), which would locate the additional line on the opposite side of the existing line and on the same side of the approach road. **No** functional impacts would result from implementation of Alternative D (Options D1 or D2). However, Alternative D (Option D1) would pose **high** experiential impacts and Alternative D (Option D2) would pose **low** experiential impacts, other than visual impacts, on the approach to the Lower Twin Falls Trailhead.

Camp Waskowitz. Some of the trails parallel or run directly under the existing lines. Broadening the right-of-way from 150 feet to 300 feet would pose a **moderate** experiential

impact to these shorter trails used by campers and school groups. An existing Christmas tree farm and several educational sites and camp structures would also be disrupted or require relocation or reconstruction, temporarily altering the functions on this portion of the Camps property. However, long-term functional impacts would be **low**.

Snoqualmie Valley Trail. An additional line would increase the disturbance at the trail crossing and the broader cleared area (150 feet expanded to 300 feet) would double a trail user's exposure to the transmission line corridor, but the trail and lines still would cross at a single location. Alternative D (Options D1 and D2) would pose **no** functional impact and a **low** experiential impact to the Snoqualmie Valley Trail.

Rattlesnake Mountain Scenic Area, Rattlesnake Mountain Trail, and Rattlesnake Lake Recreational Area. Alternative D (Options D1 and D2) would pose the same functional impacts as Alternative B. The increased right-of-way and additional line would, however, increase a trail user's awareness of the trail crossing. Alternative D (Options D1 and D2) would pose **no** functional impact and a **low** experiential impact to the Rattlesnake Mountain Scenic Area and Trail.

4.3.5.3 Mitigation Measures

BPA would coordinate with landowners and land managers in the area regarding the timing and duration of construction activities within the existing right-of-way.

The removal of Danger Trees beyond the right-of-way and along the alternatives passing through the National Forest and the Mountains to Sound Greenway would be minimized to the greatest extent possible while ensuring the safe construction and operation of the lines.

Adverse impacts to recreational resources may be offset by enhancements to the recreation network in the area. The presence of the Mountains to Sound Greenway and the organizations and partnerships that have formed or coordinated their efforts because of the greenway effort would provide an opportunity for BPA to join in a partnership to expand recreational resources and offset adverse impacts to existing recreational resources.

Mitigation suggested in the technical report on aesthetic impacts also would be used along Alternative D (Options D1 and D2) to ensure that aesthetic impacts are minimized and existing visual impacts are decreased where possible.

4.3.5.4 Cumulative Impacts

Experiential impacts related to Alternative D (Options D1 and D2) on individual recreational resources would, in most cases, be low. The sum of the impacts within the broader I-90 corridor, which comprises the Mountains to Sound Greenway and provides multiple recreational experiences to local users who would often explore many different recreation sites, would be greater than the impact on any single resource.

4.3.5.5 No Action Alternative

There would be no direct impacts to recreation from the No Action Alternative, and no mitigation would be required.

5.0 Environmental Consultation, Review, and Permit Requirements

5.1 Federal Requirements

5.1.1 National Environmental Policy Act

Compliance with the National Environmental Policy Act (NEPA) is required. This report could be used to create (in part) a Supplemental Environmental Impact Statement according to the requirements of NEPA. BPA is the federal lead agency for NEPA review and would likely consult with other federal agencies, including the following:

- U.S. Environmental Protection Agency (EPA)
- Federal Energy Regulatory Commission (FERC)
- U.S. Army Corps of Engineers (COE)
- U.S. Department of Transportation (USDOT)
- U.S. Fish and Wildlife Service (USFWS)
- National Marine Fisheries Service (NMFS)

BPA would take into account potential environmental consequences as it weighs the alternatives currently under consideration and would take action to protect, restore, and enhance the environment should BPA build the project.

5.1.2 Northwest Forest Plan, Snoqualmie Pass Adaptive Management Area Plan, and Land and Resource Management Plans for the Mt. Baker-Snoqualmie and Wenatchee National Forests

Alternatives B and D (Options D1 and D2) run through the Okanogan-Wenatchee and Mt. Baker-Snoqualmie National Forests. Both forests are managed in compliance with the applicable Land and Resource Management Plans (USDA Forest Service, 1990a; USDA Forest Service, 1990b) developed in accordance with the Forest and Rangeland Renewable Resource Planning Act and the National Forest Management Act of 1976. In addition to the two forest plans, the Record of Decision for the Northwest Forest Plan was adopted in April 1994. This plan amended U.S. Forest Service and U.S. Bureau of Land Management (BLM) planning documents within the range of the northern spotted owl.

The Northwest Forest Plan spells out standards and guidelines for all of the management allocations in this area, including late-successional reserves, riparian reserves, matrix, and adaptive management areas (AMAs), which provide a diversity of biological challenges, intermixed landownerships, natural resource objectives, and social contexts (USDA Forest Service, 1994). The Snoqualmie Pass Adaptive Management Area is one of the designated adaptive management areas and is now covered by the Snoqualmie Pass Adaptive Management Area Plan (AMA Plan). The majority of the AMA is designated a connectivity emphasis area (CEA) and is managed to protect and enhance late-successional forest conditions and connectivity (USDA Forest Service, 1997). The Snoqualmie Pass AMA exists primarily within the Okanogan-Wenatchee National Forest.

All of these plans must be considered cumulatively. For lands subject to both the Snoqualmie Pass AMA Plan and the Wenatchee or Mt. Baker-Snoqualmie Forest Plans, the

more restrictive standards and policies take precedence (USDA Forest Service, 1997). Portions of the Okanogan-Wenatchee and Mt. Baker-Snoqualmie National Forests not covered by the Snoqualmie Pass AMA Plan are managed in accordance with the Standards and Guidelines from the Northwest Forest Plan and the standards and guidelines from the Mt. Baker-Snoqualmie and Wenatchee Forest Plans. The standards and guidelines that are the most restrictive take precedence in land management decisions made for these lands (USDA Forest Service, 1994).

Development standards and guidelines from the Northwest Forest Plan and the Snoqualmie Pass AMA Plan that are applicable to Alternatives B and D (Options D1 and D2) are listed below.

Snoqualmie Pass Adaptive Management Area Plan. The AMA acknowledges the eventual need to upgrade BPA's service levels over the lines that transect the AMA. The anticipated need to upgrade is listed as one of the proposed special uses for which an application has been submitted or for which an impact has been projected.

III.A.2.

> Bonneville Power Administration (BPA) - For several years, discussions have taken place regarding the eventual need to upgrade the BPA lines that transect the AMA. At present there are no firm plans in place to accomplish this upgrade. It needs to be recognized that this upgrade will eventually be necessary to meet the growing demands for electricity. When upgraded, the impact to the habitat in the AMA would most likely be limited to widening of corridors in the existing right-of-way. (Final EIS Snoqualmie Pass Adaptive Management Plan, p. 3-119)

The AMA Plan also spells out standards guidelines, and mitigation measures for development areas as follows:

> In CEAs, development of new facilities that may adversely affect late-successional habitat and connectivity should not be permitted. New development proposals that address public needs or provide significant public benefits, such as power lines, pipelines, reservoirs, recreation sites, or other public works projects, will be reviewed on a case-by case basis and may be approved when adverse effects can be minimized and mitigated. These will be planned to have the least possible adverse impacts on late-successional habitat. Developments will be located to avoid degradation of habitat and adverse impacts on identified late-successional habitat…Routine maintenance of existing facilities is expected to have less impact on current old-growth conditions than development of new facilities…
>
> Proposals for new facilities and the expansion of existing facilities will be encouraged in non-CEAs rather than CEAs.

> New facilities and the expansion of existing facilities do not need to be neutral or beneficial to late-successional forest conditions; however, all activities in non-CEAs will provide for the conservation of Threatened and Endangered species. (Final EIS Snoqualmie Pass Adaptive Management Plan, p. 2-47)

Alternatives B and D (Options D1 and D2) are all subject to the above Standards and Guidelines along some portion of their length. Each of these alternatives crosses some CEA ground and poses potential impacts to late-successional habitat. Alternative B would be reconstructed within existing right-of-way and by not increasing the right-of-way, would likely be determined to have less impact on current old-growth conditions than development of new facilities in expanded right-of-way. The right-of-way expansion required to accommodate Alternative D (Options D1 and D2) would not be likely to be deemed consistent with the AMA Plan unless one of the alternatives were determined to be the only viable alternative that would "address public needs or provide significant public benefits." Alternative D (Options D1 and D2) is not likely to be found in compliance with applicable Standards and Guidelines in the Snoqualmie Pass AMA Plan (Rogalski, 2002).

Record of Decision for the Northwest Forest Plan. The Applicable Standards and Guidelines listed in the Northwest Forest Plan were carried forward into the AMA Plan through the above language. Portions of Alternatives B and D (both Options D1 and D2) are located outside the AMA will be covered by similar Standards and Guidelines present in the Northwest Forest Plan. Two key Standards and Guidelines from the Northwest Forest Plan are listed below.

Standards and Guidelines for Multiple-Use Activities Other Than Silviculture apply the following to Late-Successional Reserves and Managed Late-Successional Areas. Alternatives B and D (Options D1 and D2) all cross such lands.

> **Rights-of-Way, Contracted Rights, Easements, and Special Use Permits -** Access to non-federal lands through Late-Successional Reserves will be considered and existing right-of-way agreements, contracted rights, easements, and special use permits in Late-Successional Reserves will be recognized as valid uses. New access proposals may require mitigation measures to reduce adverse effects on Late-Successional Reserves. In these cases, alternate routes that avoid late-successional habitat should be considered. If roads must be routed through a reserve, they will be designed and located to have the least impact on late successional habitat. Review all special use permits and when objectives of Late-Successional Reserves are not being met, reduce impacts through either modification of existing permits or education. (Record of Decision, p. C-19)
>
> **Developments -** Development of new facilities that may adversely affect Late-Successional Reserves should not be permitted. New development proposals that address public

> needs or provide significant public benefits, such as power lines, pipelines, reservoirs recreation sites, or other public works projects, will be reviewed on a case-by case basis and may be approved when adverse effects can be minimized and mitigated. These will be planned to have the least possible adverse impacts on Late-Successional Reserves…Routine Maintenance of existing facilities is expected to have less effect on current old-growth conditions than development of new facilities. (Record of Decision, p. C-17)

Alternatives B and D (Options D1 and D2) are subject to the above Standards and Guidelines along some portion of their length. Each of these alternatives crosses some Late-Successional Reserve and poses potential impacts to late-successional habitat. Alternative B would be reconstructed within existing right-of-way and by not increasing the right-of-way, would likely be determined to have less impact on current old-growth conditions than development of new facilities in expanded right-of-way. The right-of-way expansion required to accommodate Alternative D (Options D1 and D2) would not likely be deemed consistent with the Northwest Forest Plan unless one of the alternatives were determined to be the only viable alternative that would "address public needs or provide significant public benefits." Options D1 and D2 are not likely to be found in compliance with applicable Standards and Guidelines in the Northwest Forest Plan (Rogalski, 2002).

There are also some forest-wide Standards and Guidelines that apply to allocations within the Forests. The most significant are the requirements for survey of a large number of amphibians, mammals, bryophytes, mollusks, vascular plants, fungi, lichens, and arthropods. The Survey and Manage measures are listed in the Record of Decision on page C-4. Special note was made that the January 2001 Record of Decision and Standards and Guidelines for Amendments to the Survey and Manage, Protection Buffer, and Other Mitigation Measures Standards and Guidelines must also be consulted for these species (Hansen-Murray, 2002). BPA would comply with the protocol for required surveys should Alternatives B or D (Options D1 or D2) become the preferred alternative, but as much as a full calendar year may be required to complete the surveys. The survey requirements for replacing towers within the existing right-of-way, Alternative B, would require work only at the footprint of proposed replacement towers as opposed to the expanded right-of-way alternative, Alternatives D (Options D1 and D2) , which would require survey of the entire area of the expanded corridor (Schrenk, 2002).

5.1.3 Farmland Protection Policy Act

The Farmland Protection Policy Act (7USC 4201 et. seq.) directs federal agencies to identify and quantify adverse impacts of federal programs on farmlands. The Act's purpose is to minimize the number of federal programs that contribute to the unnecessary and irreversible conversion of agricultural land to nonagricultural uses.

No agricultural land will be affected by any of the proposed alternatives.

5.2 State, Area-wide, and Local Plan and Program Consistency

As a federal agency, BPA is constitutionally prohibited from complying with the procedural requirements associated with obtaining state and local land-use approvals or permits. The

agency would, however, strive to meet or exceed the substantive standards and policies of the following environmental regulations.

5.2.1 State Environmental Policy Act

The state of Washington has adopted a State Environmental Policy Act (SEPA), which is intended to ensure that environmental values are considered during decisionmaking by state and local agencies. The objectives and requirements of SEPA are similar to those of NEPA.

All alternatives cross critical or sensitive areas and shorelines of the state. It is reasonable to assume that BPA would have to provide documentation supporting their ability to comply with SEPA and the lead agency would have to document compliance with SEPA. SEPA allows the use of NEPA documents to meet SEPA requirements (WAC 197-11-610). The lead agency will coordinate with other affected state or local agencies and may adopt the NEPA EIS prepared for the project or prepare separate documents in accordance with their SEPA regulations.

5.2.2 Growth Management Act

The Washington state legislature passed the Growth Management Act (GMA) in 1990. The GMA requires all urban counties and their cities to develop and adopt comprehensive plans and regulations to implement those plans. To ensure comparable planning efforts, the GMA requires comprehensive plans to address specific issues including, but not limited to, land use, transportation, housing, facilities and services, utilities, the natural environment, and economic development. To achieve coordinated planning efforts, the GMA further requires counties and cities to develop a set of framework policies to guide development of each jurisdiction's comprehensive plan. Jurisdictions are required to designate critical areas, agricultural lands, forestlands, and mineral resource lands; to adopt development regulations to conserve resource lands and protect critical areas; and to designate urban growth areas. King County has adopted countywide planning policies, a comprehensive plan, and development regulations in accordance with the GMA. The countywide planning policies, comprehensive plan, and zoning ordinance, and the project's consistency with those local plans and policies, are addressed in Sections 5.2.6, 5.2.7, and 5.2.8.

5.2.3 Washington Forest Practices Act

In 1974, the Washington state legislature wrote the Forest Practices Act, Chapter 76.09 of the Revised Code of Washington (RCW). The Act defines a plan to protect public resources while assuring that Washington continues to be a productive timber growing area. The Forest Practices Act regulates activities related to growing, harvesting or processing timber, including Christmas trees, on all local government, state, and private forestlands.

The Forest practices Rules and Regulations apply to all forestlands in the project area. The rules and regulations set standards to address several issues, including reforestation, clear-cut size, watershed analysis procedures, road design, riparian area buffers, wetland protection, and protection of threatened and endangered species.

Conversion of forestland is a Class IV forest practice (RCW 79.09.050). Forest practices under Class IV are not exempt from SEPA requirements. Applications for Class IV forest

practices must be submitted to and approved by the Department of Natural Resources (DNR) prior to conducting the activity (RCW 79.09.050) unless DNR has assigned review authority to the local government. Failure to state that any land covered by the application will be converted to another use would result in a six-year moratorium on development of the land (RCW 76.09.060).

The Forest Practices Act also sets forth rules for road construction and maintenance (WAC 222-24), and the Washington Forest Practices Board(WFPB) Manual contains guidelines for forest roads, including BMPs, road maintenance and abandonment plans, and recommended tools.

5.2.4 Coastal Zone Management

The Coastal Zone Management Program is authorized by the Coastal Zone Management Act of 1972 and administered at the federal level by the National Oceanic and Atmospheric Administration's Office of Ocean and Coastal Resource Management, Coastal Programs Division. Management of the program is delegated to the states participating in the program. In Washington, the Department of Ecology *(*WDOE) administers the program in partnership with local governments. The Coastal Zone Management Act requires that "Each Federal agency activity within or outside the coastal zone that affects any land or water use or natural resource of the coastal zone shall be carried out in a manner which is consistent to the maximum extent practicable with the enforceable policies of approved state management programs." The Coastal Zone Management Program (CZMP) identifies the laws the project must comply with, along with other state level environmental regulations.

A Federal agency or applicant for a federal license, permit or financial assistance is responsible for determining whether or not the proposed activity may affect any natural resource, land use, or water use in Washington's coastal zone. Ecology will concur with a determination if the federal activity is consistent to the maximum extent practicable with the Washington CZMP.

Washington State Shoreline Management Act. The SMA establishes a planning program and regulatory permit system initiated at the local level under state guidance. While Ecology is designated as the lead state agency, local governments exercise primary authority for implementing the SMA. Each local government's planning program consists of a shoreline inventory and a "shoreline master program" (SMP) to regulate shoreline uses. Substantial development permits are needed for projects that directly affect State shorelines costing over $2,500[1] Applicable regulations contained in local SMPs are summarized below. BPA would contact the WDOE for certification of a consistency determination. WDOE also provides general program overview and support. The Shorelines Hearings Board is the appeal body for shoreline permit decisions.

5.2.4.1 King County Shoreline Master Program

King County Code, Title 25–Shoreline Management-of the King County Code (King County, 1978) implements the state Shoreline Management Act and the County's Shoreline Master Program, which was adopted by ordinance in 1978. Title 25 (the "shoreline management

[1] On March 28, 2002, Governor Gary Locke signed into law an amendment to the Shoreline Act that increases the shoreline "substantial development" threshold from $2,500 to $5,000. The effective date of this change was June 13, 2002.

code") provides for regulation of development that impacts those areas of King County under the jurisdiction of the Shoreline Management Act. In the project vicinity, it would apply to the Snoqualmie River, Cedar River, Raging River, and other streams with flows of more than 20 cubic feet per second (cfs) such as Carey and Holder Creeks, and their associated wetlands, together with the lands underlying them. All alternatives would cross one or more of these "shorelines of the state," and, therefore, must be consistent with the Washington Shoreline Management Act, the guidelines and regulations of WDOE, and the King County Shoreline Master Program. County jurisdiction extends 200 feet landward of ordinary high water of designated shorelines of the state. Typically, King County requires substantial development permits for substantial development (defined in RCW 90.58.030) not exempted by RCW 90.58.140(9) and (10). The proposed project meets the definition of substantial development. However, as a federal agency, BPA is not required to obtain local permits. For King County to review the project and determine its consistency with the Shoreline Master Program, BPA would present its support for compliance with permit requirements to the County. The County can review for compliance with local regulations but this review alone does not determine federal act compliance. A request for compliance review by ecology must be made by the County and BPA (Rankin, 2002).

Title 25 indicates that utility facilities may be permitted in shoreline areas, subject to Title 25 requirements that include, but are not limited to:

- Non-water-related development is not permitted waterward of the ordinary high water mark;
- No structure shall exceed a height of 35 feet; this requirement may be modified if the view of a substantial number of residences would not be obstructed, if permitted by the underlying zoning; and if the proposed structure is agricultural, water-related, or water-dependent;
- Stormwater runoff complies with King County Code chapter 9.04; and adequate surface water, and erosion and sediment control are provided during construction;
- Development in shoreline areas shall maintain setbacks, provide easements or otherwise develop a site to permit a trail to be constructed or public access to continue where:
  - there is a proposed trail in the King County trail system, or
  - part of the site is being used and has historically been used for public access;
- Utility and transmission facilities must avoid disturbance of unique and fragile areas, and of wildlife spawning, nesting, and rearing areas; and
- Overhead facilities are not permitted in public parks, monuments, scenic recreation, or historic areas

In addition, utility transmission facilities must be designed to:

- Minimize visual impact;
- Harmonize with or enhance the surroundings;
- Not create a need for shoreline protection; and
- Utilize natural screening to the greatest extent possible.

Construction and maintenance of utility facilities shall be done in a way that:

- Preserves natural beauty and conserves resources;
- Minimizes scarring of the landscape;
- Minimizes siltation and erosion;
- Protects vegetation, natural features, and topsoil from drainage;
- Avoids disruption of critical aquatic and wildlife stages; and
- Provides rehabilitation for disturbed areas to be accomplished as rapidly as possible to minimize soil erosion and to maintain plant and wildlife habitats, and utilizes plantings compatible with native vegetation.

5.2.4.2 Kittitas County Shoreline Master Program

The Shoreline Master program for Kittitas County, adopted March 5, 1975, regulates land uses impacting shorelines of the state in Kittitas County. Alternatives B and D (Options D1 and D2) all impact Kittitas County and pass near identified shorelines such as Lake Keechelus and Lost Lake and cross the Yakima River. These shorelines are all listed as shorelines of the state within the County, along with other lakes greater than 20 acres and streams with flows of more than 20 cfs and their associated wetlands, together with the lands underlying them. The facilities would only impact state shorelines if the towers or access roads would be located within 200 feet of them or their associated wetlands.

The goal statements in the SMP related to Utilities state:

> Utilities should be designed and installed in a manner which would result in minimal damage to the normal qualities of the shoreline area.

SMP regulations pertaining to utilities are listed in Section 37 and state that Utilities which unavoidably must cross a body of water or pass through the Environment shall be permitted. Utility Services in shoreline areas designated Natural and Conservancy Environments shall be permitted subject to the following regulations:

- When alternatives exist, overhead utilities shall not parallel shorelines unless for the electrification of railroad lines.
- Where such utility systems cross shoreline areas, clearing necessary for the installation or maintenance shall be kept to the minimum necessary to prevent interference by trees and other vegetation with the proposed facilities.
- Upon Completion of installation of any underground or overhead system or of any maintenance project which disrupts the environment, the disturbed area shall be regraded to compatibility with the natural terrain and replanted to prevent erosion and provide an attractive vegetation cover which is harmonious with the surrounding area and the project requirements.
- When alternatives exist, utilities shall not obstruct parallel or destroy scenic views.

All alternatives considered will cross or parallel shorelines of the state and BPA will need to make a determination of consistency and request compliance review from DOE as discussed above. Regulations in both counties focus on minimizing impacts. Relative visual impacts of the various alternatives are discussed in the technical report on aesthetic impacts. Minimizing grading and disturbance of existing vegetation is also required in both Counties. This supports Alternatives B and A, where existing rights-of-way will be used, over Alternatives C and D (Options D1 and D2), where additional rights-of-way will need to be secured and new disturbances in areas previously undisturbed will occur.

5.2.4.3 Maple Valley Shoreline Master Program

Maple Valley is currently developing its own SMP. Until the city's SMP is adopted and takes affect King County's SMP will continue to apply (Pennala, 2002).

5.2.4.4 Covington Shoreline Master Program

Covington has adopted King County's SMP as their own and apply the substantive provisions of the county regulations to reviews within the city limits (City of Covington, 2001).

5.2.4.5 Washington State Department of Natural Resources Management Plans

The Department of Natural Resources owned or managed lands impacted by some of the proposed alternatives include Rattlesnake Mountain Scenic Area, Tiger Mountain State Forest and lands near the Mount Si Natural Resource Conservation Area. All DNR-managed trust lands in western Washington are covered by the Department of Natural Resources Habitat Conservation Plan (HCP), which is considered the major element for DNR compliance with the Forest Resource Plan policy on endangered, threatened, and sensitive species. The HCP which was adopted in 1997, was discussed in the DEIS. DNR also manages non-trust lands as Natural Resource Conservation Areas, Natural Area Preserves or Scenic Areas with site specific Management Plans. The Mount Si Natural Resources Conservation Area (NRCA), West Tiger Mountain NRCA, and Rattlesnake Mountain Scenic Area are discussed here as they apply to lands potentially impacted by the additional alternatives considered in the SDEIS. While not subject to the HCP, DNR is given credit for the habitat contributions provided by these lands in terms of meeting the conservation objectives of the HCP.

5.2.4.6 Rattlesnake Mountain Scenic Area

Alternatives B and D (Options D1 and D2) cross the Rattlesnake Scenic Area. In addition to the scenic values of the Rattlesnake Mountain Scenic Area (RMSA), the area is recognized as providing an important "habitat and recreation connection between the Cascade Mountains to the east and the Puget Sound lowlands to the west" (DNR, 1998). One of the key concerns raised in the discussion of land sensitivity is the high mass wasting and erosion potential along the steepest portions of the east facing slopes. The existing BPA right-of-way crosses lands of both high and moderate sensitivity ratings. A management recommendation for the East Face Unit, which is crossed by the existing right-of-way is to "focus on preservation of the thin, erodible soils, mass-wasting areas, many stream corridors, snag rich conifer stands and viewshed from I-90." No management recommendation explicitly dealing with utility corridors or easements is stated, but one

management recommendation is that "No new trails should be constructed in this unit due to the extreme sensitivity of the soils, topography, priority habitats and riparian corridors." The section of the management plan discussing management implications related to the geology of the site states that "Future development, infrastructure, utilities, and private property along the lower slopes of the mountain will be highly susceptible to damage or destruction by repeated landslide and debris flows."

5.2.4.7 Mount Si Natural Resources Conservation Area

The Mount Si NRCA is located just north of a portion of Alternatives B and D (Options D1 and D2). Provisions of the NRCA management plan that relate to potential impacts from these alternatives is the goal to work with the King County and its cities to minimize the impact of development on views from the Mount Si NRCA.

5.2.4.8 West Tiger Mountain Natural Resources Conservation Area

Alternative C extend north into the Tiger Mountain State Forest but stop short of the West Tiger Mountain NRCA designated by WSDNR. The remainder of Tiger Mountain State Forest not included in the NRCA is managed in accordance with DNR's Habitat Conservation Plan. (Heintz, 2002).

5.2.4.9 Forest Legacy Program Land Acquisitions

Also worth note is the acquisition of lands in the area with Forest Legacy funding. Three parcels along the existing transmission line of Alternative B and D (Options D1 and D2) have been purchased through the Forest Legacy Program. These three parcels are subject to Forest Legacy Conservation Easements. The parcels are named by DNR as follows: Kimbal Creek Parcel in Section 8 of Township 2 North, Range 8 East; the Plum Creek/WRECO Parcel in Section 1 of township 23 North, Range 7 east and Sections 6 and 7 of Township 23 North, Range 8 East; and the Grouse Ridge Parcel in Sections 29 and 30 of Township 23 North, Range 9 East. Kimbal Creek and Plum Creek/ WRECO are both located at the northern end of the Rattlesnake Mountain Scenic Area. Grouse Ridge Parcel is located just west of the Weyerhaeuser parcel on which Cadman has proposed the North Bend Gravel Mine (Pruitt, 2002).

Easement language pertaining to utilities on the Kimball Creek Parcel reads as follows:

> Grantor reserves the right to use the Property for natural resource production, non-commercial recreation, and environmental educational purposes so long as the use is consistent with the goals of the Forest Legacy Program, as currently defined or subsequently amended, and the limitations set forth hereafter. No other use is permitted.

Easement language pertaining to utilities on the Grouse Ridge and Plum Creek/WRECO Parcels reads as follows:

> To the extent reasonable and possible, no utility rights-of-way shall be located within the property after the date of the instrument unless they are located underground.

BPA will explore the impact these conservation easements may have on the feasibility of implementing Alternatives D1 or D2. Though it is not likely that these deed restrictions preclude BPA from constructing a federal project of this type, concerns regarding the intended purpose of forest legacy program will be considered through the design phase.

5.2.4.10 Countywide Planning Policies

King County countywide planning policies were updated August 2000. The countywide planning policies provide a framework of policies to ensure that plans developed by King County and the cities in King County are coordinated in a consistent manner though they may be adapted to the specific needs of each local jurisdiction. These policies guide the development and implementation of planning local land use regulations and comprehensive planning policies though they are not regulatory in their own right. Chapter VIII deals with siting regional public facilities and recognizes the complexities and concerns that often arise when doing so. The following plan policies also apply to regional capital facilities projects.

> **VIII. Siting Public Capital Facilities of a Countywide or Statewide Nature**
>
> Public capital facilities of a Countywide or statewide nature generally have characteristics that make these facilities extremely difficult to site. Such characteristics include the number of jurisdictions affected or served by the facility, the size of the facility, and the facility's potential adverse impacts, such as noise, odor, traffic, and pollution generation. The facilities can be either desirable or undesirable to jurisdictions. Some of the facilities are privately owned and regulated by public entities. Facilities also can be owned by the State and used by residents from throughout the State, such as universities and their branch campuses.
>
> The County and the cities need to develop a process for siting public capital facilities with these types of characteristics, including but not limited to, utility and transportation corridors, airports, wastewater treatment plants, solid waste landfills, higher educational facilities, correctional and in-patient treatment facilities and energy-generating facilities.
>
> **FW-32** Public capital facilities of a Countywide or statewide nature shall be sited to support the countywide land use pattern, support economic activities, mitigate environmental impacts, provide amenities or incentives, and minimize public costs. Amenities or incentives shall be provided to neighborhoods/jurisdictions in which facilities are sited. Facilities must be prioritized, coordinated, planned, and sited through an interjurisdictional process established by the Growth Management Planning Council or its successor.

S-1 The Growth Management Planning Council or its successor shall establish a process by which all jurisdictions shall cooperatively site public capital facilities of a Countywide or statewide nature. The process shall include:

- A definition of these facilities;
- An inventory of existing and future facilities;
- Economic and other incentives to jurisdictions receiving facilities;
- A public involvement strategy;
- Assurance that the environment and public health and safety are protected; and
- A consideration of alternatives to the facility, including decentralization, demand management, and other strategies.

The permit requirements of local jurisdictions i.e., applicable comprehensive plans and zoning ordinances, are discussed below. The NEPA process being followed by BPA generally addresses the items in Countywide Planning Policies FW-32 and S-1, above.

5.2.5 Comprehensive Plans

Portions of Alternative A run through the Cities of Maple Valley and Covington. Alternatives C1 and C are located wholly within King County. Alternatives B, D1, and D2 pass near the City of North Bend but are also located wholly within King County as far as Snoqualmie Pass, then continue through unincorporated Kittitas County. King County, Kittitas County, Maple Valley and Covington have all adopted comprehensive plans that respond to and implement the Growth Management Act. Applicable comprehensive plan provisions from King County, Kittitas County, Maple Valley, and Covington are discussed.

5.2.5.1 King County Comprehensive Plan

King County Comprehensive Plan was adopted February 12, 2001 and published in June 2001. The King County Comprehensive Plan responds to and implements the planning goals of the GMA, and guides land-use decisions throughout the county. This was the first significant revision of the county's plan since 1994. The next major plan revision will not be for another four years, though some itemized annual adjustments may be made. Chapter 7 of the current Comprehensive Plan deals with Facilities and Utilities. Subsection III,A.3. deals specifically with electric utilities.

3. Electric Utilities. The four-state Northwest Conservation and Electric Power Plan of the Northwest Power Planning Council provides a blueprint for the development of electricity resources. BPA and other federal agencies, the region's utilities, state and local government, private businesses and the people of the Northwest all participate in implementing the Council's goals. Electric utilities serving King County include BPA, Seattle City Light, and Tanner Electric Cooperative. Puget Sound Energy provides both electricity and natural gas service.

F-309 King County and the utilities should identify and preserve corridors to accommodate future electric power transmission and distribution lines. Corridor designation should include:

- Identification of appropriate shared uses and recognition of the values provided by non-utility uses, such as recreation;
- Recognition of County roads as utility corridors; and
- Evaluation of proposed facility plans on a system-wide basis, rather than project-by-project.

F- 310 When new, expanded or upgraded transmission is required, use of existing corridors that have above-ground utilities should be evaluated first. King County should facilitate appropriate corridor sharing among different utility types and owners.

Public concern exists over the potential health effects of electrical power lines. The concern focuses on the effects of extremely low level electromagnetic fields, called ELF/EMF or simply EMF. Seattle-King County Department of Public Health currently responds to inquiries from citizens about EMF and keeps abreast of current research. The following policy recognizes the inconclusive nature of the data concerning EMF and the need to have an informed citizenry through public disclosure of available research about the potential health risks. Scientific evidence to-date does not support firm conclusions about the existence of adverse health effects related to EMF.

F-312 King County will monitor scientific research on potential human health effects of extremely low frequency electric and magnetic fields (EMF). If federal or state agencies promulgate rules to reduce exposure to EMF-through changes in the use of appliances, construction practices, the location of electrical infrastructure or other activities-the County shall inform its citizens and take appropriate actions.

Comprehensive Plan Chapter 8 Community Plans, covers two communities that are located within the project area. Subsection IX. Snoqualmie Valley Community Plan covers the general area around Alternatives B and D (Options D1 and D2) with a focus on North Bend (CP-925 through CP-929). Subsection X. Soos Creek Community Plan covers the general area that includes Covington and Maple Valley. This plan emphasizes the importance of Crest Air Park and the need to continue compatible land uses around the Air Park (CP-1011) and also sets linking Covington to the Big Soos Creek trail network and connecting the Cedar and Green River Corridors as high priority efforts (CP-925 and CP-929). Nothing in the Community Plans dealt directly with utility facilities or goals of facility siting standards.

Chapter 4 Environment provides some guidance for local regulations adopted to protect Critical Areas as required by the GMA in subsection 1.A.

The Growth Management Act requires that critical areas be designated and protected. Critical areas include wetlands, areas with a critical recharging effect on aquifers used for potable water, fish and wildlife habitat conservation areas, frequently flooded areas and geologically hazardous areas. This chapter designates aquifer recharge areas and fish and wildlife habitat conservation areas under the Growth Management Act. Wetlands, frequently flooded areas, and geologically hazardous areas are designated in the King County Sensitive Areas Ordinance, Ordinance 9614, as amended.

While critical areas within the Urban Growth Area will receive adequate protection, the emphasis is to protect and enhance critical areas in the Rural Area and Natural Resource Lands and to avoid impacts to specific animal species, such as salmon and bald eagles, that use or pass through the Urban Growth Area. These policies provide for a watershed-based approach to planning. This approach acknowledges that different areas of King County have different resource values and face different levels of development pressure, therefore different methods of protecting critical areas need to be developed to balance the protection of the environment with the need to reduce urban sprawl and preserve our quality of life.

Chapter 4.1.A also lists the following policies:

E-108 Regulations to prevent unmitigated significant adverse impacts will be based on the importance and sensitivity of the resource. The presence of a species listed as endangered or threatened by the federal government may be considered an unusual circumstance and the County may use its authority under the State Environmental Policy Act (SEPA) to mitigate for significant adverse environmental impacts to that habitat that supports those species, pending approval by the National Marine Fisheries Service and/or the United States Fish and Wildlife Service (the "Services") of a Tri-County plan for compliance with a 4(d) rule issued by either of the Services and subsequent adoption of specific regulations by King County. Following approval by the Services and adoption of the specific regulations to protect listed salmonid species, the County shall rely upon the regulations to protect endangered and/or listed species, rather than SEPA. E- 109 King County should promote efficient provision of utilities and public services by exempting minor activities from its critical areas regulations, provided the agency has an approved best management practice plan approved by King County, and the plan ensures that proposed projects that may affect habitat of

listed species be carried out in a manner which protects the resource or mitigates adverse impacts.

E-109 King County should promote efficient provision of utilities and public services by exempting minor activities from its critical areas regulations, provided the agency has an approved best management practice plan approved by King County, and the plan ensures that proposed projects that may affect habitat of listed species be carried out in a manner which protects the resource or mitigates adverse impacts.

Chapter 3 Rural Legacy and Natural Resource Lands subsection V.A.1. Protecting Forest Lands and 2. Promoting Forest Management state the following:

R-506 Land uses, utilities and transportation facilities adjacent to Designated Agriculture and Forest Production Districts and Designated Mineral Resource Sites, shall be sited and designed to ensure compatibility with resource management.

R-529 King County should continue to work with all affected parties and the Washington Department of Natural Resources to improve the enforcement of forest practice regulations in the urban and rural areas, and to ensure that landowners comply with County regulations when they are converting portions of the site to a non-forest use. Harvesting of forestlands for the purpose of converting to non-forestry uses shall meet all applicable county standards for clearing and sensitive areas management.

The above comprehensive plan provisions, particularly F-309, F-310, E-108, and R-506, favor Alternative B over Alternatives A, C, and D, which require new rights-of-way and expanded areas of ground and vegetative disturbance. Applicable zoning, critical area and forest practice regulations discussed below confirm and clarify this direction by requiring a demonstration that alternatives with less impact do not exist before allowing new development or disturbance areas in new rights-of-way to be determined consistent with local regulations.

F-309 also provides direction to consider recreational opportunities potentially provided by utility facility corridors. This provision is also confirmed by local land use regulations discussed below.

5.2.5.2 Kittitas County Comprehensive Plan

The eastern most lengths of Alternatives B and D run through Kittitas County and the Snoqualmie Pass Sub Area. General comprehensive plan provisions and applicable provisions from the Sub Area Comprehensive Plan-Master Plan as they appear in the December 2001 Kittitas County Comprehensive Plan Volume I and II are discussed below. The existing transmission line runs through sub areas C and E of the Snoqualmie Pass Study Area.

Chapter 6 Utilities includes 33 Goals Policies and Objectives (GPO) related to utilities the most applicable GPO is:

> **GPO 6.32** Electric and natural gas transmission and distribution facilities may be sited within through areas of Kittitas County both inside and outside of municipal boundaries, UGAs, UGNs, Master Planned Resorts, and Fully Contained Communities, including to and through rural areas of Kittitas County.

Chapter 7 Snoqualmie Pass Sub Area Plan includes provisions applying to Energy and Telecommunication Utilities:

> Siting decisions for energy and telecommunications facilities should be based on applicable regulations and the following factors:
>
> - Minimal health risk to residents of neighboring properties, whether from noise, fumes, radiation or other hazards;
> - Minimal visual impact, achieved with buffering through distance and or landscaping;
> - For power lines and transmission/reception towers, no adverse impact on aviation traffic patterns;
> - Convenient access (may not be needed if facility is automated);
> - Encourage use of cold weather engineering practices to cope with power outages; and
> - Ensure that new developments are designed with facilities to withstand a minimum 48 hour power outage.

The above provisions are considered through the consideration of alternatives and permitting processes documented in this and other technical reports relied on to prepare the Final EIS. Coordination with the County through the process will ensure compliance with the Comprehensive Plan.

5.2.5.3 Maple Valley Comprehensive Plan

Alternative A passes through Maple Valley. The City of Maple Valley Comprehensive Plan, Adopted November 22, 1999, lists the city's utility policies related to Electricity and Gas as follows:

> The City of Maple Valley shall monitor current research efforts to determine whether electrical and or magnetic fields pose a potential health danger. If such efforts conclude that a potential danger exists, the City shall coordinate with other jurisdictions to pursue development of land use regulations consistent with such findings.

> The City of Maple Valley shall, where feasible, use collocation of major utility transmission facilities within shared utility corridors, such as high voltage electric transmission lines with water and natural gas trunk pipelines.
>
> Where found to be safe, the City of Maple Valley shall promote open space preservation or recreational use of utility corridors, such as trails, sport courts and similar activities.
>
> The City of Maple Valley shall encourage utility providers to comply with applicable state regulations for tree trimming and planting, such as the planting of appropriate varieties of trees in the vicinity of power lines.

These comprehensive plan provisions are similar to some policies of the City of Covington. BPA will coordinate with the city to explore opportunities for collocation with other facilities or recreational uses as appropriate.

5.2.5.4 Covington Comprehensive Plan

Alternative A also passes through Covington. The City of Covington Comprehensive Plan, last updated September 25, 2001, identifies BPA as the owner and operator of most of the "higher voltage transmission lines and substations in the Pacific Northwest." Chapter 9 Utilities also notes that at the time the plan was drafted BPA would "not be adding any new transmission lines into the Covington Substation or any distribution lines out of the substation" (Covington, 2001). Alternative A runs to and through the City of Covington past the Covington Substation.

The Comprehensive Plan policies in Chapter 9 Utilities most directly related to transmission are as follows:

> **UTP 1.9** Regulate construction of utilities within sensitive areas in accordance with the Sensitive Areas Regulations.
>
> **UTP 1.10** Encourage the joint use of utility corridors consistent with limitations of applicable law and prudent utility practice and, where possible, in conjunction with non-motorized and recreational uses.
>
> **UTP 1.12** Require utility providers to design, locate, and construct facilities within publicly owned properties and rights-of-way when possible to reasonably minimize significant, individual, and cumulative adverse impacts to the environment and to protect environmentally sensitive areas. Requirements should include the following:
>
> - Locate sewer lines and use construction methods and materials to prevent or minimize the risk of spillage into watercourses and water bodies,
> - Locate utility corridors in existing cleared areas, when possible,

- Locate utility facilities and corridors outside of wetlands, when possible.
- Minimize sewer and water line crossings of fish-bearing water courses, when possible.
- Use bi-stabilization, riprap, or other innovative engineering techniques to prevent erosion where lines may need to follow steep slopes.
- Minimize corridor width.

Chapter 7 Environment confirms that the city intends to adopt its own Sensitive Areas and Shoreline protection plan but currently has adopted the County's standards. The County's Shoreline regulations were discussed above and its Sensitive Areas Ordinance is discussed below.

Chapter 6 Parks Trails and Open Space states that "utility corridors can extend through urban areas as well as scenic and sensitive land areas. As such, they can provide important opportunities for creating open space as well as the potential for connecting open space resources for wildlife and for trail corridors." This section goes on to state:

> Covington has three power transmission lines that cross the City in a north south direction and converge at the substation southwest of the downtown. East of the Timberlane development, a gas transmission line crosses the City in a north-south direction. All of these utilities set aside a significant amount of open space within their corridors in the City, 172.6 acres in all. They also provide the opportunity for development of trails along their corridors and establishing linkages between existing and future open spaces and recreation facilities.
>
> Some of the drawbacks to using power lines for trail corridors are they can detract from the recreational experience because of : buzzing or crackling noise of the higher voltage lines, the power poles or towers and wires are very visible; and, trail users can often sense the electrical field produced by the higher voltage lines.

Alternative A should be able to be found to comply with **UTP 1.12** in that it is located within existing cleared areas on existing rights-of-way and does not require expansion of corridor width beyond the existing rights-of-way. Compliance with **UTP 1.19** will be discussed below in the discussion of the County's Sensitive Areas Ordinance. If Alternative A were to be constructed BPA would work closely with the City of Covington to evaluate the "prudence and possibility" of locating recreational facilities within the existing right-of-way to achieve compliance with **UTP 1.10** taking into account the opportunities and constraints discussed in Chapter 6.

5.2.5.5 City of Kent Wellhead Protection Program

The City of Kent owns three parcels in the vicinity all of which are managed exclusively for well head protection. These parcels include the Clark Springs, Kent Springs Lake Sawyer Wellfield and Armstrong Springs. The existing right-of-way that would accommodate Alternative C (Option C2) as it extends to connect Alternative A to the Kangley Substation. Kangley is an unincorporated community in King County that passes lengthwise through the Clark Springs parcel. Portions of Alternatives C1, C2, A, and C all pass through identified wellhead protection areas. The City of Kent Wellhead Protection Program document dated April 2, 1996, maps the capture zones for the "shallow, highly transmissive, glacial outwash aquifers" relied on by the City of Kent for groundwater recharge. Potential sources of contamination are identified in the program document as follows:

- Residential—medium-density land uses
- Residential—rural land uses
- Transportation corridors
- Industrial/Commercial sites
- Forestry land uses, and
- Mining land uses

The Landsburg Mine is ranked as the top priority risk to ground water quality for the Clark Springs source followed by medium density residential and rural residential land uses.

The program document also summarizes land use, regulatory, and planning strategies as follows:

Land Use Strategies:

- Consider special protection area designations for the SWPA

Regulatory Strategies:

- Perform hydrogeologic analyses for parcels which trigger SEPA review.
- Delegate well drilling oversight authority to King County. Encourage frequent inspection of well installation.
- Require engineering as-builts of septic systems to be recorded with the property deed.

Planning Strategies:

- Require industrial and commercial facilities to connect to sanitary sewer. Develop emergency plans for sewer breaks.
- Encourage funding of farm plans such that groundwater protection issues are identified and managed.

- Encourage research of stormwater discharge on aquifer quantity and quality. Evaluate the adequacy of stormwater facilities.
- Document the location and use of petroleum pipelines. Ensure that emergency response efforts are coordinated.
- Investigate the feasibility of rerouting hazardous materials transport out of Zone 1 of the WHPA.
- Establish formal communication with first responders for transportation hazardous materials incidents.

A more detailed discussion of these strategies and existing regulations is provided in Chapters 5 and 6 of the program document. Though none of the above strategies speak directly to the existence of the BPA transmission line easement or potential expansion of facilities within this easement, contact with the city confirms concern regarding potential impacts to the city's water sources. The city has also confirmed that though the parcels are currently unzoned land annexed for municipal purposes, the city's Wetland and Habitat Conservation Area regulations are applicable to any development with in the annexed areas (Peterson and Fitzpatrick, 2002).

5.2.6 Local Zoning and Sensitive Area Ordinances

As discussed above, multiple local governments have jurisdiction over the various alternatives. The majority of all alternatives run through King County. The Eastern end of Alternatives B and D are within the jurisdiction of Kittitas County. Alternative A runs through Covington, Maple Valley, and a parcel annexed into the City of Kent for municipal purposes. The Comprehensive Plan provisions discussed above provide guidance for determining consistency with the goals and policies of each of these jurisdictions. The discussion below will highlight some important considerations related to zoning and sensitive area regulations.

5.2.6.1 King County Zoning, and Sensitive Area Regulations

Title 21A–Zoning–of the King County Code (King County, 2002) implements the King County Comprehensive Plan policies and objectives through land-use regulations. Alternative A crosses a variety of zones including Rural Residential (RA), Urban Residential (UR), Neighborhood, Regional, and Commercial Business (NB, RB, CB), and Industrial (I). Alternative C1 is located almost entirely on ground zoned Forest (F). Alternative C (Option C2) crosses Mineral (M) and Rural Residential (RA) zoned land and follows along the southern boundary of the Cedar River Watershed which is zoned Forest (F). Alternative C (Option C1) crosses F and RA zoned land. Alternatives B and D cross predominantly F zoned land and some limited RA zoned land. The purposes of these various zones are distinctly different. However, according to 21A.08.060, the government/business services and land use matrix in the King County Code, a Utility Facility is a permitted use as long as "excluding bulk gas storage tanks" in all of these zones except the RA zone where a Utility Facility is permitted conditionally subject to 21.A.14 when located in an equestrian community identified in the Comprehensive Plan.

> **21A.14.350** Rural equestrian community trail preservation – purpose. The purposes of the rural equestrian community trail protection and improvement requirements set forth in this chapter are to promote the preservation of equestrian communities in King County as a valuable element of rural character and lifestyle. King County intends to accomplish these purposes in a flexible manner that provides incentives to and minimizes costs to private property owners, provides protection from liability for property owners with trails on their property, and does not reduce permitted residential densities in subdivisions and short subdivisions. (Ord. 14045 § 36, 2001).
>
> **21A.14.360** Rural equestrian community trails – general applicability. A. The County may accept the voluntary grant of an easement for a rural equestrian community trails [trail] consistent with K.C.C. 21A.14.350 through 21A.14.390 from any development when such development contains any existing historically established rural equestrian community trail, and when located in the RA, A, or F zones and within an equestrian community designated by the King County Comprehensive Plan.

A majority of the RA land through which the alternatives run is designated as equestrian community. The above provisions do appear to be voluntary and the County inventory of existing equestrian trails has not been consulted. The above provision will be considered when the possibility for public nonmotorized access is evaluated.

Chapter 21A.24 Environmentally Sensitive Areas implements the goals and policies of the Washington State Environmental Policy Act, RCW 43.21.C, and the King County Comprehensive Plan, both of which require protection of the natural environment and the public health and safety. This Section requires:

> **21A.24.190 Alteration.** Any human activity which results or is likely to result in an impact upon the existing condition of a sensitive area is an alteration which is subject to specific limitations as specified for each sensitive area. Alterations include, but are not limited to, grading, filling, dredging, draining, channelizing, applying herbicides or pesticides or any hazardous substance, discharging pollutants except stormwater, grazing domestic animals, paving, constructing, applying gravel, modifying for surface water management purposes, cutting, pruning, topping, trimming, relocating or removing vegetation or any other human activity which results or is likely to result in an impact to existent vegetation, hydrology, wildlife or wildlife habitat. Alterations do not include walking, fishing or any other passive recreation or other similar activities. (Ord. 10870 § 466, 1993).

C. Public water, electric and natural gas distribution, public sewer collection, cable communications, telephone utility and related activities undertaken pursuant to county-approved best management practices, as follows:

1. Normal and routine maintenance or repair of existing utility structures or rights-of-way;

2. Relocation of electric facilities, lines, equipment or appurtenances, not including substations, with an associated voltage of fifty-five thousand volts or less, only when required by a local governmental agency which approves the new location of the facilities;

3. Replacement, operation, repair, modification, installation or construction in existing developed utility corridors, an improved county road right-of-way or county-authorized private roadway of all electric facilities, lines, equipment or appurtenances, not including substations;

4. Relocation of public sewer local collection, public water local distribution, natural gas, cable communication or telephone facilities, lines, pipes, mains, equipment or appurtenances, only when required by a local governmental agency which approves the new location of the facilities;…

21A.24.070 Exceptions. A. If the application of this chapter would prohibit a development proposal by a public agency and utility, the agency or utility may apply for an exception pursuant to this subsection:

1. The public agency or utility shall apply to the department and shall make available to the department other related project documents such as permit applications to other agencies, special studies and SEPA documents.

2. The department shall review the application based on the following criteria:

a. there is no other practical alternative to the proposed development with less impact on the sensitive area; and

b. the proposal minimizes the impact on sensitive areas.

3. The department shall process exceptions, provide public notice, and provide opportunity for the public to request a public hearing, and provide an appeal process consistent with the provisions of K.C.C. 20.20.

The above language supports Alternatives A (Alternative A would require the acquisition of new right-of-way around Covington Substation) and B, which use existing rights-of-way and do not require as much disturbance to ground and vegetation as construction in a new right-of-way would require. If alternatives within existing rights-of-way were found to be

impractical under **21A.24.070 Exceptions,** the proposal of an alternative would be required to minimize impacts on sensitive areas. King County is likely to seek such mitigation measures as modification of long-term vegetation management practices to allow restoration of the values provided by midstory canopy at or within 100 feet of stream crossings (Sandin, 2002).

5.2.6.2 Kittitas County Zoning and Critical Areas Regulations

All but a few small pockets of land in the vicinity of Alternatives B and D are located in the Commercial Forest Zone (White, 2002). Kittitas County's zoning ordinance allows "the erection, construction or substantial alteration of private, public and semipublic gas, electric, water or telecommunication and utility facilities" within its Forest Zone.

Chapter 17.61 Utilities, of the zoning ordinance, lists review criteria for special utilities and their associated facilities. The following determinations must be made for a proposed facility to be found consistent with county zoning:

- Adequate measures have been undertaken by the proponent of the special utility and or associated facility to reduce the risk of accidents caused by hazardous materials.
- The proposed Special Utility or associated facilities are essential or desirable to the public convenience and/or not detrimental or injurious to the public health or safety, or to the character of the surrounding neighborhood.
- The Special Utility will not be unreasonably detrimental to the economic welfare of the county and/or that it will not create excessive public cost for public services by finding that it will be adequately serviced by existing services.
- Special utilities and/or associated facilities as defined by this Chapter shall use public right-of-ways or established utility corridors when reasonable.
- Industry standards, available technology, and proposed design technology for special utilities and associated facilities in promulgating conditions of approval.
- The incidental generation of earthen spoils resulting from the construction and /or installment of a utility or special utility, and the removal of said material from the development site shall not require a separate permit.
- The operation of some utilities and special utilities identified within this Chapter may necessitate unusual parcel configurations and/or parcel sizes. Such parcels (1) need not conform with applicable zoning requirements provided they comply with the procedures provided in KCC Title 16 (subdivision code) and so long as used for a utility or special utility; 920 are not eligible for any other

use or any rights allowed to nonconforming lots in the event the utility or Special Utility use ceases;(3)shall continue to be aggregated to the area of the parent parcel for all other zoning and subdivision requirements applicable to the parent parcel.

The Critical Areas Ordinance

5.2.6.3 Maple Valley Zoning and Sensitive Area Regulations

Maple Valley Municipal Code Title 18, Revised 04/01, lists Major or Regional Utilities as a conditional use in all residential zones and as a permitted use subject to outdoor storage standards in all other zones except neighborhood commercial. The existing right-of-way does not cross any land zoned for neighborhood commercial. BPA is not required to seek a permit from the local government but coordination with the local jurisdiction should ensure that the facility would be consistent with conditional use standards where applicable.

Maple Valley Municipal Code Title 18 also codifies the city's Critical Area Review process and criteria (18.60.320). A detailed consideration of critical areas has not been done but considering the existing land uses and levels of disturbance along with the ability of the proposed structures to span areas of concern BPA is anticipated to be able to achieve consistency with the city's Critical Areas ordinance.

5.2.6.4 Covington Zoning and Sensitive Area Regulations

Zoning districts in the City of Covington do not address utility or special utility facilities nor do they include review standards or criteria to be applied to such uses. The Comprehensive Plan does specify coordination with the city. However, as discussed above, adoption of the County's Sensitive Areas Ordinance means the County provisions should be applied within the city limits as well as outside.

5.3 Transportation

5.3.1 Washington State Department of Transportation Plan Compliance

Any franchise permits for the I-90 crossings or utility crossing permits on state highways that are triggered by the proposed action will be sought by BPA.

5.3.2 Notice to FAA

As part of transmission line design, BPA will seek to comply with FAA procedures. Final locations of structures, structure types, and structure heights will be submitted to FAA for the project. The information will include identifying structures or equipment taller than 200 feet above ground and listing all structures within prescribed distances of airports listed in the FAA airport directory. BPA will also assist the FAA in field review of the project by identifying structure locations. The FAA will then conduct its own study of the project and make recommendations to BPA for airway marking and lighting. General BPA policy is to follow FAA recommendations.

5.3.3 Local Jurisdictions

King County has no permitting requirements, however a traffic control plan will be developed in cooperation with King County and other local jurisdictions to identify plans for staging construction and controlling traffic.

5.4 Recreation

In addition to recreational elements in the USDA Forest Service, DNR, and local city and county plans discussed above, the plans described in the next subsections were reviewed.

5.4.1 Pacific Crest National Scenic Trail Comprehensive Plan

The Pacific Crest National Scenic Trail was designated as one of the first scenic trails in the nation in 1968 by passage of the National Trails System Act of 1968. The Secretary of Agriculture was directed to prepare and submit a Comprehensive Plan for the development, management, and use of the trail in 1978. The Comprehensive Plan allows for managing agencies to divide the trail into recreational opportunity spectrum classes recognizing the Primitive, Semi-Primitive, and more impacted areas through which the trail passes. The management plan calls for carrying capacity to be assessed and overuse to be controlled. There is no specific reference made in the Comprehensive Plan regarding utilities. Coordination with the USDA Forest Service should include discussions of potential impacts to the Pacific Crest Trail and necessary mitigation measures to be undertaken to offset any potential impacts related to Alternatives B and D.

5.4.2 Iron Horse State Park and the John Wayne Pioneer Trial Management Plan

This plan lists Utilities on Park Lands as a Recreational Resource Issue. The management program for this issue states:

> Park and region staff should consider the following issues when reviewing applications for utility easements:
>
> 1) Disruption of recreation caused by installation and maintenance of utilities;
>
> 2) Quality control for installation of the utility and restoration after installation;
>
> 3) Installation plans that include adequate public information (signage, news releases, and meetings);
>
> 4) Increased maintenance caused by utility providers vehicular access;
>
> 5) Impact on natural and cultural resources;
>
> 6) Limitations on siting or recreational facilities as a result of utilities placement;
>
> 7) Utility capacity of trail corridor; and

8) Ongoing maintenance impacts on recreational activities.

Appropriate coordination with land managers to establish a comprehensive mitigation and restoration plan will allow BPA to adequately address the above issues along the trail.

5.4.3 Ollalie Area Mountain Bike Study

This study is currently underway. It began as a way to identify trails for bike/horse use in eastern King County that would be separate from pedestrian use. The area in and around Ollalie area has many abandoned logging roads that could be linked together to create multiple use loop trails. State parks will develop trials on their own lands but expect that the Forest Service and Cedar River Watershed will likely refer to the plan as they plan any expansions to trails on their own lands. Due to heavy snowfall this year, release of the plan is delayed until September. Most trails identified in the study thus far are uphill from the railroad grade and are not near the existing electrical transmission line (Person, 2002).

BPA will continue to check for availability of this document and coordinate with Washington State Parks Puget Sound Region in an attempt to comply with the purpose and intent of the Plan.

5.4.4 WSDOT Mountains to Sound Greenway Implementation Plan (Vol 1-4)

WSDOT has drafted the Mountains to Sound Greenway Implementation Plan. The Department is publishing this document for release on their web site and anticipates its availability by mid to late July. The plan contains a combination of policy and conceptual planning. The four volumes are as follows:

- Volume I, Executive Summary and Funding Sources for Projects
- Volume II, Route Development for I-90
- Volume III, Roadside Development Plan
- Volume IV, Implementation Plan

Staff contacted recalled that existing transmission lines within the Greenway were inventoried but could not recall if specific policies had been drafted to address expansion or addition of transmission lines in the area (Schutz, 2002).

BPA will check for availability of this document and coordinate with WSDOT in an attempt to comply with the purpose and intent of the Plan.

5.4.5 Taylor Mountain Forest Master Plan

This 1997 Plan states the purpose of the Taylor Mountain Forest in the following terms:

1) To conserve protect and restore the natural resources inherent in the land and water;

2) To restore health and density of the forest and to demonstrate environmentally sound management and the importance of conservation of the County's forestland; and

3) To provide educational and passive recreational opportunities for the public, while preserving the site's ecological wildlife and water quality values.

Taylor Mountain program facilities and management activities focus on the following practices:

- Minimize disturbed areas, including narrowing or decommissioning and removal of roads and trails in sensitive areas, and
- Employ practices that enhance the natural beauty of the site.

This parcel was purchased in part by the use of Forest Legacy Funding and is subject to a conservation easement which includes the following restriction in its current draft:

> No utility easements or rights-of-way shall be located within the Property after the date of this instrument without Grantee's consent. All such utilities must be located underground (Blumen, 2002).

BPA has identified a preliminary corridor within which to locate Alternative C (Options C1 and C2) that avoids direct contact with the Taylor Mountain Forest..

5.4.6 Peterson Lake Natural Area Site Management Plan

This 1999 Plan addresses Utility Easements as follows:

Utility easement maintenance is a part of the current character of the site. Several restrictions and rights are part of BPA's 150-foot transmission line easement. BPA trims and or cuts hazard trees within its 150 foot wide easement corridor, maintains vegetation to a 15 foot maximum height, and maintains its easement road and culvert. The easement corridor is maintained by a "scatter and toss" method of brushing trees and vegetation, mostly along the easement road, but BPA will cooperate with King County Parks to keep any trail across the easement clear of debris. The lake and wetland area under the power lines are maintained by hand. In addition, no structure over 10' x 10' may be built within the BPA easement and structures smaller than this must be approved by BPA prior to construction. Finally transmission line sag may have implications to fishing under the power lines at the eastern end of the lake.

Continued coordination with King County Department of Natural Resources Division should ensure continued compatibility between the electric transmission line along Alternative A and Peterson Lake Natural Area.

5.4.7 Big Bend

No Management Plan for Big Bend was known to be in existence at the time of this report. A comprehensive list of management plans for recreation areas is being compiled by King County DNR but at this point no plan is known for Big Bend (Blumen, 2002).

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Schmidt. Park Manager, Washington State Parks and Recreation Commission. Electronic mail—June 26, 2002.

7.0 List of Preparers

Dorothy DeVaney, Environmental and Land Use Planner. Experience: Land use projection and planning; National Environmental Policy Act (NEPA) review; energy facility impact analysis. Education: B.S. Landscape Architecture. With CH2M HILL since 2001.

Bill Kitto, Project Manager. Experience: Management of numerous conservation and renewable energy projects; expertise in engineering and environmental aspects of high-voltage transmission lines; EIS preparation and review. Education: M.A. in Civil Engineering. With CH2M HILL since 2000.

Jon Nottage, Environmental Planner. Experience: Energy facility research and analysis. Land use and environmental planning research and fieldwork. Education: B.S. Biology, M.B.A. With CH2M HILL since 2001.

Steve Perone, GIS Analyst. Experience: Geographic information system application development and analysis, including enterprise-wide spatial database design and implementation. Education: B.S., Business Administration. With CH2M HILL since 2000.

Thomas Priestley, Aesthetic and Visual Impacts Analyst. Experience: Land use projection and planning; transmission line design and siting; environmental impact assessment. Education: B.U.P. in Urban Planning; M.C.P. in City and Regional Planning; M.LA. in Environmental Planning; Ph.D. in Environmental Planning. With CH2M HILL since 2001.

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8.1 Placeholder: Data Sources for Figures

9.0 Glossary and Acronyms

9.1 Acronyms and Abbreviations

AMA adaptive management area

BLM Bureau of Land Management

BMP	best management practice
BPA	Bonneville Power Administration
CEA	connectivity emphasis area
COE	U.S. Army Corps of Engineers
CZMP	Coastal Zone Management Program
DEIS	draft environmental impact statement
DNR	Department of Natural Resources (Washington)
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
FAA	Federal Aviation Administration
FERC	Federal Energy Regulatory Commission
GIS	geographic information system
GMA	Growth Management Act
HCP	Habitat Conservation Plan
I-90	Interstate 90
kV	kilovolt
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NRCA	Natural Resources Conservation Area
RCW	Revised Code of Washington
RMSA	Rattlesnake Mountain Scenic Area
ROW	right-of-way
SDEIS	supplemental draft environmental impact statement
SEPA	State Environmental Policy Act
SMA	Shoreline Management Act
SMP	Shoreline Management Program
SR	State Route
USDA	U.S. Department of Agriculture
USDOT	U.S. Department of Transportation
USFWS	U.S. Fish and Wildlife Service

WAC Washington Administrative Code

WDOE Washington Department of Ecology

WFPB Washington Forest Practices Board

9.2 Technical Terms

Deer and Elk Winter Range. A range usually at lower elevation, used by migratory deer and elk during the winter months.

Dispersed Recreation. Managed primarily in an unroaded condition with emphasis on dispersed recreation, scenic, wildlife or other amenity values.

General Forest. Timber harvest occurs, with a full range of silvicultural prescriptions used on suitable lands.

Late-Successional. A forest in its mature and/or old-growth stages. Also called late-seral stage forest. Typical characteristics are moderate to high canopy closure, a multilayered and multispecies canopy dominated by large overstory trees, numerous large snags, and abundant coarse woody debris (such as fallen trees) on the ground. Typically, stands 80 - 120 years old are entering this stage.

Late-Successional Reserve. Lands managed to protect and enhance conditions of late-successional and old growth forest ecosystems which serve as habitat for late-successional and old growth forest related species.

National Environmental Policy Act (NEPA). This act requires an environmental impact statement on all major federal actions substantially affecting the quality of the human environment [42 U.S.C. 4332 2(2) (C)].

Scenic Forest. The objective is to retain or enhance viewing and recreation experiences. Visual quality objectives will be applied to uses visible from recreation sites, roads, and trails.

Appendix M Geology, Soil, Climate and Hydrology Additional Alternatives Technical Report

Bonneville Power Administration
Kangley-to-Echo Lake Transmission Line Project
Geology, Soil, Climate and Hydrology
Additional Alternatives Technical Report

October 2002

Submitted To:
Mr. Gene Lynard KEC-4
Bonneville Power Administration
P.O. Box 3261
Portland, Oregon 97208-3621

By:
Shannon & Wilson, Inc.
400 N 34th Street, Suite 100
Seattle, Washington 98103

21-1-09189-002

EXECUTIVE SUMMARY

This technical report presents information regarding geologic, soil, climatic, and hydrologic conditions and natural hazards that could impact or be impacted by construction and operation of a Bonneville Power Administration (BPA) electrical transmission line along one of four proposed route alternatives. These four route alternatives have been proposed in addition to five route alternatives previously proposed that would cross the City of Seattle Cedar River Watershed. A technical report used to support a Draft Environmental Impact Statement (DEIS) was previously completed for the proposed five Cedar River Watershed route alternatives. Information from this current report will be used to prepare a Supplemental Draft Environmental Impact Statement (SDEIS) for the four additional route alternatives.

The additional four transmission line route alternatives are designated A through D. Alternative A proposes constructing a new single-circuit, 500-kilovolt (kV) line for 11 miles and rebuilding the existing 9-mile-long, Covington to Maple Valley 230-kV transmission line to a double-circuit 500-kV line. Alternative B proposes rebuilding 38 miles of the existing Rocky Reach-Maple Valley, 345-kV line from Stampede Pass to the Echo Lake substation to a double-circuit, 500-kV line. Alternative C proposes constructing a new, single-circuit, 500-kV line from BPA's Raver Substation (10 miles long, Option C 1), or from near the community of Kangley (10.5 miles long, Option C 2) on mostly new right-of-way (ROW). The new line would connect to an existing vacant (unused) Echo Lake-Maple Valley 500-kV circuit. Alternative D proposes constructing a new, single-circuit, 500-kV line for 38 miles parallel to the existing Rocky Reach-Maple Valley, 345-kV line from Stampede Pass to the Echo Lake substation. The new line could be on the south side (Option D 1) or the north side (Option D 2) of the Rocky Reach-Maple Valley line. New ROW would be required for this alternative.

Chapter 1 of this report presents an overall description of the project, project scope and methods of study. Chapter 2 summarizes the proposed route alternatives.

The affected regional environment is discussed in Chapter 3, which includes sections on topography, geology, soils, seismology, hydrology, and wind. In general, the region has moderately rugged to rugged topography. It is underlain mostly by glacial deposits and by sedimentary and volcanic rock that has been folded and faulted. The affected environment discussion for each of the four route alternatives includes information on major drainages, bedrock and surficial geology, and local topography.

Chapter 4 discusses environmental consequences of the proposed action. It begins with an overview of the resources and natural hazards evaluated, including shallow and deep-seated

landslides, soil erosion, settlement, liquefaction, faulting, flooding, and water quality-limited (303[d] listed) water bodies. Each resource was assigned ratings of no impact, low impact, moderate impact, or high impact. Following the overview, Chapter 4 discusses the impacts, mitigation, cumulative impacts, and unavoidable effects, and irreversible or irretrievable commitments of resources along each of the proposed route alternatives.

Chapter 5 provides a description of the review and permit requirements related to the resources discussed in this technical report. Chapter 6 summarizes the individuals and agencies consulted, and Chapter 7 reviews the methods used for this study.

Shannon & Wilson, Inc. has included in the Appendix our "Important Information About Your Geotechnical Report" to assist you and others in understanding the use and limitations of our report.

The affixing of the professional seal below indicates the exercise of professional judgment by participation in developing the engineering and geological matters embodied in our work for this project.

SHANNON & WILSON, INC.

Jeffrey R. Laird, C.E.G.
Senior Principal Engineering Geologist

Christopher A. Robertson, P.E.
Senior Associate

JRL:CAR:WTL/jrl

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APPENDIX

Important Information About Your Geotechnical Report

BONNEVILLE POWER ADMINISTRATION
KANGLEY-ECHO LAKE TRANSMISSION LINE PROJECT
GEOLOGY, SOIL, CLIMATE AND HYDROLOGY
ADDITIONAL ALTERNATIVES TECHNICAL REPORT

1.0 INTRODUCTION

Bonneville Power Administration (BPA) is proposing to build the Kangley-Echo Lake Transmission Line Project, which will include a new 500-kilovolt (kV) transmission line, in Washington State. BPA's primary reason for building the proposed new transmission line is to improve system reliability in the King County area. Under normal growth demands, system instability could develop as early as the winter of 2002-2003 with an outage of the existing Raver-Echo Lake 500-kV line. Another reason is to enhance the United Sates' delivery of power to Canada as required under the Columbia River Treaty of 1961. The Vicinity Map (Figure 1) shows the project location.

The Project Area Plan (Figure 2) shows the approximate locations of the four additional route alternatives (Alternatives A through D), and five previously proposed route alternatives (Alternatives 1 through 4B). Alternatives C and D each have two options, designated C 1 and C 2, and D 1 and D 2, respectively. Depending on the alternative selected, the new transmission line could be from about 9 miles long (Alternative 1) to 38 miles long (Alternatives B or D).

BPA initially proposed five route alternatives through the City of Seattle Cedar River Watershed. Shannon & Wilson, Inc. prepared a technical report, which describes geologic, soil, climatic and hydrologic conditions, and natural hazards for each of these five alternatives. That report is entitled "Bonneville Power Administration Kangley-Echo Lake Transmission Project Geology, Soil, Climate and Hydrology Technical Report," and dated January 2001.

Once the environmental review is complete, BPA will decide whether and how to proceed with the project. If BPA decides to proceed, construction could begin in 2003.

The proposed project has two major elements:

- A new 500-kV transmission line.
- An expansion to the existing Echo Lake Substation to accommodate the new transmission line. The proposed substation expansion has been addressed in our January 2001 report.

This technical report describes geologic, soil, climatic and hydrologic conditions, and natural hazards that are present along four additional proposed route alternatives that are outside of the Cedar River Watershed. It identifies potential impacts that could result because of construction, operation, and maintenance of the project. The information from this report will be used to prepare portions of a Supplemental Draft Environmental Impact Statement (SDEIS) for the proposed project.

2.0 PROPOSED ACTIONS AND ALTERNATIVES

The four additional route alternatives shown on the Project Area Plan (Figure 2) would be on new and/or existing right-of-way (ROW) and are described below.

Alternative A would begin at a tap on the Schultz-Raver No. 2 transmission line near Kangley, Washington. A new single-circuit, 500-kV line would be constructed on 135-foot-tall towers parallel to and just north of the existing Covington-Columbia Number 3 230-kV transmission line on vacant transmission line ROW. This line would extend west for about 11 miles to near the Covington Substation. New ROW would need to be acquired across from the Covington Substation to the Covington-Maple Valley ROW. That portion of the Covington-Maple Valley 230-kV single circuit transmission line between Covington and the Rocky Reach-Maple Valley, double-circuit 500-kV line, would then be rebuilt with one side operated at 230-kV and the other at 500-kV. This new double circuit line would be supported by 175-foot tall transmission structures, over a distance of approximately nine miles. The 500-kV transmission line would then tie into an existing, unused, 500-kV circuit of the Maple Valley-Echo Lake double circuit 500-kV line, and then into the Echo Lake Substation. Most of the ROW that would be needed is already owned by BPA.

Alternative B would rebuild approximately 38 miles of BPA's existing Rocky Reach-Maple Valley, 345-kV transmission line to a 500-kV, double-circuit line. The new line would be installed on 175-foot-tall towers. The new 500-kV line would be connected to the existing Schultz-Raver No. 2 500-kV transmission line just east of Stampede Pass and to the Echo Lake Substation at the west end. The line would cross Interstate 90 twice. This route would be on existing, mostly cleared BPA ROW. Some clearing would be required because approximately 20 feet of the ROW on the north side of the existing line and towers has not been cleared for many years.

Alternative C would consist of a new, single-circuit, 500-kV line constructed on 135-foot-tall towers. Alternative C could begin at one of two points. Option C 1 would originate at the Raver Substation, then proceed west approximately 2.5 miles in a vacant, cleared ROW along the

existing Raver-Tacoma double-circuit 500-kV transmission line. At this point, the segment would turn north for about 7.5 miles to tie into an unused circuit of the Echo Lake-Maple Valley double circuit 500-kV line. This segment would be on new ROW. Option C 2 would begin at a tap point along the Schultz-Raver No. 2 line near Kangley. From the tap point, it would proceed west along vacant transmission line ROW immediately north of the Covington-Columbia No. 3 230-kV transmission line for approximately 4.5 miles. At this point, the C 2 segment would join the same route described for Option C 1 and extend north for about 6 miles. The C 2 Option segment is the same as described previously for the initial section of Alternative A.

Alternative D would involve the construction of a new, single-circuit, 500-kV transmission line from just east of Stampede Pass to the Echo Lake substation. This line would parallel BPA's existing Rocky Reach-Maple Valley, 345-kV transmission line and would generally follow the Interstate 90 corridor. The new line would cross Interstate 90 twice. The new line would require the purchase and clearing of 38 miles of new ROW. Option D 1 would be located on the south side of the existing transmission line, and Option D 2 would be located on the north side of the existing transmission line.

2.1 Right-of-Way Clearing

In general, where new ROW is obtained, a strip of land about 150 feet wide would be cleared to allow for tower construction and conductor clearance. Modern logging methods, including the use of cable logging and low ground pressure equipment, would be used where appropriate to reduce the amount of access road building and ground disturbance. A low ground cover of vegetation consisting of shrubs and grasses would remain following logging, and the cleared area would not be burned. Over the years, the vegetation would grow to a taller and denser condition. Consequently, the benefits of vegetation, including root strength, soil cover, interception of precipitation, and evapotranspiration would remain to some extent during and following construction.

Alternative A would require clearing where new ROW would need to be acquired near the Covington Substation. From the tap, the initial 11 miles would occupy an existing, unused, cleared ROW adjacent to and just north of the existing Covington-Columbia Number 3 230-kV line. The remainder of the line would involve the reconstruction of an existing line in a cleared ROW. Alternative B would require clearing a band of forest vegetation approximately 20 feet wide for 38 miles within the existing ROW. The remainder of the existing ROW has already been cleared. Alternative C1 would require approximately 7.5 miles of clearing within the new 150-foot wide ROW, while Alternative C2 would require about 6 miles of clearing within the new ROW. Alternative D (Options D 1 and D 2) would require the clearing of a 38-mile long, 150-foot wide strip of forest adjacent to the existing cleared ROW.

2.2 Transmission Line

For Alternatives A and B, BPA proposes to use double-circuit, steel lattice towers averaging 175 feet in height to support the new transmission line. Alternatives C and D would use single-circuit, steel lattice towers averaging about 135 feet in height. The exact tower locations would be determined after the preferred alternative is selected.

Stable foundations for the transmission line towers would be necessary to reduce the potential for structure failures. The towers and their foundations would be designed and constructed to withstand the structural dead loads and live loads from construction, ice, wind, and earthquakes. After the preferred alternative is selected, site studies would be conducted to evaluate subsurface conditions so that adequate foundations could be designed and constructed.

In general, foundations would consist of steel plates or grillages buried in excavations averaging 15 feet deep. Soil would be backfilled and compacted over the plates. Where hard or massive rock is encountered, the towers would be anchored to the rock using rock dowels.

2.3 Access Roads

BPA normally acquires ROW easements, and develops and maintains permanent access for travel by wheeled vehicles to each structure. Access roads are designed for use by cranes, excavators, supply trucks, log trucks, boom trucks, and line trucks for construction, ROW clearing, and maintenance of the transmission line. BPA prefers road grades of 6 percent or less in areas of highly erodible soils and 10 percent or less for erosion-resistant soils. For short distances, maximum acceptable road gradients are 15 percent for trunk or main roads and 18 percent for spur roads (roads that go to each structure if the structure is not on a trunk road). The locations and lengths of new trunk and spur access roads that would be required for Alternatives A and C have not yet been determined. These would be determined after a preferred alternative is selected. The total length of new roads for Alternative B would be short because the new route is located along the existing route. Road locations have been proposed for Alternative D. These new roads would generally consist of short spur roads extending from the existing main or spur access roads.

Best Management Practices (BMPs) would be used in constructing and upgrading access roads, as described in Section 4. Where appropriate, new or existing trunk access roads would be surfaced with gravel for construction and maintenance activities. Water bars would usually be installed on spur roads after construction. Cut-and-fill slopes on trunk and spur access roads would be revegetated after construction.

Regardless of the alternative selected, much of the new transmission line could be built using the existing access road system. It is unlikely long distances of new trunk roads would be required. Easements for new trunk roads built outside the ROW would be 50 feet wide. New or existing trunk roads would be graded to provide a 14-foot-wide travel surface, with an additional 4 to 6 feet on curves. About 10 feet on both sides of a trunk road would be graded for ditches, for a total clearing width of 24 to 30 feet. The road surface is usually surfaced with gravel for construction and maintenance activities. New or upgraded spur roads would be required to access most tower locations. Spur roads would be built within the ROW from the on-ROW trunk roads to access structures. The spur roads are usually not surfaced with gravel.

3.0 AFFECTED ENVIRONMENT

Key factors that affect the susceptibility of different areas to erosion and sedimentation are topography, geology, soils, and climate of the project area. Erosion and sedimentation could cause degradation of water quality and affect fisheries and other habitat. Landslides, soil creep, and other mass wasting processes could also contribute to hillslope erosion and stream sedimentation. Logging, ROW clearing and construction, and use and maintenance of roads and towers could affect these processes. The following sections describe the topography, geology, soils, seismic conditions, climate, and hydrology present within the project area.

3.1 Topography

Alternatives A and C are located in the Puget Sound Lowland, while Alternatives B and D extend from the east side of the Cascade Mountains to the west side Cascade foothills (Figure 1). The topography of these two areas is distinctly different. Figure 4 shows topographic contours and slope gradients near each route alternative.

Beginning at the east end of Alternative A near Kangley, the proposed route would extend due west across generally flat glacial outwash plains (Sheet A-1, Figure 4A). Just north of Georgetown, the route would traverse the south side of a 250-foot-high hill and then cross the west-flowing Rock Creek drainage. From this point, the route would extend west-southwest across generally flat to gently-sloping ground, crossing the Cranmar Creek drainage, to near the Covington Substation (Sheet A-2, Figure 4A). From just west of the Covington Substation, the route would traverse north to northeast across northwest-oriented, generally low-lying ridge and swale topography. Several creeks, including Little Soos Creek and the headwater drainage of Big Soos Creek, would be crossed in this section. In addition, numerous lakes, ponds, and wetlands exist in this area (Sheet A-3, Figure 4A). Near the north end of the route, the proposed line would cross the Cedar River Valley, and then extend northeast along an unnamed valley

(Sheet A-4, Figure 4A). The route would turn north and ascend the north side of this valley and tap into the Maple Valley-Echo Lake double-circuit 500-kV line just south of the Cedar Hills Landfill.

The east end of Alternative C, Option C 1, would begin at the Raver Substation and extend along a vacant ROW just north of the Covington-Columbia No. 3 transmission line (Sheet C-1, Figure 4B). Option C1 would initially cross an unnamed, low-gradient, south-flowing drainage; and then ascend a 350-foot-high, 30 percent slope. From the slope top, the route would extend west-northwest approximately 1½ miles before turning due north. The route would cross the Cedar River Valley, and then traverse generally level to gently sloping ground along an as yet undefined ROW route in the vicinity of 276th Avenue (Sheet C-2, Figure 4B). Near the north end, the route would cross Carey and Holder Creeks (headwaters to Issaquah Creek) and then traverse a 500-foot-high, 40 to 50 percent, forested slope on the south side of South Tiger Mountain (Sheet C-3, Figure 4B). The proposed transmission line would tap into the Echo Lake-Maple Valley transmission line on the south side of South Tiger Mountain. Option C2 would follow the Alternative A route for about 4.5 miles across generally flat glacial outwash plains from Kangley to the west side of the 250-foot-high hill, at which point it would turn north and follow the Option C1 route for approximately 6 miles to the Echo Lake-Maple Valley transmission line.

Alternatives B and D would begin just east of Stampede Pass on the east side of the Yakima River Valley near Interstate 90 (Sheet B/D-1, Figure 4C). The routes would extend northwest along the valley, cross the Yakima River, and then traverse up onto the west side of the valley. The routes would continue north-northwest across steep to moderate slopes along the west side of Keechelus Lake (Sheet B/D-2, Figure 4C). The lake is a reservoir on the Yakima River maintained by the U.S. Bureau of Reclamation. Near the north end of the reservoir, the routes would turn northwest up moderately steep slopes into the Mill Creek drainage and cross the Snoqualmie West ski area (formerly Mount Hyak ski area) (Sheet B/D-3, Figure 4C). The routes would then traverse gentle slopes before descending steep slopes into the South Fork Snoqualmie River Valley. The routes would generally follow along the toe of moderate to steep slopes on the south side of this valley. Along these south valley slopes, the routes would cross 11 stream channels, as shown on the U.S. Geological Survey (USGS) topographic quadrangle maps, and numerous smaller channels that are not shown (Sheets B/D-3 and B/D-4, Figure 4C). The routes would traverse the south valley slopes for approximately 9 miles before turning north and crossing Interstate 90 and the South Fork Snoqualmie River (Sheet B/D-5, Figure 4C). Along the north valley side, the routes would traverse northwest for about 4 miles across gentle to moderate slopes and then across a nearly flat plateau. The routes would then cross Interstate 90 and the South Fork Snoqualmie River (Sheet B/D-6, Figure 4C). For about four miles west from

the South Fork Snoqualmie River, the routes would traverse moderate slopes and cross several streams below Rattlesnake Mountain (Sheet B/D-7, Figure 4C). West of these moderate slopes, the routes would traverse up and across steep slopes on the east side of Rattlesnake Mountain, crossing numerous stream channels. The routes would then extend around the north end of Rattlesnake Mountain before turning south to the Echo Lake Substation.

3.2 Geology

Alternatives A through D are located across and west of the South Cascade Range (Galster and others, 1989). The geology of Alternatives A and C is dominated by glacial deposits in the Puget Lowlands, while the geology of Alternatives B and D is dominated by volcanic rocks in the South Cascades. The South Cascades are composed primarily of Tertiary-age volcanic, volcaniclastic, and associated sedimentary rocks. These rock units have been folded and faulted since they were deposited. Pre-Tertiary Western Mélange Belt rocks occur in scattered outcrops along the South Fork Snoqualmie River Valley. Repeated advances of continental glacial ice sheets into the Puget Lowlands during the Quaternary Period eroded the Cascade foothills and deposited thick sequences of glacial sediments. The geology along the alternative routes is shown on the Geologic Map (Figures 5A, 5B, and 5C). Table 1 presents descriptions of the geologic units present along the alternative routes. The map and descriptions of the geologic units are based on published geologic maps.

3.2.1 Pre-Tertiary Geology

Pre-Tertiary rocks occur along Alternatives B and D in the South Fork Snoqualmie River Valley at and just east of North Bend, as mapped by Frizzell and others (1984) and as shown on Figure 5C. These rocks may be as old as middle Jurassic (165 million years before present [mybp]), and include well-bedded sandstone and argillite (pTwa), serpentized pyroxenite (pTwu), and metagabbro (pTwg). These rocks originated as ocean crust and ocean sedimentary deposits that were later thrust onto the overriding North American Plate. This emplacement has caused substantial deformation, as reflected in large-scale structures such as faults, folds and shear zones, as well as small-scale deformation, including mineral metamorphism, foliation and crushing.

3.2.2 Tertiary Geology

Tertiary rocks are exposed along all of the alternative routes. The following paragraphs describe each rock unit from oldest to youngest.

The oldest Tertiary rocks exposed in the project area are the late Eocene (36 to 43 mybp) rocks of the Naches Formation (Frizzell and others, 1984). The Naches Formation is mapped

along Alternatives B and D between the east end of the route and Humpback Creek. These rocks consist of rhyolite, andesite, and basalt flows, tuff and breccia, with interbedded sandstone and siltstone. The flow rocks are generally well bedded and may have columnar jointing. Rhyolite occurs as flow-banded flows and ash-flow tuffs. Interbedded sedimentary rocks include micaceous sandstone with crossbedding and graded bedding, as well as siltstone. The Naches Formation (Tn, Figure 5C) has been divided locally into the following units:

- Feldspathic sandstone and volcanic rocks (Tns, Figure 5C) consisting of tan to gray, well-bedded, medium to coarse-grained, micaceous sandstone and interbedded siltstone and shale. It also includes interbedded rhyolite, andesite, and basalt flows, tuff and breccia.

- White to gray, flow-banded, platy jointed rhyolite with ash flow tuff and pumice fragments (Tnr, Figure 5C).

- Mt. Catherine Rhyolite, a black, welded, ash flow tuff with pumice lapilli and breccia (Tnmc, Figure 5C). This unit includes thin interbeds of sandstone and shale.

- Guye Sedimentary Member (Tng, Figure 5C) consisting of light to dark gray, feldspathic sandstone, black slatey shale and hard, chert pebble conglomerate.

Nonmarine volcanic and sedimentary rocks of the 11,000-foot-thick, middle to late Eocene Puget Group are mapped along Alternatives A and C (Frizzell and others, 1984). These rocks were deposited primarily in fluvial environments and to a lesser extent in near-shore marine environments. The rocks include sandstone, siltstone, claystone, and coal. The sandstone is generally massive to cross bedded, with occasional channel cut-and-fill structures. The Puget Group has locally been divided into several formations, which include (from oldest to youngest) the Tiger Mountain, Tukwila, and Renton Formations. Only rocks of the Tukwila and Renton Formations occur along Alternatives A and C. The following paragraphs describe these formations. Numerous outcrops of the Puget Group that have not been differentiated into one of the formations are mapped at the east ends of Alternatives A and C (Tpg, Figures 5A and 5B).

The middle to late Eocene (36 to 50 mybp) Tukwila Formation conformably overlies the Tiger Mountain Formation (Vine, 1962). These rocks are composed of volcanic lava flows, sills and dikes, breccia, conglomerate and sandstone. Volcanic tuff and breccia probably make up most of the Tukwila Formation, but the volcanic flow rocks are more resistant to erosion, thereby forming much of the visible outcrop. Tukwila Formation rocks are exposed at the north end of the Alternative C route and at the west end of Alternatives B and D (Tpt, Figures 5B and 5C).

The youngest rocks in the Puget Group, the late Eocene Renton Formation, conformably overlie the Tukwila Formation. The Renton Formation is as thick as 2,250 feet and consists of sandstone, siltstone, claystone, and coal. This formation was deposited in fluvial and near-shore

marine environments. Clay commonly binds the sandstone. Fine-grained, interbedded siltstone and claystone commonly form valleys between more resistant sandstone ridges. The Renton Formation outcrops just to the north of the north end of the Alternative C route (Tpr, Figure 5B). Renton Formation coal has been mined from underground workings in the project area.

Eocene (36 to 57 mybp) dikes and plugs composed of diabase, gabbro, and basalt are mapped at the east end of Alternative A and at the north end of Alternative C, where they intrude rocks of the Puget Group (Tpg, Figures 5A and 5B). These rocks are characterized as black, fine to medium-grained diabase and gabbro (Frizzell and others, 1984).

The Oligocene (24 to 36 mybp) Mt. Persis volcanics are mapped along Alternatives B and D on the east flank of Rattlesnake Mountain (Tpa, Figure 5C). These rocks are gray to black, porphyritic andesite and andesite breccia flow rocks (Frizzell and others, 1984). The rocks are characterized as massive to blocky jointed.

Late Oligocene (25 to 30 mybp) Huckleberry Mountain Formation volcanic rocks (Thm, Figure 5C) are mapped along Alternatives B and D along the south side of the South Fork Snoqualmie River. These volcanic rocks begin at Twin Falls State Park and extend to the east end of the routes (Frizzell and others, 1984). These rocks consist of generally well-bedded andesite and basalt breccia, tuff, and lava flows with minor amounts of volcanic sandstone, siltstone, and conglomerate.

Other volcanic rocks that are probably correlative with the Huckleberry Mountain Volcanics are mapped on the north side of the South Fork Snoqualmie River (Tv, Figure 5C). These rocks include andesite breccia, tuff, and ash flow tuff.

A unit of the Huckleberry Mountain Volcanics, the Tuff of Lake Keechelus (Thmk, Figure 5C) is mapped across Alternatives B and D near the approximate center of Keechelus Lake (Frizzell and others, 1984). These rocks consist of dacite tuff and breccia.

The youngest rocks exposed in the project area are associated with the Snoqualmie Batholith (Frizzell and others, 1984). These rocks are mapped along Alternatives B and D in the South Fork Snoqualmie River Valley from Twin Falls State Park, where the rocks first crop out on the north valley side, east to Rockdale Creek. Snoqualmie Batholith rocks include granodiorite and tonalite (Tsgs, Figure 5C), characterized by equigranular medium grains and coarse jointing; fine-grained monzonite (Tsgf, Figure 5C); and mafic diorite and gabbro (Tsm, Figure 5C).

3.2.3 Quaternary Geology

Geologic processes profoundly influenced the surficial deposits and landforms in the project area during the Quaternary Period (present to 2 mybp). The areas crossed by Alternatives A and C were repeatedly overridden by continental glacial ice during the Pleistocene Era. The continental glaciers deposited variable thicknesses of till and extensive glaciofluvial and ice-contact deposits, and reshaped the surface with a series of meltwater channels that formed beneath and in front of the ice sheets as the continental glacial ice advanced and retreated. The continental ice sheets also blocked the South Fork Snoqualmie River drainage, creating lakes and causing sediment to deposit. Extensive alpine glaciers in the Cascades modified the landscape along the routes of Alternatives B and D. Following glacial retreat, the landforms were locally modified by fluvial erosion and deposition, and mass wasting.

3.2.3.1 Pleistocene Glacial Geology

At least six periods of continental glaciation have been documented in the Puget Lowland and adjacent margins of the Cascade and Olympic Mountain Ranges. The most recent period is termed the Fraser Glaciation. Each advance and retreat of an ice sheet may be characterized by a complex sequence of glaciolacustrine sediment, glaciomarine drift, advance outwash, till, and recessional outwash. Erosion and subsequent deposition of the glacial sediments between each glacial interval have altered these deposits. The total thickness of these Pleistocene deposits can range between 0 and 3,700 feet in the Puget Lowlands.

Pre-Fraser glacial deposits, consisting of hard, lacustrine clay and dense, stratified sand and gravel, are mapped in the Cedar River Valley along Alternatives A and C (Qpf, Figures 5A and 5B).

During the Vashon Stade of the Fraser Glaciation that occurred between 15,000 and 13,500 years ago in the central part of the Puget Lowlands, the Puget Lobe of the continental glacier flowed southeast across the Puget Lowlands, covering and reshaping the ground in the vicinity of Alternatives A and C, and the far west portions of Alternatives B and D. The upper limits of ice can be determined from the highest presence of till and erratic boulders. As the ice sheet advanced over the area, it eroded the underlying bedrock. A mantle of lodgment till, which consists of subangular to rounded gravel-, cobble- and boulder-sized clasts supported in a dense matrix of silt and sand, was deposited at the base of the glacier. Till is prevalent along Alternatives A and C, and along Alternatives B and D west of Twin Falls State Park (Qvt, Figures 5A, 5B, and 5C).

The Vashon Stade glacier blocked the Snoqualmie and Cedar Rivers, diverting these drainages south along the eastern ice margin. Meltwater from these drainages flowed into

the valley currently occupied by Taylor Creek, and then flowed southeast to Eagle Gorge and down the Green River to Kankaskat. From Kankaskat, meltwater continued south along the ice margin against the western Cascade foothills. Ultimately, the meltwater reached the Chehalis Valley, which was the principal outflow channel beyond the glacier terminus. At the maximum stand, ice-contact deposits, consisting of stratified sand and gravel, silt, clay and till, were deposited along the glacial margin. Stagnant ice that was covered with sediment subsequently melted, creating collapse features such as kettles. Ice-contact deposits are mapped at the east end of Alternative A, at both ends of Alternative C, and near the west end of Alternatives B and D (Qvic, Figures 5A, 5B, and 5C).

As the glacier receded, a series of meltwater channels developed as the ice front successively moved to the northwest. Meltwater streams deposited recessional outwash consisting of stratified sand and gravel. Recessional outwash is prevalent along Alternatives A and C, and in the west half of Alternatives B and D (Qvr, Figures 5A, 5B, and 5C).

Glaciolacustrine deposits consisting of well-stratified sand and silt, with a few thin lenses of gravel, were deposited in blocked drainages. These glaciolacustrine deposits typically have a limited aerial extent. As such, they are generally not included in the geologic mapping by Frizzell and others (1984) and are not shown on Figures 5A, 5B, and 5C or listed in Table 1.

Alpine glacial deposits occur along Alternatives B and D between the east end and Snoqualmie Pass (Qag, Figure 5C). These deposits typically include boulder tills in the uplands and gravel and sand outwash on valley floors.

3.2.3.2 Holocene Geology

Holocene deposits include landslides, talus, colluvium, bogs, alluvium, volcanic ash, and human-modified land. Landslide deposits result from the relatively rapid downslope movement of rock and soil, and are generally found on and at the base of hill slopes. They usually consist of a remolded, heterogeneous mixture of several soil types and commonly include organic debris. Three large, ancient, deep-seated landslides are mapped across or in the vicinity of Alternatives B and D (Qls, Figure 5C). Scattered, recent, shallow landslide and debris flow features were observed on steep slopes along Alternatives B and D. Recent deep-seated and shallow landslide features were observed on the valley walls above the Cedar River along Alternative A (Figure 5A). Section 3.2.3.3, Landslides, provides additional discussion about the occurrence of landslides along the proposed alternative routes.

Colluvium is soil that has been transported downslope, generally by mass wasting processes, including shallow landsliding, rain splash erosion, frost heave, and soil creep. The

thickness can range from a few inches to 10 feet or more, with the thickness usually increasing downslope. Colluvium is relatively widespread in the project area, as described in Section 3.3; however, the unit is generally not shown on geologic maps because it is relatively thin.

Talus deposits, consisting of nonsorted, angular boulders to gravel derived from rock slopes, are mapped at the east end of Alternatives B and D (Qt, Figure 5C). Smaller talus deposits that were not mapped on the published geologic maps likely are present along the slopes above Keechelus Lake and the South Fork Snoqualmie River Valley.

Bog deposits include peat and lacustrine deposits with organics. They occur in poorly drained, low-lying areas. Bog deposits are most prevalent along Alternatives A and C, which are characterized by till and enclosed drainages resulting from glacial deposition (Qb, Figures 5A and 5B). No mapped bog deposits occur along Alternatives B and D. Bog deposits typically are located in areas currently designated as wetlands and generally provide poor foundation conditions.

Rivers and streams deposited alluvial sediment in and adjacent to their current and historical channels after the continental glaciers had fully retreated. Alluvium includes fine-grained, overbank deposits and coarse-grained channel deposits. Extensive alluvial deposits are present along the Yakima, South Fork Snoqualmie, and Cedar Rivers (Qa, Figures 5A, 5B, and 5C). Terraces formed as the rivers eroded and incised a deeper channel, leaving remnants of the alluvial deposits along the valley sides. Recent alluvial deposits occur in and adjacent to all streams and rivers in the project area in the form of sand, gravel and cobble bars, and alluvial fans.

Volcanic ash was widely deposited over most of western Washington as a result of the catastrophic eruption of Mount Mazama in southern Oregon approximately 6,600 years ago, as well as from other, less extensive, volcanic eruptions. The ash deposits are well preserved in bog deposits. Elsewhere, they typically are mixed with other soil types.

More recently, humans have modified the land, including excavations for surface and subsurface mines and fills for highway embankments, mine spoils and landfills. Two large areas of modified land include the Cedar Hills Landfill and a gravel pit adjacent to the north end of Alternative A (Sheet A-4, Figure 5A). The abandoned Hobart Landfill is located on the north side of the Cedar River just to the east of the proposed Alternative C route (Sheet C-2, Figure 5B). The abandoned Hobart Landfill is within the Cedar River Watershed boundary.

3.2.3.3 Landslides

Three large, ancient landslides were identified in the published geologic maps of the project area. We identified several more recent landslides during our photogeologic studies and aerial overflight. The general paucity of landslides is probably due to the relatively gentle to moderate slopes along Alternatives A and C, and relatively stable bedrock conditions along Alternatives B and D.

Deep-seated landslides can range in depth from 10 feet to more than 100 feet and may involve movement of bedrock and soil. Deep-seated landslides generally initiate as a single mass movement that may then separate into discrete blocks. Typically, deep-seated landslides have a zone of weakness, such as a layer of clay or weak rock, where a landslide slip surface forms. Landslide movement is usually initiated by:

- Excessive pore water pressure in the landslide mass that typically occurs during and/or closely following wet storm periods.
- Removal of support from the toe of the landslide by stream erosion or excavation for a road or other feature.
- An increase of driving forces at the top of the landslide. Typically, this occurs when a fill is placed on the slope for construction of a road or other structure.
- Strong ground motions during an earthquake. The large, ancient, deep-seated landslides on the Alternative B and D routes may have been initiated during large-magnitude earthquakes.

Shallow landslides are normally less than 10 feet deep and occur in soil and highly weathered bedrock. Shallow landslides typically occur on slopes steeper than 65 percent (33 degrees), although they can occur on flatter slopes under certain conditions. Shallow landslides usually occur during periods of intense and/or prolonged precipitation. Other factors that contribute to shallow landslides include changes that tend to increase the steepness of a slope, such as erosion or excavation of soil at the toe of the slope or placing fill on a slope. Poorly constructed road fills are particularly susceptible to shallow landsliding. Stormwater runoff that discharges as concentrated flow on a slope can contribute to instability both by causing erosion that oversteepens a slope and by increasing the pore water pressure in the slope soils. Shallow landslides that enter confined drainages can transform into debris flows that can travel for miles.

3.2.4 Geologic Structure

The geologic structure in the project vicinity is dominated by a broad zone of northwest-southeast-trending faults and folds that comprise the Olympic-Wallowa Lineament (Frizzell and others, 1984). The once near-horizontally bedded sedimentary and volcanic flow rocks have been uplifted and folded, tilting the rock in various directions and at various angles.

Previous workers have mapped several faults in and adjacent to the project area (Frizzell and others, 1984; Phillips, 1984; and Walsh, 1984). These faults generally trend northwest to north-northwest (Figure 1). The fault planes are apparently high angle, and most displacement is vertical.

The only fault structure mapped within the Alternative A project area is a northwest-trending trace inferred along the Cedar River Valley at the north end of the route (Sheet A-4, Figure 5A). The north side is shown to have moved up relative to the south side (Vine, 1962). A southwest-plunging anticline is mapped north of the Cedar River and northwest of Alternative A.

Within the Alternative C project area, the northwest-trending Hobart Fault extends across the proposed route on the south flank of South Tiger Mountain at the north end of the route (Sheet C-3, Figure 5B). The north side of the fault is shown to have moved down relative to the south side, while a branch of this fault just to the south is indicated to have moved in the opposite direction.

Along the Alternative B and D routes, a west-trending fault trace is mapped across the routes near the center of Keechelus Lake (Sheet B/D-2, Figure 5C). This fault extends west into Lost Lake and east across Keechelus Lake. The north side of the fault has moved down relative to the south side. Just to the north of this fault, faulted contacts between Huckleberry Mountain Volcanics and Tuff of Lake Keechelus are shown. The axis of an anticline is mapped across the routes west of the Snoqualmie West ski area (Sheet B/D-3, Figure 5C). The axis of an east-southeast-plunging syncline is mapped about one mile south of the routes at McClellan Butte (Sheet B/D-4, Figure 5C). A north-trending fault trace is mapped just south of the proposed routes across the South Fork Snoqualmie River near Twin Falls State Park. The northwest-trending Rattlesnake Mountain syncline and an adjacent fault lie just to the east of the Echo Lake Substation (Sheet B/D-7, Figure 5C). This fault crosses the proposed routes and parallels them to the west. The northwest-trending Raging River fault trace extends just west of the Echo Lake Substation along the Raging River Valley.

The age of faulting in the project area is uncertain; however, Gower and others (1985) found that movement on the Rattlesnake Mountain fault is not older than the Miocene-Oligocene

boundary (24 mybp). There is no published evidence that these mapped faults have recently moved, or that these faults offset Pleistocene or Holocene sediments.

3.3 Soils

The soils in the project area have characteristics typical of the western Cascades of Washington. The soil characteristic most relevant to this study is erodability. The Soil Maps (Figures 6A, 6B, and 6C) are based on soil maps published by the Natural Resource Conservation Service (NRCS), formerly the Soil Conservation Service (SCS). Table 2 lists the soil types that have been mapped in the project area. These soils formed by a variety of processes, resulting in complex soils with varying thicknesses. The general soil types based on the processes that formed them include:

- Alluvial soil (alluvium) that was deposited directly by streams and rivers. Alluvial soils are restricted to the valley bottoms in the project area.

- Glacial soil that was deposited directly by glaciers (till) and by glacial outwash streams (glaciofluvial deposits).

- Residual soils (residuum) that formed by weathering in place of the underlying bedrock, alluvium, or glacial deposits. The composition of residual soil depends on the type of underlying parent material and its weathering characteristics, i.e., whether the soil is predominantly fine-grained (silt and clay) or coarse-grained (sand and gravel). Because of active slope processes, residual soil is relatively thin in the project area.

- Colluvial soil (colluvium) has been transported downslope, generally by mass wasting (e.g., landsliding and soil creep). Colluvial soil may cover a layer of residual soil derived from the underlying parent material.

- Volcanic ash from nearby Cascade volcanoes periodically fell over the area and mixed with the other soil types.

Most of the soils in the Alternative A and C project areas are 5 feet or more in depth, reflecting the depth of underlying glacial and alluvial deposits. Thinner soils are present in Alternative B and D project areas because of resistant bedrock, steep slopes, and lack of extensive glacial deposits. The depth of soil in areas underlain by bedrock ranges from zero to more than 5 feet, but typically is between 2 and 4 feet. The soil depth can influence surface water runoff and mass wasting potential.

3.4 Regional Seismological Setting

The project site is located in a moderately active tectonic region that has been subjected to numerous earthquakes of low to moderate strength and occasional strong shocks during the brief

170-year historical record in the Pacific Northwest. The tectonics and seismicity of the region are the result of ongoing, oblique, relative northeastward subduction of the Juan de Fuca Plate beneath the North American Plate along the Cascadia Subduction Zone. The convergence of these two plates not only results in east-west compressive strain (Lisowski, 1993), but also results in dextral shear, clockwise rotation, and north-south compression of accreted crustal blocks that form the leading edge of the North American Plate (Wells and others, 1998). The subduction zone extends from Northern California to central Vancouver Island in British Columbia. Western Washington is located in the continental forearc of the Cascadia Subduction Zone. The forearc consists of accreted sedimentary and volcanic rocks (i.e., Olympic Mountains and Puget Lowlands) in front of a landward mountainous, active volcanic arc (Cascade Mountains). The project site is located at the juncture between the accreted rocks and the landward mountainous, volcanic arc.

Within the present understanding of the regional tectonic framework and historical seismicity, three seismogenic sources have been identified (Yelin and others, 1994; Rogers and others, 1997):

- A shallow crustal zone within the North American Plate.
- A deep subcrustal zone (intraslab) in the subducted Juan de Fuca Plate and Gorda Plates.
- An interplate source in the Cascadia Subduction Zone, which is the interface between the North American and Juan de Fuca Plates beneath the coast.

3.4.1 Shallow Crustal Earthquakes

Shallow crustal earthquakes within the North American Plate beneath the Puget Lowlands have historically occurred in a diffuse pattern, typically within 12 miles of the earth's surface. The largest historic event is the 1872 North Cascades earthquake, which occurred in the vicinity of Lake Chelan and had an estimated magnitude 7.0+. However, surface rupture from this large event or other historic shallow crustal earthquakes in the Puget Lowlands or Cascade Mountains have not been observed. Two fault sources with known or suspected Holocene movement (i.e., movement within the last 10,000 years) are the Seattle and Southern Whidbey Island Faults. The locations of these faults relative to the project area are shown on Figure 1. The Seattle Fault Zone is an approximately 1½- to 4-mile-wide (north-south) zone consisting of multiple east-west-trending strands that extend from near Hood Canal on the west to the Sammamish Plateau on the east (Johnson and others, 1999). The east end of the Seattle Fault Zone (as mapped by Gower and others, 1985) is approximately 6 to 8 miles north-northwest of the Echo Lake Substation. As mapped by Rogers and others (1996), the Southern Whidbey Island Fault extends southeast from near Vancouver Island beneath the south end of Whidbey

Island and terminates at the foot of the Cascades Mountains on the north side of Mount Si (Figure 1). The southeast end of the northwest-southeast-trending Southern Whidbey Island Fault is located approximately 5 miles north-northeast of the project area.

The locations of other mapped faults are shown on Figures 1 and 5A, 5B, and 5C, some of which cross the proposed alternative routes. These faults are inferred based on offsets in Tertiary rock. However, no offset or displacement of overlying Vashon glacial deposits is known. This lack of offset indicates that no movement large enough to cause ground rupture has occurred on these faults since deposition of the Vashon deposits (i.e., no ground surface rupture within the last 13,500 to 15,000 years).

3.4.2 Intraslab Earthquakes

Deep, subcrustal, intraslab earthquakes can occur in the subducted portions of the Juan de Fuca Plate beneath the North American Plate, typically at depths of 25 to 38 miles. Earthquakes within this zone are associated with tensional forces that develop in the subducted plate because of mineralogical and density changes in the plates at depth. The largest historic earthquakes to affect the project area include the magnitude (M_s) 7.1 Olympia earthquake of April 13, 1949, the magnitude (m_b) 6.5 Seattle-Tacoma earthquake of April 29, 1965, and the recent February 28, 2001, magnitude (M_W) 6.8 Nisqually earthquake. All three of these events were located in the subducted Juan de Fuca slab beneath the Puget Lowlands at depths of 32 miles and greater. Ludwin and others (1991) estimate that the maximum magnitude from this source zone would be about 7.5.

3.4.3 Interplate Cascadia Subduction Zone Earthquakes

The third seismogenic source is within the Cascadia Subduction Zone, near the line of subduction between the Juan de Fuca Plate and the North American Plate west of the Pacific Northwest coastline. The Cascadia Subduction Zone is presently generally quiet, with only scattered and diffuse seismicity. Geologic evidence suggests that coastal estuaries have experienced rapid subsidence at various times within the last 2,000 years (Atwater, 1987 and 1997) as a result of movement along the Cascadia Subduction Zone. It appears that ruptures of this zone have occurred at irregular intervals that span from about 100 to more than 1,200 years with an average recurrence interval of about 600 years. Weaver and Shedlock (1997) estimate that rupture of this zone could result in earthquakes with magnitudes on the order of 8.5 to 9. The last large earthquake is estimated to have been a magnitude 9 event about 300 years ago, based on the geologic evidence and historical Japanese tsunami records.

3.4.4 Ground Motions

The U.S. Geological Survey (USGS) has conducted regional, probabilistic, ground motion studies to estimate potential earthquake ground motions considering the proximity and activity of the various earthquake source zones (Frankel and others, 1996). This study indicates that for ground motions with a 10 percent chance of being exceeded in 50 years (about a 500-year recurrence interval), random crustal earthquakes (i.e., earthquakes occurring on unknown or unidentified faults in the crust) are the greatest contributor to the ground motion hazard. While not as great, intraslab earthquakes also comprise a significant portion of the ground motion hazard. Peak ground accelerations (PGA) on bedrock consistent with a 10 percent chance of exceedance in 50 years range from about 0.18g at the east end of the project area (near the southeast end of Keechelus Lake) to 0.24g in the center (near North Bend), to 0.29g near the west end of the project area (Kent area).

3.5 Hydrology

3.5.1 Precipitation

Precipitation patterns in the project area are under the prevailing marine influence of the Pacific Ocean, which except in the high Cascades, produces mild, wet falls and winters; relatively dry summers; and mild temperatures year-round. There is a distinct wet season between October and April, when over 75 percent of the total annual precipitation falls. Most of the precipitation in the lowlands of the project area falls as rain. At higher elevations, snowfall dominates during the winter months. Annual precipitation in the project area averages between 40 and 60 inches in the Kent area along the western extension of Alternative A, to more than 180 inches at Stampede Pass along Alternatives B and D. In general, the annual precipitation amounts increase from west to east as elevation increases.

3.5.2 Flooding

The Federal Emergency Management Agency (FEMA) National Flood Insurance Program mapping program identifies areas that have a one-percent chance of being flooded in any given year (FEMA, 1989). These areas typically are referred to as the 100-year floodplain. This mapping is usually conducted in populated areas. As a result, floodplain mapping has not been accomplished for the entire project area. FEMA has mapped the 100-year floodplain along the Cedar River from the City of Seattle's Cedar River Watershed northwest to Puget Sound. Based on this mapping, it appears that the 100-year floodplain just west of the Cedar River Watershed is initially limited to a narrow area along the active Cedar River channel. Therefore, the Alternative C route would not be impacted by Cedar River flooding. However, farther downstream the Cedar River flows into a broad valley. From here north-northwest, the

floodplain averages 1,000 to 1,500 feet in width. Only the north end of Alternative A, where it crosses the Cedar River valley, might be affected by flooding.

The floodplain of the South Fork of the Snoqualmie River in the vicinity of North Bend has also been mapped by FEMA. Here the floodplain is also generally confined to a narrow area along the active channel. Geomorphic conditions and their effect on flooding in the area mapped by FEMA appear similar to the river reach upstream of North Bend where Alternatives B and D cross the South Fork Snoqualmie River twice. As a result, flooding is unlikely to impact these crossings. The east ends of Alternatives B and D cross the Yakima River. No FEMA mapping has been conducted in this reach of the Yakima River Valley. However, the valley is generally broad and flat in this area, and several bog areas occur. These features would tend to indicate periodic flooding does occur where the B and D routes cross the Yakima River, resulting in potential impacts. Flooding in the Yakima River is controlled to a certain degree by operation of the Keechelus Lake Reservoir, which is about 4 miles upstream of the proposed river crossing.

Tributaries to the Cedar, South Fork Snoqualmie, and Yakima Rivers are in moderately incised channels. Therefore, these streams do not have significant floodplains, and flooding generally would not overtop the incised channels. Towers and roads constructed in the vicinity of these stream channels should not affect or be affected by flooding.

3.5.3 Federal Clean Water Act

The Federal Clean Water Act requires that states protect the water quality of their rivers, streams, lakes, and estuaries. To accomplish this, Section 303(d) of the Clean Water Act requires that each state develop a list of water bodies that do not meet the standards. The 303(d) list is a means of identifying water quality problems. Once a stream is placed on the list, the Clean Water Act requires that the state develop a plan to reduce pollution. The states must submit the "water quality limited" list to the U.S. Environmental Protection Agency (EPA) every two years. In Washington State, the Department of Ecology (Ecology) is responsible for developing the standards that protect beneficial uses of water, such as drinking water, cold water for fish, industrial water supply, and recreational and agricultural uses. Ecology is also responsible for compiling the 303(d) list and submitting it to EPA for approval. The most recent EPA-approved list for Washington is for 1998. Parameters that Ecology typically monitors include bacteria, pH, dissolved oxygen, temperature, total dissolved gas, certain toxic and carcinogenic compounds, habitat and flow modification, fecal coliform, turbidity, and aquatic weeds or algae that affect aquatic life.

Water bodies that the proposed alternative routes cross which are on the Washington State 303(d) water quality-limited list are presented in Table 3. The Cedar River is listed for

fecal coliform, as measured at points 2 miles and 10 miles downstream from Alternative A and Alternative C river crossings, respectively. In our opinion, the proposed action should not increase fecal coliform, which primarily comes from livestock and failing septic systems. For Alternatives B and D, the upper Yakima River is listed as temperature-impaired at a point 7 miles downstream from where the Alternatives B and D would cross the river. In our opinion, the proposed action would not cause a measurable increase in the Yakima River water temperatures. Two segments of the South Fork Snoqualmie River are listed as pH-impaired at a point 1,000 feet upstream from the western crossing and at a point 2,000 feet downstream from the eastern crossing of Alternatives B and D. Reduced pH levels are usually a result of acid rain (not considered significant in the Puget Lowlands) and industrial discharges or drainage from acidic rock, such as mine tailings. Levels of pH could be raised because of increased temperatures and/or high nutrient levels that could cause increased productivity (University of Washington and The Nature Mapping Program in Washington, 1996). In our opinion, Alternatives B and D would not impact the existing pH levels in the South Fork Snoqualmie River.

3.5.4 Groundwater

Groundwater resources vary with the alternative route locations. No designated or EPA-proposed sole-source aquifers exist in the project area; however, numerous domestic wells and a wellhead protection program are located within the project area. The principal groundwater aquifers are in glacial outwash deposits and the underlying bedrock. These aquifers are locally developed for domestic and some farm consumption. Because Alternatives A and C traverse areas underlain by extensive deposits of glacial sediments, these areas are important local and regional aquifers. Alternatives B and D predominantly traverse moderate to steep slopes underlain with slowly permeable bedrock. However, potential aquifers in alluvium, outwash, and ice contact drift deposits exist between North Bend and Twin Falls State Park along the Snoqualmie River valley.

Alternative A traverses the Covington Plain, where several aquifers have been mapped (Woodward and others, 1995). These aquifers include 1) near-surface Holocene alluvium present along rivers and streams, 2) advance outwash deposits of the Vashon Stade, and 3) deeper, glacial drift outwash sediments deposited during glacial periods prior to the Vashon Stade. These aquifers are recharged by precipitation and stream infiltration. Numerous public supply wells in advance outwash and alluvial deposits occur along most of Alternative A, and several wells in the older outwash sediments are located near Covington (Woodward and others, 1995). Numerous domestic wells probably obtain groundwater from the shallow aquifers in the project vicinity. The southeastern boundary of the Cedar River Valley sole-source aquifer is located about 2 miles northwest across Lake Youngs from Alternative A. Alternative A extends

through an area designated for the City of Kent's wellhead protection program (City of Kent, 1996). This program is intended to protect the groundwater quality for the Clark Springs, Kent Springs, and Armstrong Springs source areas (Sheets A-1 and A-2, Figure 5A). These source areas represent approximately 95 percent of the City of Kent's water supply.

Alternative C Options C1 and C2 also cross-glacial outwash deposits and shallow aquifers similar to Alternative A; however, fewer alluvial aquifers exist. There are also numerous domestic wells in the project vicinity of Alternative C. Options C1 and C2 also extend across the Kent wellhead protection program area (Sheet C-1, Figure 5B).

The eastern end of Alternatives B and D extends across the upper Yakima River Basin. Groundwater in this portion of the project area occurs in shallow aquifers in Holocene alluvium and Pleistocene glacial outwash deposits (Pearson, 1985). Recharge is from precipitation, a substantial portion of which is snow, and stream flow. No known wells exist in the area, although scattered vacation homes in the area probably derive their domestic water from shallow wells. Between the Yakima River and the eastern crossing of the South Fork Snoqualmie River, the route traverses bedrock slopes. Porosity and permeability of the rocks is low, and groundwater is generally confined to joints and fractures. Although locally the rock is capable of yielding water to wells, it is not considered an important aquifer. From the eastern crossing of the South Fork Snoqualmie River west to Rattlesnake Mountain, the route crosses alluvium and glacial outwash deposits. Numerous domestic supply wells, as well as some public and institutional wells, occur in this area. In addition, springs also supply groundwater for human use (Turney and others, 1995). West along Rattlesnake Mountain to the Echo Lake Substation, no known water supply wells exist.

3.6 Wind

Wind could affect the stability of transmission lines and towers. Wind could also affect forests adjacent to the cleared ROW. High winds could cause windthrow, which would affect timber resources and pose a potential hazard to transmission lines. A study of the distribution of extreme wind speeds in the BPA service area was conducted in 1980 (Bonneville Power Administration, 1980). Extreme wind speeds in the project area vary from 45 to 50 miles per hour (mph) for a 10-year recurrence interval event to 60 to 70 mph for a 100-year recurrence interval event.

In addition to high winds, windthrow is affected by the soil characteristics. Trees growing on soils that preclude development of a deep and strong root system, such as saturated soil or shallow soils over massive bedrock, would have greater potential for windthrow.

4.0 ENVIRONMENTAL CONSEQUENCES

This chapter discusses the environmental consequences of the additional alternatives on the resources described in the previous chapter. This chapter is divided into three general sections: Geology and Soils, Seismology, and Hydrology and Climate. Each of these sections first defines impact levels for each resource, generally using a scale of high impact, moderate impact, low impact, and no impact. Next is a discussion of general impacts that are common to all of the proposed alternatives and a general background regarding impacts to each resource. Following the general discussion of impacts, the impacts that could occur along each alternative are described in greater detail, with a description of mitigation measures that likely would be required. Finally, cumulative impacts and unavoidable effects, and irreversible or irretrievable commitments of resources are discussed.

4.1 Geology and Soils

4.1.1 Geology and Soil Impact Levels

Direct impacts from the project would be caused by new access road construction, improvements to existing access roads, ROW clearing, and site preparation for construction of structures. During construction, these activities would disturb the soil surface, which could lead to an increase in soil erosion, runoff, and sedimentation of nearby water bodies. Long-term maintenance, and especially ROW maintenance, could impair soil productivity and remove land from timber and farm production or other uses.

The following sections describe potential environmental consequences from construction, operation, and maintenance of the proposed BPA Kangley-Echo Lake Transmission Line Project in hazard areas identified along each of the proposed alternatives. Of the identified hazards, landslides and soil erosion resulting from construction or operation and maintenance of the project would be most likely to impact environmental resources (fish and water). The extent and level of the various hazards for each alternative are summarized in Table 4.

4.1.1.1 Landslide Impact Levels

Landslide impacts could occur if construction or maintenance of the proposed project triggers a landslide, or if a landslide is triggered by natural factors, such as a large storm, combined with factors related to the transmission line.

Deep-seated landsliding has the greatest potential to impact a transmission alignment; however, the potential for a deep-seated landslide is relatively small. Three mapped, deep-seated landslides were identified along Alternative B and D routes (Figure 5C). These landslide features are apparently ancient and do not appear to be active. More recent, deep-

seated landsliding was observed along Alternative A on the north valley slope of the Cedar River. Portions of the route alternatives were assigned a high, moderate, low, or no deep-seated landslide hazard category as follows:

- **High, deep-seated landslide hazard** was assigned to areas with active deep-seated landsliding, or where numerous ancient deep-seated landslides were identified adjacent to the alignment. No high, deep-seated landslide hazard areas were identified in the project area.

- **Moderate, deep-seated landslide hazard** was assigned to areas where isolated ancient or more recent deep-seated landslides were identified near the alignment. The ancient landslides on Alternatives B and D (Sheets B/D-4 and B/D-5, Figure 6C) and the north valley slope on Alternative A (Sheet A-4, Figure 6A) are the only moderate deep-seated landslide hazards in the project area.

- **Low, deep-seated landslide hazard** was assigned to areas that had similar characteristics as the moderate hazard landslide areas (i.e., slope, dip of bedded rocks, geologic contacts, etc.), but no landslides were identified nearby. Several areas of low deep-seated landslide hazard were identified along Alternatives B and D (Sheets B/D-2 and B/D-4, Figure 6C), and one area along Alternative C (Sheet C-3, Figure 6B).

- **No deep-seated landslide hazard** was assigned to areas where deep-seated landslides were not identified and the geologic conditions do not appear conducive to deep-seated landsliding. Most of the project area falls within this category.

Shallow landslides were observed along Alternatives B and D, and along Alternative A on the south side of the Cedar River Valley. Shallow landslide hazards were assigned to a high, moderate, low, or no shallow landslide hazard category as follows:

- **High, shallow landslide hazard** was assigned to those sections of the alternative routes on slopes that exceed 65 percent and that are in the vicinity of mapped or observed areas of concentrated, past shallow landslide movement. No high shallow landslide hazard areas were identified in the project area.

- **Moderate, shallow landslide hazard** was assigned to those sections of the route alternatives on slopes that exceed 65 percent and that are in the vicinity of isolated shallow landslides. Moderate shallow landslide hazard areas were identified along Alternatives A (Sheets A-4, Figure 6A); B; and D (Sheets B/D-2, -3, -5, and -7, Figure 6C) in the project area.

- **Low, shallow landslide hazard** was assigned to those sections of the route alternatives where no existing shallow landslides were identified, but where converging slopes exceed 65 percent or where slopes steeper than 40 percent are present in confined drainages. Low shallow landslide hazard areas were identified along Alternatives B and D (Sheets B/D-2, -3, and -5, Figure 6C) in the project area.

- **No shallow landslide hazard** was assigned to all remaining sections of the alternative routes not identified as high, moderate, or low.

4.1.1.2 Soil Erosion Impact Levels

Potential soil-related impacts in the project area were evaluated and mapped using the following soil survey reports: Soil Survey of King County Area, Washington (U.S. Department of Agriculture [USDA] SCS, 1973), Soil Survey of Snoqualmie Pass Area, Parts of King and Pierce Counties, Washington (USDA NRCS, 1992), and a draft soils map of Kittitas County provided in electronic digital form by the USDA NRCS (2002). The soil surveys include soil maps and descriptions of soil composition and structure. They also describe the soil engineering characteristics, such as Unified Soil Classification (USC), grain size, plasticity, erosion potential, and organic content.

Surface erosion of soil could occur as a result of wind and downslope movement, such as creep or ravel; however, soil erosion is most often associated with flowing water. Soils that are most susceptible to surface erosion by water have no or minor cohesion (as a result of a low percentage of clay minerals) or have a low percentage of gravel-size particles (which would otherwise armor the soil surface). Other factors that could lead to high rates of soil erosion are disturbance, absence of vegetative cover, concentrated water, and steep slopes.

The referenced soil reports define soil erosion hazards of slight, moderate, severe, and very severe, which indicate the risk of loss of soil in *well-managed woodland* (italics added for emphasis). These ratings are summarized below. The soil hazard ratings for soils that occur in the project area are listed in Table 2. Those soils for which a range of hazards was provided (i.e., slight to severe), were assigned the greatest hazard level. Erosion hazard ratings have not yet been developed for the Kittitas County soil units. For those Kittitas County soil units that were not the same soil type as the adjacent King County soils (for which erosion hazards have been developed), erosion hazards were developed by Shannon & Wilson based on the soil description, the erosion factor “k,” and the slope.

- **High erosion impact** was assigned to those sections of the alternatives that cross soil units identified as very severe or severe erosion hazards. These soils could require intensive management or special equipment and methods to prevent excessive loss of soil.

- **Moderate erosion impact** was assigned to those sections of the alternatives that cross soil units identified as moderate erosion hazards. These soils could require erosion-control measures during logging and road construction to prevent excessive loss of soil.

- **Low erosion impact** was assigned to those sections of the alternatives that cross soils identified as slight erosion hazards. Loss from these soils during construction is expected to be minor.

- **No erosion impact** would occur only in soils that are not disturbed during the construction and maintenance of the proposed project.

4.1.1.3 Excavation Difficulty Impact Levels

The degree of excavation difficulty for road and transmission line tower construction is based on expected depths of soil and bedrock, and the expected strengths of bedrock. An average excavation depth of 15 feet was assumed for tower footings. Similar excavation depths could be assumed for road construction (i.e., cut slopes). For assigning excavation difficulty, rock is defined as material that requires blasting or use of hydraulic breakers for excavation. Material that could be excavated entirely with conventional earth-moving equipment, including rippers, is considered to be soil.

Although excavation difficulty would not represent a hazard to the environment, the type of excavation required would affect the construction methods used, which in turn could affect the environment. Excavation difficulty ratings of high, moderate, and low were assigned based on the expected geologic unit and the following criteria:

- **High excavation difficulty** was assigned to areas that are underlain by bedrock. Much of the near-surface rock could probably be ripped and/or excavated by machine. However, deeper excavations or excavations in harder or more massive bedrock could require blasting and/or hydraulic breaking.

- **Moderate excavation difficulty** was assigned to areas that are underlain by till and other glacially overridden soils (advance outwash and some ice-contact deposits). In general, these soil types could be excavated with conventional excavation equipment. However, excavation could require large earthwork equipment and rates may be slow. Local boulder deposits and unanticipated bedrock outcrops could require hydraulic breaking and/or blasting to complete excavations.

- **Low excavation difficulty** was assigned to the remaining sections of the alternatives that were not assigned a moderate or high hazard rate. While the potential for rock excavation is small, large boulders, rockslide blocks, or other unidentified, hard or massive rock could be encountered.

4.1.1.4 Settlement Impact Levels

Settlement occurs when soft or loose soil consolidates or densifies under loads. Loads could include fill placed for a road, or foundations of a transmission line tower or other

structure. Wet, fine-grained soil or soil that contains abundant organic material usually would have the greatest potential for settlement. These types of soil typically occur in alluvial environments, such as river valleys, bays, and estuaries. Poorly compacted fills and fills with organic material are also susceptible to settlement. Collapse of underground coalmine workings could cause surface subsidence.

Settlement impact levels were assigned as follows:

- **High settlement impact** was assigned to areas where structures might be built on swampy areas, recent alluvium, and old underground mine workings.
- **No settlement impact** was assigned to all other areas.

4.1.2 Geology and Soil General Impacts

4.1.2.1 Landslides

Poor practices in design and construction of access roads and clearing of wide swaths of forest on slopes that are susceptible to landsliding could cause an increase in the rate and/or size of landslides. The factors that affect landsliding, other than natural factors, include poor road construction practices, improperly placed fills, poorly designed cut slopes, poor drainage and, to a lesser degree, logging. Fills placed for roads on slopes steeper than about 60 percent, poorly compacted fills, poor-quality fill material, and poorly prepared subgrades create conditions that are particularly susceptible to landsliding. A steep cut made in poorly drained soil or in loose, granular soil could initiate a landslide. Landslides are commonly triggered by poor road drainage resulting from undersized culverts, culverts spaced too far apart, blocked culverts, or from poorly maintained roads and ditches. Logging dense, coniferous forests on steep slopes could increase the potential for landslides to occur as a result of reduced soil strength. Reduced soil strengths could occur from increased soil water that results from the loss of interception and evapotranspiration of precipitation, and the loss of root strength.

Most shallow landslides would probably not significantly impact the transmission line towers. However, they could increase the rate at which sediment and debris is delivered to streams, reduce the amount of land for timber production, and cause temporary access road closures. Shallow landslides could liquefy after moving a short distance and become debris flows. Debris flows typically move rapidly down the slope, eroding and accumulating additional material until they reach a low-gradient slope or the valley bottom.

Deep-seated landslides could deposit large quantities of debris into streams, which could degrade fish habitat and water quality. Because of their potential size, deep-seated landslides could have a significant impact on existing public and private roads and properties that

are downslope of the landslide. Movement of a deep-seated landslide across the transmission line ROW could displace or topple the towers and potentially snap or short the conductors. Small, chronic movements of the landslide mass would require frequent maintenance. Deep-seated landslides could be initiated by poorly designed road cuts, excessive fills, or discharge of concentrated drainage.

4.1.2.2 Soil Erosion

Construction of roads, ROW clearing, and site preparation for transmission line tower footings would expose and disturb soil, increasing the potential for surface erosion of soil from its pre-disturbed condition. The eroded soil could enter streams and impact fish habitat and water quality. Sources for increased sediment include unprotected cut-and-fill slopes, road surfaces, and spoil piles. Most impacts would likely be short-term. Once the cuts and fills adjacent to roads and the areas cleared for tower construction revegetate and the road surfaces are graveled or naturally become armored, erosion rates should reduce substantially and not significantly affect nearby streams and other water bodies. Long-term impacts should be small, unless efforts to revegetate and control erosion and runoff are unsuccessful and/or not maintained.

4.1.2.3 Excavation Difficulty

Based on expected soil depths and rock strengths, excavation for most of the roads and footings could be accomplished with conventional earthwork equipment. However, some sections of the access roads could require blasting to remove massive and/or hard bedrock. At locations where bedrock is close to the surface and is hard and sound, tower foundations could require drilled rock anchors. Blasting of the bedrock could temporarily disturb wildlife and residents living nearby. Excavations in soil could generate spoils and create slopes that typically are more susceptible to erosion than bedrock spoils and slopes.

4.1.2.4 Settlement Hazard

Transmission line towers founded improperly on settlement-prone soil could settle differentially to the point that they would not function as designed. Settlement induced by constructing the transmission line towers could have indirect environmental impacts because of additional maintenance work and possible construction of new foundations. Abandoned underground coal mine workings exist in portions of the project area. Mine collapse could cause surface subsidence, which could impact the transmission line towers.

4.1.3 Alternative A Geology and Soils

4.1.3.1 Impacts

Alternative A would parallel the existing Covington-Columbia No. 3 230-kV transmission line to the Covington substation in a vacant ROW that is already cleared. From the substation, the existing Covington-Maple Valley line would be rebuilt to a double-circuit, 500-kV line. As a result of this proposed alternative following the existing cleared ROW, clearing of undisturbed ground would not be required with the exception of the area around the Covington Substation. In addition, most of the road system is already in place. Only short spur roads to the actual tower sites along the Covington-Columbia line from the existing roads would be needed. Small intermittent streams might be crossed by these spur roads, and culverts could be required for passage of stormwater.

Landslides

One area of moderate deep-seated landslide hazard was identified along an approximately 500-foot-long portion of Alternative A (Table 4 and Sheet A-4, Figure 6A). This area includes and is adjacent to a relatively recent landslide on the valley slope north of the Cedar River. No high or low, deep-seated landslide hazard areas were identified along Alternative A.

High or low, shallow landslide hazard areas were not identified along Alternative A. A moderate shallow landslide hazard area (Table 4 and Sheet A-4, Figure 6A), extending for about 1,300 feet along the route, was identified on the valley slope south of the Cedar River.

Road construction across the deep-seated landslide hazard area could activate a landslide. Poor design and road construction practices, excessive road drainage, or poor maintenance of roads in the areas of shallow landslide hazard could initiate a landslide that could deliver sediment to fish-bearing waters. A road system already exists along most of Alternative A so that only short spur roads should be required, and towers would not be placed on the valley slopes above the Cedar River. Therefore, the potential for project-related, road or tower construction related landslides would be small. Upgrading of the existing roads (grading, drainage measures) could reduce the overall project potential for landslide initiation.

Because Alternative A traverses existing cleared ROWs, no substantial clearing would be required except near the Covington Substation. Minor clearing might be required for construction of short access roads. Landslides could be triggered in the areas identified as shallow landslide hazard because of hydrologic changes caused by clearing. However, only one area of moderate shallow landslide hazard was identified along Alternative A. Because this area

would not require additional clearing, we conclude the possibility of triggering shallow landslides is remote.

Soil Erosion

The total length of the Alternative A route is approximately 20 miles. Of this, about 2.2 miles (11 percent) crosses soil designated as a severe erosion hazard, 13.5 miles (68 percent) crosses soil designated as a moderate erosion hazard, and the remaining 4.3 miles (21 percent) of the route crosses soil designated as a slight erosion hazard (Table 4 and Figure 6A).

Poor design and construction and/or poor maintenance activities on severe and moderate hazard soil erosion areas could increase soil erosion and delivery of sediment to fish-bearing waters. In most cases, no roads or only short, new spur roads from the existing roads to the actual tower sites would be needed. In addition, the need for construction of additional culverts and bridges, and the resulting potential impacts to water bodies, would be significantly reduced compared with the number of similar drainage structures required for a new road system. Culverts could be required where the short spur roads cross small, intermittent streams.

The increased amount of surface water runoff resulting from the lengthened road prism could cause an increase in peak flows. Increased surface runoff and peak flows could cause additional erosion at road cuts and fills, along drainage ditches, below culvert outfalls, and in stream channels. Because little road construction will occur, the anticipated increase is expected to be small relative to existing conditions.

Excavation Difficulty

We did not observe rock outcrops along the Alternative A route, and soil units that are indicative of shallow bedrock were not mapped along this alternative (Figure 6A). Puget Group Formation bedrock is mapped in several locations at the east end of the alternative; however, these rocks are generally soft and weathered near the surface (Figure 5A). Therefore, we do not anticipate that shallow, hard bedrock would be present that could cause difficult excavation conditions.

Extensive boulder and gravel recessional outwash deposits are mapped along this route. In addition, isolated glacial erratic boulders could be present in glacial till deposits, i.e., at almost all locations along the proposed alignment. Large boulders might require blasting to excavate for tower foundations because rock anchors placed in large boulders generally would not form a suitable foundation.

Typically, tower foundations are placed to the same depth, whether in soft rock or soil, to provide sufficient resistance to uplift. Therefore, the amount of spoils generated should be similar for soft rock or soil excavation. However, the amount of material produced that is erodible by surface processes should be less for rock excavation than for soil excavation. Unless adequate mitigation measures are implemented, erosion of the spoils could deliver sediment to nearby water bodies.

Hard rock excavation could require the use of blasting and/or hydraulic breakers. These methods would generate more noise and dust than excavation equipment only.

Settlement Hazard

Alternative A crosses two mapped bog deposits for a total distance of 1,300 feet (Table 4 and Qb, Figure 5A). Other bog deposits are mapped in the vicinity. Towers located in the bog deposits could settle unless properly supported. Also, abandoned underground coal mine workings exist near the proposed route. Portions of these workings have collapsed in the past and have caused surface subsidence. Collapse of coalmine workings beneath a transmission tower could cause tower displacement.

4.1.3.2 Mitigation

Where practical, hazard avoidance is the most effective method of mitigating impacts from or to the project facilities. During preliminary and final route selection (including tower and road locations), avoidance would be the primary means of mitigation. For those areas where potential natural hazards are present and unavoidable, measures to mitigate impacts that could result from the construction, operation and maintenance of the project could be implemented. Site-specific mitigation measures would be developed following selection of a specific route.

Roads

Most landslide and soil erosion impacts probably would be the result of road construction and use. Therefore, the most direct way to reduce these impacts would be to reduce the amount of new road construction. Access roads would be required to construct and maintain each transmission line tower.

Once a specific route is selected, the proposed access road routes should be evaluated in the field to identify site-specific hazards. Engineering analyses should be conducted and road stabilization measures designed and constructed where required. An Erosion and Sediment Control Plan (ESCP) that incorporates Best Management Practices would be

developed and implemented for specific areas, such as road crossings at streams, to reduce delivery of sediment to sensitive resources. To reduce the potential for road failures, roads could be located along ridge tops wherever feasible. Seasonal restrictions could be placed on road construction operations to reduce the potential for erosive events and impacts to resources.

Erosion of fine sediment from road surfaces could contribute sediment to a drainage system. To reduce surface erosion, those roads that would be actively used could be surfaced with sound, crushed rock and maintained on a regular basis. Maintenance could include grading, ditch and culvert cleaning, cut-slope revegetation, and repair of failure sites. Roads that would not be used following transmission line construction could be restored to approximately preexisting conditions or stabilized with vegetation and drainage measures (e.g., water bars, culvert removal, and sidecast fill removal). Roads could also be gated to prevent unauthorized use.

Right-of-Way Clearing

ROW clearing on Alternative A would be limited to a relatively small area near the Covington Substation and possibly for some access roads. Currently, low ground cover consisting of shrubs and grasses grows along the route. Over the years, this vegetation would grow to a taller, denser condition. Consequently, the benefits of vegetation, including root strength, soil cover, interception, and evapotranspiration of precipitation, would remain. Under local regulations, wetlands and streams are required to have protective buffers. Wetlands, streams, and associated buffers would be left undisturbed where practical.

Other Mitigation Measures

- Properly space and size the culverts to reduce the chance of road failure. Use cross-drains, water bars, rolling dips, and armoring of ditches, drain inlets and outlets to drain water from the road surface in a stabilized manner.

- Improve all existing culverts and stream crossings that pose a risk to riparian, wetland, or aquatic habitat and fisheries to accommodate a 100-year flood and associated bedload and debris.

- Coordinate all culvert installations with the appropriate federal, state, and local agencies.

- Preserve vegetation where possible and stabilize disturbed portions of the site. Implement stabilization measures as soon as practicable where construction activities have temporarily or permanently ceased.

- Promptly seed disturbed sites with an approved herbaceous seed mixture suited to the site.

- Use vegetative buffers and sediment barriers to prevent sediment from moving off site and into water bodies.

- Design and construct fords and bridges to reduce bank erosion. Identify specific locations and measures when road and line designs are finalized.

- Schedule construction and maintenance operations during periods of low precipitation and runoff potential to reduce the risk of erosion, sedimentation, and soil compaction.

- Design facilities to meet regional seismic criteria.

- Use full-bench road construction and end hauling of excess material on slopes exceeding 60 percent, if needed to stabilize road prisms. Prior to construction, locate suitable waste areas for depositing and stabilizing excess material.

- Construct access roads consistent with the standards and guidelines of the Washington State Department of Natural Resources and other applicable guidelines.

- Avoid riparian areas, drainage ways, and other water bodies. Where these areas cannot be avoided, apply sediment reduction practices to prevent degradation of riparian or stream quality. Consider using riparian plantings where needed to restore streamside vegetation and increase stream bank stability.

- Restrict road construction to the minimum needed. Restore nonessential existing roads and temporary construction access roads to approximately pre-existing conditions.

- Avoid discharge of solid materials, including building materials, into waters of the United States unless authorized by a Section 404 permit of the Clean Water Act. Reduce off-site tracking of sediment and dust generation. Leave vegetative buffers along stream courses to reduce erosion and bank instability.

- Prepare a Stormwater Pollution Prevention Plan (SWPPP), as required under the National Pollutant Discharge Elimination System General Permit.

- Design the project to comply with local regulations and state and federal water quality programs to prevent degradation of aquifer quality and to avoid jeopardizing their usability as a drinking water source.

4.1.3.3 Cumulative Impacts

Most of the long-term land use impacts of the new transmission line would be in addition to similar impacts from existing transmission and distribution lines in the project

vicinity, and from other types of development and land use. Alternative A extends across substantial areas of suburban residential and commercial development, primarily in the Kent and Maple Valley areas. Existing and new residential and commercial development in the project vicinity would cause additional impacts. Additional impacts could also occur from improvement or construction of new streets and highways, such as the ongoing Highway 18 expansion. Impacts could also result from improvements to the Burlington Northern and Santa Fe Railroad that extends from Kent to Georgetown across the southern portion of the route.

The most likely impacts would be increased soil erosion from construction sites or as a result of increased surface water runoff from less pervious surfaces, such as rooftops and parking lots. Poorly planned additional development could trigger landslides by excavating and undermining slope toes, placing additional loads at slope tops, or by discharging excessive water onto steep slopes.

4.1.3.4 Unavoidable Effects, and Irreversible or Irretrievable Commitments of Resources

Some road construction, with its attendant short- and long-term impacts discussed above, would be unavoidable to complete the proposed project. However, as discussed in Section 4.1.3.3, improvements to the existing road system could result in reduced sediment delivery levels below current levels. If the project is to be abandoned, the disturbed ground could be restored and, over a period of years, revegetated to preexisting conditions. Resources, such as fuel oil, lubricants, and metals, would be consumed during construction and maintenance of the project. Aggregate materials would be used in road and tower foundation construction, and for road surfacing maintenance. These materials would require mining and transportation.

4.1.4 Alternative B Geology and Soils

4.1.4.1 Impacts

Alternative B would rebuild approximately 38 miles of BPA's existing Rocky Reach-Maple Valley, 345-kV transmission line to a 500-kV, double-circuit line. The new line would be installed on 175-foot-tall towers. The line would begin just east of Stampede Pass and extend west along the Interstate 90 corridor to the Echo Lake Substation, crossing Interstate 90 twice. This route would be on existing ROW with access roads already in place. A majority of the ROW is already cleared, however, approximately 20 feet on the north side of the existing ROW would require clearing.

Landslides

Sections of moderate (8,000 feet or 5 percent of total length) and low (12,000 feet or 6.4 percent of total length) deep-seated landslide hazard areas were identified along the Alternative B route (Figure 6C and Table 4). Shallow landslide hazard areas were identified, with about 9,500 feet (5 percent of total length) identified as moderate hazard and about 12,200 feet (6.5 percent of total length) identified as low hazard (Figure 6C and Table 4). No high hazard, shallow landslide areas were identified along this alternative.

Impacts to slope stability from Alternative B construction, such as reactivating portions of deep-seated landslides and hydrologic change, would be similar to those discussed for Alternative A (Section 4.1.3.1). Because this alternative occurs on existing, mostly cleared ROW, access roads to the tower sites currently exist in most locations. Access roads have been washed out by debris flows in at least four locations between Ollalie Creek near Snoqualmie West ski area to Alice Creek near Tinkham Campground (Sheets B/D-3 and -4, Figure 5C). These washouts required development of alternative access routes or suitable repairs. Existing condition of the access roads in this section of the route is generally poor. Most of the access roads along this route would require relatively minor clearing and road building. However, access roads on the portion of the route between Ollalie and Alice Creeks would require some reconstruction and upgrading.

Soil Erosion

About 1 mile (2 percent) of Alternative B crosses soil designated as a severe erosion hazard and 10.5 miles (28 percent) crosses soil designated as a moderate erosion hazard. The remaining 26.5 miles (70 percent) crosses soil designated as a slight erosion hazard (Table 4 and Figure 6C).

Because numerous streams cross the route, which is on steeply- to moderately-sloped ground, delivery of construction-derived sediment could be significant if appropriate BMPs are not implemented. Impacts from clearing the approximately 92 acres of ROW over a 38-mile distance are considered to be low to moderate. Most of the access roads in the ROW would require only slight modification. However, the segment requiring more extensive work is in steep terrain with significant rainfall; therefore, the amount of sediment generated could be moderate.

During construction, temporary amounts of sediment delivery to streams could rise above current background levels. These levels could be moderate because of reconstruction of existing roads across many stream crossings. The tower sites would be generally away from streams and BMPs would be employed, which would lessen the overall impacts. Following

construction and stabilization of the disturbed ground, sediment delivery levels would reduce to pre-construction background levels. Improvements made to the existing road system could reduce levels of sediment delivery below the current levels.

Excavation Difficulty

Almost half of the Alternative B route (45 percent of the total length [Table 4]) traverses bedrock mantled with generally shallow soils. This ground is rated as high excavation difficulty. Another approximately one-quarter of the route (23 percent of total length [Table 4]) crosses glacially overridden soils, which are rated as moderate excavation difficulty. Therefore, excavation difficulty and its attendant impacts (blasting, noise, dust) would be generally high.

Settlement Hazard

No settlement hazards were identified along Alternate B.

4.1.4.2 Mitigation

Refer to measures described for Alternative A, Section 4.1.3.2.

4.1.4.3 Cumulative Impacts

Activities that could cause cumulative impacts in the vicinity of Alternative B include use and maintenance of existing roads, construction and use of new roads, sand and gravel mining, rock quarries, and timber harvesting. Increased erosion because of exposed soil and/or increased surface water runoff would be the predominant cumulative impact from these activities. Landslides could occur from existing and new roads, and on slopes from which timber was harvested. Improvement and proposed expansion of Interstate 90 could also cause cumulative impacts.

4.1.4.4 Unavoidable Effects, and Irreversible or Irretrievable Commitments of Resources

Refer to the effects and commitments under Alternative A, Section 4.1.3.4.

4.1.5 Alternative C Geology and Soils

4.1.5.1 Impacts

Option C 1 would originate at the Raver Substation, then proceed west approximately 2.5 miles in a vacant, cleared ROW along the existing Raver-Tacoma double-circuit 500-kV line. At this point, the segment would turn north for about 7.5 miles to tie into an unused circuit of the Echo Lake-Maple Valley double circuit 500-kV line. This segment would

be on new ROW. Option C 2 would begin at the tap point along the Schultz-Raver No. 2 line near Kangley. From the tap point, it would proceed west along vacant transmission line ROW immediately north of the Covington-Columbia No. 3 230-kV transmission line for approximately 4.5 miles. At this point, the C 2 segment would turn north for approximately 6 miles along the same route described for Option C 1.

Some clearing and construction of short spur roads from existing BPA roads would be required along the first 2.5 miles of the Option C1 alignment or along the first 4.5 miles of the Option C2 route. The actual route along the remaining north-south oriented 7.5 miles (Option C1) or 6 miles (Option C2), much of which would pass through rural residential areas, has not been determined. This portion could require substantial clearing of vegetation and structures, and construction of access roads along the proposed ROW.

Landslides

Most of the Alternative C route is along gently sloping ground. No high or moderate hazard, deep-seated landslide areas were identified along Alternative C, Option C1 or C2. About 1,700 feet at the north end of this route (approximately 3 percent of the total length) on the southern ridge of South Tiger Mountain has been identified as an area of low, deep-seated landslide hazard, with no deep-seated landslide hazard along the remainder of the route (Table 4 and Figure 6B).

No high or moderate shallow landslide hazard areas were identified along Alternative C, Option C1 or C2. The same route portion identified as low, deep-seated landslide hazard was also identified as a low, shallow landslide hazard (Table 4 and Figure 6B).

Assuming a 150-foot-wide transmission line corridor along the northern 7.5-mile section (Option 1) or the 6-mile section (Option 2) that would require clearing, approximately 140 acres (Option C1) or 110 acres (Option C2) would be impacted. The type of impacts to slope stability from Alternative C land clearing and road construction would be similar to those of Alternative A (Section 4.1.3.1). The greatest potential landslide impacts would occur on the steep slopes listed as low-hazard, deep-seated, and shallow landslide hazards on the west-facing slope of the south ridge of South Tiger Mountain. No significant streams are present in these steep slopes area. Issaquah Creek and its tributaries, Holder and Carey Creeks, are more than 1,000 feet from the toe of these steep slopes. Therefore, it is unlikely that sediment from a landslide could enter Issaquah Creek. However, residences are located at the slope toe on the west side of the ridge.

Soil Erosion

About 1 mile (8 percent) of Alternative C, Option C1 crosses soil designated as a severe erosion hazard, and 3 miles (32 percent) crosses soil designated as a moderate erosion hazard. The remaining 6.2 miles (60 percent) of the route crosses soil designated as a slight erosion hazard (Table 4 and Figure 6B). The Option C2 route crosses about 0.5 miles (5 percent) of soil designated as a severe erosion hazard, about 3.5 miles (33 percent) of soil designated as a moderate erosion hazard, with the remaining 6.5 miles (62 percent) of the route designated as a slight erosion hazard.

Impacts from project construction and operation on soil erosion and sediment delivery would be similar to those impacts described for Alternative A (Section 4.1.3.1).

Excavation Difficulty

Bedrock, considered to have a high excavation difficulty, is mapped at the north and south ends of Alternative C, Options C1 and C2. Bedrock along Option C1 accounts for about 17 percent of the total length (Table 4). Bedrock along Option C2 accounts for about 16 percent of the total length. Because the bedrock probably consists of generally soft, weathered, sedimentary rock, it is anticipated that most excavations could be conducted with conventional equipment without the need for blasting. Glacially overridden soils, considered to have a moderate excavation difficulty, occur for about 37 and 31 percent of the total alternative Option C1 and C2 lengths, respectively.

Settlement Hazard

No soft soil settlement hazards were identified along the Alternative C alignment. Abandoned underground coalmine workings are present near the route, including the Landsburg Mine site (Sheet C-2, Figure 5B). Portions of these workings have collapsed in the past and caused surface subsidence. Collapse of coalmine workings beneath a transmission tower could cause tower displacement.

4.1.5.2 Mitigation

In general, erosion and sedimentation mitigation required for this alternative would be similar to Alternative A (Section 4.1.3.2). The north end of the route crosses into the Issaquah Creek drainage and the Tiger Mountain State Forest. The Issaquah Creek Basin and Nonpoint Action Plan (King County, 1994) discusses several measures regarding timber harvesting, including education and monitoring, to reduce pollution and improve water quality.

4.1.5.3 Cumulative Impacts

Most of the long-term land use impacts of the new transmission line would be in addition to similar impacts from existing transmission and distribution lines in the project vicinity, as well as from other types of development and land use. Both options of Alternative C extend across substantial areas of suburban residential and commercial development, primarily in the Maple Valley area. Existing and new residential and commercial development could cause cumulative impacts. Cumulative impacts could occur from improvement or construction of new streets and highways. Impacts could also result from improvements to the Burlington Northern and Santa Fe Railroad that extends through Georgetown across the southern portion of the route. Mining operations, predominantly for aggregate, occur south of the Cedar River.

The most likely impacts would be increased soil erosion from construction sites or because of increased surface water runoff from reductions in pervious surfaces, such as rooftops and parking lots. Additional development could trigger landslides by excavating and undermining slope toes, by placing additional loads at slope tops, or by discharging excessive water onto steep slopes.

4.1.5.4 Unavoidable Effects, and Irreversible or Irretrievable Commitments of Resources

Refer to the effects and commitments under Alternative A, Section 4.1.3.4.

4.1.6 Alternative D Geology and Soils

4.1.6.1 Impacts

Alternative D would involve the construction of a new, single-circuit, 500-kV transmission line from just east of Stampede Pass to the Echo Lake Substation. This line would parallel BPA's existing Rocky Reach-Maple Valley 345-kV transmission line and would generally follow the Interstate 90 corridor, which it would cross twice. The new line could be either on the north side of the existing Rocky Reach-Maple Valley transmission line (Option D1) or on the south side (Option D2).

Landslides

Landslide hazards for Alternative D are the same as for Alternative B (Section 4.1.4.1 and Table 4). However, this alternative would require clearing of approximately 650 acres of forested ground on steep to moderate slopes, and construction of additional spur roads to access the tower sites. Therefore, the potential impacts to slope instability from this alternative would be greater than for Alternative B.

Soil Erosion

Soil erosion hazard ratings along this alternative are the same as for Alternative B (Section 4.1.4.1 and Table 4), however, the large increase in the amount of clearing and road construction would result in larger soil erosion impacts. Because of the numerous streams and moderate to steep slopes along the route and evidence of past failure of roads due to debris flows, the potential for sediment delivery from the disturbed ground is considered high.

Excavation Difficulty

Excavation difficulty would be similar to Alternative B (Section 4.1.4.1 and Table 4). The additional road construction required for this alternative would make the impacts expected for this alternative greater than Alternative B.

Settlement Hazard

No settlement hazards were identified along Alternative D.

4.1.6.2 Mitigation

Refer to measures under Alternative A, Section 4.1.3.2.

4.1.6.3 Cumulative Impacts

Refer to the discussion of Alternative B, Section 4.1.3.3.

4.1.6.4 Unavoidable Effects, and Irreversible or Irretrievable Commitments of Resources

Refer to the effects and commitments under Alternative A, Section 4.1.3.4.

4.2 Seismology

4.2.1 Seismic Impact Levels

4.2.1.1 Liquefaction Impact Levels

Liquefaction is a phenomenon in which saturated, cohesionless soils are temporarily transformed into a near liquid or "quicksand" state. During an earthquake, ground shaking could result in a buildup of pore-water pressure in the saturated soil to a point where the pore-water pressure approaches the grain-to-grain contact pressure. As this occurs, the soil particles would begin to lose contact with each other and the soil would liquefy. The effects of liquefaction could include lateral spreading (permanent lateral ground displacements for a

distance to about 10 feet on near-level ground), differential settlement, loss of vertical and lateral foundation support, and buoyant rise of buried structures. Historically, soils that have high liquefaction susceptibility include artificial fill (particularly along or in bodies of water) and granular Holocene geologic deposits (e.g., alluvium) in valley bottoms and along rivers and creeks.

Regional liquefaction studies (Grant and others, 1992; Palmer, 1992; and Palmer and others, 1994 and 1995) indicate that late Pleistocene, nonglacially overridden deposits have a moderate to low liquefaction susceptibility, while Pleistocene and older, glacially overridden sediment and bedrock have a low liquefaction susceptibility. The geologic maps (Figures 5A, 5B, and 5C) show the locations of these deposits along the alternative routes. Liquefaction impact levels were assigned to these units as follows:

< **High liquefaction impact** was assigned to Holocene alluvium along the Yakima, South Fork Snoqualmie, and Cedar Rivers.

< **Moderate to low liquefaction impact** was assigned to Pleistocene, recessional glacial outwash near the Yakima, South Fork Snoqualmie and Cedar Rivers.

< **No liquefaction hazard** was assigned to all other deposits.

4.2.1.2 Soft Ground Amplification Impact Levels

Earthquake ground motion or waves could resonate in relatively soft, cohesive soil resulting in local ground motion amplification. The amount of ground motion amplification would depend on the characteristics of the earthquake and the thickness and properties of the soil. Soft, cohesive soil (e.g., clay, peat, and organic soils) is typically in geologically recent alluvial deposits that are commonly located in valley bottoms, depressions in bedrock or glaciated uplands, and along rivers and lakes.

< **High soft ground amplification impact** was assigned to areas indicated to be underlain by Holocene (nonglacially-overridden) peat and bogs.

< **No soft ground amplification impact** was assigned to all other areas.

4.2.1.3 Tsunami and Seiche Impact Levels

Earthquake-induced flooding can result from tsunami or seiche waves generated in open (i.e., oceans) or closed (e.g., lake, reservoir) water bodies, respectively. The project area is not near an ocean and would not be impacted by a tsunami; however, seiches could occur in nearby lakes and reservoirs.

4.2.1.4 Fault Ground Rupture Impact Levels

Fault ground surface rupture occurs where movement on a fault propagates to the ground surface, resulting in permanent ground displacement across the fault. It is unlikely that ground surface rupture on either the Seattle or Southern Whidbey Island Faults would affect the project routes because of the distance between the routes and the faults (5 to 45 miles). Furthermore, while movement apparently has occurred on these faults in the last 10,000 years, preliminary recurrence interval estimates for earthquakes on these faults that could cause ground rupture are on the order of 1,000 to 7,000 years. Other faults mapped within the project area do not show evidence of ground rupture for at least the last 13,500 to 15,000 years, as evidenced by no known displacement of Pleistocene glacial deposits.

- **High fault rupture hazard** was assigned to areas along and adjacent to potentially active faults.

- **Low fault rupture hazard** was assigned to all other areas because unidentified faults could be present.

4.2.2 Seismic General Impacts

4.2.2.1 Liquefaction

Construction of the project generally would not affect the liquefaction susceptibility of the soil. Transmission line tower foundations built on soil that is susceptible to liquefaction could settle differentially and/or displace laterally during strong ground motion. Depending on the magnitude of movement and/or lateral spreading that occurs, the tower could be rendered unusable or, in extreme conditions, the tower could fail. Under these circumstances, additional maintenance and/or repairs would be required, which could cause indirect environmental impacts.

Liquefiable soils could be present in the project area in alluvium on the valley floors adjacent to the Yakima, South Fork Snoqualmie, and Cedar Rivers (Qa, Figures 5A, 5B, and 5C and Table 4).

4.2.2.2 Soft Ground Amplification

Towers founded on soft ground could be subjected to amplified ground motions during an earthquake, causing damage to or failure of the structures. Soft ground amplification-related damage could have indirect environmental impacts caused by additional maintenance work and/or construction of new towers damaged during an earthquake.

Soft ground is present along less than 2 percent of Alternative A, as shown on the published geologic maps (Table 4 and Figure 5A). Therefore, most of the planned structures would not be in soft ground amplification hazard areas.

4.2.2.3 Tsunami and Seiche

A seiche in either the Chester Morse reservoir (Cedar River Watershed, Alternatives A and C) or Keechelus Lake reservoir (Yakima River watershed, Alternatives B and D) could overtop the respective dams and cause downstream flooding. Such flooding could impact Alternative A in the Cedar River floodplain or Alternatives B or D in the Yakima River floodplain. Alternative C would span the Cedar River and would not be located in the floodplain.

4.2.2.4 Fault Ground Rupture

If an unidentified active fault is present at a tower location and the fault ruptures, the tower could be damaged or fail, which could cause indirect environmental consequences during maintenance or repairs.

No potentially active faults have been identified in the project area; therefore, no high fault rupture hazard areas are known. Because unidentified faults could be present, the entire project area has a low fault rupture hazard designation.

4.2.3 Alternative A Seismic

4.2.3.1 Impacts

A high liquefaction hazard could be present in some recent alluvial deposits along the Cedar River. The hazard would be greatest in saturated sand deposits.

Moderate to low liquefaction hazards could be present in the recessional outwash sediment between the tap into the Schultz-Raver No. 2 line and to just north of the Covington Substation. Recessional outwash deposits and moderate to low liquefaction hazards also occur along the route north of the Cedar River. Liquefaction occurs only in saturated, cohesionless soil. Lakes, bogs and streams occur along and adjacent to the route and are indicative of general groundwater elevations. The liquefaction potential in these low-lying areas would be higher than in the recessional outwash at higher elevations.

4.2.3.2 Mitigation

Liquefaction-susceptible soil could be improved and/or foundations could be designed to resist liquefaction-related damage. We recommend conducting a site-specific

subsurface study prior to final design and construction to evaluate the liquefaction susceptibility of structures that would be built in liquefaction hazard areas.

4.2.3.3 Cumulative Impacts

No cumulative impacts would be associated with seismic hazards.

4.2.3.4 Unavoidable Effects, and Irreversible or Irretrievable Commitments of Resources

No unavoidable effects would be associated with seismic hazards. Improvement of liquefiable ground or construction of suitable foundations would require materials, such as concrete and steel, as well as fuel oil and lubricants used by construction equipment.

4.2.4 Alternative B Seismic

4.2.4.1 Impacts

A high liquefaction hazard could be present in some recent alluvial deposits along the Yakima and South Fork Snoqualmie Rivers. The hazard would be greatest in saturated sand deposits; however, most alluvial deposits in the upper reaches of these rivers (where the route crosses) are primarily composed of gravel and cobbles.

Moderate to low liquefaction hazards could be present in the recessional outwash sediments in the western portion of the route along the South Fork Snoqualmie River. Liquefaction occurs only in saturated cohesionless soil. The section of Alternative B that crosses the recessional outwash deposits is generally between 100 to 500 feet above the South Fork Snoqualmie River, so groundwater is probably relatively deep. These conditions tend to reduce the potential for liquefaction and reduce the likely damage that would occur if the soil liquefies. In our opinion, the potential for liquefaction in the recessional outwash deposits is low.

4.2.4.2 Mitigation, Cumulative Impacts, Unavoidable Effects, and Irreversible or Irretrievable Commitments of Resources

Mitigation, cumulative impacts and unavoidable effects, and irreversible or irretrievable commitments of resources for Alternative B would be essentially the same as for Alternative A (Section 4.2.3).

4.2.5 Alternative C Seismic

4.2.5.1 Impacts

Because no substantial Holocene alluvial deposits are present along this route, no high liquefaction hazards exist. Much of the route crosses recessional outwash deposits. Areas of recessional outwash along the route near Ravensdale and at the north end near Highway 18 are characterized by streams, lakes, and bogs. As a result, the groundwater elevation could be relatively close to the surface in these areas, resulting in a potential for liquefaction of susceptible soils. Areas of recessional outwash at higher elevations along the route generally would have deeper groundwater levels and consequently lower liquefaction potential.

4.2.5.2 Mitigation, Cumulative Impacts, Unavoidable Effects, and Irreversible or Irretrievable Commitments of Resources

Mitigation, cumulative impacts and unavoidable effects, and irreversible or irretrievable commitments of resources for Alternative C would be essentially the same as for Alternative A (Section 4.2.3).

4.2.6 Alternative D Seismic

Impacts, mitigation, cumulative impacts and unavoidable effects, and irreversible or irretrievable commitments of resources for Alternative D would be the same as along Alternative B (Section 4.2.4).

4.3 Hydrology and Climate

4.3.1 Hydrology, Water Quality and Climate Impact Levels

4.3.1.1 Floodplain Impact Levels

Construction and development could directly impact floodplains by obstructing or changing floodwater channels, which could increase downstream flows and/or upstream flooding. Indirect impacts could occur when resources are degraded (e.g., vegetation is removed and soil is compacted) to lessen the ability of the floodplain to store excess water, which would increase the chance of flooding.

- **A floodplain impact** would occur when structures or permanent access roads encroach on designated floodplains and increase the potential for flooding, or could cause loss of human life, personal property, or natural resources within the floodplain.
- **No impacts** would occur where floodplains are avoided or spanned, or where standard mitigation would effectively eliminate impacts.

4.3.1.2 Water Quality Limited Water Bodies Impact Levels

The water quality limited water bodies impact is assigned as follows:

- **High 303(d) water quality impact** is assigned to any water body segment that is on the 1998 Washington State 303(d) list and is crossed by the proposed alternatives.
- **No 303(d) water quality impact** was assigned to the remaining areas.

4.3.1.3 Groundwater Impact Levels

The City of Kent has established a wellhead protection program. Alternatives A and C cross the wellhead protection area. Numerous residential wells exist in areas of all the alternative routes. Groundwater impact is assigned as follows:

- **High groundwater impact** is assigned to areas within a 100-foot radius of groundwater wells or within a wellhead protection area.
- **Moderate groundwater impact** is assigned to private land where groundwater wells likely exist within ½ mile.
- **Low groundwater impact** was assigned to the remaining areas.

4.3.1.4 Wind Impact Levels

Table 2 shows the windthrow hazard for each soil unit, as reported in the referenced soils reports. Ratings of windthrow impacts were assigned based on these hazard ratings, which range from slight to severe. The ratings are based on soil characteristics that affect root development and the ability of the soil to hold trees firmly. Wind impact is assigned as follows:

- **Severe windthrow impact** was assigned to soil units where many trees could be blown over by moderate or strong winds.
- **Moderate windthrow impact** was assigned to soil units where some trees could be blown over by moderate or strong winds when the soil is wet.
- **Slight windthrow impact** was assigned to soil units where, under normal conditions, no trees would be blown over. Strong winds could damage some trees but no trees would be uprooted.
- **No windthrow impact** would be assigned only to areas that would not be affected by the construction and maintenance of the proposed project.

4.3.2 Hydrology, Water Quality, and Climate General Impacts

4.3.2.1 Floodplains and Flooding

Portions of the proposed transmission line Alternatives A, B, and D would be sited in the floodplains of the Yakima, South Fork Snoqualmie, or Cedar Rivers. These floodplains could be impacted by new roads and tower structures. Currently, tower structures along the existing transmission lines are located in the floodplains adjacent to these channels. With regard to floodplains along smaller streams, the transmission lines would span these features so that the floodplains would not be impacted. Alternative C would also span the Cedar River (i.e.; no towers in the floodplain) so that this floodplain would not be impacted along this alternative route.

Surface water runoff is typically more rapid from areas that have been cleared of vegetation and/or have disturbed soil than it is from areas with a mature forest canopy and/or with undisturbed soil. The forest canopy intercepts and temporarily stores some of the rainfall, much of which could evaporate. The remaining rainfall eventually reaches surface water or groundwater, but over a longer time than rain falling on unforested ground. Forested areas typically return moisture to the atmosphere by evapotranspiration, which could reduce the total amount of runoff; thus, more runoff would occur more rapidly after an area is cleared.

Disturbed soil is generally less permeable than undisturbed soil. Therefore, rainfall would be more likely to run off directly to streams from areas of disturbed soil than from undisturbed soil where rainfall typically infiltrates. While these impacts would occur along ROW clearings and access roads, the total area affected would be small compared with the watersheds they cross.

4.3.2.2 Water Quality

The proposed alternative routes would cross several major rivers and numerous smaller streams (Table 4). Segments of the Yakima, South Fork Snoqualmie, and Cedar Rivers are listed as 303(d) waters, but these segments do not occur where the alternative routes would cross the rivers. Therefore, no water quality limited water bodies would be affected by construction of a new transmission line and associated roads.

While 303(d) limited water bodies are not present along the alternative routes, the construction, operation and maintenance of the project, and especially ROW clearing and access road construction, could impact streams and rivers. As discussed in the following paragraphs, most impacts would occur for a short time. Overall, construction, operation, and maintenance

impacts are expected to be low and localized. The impacts to water quality related to the landslide and soil erosion impacts are discussed in Section 4.1.

Short-term impacts to water quality would be associated with ground disturbance from ROW clearing, the building of access roads, excavating and/or blasting for foundations and towers, and cable stringing. Clearing vegetation and exposing and disturbing soil would increase erosion, runoff, and the risk of sediment reaching surface waters. Access road construction would require complete vegetation removal and grading, which would typically disturb more soil than ROW clearing. The impacts would be most intense during and immediately after construction. Impact intensity would diminish as disturbed sites are stabilized and revegetated, which would reduce runoff and erosion.

In the long term, increased clearing could create foraging habitat that could attract deer, elk, and other warm-blooded animals that are potential sources of pathogens and viruses such as giardia and cryptosporidium. Erosion of unsurfaced roads could be a significant source of turbidity and could contribute to the turbidity levels. The amount of road surface erosion would increase with increasing traffic volumes, such as during the project construction phase. The temperature of surface water could be affected by reductions in shade where the ROW crosses streams.

4.3.2.3 Groundwater

Construction and maintenance activities generally would not directly or indirectly introduce contaminates into groundwater aquifers. The project should not affect the chemical or biological characteristics of groundwater in the area. However, uncontrolled accidental spills from construction fuels and lubricants could infiltrate into and contaminate the aquifers that provide groundwater for residences. BPA commonly uses, with concurrence of landowners, herbicides during maintenance activities to prevent the return of tall growing vegetation on its ROWs.

4.3.2.4 Wind

Trees typically develop firmness against prevailing winds. However, ROW clearing could alter the speed and direction of wind against which the trees have developed firmness. In addition, trees typically buffer each other from winds. This sheltering effect would be lost for trees exposed along the edges of the cleared ROW and new roads. Therefore, windthrow might be more likely along areas logged and maintained for the transmission line route. High winds could also affect the transmission line towers and conductors.

The main impacts from windthrow are loss of timber resources, possible damage to structures, and exposure of soil to erosion. Section 4.1.2 describes soil erosion impacts. Impacts related to ROW clearing likely would decrease in the first years after construction. New trees growing adjacent to the ROW clearing, and to some extent trees that survive windstorms following construction, would develop firmness against wind and resist windthrow in the long term.

4.3.3 Alternative A

4.3.3.1 Impacts

Floodplains and Flooding

As discussed in Section 4.3.2, the proposed project could affect the Cedar River floodplain. Roads and towers in the floodplain could alter the floodways. Debris could be trapped against the tower structures during floods and divert flows or cause the structure to fail. If additional ROW clearing and access road construction is needed, the peak runoff and total annual runoff could increase. These impacts would be most intense during and following construction. As vegetation becomes well established in the ROW, the impacts would decrease. However, because no significant, additional cleared ROW area or roads are proposed, significant project-related changes in the peak and total amount of runoff would be unlikely.

Water Quality

Two major drainage basins could be affected by Alternative A. Approximately 5.6 miles of the route would be within the Cedar River watershed, and the remaining 14.1 miles of the route would be in the Big Soos Creek drainage basin. Surface water runoff containing fuel spills, herbicide runoff, and other contaminants could reach these main streams. Construction-related landslides, soil erosion, and clearing activities along the ROW could affect water quality, as discussed in Section 4.3.2. Because Alternative A would follow existing transmission line ROW, new access road construction would be limited to improving the existing trunk access and spur roads, and construction of some new, short spur roads to the new tower locations. Because the ROW would cross gently to moderately sloping ground, the potential for erosion and landslides would be generally low. Section 4.1.3.1 describes landslide and soil erosion impacts that could affect water resources. Most potential landslide and soil erosion impacts would be short term.

Groundwater

From the tap point of the Schultz-Raver No. 2 line west to Covington, Alternative A would cross private land with numerous residences. Many of the residences likely have groundwater wells for domestic use. This portion of the route also extends through an area designated for the City of Kent's wellhead protection program (City of Kent, 1996). This program is intended to protect the groundwater quality for the Clark Springs, Kent Springs, and Armstrong Springs source areas (Figure 5A). These source areas represent approximately 95 percent of the City of Kent's water supply (City of Kent, 1996). Alternative A would cross directly through the Clark Springs area. Much of the wellhead protection area that Alternative A traverses has been rated as highly susceptible to groundwater contamination. Construction- and maintenance-related accidental fuel spills or use of herbicides could affect groundwater quality. This portion of the route has been designated as a high groundwater impact area (Table 4).

The remainder of Alternative A north of Covington would also cross private land with numerous residences. Many of these residences likely have groundwater wells for domestic use. This portion of the route is designated as a moderate groundwater impact area (Table 4).

Wind

Because the route is mostly in an existing cleared ROW, large areas of timber would not be removed, although danger trees may need to be removed. As a result, the potential for windthrow that would impact the lines would be low.

4.3.3.2 Mitigation

Floodplains and Flooding

Impacts to floodplains and impacts from flooding could be avoided by locating the towers and associated roads outside of the floodplain. If construction must occur within a floodplain, the towers should be located, to the extent feasible, as far as practical from active channels and out of the channel migration zone. The towers should be designed to withstand floodwater forces. If towers are located near active channels or if the active channel could migrate to a tower location, foundations should be reinforced to withstand scour. Access road lengths should be kept to a minimum to reduce hydrologic and erosion impacts.

Water Quality

Most impacts to water quality would be from construction of roads and ROW clearing, followed by operation and maintenance of roads. Most of the impacts and mitigation

measures would be related to soil erosion, as discussed in Section 4.1.3.2. In addition to those mitigation measures, the following measures could be used to reduce impacts on water quality:

- Preserve existing vegetation where practical, especially adjacent to intermittent and perennial creeks and streams. Plant riparian vegetation that provides shade for streams but that also meets clearance requirements for the proposed transmission line.

- Avoid construction in wetland areas.

- Gate roads to restrict access.

- Avoid refueling and/or mixing hazardous materials where accidental spills could enter surface or groundwater.

- Use BMPs to prevent fuel spills and herbicide runoff from reaching streams.

- Have a Spill Prevention Plan in place prior to construction activities.

- Avoid or mitigate water quality and fish habitat degradation. Design and maintain roads so that drainage from the road surface does not directly enter streams, ponds, lakes, or impoundments. Direct water off the roads into vegetation buffer strips or control through other sediment-reduction practices. Restrict road construction to areas physically suitable based on watershed resource characteristics. Design stream crossings to avoid adverse impacts to stream hydraulics and deterioration of stream bank and bed characteristics.

Groundwater

The BPA would design, construct, and maintain the project to comply with local ordinances and laws, and state and federal water quality programs to prevent degradation of the quality of aquifers so as not to jeopardize their usability as a drinking water source. An on-site refueling plan and spill notification plan would be designed and implemented to protect groundwater quality. During construction and maintenance, refueling and/or mixing of hazardous materials would be done in a manner and location that would reduce the potential for accidental spills to impact groundwater.

Prior to using herbicides for ROW maintenance, BPA would contact affected landowners to find out if they have concerns with the use of herbicides on or near their properties. BPA's policy on herbicide use in the vicinity of domestic and public drinking water wells is to maintain a 165-foot buffer for any herbicide having a ground or surface water advisory and a 50-foot buffer for any other herbicide. Any herbicide used in construction, operation or maintenance of the proposed project would be EPA-approved and would be applied by licensed applicators in accordance with the label instructions.

Wind

Structures and conductors would be designed to resist toppling and excessive sway, respectively. Because no ROW clearing of timber would be required, the potential for windthrow damage that could affect the transmission line, and potentially affect service or cause a fire, would be low. The transmission line would be inspected following severe windstorms to evaluate possible windthrow damage, so that appropriate remedial measures could be implemented as needed for safety and to prevent excessive soil erosion.

4.3.3.3 Cumulative Impacts

Although no waters are 303(d) listed within the Alternative A alignment, potential increases in sedimentation, temperature, or other 303(d) parameters from this and other construction projects in the cities and county could affect future listings. The potential cumulative impacts on water quality and fish and other habitat would occur mostly from soil-disturbing activities such as construction of buildings and roadways or development of new tracts of housing. In addition, many of the streams could contain populations of fish with special status that could be impacted by the cumulative effects of many soil-disturbing projects happening at once within a watershed. Several impacts discussed in the previous section could affect fish habitat. These include changes in water temperature from clearing vegetation adjacent to stream channels, increased sedimentation, increased peak runoff resulting from reduced evapotranspiration and interception in cleared areas, and from reduced permeability of road surfaces.

Increased development in the watersheds through which Alternative A passes could lead to increased flood flows as a result of reduced evapotranspiration and interception in cleared areas, and reduced permeability of road surfaces. Cumulative impacts to groundwater could occur from existing and future development. Residential and commercial development will require additional water supplies. Development and increased human population would increase risks of groundwater contamination from spills or misapplication of chemicals.

4.3.3.4 Unavoidable Effects, and Irreversible or Irretrievable Commitments of Resources

Impacts from the additional roads, if any, would diminish with time, but not completely. Therefore, during the project life, the long-term impacts described in the previous sections would continue. If the transmission line is abandoned, a mature forest canopy could develop, and unused road surfaces would revegetate. Related geology and soils effects and commitments of resources are discussed in Section 4.1.

4.3.4 Alternative B

4.3.4.1 Impacts

Floodplains and Flooding

Construction of Alternative B would consist of tearing down the existing transmission structures, extending existing short spur roads to new tower locations, excavating new foundations in different locations from the existing towers, and erecting new towers along the existing route. Construction activity would include removing danger trees outside the ROW, and reconstructing and upgrading existing roads. Alternative B crosses the Yakima River and South Fork Snoqualmie River floodplains. These floodplains are wide and may require tower structures within the floodplain to cross them. Therefore, floodplain impacts would be similar to those described for Alternative A in Section 4.3.3.1. Because some additional ROW clearing and reconstruction of roads would be required, some impacts to peak flows from the project are likely.

Water Quality

Two major drainage basins could be affected by Alternative B. Approximately 11 miles of the route would be within the Yakima River watershed, and the remaining 27 miles of the route would be in the South Fork Snoqualmie River watershed. Surface water runoff containing fuel spills, herbicide runoff and other contaminants could reach these main streams. Construction-related landslides, soil erosion, and clearing activities along the ROW could affect water quality, as discussed in Section 4.3.2. Alternative B would follow an existing transmission line ROW; therefore, new access road construction would be limited to improving the existing trunk access and spur roads, reconstructing some spur roads to improve drainage, and construction of some new, short spur roads to any new tower locations. Because of the amount of earth-disturbing activities, the numerous streams crossed, and the moderate to steep topography, the potential for erosion and landslides is considered to be moderate. Section 4.1.3.1 describes landslide and soil erosion impacts that could affect water resources. Most potential landslide and soil erosion impacts would be short-term.

Alternative B would cross numerous streams in the existing ROW. Towers for the transmission line could be placed far from the channel so that streamside vegetation would not be impacted. However, streamside vegetation would be removed in some locations within the ROW for transmission line reliability and where access roads require reconstruction or improvement. This route would cross the Yakima and South Fork Snoqualmie Rivers in an existing ROW. Some existing bank vegetation at these crossings may be disturbed if clearing of the additional 20 feet within the ROW is needed for transmission line reliability.

Groundwater

Alternative B would cross the Yakima River Valley floor where substantial groundwater probably occurs. However, few residences that may be dependent on groundwater supply wells are located in this area. The route would continue west across the lower portion of steep to moderate slopes, where there is also minor development. Between the most western crossing of the South Fork Snoqualmie River and Rattlesnake Mountain, southeast of the City of North Bend, residential development increases. Many of these residences may be dependent upon wells for water supply. No groundwater supply users exist along Rattlesnake Mountain to the Echo Lake Substation. All of the route is considered to be a low groundwater impact area except the area of denser residential development southeast of North Bend, which is considered a moderate impact area (Table 4).

Wind

Structures and conductors would be designed to resist toppling and excessive sway, respectively. Because the ROW clearing of trees that is required is predominantly trees less than 40 years old, the potential for windthrow damage that could affect the transmission line, and potentially affect service or cause a fire, would be low. The transmission line would be inspected following severe windstorms to evaluate possible windthrow damage, so that appropriate remedial measures could be implemented as needed for safety and excessive soil erosion prevention.

4.3.4.2 Mitigation

Refer to the measures under Alternative A, Section 4.3.3.2.

4.3.4.3 Cumulative Impacts

Refer to the discussion of Alternative A, Section 4.3.3.3.

4.3.4.4 Unavoidable Effects, and Irreversible or Irretrievable Commitments of Resources

Refer to effects and commitments under Alternative A, Section 4.3.3.4.

4.3.5 Alternative C

4.3.5.1 Impacts

Floodplains and Flooding

This route would be located in a new ROW north of Ravensdale. The Cedar River floodplain is narrow in the vicinity of the proposed crossing so that the floodplain would be spanned and therefore would not be impacted. Smaller streams along the route would also be spanned so that their floodplains would not be impacted. The required ROW clearing and access road construction could increase the peak and total annual runoff volumes. These impacts would be most intense during and following construction. As vegetation becomes more established in the ROW clearing, the runoff impacts would decrease.

Water Quality

Three major drainage basins could be affected by Alternative C. From south to north, approximately 3.6 miles of the Option C1 route or 4.0 miles of the Option C2 route, would be within the Cedar River watershed. About 4 miles of the Alternative C route would be in the Big Soos Creek watershed. The remaining 2.6 miles of the route would be in the Issaquah Creek drainage basin. Surface water runoff containing fuel spills, herbicide runoff, and other contaminants could reach these main streams. Construction-related landslides, soil erosion, and clearing activities along the ROW could affect water quality, as discussed in Section 4.3.2. Because much of Alternative C would be in a new ROW, erosion and sedimentation from additional cleared ground and new roads could impact surface water sources. Section 4.1.3.1 describes landslide and soil erosion impacts that could affect these resources. Most potential landslide and soil erosion impacts would be short-term.

Alternative C would cross several streams, including the Cedar River. These streams would be spanned so that as little streamside vegetation as practical would be impacted; therefore, substantial impacts to water quality, such as temperature increase, should not occur.

Groundwater

Alternative C would cross the east end of the City of Kent's wellhead protection area. This section of the route is rated as a high groundwater impact area (Table 4). To the north, the route traverses rural residential development. Some of these residences may be dependent upon groundwater supplies for domestic use. This area is designated a moderate groundwater impact (Table 4).

Wind

This alternative would require clearing of timber within newly acquired ROW. Soils along the route are generally evenly divided between low and moderate windthrow hazard, with only 3 percent of the route soils rated as high windthrow hazard for both Options C1 and C2. These high hazard windthrow soils are characterized by generally constant, saturated conditions and occur in wetlands, ponds, and other closed depressions where water could collect.

4.3.5.2 Mitigation

Refer to measures under Alternative A, Section 4.3.3.2. Because ROW clearing would be required, the initial clearing would be wider than that required for safe operation of the line. This would allow the trees to grow back along the new ROW edge under the changed conditions and develop wind firmness.

4.3.5.3 Cumulative Impacts

Refer to discussions of Alternative A, Section 4.3.3.3.

4.3.5.4 Unavoidable Effects and Irreversible or Irretrievable Commitments of Resources

Refer to effects and commitments under Alternative A, Section 4.3.3.4).

4.3.6 Alternative D

4.3.6.1 Impacts

Floodplains and Flooding

Alternative D would require new ROW clearing and access roads. The new ROW would be adjacent to the existing ROW so that new road construction would be limited to short spur-road extensions to the new tower sites from existing roads. Alternative D would cross the Yakima River and South Fork Snoqualmie River floodplains. These floodplains are wide and may require tower structures and roads within the floodplain to cross them. Therefore, the impacts would be similar to those described for Alternative A, Section 4.3.3.1. Because additional ROW clearing and roads are required, peak and total flow volumes would likely increase. However, because the total area of cleared and roaded ground would be small relative to the total watershed areas, such impacts would not be significant. Floodplains of smaller streams would be spanned by the new route so that they would not be impacted.

Water Quality

Two major drainage basins could be affected by Alternative D. Approximately 11 miles of the route would be within the Yakima River watershed, and the remaining 27 miles of the route would be in the South Fork Snoqualmie River drainage basin. Surface water runoff containing fuel spills, herbicide runoff, and other contaminants could reach these main streams. Construction-related landslides, soil erosion, and clearing activities along the ROW could affect water quality, as discussed in Section 4.3.2. Because of the increased earth-disturbing activities relative to Alternative B, the potential for erosion and landslides would be greater for Alternative D. This potential would be greatest during and following construction, but would diminish with time as the areas revegetate and stabilize. Section 4.1.3.1 describes landslide and soil erosion impacts that could affect water resources.

Alternative D would cross numerous streams. These streams would be spanned as much as practical to limit impacts to streamside vegetation. However, it is likely that some streamside vegetation would be removed in many locations. This route would cross the South Fork Snoqualmie River twice in a new ROW. Depending on tower location and clearing requirements, vegetation could be removed from the riverbanks. This vegetation removal could result in impacts to water quality, such as increased temperature resulting from reduced shade.

Groundwater

Impacts to groundwater resources from Alternative D would be similar to those for Alternative B (Section 4.3.4.1). However, because this alternative would require new ROW clearing, the impacts would be greater.

Wind

This alternative would require clearing new ROW along one side of the existing cleared ROW, so that one edge of the new, wider ROW would be forested with trees that had not developed wind firmness. However, less than one percent of the route length would cross soils rated with a high windthrow potential, with the remainder of the route generally divided evenly between low and moderate windthrow potential. The high hazard windthrow soils are characterized by generally constant, saturated conditions and occur in wetlands, ponds, and other closed depressions where water could collect.

4.3.6.2 Mitigation

Refer to measures under Alternative A, Section 4.3.3.2. Because ROW clearing would be required, the initial clearing would be wider than that required for safe operation of the

line. This would allow the trees to grow back along the new ROW edge under the changed conditions and to develop wind firmness.

4.3.6.3 Cumulative Impacts

Refer to discussion of Alternative A, Section 4.3.3.3.

4.3.6.4 Unavoidable Effects, and Irreversible or Irretrievable Commitments of Resources

Refer to effects and commitments under Alternative A, Section 4.3.3.4.

5.0 ENVIRONMENTAL CONSULTATION, REVIEW AND PERMIT REQUIREMENTS

The specific permits/reviews that would likely be involved in this project follow:

- **Army Corps of Engineers (Corps) – Section 404.** The Corps Section 404 review process is required for projects involving discharges of dredged or fill materials into the waters of the U.S., including wetlands and streams. Any proposed work located within a jurisdictional wetland and/or below the ordinary high water mark of a stream would require a permit from the Corps, either a nationwide permit (NWP) or an individual permit.. Nationwide permits that could apply to this project include: (1) NWP 7 for outfall structures and maintenance, (2) NWP 12 for utility line activities, and (3) NWP 39 for wetland fills that would not be covered in NWP 12, such as maintenance buildings or structures.

- **National Marine Fisheries Service (NMFS) and United States Fish and Wildlife Service (USFWS) – Endangered Species Act compliance**. The project has a federal nexus (actions authorized, funded, or carried out by federal agencies). Therefore, a biological evaluation/assessment of the project area would be required to determine whether this project would affect Endangered Species Act (ESA) species or their habitat. Based on the findings of the biological evaluation/assessment, either informal or formal consultation would be required with NMFS and/or USFWS.

- **Ecology – Section 401 Water Quality Certification and Coastal Zone Management Consistency.** Section 401 Water Quality Certification and a Coastal Zone Management Consistency determination, issued by Ecology, could be required as a condition of the Section 404 Nationwide permits for the proposed project. Some general requirements for Section 401, if required, include pollution spill prevention and response measures, disposal of excavated or dredged material in upland areas, use of fill material that does not compromise water quality, equipment fueling and wash water discharge restrictions, clear identification of construction boundaries, and site access to permitting agency for

inspection.

If Coastal Zone Management Consistency is required, a brief project description, assessment of project impacts, and a statement of whether the project complies with the Coastal Zone Management Program would be required for Ecology's review. If the project is consistent with the Coastal Zone Management Program, Ecology would concur in writing.

< **Ecology – Section 303(d).** The proposed transmission line alternatives cross the water bodies listed in Table 4. At this time, no segments in these water bodies are listed on the approved 1998 Washington State 303(d) water quality limited water bodies list for the alternative alignments. Therefore, a 303(d) review most likely would not be required.

< **Ecology – Section 402 NPDES Permit to Discharge Stormwater During Construction Activity.** The clearing, grading, and/or excavating activities involved with this project are expected to disturb more than 1 acre and would discharge stormwater from the project area into surface water. Land-disturbing activities of one or more acres would require an NPDES General Permit to Discharge Stormwater associated with construction activity from Ecology. The purpose of this permit is to reduce stormwater pollution from construction activities.

The application for this permitting process is referred to as a Notice of Intent (NOI) and must be submitted to Ecology at least 38 days prior to the start of construction activities. At the time of application, the permittee must also publish a notice in the newspaper that has general circulation within the county in which the project is to take place.

Prior to granting the permit, the applicant must prepare a Stormwater Pollution Prevention Plan (SWPPP) for the project. The SWPPP must include Temporary Erosion and Sedimentation Control (TESC) and Spill Control Containment and Countermeasures (SPCC) plans. The SWPPP is not submitted to Ecology, but is required to be kept on site during construction activities and made available to Ecology and local government agencies upon request.

< **Washington State Department of Fish and Wildlife (WDFW) – Hydraulic Permit Approval (HPA).** An HPA issued by the WDFW is required for any project that uses, diverts, obstructs, or changes the natural flow or bed of any fresh water in the state. General plans for the overall project and complete plans and specifications of the proposed construction are required for the permit submittal. The plans and specifications must include provisions for the proper protection of fish life.

The BPA is not subject to local government's land use permit requirements. However, the BPA does intend to meet local governments substantive regulations. Local government permits that would be required for a similar non-federal government project include the following:

- **Washington State Department of Natural Resources (DNR) – Forest Practice Application (FPA).** An FPA is required when harvesting timber, constructing forest roads or applying forest chemicals. The FPA must address road design and layout, and drainage features. The FPA must also address property ownership, harvest plans, and sensitive areas needing protection.

- **King County Department of Development and Environmental Services (DDES) – Grading Permit and Environmentally Sensitive Areas Review.** A clearing and grading permit is generally required for any earth disturbing project in which:
  - Cumulative filling and excavating of 100 cubic yards or more.
  - Filling to a depth of 3 feet or more.
  - Excavating to a depth of 5 feet or more.
  - Clearing, filling or grading in a shoreline area, on steep slopes, in wetlands, or into or next to any body of water or sensitive area.

- One of many exceptions to this requirement is if the clearing and grading occurs in Class II, III, or IV Special Forest Practice in an F (Forestry) zone and conducted in accordance with RCW 76.09 and WAC 22. The proposed project appears to lie partially within a Forestry Production Zone.

  If requested, King County would review the proposed project for compliance with the Environmentally Sensitive Areas Ordinance in conjunction with their grading permit review. Environmentally sensitive areas in the project area could include wetlands, streams, flood hazards, erosion hazards, landslide hazards, seismic hazards, coalmine hazards, steep slope hazards, and/or volcanic hazards.

- **Wellhead Protection Program.** Alternatives A and C would extend across the City of Kent's wellhead protection program area. In addition, residential wells exist in the project area. Regulatory agencies could require an on-site refueling plan and spill notification plan for this project to protect groundwater quality. Manual brush removal instead of pesticide application could also be required in some areas.

6.0 INDIVIDUALS AND AGENCIES CONSULTED

During the course of this study, the following agencies were consulted, by direct telephone conversations, web sites, or policy publications:

- Seattle Public Utilities
- King County Department of Development and Environmental Services
- City of Kent Wellhead Protection Program, Kelly Peterson, Environmental Engineer
- USDA Natural Resources and Conservation Service, Kittitas County, WA

7.0 PROJECT STUDY METHODS

The objective of this study was to evaluate the geologic, soil, hydrologic and climatic conditions that could be affected by or could affect the siting, design, construction, and maintenance of the proposed project. This objective was met by accomplishing the following items of work:

Data Gathering. Existing available information was collected from government agencies, private companies, and public libraries:

U.S. Geologic Survey (USGS) 1:24,000 scale Washington topographic maps:
- 1989 Bandera, Washington
- 1989 Chester Morse Lake
- 1989 Lost Lake
- 1989 Snoqualmie Pass
- 1989 Stampede Pass
- 1993 Cumberland
- 1993 North Bend
- 1993 Hobart
- 1994 Black Diamond
- 1995 Maple Valley

USGS geologic maps and reports
USGS seismologic studies
Aerial photographs (Bonneville Power Administration and private)
U.S. Department of Agriculture soil maps
Washington State Department of Natural Resources Division of Geology and Earth Resources maps and charts
BPA and Seattle Public Utilities (SPU) geographic information system (GIS) files and maps for the project area
Digital orthophoto maps for the project area

Data Compilation. The geologic, soil, hydrologic and wind data were compiled and plotted on GIS base maps provided by BPA.

Aerial Photograph Analyses. We interpreted and mapped geologic features along the route alternatives using stereo pairs of aerial photographs. This mapping focused on identifying features such as landslides, chronic erosion areas, floodplains, and organic soils, using the following aerial photographs:

Date Flown	Color	Approximate Scale	Flight	Source
May 2001	Color	1:12,000	BPA-SHEL	BPA
July 2000	Color	1:24,000	BPA-GCR	BPA
October 1999	Color	1:24,000	BPA-RMV	BPA

Date Flown	Color	Approximate Scale	Flight	Source
July 1999	Color	1:12,900	BPA-RMV	BPA
July 1999	Color	1:12,400	BPA-CMV	BPA
July 1999	Color	1:12,800	BPA-TGC	BPA
July 1990	Black and White	1:13,700	BPA-CJSQ	BPA

Helicopter Overflight. Following the aerial photographic interpretation and mapping, we flew over each alternative route at low altitude to observe the landforms and ground conditions.

Technical Report. The findings of this study are documented in this technical report.

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GLOSSARY

100-year Floodplain – Areas that have a 1 percent chance of being flooded in a given year. (See **Floodplain**.)

Alluvial – Formed by flowing water.

Access road – Roads constructed to each structure site, first to build the tower and line, and later to maintain and repair it. Access roads are built where no roads exist. Where county roads or other access is already established, access roads are built as short spurs to the structure. Access roads are maintained even after construction.

Advance outwash – Glacial outwash that is deposited by, and in front of, an advancing glacier and is subsequently overridden by the glacier. Advance outwash deposits are overconsolidated and typically are very dense.

Alluvium – Clay, silt, sand, gravel, or similar material deposited by running water.

Alternatives – Refers to different choices of means to meet the need for action.

Andesite – A moderate-colored volcanic rock containing iron and magnesium minerals and quartz. Andesite is usually derived from Cascade volcanoes.

Anticline – A convex-up fold, the core of which contains stratigraphically older rocks.

Aquifer – Water-bearing rock or sediment below the ground surface.

Argillite – A compact metamorphic rock derived from mudstone or shale.

Basalt – A dark-colored volcanic rock containing iron and magnesium minerals, usually covering an extensive area.

Batholith – An intrusive rock body with a surface area of at least 40 square miles.

Bedding (geologic) – The arrangement of a sedimentary deposit or rock in beds or layers of varying thickness and character.

Bedrock – The solid rock that underlies the soil and other unconsolidated material that is exposed at the surface.

Best Management Practices (BMP) – A practice or combination of practices that are the most effective and practical means of preventing or reducing the amount of pollution generated by non-point sources to a level compatible with water quality goals.

BPA – Bonneville Power Administration

Breccia – A coarse-grained clastic rock composed of large (greater than sand-sized), angular, and broken rock fragments that are cemented together in a finer-grained matrix. Breccia is similar to conglomerate except that most of the fragments have sharp edges and unworn corners.

Chert – A hard, extremely dense rock composed of microcrystalline quartz.

Clast - An individual constituent, grain, or fragment of a sediment or rock produced by the disintegration of a larger rock mass.

Clastic – Pertaining to or being a rock or sediment composed principally of clasts that have been transported individually for some distance from their places of origin.

Claystone – An indurated clay having the texture and composition, but lacking the fine lamination, of shale.

Coal – A readily combustible rock containing more than 50 percent by weight and more than 70 percent by volume carbonaceous material that was formed from compaction and induration of plant remains similar to those in peat.

Cohesive – Said of a soil that has relatively high shear strength when wet, e.g., a clayey soil.

Cohesionless – Said of a soil that has relatively low shear strength when air dried, e.g., a sandy soil.

Colluvial soil, Colluvium – Rock and soil accumulated on or at the foot of a slope.

Columnar Jointing – rock jointing that forms columns, usually in a hexagonal pattern.

Conductor – The wire cable strung between transmission towers through which electric current flows.

Conformable (geologic) – Said of sedimentary strata characterized by an unbroken sequence in which the layers are formed one above the other in parallel order.

Conglomerate – A coarse-grained, clastic sedimentary rock composed of rounded fragments larger than 2 millimeters in diameter (granules, pebbles, cobbles, and boulders) set in a fine-grained matrix of sand, silt or cementing materials. The rock equivalent of gravelly soil deposits.

Creep – The slow, continuous downslope movements of soil and rock under the influence of gravity.

Crossbedding – The arrangement of laminations of strata transverse or oblique to the main bedding layers.

Culvert – A corrugated metal or concrete pipe used to carry or divert runoff water from a drainage, usually installed under roads to prevent washouts and erosion.

Cumulative impact – Created by the incremental effect of an action when added to other past, present, and reasonably foreseeable future actions.

Current – The amount of electrical charge flowing through a conductor (compared with voltage, which is the force that drives the electrical charge).

Cut and Fill – The process whereby a road is cut or filled on a side slope. The term refers to the amount of soil that is removed (cut) or added (fill).

Dacite – A fine-grained volcanic rock with the same general composition as granite.

Danger Trees – Trees or high-growing brush outside of the ROW that could be hazardous to the transmission line. These trees are identified by special crews and must be removed to prevent tree-fall into the line or other interference with the wires. The owners of danger trees are compensated if they would be found to be merchantable timber. BPA's Construction Clearing Policy requires that trees be removed that meet either one of two technical categories. Category A is any tree that within 15 years would grow to within about 18 feet of conductors with the conductor at maximum sag (212 degrees F) and swung by 6 lb. per sq. ft. of wind (58 mph). Category B is any tree or high-growing brush that after 8 years of growth would fall within about 8 feet of the conductor at maximum sag (176^{o} F) and in a static position.

DDES – King County Department of Development and Environmental Services

Debris Flows – Rapid movement of water-charged mixtures of soil, rock, and organic debris.

DEIS – Draft Environmental Impact Statement

Dextral shear – Shear movement, as occurs along a fault, where the movement of the side opposite an observer appears to have moved to the right.

Diabase – A dark colored, intrusive igneous rock comprised essentially of the minerals labradorite and pyroxene.

Dike (geologic) – A long, narrow, crosscutting mass of igneous or eruptive rock intruded into a fissure in older rock.

DNR – Washington State Department of Natural Resources

Easement – The granting of certain rights to use a piece of land (which then becomes a "ROW"). BPA acquires easement for many of its transmission facilities. This includes the right to enter the ROW to build, maintain, and repair facilities. Permission for these activities is included in the negation process for acquiring easements of private land.

Ecology – Washington State Department of Ecology

Environmental Impact Statement (EIS) – A detailed statement of environmental impacts caused by an action, written as required by the National Environmental Policy Act.

Eocene – An epoch of the lower Tertiary period, lasting 21 million years, after the Paleocene (57.8 mybp) and before the Oligocene (36.6 mybp).

Erosion – The process by which the surface of the earth is worn away by water, wind, glaciers, waves, and other forces of nature.

ESA – Endangered Species Act

ESCP – Erosion and Sediment Control Plan

EPA – U.S. Environmental Protection Agency

Evapotranspiration – The combined processes of evaporation and transpiration. Transpiration is the process by which plants take water from the subsurface, convey it through their woody parts, and give off water vapor through their leaves.

Fault (geologic) – A surface or zone of rock fracture along which there has been movement. The amount of movement can range from a few inches to miles.

Fault trace – The line formed where a fault intersects the ground surface.

FEMA – Federal Emergency Management Agency

Feldspathic – Said of sedimentary rocks containing a certain percentage of feldspar minerals.

Floodplain – The surface or strip of relatively smooth land adjacent to a river channel, constructed (or in the process of being constructed) by the present river in its existing regimen and covered with water when the river overflows its banks.

Fluvial – Of or pertaining to a river or rivers.

Foliation – The planar arrangement of textural or structural features in any type of rock.

Footings – The supporting base for the transmission towers, usually steel assemblies buried in the ground for lattice-steel towers.

Forearc – The zone in front (toward the ocean) of an island arc complex.

Formation – The basic stratigraphic unit used in the local classification of rocks that have some character (age, origin, composition) in common.

FPA – Forest Practice Application

g – Acceleration due to gravity, equal to 9.8 meters/second/second (32.2 feet/second/second).

Gabbro – A dark colored, intrusive igneous rock composed chiefly of the minerals labradorite and augite.

GIS – Geographic Information Systems, a computer system that analyzes graphical map data.

Geotechnical – Pertaining to the properties of soil and rock, such as compaction, stabilization, and compressibility.

Glacial drift – A general term for sediment transported and deposited directly by glaciers.

Glacial erratic – A rock fragment carried by glacier ice and deposited when the ice melted some distance from the outcrop from which the fragment was derived. Generally of boulder size, although fragments range from pebbles to house-sized blocks.

Glacial outwash – Stratified sediment, consisting chiefly of sand and gravel, removed or "washed out" from a glacier by meltwater streams and deposited in front of or beyond the terminal moraine or the margin of an active glacier.

Glaciofluvial – Pertaining to the meltwater streams flowing from wasting glacier ice, and especially to the deposits and landforms produced by such streams.

Glaciolacustrine – Pertaining to, derived from, or deposited in glacial lakes. Also said of the deposits and landforms composed of suspended material brought by meltwater streams flowing into lakes bordering a glacier.

Glaciomarine – Said of marine sediments that contain glacial material. Similar to glaciolacustrine, except related to marine water that borders a glacier, and containing clastic debris.

Granodiorite – An igneous intrusive rock of intermediate chemistry similar in composition to granite.

Groundwater – The water beneath the surface of the ground. Typically, groundwater occurs in the small pores between grains of soil or in rock.

Group – A major rock stratigraphic unit next higher in rank than formation, consisting of two or more associated formations.

Headwater – The source (or sources) and upper part of a stream, including the upper drainage basin.

Holocene – The upper epoch of the Quaternary period, from the end of the Pleistocene to present time. Formerly referred to as "Recent."

HPA – Hydraulic Permit Approval

Hydrogeology – The science that deals with subsurface waters and related geologic aspects of surface waters.

Hydrology – The science dealing with the properties, distribution, and circulation of water.

Ice-contact deposits – Stratified glacial drift deposited in contact with melting glacier ice, normally marked by numerous kettles and hummocky ground.

Intermittent – Referring to periodic water flow in creeks or streams.

Intraslab earthquakes – Earthquakes that originate within a subducting slab, or plate, as opposed to originating on the slab or plate boundaries (interslab).

Intrusive igneous rock – Rock formed when molten rock (magma) is injected into existing rock. The intrusive body can range from a narrow dike or sill to a body that is miles across.

Island arc complex – A generally curved linear belt of volcanoes above a subduction zone, and the volcanic (extrusive) and plutonic (intrusive) rocks formed there.

Joint (geologic) – A fracture or parting surface in a rock without displacement.

Jurassic – The second period of the Mesozoic era covering the span of time between 190 and 135 million years ago.

Kettle (geologic) – A steep-sided, usually basin- or bowl-shaped hole or depression without surface drainage in glacial drift deposits. Commonly contains a lake, pond or swamp. Formed by the melting of a large block of stagnant ice (left behind after a retreating glacier) that had been wholly or partly buried in the glacial drift.

kV – kilovolt (thousand volts)

Landform – Any physical, recognizable form or feature of the Earth's surface, having a characteristic shape, and produced by natural causes. It includes major forms such as a plain, plateau, mountain, slope or dune, among others.

Landslide – Any mass movement process characterized by downslope movement of soil and rock by means of gravity, or the resulting landform. Can also include other forms of mass wasting not involving sliding, e.g., rockfall. The terminology designating particular landslide types generally refers to the landform as well as the process responsible for the landform, e.g., deep-seated landslide, or earth flow.

Lapilli – Grains of pyroclastic material with a size range between 2 and 64 mm.

Lattice steel – Refers to a transmission tower constructed of multiple steel members connected to make up the frame.

Liquefaction – The phenomenon in which saturated, cohesionless soils are temporarily transformed into a near liquid or "quicksand" state. During an earthquake, ground shaking may result in a buildup of pore-water pressure in the saturated soil to a point where the pore-water pressure approaches the grain-to-grain contact pressure. As this occurs, the soil particles begin to lose contact with each other and the soil liquefies.

Lodgment till – A very dense glacial till containing a distribution of all soil particles, from clay to boulders, formed beneath a moving glacier and deposited upon bedrock or other glacial deposits. Commonly characterized by fissile structure (capable of being split easily along closely spaced planes) and stones oriented with their long axes generally parallel to the direction of ice movement.

Low-gradient – With gentle slopes.

Mafic Diorite – An intrusive igneous rock of intermediate chemistry with a composition between granite and gabbro.

Magnitude (earthquake) – A measure of the strength of an earthquake or the strain energy released by it, as determined by seismographic observations.

Mass movement – The dislodgment and downhill transport of soil and rock materials under the direct influence of gravity. Includes movements such as creep, debris torrents, rock slides, and avalanches.

Mass wasting – A general term for the dislodgement and downslope transport of soil and rock material under gravitational forces. It includes slow displacements such as soil creep and rapid movements such as earthflows, rock falls and avalanches.

M_b – An earthquake magnitude determined by using the logarithm of the ratio of amplitude to period for body waves.

Metagabbro – A metamorphosed gabbro.

Metamorphism – The mineralogical, chemical and structural adjustment of solid rocks to changed physical and chemical conditions at depth below the Earth's surface.

Micaceous – Rock containing a significant percentage of mica, a mineral that typically forms as sheets.

Miocene – An epoch of the upper Tertiary period, lasting 18.4 million years, after the Oligocene (23.7 mybp) and before the Pliocene (5.3 mybp).

Mitigation – Steps taken to lessen the effects predicted for each resource, as potentially caused by the transmission project. They may include reducing the impact, avoiding it completely, or compensating for the impact. Some mitigation, such as adjusting the location of a tower to avoid a special resource, is taken during the design and location process. Other mitigation, such as reseeding access roads to desirable grasses and avoiding weed proliferation, is taken after construction.

Monzonite – An intrusive igneous rock of intermediate chemistry similar in composition to granite.

mph – miles per hour

M_s - An earthquake magnitude determined by using the logarithm of the amplitude of the 20-second period earthquake surface waves.

M_w - An earthquake magnitude determined, in part, by multiplying the area of the fault's rupture surface by the distance the earth moves along the fault. This measurement provides a direct value of earthquake energy and is the preferred method.

mybp – million years before present

NMFS – National Marine Fisheries Service

NOI – Notice of Intent

Normally consolidated – Soil and sedimentary deposits that are consolidated in equilibrium with the overburden pressure.

NPDES – National Pollutant Discharge Elimination System

NRCS – National Resource Conservation Service (formerly Soil Conservation Service)

NWP – Nationwide Permit

Oligocene – An epoch of the lower Tertiary period, lasting 12.9 million years, after the Eocene (36.6 mybp) and before the Miocene (23.7 mybp).

Outcrop – An area where rock is exposed at the Earth's surface.

Overconsolidated – Said of soil and sedimentary deposits that are consolidated greater than normal for the existing overburden pressure. Commonly caused by large overburden pressures that have subsequently been removed. Soil and sedimentary deposits that were overridden by glacier ice are typically overconsolidated.

Peak ground acceleration – The maximum instantaneous ground acceleration caused by an earthquake.

Perennial – Streams or creeks with year-round water flow.

Permeability – The ease with which a fluid will move through a porous medium, such as rock or soil.

PGA – peak ground acceleration

Pleistocene – An epoch of the Quaternary, lasting 2 million years, after the Pliocene (2 mybp) and before the Holocene (0.01 mybp).

Plug (geologic) – A vertical, pipe-shaped body of magma that represents the conduit of a former volcano.

Plunging (geologic) – The inclination of a fold axis inclined to the horizontal.

Porphyritic – Said of the texture of an igneous rock in which larger crystals are present in a generally fine-grained rock.

Pumice – A light-colored, vesicular, glassy, volcanic rock with the composition of rhyolite.

Pyroxenite – An iron and magnesium rich igneous intrusive rock chiefly composed of the mineral pyroxene.

Quaternary – The second period of the Cenozoic era (following the Tertiary) thought to cover the last 2 or 3 million years. It includes the Pleistocene and Holocene epochs.

Rainsplash erosion – Erosion that occurs when raindrops impact bare soil and incorporate soil particles in the water that splashes. On a slope, more of the rainsplash moves downslope, resulting in a net downslope soil movement.

Ravel – The downslope movement of single, granular particles, usually as a result of gravity.

Recessional outwash - Glacial outwash deposited by a receding glacier. Recessional outwash deposits are normally consolidated and typically are loose to medium dense.

Residual soil, residuum – An accumulation of rock debris and soil formed by weathering and remaining essentially in place as a thin surface layer over the underlying parent material.

Rhyolite – An extrusive igneous rock with large crystals in a fine grained mass, typically showing flow texture.

ROW (ROW) – An easement for a certain purpose over the land of another, such as a strip of land used for a road, electric transmission line, or pipeline.

Sandstone – Sedimentary rock consisting usually of quartz sand, but also feldspar or basalt, united by some cementing agent.

SCS – Soil Conservation Service

SDEIS – Supplemental Draft Environmental Impact Statement

Sediment – Solid fragmental material or a mass of such material, either inorganic or organic, that originates from weathering rocks and is transported by, suspended in, or deposited by air, water, or ice, and that forms in layers on the Earth's surface.

Sedimentary – Pertaining to or containing sediment.

Sedimentation – The process of forming or accumulating sediment in layers.

Seiche – A seismically induced wave that forms on a lake or other closed body of water. It is similar to a tsunami but restricted to a closed body of water.

Seismic – Earthquake activity

Seismogenic – Said of a fault or zone that is capable of generating earthquakes.

Serpentinized – Hydrothermally-altered rock by which magnesium-rich silicate minerals are replaced by the mineral serpentine.

Shale – A fissile rock that is formed by the consolidation of clay, mud, or silt, has a finely stratified or laminated structure, and is composed of minerals essentially unaltered since deposition.

Sill (geologic) – A tabular body of igneous intrusion that parallels the planar structure of the surrounding rock. Similar to a dike, except that the orientation of a dike cuts across the planar structure of the surrounding older rock.

Siltstone – A rock composed chiefly of indurated silt.

Single circuit – A line with one electrical circuit on the same tower.

Slump – Deep, rotational landslide, generally producing coherent movement (back rotation) of blocks over a concave failure surface. Typically, slumps are triggered by the buildup of pore-water pressure in mechanically weak materials (deep soil or clay-rock rock).

Soil – All earthy material overlying bedrock.

SPCC – Spill Control Containment and Countermeasures

SPU – Seattle Public Utilities

Stratified – Formed, arranged, or laid down in layers or strata, especially said of any layered sedimentary rock or deposit.

Structure – Refers to a type of support used to hold up transmission or substation equipment.

Subduction zone – An elongate region along which a crustal block of the Earth's surface descends relative to another crustal block.

Subcrustal intraslab earthquake – An earthquake that occurs within a subducting plate beneath the crustal plate.

Substation – The fenced site that contains the terminal switching and transformation equipment needed at the end of a transmission line.

Swale – A low-lying or depressed and sometimes wet stretch of land.

SWPPP – Stormwater Pollution Prevention Plan

Syncline – A concave-up fold, the core of which contains stratigraphically younger rocks.

Talus – Rock debris that has accumulated at the base of a cliff or steep slope.

Tap – The point at which a transmission line is connected to a substation or other electrical device to provide service to a local load.

Tectonics – A branch of geology concerned with the structure of the crust of a planet (as Earth) with the formation of folds and faults in it.

Terrace – An old plain of various origins, ordinarily flat or undulating, that borders a river, lake or the sea.

Tertiary - The first period of the Cenozoic era covering the span of time between 65 and 2 million years ago.

TESC – Temporary Erosion and Sedimentation Control

Till – Unsorted and unstratified glacial drift deposited directly by and underneath a glacier without subsequent reworking by water from the glacier. Glacial till typically consists of a heterogeneous mixture of clay, silt, sand, gravel, cobbles and boulders that vary widely in size and shape.

Tonalite – A light-colored, intrusive igneous rock similar to granite.

Tower – See **Structure**.

Transmission line – The structures, insulators, conductors, and other equipment used to transmit electrical power from one point to another.

Tsunami – A gravitational sea wave formed by any large-scale, short-duration disturbance of the ocean floor, which commonly is an earthquake.

Tuff – A general term for lithified consolidated pyroclastic rocks.

Turbidity – The state or condition or quality of opaqueness or reduced clarity of a fluid, due to the presence of suspended matter.

USC – Unified Soil Classification

USDA – U.S. Department of Agriculture

USFWS – United States Fish and Wildlife Service

USGS – United States Geological Survey

USLE – Universal Soil Loss Equation

Vashon Stade – The middle of three stades of the last glaciation of the Puget Lowland, the most recent stade that reached the central Puget Lowland.

Volcanic – Pertaining to the activities, structures or rock types of a volcano.

Volcanic ash – Fine material formed by a volcanic explosion or aerial expulsion from a volcanic vent.

Volcaniclastic – Pertaining to clastic rocks, containing volcanic material in various proportions and without regard to its origin or environment.

Volcanic tuff – A compact deposit of volcanic ash and dust formed by a volcanic explosion or aerial expulsion from a volcanic vent. It may contain up to 50 percent of non-volcanic sediment.

Volt – The international system unit of electric potential and electromotive force.

Voltage – The driving force that causes a current to flow in an electrical circuit.

Water bars – Smooth, shallow ditches excavated at an angle across a road to decrease water velocity and divert water off and away from the road surface.

WDFW – Washington State Department of Fish and Wildlife

WRIA – Water Resource Inventory Area

Wetlands – An area where the soil experiences anaerobic conditions because of inundation of water during the growing season. Indicators of a wetland include types of plants, soil characteristics, and hydrology of the area.

Windthrow – The uprooting and tipping over of trees by wind.

LIST OF PREPARERS

Principal Investigators

William T. Laprade, C.E.G. — Engineering Geologist, Vice President
Responsible for geology and engineering geology review.
Education: B.A. and M.A. Geography, B.S. Geological Sciences, Post-Graduate Studies.
Experience: Engineering geology including landslides, tunnels, foundations, dams, and pipeline and roadway alignments; with Shannon & Wilson since 1973.

Christopher A. Robertson, P.E., C.E.G. — Geotechnical Engineer, Project Manager
Responsible for geotechnical engineering and project management.
Education: B.S. and M.S. Geology, M.S. Civil Engineering
Experience: 20 years of professional experience in geotechnical engineering, hydrogeology, slope stability, and seismic geotechnical engineering; with Shannon & Wilson since 1995.

Jeffrey R. Laird, C.E.G. — Senior Principal Engineering Geologist
Responsible for geologic analysis and report preparation.
Education: B.S. Geology, M.S. Geomorphology
Experience: 15 years of professional experience in geologic field mapping, erosion and sedimentation, and fluvial geomorphology and slope stability; with Shannon & Wilson since 1987.

Technical and Clerical Assistance

A.G. Black	Reproduction Technician
Andrew J. Caneday	Geologist, GIS Technician
Conrad S. Kartanas	Information Resources Specialist
Lori K. Doherty	Word Processing Supervisor
William J. Perkins, R.P.G	Geologist, Seismic Hazards Specialist
Becki S. Kniveton	Ecologist
Katie L. Walter, P.W.S.	Senior Principal, Wetland Biologist

TABLE 1
BONNEVILLE POWER ADMINISTRATION
KANGLEY-TO-ECHO LAKE TRANSMISSION PROJECT GEOLOGIC DESCRIPTIONS OF UNITS LIKELY TO BE ENCOUNTERED ON PROPOSED ALTERNATIVE ALIGNMENTS

Map Unit	Description	Age	Soil/Rock Type	Structure and Bedding	Associated Hazards
QUATERNARY DEPOSITS					
Qf	Fill	Holocene	Unit primarily includes Cedar River Landfill; other fill material could include highway embankments, and quarry and borrow pits.	Fill commonly placed in lifts and compacted, but does not create internal structure with potential planes of weakness.	Generally low and variable density levels, leachate and methane gas from landfill material, variable materials over short distances.
Qa	Alluvium	Holocene	Cedar and Snoqualmie Rivers: Well-sorted pebble to cobble gravel and sand, bars and terraces. Smaller streams: thin deposits of sand and gravel.	Very loose to medium dense. Stratified with crossbedding. May contain organic material.	Streambank erosion, ponding, high groundwater, flooding, siltation and potentially liquefiable; locally compressible.
Qb	Bog	Holocene	Organic sediment deposited mostly in closed depressions. The thickness is highly variable.	Very soft to medium stiff. Horizontally laminated, rooted and bioturbated.	Poor foundation material that could cause large, differential foundation and/or road settlements. Fills potentially unstable. High groundwater and ponded water.
Qt	Talus Deposits	Holocene	Nonsorted, angular boulder gravel to boulder diamicton.	No sorting or structure.	Variable foundation strength. Excavations or drainage modifications could reactivate movement. Boulders would impede excavations.
Qls	Landslide	Holocene to Pleistocene	Landslide debris composed of colluvium and/or weak bedrock.	No sorting or structure, hummocky topography, and weak slip planes.	Renewed ground movement, variable foundation strength, poor drainage. Excavations, erosion, fills, drainage modifications or removal of vegetation could reactivate movement.
Qag	Alpine Glacial Deposits	Pleistocene	Ranges from boulder till in mountains to gravel and sand outwash in valleys.	Loose to dense. Well-sorted and stratified to poorly sorted and massive deposits.	Variable strength and drainage characteristics, low liquefaction potential. Scattered boulders could impede excavation.
Qvic	Vashon Stade Ice Contact Deposits	Pleistocene	Pebbly sand and pebble-cobble gravel, with occasional boulders. Forms kames, kame terraces and eskers.	Loose to dense. Well-sorted and stratified to poorly sorted and massive deposits.	Variable strength and drainage characteristics, low liquefaction potential. Scattered boulders could impede excavation.

TABLE 1
BONNEVILLE POWER ADMINISTRATION
KANGLEY-TO-ECHO LAKE TRANSMISSION PROJECT GEOLOGIC DESCRIPTIONS OF UNITS LIKELY TO BE ENCOUNTERED ON PROPOSED ALTERNATIVE ALIGNMENTS

Map Unit	Description	Age	Soil/Rock Type	Structure and Bedding	Associated Hazards
Qvr	Vashon Stade Glacial Recessional Outwash	Pleistocene	Sand, pebble-cobble gravel, and silty sand.	Stratified, moderately to well-sorted sand and gravel to well-bedded silt and clay. Loose to dense, variable permeability.	Variable strength and drainage characteristics, cut slopes could ravel from lack of cohesion, low liquefaction potential. Scattered boulders could impede excavation.
Qvt	Vashon Stade Till	Pleistocene	Gravel and occasional boulders in a silty sand matrix. Glacial till deposits are typically 10 feet thick, but could be as thick as 50 feet.	Dense to very dense. Typically massive and unsorted to poorly sorted, may contain lenses of sand.	Typically high load-bearing characteristics, but high pore-water pressure could exist in perched ground water or in confined sand lenses. Scattered boulders could impede excavation.
Qpf	Pre-Fraser glaciation sedimentary deposits	Pleistocene	Sand and gravel, lacustrine deposits and diamict composed of silt-rounded gravel in silt matrix.	Moderately dense to very dense. Sand and gravel could show bedding, diamict typically massive and unsorted.	Typically high load-bearing characteristics, but high pore-water pressure could exist in perched ground water or in confined sand lenses. Scattered boulders could impede excavation.
TERTIARY BEDROCK UNITS					
Tsgs	Snoqualmie Batholith Granodiorite and Tonalite	Early Miocene	Hornblende-biotite granodiorite and tonalite, medium-grained, equigranular.	Generally massive with widely spaced jointing.	Adversely oriented joints could form failure planes if daylighted. Rockfall.
Tsgf	Snoqualmie Batholith Fine-Grained Monzonite	Early Miocene	Highly altered, light-colored, fine-grained monzonite.	Generally massive with widely spaced jointing.	Adversely oriented joints could form failure planes if daylighted. Rockfall.
Tsm	Snoqualmie Batholith Mafic Diorite and Gabbro	Early Miocene	Biotite-hornblende diorite and gabbro.	Fractures and joints.	Adversely oriented joints could form failure planes if daylighted. Rockfall.

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Map Unit	Description	Age	Soil/Rock Type	Structure and Bedding	Associated Hazards
Thm	Huckleberry Mountain Volcanics	Oligocene	Andesite and basalt breccia, tuff and flows, minor dacite and rhyoloite tuff and breccia.	Bedding, joints and fractures.	Adversely oriented joints and bedding could form failure planes if daylighted. Failures could develop on weak interbedded layers. Rockfall.
Thmk	Tuff of Lake Keechelus	Oligocene	Dacite crystal-vitric tuff and breccia.	Massive to relict bedding defined by flattened pumice grains, and breccia blocks to 3.5 feet in diameter.	Adversely oriented joints and bedding could form failure planes if daylighted. Failures could develop on weak interbedded layers. Rockfall. Massive, fresh flow rocks could require blasting/hydraulic breaking.
Tv	Volcanic Rocks	Oligocene	Andesite with minor dacite and rhyolite breccia, tuff, ash flow tuff and rare flows, most recrystallized by thermal metamorphism to biotite hornfels.	Massive to blocky jointing. Obscure flow layering.	Adversely oriented joints could form failure planes if daylighted. Rockfall. Massive, metamorphically-altered rocks could require blasting/hydraulic breaking.
Tdg	Diabase, gabbro and basalt	Oligocene	Fine- to medium-grained, black diabase and gabbro dikes and plugs.	Jointing and dike contacts.	Adversely oriented joints could form failure planes if daylighted. Rockfall. Massive, fresh flow rocks could require blasting/hydraulic breaking.
Tpa	Volcanic Rocks of Mt. Persis	Oligocene	Gray to black, porphyritic andesite and andesite breccia.	Massive to blocky jointing. Obscure flow layering.	Adversely oriented joints could form failure planes if daylighted. Rockfall. Massive, fresh-flow rocks could require blasting/hydraulic breaking.

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Map Unit	Description	Age	Soil/Rock Type	Structure and Bedding	Associated Hazards
Tpg	Puget Group, undifferentiated	Middle to Late Eocene	Sandstone, siltstone, claystone and coal, deposited primarily in a fluvial environment.	Sandstone is generally massive to crossbedded. Occasional channel cut-and-fill structures. Fractures, joints, bedding planes and facies contacts.	Adversely oriented, interbedded weak rocks (coal, claystone), bedding planes and joints could form failure planes. Rockfall. High pore-water pressures in perched groundwater. Massive rock could require blasting/hydraulic breakers.
Tpr	Renton Formation	Late Eocene	Sandstone, siltstone, claystone and coal deposited in fluvial and nearshore marine environments.	Fine-grained siltstone and claystone interbeds commonly form valleys between more resistant sandstone- capped ridges. Fractures, joints, bedding planes and facies contacts.	Adversely oriented, interbedded weak rocks (coal, claystone), bedding planes and joints could form failure planes. Rockfall. High pore-water pressures in perched groundwater. Massive rock could require blasting/hydraulic breakers.
Tpt	Tukwila Formation	Middle to Late Eocene	Volcanic lava flows, sills and dikes, tuff, and breccia, with sandstone and conglomerate interbeds.	Flow rocks are more resistant to erosion and make up most Tukwila Formation outcrops. Fractures, joints, bedding planes and facies contacts.	Interbedded and fractured/jointed weak and strong rocks, and zones of highly weathered rock form failure planes. Rockfall. Massive, fresh-flow rocks could require blasting/hydraulic breaking.
Tn	Naches Formation	Late Eocene	Rhyolite, andesite and basalt flows, tuff and breccia with interbedded sandstone and siltstone.	Flow bedding, columnar jointing, joint sets. Sedimentary beds with crossbedding and graded bedding.	Interbedded and fractured/jointed weak and strong rocks and zones of highly weathered rock form failure planes. Rockfall. Massive, fresh-flow rocks could require blasting/hydraulic breaking.
Tnr	Naches Formation Rhyolite	Late Eocene	White to gray flows or ash-flow tuffs with pumice. Minor interbeds of basaltic flows and tuff.	Flow banding and platy jointing. Beds tens to hundreds of feet thick.	Interbedded and fractured/jointed weak and strong rocks, and zones of highly weathered rock form failure planes. Rockfall. Massive, fresh-flow rocks could require blasting/hydraulic breaking.

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Map Unit	Description	Age	Soil/Rock Type	Structure and Bedding	Associated Hazards
Tns	Feldspathic Sandstone and Volcanic Rocks	Late Eocene	Tan to gray, well-bedded, medium to coarse-grained, micaceous sandstone and interbedded siltstone and shale, with rhyolite, andesite and basalt flows, tuff and breccia.	Bedding, interbeds, joint sets	Interbedded and fractured/jointed weak and strong rocks, and zones of highly weathered rock form failure planes. Rockfall. Massive, fresh-flow rocks could require blasting/hydraulic breaking.
Tnmc	Mt. Catherine Rhyolite	Late Eocene	Black, welded, crystal-lithic ash-flow tuff with pumice lapilli and breccia. Interbedded thin sandstone and shale.	Flow-banded, platy jointing.	Interbedded and fractured/jointed weak and strong rocks, and zones of highly weathered rock form failure planes. Rockfall. Massive, fresh-flow rocks could require blasting/hydraulic breaking.
Tng	Guye Sedimentary Member	Late Eocene	Light to dark-gray feldspathic sandstone, black slaty shale, and hard chert pebble conglomerates. Rare volcanic interbeds.	Bedding and joint sets.	Interbedded and fractured/jointed weak and strong rocks, and zones of highly weathered rock form failure planes. Rockfall. Massive, fresh-flow rocks could require blasting/hydraulic breaking.
pTwa	Western Melange Belt Argillite and Graywacke	Pre-Tertiary	Well-bedded marine sandstone and argillite.	Bedding, graded bedding, load casts. Folds and shears.	Interbedded and fractured/jointed weak and strong rocks, and zones of highly weathered rock form failure planes. Rockfall. Massive, fresh-flow rocks could require blasting/hydraulic breaking.
pTwg	Western Melange Belt Metagabbro	Pre-Tertiary	Massive to foliated, fine to medium grained metagabbro.	Foliation, shears	Interbedded and fractured/jointed weak and strong rocks, and zones of highly weathered rock-form failure planes. Rockfall. Massive, fresh-flow rocks could require blasting/hydraulic breaking.

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Map Unit	Description	Age	Soil/Rock Type	Structure and Bedding	Associated Hazards
pTwu	Western Melange Belt Ultramafite	Pre-Tertiary	Serpentinized pyroxenite	Shears	Interbedded and fractured/jointed weak and strong rocks, and zones of highly weathered rock-form failure planes. Rockfall. Massive, fresh-flow rocks could require blasting/hydraulic breaking.

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Map Unit	Name	Bedrock Depth (inches)	Erosion Factor, K	Slope %	Description	Erosion Hazard	Windthrow Hazard
1	Alderwood gravelly loam	20-60	0.32	6-15	Weathered glacial till.	Slight	Moderate
2	Alderwood gravelly loam	40-60	0.32	15-30	Weathered glacial till.	Slight	Moderate
5	Altapeak gravelly sandy loam	40-60 Soft	0.15	30-65	Mixture of volcanic ash and colluvium over granitic and metamorphic rocks.	Moderate	Slight
7	Altapeak - Rock outcrop complex	0 Hard	0.15	45-90	Hard and mostly unweathered granitic or metamorphic rocks.	Severe	Slight
10	Barneston gravelly coarse sandy loam	>60	0.15	0-6	Glacial outwash terraces and volcanic ash.	Slight	Slight
11	Barneston gravelly coarse sandy loam	>60	0.15	6-30	Glacial outwash terraces and volcanic ash.	Slight	Slight
12	Barneston gravelly coarse sandy loam	>60	0.15	30-65	Glacial outwash terraces and volcanic ash.	Moderate	Slight
13	Barneston gravelly sandy loam	>60	0.15	0-8	Glacial outwash terraces and volcanic ash.	Slight	Slight
14	Barneston gravelly sandy loam	>60	0.15	8-30	Glacial outwash terraces, terrace escarpments and volcanic ash.	Slight	Slight
15	Barneston gravelly sandy loam	>60	0.15	30-65	Glacial outwash terraces, terrace escarpments and volcanic ash.	Moderate	Slight
16	Barneston gravelly sandy loam, windswept	>60	0.15	6-30	Glacial outwash terraces and volcanic ash.	Slight	Slight
17	Beausite gravelly loam	24-60	0.20	6-30	Colluvium derived from glacial till and sandstone.	Slight	Moderate
18	Beausite gravelly loam	24-60	0.20	30-65	Colluvium derived from glacial till and sandstone.	Moderate	Moderate
24	Blenthen gravelly loam	>60	0.24	30-65	Colluvium and slope alluvium formed from glacial drift. Some admixture of volcanic ash.	Moderate	Slight
35	Chinkmin sandy loam	>60	0.20	15-30	Mixture of volcanic ash and colluvium derived from glacial till.	Slight	Moderate
36	Chinkmin sandy loam	>60	0.20	30-65	Mixture of volcanic ash and colluvium derived from glacial till.	Moderate	Moderate
41	Chuckanut loam	>60	0.32	6-15	Colluvium and slope alluvium formed from glacial drift. Some admixture of volcanic ash.	Slight	Slight
42	Chuckanut loam	40-60	0.32	15-30	Mixture of volcanic ash and colluvium derived from sandstone and glacial till.	Slight	Slight

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Map Unit	Name	Bedrock Depth (inches)	Erosion Factor, K	Slope %	Description	Erosion Hazard	Windthrow Hazard
43	Chuckanut loam	40-60	0.32	30-65	Mixture of volcanic ash and colluvium derived from sandstone and glacial till.	Moderate	Slight
51	Cryohemists	>60	0.00	0-2	Mixture of peat, muck, pumice, volcanic ash, and glacial till.	Not evaluated	Not evaluated
53	Edgewick silt loam	>60	0.37	0-3	River terrace alluvium.	Slight	Slight
54	Elwell silt loam	>60	0.28	6-30	Weathered glacial till and volcanic ash.	Slight	Moderate
55	Elwell silt loam	20-40	0.28	30-65	Weathered glacial till with an admixture of volcanic ash and loess.	Moderate	Moderate
65	Gallup loam, breccia substratum	>60	0.32	30-65	Volcanic ash and colluvium derived from volcanic breccia.	Moderate	Slight
70	Grotto gravelly loamy sand	>60	0.10	0-8	Alluvial terraces.	Slight	Slight
71	Hartnit silt loam	20-40	0.24	8-30	Mixture of glacial till, volcanic ash, and colluvium derived from andesite.	Slight	Moderate
73	Haywire sandy loam	20-40 Hard	0.20	30-65	Mixture of volcanic ash and colluvium derived from volcanic rock.	Moderate	Moderate
80	Index loamy sand	40-70 Soft	0.15	8-30	Mixture of volcanic ash and colluvium derived from granitic and metamorphic rocks.	Slight	Slight
81	Index loamy sand	40-70 Soft	0.15	30-65	Mixture of volcanic ash and colluvium derived from granitic and metamorphic rocks.	Moderate	Slight
82	Index loamy sand	40-70 Soft	0.15	65-90	Mixture of volcanic ash and colluvium derived from granitic and metamorphic rocks.	Moderate	Slight
83	Index - Rock outcrop complex	0	0.15	45-90	Granitic or metamorphic rocks.	Severe	Slight
90	Kaleetan sandy loam	>60	0.20	30-65	Mixture of volcanic ash and colluvium derived from andesite and glacial till.	Moderate	Slight
91	Kaleetan sandy loam, windswept	>60	0.20	30-65	Mixture of volcanic ash and colluvium derived from andesite and glacial till.	Moderate	Slight
92	Kaleetan sandy loam, till substratum	>60	0.20	8-30	Mixture of volcanic ash and colluvium derived from andesite and glacial till.	Slight	Slight
93	Kaleetan sandy loam, till substratum	>60	0.20	30-65	Mixture of volcanic ash and colluvium derived from andesite and glacial till.	Moderate	Slight

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Map Unit	Name	Bedrock Depth (inches)	Erosion Factor, K	Slope %	Description	Erosion Hazard	Windthrow Hazard
106	Klaber silt loam	30-40	0.32	0-8	Mixture of volcanic ash and colluvium derived from granitic and metamorphic rocks.	Slight	Severe
109	Klapatche loamy sand	30-40 Hard	0.20	30-65	Mixture of volcanic ash and colluvium derived from granitic and metamorphic rocks.	Moderate	Moderate
110	Klapatche - Rock outcrop complex	30-40 Hard	0.20	45-90	Hard and mostly unweathered granitic or metamorphic rocks.	Severe	Moderate
111	Klaus sandy loam	>60	0.20	0-8	Mixture of volcanic ash and alluvium overlying glacial outwash.	Slight	Moderate
114	Klaus sandy loam, windswept	>60	0.20	0-8	Glacial outwash terraces and volcanic ash.	Slight	Moderate
115	Klaus sandy loam, windswept	>60	0.20	30-65	Glacial outwash terraces and volcanic ash.	Moderate	Moderate
121	Littlejohn gravelly sandy loam	25-40	0.15	30-65	Mixture of volcanic ash and pumice overlying residuum and colluvium derived from extrusive igneous rocks.	Moderate	Moderate
128	Marblemount gravelly loamy sand	20-40 Soft	0.10	8-30	Mixture of volcanic ash and colluvium derived from granitic and metamorphic rocks.	Slight	Moderate
129	Marblemount gravelly loamy sand	20-40 Soft	0.10	30-65	Mixture of volcanic ash, glacial till, and colluvium derived from granitic and metamorphic rocks.	Moderate	Moderate
131	Marblemount - Rock outcrop complex	20-40 Soft	0.10	45-90	Hard and mostly unweathered granitic or low-grade metamorphic rocks.	Severe	Moderate
135	Melakwa sandy loam	20-40 Hard	0.28	30-65	Mixture of volcanic ash and pumice overlying residuum and colluvium derived from andesite.	Moderate	Moderate
136	Melakwa sandy loam, windswept	20-40 Hard	0.28	30-65	Mixture of volcanic ash and pumice overlying residuum and colluvium derived from andesite.	Moderate	Moderate
138	Melakwa - Rock outcrop complex	20-40 Hard	0.28	45-90	Hard and mostly unweathered andesite.	Severe	Moderate
142	Nagrom sandy loam	20-40 Hard	0.17	30-65	Mixture of volcanic ash and pumice overlying residuum and colluvium derived from volcanic rock.	Moderate	Moderate
145	Nagrom - Rock outcrop complex	20-40 Hard	0.17	30-90	Hard and mostly unweathered andesite.	Moderate	Moderate

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Map Unit	Name	Bedrock Depth (inches)	Erosion Factor, K	Slope %	Description	Erosion Hazard	Windthrow Hazard
146	Nargar fine sandy loam	>60	0.32	0-15	Mixture of volcanic ash and sandy alluvium over glacial outwash.	Slight	Slight
147	Nargar fine sandy loam	>60	0.32	15-30	Mixture of volcanic ash and sandy alluvium and glacial outwash terraces.	Slight	Slight
148	Nargar-Pastik complex	>60	0.32	35-70	Terrace escarpments of sandy alluvium and glacial outwash, and lake sediments mixed with volcanic ash.	Moderate	Slight
152	Nimue loamy sand	>60	0.17	30-65	Mixture of volcanic ash and pumice overlying residuum and colluvium derived from volcanic rock.	Moderate	Slight
156	Nimue - Rock outcrop complex	0 Hard	0.17	30-90	Hard and mostly unweathered andesite.	Moderate	Slight
157	Nooksack silt loam	>60	0.37	0-2	Flood plains and alluvial terraces.	Slight	Slight
158	Norma loam	>60	0.37	0-3	Alluvium in depressions in glacial till.	Slight	Severe
162	Ogarty gravelly loam	20-40 Hard	0.20	8-30	Volcanic ash and colluvium, and residuum developed from andesite and breccia.	Slight	Moderate
163	Ogarty gravelly loam	20-40	0.20	30-65	Volcanic ash and colluvium, and residuum developed from andesite and breccia.	Moderate	Moderate
171	Orthents, avalanche chutes - Humods complex	20-60 Hard	0.10	30-100	Colluvium derived from granite.	Not evaluated	Not evaluated
172	Ovall gravelly loam	20-40	0.17	15-30	Mixture of glacial drift and colluvium derived from andesite.	Slight	Moderate
173	Ovall gravelly loam	20-40	0.17	30-65	Mixture of glacial drift and colluvium derived from andesite.	Moderate	Moderate
174	Pastik silt loam	>60	0.32	0-30	Terrace escarpments of lake sediments and volcanic ash.	Slight	Moderate
176	Persis sandy loam	>60	0.28	0-8	Stream terraces of a mixture of volcanic ash and alluvium over deltaic deposits.	Slight	Slight
181	Pheeney - Rock outcrop complex	0	0.17	30-90	Andesite.	Moderate	Moderate
182	Phillipa sandy loam	>60	0.32	0-30	Mixture of volcanic ash, colluvium, and ablation till over dense glacial till.	Slight	Moderate

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Map Unit	Name	Bedrock Depth (inches)	Erosion Factor, K	Slope %	Description	Erosion Hazard	Windthrow Hazard
183	Phillipa sandy loam	>60	0.32	30-65	Mixture of volcanic ash, colluvium, and ablation till over dense glacial till.	Moderate	Moderate
187	Pilchuck loamy fine sand	>60	0.10	0-3	Sandy alluviual flood plains.	Slight	Slight
189	Pitcher sandy loam	>60	0.28	30-65	Volcanic ash and colluvium and residuum derived from andesite.	Moderate	Slight
195	Pits	>60	Not evaluated	na	Areas excavated for gravel, sand, and hard rock.	Not evaluated	Not evaluated
197	Playco loamy sand	>60	0.17	30-65	Mixture of volcanic ash and pumice and colluvium derived dominantly from volcanic rock.	Moderate	Slight
201	Playco - Rock outcrop complex	0 Hard	0.17	30-90	Volcanic rocks.	Moderate	Slight
203	Ragnar loam	>60	0.32	6-15	Glacial outwash terraces.	Slight	Slight
204	Ragnar loam	>60	0.32	15-30	Glacial outwash terraces.	Slight	Slight
205	Ragnar-Lynnwood complex	>60	0.32	2-15	Glacial outwash terraces.	Slight	Slight
206	Ragnar-Lynnwood complex	>60	0.32	30-45	Glacial outwash terraces.	Moderate	Slight
207	Reggad very cobbly muck	>60	0.02	30-90	Mixture of organic material, volcanic ash, and pumice over rock rubble.	Not evaluated	Not evaluated
210	Reggad-Serene complex	20-40	0.02	45-90	Mixture of volcanic ash and colluvium and residuum derived from granitic and low-grade metamorphic rocks.	Moderate	Moderate
211	Reichel silt loam	40-60 Hard	0.32	6-30	Mixture of volcanic ash and colluvium and residuum derived dominantly from volcanic rock.	Slight	Slight
216	Rober loam	>60	0.32	0-30	Volcanic ash and glaciolacustrine sediments.	Slight	Moderate
218	Rock outcrop	0 Hard	Not evaluated	na	Granite, andesite, breccia, or metasedimentary rocks.	Not evaluated	Not evaluated
223	Rock outcrop - Rubble land - Serene complex	0 Hard	0.15	45-90	Mixture of volcanic ash and colluvium, and residuum derived from granitic and low-grade metamorphic rocks.	Moderate	Moderate
224	Rubble land	>40 Hard	Not evaluated	na	Talus slopes at the base of rock outcrops.	Not evaluated	Not evaluated
227	Sauk silt loam	>60	0.28	0-8	River terraces of alluvium and volcanic ash.	Slight	Slight

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Map Unit	Name	Bedrock Depth (inches)	Erosion Factor, K	Slope %	Description	Erosion Hazard	Windthrow Hazard
233	Serene gravelly sandy loam	20-40 Soft	0.15	30-65	Mixture of volcanic ash and colluvium derived from granitic and metamorphic rocks.	Moderate	Moderate
235	Shalcar muck	>60	0.49	0-1	Herbaceous and woody organic deposits over glaciofluvial deposits.	Slight	Severe
236	Si silt loam	>60	0.37	0-2	Alluvial terraces.	Slight	Moderate
239	Skykomish gravelly sandy loam, windswept	>60	0.10	0-30	Glacial outwash terraces and volcanic ash.	Slight	Slight
240	Skykomish very stony loam	>60	0.17	0-30	Glacial outwash terraces, terrace escarpments and volcanic ash.	Slight	Slight
249	Teneriffe loamy sand	>60	0.17	8-30	Mixture of volcanic ash and colluvium derived from granitic and metamorphic rocks.	Slight	Slight
250	Teneriffe loamy sand	>60	0.17	30-65	Mixture of volcanic ash and colluvium derived from granitic and metamorphic rocks.	Moderate	Slight
251	Teneriffe loamy sand, windswept	40-60 Soft	0.17	30-65	Mixture of volcanic ash and colluvium derived from granitic and metamorphic rocks.	Slight	Slight
255	Tokul gravelly loam	20-40	0.20	6-15	Mixture of volcanic ash and glacial till.	Slight	Moderate
256	Tokul gravelly loam	20-40	0.20	15-30	Mixture of volcanic ash and glacial till.	Slight	Moderate
257	Tokul gravelly loam	20-40	0.20	30-65	Mixture of volcanic ash and glacial till.	Moderate	Moderate
258	Tokul - Pastik complex	20-40	0.20	45-90	Mixture of volcanic ash and glacial till.	Severe	Moderate
259	Tokul - Pastik complex, windswept	>60	0.32	45-90	Lake sediments and volcanic ash.	Slight	Moderate
267	Udifluvents	>60	0.15	0-8	Alluvium in low stream terraces and drainageways.	Slight	Slight
280	Winston loam, windswept	>60	0.24	0-30	Glacial outwash terraces, terrace escarpments and volcanic ash.	Slight	Slight
158 / No	Norma loam	>60	0.37	0-3	Alluvium formed in depressions of glacial till.	Slight	Severe
187 / Pc	Pilchuck loamy fine sand	>60	0.10	0-3	Floodplains of sandy alluvium.	Slight to severe	Slight
215 / Rh	Riverwash	>60	Not evaluated	na	Bottom land along rivers - typically stratified cobbles, pebbles, and sand.	Severe to very severe	Not evaluated
231 / Sk	Seattle muck	>60	0.00	0-1	Herbaceous and woody organic deposits.	Slight	Severe

TABLE 2
BONNEVILLE POWER ADMINISTRATION
KANGLEY-TO-ECHO LAKE TRANSMISSION PROJECT SOIL DESCRIPTIONS
OF UNITS LIKELY TO BE ENCOUNTERED ON PROPOSED ALTERNATIVE ALIGHMENTS

Map Unit	Name	Bedrock Depth (inches)	Erosion Factor, K	Slope %	Description	Erosion Hazard	Windthrow Hazard
235 / Sm	Shalcar muck	>60	0.49	0-1	Herbaceous and woody organic deposits over alluvium and glaciofluvial deposits.	Slight	Severe
261 / Tu	Tukwila muck	>60	0.00	0-1	Herbaceous and woody organic deposits stratified with mineral layers.	Slight	Severe
AgB	Alderwood gravelly sand loam	20-40	Not evaluated	0-6	Soils formed from glacial deposits overlying glacial till.	Slight to severe	Slight
AgC	Alderwood gravelly sand loam	20-40	Not evaluated	6-15	Soils formed from glacial deposits overlying glacial till.	Moderate to very severe	Slight
AgD	Alderwood gravelly sand loam	20-40	Not evaluated	15-30	Soils formed from glacial deposits overlying glacial till.	Moderate to very severe	Slight
AkF	Alderwood and Kitsap Soils	20-40	Not evaluated	25-70	Soils formed from glacial deposits overlying glacial till.	Severe to very severe	Moderate
BeC	Beausite gravelly sandy loam	20-40	Not evaluated	6-15	Soils formed from glacial deposits overlying sandstone.	Slight to severe	Slight
BeD	Beausite gravelly sandy loam	20-40	Not evaluated	15-30	Soils formed from glacial deposits overlying sandstone.	Moderate to very severe	Slight
Bh	Bellingham silt loam	> 60	Not evaluated	0-2	Alluvial soils in depressions on glacial till.	Slight	Severe
EvB	Everett gravelly sandy loam	> 60	Not evaluated	0-5	Glacial outwash deposits.	Slight to moderate	Slight
EvC	Everett gravelly sandy loam	> 60	Not evaluated	5-15	Glacial outwash deposits.	Slight to moderate	Slight
EvD	Everett gravelly sandy loam	> 60	Not evaluated	15-30	Glacial outwash deposits.	Moderate to severe	Slight
KpB	Kitsap silt loam	> 60	Not evaluated	2-8	Terraces of glacial lake deposits.	Slight to severe	Moderate
KpD	Kitsap silt loam	> 60	Not evaluated	15-30	Terraces of glacial lake deposits.	Severe to very severe	Moderate
Ma	Mixed alluvial land	> 60	Not evaluated	0-2	Alluvial soils.	Slight	Slight
NeC	Neilton very gravelly loamy sand	> 60	Not evaluated	2-15	Glacial outwash terraces.	Slight to moderate	Slight
Or	Orcas peat	> 60	Not evaluated	0-1	Herbaceous and woody organic deposits in basins.	None	Severe
Os	Oridia silt loam	> 60	Not evaluated	0-2	Alluvial soils in river valleys.	Slight	Moderate

TABLE 2
BONNEVILLE POWER ADMINISTRATION
KANGLEY-TO-ECHO LAKE TRANSMISSION PROJECT SOIL DESCRIPTIONS
OF UNITS LIKELY TO BE ENCOUNTERED ON PROPOSED ALTERNATIVE ALIGHMENTS

Map Unit	Name	Bedrock Depth (inches)	Erosion Factor, K	Slope %	Description	Erosion Hazard	Windthrow Hazard
Py	Puyallup fine sandy loam	> 60	Not evaluated	0-2	Alluvial soils on levees and adjacent to streams in river valleys.	Slight	Slight
RdC	Ragnar - Indianola association, sloping	> 60	Not evaluated	2-15	Glacial outwash terraces.	Slight to moderate	Slight
Su	Sultan silt loam	> 60	Not evaluated	0-2	Alluvial soils in the river valleys.	Slight	Moderate
Ur	Urban land	> 60	Not evaluated	na	Soils that have been modified by disturbance and addition of fill material.	Slight to moderate	Not evaluated
95k	Andic dystrudepts	> 60	0.20	0-3		Slight*	
138k	Pits, mine	0	Not evaluated	na		Not evaluated	
139k	Nard ashy loam	> 60	0.43	0-3		Moderate*	
180k	Nimue ashy sandy loam	> 60	0.17	5-30		Slight*	
214k	Borosaprists	> 60	Not evaluated	0-2		Not evaluated	
217k	Roxer gravelly ashy sandy loam	> 60	0.15	5-25		Slight*	
230k	Rock outcrop - Roxer complex	0	Not evaluated	40-70		Not evaluated	
237k	Kladnick ashy sandy loam	> 60	0.20	0-3		Slight*	
241k	Thetis ashy sandy loam	> 60	0.15	25-45		Slight*	
242k	Roxer gravelly ashy sandy loam	> 60	0.15	25-45		Slight*	
254k	Kachess gravelly ashy sandy loam		0.10	5-25		Slight*	
255k	Thetis ashy sandy loam	> 60	.15	45-65		Slight*	
259k	Fluvaquents	> 60	.37	0-2		Moderate*	
301k	Vabus ashy sandy loam	20-40	.24	0-25		Slight*	
306k	Vabus stony ashy sandy loam	20-40	.24	5-25		Slight*	
308k	Vabus stony ashy sandy loam	20-40	.24	45-65		Slight*	
309k	Vabus ashy sandy loam	20-40	.24	45-65		Slight*	
313k	Vabus stony ashy sandy loam	20-40	.24	25-45		Slight*	
332k	Stirrup ashy sandy loam	> 60	.24	5-30		Slight*	
333k	Stirrup ashy sandy loam	> 60	.24	30-65		Slight*	
335k	Vabus-rock outcrop complex	20-40		45-70		Slight*	

TABLE 2
BONNEVILLE POWER ADMINISTRATION
KANGLEY-TO-ECHO LAKE TRANSMISSION PROJECT SOIL DESCRIPTIONS
OF UNITS LIKELY TO BE ENCOUNTERED ON PROPOSED ALTERNATIVE ALIGHMENTS

Map Unit	Name	Bedrock Depth (inches)	Erosion Factor, K	Slope %	Description	Erosion Hazard	Windthrow Hazard
342k	Gilpar-rock outcrop complex	0	.2	45-65		Slight*	
346k	Gilpar ashy sandy loam	> 60	.2	25-45		Slight*	
347k	Gilpar ashy sandy loam	>60	.2	45-65		Slight*	

* Erosion hazard estimated based on erosion factor and slope.

TABLE 3
303(D) LISTINGS OF WATER BODIES CROSSED BY ALTERNATIVE ALIGNMENTS

303(d) LISTINGS OF WATER BODIES CROSSED BY ALTERNATIVE ALIGNMENTS					
Water Body	**WRIA***	**303d Listed**	**Segment**	**Parameter**	**Segment Location**
ALTERNATIVE A (see Figure 3B)					
Rock Creek	No. 8 Cedar/S Sammamish	No		-	-
Cranmar Creek	No. 8 Cedar/S Sammamish	No		-	-
Jenkins Creek	No. 8 Cedar/S Sammamish	No		-	-
Little Soos Creek	No. 8 Cedar/S Sammamish	No		-	-
Cedar River	No. 8 Cedar/S Sammamish	Yes	833	Fecal Coliform	2 miles downstream
ALTERNATIVE C (see Figure 3C)					
Cedar River	No. 8 Cedar/S Sammamish	Yes	833	Fecal Coliform	10 miles downstream
Walsh Diversion	No. 8 Cedar/S Sammamish	No		-	-
Carey Creek	No. 8 Cedar/S Sammamish	No		-	-
Holder Creek	No. 8 Cedar/S Sammamish	No		-	-
ALTERNATIVE B AND D (see Figure 3D)					
Upper Yakima River	No. 39 Upper Yakima	Yes	77	Temperature	7 miles downstream
Mosquito Creek	No. 39 Upper Yakima	No		-	-
Meadow Creek	No. 39 Upper Yakima	No		-	-
Roaring Creek	No. 39 Upper Yakima	No		-	-
Cold Creek	No. 39 Upper Yakima	No		-	-
Mill Creek	No. 39 Upper Yakima	No		-	-
Rockdale Creek	No. 7 Snohomish	No		-	-
Olallie Creek	No. 7 Snohomish	No		-	-
Humpback Creek	No. 7 Snohomish	No		-	-
Hansen Creek	No. 7 Snohomish	No		-	-
Carter Creek	No. 7 Snohomish	No		-	-
Harris Creek	No. 7 Snohomish	No		-	-
Rock Creek	No. 7 Snohomish	No		-	-
Alice Creek	No. 7 Snohomish	No		-	-
Wood Creek	No. 7 Snohomish	No		-	-
Mine Creek	No. 7 Snohomish	No		-	-
S. Fork Snoqualmie	No. 7 Snohomish	Yes	955	pH	1,000 feet upstream
S. Fork Snoqualmie	No. 7 Snohomish	Yes	956	pH	2,000 feet downstream
Boxley Creek	No. 7 Snohomish	No		-	-

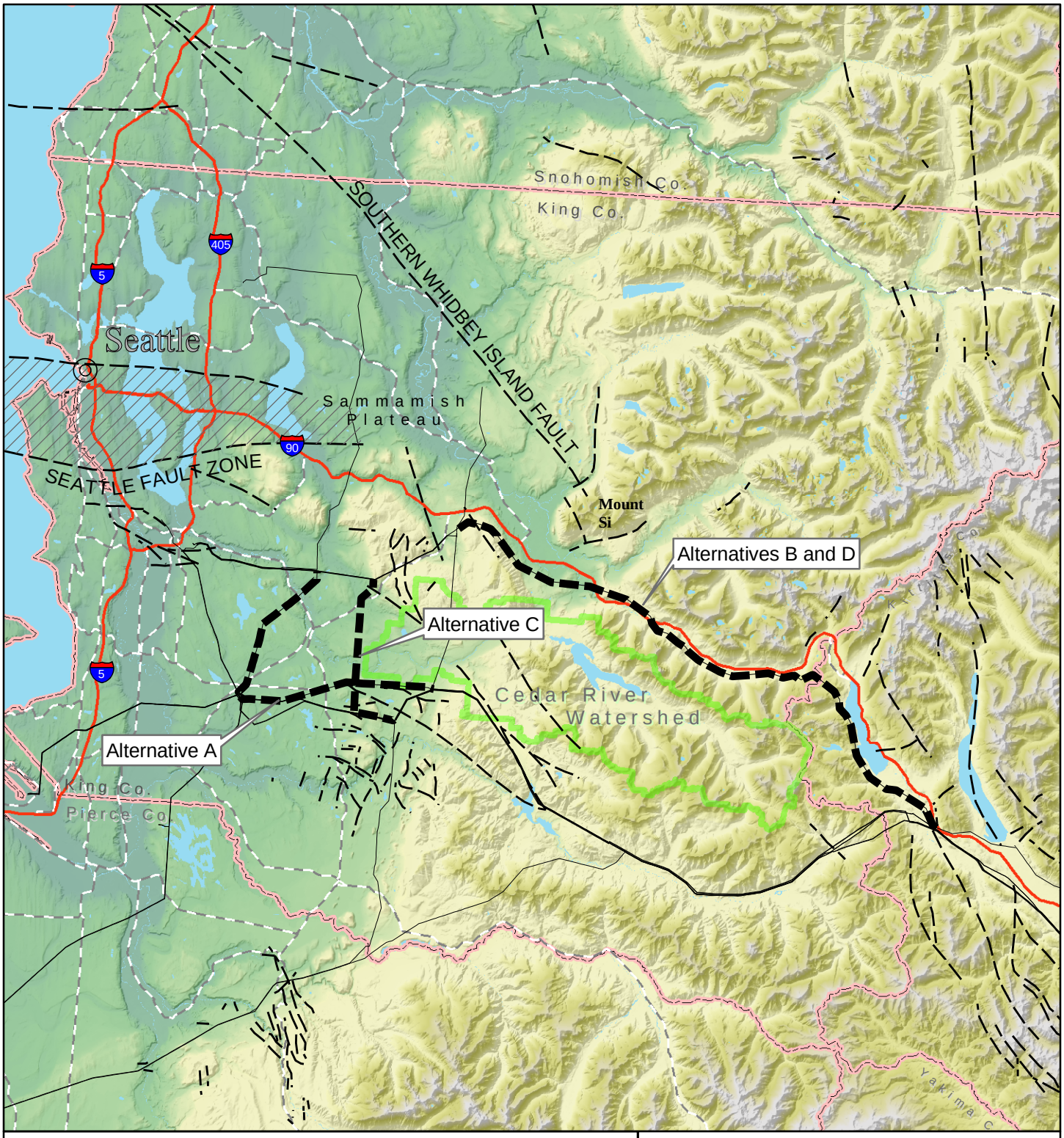
* WRIA = Water Resource Inventory Area

TABLE 4
SUMMARY OF ALTERNATIVE ALIGNMENT HAZARD RATINGS

HAZARD	A	B	C1	C2	D
Length (miles)	20	38	10	10.5	38
Clearing[1] (acres)	0	0	140	110	650
Stream Crossings[2]	11	38	7	5	38
Deep-Seated Landslide (% of Length)					
High	0	0	0	0	0
Moderate	1	4	0	0	5
Low	0	6	3	3	6
None	99	89	97	97	89
Shallow Landslide (% of Length)					
High	0	0	0	0	0
Moderate	1	5	0	0	5
Low	0	7	3	3	6
None	99	89	97	97	88
Soil Erosion (% of Length)					
High	11	2	8	5	2
Moderate	68	28	32	33	28
Low	21	70	60	62	70
Excavation Difficulty (% of Length)					
High	4	45	17	16	45
Moderate	36	23	37	31	23
Low	60	32	46	53	32
Settlement Impact (% of Length)					
High	2	0	0	0	0
None	98	100	100	100	100
Seismic Liquefaction Impacts (% of Length)					
High	2	6	0	0	6
Moderate to Low	0	0	1	1	0
None	98	94	99	99	94
Soft Ground Amplification (% of Length)					
High	2	0	0	0	0
None	98	100	100	100	100
Fault Ground Rupture (% of Length)					
High	0	0	0	0	0
Low	100	100	100	100	100
Floodplain Impacts					
Impacts	X	X	-	-	X
No Impacts	-	-	X	X	-
Water-Quality Limited Water Body Segments					
High	-	-	-	-	-
None	X	X	X	X	X
Groundwater Impacts (% of Length)					
High	56	0	37	37	0
Moderate	44	11	63	63	11
Low	0	89	0	0	89
Windthrow (% of Length)					
High	4	1	3	3	1
Moderate	4	45	43	43	45
Low	92	54	54	54	54

[1] – Assumes a 150-foot-wide ROW clearing.

[2] –Based on perennial and intermittent streams shown on USGS topographic maps (see references). Includes multiple crossings of same stream.



Bonneville Power Administration
Kangley-Echo Lake
Transmission Line Project

VICINITY AND REGIONAL FAULT MAP

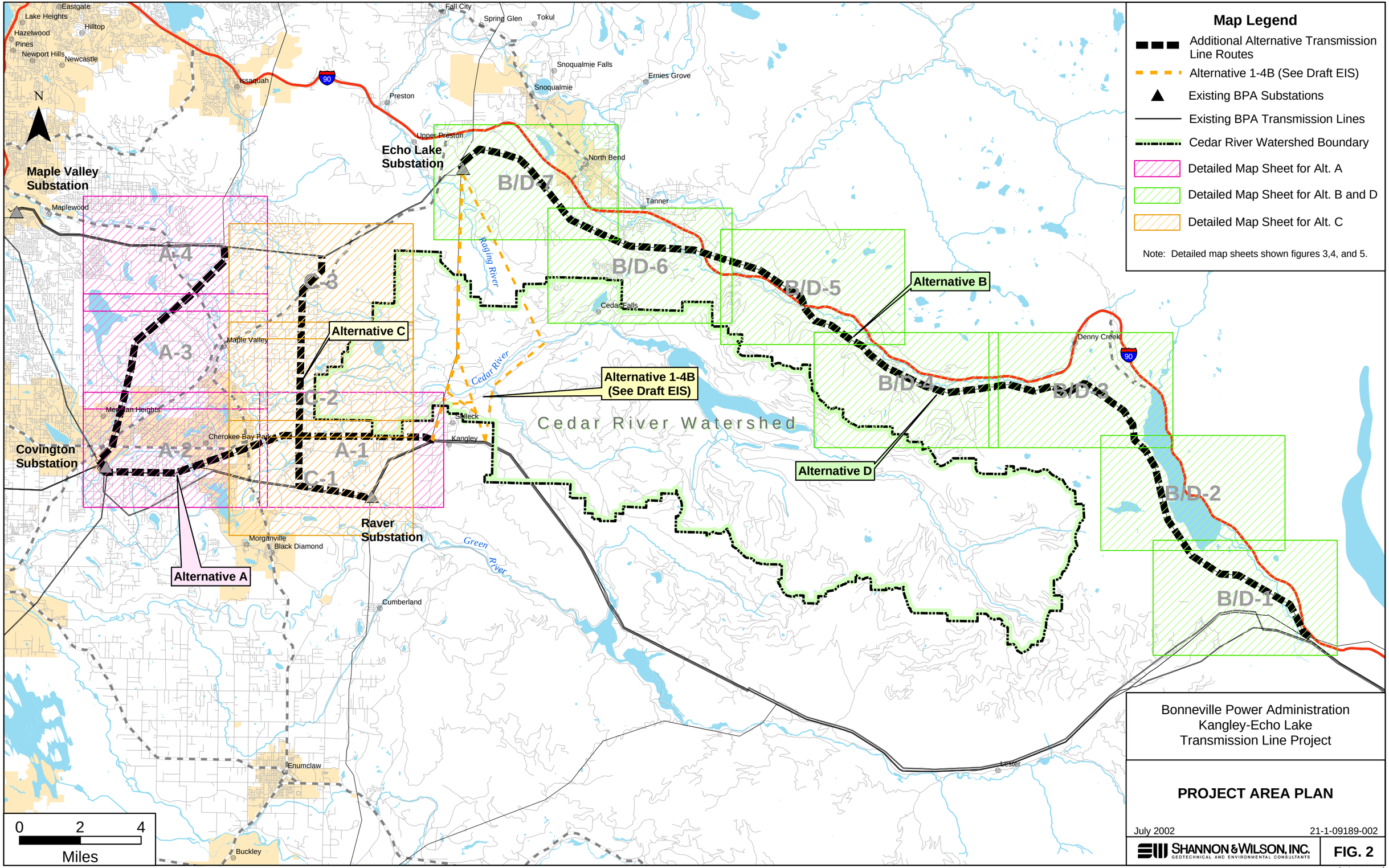
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FIG. 1

perkins.mxd


Map Legend
Additional Alternative Transmission Line Routes
Alternative 1-4B (See Draft EIS)
Existing BPA Substations
Existing BPA Transmission Lines
Cedar River Watershed Boundary
Detailed Map Sheet for Alt. A
Detailed Map Sheet for Alt. B and D
Detailed Map Sheet for Alt. C
Note: Detailed map sheets shown figures 3,4, and 5.
Maple Valley Substation
Echo Lake Substation
Covington Substation
Raver Substation
Alternative A
Alternative B
Alternative C
Alternative D
Alternative 1-4B (See Draft EIS)
A-4
A-3
A-2
A-1
C-3
C-2
C-1
B/D-7
B/D-6
B/D-5
B/D-4
B/D-3
B/D-2
B/D-1
Cedar River Watershed
Roging River
Cedar River
Green River
Eastgate
Lake Heights
Hilltop
Hazelwood
Pines
Newport Hills
Newcastle
Issaquah
Fall City
Spring Glen
Tokul
Snoqualmie Falls
Ernies Grove
Snoqualmie
Preston
Upper Preston
North Bend
Tanner
Cedar Falls
Maplewood
Maple Valley
Meridian Heights
Cherokee Bay Park
Skyleck
Kangley
Morganville
Black Diamond
Cumberland
Enumclaw
Buckley
Lester
Denny Creek
90
N
0 2 4
Miles
Bonneville Power Administration
Kangley-Echo Lake
Transmission Line Project
PROJECT AREA PLAN
July 2002
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FIG. 2
project_area.mxd

Faulted and Folded Geologic Structures

Observed Location | Approximate Location | Concealed

Syncline

Anticline

Fault (Ball on downthrown side)

Landslides

Deep-Seated Landslides observed by S & W (not to scale)

Shallow Landslides/Debris Torrents observed by S & W

Arrow shows direction of landslide movement

Geologic Units; See Table 1 for Unit Descriptions

Quaternary Deposits

- Qf - Fill
- Qa - Alluvium
- Qb - Bog
- Qt - Talus Deposits
- Qls - Landslide
- Qag - Alpine Glacial Deposits
- Qvic - Vashon Stade Ice Contact Deposits
- Qvr - Vashon Stade Glacial Recessional Outwash
- Qvt - Vashon Stade Till
- Qpf - Pre-Fraser Glaciation Sedimentary Deposits

Tertiary Bedrock

- Tsgs - Snoqualmie Batholith Granodiorite and Tonalite
- Tsgf - Snoqualmie Batholith Fine Grained Monzonite
- Tsm - Snoqualmie Batholith Mafic Diorite and Gabbro
- Thm - Huckleberry Mountain Volcanics
- Thmk - Tuff of Lake Keechelus
- Tv - Volcanic Rocks
- Tdg - Diabase, Gabbro and Basalt
- Tpa - Volcanic Rocks of Mt. Persis
- Tpg - Puget Group, Undifferentiated
- Tpr - Renton Formation
- Tpt - Tukwila Formation
- Tn - Naches Formation
- Tnr - Naches Formation Rhyolite
- Tns - Naches Formation Feldspathic Sandstone and Volcanic Rocks
- Tnmc - Naches Formation Mt. Catherine Rhyolite
- Tng - Naches Formation Guye Sedimentary Member

Pre-Tertiary Bedrock

- pTwa - Western Melange Belt Argilite and Graywacke
- pTwg - Western Melange Belt Metagabbro
- pTwu - Western Melange Belt Ultramafite

Note:

1. Geologic mapping adapted from Vine (1962), Frizzel et al (1984), Walsh (1984) and Booth (1995). Additional mapping by Shannon and Wilson, Inc. (2002).

36 / 188 — Soil Units; See Table 2 for Unit Descriptions

Additional Alternative Transmission Line Routes

Existing BPA Substations

Existing BPA Transmission Lines

River / Stream

Waterbody

Freeway

Major Road

Minor Road

2400 — Contour with elevation; 40 ft intervals

22 — Section Number

Cedar River Watershed Boundary

Bonneville Power Administration
Kangley-Echo Lake
Transmission Line Project

LEGEND

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FIG. 3

legend.mxd

N

Cedar River

Cedar River Watershed

27th Avenue

Landsburg Mine

Clark Springs

Rock Creek

Alternative A

Alternative C

Existing Transmission Line

Raver Substation

0 1000 2000
Feet

Percent Slope

- 0-15
- 15-40
- 40-65
- >65

Note:

1. Slope derived from USGS 10-meter DEM- Tacoma and Snohomish 1:100,000 quadrangles.

Bonneville Power Administration
Kangley-Echo Lake
Transmission Line Project

SLOPE MAP
ALTERNATIVE A
SHEET A-1

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FIG. 4A
Sheet 1 of 4

N

Percent Slope

- 0-15
- 15-40
- 40-65
- >65

Note:

1. Slope derived from USGS 10-meter DEM- Tacoma and Snohomish 1:100,000 quadrangles.

Meridian Heights

Cherokee Bay Park

Alternative A

Covington Substation

Armstrong Springs

Kent Springs

Jenkins Creek

Little Soos Creek

Cedar River

Rock Creek

Crimmer Creek

Covington Creek

SR-169

0 1000 2000
Feet

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SLOPE MAP
ALTERNATIVE A
SHEET A-2

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FIG. 4A
Sheet 2 of 4

N

Lake Youngs

Alternative A

Cedar River

Cedar River

SR-18

Maple Valley

Little Soos Creek

Percent Slope

- 0-15
- 15-40
- 40-65
- >65

Note:

1. Slope derived from USGS 10-meter DEM- Tacoma and Snohomish 1:100,000 quadrangles.

0 1000 2000
Feet

Bonneville Power Administration
Kangley-Echo Lake
Transmission Line Project

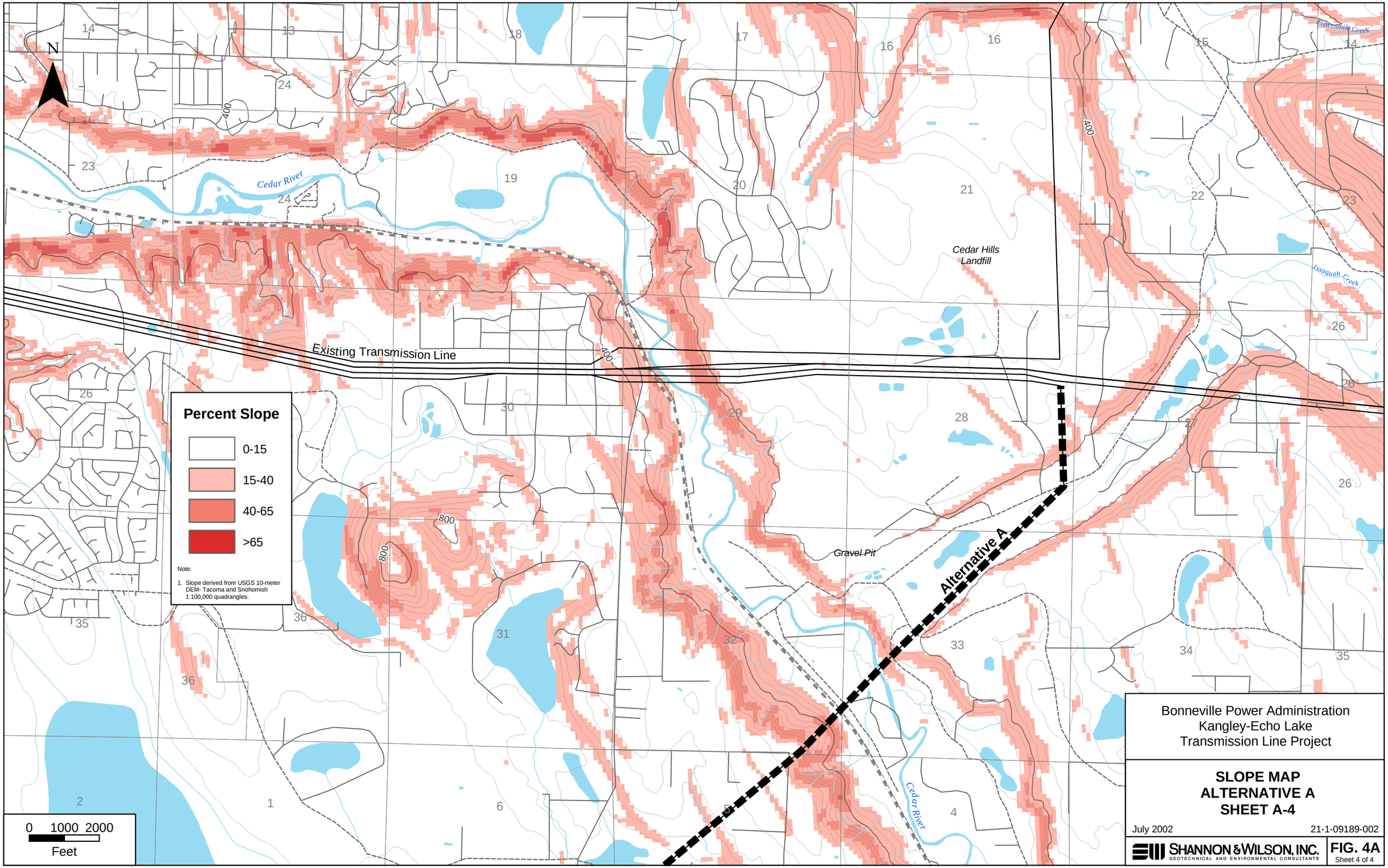
SLOPE MAP
ALTERNATIVE A
SHEET A-3

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FIG. 4A
Sheet 3 of 4



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SLOPE MAP
ALTERNATIVE A
SHEET A-4

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FIG. 4A
Sheet 4 of 4

N

Alternative A

Alternative C

Landsburg Mine

Clark Springs

Rock Creek

Cedar River Watershed

Existing Transmission Line

SR 169

Raver Substation

Percent Slope

- 0-15
- 15-40
- 40-65
- >65

Note:

1. Slope derived from USGS 10-meter DEM- Tacoma and Snohomish 1:100,000 quadrangles.

0 1000 2000
Feet

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SLOPE MAP
ALTERNATIVE C
SHEET C-1

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FIG. 4B
Sheet 1 of 3

N

SR-18

Alternative C

276th Avenue

Hobart Landfill

Landsburg Mine

Walsh Diversion

Rock Creek

Cedar River

Cedar River Watershed

Percent Slope

	0-15
	15-40
	40-65
	>65

Note:

1. Slope derived from USGS 10-meter DEM- Tacoma and Snohomish 1:100,000 quadrangles.

0 1000 2000

Feet

Bonneville Power Administration
Kangley-Echo Lake
Transmission Line Project

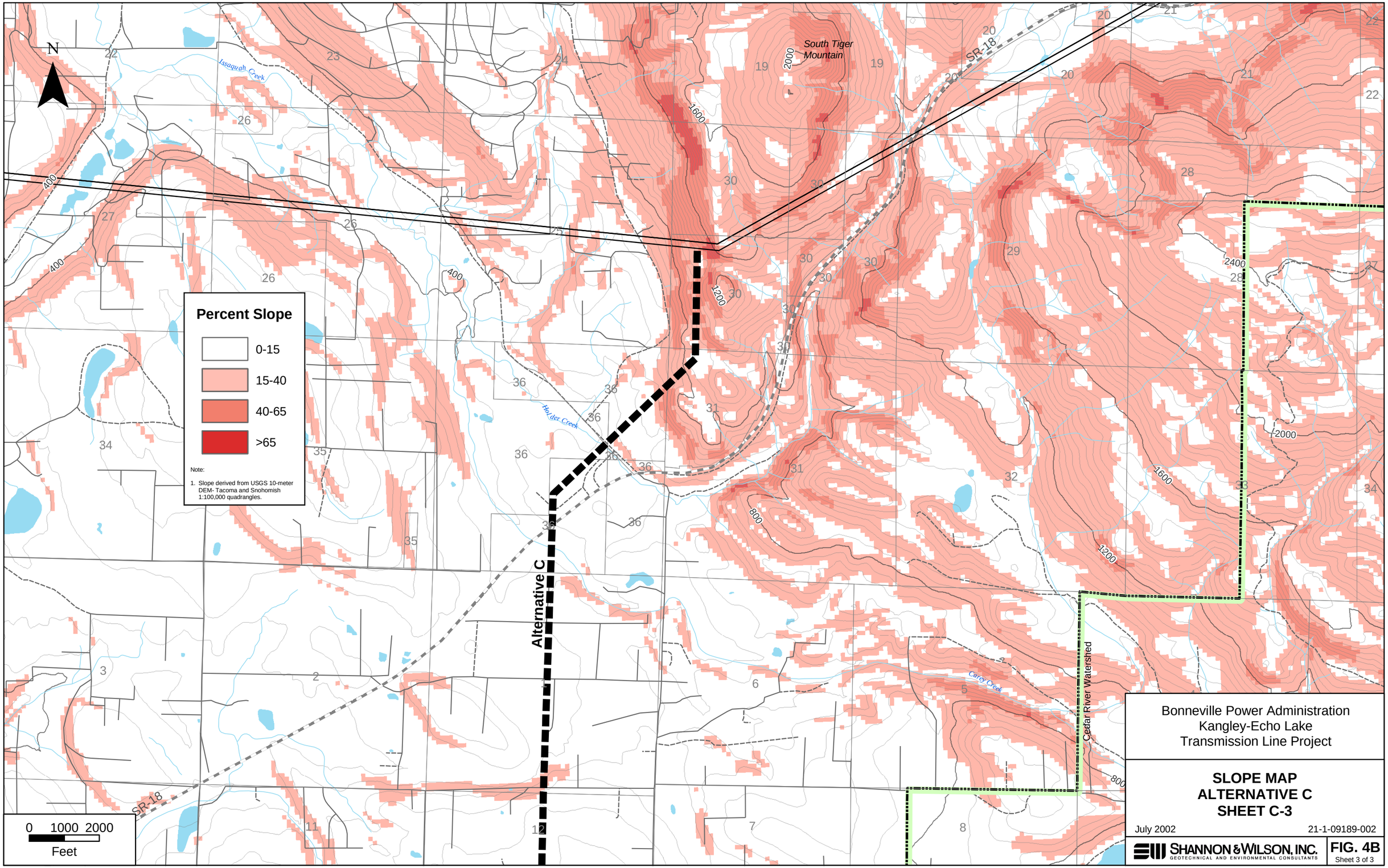
SLOPE MAP
ALTERNATIVE C
SHEET C-2

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FIG. 4B
Sheet 2 of 3



Bonneville Power Administration
Kangley-Echo Lake
Transmission Line Project

SLOPE MAP
ALTERNATIVE C
SHEET C-3

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FIG. 4B
Sheet 3 of 3

Bonneville Power Administration
Kangley-Echo Lake
Transmission Line Project

SLOPE MAP
ALTERNATIVE B & D
SHEET B/D-1

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FIG. 4C
Sheet 1 of 7

N

Alternative B

Alternative D

Existing Transmission Line

Yakima River

Meadow Creek

Mosquito Creek

Percent Slope

- 0-15
- 15-40
- 40-65
- >65

Note:

1. Slope derived from USGS 10-meter DEM- Tacoma and Snohomish 1:100,000 quadrangles.

0 1000 2000
Feet

FIG. 4C
Sheet 1 of 7

Bonneville Power Administration
Kangley-Echo Lake
Transmission Line Project

SLOPE MAP
ALTERNATIVE B & D
SHEET B/D-2

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July 2002

FIG. 4C
Sheet 2 of 7

N

Keechelus Lake

Lost Lake

Cold Creek

Roaring Creek

Yakima River

Keechelus Ridge

Alternative B

Alternative D

90

Percent Slope

- 0-15
- 15-40
- 40-65
- >65

Note:

1. Slope derived from USGS 10-meter DEM- Tacoma and Snohomish 1:100,000 quadrangles.

0 1000 2000
Feet

FIG. 4C
Sheet 2 of 7

Granite Mt.

Denny Creek

South Fork Snoqualmie River

Rockdale Creek

Olallie Creek

Mill Creek

Hornpluck Creek

Cold Creek

Mt. Hyalc

Mt. Cathrine

Keechelus Lake

Alternative B

Alternative D

N

Percent Slope

- 0-15
- 15-40
- 40-65
- >65

Note:

1. Slope derived from USGS 10-meter DEM- Tacoma and Snohomish 1:100,000 quadrangles.

0 1000 2000

Feet

Bonneville Power Administration
Kangley-Echo Lake
Transmission Line Project

SLOPE MAP
ALTERNATIVE B & D
SHEET B/D-3

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FIG. 4C
Sheet 3 of 7

FIG. 4C
Sheet 3 of 7

N

Percent Slope

- 0-15
- 15-40
- 40-65
- >65

Note:

1. Slope derived from USGS 10-meter DEM- Tacoma and Snohomish 1:100,000 quadrangles.

Alternative B
Alternative D

Cedar River Watershed

McClellan Butte

Benders Mt.

South Fork Snoqualmie River

Wood Creek

Alice Creek

Rock Creek

Harris Creek

Carter Creek

Hancock Creek

0 1000 2000
Feet

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SLOPE MAP
ALTERNATIVE B & D
SHEET B/D-4

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FIG. 4C
Sheet 4 of 7

Bonneville Power Administration
Kangley-Echo Lake
Transmission Line Project

SLOPE MAP
ALTERNATIVE B & D
SHEET B/D-5

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FIG. 4C
Sheet 5 of 7

N

Alternative B

Alternative D

Percent Slope

- 0-15
- 15-40
- 40-65
- >65

Note:

1. Slope derived from USGS 10-meter DEM- Tacoma and Snohomish 1:100,000 quadrangles.

Granite Creek

Mine Creek

South Fork Snoqualmie River

Wood Creek

Mt. Defiance

Cedar River Watershed

0 1000 2000
Feet

FIG. 4C
Sheet 5 of 7

N

South Fork Snoqualmie River

Alternative B
Alternative D

Rattlesnake Mountain

Cedar River Watershed

Rattlesnake Lake

Cedar Falls

Boxley Creek

Percent Slope

- 0-15
- 15-40
- 40-65
- >65

Note:

1. Slope derived from USGS 10-meter DEM- Tacoma and Snohomish 1:100,000 quadrangles.

0 1000 2000
Feet

Bonneville Power Administration
Kangley-Echo Lake
Transmission Line Project

SLOPE MAP
ALTERNATIVE B & D
SHEET B/D-6

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SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. 4C
Sheet 6 of 7

Bonneville Power Administration
Kangley-Echo Lake
Transmission Line Project

SLOPE MAP
ALTERNATIVE B & D
SHEET B/D-7

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FIG. 4C
Sheet 7 of 7

N

Echo Lake Substation

Alternative B

Alternative D

North Bend

Rattlesnake Mountain

Kimball Creek

South Fork Snoqualmie River

Raging River

SR-18

Percent Slope

- 0-15
- 15-40
- 40-65
- >65

Note:

1. Slope derived from USGS 10-meter DEM- Tacoma and Snohomish 1:100,000 quadrangles.

0 1000 2000
Feet

FIG. 4C
Sheet 7 of 7

N

276th Avenue

Alternative A

Alternative C

Cedar River

Cedar River Watershed

Rock Creek

Landsburg Mine

Clark Springs

Existing Transmission Line

Raver Substation

Qa

Qvr

Qvt

Qvic

Tpg

Tdg

800

1200

0 1000 2000

Feet

Bonneville Power Administration
Kangley-Echo Lake
Transmission Line Project

GEOLOGIC MAP
ALTERNATIVE A
SHEET A-1

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FIG. 5A
Sheet 1 of 4

N

Meridian Heights

Cherokee Bay Park

Covington Substation

Armstrong Springs

Kent Springs

Clark Springs

Alternative A

Alternative A

SR-169

Existing

Jenkins Creek

Grammar Creek

Rock Creek

Ceda River

Covington Creek

Qvt

Qb

Qvr

400

0 1000 2000

Feet

Bonneville Power Administration
Kangley-Echo Lake
Transmission Line Project

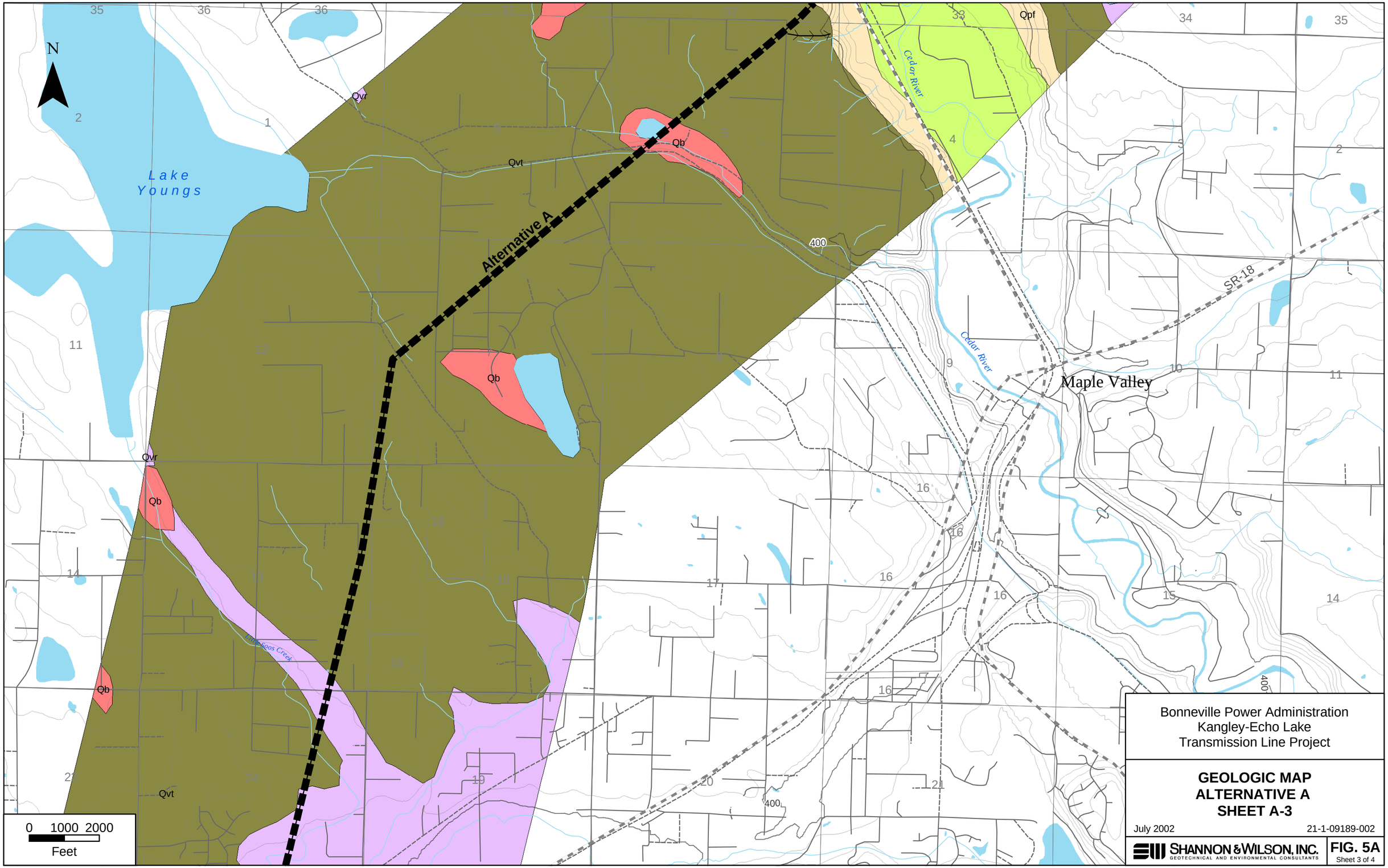
GEOLOGIC MAP
ALTERNATIVE A
SHEET A-2

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SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. 5A
Sheet 2 of 4



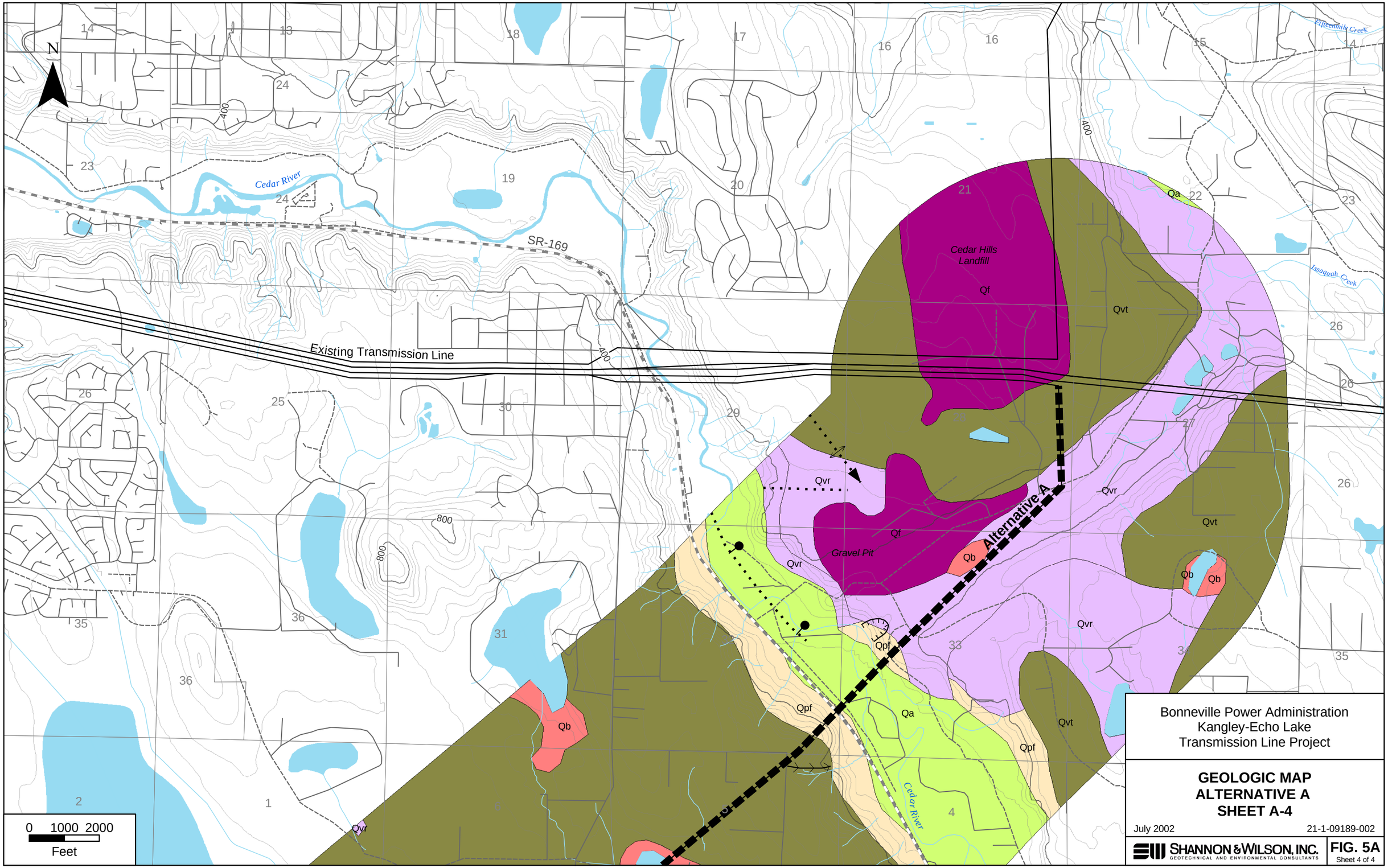
Bonneville Power Administration
Kangley-Echo Lake
Transmission Line Project

GEOLOGIC MAP
ALTERNATIVE A
SHEET A-3

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SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. 5A
Sheet 3 of 4



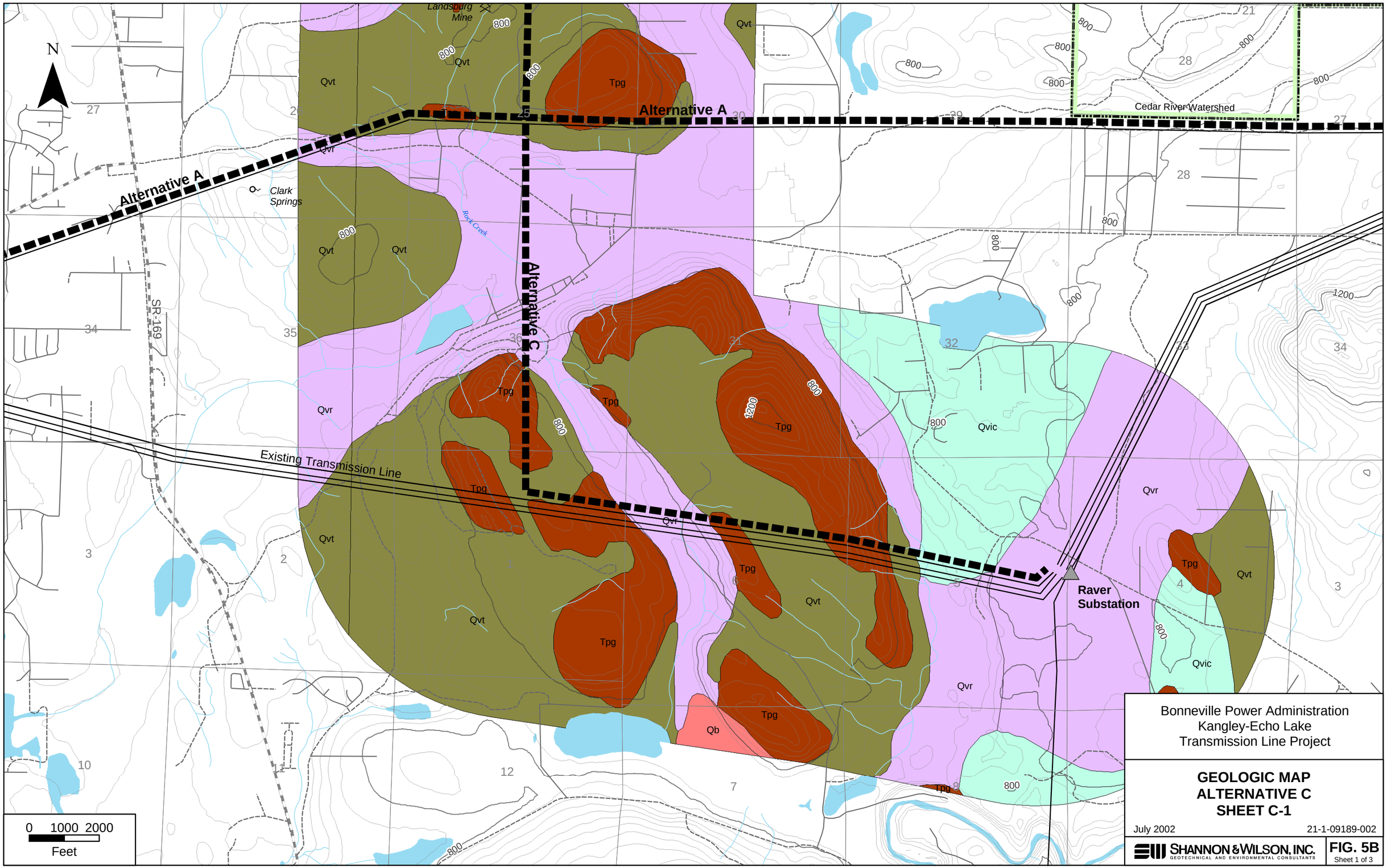
Bonneville Power Administration
Kangley-Echo Lake
Transmission Line Project

GEOLOGIC MAP
ALTERNATIVE A
SHEET A-4

July 2002 21-1-09189-002

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. 5A
Sheet 4 of 4



Bonneville Power Administration
Kangley-Echo Lake
Transmission Line Project

GEOLOGIC MAP
ALTERNATIVE C
SHEET C-1

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SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. 5B
Sheet 1 of 3

N

SR-18

Alternative C

276th Avenue

Hobart Landfill

Landsburg Mine

Cedar River Watershed

Cedar River

Rock Creek

Walsh Diversion

Qvt

Qvr

Qpf

Qa

Tpg

800

400

0 1000 2000
Feet

Bonneville Power Administration
Kangley-Echo Lake
Transmission Line Project

GEOLOGIC MAP
ALTERNATIVE C
SHEET C-2

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SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. 5B
Sheet 2 of 3

N

Issaquah Creek

Holder Creek

Carey Creek

Cedar River Watershed

South Tiger Mountain

SR-18

Hobart Fault

Alternative C

Qvt

Tpt

Tdg

Tpr

Qvr

Qvic

Qb

400

800

1200

1600

2000

2400

0 1000 2000
Feet

Bonneville Power Administration
Kangley-Echo Lake
Transmission Line Project

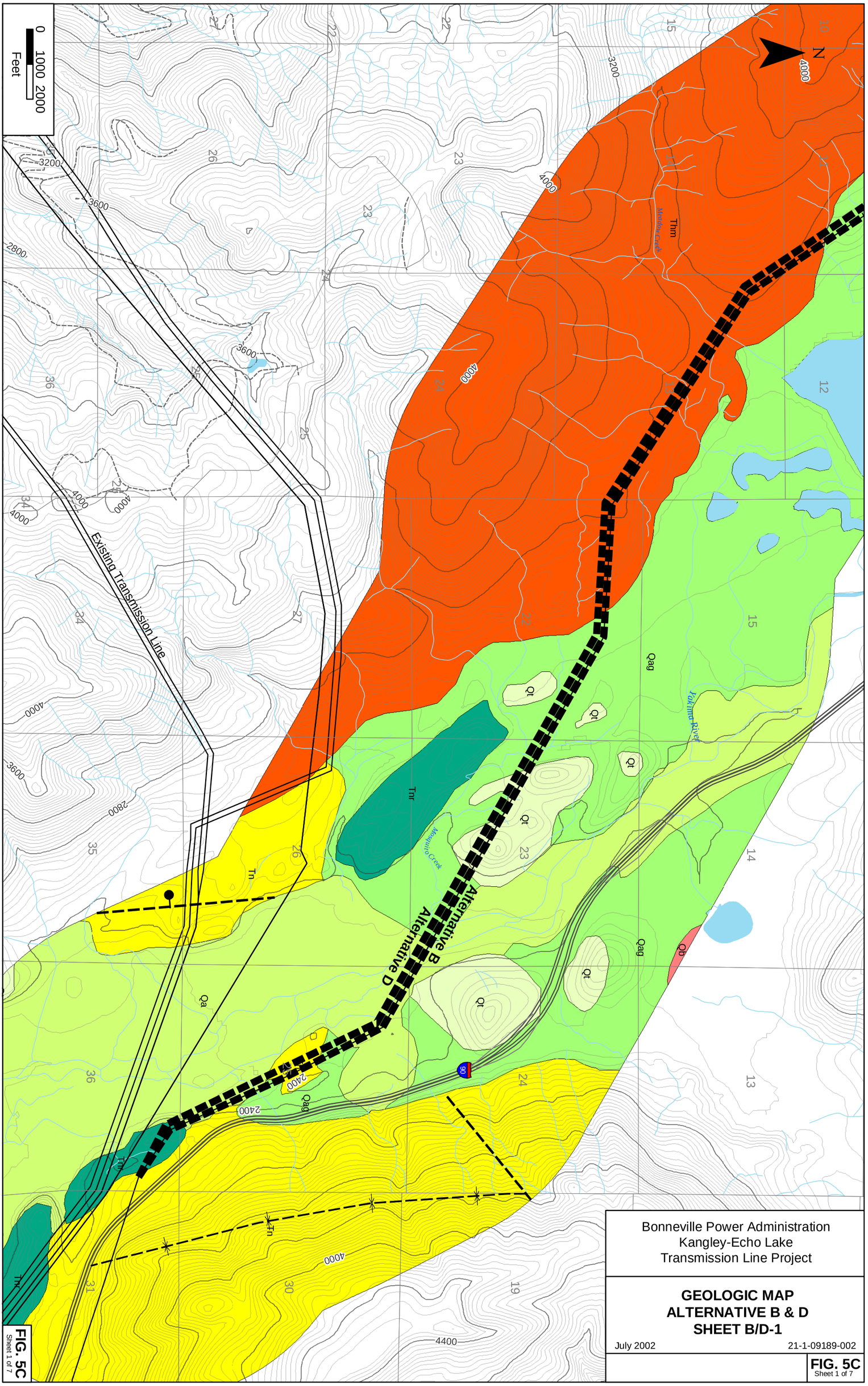
GEOLOGIC MAP
ALTERNATIVE C
SHEET C-3

July 2002

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SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. 5B
Sheet 3 of 3


0 1000 2000
Feet
N
Existing Transmission Line
Alternative B
Alternative D
Qt
Qag
Qa
Tnr
Tn
Thm
Qb
Pokeme River
Meadow Creek
Moraine Creek
Bonneville Power Administration
Kangley-Echo Lake
Transmission Line Project
GEOLOGIC MAP
ALTERNATIVE B & D
SHEET B/D-1
July 2002
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FIG. 5C
Sheet 1 of 7

Bonneville Power Administration
Kangley-Echo Lake
Transmission Line Project

GEOLOGIC MAP
ALTERNATIVE B & D
SHEET B/D-2

21-1-09189-002

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FIG. 5C
Sheet 2 of 7

N

Keechelus Lake

Lost Lake

Cold Creek

Roaring Creek

Yakima River

Keechelus Ridge

Alternative B

Alternative D

Qag

Tng

Thm

Thmk

Qls

0 1000 2000
Feet

FIG. 5C
Sheet 2 of 7

Bonneville Power Administration
Kangley-Echo Lake
Transmission Line Project

GEOLOGIC MAP
ALTERNATIVE B & D
SHEET B/D-3

July 2002

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FIG. 5C
Sheet 3 of 7

N

Granite Mt.

Denny Creek

Ski Acres Ski Area

Mt. Hyalc Ski Area

Alternative B

Alternative D

Tns

Tng

Tnmc

Tnsgs

Qag

Qa

Mt. Hyalc

Mt. Cathrine

South Fork Snoqualmie River

Rockdale Creek

Mill Creek

Humpback Creek

Cold Creek

Keechelus Lake

0 1000 2000
Feet

FIG. 5C
Sheet 3 of 7

N

Alternative B
Alternative D

Qls
Tsgs
Tsm
Qvr
Qag
Thm
Qa

McClellan Butte
Benders Mt.

Cedar River Watershed

South Fork Snoqualmie River
Rock Creek
Harris Creek
Carter Creek
Hancock Creek

0 1000 2000
Feet

Bonneville Power Administration
Kangley-Echo Lake
Transmission Line Project

GEOLOGIC MAP
ALTERNATIVE B & D
SHEET B/D-4

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SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. 5C
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Bonneville Power Administration
Kangley-Echo Lake
Transmission Line Project

GEOLOGIC MAP
ALTERNATIVE B & D
SHEET B/D-5

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FIG. 5C
Sheet 5 of 7

N

Qa
Qvr
Tsgs
Tsm
Thm
pTwg
Tv
Tsgf

Alternative B
Alternative D

Granite Creek
South Fork Snoqualmie River
Mt. Defiance

Cedar River Watershed

0 1000 2000
Feet

FIG. 5C
Sheet 5 of 7

N

South Fork Snoqualmie River

Alternative B
Alternative D

Qa
pTwg
pTwu
Qvic
Qvt
pTwa
Qpf
Thm
Qvr

Rattlesnake Mountain

Bessey Creek

Twin Falls State Park

Cedar River Watershed

Rattlesnake Lake

Cedar Falls

0 1000 2000
Feet

Bonneville Power Administration
Kangley-Echo Lake
Transmission Line Project

GEOLOGIC MAP
ALTERNATIVE B & D
SHEET B/D-6

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SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. 5C
Sheet 6 of 7

Bonneville Power Administration
Kangley-Echo Lake
Transmission Line Project

GEOLOGIC MAP
ALTERNATIVE B & D
SHEET B/D-7

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FIG. 5C
Sheet 7 of 7

N

Qvt
Qvr
Qls
Tpt
Tpa
Qa
pTwa

Rattlesnake Mt. Syncline
Rattlesnake Mt. Fault
Rattlesnake Mt. Fault
Alternative D
Alternative B

Echo Lake Substation

North Bend

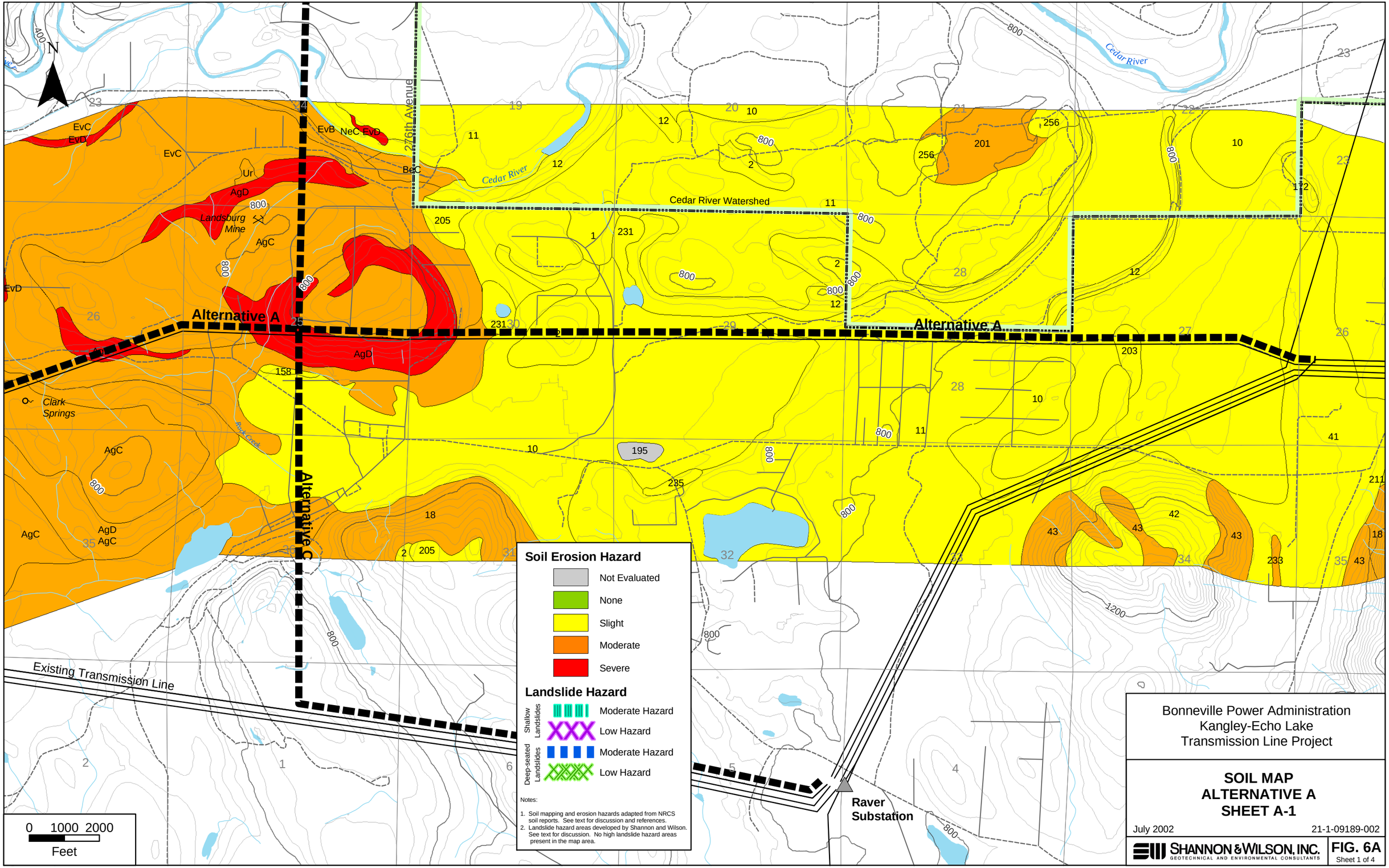
Krimbill Creek
South Fork Snoqualmie River
Raging River
Rattlesnake Mountain

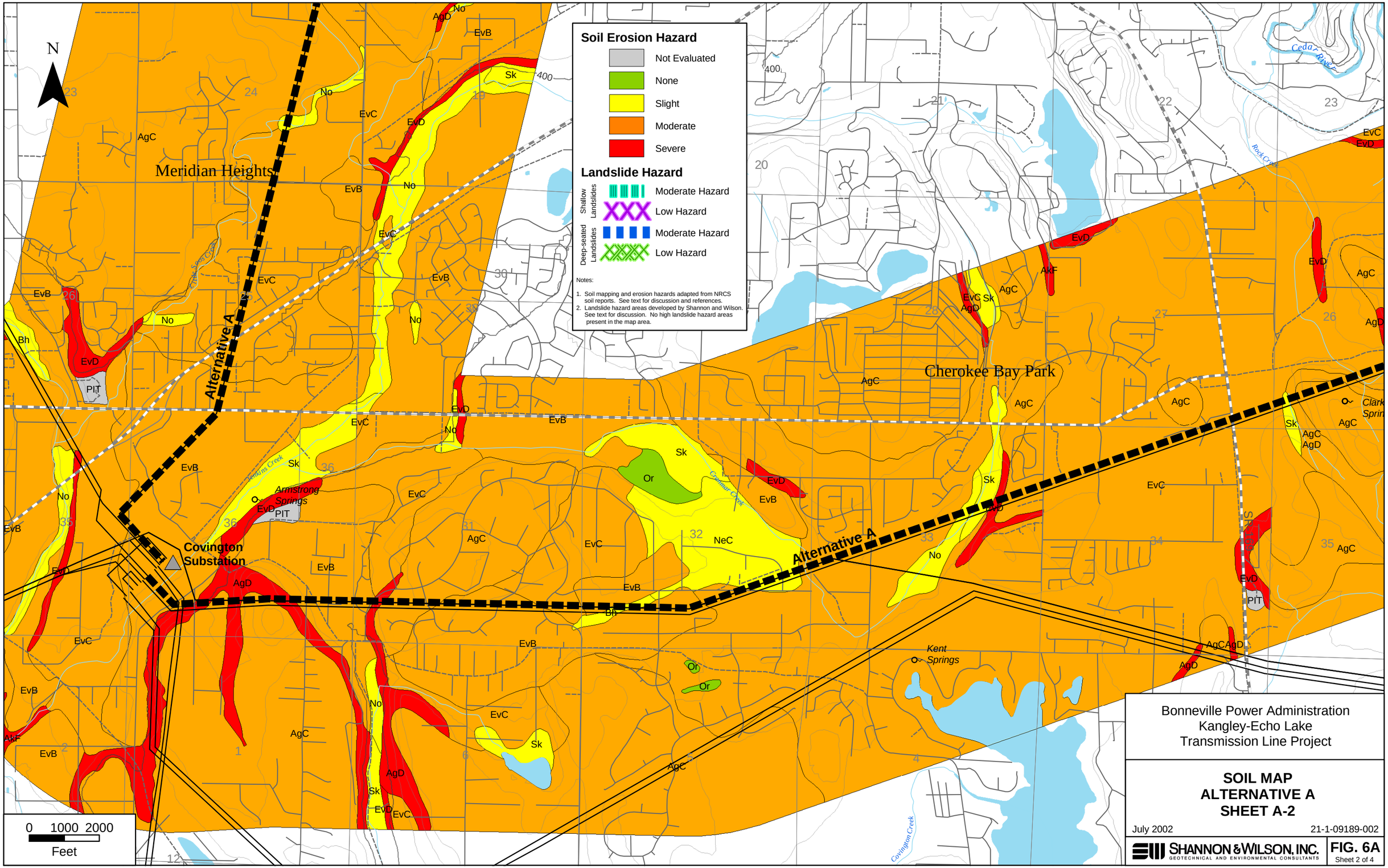
SR-18

90

0 1000 2000
Feet

FIG. 5C
Sheet 7 of 7


N
Alternative A
Alternative C
Alternative A
Cedar River
Cedar River
Cedar River Watershed
276th Avenue
Landsburg Mine
Clark Springs
Rock Creek
Existing Transmission Line
Raver Substation
EvC
EvD
EvB
NeC
BeC
Ur
AgD
AgC
205
231
158
195
235
18
256
201
203
233
0 1000 2000
Feet
Soil Erosion Hazard
Not Evaluated
None
Slight
Moderate
Severe
Landslide Hazard
Shallow Landslides
Moderate Hazard
Low Hazard
Deep-seated Landslides
Moderate Hazard
Low Hazard
Notes:
1. Soil mapping and erosion hazards adapted from NRCS soil reports. See text for discussion and references.
2. Landslide hazard areas developed by Shannon and Wilson. See text for discussion. No high landslide hazard areas present in the map area.
Bonneville Power Administration
Kangley-Echo Lake
Transmission Line Project
SOIL MAP
ALTERNATIVE A
SHEET A-1
July 2002
21-1-09189-002
SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS
FIG. 6A
Sheet 1 of 4



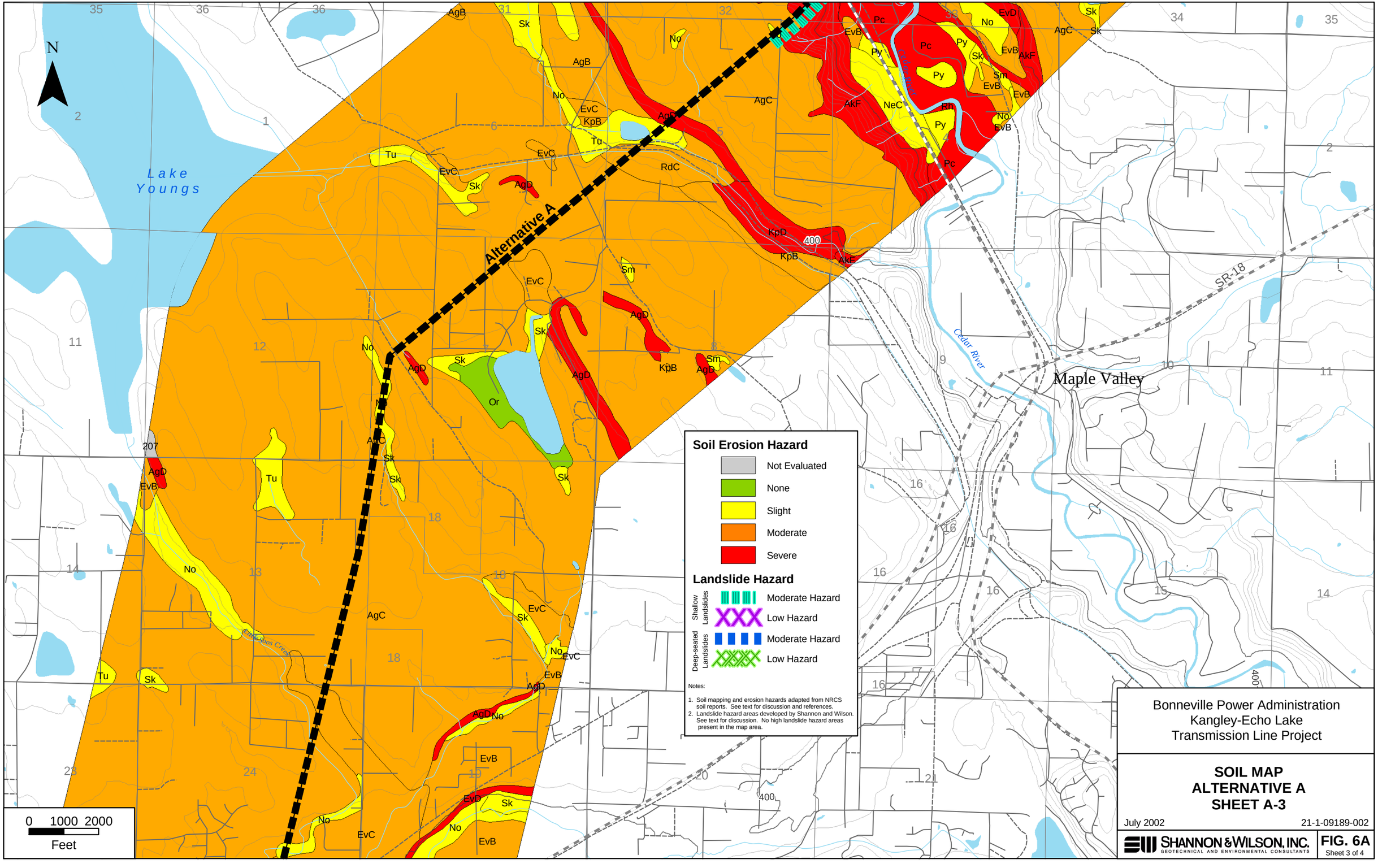
Bonneville Power Administration
Kangley-Echo Lake
Transmission Line Project

SOIL MAP
ALTERNATIVE A
SHEET A-2

July 2002 21-1-09189-002

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. 6A
Sheet 2 of 4



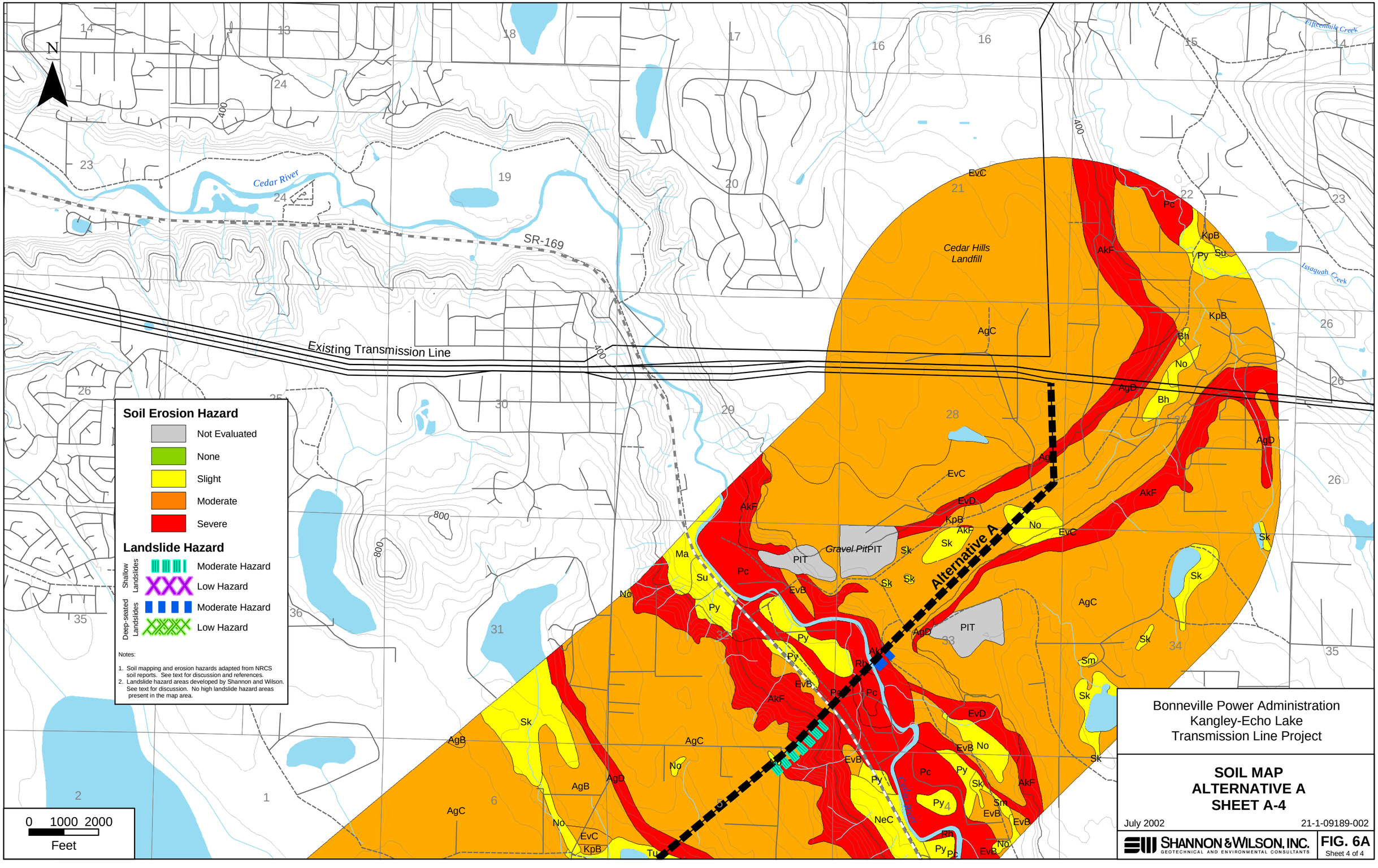
Bonneville Power Administration
Kangley-Echo Lake
Transmission Line Project

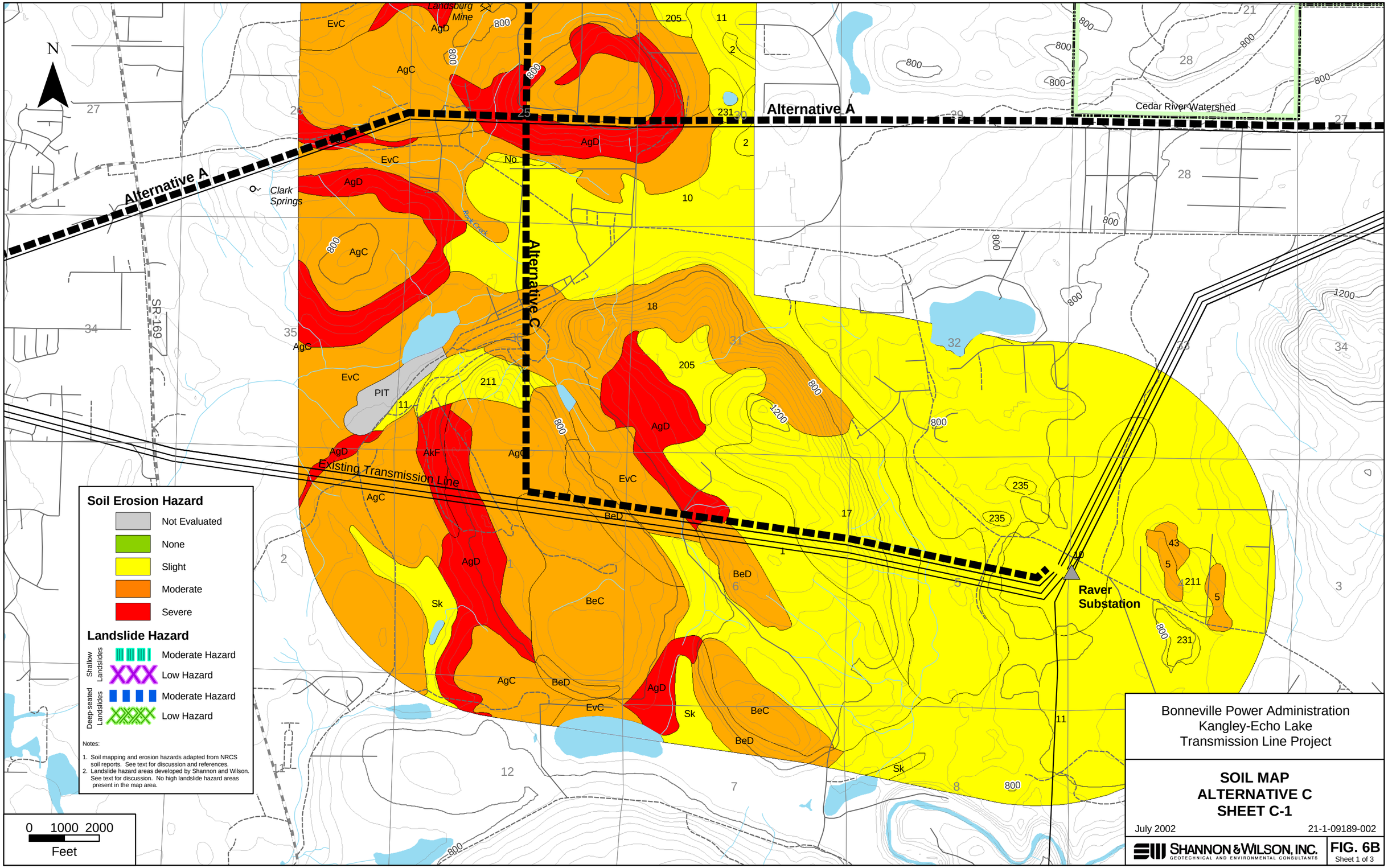
SOIL MAP
ALTERNATIVE A
SHEET A-3

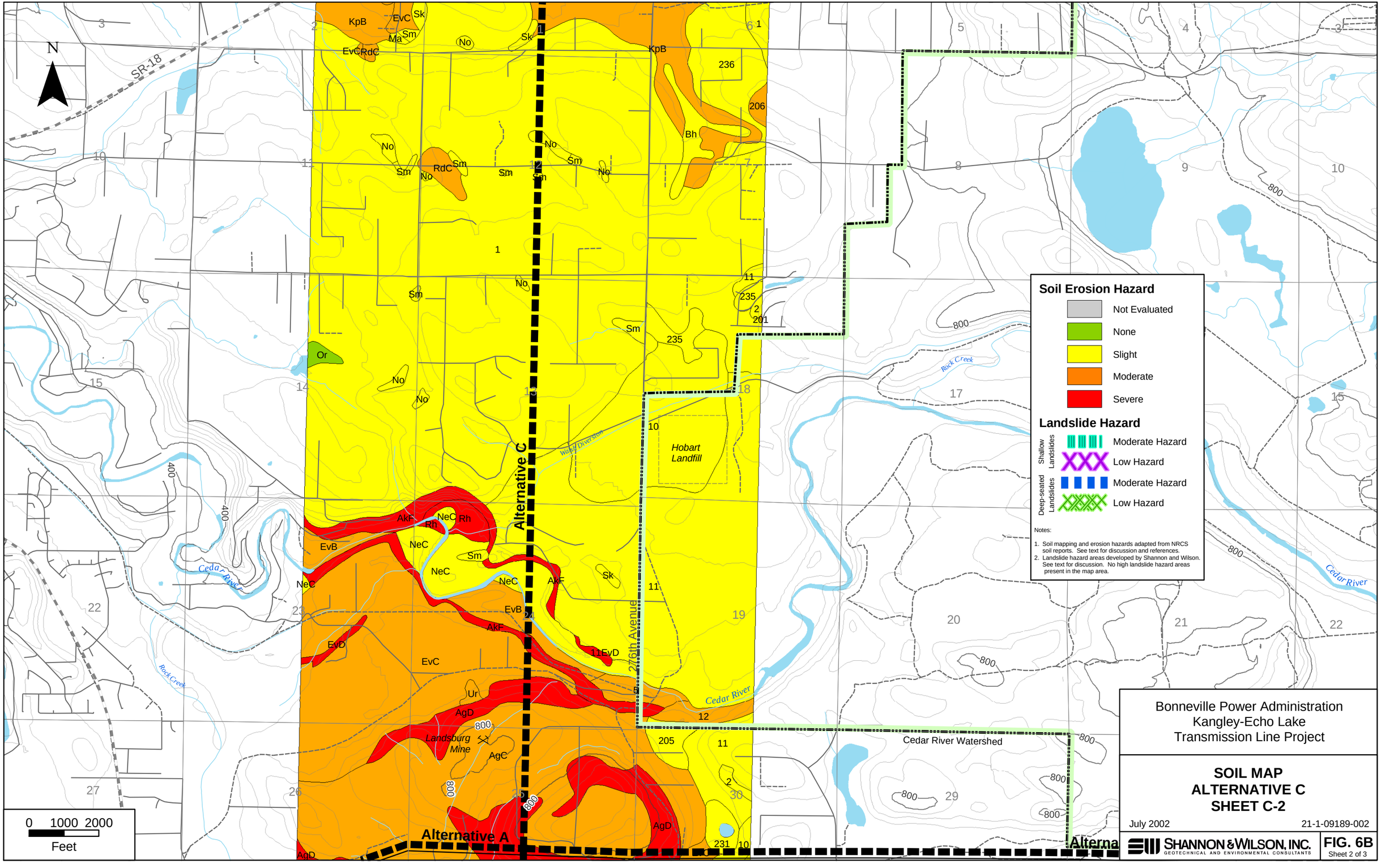
July 2002 21-1-09189-002

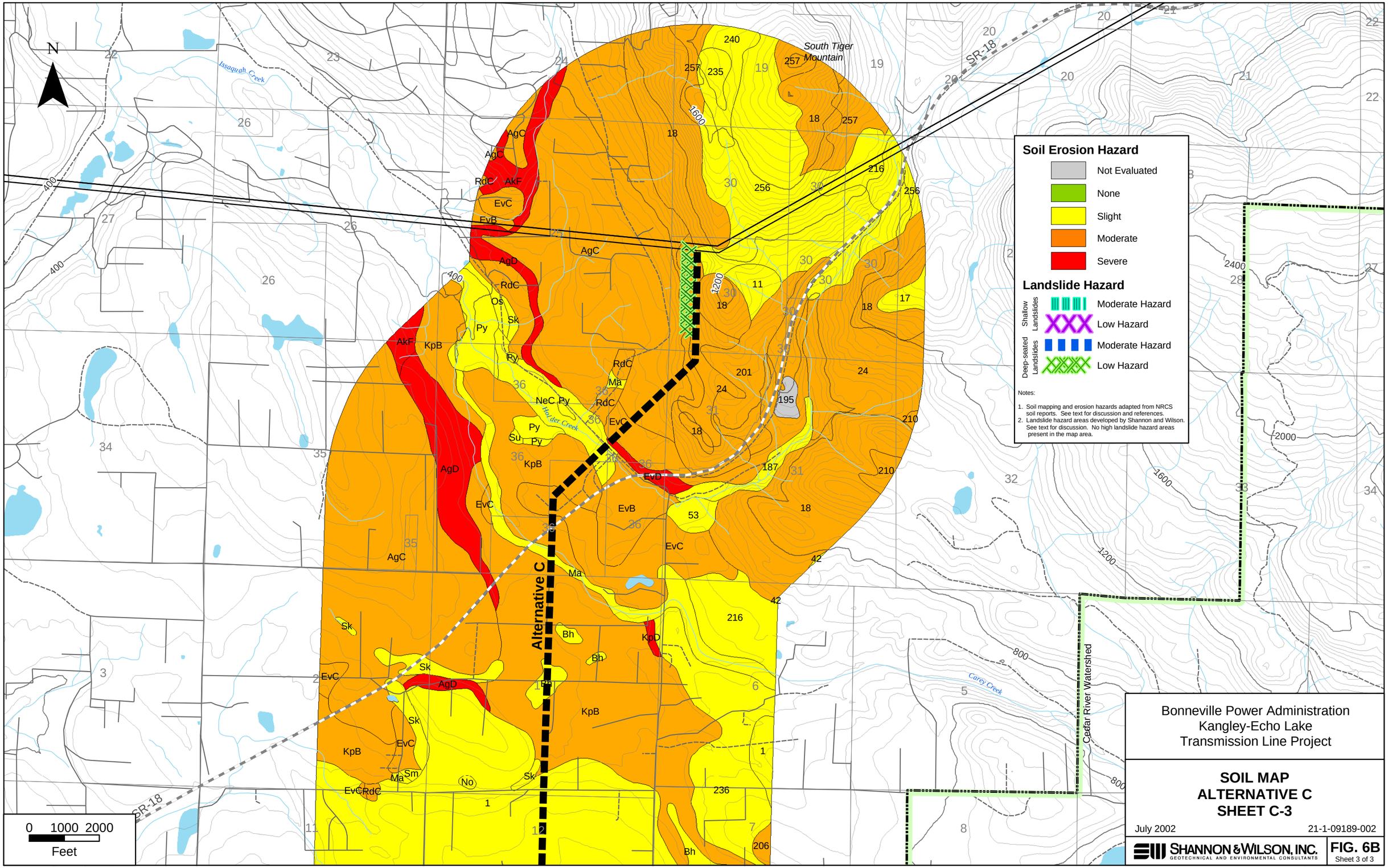
SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. 6A
Sheet 3 of 4


N
Cedar River
SR-169
Existing Transmission Line
Cedar Hills Landfill
Gravel PitPIT
Alternative A
Fifteenmile Creek
Issaquah Creek
Soil Erosion Hazard
Not Evaluated
None
Slight
Moderate
Severe
Landslide Hazard
Shallow Landslides
Moderate Hazard
Low Hazard
Deep-seated Landslides
Moderate Hazard
Low Hazard
Notes:
1. Soil mapping and erosion hazards adapted from NRCS soil reports. See text for discussion and references.
2. Landslide hazard areas developed by Shannon and Wilson. See text for discussion. No high landslide hazard areas present in the map area.
0 1000 2000
Feet
Bonneville Power Administration
Kangley-Echo Lake
Transmission Line Project
SOIL MAP
ALTERNATIVE A
SHEET A-4
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SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS
FIG. 6A
Sheet 4 of 4


N
Alternative A
Alternative C
Alternative A
Landsburg Mine
Clark Springs
Rock Creek
Cedar River Watershed
SR 169
Existing Transmission Line
Raver Substation
EvC
AgD
AgC
AkF
PIT
Sk
BeD
BeC
205
211
231
235
800
1200
Soil Erosion Hazard
Not Evaluated
None
Slight
Moderate
Severe
Landslide Hazard
Shallow Landslides
Moderate Hazard
Low Hazard
Deep-seated Landslides
Moderate Hazard
Low Hazard
Notes:
1. Soil mapping and erosion hazards adapted from NRCS soil reports. See text for discussion and references.
2. Landslide hazard areas developed by Shannon and Wilson. See text for discussion. No high landslide hazard areas present in the map area.
0 1000 2000
Feet
Bonneville Power Administration
Kangley-Echo Lake
Transmission Line Project
SOIL MAP
ALTERNATIVE C
SHEET C-1
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SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS
FIG. 6B
Sheet 1 of 3


N
SR-18
Alternative C
Alternative A
276th Avenue
Hobart Landfill
Cedar River
Rock Creek
Cedar River Watershed
Landsburg Mine
Water Diversion
KpB
EvC
Sk
Sm
Ma
No
EvC
RdC
Bh
RdC
AkF
NeC
Rh
EvB
Sm
Sk
EvD
11EvD
Ur
AgD
AgC
Or
800
400
0 1000 2000
Feet
Soil Erosion Hazard
Not Evaluated
None
Slight
Moderate
Severe
Landslide Hazard
Shallow Landslides
Moderate Hazard
Low Hazard
Deep-seated Landslides
Moderate Hazard
Low Hazard
Notes:
1. Soil mapping and erosion hazards adapted from NRCS soil reports. See text for discussion and references.
2. Landslide hazard areas developed by Shannon and Wilson. See text for discussion. No high landslide hazard areas present in the map area.
Bonneville Power Administration
Kangley-Echo Lake
Transmission Line Project
SOIL MAP
ALTERNATIVE C
SHEET C-2
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SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS
FIG. 6B
Sheet 2 of 3



Soil Erosion Hazard

- Not Evaluated
- None
- Slight
- Moderate
- Severe

Landslide Hazard

Shallow Landslides
- Moderate Hazard
- Low Hazard

Deep-seated Landslides
- Moderate Hazard
- Low Hazard

Notes:

1. Soil mapping and erosion hazards adapted from NRCS soil reports. See text for discussion and references.
2. Landslide hazard areas developed by Shannon and Wilson. See text for discussion. No high landslide hazard areas present in the map area.

Bonneville Power Administration
Kangley-Echo Lake
Transmission Line Project

SOIL MAP
ALTERNATIVE C
SHEET C-3

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SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. 6B
Sheet 3 of 3

Bonneville Power Administration
Kangley-Echo Lake
Transmission Line Project

SOIL MAP
ALTERNATIVE B & D
SHEET B/D-1

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FIG. 6C
Sheet 1 of 7

Soil Erosion Hazard

- Not Evaluated
- None
- Slight
- Moderate
- Severe

Landslide Hazard

- Shallow Landslides: Moderate Hazard
- Shallow Landslides: Low Hazard
- Deep-seated Landslides: Moderate Hazard
- Deep-seated Landslides: Low Hazard

Notes:

1. Soil mapping and erosion hazards adapted from NRCS soil reports. See text for discussion and references.
2. Landslide hazard areas developed by Shannon and Wilson. See text for discussion. No high landslide hazard areas present in the map area.

0 1000 2000
Feet

Alternative B
Alternative D
Existing Transmission Line
Yakima River
Meadow Creek
Mosquito Creek

FIG. 6C
Sheet 1 of 7

Bonneville Power Administration
Kangley-Echo Lake
Transmission Line Project

SOIL MAP
ALTERNATIVE B & D
SHEET B/D-2

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July 2002

FIG. 6C
Sheet 2 of 7

Soil Erosion Hazard

- Not Evaluated
- None
- Slight
- Moderate
- Severe

Landslide Hazard

Shallow Landslides
- Moderate Hazard
- Low Hazard

Deep-seated Landslides
- Moderate Hazard
- Low Hazard

Notes:

1. Soil mapping and erosion hazards adapted from NRCS soil reports. See text for discussion and references.
2. Landslide hazard areas developed by Shannon and Wilson. See text for discussion. No high landslide hazard areas present in the map area.

Alternative B

Alternative D

Keechelus Lake

Lost Lake

Cold Creek

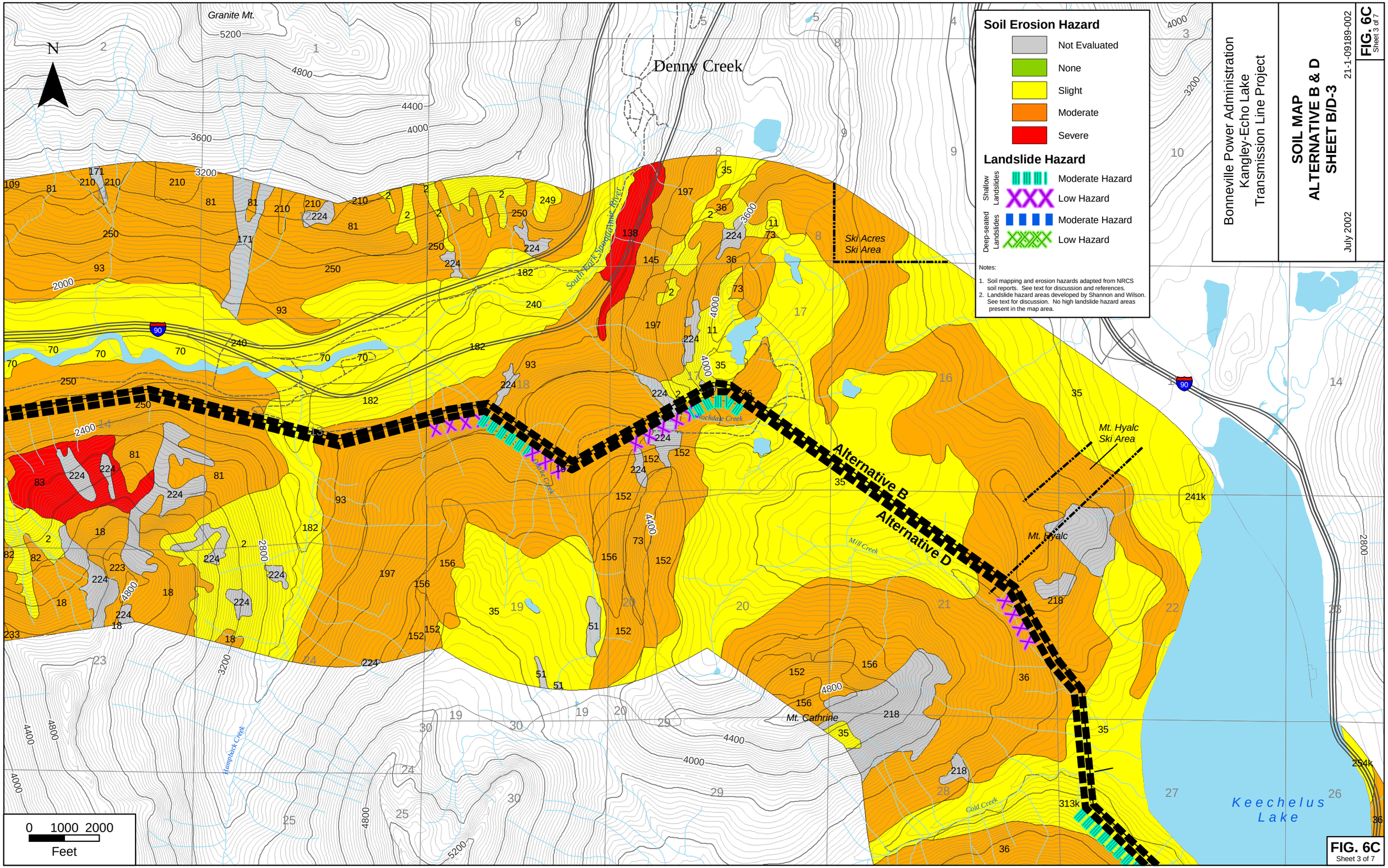
Roaring Creek

Yakima River

Keechelus Ridge

0 1000 2000
Feet

FIG. 6C
Sheet 2 of 7



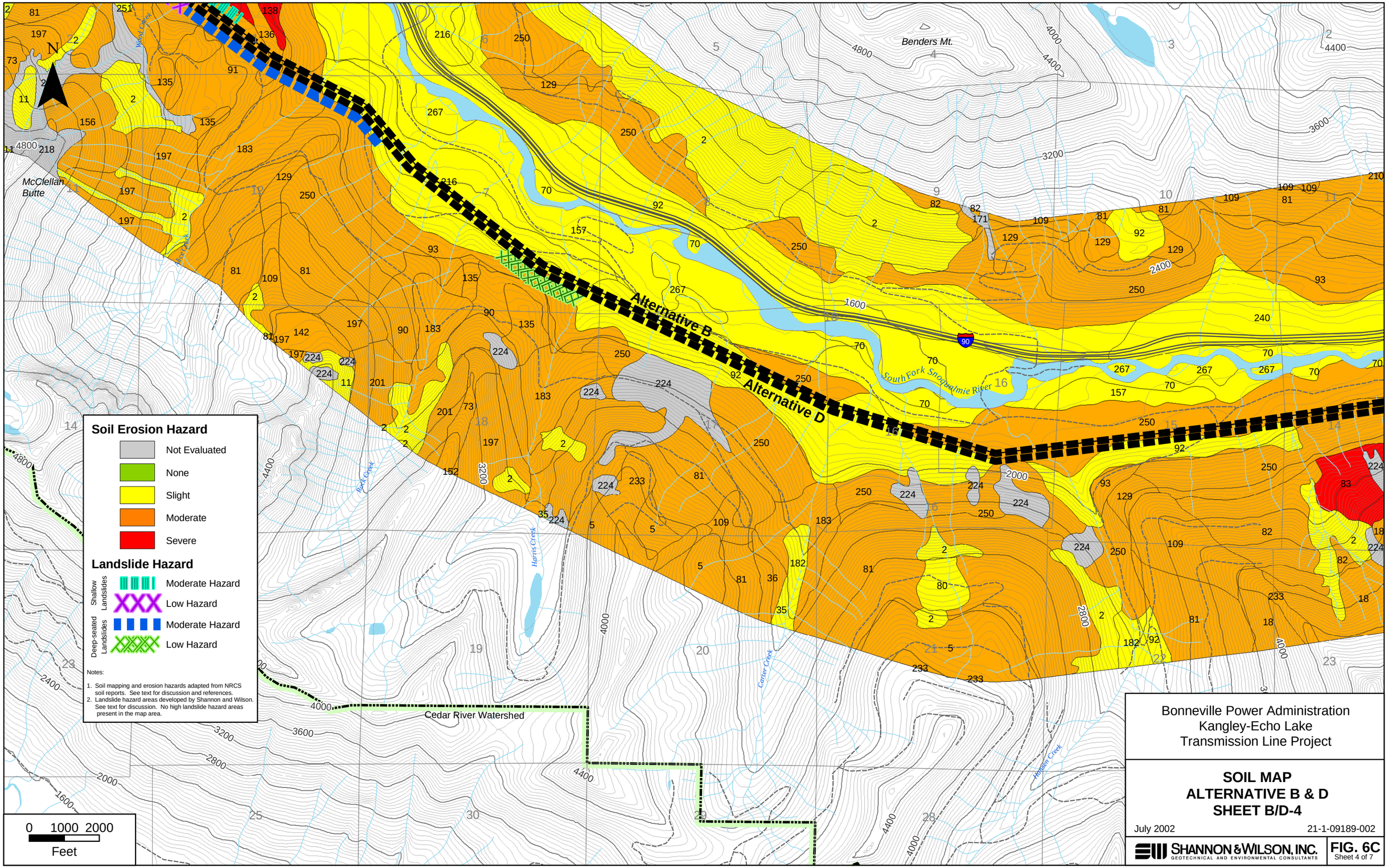
Bonneville Power Administration
Kangley-Echo Lake
Transmission Line Project

SOIL MAP
ALTERNATIVE B & D
SHEET B/D-3

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FIG. 6C
Sheet 3 of 7

FIG. 6C
Sheet 3 of 7



Bonneville Power Administration
Kangley-Echo Lake
Transmission Line Project

SOIL MAP
ALTERNATIVE B & D
SHEET B/D-4

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SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. 6C
Sheet 4 of 7

Bonneville Power Administration
Kangley-Echo Lake
Transmission Line Project

SOIL MAP
ALTERNATIVE B & D
SHEET B/D-5

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July 2002

FIG. 6C
Sheet 5 of 7

N

Alternative B

Alternative D

Soil Erosion Hazard

- Not Evaluated
- None
- Slight
- Moderate
- Severe

Landslide Hazard

- Shallow Landslides: Moderate Hazard
- Shallow Landslides: Low Hazard
- Deep-seated Landslides: Moderate Hazard
- Deep-seated Landslides: Low Hazard

Notes:

1. Soil mapping and erosion hazards adapted from NRCS soil reports. See text for discussion and references.
2. Landslide hazard areas developed by Shannon and Wilson. See text for discussion. No high landslide hazard areas present in the map area.

Granite Creek

Mt. Defiance

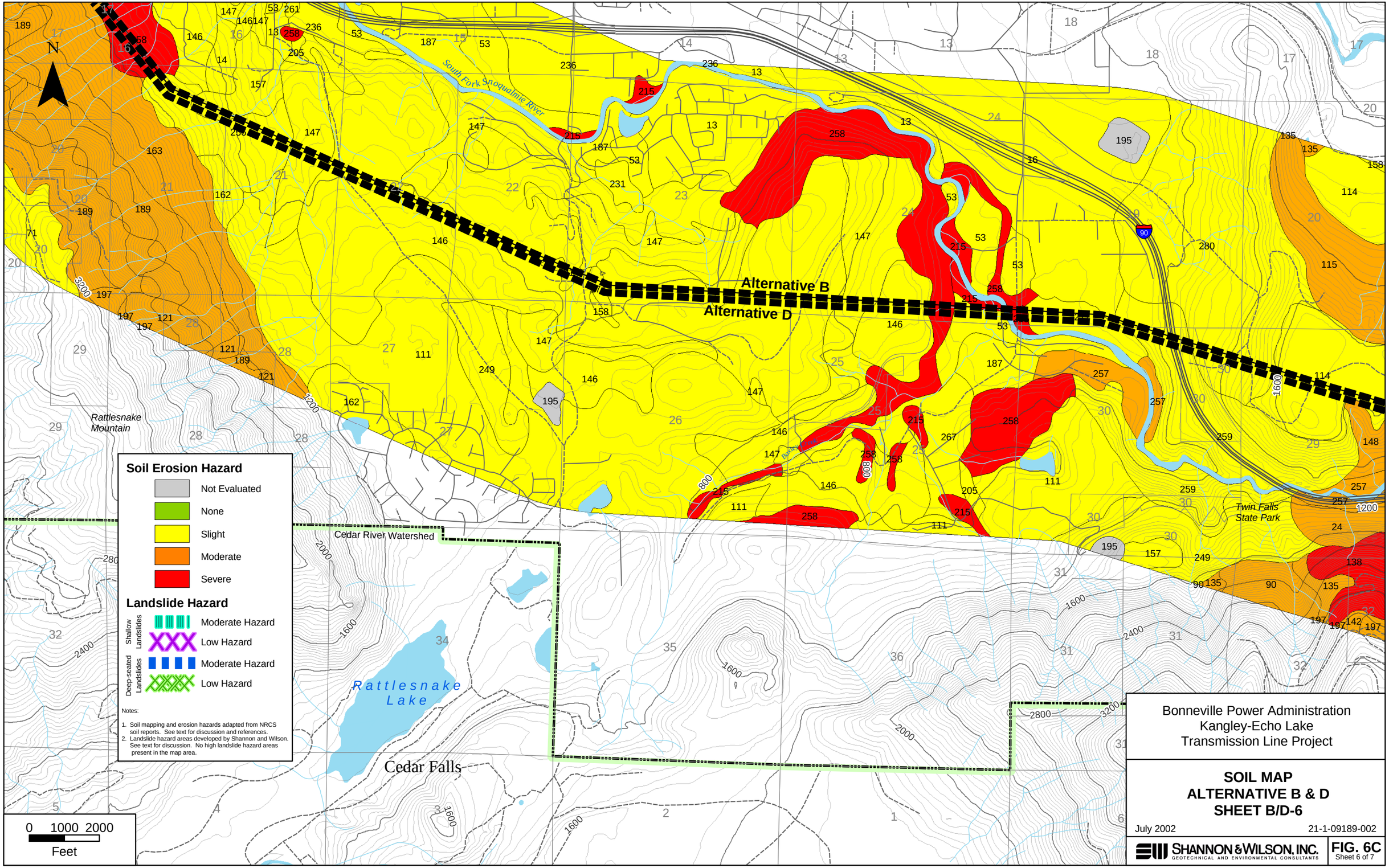
South Fork Snoqualmie River

Wood Creek

Cedar River Watershed

0 1000 2000
Feet

FIG. 6C
Sheet 5 of 7



Bonneville Power Administration
Kangley-Echo Lake
Transmission Line Project

SOIL MAP
ALTERNATIVE B & D
SHEET B/D-6

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SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. 6C
Sheet 6 of 7

Bonneville Power Administration
Kangley-Echo Lake
Transmission Line Project

SOIL MAP
ALTERNATIVE B & D
SHEET B/D-7

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FIG. 6C
Sheet 7 of 7

N

Alternative D

Alternative B

Echo Lake Substation

North Bend

SR-18

Kimball Creek

South Fork Snoqualmie River

Raging River

Rattlesnake Mountain

Soil Erosion Hazard

- Not Evaluated
- None
- Slight
- Moderate
- Severe

Landslide Hazard

Shallow Landslides
- Moderate Hazard
- Low Hazard

Deep-seated Landslides
- Moderate Hazard
- Low Hazard

Notes:

1. Soil mapping and erosion hazards adapted from NRCS soil reports. See text for discussion and references.
2. Landslide hazard areas developed by Shannon and Wilson. See text for discussion. No high landslide hazard areas present in the map area.

0 1000 2000
Feet

FIG. 6C
Sheet 7 of 7

Appendix N Final Supplemental Fisheries Technical Report

Final Supplemental Fisheries Technical Report

Bonneville Power Administration
Kangley-Echo Lake Transmission Line Project

Prepared for:

Bonneville Power Administration
905 NE 11th Avenue
Portland, Oregon 97208-3621

Prepared by:

Jones & Stokes
11820 Northup Way, Suite E300
Bellevue, Washington 98005-1946

December 2002

This document should be cited as:

Jones & Stokes. 2002. Bonneville Power Administration Kangley-Echo Lake Transmission Project. Final supplemental fisheries technical report. December 2. (JSA 0P005.00.) Bellevue, WA. Prepared for Bonneville Power Administration, Portland, OR.

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1.0 Executive Summary

This report describes the existing conditions and potential impacts to fisheries from the proposed Bonneville Power Administration (BPA) Kangley-Echo Lake Transmission Line Project. This report serves as the primary basis for the fisheries discussion in the National Environmental Policy Act (NEPA) Supplemental Draft Environmental Impact Statement (SDEIS) prepared for the project.

1.1 Alternatives

This Technical Report presents the preferred alternative (Alternative 1) and four additional action alternatives for constructing a new 500-kilovolt (kV) electrical transmission line intended to increase the capacity and reliability of energy provided to the Seattle metropolitan area. This increased capacity and reliability would reduce the potential for rolling brownouts or blackouts that could transpire by the winter of 2002 to 2003 if severe winter weather were to cause inordinate power demand and a simultaneous outage were to occur on one of the existing transmission lines in the area. Each alternative as shown in Figure 1 is described below in Section 1.1.2.

1.1.1 Construction Methods

BPA would construct all of the action alternatives using the existing practices described below for building transmission lines and substations. BPA would first obtain from landowners any additional easements for right-of-way (ROW) for the transmission line or access roads that would be needed. BPA would then build or improve access roads as necessary, clear vegetation in the ROW, and construct the required towers. BPA typically uses existing, cleared staging areas for storage and assembly of materials or structures.

After the structures are in place and conductors are strung between the structures, BPA would restore all disturbed areas.

The following sections describe in greater detail the sequential steps that BPA typically takes to construct a transmission line.

1.1.1.1 Right-of-Way Requirements

BPA would obtain easements from landowners for the transmission line ROW, and easements for access roads outside of the transmission line ROW easement. The easements give BPA the right to construct, operate, and maintain the line and access roads. A 150-foot (ft.) ROW width is assumed for the proposed 500-kV line.

Fee title to the land comprising the easement generally remains with the owner, subject to the provisions of the easement. The easement prohibits structures, tall trees, storing of flammable materials, and other activities that could be hazardous to people or endanger the transmission line. Activities that do not interfere with the transmission line or endanger people are usually not restricted.

Rights (usually easements) for new access roads that are outside the transmission line ROW would be acquired from property owners, as necessary. A 50-ft. ROW easement generally would be acquired for the new access roads, which are typically constructed to a roadbed width about

16 ft. wide. A 20-ft-wide easement would be purchased for the use of any existing access roads that are needed.

1.1.1.2 Clearing

The height of vegetation within the ROW would be restricted to provide safe and reliable operation of the line. All tall growing vegetation would be cleared within the transmission line ROW. Some trees outside of the ROW would also be cleared to prevent unstable or undesirable trees from falling onto the lines. These trees are referred to as "danger trees." A clearing advisory would be generated using ground information from cross section data. This clearing advisory would specify a safe vegetation height along and at varying distances from the line. The amount of vegetation removed would be based on this clearing advisory and local knowledge of regional conditions such as weather patterns, storm frequency and severity, general tree health, and soils. Other factors that influence the amount of clearing along the line are the line voltage; vegetation species, height, and growth rates; ground slope; conductor elevation above the ground; and clearance distance required between the conductors and other objects.

Merchantable timber purchased from private owners would be marketed and non-merchantable timber would be either lopped and scattered, piled, and/or chipped and left onsite, or would be taken offsite. Non-merchantable timber may or may not be burned because of air quality constraints. Contractors would be required to use brush blades that leave low-growing vegetation in place instead of dirt blades on bulldozers for clearing. Other specialized brushing/mulching equipment may also be required. Additional best management practices (BMPs) for timberland would also be used.

At the new tower sites, all trees and snags would be felled and stumps over 22 inches (in.) would be removed, including their root systems. The site would be graded to provide a relatively level work surface. The total amount of clearing required for this project is presently unknown.

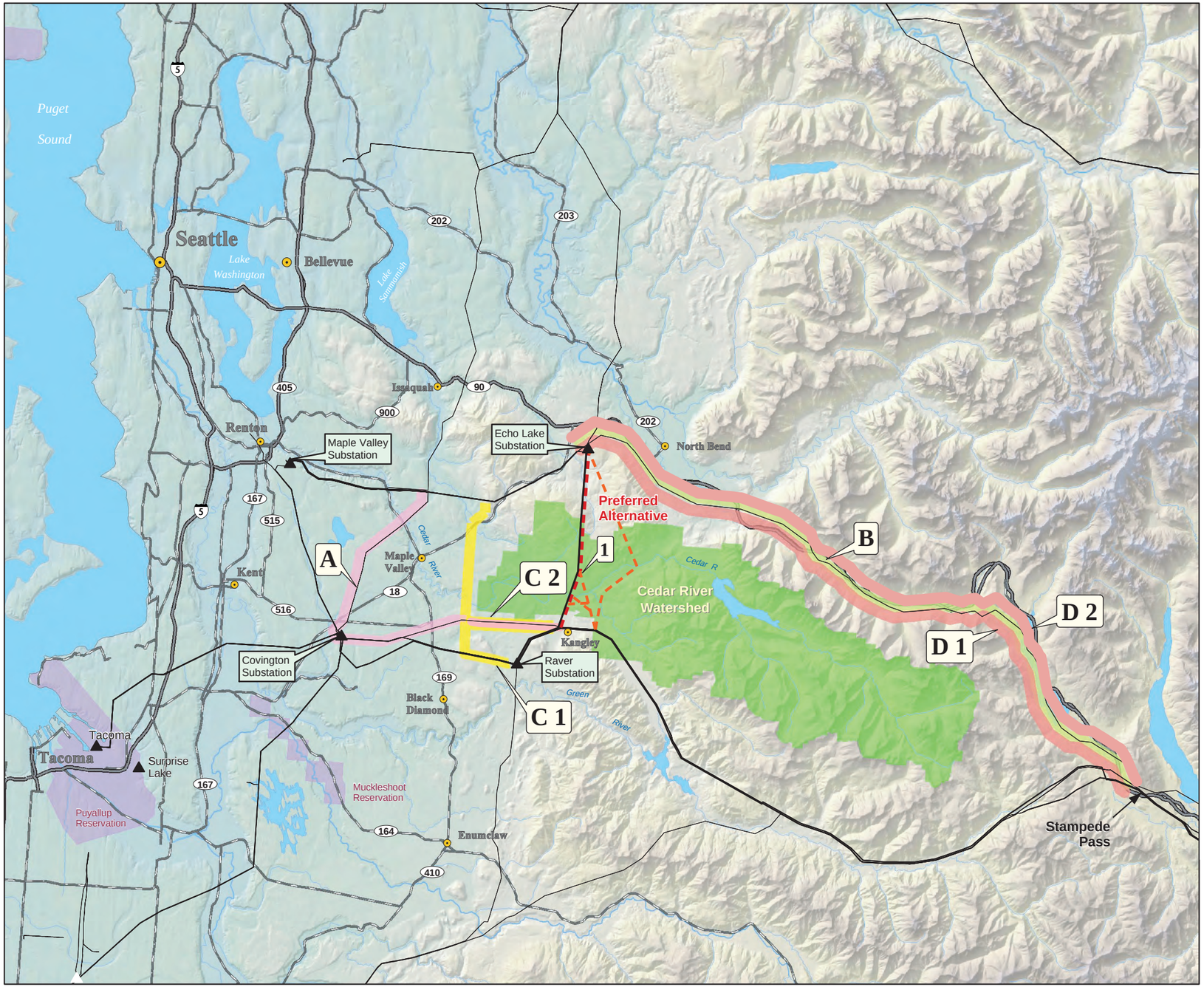
Additional land would be cleared for roads that are needed off the ROW and for roads determined to be in poor condition and requiring upgrading by BPA.

1.1.1.3 Access Road Construction and Improvement

An access road system within and outside of the ROW would be used to construct and maintain the new line. Access roads would be 16 ft. wide, with additional road widths of up to 20 ft. for curves. Existing access roads may also need improvement. Roads generally would be surfaced with gravel, and appropriately designed for drainage and erosion control. The access roads would generally have grades of 6% or less for erodible soils and 10% or less for resistant soils. The maximum grades would be 15% for trunk roads and 18% for spur roads. No permanent access road construction would be allowed in cultivated or fallow fields.

Clearing and construction activities for new access roads would disturb an area about 20 ft. wide, depending on terrain. New roads would be constructed within the ROW wherever possible, but where conditions dictate, roads would be constructed and used outside of the ROW. Construction of new roads is recommended only to access new towers or to avoid greater natural resource impacts.

Dips, culverts, and waterbars would be installed within the roadbed to provide drainage. Fences, gates, cattle guards, and additional rock would be added to access roads as necessary.



ADDITIONAL ALTERNATIVES to be CONSIDERED

Kangley - Echo Lake Transmission Line Project

Legend

- Existing BPA Transmission Lines
- Preferred Alternative
- ▲ BPA Substations

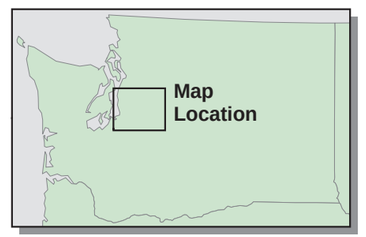
Alternatives

A Construct New Single-Circuit 500-kV Line from tap near Kangley to Covington Substation.
Rebuild Covington - Maple Valley 230-kV to Double-Circuit 500-kV

B Rebuild Portion of Rocky Reach-Maple Valley 345-kV to Double-Circuit 500-kV from East of Stampede Pass to Echo Lake Substation

C Construct New Single-Circuit 500-kV Line West of the Cedar River Watershed to the Echo Lake - Maple Valley Lines

D Construct New Single-Circuit 500-kV Line from East of Stampede Pass Adjacent to Rocky Reach-Maple Valley Line



N

0 3 6 9 12

Miles

May 10, 2002

Source: Bonneville Power Administration 2002.

0P005.00 016 (8/02)

Jones & Stokes

Figure 1
Location Map and Proposed Transmission Line Alternatives

Where temporary roads are used, any disturbed ground would be repaired and, where land use permits, the road would be reseeded with grass or other appropriate seed mixtures. After construction, access roads would be used for line maintenance. Where ground must be disturbed for maintenance activities, the roadbed would be repaired and reseeded as necessary.

The amount of new roads required for this project would vary depending on the alternative chosen and the ability of BPA to acquire rights on existing roads in the area.

1.1.1.4 Storage, Assembly, and Refueling Areas

Construction contractors usually establish storage areas near the transmission line where they can stockpile tower steel, conductor spools, and other construction materials. These areas would be accessible from major highways. Structural steel would be delivered in pieces on flatbed trucks and would be assembled either on or offsite. A mobile crane may be needed to handle the bundles. If the terrain were too steep at the actual tower site, general assembly yards would be used to erect the tower in pieces. The structure would then be transported to the tower site by truck or helicopter. Because trucks and helicopters need to refuel often, these construction areas may also be used for refueling.

1.1.1.5 Tower Site Preparation

Site preparation begins with removing all vegetation from a tower site. In areas of uneven topography, the site would be graded to provide a level work area. An average area of 30,000 square feet (150 by 200 ft.) could be disturbed at each tower site. Additional areas that could be disturbed include the site where the conductor is strung and pulled. These disturbances could be as large as a 370-ft. radius from the tower center.

Bulldozers would be used to clear and construct any new access roads to the transmission line towers and any new tower site landings. Manual methods, including chainsaws and brush hogs, would be used to clear the new ROW. BMPs would be used during clearing and construction to reduce impacts.

In addition to clearing the ROW for the transmission line towers, construction crews would remove selected trees in a 50- to 60-ft.-wide area on each side of the ROW. This additional clearing would be done to reduce the possibility of unstable trees falling on the new transmission line. Some trees newly exposed to the wind would be expected to fall after the initial clearing process because they have not developed the root structure to remain standing once they become more fully exposed to strong winds.

1.1.1.6 Towers and Tower Construction

Steel lattice towers would be erected to support the transmission line conductors. The height of each tower would vary by location and surrounding landforms. Single circuit towers would average 135 ft. high and double circuit towers would average 180 ft. high. The towers would be spaced about 1,100 to 1,200 ft. apart.

Most towers used on the proposed line would be “tangent” or “suspension” towers. This type of tower is designed to support conductors strung along a virtually straight line with only small turns or angles. “Deadend” towers would also be used on a limited basis where stresses on the transmission line conductors would have to be equalized because of changes in direction, because of the need to support an excessively long span, or where a span crossing is needed for extremely

steep or rugged terrain or a river. Deadend towers use more insulators and heavier steel than tangent or suspension towers, thus making them more visible. Deadend towers also are more costly to build than suspension towers.

The towers would be constructed from the ground as much as possible, rather than using helicopters. The equipment used depends on the weight and size of the towers and such site conditions as weather and soil characteristics. Most of the 500-kV towers would be built using mobile cranes; however, helicopter tower erection could be used if access was not available or if sensitive resources would be encountered.

Steel towers would be assembled in sections near the tower site. Each tower contains three components: the legs, body, and bridge. The bridge is the uppermost portion of the tower and serves as the attachment point for the insulators that support the conductors.

Steel towers are anchored to the ground by footings. Each tower requires four footings placed in holes that have been excavated, augured, or blasted. Large machinery, such as backhoes or truck-mounted augers, would be used to excavate the footings. Topsoil would be stockpiled during excavation. The design of the footings would vary based on soil properties, bedrock depth, and the soundness of the bedrock at each site. Typically, towers would be attached to steel plates or grillages placed within the excavated area. The areas would then be backfilled with excavated material or concrete. Topsoil would then be replaced to restore the original ground surface.

Typical footings for single-circuit towers include 4- by 4-ft. plates placed 10 to 12 ft. deep for suspension towers and 12.5- by 12.5-ft. grillage placed 14 to 16 ft. deep for heavy deadend towers. Typical footings for the double-circuit towers include 8.25- by 8.25-ft. grillage placed 12 to 14 ft. deep for suspension towers and 16- by 16-ft. grillage placed 14.5 to 18.5 ft. deep for heavy deadend towers. On average, for an entire transmission line project, each footing would occupy an area about 10 by 10 ft. to a depth of 15 ft. if bedrock was not encountered. The holes in which the plates and grillage would be installed must be large enough to provide about 1 ft. of clearance on each side of the plate or grillage. If bedrock were encountered and had properties that allowed anchor borings, holes would be drilled and steel rods grouted into the rock. These rods would either be attached to a concrete footing or welded directly to a tower member and embedded in compacted backfill. If rock properties were not suitable for anchor rods, the rock may be blasted to obtain adequate footing depth.

As the towers are built, heavy machinery would disturb the ground surface and/or compact soils at the tower site and along access roads. The machinery also would generate noise and dust.

1.1.1.7 Conductors, Overhead Ground Wires, and Insulators

The wires or lines that carry the electrical current in a transmission line are called conductors. Alternating-current transmission lines, such as the proposed line, require three wires or sets of wires, each of which is referred to as a “phase.” Three 1.3-in. Bunting conductors would be included for each phase. Each bundle is 16 by 20 in.

Conductors are not covered with insulating material. Instead, the air surrounding each conductor acts as insulation. Each phase of conductor would be physically separated on the transmission tower.

After the transmission towers are in place, workers would attach a smaller steel cable to the conductor and then pull the conductor under tension through the insulators and string the

conductor between towers. Conductors would be attached to the structure using glass, porcelain, or fiberglass insulators. Insulators prevent the electricity in the conductors from moving to other conductors on the tower, the tower itself, and the ground. As the conductors are strung, the ground surface would be disturbed at the tensioning sites, and noise and dust would be generated by the machinery.

Transmission towers elevate conductors to provide safe clearance for people and structures within the ROW. The National Electrical Safety Code (NESC) establishes minimum conductor heights. The minimum conductor-to-ground clearance for a 500-kV line is a little more than 29 ft. Greater clearances would be provided by BPA over county roads and highways, railroads, and river crossings.

One or two smaller wires, called overhead ground wires, would also be attached to the top of the transmission towers. Overhead ground wires would be installed to protect the transmission line against lightning damage. The diameter of the wire would vary from 0.375 to 0.625 in.

1.1.1.8 Substation Addition

Under the current proposal, the Echo Lake Substation would be expanded to the east on land owned in fee title by BPA. The size of the expansion would be approximately 150 by 750 ft. The site would be cleared in the same manner as the ROW for the transmission line. The site would include a fenced yard and a graded and graveled parking lot. The existing road around the substation would be realigned to the east to accommodate this expansion. New transformers, switches, and other equipment would be installed in the expanded area. A continuous ground wire would also be installed.

1.1.1.9 Site Restoration and Clean-up

Disturbed areas around the towers, conductor reels, and pull site locations would be reshaped and contoured to be consistent with their original condition. Access roads would be repaired.

Disturbed areas would be reseeded with grass or an appropriate seed mixture to prevent erosion. The seed mixture would include native plant species and would be free of noxious weeds. All solid waste from construction would be removed and properly disposed offsite, and equipment would be removed from the ROW.

1.1.2 Alternative Rights-of-Way

Alternative 1, the preferred alternative, is presented for comparison purposes only. Please refer to the *Final Wetlands Technical Report* (Jones & Stokes 2002) for a detailed description.

1.1.2.1 Alternative 1: Preferred Alternative

The alignment for Alternative 1 would be immediately adjacent and parallel to a portion of the existing 12-mi. Raver-Echo Lake transmission line from a point approximately 3 mi. north of Raver (S26, T22N, R7E) to the Echo Lake Substation (S11, T23N, R7E) (see Figure 1). This alternative would be approximately 9 mi. long and would require about 2.9 mi. of new access roads. The existing 150-ft. ROW would be widened to 300 ft., with the widening and new line located east of the existing ROW.

1.1.2.2 Alternative A

The alignment for Alternative A would be located west of the Cedar River Municipal Watershed (Figure 1). This alternative proposes to construct a new single-circuit 500-kV line within an existing BPA ROW from a tap along the Schultz-Raver No. 2 line near the community of Kangley to just outside BPA's substation near Covington. The line then routes along the outside of the northeast fence line of Covington Substation to the existing Covington-Maple Valley 230-kV transmission line. This entire segment would be constructed in a single-circuit configuration with tower heights averaging 135 ft.

The remainder of this alternative would require replacing a portion of BPA's existing Covington-Maple Valley single-circuit 230-kV transmission line with a double-circuit 500-kV line north of Covington Substation. One side of the new double circuit towers would be operating at 500-kV and the other side at 230-kV. The 500-kV circuit would continue on to terminate at Echo Lake Substation utilizing a vacant circuit on the Maple Valley-Echo Lake double-circuit 500-kV transmission line. New double-circuit towers, about 180 ft. tall, would support both double circuit segments. The new transmission lines would be built on existing rights-of-way, with the exception of a portion of the single-circuit line near the Covington Substation. New right-of-way would need to be acquired across from the Covington Substation to connect the single-circuit 500-kV transmission line with the double-circuit line.

1.1.2.3 Alternative B

Alternative B proposes to replace about 38 mi. of BPA's existing Rocky Reach-Maple Valley 345-kV transmission line to a double-circuit 500-kV line (Figure 1). The new towers would be about 180 ft. tall, approximately 30 to 90 ft. taller than the existing towers. The new 500-kV line would be connected to the existing Schultz–Raver No. 2, 500-kV transmission line just east of Stampede Pass and to Echo Lake Substation at the west end. The line would cross Interstate 90 (I-90) twice. Almost all of this route would be on existing right-of-way.

1.1.2.4 Alternative C (Option C-1)

Alternative C (Option C-1) proposes to construct a new single-circuit 500-kV line from near the community of Kangley at BPA's Raver Substation on mostly new 150-ft.-wide right-of-way totaling 10 mi. in length (see Figure 1). The proposed transmission line would be carried on towers approximately 135 ft. high and originate at the Raver Substation. The proposed line would proceed westerly a distance of about 2.5 mi. on new 150-ft.-wide right-of-way immediately north of the Tacoma-Raver double-circuit 500-kV transmission line. At that point the line would turn north through the Ravensdale and Hobart areas and would be connected to an existing vacant (unused) Echo Lake-Maple Valley 500-kV circuit. The vacant circuit would need to be connected to a new bay in the Echo Lake Substation. This option would require the purchase of approximately 6 mi. of new transmission line right–of-way.

1.1.2.5 Alternative C (Option C-2)

Alternative C (Option C-2) proposes to construct a new single-circuit 500-kV line from a tap along the Schultz-Raver No. 2 line near the community of Kangley, to an existing vacant (unused) Echo Lake-Maple Valley 500-kV circuit (see Figure 1). New towers would be about 135 ft. tall. The new line would pass through the Ravensdale and Hobart areas. The vacant circuit would then need to be connected to a new bay in the Echo Lake Substation. This option would require the purchase of approximately 10.5 mi. of new transmission line right–of-way.

1.1.2.6 Alternative D (Options D-1 and D-2)

Alternative D proposes to construct a new single-circuit 500-kV transmission line from east of Stampede Pass to the Echo Lake Substation, over a distance of approximately 38 mi. (see Figure 1). The new line would be located either on the south side or the north side of the existing Rocky Reach-Maple Valley 345-kV line, immediately adjacent to the existing cleared transmission line right-of-way. New towers would average about 135 ft. tall. The line would cross I-90 twice. A new 150-ft.-wide right-of-way would need to be acquired either on the south side of the existing ROW (Option D-1) or on the north side (Option D-2).

1.2 Key Issues for Fisheries

Three key issues have been identified during the scoping process:

- The proposed project could adversely affect habitat for four distinct population segments listed as threatened under the Endangered Species Act (ESA): Puget Sound chinook salmon, Coastal/Puget Sound bull trout, Columbia River bull trout, and Middle Columbia steelhead.

- The proposed project could impact riparian reserves and streams in lands currently administered by the United States Forest Service (USFS) under the standards and guidelines of the Northwest Forest Plan Final Environmental Impact Statement (FEIS) (USFS & BLM 1994a) and Record of Decision (ROD) (USFS & BLM 1994b). Under the ROD, all actions on USFS land must maintain or restore aquatic habitat in accordance with the Aquatic Conservation Strategy Objectives (ACSOs) to qualify for approval.

- The proposed project could impact riparian areas and streams near the City of Kent in the Rock Creek basin. Kent withdraws water from the Clark Springs Supply in the Rock Creek vicinity and supplements the flow of Rock Creek, a stream bearing anadromous fish, as part of the city's salmonid conservation program.

1.3 Major Conclusions

All action alternatives would have similar impacts to fish and their habitat. All action alternatives would require removal of riparian forest vegetation in an area where such activity has previously been determined to cause adverse effects to fish species listed as threatened under the ESA. Although measures could be taken to minimize vegetation clearing in riparian areas, the residual impacts would persist throughout the life of the project. All action alternatives would also require the construction and maintenance of roads. Mitigation methods are available that would reduce road-related impacts to a negligible level. All action alternatives that pass through USFS-managed lands would likely result in short-term impacts to riparian reserves and nonattainment of ACSOs and in some cases would result in long-term inability to maintain or restore riparian habitat.

2.0 Study Scope and Methodology

2.1 Data Sources and Study Methods

Because of the recent listings of several fish species as threatened under the ESA and the general concerns regarding fish populations, fish and fish habitat in all of the watersheds in the project

area have been extensively studied. Unless otherwise stated, this fisheries analysis is based on the following sources:

- The StreamNet Database (www.streamnet.org).
- National Marine Fisheries Service (NMFS) formal status reviews of fish populations within the project area (Busby et al. 1996, Gustafson et al. 1997, Johnson et al. 1999, Myers et al. 1998, Weitkamp et al. 1995).
- The Northwest Forest Plan FEIS (USFS & BLM 1994a).
- The Northwest Forest Plan ROD (USFS & BLM 1994b).
- Geographic Information System (GIS) data provided by BPA and the U.S. Geological Survey (USGS).
- Washington State Conservation Commission Habitat Limiting Factor Reports for the Cedar-Sammamish, Green-Duwamish, and Upper Yakima Water Resource Inventory Areas (WRIAs).
- USFS Watershed Analyses for the South Fork Snoqualmie River and Upper Yakima River (USFS 1995, USFS 1997).
- Interviews with agency personnel (see Section 6).
- Examination and interpretation of 1:24,000-scale USGS topographic maps and 1:24,000-scale color aerial photographs flown on July 20,1999.
- Field studies conducted in early June 2002.
- Scientific and agency publications and studies, as cited below.

The analysis of impacts assumes standard BPA clearing, grading, and filling requirements for the construction of towers and roads as described in Section 1.1.1 of this report. Potential locations for the construction of new transmission towers were approximated based on standard BPA construction requirements, the location of existing towers, topographical and natural features, and conversations with BPA engineers. All tower locations are approximate and subject to modification. The majority of potential access road construction and reconstruction was determined by field review of the alternative alignments by a BPA engineer, whose findings were subsequently provided to Jones & Stokes.

The impact assessment for this analysis relied upon remote methods to identify potential fish-bearing streams, including GIS data provided by BPA. Potential fish-bearing streams were identified as all streams in the GIS database having a gradient of less than 20% and a headwater catchment of more than 50 acres (ac.) as measured from USGS topographic maps. The GIS database was revised to include all fish-bearing and non-fish-bearing streams identified during the field reconnaissance phase. For reasons described below, all stream reaches located within 300 ft. of an area proposed for vegetation clearing under any of the action alternatives were considered to be potentially affected.

Color aerial photographs provided information about the size and species composition of riparian vegetation and the existing riparian shade along all potentially affected streams. This review used established methods for watershed analysis delineated by the Forest Practices Division of the Washington Department of Natural Resources (WFPB 1998). Fish-bearing and non-fish-bearing streams were identified and assessed in field studies. Channel geomorphology and fish habitat were observed at first-hand, and field study was used to ground-truth the aerial photograph assessment.

Some portions of the study area were inaccessible for field review because of heavy snow cover, degraded access roads, inaccessible private property, and time restrictions. In the absence of field verification, stream data was based on GIS data and literature review of each specific watershed and basin.

For the impact assessment, vegetation clearing impacts were estimated based on an assumption that the entire length of the 150-ft.-wide transmission line corridor would be completely cleared. This assumption represents a worst-case scenario. Topography and the ability to span trees in low areas will spare vegetation in some locales, and actual cleared acreage within the proposed transmission line corridors will likely be less than the amount shown in this analysis. BPA would also minimize vegetation clearing by placing towers outside riparian areas. The extent of such mitigation is not yet known, however.

The assessment assumes that vegetation clearing within 300 ft. of any stream would have potential adverse effects on stream microclimate and large woody debris (LWD) recruitment potential, and that clearing within 100 ft. of any stream would additionally have potential adverse effects on bank reinforcement by roots, on fine litter inputs to the stream, and on riparian shade. The assessment assumes that vegetation clearing within USFS Riparian Reserves of any stream would have potential adverse effects on USFS-managed lands specially protected under the Northwest Forest Plan. Locally applicable analyses such as FEMAT (1993) and City of Seattle (1998) support the use of the100-ft. and 300-ft. study perspectives with provision for greater buffers at sensitive sites. These accepted standards represent simplifications because the structural and functional importance of the riparian ecosystem varies continuously as a function of distance from the stream.

2.2 Agencies Contacted

In the course of this report's preparation, the following agencies were contacted and consulted

- Kittitas County Planning Department
- City of Covington Planning and Community Development Department
- Seattle Public Utilities (SPU)
- Muckleshoot Tribe Fisheries Department

3.0 Affected Environment

3.1 Regional Overview

The fish resources in the study area include resident and anadromous species. Resident species live their life cycles within the watershed. Anadromous species are hatched in fresh water, and then spend part of their life at sea before returning to their home waters to spawn.

3.2 Regulations, Standards, and Guidelines

3.2.1 Special-Status Fish Species

Special-status fish species include those that are listed, proposed, or candidates for listing as threatened or endangered under the federal ESA, or that are regarded as species of concern by the U.S. Fish and Wildlife Service (USFWS), or that are listed as species of concern (including endangered, threatened, sensitive, and candidate categories) according to the Washington Department of Fish and Wildlife (WDFW). Table 1 summarizes special-status fish potentially present in streams crossed by the alternative ROWs.

Table 1. Special-Status Fish in Streams Crossed by the Alternative ROWs

Fish	Scientific Name	Federal Status	State Status
Chinook salmon	*Oncorhynchus tshawytscha*	Threatened	Candidate
Coho salmon	*Oncorhynchus kisutch*	Candidate	None
Steelhead	*Oncorhynchus mykiss*	Threatened	Candidate
Bull trout	*Salvelinus confluentus*	Threatened	Candidate
Pacific lamprey	*Entosphenus tridentatus*	Species of Concern	None
River lamprey	*Lampetra ayresi*	Species of Concern	Candidate

3.2.1.1 Federally-Listed Species

All action alternatives could affect two species of fish, Puget Sound chinook salmon and Puget Sound bull trout, listed as either threatened or endangered under the ESA, referred to as listed species. Action Alternatives B and D (Options D-1 and D-2) could affect two additional species of fish, Middle Columbia steelhead and Columbia River bull trout, listed as threatened under the ESA. The following paragraphs provide additional information about listed species and habitats that could be affected by the project.

The Puget Sound Evolutionary Significant Unit (ESU) **chinook salmon** was listed by NMFS as threatened under the ESA on March 24, 1999 (64 FR 14308). This ESU includes all naturally spawned chinook populations residing below impassable natural barriers in the Puget Sound region from the North Fork Nooksack River to the Elwha River on the Olympic Peninsula. Chinook salmon are potentially present in one or more streams crossed by each of the action alternatives (Table 1).

The Middle Columbia ESU **steelhead** was listed by NMFS as threatened under the ESA on March 25, 1999 (64 FR 14517). The ESU includes all naturally spawned populations of steelhead in streams from above the Wind River, Washington, and the Hood River, Oregon,

upstream to, and including, the Yakima River, Washington. Excluded are steelhead from the Snake River Basin. Steelhead are potentially present in one or more streams crossed by each of the action alternatives (Table 1).

The Puget Sound distinct population segment (DPS) **bull trout** was listed by the USFWS as threatened under the ESA on November 1, 1999 (64 FR 58910). The Columbia River DPS **bull trout** was listed by the USFWS as threatened under the ESA on June 10, 1998 (63 FR 31647). Bull trout from at least one of these populations is potentially present in streams crossed by each of the action alternatives (Table 1).

3.2.1.2 Federal Candidate Species

All action alternatives could affect one species of fish that is a candidate for listing under the ESA, referred to as a candidate species. The Puget Sound/Strait of Georgia ESU **coho salmon** was proposed for listing by NMFS as threatened under the ESA on July 25, 1995 (60 FR 38011). This ESU includes coho salmon from drainages of Puget Sound and Hood Canal, the eastern Olympic Peninsula (east of Salt Creek), and the Strait of Georgia from the eastern side of Vancouver Island and the British Columbia mainland (excluding the upper Fraser River). Although NMFS, in its proposal, found listing to be "not warranted," the species has not been withdrawn from candidate status and may be listed in the future. Coho salmon are potentially present in streams crossed by each of the action alternatives (Table 1).

3.2.1.3 Federal Species of Concern

The USFWS has identified the Pacific lamprey and river lamprey as species of concern potentially occurring in the project area (USFWS 2000).

The **Pacific lamprey** is widely distributed in coastal and Columbia River drainages, but the extent of its distribution and population trends are poorly understood. It is thought that destruction of spawning and rearing habitats as well as reduced numbers of prey (salmonids) have contributed to a reduction in the population of Pacific lamprey. Spawning habitat is similar to salmonids including cool, flowing water and clean gravel. Rearing areas are slow-moving backwaters with fine sediment (ODFW 1995). Pacific lamprey are potentially present in streams crossed by each of the action alternatives (Table 1).

The habitat, distribution, and status of the **river lamprey** are essentially the same as Pacific lamprey. The two species differ primarily in size; Pacific lampreys may grow considerably larger (to 30 in.) than river lampreys (to 12 in.) (Wydoski and Whitney 1979). River lamprey are potentially present in streams crossed by each of the action alternatives (Table 1).

3.2.1.4 Washington State Special-Status Species

Chinook salmon, steelhead, bull trout, and river lamprey, all described above, are state candidates for listing by the WDFW (2002). Pygmy whitefish and kokanee are also state species of concern found in Lake Keechelus within 0.25 mi. of the proposed alignments for Alternatives B and D (Options D-1 and D-2).

3.2.2 Essential Fish Habitat

All actions could affect two fisheries protected by the Essential Fish Habitat (EFH) provisions of the Magnuson-Stevens Act (16 U.S.C. 1855(b)): the chinook salmon and coho salmon fisheries.

All streams in the study area are included in designated EFH for these two fisheries. Some streams are included because they may support spawning, rearing, and migratory use by chinook and coho salmon. Other streams are included because they are situated upstream of areas used by salmon, and the salmon are sensitive to water quality in these streams. Since chinook salmon is a federally-listed species (Section 3.2.1.1) and coho salmon is a federal candidate species (Section 3.2.1.2), the analyses of current conditions and potential impacts (Section 4) to these species also serve to describe all potential impacts to EFH.

3.2.3 United States Forest Service

USFS manages two National Forests in the project area, the Mt. Baker-Snoqualmie National Forest and the Okanogan-Wenatchee National Forest. USFS also manages lands on the fringes of these two national forests within the project area. In 1993, USFS and the Bureau of Land Management (BLM) developed the Northwest Forest Plan to set guidelines for the management of the natural environment in Pacific Region National Forests. The goals of the Northwest Forest Plan are designed to protect forest ecosystems and allow renewable use of forest material, but they also include protection for riparian areas and waters. The forest management and implementation portion of the strategy was analyzed in a draft supplemental environmental impact statement. The final EIS and the ROD were published in February 1994. The ROD amended the planning documents of 19 National Forests and 7 Bureau of Land Management Districts.

The Aquatic Conservation Strategy (ACS) was developed to restore and maintain the ecological health of watersheds and aquatic ecosystems contained within them on public lands. The strategy will protect salmon and steelhead habitat on federal lands managed by USFS and BLM. The Northwest Forest Plan Standards and Guidelines define the process by which proposed projects are determined to be in compliance with the ACSOs. ACSOs (listed below) are designed to protect the watershed at a variety of spatial and temporal scales.

1. Maintain and restore the distribution, diversity, and complexity of watershed and landscape scale features to ensure the protection of the aquatic systems to which species, populations, and communities are uniquely adapted (Watershed complexity).

2. Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life history requirements of aquatic and riparian-dependent species (Watershed connectivity).

3. Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations (Geomorphic integrity).

4. Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain in the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities (Water quality).

5. Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of the sediment input, storage, and transport (Sediment Regime).

6. Maintain and restore in-stream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected (Streamflow).

7. Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands (Water table elevation).

8. Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation, nutrient filtering, appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distribution of coarse woody debris sufficient to sustain physical complexity and stability (Riparian/wetland vegetation).

9. Maintain and restore habitat to support well-distributed populations of native plant, invertebrate, and vertebrate riparian-dependent species (Habitat)

The ACS seeks to manage and evaluate aquatic ecosystems at larger watershed scales, but it also incorporates ecosystem principles in project-level planning. Both positive and negative impacts may span temporal scales ranging from days to centuries, often taking decades or longer to become evident. The anticipated effect of an action can be used to determine consistency of the action with ACSOs even though the effects may not be fully evident until some distant time. Management actions that do not maintain the existing condition or lead to improved conditions in the long term would not meet the intent of the ACS and should not be implemented (USFS and BLM 1994b).

The four main components that allow attainment of the ACSOs are Riparian Reserves, Key Watersheds, Watershed Analysis, and Watershed Restoration. Actions that negatively affect or impede implementation of these components would result in nonattainment of the ACSOs. Riparian Reserves include those portions of a watershed directly coupled to streams and rivers; that is, the portions of a watershed required for maintaining hydrologic, geomorphic, and ecologic processes that directly affect standing and flowing waterbodies such as lakes and ponds, wetlands, streams, stream processes, and fish habitats. Guidelines for the width of riparian reserves are described in detail in Table 2.

Table 2. USFS Riparian Reserve Widths

Standard	Jurisdiction	Stream Type	Provisions
United States Forest Service Northwest Forest Plan Standards and Guidelines (USFS & BLM 1994b)	USFS Region 6 managed forest lands	Class 1- Fish-Bearing Streams	Stream plus the greater distance of top of inner gorge, outer edges of 100-year floodplain, outer edges of riparian vegetation, two times the site potential tree height (SPTH), or 300-ft. slope distance on each side.
		Class 2- Perennial, Non-Fish-Bearing Streams	Stream plus the greater distance of top of inner gorge, outer edges of 100-year floodplain, outer edges of riparian vegetation, one times the SPTH, or 150-ft. slope distance on each side.
		Class 3- Intermittent Streams	Stream plus the greater distance of top of inner gorge, outer edges of riparian vegetation, one times the SPTH, or 100-ft. slope distance on each side.

Key watersheds contribute directly to conservation of at-risk anadromous salmonids, bull trout, and resident fish species. They are also likely candidates for watershed restoration programs. USFS does not identify either of the affected watersheds (Yakima River and South Fork Snoqualmie) as a key watershed. The Box Canyon drainage within the upper portion of the Yakima River watershed is a Tier 1 Key watershed. However, none of the proposed alternatives either directly crosses the Box Canyon Drainage or crosses areas that drain towards the Box Canyon Drainage.

Watershed analyses are the foundation of this process, and each watershed analysis must describe existing conditions, natural variability, and the effects of proposed management activities. Watershed analysis is one of the principal analyses that will be used in making decisions on implementation of the Aquatic Conservation Strategy. Watershed Analyses have been completed for Yakima River (USFS 1997) and South Fork Snoqualmie River (USFS 1995). The Keechelus Lake-Mosquito Creek sub-watershed occurs within the greater Yakima River Watershed and also has a completed Watershed Analysis (Plum Creek 1997). Watershed restoration is expected to be an integral part of a program to aid recovery of fish habitat, riparian habitat, and water quality. Restoration should be based on watershed analysis and planning and should be identified in the watershed analysis.

This document will be the primary NEPA document for identifying impacts to USFS-managed lands in the project area. Impacts to ACSOs and riparian reserves are described at a scale equivalent to the current level of analysis within the affected watersheds under the proposed alternatives. If either Alternatives B or D (Options D-1 or D-2) is chosen as the preferred alternative, USFS-managed lands would be involved, and the appropriate level of analysis for ascertaining impacts to ACSOs would be completed.

3.2.4 Washington Department of Natural Resources

Alternatives B and D cross at least one parcel of WDNR-managed land. The WDNR Habitat Conservation Plan (HCP) was prepared by that agency to establish a comprehensive long-term management plan for all WDNR-managed timberlands within the range of the northern spotted owl in Washington. The WDNR HCP includes numerous provisions intended to maintain the quality of fish habitat and the health of fish populations in the watershed. These provisions are summarized in the Riparian Conservation Strategy Objectives:

1. To maintain or restore salmonid freshwater habitat on WDNR-managed lands; and

2. To contribute to the conservation of other aquatic and riparian obligate species.

The purpose of these objectives is to maintain or restore the functions of riparian and upland areas that directly affect the quality of salmonid freshwater habitat. The WDNR HCP applies the WDNR stream classification system (WAC 222-16-030) and specifies riparian buffer zones for each class of stream.

3.2.5 Local Regulations and Policies

The Washington State Environmental Policy Act (SEPA), RCW 4 3.21C, requires local jurisdictions to develop codes and policies that integrate its practices and regulations with local codes and policies. A detailed description of the applicable policies and codes within the affected area is described below.

3.2.5.1 King County

All of the action alternatives cross at least one major salmon-bearing stream within King County's jurisdiction. Title 21A, Chapter 24 of the King County Code implements the goals and policies of SEPA and the King County Comprehensive Plan in an effort to protect the environment in unincorporated King County. This portion of the King County Code includes the county's development regulations for streams and riparian buffers. Stream classes are defined in Chapter 6 of Title 21A of the County Code. Stream classes and standard buffer widths are summarized in Table 3.

Table 3. Stream Typing and Regulatory Standards for Riparian Buffers in King County

Jurisdiction	Stream Type		Buffer Requirement
King County	Class 1	Streams inventoried as "Shorelines of the State" under King County's Shoreline Master Program, K.C.C. Title 25, pursuant to RCW 90.58	No trees to be cut in a minimum 100-ft.-wide buffer.
	Class 2	Streams smaller than Class 1 streams which flow year-round during years of normal rainfall or those which are used by salmonids	No trees to be cut in a minimum 100-ft.-wide buffer if used by salmonids and minimum 50-ft.-wide buffer in Class 2 streams without salmonids.
	Class 3	Streams which are intermittent or ephemeral during years of normal rainfall and which are not used by salmonids.	No trees to be cut in a minimum 25-ft.-wide buffer.

3.2.5.2 Kittitas County

Two of the action Alternatives B and D (Options D-1 and D-2) cross at least one major salmon-bearing stream in the Upper Yakima watershed within Kittitas County's jurisdiction. Title 17A of the Kittitas County Code defines the critical areas regulations applicable within the county, including typing and protection of streams. Section 17A.02.300 sets forth the stream typing system for the county. However, the code is currently under revision and Kittitas County has requested that streams within the county jurisdiction be classified under the WDNR stream classification system shown in Table 4 (Hall pers. comm.).

Table 4. WDNR Stream Classification System (WAC 222-16-030)

Stream Type	Definition
Type 1	Major streams: waters inventoried as "shorelines of the state" under RCW 90.58.
Type 2	Waters that are not Type 1 and are used for domestic water supplies, or that are used by fish hatcheries, or that have a bankfull width of more than 20 ft. and a gradient of less than 4%, or are lakes larger than 1 ac., or are used by salmonids for off-channel habitat.
Type 3	Waters that are not Type 1 or 2 and have major fish use. Streams with a bankfull width of 2 ft. or more and a gradient of less than 16% are assumed to have major fish use. If the basin is larger than 50 ac., major fish use is assumed for streams with a gradient less than 20%. Ponds smaller than 1 ac. are also Type 3 waters.
Type 4	Waters that are not Type 1, 2, or 3 and have perennial flow.
Type 5	Waters that are not Type 1, 2, 3, or 4 and have a defined channel.

Riparian buffers are currently defined as per WAC 222-16-030, Water Typing System, Forest Practices Rules and codified by Kittitas County in Title 17A and shown in Table 5.

Table 5. Regulatory Standards for Riparian Management Zones and Riparian Buffers in the Study Area

Standard	Jurisdiction	Stream Type	Provisions
Cedar River Watershed Habitat Conservation Plan (City of Seattle 2000)	Cedar River Municipal Watershed	Not applicable	No commercial forest harvest within the Cedar River Watershed. Manage all forests to provide certain enumerated ecological functions.
Department of Natural Resources Habitat Conservation Plan (WDNR 1997)	State-owned timberlands	Type 1, 2, or 3	No trees to be cut in a buffer width corresponding to the 100-year SPTH, with a minimum 100-ft. width.
		Type 4	No trees to be cut in a 100-ft.-wide buffer.
		Type 5	Buffer width to be determined on a case-by-case basis pending further studies.
Washington Forest Practices Rules (WAC 222)	Privately owned commercial timberlands	Type 1, 2, or 3	For Site Class 2 lands (50-year SPTH, 119 to 136 ft.): No trees to be cut in a 50-ft.-wide core buffer; very limited tree removal in an additional buffer 63-ft.-wide on streams with a bankfull width of less than 10 ft., or 78 ft. wide on streams with a bankfull width of more than 10 ft.; leave 20 trees per ac. larger than 12 in. dbh in an additional buffer 57 ft. wide on streams with a bankfull width of less than 10 ft., or 78 ft. wide on streams with a bankfull width of more than 10 ft.
		Type 4	No trees to be cut in a 50-ft.-wide buffer within 300 ft. of a junction with a WDNR Type 1, 2 or 3 stream. On longer streams, buffer at least 50% of stream length with a 50-ft.-wide buffer. No trees to be cut near certain sensitive sites. Numerous additional restrictions.

3.2.5.3 City of Kent

Alternative A crosses one major salmon-bearing stream in the Soos Creek basin within the City of Kent jurisdiction. Title 15, Chapter 8 of the Kent City Code includes the City's development regulations for streams and riparian buffers as part of the general and supplementary provisions of the City Zoning Code in order to protect the Soos Creek Basin. In this section the City classification system for streams and the buffer requirements for development are defined. Stream classes and standard buffer widths are summarized in Table 6. The City of Kent's code for streams is almost identical to King County's.

3.2.5.4 City of Covington

Alternative A crosses the jurisdictional boundaries of the City of Covington and two major salmon-bearing streams in the Soos Creek basin while within that jurisdiction. The City of Covington has adopted, in whole, the environmental policies and codes of King County. The King County stream classes and riparian buffer requirements shown in Table 3 also apply in the City of Covington limits.

Table 6. Stream Typing and Regulatory Standards for Riparian Buffers in the City of Kent

Jurisdiction	Stream Type		Buffer Requirement
City of Kent	Class 1	Streams inventoried as "shorelines of the state" under the City of Kent Shoreline Master Program, Ch. 11.04 KCC, pursuant to Chapter 90.58 RCW.	Minimum 100-ft.-wide buffer from each side of the Ordinary High Water Mark (OHWM).
	Class 2	Streams smaller than Class 1 streams which flow year-round during years of normal rainfall or those which are used by salmonids	Minimum 100-ft.-wide buffer if used by salmonids and minimum 50-ft.-wide buffer in Class 2 streams without salmonids from each side of the OHWM.
	Class 3	Streams which are intermittent or ephemeral during years of normal rainfall and which are not used by salmonids.	No trees to be cut in a minimum 25-ft.-wide buffer.

3.2.5.5 City of Maple Valley

Alternative A crosses the jurisdictional boundaries of the City of Maple Valley. No perennial waterbodies were identified as being crossed by the proposed project within this jurisdiction. Title 18, Chapter 60, Section 310 of the Maple Valley City Code includes the City's development regulations for streams and riparian buffers. The Maple Valley stream classes and riparian buffer requirements are not referenced, as they are not applicable to the current action alternatives.

3.3 Study Area and Approach

The study area examined includes all mapped streams (USGS 7.5-minute topography coverage) that are within 300 ft. of the proposed 150-ft. ROW (see Figure 2). These streams occur within five watersheds, those of the Yakima River, the Snoqualmie River, the Raging River, the Cedar River, and the Green River, located within WRIA 7, 8, 9 and 39.

3.4 Transmission Line Alternatives

The following sections discuss existing fisheries resources in drainages crossed by the four action alternatives. The streams within the 750-ft. study corridor (i.e., within 300 ft. of either side of each 150-ft. alternative ROW) are listed in detail with documented fish presence data in Appendix A. Alternative 1, the Preferred Alternative, is presented for comparison purposes only. Please refer to the BPA Final Fisheries Technical Report (Jones & Stokes 2002) for a detailed description of the Preferred Alternative.

3.4.1 Alternative 1: Preferred Alternative

From south to north, the Alternative 1 ROW begins within the Green River Watershed, crosses the Cedar River Watershed (CRW), and ends in the watershed of the Raging River (a tributary to the Snoqualmie River). The route parallels an existing 500-kV BPA transmission line. The following sections summarize fisheries in the various segments that comprise the Alternative 1 ROW.

Segment A—Segment A lies within the Green River and Cedar River watersheds. One fish-bearing stream has been identified within the 750-ft. corridor in this short (1.2 mi.) segment. It is possible that non-fish-bearing seasonal streams occur within the 750-ft. corridor. The stream likely drains to the Cedar River or its floodplain.

The topography of Segment A is mostly flat, and most of the land has been developed for agricultural or rural residential purposes. Any surface waters in this segment have little shading by vegetation. Runoff draining this area could adversely impact fish habitat by conveying warm water and fine sediment to fish-bearing streams.

Segment B—This short (0.5 mi.) segment also lies within the CRW. No streams have been identified within the 750-ft. corridor in this segment. It is possible that non-fish-bearing seasonal streams occur within the 750-ft. corridor. Such streams would likely drain to the Cedar River or its floodplain.

The topography of Segment B is mostly flat. Most of the land is conifer forest within the CRW. Any surface waters in this segment are likely well shaded by vegetation, and runoff from them would have a beneficial impact on downstream fish habitat.

Segment C—This segment crosses the Cedar River and its floodplain. No other fish-bearing streams have been identified within the 750-ft. corridor in this short (1.3 mi.) segment. It is possible that non-fish-bearing seasonal streams occur within the 750-ft. corridor. Such streams would likely drain to the Cedar River or its floodplain.

The topography of Segment C includes a steep, north-facing slope above the south side of the Cedar River floodplain, the relatively flat floodplain, and a dissected area of former gravel mines near the north side of the floodplain. The entire area is largely forested by mixed hardwood and conifer stands. Trees are large enough to provide recruitment of functional LWD to the river, with many trees larger than 20 in. diameter at breast height (dbh). However, the river and its floodplain are wide enough that the existing forest can provide only about 10% riparian shade, so that riparian shade likely is not a primary control on stream temperature in this reach.

The river in this area has deep pools and a gravel bed very well suited for salmon spawning, and the floodplain is not confined, contains a complex of gravel bars and back channels, and is well suited as anadromous fish-rearing habitat. Currently, this reach of the Cedar River supports rainbow trout and a small population of cutthroat trout. Once passage around the Landsburg Diversion Dam has been established (in August 2003), it is likely that this reach would support anadromous species now prevented from upstream migration by the Landsburg Diversion Dam: chinook and coho salmon, and steelhead. However, under the terms of the CRW HCP, sockeye salmon would continue to be prevented from migrating upstream past Landsburg Diversion Dam.

Segment D—From south to north, this segment crosses Rock Creek in the Walsh Lake sub-basin of the CRW, and the Raging River and several of its tributaries in the Raging River Watershed. This segment is 6.0 mi. long. An undetermined number of non-fish-bearing streams occur within the 750-ft. corridor, including tributaries to Rock Creek and Williams Creek in the CRW, and Deep Creek and Raging River in the Raging River Watershed.

The topography of Segment D consists primarily of a long rise on a slope of approximately 20 to 40% to the Cedar-Raging watershed divide, and a long descent of comparable gradient to the Raging River. The Raging River runs in a canyon approximately 250 ft. deep with slopes of 60 to 70%. North of the Raging River, the ROW climbs over uneven moderate slopes to a terminus at

1320000 1340000 1360000 1380000

160000

140000

AS10 AS11 AS8 AS9 AS7 AS6 AS5 AS4 AS3 AS1 AS2

Lake Youngs · Shadow Lake · Shadow Lake · Francis Lake · Webster Lake · Walsh Lake · Walsh Lake · Ravensdale Lake · Retreat Lake · Wilderness Lake · Pipe Lake · Glass Lake · Cedar Rock · Taylor Mtn 793 · Tiger Mtn

Hobart · Taylor (Site) · Ravensdale · Georgetown · Kangley · Kanaska Junction

Old RR Grade · Carey Creek · Webster Creek · Walsh Creek · Rock Creek · Cedar Creek · Jenkins Creek · Little Soos Creek · Soos Creek · Gale Creek · Ginder Creek

POWERLINE · BURLINGTON · CHICAGO · NORTHERN · Substation · Sugarloaf Mtn

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Figure 2-A
Alternative A
Stream Locations and Fish Distribution within the Action Alternatives

Legend

- Non-Fish Bearing Stream
- Fish Bearing Stream
- Alternative A Centerline
- Existing BPA Transmission Lines

Source: USGS Tacoma, Snoqualmie Pass, WA 100K Quadrangles.

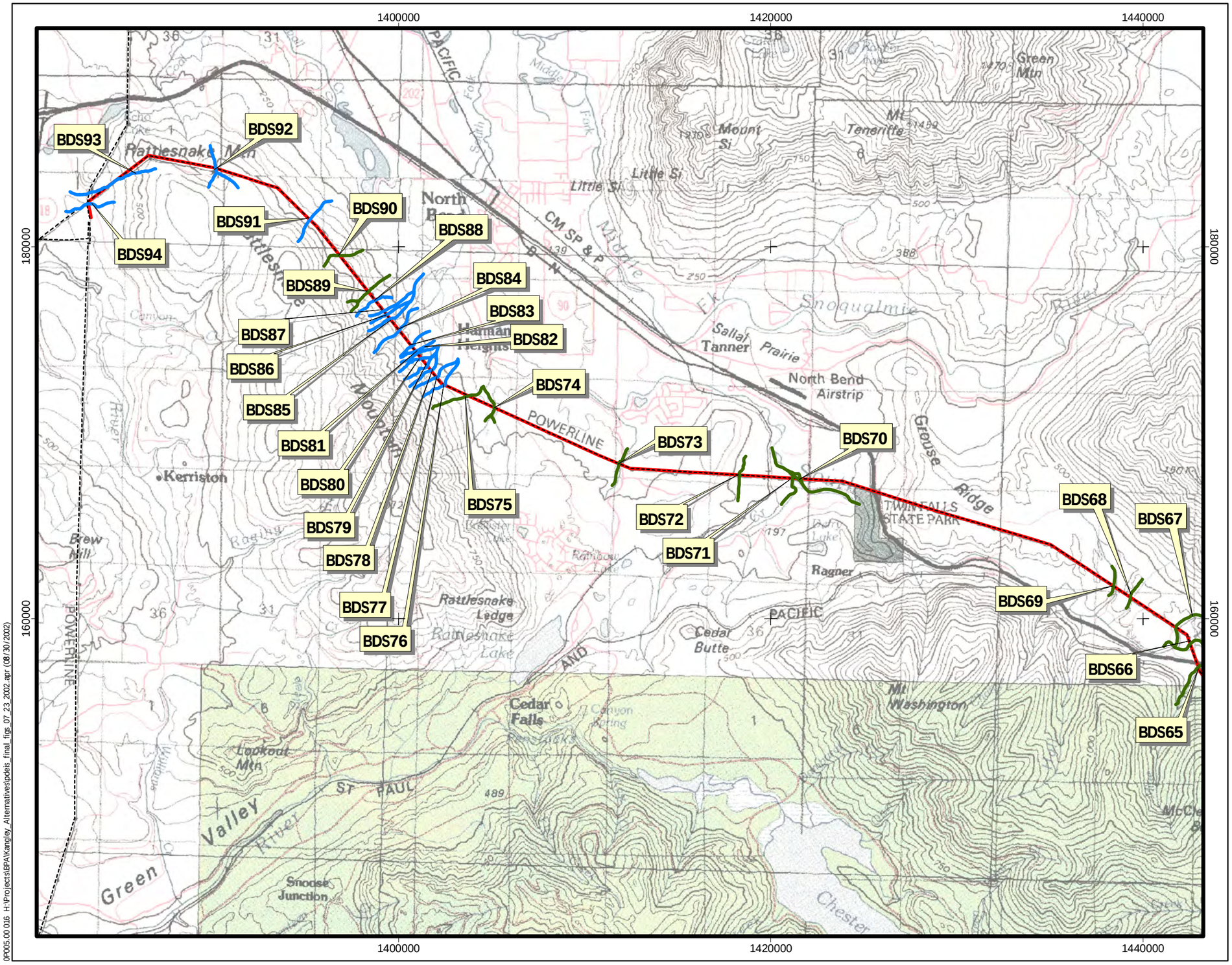
Projection: Washington State Plane
Zone: North Zone
Datum: NAD83
Units: Feet US

N

0.5 0 0.5 1 1.5 Miles

Scale 1" = 1 Mile

Jones & Stokes



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Figure 2-B
Sheet 1 of 3
Alternative B
Stream Locations and Fish Distribution within the Action Alternatives

Legend

- Non-Fish Bearing Stream
- Fish Bearing Stream
- Alternative B Centerline
- Existing BPA Transmission Lines

Source: USGS Skykomish River, Snoqualmie Pass, WA 100K Quadrangles.

Projection: Washington State Plane
Zone: North Zone
Datum: NAD83
Units: Feet US

N

0.5 0 0.5 1 1.5 Miles

Scale 1" = 1 Mile

Jones & Stokes

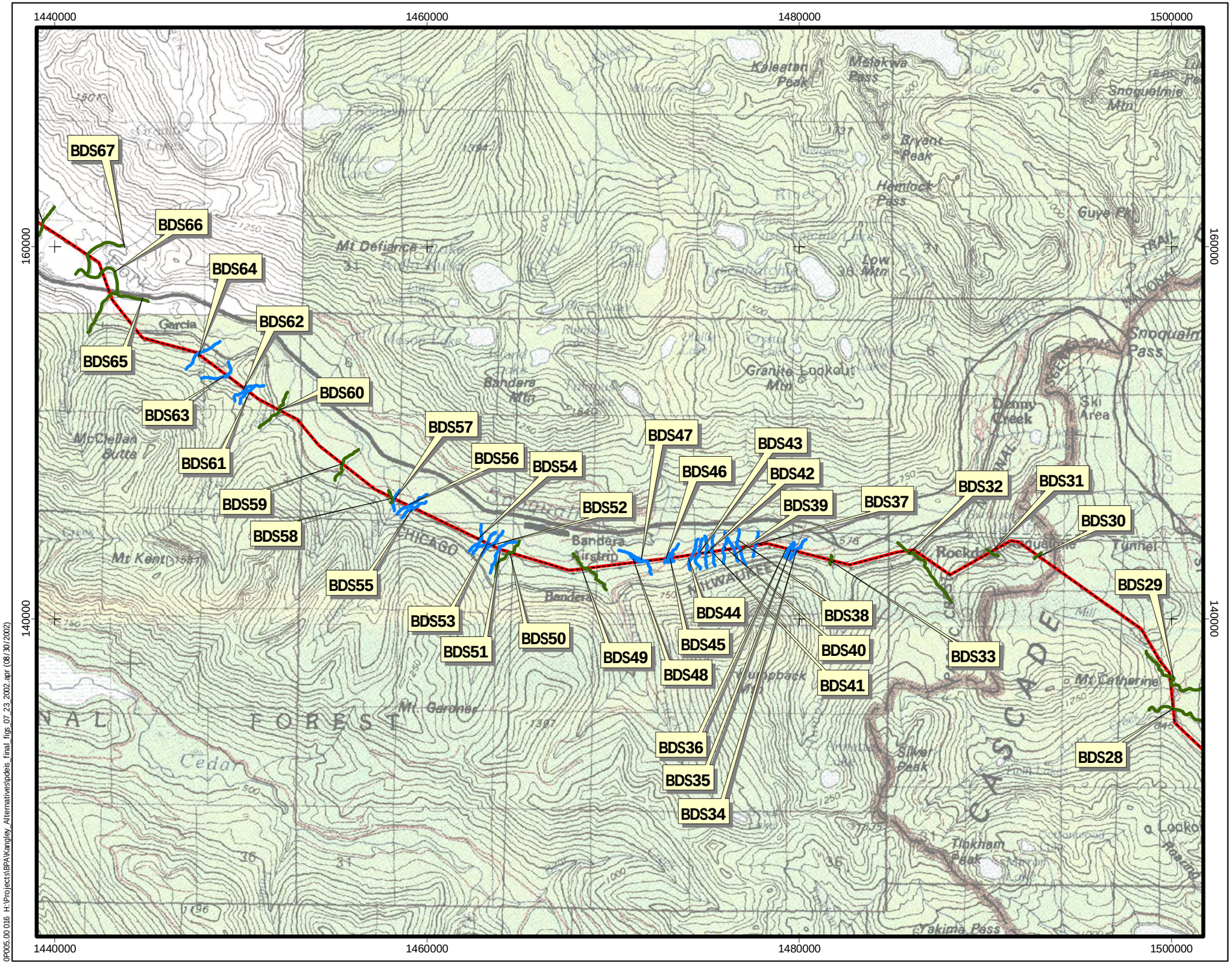


Figure 2-B
Sheet 2 of 3
Alternative B
Stream Locations and Fish Distribution within the Action Alternatives

Legend

- Non-Fish Bearing Stream
- Fish Bearing Stream
- Alternative B Centerline
- Existing BPA Transmission Lines

Source: USGS Snoqualmie Pass, WA
100K Quadrangle.

Projection: Washington State Plane
Zone: North Zone
Datum: NAD83
Units: Feet US

N

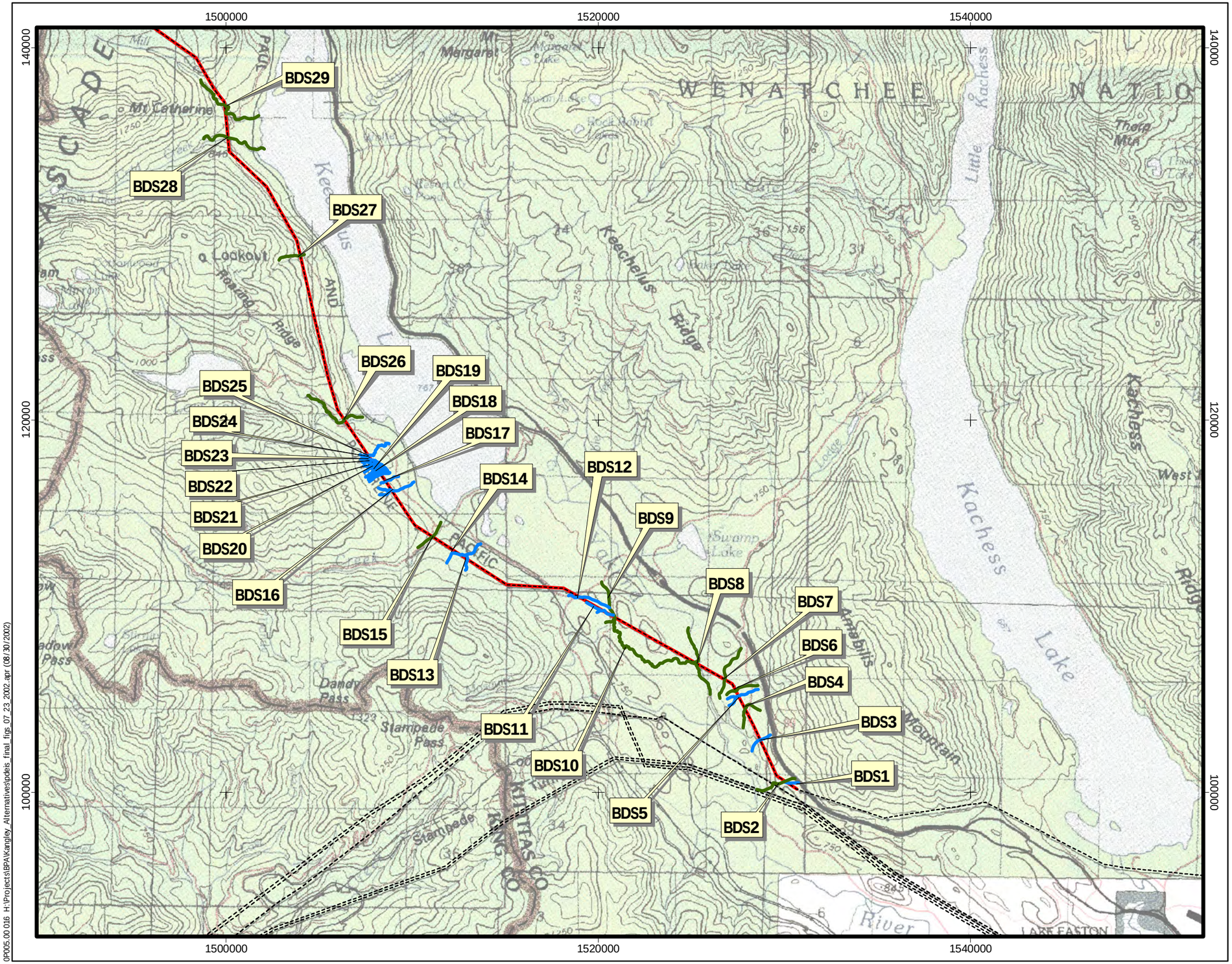
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Scale 1" = 1 Mile

Jones & Stokes

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Figure 2-B
Sheet 3 of 3
Alternative B
Stream Locations and Fish Distribution within the Action Alternatives



Legend

- Non-Fish Bearing Stream
- Fish Bearing Stream
- Alternative B Centerline
- Existing BPA Transmission Lines

Source: USGS Snoqualmie Pass, WA
100K Quadrangle.

Projection: Washington State Plane
Zone: North Zone
Datum: NAD83
Units: Feet US

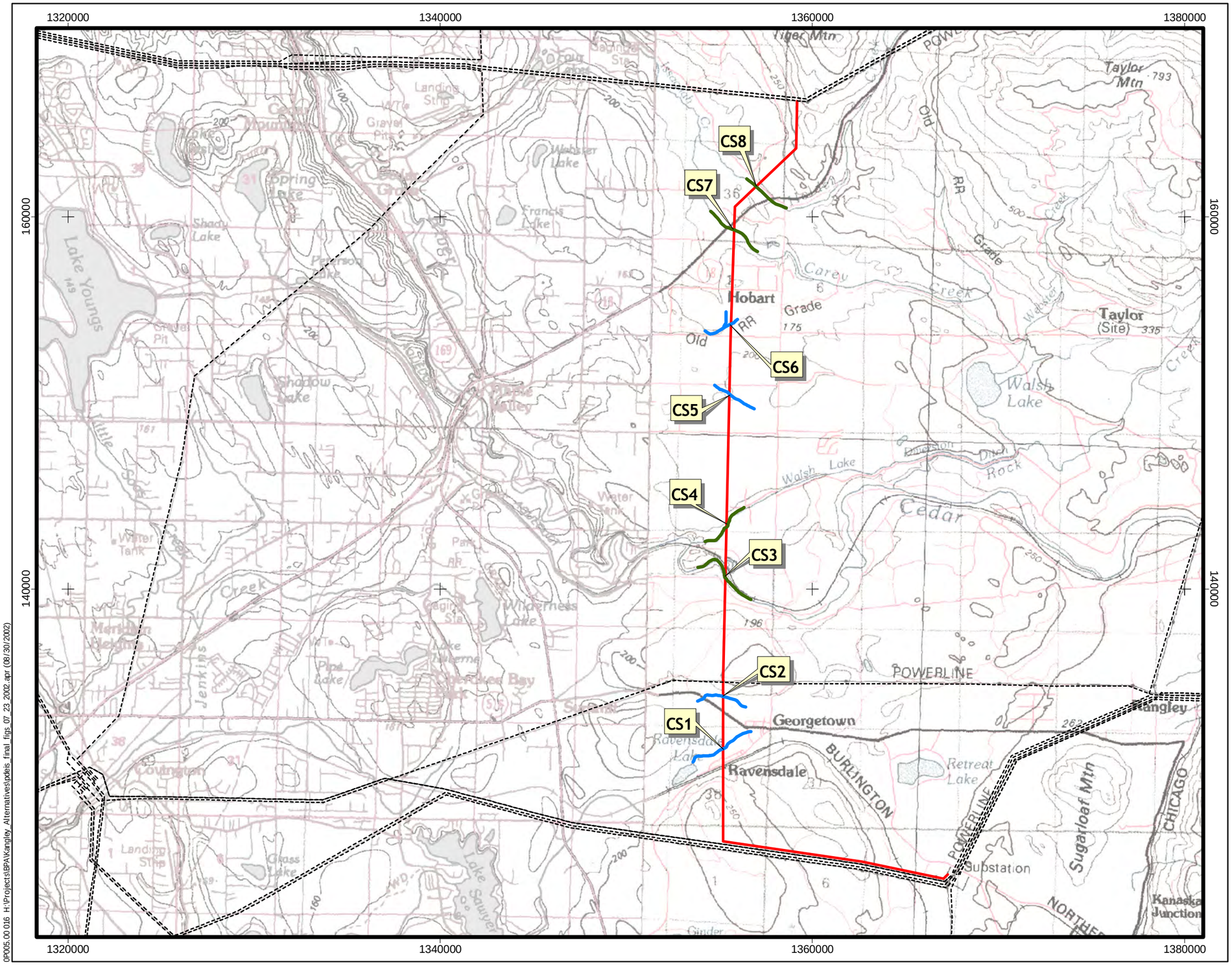
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Scale 1" = 1 Mile

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Figure 2-C-1
Alternative C (Option C-1)
Stream Locations and
Fish Distribution within
the Action Alternatives

Legend

- Non-Fish Bearing Stream
- Fish Bearing Stream
- Alternative C1 Centerline
- Existing BPA Transmission Lines

Source: USGS Tacoma, Snoqualmie Pass, WA 100K Quadrangles.

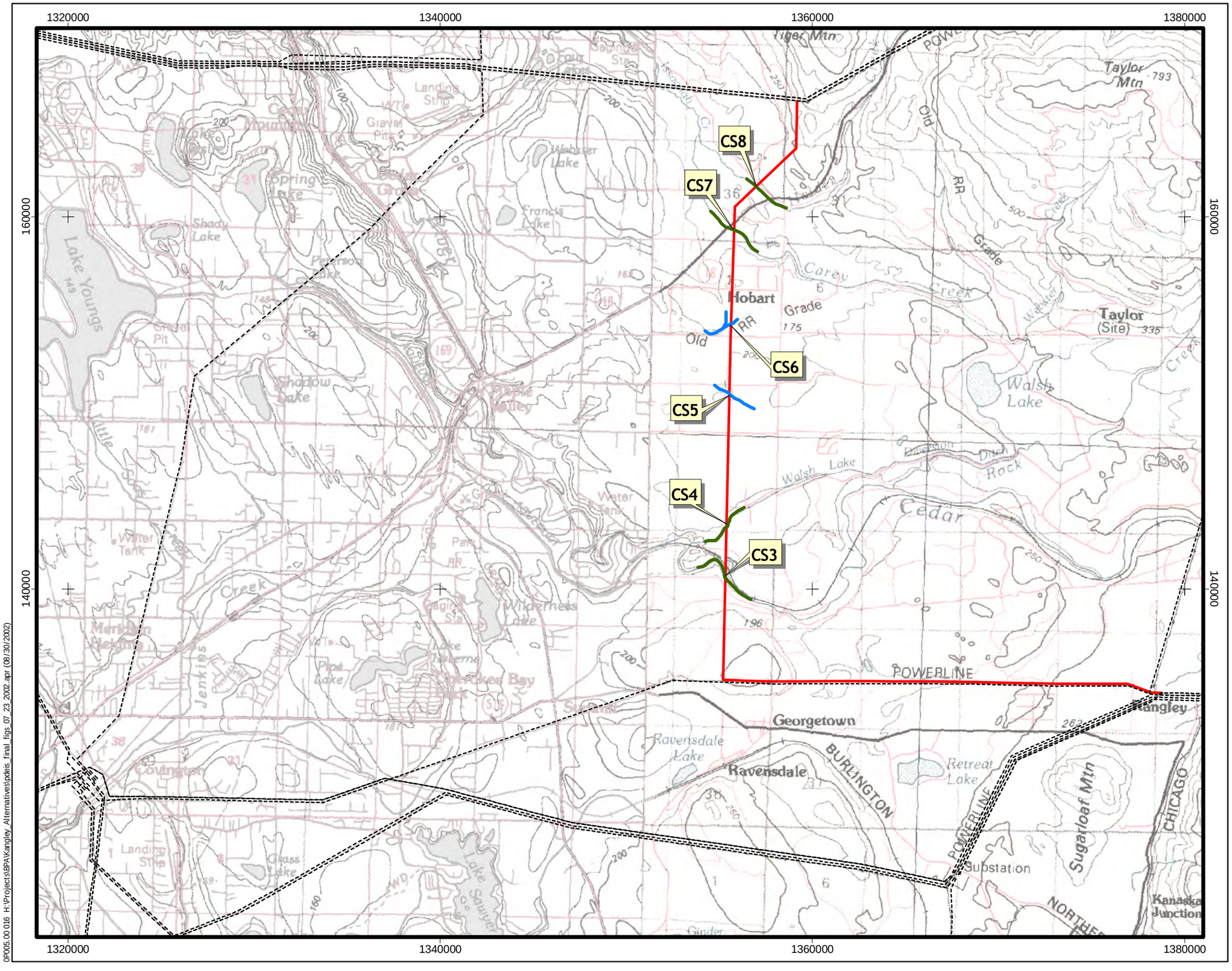
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Scale 1" = 1 Mile

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Figure 2-C-2
Alternative C (Option C-2)
Stream Locations and
Fish Distribution within
the Action Alternatives

Legend

- Non-Fish Bearing Stream
- Fish Bearing Stream
- Alternative C2 Centerline
- Existing BPA Transmission Lines

Source: USGS Tacoma, Snoqualmie Pass, WA 100K Quadrangles.

Projection: Washington State Plane
Zone: North Zone
Datum: NAD83
Units: Feet US

N

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Scale 1" = 1 Mile

Jones & Stokes

Figure 2-D-1
Sheet 1 of 3
Alternative D (Option D-1)
Stream Locations and
Fish Distribution within
the Action Alternatives

Legend

- Non-Fish Bearing Stream
- Fish Bearing Stream
- Alternative D South Centerline
- Existing BPA Transmission Lines

Source: USGS Skykomish River, Snoqualmie Pass, WA 100K Quadrangles.

Projection: Washington State Plane
Zone: North Zone
Datum: NAD83
Units: Feet US

N

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Scale 1" = 1 Mile

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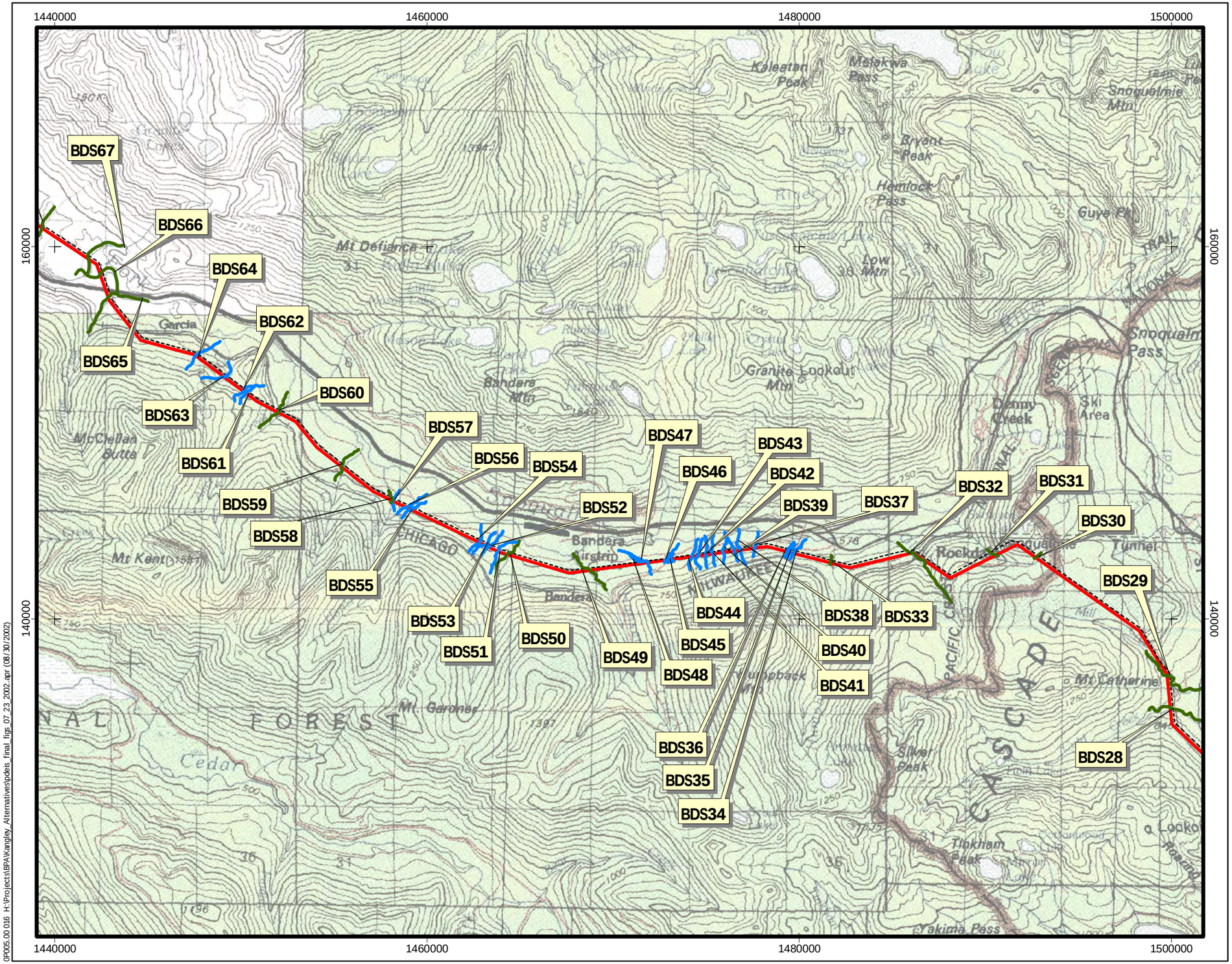


Figure 2-D-1
Sheet 2 of 3
Alternative D (Option D-1)
Stream Locations and
Fish Distribution within
the Action Alternatives

Legend

- Non-Fish Bearing Stream
- Fish Bearing Stream
- Alternative D South Centerline
- Existing BPA Transmission Lines

Source: USGS Snoqualmie Pass, WA
100K Quadrangle.

Projection: Washington State Plane
Zone: North Zone
Datum: NAD83
Units: Feet US

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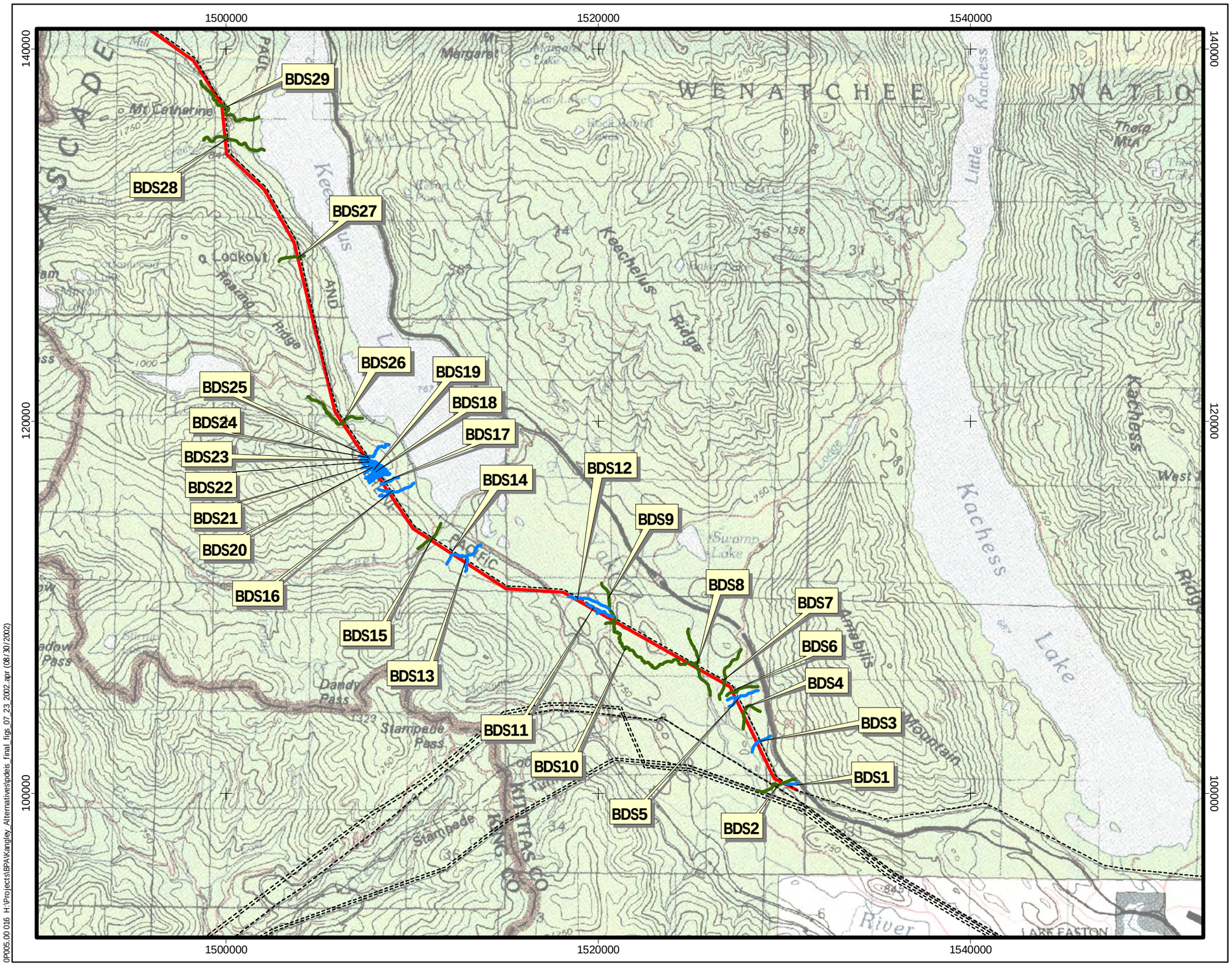
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Scale 1" = 1 Mile

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Figure 2-D-1
Sheet 3 of 3
Alternative D (Option D-1)
Stream Locations and Fish Distribution within the Action Alternatives



Legend

- Non-Fish Bearing Stream
- Fish Bearing Stream
- Alternative D South Centerline
- Existing BPA Transmission Lines

Source: USGS Snoqualmie Pass, WA 100K Quadrangle.

Projection: Washington State Plane
Zone: North Zone
Datum: NAD83
Units: Feet US

N

0.5 0 0.5 1 1.5 Miles

Scale 1" = 1 Mile

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Figure 2-D-2
Sheet 1 of 3
Alternative D (Option D-2)
Stream Locations and
Fish Distribution within
the Action Alternatives

Legend

- Non-Fish Bearing Stream
- Fish Bearing Stream
- Alternative D North Centerline
- Existing BPA Transmission Lines

Source: USGS Skykomish River, Snoqualmie Pass, WA 100K Quadrangles.

Projection: Washington State Plane
Zone: North Zone
Datum: NAD83
Units: Feet US

N

0.5 0 0.5 1 1.5 Miles

Scale 1" = 1 Mile

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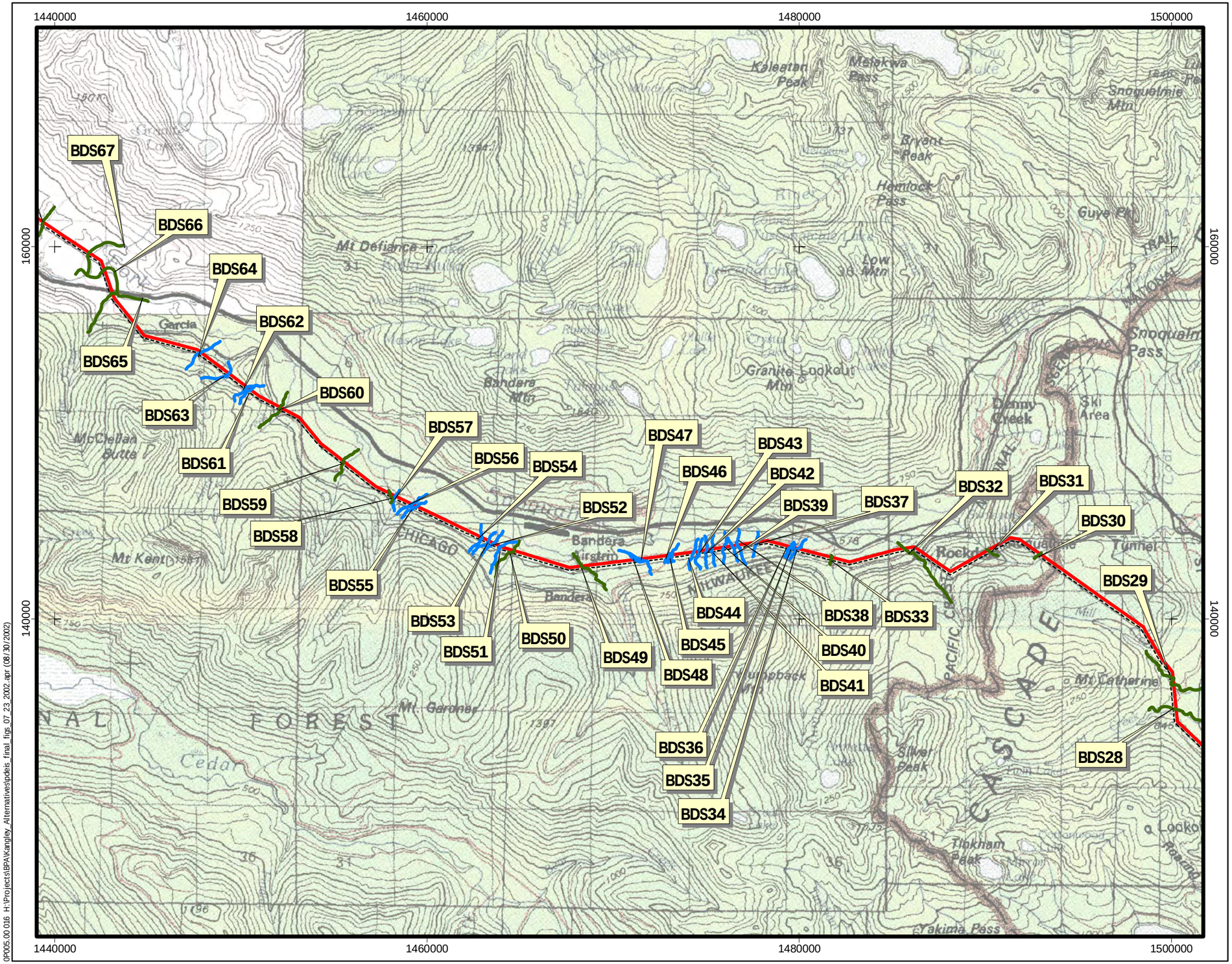


Figure 2-D-2
Sheet 2 of 3
Alternative D (Option D-2)
Stream Locations and
Fish Distribution within
the Action Alternatives

Legend

- Non-Fish Bearing Stream
- Fish Bearing Stream
- Alternative D North Centerline
- Existing BPA Transmission Lines

Source: USGS Snoqualmie Pass, WA
100K Quadrangle.

Projection: Washington State Plane
Zone: North Zone
Datum: NAD83
Units: Feet US

N

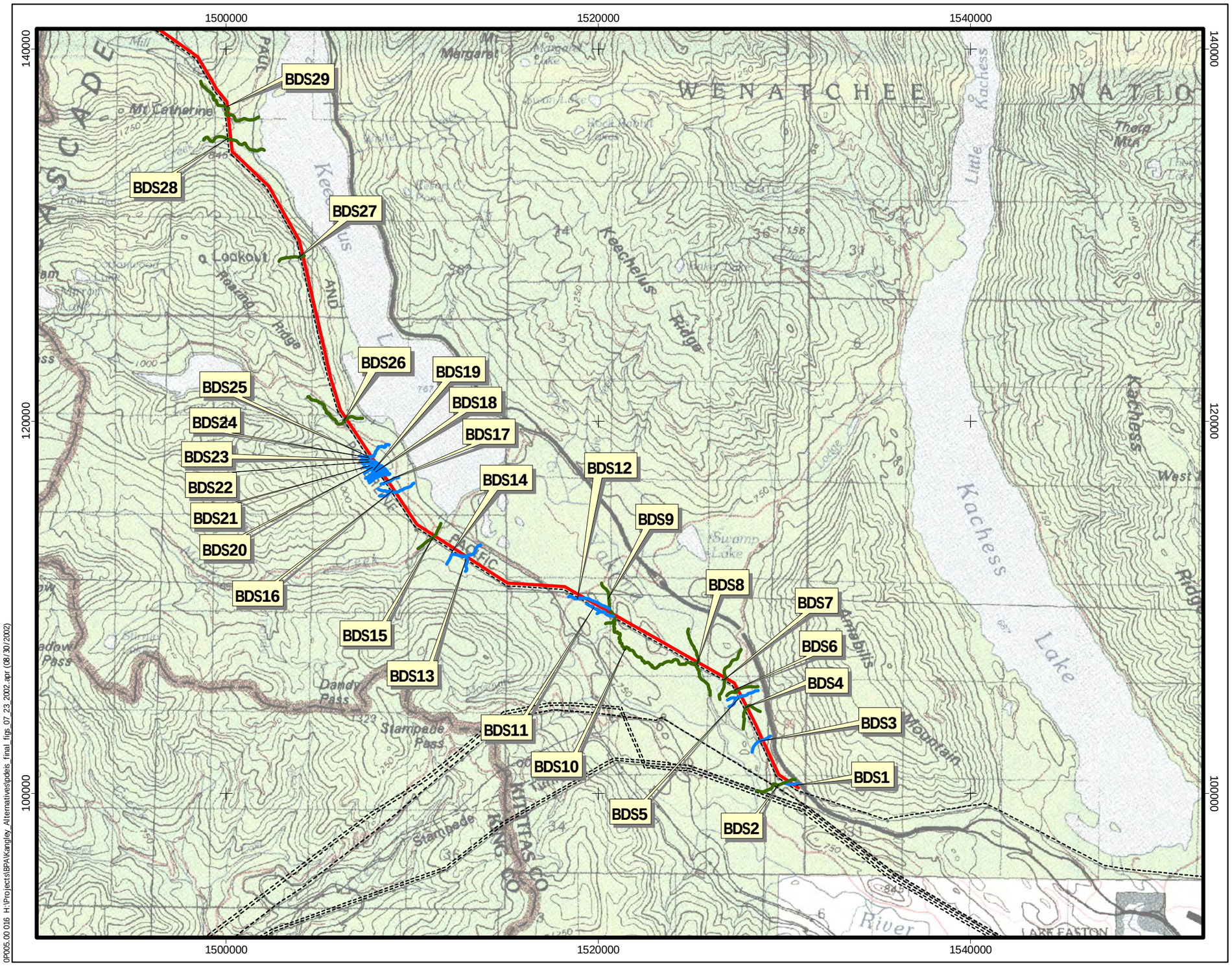
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Scale 1" = 1 Mile

Jones & Stokes

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Figure 2-D-2
Sheet 3 of 3
Alternative D (Option D-2)
Stream Locations and Fish Distribution within the Action Alternatives



Legend

- Non-Fish Bearing Stream
- Fish Bearing Stream
- Alternative D North Centerline
- Existing BPA Transmission Lines

Source: USGS Snoqualmie Pass, WA
100K Quadrangle.

Projection: Washington State Plane
Zone: North Zone
Datum: NAD83
Units: Feet US

N

0.5 0 0.5 1 1.5 Miles

Scale 1" = 1 Mile

Jones & Stokes

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the Echo Lake Substation. Most of the segment is vegetated by mixed hardwood and conifer stands with closed canopies. Stand ages are variable, ranging from very young (approximately 10 years) to mature forest (>75 years), although submature stands predominate. Trees adjoining fish-bearing streams are large enough to provide recruitment of functional LWD to the stream, with most stands dominated by trees larger than 12 in. dbh. Forest stands adjoining fish-bearing streams are capable of providing more than 80% shade to the stream, and in such settings, shade is likely a primary control on water temperature both directly, by preventing solar radiation from striking the stream, and indirectly, by providing relatively low air temperatures in the riparian area.

The affected streams have a pool-riffle morphology with bed materials varying from gravel to small boulders; the Raging River additionally has a gravel floodplain approximately 165 ft. wide. Thus, these streams likely provide suitable spawning and rearing habitat for anadromous and resident fish. Rock Creek, in this segment, is known to be a fish-bearing stream; once fish passage is established at the Landsburg Diversion Dam in August 2003, the creek is expected to be accessible to anadromous fish (Wells pers. comm.). Rock Creek, downstream of this segment, is known to be used by cutthroat trout. The Raging River and its tributaries in this segment are known to be used by rainbow trout, cutthroat trout and their hybrids ("cutbows"), as well as by coho salmon and steelhead (McHenry pers. comm.).

3.4.2 Alternative A

The Alternative A ROW would be located west of the CRW. From east to west, the alignment for Alternative A begins in the Lower Cedar River basin, crosses the Rock Creek basin, and ends in the Soos Creek basin in the Green River Watershed. The south-to-north segment of the alignment crosses Jenkins Creek at Covington Substation and the Soos Creek basin, terminating in the Lower Cedar River basin. The following sections summarize fisheries in the basins crossed by the Alternative A ROW. See Appendix A for details of streams along this alternative.

The topography of Alternative A is relatively flat, running along the southern boundary of the Lower Cedar River basin, and gradually descends into the Rock Creek basin. The line turns north just after crossing Jenkins Creek into the Soos Creek basin. The topography of the south-to-north segment of Alternative A is relatively flat with one major ridge where the Soos-Lower Cedar basin boundary lies. The ROW reenters the Lower Cedar River basin at the northern terminus of Alternative A after crossing both Peterson Creek and the Cedar River within the Lower Cedar River basin. The alignment intersects the cities of Maple Valley, Covington, and Kent.

Forested areas of the alignment are dominated by mixed hardwood and conifer stands with closed canopies but varying ages ranging from early growth (< 20 years) to mature growth (> 75 years). Because of past maintenance clearing, LWD for recruitment is deficient in large portions of the transmission line ROW within the Cedar River and Soos Creek basins. The existing south-to-north ROW is well cleared and would require relatively little to no additional clearing. The east-to-west alignment would require additional clearing on the north side of the Schultz-Raver No. 2 line in the rural communities of Kangley and Georgetown and the City of Maple Valley.

Forest stands adjoining fish-bearing streams are capable of providing more than 50% shade to the stream, and in such settings, shade is likely a primary control on water temperature both directly, by preventing solar radiation from striking the stream, and indirectly, by providing relatively low air temperatures in the riparian area. Landscaped vegetation and grasses with high percentages of nonnative species dominate developed portions of the watershed. The Rock Creek drainage has been sparsely developed. Much of the riparian vegetation has a high proportion of large second

growth conifers in the vicinity of the cleared ROW. In many reaches the habitat can best be typified as continuous debris complexes, within which complex pool and riffle habitats have developed (King County 1993).

Riparian conditions on the Lower Cedar River are primarily forested with generally increased riparian buffer upstream towards the Landsburg Diversion Dam. The majority of large pools in the Cedar River mainstem occur in the immediate vicinity of the proposed alignment, generally along the base of high bluffs. Several of these bluffs, especially in the vicinity of the mouth of the artificially created Walsh Lake Diversion Channel immediately downstream of the proposed ROW, are important sources of spawning gravel (Kerwin 2001). Streambank erosion is common throughout the Soos Creek Basin and spawning gravels occur as patches rather than extensive beds in most of the basin tributaries (King County 1990).

The Lower Cedar River basin, including Peterson Creek, provides the majority of the current spawning habitat for chinook in the Cedar-Sammamish Watershed. The proposed ROW crosses Peterson Creek at Peterson Lake and the lake's associated wetland complex. The lake and associated wetlands have LWD that provides habitat complexity (Kerwin 2001). The accumulation of fine sediments near the lake and wetlands likely precludes spawning in the immediate vicinity of the proposed ROW.

The mainstem Cedar River environments, below Landsburg Dam, are used by chinook salmon and bull trout. In the Soos Creek basin, chinook are known to be present in Jenkins and Little Soos Creek. Resident cutthroat trout and rainbow trout are known to be present or likely to be present in all fish-bearing streams in the study area (Kerwin and Nelson 2000). Rock Creek is also known to be an anadromous fish-bearing stream and will be crossed just outside the City of Kent Watershed.

3.4.3 Alternative B

From east to west, the Alternative B ROW begins within the Upper Yakima River Watershed, crosses the crest of the Cascade Range into the South Fork Snoqualmie River watershed, and ends in the drainage of the Raging River (a tributary to the Snoqualmie River). The proposed alternative is a rebuild of an existing 350-kV BPA transmission line within a maintained ROW. The following sections summarize fisheries in the basins crossed by the Alternative B ROW. See Appendix A for details of streams along this alternative.

3.4.3.1 Yakima River Watershed

Within the Yakima River watershed, the topography of the Alternative B ROW is highly varied, but is characterized by the westward ascent to Stampede Pass (elevation 4,000 ft.). The route follows the periphery of the Yakima River floodplain and ascends Roaring Ridge on east side of the Pacific Crest. The topography near the crest results in long conductor spans, including spans of Cold Creek and Mill Creek as the transmission line crosses from Roaring Ridge to Mt. Catherine and on to Hyak Mountain. Considerable variation in vegetation cover has resulted from past land use practices. The watershed is currently dominated by mature (>75 year old) second-growth forest. Streams in the Keechelus Lake area within the proposed ROW are typically high gradient, intermittent streams. Below Keechelus Dam, the mainstem of the Yakima River is characterized by numerous side channels, logjams, and braided channels, and is generally considered to be high quality spawning and rearing habitat with little influence from development (Haring 2001). However, tributary riparian habitat below Keechelus Lake is highly variable, and variations reflect historic land use.

Past logging has left tributaries of Keechelus Lake vulnerable to mass wasting and increased sediment load throughout the basin (Plum Creek 1997). USFS (1996) rates the relative risk of surface erosion as high in the Keechelus Lake sub-watershed and moderate in the Upper Yakima sub-watershed. Most of the erosion within these watersheds results from historical road building and logging operations. However, studies and on-site information are limited for the local sediment regime. High levels of turbidity, which would indicate increased fine sediment load in streams, have not been identified in any of the affected drainages in the Yakima River Watershed. Increased protection of intermittent streams and lower order streams has been identified as a measure to protect sediment accumulation in perennial, fish-bearing streams.

The Meadow Creek and Cold Creek drainages have both been found in exceedence of Washington State daily maximum temperatures (61°F). High temperatures in the Meadow Creek drainage because of past logging likely preclude significant bull trout use until future regrowth provides shade (Haring 2001). Elevated temperatures in similar areas are typically explained by extensive timber harvests on both private and federal lands. However, other drainages in this area not subjected to these practices are still in exceedence of water quality standards. This result could be attributed to broad glacial valley bottoms with open canopies and high width-to-depth ratios. In these cases, the state standard could be difficult to achieve. The necessity for additional studies intended to properly characterize the temperature regime of the watershed has been recognized (USFS 1996).

The Bureau of Reclamation operates three storage dams in the upper portion of the Yakima River watershed including the Keechelus Lake Dam. Dams result in altered hydrology throughout the watershed and typically are known to "smooth" the hydrograph, or moderate annual peak and base flows downstream of the dams. This effect is achieved by storing water during higher flows and releasing water during low flow periods. The storage aspect also results in the flooding of mainstem and tributary habitat upstream of the dam and contributes to reduced habitat complexity. The Keechelus Reservoir seasonally floods the majority of historic anadromous habitat on the west side of the lake.

LWD is generally rated as fair in the Keechelus Lake sub-watershed. Logging operations in the affected portion of the Yakima River watershed, development in the Snoqualmie Summit area, and future expansion of the I-90 corridor could contribute to low recruitment potential of LWD and lack of suitable riparian habitat in the basin and at the intersection of the proposed alignment and the mainstem of the Yakima River. Most potential spawning habitats are in the lower reaches of tributaries and within the floodplain of the mainstem Yakima River within the proposed alignment.

3.4.3.2 South Fork Snoqualmie River Watershed

The South Fork Snoqualmie River watershed topography within the existing BPA ROW is characterized by the westward descent from the Pacific Crest. Snoqualmie Falls is an impassable barrier to anadromous fish. Consequently, the entire 31 mi. of the South Fork Snoqualmie River and all of the tributaries currently support only resident cutthroat and rainbow trout. Eastern brook trout are stocked in several lakes in the basin. The route follows mid-ridge plateaus along the southern edge of the South Fork Snoqualmie River Valley. The majority of the tributaries crossed in this area average 5 to 8% gradient. More than 75% of the streams in the watershed are classified as seasonal non-fish-bearing streams (USFS 1995). Tributaries of the South Fork Snoqualmie River are generally steep with incised channels and a relatively small, low gradient depositional zone where the streams reach main river terraces. Streamflow characteristics of the

watershed depend on groundwater recharge and seasonal snowmelt with flooding during rain-on-snow events.

The gradient of tributaries has left the mainstem South Fork Snoqualmie River as the only depositional reach within the watershed. Although historical contribution of fine sediment is believed to be low, land management practices throughout the watershed appear to have contributed increased sediment load through road failures and other anthropogenic sources of erosion. Water quality in the South Fork Snoqualmie watershed (and for the majority of streams in the Cascade region) is defined by a low concentration of dissolved minerals and a relative inability to buffer acidic inputs. These characteristics result in a watershed that is sensitive to any pollutant inputs. Three segments of the mainstem South Fork Snoqualmie River are currently listed on Washington State's 303(d) list. Two of those segments are located in the reach from the mainstem confluence with Boxley Creek upstream to Mine Creek and both are cited for pH below the optimal range (pH of 6.5 to 8.5).

Most of the segment is vegetated by mixed hardwood and conifer stands with closed canopies. Stand ages are variable, ranging from very young (approximately 10 years) to old-growth forest (>250 years). Submature (<75 years) stands predominate. The majority of affected fish-bearing streams in the basin have 25% or less mature or old-growth vegetation available for LWD recruitment in the riparian corridor.

Fire has been a common source of disturbance for vegetation over large portions of the watershed, resulting in periods of mass wasting and increased sediment load followed by periods of stand regeneration with little disturbance throughout the watershed. The current disturbance regime is marked by timber harvesting with regeneration dependent on human intervention. The Mt. Baker-Snoqualmie Forest Land Management plan set a vegetation disturbance threshold. The plan specifies that disturbances exceeding 12% create unacceptable watershed and channel conditions (USFS 1990). The South Fork Snoqualmie watershed analysis (USFS 1995) lists the contemporary disturbance rate as 25% with 2% of the basin permanently disturbed from development. Large openings in the landscape from clear-cuts have also resulted in the susceptibility of riparian vegetation to blowdown.

The Alternative B transmission line ROW climbs over Rattlesnake Mountain (elevation 1,800 ft.) to a terminus at the Echo Lake Substation in the Raging River basin. The streams associated with Rattlesnake Mountain have a pool-riffle morphology with bed materials varying from gravel to small boulders and a gradient averaging more than 10%. The Raging River additionally has a gravel floodplain approximately 165 ft. wide. Thus, low gradient streams in the lower reaches of the basin likely provide suitable spawning and rearing habitat for anadromous and resident fish. The Raging River and its tributaries in this segment are used by rainbow trout, cutthroat trout, and their hybrids ("cutbows"), as well as by coho salmon and steelhead (McHenry pers. comm.).

3.4.4 Alternative C (Option C-1)

Alternative C (Option C-1) would run south to north, originating in the Green River watershed, but not crossing any perennial water bodies before entering the Lower Cedar River basin. The alternative ends in the upper portion of the Issaquah Creek Basin. The following sections summarize fisheries in the basins crossed by Alternative C (Option C-1). See Appendix A for details of streams along this alternative.

The topography of Alternative C (Option C-1) consists of two ascents in the first east-to-west segment of the alignment before turning north and descending into the rural community of

Ravensdale in the Rock Creek Basin. The topography of the south-to-north segment of Alternative C (Option C-1) is relatively flat with one major ridge where the Rock Creek-Lower Cedar basin boundary lies. The proposed ROW reenters the Lower Cedar River basin and crosses the Cedar River just below Landsburg Dam. The alignment continues north across relatively flat terrain and over a small ridge into the upper portion of the Issaquah Creek Basin before ascending towards South Tiger Mountain at the end of the segment. The proposed alignment runs through the rural communities of Ravensdale, Georgetown, and Hobart in unincorporated King County. These rural communities are sparsely forested with the exception of the ascent of South Tiger Mountain and the area around the crossing of Cedar River and the Lake Walsh Diversion Channel. Vegetation clearing would be necessary in the construction of the alignment in these forested areas.

The Rock Creek drainage has been sparsely developed. Much of the riparian vegetation has a high proportion of large second growth conifers in the vicinity of the cleared ROW. In many reaches the habitat can best be typified as continuous debris complexes, within which complex pool and riffle habitats have developed (King County 1993). Riparian conditions on the Lower Cedar River are primarily forested. Riparian buffer generally increases closer to the Landsburg Diversion Dam. The majority of large pools in the Cedar River mainstem occur in the immediate vicinity of the proposed alignment, generally along the base of high bluffs. Several of these bluffs, especially near the mouth of the artificially created Walsh Lake Diversion Channel immediately downstream of the proposed ROW, are important sources of spawning gravel (Kerwin 2001).

The upper sections of the Issaquah Creek basin, including Carey and Holder Creek, are in variable condition with good spawning habitat (Kerwin 2001). However, reaches of both Carey and Holder Creek have high sediment loads near State Highway 18 next to the proposed ROW (King County 1994). Carey Creek in the vicinity of the proposed alignment has suffered from debris torrents in recent years (King County 1994). The lower sections of the basin are highly degraded with as many as 8 culverts and the Issaquah State Fish hatchery presenting barriers for resident and anadromous fish migration into the upper basin reaches (Kerwin 2001).

The Lower Cedar River basin near the proposed ROW, including the Walsh Lake Diversion Channel, provides the majority of the current spawning habitat for chinook in the Cedar-Sammamish Watershed. The mainstem Cedar River environments, below Landsburg Dam, are used by chinook salmon and bull trout. In the Issaquah Creek basin, the presence of chinook is documented in Carey Creek and as far as 11 mi. upstream in Holder Creek. Resident cutthroat and rainbow trout are present or likely to be present in all fish-bearing streams in the study area.

3.4.5 Alternative C (Option C-2)

Alternative C (Option C-2) would run south to north with an east-west segment originating from the Shultz-Raver No. 2 line. The proposed alignment originates in the Lower Cedar River Basin and terminates in the upper reaches of the Issaquah Creek Basin. The following sections summarize fisheries in the basins crossed by Alternative C (Option C-2). See Appendix A for details of streams along this alternative.

The topography of Alternative C (Option C-2) consists of two ascents in the first east-to-west segment of the alignment before turning north and descending into the rural community of Ravensdale in the Rock Creek Basin to follow the south-to-north alignment of Alternative C (Option C-1). The aquatic resources found in the Alternative C (Option C-2) ROW are discussed in the description of Alternative C (Option C-1), with the exception of the Green River

Watershed, which is not crossed by the Alternative C (Option C-1) alignment, but is crossed by the Alternative C (Option C-2) east-west alignment. However, no fish-bearing streams would be crossed in the east-west portion of the Alternative C (Option C-2) ROW. Vegetation clearing would be necessary in the construction of the alignment except in the Hobart and Georgetown communities where clearing for agriculture and residential development has already occurred.

3.4.6 Alternative D (Option D-1)

From east to west, the Alternative D (Option D-1) ROW begins within the Upper Yakima River Watershed, crosses the crest of the Cascade Range into the South Fork Snoqualmie River basin, and ends in the basin of the Raging River (a tributary to the Snoqualmie River). The route would parallel the south side of an existing 500-kV BPA transmission line. Almost all of the eastern 23 mi. of the proposed alignment is within USFS-managed lands that are largely forested. The western 15 mi. of the alignment lies within rural developed areas in unincorporated King County and clearing would also be required for a majority of this segment. Cleared areas also exist along the proposed alignment in the vicinity of Snoqualmie Summit and in checkerboard private holdings within Kittitas County. No riparian zones of fish-bearing streams are crossed within private property in Kittitas County.

The aquatic resources found in the Alternative D (Option D-1) ROW are discussed in the description of Alternative B. However, riparian conditions in the proposed Alternative D (Option D-1) ROW are more forested than the Alternative B ROW because of the lack of an existing transmission line within Alternative D (Option D-1). Alternative D (Option D-1) would vary in relative position to the mainstem of both the Yakima and Snoqualmie rivers as compared with Alternative B. The proposed line crosses the Yakima River at about the halfway point between the start of the alignment and the Keechelus Reservoir. This alignment results in Alternative D (Option D-1) more closely approaching the Yakima River between the beginning of the alignment and the crossing of I-90. The proposed line crosses the South Fork Snoqualmie River twice as it parallels the river valley. This path results in a course for Alternative D (Option D-1) that is closer to the South Fork Snoqualmie River than Alternative B for one-third of the distance the alignment parallels the South Fork Snoqualmie River valley. This interaction occurs in the vicinity of Grouse Ridge. See Appendix A for details of streams along this alternative.

3.4.7 Alternative D (Option D-2)

From east to west, the Alternative D (Option D-2) ROW begins within the Upper Yakima River Watershed, crosses the crest of the Cascade Range into the South Fork Snoqualmie River basin, and ends in the basin of the Raging River (a tributary to the Snoqualmie River). The route would parallel the north side of an existing 500-kV BPA transmission line. Almost all of the eastern 23 mi. of the proposed alignment is within USFS-managed lands that are largely forested. The western 15 mi. of the alignment lies within rural developed areas in unincorporated King County and clearing would also be required for a majority of this segment. Cleared areas also exist along the proposed alignment in the vicinity of Snoqualmie Summit and in checkerboard private holdings within Kittitas County. No riparian zones of fish-bearing streams are crossed within unincorporated Kittitas County that are not on USFS-managed lands.

The aquatic resources found in the Alternative D (Option D-2) ROW are discussed in the description of Alternative B. However, riparian conditions in the proposed Alternative D (Option D-2) ROW are more forested than the Alternative B ROW because of the lack of an existing transmission line within Alternative D (Option D-2). Alternative D (Option D-2) would

vary in relative position to the mainstem of both the Yakima and Snoqualmie rivers as compared with Alternative B. The proposed line crosses the Yakima River at about the halfway point between the start of the alignment and the Keechelus Reservoir.

This alignment brings Alternative D (Option D-2) closer to the Yakima River between the crossing of I-90 and Keechelus Lake. The proposed line crosses the South Fork Snoqualmie River twice as it parallels the river valley. Thus, Alternative D (Option D-2) more closely approaches the South Fork Snoqualmie River when the alignment is on the south side of the river, representing two-thirds of the length of interaction between the South Fork Snoqualmie River and the alignment. See Appendix A for details of streams along this alternative.

3.5 Access Roads

All new access roads within 300 ft. of fish-bearing streams would be located within the cleared ROW. Thus, impacts caused by clearing vegetation for access roads are incorporated within the clearing zones for each of the action alternatives. All of the action alternatives would require new access road construction within the corridors described for each alternative. Potential retrofitting of culverts is also possible in cases where potential water quality or fish passage problems exist on roads in existing corridors where upgrades have been proposed.

3.6 Substations

One fish-bearing stream crosses the Echo Lake Substation property. This tributary to Lake Creek has no documented anadromous fish presence, but is used by resident salmonids. The stream channel has been historically modified and now runs through a detention pond facility on the site.

4.0 Environmental Consequences and Mitigation

This section describes the potential environmental consequences that could occur from each alternative, the project facilities, and the potential mitigation that could be implemented to minimize those impacts. Impacts have been categorized as high, moderate, and low, as described below.

An impact would be **high** if an action causes:

- an adverse effect on a federally-listed threatened fish species, as determined through interagency consultation with the USFWS and NMFS under Section 7 of the Endangered Species Act; or
- substantial adverse effects to essential fish habitat; or
- non-attainment of USFS ACSOs and/or direct impacts to USFS-managed riparian reserves; or
- a regional adverse effect on the populations, habitat, or viability of fish species of concern, which would tend toward endangerment and the need for federal listing of the species.

An impact would be **moderate** if an action causes:

- an effect on threatened or endangered species that could be mitigated through interagency consultation with the USFWS and NMFS under Section 7 of the ESA; or

- minimal adverse effect or less than substantial adverse effect to essential fish habitat; or

- temporary impediments to attainment of USFS ACSOs and/or temporary impacts to USFS-managed riparian reserves; or

- a localized and/or short-term (up to three years) reduction in the quality or quantity of aquatic resources or habitats that does not result in the take of a federally-listed species, or have a major effect on a fish species of concern.

An impact would be **low** if an action causes:

- an effect on fish species not listed under the ESA, that would be largely mitigated; or

- no adverse effect to essential fish habitat; or

- attainment of USFS ACSOs with temporary impacts to USFS-managed riparian reserves that would be largely mitigated; or

- a temporary (less than three years) reduction in the quantity or quality of aquatic resources or habitats confined to the site of the action.

No impacts would occur if the action would result in no loss of quantity or quality of aquatic resources, temporary or otherwise.

Construction, operation, and maintenance of transmission facilities could impact fish and their habitat as a result of:

- reduced in-stream LWD, reduced LWD recruitment potential, and changes in stream thermal regime associated with vegetation and tree clearing within designated riparian buffers for the transmission line ROW and access roads;

- disturbance of fish habitat or passage from placement of culverts, fords, or other crossing structures in streams;

- degradation of water or spawning gravel quality from ground surface disturbance associated with ROW clearing or road construction that contributes sediment to streams;

- catastrophic loss of habitat and fish populations if a debris torrent affects a stream channel as a result of ROW clearing, road construction, or road maintenance;

- acoustic shock from the use of explosives in or close to fish-bearing streams; or

- toxicity or deterioration of water quality from accidental spills of hazardous materials.

All of these are recognized as common impacts to fish populations and habitat as a result of timber harvest and associated activities in mountainous terrain in the Pacific Northwest (WFPB 1998, City of Seattle 2000). It is largely incidental that timber harvest would be followed by installation of a transmission line for the proposed project. The physical transmission line structure would not be expected to impact fish or their habitat. Impacts would primarily be associated with ROW clearing and road construction for construction and maintenance of the transmission facilities and access roads.

The sensitivity of fish and fish habitat in individual streams to potential impacts from the proposed project would depend on a number of factors. In regard to existing conditions, impacts would be greater in streams occupied by threatened, endangered, or sensitive species than if the streams were not occupied by such species. Actions within riparian zones of perennial streams would have a greater potential impact to fish and their habitat than actions within riparian zones of intermittent streams or wetlands. The removal of mature or older timber, particularly conifers, from riparian zones would have a greater potential effect on fish habitat than removal of small, young trees, hardwood trees, or shrub vegetation, or spanning conductors over riparian vegetation. The number, location, design, and maintenance of stream crossings; the amount of disturbed area (tower sites, access roads, etc); the erodibility of soils in different areas; and the stability of slopes potentially delivering landslides or debris torrents to streams could also affect the severity of potential impacts.

The following section discusses potential impact mechanisms common to all action alternatives. Potential impacts resulting from each action alternative are discussed later in this section.

4.1 Construction Impacts

4.1.1 Impacts Common to All Action Alternatives

4.1.1.1 Impacts

Disturbance to Fish Habitat from Removal of Riparian Vegetation—Removal of riparian trees during construction could affect fish habitat. Such effects would be permanent because the ROW would be kept clear during operation and maintenance. Riparian trees protect fish habitat by filtering runoff before it reaches the stream, shading the stream and reducing mid-summer temperatures, providing LWD to streams, which increases habitat complexity, stabilizing streambanks, and providing organic matter to the stream that increases productivity in the aquatic food chain. Removal of riparian trees and disturbance of the streambank could result in increased erosion, sediment loading, and turbidity; increased temperature; changes in habitat complexity; and lower productivity.

There has been a great deal of debate about how the ecological role of riparian vegetation varies with distance from the stream. The principal ecological variables of concern include LWD delivery to streams, root reinforcement of streambanks, litterfall, and shading (FEMAT 1993). All of these variables are generally agreed to vary approximately in proportion to the distance from the channel, relative to SPTH. The SPTH is the height that trees in the riparian forest may reasonably be expected to achieve within an appropriate time period, often established as 50 or 100 years. Most analysts also agree that the size of the affected stream should be considered in assessing riparian zone effects on the stream. In Washington, streams are commonly classified from Type 1 to 5, according to a system established by the WDNR and summarized in Table 4. When determining riparian reserve widths on USFS-managed lands, stream classes are defined by the Northwest Plan Standards and Guidelines and summarized in Table 2. Stream types developed by local jurisdictions are also used classify streams in the project area for permitting and development guidelines and are described in detail in Section 3.2.

Development pressures that generally entail removal of forest cover have forced land management agencies in the Pacific Northwest to face special challenges in managing riparian ecological functions. The most widespread removal activity is logging, but loss of riparian vegetation is also a major concern in areas subject to agricultural, residential, industrial, and other land uses. The usual response by management agencies has been to require preservation of a

riparian buffer or riparian management zone (RMZ), within which tree removal is restricted or prohibited and impacts to riparian vegetation must be minimized.

Within the project area, several regulatory standards have been approved by the USFWS and NMFS. These standards have been deemed sufficiently protective of riparian and fisheries resources to ensure compliance with the ESA. These regulatory standards are the CRW HCP (City of Seattle 2000), WDNR HCP (WDNR 1997), the Northwest Forest Plan (USFS and BLM 1994a), and Washington Forest Practices Rules, as amended in March 2000 (WAC 222). These regulatory standards are summarized in Table 5. Local municipal codes also set minimum limits for stream buffers within each local jurisdiction as discussed in Section 3.2.5.

Each of these regulatory standards has received concurrence from the USFWS and NMFS as having low potential to adversely affect listed salmonid species. Therefore, vegetation clearing under each of the action alternatives, if performed under the applicable regulatory standard, is assumed to have no (or low) impact to fish and their habitat. Conversely, vegetation clearing that exceeds the criteria specified in Table 5 is assumed to have a moderate or high impact to fish resources. Moderate and high impacts are further distinguished by the criteria described earlier in this section.

Clearing of the transmission line ROW would involve removal of trees and other tall vegetation for construction. Trees adjoining the ROW that could fall on the line (danger trees) would also be removed. Not all trees in the ROW would be removed. Transmission towers are typically sited on higher ground, and they generally span drainages and associated riparian areas. This requirement would minimize potential impacts from riparian clearing because topography facilitates placement of structures that span drainages and increases the likelihood that conductors would be above many riparian areas and require only limited removal of danger trees.

Construction of the transmission line would result in high impacts to fish from clearing of riparian vegetation on streams inhabited by protected species. Construction of the transmission line would result in moderate impacts to fish from clearing of riparian vegetation in all other streams not inhabited by protected species. BPA would prepare a clearing advisory as part of the design of the project. This plan would evaluate areas to be cleared and the permissible height of existing vegetation that could remain. As noted in the mitigation section, facilities would be sited to minimize clearing of riparian forests along each of the action alternatives.

BPA would also minimize potential effects to fish habitat from vegetation clearing during road construction. As noted in the mitigation section, roads would be constructed outside of riparian zones except at stream crossings, steep and erodible areas would be avoided, and water bars and drainage features would be installed where needed in accordance with the Washington Forest Practices Rules, the Northwest Forest Plan (USFS & BLM 1994b), and the Memorandum of Understanding (MOU) between the Forest Service and WDFW (WDFW and USFS 1997).

Culvert or Bridge Installation—During the construction of the transmission line, BPA may need to install some culverts or bridges to provide or upgrade stream crossings for access roads. Improper stream crossing installation may cause drainage network extension, increasing peak flows in affected streams. It may also result in increased delivery of fine sediment to affected streams, either by exposing erodible surfaces during stream crossing placement, by channeling ditch runoff to the streams, or by increasing stream power due to the above-mentioned changes in peak flows. Peak flow increases may cause stream channel instability, altering fish habitat and increasing scour in spawning gravels. Fine sediment effects are detailed below.

Improperly installed stream crossings may block or impede fish passage by increasing the velocity or decreasing the depth of water flowing through the structure, or because the culvert poses a physical barrier (as with a hung culvert). Blocking a stream to fish passage could result in a loss of access to spawning and rearing habitat. Some fish in the streams along the proposed transmission line ROW—including sensitive species such as bull trout, steelhead, and salmon—migrate upstream to spawn. Although spawning fish could tolerate short delays in migration, blocking or prolonged delays in migration to spawning grounds could locally reduce the productivity of these species. In-water work windows as defined by WDFW, USFWS, and NMFS would be applied to the transmission line construction for the protection of migrating fish.

BPA would comply with guidelines for fish passage in the design of all culverts as specified in the WDFW guidelines and criteria for stream crossings (WDFW 1999) and would comply with WDFW guidelines for in-water work, as specified in the Hydraulic Project Approval (HPA) for each stream-crossing structure. In addition, as specified in the mitigation measures, BPA would design roads to minimize the number of stream crossings. BPA would also meet all of the requirements of the Northwest Forest Plan related to culvert design (USFS and BLM 1994b) and the measures included in the MOU between the Forest Service and WDFW (USFS and WDFW 1997). Because of these measures, culvert and bridge installations would result in low impacts to fish and their habitat. Because of the methods used to design and site culverts, construction of the transmission line would not affect fish passage.

Fine Sediment Delivery to Streams—Clearing of the transmission line ROW, grading and placement of tower footings, and construction of new access roads and their associated stream crossing structures would expose soil to the erosive forces of wind, rain, and surface runoff during construction and until sites were revegetated. Such erosion could deliver fine sediment into streams.

Excessive delivery of fine sediment to streams would degrade water quality and fish habitat. Increased turbidity, the fine suspended sediment load carried by a stream, could affect fish and other aquatic organisms directly by abrasion, clogging of gills, decreasing feeding success due to reduced visibility, and by affecting other organisms that fish eat. As sediment settled, it could enter spawning gravels, reducing spawning gravel permeability and causing increased egg and fry mortality and reduced fry growth rates. Fine sediment could also reduce plant or phytoplankton productivity, reduce flows within gravels that are important to maintaining low stream temperatures, and smother or displace aquatic invertebrates. In very large quantities, fine sediment could fill pools (which are important habitat for fish).

Construction of the transmission line would cause low impacts to fish and their habitat as a result of erosion and sedimentation. BPA has constructed transmission lines using a number of standard construction practices and BMPs that would minimize potential impacts to fish from turbidity and sedimentation (see Section 4.1.1.2 for discussion of mitigation common to all action alternatives). Briefly, these measures include minimizing removal of riparian vegetation, siting towers and roads in stable areas where possible, minimizing the number of stream crossings, using appropriate sizing and culvert installation techniques, timing culvert installation to avoid sensitive periods for fish, and using effective sediment and erosion control methods. Conduit crossing provisions included in the MOU between USFS and WDFW (1997) would be observed on Forest Service managed lands.

Catastrophic Channel Disturbance—Clearing of the transmission line ROW and for new access road construction would entail removal of forest vegetation. On steep slopes (generally slopes steeper than 70%), such clearing may reduce soil strength as tree roots decay that formerly

stabilized the soil. This mechanism has been shown to be a principal cause of landsliding in logged areas (WFPB 1998). Such landslides typically occur during exceptional winter storms, which occur about once every 10 years in the mountains of western Washington. If such a landslide enters a stream, it becomes a debris torrent or debris flow, which is a water-rich landslide that descends a stream channel. A debris torrent may cause greatly increased erosion rates, effectively multiplying the destructive power of the landslide and allowing it to descend the stream channel to the point where the stream gradient drops below 16%. At that point, most streams in the study area are thought to support populations of fish.

The effect of debris torrents on fish habitat is commonly described as "catastrophic" because they cause loss of most in-stream LWD, remove much riparian vegetation, provide a large source of fine sediment that is redistributed downstream, and kill all fish in the directly affected channel (WFPB 1998, Coho and Burges 1994). Improper construction or maintenance of stream crossing structures commonly exacerbates the effects of debris torrents. If a debris torrent should clog a culvert or bridge situated on a steep stream channel (gradient typically greater than 20%), the stream crossing may act as a dam. The debris torrent pools behind the dam and overtops it. The resulting event is called a dam-break flood and may be much more destructive than a normal debris torrent, scouring all sediment and LWD from the steep stream channel and delivering it to lower gradient channel reaches occupied by fish (Coho and Burges 1994).

Adverse Effects to Fish from Acoustic Shock Associated with Blasting Tower Footings— Although specific sites have not yet been identified, it is likely that BPA would need to blast bedrock to install some tower footings. Detonating explosives in or adjacent to fish habitat could cause disturbance, injury, or death to fish and destruction or alteration of their habitat.

Blasting could affect fish through two different mechanisms, depending on where charges were placed (Wright 1982). First, if the charge was detonated in water, it would produce a post-detonation compressive shockwave that could rupture the swim bladder (a gas-filled organ that allows fish to maintain buoyancy) or affect other organs. Fish eggs and larvae could also be affected by this pressure wave. Second, when a charge is detonated next to fish-bearing waters, the charge sets up a vibration, which may damage incubating eggs.

BPA does not expect that any in-water blasting would be necessary. However, some towers would be located within 400 ft. of streams. If blasting was required for those footings, and streams near the blast site were fish-bearing, BPA would blast footings during periods when eggs or alevins were not present in gravels. If blasting was required in or adjacent to streams supporting federally-listed or proposed species, BPA would also be required to contact the USFWS and/or NMFS. Construction, including blasting near streams, would only be performed during authorized in-water work windows based on WDFW procedures for protection of salmon and their eggs. (See Section 4.1.1.2 for mitigation common to all action alternatives.)

Certain other construction activities, such as operation of heavy machinery, would also generate noise. Noise from such relatively low-intensity sources, when not generated by in-water equipment, has not been shown to have any impact on salmonid fishes.

Adverse Effects to Fish from Accidental Spills of Hazardous Materials—Construction of the proposed transmission line and access roads would require several fairly common construction materials (e.g., concrete, paint, and wood preservatives) and petroleum products (e.g., fuels, lubricants, and hydraulic fluids) that could be toxic to fish and other aquatic organisms. BPA might store small quantities of these materials either along the ROWs or in staging areas. An

accidental spill of these materials that reached streams, lakes, ponds, or wetlands could impact fish.

The potential for impacts to fish from accidental spills of these materials would be low. BPA would prepare a Spill Prevention and Contingency Plan to minimize the potential for spills of hazardous materials to streams and other water bodies (see Section 4.1.1.2 for discussion of mitigation common to all action alternatives). The plan would include restrictions on storage or transfer of fuels or other hazardous materials within riparian areas, and plans for clean-up in the unlikely event of a spill.

Impacts to Species Listed and Proposed for Listing under the Endangered Species Act— Any of the action alternatives could potentially impact chinook salmon, steelhead, bull trout, and coho salmon. These species would be susceptible to the impact mechanisms discussed above. Reduced LWD recruitment potential and impacts to stream thermal regime are the two primary issues of concern. The level of these impacts would be high in stream reaches occupied by protected species for the following reasons: First, the loss of LWD recruitment would be permanent and would affect streams that are already generally characterized by insufficient LWD. Second, in view of the low elevation of Alternatives 1, A, and C (Options C-1 and C-2), potential thermal effects could harm fish by causing thermal stress during low flows.

Streams accessible to anadromous fish east of the Pacific Crest in the study area are regarded by the USFWS and NMFS as having the potential to support steelhead, and bull trout (listed federally as threatened). Streams accessible to anadromous fish west of the Pacific Crest in the study area are regarded by the USFWS and NMFS as having the potential to support chinook salmon, bull trout (listed federally as threatened), and coho salmon (a candidate for federal listing). Snoqualmie Falls precludes accessibility of the South Fork Snoqualmie Basin by any anadromous species. Streams west of the Pacific Crest that are accessible to anadromous fish in the study area are assumed to have the potential to provide coho salmon spawning habitat, although many of these streams are locally too steep to support such use. Listed Middle Columbia steelhead and bull trout are known to be present in the mainstem of the Yakima River.

The Lower Cedar River subarea, including Peterson Creek and the Walsh Lake Diversion Channel, provides most of the current spawning habitat for chinook in the Cedar-Sammamish Watershed. The mainstem environments are used by chinook salmon. Bull trout have been observed in the Lower Cedar River, but adult salmon are currently unable to migrate past the Landsburg Diversion Dam. The only known spawning population of bull trout in the Cedar-Sammamish Basin is upstream of the Landsburg Dam in Chester Morse Lake and the surrounding drainages. The Upper Cedar River contains suitable chinook salmon spawning habitat, and such use is expected to occur after the Landsburg Diversion Dam fish ladder is completed in August 2003, before project construction. In the Soos Creek basin, chinook are known to be present in Jenkins and Little Soos Creek at the locations crossed by Alternative A. In the Issaquah Creek basin, the presence of chinook has been document in Carey Creek and as far as 11 mi. upstream in Holder Creek. Chinook salmon have also been recorded in the Raging River less than 1 mi. downstream of the Alternative 1 crossing.

4.1.1.2 Mitigation

To minimize potential impacts to fisheries habitat from clearing of vegetation:

- BPA would site the transmission line to minimize clearing of riparian vegetation. In some cases, the topography would allow BPA to site towers so that the conductor would span

drainages and associated riparian areas. Hazardous trees within the riparian zone would be removed with a minimum of disturbance to ground cover.

- BPA would maximize the use of existing roads during construction. Thus, in locations where existing roads are available, no additional clearing in riparian areas would be required for road construction.

To ensure adequate fish passage at stream crossings:

- BPA would design stream crossings following WDFW guidelines. Factors that could affect fish passage through culverts include the type, length, size, and gradient of the culvert; the number of culverts that need to be passed; and the condition of the culverts. BPA would design and install culverts, when necessary, with consideration for fish passage. Culverted crossings in areas where fish are present would be designed to achieve appropriate flow and depth for fish passage and would be large enough to prevent clogging with debris. Where practical, the culvert would be set to grade and provide direct entrance and exit for water flow. Where necessary, BPA would armor the culvert entrance and exit to prevent erosion and development of physical barriers.

To minimize the potential for increases in fine sediment delivery to streams:

- BPA would site towers and roads appropriately, use sediment and erosion control methods during construction, and minimize clearing of riparian vegetation.

- BPA uses several standard methods to minimize erosion and sedimentation associated with transmission line construction. BPA would maximize the use of existing roads, minimizing the need for new road construction. BPA would, where feasible, avoid tower construction on potentially unstable slopes.

- BPA would prepare an Erosion Control Plan as part of their stormwater National Pollutant Discharge Elimination System (NPDES) permit. BPA would incorporate appropriate erosion protection techniques during site clearing, tower assembly and erection, line stringing, and counterpoise installation. These techniques typically include installation of erosion control devices such as weed-free hay bales or sediment fencing where appropriate, to minimize transport of sediments to streams via runoff. In areas that could be susceptible to erosion, BPA would stabilize the site or road using a variety of methods, which may include riprapping or mulching. All disturbed areas would be reseeded following construction.

- ROW clearing would use methods that minimize erosion. BPA would prepare a clearing plan that allows as much vegetation to remain on the ROW as possible, yet assures that the reliability of service is not jeopardized. The clearing plan would include a clearing back-line, which would be marked in the field to delineate areas for contractors where vegetation would be retained. The plan would also identify the permissible height of remaining vegetation for each area. During the clearing of the ROW, contractors would be required to use a brush hog to minimize damage to root systems of low-growing vegetation, thus providing more rapid recovery of this vegetation and greater protection against runoff in the ROW.

- Access roads would be designed to minimize the potential for erosion. Construction of steep, straight road sections, which could result in channelization and concentration of runoff, would be avoided. Waterbars and drainage would be installed where appropriate.

- Except at stream crossings, new roads would be constructed outside of the riparian corridors of streams so that vegetation provides a protective buffer between streams and construction areas. Stream crossings would be designed to minimize impacts to the bed and banks by orienting crossings perpendicular to streams, minimizing the removal of riparian vegetation, preventing the disruption of normal flow patterns, and choosing the appropriate crossing structure (e.g., bridges, culverts, or fords). Stream crossings would be sited to minimize the potential for erosion and avoid sensitive fisheries habitat.

- Construction activities near streams would be scheduled to avoid sensitive fish spawning, incubation, and migration periods (following WDFW in-water work timing guidelines).

- Culverts would be sized to convey 100-year flows. Culverts would be installed using standard construction techniques that minimize the potential for erosion during or after installation. Methods may include (where appropriate) isolating the working area from the streamflow (using temporary diversions or dams), providing sediment containment devices during construction, armoring streambanks near the culvert entrance and exit, installing culverts on straight sections of stream to ensure unimpeded flow, and following the contour of the stream channel. In areas that provide fish habitat or migration corridors, culverts would be sized and sloped to allow appropriate depth and flow velocities for fish passage, and culvert design would follow WDFW fish passage guidelines.

To minimize the potential for impacts from accidental spills:

- BPA would develop and implement a Spill Prevention and Contingency Plan to minimize the potential for spills of hazardous materials and its transport to streams and other water bodies. The plan would include provisions for storage of hazardous materials and refueling of construction equipment outside of riparian zones, a spill containment and recovery plan, and notification and activation protocols.

To avoid potential impacts to fish from acoustic shock:

- Blasting for tower footings near fish-bearing streams containing spawning habitat would occur only during periods when no spawning fish were in the area and when fish eggs and alevins were not present in gravels.

To avoid impacts to fish from vegetation management:

- BPA would comply with the standards and guidelines established in the Record of Decision (ROD) for vegetation management (BPA 2000).

4.1.1.3 Cumulative Impacts

Cumulative impacts on fish and other aquatic resources are those impacts that act not only on the local area where the impact occurs, but also at every point downstream that is influenced by the impact. Vegetation removal and road building could impact fine sediment load, stream temperature, LWD recruitment, and toxic pollutant load. These impacts could be additive throughout a watershed, and they could produce a moderate or high impact in the lower reaches, even if the upper reaches appear to have adequate conditions. In the case of the proposed transmission line, cumulative impacts include impacts associated with the existing transmission line, and impacts associated with other human uses of the affected watersheds, such as forest practices and watershed restoration activities.

Application of appropriate construction methods (including BMPs) and rapid correction of erosion problems associated with routine maintenance of the transmission line ROW or roads could minimize many possible cumulative impacts. To minimize cumulative impacts, BPA should seek to perform construction and maintenance activities consistent with the highly conservative guidelines established in the CRW HCP, and the somewhat less conservative regulation contained in the Washington Forest Practices Rules, when applicable. Operations performed under these guidelines have been evaluated by the USFWS and NMFS as having a low potential to adversely affect threatened and endangered fish species.

Fine Sediment Load—Fine sediment that could harm fish and degrade fish habitat is transported downstream through a river system. Downstream habitat is, therefore, dependent on the conditions in all headwater streams. The effect of an increase in sediment load is not just a local concern, but becomes additive with sediment increases throughout the watershed. Timber harvesting, agriculture, road building, and other development resulting in clearing of vegetation and construction of impervious surfaces such as parking lots and rooftops could all contribute to increased sediment load in a watershed. The sensitivity of a watershed to the cumulative effects of additional sediment load depends on the distribution of resources sensitive to fine sediment inputs, such as spawning beds, as well as the quantity and location of fine sediment sources, soils, slopes, vegetation cover, and flow regime.

LWD Recruitment—Large woody debris or LWD is critical to maintaining structure and stability of streams in the western Cascade Mountains. LWD forms pools, traps sediment, provides cover for fish, creates "steps" that can facilitate stream passage, and provides a substrate and food source for aquatic invertebrates. Most streams in parts of the Northwest that have experienced timber harvest are currently depleted in LWD relative to historic conditions, and recovery of in-stream LWD concentrations is a principal goal of land management agencies in the region. The Washington Forest Practices Rules, The Northwest Forest Plan, and the Cedar River and WDNR HCPs, seek to restore LWD levels by maintaining a riparian forest of large conifers that would occasionally fall into the stream, thereby maintaining stable in-stream LWD structure. Any activity that removes large trees from the riparian forest would tend to decrease the loading of in-stream LWD with resulting adverse impacts to fish habitat. If the affected fish were not special-status species, the impact would be moderate. If affected fish were protected under the ESA, the impact would be high.

Stream Temperature—Although reduction of shading along a small length of stream may have a small influence on stream temperature, this effect could produce a moderate or high impact if there were many such reductions in shading throughout the watershed. In Washington State, research has determined that riparian shade and elevation are two major determinants of peak annual stream temperatures (Sullivan et al. 1990). At the elevations found in the study area, 700 to 4,000 ft., riparian shade levels of 50 to 85% are necessary to prevent stream temperatures from exceeding state water quality standards (WAC 173-201A, WFPB 2000). Vegetation clearing could reduce riparian shade enough to cause impairment of water quality standards, with concomitant adverse impacts to designated beneficial uses of the water body, such as fish habitat.

Toxic Pollutant Loading—Toxic substances could enter the stream system of a watershed from a number of sources. No herbicides would be used for vegetation control within 400 ft. of streams and none would be used in the CRW. In addition, assuming that BMPs were used to prevent fuel spills on or near construction sites, petroleum products used in vehicles and other machinery during transmission line installation would probably be diluted in the watershed to the point where there would be no cumulative effect. Therefore, cumulative effects of toxic

substances from the power line would be unlikely even when combined with other sources in the watersheds.

4.1.1.4 Unavoidable Effects, Irreversible or Irretrievable Commitment of Resources

Even with BMPs to control erosion, road repair and construction would likely cause some fine sediment to enter nearby streams. This effect could be minimized by consistent monitoring, especially during storm events, and by proper maintenance of road and stream crossings.

Because native vegetation in the study area consists of dense conifer and deciduous forests, maintaining a ROW free of tall trees would increase solar radiation and convective heating in all streams by allowing more sunlight to reach these streams (Adams and Sullivan 1989, Sullivan et al. 1990). This effect would be greatest on streams more than about 20 ft. wide, where low-growing vegetation could not shade the entire stream. Stream temperature impacts are very site specific and dependent on elevation, local topography, existing vegetation, stream gradient, the presence of groundwater, drainage from riparian wetlands, channel morphology, and microclimatic effects (Beschta et al. 1987, Sullivan et al. 1990). Existing standards for water protection in the Washington Forest Practices Act (WAC 222) do not acknowledge the importance of factors other than shade and elevation as determinants of stream temperature and are generally inadequate to ensure that stream temperatures do not exceed the state water quality criterion (Earle 1998).

Studies on timberlands in the western foothills of the Washington Cascade Range have found that in the absence of adequate riparian shade, fish-bearing streams commonly achieve peak annual temperatures of 18 to 21°C (Earle 1998; see also data cited in Ecology 2000). Such temperatures may cause stress in most salmonid fishes but would not be lethal (Bell 1991). Moreover, most streams contain thermal refugia in the form of deep pools, tributary junctions, or areas of groundwater influx, where more equable temperatures persist and fish could hold during peak water temperature periods (Beschta et al. 1987, Keller and Hofstra 1982, Nielsen et al. 1994). Bull trout, if present in the area, may be severely stressed and may suffer some mortality if subjected to temperatures as high as 18 to 21°C (McCullough 1999).

4.1.2 Echo Lake Substation Impacts

4.1.2.1 Impacts

One fish-bearing stream crosses the Echo Lake Substation property. This fish-bearing tributary to Lake Creek has no documented anadromous fish presence, but is used by resident salmonids. The stream channel has been historically modified and now runs through a detention pond facility on the site. This impact would be low to moderate.

4.1.2.2 Mitigation

Erosion control BMPs described in Section 4.1.1.2 would be implemented to avoid impacts to fish or their habitat.

4.1.2.3 Unavoidable Effects, Irreversible or Irretrievable Commitment of Resources

No unavoidable, irreversible, or irretrievable impacts would occur.

4.1.3 Access Roads

4.1.3.1 Impacts

All new access roads within 300 ft. of fish-bearing streams would be located within the cleared ROW. Thus, impacts resulting from the clearing of vegetation to accommodate access roads are incorporated within the assessments given above for each of the action alternatives. Additionally, access roads could affect fish and fish habitat because construction of stream-crossing structures (bridges and culverts) could create a fish passage barrier or cause direct physical harm to fish, while delivery of fine sediment to streams may be caused by road construction or road surface erosion.

Table 7 shows that Alternatives 1 and C (Options C-1 and C-2) would require no new stream crossing structures. Alternative A would cross a known anadromous fish-bearing tributary of Little Soos Creek. Alternatives B and D (Option D-2) would cross a known fish-bearing stream, Rock Creek, which is upstream of Snoqualmie Falls and inaccessible to anadromous fish. Two new roads would be built in Alternative D (Option D-1) that would cross known fish-bearing streams, Rock Creek and Olallie Creek, which are upstream of Snoqualmie Falls and inaccessible to anadromous fish. Potential retrofitting of culverts is also possible in cases where potential water quality or fish passage problems exist. No fish-bearing streams will be crossed by new roads on Forest Service lands, and road construction will consequently have no effect on attainment of ACSOs.

Table 7. Riparian Buffer Areas to be Cleared under Each Action Alternative

Affected Area	Alternative						
	A	**B**	**C (Option C-1)**	**C (Option C-2)**	**D (Option D-1)**	**D (Option D-2)**	**1**
Number of Fish-Bearing Streams Crossed by Conductors	8	31	4	4	31	31	10
Number of Fish-Bearing Streams Crossed by New Roads	1	1	0	0	2	1	0
Number of Fish-Bearing Streams within 100 ft. of Clearing	8	34	4	4	34	34	11
Area Cleared within 100 ft. of Fish-Bearing Stream (ac.)[a]	8	7	4	4	40	31	12
Number of Fish-Bearing Streams within 300 ft. of Clearing	8	34	4	4	34	34	15
Area Cleared within 300 ft. of Fish-Bearing Stream (ac.)[a]	24	28	14	14	120	95	33
Number of Towers within 300 ft. of Fish-Bearing Streams	4	13	5	5	18	6	N/A
Length of Fish-Bearing Stream within Cleared Area (ft.)	1,708	1,427	963	964	9,199	6,866	2,869
Length of Non-Fish-Bearing Stream within Cleared Area (ft.)	473	3,380	727	367	13,705	14,119	N/A

Affected Area	Alternative						
	A	B	C (Option C-1)	C (Option C-2)	D (Option D-1)	D (Option D-2)	1
Number of Fish-Bearing Streams on USFS-Managed Lands Crossed by Conductors	N/A	19	N/A	N/A	19	20	N/A
Length of Fish-Bearing Stream on USFS-Managed Lands within Cleared Area (ft.)	N/A	999	N/A	N/A	5,114	3,667	N/A
Length of Non-Fish-Bearing Stream on USFS-Managed Lands within Cleared Area (ft.)	N/A	2,044	N/A	N/A	8,778	8,892	N/A
Area Cleared within Riparian Reserves (ac.)[a]	N/A	24	N/A	N/A	110	89	N/A
[a] The cleared areas shown could vary from final actual clearing by as much as +/- 20%.							

4.1.3.2 Mitigation

The mitigation measures cited in Section 4.1.1.2 would result in a low impact caused by roads and stream crossing structures under each of the action alternatives.

4.1.3.3 Unavoidable Effects, Irreversible or Irretrievable Commitment of Resources

Some road wear and erosion could occur in association with increased vehicle usage during project construction, and some of those vehicles might leak or spill petrochemicals. These impacts, although minimized by mitigation measures (Section 4.1.1.2), would be unavoidable, irreversible, and irretrievable.

Each of the action alternatives would require new road construction. Land contours would be altered. Flow paths would be disrupted, and road wear and erosion could occur in association with increased vehicle usage during project construction, and some of those vehicles might leak or spill petrochemicals. These impacts, although minimized by mitigation measures (Section 4.1.1.2), would be unavoidable. The roads could be decommissioned at some future date, and the process of decommissioning could potentially include re-grading of land surfaces. In that event, no irreversible or irremediable impacts would occur.

4.1.4 Alternative Transmission Line Impacts

The following sections discuss impacts to fisheries resources in drainages crossed by the four action alternatives. The streams within the 750-ft. study corridor (i.e., within 300 ft. of either side of each 150-ft. alternative ROW) are listed in detail with documented fish presence data in Appendix A. Alternative 1, the Preferred Alternative, is presented for comparison purposes only. Please refer to the BPA Final Fisheries Technical Report (Jones & Stokes 2002) for a detailed description of the Preferred Alternative.

4.1.4.1 Alternative 1: Preferred Alternative

Impacts—The types of potential impacts to fish under Alternative 1 would be the same as those discussed earlier for all the alternatives. In order to compare ROW alternatives, a number of

factors that could affect fish were evaluated (Table 7), including the extent of clearing required (assuming that the full width of the ROW were cleared), number and location of potential fish-bearing streams crossed by the ROW, the number and location of stream-crossing structures (culverts or bridges) associated with new roads, and the sensitivity of fish resources (whether accessible to anadromous fish). Note that the estimates of clearing in Table 7 reflect the assumption that all trees in the ROW would be cleared. In practice, clearing requirements would be reduced in some areas due to local topography. Conversely, clearing requirements may be greater in other areas to accommodate hazards such as very tall trees or unfavorable topography. Thus, the cleared areas shown in Table 7 could vary from final actual clearing by as much as +/- 20%.

The Alternative 1 ROW would be 9 mi. long and cross 10 fish-bearing (Type 1, 2, or 3) streams and an unknown number of non-fish-bearing (Type 4 or 5) streams. The ROW would cross three watersheds: Green River, Cedar River, and Raging River. One of these streams, the Raging River, is currently accessible to anadromous fish. Two of these streams, Rock Creek and the Cedar River, are expected to be accessible to anadromous fish by the time the project would be constructed, due to completion of the fish ladder at Landsburg Diversion Dam. The fish ladder is scheduled for construction between mid-July and mid-September 2002. Beginning in August 2003, adult and juvenile anadromous salmonids may be present in the study area (as shown in the BPA Final Fisheries Technical Report (Jones & Stokes 2002). No fish-bearing streams would be crossed in the Green River Watershed.

Construction of Alternative 1 would result in the clearing of 33 ac. within 300 ft. of potentially fish-bearing streams, and 12 ac. within 100 ft. of potentially fish-bearing streams. About 2,900 ft. of stream would be within the cleared ROW. Impacts from clearing of vegetation would be as described in Section 4.1.1.1. Clearing within 300 ft. of the stream could affect LWD recruitment to the stream and stream microclimate. Clearing within 100 ft. of the stream could reduce riparian shading, bank reinforcement by roots, and fine litter contributions to the stream. New roads would not cross any fish-bearing streams, so no new culverts or bridges would be built. Potential retrofitting of culverts is possible in cases where potential water quality or fish passage problems exist.

Mitigation—All of the mitigation measures cited in Section 4.1.1.2 would apply to Alternative 1.

Cumulative Impacts—*Fine Sediment Load*—Fine sediment could be produced during vegetation clearing, maintenance of the existing road system, and tower construction. Currently, the only other anthropogenic source of fine sediment is forest road maintenance. Under applicable regulations, current fine sediment production is low. If Alternative 1 were implemented, fine sediment production would continue to be low as a result of new road development. The cumulative impacts of new roads would be low because the existing road system would be used for the majority of the project.

Stream Temperature—Currently, provisions of the Washington Forest Practices Rules and the Cedar River and WDNR HCPs ensure retention of adequate riparian shade to protect stream temperature. Of these three regulatory standards, the Washington Forest Practices Rules are the least restrictive. The Rules require maintaining a certain amount of riparian shade in order to avoid exceeding the state water quality standards for temperature. The standard calls for less shade with increasing elevation because ambient air temperatures tend to be lower at high elevations. At the elevation of most streams in the project area, 600 to 1,800 ft., between 50% and 86% riparian shade is needed to avoid exceeding the Class AA water quality criterion of 61°F. The Cedar River HCP applies a much more restrictive standard, which recognizes the anti-

degradation provisions of Washington's water quality standards (WAC 173-201(a)). Under this standard, any reduction in riparian shade would be expected to cause increased stream temperatures, degrading the stream's capacity to provide optimal fish habitat.

Proposed vegetation clearing would not comply with riparian shade protections called for by either the Washington Forest Practices Rules or the CRW HCP, and may result in local peak stream temperatures exceeding metabolic optima for salmonids. In streams only used by resident salmonids, this would constitute a moderate impact. In the three streams potentially used by threatened salmonid species (Cedar River, Raging River, and Rock Creek), this could constitute a high impact. However, two of those streams, the Cedar River and the Raging River, run in relatively deep canyons where little vegetation clearing may be required. The third stream, Rock Creek, would be crossed in a headwaters area and would be very unlikely to be used by chinook salmon (which avoid such narrow, high-gradient streams) or bull trout (which do not spawn in such warm streams; see King County Department of Natural Resources (2000)). These considerations may result in a moderate or low impact to threatened species, but this conclusion cannot be confirmed until the extent of clearing needed in the affected areas is known.

LWD Recruitment—The affected streams are, for the most part, relatively narrow. All of the streams in Alternative 1 have bankfull widths of less than 33 ft. except for the Cedar River and Raging River. The Cedar River has a bankfull width of approximately 330 ft. at the proposed crossing, and the Raging River, 165 ft. Because of the Cedar River's width, the proposed work would have little effect on riparian shading or bank stability, but LWD recruitment potential would be reduced. Topping of large riparian trees, rather than full removal, is proposed in order to minimize this impact.

The Raging River, as previously noted, flows in a deep gorge, and limited clearing would be required. The proposed clearing would have little effect on riparian functions other than LWD recruitment. The surrounding landscape in the CRW is primarily forested by mature Douglas-fir forest, excepting the cleared area along the existing BPA transmission line. Because these streams all flow through dense forest, they currently have full riparian function with regard to LWD recruitment. Thus, the canopy gaps created by the proposed action are unlikely to significantly reduce the capacity of any of these streams to provide a structurally diverse riparian environment supporting salmonid habitat functions. The canopy gaps may in fact promote a more complex habitat with greater production of aquatic plants in what is currently a very uniform riparian environment. In the Raging River Watershed, however, past land use practices have established a very discontinuous canopy and the proposed action has the potential to further degrade riparian habitat that is already impaired.

Toxic Pollutant Loading—Some toxic pollutant loading could occur as a result of road maintenance and tower construction. In view of the mitigation measures described earlier, the likely impact would be low. Because no herbicides would be used in vegetation control within 400 ft. of streams and none would be used in the CRW, cumulative effects of toxic substances from the power line would be unlikely even when combined with other sources in the watersheds.

Unavoidable Effects, Irreversible or Irretrievable Commitment of Resources—Alternative 1 would require vegetation clearing in riparian areas. This unavoidable impact would result in increased fine sediment delivery to streams in association with project construction, as well as permanent reductions in LWD recruitment to streams, stream shading, bank reinforcement by tree roots, and fine litter inputs. None of these impacts would be irreversible or irretrievable. If all maintenance of the proposed project were to stop, and stream crossing structures were to be

removed, project impacts would become negligible or undetectable within approximately 150 years.

4.1.4.2 Alternative A

Impacts—The types of potential impacts to fish under Alternative A would be the same as those discussed earlier for all the alternatives. Table 7 shows the various factors evaluated in comparing Alternative A with the other action alternatives.

The Alternative A ROW would be approximately 20 mi. long and cross eight fish-bearing streams and an unknown number of non-fish-bearing streams (Figure 2-A). The ROW would cross two basins: Lower Cedar River and Soos Creek. All of these basins are currently accessible to anadromous fish.

Construction of Alternative A would result in the clearing of 24 ac. within 300 ft. of potentially fish-bearing streams, and 8 ac. within 100 ft. of potentially fish-bearing streams. About 1,708 ft. of stream would be within the cleared ROW. Impacts from clearing of vegetation would be as described in Section 4.1.1.1. For the impact assessment, vegetation clearing impacts were estimated based on an assumption that the entire length of the 150-ft.-wide transmission line corridor would be completely cleared. Clearing within 300 ft. of the stream could affect LWD recruitment to the stream and stream microclimate. Clearing within 100 ft. of the stream could reduce riparian shading, bank reinforcement by roots, and fine litter contributions to the stream. Clearing associated with Alternative A would result in a high impact to aquatic resources. One new road would be built in Alternative A that would cross a known anadromous fish-bearing tributary of Little Soos Creek. Potential retrofitting of culverts is also possible in cases where potential water quality or fish passage problems exist.

Alternative A would cross seven fish-bearing streams. All of these streams potentially support resident salmonids, including cutthroat and rainbow trout. All of these streams, which include Jenkins Creek, Little Soos Creek, a tributary of Little Soos Creek, Peterson Creek, Rock Creek, and the Cedar River, are accessible to and known to support anadromous fish. Appendix A shows documented anadromous fish presence in greater detail for each affected stream.

Mitigation—All of the mitigation measures cited in Section 4.1.1.2 would apply to Alternative A.

Cumulative Impacts—*Fine Sediment Load*—Fine sediment could be produced during vegetation clearing, construction of new access roads, maintenance of the existing road system, and tower construction. Development in the Soos Creek Basin has resulted in increased fine sediment load in Little Soos Creek, Jenkins Creek, and other system tributaries. Excessive channel incision and sedimentation have been identified as limiting factors within the Soos Creek basin. Given the rate of development within the Soos Creek basin, if Alternative A were implemented, it could contribute to a cumulative increase in fine sediment production. High fine sediment load is not an identified limiting factor in the Lower Cedar River basin. However, fine sediments do accumulate in the lower reaches of the river, and the bluffs in the affected reach of the stream are considered to be a major source of spawning gravels. Implementation of Alternative A probably could not contribute to a cumulative increase in fine sediment production in the Lower Cedar River basin.

Stream Temperature—Currently, stream temperature is protected under King County surface water regulations. King County Surface Water Management Code (Title 9) recognizes the anti-

degradation provisions of Washington's water quality standards (WAC 173-201(a)). Under this standard, any reduction in riparian shade would be expected to cause increased stream temperatures, degrading the stream's capacity to provide optimal fish habitat. Streams in the project area require greater than 50% riparian shade to avoid exceeding the Class AA water quality criterion of 61°F.

Proposed vegetation clearing would not comply with riparian shade protections called for by the Washington State water quality regulations, and may result in local peak stream temperatures exceeding metabolic optima for salmonids. In streams only used by resident salmonids, this outcome would constitute a moderate impact. In the streams potentially used by threatened salmonid species (Cedar River, Peterson Creek, Rock Creek, Jenkins Creek, and Little Soos Creek), this outcome could constitute a high impact.

The Cedar River and Peterson Creek, however, run in relatively deep valleys where little vegetation clearing may be required. Rock Creek could be impaired, but the level of impact is unknown. Little Soos Creek is listed on the 1998 Washington State 303(d) list of impacted waters due to temperature concerns (Ecology 2000). Any additional increase in temperature could create a blockage to anadromous fish usage and cumulative water quality impacts throughout the Soos Creek basin. These considerations may result in a high impact to threatened species, as clearing cannot be avoided at the locations where the transmission line would cross Little Soos Creek or Jenkins Creek. This conclusion cannot be confirmed until the extent of clearing needed in the affected areas is known.

LWD Recruitment—Currently, municipal codes require retention of riparian buffers at least 25 ft. wide. Proposed vegetation clearing would not comply with this standard and would consequently result in reduced LWD recruitment and high impact to in-stream fish habitat. In streams only used by resident salmonids, this outcome would constitute a moderate impact. In the streams potentially used by threatened salmonid species (Cedar River, Peterson Creek, Rock Creek, Jenkins Creek, and Little Soos Creek), this outcome could constitute a high impact. The Soos Creek basin has moderate but insufficient LWD (Kerwin and Nelson 2000) and continued clearing impacts due to development in the basin are expected. In the Soos Creek basin streams, a high impact would be expected for threatened species. The Cedar River is a large stream where very large conifers are required to provide recruitment of functional LWD. Trees removed along this stream would not be available to provide LWD, and the resulting deficiency would be a high impact.

Toxic Pollutant Loading—Some toxic pollutant loading could occur as a result of new road construction, road maintenance, and tower construction. In view of the mitigation measures described earlier, the likely impact would be low. Cumulative effects of toxic substances from the power line would be unlikely even when combined with other sources (such as organic runoff and petrochemicals) in the affected watersheds.

Unavoidable Effects, Irreversible or Irretrievable Commitment of Resources—Alternative A would require vegetation clearing in riparian areas. This unavoidable impact would result in increased fine sediment delivery to streams in association with project construction, as well as permanent reductions in LWD recruitment to streams, stream shading, bank reinforcement by tree roots, and fine litter inputs. None of these impacts would be irreversible or irretrievable. If all maintenance of the proposed project were to stop, and stream crossing structures were to be removed, project impacts would become negligible or undetectable within approximately 150 years.

4.1.4.3 Alternative B

Impacts—The types of potential impacts to fish under Alternative B would be the same as those discussed earlier for all the alternatives. Table 7 shows the various factors evaluated in comparing Alternative B with the other action alternatives.

The Alternative B ROW would be 38 mi. long and cross 31 fish-bearing streams and an unknown number of non-fish-bearing streams (Figure 2-B). The ROW would cross three watersheds: Upper Yakima River, South Fork Snoqualmie River, and Raging River. Both the Upper Yakima River and Raging River basins are currently accessible to anadromous fish.

Construction of Alternative B would result in the clearing of 28 ac. within 300 ft. of potentially fish-bearing streams, and 7 ac. within 100 ft. of potentially fish-bearing streams. About 1,427 ft. of stream would be within the cleared ROW. Impacts from clearing of vegetation would be as described in Section 4.1.1.1. For the impact assessment, impacts resulting from vegetation clearing were estimated based on an assumption that only the northern 20 ft. of the existing 150-ft.-wide transmission line corridor would be cleared. This is a result of Alternative B following an existing corridor that is already cleared. Only the northern portion of the existing corridor, where the new line will be hung, will need to be cleared for construction. Clearing within 300 ft. of the stream could affect LWD recruitment to the stream and stream microclimate. Clearing within 100 ft. of the stream could reduce riparian shading, bank reinforcement by roots, and fine litter contributions to the stream.

One new road would be built in Alternative B that would cross a known fish-bearing stream, Rock Creek, which is upstream of Snoqualmie Falls and inaccessible to anadromous fish. Retrofitting of culverts is possible in cases where potential water quality or fish passage problems exist. Clearing impacts would not be as high as noted due to the fact that this alternative proposes a rebuild of an existing corridor that is already partially cleared. Clearing associated with Alternative B would result in a high impact to aquatic resources in the Upper Yakima and Raging River basins and a moderate impact in the South Fork Snoqualmie River basin.

All of the streams crossed by Alternative B potentially support resident salmonids, including cutthroat and rainbow trout. Two of these streams, which include the Yakima River and an unnamed tributary of the Yakima River, are accessible and known to support anadromous fish. All of the 11 fish-bearing streams in the Upper Yakima watershed are accessible to anadromous fish, including Middle Columbia steelhead. Appendix A shows documented anadromous fish presence in greater detail for each affected stream.

Inclusive in the impacts described above are impacts specific to USFS-managed lands and designated Riparian Reserves that are protected under the standards and guidelines of the Northwest Forest Plan and an integral component in attainment of ACSOs. A total of 19 streams and their associated Riparian Reserves are crossed on USFS lands. Construction of Alternative B would result in the clearing of 24 ac. of Riparian Reserves on Forest Service lands. About 999 linear ft. of fish-bearing stream and another 2,044 linear ft. of non-fish-bearing stream would occur within the cleared ROW on Forest Service lands. Impacts from clearing of vegetation are described in Section 4.1.1.1. For the impact assessment, vegetation clearing impacts were estimated based on an assumption that the entire length of the 150-ft.-wide transmission line corridor would be completely cleared. In the case of Alternative B, however, a significant portion of the ROW has already been cleared for the existing transmission line. Direct loss of Riparian Reserves would contribute to non-attainment of all nine ACSOs and therefore constitute a high impact.

Mitigation—All of the mitigation measures cited in Section 4.1.1.2 would apply to Alternative B.

Cumulative Impacts—*Fine Sediment Load*—Fine sediment could be produced during vegetation clearing, construction of new roads, maintenance of the existing road system, and tower construction. Currently, the other anthropogenic sources of fine sediment include ski areas at Snoqualmie Pass, logging operations on either side of the Pacific Crest, and development in privately owned areas within both unincorporated King and Kittitas counties. High sediment load is characterized as a localized problem that is not pervasive in the Keechelus Lake Sub-watershed (Plum Creek 1997). The Keechelus Lake-Mosquito Creek watershed analysis rates both Meadow Creek and Mosquito Creek as high erosion hazard areas (Plum Creek 1997). The South Fork Snoqualmie watershed analysis does not define sediment load as a limiting factor, but does note that most erosion in the watershed is due to forest roads (USFS 1995).

Increases in fine sediment load produced by construction of Alternative B would result in a high impact in the Yakima River watershed and a moderate impact in the South Fork Snoqualmie River watershed. The temporary impacts to sediment load from construction and clearing can be largely mitigated and will be temporary in nature. However, long-term erosion impacts from maintenance and permanent vegetation loss are likely. These impacts will result in non-attainment of ACSOs for watershed complexity, geomorphic integrity, water quality, sediment regime, and habitat. Consequently, Alternative B will result in a high impact to fine sediment load.

Stream Temperature—Currently, provisions of the Washington Forest Practices Rules and the Northwest Forest Plan ensure retention of adequate riparian shade to protect stream temperature. Of these regulatory standards, the Washington Forest Practices Rules are the least restrictive. The Rules require maintaining a certain amount of riparian shade in order to avoid exceeding the state water quality standards for temperature. The standard calls for less shade with increasing elevation because ambient air temperatures tend to be lower at high elevations. Streams in the project area require greater than 75% riparian shade to avoid exceeding the Class AA water quality criterion of 61°F (16°C). However, temperature-sensitive bull trout are known to inhabit the Upper Yakima Watershed and require optimal temperatures of 59°F (15°C) or lower (USFWS 1998).

Proposed vegetation clearing would not comply with riparian shade protections called for by the Washington Forest Practices Rules, and may result in local peak stream temperatures exceeding metabolic optima for salmonids. In streams only used by resident salmonids, this outcome would constitute a moderate impact. In streams potentially used by threatened salmonid species, this outcome could constitute a high impact. Alternative B would result in additional clearing beyond the existing corridor and in the long term would result in non-attainment of ACSOs for watershed complexity, watershed connectivity, water quality, and habitat. Such an outcome would constitute a high impact.

The Yakima River, Mill Creek, and Cold Creek, however, run in relatively deep canyons/valleys where little vegetation clearing may be required. The Keechelus Lake watershed analysis notes shade levels below the targets for temperature exceedence. Average highs in the drainage were 16°C to 20°C, outside of the optimal range for bull trout and anadromous salmonids (Plum Creek 1997). Meadow Creek and a portion of the mainstem South Fork Snoqualmie River are listed on the 1998 Washington State 303(d) list of impacted waters due to temperature concerns (Ecology 2000). Any additional increase in temperature could create a blockage to anadromous fish usage and cumulative water quality impacts. In all streams listed on the Washington State 303(d) list

this outcome would constitute a high impact. In all other streams, these considerations would result in a moderate impact to threatened species because of the historical loss of shade trees in the corridor and the lack of priority species in the South Fork Snoqualmie watershed.

LWD Recruitment—Currently, provisions of the Washington Forest Practices Act and the Northwest Forest Plan ensure retention of riparian forest buffers at least 100 ft. wide to protect LWD recruitment. Proposed vegetation clearing would not comply with those protections and may result in reduced LWD recruitment and consequent adverse impacts to in-stream fish habitat. In streams only used by resident salmonids, this outcome would constitute a moderate impact. In streams potentially used by threatened salmonid species, this outcome could constitute a high impact. Alternative B would result in additional clearing beyond the existing corridor and in the long term would result in non-attainment of ACSOs for watershed complexity, geomorphic integrity, streamflow, riparian vegetation, and habitat due to additional losses of recruitable LWD. This outcome would constitute a high impact.

Mill Creek and Cold Creek run in relatively deep canyons where little vegetation clearing may be required. Available LWD for recruitment was rated as high to moderate in the Keechelus Lake drainage, but in-stream LWD was rated as low (Plum Creek 1997). The Yakima River is a large stream where very large conifers are required to provide recruitment of functional LWD. Trees removed or topped along this stream would not be available to provide LWD, resulting in a high impact. The South Fork Snoqualmie watershed analysis does not describe LWD recruitment potential in tributaries, but does list the mainstem as deficient (USFS 1995).

Toxic Pollutant Loading—Some toxic pollutant loading could occur as a result of road maintenance and tower construction. Cumulative effects of toxic substances from the power line would be unlikely even when combined with other sources (such as the Snoqualmie Summit sewage treatment facility and I-90) in the affected watersheds. None of the analyses for the Yakima River watershed, the Keechelus Lake-Mosquito Creek watershed, or the South Fork Snoqualmie River watershed describes water quality impacts that could contribute to cumulative impacts to water quality. In view of the mitigation measures described earlier, the likely impact would be low. Alternative B, with the proposed mitigation, could have a temporary impact on water quality on USFS lands, but would maintain long-term water quality conditions and would therefore constitute a low impact or a moderate impact if an accidental spill were to occur during construction.

Unavoidable Effects, Irreversible or Irretrievable Commitment of Resources—Alternative B would require vegetation clearing in riparian areas. This unavoidable impact would result in increased fine sediment delivery to streams in association with project construction, as well as permanent reductions in LWD recruitment to streams, stream shading, bank reinforcement by tree roots, and fine litter inputs. Alternative B would result in non-attainment of USFS ACSOs for watershed complexity, watershed connectivity, geomorphic integrity, riparian vegetation, water quality, sediment regime, stream flow, and habitat. None of these impacts would be irreversible or irretrievable. If all maintenance of the proposed project were to stop, and stream crossing structures were to be removed, project impacts would become negligible or undetectable within approximately 150 years.

4.1.4.4 Alternative C (Option C-1)

Impacts—The types of potential impacts to fish under Alternative C (Option C-1) would be the same as those discussed earlier for all the alternatives. Table 7 shows the various factors evaluated in comparing Alternative C (Option C-1) with the other action alternatives.

The Alternative C (Option C-1) ROW would be 10 mi. long and cross four fish-bearing streams and an unknown number of non-fish-bearing streams (Figure 2-C-1). The ROW would cross four basins: Green River, Rock Creek, Lower Cedar River, and Issaquah Creek. All of these basins are currently accessible to anadromous fish.

Construction of Alternative C (Option C-1) would result in the clearing of 14 ac. within 300 ft. of potentially fish-bearing streams, and 4 ac. within 100 ft. of potentially fish-bearing streams. About 963 ft. of stream would be within the cleared ROW. Impacts from clearing of vegetation would be as described in Section 4.1.1.1. For the impact assessment, vegetation clearing impacts were estimated based on an assumption that the entire length of the 150-ft.-wide transmission line corridor would be completely cleared. Clearing within 300 ft. of the stream could affect LWD recruitment to the stream and stream microclimate. Clearing within 100 ft. of the stream could reduce riparian shading, bank reinforcement by roots, and fine litter contributions to the stream. New roads would not cross any fish-bearing streams, so no new culverts or bridges would be built. Retrofitting of culverts is possible in cases where potential water quality or fish passage problems exist.

Alternative C (Option C-1) would cross four fish-bearing streams. All of these streams potentially support resident salmonids, including cutthroat and rainbow trout. All of these streams, which include Holder Creek, Carey Creek, the Lake Walsh Diversion, and the Cedar River, are accessible and known to support anadromous fish. Appendix A shows documented anadromous fish presence in greater detail for each affected stream.

Mitigation—All of the mitigation measures cited in Section 4.1.1.2 would apply to Alternative C (Option C-1).

Cumulative Impacts—*Fine Sediment Load*—Fine sediment could be produced during vegetation clearing, maintenance of the existing road system, and tower construction. Excessive channel incision and sedimentation have been identified as limiting factors within the Issaquah Creek basin as a whole, with some site specific sediment load problems in Carey and Holder Creeks (King County 1994, Kerwin 2001). If Alternative C (Option C-1) were implemented, it could contribute to a cumulative increase in fine sediment production within the basin. High fine sediment load is not an identified limiting factor in the Lower Cedar River basin. However fine sediments do accumulate in the lower reaches of the river, and the bluffs in the affected reach of the stream are a major source of spawning gravels. Implementation of Alternative C (Option C-1) probably would not contribute to a cumulative increase in fine sediment production in the Lower Cedar River basin.

Stream Temperature—Currently, stream temperature is protected under King County surface water regulations. King County Surface Water Management Code (Title 9) recognizes the anti-degradation provisions of Washington's water quality standards (WAC 173-201(a)). Under this standard, any reduction in riparian shade would be expected to cause increased stream temperatures, degrading the stream's capacity to provide optimal fish habitat. Streams in the project area require greater than 50% riparian shade to avoid exceeding the Class AA water quality criterion of 61°F.

Proposed vegetation clearing would not comply with riparian shade protections called for by either the Washington Forest Practices Rules or Washington State water quality regulations, and may result in local peak stream temperatures exceeding metabolic optima for salmonids. In streams only used by resident salmonids, this outcome would constitute a moderate impact. In the streams potentially used by threatened salmonid species (Cedar River, Lake Walsh Diversion

Channel, Carey Creek, and Holder Creek), this outcome could constitute a high impact. The Cedar River and Lake Walsh Diversion, however, run in relatively deep valleys where little vegetation clearing may be required. Rock Creek, in the vicinity of the City of Kent Watershed, could be impaired, but this conclusion cannot be confirmed until the extent of clearing needed in the affected areas is known.

LWD Recruitment—Currently, municipal codes require retention of riparian buffers at least 25 ft. wide. Proposed vegetation clearing would not comply with this standard and would consequently result in reduced LWD recruitment and resulting adverse impacts to in-stream fish habitat. In streams only used by resident salmonids, this outcome would constitute a moderate impact. In the streams potentially used by threatened salmonid species (Cedar River, Lake Walsh Diversion Channel, Carey Creek, and Holder Creek), this outcome could constitute a high impact. One of those streams, however, the Lake Walsh Diversion Channel, runs in a relatively deep valley where little vegetation clearing may be required.

LWD is greatly lacking in the Issaquah Creek basin and has been identified as a limiting factor. Both Holder and Carey creeks are high in the basin and relatively undisturbed. Therefore, both streams are primary sources for LWD within the basin and a high impact would be expected for threatened species. The Cedar River is a large stream where very large conifers are required to provide recruitment of functional LWD. Existing trees removed along this stream would not be available to provide LWD, and the resulting deficiency would be a high impact.

Toxic Pollutant Loading—Some toxic pollutant loading could occur as a result of road maintenance and tower construction. In view of the mitigation measures described earlier, the likely impact would be low. Cumulative effects of toxic substances from the power line would be unlikely even when combined with other sources (such as organic runoff and petrochemicals) in the affected watersheds.

Unavoidable Effects, Irreversible or Irretrievable Commitment of Resources—Alternative C (Option C-1) would require vegetation clearing in riparian areas. This unavoidable impact would result in increased fine sediment delivery to streams in association with project construction, as well as permanent reductions in LWD recruitment to streams, stream shading, bank reinforcement by tree roots, and fine litter inputs. None of these impacts would be irreversible or irretrievable. If all maintenance of the proposed project were to stop, and stream crossing structures were to be removed, project impacts would become negligible or undetectable within approximately 150 years.

4.1.4.5 Alternative C (Option C-2)

Impacts—The types of potential impacts to fish under Alternative C (Option C-2) would be the same as those discussed earlier for all the alternatives. Table 7 shows the various factors evaluated in comparing Alternative C (Option C-2) with the other action alternatives.

The Alternative C (Option C-2) ROW would be 10.5 mi. long and cross four fish-bearing streams and an unknown number of non-fish-bearing streams (Figure 2-C-2). The ROW would cross three basins: Rock Creek, Lower Cedar River, and Issaquah Creek. All of these basins are currently accessible to anadromous fish.

Construction of Alternative C (Option C-2) would result in the clearing of 14 ac. within 300 ft. of potentially fish-bearing streams, and 4 ac. within 100 ft. of potentially fish-bearing streams. About 964 ft. of stream would be within the cleared ROW. Impacts from clearing of vegetation

would be as described in Section 4.1.1.1. For the impact assessment, vegetation clearing impacts were estimated based on an assumption that the entire length of the 150-ft.-wide transmission line corridor would be completely cleared. Clearing within 300 ft. of the stream could affect LWD recruitment to the stream and stream microclimate. Clearing within 100 ft. of the stream could reduce riparian shading, bank reinforcement by roots, and fine litter contributions to the stream. New roads would not cross any fish-bearing streams, so no new culverts or bridges would be built. Retrofitting of culverts is possible in cases where potential water quality or fish passage problems exist.

Alternative C (Option C-2) would cross four fish-bearing streams. All of these streams potentially support resident salmonids, including cutthroat and rainbow trout. All of these streams, which include Holder Creek, Carey Creek, the Lake Walsh Diversion Channel, and the Cedar River, are accessible and known to support anadromous fish. Appendix A shows documented anadromous fish presence in greater detail for each affected stream.

Mitigation—All of the mitigation measures cited in Section 4.1.1.2 would apply to Alternative C (Option C-2).

Cumulative Impacts—Cumulative impacts from fine sediment loading, stream temperature, LWD recruitment, and toxic pollutant loading under Alternative C (Option C-2) would be the same as Alternative C (Option C-1) because Alternative C (Option C-2) would involve the same types of construction activities within the same general area.

Unavoidable Effects, Irreversible or Irretrievable Commitment of Resources—Alternative C (Option C-2) would require vegetation clearing in riparian areas. This unavoidable impact would result in increased fine sediment delivery to streams in association with project construction, as well as permanent reductions in LWD recruitment to streams, stream shading, bank reinforcement by tree roots, and fine litter inputs. None of these impacts would be irreversible or irretrievable. If all maintenance of the proposed project were to stop, and stream crossing structures were to be removed, project impacts would become negligible or undetectable within approximately 150 years.

4.1.4.6 Alternative D (Option D-1)

Impacts—The types of potential impacts to fish under Alternative D (Option D-1) would be the same as those discussed earlier for all the alternatives. Table 7 shows the various factors evaluated in comparing Alternative D (Option D-1) with the other action alternatives.

The Alternative D (Option D-1) ROW would be 38 mi. long and cross 31 fish-bearing streams and an unknown number of non-fish-bearing streams (Figure 2-D-1). The ROW would cross three basins: Upper Yakima River, South Fork Snoqualmie River, and Raging River. Both the Upper Yakima River and Raging River basins are currently accessible to anadromous fish.

Construction of Alternative D (Option D-1) would result in the clearing of 120 ac. within 300 ft. of potentially fish-bearing streams, and 40 ac. within 100 ft. of potentially fish-bearing streams. About 9,200 ft. of stream would be within the cleared ROW. Impacts from clearing of vegetation would be as described in Section 4.1.1.1. For the impact assessment, vegetation clearing impacts were estimated based on an assumption that the entire length of the 150-ft.-wide transmission line corridor would be completely cleared. Clearing within 300 ft. of the stream could affect LWD recruitment to the stream and stream microclimate. Clearing within 100 ft. of the stream could reduce riparian shading, bank reinforcement by roots, and fine litter contributions to the stream.

Two new roads would be built in Alternative D (Option D-1) that would cross known fish-bearing streams, Rock Creek and Olallie Creek, which are upstream of Snoqualmie Falls and inaccessible to anadromous fish. Retrofitting of culverts is also possible in cases where potential water quality or fish passage problems exist.

Alternative D (Option D-1) would cross 31 fish-bearing streams. All of these streams potentially support resident salmonids, including cutthroat and rainbow trout. Two of these streams, which include the Yakima River and an unnamed tributary of the Yakima River, are accessible and known to support anadromous fish. All of the 11 fish-bearing streams in the Upper Yakima watershed are accessible to anadromous fish, including Middle Columbia steelhead. Appendix A shows documented anadromous fish presence in greater detail for each affected stream.

Inclusive in the impacts described above are impacts specific to USFS-managed lands and designated Riparian Reserves that are protected under the standards and guidelines of the Northwest Forest Plan and an integral component in attainment of ACSOs. A total of 19 streams and their associated Riparian Reserves are crossed on USFS lands. Construction of Alternative D (Option D-1) would result in the clearing of 110 ac. of Riparian Reserves on Forest Service lands. About 5,114 linear ft. of fish-bearing stream and another 8,778 linear ft. of non-fish-bearing stream would occur within the cleared ROW on Forest Service lands. Impacts from clearing of vegetation are described in Section 4.1.1.1. For the impact assessment, vegetation clearing impacts were estimated based on an assumption that the entire length of the 150-ft.-wide transmission line corridor would be completely cleared. Direct loss of Riparian Reserves would contribute to non-attainment of all nine ACSOs and therefore constitutes a high impact.

Mitigation—All of the mitigation measures cited in Section 4.1.1.2 would apply to Alternative D (Option D-1).

Cumulative Impacts—Cumulative impacts from fine sediment loading, stream temperature, LWD recruitment, and toxic pollutant loading under Alternative D (Option D-1) would be the same as Alternative B because Alternative D (Option D-1) would involve the same types of construction activities within the same general area. The notable difference is that Alternative B is already cleared for the existing transmission line and Alternative D (Option D-1) in still primarily forested. While impacts would be similar in nature to those in Alternative B (increased fine sediment load, decreased riparian vegetation and LWD), the magnitude of those impacts could double, as the proposed Alternative D (Option D-1) ROW would create a new clearing footprint equivalent to the existing Rocky Reach-Maple Valley ROW it would parallel. Alternative D (Option D-1) would subsequently have a high cumulative impact to sediment load, stream temperature, and LWD recruitment.

Unavoidable Effects, Irreversible or Irretrievable Commitment of Resources—Alternative D (Option D-1) would require vegetation clearing in riparian areas. This unavoidable impact would result in increased fine sediment delivery to streams in association with project construction, as well as permanent reductions in LWD recruitment to streams, stream shading, bank reinforcement by tree roots, and fine litter inputs. Alternative D (Option D-1) would result in non-attainment of USFS ACSOs for watershed complexity, watershed connectivity, geomorphic integrity, riparian vegetation, water quality, sediment regime, stream flow, and habitat. None of these impacts would be irreversible or irretrievable. If all maintenance of the proposed project were to stop, and stream crossing structures were to be removed, project impacts would become negligible or undetectable within approximately 150 years.

4.1.4.7 Alternative D (Option D-2)

Impacts—The types of potential impacts to fish under Alternative D (Option D-2) would be the same as those discussed earlier for all the alternatives. Table 7 shows the various factors evaluated in comparing Alternative D (Option D-2) with the other action alternatives.

The Alternative D (Option D-2) ROW would be 38 mi. long and cross 31 fish-bearing streams and an unknown number of non-fish-bearing streams (Figure 2-D-2). The ROW would cross three basins: Upper Yakima River, South Fork Snoqualmie River and Raging River. Both the Upper Yakima River and Raging River basins are currently accessible to anadromous fish.

Construction of Alternative D (Option D-2) would result in the clearing of 95 ac. within 300 ft. of potentially fish-bearing streams, and 31 ac. within 100 ft. of potentially fish-bearing streams. About 6,866 ft. of stream would be within the cleared ROW. Impacts from clearing of vegetation would be as described in Section 4.1.1.1. For the impact assessment, vegetation clearing impacts were estimated based on an assumption that the entire length of the 150-ft.-wide transmission line corridor would be completely cleared. Clearing within 300 ft. of the stream could affect LWD recruitment to the stream and stream microclimate. Clearing within 100 ft. of the stream could reduce riparian shading, bank reinforcement by roots, and fine litter contributions to the stream. One new road would be built in Alternative D (Option D-2) that would cross a known fish-bearing stream, Rock Creek, which is upstream of Snoqualmie Falls and inaccessible to anadromous fish. Retrofitting of culverts is also possible in cases where potential water quality or fish passage problems exist.

Alternative D (Option D-2) would cross 31 fish-bearing streams. All of these streams potentially support resident salmonids, including cutthroat and rainbow trout. Two of these streams, which include the Yakima River and an unnamed tributary of the Yakima River, are accessible and known to support anadromous fish. All of the 11 fish-bearing streams in the Upper Yakima watershed are accessible to anadromous fish, including Middle Columbia steelhead. Appendix A shows documented anadromous fish presence in greater detail for each affected stream.

Inclusive in the impacts described above are impacts specific to USFS-managed lands and designated Riparian Reserves that are protected under the standards and guidelines of the Northwest Forest Plan and an integral component in attainment of ACSOs. A total of 20 streams and their associated Riparian Reserves are crossed while on USFS lands. Construction of Alternative D (Option D-2) would result in the clearing of 89 ac. of Riparian Reserves on Forest Service lands. About 3,667 linear ft. of fish-bearing stream and another 8,892 linear ft. of non-fish-bearing stream would be within the cleared ROW on Forest Service lands. Impacts from clearing of vegetation are described in Section 4.1.1.1. For the impact assessment, vegetation clearing impacts were estimated based on an assumption that the entire length of the 150-ft.-wide transmission line corridor would be completely cleared. Direct loss of Riparian Reserves would contribute to non-attainment of all nine ACSOs and therefore constitutes a high impact.

Mitigation—All of the mitigation measures cited in Section 4.1.1.2 would apply to Alternative D (Option D-2).

Cumulative Impacts—Cumulative impacts from fine sediment loading, stream temperature, LWD recruitment, and toxic pollutant loading under Alternative D (Option D-2) would be similar to Alternative B because Alternative D (Option D-2) would involve the same types of construction activities within the same general area. The notable difference is that Alternative B is already cleared for the existing transmission line and Alternative D (Option D-2) in still

primarily forested. While impacts would be similar in nature to those in Alternative B (increased fine sediment load, decreased riparian vegetation and LWD), the magnitude of those impacts could double, as the proposed Alternative D (Option D-2) ROW would create a new clearing footprint equivalent to the existing Rocky Reach-Maple Valley ROW it would parallel. Alternative D (Option D-2) would subsequently have a high cumulative impact to sediment load, stream temperature, and LWD recruitment.

Unavoidable Effects, Irreversible or Irretrievable Commitment of Resources—Alternative D (Option D-2) would require vegetation clearing in riparian areas. This unavoidable impact would result in increased fine sediment delivery to streams in association with project construction, as well as permanent reductions in LWD recruitment to streams, stream shading, bank reinforcement by tree roots, and fine litter inputs. Alternative D (Option D-2) would result in non-attainment of USFS ACSOs for watershed complexity, watershed connectivity, geomorphic integrity, riparian vegetation, water quality, sediment regime, stream flow, and habitat. None of these impacts would be irreversible or irretrievable. If all maintenance of the proposed project were to stop, and stream crossing structures were to be removed, project impacts would become negligible or undetectable within approximately 150 years.

4.1.5 Cumulative Impacts

Federal and State lands in the project area are managed to preserve and restore a wide range of ecological functions and for commercial timber production. Local management codes and policies include measures that provide some protection for fish habitat. However, development in the Puget Sound region is increasing and Puget Sound Regional Council (PSRC) forecasts a population of over 4 million by 2020.

This growth could result in increased development pressure, especially within the basins affected by Alternatives A and C (Options C-1 and C-2) where development has already resulted in increased sediment load and temperature degradation in the Soos Creek Basin. Planned expansion of the I-90 corridor, which parallels a large segment of the B and D (Options D-1 and D-2) alternatives, could contribute to increased runoff and associated water quality/quantity degradation within USFS-managed lands.

All alternatives are impacted by potential growth within municipal Urban Growth Area (UGAs) in both King and Kittitas Counties. Growth could result in increased runoff due to increased impervious surface within watersheds, and this development could culminate in increased sediment and pollutant load impacts to streams outside of managed areas. Thus, future maintenance and operation impacts associated with transmission line construction would result in cumulative impacts to watersheds and impacts to managed areas within watersheds in the project area.

4.2 Operation and Maintenance Impacts

4.2.1 Impacts Common to All Transmission Line Alternatives

4.2.1.1 Impacts

Once the project is constructed, BPA would conduct routine monitoring of the transmission line. BPA generally inspects transmission lines and access roads every 3 to 4 months by air or by using ground vehicles. Routine inspection activities would not affect fish.

Management of vegetation within the ROW is necessary to control tall vegetation that may fall onto conductors or provide a flashover point, which could jeopardize reliable continued service of the transmission line. BPA has prepared a programmatic NEPA EIS for its vegetation management program associated with transmission lines, roads, and related facilities (BPA 2000). The EIS identifies appropriate measures to protect the environment while minimizing hazard tree risks and maintaining the ROW within safe, reliable conditions. The program seeks to manage vegetation in ROWs by:

- promoting the establishment of low-growing plant communities on the ROWs to "out compete" trees and tall-growing brush; and

- having all possible vegetation control methods available for use to maintain ROWs (manual, mechanical, chemical, and biological) (BPA 2000).

These guidelines additionally provide for protecting water resources by using herbicide buffer zones. As requested by SPU, BPA would use no herbicides anywhere within the CRW. These standards and guidelines provide sufficient mitigation to avoid disturbance of listed, sensitive, or other fish species.

During routine maintenance, BPA would also inspect roads, identify potential erosion problems, and correct any erosion problems identified.

4.2.1.2 Mitigation

Mitigation measures identified in Section 4.1.1.2 would be implemented.

4.2.1.3 Cumulative Impacts

Federal and State lands in the project area are managed to preserve and restore a wide range of ecological functions and for commercial timber production. Local management codes and policies include measures that provide some protection for fish habitat. However, development in the Puget Sound region is increasing and PSRC forecasts a population of over 4 million by 2020.

This growth could result in increased development pressure, especially within the basins affected by Alternatives A and C (Options C-1, and C-2) where development has already resulted in increased sediment load and temperature degradation in the Soos Creek Basin. Planned expansion of the I-90 corridor, which parallels a large segment of the B and D (Options D-1 and D-2) alternatives, could contribute to increased runoff and the associated water quality/quantity degradation within USFS-managed lands.

All alternatives are impacted by potential growth within municipal UGAs in both King and Kittitas counties. Growth could result in increased runoff due to increased impervious surface within watersheds, and this development could culminate in increased sediment and pollutant load impacts to streams outside of managed areas. Thus, future maintenance and operation impacts associated with transmission line construction would result in cumulative impacts to watersheds and impacts to managed areas within watersheds in the project area.

4.2.1.4 Unavoidable Effects, Irreversible or Irretrievable Commitment of Resources

During the project lifetime, maintenance of the road system and continued absence of forest in the cleared ROW would perpetuate the impacts identified in Section 4.1. None of these impacts

would be irreversible or irretrievable. If all maintenance of the constructed project were to stop, and stream crossing structures were to be removed, project impacts would become negligible or undetectable within approximately 150 years.

4.2.2 Access Roads

4.2.2.1 Impacts

Some road wear and erosion could occur in association with increased vehicle usage during project maintenance, and some of the vehicles used might leak or spill petrochemicals. Long-term use of access roads will require maintenance actions including potential grading, culvert repair/replacement, and ditch clearing. These impacts would be low to moderate.

4.2.2.2 Mitigation

Mitigation measures identified in Section 4.1.1.2 would be implemented.

4.2.2.3 Cumulative Impacts

Federal and State lands in the project area are managed to preserve and restore a wide range of ecological functions and for commercial timber production. Local management codes and policies include measures that provide some protection for fish habitat. However, development in the Puget Sound region is increasing and PSRC forecasts a population of over 4 million by 2020.

This growth could result in increased development pressure, especially within the basins affected by Alternatives A and C (Options C-1, and C-2) where development has already resulted in increased sediment load and temperature degradation in the Soos Creek Basin. Planned expansion of the I-90 corridor, which parallels a large segment of the B and D (Options D-1 and D-2) alternatives, could contribute to increased runoff and associated water quality/quantity degradation within USFS-managed lands.

All alternatives are impacted by potential growth within municipal UGAs outside of the greater Puget Sound region in both King and Kittitas counties. Growth could result in increased runoff associated with increased impervious surface within watersheds, and this development could culminate in increased sediment and pollutant load impacts to streams outside of managed areas. Thus, future maintenance and operation impacts associated with transmission line construction would result in cumulative impacts to watersheds and impacts to managed areas within watersheds in the project area.

4.2.2.4 Unavoidable Effects, Irreversible or Irretrievable Commitment of Resources

Some road wear and erosion could occur in association with increased vehicle usage during project construction, and some of the vehicles used might leak or spill petrochemicals. These impacts, although minimized by mitigation measures (Section 4.1.1.2), would be unavoidable, irreversible, and irretrievable.

4.2.3 Substation

4.2.3.1 Impacts

One fish-bearing stream crosses the Echo Lake Substation property. The fish-bearing tributary to Lake Creek has no documented anadromous fish presence, but is potentially used by resident salmonids. The stream has had historical hydromodification and now runs through a detention pond facility on the site. This impact would be low to moderate.

4.2.3.2 Mitigation

Mitigation measures identified in Section 4.1.1.2 would be implemented.

4.2.3.3 Cumulative Impacts

Federal and State lands in the project area are managed to preserve and restore a wide range of ecological functions and for commercial timber production. King County codes and policies include measures that provide some protection for fish habitat. However, development in the Puget Sound region is increasing and PSRC forecasts a population of over 4 million by 2020.

This growth could result in increased development pressure within the Raging River basin. Planned expansion of the I-90 corridor, in the vicinity of the substation, could contribute to increased runoff and the associated water quality/quantity degradation. The substation is impacted by potential growth of the municipal UGA of Issaquah. Growth could result in increased runoff due to increased impervious surface within watersheds, and this development could culminate in increased sediment and pollutant load impacts to streams within the Raging River Basin. Thus, substation expansion could result in cumulative impacts to the Raging River Basin.

4.2.3.4 Unavoidable Effects, Irreversible or Irretrievable Commitment of Resources

No unavoidable, irreversible or irretrievable impacts would occur.

4.2.4 Cumulative Impacts

Federal and State lands in the project area are managed to preserve and restore a wide range of ecological functions and for commercial timber production. Local management codes and policies include measures that provide some protection for fish habitat. However, development in the Puget Sound region is increasing and PSRC forecasts a population of over 4 million by 2020.

This growth could result in increased development pressure, especially within the basins affected by Alternatives A and C (Options C-1 and C-2) where development has already resulted in increased sediment load and temperature degradation in the Soos Creek Basin. Planned expansion of the I-90 corridor, which parallels a large segment of the B and D (Options D-1 and D-2) alternatives, could contribute to increased runoff and the associated water quality/quantity degradation within USFS-managed lands.

All alternatives are impacted by potential growth within municipal UGAs in both King and Kittitas counties. Growth could result in increased runoff due to increased impervious surface within watersheds, and this development could in increased sediment and pollutant load impacts to streams outside of managed areas. Thus, future maintenance and operation impacts associated

with transmission line construction would result in cumulative impacts to watersheds and impacts to managed areas within watersheds in the project area.

5.0 Environmental Consultation, Review and Permit Requirements

5.1 Federal

Public Law 104-297, the Sustainable Fisheries Act of 1996, amended the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) to establish new requirements for "Essential Fish Habitat" (EFH) descriptions in federal fishery management plans and to require federal agencies to consult with National Marine Fisheries Service (NMFS) on activities that may adversely affect EFH. The Magnuson-Stevens Act requires all fishery management councils to amend their fishery management plans to describe and identify EFH for each managed fishery. The Pacific Fishery Management Council (1999) has issued such an amendment in the form of Amendment 14 to the Pacific Coast Salmon Plan, and this amendment covers EFH for all fisheries under NMFS jurisdiction that would potentially be affected by the proposed action. Specifically, these are the chinook and coho salmon fisheries. EFH includes all streams, lakes, ponds, wetlands, and other currently viable water bodies and most of the habitat historically accessible to salmon. Activities occurring above impassable barriers that are likely to adversely affect EFH below impassable barriers are subject to the consultation provisions of the Magnuson-Stevens Act.

The Magnuson-Stevens Act requires consultation for all federal agency actions that may adversely affect EFH. EFH consultation with NMFS is required by federal agencies undertaking, permitting, or funding activities that may adversely affect EFH, regardless of its location. Under Section 305(b)(4) of the Magnuson-Stevens Act, NMFS is required to provide EFH Conservation and enhancement recommendations to federal and state agencies for actions that adversely affect EFH. Wherever possible, NMFS uses existing interagency coordination processes to fulfill EFH consultations with federal agencies. For the proposed action, this goal would be met by incorporating EFH consultation to the Endangered Species Act Section 7 consultation, described below.

The Endangered Species Act of 1973 (16 USC 1536) provides for conserving endangered and threatened species of fish, wildlife, and plants. Federal agencies must determine whether proposed actions would adversely affect any endangered or threatened species. When conducting an environmental impact analysis for specific projects, agencies must identify practicable alternatives to conserve or enhance such species.

The ESA protects species whose populations are declining to the point where they are now at risk of extinction, or are likely to be in the future. The ESA prohibits "taking" any species listed as endangered. The prohibition against taking can be extended to threatened species under regulations promulgated by the USFWS and NMFS. Under the Act, "to take" is defined as "to harass, harm, pursue, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct" (16 USC 1532(18)). "Harming" includes any action that reduces an individual species' ability to feed, breed, or seek shelter and can include major habitat modifications that result in killing or injuring wildlife by materially impairing behavioral patterns.

Section 7 of the ESA requires federal agencies to consult with the USFWS and/or the NMFS on actions leading to activities that might affect listed species. Consultation typically involves preparing a Biological Assessment that describes the expected effects of a proposed action on a listed species. If the Biological Assessment indicates that the action is likely to adversely affect a

listed species, then formal consultation with the USFWS or NMFS is required. Formal consultation results in the issuance of a Biological Opinion – a formal determination on whether or not an action will jeopardize the continued existence of the species or destroy or adversely modify a species' critical habitat, and if so whether there are reasonable and prudent alternatives that avoid such a result (50 CFR 17.3).

5.1.1 Designated Critical Habitat for Listed Species

The ESA requires that, to the maximum extant determinable, NMFS and USFWS must designate critical habitat for federally-listed species at the time of their listing. Critical habitat designation establishes areas that are to be given special consideration in Section 7 consultations. Of the listed fish species potentially present in the project area (Table 1), critical habitat has been defined only for chinook salmon.

5.2 State

Species listed by Washington State as threatened and endangered are not protected in the same way as federally-listed species for which an Incidental Take Statement is required. Instead, Washington State uses these classifications to assist with agency management programs and decision-making. The state also defines Priority Habitats as those habitats having unique or significant value to species because they contain a unique vegetation type or a specific habitat element that is key to fish and wildlife.

5.3 Local

In general, a federal agency consults early in the planning process with local authorities to ensure that its planning and decisions reflect environmental values. Each federal agency must also provide for cases where actions by private applicants or other non-federal entities are planned before federal involvement so that the federal agency consults early with appropriate local interests when its own involvement is reasonably foreseeable [NEPA Sec. 1501.2(d)(2)]. Any affected local interest must be invited to participate in the process for determining the scope of issues to be addressed in an EIS [NEPA Sec. 1501.7(l)]. The EIS must, among other things, address possible conflicts between the proposed action and the objectives of a local interest as the action concerns land use plans, policies, and controls for the affected area [NEPA Sec. 1502.16(c)].

After preparing a draft EIS and before preparing a final EIS, an agency must request the comments of local interests. An agency must provide public notice of NEPA-related hearings, public meetings, and the availability of environmental documents to local interests when the effects may be within the jurisdiction of that particular local interest. Local jurisdictions within the affected project area are Kittitas County, King County, the City of Covington, the City of Kent, and the City of Maple Valley. Local jurisdiction of streams identified in the study are annotated by resource in Appendix A and summarized below in Table 8.

Table 8. Potential Impacts to Aquatic Resources within Local Jurisdictions

Jurisdiction	Alternatives	Number of Fish Bearing Streams Potentially Impacted	Number of Streams Potentially Impacted
Kittitas County	B, D (Options D-1 and D-2)	N/A	N/A
USFS lands in Kittitas County	B, D (Options D-1 and D-2)	11	29
King County	A, B, C (Options C-1 and C-2), D (Options D-1 and D-2)	A: 5 B & D (Options D-1 and D-2): 14 C (Options C-1 and C-2): 4	A: 8 B & D (Options D-1 and D-2): 33 C (Options C-1 and C-2): 7
USFS lands in King County	B, D (Options D-1 and D-2)	6	30
City of Covington	A	2	2
City of Kent	A	1	1
City of Maple Valley	A	N/A	N/A

5.4 Other Standards and Guidelines

5.4.1 Washington Department of Natural Resources Habitat Conservation Plan

WDNR prepared an HCP to establish a comprehensive long-term management plan for all WDNR-managed timberlands within the range of the northern spotted owl in Washington. The HCP also includes numerous provisions intended to maintain the quality of fish habitat and the health of fish populations. The proposed project would not comply with riparian protection measures specified in this HCP.

5.4.2 Washington Department of Natural Resources Forest Practices Rules

The WDNR Forest Practices Rules (WAC 222) describe the types of forest practices allowed under the State of Washington Forest Practices Act (RCW 76.09). They divide forest practices into four classes, based on potential impact to public resources, and outline the processes for permitting of each class. The proposed project would not comply with riparian protection measures specified in the Forest Practices Rules.

5.4.3 Northwest Forest Plan

USFS manages two National Forests in the project area, the Mt. Baker-Snoqualmie National Forest and the Wenatchee National Forest. USFS also manages lands on the fringes of these two national forests within the project area. USFS and BLM developed the Northwest Forest Plan in 1993 to set guidelines for the management of the natural environment in Pacific Region National Forests. The goals of the Northwest Forest Plan are designed to protect forest ecosystems and allow renewable use of forest material. Protection for riparian areas and waters is also provided. The forest management and implementation portion of the strategy was analyzed in a draft supplemental environmental impact statement, of which the final EIS and record of decision

(ROD) were published in February 1994. The ROD amended the planning documents of 19 National Forests and 7 Bureau of Land Management Districts.

The Aquatic Conservation Strategy was developed to restore and maintain the ecological health of watersheds and aquatic ecosystems contained within them on public lands. The strategy will protect salmon and steelhead habitat on federal lands managed by the Forest Service and Bureau of Land Management. The Northwest Forest Plan guides the process by which proposed projects are determined to be in compliance with the Aquatic Conservation Strategy Objectives (ACSOs). Watershed analyses are the foundation of this process, and each watershed analysis must describe existing conditions, natural variability, and the effects of proposed management activities.

6.0 Individuals and Agencies Contacted

Greg Hall
Planner
Kittitas County Planning Department
Contacted by telephone June 10, 2002

Hans Korve
Associate Planner
City of Covington
Contacted by telephone June 12, 2002

Karen Walter
Senior Watershed Coordinator
Muckleshoot Tribe Fisheries Department
Contacted by telephone August 21, 2002

Bob Wells
Project Manager
Resource Development Division
Seattle Public Utilities
Contacted by telephone July 8, 2002

7.0 List of Preparers

Randy Edwards, Information Team Leader
More than 20 years of experience in the GIS and environmental industries
B.S., Oceanography, Humboldt State University, 1983

Matthew Jones, Fisheries Biologist
Two years of experience in ESA compliance and NEPA/SEPA documentation
B.S., Animal Biology, Middle Tennessee State University, 2000

Sean Robertson, CAD/GIS Specialist
Two years of experience in GIS mapping and evaluations
B.S., Environmental and Resource Sciences, University of California – Davis, 1999.

John Soden, Project Manager
Five years of experience in wetland delineation and assessment of aquatic resources, resource

inventory and classification, riparian and wetlands research, and permitting assistance
M.S., Forestry (Riparian and Wetland Research Program), University of Montana, 1999

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9.0 Glossary and Acronyms

This section contains a list of acronyms, abbreviations, and technical terms used in this report. Words that would be defined in a desk-size dictionary (for example, the College Edition of the American Heritage Dictionary) are not included.

9.1 Glossary

100-year floodplains are areas that have a 1% chance of being flooded in a given year.

Access roads are constructed to each structure site first to build the tower and line and later to maintain and repair it. Access roads are built where no roads exist. Where county roads or other access is already established, short spurs are built to the structure sites. Access roads are maintained after construction, except where they pass through cultivated land where the roads would be removed and crop production would be restored after construction is completed.

Alternatives refer to different choices or means to meet the need for action.

Anthropogenic is of, relating to, or resulting from the influence of human beings on nature.

Aquifers are water-bearing rock or sediments below the surface of the earth.

Best Management Practices are a practice or a combination of practices that are the most effective and practical means of preventing or reducing the amount of pollution generated by non-point sources to a level compatible with water quality goals.

Biological Assessments are documents prepared to fulfill the implementing regulations of the Endangered Species Act, found at 50 CFR, part 402, which require an assessment of potential effects on listed species and critical habitat prior to implementing a proposed action. A proposed action is defined as any activity authorized, funded, or carried out by a federal agency (50 CFR 402.10).

Biological Evaluations are the means by which the U.S. Forest Service conducts a review and documents the findings of the effects of an action or proposed action on any sensitive species.

Culverts are corrugated metal or concrete pipes used to carry or divert runoff water from a discharge. Culverts are usually installed under roads to prevent washouts and erosion.

Cumulative impacts are created by the incremental effect of an action when added to other past, present, and reasonably foreseeable future actions.

Cut and fill is the process by which a road is cut or filled on a side slope. The term refers to the amount of soil that is removed (cut) or added (filled).

CWA signifies the Clean Water Act, a federal law intended to restore and maintain the chemical, physical, and biological integrity of the nation's waters and secure water quality.

Danger trees or high-growing brush occur in or alongside the project right-of-way and are hazardous to the transmission line. These trees are identified by special crews and must be removed to prevent tree-fall into the line or other interference with the wires. The owner of danger trees off the right-of-way is compensated for their value. BPA's Construction Clearing

Policy requires that trees be removed that meet either one of two technical categories: Category A contains any tree that in 15 years will grow within about 5 m (18 ft.) of conductors when the conductor is at maximum sag (100°C or 212°F) and is swung by 30 kg per sq/m (6 lb per sq/ft.) of wind (93 kph or 58 mph); Category B represents any tree or high-growing bush that after 8 years of growth will fall within about 2 m (8 ft.) of the conductor when it reaches maximum sag (80° C or 176° F) in a static position.

Deadends are heavy towers designed for use where the transmission line loads the tower primarily in tension rather than compression. Deadends are used in turning large angles along a line or in bringing a line into a substation.

Easement is a grant of certain rights to use a piece of land, which then becomes a "right-of-way." BPA normally acquires easements for its transmission lines. Easement includes the right to enter the ROW to build, maintain, and repair facilities.

Emergent plants have their bases submerged in water.

Endangered species are those species listed as endangered either by the Federal Government or the State of Washington. Federally-listed Endangered Species are those officially designated by the U.S. Fish and Wildlife Service as being in danger of extinction throughout all or a significant portion of their range. These species receive full protection under the Endangered Species Act. State-listed Endangered Species are those species native to the State of Washington that are seriously threatened with extinction throughout all or a significant portion of their range within the state, as designated in Washington Administrative Code 232-12-014.

Floodplain refers to a portion of a river valley adjacent to the stream channel that is covered with water when the stream overflows its banks during flood stage.

Footings are the supporting base for the transmission towers. They are usually steel assemblies buried in the ground for lattice-steel towers.

Forb is any herbaceous plant that is not a grass or grasslike.

Ford is a travelway across a stream where water depth does not prevent vehicle movement. Ford construction can include grading and stabilizing streambanks at the approaches and adding coarse fill material within the channel to stabilize the roadbed.

GIS signifies Geographic Information System, a computer system that analyzes graphical map data.

Ground wire (overhead) is wire strung from the top of one tower to the next; it shields the line against lightning strikes.

HCP is Habitat Conservation Plan.

Hydrology addresses properties, distribution, and circulation of water.

Hydroperiod is the seasonal occurrence of flooding and/or soil saturation.

Insulators are ceramic or other nonconducting materials used to keep electrical circuits from jumping to ground.

Intermittent refers to periodic water flow in creeks or streams.

Internal drainage refers to streams that are not connected to the ocean by surface waters.

Jurisdictional wetlands are areas that are consistently inundated or saturated by surface or ground water at a frequency and duration sufficient to support a prevalence of vegetation typically adapted for life in saturated soil conditions.

Kilovolt is one thousand volts.

Lattice steel refers to a transmission tower constructed of multiple steel members that are connected together to make up the tower's frame.

Low vegetation area is the area where vegetation is kept below a maximum reliable operation height.

Low-gradient refers to gentle slopes.

LWD is large woody debris, defined as any piece of downed wood larger than 4 in. in diameter and 6 ft. long.

Mitigation is the step(s) taken to lessen the potential environmental effects predicted for each resource impacted by the transmission project. Mitigation may reduce the impact, avoid it completely, or compensate for the impact. Some mitigation, such as adjusting the location of a tower to avoid a special resource, is enacted during the design and location process. Other mitigation, such as reseeding access roads with desirable grasses and avoiding weed proliferation, is taken after construction.

Monitor species are those species for which the State of Washington monitors status and distribution either because they have been listed as State-threatened, endangered or sensitive within the previous 5 years; they require a habitat that has limited availability during at least some portion of their life cycle; they are environmental indicators; or their taxonomy is in question and it is unclear whether they should be included as listed species.

Montane areas refer to those occurring in the biogeographic zone of relatively moist, cool upland slopes below timberline dominated by large coniferous trees.

National Environmental Policy Act (NEPA) requires an environmental impact statement on all major federal actions significantly affecting the quality of the human environment.
(42 U.S.C. 4332 2(2)(C))

Noxious weeds are plants that are injurious to public health, crops, livestock, land, or other property.

Perennial streams and creeks have year-round water flows.

Permeability refers to the capability of various materials to transport liquids.

Pulling site is a staging area for machinery used to string conductors.

Revegetation is reestablishment of vegetation on a disturbed site.

Right-of-way (ROW) is an easement for a certain purpose over the land of another owner, such as a strip of land used for a road, electric transmission line, pipeline, etc.

Riparian habitat is a zone of vegetation that extends from the water's edge landward to the edge of the vegetative canopy. The term is associated with watercourses such as streams, rivers, springs, ponds, lakes, or tidewater.

Sensitive species are those species native to Washington State that are vulnerable or declining and are likely to become endangered or threatened in a significant portion of their range within the state without cooperative management or removal of threats, as defined in Washington Administrative Code 232-12-011.

Seral stage designates a given sere, which is a stage of ecological succession. Phases in the growth and development of plant communities from a disturbance or colonization event to the climax community are characterized as seres.

Silt is a designation referring to individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 mm) to the lower limit of very fine sand (0.05mm).

Sole source aquifer is designated by the U.S. Environmental Protection Agency as an aquifer providing at least half of an area's drinking water.

Substation deadends are towers within the confines of the substation where incoming and outgoing transmission lines end. Deadends are typically the tallest structures in a substation.

Substation is the fenced site that contains the terminal switching and transformation equipment needed at the end of a transmission line.

Survey and manage is a mitigation measure adopted as a standard and guideline within the NFP Record of Decision that is intended to mitigate impacts of land management efforts on species that are closely associated with late-successional or old-growth forests whose long-term persistence is a concern. (U.S. Department of Agriculture, Forest Service, and U.S. Department of Interior, Bureau of Land Management 2000)

Survey protocols are interagency documents describing the survey techniques needed to have a reasonable chance of locating a species when it is present on a site, or needed to make an "equivalent effort" of locating the species when it is present on the site. Survey protocols also identify habitats needing surveys and may identify habitats or circumstances not needing surveys. (U.S. Department of Agriculture, Forest Service, and U.S. Department of Interior, Bureau of Land Management 2000)

Take is to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct (Federal Endangered Species Act, Section 3(18)).

Threatened species are those species listed as threatened either by the Federal Government or the State of Washington. Federally-listed threatened species are those officially designated by the U.S. Fish and Wildlife Service as being in danger of becoming endangered throughout all or a significant portion of their range. These species receive full protection under the Endangered Species Act. State-listed threatened species are those species native to the State of Washington that are likely to become endangered within the foreseeable future throughout all or a significant

portion of their range within the state without cooperative management or removal of threats, as designated in Washington Administrative Code 232-12-011.

Transmission deadend towers are the last transmission line towers on both the incoming and outgoing sides of the substation. These towers are structurally reinforced to reduce conductor tension on substation deadends and provide added reliability to the substation.

Transmission line includes the structures, insulators, conductors, and other equipment used to transmit electrical power from one point to another.

Water bars are smooth, shallow ditches excavated at an angle across a road to decrease water velocity and divert water off and away from the road surface.

Wetlands are areas where the soil experiences anaerobic conditions because of inundation of water during the growing season. Indicators of a wetland include types of plants, soil characteristics, and hydrology of the area.

9.2 Acronyms and Abbreviations

ac. .....acre or acres
ACS.....Aquatic Conservation Strategy
ACSO.....Aquatic Conservation Strategy Objective
BLM.....Bureau of Land Management
BMPs .....best management practices
BPA.....Bonneville Power Administration
CFR.....Code of Federal Regulations
CRW .....Cedar River Watershed
dbh .....diameter at breast height
DPS .....distinct population segment
EFH.....Essential Fish Habitat
EIS.....environmental impact statement
ESA.....Endangered Species Act
ESU.....Evolutionarily Significant Unit
FEIS .....final environmental impact statement
FR.....Federal Register
ft. .....foot or feet
GIS .....Geographic Information System
HCP.....Habitat Conservation Plan
HPA .....Hydraulic Project Approval
in. .....inch or inches
kV.....kilovolt
LWD .....large woody debris
mi. .....mile or miles
MOU .....memorandum of understanding
NEPA .....National Environmental Policy Act
NESC .....National Electrical Safety Code
NMFS.....National Marine Fisheries Service
NPDES.....National Pollutant Discharge Elimination System
OHWM .....Ordinary High Water Mark
PRSC.....Puget Sound Regional Council
RCW .....Revised Code of Washington

RMZ.....Riparian Management Zone
ROD.....Record of Decision
ROW.....right-of-way
SEPA.....State Environmental Policy Act
SPTH.....site potential tree height
SPU.....Seattle Public Utilities
UGA.....Urban Growth Area
USC.....U.S. Code
USFS.....U.S. Forest Service
USFWS.....U.S. Fish and Wildlife Service
USGS.....U.S. Geological Survey
WAC.....Washington Administrative Code
WDFW.....Washington Department of Fish and Wildlife
WDNR.....Washington Department of Natural Resources
WRIA.....Water Resource Inventory Area

Appendix A

Aquatic Resource Notes and Data for Jurisdiction and Salmonid Presence

Table A-1. Aquatic Resource Inventory with Jurisdictional Notes

Drainage Name	Segment	Number	Jurisdiction	Estimated Bank-Full Width (ft.)	Estimated Gradient (%)	Fish-Bearing	WA-DNR Stream Type	King County/ City of Kent Stream Type	USFS Stream Type	Description of Riparian Management Zone (within 100 ft. on either side of drainage)
Unnamed Tributary of Rock Creek	A	S1	King County	3	>20	No	N/A	3	N/A	Overstory of deciduous species with understory of Himalayan blackberry.
Rock Creek, Tributary of Cedar River	A	S2	City of Kent	11	5-10	Yes	N/A	1	N/A	Dominated by deciduous with few conifers.
Jenkins Creek, Tributary of Big Soos Creek	A	S3	City of Covington	16	5-10	Yes	N/A	1	N/A	Dominated by deciduous with few conifers.
Little Soos Creek, Tributary of Big Soos Creek	A	S4	City of Covington	14	5-10	Yes	N/A	2	N/A	Dominated by deciduous with few conifers.
Unnamed Tributary of Little Soos Creek	A	S5	King County	data gap	5-10	Yes	N/A	2	N/A	Dominated by deciduous with few conifers.
Little Soos Creek, Tributary of Big Soos Creek	A	S6	King County	12	5-10	Yes	N/A	2	N/A	Dominated by deciduous with few conifers.
Petersen Creek, Tributary of Cedar River	A	S7	King County	10	<5	Yes	N/A	2	N/A	Dominated by hydrophilic plant species. Small stands of conifers and deciduous species.
Unnamed Tributary of Petersen Creek	A	S8	King County	data gap	5-10	No	N/A	3	N/A	
Unnamed Tributary of Petersen Creek	A	S9	King County	data gap	5-10	No	N/A	3	N/A	
Side Channel of Cedar River	A	S10	King County	3	<5	Yes	N/A	2	N/A	Landscaped lawns dominated by grass species and non-native plants.
Cedar River	A	S11	King County	40	<5	Yes	N/A	1	N/A	Conifers with occasional deciduous species.
Unnamed Tributary to Telephone Creek	BD	S1	USFS/WA-DNR Kittitas County	2	5-10	No	5	N/A	3	Conifers with occasional deciduous species.
Telephone Creek, Tributary to Yakima River	BD	S2	USFS/WA-DNR Kittitas County	6	5-10	Yes	3	N/A	1	Conifers with occasional deciduous species.
Unnamed Tributary to #1212835472728	BD	S3	USFS/WA-DNR Kittitas County	3	5-10	No	5	N/A	3	Conifers with occasional deciduous species.
Unnamed Tributary to #1212835472728	BD	S4	USFS/WA-DNR Kittitas County	2	<5	Yes	3	N/A	1	Dominated by hydrophilic understory with occasional deciduous species.
Unnamed Tributary to #1212835472728	BD	S5	USFS/WA-DNR Kittitas County	2	<5	No	4	N/A	2	Conifers with occasional deciduous species with extensive hydrophilic understory.
Unnamed Tributary to #1212835472728	BD	S6	USFS/WA-DNR Kittitas County	7	5-10	Yes	3	N/A	1	Conifers with occasional deciduous species with extensive hydrophilic understory.
#1212835472728 Tributary to Yakima River	BD	S7	USFS/WA-DNR Kittitas County	22	5-10	Yes	2	N/A	1	Conifers with occasional deciduous species.
Yakima River	BD	S8	USFS/WA-DNR Kittitas County	40+	<5	Yes	1	N/A	1	Sparse conifers with occasional deciduous species.
Unnamed Creek, Tributary to Mosquito Creek	BD	S9	USFS/WA-DNR Kittitas County	6	5-10	Yes	3	N/A	1	Sparse conifers with occasional deciduous species.
Mosquito Creek, Tributary to Yakima River	BD	S10	USFS/WA-DNR Kittitas County	10	5-10	Yes	3	N/A	1	Conifers with occasional deciduous species.
Unnamed Creek, Tributary to BDS9	BD	S11	USFS/WA-DNR Kittitas County	3	<5	No	5	N/A	3	Conifers with occasional deciduous species.
Unnamed Creek, Tributary to BDS9	BD	S12	USFS/WA-DNR Kittitas County	2	<5	No	5	N/A	3	Few conifers with occasional deciduous species. Intersection cleared for road.
Unnamed Creek, Tributary to BDS14	BD	S13	USFS/WA-DNR Kittitas County	3	5-10	No	5	N/A	3	Conifers with occasional deciduous species.

Table A-1. Continued

Drainage Name	Segment	Number	Jurisdiction	Estimated Bank-Full Width (ft.)	Estimated Gradient (%)	Fish-Bearing	WA-DNR Stream Type	King County/ City of Kent Stream Type	USFS Stream Type	Description of Riparian Management Zone (within 100 ft. on either side of drainage)
Unnamed Creek, ? Routing towards Yakima River	BD	S14	USFS/WA-DNR Kittitas County	3	5-10	No	5	N/A	3	Conifers with occasional deciduous species.
Meadow Creek	BD	S15	USFS/WA-DNR Kittitas County	30	5-10	Yes	2	N/A	1	Conifers with occasional deciduous species.
Unnamed Creek, Tributary to Keechelus Lake	BD	S16	USFS/WA-DNR Kittitas County	2	5-10	No	5	N/A	3	Conifers with deciduous species.
Unnamed Creek, Tributary to Keechelus Lake	BD	S17	USFS/WA-DNR Kittitas County	1	>10	No	5	N/A	3	Conifers with deciduous species.
Unnamed Creek, Tributary to Keechelus Lake	BD	S18	USFS/WA-DNR Kittitas County	2	>10	No	5	N/A	3	Conifers with deciduous species.
Unnamed Creek, Tributary to Keechelus Lake	BD	S19	USFS/WA-DNR Kittitas County	2	>10	No	5	N/A	3	Conifers with deciduous species.
Unnamed Creek, Tributary to Keechelus Lake	BD	S20	USFS/WA-DNR Kittitas County	2	>10	No	5	N/A	3	Conifers with deciduous species.
Unnamed Creek, Tributary to Keechelus Lake	BD	S21	USFS/WA-DNR Kittitas County	2	>10	No	5	N/A	3	Conifers with deciduous species.
Unnamed Creek, Tributary to Keechelus Lake	BD	S22	USFS/WA-DNR Kittitas County	1	>10	No	5	N/A	3	Conifers with deciduous species.
Unnamed Creek, Tributary to Keechelus Lake	BD	S23	USFS/WA-DNR Kittitas County	1	>10	No	5	N/A	3	Conifers with deciduous species.
Unnamed Creek, Tributary to Keechelus Lake	BD	S24	USFS/WA-DNR Kittitas County	4	>10	No	4	N/A	2	Conifers with deciduous species dominant.
Unnamed Creek, Tributary to Keechelus Lake	BD	S25	USFS/WA-DNR Kittitas County	4	>10	No	4	N/A	2	Deciduous species and occasional conifer. B alignment partially cleared.
Roaring Creek	BD	S26	USFS/WA-DNR Kittitas County	18	>10	Yes	3	N/A	1	Widely spaced conifer stand with occasional deciduous species.
Unnamed Creek, Tributary to Keechelus Lake	BD	S27	USFS/WA-DNR Kittitas County	data gap	>10	No	4	N/A	2	Conifers with occasional deciduous species.
Cold Creek	BD	S28	USFS/WA-DNR Kittitas County	data gap	>10	Yes	3	N/A	1	Conifers with occasional deciduous species.
Mill Creek	BD	S29	USFS/WA-DNR Kittitas County	20	>10	Yes	3	N/A	1	Conifers with occasional deciduous species.
Rockdale Creek[a]	BD	S30	USFS/WA-DNR King County	data gap	>10	Yes	3	N/A	1	Vegetation indiscernible from aerial photos.
Rockdale Creek[a]	BD	S31	USFS/WA-DNR King County	data gap	>10	Yes	3	N/A	1	Partially cleared. Vegetation indiscernible from aerial photos.
Olallie Creek[a]	BD	S32	King County	data gap	>10	Yes	N/A	2	N/A	Vegetation indiscernible from aerial photos.
Humpback Creek[a]	BD	S33	USFS/WA-DNR King County	20+	>10	Yes	2	N/A	1	Conifers with occasional deciduous species.
Unnamed Creek, Tributary to South Fork Snoqualmie River[a]	BD	S34	USFS/WA-DNR King County	2	>10	No	5	N/A	3	Conifers with deciduous understory.
Unnamed Creek, Tributary to South Fork Snoqualmie River[a]	BD	S35	USFS/WA-DNR King County	4	>10	No	4	N/A	2	Conifers with deciduous understory.

Table A-1. Continued

Drainage Name	Segment	Number	Jurisdiction	Estimated Bank-Full Width (ft.)	Estimated Gradient (%)	Fish-Bearing	WA-DNR Stream Type	King County/ City of Kent Stream Type	USFS Stream Type	Description of Riparian Management Zone (within 100 ft. on either side of drainage)
Unnamed Creek, Tributary to South Fork Snoqualmie River[a]	BD	S36	USFS/WA-DNR King County	2	>10	No	5	N/A	3	Conifers with deciduous understory.
Unnamed Creek, Tributary to South Fork Snoqualmie River[a]	BD	S37	USFS/WA-DNR King County	2	>10	No	5	N/A	3	Conifers with deciduous understory.
Unnamed Creek, Tributary to South Fork Snoqualmie River[a]	BD	S38	USFS/WA-DNR King County	2	>10	No	5	N/A	3	Conifers with deciduous understory.
Unnamed Creek, Tributary to South Fork Snoqualmie River[a]	BD	S39	USFS/WA-DNR King County	2	>10	No	5	N/A	3	Conifers with deciduous understory.
Unnamed Creek, Tributary to South Fork Snoqualmie River[a]	BD	S40	USFS/WA-DNR King County	4	>10	No	4	N/A	2	Conifers with deciduous understory.
Unnamed Creek, Tributary to South Fork Snoqualmie River[a]	BD	S41	USFS/WA-DNR King County	3	>10	No	4	N/A	2	Conifers with occasional deciduous species and deciduous understory.
Unnamed Creek, Tributary to South Fork Snoqualmie River[a]	BD	S42	USFS/WA-DNR King County	2	>10	No	5	N/A	3	Conifers with occasional deciduous species and deciduous understory.
Unnamed Creek, Tributary to South Fork Snoqualmie River[a]	BD	S43	USFS/WA-DNR King County	2	>10	No	5	N/A	3	Conifers with occasional deciduous species and deciduous understory.
Unnamed Creek, Tributary to South Fork Snoqualmie River[a]	BD	S44	USFS/WA-DNR King County	6	>10	No	4	N/A	2	Conifers with occasional deciduous species and deciduous understory.
Unnamed Creek, Tributary to South Fork Snoqualmie River[a]	BD	S45	USFS/WA-DNR King County	2	>10	No	5	N/A	3	Conifers with occasional deciduous species and deciduous understory.
Unnamed Creek, Tributary to South Fork Snoqualmie River[a]	BD	S46	USFS/WA-DNR King County	2	>10	No	5	N/A	3	Conifers with occasional deciduous species and deciduous understory.
Unnamed Creek, Tributary to South Fork Snoqualmie River[a]	BD	S47	USFS/WA-DNR King County	2	>10	No	5	N/A	3	Deciduous species and occasional conifer. Deciduous understory.
Unnamed Creek, Tributary to South Fork Snoqualmie River[a]	BD	S48	USFS/WA-DNR King County	2	>10	No	5	N/A	3	Conifers with deciduous understory.
Hansen Creek[a]	BD	S49	USFS/WA-DNR King County	18	>10	Yes	3	N/A	1	Conifers dominant with deciduous understory.
Carter Creek[a]	BD	S50	USFS/WA-DNR King County	22	>10	Yes	2	N/A	1	Deciduous species and occasional conifer.
Unnamed Creek, Tributary to Carter Creek[a]	BD	S51	USFS/WA-DNR King County	4	>10	No	4	N/A	2	Deciduous species and occasional conifer.
Unnamed Creek, Tributary to South Fork Snoqualmie River[a]	BD	S52	USFS/WA-DNR King County	2	>10	No	5	N/A	3	Deciduous species and occasional conifer.
Unnamed Creek, Tributary to South Fork Snoqualmie River[a]	BD	S53	USFS/WA-DNR King County	4	>10	No	4	N/A	2	Deciduous species and occasional conifer.
Unnamed Creek, Tributary to South Fork Snoqualmie River[a]	BD	S54	USFS/WA-DNR King County	2	>10	No	5	N/A	3	Deciduous species and occasional conifer.
Unnamed Creek, Tributary to South Fork Snoqualmie River[a]	BD	S55	USFS/WA-DNR King County	1	>10	No	5	N/A	3	Deciduous species and occasional conifer.
Unnamed Creek, Tributary to South Fork Snoqualmie River[a]	BD	S56	USFS/WA-DNR King County	2	>10	No	5	N/A	3	Deciduous species and occasional conifer.
Unnamed Creek, Tributary to South Fork Snoqualmie River[a]	BD	S57	USFS/WA-DNR King County	4	>10	No	4	N/A	2	Deciduous species and occasional conifer.

Table A-1. Continued

Drainage Name	Segment	Number	Jurisdiction	Estimated Bank-Full Width (ft.)	Estimated Gradient (%)	Fish-Bearing	WA-DNR Stream Type	King County/ City of Kent Stream Type	USFS Stream Type	Description of Riparian Management Zone (within 100 ft. on either side of drainage)
Harris Creek[a]	BD	S58	USFS/WA-DNR King County	18	>10	Yes	3	N/A	1	Deciduous species and occasional conifer.
Rock Creek[a]	BD	S59	USFS/WA-DNR King County	24	>10	Yes	2	N/A	1	Conifers dominant with occasional deciduous species.
Alice Creek[a]	BD	S60	King County	data gap	>10	Yes	N/A	2	N/A	Vegetation indiscernible from aerial photos.
Unnamed Creek, Tributary to South Fork Snoqualmie River[a]	BD	S61	King County	2	>10	No	N/A	3	N/A	Conifers with occasional deciduous species.
Unnamed Creek, Tributary to South Fork Snoqualmie River[a]	BD	S62	King County	2	>10	No	N/A	3	N/A	Conifers with occasional deciduous species.
Wood Creek[a]	BD	S63	USFS/WA-DNR King County	4	>10	No	4	N/A	2	Conifers with deciduous species.
Unnamed Creek, Tributary to Wood Creek[a]	BD	S64	USFS/WA-DNR King County	2	>10	No	5	N/A	3	Conifers with deciduous species.
Mine Creek[a]	BD	S65	King County	16	<5	Yes	N/A	2	N/A	Deciduous dominant. Partially cleared for Interstate-90 and access roads.
South Fork Snoqualmie River[a]	BD	S66	King County	40+	<5	Yes	N/A	1	N/A	Conifers with occasional deciduous species. Mostly clear due to channel migration.
Unnamed Creek, Tributary to South Fork Snoqualmie River[a]	BD	S67	King County	6	5-10	Yes	N/A	2	N/A	Conifers with occasional deciduous species.
Unnamed Creek, Tributary to South Fork Snoqualmie River[a]	BD	S68	King County	data gap	>10	Yes	N/A	2	N/A	Conifers with occasional deciduous species with extensive hydrophilic understory.
Unnamed Creek, Tributary to South Fork Snoqualmie River[a]	BD	S69	King County	7	<5	Yes	N/A	2	N/A	Deciduous species dominant.
South Fork Snoqualmie River[a]	BD	S70	King County	40+	<5	Yes	N/A	1	N/A	Deciduous species dominant.
Boxley Creek[a]	BD	S71	King County	data gap	<5	Yes	N/A	1	N/A	Deciduous species dominant.
Unnamed Creek, Tributary to South Fork Snoqualmie River[a]	BD	S72	King County	4	5-10	Yes	N/A	2	N/A	Conifers with occasional deciduous species with extensive hydrophilic vegetation.
Unnamed Creek, Tributary to South Fork Snoqualmie River[a]	BD	S73	King County	4	5-10	Yes	N/A	2	N/A	Conifers with deciduous species and landscaped residential yards.
Unnamed Creek, Tributary to South Fork Snoqualmie River[a]	BD	S74	King County	14	5-10	Yes	N/A	2	N/A	Conifers with deciduous species.
Unnamed Creek, Tributary to BDS74[a]	BD	S75	King County	data gap	5-10	Yes	N/A	2	N/A	Conifers with deciduous species and landscaped residential yards.
Unnamed Creek, Tributary to South Fork Snoqualmie River[a]	BD	S76	King County	2	>10	No	N/A	3	N/A	Conifers with deciduous species.
Unnamed Creek, Tributary to South Fork Snoqualmie River[a]	BD	S77	King County	4	>10	No	N/A	2	N/A	Conifers with occasional deciduous species. Understory choked with non-native vegetation.
Unnamed Creek, Tributary to South Fork Snoqualmie River[a]	BD	S78	King County	5	>10	No	N/A	2	N/A	Conifers with deciduous species and landscaped residential yards.
Unnamed Creek, Tributary to BDS78[a]	BD	S79	King County	4	>10	No	N/A	2	N/A	Deciduous species dominant.
Unnamed Creek, Tributary to BDS78[a]	BD	S80	King County	2	>10	No	N/A	3	N/A	Deciduous species dominant.
Unnamed Creek, Tributary to BDS78[a]	BD	S81	King County	2	>10	No	N/A	3	N/A	Deciduous species dominant.
Unnamed Creek, Tributary to BDS78[a]	BD	S82	King County	5	>10	No	N/A	2	N/A	Deciduous species dominant.

Table A-1. Continued

Drainage Name	Segment	Number	Jurisdiction	Estimated Bank-Full Width (ft.)	Estimated Gradient (%)	Fish-Bearing	WA-DNR Stream Type	King County/ City of Kent Stream Type	USFS Stream Type	Description of Riparian Management Zone (within 100 ft. on either side of drainage)
Unnamed Creek, Tributary to South Fork Snoqualmie River[a]	BD	S83	King County	2	>10	No	N/A	3	N/A	Conifers with occasional deciduous species. Understory choked with non-native vegetation.
Unnamed Creek, Tributary to South Fork Snoqualmie River[a]	BD	S84	King County	2	>10	No	N/A	3	N/A	Sparse conifers and deciduous species. Mainly understory vegetation.
Unnamed Creek, Tributary to South Fork Snoqualmie River[a]	BD	S85	King County	data gap	>10	No	N/A	3	N/A	Sparse conifers and deciduous species. Mainly understory vegetation.
Unnamed Creek, Tributary to BDS85[a]	BD	S86	King County	2	>10	No	N/A	3	N/A	Sparse conifers and deciduous species. Mainly understory vegetation.
Unnamed Creek, Tributary to BDS85[a]	BD	S87	King County	1	>10	No	N/A	3	N/A	Sparse conifers and deciduous species. Mainly understory vegetation.
Unnamed Creek, Tributary to South Fork Snoqualmie River[a]	BD	S88	King County	data gap	>10	No	N/A	3	N/A	Sparse conifers and deciduous species. Mainly understory vegetation.
Unnamed Creek, Tributary to South Fork Snoqualmie River[a]	BD	S89	King County	data gap	>10	Yes	N/A	2	N/A	Sparse conifers and deciduous species. Mainly understory vegetation.
Unnamed Creek, Tributary to South Fork Snoqualmie River[a]	BD	S90	King County	4	5-10	Yes	N/A	2	N/A	Sparse conifers and deciduous species. Mainly understory vegetation.
Unnamed Creek, Tributary to Kimball Creek[a]	BD	S91	King County	1	>10	No	N/A	3	N/A	Sparse conifers and deciduous species. Mainly understory vegetation.
Unnamed Creek, Tributary to Coal Creek[a]	BD	S92	King County	4	>10	No	N/A	2	N/A	Sparse conifers and deciduous species. Mainly understory vegetation.
Unnamed Creek, Tributary to Lake Creek	BD	S93	King County	3	>10	No	N/A	2	N/A	Partially cleared. Conifers with occasional deciduous species.
Unnamed Creek, Tributary to Lake Creek	BD	S94	King County	4	5-10	Yes	N/A	2	N/A	Mostly cleared for substation facility. Conifers with occasional deciduous species.
Rock Creek, Tributary to Cedar River	C	S1	King County	2	<4	No	N/A	3	N/A	Conifers with occasional deciduous species.
Rock Creek, Tributary to Cedar River	C	S2	King County	2	<4	No	N/A	3	N/A	Dominated by hydrophilic plant species. Small conifer stands present.
Cedar River	C	S3	King County	40	<4	Yes	N/A	1	N/A	Conifers with occasional deciduous species. Northern buffer partially cleared for 10-ft.-wide nature trail.
Walsh Lake Diversion, Tributary to Cedar River	C	S4	King County	8	<4	Yes	N/A	2	N/A	Conifers with occasional deciduous species. Understory overgrown with non-native plant species.
Unknown Tributary to Cedar River	C	S5	King County	1	<4	No	N/A	3	N/A	Dominated by hydrophilic plant species. Some conifers and a few deciduous species present.
Jem Creek, Tributary to Cedar River	C	S6	King County	1	<4	No	N/A	3	N/A	Dominated by native willow species and hydrophilic plant species.
Carey Creek, Tributary to Issaquah Creek	C	S7	King County	12	<4	Yes	N/A	2	N/A	Conifers with occasional deciduous species (most likely alder).
Holder Creek, Tributary to Issaquah Creek	C	S8	King County	25	<4	Yes	N/A	2	N/A	Conifers with occasional deciduous species (most likely alder).

[a] upstream of Snoqualmie Falls

Table A-2. Salmonid Status in Fish-Bearing Waters

Drainage Name	Segment	Number	Jurisdiction	WRIA	Potential Resident	Documented Resident	Potential Anadromous	Documented Anadromous	References[a]	Description of Riparian Management Zone (within 100 feet on either side of drainage)
Rock Creek, Tributary of Cedar River	A	S2	City of Kent	8	Rainbow	Cutthroat		Coho Chinook Sockeye Steelhead	Kerwin 2001 SN2002	Dominated by deciduous with few conifers.
Jenkins Creek, Tributary of Big Soos Creek	A	S3	City of Covington	9	Rainbow	Cutthroat		Coho Steelhead	K&N 2000 SN 2002	Dominated by deciduous with few conifers.
Little Soos Creek, Tributary of Big Soos Creek	A	S4	City of Covington	9	Rainbow	Cutthroat		Coho Steelhead	K&N 2000 SN 2002	Dominated by deciduous with few conifers.
Unnamed Tributary of Little Soos Creek	A	S5	King County	9	Rainbow Cutthroat			Coho	K&N 2000 SN 2002	Dominated by deciduous with few conifers.
Little Soos Creek, Tributary of Big Soos Creek	A	S6	King County	9	Rainbow	Cutthroat		Coho Steelhead	K&N 2000 SN 2002	Dominated by deciduous with few conifers.
Petersen Creek, Tributary of Cedar River	A	S7	King County	8	Rainbow	Cutthroat		Coho Chinook Sockeye	Kerwin 2001 SN2002	Dominated by hydrophilic plant species. Small stands of conifers and deciduous species.
Side Channel of Cedar River	A	S10	King County	8	Rainbow	Cutthroat		Coho Chinook Sockeye Steelhead	Kerwin 2001 SN2002	Landscaped lawns dominated by grass species and non-native plants.
Cedar River	A	S11	King County	8	Rainbow	Cutthroat		Coho Chinook Sockeye Steelhead	Kerwin 2001 SN2002	Conifers with occasional deciduous species.
Telephone Creek, Tributary to Yakima River	BD	S2	USFS/WA-DNR Kittitas County	39		Rainbow Cutthroat	Steelhead Bull trout		PC 1997	Conifers with occasional deciduous species.
Unnamed Tributary to #1212835472728	BD	S4	USFS/WA-DNR Kittitas County	39	Rainbow Cutthroat		Steelhead Bull trout			Dominated by hydrophilic understory with occasional deciduous species.
Unnamed Tributary to #1212835472728	BD	S6	USFS/WA-DNR Kittitas County	39	Rainbow Cutthroat		Steelhead Bull trout			Conifers with occasional deciduous species with extensive hydrophilic understory.
#1212835472728. Tributary to Yakima River	BD	S7	USFS/WA-DNR Kittitas County	39		Rainbow Cutthroat		Chinook Steelhead Bull trout	SN 2002 PC 1997	Conifers with occasional deciduous species.
Yakima River	BD	S8	USFS/WA-DNR Kittitas County	39		Rainbow Cutthroat		Chinook Steelhead Bull trout	SN 2002 PC 1997	Sparse conifers with occasional deciduous species.
Unnamed Creek, Tributary to Mosquito Creek	BD	S9	USFS/WA-DNR Kittitas County	39		Rainbow Cutthroat	Steelhead Bull trout		PC 1997	Sparse conifers with occasional deciduous species.
Mosquito Creek, Tributary to Yakima River	BD	S10	USFS/WA-DNR Kittitas County	39		Rainbow Cutthroat	Steelhead Bull trout		PC 1997	Conifers with occasional deciduous species.
Meadow Creek	BD	S15	USFS/WA-DNR Kittitas County	39		Rainbow Cutthroat	Steelhead Bull trout		PC 1997	Conifers with occasional deciduous species.
Roaring Creek	BD	S26	USFS/WA-DNR Kittitas County	39		Cutthroat	Steelhead Bull trout		PC 1997	Widely spaced conifer stand with occasional deciduous species.
Cold Creek	BD	S28	USFS/WA-DNR Kittitas County	39		Rainbow Cutthroat	Steelhead Bull trout		PC 1997	Conifers with occasional deciduous species.
Mill Creek	BD	S29	USFS/WA-DNR Kittitas County	39		Rainbow Cutthroat	Steelhead Bull trout		PC 1997	Conifers with occasional deciduous species.
Rockdale Creek[b]	BD	S30	USFS/WA-DNR King County	7		Rainbow	N/A	N/A	USFS 1995	Vegetation indiscernible from aerial photos.

Table A-2. Continued

Drainage Name	Segment	Number	Jurisdiction	WRIA	Potential Resident	Documented Resident	Potential Anadromous	Documented Anadromous	References[a]	Description of Riparian Management Zone (within 100 feet on either side of drainage)
Rockdale Creek[b]	BD	S31	USFS/WA-DNR King County	7		Rainbow	N/A	N/A	USFS 1995	Partially cleared. Vegetation indiscernible from aerial photos.
Olallie Creek[b]	BD	S32	King County	7		Rainbow	N/A	N/A	USFS 1995	Vegetation indiscernible from aerial photos.
Humpback Creek[b]	BD	S33	USFS/WA-DNR King County	7	Rainbow Cutthroat		N/A	N/A		Conifers with occasional deciduous species.
Hansen Creek[b]	BD	S49	USFS/WA-DNR King County	7	Rainbow Cutthroat		N/A	N/A		Conifers dominant with deciduous understory.
Carter Creek[b]	BD	S50	USFS/WA-DNR King County	7		Rainbow Cutthroat	N/A	N/A	USFS 1995 WDF 1975	Deciduous species and occasional conifer.
Harris Creek[b]	BD	S58	USFS/WA-DNR King County	7			N/A	N/A		Deciduous species and occasional conifer.
Rock Creek[b]	BD	S59	USFS/WA-DNR King County	7	Rainbow Cutthroat		N/A	N/A		Conifers dominant with occasional deciduous species.
Alice Creek[b]	BD	S60	King County	7		Rainbow Cutthroat	N/A	N/A	USFS 1995	Vegetation indiscernible from aerial photos.
Mine Creek[b]	BD	S65	King County	7		Rainbow	N/A	N/A	USFS 1995	Deciduous dominant. Partially cleared for Interstate 90 and access roads.
South Fork Snoqualmie River[b]	BD	S66	King County	7		Eastern Brook Rainbow Cutthroat	N/A	N/A	USFS 1995 WDF 1975	Conifers with occasional deciduous species. Mostly clear due to channel migration.
Unnamed Creek, Tributary to South Fork Snoqualmie River[b]	BD	S67	King County	7	Rainbow Cutthroat		N/A	N/A		Conifers with occasional deciduous species.
Unnamed Creek, Tributary to South Fork Snoqualmie River[b]	BD	S68	King County	7	Rainbow Cutthroat		N/A	N/A		Conifers with occasional deciduous species with extensive hydrophilic understory.
Unnamed Creek, Tributary to South Fork Snoqualmie River[b]	BD	S69	King County	7	Rainbow Cutthroat		N/A	N/A		Deciduous species dominant.
South Fork Snoqualmie River[b]	BD	S70	King County	7		Eastern Brook Rainbow Cutthroat	N/A	N/A	USFS 1995 WDF 1975	Deciduous species dominant.
Boxley Creek[b]	BD	S71	King County	7		Eastern Brook Rainbow Cutthroat	N/A	N/A	USFS 1995 WDF 1975	Deciduous species dominant.
Unnamed Creek, Tributary to South Fork Snoqualmie River[b]	BD	S72	King County	7	Rainbow Cutthroat		N/A	N/A		Conifers with occasional deciduous species with extensive hydrophilic vegetation.
Unnamed Creek, Tributary to South Fork Snoqualmie River[b]	BD	S73	King County	7	Rainbow Cutthroat		N/A	N/A		Conifers with deciduous species and landscaped residential yards.
Unnamed Creek, Tributary to South Fork Snoqualmie River[b]	BD	S74	King County	7	Rainbow Cutthroat		N/A	N/A		Conifers with deciduous species.
Unnamed Creek, Tributary to BDS74[b]	BD	S75	King County	7	Rainbow Cutthroat		N/A	N/A		Conifers with deciduous species and landscaped residential yards.
Unnamed Creek, Tributary to South Fork Snoqualmie River[b]	BD	S89	King County	7	Rainbow Cutthroat		N/A	N/A		Sparse conifers and deciduous species. Mainly understory vegetation.
Unnamed Creek, Tributary to South Fork Snoqualmie River[b]	BD	S90	King County	7	Rainbow Cutthroat		N/A	N/A		Sparse conifers and deciduous species. Mainly understory vegetation.
Unnamed Creek, Tributary to Lake Creek	BD	S94	King County	8	Cutthroat				Kerwin 2001	Mostly cleared for substation facility. Conifers with occasional deciduous species.
Cedar River	C	S3	King County	8	Rainbow	Cutthroat		Coho Chinook Sockeye Steelhead	Kerwin 2001 SN2002	Conifers with occasional deciduous species. Northern buffer partially cleared for 10-ft.-wide nature trail.

Table A-2. Continued

Drainage Name	Segment	Number	Jurisdiction	WRIA	Potential Resident	Documented Resident	Potential Anadromous	Documented Anadromous	References[a]	Description of Riparian Management Zone (within 100 feet on either side of drainage)
Walsh Lake Diversion, Tributary to Cedar River	C	S4	King County	8	Rainbow	Cutthroat		Coho Steelhead	Kerwin 2001 SN2002	Conifers with occasional deciduous species. Understory overgrown with non-native plant species.
Carey Creek, Tributary to Issaquah Creek	C	S7	King County	8	Rainbow	Cutthroat		Coho Steelhead	Kerwin 2001 SN2002	Conifers with occasional deciduous species (most likely alder).
Holder Creek, Tributary to Issaquah Creek	C	S8	King County	8	Rainbow	Cutthroat		Coho	Kerwin 2001 SN2002	Conifers with occasional deciduous species (most likely alder).

[a] Reference abbreviations:
Kerwin 2001 = Kerwin, J., 2001. Salmon and Steelhead Habitat Limiting Factors Report for the Cedar – Sammamish Basin (Water Resource Inventory Area 8). Washington Conservation Commission. Olympia, WA.
K&N 2000 = Kerwin, John and Nelson, Tom S. (Eds.). December 2000. Habitat Limiting Factors and Reconnaissance Assessment Report, Green/Duwamish and Central Puget Sound Watersheds (WRIA 9 and Vashon Island). Washington Conservation Commission and the King County Department of Natural Resources.
PC 1997 = Plum Creek. 1997. Keechelus Lake - Mosquito Creek Watershed Analysis.
SN2000 = www.streamnet.org, data accessed in June 2002.
WDF 1975 = Washington Department of Fisheries. 1975. A Catalog of Washington Stream and Salmon Utilization. Volume 1, Puget Sound.
USFS 1995 = USDA Forest Service, Pacific Northwest Region. 1995. South Fork Snoqualmie Watershed Analysis.
[b] upstream of Snoqualmie Falls

Appendix O Final Supplemental Wildlife Technical Report

Final Supplemental Wildlife Technical Report

Bonneville Power Administration
Kangley-Echo Lake Transmission Line Project

Prepared for:

Bonneville Power Administration
905 NE 11th Avenue
Portland, Oregon 97208-3621

Prepared by:

Jones & Stokes
11820 Northup Way, Suite E300
Bellevue, Washington 98005-1946

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1.0 Executive Summary

This report describes the existing conditions and potential impacts to wildlife from the proposed Bonneville Power Administration (BPA) Kangley-Echo Lake Transmission Line Project. This report serves as the primary basis for the wildlife discussion in the National Environmental Policy Act (NEPA) Supplemental Draft Environmental Impact Statement (SDEIS) prepared for the project.

1.1 Alternatives

This Technical Report presents the preferred alternative (Alternative 1) and four additional action alternatives for constructing a new 500-kilovolt (kV) electrical transmission line intended to increase the capacity and reliability of energy provided to the Seattle metropolitan area. This increased capacity and reliability would reduce the potential for rolling brownouts or blackouts that could transpire by the winter of 2002 to 2003 if severe winter weather were to cause inordinate power demand and a simultaneous outage were to occur on one of the existing transmission lines in the area. Each alternative as shown in Figure 1 is described below in Section 1.1.2.

1.1.1 Construction Methods

BPA would construct all of the action alternatives using the existing practices described below for building transmission lines and substations. BPA would first obtain from landowners any additional easements for right-of-way (ROW) for the transmission line or access roads that would be needed. BPA would then build or improve access roads as necessary, clear vegetation in the ROW, and construct the required towers. BPA typically uses existing, cleared staging areas for storage and assembly of materials or structures.

After the structures are in place and conductors are strung between the structures, BPA would restore all disturbed areas.

The following sections describe in greater detail the sequential steps that BPA typically takes to construct a transmission line.

1.1.1.1 Right-of-Way Requirements

BPA would obtain easements from landowners for the transmission line ROW, and easements for access roads outside of the transmission line ROW easement. The easements give BPA the right to construct, operate, and maintain the line and access roads. A 150-foot (ft.) ROW width is assumed for the proposed 500-kV line.

Fee title to the land comprising the easement generally remains with the owner, subject to the provisions of the easement. The easement prohibits structures, tall trees, storing of flammable materials, and other activities that could be hazardous to people or endanger the transmission line. Activities that do not interfere with the transmission line or endanger people are usually not restricted.

Rights (usually easements) for new access roads that are outside the transmission line ROW would be acquired from property owners, as necessary. A 50-ft. ROW easement generally would be acquired for the new access roads, which are typically constructed to a roadbed width about

16 ft. wide. A 20-ft-wide easement would be purchased for the use of any existing access roads that are needed.

1.1.1.2 Clearing

The height of vegetation within the ROW would be restricted to provide safe and reliable operation of the line. All tall growing vegetation would be cleared within the transmission line ROW. Some trees outside of the ROW would also be cleared to prevent unstable or undesirable trees from falling onto the lines. These trees are referred to as "danger trees." A clearing advisory would be generated using ground information from cross section data. This clearing advisory would specify a safe vegetation height along and at varying distances from the line. The amount of vegetation removed would be based on this clearing advisory and local knowledge of regional conditions such as weather patterns, storm frequency and severity, general tree health, and soils. Other factors that influence the amount of clearing along the line are the line voltage; vegetation species, height, and growth rates; ground slope; conductor elevation above the ground; and clearance distance required between the conductors and other objects.

Merchantable timber purchased from private owners would be marketed and non-merchantable timber would be either lopped and scattered, piled, and/or chipped and left onsite, or would be taken offsite. Non-merchantable timber may or may not be burned because of air quality constraints. Contractors would be required to use brush blades that leave low-growing vegetation in place instead of dirt blades on bulldozers for clearing. Other specialized brushing/mulching equipment may also be required. Additional best management practices (BMPs) for timberland would also be used. Timber, either merchantable or non-merchantable, cut on National Forest lands would be disposed of according to Forest Service guidance.

At the new tower sites, all trees and snags would be felled and stumps over 22 inches (in.) would be removed, including their root systems. The site would be graded to provide a relatively level work surface. The total amount of clearing required for this project is presently unknown.

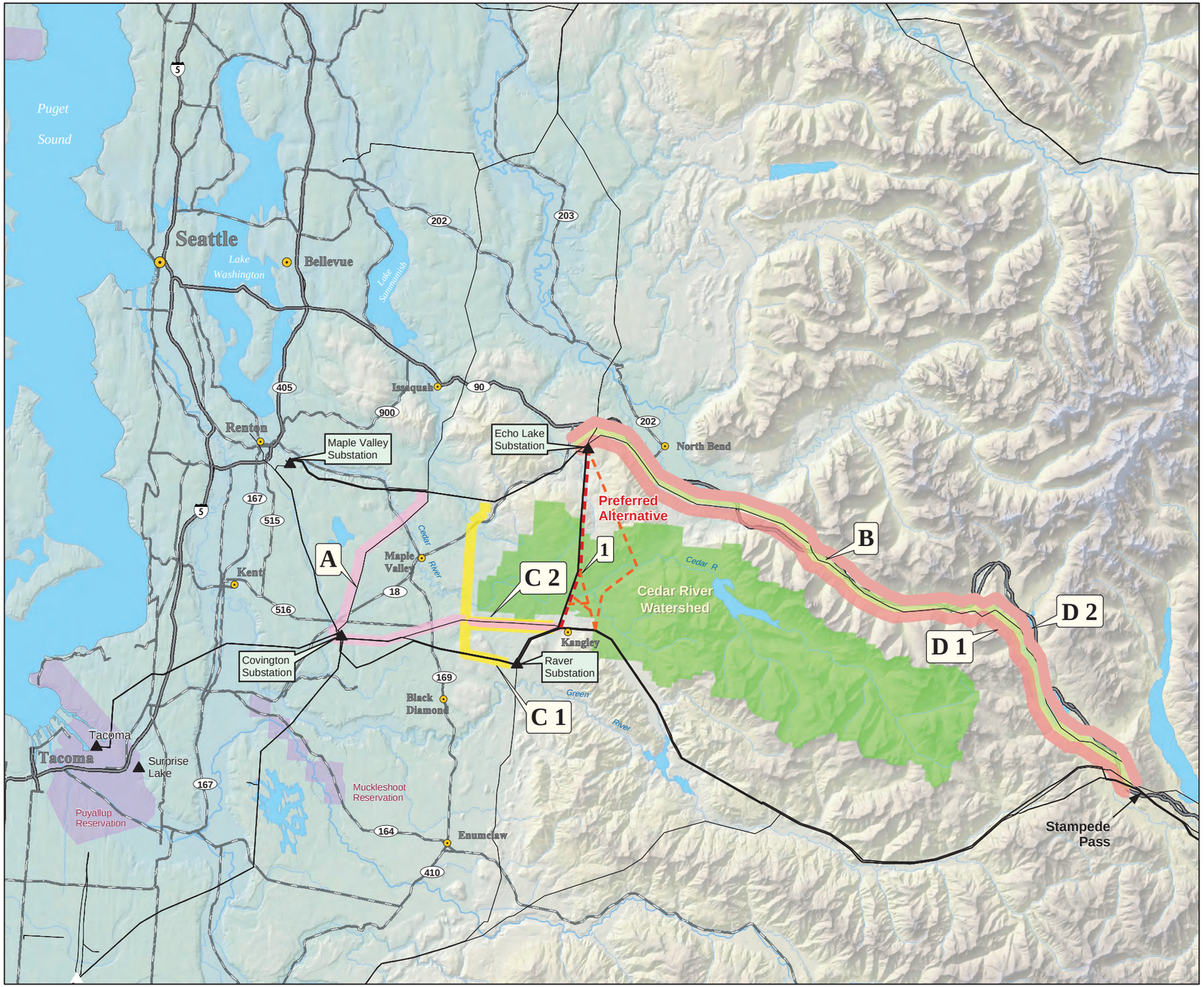
Additional land would be cleared for roads that are needed off the ROW and for roads determined to be in poor condition and requiring upgrading by BPA.

1.1.1.3 Access Road Construction and Improvement

An access road system within and outside of the ROW would be used to construct and maintain the new line. Access roads would be 16 ft. wide, with additional road widths of up to 20 ft. for curves. Existing access roads may also need improvement. Roads generally would be surfaced with gravel, and appropriately designed for drainage and erosion control. The access roads would generally have grades of 6% or less for erodible soils and 10% or less for resistant soils. The maximum grades would be 15% for trunk roads and 18% for spur roads. No permanent access road construction would be allowed in cultivated or fallow fields.

Clearing and construction activities for new access roads would disturb an area about 20 ft. wide, depending on terrain. New roads would be constructed within the ROW wherever possible, but where conditions dictate, roads would be constructed and used outside of the ROW. Construction of new roads is recommended only to access new towers or to avoid greater natural resource impacts.

Dips, culverts, and waterbars would be installed within the roadbed to provide drainage. Fences, gates, cattle guards, and additional rock would be added to access roads as necessary.



ADDITIONAL ALTERNATIVES to be CONSIDERED

Kangley - Echo Lake Transmission Line Project

Legend

- Existing BPA Transmission Lines
- Preferred Alternative
- ▲ BPA Substations

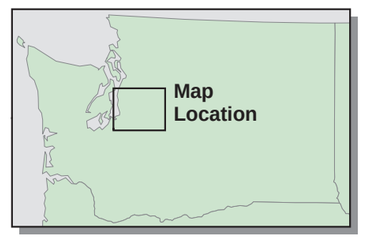
Alternatives

A Construct New Single-Circuit 500-kV Line from tap near Kangley to Covington Substation.
Rebuild Covington - Maple Valley 230-kV to Double-Circuit 500-kV

B Rebuild Portion of Rocky Reach-Maple Valley 345-kV to Double-Circuit 500-kV from East of Stampede Pass to Echo Lake Substation

C Construct New Single-Circuit 500-kV Line West of the Cedar River Watershed to the Echo Lake - Maple Valley Lines

D Construct New Single-Circuit 500-kV Line from East of Stampede Pass Adjacent to Rocky Reach-Maple Valley Line



N

0 3 6 9 12

Miles

May 10, 2002

Source: Bonneville Power Administration 2002.

0P005.00 016 (8/02)

Jones & Stokes

Figure 1
Location Map and Proposed Transmission Line Alternatives

Where temporary roads are used, any disturbed ground would be repaired and, where land use permits, the road would be reseeded with grass or other appropriate seed mixtures. After construction, access roads would be used for line maintenance. Where ground must be disturbed for maintenance activities, the roadbed would be repaired and reseeded as necessary. Recreational use of the roads will be determined by adjacent land management regulations.

The amount of new roads required for this project would vary depending on the alternative chosen and the ability of BPA to acquire rights on existing roads in the area.

1.1.1.4 Storage, Assembly, and Refueling Areas

Construction contractors usually establish storage areas near the transmission line where they can stockpile tower steel, conductor spools, and other construction materials. These areas would be accessible from major highways. Structural steel would be delivered in pieces on flatbed trucks and would be assembled either on or offsite. A mobile crane may be needed to handle the bundles. If the terrain were too steep at the actual tower site, general assembly yards would be used to erect the tower in pieces. The structure would then be transported to the tower site by truck or helicopter. Because trucks and helicopters need to refuel often, these construction areas may also be used for refueling.

1.1.1.5 Tower Site Preparation

Site preparation begins with removing all vegetation from a tower site. In areas of uneven topography, the site would be graded to provide a level work area. An average area of 30,000 square feet (150 by 200 ft.) could be disturbed at each tower site. Additional areas that could be disturbed include the site where the conductor is strung and pulled. These disturbances could be as large as a 370-ft. radius from the tower center.

Bulldozers would be used to clear and construct any new access roads to the transmission line towers and any new tower site landings. Manual methods, including chainsaws and brush hogs, would be used to clear the new ROW. BMPs would be used during clearing and construction to reduce impacts.

In addition to clearing the ROW for the transmission line towers, construction crews would remove selected trees in a 50- to 60-ft.-wide area on each side of the ROW. This additional clearing would be done to reduce the possibility of unstable trees falling on the new transmission line. Some trees newly exposed to the wind would be expected to fall after the initial clearing process because they have not developed the root structure to remain standing once they become more fully exposed to strong winds.

1.1.1.6 Towers and Tower Construction

Steel lattice towers would be erected to support the transmission line conductors. The height of each tower would vary by location and surrounding landforms. Single circuit towers would average 135 ft. high and double circuit towers would average 180 ft. high. The towers would be spaced about 1,100 to 1,200 ft. apart.

Most towers used on the proposed line would be “tangent” or “suspension” towers. This type of tower is designed to support conductors strung along a virtually straight line with only small turns or angles. “Deadend” towers would also be used on a limited basis where stresses on the transmission line conductors would have to be equalized because of changes in direction, because

of the need to support an excessively long span, or where a span crossing is needed for extremely steep or rugged terrain or a river. Deadend towers use more insulators and heavier steel than tangent or suspension towers, thus making them more visible. Deadend towers also are more costly to build than suspension towers.

The towers would be constructed from the ground as much as possible, rather than using helicopters. The equipment used depends on the weight and size of the towers and such site conditions as weather and soil characteristics. Most of the 500-kV towers would be built using mobile cranes; however, helicopter tower erection could be used if access was not available or if sensitive resources would be encountered.

Steel towers would be assembled in sections near the tower site. Each tower contains three components: the legs, body, and bridge. The bridge is the uppermost portion of the tower and serves as the attachment point for the insulators that support the conductors.

Steel towers are anchored to the ground by footings. Each tower requires four footings placed in holes that have been excavated, augured, or blasted. Large machinery, such as backhoes or truck-mounted augers, would be used to excavate the footings. Topsoil would be stockpiled during excavation. The design of the footings would vary based on soil properties, bedrock depth, and the soundness of the bedrock at each site. Typically, towers would be attached to steel plates or grillages placed within the excavated area. The areas would then be backfilled with excavated material or concrete. Topsoil would then be replaced to restore the original ground surface.

Typical footings for single-circuit towers include 4- by 4-ft. plates placed 10 to 12 ft. deep for suspension towers and 12.5- by 12.5-ft. grillage placed 14 to 16 ft. deep for heavy deadend towers. Typical footings for the double-circuit towers include 8.25- by 8.25-ft. grillage placed 12 to 14 ft. deep for suspension towers and 16- by 16-ft. grillage placed 14.5 to 18.5 ft. deep for heavy deadend towers. On average, for an entire transmission line project, each footing would occupy an area about 10 by 10 ft. to a depth of 15 ft. if bedrock was not encountered. The holes in which the plates and grillage would be installed must be large enough to provide about 1 ft. of clearance on each side of the plate or grillage. If bedrock were encountered and had properties that allowed anchor borings, holes would be drilled and steel rods grouted into the rock. These rods would either be attached to a concrete footing or welded directly to a tower member and embedded in compacted backfill. If rock properties were not suitable for anchor rods, the rock may be blasted to obtain adequate footing depth.

As the towers are built, heavy machinery would disturb the ground surface and/or compact soils at the tower site and along access roads. The machinery also would generate noise and dust.

1.1.1.7 Conductors, Overhead Ground Wires, and Insulators

The wires or lines that carry the electrical current in a transmission line are called conductors. Alternating-current transmission lines, such as the proposed line, require three wires or sets of wires, each of which is referred to as a "phase." Three 1.3-in. Bunting conductors would be included for each phase. Each bundle is 16 by 20 in.

Conductors are not covered with insulating material. Instead, the air surrounding each conductor acts as insulation. Each phase of conductor would be physically separated on the transmission tower.

After the transmission towers are in place, workers would attach a smaller steel cable to the conductor and then pull the conductor under tension through the insulators and string the conductor between towers. Conductors would be attached to the structure using glass, porcelain, or fiberglass insulators. Insulators prevent the electricity in the conductors from moving to other conductors on the tower, the tower itself, and the ground. As the conductors are strung, the ground surface would be disturbed at the tensioning sites, and noise and dust would be generated by the machinery.

Transmission towers elevate conductors to provide safe clearance for people and structures within the ROW. The National Electrical Safety Code (NESC) establishes minimum conductor heights. The minimum conductor-to-ground clearance for a 500-kV line is a little more than 29 ft. Greater clearances would be provided by BPA over county roads and highways, railroads, and river crossings.

One or two smaller wires, called overhead ground wires, would also be attached to the top of the transmission towers. Overhead ground wires would be installed to protect the transmission line against lightning damage. The diameter of the wire would vary from 0.375 to 0.625 in.

1.1.1.8 Substation Addition

Under the current proposal, the Echo Lake Substation would be expanded to the east on land owned in fee title by BPA. The size of the expansion would be approximately 150 by 750 ft. The site would be cleared in the same manner as the ROW for the transmission line. The site would include a fenced yard and a graded and graveled parking lot. The existing road around the substation would be realigned to the east to accommodate this expansion. New transformers, switches, and other equipment would be installed in the expanded area. A continuous ground wire would also be installed.

1.1.1.9 Site Restoration and Clean-up

Disturbed areas around the towers, conductor reels, and pull site locations would be reshaped and contoured to be consistent with their original condition. Access roads would be repaired.

Disturbed areas would be reseeded with grass or an appropriate seed mixture to prevent erosion. The seed mixture would include native plant species and would be free of noxious weeds. All solid waste from construction would be removed and properly disposed offsite, and equipment would be removed from the ROW.

1.1.2 Alternative Rights-of-Way

Alternative 1, the preferred alternative, is presented for comparison purposes only. Please refer to the *Final Wetlands Technical Report* (Jones & Stokes 2002a) for a detailed description.

1.1.2.1 Alternative 1: Preferred Alternative

The alignment for Alternative 1 would be immediately adjacent and parallel to a portion of the existing 12-mi. Raver-Echo Lake transmission line from a point approximately 3 mi. north of Raver (S26, T22N, R7E) to the Echo Lake Substation (S11, T23N, R7E) (see Figure 1). This alternative would be approximately 9 mi. long and would require about 2.9 mi. of new access roads. The existing 150-ft. ROW would be widened to 300 ft., with the widening and new line located east of the existing ROW.

1.1.2.2 Alternative A

The alignment for Alternative A would be located west of the Cedar River Municipal Watershed (Figure 1). This alternative proposes to construct a new single-circuit 500-kV line within an existing BPA ROW from a tap along the Schultz-Raver No. 2 line near the community of Kangley to just outside BPA's substation near Covington. The line then routes along the outside of the northeast fence line of Covington substation to the existing Covington-Maple Valley 230-kV transmission line. This entire segment would be constructed in a single-circuit configuration with tower heights averaging 135 ft.

The remainder of this alternative would require replacing a portion of BPA's existing Covington-Maple Valley single-circuit 230-kV transmission line with a double-circuit 500-kV line north of Covington Substation. One side of the new double circuit towers would be operating at 500-kV and the other side at 230-kV. The 500-kV circuit would continue on to terminate at Echo Lake Substation utilizing a vacant circuit on the Maple Valley-Echo Lake double-circuit 500-kV transmission line. New double-circuit towers, about 180 ft. tall, would support both double circuit segments. The new transmission lines would be built on existing rights-of-way, with the exception of a portion of the single-circuit line near the Covington Substation. New right-of-way would need to be acquired across from the Covington Substation to connect the single-circuit 500-kV transmission line with the double-circuit line

1.1.2.3 Alternative B

Alternative B proposes to replace about 38 mi. of BPA's existing Rocky Reach-Maple Valley 345-kV transmission line to a double-circuit 500-kV line (Figure 1). The new towers would be about 180 ft. tall, approximately 30 to 90 ft. taller than the existing towers. The new 500-kV line would be connected to the existing Schultz–Raver No. 2, 500-kV transmission line just east of Stampede Pass and to Echo Lake Substation at the west end. The line would cross Interstate 90 (I-90) twice. Almost all of this route would be on existing right-of-way.

1.1.2.4 Alternative C (Option C-1)

Alternative C (Option C-1) proposes to construct a new single-circuit 500-kV line from near the community of Kangley at BPA's Raver Substation on mostly new 150-ft.-wide right-of-way totaling 10 mi. in length (see Figure 1). The proposed transmission line would be carried on towers approximately 135 ft. high and originate at the Raver Substation. The proposed line would proceed westerly a distance of about 2.5 mi. on new 150-ft.-wide right-of-way immediately north of the Tacoma-Raver double-circuit 500-kV transmission line. At that point the line would turn north through the Ravensdale and Hobart areas and would be connected to an existing vacant (unused) Echo Lake-Maple Valley 500-kV circuit. The vacant circuit would need to be connected to a new bay in the Echo Lake Substation. This option would require the purchase of approximately 6 mi. of new transmission line right–of-way.

1.1.2.5 Alternative C (Option C-2)

Alternative C (Option C-2) proposes to construct a new single-circuit 500-kV line from a tap along the Schultz-Raver No. 2 line near the community of Kangley, to an existing vacant (unused) Echo Lake-Maple Valley 500-kV circuit (see Figure 1). New towers would be about 135 ft. tall. The new line would pass through the Ravensdale and Hobart areas. The vacant circuit would then need to be connected to a new bay in the Echo Lake Substation. This option would require the purchase of approximately 10.5 mi. of new transmission line right–of-way.

1.1.2.6 Alternative D (Options D-1 and D-2)

Alternative D proposes to construct a new single-circuit 500-kV transmission line from east of Stampede Pass to the Echo Lake Substation, over a distance of approximately 38 mi. (see Figure 1). The new line would be located either on the south side or the north side of the existing Rocky Reach-Maple Valley 345-kV line, immediately adjacent to the existing cleared transmission line right-of-way. New towers would average about 135 ft. tall. The line would cross I-90 twice. A new 150-ft.-wide right-of-way would need to be acquired either on the south side of the existing ROW (Option D-1) or on the north side (D-2).

1.2 Key Issues for Wildlife

Key wildlife issues were developed from public comments made during the scoping period for this project and from consultation with state and federal and agencies.

1.2.1 Impacts on Threatened, Endangered, and other Sensitive Species

The study area provides habitat or potential habitat for several species of wildlife that are listed either federally under the Endangered Species Act (ESA), as U.S. Fish and Wildlife Service (USFWS) Species of Concern, as U.S. Forest Service (USFS) Sensitive Species, as Mt. Baker-Snoqualmie and Okanogan-Wenatchee National Forest Management Indicator Species, as "Survey and Manage" under the Northwest Forest Plan (NFP), and/or by the State of Washington. Habitat conditions and availability within the study area and potential impacts from the proposed project to these species and their habitats have been identified as potential issues of concern.

1.2.2 Habitat Loss

Construction of the proposed project would require varying amounts of vegetation clearing, depending upon the alternative selected. This clearing would result in the removal of habitat or potential habitat for many species, potential alteration of habitat conditions for wildlife species, and loss of recruitment habitat for late-successional forest dependent species.

1.2.3 Habitat Fragmentation

Construction of the proposed project, including associated access road construction, would involve vegetation clearing, possibly increasing the amount of habitat fragmentation and the amount of edge habitat within the study area.

1.2.4 Bird Collision

Birds may be injured through collisions with power lines or overhead ground wires.

1.2.5 Disturbance of Wildlife

Many species of wildlife are sensitive to noise and human presence, particularly during the breeding season. The USFWS identified this sensitivity as an issue of concern for bald eagles, spotted owls, and marbled murrelets, species that potentially occur in the study area. Disturbance may also occur during project construction or as a result of operation and maintenance activities, including maintenance of the transmission line and the use and maintenance of access roads.

1.3 Major Conclusions

Construction impacts would occur under all action alternatives. Potential habitat for threatened, endangered, and sensitive species occurring along the study area would experience a moderate-level impact overall. Impacts to different species groups would vary: Construction impacts to forested community species is expected to be low level; impacts to riparian and aquatic community species are expected to be moderate level; and impacts to early seral communities are expected to be either beneficial, minimal, or nonexistent.

Habitat fragmentation is also expected to occur under all action alternatives, with the least amount occurring under Alternative C (Option C-2) and the greatest amount under Alternative D (Option D-2).

Mortality of listed bird species is possible under Alternatives 1, B, and D (Options D-1 and D-2), resulting from collisions with the transmission line or overhead ground wires. If this outcome were to occur it would be a high-level impact. Because the study area is not known to be a high use area for listed species, the probability of mortality of listed species from collision would be low. Listed species are those listed as either threatened or endangered under the ESA. Listed bird species potentially occurring in the area include bald eagle, northern spotted owl, and marbled murrelet. Other species (non-listed) that may be impacted by transmission line collisions include goshawk and merlin.

Under all action alternatives potential exists for wildlife disturbance as a result of construction activities. Planning and mitigation should keep these risks at low levels.

Impacts would also occur as a result of maintenance and operation of the proposed project. Impacts resulting from the maintenance of the ROW in an early seral condition would include both potential noise from maintenance activities and long-term impacts to wildlife habitat caused by maintaining both edge habitat and the ROW opening.

Impacts from noise disturbance associated with maintenance and operation could be minimized through planning**.** Maintenance of the ROW as edge habitat and a potential barrier to species that avoid openings would reduce the value of habitat in the area of the ROW and be considered a moderate-level impact.

2.0 Study Scope and Methodology

2.1 Data Sources and Study Methods

The analysis of impacts assumes standard BPA clearing, grading, and filling requirements for the construction of towers and roads as described in Section 1.1.1 of this report. Potential locations for the construction of new transmission towers were approximated based on standard BPA construction requirements, the location of existing towers, topographical and natural features, and conversations with BPA engineers. All tower locations are approximate and subject to modification. The majority of potential access road construction and reconstruction was determined by field review of the alternative alignments by a BPA engineer and subsequently provided to Jones & Stokes.

Data sources for this project include discussions with USFS, Geographic Information System (GIS) vegetation data, analysis of aerial photographs, review of pertinent literature, and field reconnaissance of the study area. The field reconnaissance was conducted by wildlife biologists

and consisted of an aerial survey of the proposed alignments, driving and walking the accessible sections of the proposed alignments, and compiling field notes on the habitats encountered and any signs of wildlife use observed.

Species potentially present and habitat associations for these species were determined by review of:

- a data search of the Washington Priority Habitats and Species database;
- a list of species of concern provided by the Washington Department of Fish and Wildlife (WDFW);
- local field guides for birds and amphibians; and
- scientific literature regarding the natural history and habitat associations of wildlife species potentially present in the study area, as listed in the references (Section 8.0) of this document.

Analysis of aerial photograph was conducted to identify general habitat types and to facilitate field review of the proposed rights-of-way (ROWs). Field visits were conducted on June 6 and 7, 2002.

2.2 Agencies Contacted

- USFWS, species request letter (reply pending).
- City of Seattle, Cedar River Watershed (CRW).
- Mt. Baker-Snoqualmie and Okanogan-Wenatchee National Forests (MBSWNF).

3.0 Affected Environment

3.1 Regional Overview

The proposed project area is located east of Seattle and extends from the foothills to the crest of the west slopes of the Washington Cascades. This is a region with a long history of resource extraction, particularly timber harvest. This region is also known for its old-growth forests and associated species. Since the 1980s, a major shift in land management has occurred, largely in response to the listing of species under the ESA, toward protection of forested habitats, streams and rivers, and the species dependent upon them. This shift has resulted in a reduction of timber harvest on public lands and changes in the way timber is harvested on both public and private lands.

Due to the listing of the northern spotted owl and marbled murrelet under the ESA, protection of late-successional forest habitats has become a major issue in the Cascade Mountains. The listing and potential future listing of several fish species has led to an increased concern for protecting riparian habitats and water quality.

This region has also experienced a large influx of people in the last two decades, resulting in increased urbanization from the Cascade foothills to Puget Sound. Human population pressure

has reduced habitat available for species living at lower elevations, as areas historically managed for timber production are converted to residential development.

The proposed transmission line ROWs pass through one or more of five distinct land management areas: developed, rural residential, municipal watershed, industrial forest land, and public forest land (USFS). Developed areas occur along Alternatives A and C. Rural residential areas occur along all the alternatives, but are most common along Alternatives A and C. These two land management areas are largely governed by the Washington State Growth Management Act and by local regulations. These forest lands are managed under the Washington State Forest Practices Act. Over half of Alternatives B and D occur along the Mt. Baker-Snoqualmie and Okanogan-Wenatchee National Forests, which are regulated by USFS under the guidelines of the Northwest Forest Plan (NFP).

3.2 Regulations, Standards, and Guidelines

3.2.1 Federal

The ESA requires federal agencies to assess potential impacts to species listed under the ESA resulting from implementation of federal projects. If impacts to species are expected, then consultation with the USFWS is required to determine whether "take" would occur. Take is defined as killing or causing direct harm to a listed species as well as any form of harassment that potentially affects a species' ability to breed, feed, or seek shelter.

The Migratory Bird Treaty Act protects birds defined as migratory, which includes many songbirds, waterfowl, and raptors. This Act prohibits the killing, harming, or capture of migratory birds, bird parts, nests, and eggs, unless permitted by regulations.

The Bald Eagle Protection Act prohibits the taking of both bald and golden eagles or any parts, nests, or eggs. This Act prohibits killing, collection, and disturbance of these species.

If the study area contains potentially suitable habitat for "Survey and Manage" species listed in the Northwest Forest Plan, the Forest Service requires completion of protocol-level surveys to evaluate whether the proposed project will affect any of those species.

Partners-In-Flight, an international coalition of government agencies, conservation groups, academic institutions, private organizations, and citizens, has developed a series of Bird Conservation Plans (BCPs) to promote the conservation of nongame birds throughout the U.S. Hopefully, the BCPs will help reverse, minimize, and avoid negative trends in native landbird populations by stimulating proactive approaches to conservation. A comprehensive avian monitoring program, termed the Landbird Monitoring Strategy (LMS), is used to assess the effectiveness of the BCPs at local, regional, and national levels. The LMS is based on existing monitoring studies and protocols and is designed to provide the broadest picture relative to the current trends of landbird species.

3.2.2 State

The Washington Forest Practices Act has provisions for managing riparian and wetland vegetation and wildlife habitats in areas where timber harvest is planned. It requires landowners to consult with the Washington Department of Fish and Wildlife (WDFW) to protect critical habitats, to preserve wildlife reserve trees, and to avoid disturbance to both spotted owls and marbled murrelets during their nesting seasons.

3.2.3 Local

Key objectives of the King County Comprehensive Plan include conserving wildlife resources and maintaining biodiversity within the county. To accomplish these objectives, the county has identified areas of important wildlife habitat and linkage corridors between these habitats. The comprehensive plan also requires that species listed as threatened or endangered, either federally or by the state, and species listed as sensitive by the state be considered in project planning and protected. This level of consideration is also extended to species that are not listed either federally or by the state, but that are considered to be of local importance in the county. The study area contains habitat linkage corridors and either known or potential habitat for species included under the comprehensive plan.

Kittitas County, King County, the Cities of Covington, Kent, and Maple Valley all have adopted or established through local ordinance "Critical Areas" or "Sensitive Areas" regulations to implement the goals and policies of the Washington State Growth Management Act, which requires each local jurisdiction to adopt rules for protection of environmentally critical areas.

3.3 Study Area and Approach

Wildlife species and their habitats occurring or potentially occurring within the affected environment are discussed at two levels. The first is the broad project area, encompassed by the city of Covington, southeast to Stampede Pass, northwest along I-90 to North Bend and back to Covington in a southwest direction. Discussion of this area is general and is intended to address issues related to wide-ranging species, migratory species, and species with large home ranges. The study area addressed in a more focused manner includes only the area within 0.25 mi. of the proposed transmission line ROWs. This distance was chosen because data were readily available, and the majority of direct and indirect impacts from the proposed project would occur within this area. Where impacts are expected outside of this focused study area, they are discussed at the project area level.

As mentioned previously, the proposed ROWs pass through one or more of five distinct land management areas. Alternatives A and C cross through developed lands that are described as any land cleared for the building of residential, commercial, or industrial structures, including associated lawns and parking lots. This area has a very low wildlife habitat value. Species generally found in developed areas include house sparrows, European starlings, American crows, and rodents.

Rural residential areas occur along Alternatives A, C (Options C-1 and C-2), portions of B and D (Options 1 and 2), and Alternative 1. This management area is characterized by low-density housing and agricultural/pasture land interspersed with second growth forest. This area provides potential habitat for species adapted to human activity and disturbed sites including some songbirds, raptors, large and small mammals, and amphibians.

All of the alternatives pass through industrial forest land. These lands are primarily managed by the Weyerhaeuser Company, Washington Department of Natural Resources (WDNR), and small land owners. Lands in this portion of the study area have been intensively managed for timber production, and they are predominantly second and third growth forests. In alternatives that currently house transmission line ROWs, the predominant vegetation types within the ROWs are managed grass/forb/shrub, early regeneration mixed, mid-regeneration mixed, and coniferous forest, as described in Table 1. An exception exists where the ROWs cross buffers left in riparian areas, where older regeneration stands predominate.

Table 1. Wildlife Habitat Types within the Study Area

Habitat Type	Code	Description
Mid-regeneration deciduous	MRD	Early regeneration second- or third-growth deciduous forest. Deciduous coverage is over 70%. Sapling to pole-size between 10 to 30 years old. Tree height is between 25 and 40 ft.
Mature deciduous	MD	Mature regeneration second- or third-growth deciduous forest. Reaching mature stage but not late-successional habitat. Deciduous coverage is over 70%. Stands dominated by mature trees over 30 years old. Tree height is between 40 and 80 ft.
Early regeneration coniferous	ERC	Early regeneration second- or third-growth coniferous forest. Conifer coverage is over 30%. Young plantation less than 20 years old. Tree height is between 15 and 30 ft. Understory herb and shrub coverage is generally low, due to the stand density.
Mid-regeneration coniferous	MRC	Mid-regeneration second- or third-growth coniferous forest. Medium-age between 20 to 35 years old. On National Forest lands, some of these forests are unmanaged stands of natural origin. Tree height is between 40 and 80 ft.
Mature coniferous regeneration	MCR	Mature regeneration of a managed second- or third-growth coniferous forest. On National Forest lands, these forests are predominantly unmanaged stands of natural origin. Reaching a mature stage but not late-successional habitat. Between 36 and 75 years old. Tree height is between 100 and 130 ft.
Mature coniferous	MC	Natural forested areas dominated by older conifers between 80 and 250 years old. Two-storied to multi-storied stands. Medium to high density of snags and down woody material.
Old forest	OF	Stands dominated by mature trees, greater than 250 years old. Canopy closure exceeding 60%, multi-storied stands, abundant snag and down woody material, and at least two tree species.
Managed early regeneration coniferous	MERC	Volunteer growth of young conifers within managed areas that are kept clear of trees. These trees will be removed before maturity and are less than 20 years old and under 15 ft. tall.
Early regeneration mixed	ERM	Early regeneration second- or third-growth mixed deciduous and coniferous forest in areas that have been harvested within the last 10 years—typically clearcuts. More than 30% cover of deciduous trees present. Tree height is between 8 and 15 ft.
Mid-regeneration mixed	MRM	Mid-regeneration second- or third-growth stands comprised of roughly even coverages of conifers and hardwoods. Conifers are between 10 and 30 years old. Hardwoods are under 30 years old. Tree height is between 35 and 45 ft.
Mature mixed regeneration	MMR	Mature regeneration second- or third-growth stands with mixed deciduous and coniferous coverages each exceeding 30%. Reaching a mature stage but not considered late-successional habitat. Average age of trees is over 30 years old. Tree height exceeds 45 ft.
Lake/river/stream	LRS	Lakes, ponds or other natural impoundments of water, and drainages with perennial flows.
Rural residential/ managed landscape	RRM	Areas with scattered, low-density single-family housing on larger lots, including small-scale farms and horse pastures. High percentage of the pre-construction landscape is relatively intact and highly managed. Tree coverage is under 30%.
Developed	DEV	Developed areas for commercial, industrial, and residential purposes including large residential developments and associated lawns, roads, and parking lots.
Natural non-vegetated	NNV	Naturally nonvegetated areas such as rock outcrops or natural slides. Less than 10% vegetative cover.
Managed grass/ forb/shrub	MGFS	Habitat types that are maintained in an early seral condition.
Natural nonforest shrubland	NNFS	Naturally nonforested habitat with a significant shrub layer. Forested cover is less than 10%; shrub cover is over 40%.
Natural nonforest grassland	NNFG	Naturally nonforested habitat with significant grass/forb cover such as prairies and alpine meadows. Forested cover is less than 10%; grass and forb cover is over 60%.

Alternatives B and D (Options D-1 and D-2) cross public forest lands of the Mt. Baker-Snoqualmie and Okanogan-Wenatchee National Forests. This land management area has been managed for recreation and timber production. Many parcels of land in this area were recently obtained in land exchanges with private timber companies and are predominantly second- and third-growth forest. A few stands near the existing managed ROW (0.25-mi. buffer) are categorized as mature forest and provide habitat for mature forest dependent species. Lands along Alternatives B and D ROWs have been designated under the NFP as Late-Successional Reserve (LSR) habitats, and are therefore managed under standards and guidelines for LSRs contained in the NFP.

3.3.1 Wildlife Habitats Within the Study area

A vegetation cover map was developed for the study area (Figures 2-A, 2-B, 2-C-1 [Option C-1], 2-C-2 [Option C-2], 2-D-1 [Option D-1], and 2-D-2 [Option D-2]) based on GIS data from the Mt. Baker-Snoqualmie and Okanogan-Wenatchee National Forests (Alternative B and D [Options D-1 and D-2]), and aerial photograph interpretation (Alternatives A, B, C [Options C-1 and C-2] and D [Options D-1 and D-2]).

Field reconnaissance visits were also conducted to verify data. Habitat types within the proposed ROWs are presented in Table 1. For a more complete description of these vegetation types, refer to the Vegetation Technical Report prepared for this project (Jones & Stokes 2002b).

The ESA requires that, to the maximum extant determinable, NMFS and USFWS must designate critical habitat for federally-listed species at the time of their listing. Critical habitat designation establishes areas that are to be given special consideration in Section 7 consultations. The proposed location for Alternatives B and D (Options D-1 and D-2) contain designated critical habitat for the northern spotted owl and the marbled murrelet. Alternatives B and D (Options D-1 and D-2) would cross the designated critical habitat in the same three locations. In general, all three crossings occur adjacent to the existing BPA transmission line where it runs immediately south of I-90, east of Twin Falls State Park, and west of Keechelus Lake.

Moving from the east to west, the first crossing would occur south of I-90, north of McClellan Butte, east of Mime Creek, and west of Wood Creek. The second crossing would occur south of I-90, north of Humpback Mountain and Silver Peak, east of Hansen Creek, and west of Snoqualmie and Rockdale. The third crossing would occur south of Snoqualmie and Pacific West Ski Area, north of Keechelus Dam, east of Mt. Catherine and Lost Lake, and immediately west of Keechelus Lake.

In addition to the above habitat types, the King County Comprehensive Plan (King County 2000) identifies wildlife network corridors as important habitat components to be protected within the comprehensive planning area and greater King County. This network of corridors is displayed in Figure 3. The map shows a number of the designated wildlife corridors that would be crossed by the design alternatives of the proposed project.

Alternative C (Options C-1 and C-2) would cross three designated wildlife corridors (Figure 3). Moving along the proposed alternative from south to north, the first crossing of a wildlife corridor would occur where Alternative C (Options C-1 and C-2) intersects with Alternative A. This is just east of Maple Valley and southwest of the CRW. At this intersection, Alternative C (Options C-1 and C-2) would be oriented in a south-to-north direction as it crosses Alternative A

and the first corridor. The wildlife corridor is oriented northeast to southwest at the point of intersection.

The second corridor Alternative C (Options C-1 and C-2) would cross is the Cedar River outside the western boundary of the watershed. Alternative C (Options C-1 and C-2) crosses this corridor east/northeast of Maple Valley, west of the watershed, and south of State Route 18 (SR-18). The alternatives would cross this corridor while still situated in a south-to-north direction. The corridor is oriented east to west at the point of intersection.

The third corridor Alternative C (Options C-1 and C-2) would intersect occurs at the same location where it would cross SR-18. This is northeast of Maple Valley, and west of the CRW. At the point of intersection, Alternative C (Options C-1 and C-2) would again be oriented south to north, while the corridor is oriented southeast to northwest.

Alternative B and D (Options D-1 and D-2) would cross two designated wildlife corridors. Alternatives B and D (Options D-1 and D-2) would cross each wildlife corridor in the same location (Figure 3). The first crossing would occur west of North Bend, southwest of Snoqualmie, and south of I-90 as the alternatives would be oriented in a southeast-to-northwest direction along I-90. The wildlife corridor is oriented north to south at the point of intersection.

The second crossing would occur west of the King County/Kittitas County line, east of North Bend and Cedar Falls, south of I-90, and north of Cedar River. At the point of intersection the alternatives would be oriented in an east-to-west direction. The wildlife corridor is oriented north to south.

3.3.2 Species to be Analyzed

For the purpose of this document, species selected for analysis included those that are federally-listed under the ESA as threatened or endangered; federal species of concern; USFS "Survey and Manage," sensitive, proposed sensitive, MIS (USFS Management Indicator Species), and J2 species (USFS species of interest); and Washington State-listed threatened, endangered, sensitive, and monitor species with the potential to occur in the project area. This perspective resulted in a list of 56 species.

Based on the habitat requirements of these species and the availability of habitat within the study area, 15 of these species are not expected to occur within the study area, reducing the list to 41 species. Six species identified in the King County Comprehensive Plan (King County 2000) as being of local concern, and which may occur in the project area, were also included. One species, the black-tailed deer, was also included as being of local concern in response to comments received during public scoping for the proposed project, bringing the final number of species analyzed to 48.

These species have been sorted by their primary habitat associations, which are defined as forest communities, riparian communities, aquatic communities, early seral communities, and unique habitats. Species are addressed in these groups throughout the remainder of this document. A complete list of species, their status, primary habitat associations, and the probability of the species occurring in the proposed study area are described in Table 2. Table 3 describes the species excluded from analysis, their status, primary habitat associations, and the rationale for excluding them.

1320000 1340000 1360000 1380000

160000

140000

Hobart
Taylor (Site)
Ravensdale
Georgetown
Lake Youngs
Shadow Lake
Walsh Lake
Retreat Lake
Taylor Mtn
Tiger Mtn
Sugarloaf Mtn
Cedar
Rock
Substation
Kanaska Junction
BURLINGTON
POWERLINE
CHICAGO
NORTHE
Old RR Grade
Carey Creek
Webster Creek
Cedar

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Figure 2-A
Alternative A
Vegetation Cover Types within 0.25-Mile of the Action Alternatives

Legend

- Developed
- Early Regeneration Conifer
- Early Regeneration Mixed
- Lake / River / Stream
- Mature Conifer Regeneration
- Mature Deciduous
- Managed Grass / Forb / Shrub
- Mature Mixed Regeneration
- Mid-Regeneration Conifer
- Mid-Regeneration Deciduous
- Mid-Regeneration Mixed
- Natural Non-Forested Grassland
- Natural Non-Forested Shrubland
- Rural Residential / Managed Landscape
- Riparian Habitat
- Alternative A Centerline
- Existing BPA Transmission Lines

Source: USGS Tacoma, Snoqualmie Pass, WA 100K Quadrangles.

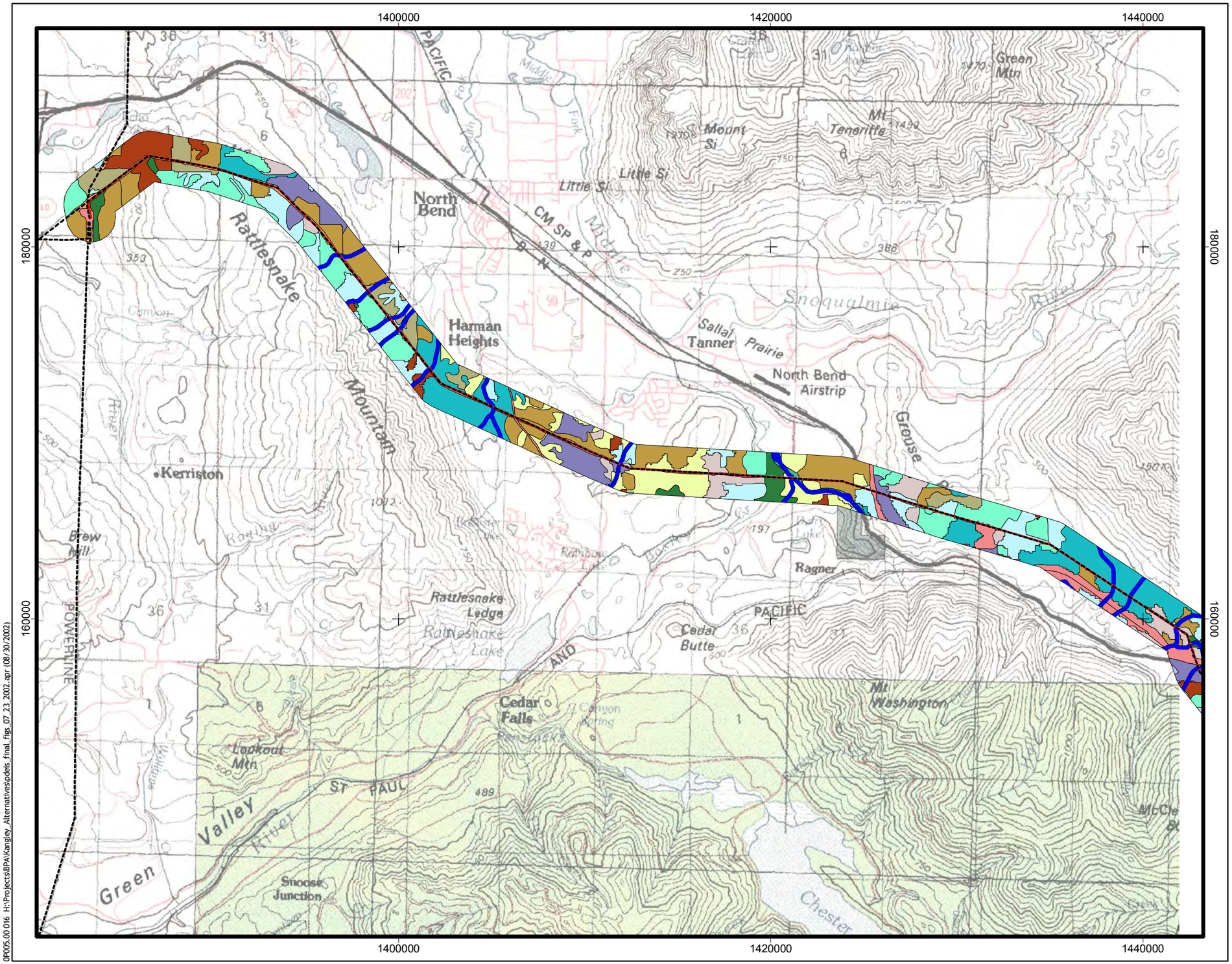
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Zone: North Zone
Datum: NAD83
Units: Feet US

N

0.5 0 0.5 1 1.5 Miles

Scale 1" = 1 Mile

Jones & Stokes



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Figure 2-B
Sheet 1 of 3
Alternative B
Vegetation Cover Types within 0.25-Mile of the Action Alternatives

Legend

- Developed
- Early Regeneration Conifer
- Managed Early Regeneration Conifer
- Early Regeneration Mixed
- Lake / River / Stream
- Mature Conifer Regeneration
- Mature Conifer
- Mature Deciduous
- Managed Grass / Forb / Shrub
- Mature Mixed Regeneration
- Mid-Regeneration Conifer
- Mid-Regeneration Deciduous
- Mid-Regeneration Mixed
- Natural Non-Forested Grassland
- Natural Non-Forested Shrubland
- Rural Residential / Managed Landscape
- Natural Non-Vegetation
- Riparian Habitat
- Alternative D North Centerline
- Existing BPA Transmission Lines

Source: USGS Snoqualmie Pass, WA 100K Quadrangle.

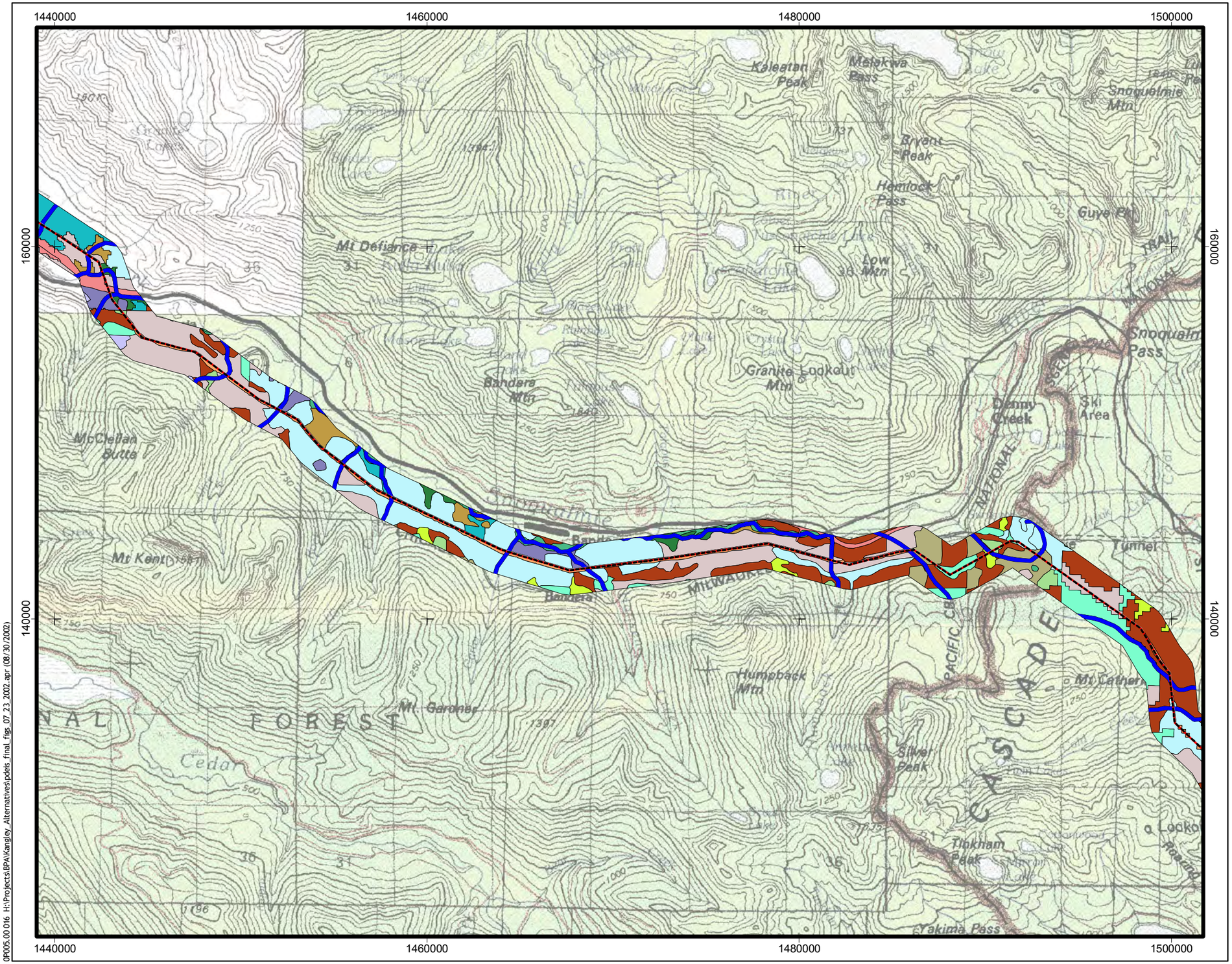
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Zone: North Zone
Datum: NAD83
Units: Feet US

N

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Scale 1" = 1 Mile

Jones & Stokes



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Figure 2-B
Sheet 2 of 3
Alternative B
Vegetation Cover Types within 0.25-Mile of the Action Alternatives

Legend

- Developed
- Early Regeneration Conifer
- Managed Early Regeneration Conifer
- Early Regeneration Mixed
- Lake / River / Stream
- Mature Conifer Regeneration
- Mature Conifer
- Mature Deciduous
- Managed Grass / Forb / Shrub
- Mature Mixed Regeneration
- Mid-Regeneration Conifer
- Mid-Regeneration Deciduous
- Mid-Regeneration Mixed
- Natural Non-Forested Grassland
- Natural Non-Forested Shrubland
- Rural Residential / Managed Landscape
- Natural Non-Vegetation
- Riparian Habitat
- Alternative D North Centerline
- Existing BPA Transmission Lines

Source: USGS Snoqualmie Pass, WA 100K Quadrangle.

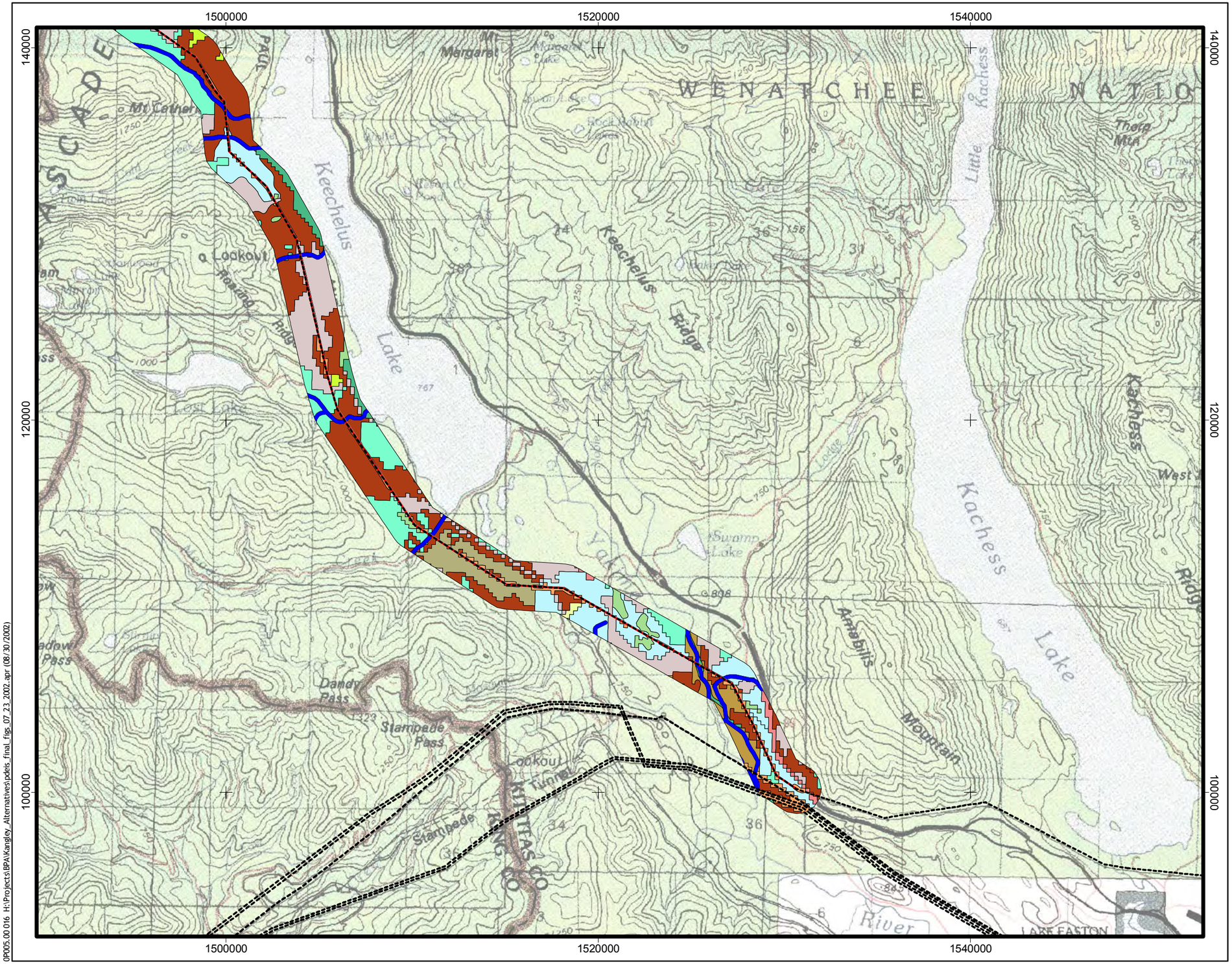
Projection: Washington State Plane
Zone: North Zone
Datum: NAD83
Units: Feet US

N

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Scale 1" = 1 Mile

Jones & Stokes



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Figure 2-B
Sheet 3 of 3
Alternative B
Vegetation Cover Types within 0.25-Mile of the Action Alternatives

Legend

- Developed
- Early Regeneration Conifer
- Managed Early Regeneration Conifer
- Early Regeneration Mixed
- Lake / River / Stream
- Mature Conifer Regeneration
- Mature Conifer
- Mature Deciduous
- Managed Grass / Forb / Shrub
- Mature Mixed Regeneration
- Mid-Regeneration Conifer
- Mid-Regeneration Deciduous
- Mid-Regeneration Mixed
- Natural Non-Forested Grassland
- Natural Non-Forested Shrubland
- Rural Residential / Managed Landscape
- Natural Non-Vegetation
- Riparian Habitat
- Alternative D North Centerline
- Existing BPA Transmission Lines

Source: USGS Snoqualmie Pass, WA 100K Quadrangle.

Projection: Washington State Plane
Zone: North Zone
Datum: NAD83
Units: Feet US

N

0.5 0 0.5 1 1.5 Miles

Scale 1" = 1 Mile

Jones & Stokes

Figure 2-C-1
Alternative C (Option C-1)
Vegetation Cover Types within 0.25-Mile of the Action Alternatives

Legend

- Developed
- Early Regeneration Conifer
- Early Regeneration Mixed
- Lake / River / Stream
- Mature Conifer Regeneration
- Mature Conifer
- Mature Deciduous
- Managed Grass / Forb / Shrub
- Mature Mixed Regeneration
- Mid-Regeneration Conifer
- Mid-Regeneration Deciduous
- Mid-Regeneration Mixed
- Natural Non-Forested Grassland
- Natural Non-Forested Shrubland
- Rural Residential / Managed Landscape
- Riparian Habitat
- Alternative C1 Centerline
- Existing BPA Transmission Lines

Source: USGS Tacoma, Snoqualmie Pass, WA 100K Quadrangles.

Projection: Washington State Plane
Zone: North Zone
Datum: NAD83
Units: Feet US

N

0.5 0 0.5 1 1.5 Miles

Scale 1" = 1 Mile

Jones & Stokes

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1320000 1340000 1360000 1380000

160000

140000

Tiger Mtn
Taylor Mtn 793
Old RR Grade
Carey Creek
Webster Creek
Taylor (Site) 335
Walsh Lake
Rock Creek
Cedar
Lake Youngs
Shadow Lake
Spring Lake
Webster Lake
Francis Lake
Pipe Lake
Wilderness Lake
Jenkins Creek
Ravensdale Lake
Retreat Lake
Georgetown
Ravensdale
BURLINGTON
POWERLINE
CHICAGO
Sugarloaf Mtn
Substation
Kanaska Junction
NORTHER

1320000 1340000 1360000 1380000

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Figure 2-C-2
Alternative C (Option C-2)
Vegetation Cover Types within 0.25-Mile of the Action Alternatives

Legend

- Developed
- Early Regeneration Conifer
- Early Regeneration Mixed
- Lake / River / Stream
- Mature Conifer Regeneration
- Mature Conifer
- Mature Deciduous
- Managed Grass / Forb / Shrub
- Mature Mixed Regeneration
- Mid-Regeneration Conifer
- Mid-Regeneration Deciduous
- Mid-Regeneration Mixed
- Natural Non-Forested Grassland
- Natural Non-Forested Shrubland
- Rural Residential / Managed Landscape
- Riparian Habitat
- Alternative C2 Centerline
- Existing BPA Transmission Lines

Source: USGS Tacoma, Snoqualmie Pass, WA 100K Quadrangles.

Projection: Washington State Plane
Zone: North Zone
Datum: NAD83
Units: Feet US

N

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Scale 1" = 1 Mile

Jones & Stokes

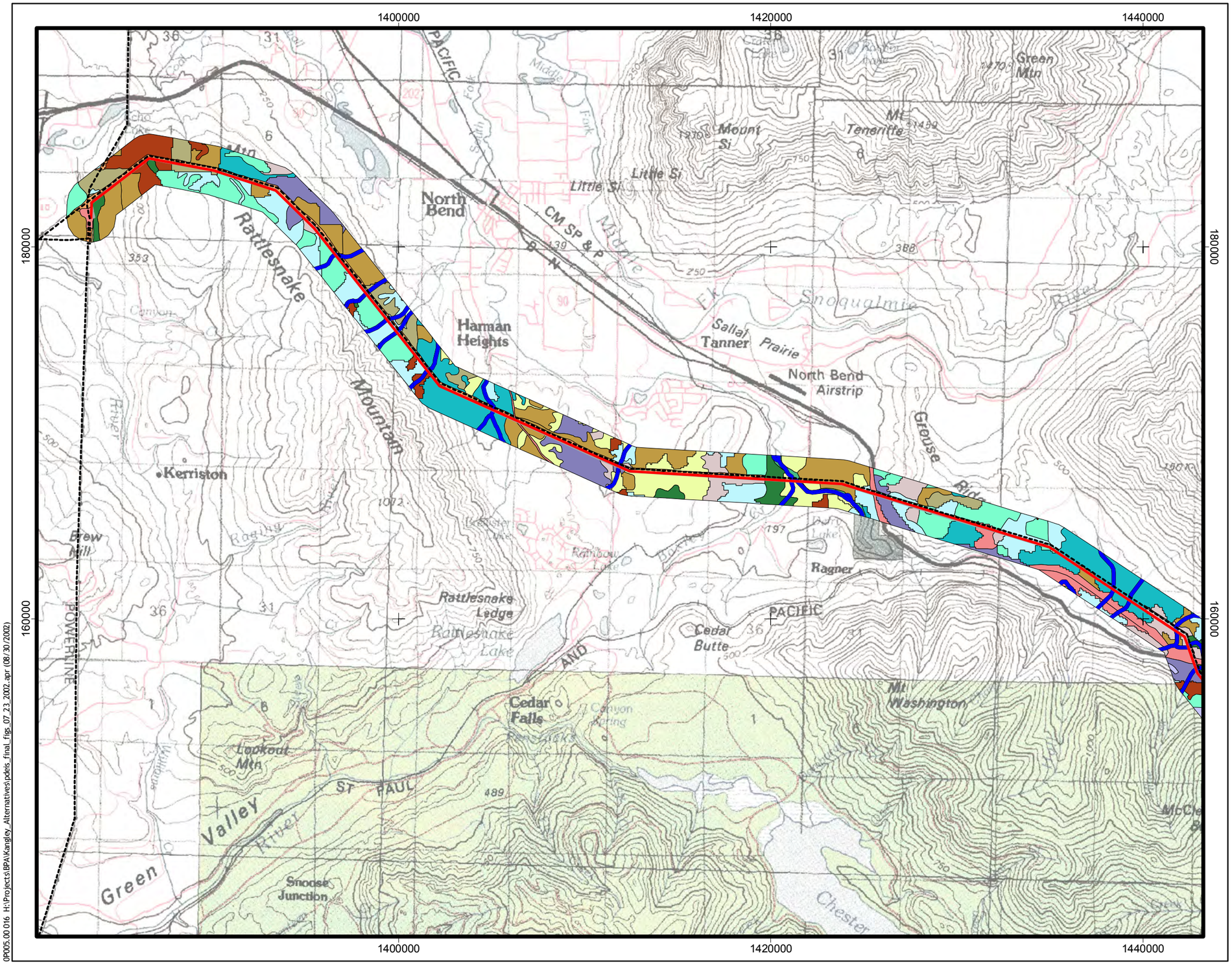


Figure 2-D-1
Sheet 1 of 3
Alternative D (Option D-1)
Vegetation Cover Types within 0.25-Mile of the Action Alternatives

Legend

- Developed
- Early Regeneration Conifer
- Managed Early Regeneration Conifer
- Early Regeneration Mixed
- Lake / River / Stream
- Mature Conifer Regeneration
- Mature Conifer
- Mature Deciduous
- Managed Grass / Forb / Shrub
- Mature Mixed Regeneration
- Mid-Regeneration Conifer
- Mid-Regeneration Deciduous
- Mid-Regeneration Mixed
- Natural Non-Forested Grassland
- Natural Non-Forested Shrubland
- Rural Residential / Managed Landscape
- Natural Non-Vegetation
- Riparian Habitat
- Alternative D North Centerline
- Existing BPA Transmission Lines

Source: USGS Snoqualmie Pass, WA 100K Quadrangle.

Projection: Washington State Plane
Zone: North Zone
Datum: NAD83
Units: Feet US

N

0.5 0 0.5 1 1.5 Miles

Scale 1" = 1 Mile

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1440000 1460000 1480000 1500000

160000

140000

Kaleetan Peak
Melakwa Pass
Snoqualmie Mtn
Bryant Peak
Hemlock Pass
Guye Pk
Mt Defiance
Low Mtn
Snoqualmie Pass
Granite Lookout Mtn
Bandera Mtn
Denny Creek
Ski Area
McClellan Butte
Mt Kent
Humpback Mtn
Mt. Gardner
FOREST
Cedar
Silver Peak
Tinkham Peak
Mt Cather
Tunnel
Yakima Pass
CASCADE
PACIFIC CREST NATIONAL

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Figure 2-D-1
Sheet 2 of 3
Alternative D (Option D-1)
Vegetation Cover Types within 0.25-Mile of the Action Alternatives

Legend

- Developed
- Early Regeneration Conifer
- Managed Early Regeneration Conifer
- Early Regeneration Mixed
- Lake / River / Stream
- Mature Conifer Regeneration
- Mature Conifer
- Mature Deciduous
- Managed Grass / Forb / Shrub
- Mature Mixed Regeneration
- Mid-Regeneration Conifer
- Mid-Regeneration Deciduous
- Mid-Regeneration Mixed
- Natural Non-Forested Grassland
- Natural Non-Forested Shrubland
- Rural Residential / Managed Landscape
- Natural Non-Vegetation
- Riparian Habitat
- Alternative D North Centerline
- Existing BPA Transmission Lines

Source: USGS Snoqualmie Pass, WA 100K Quadrangle.

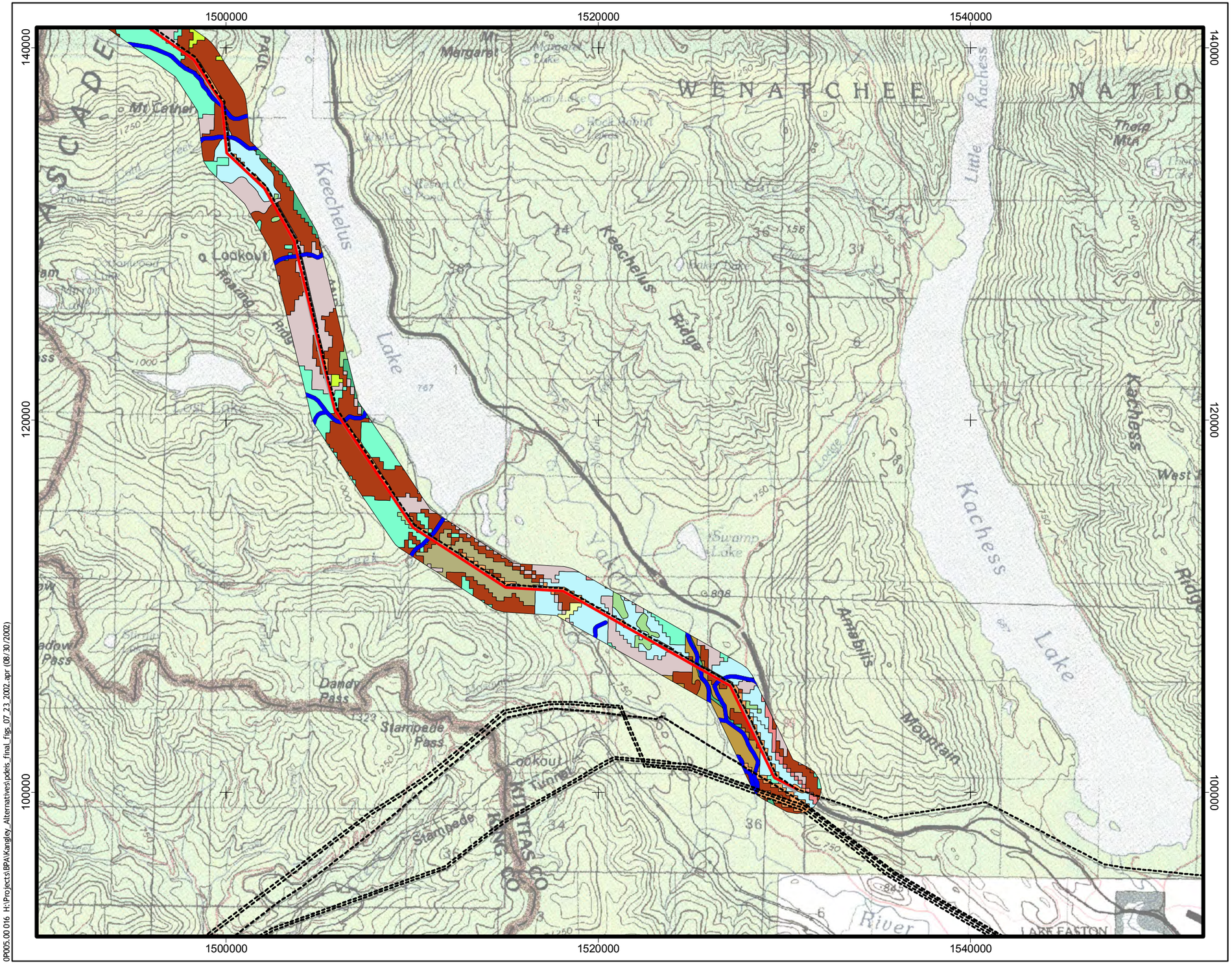
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Scale 1" = 1 Mile

Jones & Stokes



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Figure 2-D-1
Sheet 3 of 3
Alternative D (Option D-1)
Vegetation Cover Types within 0.25-Mile of the Action Alternatives

Legend

- Developed
- Early Regeneration Conifer
- Managed Early Regeneration Conifer
- Early Regeneration Mixed
- Lake / River / Stream
- Mature Conifer Regeneration
- Mature Conifer
- Mature Deciduous
- Managed Grass / Forb / Shrub
- Mature Mixed Regeneration
- Mid-Regeneration Conifer
- Mid-Regeneration Deciduous
- Mid-Regeneration Mixed
- Natural Non-Forested Grassland
- Natural Non-Forested Shrubland
- Rural Residential / Managed Landscape
- Natural Non-Vegetation
- Riparian Habitat
- Alternative D North Centerline
- Existing BPA Transmission Lines

Source: USGS Snoqualmie Pass, WA 100K Quadrangle.

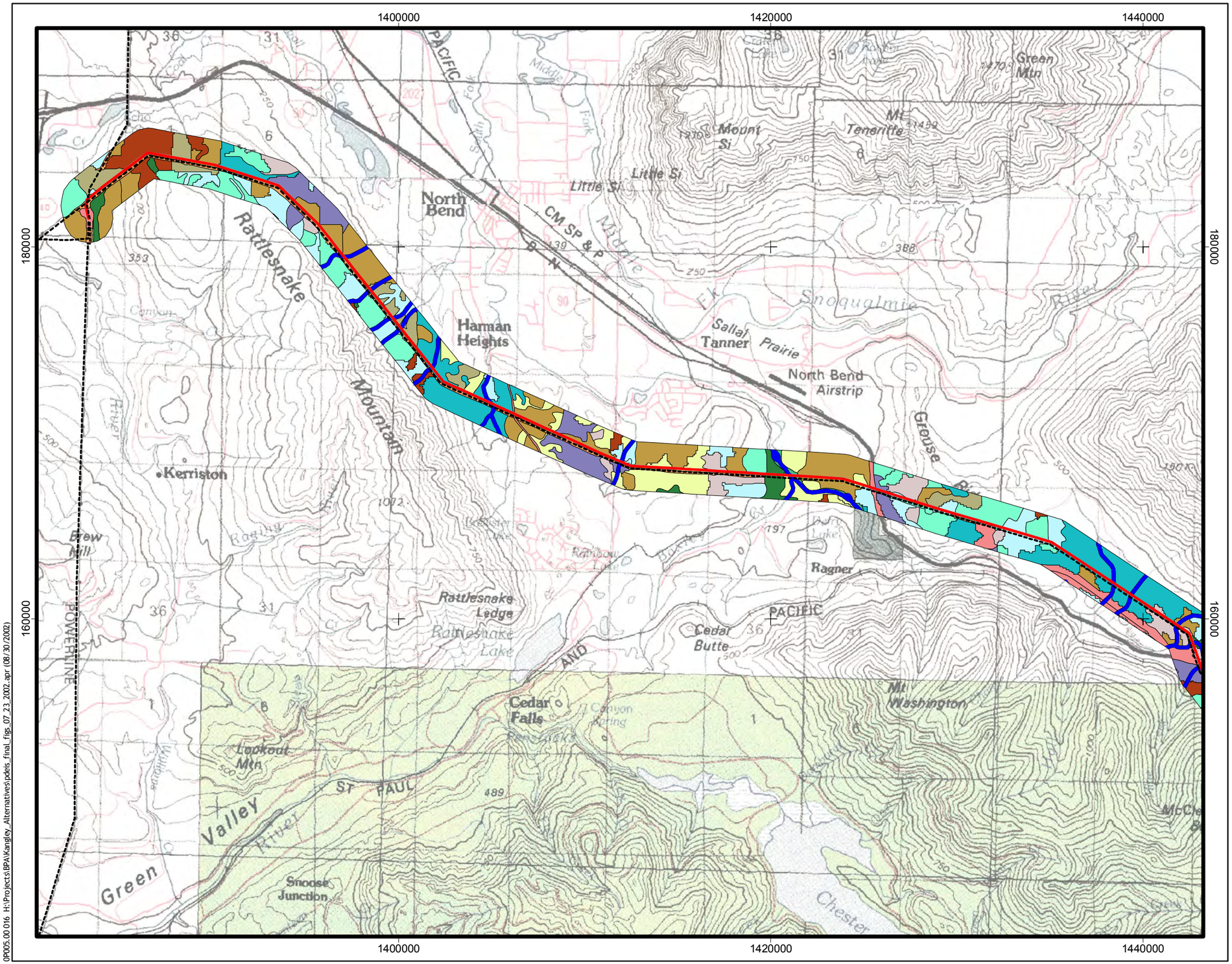
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Scale 1" = 1 Mile

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Figure 2-D-2
Sheet 1 of 3
Alternative D (Option D-2)
Vegetation Cover Types within 0.25-Mile of the Action Alternatives

Legend

- Developed
- Early Regeneration Conifer
- Managed Early Regeneration Conifer
- Early Regeneration Mixed
- Lake / River / Stream
- Mature Conifer Regeneration
- Mature Conifer
- Mature Deciduous
- Managed Grass / Forb / Shrub
- Mature Mixed Regeneration
- Mid-Regeneration Conifer
- Mid-Regeneration Deciduous
- Mid-Regeneration Mixed
- Natural Non-Forested Grassland
- Natural Non-Forested Shrubland
- Rural Residential / Managed Landscape
- Natural Non-Vegetation
- Riparian Habitat
- Alternative D North Centerline
- Existing BPA Transmission Lines

Source: USGS Snoqualmie Pass, WA 100K Quadrangle.

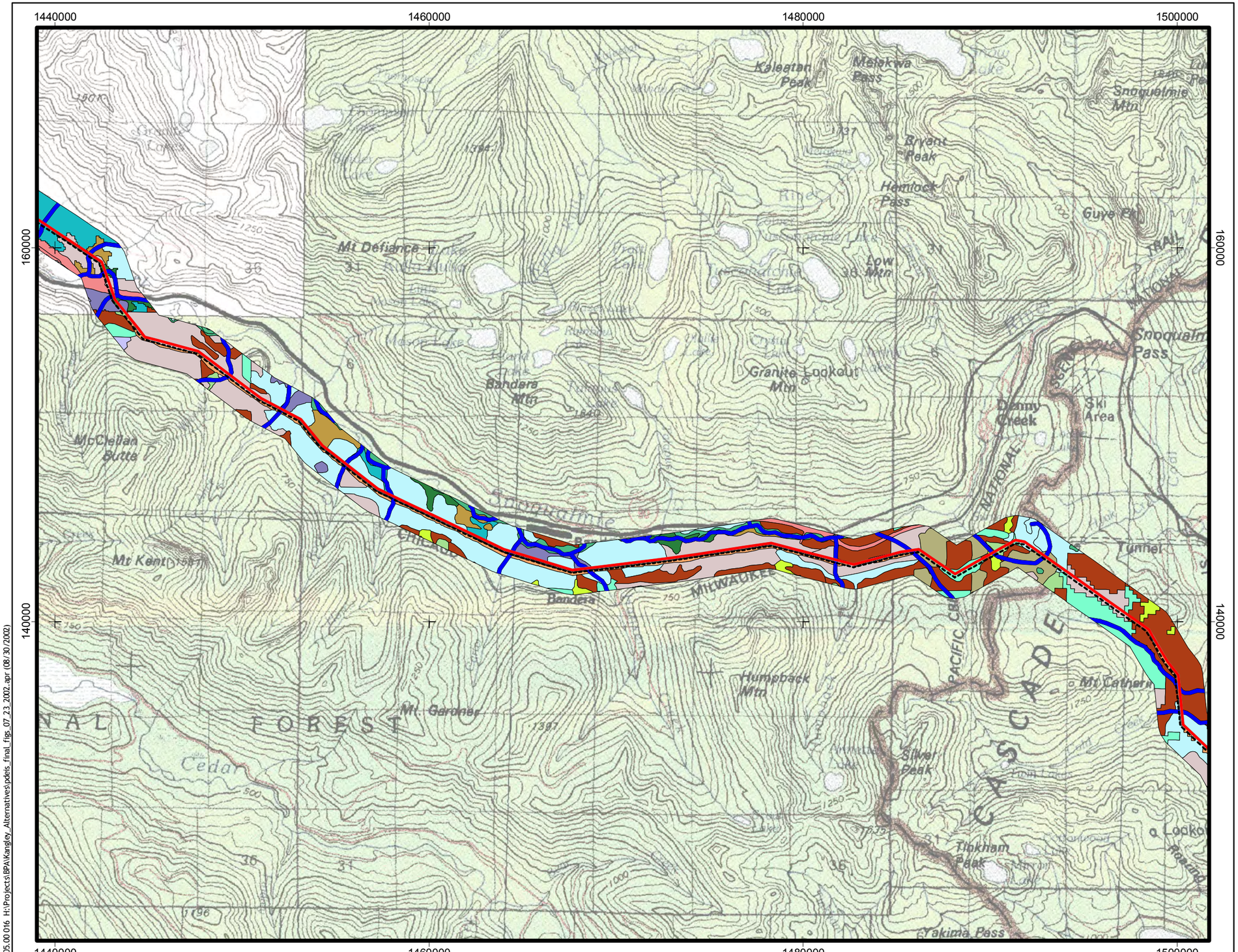
Projection: Washington State Plane
Zone: North Zone
Datum: NAD83
Units: Feet US

N

0.5 0 0.5 1 1.5 Miles

Scale 1" = 1 Mile

Jones & Stokes



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Figure 2-D-2
Sheet 2 of 3
Alternative D (Option D-2)
Vegetation Cover Types within 0.25-Mile of the Action Alternatives

Legend

- Developed
- Early Regeneration Conifer
- Managed Early Regeneration Conifer
- Early Regeneration Mixed
- Lake / River / Stream
- Mature Conifer Regeneration
- Mature Conifer
- Mature Deciduous
- Managed Grass / Forb / Shrub
- Mature Mixed Regeneration
- Mid-Regeneration Conifer
- Mid-Regeneration Deciduous
- Mid-Regeneration Mixed
- Natural Non-Forested Grassland
- Natural Non-Forested Shrubland
- Rural Residential / Managed Landscape
- Natural Non-Vegetation
- Riparian Habitat
- Alternative D North Centerline
- Existing BPA Transmission Lines

Source: USGS Snoqualmie Pass, WA 100K Quadrangle.

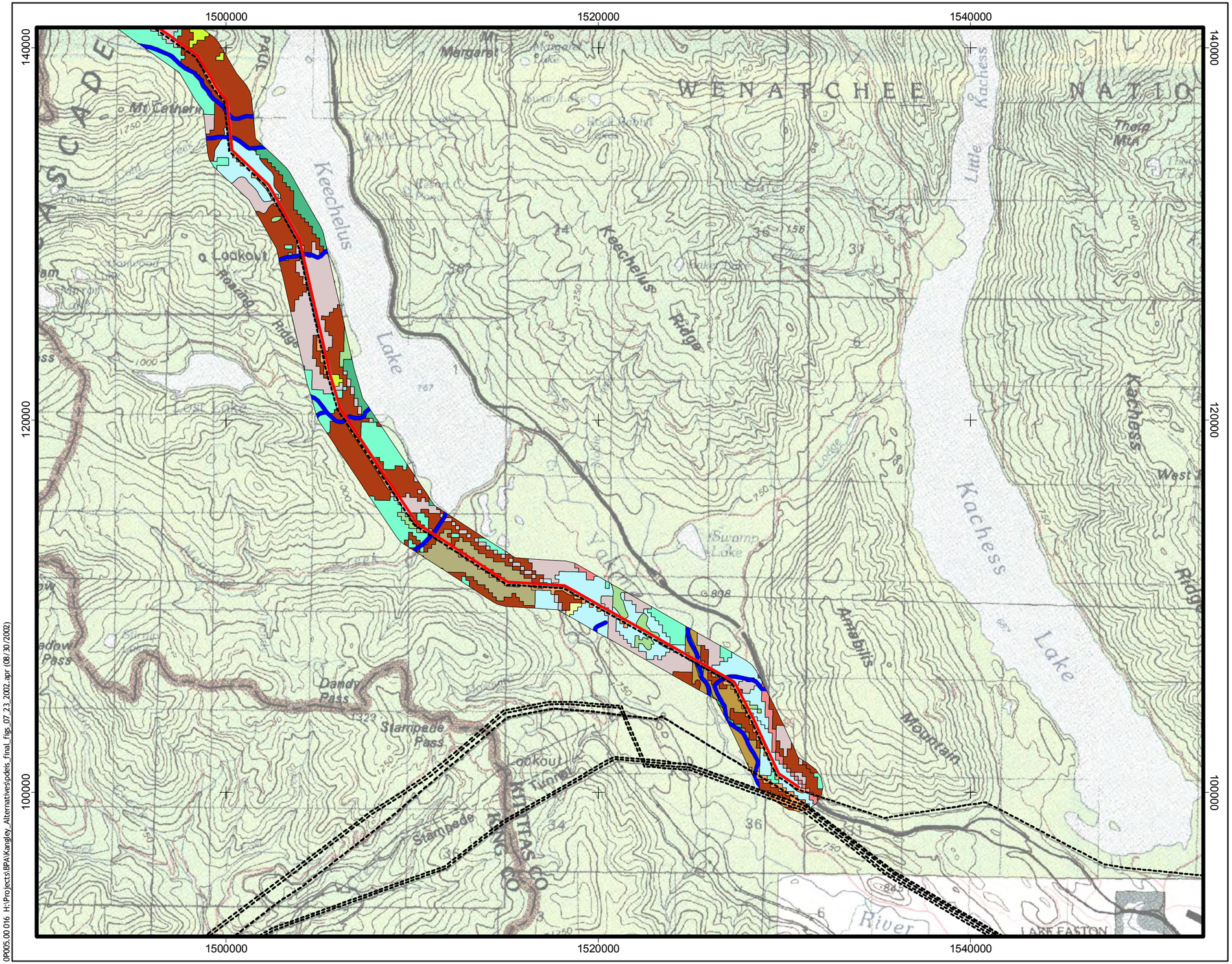
Projection: Washington State Plane
Zone: North Zone
Datum: NAD83
Units: Feet US

N

0.5 0 0.5 1 1.5 Miles

Scale 1" = 1 Mile

Jones & Stokes



0P005.00 016 H:\Projects\BPA\Kangley_Alternatives\pdeis_final_figs_07_23_2002.apr (08/30/2002)

Figure 2-D-2
Sheet 3 of 3
Alternative D (Option D-2)
Vegetation Cover Types within 0.25-Mile of the Action Alternatives

Legend

- Developed
- Early Regeneration Conifer
- Managed Early Regeneration Conifer
- Early Regeneration Mixed
- Lake / River / Stream
- Mature Conifer Regeneration
- Mature Conifer
- Mature Deciduous
- Managed Grass / Forb / Shrub
- Mature Mixed Regeneration
- Mid-Regeneration Conifer
- Mid-Regeneration Deciduous
- Mid-Regeneration Mixed
- Natural Non-Forested Grassland
- Natural Non-Forested Shrubland
- Rural Residential / Managed Landscape
- Natural Non-Vegetation
- Riparian Habitat
- Alternative D North Centerline
- Existing BPA Transmission Lines

Source: USGS Snoqualmie Pass, WA 100K Quadrangle.

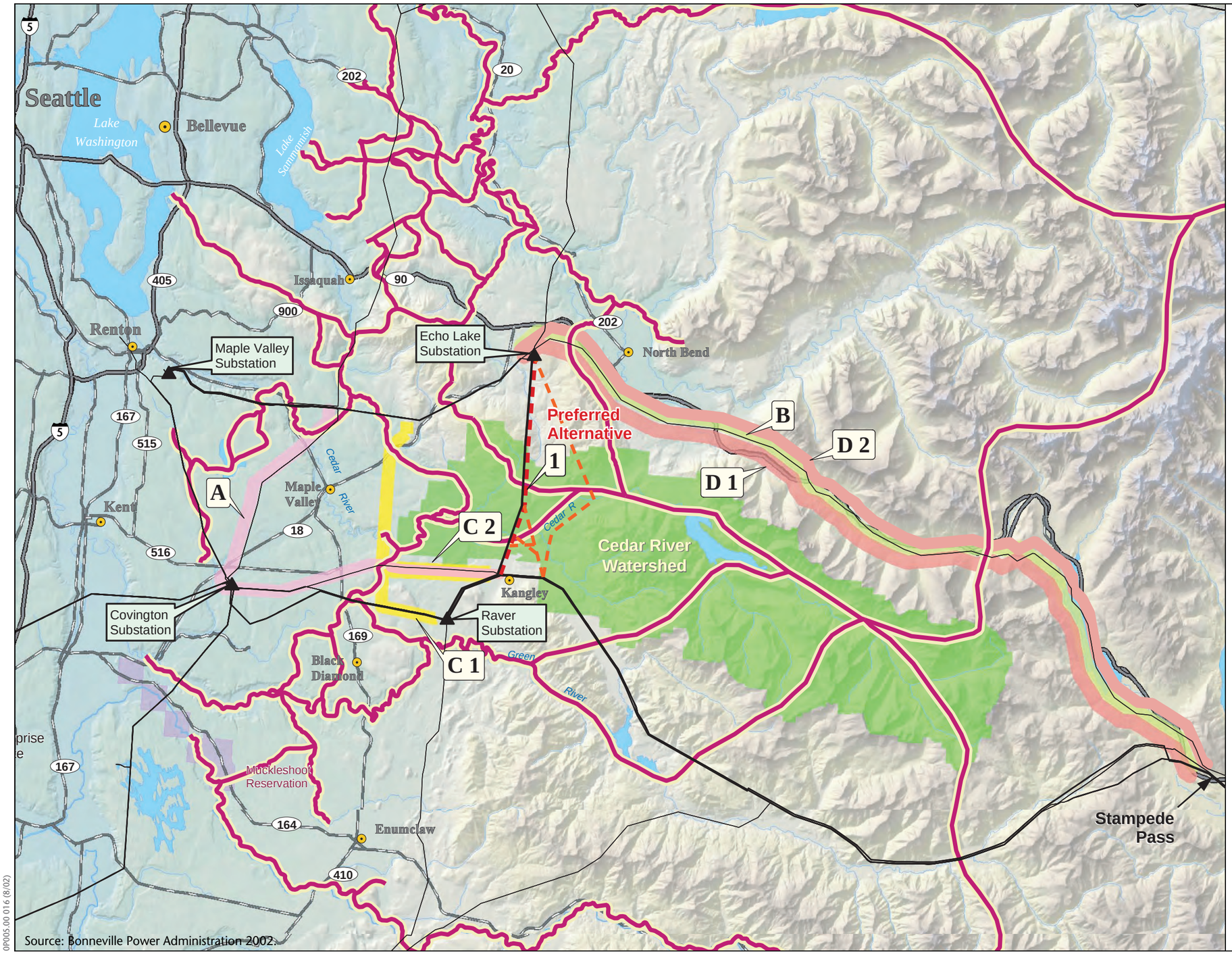
Projection: Washington State Plane
Zone: North Zone
Datum: NAD83
Units: Feet US

N

0.5 0 0.5 1 1.5 Miles

Scale 1" = 1 Mile

Jones & Stokes



Source: Bonneville Power Administration 2002.

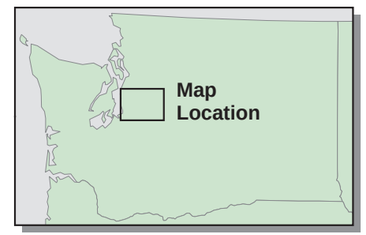
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Legend

- Existing BPA Transmission Lines
- Preferred Alternative
- Wildlife Habitat Network
- BPA Substations

Alternatives

- A
- B
- C
- D



N

0 3 6 9 12

Miles

May 10, 2002

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Figure 3
Wildlife Corridors Identified in the King County Comprehensive Plan

Table 2. Wildlife Species with Federal or State Listing Status Potentially Present in Proposed Study Area

Species Name	Status[a]	Habitat Association	Probability of Occurrence
Primary Association with Forested Communities			
Northern spotted owl (*Strix occidentalis caurina*)	FT, SE	Mature and old-growth forest with multiple canopy layers and large amounts of dead and down woody material (FEMAT 1993).	Known to occur in the project vicinity. Potential nesting habitat is located in the mature coniferous forest type within the study area. Roosting, foraging, and dispersal habitat may occur within the mature regeneration forest habitat types. May occur in the study area.
Marbled murrelet (*Brachyramphus marmoratus*)	FT, ST	Mature and old-growth forest with trees having large-diameter branches for nesting (Hamer and Cummins 1991).	Known to occur in the project vicinity. Potential nesting habitat is located in the mature coniferous forest type within the study area. May pass through study area, while traveling to suitable nesting habitat nearby.
Northern goshawk (*Accipiter gentilis*)	FC, SC	Generally found in large stands of multi-layered, old-growth forest containing small openings. May forage in younger stands. (Reynolds et al. 1992).	Known to occur within the project vicinity; potentially suitable nesting habitat occurs in the mature forest types within the study area; suitable foraging habitat occurs throughout the study area in the mid regeneration forest habitat types.
Black swift (*Cypseloides niger*)	SM	Forested habitats at moderate elevations in the Washington Cascades; mid- to late seral conifer and mixed forests and forested riparian areas above the Puget Sound Douglas fir zone. May nest in cliffs (Smith et al. 1997).	Known to occur within the project vicinity; potentially suitable habitat occurs within the study area.
Merlin (*Falco columbarius*)	SC	A migratory bird with potential nesting habitat in high-elevation forests along the Cascade crest; coniferous forest in the Pacific silver fir zone and above (Smith et al. 1997).	Known to occur within the project vicinity; nesting most likely to occur at higher elevations. May utilize lower elevation areas in study area as a migrant. May occur in the study area.
Western sulphur butterfly (*Cosias occidentalis occidentalis*)	SM	Open areas including meadows, sagebrush flats, conifer forest openings, and power-line cuts (USGS 2002b).	Known to occur within the project vicinity; potential habitat occurs within the study area (USGS 2002b).
Black-backed woodpecker (*Picoides arcticus*)	SC	Inhabits high elevation (above 3,000 ft.) forests of spruce/fir and mixed deciduous/coniferous especially those with burned areas, windfalls, and a lot of standing dead trees. Also found in swamps at high elevation. During the winter will wander into lower elevation coniferous forests (below 3,000 ft.) (PBI 2002b).	Known to occur within the project vicinity; potential habitat occurs within the study area (WDFW 2002).

Species Name	Status[a]	Habitat Association	Probability of Occurrence
Olive-sided flycatcher (*Contopus borealis*)	FC	Forested areas where large patches of trees are adjacent to openings caused by factors such as fire, timber cutting, and water bodies; at all elevations (Smith et al. 1997).	Known to occur within the project vicinity; potential nesting habitat occurs in the forest habitat types within the study area; in the rural residential areas where large trees remain; and in riparian forest buffers.
Pileated woodpecker (*Dryocopus pileatus*)	SC	Mature and old-growth forest; second growth with abundant snag and down wood component (Rodrick and Milner 1991).	Known to occur within the project vicinity; potential habitat occurs in the forest habitat types within the study area where snags are abundant. Potential habitat also occurs within riparian forest buffers and within the rural residential area where large trees remain.
Vaux's swift (*Chaetura vauxi*)	SC	Mature and old-growth coniferous forest; large hollow trees needed for roosting and nesting; occasionally utilize chimneys and cliffs (Rodrick and Milner 1991).	Known to occur within the project vicinity; potential habitat occurs in the forest habitat types within the study area, where snags are abundant. Potential habitat also occurs within riparian forest buffers and within the rural residential area where swifts may also utilize chimneys.
Band-tailed pigeon (*Columba fasciata)*	LC	Migratory birds that breed in western Washington, primarily below 1,000 ft. in elevation in early to late seral coniferous or deciduous forests. Move to higher elevations in late summer (Rodrick and Milner 1991).	Known to occur within the project vicinity; potential nesting habitat occurs in the forest habitat types within the lower elevations of the study area. May occur within the study area.
Red-tailed hawk (*Buteo jamaicensis*)	LC	Require trees for nesting and open habitats for foraging (Udvardy 1977). In western Washington, nest in hardwoods, preferring black cottonwood and red alder. Occur in all forested areas except dense mature or old-growth forest and alpine/parkland areas. Common around human developments and roads (Smith et al. 1997).	Known to occur within the project vicinity; potential nesting habitat occurs in the forest habitat types. May occur in the study area.
Blue grouse (*Dendragapus obscurus*)	LC	Mixed and coniferous forests at all elevations (Smith et al. 1997).	Potentially suitable habitat occurs throughout the forested portions of the study area.
Great arctic butterfly (*Oeneis nevadensis gigas*)	SC	Inhabit coniferous forest openings, rocky hills, and meadow edges in the mountains. Males perch all day in valley glades and on hilltops to seek females. Eggs are laid on dry grasses. Pupation takes place at roots of grasses or under rocks (USGS 2002d).	Known to occur within the project vicinity; potential habitat occurs within the study area (USGS 2002d).
Fisher (*Martes pennanti*)	FC, SC	Dense mature forest; second growth with adequate cover; require snags and down logs; low to mid elevational forest (Johnson and Cassidy 1997).	May occur in forested areas, riparian buffers, and rural residential areas within the study area where large trees remain.

Species Name	Status[a]	Habitat Association	Probability of Occurrence
Fringed myotis (*Myotis thysanoides*)	FC, SM	Primarily an eastside species that utilizes dry woodlands, desert, and grassland. Not strongly associated with human structures (Johnson and Cassidy 1997). Also found in immature coniferous forest west of the Cascade crest (City of Seattle 2000).	May occur in forested areas, riparian buffers, and rural residential areas within the study area.
Keen's myotis (*Myotis keenii*)	SM	Low-elevation forests in the Puget Sound Douglas fir and western hemlock zones; coastal forests (Johnson and Cassidy 1997).	May occur in the lower elevation forested areas, riparian buffers, and rural residential areas within the study area.
Long-eared myotis (*Myotis evotis*)	FC, SM	Forested habitat below the subalpine/parkland zone; roosts in trees, buildings, and caves and occurs in areas of low-density development (Johnson and Cassidy 1997).	May occur in the lower elevation forested areas, riparian buffers, and rural residential areas within the study area.
Long-legged myotis (*Myotis volans*)	FC, SM	Widespread within a wide range of habitats. Breeds in caves, abandoned mine tunnels, and attics (Barbour and Davis 1969).	May occur in the lower elevation forested areas, riparian buffers, and rural residential areas within the study area.
Townsend's western big-eared bat (*Plecotus townsendii*)	FC, SC	Caves, lava tubes, abandoned buildings, away from human disturbance (Rodrick and Milner 1991). Any forest type containing suitable roost, nursery, or hibernation sites such as caves, mines, buildings, and bridges; forage along forest edges (Christy and West 1993).	May occur in the lower elevation forested areas, riparian buffers, and rural residential areas within the study area.
Hoary bat (*Lasiurus cinereus*)	J2	Frequents wooded areas where it roosts in the open by hanging from a branch or twig, typically coniferous (BCII 2002).	Known to occur within the project vicinity; potential habitat occurs in the coniferous forest habitat types within the study area (WDFW 2002).
Johnson's hairstreak (*Mitoura johnsoni*)	SC	Coniferous forests, especially old-growth on Pacific slope side of mountains (USGS 2002a). Lowland old-growth coniferous forest containing mistletoe in the genus Arceuthobium, which is usually associated with western hemlock but may occur in true firs (Larsen et al. 1995).	Known to occur within the project vicinity; potential habitat occurs in the coniferous forest habitat types within the study area (WDFW 2002).
Silver-haired bat (*Lasionycteris noctivagans*)	J2	Found in coniferous or mixed coniferous and deciduous forest types, especially in areas of old-growth. They form maternity colonies almost exclusively in tree cavities or small hollows. Unlike many bat species, silver-haired bats also appear to hibernate mainly in forested areas, though they may be making long migrations from their summer forest to a winter forest site. Typical hibernation roosts for this species include small tree hollows, beneath exfoliating bark, in wood piles, and in cliff faces. Occasionally silver-haired bats will hibernate in cave entrances. Feed predominantly in disturbed areas, sometimes at tree-top level, but often in small clearings and along roadways or water courses. [BCII 2002]	Known to occur within the project vicinity; potential habitat occurs in coniferous or mixed coniferous/deciduous forest (especially the mature forest habitat types) within the study area (WDFW 2002).

Species Name	Status[a]	Habitat Association	Probability of Occurrence
Blue-gray tail-dropper (*Prophysaon coeruleum*)	C-3 ROD Species in Northwest Forest Plan	Puget Trough and western Cascade Range and possibly on eastern slope of the Cascade Range to 3,000-ft. elevation. Found in open to moist conifer and mixed conifer forests within areas of high shade and moisture levels; associated with partially decayed logs, leaf litter. (Furnish et al. 1997; Frest and Johannes 1993).	Potential habitat occurs within the study area in forested areas with a large down wood component.
Oregon megomphix (*Megomphix hemphilli*)	C-3 ROD Species in Northwest Forest Plan	Moist low- to mid-elevation forests, preferably undisturbed; late-successional forest in riparian areas (Frest and Johannes 1993).	Potential habitat occurs within the study area in forested areas with a large down wood component.
Puget Oregonian snail (*Cryptomastix devia*)	C-3 ROD Species in Northwest Forest Plan	Western Cascade Range and Puget Trough at low to moderate elevations. On or under hardwood logs and litter and cool, moist talus and rocks; under sword ferns, bigleaf maples; western hemlock zone. (Furnish et al. 1997, Tables 1 and 2; Frest and Johannes 1993).	Known to occur within the project vicinity; potential habitat occurs in the forest habitat types within the study area where down wood, litter, and debris is abundant.
Evening field slug (*Derocerus hesperium*)	C-3 ROD Species in Northwest Forest Plan	Forested areas west of the crest of the Cascade Range, usually below 610 m (2,000 ft.). Key features: variety of low shrubs, litter, debris, and rocks.	Known to occur within the project vicinity; potential habitat occurs in the forest habitat types within the study area where down wood, litter, and debris is abundant.
Keeled jumping slug (*Hemphillia burringtoni*)	C-3 ROD Species in Northwest Forest Plan	Mesic to moist conifer forests. Key features: conifer logs and/or heavy ground cover of low vegetation, litter, and debris.	Known to occur within the project vicinity; potential habitat occurs in the forest habitat types within the study area where down wood, litter, and debris is abundant.
Warty jumping slug (*Hemphillia glandulosa*)	C-3 ROD Species in Northwest Forest Plan	Mesic to moist conifer forests. Key features: Conifer logs and/or heavy ground cover of low vegetation, litter, and debris.	Known to occur within the project vicinity; potential habitat occurs in the forest habitat types within the study area where down wood, litter, and debris is abundant.
Primary Association with Riparian Communities			
Bald eagle (*Haliaeetus leucocephalus*)	FT (PD), ST	Usually found near large bodies of water where primary prey items of fish and waterfowl can be found (USFWS 1986).	There are no known nests within the study area (WDFW 2000), although potential nesting habitat occurs in the mature forest habitat type near water in the study area; known to occur as transients in the study area; may forage along river systems within the study area.
Great blue heron (*Ardea herodias*)	SM	Breed in colonies located in deciduous or evergreen trees; feed on aquatic and marine animals in shallow water; small mammals also utilized (Quinn and Milner in press).	There are no known nesting colonies within the study area; potential foraging habitat occurs in wetlands and along streams. May occur in the study area.

Species Name	Status[a]	Habitat Association	Probability of Occurrence
Common loon (*Gavia Immer*)	SC	Large lakes with minimal human disturbance (Rodrick and Milner 1991)	Known to occur within the project vicinity; potential habitat occurs within the study area.
Osprey (*Pandion haliaetus*)	SM	Nests constructed in large snags or live trees with flat tops; prey on fish captured near water surface (Rodrick and Milner 1991).	Known to nest within the project vicinity; potential habitat exists within riparian areas; in the rural residential areas where large trees remain; and in riparian buffers. May occur in the study area.
Aleutian Canada goose (*Branta canadensis*)	ST	Nest and feed in various habitats in and around the shoreline of streams, rivers, ponds, lakes, and reservoirs. However, can also be found feeding in upland habitats including agricultural land, pastures, and meadows (Csuti et al. 1997).	Known to occur within the project vicinity; potential habitat may occur in and around bodies of water adjacent to the study area (WDFW 2002).
Willow flycatcher (*Empidonax traillii*)	FC	Low-elevation wetlands, clearcuts, and shrub habitats. Forested areas below the pacific silver fir zone in western Washington containing suitable microhabitats (Smith et al. 1997).	Known to nest within the project vicinity; potential habitat occurs throughout the study area. May occur in the study area.
Harlequin duck (*Histrionicus histrionicus*)	LC	Nests in riparian areas of clear, clean, swiftly flowing second- to fifth-order streams; winters in coastal waters (Rodrick and Milner 1991).	Known to occur within the project vicinity; potential nesting habitat occurs within the proposed alignments where it crosses forested riparian areas. May occur in study area.
Mink (*Mustela vison*)	LC	Found along the banks of streams, rivers, lakes, ditches, and wetlands and in surrounding forests and meadows at all elevations (Johnson and Cassidy 1997).	Potential habitat occurs in the study area within the riparian habitat type.
Great gray owl (*Strix nebulosa*)	SM	Great gray owls inhabit a range of forested habitats. They are frequently found in stunted coniferous and hardwood forests, typically at high elevations. Nesting habitat usually includes copses or islands of aspens within pure stands of conifers. Most foraging is done in open areas such as swamps, bogs, and forest clearings where there are scattered trees and shrubs that can be used as perches. During migration they may be found in estuaries, mountain meadows, and along farm fields (The Owl Pages 2002).	Known to occur near the project vicinity. Potentially suitable habitat occurs within the study area in the forest habitat types. Only recorded locations in Washington are along the border between Okanogan and Ferry Counties (WDFW 2002) and Elk Heights (USFS 2002).
Van Dyke's salamander (*Plethodon vandykei*)	SC	Usually among large, woody debris within the wetted edge of streams and seeps. Near the northernmost edge of known range. (Leonard et al. 1993).	Potential habitat occurs in the study area within the forested riparian habitat types.

Species Name	Status[a]	Habitat Association	Probability of Occurrence
Primary Association with Aquatic Communities			
Cascades frog (*Rana cascadae*)	FC, SM	Highly aquatic. Closely associated with edges of seeps and other wetlands (Leonard et al. 1993).	Known to occur within the project vicinity; potential habitat occurs in ponds, wetlands, slow-moving streams, and riparian areas. May occur in the study area.
Red-legged frog (*Rana aurora*)	FC, SM	Breeds in ponds or slow-moving water containing aquatic vegetation; adults highly terrestrial, occurring in forested areas or disturbed sites with a residual down wood component (Dvornich et al. 1997).	Known to occur within the project vicinity; potential habitat occurs in riparian forest, wetlands, seeps, and slow-moving streams. May occur in the study area.
Cascade torrent salamander (*Rhyacotriton cascadae*)	SC	Associated with splash zones of cold-water seeps, streams, and waterfalls in the southern Cascades, primarily within the western hemlock zone; known to occur from Mt. Rainier south in the Cascades (Dvornich et al. 1997).	May occur where seeps and small cold streams occur within the study area.
Oregon spotted frog (*Rana pretiosa*)	FC, SC	Marshes, ponds, streams and lakes; shallow, slow-moving water with abundant emergent vegetation (Nordstrom and Milner 1997).	Potential habitat occurs within the study area in wetlands and ponds.
Tailed frog (*Ascaphus truei*)	FC, SM	Turbulent mountain streams (Leonard et al. 1993). Has been found as high as 7,000 ft. elevation.	Known to occur in the project vicinity; potential habitat occurs within the study area in cold, fast-flowing streams.
Western toad (*Bufo boreas*)	FC	Ponds and shallow lakes, with forest, brush, and meadow associated; adults terrestrial, large down wood an important habitat component (Corkran and Thoms 1996).	Known to occur within the project vicinity; potential habitat exists within study area in wetlands and the forested riparian habitat types.
Fender's Soliperlan stonefly (*Solipera fenderi*)	FC	Cold fast-flowing streams and springs; seeps and headwaters of small streams (Pacific Biodiversity Institute 2000).	Potential habitat occurs within the study area in cold, fast-flowing streams.
Primary Association with Unique Habitats			
Peregrine falcon (*Falco peregrinus*)	SE	Cliffs, areas with large concentrations of waterfowl or flocking birds (Johnsgard 1990).	Potentially suitable nesting habitat is located along ridges within the study area. May occur in the study area.
Larch Mountain salamander (*Plethodon larselli)*	FC, SS	Steep, moist talus slopes, usually moss-covered and under a forest canopy (Leonard et al. 1993). Species has been found as far north as Cle Elum, WA.	May occur within the forested habitat types within the study area where either talus or woody debris occur.
Yuma myotis (*Myotis yumanensis*)	FCo	Always near ponds, streams, or lakes (bodies of water). Daytime roosts include rock or tree crevice and underneath siding and shingles. Night roosts include buildings, caves, mine shafts (Whitaker 1980).	Known to occur within the project vicinity; potential habitat occurs in and around rocky cliffs, walls, and cave areas (especially those that surround bodies of water) within the study area (WDFW 2002).

Species Name	Status[a]	Habitat Association	Probability of Occurrence
Valley silverspot (*Speyeria zerene bremnerii*)	FCo, SC	Open prairies, sub-alpine glades, mid-elevation roadsides, and clearings. Western blue violet is host plant.	Not known to occur within the project vicinity; potential habitat may occur in open or disturbed habitat adjacent to the study area.
Mardon skipper (*Polites mardon*)	FC, SE	Inhabits grasslands and meadows at low elevations in the Cascades, especially on serpentine soil. Has been found but is uncommon in western Washington, western Oregon, and northwestern California (USGS 2002c).	Known to occur within the project vicinity; potential habitat may occur in and around bodies of water adjacent to the study area (USGS 2002c).
Primary Association with Early Seral Communities			
Gray wolf (*Canis lupus*)	FE, SE	Wilderness; isolation from human disturbance for denning (Paradiso and Nowak 1982).	Known to occur in the project vicinity (USFS 2002). Wide-ranging species that is expected to occur in the project area while dispersing/traveling. Denning and rendezvous sites occur in remote areas. Due to human disturbances in the project area, the species' use of the available habitat would be incidental.
Elk (*Cervus elaphus*)	LC	Combination of forest and open habitats; edge habitats; seclusion from human disturbance important for calving (Thomas and Toweill 1982).	Known to occur in the study area year-round.
Black-tailed deer (*Odocoileus hemionus*)	LC	Hardwood and coniferous forest; dense shrubs or other early successional stages containing trees or shrubs. Also meadows and grasslands (Johnson and Cassidy 1997).	Known to occur in the study area year-round.
Western bluebird (*Sialia mexicana*)	SM	Insectivorous cavity-nesting bird; lowlands and foothills of Washington (Rodrick and Milner 1991).	Limited nesting habitat present within the project vicinity; may occur in the riparian buffers and within the rural residential areas.
Grizzly bear (*Ursus arctos*)	FT, SE	Large tracts of wilderness; meadows, wet areas, open slopes with huckleberries for foraging (USFWS 1993).	Known to occur in the project vicinity (USFS 2002). Wide-ranging species that is expected to occur in the project area. Due to human disturbances in the project area, their use of the available habitat would be incidental.

[a] FT = federal threatened, FE = federal endangered, FT(PD) = federal threatened, proposed for delisting, FC = federal (USFWS) species of concern, J2 = USFS species of interest, SE = state endangered, SS = state sensitive, ST = state threatened, SC = state candidate, SM = state monitor, and LC = local concern.

Table 3. Species with Federal or State Listing Status Not Expected to Occur within the Proposed Study Area

Species	Status[a]	Habitat Association	Probability of Occurrence
Three-toed woodpecker (*Picoides tridactylus*)	SM	Conifer forests at high elevation; may occur in the Pacific silver zone but more likely in higher zones. Closed-canopy forests preferred; also known to use open habitats including burns (Smith et al. 1997).	May occur within the project vicinity at higher elevations. Habitat lacking within the lower elevation forests of the study area. Not expected to occur in the study area.
Canada lynx (*Lynx canadensis*)	FT, ST	Requires early successional habitat for primary prey (snowshoe hare) and late-successional subalpine fir/spruce forest for breeding. (Ruediger et al. 2000).	Study area is not within the expected range of Canada lynx in the western Cascades; may occur in the upper elevations within the project vicinity.
Western pond turtle (*Clemmys marmorata*)	FC, SE	Marshes, sloughs, and slow-moving streams; soils that drain quickly are preferred for nesting (Dvornach et al. 1997).	Habitat for this species lacking within the proposed ROWs. Not expected to occur in the study area.
Mountain goat (*Oreamnos americanus*)	LC	Rocky mountainous areas above timberline (Whitaker 1980).	Mountain goats are found near the project vicinity. However, because the study area is well below timberline, it is unlikely they will be present. (WDFW 2002).
Beller's ground beetle (*Agonum belleri*)	FC, SC	Sphagnum bogs from sea level to 3,300-ft. elevation (Rodrick and Milner 1991).	Not expected to occur in the study area due to a lack of sphagnum bogs.
Hatch's click beetle (*Eanus hatchi*)	FC, SC	Eutrophic sphagnum bogs from sea level to the 3,300-ft. elevation (Rodrick and Milner 1991).	Not expected to occur in the study area due to a lack of sphagnum bogs.
Long-horned leaf beetle (*Donacia idola*)	SC	Eutrophic sphagnum bogs from sea level to 3,300-ft. elevation (Rodrick and Milner 1991).	Not expected to occur in the study area due to a lack of sphagnum bogs.
Golden eagle (*Aquila chrysaetos*)	SC	Nests primarily in high rocky cliffs in areas with a suitable prey base, primarily rabbits and marmots. West of the Cascades is known to utilize the high-elevation subalpine/parkland zones and has been observed foraging in clearcuts at moderate elevation (Smith et al. 1997).	No known occurrences in the project vicinity; may occur in the higher elevations within the project vicinity.
Wolverine (*Gulo gulo*)	FC, SM	A true wilderness species requiring large areas of minimally disturbed habitats (Banci 1994).	May occur within the higher elevation areas of the project vicinity; habitat is lacking in the study area.

[a] FT = federal threatened, FE = federal endangered, FC = federal (USFWS) species of concern, SE = state endangered, ST = state threatened, SC = state candidate, SM = state monitor, and LC = local concern.

3.3.2.1 Forest Community Dependent Species

A number of wildlife species, including invertebrates, were identified as potentially occurring within the study area and as having a primary association with forested community habitat. These species are discussed in the following text. For definitions of the wildlife habitat type codes used in the text, see Table 1.

Northern spotted owls may occur within the study area. There are no known spotted owl site centers within or adjacent to the ROWs, but thorough surveys have not been conducted in the study area (WDFW 2000). Mature coniferous forest (MC) is potential nesting habitat for northern spotted owls and occurs in limited amounts in the project area. Mature coniferous regeneration and mature coniferous forest may provide foraging habitat for spotted owls. In addition, areas of mid- to mature coniferous regeneration and mature coniferous forest in this area could be important for dispersal between suitable nesting habitat adjacent to the study area and future potential nesting habitat within the study area.

Marbled murrelets may occur within the study area because it includes stands of mature coniferous and mature regeneration coniferous forest that may contain structures large enough to support nesting habitat. Although surveys have not been thoroughly conducted, there are no known records of marbled murrelets located within the study area (WDFW 2000).

Great gray owls may occur in the vicinity of the proposed project, particularly in the higher elevation areas; however the probability of occurrence is low. Currently, the only confirmed and probable locations of breeding evidence that have been recorded in Washington are along the U.S./Canadian border between Okanogan and Ferry Counties in the northeast portion of the state (WDFW 2002).

Great gray owls inhabit a range of high elevation, forested habitats including coniferous and deciduous forests and are suspected to occur in the Cascade Range (The Owl Pages 2002). Nesting habitat usually includes copses or islands of aspens or other deciduous trees within pure stands of conifers (ERC, MRC, MCR, MC, MRD, MD, ERM, MRM, and MMR). Great gray owls generally forage in open areas such as forest clearings, bogs, and swamps that contain perches such as scattered trees and shrubs. During migration they may be found along farm fields, in mountain meadows, and in estuaries and wetlands.

Northern goshawks and **pileated woodpeckers** are known to nest in portions of the study area. Goshawks and pileated woodpeckers are both known to nest in older forest types (Reynolds et al. 1992, Rodrick and Milner 1991). The study area contains mature conifer and mature regeneration conifer that are either at or approaching conditions that would make them suitable nesting habitat for these species. Although no evidence of nesting was observed during field reconnaissance surveys, these stands may provide nesting habitat for these species, particularly in riparian areas. Pileated woodpeckers may nest in second-growth stands if large downed wood and snags are abundant (Rodrick and Milner 1991). Mature conifer and all mature regeneration forest types (MCR, MD, and MM) within the study area may be suitable foraging habitat for pileated woodpeckers. All mid-regeneration, mature regeneration (MRC, MCR, MRD, MD, MRM, and MMR), and mature conifer (MC) forest types are potential dispersal habitat for both pileated woodpeckers and northern goshawks, and potential foraging habitat for northern goshawks.

Vaux's swifts may nest within the study area. Large hollow trees, suitable for nesting Vaux's swift, may be found in the limited amount of mature coniferous forest, but are generally lacking within the study area. Abandoned chimneys in the residential areas (DEV and RRM) could

potentially provide nesting habitat (Smith et al. 1997). However, all forest types (ERC, MRC, MCR, MC, MRD, MD, ERM, MRM, and MMR) within the study area are suitable for use as foraging habitat for Vaux's swift, because they are known to feed on flying insects in all forest seral stages (Rodrick and Milner 1991).

Merlins are rare in Washington, and nesting in the Cascades occurs in high-elevation forests (Smith et al. 1997). Merlins could potentially nest in the higher elevations near Stampede Pass, although their presence there is unlikely. However, forest within the study area (ERC, MRC, MCR, MC, MRD, MD, ERM, MRM, and MMR) may contain potential dispersal or migratory habitat for merlins.

Mature deciduous regeneration, mature coniferous regeneration, and mature coniferous forest within the study area are potential nesting and foraging habitat for **black swifts**, which utilize both coniferous and mixed coniferous/deciduous mid- to late seral forests (Smith et al. 1997). Mature regeneration and mature coniferous, as used in this document, have characteristics of mid- to late seral forest.

Both **olive-sided flycatchers** and **red-tailed hawks** nest in forested habitat and utilize edges and openings for foraging (Smith et al. 1997). All forested stands (MRD, MD, ERC, MRC, MCR, MC, ERM, MRM, and MMR) within the study area are potential nesting habitat for these species, and vegetated open areas (MGF, MS, NNFS, and NNFG) are potential foraging habitat. Rural residential/managed landscape areas (RRM) are not included for olive-sided flycatchers because they are not areas of primary use; however, such areas are included for the red-tailed hawk, which often occurs near areas of human activity (Smith et al. 1997).

The **black-backed woodpecker** occurs in the general vicinity of the proposed project (WDFW 2002). It inhabits high elevation (above 3,000 ft.) coniferous and coniferous deciduous mixed forests especially those with burned areas, windfalls, and many standing dead trees (ERC, MRC, MCR, MC, ERM, MRM, and MMR). The species can also be found in swamps at a high elevation. During the winter the species travels into lower elevation forests (below 3,000 ft.) (Pacific Biodiversity Institute 2002).

Both **band-tailed pigeons** and **blue grouse** occur in forest habitats ranging from early to late seral (Smith et al. 1997); therefore all forested types (MRD, MD, ERC, MRC, MC, MCR, MRM, and MMR) in the study area may be habitat for them. Band-tailed pigeons are migratory and nest at lower elevations, moving upslope with the fruit and berry crops in late summer and then migrating south for the winter (Rodrick and Milner 1991). The higher elevation areas within the study area would likely be used for nesting. Blue grouse, however, would occur in the study area year-round because they are not migratory (Rodrick and Milner 1991).

Fisher are most commonly associated with late-successional forest with an abundant supply of large downed wood and snags available for breeding and resting, but they will travel through any type of forested habitat and avoid openings (Maser 1998, Johnson and Cassidy 1997). For this reason, all forest types in the study area (ERC, MRC, MCR, MC, MRD, MD, ERM, MRM, and MMR) were included as potential travel habitat for fisher. These types are also considered potential foraging habitat because the foraging behavior of fisher appears to be largely opportunistic (Maser 1998).

Six species of bats have been identified as potentially occurring in the forest community. Four of these are species within the genus myotis and are associated with forested habitat. Three of these species (**Keen's myotis**, **long-eared myotis**, and **long-legged myotis**) are also known to utilize

structures such as buildings and bridges for roosting (Johnson and Cassidy 1997, Barbour and Davis 1969). For these reasons, all forest (ERC, MRC, MC, MCR, MRD, MD, ERM, MRM, and MMR), lake/river/stream, rural residential/managed landscape, and developed areas were included as potential habitat for these three species.

Rural residential/managed landscape and developed areas were not included for **fringed myotis,** because they are less likely to utilize human structures (Johnson and Cassidy 1997). Within forested areas, these bats are most likely to utilize older forest containing snags that are either hollow or have loose bark for roosting or for maternity colonies. The forest habitat types (ERC, MRC, MC, MCR, MRD, MD, ERM, MRM, and MMR), occurring within the study area are potential foraging habitat for these species (Maser 1998).

In addition to the myotis species, the **Townsend's big-eared bat** occurs in forested habitats, but is strongly associated with caves, mines, and buildings for roosting, maternity colonies, and hibernation (Christy and West 1993, Johnson and Cassidy 1997, Rodrick and Milner 1991). This species forages in forest habitats, often along edges (Christy and West 1993) and, therefore, all forested types (ERC, MRC, MCR, MC, MRD, MD, ERM, MRM, and MMR) were included as potential habitat. Rural residential/managed landscape and developed areas were also included due to the association of this species with human structures.

The **silver-haired bat** has not been recorded in the vicinity of the proposed project, although they have been found in locations in northwestern King County (WDFW 2002). This species probably occurs in the vicinity of the proposed project, especially in older coniferous or mixed coniferous and deciduous forest habitat and around rocky cliffs and caves (MRC, MCR, MC, MRD, MD, MRM, and MMR). The silver-haired bat inhabits coniferous or mixed coniferous and deciduous forest types, usually in areas of old growth. The species also hibernates in forested areas, typically in small tree hollows, beneath exfoliating bark, in woodpiles, and in rocky cliff faces. Silver-haired bats will occasionally hibernate in cave entrances. The species forms maternity colonies located almost exclusively in small hollows or tree cavities. The animals feed predominantly in disturbed areas, sometimes at treetop level, but often in small clearings and along roadways or watercourses (Bat Conservation International 2002).

Seven species of terrestrial mollusks may occur within the study area: two snails (**Puget Oregonian** (known to occur in the Cle Elum Ranger District) and **Oregon megomphix**) and five slugs (**Panther jumping slug**, **blue-gray tail-dropper, keeled jumping slug, warty jumping slug, and evening field slug**). These mollusks are all associated with forested communities, particularly conifer and mixed conifer/deciduous forest (MRD, MD, MRC, MCR, MC, MRM, and MMR) and are often found associated either with leaf litter or with woody debris (Frest and Johannes unpub., Frest and Johannes 1993). The Puget Oregonian and blue-gray tail-dropper are found in a wider variety of forest types (Frest and Johannes unpub., Frest and Johannes 1993). They prefer moist low- to mid-elevation forests, preferably undisturbed or late-successional forest in riparian areas (Frest and Johannes 1993).

The keeled jumping slug, warty jumping slug, and Oregon megomphix occur in the Western Cascade Range of Washington, including the Mt. Baker-Snoqualmie National Forest (MBSNF) (Burke et al. 1999). They are known to inhabit mesic to moist conifer forests, typically with a moderate hardwood component, and can also be found in riparian zones (ERC, MRC, MCR, MC, ERM, MRM, and MMR). Key habitat features include litter and debris, heavy ground cover of low vegetation and conifer logs. These species are found at low to mid-elevations (sea level to 3,000 ft. above sea level). To date, there has been only one panther jumping slug identified. It

was found in deep forest floor litter near a stream. It is assumed to use similar habitat as other jumping slugs (Furnish et al. 1997).

The evening field slug also occurs in the western Cascade Range of Washington, and is suspected to inhabit areas of the MBSNF (Burke et al. 1999). This species has been found in forest and riparian habitat including coniferous and mixed coniferous and deciduous forest types, in areas below 2,000 ft. above sea level (ERC, MRC, MCR, MC, ERM, MRM, and MMR). Key habitat features include a variety of low shrubs, litter, debris, and rocks.

One species of butterfly**, Johnson's (mistletoe) hairstreak** may occur in the study area. This butterfly is associated with mistletoe in the genus *Arceuthobium*, which occurs primarily in low elevation old-growth and late-successional second-growth stands (MCR and MC) containing western hemlock (*Tsuga heterophylla*) (Larsen et al. 1995).

3.3.2.2 Riparian Community Dependent Species

Nine wildlife species were identified as potentially occurring within the project area and having a primary association with riparian community habitat. A riparian buffer of 100 ft. was established along each side of streams identified within the study area by the Stream Net Database (www.streamnet.org).

Bald eagles are known to occur within the study area. This species was proposed for delisting in 1999 (64 FR 36453) and was tentatively scheduled to be delisted in July 2000. To date, the bald eagle has not been delisted and remains a federally-listed threatened species. However, delisting may occur during the lifetime of the proposed project. No bald eagle nests are known to occur within the study area (City of Seattle 2000, WDFW 2000). Nest trees are usually located in uneven-aged stands containing old-growth components and nest trees often have broken or forked tops to support the nest. An uneven canopy is important for allowing flight into and out from both the nest and perch trees located within the nest stand (Rodrick and Milner 1991). The mature coniferous forest habitat located within the study area may contain nesting habitat.

Mid- and mature regeneration, and mature conifer forest stands (MRC, MCR, MC, MRD, MD, MRM, and MMR) may provide perch sites for bald eagles foraging along rivers within the study area. Migratory or dispersing bald eagles potentially passing through the study area are also more likely to occur within the forested riparian areas.

Great blue herons are not known to nest within the study area (City of Seattle 2000, WDFW 2000). However, potential nesting and foraging habitat occurs in forested (MRC, MCR, MC, MRD, MD, MRM, and MMR) riparian areas adjacent to wetlands, streams, or lakes (LRS).

Osprey nesting habitat is similar to that of the bald eagle, usually occurring near a large body of water in a snag or tree with a broken top (Smith et al. 1997). Potential nesting habitat within the study area occurs in mature coniferous and mid- to mature regeneration forest types (MCR, MC, MD, MMR) within riparian areas. Mid-regeneration forest stands (MFD, MFC, MRM) may also be utilized for perching during foraging activity or dispersal and migration.

Willow flycatchers may occur in the study area and are known to nest in wetlands containing shrubs or young trees, in shrub or forested areas containing appropriate wetland microhabitats (MMFS, ERC, and ERM), rural residential/managed landscapes, and in developed areas (Smith et al. 1997). Potential nesting habitat occurs in wetlands in and surrounding shrub or early seral

habitat. Migratory willow flycatchers may also occur in wetlands and early seral habitat types in the study area (ERC, ERM, MGF, and MS).

Harlequin ducks nest in forested habitats along fast-moving streams and rivers; therefore all forested (ERC, MRC, MCR, MC, MRD, MD, MRM, MMR) riparian habitat in the study area may be suitable nesting habitat for this species.

The **Aleutian Canada goose** is found throughout King County (WDFW 2002). This species may occur in the area of the proposed project in and around bodies of water, grassland, and agricultural fields. They nest and feed in various habitats that are in and around the shoreline of streams, rivers, ponds, lakes, and reservoirs. However, they can also be found feeding in upland habitats including agricultural land, pastures, and meadows (RRM, MGF, and NNFG) (Csuti et. al. 1997).

Mink occur in all vegetation types within the riparian areas of streams, lakes, rivers, ditches, and wetlands (Johnson and Cassidy 1997); therefore all riparian habitats in the study area may be year-round habitat for this species.

The **hoary bat** is found in northern King County, although there are no recorded locations of the species in the vicinity of the proposed study area (WDFW 2002). This species may occur in the area of the proposed project in coniferous or mixed coniferous and deciduous forest habitat (MRC, MCR, MC, MRD, MD, MRM, and MMR). The hoary bat inhabits coniferous and deciduous forests and roosts in the open during the day by hanging from a branch or twig (Csuti et al. 1997). The species is rarely found roosting in urban areas (Tuttle 1995). The hoary bat feeds over riparian areas and bodies of water (Csuti et. al. 1997).

Van Dyke's salamanders are terrestrial salamanders usually found near the edges of streams in association with large woody debris (Corkran and Thoms 1996). Potential habitat for this species occurs in the study area where mature coniferous and mature regeneration forest types (MCR, MC, MD, and MMR) occur in riparian areas.

3.3.2.3 Aquatic Community Dependent Species

Nine wildlife species were identified as potentially occurring within the project area and having a primary association with aquatic community habitat.

The **Common Loon** occurs within the project area. They require large lakes, with minimal human disturbance (Rodrick and Milner 1991). Potential habitat may occur within lakes near the study area (LRS).

The **yuma myotis** is found in King County and more specifically in the general vicinity of the proposed project (WDFW 2002). This species may occur in the area of the proposed project around rocky cliffs, walls, caves, and urban/residential areas that are adjacent to bodies of water. They feed at night in the vicinity of ponds, streams, or lakes. Night roosts include buildings, caves, and mineshafts. Daytime roosts for the species include rock or tree crevices and in urban environments, the species roosts underneath siding and shingles (NNV and DEV) (Whitaker 1980).

The **Cascades frog** is found in the Olympic and Cascade Mountains of Washington and Oregon; generally above 2,600 ft. in elevation, and in montane meadows, slow-moving streams, lakes, and ponds. It has also been recorded at elevations as low as 1,600 ft. The **northern red-legged frog**

is found in wetlands and forests at lower elevations west of the Cascade Mountains. Both require ponds or wetlands for egg laying and development of tadpoles (Leonard et al. 1993). These species are common and would be expected to occur in the higher elevation wetlands near lakes, rivers, and streams (LRS) within the study area.

The **Cascade torrent salamander** lives in small streams and seeps in moist conifer forests or in nearby splash zones. They require cold moving water, but may move short distances into forests in wet weather. Stream habitat for torrent salamanders exists in the study area, although the northern limit of their range is reported to be south of Mt. Rainier (Larsen 1997, Leonard et al. 1993).

The **Oregon spotted frog** is highly aquatic, breeding in shallow emergent wetlands and remaining in wetland and riparian areas as adults. The Oregon spotted frog was once common in the lowlands of western Washington, but is now found only at three sites in southwest Washington (Nordstrom and Milner 1997). Wetlands within the study area may be potential habitat for the spotted frog.

The **tailed frog** is endemic to the Pacific Northwest, occurring in Washington in fast-flowing mountain streams on the west side of the Cascades. The adults generally stay in or near streams but may use nearby forests in wet weather (Leonard et al. 1993). The species appears to be associated with mature forest habitats that can produce cold streams free of fine sediment. They are considered susceptible to loss of old-growth forests (Blaustein et al. 1995). Watershed alterations such as road building and timber harvest are suspected to have caused declines in some areas (Leonard et al. 1993). Tailed frogs would be expected to occur in the study area because of the presence of stream and forest habitat (LRS, MC, and MCR).

The **western toad** is widely distributed over all but the most arid regions of the western United States and can utilize a wide variety of habitats from sea level to over 7,000 ft. (Blaustein et al. 1995, Leonard et al. 1993). The adults can disperse through forest, grass, and shrub habitats, but are most common near lakes, ponds, and wetlands. They require open water ponds or wetlands for breeding. Toads can be very abundant locally but have appeared to decline in overall population, especially in the lowlands of western Washington and some high-elevation habitats (Leonard et al. 1993). This toad would be expected to occur in the wetland and forest habitat in the study area.

Fender's soliperlan stonefly is endemic to western Washington. The nymphs are largely predatory and live in seeps and small streams with clean, clear water. The adults are poor fliers and live in riparian zones of small streams, feeding on algae and vegetation. They may occur in streams within the study area, although the only confirmed sightings have been in Pierce and Skamania Counties (Pacific Biodiversity Institute 2000).

3.3.2.4 Species Dependent upon Unique Habitats

Two wildlife species, the **Larch Mountain salamander** and the **peregrine falcon**, were identified as potentially occurring within the project area and having a primary association with unique habitat types.

The Larch Mountain salamander is associated with forested and talus environments that provide cool, moist conditions. The species occupies forests with late seral characteristics, early to late seral forests, nonforested talus, caves, and occasionally seeps (Crisafulli 1998). Its core distribution is along the Columbia River Gorge at elevations ranging from 2,000 to 4,000 ft., but

because "Survey and Manage" requirements have been in place, scattered additional populations of this species have been found on the Mt. Baker-Snoqualmie National Forest in the Green River Watershed and on the Wenatchee National Forest, Cle Elum Ranger District. The species may occur in the study area where suitable talus habitat is present. Within the study area, no reliable estimate of the amount of talus habitat is available, because it generally occurs in small patches within other habitat types and is not mapped separately. Mature coniferous and mature coniferous regeneration forest may be utilized by this species if an adequate down wood component exists.

Peregrine falcons are associated with cliffs, which they utilize for nesting habitat. Peregrines forage on other species of birds, and forage primarily in areas where there are large concentrations of waterfowl or flocking birds (Johnsgard 1990). Peregrines have been documented within the project area (WDFW 2000). Because peregrines are known to have hunting territories that extend up to 15 mi. from nest sites, peregrines may use the study area as foraging habitat.

3.3.2.5 Early Seral Community Dependent Species

Seven wildlife species were identified as potentially occurring within the project area and having a primary habitat association with early seral community habitat types.

Elk are known to occur throughout the study area (City of Seattle 2000, WDFW 2000) and are expected to utilize all the different habitat types within the study area during some part of the year. Mature coniferous and mid- to mature regeneration forest types (MCR, MRC, MC, MD, MRD, MRM, and MMR) provide potential cover, including hiding and thermal cover, during all seasons and provide foraging habitat where an understory is present. Early seral types (MGF, MS, ERC, ERM, NNFG, and NNFS) provide foraging habitat, and wetlands provide both foraging and cover habitat. Calving is likely to occur in areas away from human disturbance where hiding cover is available, with wetlands and early seral habitats being the most likely areas (Thomas and Toweill 1982).

Black-tailed deer are more closely associated with forested habitats than elk, and are expected to utilize all forested habitat types (MRD, MD, ERC, MRC, MCR, MC, ERM, MRM, and MMR) within the study area. They may also utilize the early seral types (ERC and ERM), but prefer smaller openings or edges (Johnson and Cassidy 1997).

Western bluebirds are cavity-nesting birds that forage in open habitats (Rodrick and Milner 1991). The mature coniferous forest stands found within the study area may provide nesting habitat where open foraging grounds are located nearby. Potential habitat occurs where late forest types are beginning to contain snags and in areas where remnant snags remain.

The **western sulphur butterfly** is found in King County. They may occur in the proposed study area especially in grasslands and in the pre-existing power-line corridors. This butterfly inhabits open and disturbed areas including meadows, sagebrush flats, conifer forest openings, and power-line cuts (MGF, MS, NNFS, and NNFG) (USGS 2002a).

The **mardon skipper butterfly** is found in King County. They may occur in the proposed study area especially in grassland and meadow habitat. This butterfly inhabits low elevation grassland and meadows in the Cascades, especially on serpentine soil (MGF and NNFG) (USGS 2002b).

The **great arctic butterfly** is found in King County. They may occur in the proposed study area especially in grasslands and meadow openings within coniferous forest habitat. This butterfly inhabits coniferous forest openings, rocky hills, and meadow edges at higher elevations (NNFG, NNV, and MGF) (USGS 2002c).

The **valley silverspot** butterfly may occur in the project area. They inhabit open prairies, sub-alpine glades, mid-elevation roadsides, and clearings (NNFG, NNFS, MGF, and MS) (WDFW 2000).

3.4 Transmission Line Alternatives

The amount of each type of wildlife habitat present within 0.25 mi. of the transmission line ROW is shown in Table 4.

Table 4. Wildlife Habitat Present along Transmission Line ROW by Alternative

Habitat Type	Acres of Habitat Present by Alternative						
	A	**B**	**C (Option C-1)**	**C (Option C-2)**	**D (Option D-1)**	**D (Option D-2)**	**1**
Forested Communities							
Mid-regeneration deciduous	50	146	155	135	149	147	183
Mature deciduous	133	374	366	374	379	373	110
Early regeneration conifer	541	1,098	38	528	1,145	1,056	77
Mid-regeneration conifer	541	1,688	599	134	1,699	1,657	41
Mature regeneration conifer	272	2,048	91	82	2,054	2,035	1,467
Mature conifer	0	1,918	25	25	1,935	1,901	0
Managed early regeneration conifer	0	59	0	0	59	59	0
Early regeneration mixed	80	590	221	25	591	592	157
Mid-regeneration mixed	572	903	377	500	871	937	319
Mature mixed regeneration	972	695	263	309	669	720	0
Totals	**3,161**	**9,519**	**2,135**	**2,112**	**9,551**	**9,477**	**2,354**
Riparian Communities							
Mid-regeneration deciduous	3	27	16	16	24	28	19
Mature deciduous	0	20	15	19	19	20	11
Early regeneration conifer	0	54	0	0	60	48	10
Mid-regeneration conifer	13	41	7	7	42	41	5
Managed early regeneration conifer	0	3	0	0	3	3	0
Mature regeneration conifer	<1	94	0	0	90	93	143
Mature conifer	0	85	0	0	88	81	0
Early regeneration mixed	0	23	3	3	23	24	16
Mid-regeneration mixed	15	57	13	13	56	57	26
Mature mixed regeneration	15	58	11	11	56	60	0

Habitat Type	Acres of Habitat Present by Alternative						
	A	B	C (Option C-1)	C (Option C-2)	D (Option D-1)	D (Option D-2)	1
Rural residential/managed landscape	40	23	4	4	23	22	0
Developed	4	19	0	0	18	18	2
Lakes/rivers/stream	8	88	0	0	73	106	0
Natural nonvegetated	0	1	0	0	3	1	0
Managed grass/forb/shrub	8	13	<1	3	15	12	43
Natural nonforest shrubland	<1	3	0	0	3	3	0
Natural nonforest grassland	0	0	0	0	0	0	0
Totals	**108**	**609**	**70**	**76**	**596**	**616**	**275**
Aquatic Communities							
Lakes/rivers/stream	27	138	10	8	89	205	6
Wetlands[a]	40	67	37	30	70	62	141
Totals	**67**	**205**	**47**	**38**	**159**	**267**	**147**
Unique Habitats							
Rural residential/managed landscape	1,797	354	604	776	353	353	0
Developed	1,063	252	130	139	243	261	80
Natural nonvegetated	0	75	0	0	78	67	0
Total	**2,860**	**681**	**734**	**915**	**674**	**674**	**80**
Early Seral Communities							
Managed grass/forbs/shrubs	410	431	294	301	432	426	425
Natural nonforest shrubland	81	115	102	78	119	116	0
Natural nonforested grassland	1	14	5	5	20	8	0
Totals	**492**	**560**	**401**	**384**	**571**	**551**	**425**

[a] The wetland acreage is comprised of a variety of forested, aquatic, unique, and early seral community habitat types within the study area. This acreage is already included as part of the other community habitat types.

3.4.1 Alternative 1: Preferred Alternative

Alternative 1, the preferred alternative, is presented for comparison purposes only. Please refer to the *Final Wildlife Technical Report* (Jones & Stokes 2002c) for a detailed description of the preferred alternative.

The study area for Alternative 1 covers just over 3,000 ac. It is dominated by coniferous forest stands in the mature coniferous regeneration cover type. Alternative 1 parallels a portion of the existing transmission line ROW, to the Echo Lake Substation. As a result, the developed land area is greater than for other alternatives. The north leg of Alternative 1 tends to be mixed coniferous-deciduous forest. The south leg of Alternative 1 has more conifer-dominated stands.

A thin riparian strip along the Raging River contains several large old conifers, including Douglas-fir and western red cedar trees over 35 in. diameter at breast height (dbh).

3.4.2 Alternative A

Alternative A (see Figure 2-A) is dominated by rural residential and suburban development cover types, and by the managed shrubland communities typical of existing transmission line corridors. More than 40% of the study area for Alternative A is in developed or rural residential cover types. Less than a quarter of the area is in conifer-dominated forest. Of the coniferous forest present, most is under 35 years old, and conifers up to 75 years old dominate only 4% of the total study area. While remnant older trees are likely present in the Alternative A study area, no stands were identified that are dominated by trees older than 75 years.

3.4.3 Alternative B

Alternative B (see Figure 2-B) lies within the existing transmission line ROW that extends westward from Stampede Pass to the Echo Lake Substation. In the eastern two-thirds of Alternative B, vegetation communities adjacent to the existing corridor are dominated by coniferous forested stands. Most of these are mature stands, especially near the eastern end of Alternative B.

Within the portion of Alternative B cleared for operation and maintenance of the transmission line, vegetative cover types are dominated by managed shrublands and patches of managed early regeneration coniferous stands. Most of the young regenerating conifers are Douglas-fir and, in higher elevations generally above 3,500 ft. above sea level, Pacific silver fir seedlings that have volunteered in from adjacent mature stands. Since no transmission line is currently hung from the south edge of the tower system, the need to keep that side of the corridor cleared has not been as great as on the north edge under the line. As a result, most of the young coniferous regeneration is along the south edge of the cleared transmission line corridor.

3.4.4 Alternative C (Option C-1)

The study area of Alternative C (Option C-1) (see Figure 2-C-1) presents an intermediate condition between the development-dominated Alternative A and the forest-dominated Alternatives 1 and D (Options D-1 and D-2). Total developed and rural residential area is less than 25%, and forested communities of any kind account for approximately two-thirds of the study area. However, as with Alternative A, conifer-dominated communities within Alternative C (Option C-1) study area are primarily young stands under 35 years old. Mid-regeneration coniferous stands (20 to 35 years old), mid-regeneration mixed stands (10 to 30 years old) and early regeneration coniferous stands (less than 20 years old) account for 31% of the study area. Rural residential managed landscape has the highest percentage cover of any type.

3.4.5 Alternative C (Option C-2)

The study area of Alternative C (Option C-2) (see Figure 2-C-2) shares the northern portion of the Alternative C (Option C-1) alignment and also presents an intermediate condition between the development-dominated Alternative A and the forest-dominated Alternatives 1 and D (Options D-1 and D-2). Total developed and rural residential area is less than 25%, and forested communities of any kind account for approximately two-thirds of the study area. However, as with Alternative A, conifer-dominated communities within the Alternative C (Option C-2) study area are primarily young stands under 35 years old. Mid-regeneration coniferous stands (20 to 35 years old), mid-regeneration mixed stands (10 to 30 years old) and early regeneration coniferous stands (less than 20 years old) account for 34% of the study area. Rural residential managed landscape has the highest percentage cover of any type.

3.4.6 Alternative D (Options D-1 and D-2)

Most of the study area of Alternative D (Options D-1 and D-2) passes through the USFS Okanogan-Wenatchee and Mt. Baker-Snoqualmie National Forests, from Stampede Pass heading west toward North Bend (see Figures 2-D-1 and 2-D-2). Vegetation within the study area of this alternative is 87% forested, with 62% of the area in coniferous forest. Alternative D (Options D-1 and D-2) contains the oldest and largest conifer stands of the four action alternatives under consideration. Nearly 17% of the conifer stands in the study area are between 75 and 250 years old, and another 19% are approaching 75 years old. Development and rural residential areas account for less than 6% of the study area.

3.5 Access Roads

Dirt and gravel roads exist to provide access to existing transmission line corridors associated with Alternatives A, B, and portions of C (Options C-1 and C-2). These roads are currently used for operation and maintenance access. Some of the old access roads are not frequently used or maintained, however, and have become impassable because of vegetation growth or washout. New access roads would be needed for portions of Alternatives 1, C (Options C-1 and C-2), and D (Options D-1 and D-2).

3.6 Substations

The Echo Lake Substation occupies approximately 16 ac. The perimeter area to about 100 ft. around the substation is surrounded by gravel and nonnative grasses. Beyond that are managed grass/forb/shrub areas, with small mixed coniferous-deciduous stands.

4.0 Environmental Consequences and Mitigation

BPA defines environmental impact levels in three categories: high, moderate, and low.

High-level impacts on wildlife would occur when an action creates an adverse change in wildlife populations or habitats. Adverse changes include impacts that would:

- Create an unavoidable adverse effect on a species federally-listed as threatened or endangered;
- Reduce the quantity or quality of a regionally or nationally important wildlife population or habitat or habitats associated with USFS-managed “Survey and Manage” species;
- Reduce the quantity or quality of habitat critical for local animal populations, such as big-game winter range; or
- Adversely affect rare or declining species, or other species with high public profiles, values or appeal, such as elk, gray wolves, or bald eagles.

Moderate-level impacts on wildlife occur if the actions would:

- Create an effect on a threatened or endangered species that could be partially mitigated through an interagency consultation with the USFWS under Section 7 of the ESA;

- Cause a local reduction or a temporary impact in the quality or quantity of wildlife habitats associated with USFS-managed "Survey and Manage" species; or

- Marginally reduce the productivity of adjacent wildlife habitats or resources (such as nest sites).

Low-level impacts occur when an action would:

- Create an effect that could be largely mitigated;

- Reduce the quality or quantity of wildlife habitat or species confined to the site of the action;

- Cause no major effect on productivity of adjacent wildlife habitat;

- Temporarily disturb common wildlife species;

- Reduce habitat that is very common in the project area;

- Adversely affect relatively common species at a local level; or

- Cause temporary effects that can be minimized by site planning or by placing seasonal restrictions on activities.

A project may also have no impact.

Impacts could result either from construction of the facilities or from ongoing operation and maintenance. In addition, these impacts could be either temporary or permanent. Impacts may consist of the physical loss of habitat, or disturbance of wildlife from the construction activities or ongoing facility use and maintenance.

4.1 Construction Impacts

Construction impacts would occur when an area is modified and maintained in the modified state. Examples include clearing for transmission lines, building sites, and roads. Permanent loss of wildlife habitat would be exemplified where vegetation removal is associated with facility development.

Temporary construction impacts would be associated with noise and human presence. Temporary construction impacts would result from tower installation involving the use of heavy equipment, helicopters, and blasting, and intense levels of human activity around the construction site; construction of substation addition and roads; clearing ROWs; and pulling conductors. These types of activities would occur only during the construction phase and would not be long-term.

4.1.1 Impacts Common to All Transmission Line Alternatives

4.1.1.1 Impacts

Vegetation clearing impacts were estimated based on an assumption that the entire length of the 150-ft.-wide transmission line ROW would be cleared of existing vegetation. This outcome represents a worst-case scenario for clearing. Actual cleared acreage within the proposed

transmission line corridors would likely be less than shown due to topography and the ability to span trees in low areas. Actual estimated clearing of forest vegetation within Alternative B would include cover types with vegetation that is taller than 5 to 10 ft. within 20 ft. of the northern edge of the existing ROW. The remainder of the ROW has been maintained in a cleared condition.

The types of impacts that would occur as a result of project implementation would be the same for all the action alternatives, with differences occurring in the magnitude of the impacts. The following types of impacts would occur under all alternatives.

Impacts on Threatened, Endangered, and other Sensitive Species—Potential impacts to threatened, endangered, and other sensitive species could occur as a result of habitat loss or alteration, disturbance, or collision with transmission lines, and are discussed in subsequent sections.

Habitat Loss—Impacts would occur to several wildlife habitat types described in Section 3.0 of this document under all action alternatives. Impacts would differ in magnitude and location, as is discussed under each alternative later in this section. Habitat for species dependent upon forested communities, riparian communities, aquatic communities, and unique habitats would be reduced, while habitat for early seral dependent or edge species would be increased. Based upon the definitions above, this would be a moderate-level impact.

Within USFS lands there would also be a loss of recruitment habitat for late-successional forest dependent species. USFS has land within three of the proposed ROWs set aside as LSR. Permanent conversion of these stands from a forested condition to either being maintained in an early seral condition (within the ROW) or a developed condition (new access roads) would cause a permanent loss of recruitment habitat. This would be a moderate level of impact. The amount of forested habitat lost is described by alternative in Section 4.1.3.

Habitat Fragmentation—Under all of the alternatives, the amount of habitat fragmentation within the project area would increase, resulting in a moderate-level impact. Fragmentation can affect wildlife habitat in three ways:

- It can cause an increase in the amount of edge habitat in an area.
- It can cause a decrease in the size of habitat patches leading to decrease in interior habitat.
- It can create barriers to travel and/or dispersal for species that utilize forested habitats.

The first two impacts are related: As habitats are fragmented, the amount of edge habitat generally increases and the amount of interior habitat decreases. Edge effect (the distance into the stand that an edge impacts such features as microclimate) varies by the types of vegetation structure that abut one another. The most extreme outcome occurs when early seral or developed types abut late seral habitat. Changes in microclimate can be expected to occur 200 to 260 ft. into the stand adjacent to roads and 360 to 720 ft. into the stand adjacent to regeneration harvest, depending on site conditions (Jones 1999).

New edge habitat would be created under all alternatives in association with both clearing the transmission line ROW and construction of new access roads. Increases in edge habitat would be beneficial to species that utilize edges, such as elk and bats. However, increases in edge would reduce the quantity and quality of habitat present for species that utilize interior habitats, such as

spotted owls and goshawks. The amount of new edge habitat created would vary by alternative, with Alternative C (Option C-2) creating the least and Alternative D (Option D-2) the most.

Habitat fragmentation can also impact the suitability of the landscape for migratory or wide-ranging animals. This outcome can take the form of limiting the amount of habitat available to species that avoid crossing large openings, such as fisher, or an increase in the potential for predation for species that may cross openings but are more susceptible to predation while doing so, such as spotted owl. Habitat connectivity has been identified in the Snoqualmie Pass AMA EIS as an important issue for wildlife in the I-90 corridor (USDA 1996).

If an opening creates a dispersal barrier for a given species, otherwise suitable habitat may remain unoccupied; population segments may be isolated, resulting in possible local extinctions. Habitat available for establishment of home ranges may also be limited, reducing the ability of a species to populate an area.

If an opening creates a travel barrier for a given species, available habitat within a home range could be limited with the result that home ranges become too small to support individuals. If the potential increase in predation on individuals crossing an opening were to occur, it could limit the potential for a species to repopulate an area. One of the goals of the NFP (USFS) is to manage forested habitat so that it develops into habitat suitable for late-successional species. Creating an opening that could limit the potential for these species to utilize the habitat could affect the probability of reaching these goals.

For some species, allowing brush to revegetate the site and providing large down wood within the cleared ROW may provide enough cover to allow individuals to cross the ROW. This approach would be most effective for small-bodied animals, such as small mammals.

Alternatives 1 and D (Options D-1 and D-2) would widen an opening that currently exists and so create more of a barrier to animals moving through the area. Alternative A would create a wider opening along those portions of the ROW that parallel the existing transmission line ROW, and would create new openings in those areas that do not parallel it. Alternative C (Options C-1 and C-2) would create an entirely new corridor through the study area, establishing a new barrier for animals that avoid openings. Alternative B, already in an existing cleared ROW, would not widen the opening, and would thus avoid any additional impacts to wildlife movement.

Because habitat fragmentation reduces habitat quantity and quality for some species and also reduces productivity of adjacent habitat for interior forest species, this outcome would be a moderate-level impact. Alternative D would have the greatest potential impact of all the alternatives since it occurs partially within the Snoqualmie Pass AMA and would potentially cause a decrease in habitat connectivity within the AMA.

Under all action alternatives the proposed transmission line would also cross wildlife linkage corridors identified in the King County Comprehensive Plan (King County 2000). Under Alternatives B and D (Options D-1 and D-2), one corridor would be crossed; under Alternatives 1 and A, two corridors would be crossed. Under Alternative C (Options C-1 and C-2), three corridors would be crossed. Creating openings with early seral vegetation may reduce the effectiveness of these corridors for species dependent on cover for travel habitat. Because all of the alternatives involve permanent removal of habitat, a moderate-level impact will result to low-mobility species for which such an opening may be a barrier. In instances where riparian vegetation within these corridors is expected to remain intact, with the transmission line spanning the riparian zone, impacts to corridors would be low-level.

Bird Collision—The risk of bird mortality from collision with transmission lines would be similar under all alternatives. Historically, raptors were known to have a high incidence of mortality associated with power lines, primarily from electrocution; however, current design standards and the wide spacing between phases on 500-kV lines prevents the probability of this occurring, as described in Section 4.1.1.2. Raptor collisions with power lines are relatively rare, although they do occur. Keen eyesight and a tendency to avoid flying in inclement weather are believed to reduce the risk of power line collisions by raptors (Olendorff and Lehman 1986). If raptor mortality were to occur, particularly to a bald eagle, this would be a high-level impact.

Species that are at greatest risk of collision with power lines are waterfowl, particularly near wetlands or open water and during conditions of low visibility (Stout 1976, Arend 1970, Anderson 1978). Within the project area, small wetlands occur that may be utilized by waterfowl, and collisions may occur when these birds are traveling between areas.

Other species may also collide with transmission lines, including marbled murrelets potentially flying up river systems en route to suitable nesting habitat in the Mt. Baker-Snoqualmie and Okanogan-Wenatchee National Forests. The risk of this occurrence is unknown; however, the risk would be related to the height at which murrelets fly above the canopy while traveling to nest sites, which is not well documented. Peregrine falcons foraging in the vicinity of the transmission lines may also be at risk for collision. If mortality were to occur to either of these species, it would be a high level impact.

According to the Avian Power line Interaction Committee (APLIC 1994), four factors contribute to the level of risk of collision with power lines: the current level of risk, the type of power line, the amount of avian use in the area, and the inherent tendency of a species to collide with overhead wires. Because the proposed transmission lines would have a ground wire, which is located at the top of the lines and is usually a smaller diameter than the transmission lines, the level of risk is higher than would exist in the absence of a ground wire. The level of use of species susceptible to collision in the study area is not known; however, some use is expected to occur and the susceptibility of different species is described above. Although measures would be taken to prevent collisions, as described in Section 4.1.1.2, some level of mortality caused by power line collision would probably occur.

Disturbance of Wildlife—Noise associated with construction of the proposed transmission line could disturb wildlife potentially present within the study area. Construction activities with the potential to cause noise disturbance include use of chainsaws, heavy equipment, helicopters, and explosives (blasting). Because potential disturbance would be confined to the site of the action, would be temporary, and could be limited by seasonal restrictions if a high-priority resource such as a bald eagle nest were discovered in the area, this would be a low-level impact.

Noise from blasting would be audible over a larger area than the other potential disturbance mechanisms; however, blasting would be infrequent and of short duration and so would result in a low-level impact. The exception would be blasting that occurred during the nesting season of species sensitive to noise, such as spotted owls, which could cause disturbance impacts up to a mile from the blasting site. Measures to avoid these impacts are described in Section 4.1.1.2.

Construction of Alternatives B, and D (Options D-1 and D-2) has the highest potential for causing disturbance because these alternatives would be constructed through habitats currently receiving the least human use. Construction of Alternatives A and C (Options C-1 and C-2) would have the least potential impacts because they would occur primarily in rural residential/managed areas,

(i.e., within an area of ongoing regular human activity in which wildlife is adapted to these types of activities).

4.1.1.2 Mitigation

Impacts on Threatened, Endangered, and other Sensitive Species—Potential mitigation for habitat alteration or removal includes:

- Minimize the amount of forest vegetation clearing by clearing only as much as necessary. Along ROW edges, selectively cut only those trees with sufficient height to damage the transmission line if they should fall, leaving shorter trees in place.

- Improve forest habitat conditions outside of the ROW through stand manipulations such as pre-commercial thinning, in cooperation with the landowner.

- Where trees must be felled along the ROW edges, fell and leave some trees in the adjacent stand to provide coarse woody debris. Larger trees would be the most valuable in providing this function.

Habitat Fragmentation—Potential mitigation for habitat fragmentation includes:

- Clear only as much vegetation as necessary.

- Provide coarse woody debris within the cleared ROW for cover for small mammals and for connectivity of habitat for invertebrates. This outcome can be accomplished by either leaving some logs in place during clearing operations or by placing logs within the ROW following construction. Large logs have the highest value for this purpose.

- Span riparian corridors to the maximum extent possible, leaving riparian vegetation across the cleared ROW for use as travel corridors.

Bird Collision—To minimize the risk of mortality from collision:

- Base design and construction of the new transmission line on guidelines described in the publication, Suggested Practices for Raptor Protection on Power Lines: The State of the Art in 1996 (APLIC 1996).

- Bird diverters would be installed where the transmission line crosses riparian corridors or other likely areas of migration to make the transmission line more visible and reduce the potential for collision.

Disturbance of Wildlife—To minimize or avoid the risk of disturbance to wildlife:

- Before construction, verify that no new bald eagle or spotted owl nests, or marbled murrelet occupied sites, have been found within 1 mi. of the proposed ROW. If any are found, avoid blasting within 1.0 mi. or construction within 0.5 mi. of bald eagle nests and 0.25 mi. of spotted owl and marbled murrelet sites during the nesting period (January 1 through August 15, March 1 through September 30, and April 1 through September 15, respectively). Survey techniques would follow available existing protocols or would be determined and would be included in the mitigation action plan to be prepared for this project.

- Before construction, verify that no other special status raptor nests occur within 1 mi. of the proposed ROW. If any are found, avoid construction within 0.25 mi. of the nest during the nesting season (varies by species), or within 1 mi. for blasting. Survey techniques are to be determined and would be included in the mitigation action plan to be prepared for this project.

- Plan flight paths for helicopters used during construction so that they do not fly over potential nesting habitat for either northern spotted owls or marbled murrelets in the project area during their nesting seasons, or maintain a minimum altitude of 500 ft. over these stands if they are unavoidable.

- Plan flight paths for helicopters used during construction so that they do not fly over potential nesting habitat for peregrine falcons in the project area during their nesting season or maintain a minimum altitude of 1,500 ft. above the habitat if the nests are unavoidable. The nesting season for peregrine falcons is March 1 through June 30.

4.1.1.3 Unavoidable Effects, Irreversible or Irretrievable Commitment of Resources

Permanent alteration of forested habitat types to managed early seral habitat types would occur under all alternatives. The amount of alteration would vary by alternative, as discussed below. Permanent impacts to both wetland and riparian habitat may also occur.

4.1.2 Echo Lake Substation Impacts

4.1.2.1 Impacts

The proposed expansion of the Echo Lake Substation would occur east of the existing substation. Habitat types in the area are early regeneration, coniferous forest and early regeneration, mixed forest, types that are most likely to provide habitat for early seral community dependent species or forest community dependent species that utilize early regeneration forest. Given the large amount of this habitat type available in the surrounding area and the existing disturbed nature of the site, impacts associated with expansion of the substation are expected to be low level.

4.1.2.2 Mitigation

No mitigation measures would be required for substation expansion.

4.1.2.3 Unavoidable Effects, Irreversible or Irretrievable Commitment of Resources

Expansion of the Echo Lake Substation would result in a permanent conversion of land capable of supporting forested habitat types to a developed condition.

4.1.3 Alternative Transmission Line Impacts

To assess potential impacts to wildlife habitat (Table 5), the vegetation cover developed for the proposed study area (Figure 2) was used, with the assumption that a 150-ft. ROW centered on the proposed transmission line and a 370-ft. radius around the outside bend of corner towers would be cleared. Unlike the other proposed alternatives, clearing impacts for Alternative B assume a 20-ft.-wide clearing corridor on the northern side of the ROW because maintenance has kept the majority of the existing alignment free of tall shrubs and trees. Additional clearing will not be required if Alternative B is chosen as the preferred alternative. Clearing for riparian vegetation

represents the worst-case-scenario because stream corridors will be spanned, where possible, making it unnecessary to clear the riparian corridor.

Table 5. Habitat Impacts within the Alternative Transmission Line Alignments

Habitat Type	Change in Acreage for Each Habitat Type due to Vegetation Clearing Associated with each Alternative						
	A	**B**	**C (Option C-1)**	**C (Option C-2)**	**D (Option D-1)**	**D (Option D-2)**	**1**
Forested Communities							
Mid-regeneration deciduous	-3	-2	-16	-16	-11	-9	-9
Mature deciduous	-5	-9	-28	-27	-28	-30	-3
Early regeneration conifer	-6	-17	-2	-8	-67	-44	0
Mid-regeneration conifer	-9	-34	-40	-3	-135	-144	-1
Mature regeneration conifer	-8	-59	-4	-<1	-158	-186	-85
Mature conifer	0	-28	0	0	-108	-97	0
Managed early regeneration conifer	0	-22	0	0	-3	-4	0
Early regeneration mixed	-5	-12	-7	0	-43	-50	-4
Mid-regeneration mixed	-45	-10	-24	-47	-40	-73	-16
Mature mixed regeneration	-37	-9	-9	-13	-39	-57	0
Totals	**-118**	**-202**	**-130**	**-115**	**-632**	**-694**	**-118**
Riparian Communities							
Mid-regeneration deciduous	0	<-1	-1	-1	-<1	-2	-<1
Mature deciduous	0	-1	-1	-1	-3	-3	0
Early regeneration conifer	0	0	0	0	-11	-<	0
Mid-regeneration conifer	-<1	-<1	-1	-1	-3	-3	-<1
Managed early regeneration conifer	0	-1	0	0	-<1	0	0
Mature regeneration conifer	0	-1	0	0	-6	-7	-5
Mature conifer	0	-<1	0	0	-5	-3	0
Early regeneration mixed	0	-<1	0	0	-2	-2	-<1
Mid-regeneration mixed	-2	-<1	-1	-1	-<1	-2	-2
Mature mixed regeneration	-1	-<1	-<1	-<1	-2	-5	0
Rural residential/managed landscape	-1	-<1	0	0	-2	-1	0
Developed	-<1	0	0	0	-<1	0	0
Lakes/rivers/stream	-1	-<1	0	0	-1	-1	0
Natural nonvegetated	0	-<1	0	0	-<1	-<1	0
Managed grass/forb/shrub	-2, +7[a]	--<1 +12[a]	0, +5[a]	0, +5[a]	-3, +31[a]	-<1, +31[a]	-5, +10[a]
Natural nonforest shrubland	0	0	0	0	-<1	0	0
Natural nonforest grassland	0	0	0	0	0	0	0

Habitat Type	Change in Acreage for Each Habitat Type due to Vegetation Clearing Associated with each Alternative						
	A	B	C (Option C-1)	C (Option C-2)	D (Option D-1)	D (Option D-2)	1
Totals	**-9**	**-13**	**-5**	**-5**	**-34**	**-32**	**-15**
Aquatic Communities							
Lakes/rivers/stream	-3	-<1	-<1	-<1	-2	-2	0
Wetlands[b]	-17	-27	-10	-8	-18	-16	-11
Totals	**-20**	**-28**	**-11**	**-19**	**-20**	**-18**	**-11**
Unique Habitats							
Rural residential/managed landscape	-105	-4	-25	-41	-18	-18	0
Developed	-54	-2	-10	-5	-10	-7	-10
Natural nonvegetated	0	-<1	0	0	-1	-2	0
Total	**-159**	**-7**	**-35**	**-46**	**-29**	**-27**	**-10**
Early Seral Communities							
Managed grass/forbs/shrubs	-113, +284[a]	-30, +215[a]	-26, +169[a]	-41, +165[a]	-97, +672[a]	-43, +733[a]	-23, +128[a]
Natural nonforest shrubland	-4	-3	-3	-3	-9	-10	0
Natural nonforested grassland	0	0	0	0	0	0	0
Totals	**-117**	**-33**	**-29**	**-44**	**-106**	**-53**	**-23**

[a] The total impacted acreage for each community habitat type does not reflect the increase in managed grass/forb/shrub (MGFS) acreage resulting from conversion of other habitat types (excluding aquatic communities) in the study area. The positive acreage in the MGFS category is the increase that will occur as part of this conversion. Impacts to existing MGFS habitat will be temporary because these areas will continue to be managed in their current state.

[b] The wetland acreage is comprised of a variety of forested, aquatic, unique, and early seral community habitat types within the study area. This acreage is already included as part of the other community habitat types.

Changes in vegetation types represent vegetation clearing for the proposed new ROW. This clearing would result in a permanent conversion of vegetation type for all types except the managed grass/forb/shrub. Vegetation types cleared would be permanently converted to the managed grass/forb/shrub type, while vegetation that is currently managed grass/forb/shrub would be temporarily impacted and then allowed to regenerate. Therefore, the acres lost represent a temporary loss and the acres gained represent a permanent gain.

4.1.3.1 Alternative 1: Preferred Alternative

Impacts—Alternative 1, the preferred alternative, is presented for comparison purposes only. The following information is a summary of the impacts associated with Alternative 1. A detailed analysis of the impacts and mitigation for Alternative 1 is included in the *Final Wildlife Technical Report* (Jones & Stokes 2002c).

Forest Community Dependent Species—Construction of Alternative 1 would result in clearing 118 acres (ac.) of forested community habitat, representing 5% of this habitat in the study area. A total of 85 ac. of mature coniferous regeneration forest would be cleared, representing 6% of the

amount present in the study area. This outcome is a reduction in the amount of recruitment habitat available for late-successional forest dependent species. Because this habitat type is common in the project area and the amount of reduction is relatively small, construction of Alternative 1 would result in low-level impacts on forest community dependent species.

Riparian Community Dependent Species—Construction of Alternative 1 would result in the clearing of 15 ac. of riparian community habitat (5% of that present in the study area). A total of 10 ac. of forested riparian and 5 ac. of mature coniferous regeneration riparian forest habitat would be removed, representing 4% and 3% of the total present in the project area, respectively. Because this impact could result in a loss of productivity in adjacent aquatic habitat and cause a local reduction in the quantity of wildlife habitat, this outcome would represent a moderate-level impact.

Aquatic Community Dependent Species—Construction of Alternative 1 would potentially impact 11 ac. of wetlands and 0 ac. of lakes, rivers, and streams, representing 8% and 0% of the amount present in the study area, respectively.

Early Seral Community Dependent Species—Construction of Alternative 1 would result in an increase of early seral habitat (managed grass/forb/shrub) by 128 ac. This outcome would benefit wildlife species dependent upon this habitat type.

Mitigation—Mitigation measures to minimize or reduce potential impacts under Alternative 1 would be the same as those described below under Alternative A.

Unavoidable Effects, Irreversible or Irretrievable Commitment of Resources—Under Alternative 1, forested habitats, riparian habitats, and wetland habitats would be permanently converted to a managed early seral habitat type, as shown in Table 5.

4.1.3.2 Alternative A

Impacts—*Forest Community Dependent Species*—Construction of Alternative A would result in clearing 118 ac. of forested community habitat, representing 4% of the forest community habitat in the Alternative A study area. A total of 8 ac. of mature coniferous regeneration forest would be cleared, representing 3% of the amount present in the study area. This also represents a reduction in the amount of recruitment habitat available for late-successional forest dependent species. This habitat would develop into potentially suitable nesting habitat for these species. Because Alternative A would result in a reduction in a habitat type that is very common in the project area, impacts to forest community dependent species would be would be low-level impacts.

Clearing of forested communities would also reduce the amount of potential nesting habitat available for both olive-sided flycatchers and red-tailed hawks in the study area, but would increase the amount of foraging habitat available for them. Potential roosting and foraging habitat would decrease for six species of bats potentially occurring in the forested community of the study area.

Clearing of forested communities would reduce the amount of potential nesting habitat available for both band-tailed pigeon and blue grouse. Clearing would also reduce the amount of winter foraging and cover habitat for blue grouse.

Clearing of mature coniferous regeneration would decrease the amount of potentially suitable habitat available for Johnson's hairstreak (butterfly). If individuals in the larval form are present during project implementation, mortality of individuals may also occur. Permanent conversion of forested habitat to managed grass/forb/shrub would also decrease future potential habitat for this species.

Riparian Community Dependent Species—Construction of Alternative A would result in the clearing of 9 ac. of riparian community habitat (8% of that present in the study area). This would reduce potential habitat for bald eagle, great-blue heron, harlequin duck, Aleutian Canada goose, and hoary bat. Forested riparian vegetation totaling 4 ac (9% of the amount present in the study area) would be cleared, reducing the amount of habitat available for osprey and mink. Habitat for willow flycatchers would increase due to conversion of current forested habitat to the managed grass/forb/shrub habitat type. Under Alternative A, impacts to riparian community dependent species are expected to be moderate to low-level impacts since the outcome would represent a local reduction in wildlife habitat quantity and quality, but would be confined to the site of the action.

Aquatic Community Dependent Species—Construction of Alternative A would potentially impact 17 ac. of wetlands and 3 ac. of lakes, rivers, and streams, representing 43% and 11% of the amount present in the study area, respectively. This is potential habitat for yuma bat, Cascade frog, red-legged frog, Oregon spotted frog, western toad, and Fender's Soliperlan stonefly. The amount of impacts to lakes, rivers, and streams in Alternative A is the highest among all action alternatives. Under Alternative A, impacts to aquatic community dependent species are expected to be moderate-level impacts since the outcome would represent a local reduction in the quantity of wildlife habitat for these species.

Species Dependent upon Unique Habitats—Under Alternative A, impacts to species dependent on unique habitat types (unmapped talus habitat and clearing of mature coniferous regeneration forest habitat) would result in a low level of impact. The amount of mature coniferous regeneration forest habitat cleared under Alternative A would be 8 ac., or 3% of the amount in the study area. As described under forest communities, this removal of mature coniferous regeneration forest habitat, a type that is common in the project area, would result in a low level of impact. Additionally, talus habitat is unlikely to occur in this proposed alignment, given the topography of the route, and is not expected to be impacted.

Construction of Alternative A would not impact nesting habitat for peregrine falcons. By creating a larger opening in the canopy, Alternative A may increase available foraging habitat; however, the risk of collision with the power lines, as mentioned in Section 1.2.4, would counteract the benefits of increasing potential foraging habitat.

Early Seral Community Dependent Species—Construction of Alternative A would result in an increase in early seral habitat (managed grass/forb/shrub) of 284 ac. This would benefit elk, black-tailed deer, valley silverspot, great arctic, mardon skipper, and western sulphur. Given the lack of suitable nesting habitat for western bluebirds in the study area, the increase in foraging habitat for this species would likely not appreciably benefit western bluebirds and so the project is expected to have little or no impact on them.

Mitigation—Mitigation measures to minimize or reduce potential impacts to forested community dependent species include:

- Minimize the amount of forest vegetation removed by clearing only as much as necessary. Along ROW edges, selectively cut only those trees with sufficient height to damage the transmission line if they should fall, leaving shorter trees in place.

- Improve forest habitat conditions outside of the ROW through stand manipulations such as pre-commercial thinning, in cooperation with the landowner.

- Within the cleared ROW, clear only as much vegetation as necessary.

- Provide coarse woody debris within the cleared ROW for cover for small mammals and for connectivity of habitat for invertebrates. This outcome can be accomplished by either leaving some logs in place during clearing operations or by placing logs within the ROW following construction. Large logs have the highest value for this purpose.

- Where trees must be felled along the ROW edges, fell some trees into the adjacent stand and leave them for coarse woody debris. Larger trees have the most value in this function.

Mitigation measures to minimize or reduce potential impacts to riparian community dependent species include:

- Span riparian corridors to the extent possible, leaving riparian vegetation across the cleared ROW for use as travel corridors.

Mitigation measures to minimize or reduce potential impacts to aquatic community dependent species include:

- Avoid placing tower footings within or adjacent to wetlands to the extent possible.

- Minimize soil disturbance within or adjacent to wetlands and stream banks to the extent possible.

Mitigation measures to minimize or reduce potential impacts to species dependent on unique habitats include:

- Provide coarse woody debris within the cleared ROW for cover for small mammals and for connectivity of habitat for invertebrates. This outcome can be accomplished by either leaving some logs in place during clearing operations or by placing logs within the ROW following construction. Large logs have the highest value for this purpose.

- Where trees must be felled along the ROW edges, fell some trees into the adjacent stand and leave them for coarse woody debris. Larger trees having the most value in this function.

Mitigation measures to minimize or reduce potential impacts to species dependent on early seral habitats:

- Create snags along the edges of the cleared ROW to create potential nesting habitat for western bluebirds.

Unavoidable Effects, Irreversible or Irretrievable Commitment of Resources—Under Alternative A, forested habitats, riparian habitats, and wetland habitats would be permanently converted to a managed early seral habitat type, as shown in Table 5.

4.1.3.3 Alternative B

Impacts—*Forest Community Dependent Species*—Construction of Alternative B would result in clearing 202 ac. of forested community habitat, with 59 ac. of this total in the mature coniferous regeneration (MCR) type and 28 ac. in the mature coniferous (MC) forest type. This outcome would result in the clearing of 2% of the total forest community habitat present within the study area. 3% of the amount of mature coniferous regeneration within the study area would be cleared, and 1% of the mature coniferous forest present within the study area would be cleared.

Clearing of mature coniferous (MC) forest would cause a high level impact, since this habitat type is potential nesting habitat for a Forest Service "Survey and Manage" species (great gray owl) and for two federally-listed species (northern spotted owl and marbled murrelet). Additionally, Alternative B passes through designated critical habitat for both the northern spotted owl and the marbled murrelet and would result in clearing of 37 ac. of habitat within spotted owl critical habitat and 11 ac. within marbled murrelet critical habitat. Of this, 6 ac. are currently suitable nesting habitat for the northern spotted owl and 3 ac. are currently suitable nesting habitat for the marbled murrelet. Clearing of forested habitat that is not currently suitable nesting habitat for these species also represents a reduction in the amount of recruitment habitat available for them and for other late-successional forest dependent species. Clearing this habitat type would also reduce the amount of habitat available to great gray owl, goshawk, merlin, pileated and black-backed woodpecker, and Vaux's swift

Clearing the 128 ac. of forested habitat (ERC, MERC, MRC, MCR, MC, MRD, MD, MRM, and MMR) within the MBSWNF (Table 6) would also lead to a reduction in unsurveyed potential habitat for Forest Service "Survey and Manage" mollusks and salamanders (Table 7). Because this impact has regional importance, the impact would be high level.

Table 6. Wildlife Habitat Impacts within Alternative Transmission Line Alignments within USFS-Managed Lands

Habitat Type	Acres of Habitat Impacted by Alternative within USFS-Managed Lands			
	B	D (Option D-1)	D (Option D-2)	1
Forested Communities				
Mid-regeneration deciduous	<1	0	2	183
Mature deciduous	3	6	6	110
Early regeneration conifer	13	30	25	77
Mid-regeneration conifer	25	94	112	41
Mature regeneration conifer	42	107	141	1,467
Mature conifer	18	74	68	0
Managed early regeneration conifer	18	2	5	0
Early regeneration mixed	6	30	18	157
Mid-regeneration mixed	<1	7	7	319
Mature mixed regeneration	<1	0	5	0
Totals	**128**	**350**	**389**	**2,354**
Riparian Communities				
Mid-regeneration deciduous	<1	0	<1	19
Mature deciduous	1	2	2	11
Early regeneration conifer	0	<1	<1	10
Mid-regeneration conifer	<1	8	2	5
Managed early regeneration conifer	1	0	0	0
Mature regeneration conifer	1	2	4	143
Mature conifer	<1	7	3	0
Early regeneration mixed	<1	0	<1	16
Mid-regeneration mixed	<1	<1	<1	26
Mature mixed regeneration	<1	0	1	0
Rural residential/managed landscape	0	0	0	0
Developed	0	0	0	2
Lakes/rivers/stream	<1	1	<1	0
Natural nonvegetated	<1	<1	<1	0
Managed grass/forb/shrub	<1	2	<1	43
Natural nonforest shrubland	0	<1	0	0
Natural nonforest grassland	0	0	0	0
Totals	**12**	**18**	**19**	**275**

Habitat Type	Acres of Habitat Impacted by Alternative within USFS-Managed Lands			
	B	**D (Option D-1)**	**D (Option D-2)**	**1**
Aquatic Communities				
Lakes/rivers/stream	<1	-<1	1	6
Totals	**1**	**1**	**1**	**6**
Unique Habitats				
Rural residential/managed landscape	0	0	0	0
Developed	<1	2	0	80
Natural nonvegetated	0	2	1	0
Total	**1**	**4**	**1**	**80**
Early Seral Communities				
Managed grass/forbs/shrubs	14	34	64	425
Natural nonforest shrubland	<1	10	8	0
Natural nonforested grassland	0	0	0	0
Totals	**15**	**44**	**72**	**425**

Table 7. Suitability of Vegetative Cover Types for Survey & Manage and T&E Wildlife Species

Species	Vegetative Cover Types																	
	ERC	**MERC**	**MRC**	**MCR**	**MC**	**MRD**	**MD**	**ERM**	**MRM**	**MMR**	**MGFS**	**NNFG**	**NNFS**	**LRS**	**DEV**	**NNV**	**RRM**	**OF**
Survey and Manage																		
Larch Mountain Salamander	X	X	X	X	X	X	X		X	X			X[a]			X[a]		X
Van Dyke's Salamander	X	X	X	X	X	X	X		X	X			X[a]			X[a]		X
Mollusks:																		
Cryptomastix devia	X	X	X	X	X	X	X		X	X								X
Hemphillia glandulosa	X	X	X	X	X	X	X		X	X								X
Prophysaon coeruleum	X	X	X	X	X	X	X		X	X								X
Vespericola pressleyi	X	X	X	X	X	X	X		X	X								X
Deroceras hesperium	X	X	X	X	X	X	X		X	X								X
Hemphillisa burringtoni	X	X	X	X	X	X	X		X	X								X
Great Gray Owl					X[b]													X[b]
T&E																		
Northern Spotted Owl																		
Marbled Murrelet																		

[a] Surveys would be required in these habitat types if they contain rocky outcrops, fissured bedrock, colluvial slumps, or talus.
[b] Surveys for great gray owls would be required where these habitat types occur within 1,000 ft. of a natural meadow that is 10 ac. or greater in size.

Under Alternative B, impacts to forest community dependent species that are not dependent on the MC habitat type are expected to be comparable to those described under Alternative A, and, therefore, would be low-level impacts because this is a common habitat type in the project area.

Riparian Community Dependent Species—Construction of Alternative B would result in the clearing of 13 ac. of riparian community habitat, 9 ac. of which is forested riparian habitat. This outcome would result in the clearing of 2% of the total riparian community habitat present in the study area and 2% of the forested riparian vegetation present in the study area. Under Alternative B, impacts to riparian community dependent species are expected to be comparable in general to those described under Alternative A, and, therefore, would result in a moderate to low-level impact. However, 12 acres occur on the MBSWNF and removal of these habitat types would create a high level impact by causing a reduction in a regionally important Forest Service "Survey and Manage" species habitat—specifically unsurveyed potential habitat for Van Dyke's salamander and Pressley Hesperian (snail).

Aquatic Community Dependent Species—Construction of Alternative B would potentially impact 27 ac. of wetlands and 1 ac. of lakes, rivers, and streams (40% and 1% of the amount present in the study area, respectively). This is potential habitat for common loon. Under Alternative B, impacts to aquatic community dependent species are expected to be comparable in general to those described under Alternative A, and, therefore, would be moderate-level impacts because a local reduction in the quantity of wildlife habitat would result for these species.

Species Dependent upon Unique Habitats—Peregrine falcons and Larch Mountain salamanders were identified as primarily associated with unique habitats and may occur within the study area. Peregrine falcons are associated with cliffs, which they use for nesting habitat. The Larch Mountain salamander is associated with talus habitat, a type that has not been mapped in the study area. Given the topography of this alternative, and based on field observations, talus is likely to occur within the Alternative B alignment. Removal of this habitat type on the MBSWNF would create a high level impact by causing a reduction in a regionally important habitat—specifically unsurveyed potential habitat for Larch Mountain salamander, a Forest Service "Survey and Manage" species.

The Larch Mountain salamander is also known to occur in association with large woody debris as described in Section 3.3.2.4. This habitat type is most likely to occur in the mature coniferous regeneration and mature coniferous forest habitat type, which have been mapped. Alternative B would clear 59 ac. of mature coniferous regeneration and 28 ac. of mature coniferous forest habitat containing large woody debris from within the study area. This is 2% and 1% (respectively) of the amount present in the study area. As described under forest communities, removal of mature coniferous forest habitat would result in a high-level impact.

Early Seral Community Dependent Species—Construction of Alternative B would result in an increase in early seral habitat (managed grass/forb/shrub) of 215 ac. This outcome would benefit elk, black-tailed deer, valley silverspot, great arctic, mardon skipper, and western sulphur. Given the lack of suitable nesting habitat for western bluebirds in the study area, the increase in foraging habitat for this species would likely not appreciably benefit western bluebirds and so the project is expected to have little or no impact on them.

Mitigation—Mitigation measures to minimize or reduce potential impacts under Alternative B would be the same as described under Alternative A, with the following additions:

- If Alternative B is chosen as the new BPA transmission alignment, protocol-level surveys for Forest Service "Survey and Manage" species will be conducted to evaluate whether the proposed project will affect any of those species.

- If Forest Service "Survey and Manage" species are found, BPA will provide the appropriate mitigation to reduce the amount of impacts.

Unavoidable Effects, Irreversible or Irretrievable Commitment of Resources—Under Alternative B, forested habitats, riparian habitats, and wetland habitats would be permanently converted to a managed early seral habitat type, as shown in Table 5.

4.1.3.4 Alternative C (Option C-1)

Impacts—*Forest Community Dependent Species*—Construction of Alternative C (Option C-1) would result in clearing 130 ac. of forested community habitat of which 4 ac. is mature coniferous regeneration forest (6% and 4% of the amount present in the study area, respectively). This outcome also represents a reduction in the amount of recruitment habitat available for late-successional forest dependent species. This habitat would develop into potentially suitable nesting habitat for these species. Under Alternative C (Option C-1), impacts to forest community dependent species are expected to be comparable in general to those described under Alternative A, and, therefore, would be low-level impacts.

Riparian Community Dependent Species—Construction of Alternative C (Option C-1) would result in the clearing of 5 ac. of riparian community habitat (7% of the amount present in the study area). All 5 ac. of cleared riparian community vegetation would be forested riparian habitat (8% of the amount present in the study area). This alternative would result in the least amount of riparian community habitat clearing of all action alternatives (with the exception of Alternative C (Option C-2), which would also clear 5 ac. of riparian community habitat). Under Alternative C (Option C-1), impacts to riparian community dependent species are expected to be comparable in general to those described under Alternative A, and, therefore, would be moderate to low-level impacts because local wildlife habitat quantity and quality would be reduced.

Aquatic Community Dependent Species—Construction of Alternative C (Option C-1) would potentially impact 10 ac. of wetlands and <1 ac. of lakes, rivers, and streams, representing 27% and 10% of the amount present in the study area, respectively. Under Alternative C (Option C-1), impacts to aquatic community dependent species are expected to be comparable in general to those described under Alternative A, and, therefore, would be moderate-level impacts because a local reduction in the quantity of wildlife habitat would result for these species.

Species Dependent upon Unique Habitats—Under Alternative C (Option C-1), impacts to species dependent on unique habitat types would be similar to those described under Alternative A (that is, potential disturbance to unmapped talus habitat and clearing of mature coniferous regeneration habitat). The amount of mature coniferous regeneration forest habitat cleared under Alternative C (Option C-1) would be 4 ac., or 4% of the amount present in the study area. As described under forest communities, this removal of mature coniferous regeneration forest habitat, a type that is common in the project area, would result in a low level of impact. Additionally, talus habitat is unlikely to occur in this proposed alignment, given the topography of the route, and is not expected to be impacted.

Construction of Alternative C (Option C-1) would not impact nesting habitat for peregrine falcons. By creating a larger opening in the canopy, Alternative C (Option C-1) may increase available foraging habitat. However the risk of collision with the power lines, as mentioned in Section 1.2.4, would counteract the benefits of increasing potential foraging habitat.

Early Seral Community Dependent Species—Construction of Alternative C (Option C-1) would result in an increase in early seral habitat (managed grass/forb/shrub) of 169 ac. This outcome would benefit elk, black-tailed deer, valley silverspot, great arctic, mardon skipper, and western sulphur. Given the lack of suitable nesting habitat for western bluebirds in the study area, the increase in foraging habitat for this species would likely not appreciably benefit western bluebirds and so the project would have little or no impact on them.

Mitigation—Mitigation measures to minimize or reduce potential impacts under Alternative C (Option C-1) would be the same as those described under Alternative 1.

Unavoidable Effects, Irreversible or Irretrievable Commitment of Resources—Under Alternative C (Option C-1), forested habitats, riparian habitats, and wetland habitats would be permanently converted to a managed early seral habitat type, as shown in Table 5.

4.1.3.5 Alternative C (Option C-2)

Impacts—*Forest Community Dependent Species*—Construction of Alternative C (Option C-2) would result in clearing 115 ac. of forested community habitat of which <1 ac. is mature coniferous regeneration forest (5% and 1% of the amount present in the study area, respectively). This outcome also represents a reduction in the amount of recruitment habitat available for late-successional forest dependent species. This habitat would develop into potentially suitable nesting habitat for these species. Under Alternative C (Option C-2), impacts to forest community dependent species are expected to be comparable in general to those described under Alternative A, and, therefore, would be low-level impacts.

Under Alternative C (Option C-2), impacts to forest community dependent species that are not dependent on the MC habitat type are expected to be comparable to those described under Alternative A, and, therefore, would be low-level impacts because this is a common habitat type in the project area.

Riparian Community Dependent Species—Construction of Alternative C (Option C-2) would result in the clearing of 5 ac. of riparian community habitat (7% of the amount present in the study area), of which 5 ac. is forested riparian habitat (7% of the amount present in the study area). This alternative would result in the least amount of riparian community habitat clearing of all action alternatives (with the exception of Alternative C [Option C-1], which would also clear 5 ac. of riparian community habitat). Under Alternative C (Option C-2), impacts to riparian community dependent species are expected to be comparable in general to those described under Alternative A, and, therefore, would be moderate to low-level impacts because a local reduction in wildlife habitat quantity and quality would result.

Aquatic Community Dependent Species—Construction of Alternative C (Option C-2) would potentially impact 8 ac. of wetlands and <1 ac. of lakes, rivers, and streams; representing 27% and 13% of the amount present in the study area, respectively. This alternative would result in the least amount of wetland clearing of all action alternatives. Under Alternative C (Option C-2), impacts to aquatic community dependent species are expected to be comparable in general to

those described under Alternative A, and, therefore, would be moderate-level impacts since a local reduction in the quantity of wildlife habitat would result for these species.

Species Dependent upon Unique Habitats—Under Alternative C (Option C-2), impacts to species dependent on unique habitat types would be similar to those described under Alternative A (that is, potential disturbance to unmapped talus habitat and clearing of mature coniferous regeneration forest habitat). The amount of mature coniferous regeneration forest habitat cleared under Alternative C (Option C-2) would be <1 ac., or 1% of the amount present in the study area. This alternative would result in the least amount of unique habitat clearing of all action alternatives. As described under forest communities, this removal of mature coniferous regeneration forest habitat, a type that is common in the project area, would result in a low level of impact. Additionally, talus habitat is unlikely to occur in this proposed alignment, given the topography of the route, and is not expected to be impacted.

Construction of Alternative C (Option C-2) would not impact nesting habitat for peregrine falcons. By creating a larger opening in the canopy, Alternative C (Option C-2) may increase available foraging habitat. However, the risk of collision with the power lines, as mentioned in Section 1.2.4, would counteract the benefits of increasing potential foraging habitat.

Early Seral Community Dependent Species—Construction of Alternative C (Option C-2) would result in an increase in early seral habitat (managed grass/forb/shrub) of 165 ac. This outcome would benefit elk, black-tailed deer, valley silverspot, great arctic, mardon skipper, and western sulphur. Given the lack of suitable nesting habitat for western bluebirds in the study area, the increase in foraging habitat for this species would likely not appreciably benefit western bluebirds and so the project would have little or no impact on them.

Mitigation—Mitigation measures to minimize or reduce potential impacts under Alternative C (Option C-2) would be the same as those described under Alternative A.

Unavoidable Effects, Irreversible or Irretrievable Commitment of Resources—Under Alternative C (Option C-2), forested habitats, riparian habitats, and wetland habitats would be permanently converted to a managed early seral habitat type, as shown in Table 5.

4.1.3.6 D (Option D-1)

Impacts—*Forest Community Dependent Species*—Construction of Alternative D (Option D-1) would result in clearing 632 ac. of forested community habitat, with 158 ac. of this total in the mature coniferous regeneration (MCR) type and 108 ac. in the mature coniferous (MC) forest type. This would result in the clearing of 6% of the total forest community habitat present within the study area, 7% of the amount of mature coniferous regeneration, and 5% of the mature coniferous forest present within the study area. This alternative would result in the greatest amount of mature coniferous vegetation clearing of all action alternatives.

Clearing of mature coniferous (MC) forest would cause a high level impact, because this habitat type is potential nesting habitat for a Forest Service "Survey and Manage" species (great gray owl) and two federally-listed species (northern spotted owl and marbled murrelet). Additionally, Alternative D (Option D-1) passes through designated critical habitat for both the northern spotted owl and the marbled murrelet and would result in clearing of 101 ac. of habitat within spotted owl critical habitat and 32 ac. within marbled murrelet critical habitat. Of this, 23 ac. are currently suitable nesting habitat for the northern spotted owl and 8 ac. is currently suitable nesting habitat for the marbled murrelet. Clearing of forested habitat that is not currently suitable

nesting habitat for these species also represents a reduction in the amount of recruitment habitat available for them and for other late-successional forest dependent species.

Clearing the 350 ac. of forested habitat (ERC, MERC, MRC, MCR, MC, MRD, MD, MRM, and MMR) within the MBSWNF (Table 6) would also lead to a reduction in unsurveyed potential habitat for Forest Service "Survey and Manage" mollusks and salamanders (Table 7). Because this impact has regional importance, the impact would be high level.

Under Alternative D (Option D-1), impacts to forest community dependent species that are not dependent on the MC habitat type are expected to be comparable to those described under Alternative A, and, therefore, would be low-level impacts because this is a common habitat type in the project area.

Clearing of forested habitat would decrease the amount of travel and foraging habitat available for fisher. Because Alternative D (Option D-1) would parallel an existing transmission line, it would not represent a new barrier to fishers potentially moving through the area, but it would increase the width of the current barrier.

Riparian Community Dependent Species—Construction of Alternative D (Option D-1) would result in the clearing of 34 ac. of riparian community habitat, 25 ac. of which is forested riparian habitat. This would result in the clearing of 5% of the total riparian community habitat present in the study area and 5% of the forested riparian vegetation present in the study area. This alternative would result in the greatest amount of riparian community habitat clearing of all action alternatives. Under Alternative D (Option D-1), impacts to riparian community dependent species are expected to be comparable in general to those described under Alternative A, and, therefore, would result in a moderate to low-level impact. However, 18 ac. occur on the MBSWNF and removal of these habitat types would create a high level impact by causing a reduction in a regionally important Forest Service "Survey and Manage" species habitat—specifically unsurveyed potential habitat for Van Dyke's salamander and Pressley Hesperian (snail).

Aquatic Community Dependent Species—Construction of Alternative D (Option D-1) would potentially impact 18 ac. of wetlands and 2 ac. of lakes, rivers, and streams (26% and 1% of the amount present in the study area, respectively). Under Alternative D (Option D-1), impacts to aquatic community dependent species are expected to be comparable in general to those described under Alternative A, and, therefore, would be moderate-level impacts because a local reduction in the quantity of wildlife habitat would result for these species.

Species Dependent upon Unique Habitats—Peregrine falcons and Larch Mountain salamanders were identified as primarily associated with unique habitats and may occur within the study area. Peregrine falcons are associated with cliffs, which they use for nesting habitat. The Larch Mountain salamander is associated with talus habitat, a type that has not been mapped in the study area. Given the topography of this alternative, and based on field observations, talus is likely to occur within the Alternative D (Option D-1) alignment. Removal of this habitat type on the MBSWNF would create a high level impact by causing a reduction in a regionally important habitat—specifically unsurveyed potential habitat for Larch Mountain salamander, a Forest Service "Survey and Manage" species.

The Larch Mountain salamander is also known to occur in association with large woody debris as described in Section 3.3.2.4. This habitat type is most likely to occur in the mature coniferous regeneration and mature coniferous forest habitat type, which have been mapped. Alternative D

(Option D-1) would clear 158 ac. of mature coniferous regeneration and 108 ac. of mature coniferous forest habitat containing large woody debris from within the study area. This is 7% and 5% (respectively) of the amount present in the study area. As described under forest communities, removal of mature coniferous forest habitat would result in a high-level impact.

Early Seral Community Dependent Species—Construction of Alternative D (Option D-1) would result in an increase in early seral habitat (managed grass/forb/shrub) of 672 ac. This outcome would benefit elk, black-tailed deer, valley silverspot, great arctic, mardon skipper, and western sulphur. Given the lack of suitable nesting habitat for western bluebirds in the study area, the increase in foraging habitat for this species would likely not appreciably benefit western bluebirds and so the project is expected to have little or no impact on them.

Mitigation—Mitigation measures to minimize or reduce potential impacts under Alternative D (Option D-1) would be the same as those described under Alternative A, with the following additions:

- If Alternative D (Option D-1) is chosen as the new BPA transmission alignment, protocol-level surveys for Forest Service "Survey and Manage" species will be conducted to evaluate whether the proposed project will affect any of those species.

- If Forest Service "Survey and Manage" species are found, BPA will provide the appropriate mitigation to reduce the amount of impacts.

Unavoidable Effects, Irreversible or Irretrievable Commitment of Resources—Under Alternative D (Option D-1), forested habitats, riparian habitats, and wetland habitats would be permanently converted to a managed early seral habitat type, as shown in Table 5.

4.1.3.7 Alternative D (Option D-2)

Impacts—*Forest Community Dependent Species*—Construction of Alternative D (Option D-2) would result in clearing 694 ac. of forested community habitat, with 186 ac. of this total in the mature coniferous regeneration (MCR) type and 97 ac. in the mature coniferous (MC) forest type. This outcome would result in the clearing of 6% of the total forest community habitat present within the study area, 8% of the amount of mature coniferous regeneration, and 4% of the mature coniferous forest present within the study area. This alternative would result in the greatest amount of mature regenerating coniferous vegetation clearing of all action alternatives.

Clearing of mature coniferous (MC) forest would cause a high level impact because this habitat type is potential nesting habitat for a Forest Service "Survey and Manage" species (great gray owl) and two federally-listed species (northern spotted owl and marbled murrelet). Additionally, Alternative D (Option D-2) also passes through designated critical habitat for both the northern spotted owl and the marbled murrelet and would result in clearing of 92 ac. of habitat within spotted owl critical habitat and 19 ac. within marbled murrelet critical habitat. Of this, 19 ac. are currently suitable nesting habitat for the northern spotted owl and 4 ac. is currently suitable nesting habitat for the marbled murrelet. Clearing of forested habitat that is not currently suitable nesting habitat for these species also represents a reduction in the amount of recruitment habitat available for them and for other late-successional forest dependent species.

Clearing the 389 ac. of forested habitat (ERC, MERC, MRC, MCR, MC, MRD, MD, MRM, and MMR) within the MBSWNF (Table 6) would also create a reduction in unsurveyed potential

habitat for Forest Service "Survey and Manage" mollusks and salamanders (Table 7). Because this impact has regional importance, the impact would be high level.

Under Alternative D (Option D-2), impacts to forest community dependent species that are not dependent on the MC habitat type are expected to be comparable to those described under Alternative A, and, therefore, would be low-level impacts because this is a common habitat type in the project area.

Clearing of forested habitat would decrease the amount of travel and foraging habitat available for fisher. Because Alternative D (Option D-2) would parallel an existing transmission line, it would not represent a new barrier to fishers potentially moving through the area, but it would increase the width of the current barrier.

Riparian Community Dependent Species—Construction of Alternative D (Option D-2) would result in the clearing of 32 ac. of riparian community habitat, 28 ac. of which is forested riparian habitat. This outcome would result in the clearing of 5% of the total riparian community habitat present in the study area and 5% of the forested riparian vegetation present in the study area. Under Alternative D (Option D-2), impacts to riparian community dependent species are expected to be comparable in general to those described under Alternative A, and, therefore, would result in a moderate to low-level impact. However, 19 ac. occur on the MBSWNF and removal of these habitat types would create a high level impact by reducing a regionally important Forest Service "Survey and Manage" species habitat—specifically unsurveyed potential habitat for Van Dyke's salamander and Pressley Hesperian (snail).

Aquatic Community Dependent Species—Construction of Alternative D (Option D-2) would potentially impact 16 ac. of wetlands and 2 ac. of lakes, rivers, and streams (26% and 1% of the amount present in the study area, respectively). Under Alternative D (Option D-2), impacts to aquatic community dependent species are expected to be comparable in general to those described under Alternative A, and, therefore, would be moderate-level impacts because a local reduction in the quantity of wildlife habitat would result for these species.

Species Dependent upon Unique Habitats—Peregrine falcons and Larch Mountain salamanders were identified as primarily associated with unique habitats and may occur within the study area. Peregrine falcons are associated with cliffs, which they use for nesting habitat. The Larch Mountain salamander is associated with talus habitat, a type that has not been mapped in the study area. Given the topography of this alternative, and based on field observations, talus is likely to occur within the Alternative D (Option D-2) alignment. Removal of this habitat type on the MBSWNF would create a high level impact by reducing a regionally important habitat—specifically unsurveyed potential habitat for Larch Mountain salamander, a Forest Service "Survey and Manage" species.

The Larch Mountain salamander is also known to occur in association with large woody debris as described in Section 3.3.2.4. This habitat type is most likely to occur in the mature coniferous regeneration and mature coniferous forest habitat type, which have been mapped. Alternative D (Option D-2) would clear 186 ac. of mature coniferous regeneration and 97 ac. of mature coniferous forest habitat containing large woody debris from within the study area. This outcome is 8% and 4% (respectively) of the amount present in the study area. This alternative would result in the greatest amount of mature regenerating coniferous vegetation clearing of all action alternatives. As described under forest communities, removal of mature coniferous forest habitat would result in a high-level impact.

Early Seral Community Dependent Species—Construction of Alternative D (Option D-2) would result in an increase in early seral habitat (managed grass/forb/shrub) of 733 ac. This alternative would result in the highest amount of early seral habitat conversion of all action alternatives. This outcome would benefit elk, black-tailed deer, valley silverspot, great arctic, mardon skipper, and western sulphur. Given the lack of suitable nesting habitat for western bluebirds in the study area, the increase in foraging habitat for this species would likely not appreciably benefit western bluebirds and so the project is expected to have little or no impact on them.

Mitigation—Mitigation measures to minimize or reduce potential impacts under Alternative D (Option D-2) would be the same as those described under Alternative A, with the following additions:

- If Alternative D (Option D-2) is chosen as the new BPA transmission alignment, protocol-level surveys for Forest Service "Survey and Manage" species will be conducted to evaluate whether the proposed project will affect any of those species.

- If Forest Service "Survey and Manage" species are found, BPA will provide the appropriate mitigation to reduce the amount of impacts.

Unavoidable Effects, Irreversible or Irretrievable Commitment of Resources—Under Alternative D (Option D-2), forested habitats, riparian habitats, and wetland habitats would be permanently converted to a managed early seral habitat type, as shown in Table 5.

4.1.4 Access Roads

4.1.4.1 Impacts

Under Alternative 1, vegetation totaling <1 ac. would be removed in the construction of new access roads, predominantly in the mature coniferous regeneration forest and early regeneration, mixed forest habitat types. Alternative 1 would require the least amount of new roads of all the alternatives. A portion of this clearing would coincide with clearing for the transmission ROW and so is not an additive impact. The additional clearing for new roads would not alter the impact level in forested habitat as described under Alternative 1.

The majority of Alternative A parallels an existing transmission line. However, most new roads associated with this alternative would be constructed in the portion of the alignment that does not parallel the existing line. New road construction would require clearing 33 ac., primarily within the managed grass/forb/shrub and rural residential/managed landscape habitat types. Clearing associated with road construction is not expected to change the impact level for this alternative as described earlier.

Alternative B would require 14 ac. of clearing for new road construction in the managed grass/forb/shrub, early regeneration coniferous, mid-regeneration coniferous, mature regeneration coniferous, and mature coniferous forest habitat types. Clearing associated with road construction would contribute to impacts of this alternative and would not change the impact level for this alternative as described earlier.

Alternative C (Option C-1) would require 23 ac. of vegetation clearing for new access road construction, with the majority occurring in the rural residential/managed landscape, mid-regeneration mixed and mature deciduous forest, and managed grass/forb/shrub habitat types.

Clearing associated with road construction is not expected to change the impact level for this alternative as described earlier.

Alternative C (Option C-2) would require 30 ac. of vegetation clearing for new access road construction, with the majority in the rural residential/managed landscape, mid-regeneration mixed, mature deciduous forest, and managed grass/forb/shrub habitat types. Clearing associated with road construction is not expected to change the impact level for this alternative as described earlier.

Alternative D (Options D-1 and D-2) would require 40 and 42 ac. respectively of vegetation clearing for new road construction in the managed grass/forb/shrub, mid-regeneration coniferous, mature coniferous regeneration, and mature coniferous forest habitat types. Alternative D (Option D-2) requires the greatest amount of road construction of all the alternatives. Clearing associated with road construction would contribute to impacts of this alternative and would not change the impact level for this alternative as described earlier.

Construction of new roads may also lead to disturbance of wildlife, as described under the discussion of impacts common to all alternatives. Disturbance from road construction would result from use of power saws to clear the new ROW, heavy equipment used to construct the road, and use of the road following construction. Potential disturbance is expected to be lowest under Alternatives A and C (Options C-1 and C-2) because it would be located adjacent to an area that currently receives a relatively high level of human use, and greatest for Alternatives 1, B, and D (Options D-1 and D-2), which would be constructed in an area currently receiving the least human use.

New road construction through areas of uniform habitat type would also increase the amount of edge habitat in the stand, contributing to habitat fragmentation for low-mobility species such as mollusks. New road construction through MC habitat types would fragment potential nesting habitat for both marbled murrelet and northern spotted owl, reducing the effectiveness of this habitat.

4.1.4.2 Mitigation

Mitigation measures to reduce or minimize impacts from new road construction include:

- Avoid building new roads within or adjacent to wetlands.

4.1.4.3 Unavoidable Effects, Irreversible or Irretrievable Commitment of Resources

Construction of access roads would result in permanent removal of potential wildlife habitat. Although roads can be decommissioned and so are not an irreversible impact in general, construction of roads in association with the proposed project is considered permanent because there is no plan in place to later close these roads, and the intention is to maintain them as a permanent feature.

4.1.5 Cumulative Impacts

Construction impacts resulting from the proposed new transmission line, associated access roads, and the substation expansion would occur in conjunction with the current land management activities on the properties that the proposed new ROW would cross. Therefore, impacts in these areas would not be limited to those resulting only from the proposed transmission project. By

definition, cumulative impacts are meant to consider other reasonably foreseeable actions in the study area.

Within rural residential and developed areas, development can be expected to continue, following the trend in the greater Puget Sound region. Vegetation removal and habitat alteration would not be confined to that occurring in conjunction with the proposed project but would also include vegetation removal associated with development.

Industrial forest lands crossed by portions of the proposed project would continue to be managed for timber production, and so impacts to vegetation described earlier would be additive to impacts caused by timber management activities. The exception would be within forested riparian areas, which would be maintained as riparian buffers on industrial forest lands.

Land Management allocations on the National Forest land crossed under Alternatives B and D (Options D-1 and D-2) include the Snoqualmie Pass Adaptive Management Area, which is managed to create late-successional habitat; Matrix land, which is managed for timber production; and LSR, which by definition is described as land reserves designed to restore a functional, interactive, late-successional and old-growth forest ecosystem over time. These land reserves also serve as habitat for terrestrial and aquatic species that depend on these old-growth characteristics. Not all of the reserves are currently in old-growth condition. Some silvicultural treatment is allowed to enhance development of old-growth conditions in stands less than 80 years old (USDA 1996).

4.2 Operation and Maintenance Impacts

4.2.1 Impacts Common to all Transmission Line Alternatives

4.2.1.1 Impacts

Operation and maintenance impacts would be associated with the transmission line and substation. Impacts associated with operations tend to be indirect, short-term disturbance impacts, potentially leading to avoidance of areas by wildlife even if habitat in the area has not been altered in a way that would make it otherwise unsuitable. Maintenance impacts tend to be less intense, but are long term and may influence wildlife use of an area to a greater extent than shorter term, more intense construction activities. Such impacts could result from activities such as road maintenance, repair of towers or conductors, and vegetation removal within or adjacent to the ROW.

Under all action alternatives, vegetation within the cleared transmission line ROW would be maintained in the early seral managed grass/forb/shrub habitat type. Associated impacts include the potential for noise disturbance to wildlife in adjacent forest habitats during maintenance activities, and the long-term maintenance of a cleared ROW with associated edge habitat and potential barriers to wildlife travel.

As the stands adjacent to the cleared ROW continue to develop, the potential for use by forest community dependent species would increase. As this occurs, the presence of a cleared ROW and associated edge habitat would have an increasing impact on the quality of forested habitat in the study area. For species that utilize interior habitat, the maintenance of edge habitat may preclude the use of otherwise suitable habitat in the future.

Maintaining a cleared ROW through stands that are developing late-successional characteristics may also maintain a barrier between patches of suitable habitat for both low-mobility species, such as mollusks, and species that avoid openings, such as fisher. This outcome would reduce the quality of the habitat in the study area. Because of the long, linear nature of the proposed project, this would be a moderate-level impact on these species.

Noise associated with the operation of the line, including constant humming and crackling during rain showers, has the potential to cause noise disturbance in the immediate vicinity of the line. Since this noise would be constant, wildlife in the vicinity would be expected to acclimate to it. Also, only the area immediately adjacent to the line would be impacted. For these reasons, noise impacts during project operation would be low level.

4.2.1.2 Mitigation

Mitigation measures to reduce or minimize potential impacts from noise disturbance include:

- Prior to maintenance activities, verify that no new bald eagle or spotted owl nests; or marbled murrelet occupied sites have been found within 1 mi. of the proposed ROW. If any are found, avoid blasting within 1.0 mi. or construction within 0.5 mi. of bald eagle nests and 0.25 mi. of spotted owl and marbled murrelet sites during the nesting period (January 1 through August 15, March 1 through September 30, and April 1 through September 15 respectively). Survey techniques would follow available protocols or would be determined and included in the mitigation action plan to be prepared for this project. Alternately, maintenance activities could be conducted outside of the listed nesting seasons within the given distances of suitable habitat for these species.

Mitigation measures to reduce or minimize potential impacts from habitat fragmentation include:

- Clear only as much vegetation as necessary. Where possible, limit clearing to overstory removal and leave shrubs and small trees.

- Provide coarse woody debris within the cleared ROW for cover for small mammals, such as chipmunks, mice and shrews, and for connectivity of habitat for invertebrates, such as species of mollusks included in this document. This outcome can be accomplished by either leaving some logs in place during clearing or by placing logs within the ROW following construction. Large logs have the highest value for this purpose.

- Span riparian corridors to the extent possible, leaving riparian vegetation across the cleared ROW for use as travel corridors.

4.2.1.3 Unavoidable Effects, Irreversible or Irretrievable Commitment of Resources

The long-term maintenance of the proposed ROW in a managed early seral condition would be considered irreversible because it is intended to be maintained this way indefinitely.

4.2.2 Access Roads

4.2.2.1 Impacts

Impacts from maintenance of access roads would be similar to those described for the transmission lines, although access roads would present a lesser barrier to wide-ranging species.

4.2.2.2 Mitigation

Mitigation measures to reduce or minimize impacts from access road maintenance include:

- Prior to maintenance activities, verify that no new bald eagle or spotted owl nests; or marbled murrelet occupied sites have been found within 1 mi. of the proposed ROW. If any are found, avoid blasting within 1.0 mi. or construction within 0.5 mi. of bald eagle nests and 0.25 mi. of spotted owl and marbled murrelet sites during the nesting period (January 1 through August 15, March 1 through September 30, and April 1 through September 15 respectively). Survey techniques would follow available protocols or would be developed and included in the mitigation action plan to be prepared for this project. Alternately, maintenance activities could be conducted outside of the listed nesting seasons within the given distances of suitable habitat for these species.

4.2.2.3 Unavoidable Effects, Irreversible or Irretrievable Commitment of Resources

The long-term maintenance of the proposed ROW in a managed early seral condition would be considered irreversible because it is intended to be maintained this way indefinitely.

4.2.3 Substation

4.2.3.1 Impacts

Impacts from maintenance and operation of the expanded Echo Lake Substation would not differ from the existing condition. The site would continue to be of low quality as wildlife habitat, and wildlife use of the area is not expected to change.

4.2.3.2 Mitigation

No mitigation measure would be required for operation and maintenance of the expanded substation.

4.2.3.3 Unavoidable Effects, Irreversible or Irretrievable Commitment of Resources

No unavoidable, irreversible, or irretrievable impacts would occur.

4.2.4 Cumulative Impacts

Maintenance of the proposed new ROW in an early seral condition, along with new access roads and the expanded substation, would occur in conjunction with other current land management activities on properties where the new ROW would cross. Therefore impacts in these areas would not be limited to those of the proposed project.

Maintenance activities would consist primarily of vegetation maintenance under the transmission lines, resulting in potential disturbance of wildlife in adjacent habitats. Within the rural residential areas, this would occur simultaneously with a high level of human activity and so would not be appreciably different from the existing condition. The same is true for forest lands managed for timber production by private landowners and the USFS.

Within the USFS lands, maintenance activities would have a greater potential to cause noise disturbance to wildlife because human activity is limited in these areas. Activities that do occur

include some road use, road maintenance, and vegetation management along roads. Thinning may also occur in the future, which could compound potential impacts from ROW maintenance if they are in the same general vicinity.

5.0 Environmental Consultation, Review, and Permit Requirements

Several federal laws and administrative procedures must be met by the alternatives. This section lists and briefly describes requirements that would apply to wildlife elements of this project.

5.1 Federal

5.1.1 National Environmental Policy Act (NEPA)

This report was prepared in support of environmental documentation required by NEPA (42 USC 4321 et seq.). NEPA is a national law for protection of the environment. NEPA applies to all federal projects or projects that require federal involvement. BPA would take into account potential environmental consequences and would take action to protect, restore, and enhance the environment before making a decision on the proposed action.

5.1.2 Endangered Species Act (ESA)

The ESA of 1973 (16 USC 1536) provides for conserving endangered and threatened species of fish, wildlife, and plants. Federal agencies must determine whether proposed actions would adversely affect any endangered or threatened species. When conducting an environmental impact analysis for specific projects, agencies must identify practicable alternatives to conserve or enhance such species.

The ESA protects species whose populations are declining to the point where they are now at risk of extinction, or are likely to be in the future. The ESA prohibits "taking" any species listed as endangered. The prohibition against taking can be extended to threatened species under regulations promulgated by the USFWS and National Marine Fisheries Service (NMFS). Under the Act, "to take" is defined as "to harass, harm, pursue, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct" (16 USC 1532(18)). "Harming" includes any action that reduces an individual species' ability to feed, breed, or seek shelter and can include major habitat modifications that result in killing or injuring wildlife by significantly impairing behavioral patterns.

Section 7 of the ESA requires federal agencies to consult with the USFWS and/or the NMFS on actions leading to activities that might affect listed species. Consultation typically involves preparing a Biological Assessment that describes the expected effects of a proposed action on a listed species. If the Biological Assessment indicates that the action is likely to adversely affect a listed species, then formal consultation with the USFWS or NMFS is required. Formal consultation results in the issuance of a Biological Opinion—a formal determination on whether or not an action will jeopardize the continued existence of the species or destroy or adversely modify a species' critical habitat, and if so whether there are reasonable and prudent alternatives that avoid such a result (50 CFR 17.3).

Under Section 10 of the ESA, as amended in 1982, incidental takes (those that are incidental to otherwise lawful activity) of listed species may be authorized through voluntary agreements including HCPs. HCPs must be approved by the Secretary of the listing department. When approving a plan, the Secretary must find that:

1. the plan will minimize and mitigate the impacts of the incidental take to the maximum extent possible;

2. the incidental take will not appreciably reduce the likelihood of the survival and recovery of the species in the wild; and

3. adequate funding for the plan is provided.

5.1.3 Northwest Forest Plan

USFS and BLM developed the Northwest Forest Plan in 1993 to set guidelines for the management of the natural environment in Pacific Region National Forests. The goals of the Northwest Forest Plan are designed to protect forest ecosystems and allow renewable use of forest material, but include protection for riparian areas and waters. The forest management and implementation portion of the strategy was analyzed in a draft supplemental environmental impact statement, of which the final EIS and the record of decision (ROD) were published in February 1994. The ROD amended the planning documents of 19 National Forests and 7 Bureau of Land Management Districts.

5.1.4 Designated Critical Habitat for Listed Species

The ESA requires that, to the maximum extent determinable, NMFS and USFWS must designate critical habitat for federally-listed species at the time of their listing. Critical habitat designation establishes areas that are to be given special consideration in Section 7 consultations. Of the listed wildlife species potentially present in the project area, critical habitat has been defined only for spotted owl and marbled murrelet.

5.1.5 Migratory Bird Treaty Act

The Migratory Bird Treaty Act protects birds defined as migratory, which includes many songbirds, waterfowl, and raptors. This Act prohibits the killing, harming, or capture of migratory birds, bird parts, nests, and eggs, unless permitted by regulation.

5.1.6 Bald Eagle Protection Act

The Bald Eagle Protection Act prohibits the taking of both bald and golden eagles or any parts, nests, or eggs. This Act prohibits killing, collection, and disturbance of these species. Project activities that caused direct mortality of these species or removal or alteration of a nest site would likely not be in compliance with this Act; however, such consequences are not expected to occur.

5.2 State

Washington State-listed threatened and endangered species are not protected in the same way as federally-listed species, where a “taking” is generally prohibited unless authorized by an Incidental Take Permit or an Incidental Take Statement. Instead, the State uses these classifications to assist with agency management programs and decision making. The State also

defines Priority Habitats as those habitats having unique or significant value to species because they contain a unique vegetation type or a specific habitat element that is key to fish and wildlife. Priority habitats occurring or potentially occurring within the study area include riparian areas, areas containing down logs and snags, wetlands, and talus.

5.2.1 Washington Forest Practices Act

The Washington Forest Practices Act has provisions for managing riparian and wetland vegetation and wildlife habitats in areas where timber harvest is planned. It requires landowners to consult with the WDFW to protect critical habitats; to preserve wildlife reserve trees; and to avoid disturbance to both spotted owls and marbled murrelets during their nesting seasons.

5.3 Local

5.3.1 King County Comprehensive Plan

Key objectives of the King County Comprehensive Plan include conserving wildlife resources and maintaining biodiversity within the county. To accomplish these objectives, the county has identified areas of important wildlife habitat and linkage corridors between these habitats. The comprehensive plan also requires that species listed as threatened or endangered, either federally or by the state, and species listed as sensitive by the state be considered in project planning and protected. This level of consideration is also extended to species that are not listed either federally or by the state, but that are considered to be of local importance in the county. The study area contains habitat linkage corridors and either known or potential habitat for species included under the comprehensive plan.

5.3.2 Kittitas County's Critical Areas Title

Kittitas County's Critical Areas Title 17A.07 provides regulations for protecting critical habitats. The ordinance contains five sections, which are protecting riparian habitat, designation of big game winter range, priority species habitat, habitats for species of local importance, and species of local importance.

5.3.3 City of Covington

The City of Covington does not have its own critical area ordinance, by instead adopted the King County Comprehensive plan for environmental regulation.

5.3.4 City of Maple Valley

The City of Maple Valley has a set of Critical Area Regulations addressed in Title 18, Chapter 18.60. The City's objective in developing the Critical Area Regulations is to implement the goals and policies of the Washington State Growth Management Act, which requires each local jurisdiction to adopt rules for protection of environmentally critical areas. The City's regulations also address elements of the Washington State Environmental Policy Act and the Maple Valley comprehensive plan that protect the natural environment.

5.3.5 City of Kent

The City of Kent does not have its own environmental policy, but instead adopted the State Environmental Policy Act (SEPA), RCW 43.21C.120(3) and the SEPA rules, WAC 197-11-904 for its environmental regulation.

6.0 Individuals and Agencies Consulted

- Dwayne Paige
  Wildlife Biologist
  City of Seattle, Cedar River Watershed
  Contacted by telephone November 6, 2000

- U.S. Fish and Wildlife Service, species request letter

- Mt. Baker-Snoqualmie and Wenatchee National Forests

7.0 List of Preparers

Randy Edwards, Information Team Leader
More than 20 years of experience in the GIS and environmental industries
B.S., Oceanography, Humboldt State University, 1983

Sloan Gordon, Wildlife Biologist
Seven years of experience in "Survey and Manage" (USFS), threatened, and endangered (USFWS) species monitoring and regulation; state and local wildlife regulation compliance
B.S., Wildlife Biology, Washington State University, 1996

Sean Robertson, CAD/GIS Specialist
Two years of experience in GIS mapping and evaluations
B.S., Environmental and Resource Sciences, University of California – Davis, 1999

John Soden, Project Manager
Five years of experience in wetland delineation and assessment of aquatic resources, resource inventory and classification, riparian and wetlands research, and permitting assistance
M.S., Forestry (Riparian and Wetland Research Program), University of Montana, 1999

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9.0 Glossary and Acronyms

This section contains a list of acronyms, abbreviations, and technical terms used in this report. Words that would be defined in a desk-size dictionary (for example, the College Edition of the American Heritage Dictionary) are not included.

9.1 Glossary

100-year floodplains are areas that have a 1% chance of being flooded in a given year.

Access roads are constructed to each structure site first to build the tower and line and later to maintain and repair it. Access roads are built where no roads exist. Where county roads or other access is already established, short spurs are built to the structure sites. Access roads are maintained after construction, except where they pass through cultivated land where the roads would be removed and crop production would be restored after construction is completed.

Alternatives refer to different choices or means to meet the need for action.

Anthropogenic is of, relating to, or resulting from the influence of human beings on nature.

Aquifers are water-bearing rock or sediments below the surface of the earth.

Best Management Practices are a practice or a combination of practices that are the most effective and practical means of preventing or reducing the amount of pollution generated by non-point sources to a level compatible with water quality goals.

Biological Assessments are documents prepared to fulfill the implementing regulations of the Endangered Species Act, found at 50 CFR, part 402, which require an assessment of potential effects on listed species and critical habitat prior to implementing a proposed action. A proposed

action is defined as any activity authorized, funded, or carried out by a federal agency (50 CFR 402.10).

Biological Evaluations are the means by which the U.S. Forest Service conducts a review and documents the findings of the effects of an action or proposed action on any sensitive species.

Culverts are corrugated metal or concrete pipes used to carry or divert runoff water from a discharge. Culverts are usually installed under roads to prevent washouts and erosion.

Cumulative impacts are created by the incremental effect of an action when added to other past, present, and reasonably foreseeable future actions.

Cut and fill is the process by which a road is cut or filled on a side slope. The term refers to the amount of soil that is removed (cut) or added (filled).

CWA signifies the Clean Water Act, a federal law intended to restore and maintain the chemical, physical, and biological integrity of the nation's waters and secure water quality.

Danger trees or high-growing brush occur in or alongside the project right-of-way and are hazardous to the transmission line. These trees are identified by special crews and must be removed to prevent tree-fall into the line or other interference with the wires. The owner of danger trees off the right-of-way is compensated for their value. BPA's Construction Clearing Policy requires that trees be removed that meet either one of two technical categories: Category A contains any tree that in 15 years will grow within about 5 m (18 ft.) of conductors when the conductor is at maximum sag (100°C or 212°F) and is swung by 30 kg per sq/m (6 lb per sq/ft.) of wind (93 kph or 58 mph); Category B represents any tree or high-growing bush that after 8 years of growth will fall within about 2 m (8 ft.) of the conductor when it reaches maximum sag (80°C or 176°F) in a static position.

Deadends are heavy towers designed for use where the transmission line loads the tower primarily in tension rather than compression. Deadends are used in turning large angles along a line or in bringing a line into a substation.

Easement is a grant of certain rights to use a piece of land, which then becomes a "right-of-way." BPA normally acquires easements for its transmission lines. Easement includes the right to enter the ROW to build, maintain, and repair facilities.

Emergent plants have their bases submerged in water.

Endangered species are those species listed as endangered either by the Federal Government or the State of Washington. Federally-listed Endangered Species are those officially designated by the U.S. Fish and Wildlife Service as being in danger of extinction throughout all or a significant portion of their range. These species receive full protection under the Endangered Species Act. State-listed Endangered Species are those species native to the State of Washington that are seriously threatened with extinction throughout all or a significant portion of their range within the state, as designated in Washington Administrative Code 232-12-014.

Floodplain refers to a portion of a river valley adjacent to the stream channel that is covered with water when the stream overflows its banks during flood stage.

Footings are the supporting base for the transmission towers. They are usually steel assemblies buried in the ground for lattice-steel towers.

Forb is any herbaceous plant that is not a grass or grasslike.

Ford is a travelway across a stream where water depth does not prevent vehicle movement. Ford construction can include grading and stabilizing streambanks at the approaches and adding coarse fill material within the channel to stabilize the roadbed.

GIS signifies Geographic Information System, a computer system that analyzes graphical map data.

Ground wire (overhead) is wire strung from the top of one tower to the next; it shields the line against lightning strikes.

HCP is Habitat Conservation Plan.

Hydrology addresses properties, distribution, and circulation of water.

Hydroperiod is the seasonal occurrence of flooding and/or soil saturation.

Insulators are ceramic or other nonconducting materials used to keep electrical circuits from jumping to ground.

Intermittent refers to periodic water flow in creeks or streams.

Internal drainage refers to streams that are not connected to the ocean by surface waters.

Jurisdictional wetlands are areas that are consistently inundated or saturated by surface or ground water at a frequency and duration sufficient to support a prevalence of vegetation typically adapted for life in saturated soil conditions.

Kilovolt is one thousand volts.

Lattice steel refers to a transmission tower constructed of multiple steel members that are connected together to make up the tower's frame.

Low vegetation area is the area where vegetation is kept below a maximum reliable operation height.

Low-gradient refers to gentle slopes.

LWD is large woody debris, defined as any piece of downed wood larger than 4 in. in diameter and 6 ft. long.

Mitigation is the step(s) taken to lessen the potential environmental effects predicted for each resource impacted by the transmission project. Mitigation may reduce the impact, avoid it completely, or compensate for the impact. Some mitigation, such as adjusting the location of a tower to avoid a special resource, is enacted during the design and location process. Other mitigation, such as reseeding access roads with desirable grasses and avoiding weed proliferation, is taken after construction.

Monitor species are those species for which the State of Washington monitors status and distribution either because they have been listed as State-threatened, endangered or sensitive within the previous 5 years; they require a habitat that has limited availability during at least some portion of their life cycle; they are environmental indicators; or their taxonomy is in question and it is unclear whether they should be included as listed species.

Montane areas refer to those occurring in the biogeographic zone of relatively moist, cool upland slopes below timberline dominated by large coniferous trees.

National Environmental Policy Act (NEPA) requires an environmental impact statement on all major federal actions significantly affecting the quality of the human environment. (42 U.S.C. 4332 2(2)(C))

Noxious weeds are plants that are injurious to public health, crops, livestock, land, or other property.

Perennial streams and creeks have year-round water flows.

Permeability refers to the capability of various materials to transport liquids.

Pulling site is a staging area for machinery used to string conductors.

Revegetation is reestablishment of vegetation on a disturbed site.

Right-of-way (ROW) is an easement for a certain purpose over the land of another owner, such as a strip of land used for a road, electric transmission line, pipeline, etc.

Riparian habitat is a zone of vegetation that extends from the water's edge landward to the edge of the vegetative canopy. The term is associated with watercourses such as streams, rivers, springs, ponds, lakes, or tidewater.

Sensitive species are those species native to Washington State that are vulnerable or declining and are likely to become endangered or threatened in a significant portion of their range within the state without cooperative management or removal of threats, as defined in Washington Administrative Code 232-12-011.

Seral stage designates a given sere, which is a stage of ecological succession. Phases in the growth and development of plant communities from a disturbance or colonization event to the climax community are characterized as seres.

Silt is a designation referring to individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 mm) to the lower limit of very fine sand (0.05 mm).

Sole source aquifer is designated by the U.S. Environmental Protection Agency as an aquifer providing at least half of an area's drinking water.

Substation deadends are towers within the confines of the substation where incoming and outgoing transmission lines end. Deadends are typically the tallest structures in a substation.

Substation is the fenced site that contains the terminal switching and transformation equipment needed at the end of a transmission line.

Survey and manage is a mitigation measure adopted as a standard and guideline within the NFP Record of Decision that is intended to mitigate impacts of land management efforts on species that are closely associated with late-successional or old-growth forests whose long-term persistence is a concern. (U.S. Department of Agriculture, Forest Service, and U.S. Department of Interior, Bureau of Land Management 2000)

Survey protocols are interagency documents describing the survey techniques needed to have a reasonable chance of locating a species when it is present on a site, or needed to make an "equivalent effort" of locating the species when it is present on the site. Survey protocols also identify habitats needing surveys and may identify habitats or circumstances not needing surveys. (U.S. Department of Agriculture, Forest Service, and U.S. Department of Interior, Bureau of Land Management 2000)

Take is to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct (Federal Endangered Species Act, Section 3(18)).

Threatened species are those species listed as threatened either by the Federal Government or the State of Washington. Federally-listed threatened species are those officially designated by the U.S. Fish and Wildlife Service as being in danger of becoming endangered throughout all or a significant portion of their range. These species receive full protection under the Endangered Species Act. State-listed threatened species are those species native to the State of Washington that are likely to become endangered within the foreseeable future throughout all or a significant portion of their range within the state without cooperative management or removal of threats, as designated in Washington Administrative Code 232-12-011.

Transmission deadend towers are the last transmission line towers on both the incoming and outgoing sides of the substation. These towers are structurally reinforced to reduce conductor tension on substation deadends and provide added reliability to the substation.

Transmission line includes the structures, insulators, conductors, and other equipment used to transmit electrical power from one point to another.

Water bars are smooth, shallow ditches excavated at an angle across a road to decrease water velocity and divert water off and away from the road surface.

Wetlands are areas where the soil experiences anaerobic conditions because of inundation of water during the growing season. Indicators of a wetland include types of plants, soil characteristics, and hydrology of the area.

9.2 Acronyms and Abbreviations

ac. .....acre or acres
BCPs .....Bird Conservation Plans
BMPs .....Best Management Practices
BPA.....Bonneville Power Administration
CFR.....Code of Federal Regulations
CRW .....Cedar River Watershed
dbh .....diameter at breast height
FR.....Federal Register
ft. .....foot or feet
EIS.....environmental impact statement

ESA.....Endangered Species Act
GIS.....Geographic Information System
in. .....inch or inches
kV.....kilovolt
LMS .....Landbird Monitoring Strategy
LSR .....Late-Successional Reserve
mi. .....mile or miles
MBSNF.....Mt. Baker-Snoqualmie National Forest
MBSWNF .....Mt. Baker-Snoqualmie and Okanogan-Wenatchee National Forests
MIS .....Management Indicator Species
NEPA.....National Environmental Policy Act
NESC .....National Electrical Safety Code
NFP .....Northwest Forest Plan
NMFS.....National Marine Fisheries Service
ROW .....right-of-way
SEPA.....State Environmental Policy Act
USC.....U.S. Code
USFS.....U.S. Forest Service
USFWS .....U.S. Fish and Wildlife Service
WDFW.....Washington Department of Fish and Wildlife
WDNR .....Washington Department of Natural Resources

Appendix P Final Supplemental Vegetation Technical Report

Final Supplemental Vegetation Technical Report

Bonneville Power Administration
Kangley-Echo Lake Transmission Line Project

Prepared for:

Bonneville Power Administration
905 NE 11th Avenue
Portland, Oregon 97208-3621

Prepared by:

Jones & Stokes
11820 Northup Way, Suite E300
Bellevue, Washington 98005-1946

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1.0 Executive Summary

This report describes the existing conditions and potential impacts to vegetation from the proposed Bonneville Power Administration (BPA) Kangley-Echo Lake Transmission Line Project. This report serves as the primary basis for the vegetation discussion in the National Environmental Policy Act (NEPA) Supplemental Draft Environmental Impact Statement (SDEIS) prepared for the project.

1.1 Alternatives

This Technical Report presents the preferred alternative (Alternative 1) and four additional action alternatives for constructing a new 500-kilovolt (kV) electrical transmission line intended to increase the capacity and reliability of energy provided to the Seattle metropolitan area. This increased capacity and reliability would reduce the potential for rolling brownouts or blackouts that could transpire by the winter of 2002 to 2003 if severe winter weather were to cause inordinate power demand and a simultaneous outage were to occur on one of the existing transmission lines in the area. Each alternative as shown in Figure 1 is described below in Section 1.1.2.

1.1.1 Construction Methods

BPA would construct all of the action alternatives using the existing practices described below for building transmission lines and substations. BPA would first obtain from landowners any additional easements for right-of-way (ROW) for the transmission line or access roads that would be needed. BPA would then build or improve access roads as necessary, clear vegetation in the ROW, and construct the required towers. BPA typically uses existing, cleared staging areas for storage and assembly of materials or structures.

After the structures are in place and conductors are strung between the structures, BPA would restore all disturbed areas.

The following sections describe in greater detail the sequential steps that BPA typically takes to construct a transmission line.

1.1.1.1 Right-of-Way Requirements

BPA would obtain easements from landowners for the transmission line ROW, and easements for access roads outside of the transmission line ROW easement. The easements give BPA the right to construct, operate, and maintain the line and access roads. A 150-foot (ft.) ROW width is assumed for the proposed 500-kV line.

Fee title to the land comprising the easement generally remains with the owner, subject to the provisions of the easement. The easement prohibits structures, tall trees, storing of flammable materials, and other activities that could be hazardous to people or endanger the transmission line. Activities that do not interfere with the transmission line or endanger people are usually not restricted.

Rights (usually easements) for new access roads that are outside the transmission line ROW would be acquired from property owners, as necessary. A 50-ft. ROW easement generally would be acquired for the new access roads, which are typically constructed to a roadbed width about

16 ft. wide. A 20-ft-wide easement would be purchased for the use of any existing access roads that are needed.

1.1.1.2 Clearing

The height of vegetation within the ROW would be restricted to provide safe and reliable operation of the line. All tall growing vegetation would be cleared within the transmission line ROW. Some trees outside of the ROW would also be cleared to prevent unstable or undesirable trees from falling onto the lines. These trees are referred to as "danger trees." A clearing advisory would be generated using ground information from cross section data. This clearing advisory would specify a safe vegetation height along and at varying distances from the line. The amount of vegetation removed would be based on this clearing advisory and local knowledge of regional conditions such as weather patterns, storm frequency and severity, general tree health, and soils. Other factors that influence the amount of clearing along the line are the line voltage; vegetation species, height, and growth rates; ground slope; conductor elevation above the ground; and clearance distance required between the conductors and other objects.

Merchantable timber purchased from private owners would be marketed and non-merchantable timber would be either lopped and scattered, piled, and/or chipped and left onsite, or would be taken offsite. Non-merchantable timber may or may not be burned because of air quality constraints. Contractors would be required to use brush blades that leave low-growing vegetation in place instead of dirt blades on bulldozers for clearing. Other specialized brushing/mulching equipment may also be required. Additional best management practices (BMPs) for timberland would also be used.

At the new tower sites, all trees and snags would be felled and stumps over 22 inches (in.) would be removed, including their root systems. The site would be graded to provide a relatively level work surface. The total amount of clearing required for this project is presently unknown.

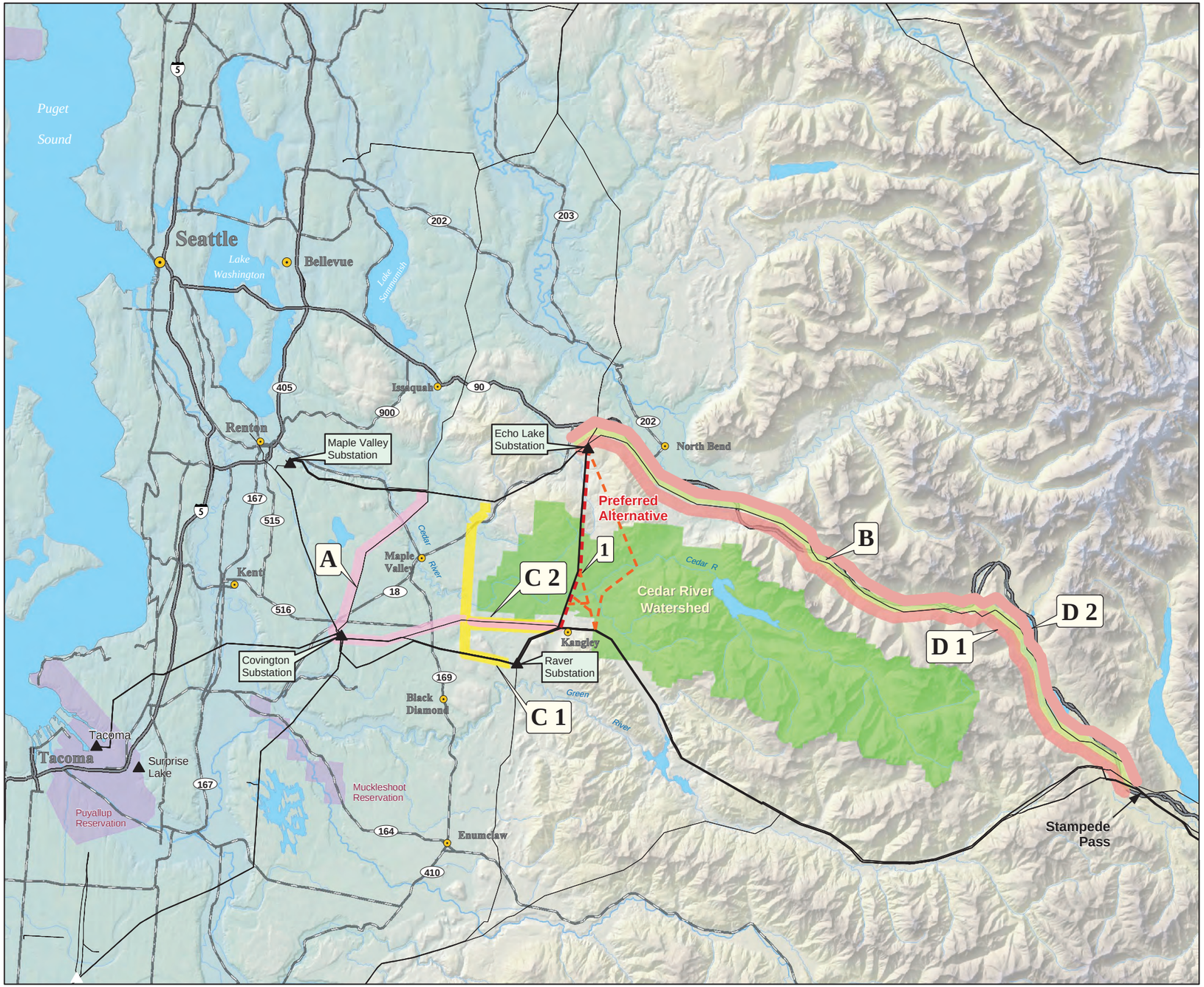
Additional land would be cleared for roads that are needed off the ROW and for roads determined to be in poor condition and requiring upgrading by BPA.

1.1.1.3 Access Road Construction and Improvement

An access road system within and outside of the ROW would be used to construct and maintain the new line. Access roads would be 16 ft. wide, with additional road widths of up to 20 ft. for curves. Existing access roads may also need improvement. Roads generally would be surfaced with gravel, and appropriately designed for drainage and erosion control. The access roads would generally have grades of 6% or less for erodible soils and 10% or less for resistant soils. The maximum grades would be 15% for trunk roads and 18% for spur roads. No permanent access road construction would be allowed in cultivated or fallow fields.

Clearing and construction activities for new access roads would disturb an area about 20 ft. wide, depending on terrain. New roads would be constructed within the ROW wherever possible, but where conditions dictate, roads would be constructed and used outside of the ROW. Construction of new roads is recommended only to access new towers or to avoid greater natural resource impacts.

Dips, culverts, and waterbars would be installed within the roadbed to provide drainage. Fences, gates, cattle guards, and additional rock would be added to access roads as necessary.



ADDITIONAL ALTERNATIVES to be CONSIDERED

Kangley - Echo Lake Transmission Line Project

Legend

- Existing BPA Transmission Lines
- Preferred Alternative
- ▲ BPA Substations

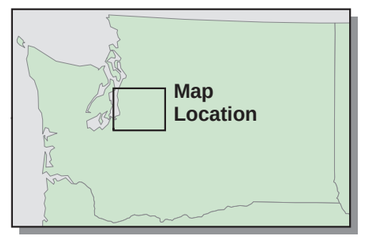
Alternatives

A Construct New Single-Circuit 500-kV Line from tap near Kangley to Covington Substation.
Rebuild Covington - Maple Valley 230-kV to Double-Circuit 500-kV

B Rebuild Portion of Rocky Reach-Maple Valley 345-kV to Double-Circuit 500-kV from East of Stampede Pass to Echo Lake Substation

C Construct New Single-Circuit 500-kV Line West of the Cedar River Watershed to the Echo Lake - Maple Valley Lines

D Construct New Single-Circuit 500-kV Line from East of Stampede Pass Adjacent to Rocky Reach-Maple Valley Line



N

0 3 6 9 12

Miles

May 10, 2002

Source: Bonneville Power Administration 2002.

0P005.00 016 (8/02)

Jones & Stokes

Figure 1
Location Map and Proposed Transmission Line Alternatives

Where temporary roads are used, any disturbed ground would be repaired and, where land use permits, the road would be reseeded with grass or other appropriate seed mixtures. After construction, access roads would be used for line maintenance. Where ground must be disturbed for maintenance activities, the roadbed would be repaired and reseeded as necessary.

The amount of new roads required for this project would vary depending on the alternative chosen and the ability of BPA to acquire rights on existing roads in the area.

1.1.1.4 Storage, Assembly, and Refueling Areas

Construction contractors usually establish storage areas near the transmission line where they can stockpile tower steel, conductor spools, and other construction materials. These areas would be accessible from major highways. Structural steel would be delivered in pieces on flatbed trucks and would be assembled either on or offsite. A mobile crane may be needed to handle the bundles. If the terrain were too steep at the actual tower site, general assembly yards would be used to erect the tower in pieces. The structure would then be transported to the tower site by truck or helicopter. Because trucks and helicopters need to refuel often, these construction areas may also be used for refueling.

1.1.1.5 Tower Site Preparation

Site preparation begins with removing all vegetation from a tower site. In areas of uneven topography, the site would be graded to provide a level work area. An average area of 30,000 square feet (150 by 200 ft.) could be disturbed at each tower site. Additional areas that could be disturbed include the site where the conductor is strung and pulled. These disturbances could be as large as a 370-ft. radius from the tower center.

Bulldozers would be used to clear and construct any new access roads to the transmission line towers and any new tower site landings. Manual methods, including chainsaws and brush hogs, would be used to clear the new ROW. BMPs would be used during clearing and construction to reduce impacts.

In addition to clearing the ROW for the transmission line towers, construction crews would remove selected trees in a 50- to 60-ft.-wide area on each side of the ROW. This additional clearing would be done to reduce the possibility of unstable trees falling on the new transmission line. Some trees newly exposed to the wind would be expected to fall after the initial clearing process because they have not developed the root structure to remain standing once they become more fully exposed to strong winds.

1.1.1.6 Towers and Tower Construction

Steel lattice towers would be erected to support the transmission line conductors. The height of each tower would vary by location and surrounding landforms. Single circuit towers would average 135 ft. high and double circuit towers would average 180 ft. high. The towers would be spaced about 1,100 to 1,200 ft. apart.

Most towers used on the proposed line would be “tangent” or “suspension” towers. This type of tower is designed to support conductors strung along a virtually straight line with only small turns or angles. “Deadend” towers would also be used on a limited basis where stresses on the transmission line conductors would have to be equalized because of changes in direction, because of the need to support an excessively long span, or where a span crossing is needed for extremely

steep or rugged terrain or a river. Deadend towers use more insulators and heavier steel than tangent or suspension towers, thus making them more visible. Deadend towers also are more costly to build than suspension towers.

The towers would be constructed from the ground as much as possible, rather than using helicopters. The equipment used depends on the weight and size of the towers and such site conditions as weather and soil characteristics. Most of the 500-kV towers would be built using mobile cranes; however, helicopter tower erection could be used if access was not available or if sensitive resources would be encountered.

Steel towers would be assembled in sections near the tower site. Each tower contains three components: the legs, body, and bridge. The bridge is the uppermost portion of the tower and serves as the attachment point for the insulators that support the conductors.

Steel towers are anchored to the ground by footings. Each tower requires four footings placed in holes that have been excavated, augured, or blasted. Large machinery, such as backhoes or truck-mounted augers, would be used to excavate the footings. Topsoil would be stockpiled during excavation. The design of the footings would vary based on soil properties, bedrock depth, and the soundness of the bedrock at each site. Typically, towers would be attached to steel plates or grillages placed within the excavated area. The areas would then be backfilled with excavated material or concrete. Topsoil would then be replaced to restore the original ground surface.

Typical footings for single-circuit towers include 4- by 4-ft. plates placed 10 to 12 ft. deep for suspension towers and 12.5- by 12.5-ft. grillage placed 14 to 16 ft. deep for heavy deadend towers. Typical footings for the double-circuit towers include 8.25- by 8.25-ft. grillage placed 12 to 14 ft. deep for suspension towers and 16- by 16-ft. grillage placed 14.5 to 18.5 ft. deep for heavy deadend towers. On average, for an entire transmission line project, each footing would occupy an area about 10 by 10 ft. to a depth of 15 ft. if bedrock was not encountered. The holes in which the plates and grillage would be installed must be large enough to provide about 1 ft. of clearance on each side of the plate or grillage. If bedrock were encountered and had properties that allowed anchor borings, holes would be drilled and steel rods grouted into the rock. These rods would either be attached to a concrete footing or welded directly to a tower member and embedded in compacted backfill. If rock properties were not suitable for anchor rods, the rock may be blasted to obtain adequate footing depth.

As the towers are built, heavy machinery would disturb the ground surface and/or compact soils at the tower site and along access roads. The machinery also would generate noise and dust.

1.1.1.7 Conductors, Overhead Ground Wires, and Insulators

The wires or lines that carry the electrical current in a transmission line are called conductors. Alternating-current transmission lines, such as the proposed line, require three wires or sets of wires, each of which is referred to as a "phase." Three 1.3-in. Bunting conductors would be included for each phase. Each bundle is 16 by 20 in.

Conductors are not covered with insulating material. Instead, the air surrounding each conductor acts as insulation. Each phase of conductor would be physically separated on the transmission tower.

After the transmission towers are in place, workers would attach a smaller steel cable to the conductor and then pull the conductor under tension through the insulators and string the

conductor between towers. Conductors would be attached to the structure using glass, porcelain, or fiberglass insulators. Insulators prevent the electricity in the conductors from moving to other conductors on the tower, the tower itself, and the ground. As the conductors are strung, the ground surface would be disturbed at the tensioning sites, and noise and dust would be generated by the machinery.

Transmission towers elevate conductors to provide safe clearance for people and structures within the ROW. The National Electrical Safety Code (NESC) establishes minimum conductor heights. The minimum conductor-to-ground clearance for a 500-kV line is a little more than 29 ft. Greater clearances would be provided by BPA over county roads and highways, railroads, and river crossings.

One or two smaller wires, called overhead ground wires, would also be attached to the top of the transmission towers. Overhead ground wires would be installed to protect the transmission line against lightning damage. The diameter of the wire would vary from 0.375 to 0.625 in.

1.1.1.8 Substation Addition

Under the current proposal, the Echo Lake Substation would be expanded to the east on land owned in fee title by BPA. The size of the expansion would be approximately 150 by 750 ft. The site would be cleared in the same manner as the ROW for the transmission line. The site would include a fenced yard and a graded and graveled parking lot. The existing road around the substation would be realigned to the east to accommodate this expansion. New transformers, switches, and other equipment would be installed in the expanded area. A continuous ground wire would also be installed.

1.1.1.9 Site Restoration and Clean-up

Disturbed areas around the towers, conductor reels, and pull site locations would be reshaped and contoured to be consistent with their original condition. Access roads would be repaired.

Disturbed areas would be reseeded with grass or an appropriate seed mixture to prevent erosion. The seed mixture would include native plant species and would be free of noxious weeds. All solid waste from construction would be removed and properly disposed offsite, and equipment would be removed from the ROW.

1.1.2 Alternative Rights-of-Way

Alternative 1, the preferred alternative, is presented for comparison purposes only. Please refer to the *Final Wetlands Technical Report* (Jones & Stokes 2002) for a detailed description.

1.1.2.1 Alternative 1: Preferred Alternative

The alignment for Alternative 1 would be immediately adjacent and parallel to a portion of the existing 12-mi. Raver-Echo Lake transmission line from a point approximately 3 mi. north of Raver (S26, T22N, R7E) to the Echo Lake Substation (S11, T23N, R7E) (see Figure 1). This alternative would be approximately 9 mi. long and would require about 2.9 mi. of new access roads. The existing 150-ft. ROW would be widened to 300 ft., with the widening and new line located east of the existing ROW.

1.1.2.2 Alternative A

The alignment for Alternative A would be located west of the Cedar River Municipal Watershed (Figure 1). This alternative proposes to construct a new single-circuit 500-kV line within an existing BPA ROW from a tap along the Schultz-Raver No. 2 line near the community of Kangley to just outside BPA's substation near Covington. The line then routes along the outside of the northeast fence line of Covington substation to the existing Covington-Maple Valley 230-kV transmission line. This entire segment would be constructed in a single-circuit configuration with tower heights averaging 135 ft.

The remainder of this alternative would require replacing a portion of BPA's existing Covington-Maple Valley single-circuit 230-kV transmission line with a double-circuit 500-kV line north of Covington Substation. One side of the new double circuit towers would be operating at 500-kV and the other side at 230-kV. The 500-kV circuit would continue on to terminate at Echo Lake Substation utilizing a vacant circuit on the Maple Valley-Echo Lake double-circuit 500-kV transmission line. New double-circuit towers, about 180 ft. tall, would support both double circuit segments. The new transmission lines would be built on existing rights-of-way, with the exception of a portion of the single-circuit line near the Covington Substation. New right-of-way would need to be acquired across from the Covington Substation to connect the single-circuit 500-kV transmission line with the double-circuit line

1.1.2.3 Alternative B

Alternative B proposes to replace about 38 mi. of BPA's existing Rocky Reach-Maple Valley 345-kV transmission line to a double-circuit 500-kV line (Figure 1). The new towers would be about 180 ft. tall, approximately 30 to 90 ft. taller than the existing towers. The new 500-kV line would be connected to the existing Schultz–Raver No. 2, 500-kV transmission line just east of Stampede Pass and to Echo Lake Substation at the west end. The line would cross Interstate 90 (I-90) twice. Almost all of this route would be on existing right-of-way.

1.1.2.4 Alternative C (Option C-1)

Alternative C (Option C-1) proposes to construct a new single-circuit 500-kV line from near the community of Kangley at BPA's Raver Substation on mostly new 150-ft.-wide right-of-way totaling 10 mi. in length (see Figure 1). The proposed transmission line would be carried on towers approximately 135 ft. high and originate at the Raver Substation. The proposed line would proceed westerly a distance of about 2.5 mi. on new 150-ft.-wide right-of-way immediately north of the Tacoma-Raver double-circuit 500-kV transmission line. At that point the line would turn north through the Ravensdale and Hobart areas and would be connected to an existing vacant (unused) Echo Lake-Maple Valley 500-kV circuit. The vacant circuit would need to be connected to a new bay in the Echo Lake Substation. This option would require the purchase of approximately 6 mi. of new transmission line right–of-way.

1.1.2.5 Alternative C (Option C-2)

Alternative C (Option C-2) proposes to construct a new single-circuit 500-kV line from a tap along the Schultz-Raver No. 2 line near the community of Kangley, to an existing vacant (unused) Echo Lake-Maple Valley 500-kV circuit (see Figure 1). New towers would be about 135 ft. tall. The new line would pass through the Ravensdale and Hobart areas. The vacant circuit would then need to be connected to a new bay in the Echo Lake Substation. This option would require the purchase of approximately 10.5 mi. of new transmission line right–of-way.

1.1.2.6 Alternative D (Options D-1 and D-2)

Alternative D (Options D-1 and D-2) proposes to construct a new single-circuit 500-kV transmission line from east of Stampede Pass to the Echo Lake Substation, over a distance of approximately 38 mi. (see Figure 1). The new line would be located either on the south side or the north side of the existing Rocky Reach-Maple Valley 345-kV line, immediately adjacent to the existing cleared transmission line right-of-way. New towers would average about 135 ft. tall. The line would cross I-90 twice. A new 150-ft.-wide right-of-way would need to be acquired either on the south side of the existing ROW (Option D-1) or on the north side (Option D-2).

1.2 Key Issues for Vegetation

1.2.1 Vegetation Removal, Alteration and Fragmentation

Implementation of the proposed project would require varying amounts of vegetation clearing, depending on the alternative selected. Moreover, the project would require the long-term conversion of certain areas from managed forest to non-forest use. The ratio of forested to non-forested vegetative cover would decrease. Under certain alternatives being considered, the project would also increase the amount of forest edge. In portions of certain alternatives under consideration, clearing for the transmission line corridor would fragment existing large tracts of forested communities.

1.2.2 Impacts on Threatened, Endangered and Other Special Status Plant Species

The project area could provide habitat or potential habitat for several plant species that are listed either federally under the Endangered Species Act (ESA) or by the State of Washington. Also, species may be present that are listed in the Record of Decision (ROD) and Standards and Guidelines for Amendments to the Survey and Manage Protection Buffer, and other Mitigation Measures Standards and Guidelines (USFS and BLM 2001). This ROD amends the initial list of plant species identified in the Final Supplemental Impact Statement on Management of Habitat for Late-Successional and Old-Growth Forest-Related Species Within the Range of the Northern Spotted Owl (USFS and BLM 1994b), commonly called the Northwest Forest Plan.

These species include vascular and nonvascular plant species, and fungal species. Habitat conditions and availability within the project area and potential impacts from the proposed project to these species and their habitats have been identified as issues. Finally, both the USFS Mt. Baker-Snoqualmie and Wenatchee National Forests maintain lists of vascular plant species that are designated as sensitive species for their rarity and/or for scarcity of suitable habitat in those forests. The project area could provide habitat or potential habitat for several of these sensitive species.

1.2.3 Removal of Forest from Timber Production

Under certain alternatives being considered, forest stands that are currently part of active timber rotations would be removed. The resulting loss of merchantable timber production would not be replaced.

1.2.4 Introduction and Management of Nonnative Plant Species

Removal of relatively large tracts of tree and understory species native to Washington could favor colonization of the cleared areas by nonnative species. Most nonnative species are adapted to disturbance, and they frequently out-compete and displace the native species that have been removed.

1.3 Major Conclusions

1.3.1 Diversity of Vegetation Communities Between Alternatives

Vegetation communities found in the vicinity of the transmission line alternatives under consideration vary considerably in their general characteristics and species composition. Each of the four action alternatives falls into one of three generalized vegetation cover categories, based on the degree of past disturbance and current management intensity.

Alternative A is generally characterized by highly disturbed, intensely managed vegetation communities typically found in cleared and maintained transmission line corridors and surrounding residential and commercial development. Alternative B is also a highly disturbed, intensely managed transmission line corridor; however, the area immediately adjacent to the corridor is relatively undisturbed and infrequently managed. Alternatives C (Options C-1 and C-2) are distinguished by moderately disturbed, moderately managed vegetation communities typical of rural and suburban development. Alternative D (Options D-1 and D-2) and Alternative 1 generally contain vegetation communities with low-to-moderate disturbance and low management intensity.

1.3.2 Removal of Forested Communities

All four action alternatives would require removal of forested communities. Under Alternative 1, removal of coniferous forest would come predominantly from 36- to 75-year-old stands dominated by Douglas-fir (*Pseudotsuga menziesii*). These stands average 18 to 36 in. diameter at breast height (dbh) and are 100 to 130 ft. tall. Under Alternatives A and C (Options C-1 and C-2), both coniferous and hardwood forest would be removed. Most of the stands affected are 15 to 30 years old. Under Alternative D (Options D-1 and D-2), older coniferous forest communities would be removed. These stands are approximately 75 to 250 years old, and are dominated by Douglas-fir, western hemlock, and Pacific silver fir. Under Alternative B, early regeneration coniferous stands would be removed, primarily from within the existing transmission line corridor.

1.3.3 Conversion to Non-Forest Use

Under all four action alternatives, at least 30% of the affected land would be converted in the long term from forest to nonforest use.

1.3.4 Threatened, Endangered, and Other Special-Status Species

The U.S. Fish and Wildlife Service (USFWS) has been consulted regarding the presence of federally-listed plant species within the project area. Based on Washington Natural Heritage Program (NHP) listings of known occurrences of rare plants in King and Kittitas Counties, it is unlikely that any federally-listed plant species occur within the study areas of any of the alternatives.

Certain vascular and nonvascular plant species and fungal species listed as Survey and Manage species in the Northwest Forest Plan may be present within the study areas of those alternatives that occur on National Forest lands managed by the U.S. Forest Service (USFS) (Alternatives B and D [Options D-1 and D-2]). BPA and personnel from the USFS will determine the timing of pre-construction surveys for Survey and Manage species to identify potential occurrence of species, impacts, and mitigation measures, if required. Certain vascular plant species designated as USFS Mt. Baker-Snoqualmie and/or Wenatchee National Forest sensitive species may also be present within those portions of the study areas that occur on National Forest lands managed by the USFS.

2.0 Study Scope and Methodology

2.1 Data Sources and Scope

This technical report assesses existing vegetation, potential impacts to vegetation, and management of vegetation during construction, operation, and maintenance of the proposed transmission line. Data sources consulted for this report include:

- Geographic Information System (GIS) data provided by BPA, the U.S. Geological Survey (USGS), and USFS Mt. Baker-Snoqualmie and Okanogan-Wenatchee National Forests
- Examination and interpretation of 1:24,000-scale USGS topographic maps and 1:24,000-scale color aerial photographs flown on July 20, 1999.
- Washington Department of Natural Resources (WDNR) Natural Heritage Program lists of threatened, endangered, and other special status plant species.
- Helicopter reconnaissance conducted May 24, 2002.
- Field surveys conducted June 5 to 7, 2002.

In this technical report, vegetation is classified by vegetative cover type. Vegetation cover type, for the purposes of this report, is a description of the type and average size and age of the plants growing on a specific site.

Vegetation cover types were determined by the type of dominant plants (e.g., tree, grass, shrub), the species of dominant plants (e.g., Douglas-fir, alder, and maple) and the estimated stage of succession of a given forested stand.

Analysis of existing vegetation relied primarily on aerial photo interpretation and review of GIS databases. A study area was defined that extended 0.25 mi. in either direction from the centerline of the alignment of each alternative. Initial analyses were field-verified by visiting representative stands. At each stand visited, dominant cover type, average size and average stand age was evaluated and checked against preliminary estimates of age class and cover type made from the aerial photographs and GIS database.

For the majority of Alternatives B and D (Options D-1 and D-2), analyses of existing vegetation communities were based on Forest Service stand data. For the purposes of this study, cover type identifiers used by these agencies on National Forest lands were correlated to the cover types previously used by Jones & Stokes on private lands in the Final Vegetation Technical Report prepared for Alternatives 1 through 4B (Jones & Stokes 2002a). Certain older forested stand

types were not present in the study area of the April 2002 technical report (Jones & Stokes 2002a). As a result, the list of specific cover types used in the earlier report was expanded to provide appropriate definitions for late mature forest communities. A cover type definition was also added for managed rural-residential areas, a type not found in the Cedar River Watershed or Weyerhaeuser lands to the north of the CRW.

For impact analysis, it was assumed that the action alternatives would require clearing vegetation over a 150-ft.-wide area along the centerline of each alternative except for Alternative B which would require clearing vegetation over a 20-ft.-wide area. The analysis of impacts also assumes standard BPA clearing, grading, and filling requirements for the construction of towers and roads as described in Section 1.1.1 of this report. Potential locations for the construction of new transmission towers were approximated based on standard BPA construction requirements, the location of existing towers, topographical and natural features, and conversations with BPA engineers. All tower locations are approximate and subject to modification. The location of potential access road construction and reconstruction was determined by field review of the alternative alignments by a BPA engineer and subsequently provided to Jones & Stokes.

2.2 Agencies Contacted

The following agencies were contacted during the preparation of this report:

- King County Department of Development and Environmental Services (DDES).
- Washington Department of Natural Resources Natural Heritage Program
- USFWS, North Pacific Ecoregion, Western Washington Office
- USFS Mt. Baker-Snoqualmie National Forest
- USFS Okanogan-Wenatchee National Forest
- Kittitas County Planning Department

3.0 Affected Environment

3.1 Regional Overview

3.1.1 Physiography

The alternatives under consideration are located across a variety of landscape features, from the Puget lowlands to near the crest of the Cascades. Natural vegetation communities associated with the alternatives under consideration are determined in part by the type and distribution of topographic and edaphic features found within this varied landscape. Variation in the combinations of these features leads to differentiation in local climate conditions and, in turn, in general plant community types. Combinations of physical features in the Pacific Northwest have been grouped by Franklin and Dyrness (1973) into physiographic provinces with distinctive attributes. The four action alternatives being considered are spread over two adjacent physiographic provinces of Western Washington.

Alternatives 1, A, and C (Options C-1 and C-2) lie within the Puget Trough province. Soils and topography in this province are the result of several past glacial events. The advance and retreat of glaciers here has created a regional landscape of small lakes and depressions underlain by glacial till. Soils forming in these glacial deposits have been further influenced by the coniferous forest vegetation that came to dominate the region. As a result of these contributing factors, the

majority of the soils in the region are iron- and humus-enriched gravelly sandy loams (Franklin and Dyrness 1973).

Alternatives B and D (Options D-1 and D-2) are situated at the extreme southern limit of the North Cascades physiographic province. This province is characterized by its rugged relief, with deep, steep-sided valleys. Soils are developed from a variety of parent materials, and are further influenced by the extensive glaciation within the province. Soils found within these alternatives are a combination of deep glacial soils in the valleys and side slopes, and glacial lake-deposited soils in the valley bottoms.

3.1.2 Regional Vegetation Zones

Variations in climate have an additional effect on natural vegetation communities. In the Pacific Northwest, vegetation zones have been classified based on the vegetative cover types that dominate in a given set of temperature and precipitation conditions (Franklin and Dyrness 1973). These zones tend to be delineated along gradients in average annual temperature and average annual precipitation. Climate gradients in the region occur with movement inland and with increasing elevation. The four action alternatives under consideration are situated along both of those climate gradients. While the variation in climate conditions between alternatives is relatively small, there are some differences in the resulting vegetation zone classifications for each alternative.

Each of the four alternatives under consideration for the Kangley-Echo Lake Transmission Line expansion lies wholly or partially within the western hemlock vegetation community zone. It is the largest vegetation zone in the Pacific Northwest, and is characterized by coniferous forests dominated by Douglas-fir and western hemlock (*Tsuga heterophylla*).

Alternatives A and C (Options C-1 and C-2) are in the Puget Sound area, which is further recognized as a "special type" within the Western hemlock zone. Plant communities in the Puget Sound area have the basic characteristics of the western hemlock zone, with additional features not normally found further south or east within the zone (Franklin and Dyrness 1973). In the vicinity of Alternatives A and C (Options C-1 and C-2), the most noticeable of these features are the numerous poorly drained wet areas interspersed with wooded upland habitats.

The portions of Alternatives B and D (Options D-1 and D-2) from approximately 7 mi. east of North Bend to Stampede Pass are in the Pacific silver fir subalpine forest zone. This zone tends to be cooler and wetter than the western hemlock zone, with deeper, more persistent snowfall (Franklin and Dyrness 1973). The specific composition of vegetation communities typically includes a canopy dominated by Pacific silver fir (*Abies amabilis*), western hemlock, and Douglas-fir; however, most western Washington conifers can be found in this zone (Kruckeberg 1991). The shrub layer tends to be dense and diverse, dominated by various huckleberry species (*Vaccinium* spp.), salal (*Gaultheria shallon*) and rhododendron (*Rhododendron macrophyllum*) (Franklin and Dyrness 1973).

3.2 Regulations, Standards, and Guidelines

Federal, state, and local government ordinances, regulations, and administrative rules pertaining to vegetation management and forest practices were consulted in the preparation of this report.

3.2.1 Federal

The BPA Vegetation Management Program defines mitigation measures and management practices for maintenance of BPA transmission facilities.

Impacts to vegetation on Forest Service lands are described in terms applicable to Forest Plans at a scale equivalent to the current level of analysis on other alternatives. Specific impacts to Northwest Forest Plan components based on a more detailed level of effort would be addressed should alternative B or D (Options D-1 or D-2) become the preferred alternative.

3.2.2 State

The WDNR Forest Practices Rules (Washington Administrative Code [WAC] 222) describe the types of forest practices allowed under the State of Washington Forest Practices Act (Revised Code of Washington [RCW] 76.09). They divide forest practices into four classes and outline the processes for permitting of forest practices in each class. BPA would strive to follow forest practices defined by these rules where timber is removed on nonfederal lands.

3.2.3 Local

The King County DDES Conversion Option Harvest Plan (COHP) is a voluntary timber harvesting plan developed by the landowner and approved by King County, indicating limits of timber harvest, road locations, sensitive areas, and vegetation management practices. A COHP defines the local government standards and regulations that the landowner must follow.

3.3 Study Area and Approach

The study area for vegetation is a 0.25-mi. corridor drawn around the centerlines of the proposed alternatives. This includes areas within the proposed ROW where vegetation would be cleared for transmission line construction, as well as areas beyond the proposed ROW where vegetation would be cleared for line tensioning or access roads. For Alternatives A and C (Options C-1 and C-2), D (Options D-1 and D-2), and Alternative 1, the ROW would be 150 ft. wide. For Alternative B, only the northern 20 ft. of the existing 150-ft.-wide transmission line ROW would be cleared of vegetation, as the majority of the alignment has been maintained for conductor clearance.

3.4 Transmission Line Alternatives

The following sections discuss existing vegetation cover types crossed by the four action alternatives. Alternative 1, the preferred alternative, is presented for comparison purposes only. Please refer to the BPA Final Vegetation Technical Report (Jones & Stokes 2002a) for a detailed description of the preferred alternative.

Vegetation communities found in the vicinity of the transmission line alternatives under consideration fall into one of three generalized vegetation cover categories, based on the degree of past disturbance and current management intensity. In general, Alternative A is characterized by highly disturbed, intensely managed vegetation communities typically found in cleared and maintained transmission line corridors and surrounding residential and commercial development. Alternative B is also a highly disturbed, intensely managed developed transmission line corridor; however, the area immediately adjacent to the corridor is relatively undisturbed and infrequently managed. Alternative C (Options C-1 and C-2) is distinguished by moderately disturbed,

moderately managed vegetation communities typical of rural and suburban development. Alternative D (Options D-1 and D-2) and Alternative 1 generally contain vegetation communities with low to moderate disturbance and low management intensity.

Within the study areas of the alternatives under consideration, 18 vegetative cover types were identified.

Wetlands were not included in the vegetative cover type definitions. For the purposes of evaluating vegetation on the four action alternatives, wetlands were included within the dominant cover type of the surrounding study area. For a detailed description of wetlands present on the four alternatives, see the Final Wetlands Technical Report (Jones & Stokes 2002b)

The specific definitions of the 18 cover types are given below:

Early regeneration coniferous—young plantations of Douglas-fir, in sufficient densities to preclude more than 30% hardwood coverage. Stands are generally less than 20 years old and range in height from 15 to 30 ft. Understory herb and shrub coverage is generally low because of stand density.

Managed early regeneration coniferous—coniferous regeneration within managed transmission line corridors. This cover type is found only within Alternative B, and reflects volunteer growth of young conifers, mostly Douglas-fir, within areas of the transmission line corridor that are normally kept clear of trees. Because of their location under the power lines, these trees will be removed well before maturity. These trees are generally less than 20 years old and under 15 ft. tall.

Mid-regeneration coniferous—medium-age coniferous stands dominated by Douglas-fir, with occasional hemlock and western red cedar. At higher elevations, subalpine fir and Pacific silver fir become components of the overstory. Understory trees are dominated by western hemlock except in higher elevations where subalpine fir or Pacific silver fir may become more common. Herb and shrub coverage is dominated by sword fern and salal, with occasional vine maple. Individual canopy trees in this cover type range in size from 12 to 20 in. dbh and average 40 to 80 ft. Ages of these stands are generally in the range of 20 to 35 years. On National Forest lands, some of these forests are unmanaged stands of natural origin.

Mature coniferous regeneration—late stage of regenerative growth in a managed stand, typically 36 to 75 years old. On National Forest lands, some of these forests are unmanaged stands of natural origin. Older trees are present but uncommon. This type represents late second-growth stands of conifers in managed areas, but can include stands initiated following natural disturbance on the National Forest lands. This cover type represents stands that would be at or near typical commercial harvest age. This cover type is represented primarily by stands dominated by Douglas-fir, with occasional western hemlock and western red-cedar. In some cases, especially near drainages, stands are co-dominated by Douglas-fir and Sitka spruce. At higher elevations, subalpine fir and Pacific silver fir become components of the overstory. Western hemlock is the dominant species in the understory, except in higher elevations where subalpine fir or Pacific silver fir may become more common. The forest floor is dominated by salal and sword fern, with vine maple occasionally present. Individual trees in this cover type range in size from 18 to over 36 in. and average 100 to 130 ft. This cover type also includes coniferous stands that have matured, but do not yet have the complex canopy structure, dense down woody material [DWM], and other attributes of old-growth forest

Mature coniferous—forested areas dominated by mid- to large-size trees (12 in. to 24 in. dbh), 80 to 250 years old, usually two-storied to multi-storied stands. This classification reflects medium to high density of snags and DWM.

Old forest—areas dominated by mature (>24 in. dbh) trees, usually greater than 250 years in age, crown closure exceeding 60%, multi-storied stands, abundant snag and DWM, and at least two tree species. Within the four action alternatives, the old forest cover type occurs only within isolated pockets of the project areas of Alternatives B and D (Option D-1 and D-2).

Mid-regeneration deciduous—sapling to pole-size hardwoods. Hardwood coverage is over 70%. The dominant species are red alder, black cottonwood, and/or big-leaf maple. Stand ages are in the 10- to-30-year range and heights average 25 to 40 ft.

Mature deciduous—stands dominated by mature hardwoods. Hardwood coverage is over 70%. The dominant species is red alder. Black cottonwoods are occasionally co-dominant and are usually the largest trees present, often over 25 in. dbh. Big-leaf maple is also an occasional co-dominant. Stand ages are generally over 30 years and heights average 40 to 80 ft.

Early regeneration mixed—primarily stands of mixed conifers and hardwoods in areas that have been harvested within the last 10 years. Most of these areas are clearcuts. This type differs from the coniferous early regeneration stage by having more than 30% cover of hardwood trees present. Some also have up to 20% retention of mature trees, especially those areas with drainages. The dominant coniferous species is Douglas-fir. Hardwood species, including red alder, vine maple, and willows, are also present, often in higher percent coverages than the conifers. Heights of these stands range from 8 to 15 ft., with the hardwood species frequently overtopping the young conifers. Shrub species are dominated by trailing blackberry, salal, and red huckleberry.

Mid-regeneration mixed—stands comprised of roughly even coverages of conifers and hardwoods. The dominant conifer is Douglas-fir, though in many areas western hemlock co-dominates. The dominant hardwood is red alder, with occasional black cottonwood and big-leaf maple. Conifers average 5 to 8 in. dbh and are between 10 and 30 years old. Hardwoods average 4 to 10 in. dbh, and are under 30 years old. Heights of these stands range from 35 to 45 ft.

Mature mixed regeneration—stands with coniferous and hardwood coverages each exceeding 30%. Diameters of both hardwoods and conifers vary widely, but are generally over 14 in. dbh. The average age of trees in these stands is over 30 years. Heights generally exceed 45 ft.

Managed grass/forb/shrub—areas that are managed to maintain an existing condition that prevents typical ecological succession.

Natural nonforested grassland—communities that tend to have a higher percentage of native species. Forested cover is less than 10%; grass and forb cover is over 60%.

Natural nonforested shrubland—communities that tend to have a higher percentage of native species. Forested cover is less than 10%; shrub cover is over 40%.

Lakes/rivers/streams—lakes, ponds, or other natural impoundments of water, and drainages with perennial flows.

Developed—any area cleared for the building of commercial or industrial structures, or larger, planned residential communities, including associated lawns and parking lots.

Natural nonvegetated—open areas with less than 10% vegetative cover. Cliffs, talus slopes, scree, large rock outcrops, etc.

Rural-residential, managed landscape—areas with scattered, low-density single-family housing on larger lots, including small-scale farms and horse pastures. This cover type is differentiated from the Developed type in that a higher percentage of the pre-construction landscape is relatively intact, though still highly managed. These areas tend to occur in unincorporated portions of the county. Tree coverage in these areas is generally under 30%, but can be locally higher.

Table 1 shows the approximate acreage of these 18 cover types within the 0.25-mile (mi.) study area of each of the alternatives. Figures 2-A, 2-B, 2-C-1, 2-C-2, 2-D-1, and 2-D-2 show the vegetation cover types surveyed within the 0.25-mi. study area of each of the four alternatives.

Table 1. Acreage of Vegetative Cover Types by Alternative

	Acreage in Study Area by Alternative						
Cover Type	1	A	B	C (Option C-1)	C (Option C-2)	D (Option D-1)	D (Option D-2)
Early regeneration coniferous	77	541	1,152	38	528	1,205	1,104
Managed early regeneration coniferous	0	0	62	0	0	62	62
Mid-regeneration coniferous	41	541	1,730	599	134	1,742	1,698
Mature coniferous regeneration	1,466	272	2,124	91	82	2,144	2,128
Mature coniferous	0	0	2,003	25	25	2,023	1,982
Old forest	0	0	0	0	0	0	0
Mid-regeneration deciduous	183	50	173	155	135	173	175
Mature deciduous	110	133	393	366	374	398	393
Early regeneration mixed	157	80	613	221	25	614	616
Mid-regeneration mixed	319	572	960	377	500	927	994
Mature mixed regeneration	0	972	754	263	309	724	780
Managed grass/forb/shrub	425	410	444	294	301	447	438
Natural nonforested grassland	0	1	14	5	5	21	8
Natural nonforested shrubland	0	81	118	102	78	122	119
Lake/river/stream	6	27	226	10	8	162	311
Developed	80	1063	270	130	139	261	279
Natural nonvegetated	0	0	76	0	0	80	68
Rural residential, managed landscape	0	1797	377	604	776	376	375
Total	**2,864**	**6,540**	**11,507**	**3,280**	**3,419**	**11,481**	**11,530**

The total acreage of the 0.25-mi. study areas for the four action alternatives varies widely. Comparison of the acreage of a given cover type across alternatives is hampered by this variance. Tables 2 and 3 improve comparisons and analyses across alternatives by normalizing the general vegetative cover types in each alternative. Table 2 shows the same cover types by alternative

shown in Table 1; however, the data expresses each cover type as a percent of the total study area instead of providing acreages.

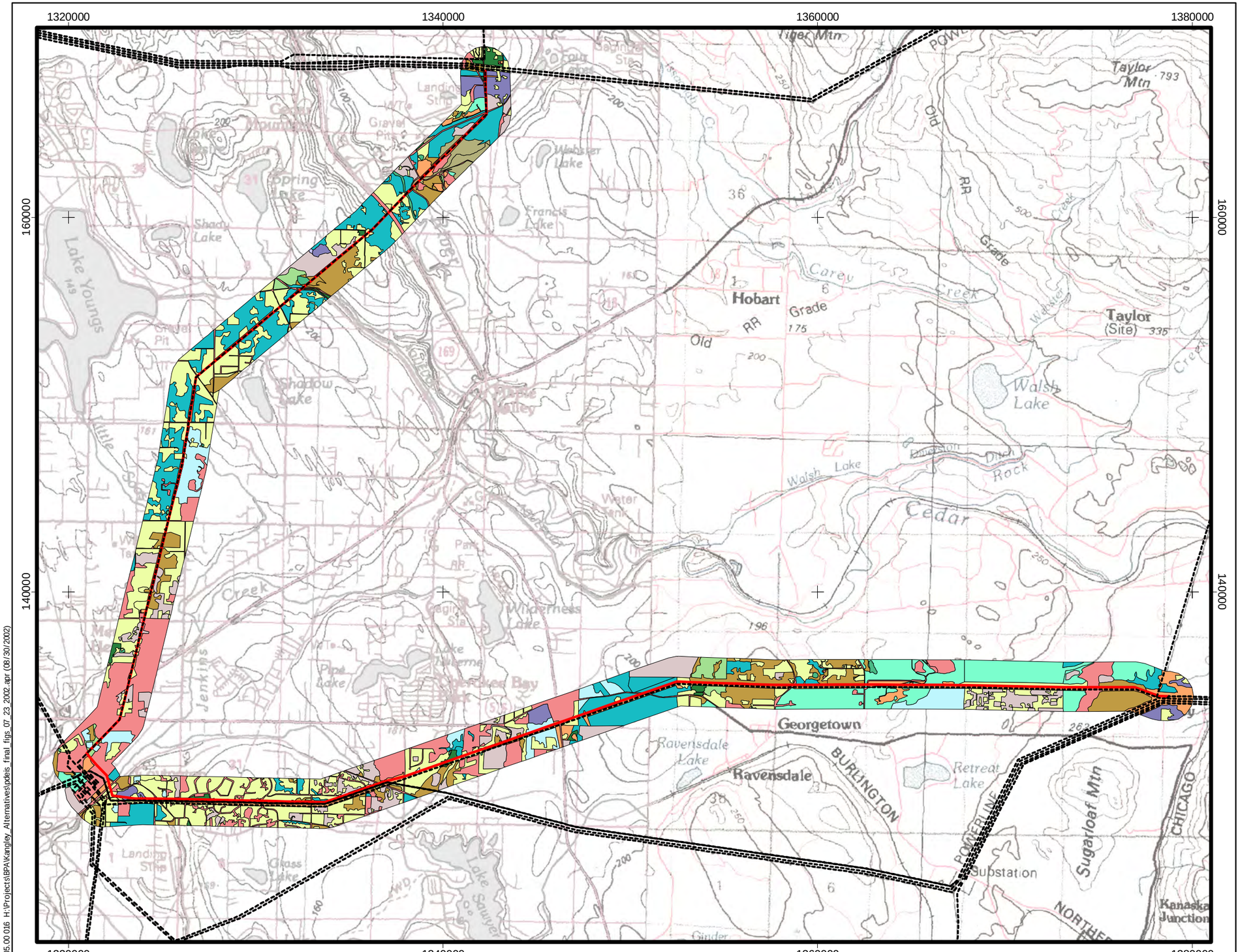
In Table 3, all conifer-dominated types in a given alternative are grouped and expressed as a percentage of the total area. Similarly, deciduous/mixed-dominated types, developed and rural residential areas, and other types (water, nonforested and nonvegetated) are each grouped and expressed as a percentage of the total acreage within the 0.25-mi. study area of a given alternative.

Table 2. Percent of Vegetative Cover Type in Study Area by Alternative

	Percent Cover in Study Area by Alternative						
Cover Type	**1**	**A**	**B**	**C (Option C-1)**	**C (Option C-2)**	**D (Option D-1)**	**D (Option D-2)**
Early regeneration coniferous	2.7	8.3	10.0	1.2	15.4	10.5	9.6
Managed early regeneration coniferous	0	0	0.5	0	0	0.5	0.5
Mid-regeneration coniferous	1.4	8.3	15.0	18.3	3.9	15.2	14.7
Mature coniferous regeneration	51.2	4.1	18.6	2.8	2.4	18.6	18.5
Mature coniferous	0	0	17.4	0.8	0.7	17.6	17.2
Old forest	0	0	0	0	0	0	0
Mid-regeneration deciduous	6.3	0.8	1.5	4.7	4.0	1.5	1.5
Mature deciduous	3.8	2.0	3.4	11.2	11.0	3.5	3.4
Early regeneration mixed	5.5	1.2	5.3	6.7	0.7	5.3	5.3
Mid-regeneration mixed	11.1	8.7	8.3	11.5	14.6	8.1	8.6
Mature mixed regeneration	0	14.9	6.6	8.0	9.0	6.3	6.8
Managed grass/forb/shrub	14.8	6.3	3.9	8.9	8.8	3.9	3.8
Natural nonforested grassland	0	0[a]	0.1	0.2	0.2	0.2	0.1
Natural nonforested shrubland	0	1.2	1.0	3.0	2.3	1.1	1.0
Lake/river/stream	0.2	0.4	2.0	0.3	0.2	1.4	2.7
Developed	2.8	16.3	2.4	4.0	4.1	2.3	2.4
Natural nonvegetated	0	0	0.7	0	0	0.7	0.6
Rural residential/managed landscape	0	27.5	3.3	18.4	22.7	3.3	3.3
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**

[a] less than 0.1%; all other "0" values represent absolute zero, i.e.; cover type not present.

Figure 2-A
Alternative A
Vegetation Cover Types



Legend

- Developed
- Early Regeneration Conifer
- Early Regeneration Mixed
- Lake / River / Stream
- Mature Conifer Regeneration
- Mature Deciduous
- Managed Grass / Forb / Shrub
- Mature Mixed Regeneration
- Mid-Regeneration Conifer
- Mid-Regeneration Deciduous
- Mid-Regeneration Mixed
- Natural Non-Forested Grassland
- Natural Non-Forested Shrubland
- Rural Residential / Managed Landscape
- Existing BPA Transmission Lines
- Alternative A Centerline

Source: USGS Tacoma, Snoqualmie Pass, WA 100K Quadrangles.

Projection: Washington State Plane
Zone: North Zone
Datum: NAD83
Units: Feet US

N

0.5 0 0.5 1 1.5 Miles

Scale 1" = 1 Mile

Jones & Stokes

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Figure 2-B
Sheet 1 of 3
Alternative B
Vegetation Cover Types

1400000 1420000 1440000

180000

160000

North Bend
Rattlesnake Mountain
Harman Heights
Sallal Prairie
North Bend Airstrip
Mount Si
Little Si
Mt Teneriffe
Green Mtn
Middle Fork Snoqualmie River
Kerriston
Brew Mill
Rattlesnake Ledge
Rattlesnake Lake
Ragner
Cedar Butte
Cedar Falls
Lookout Mtn
Mt Washington
Snoose Junction
Chester
Green River Valley
POWERLINE
PACIFIC
CM SP & P
AND
ST PAUL

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Legend

- Developed
- Early Regeneration Conifer
- Managed Early Regeneration Conifer
- Early Regeneration Mixed
- Lake / River / Stream
- Mature Conifer Regeneration
- Mature Conifer
- Mature Deciduous
- Managed Grass / Forb / Shrub
- Mature Mixed Regeneration
- Mid-Regeneration Conifer
- Mid-Regeneration Deciduous
- Mid-Regeneration Mixed
- Natural Non-Forested Grassland
- Natural Non-Forested Shrubland
- Rural Residential / Managed Landscape
- Natural Non-Vegetation
- Existing BPA Transmission Lines
- Alternative B Centerline

Source: USGS Skykomish River, Snoqualmie Pass, WA 100K Quadrangles.

Projection: Washington State Plane
Zone: North Zone
Datum: NAD83
Units: Feet US

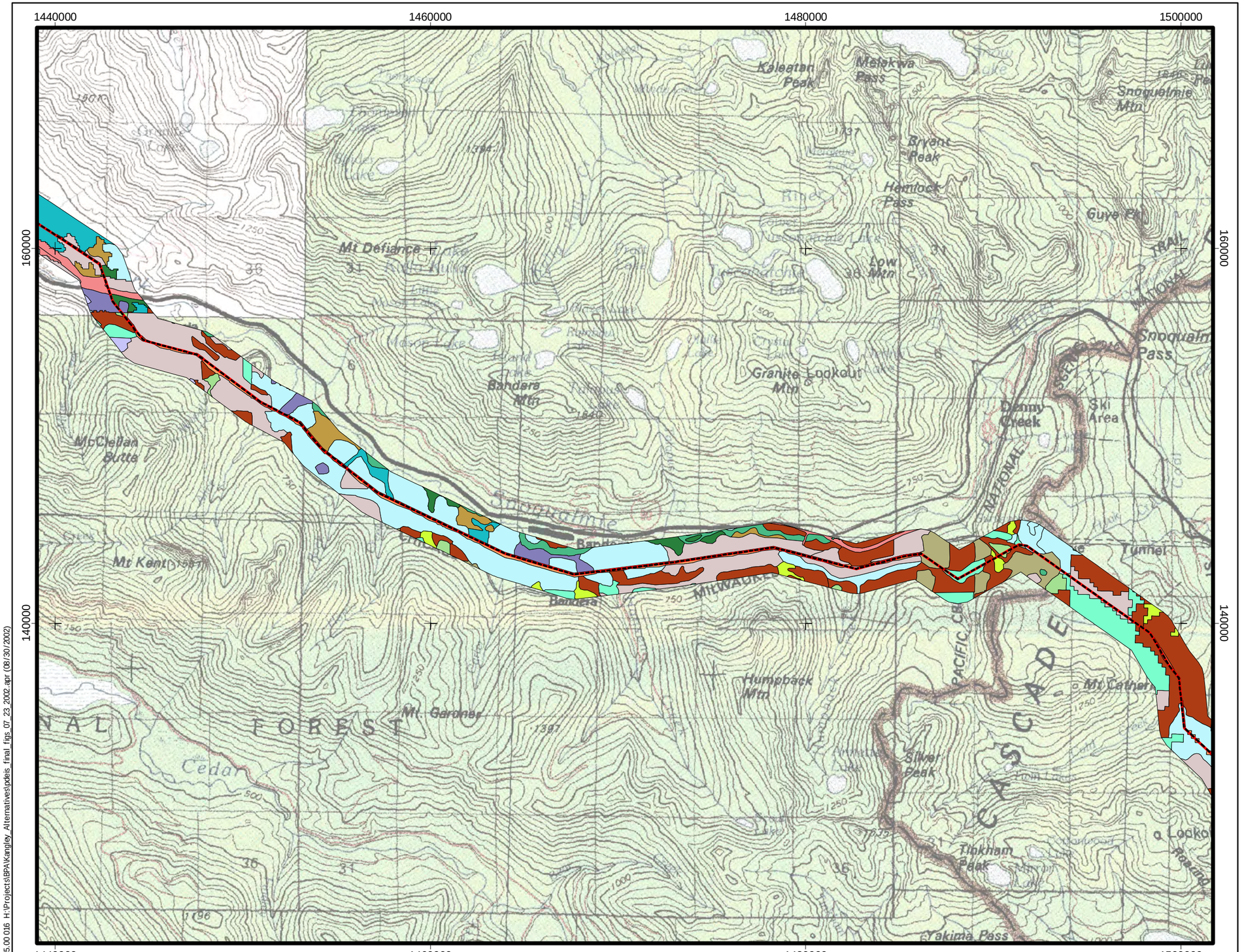
N

0.5 0 0.5 1 1.5 Miles

Scale 1" = 1 Mile

Jones & Stokes

Figure 2-B
Sheet 2 of 3
Alternative B
Vegetation Cover Types



Legend

- Developed
- Early Regeneration Conifer
- Managed Early Regeneration Conifer
- Early Regeneration Mixed
- Lake / River / Stream
- Mature Conifer Regeneration
- Mature Conifer
- Mature Deciduous
- Managed Grass / Forb / Shrub
- Mature Mixed Regeneration
- Mid-Regeneration Conifer
- Mid-Regeneration Deciduous
- Mid-Regeneration Mixed
- Natural Non-Forested Grassland
- Natural Non-Forested Shrubland
- Rural Residential / Managed Landscape
- Natural Non-Vegetation
- Existing BPA Transmission Lines
- Alternative B Centerline

Source: USGS Skykomish River, Snoqualmie Pass, WA 100K Quadrangles.

Projection: Washington State Plane
Zone: North Zone
Datum: NAD83
Units: Feet US

N

0.5 0 0.5 1 1.5 Miles

Scale 1" = 1 Mile

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Figure 2-B
Sheet 3 of 3
Alternative B
Vegetation Cover Types

1500000 1520000 1540000

140000 120000 100000

Legend

- Developed
- Early Regeneration Conifer
- Managed Early Regeneration Conifer
- Early Regeneration Mixed
- Lake / River / Stream
- Mature Conifer Regeneration
- Mature Conifer
- Mature Deciduous
- Managed Grass / Forb / Shrub
- Mature Mixed Regeneration
- Mid-Regeneration Conifer
- Mid-Regeneration Deciduous
- Mid-Regeneration Mixed
- Natural Non-Forested Grassland
- Natural Non-Forested Shrubland
- Rural Residential / Managed Landscape
- Natural Non-Vegetation
- Existing BPA Transmission Lines
- Alternative B Centerline

Source: USGS Skykomish River, Snoqualmie Pass, WA 100K Quadrangles.

Projection: Washington State Plane
Zone: North Zone
Datum: NAD83
Units: Feet US

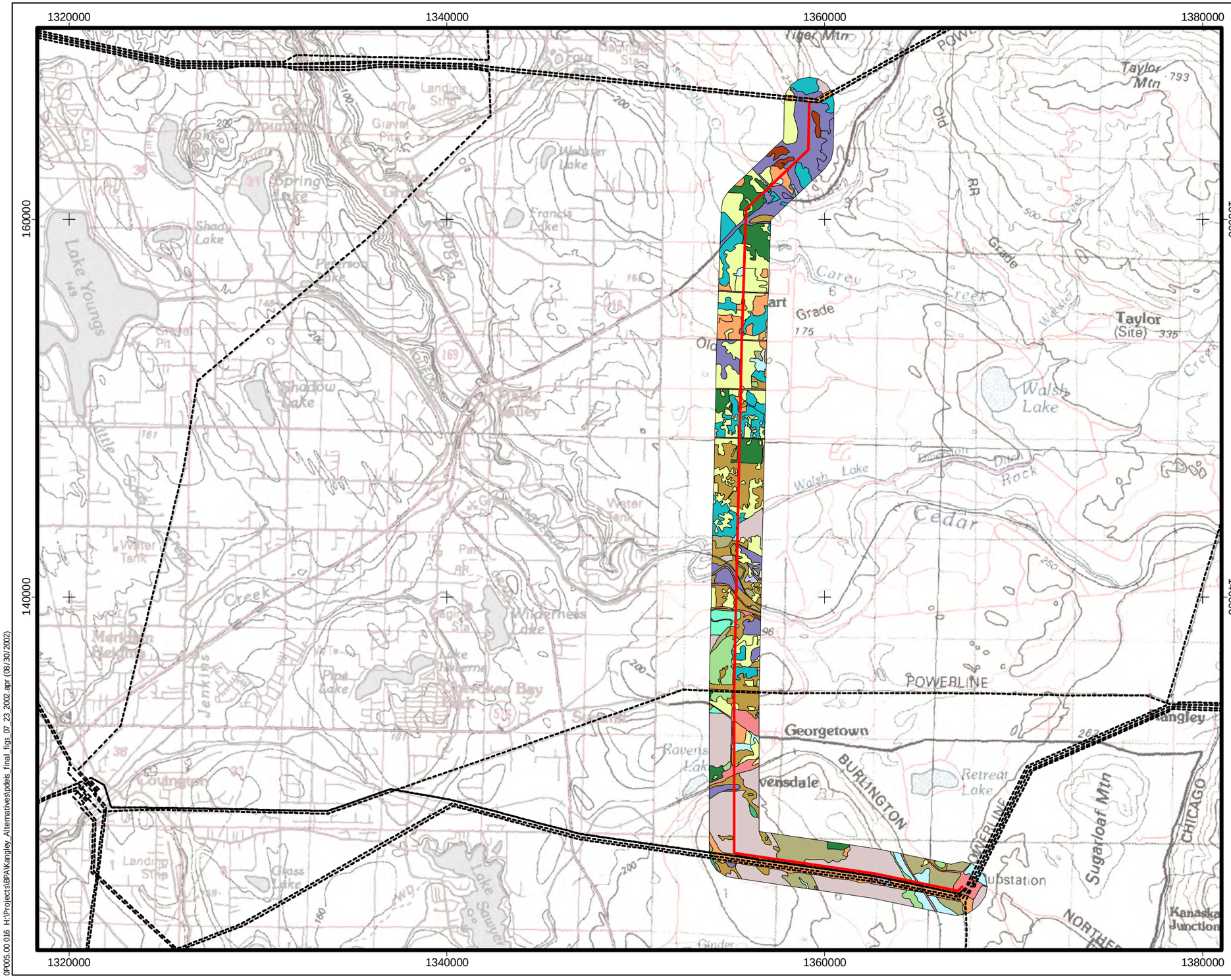
N

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Scale 1" = 1 Mile

Jones & Stokes

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Figure 2-C-1
Alternative C (Option C-1)
Vegetation Cover Types

Legend

- Developed
- Early Regeneration Conifer
- Early Regeneration Mixed
- Lake / River / Stream
- Mature Conifer Regeneration
- Mature Conifer
- Mature Deciduous
- Managed Grass / Forb / Shrub
- Mature Mixed Regeneration
- Mid-Regeneration Conifer
- Mid-Regeneration Deciduous
- Mid-Regeneration Mixed
- Natural Non-Forested Grassland
- Natural Non-Forested Shrubland
- Rural Residential / Managed Landscape
- Existing BPA Transmission Lines
- Alternative C1 Centerline

Source: USGS Tacoma, Snoqualmie Pass, WA 100K Quadrangles.

Projection: Washington State Plane
Zone: North Zone
Datum: NAD83
Units: Feet US

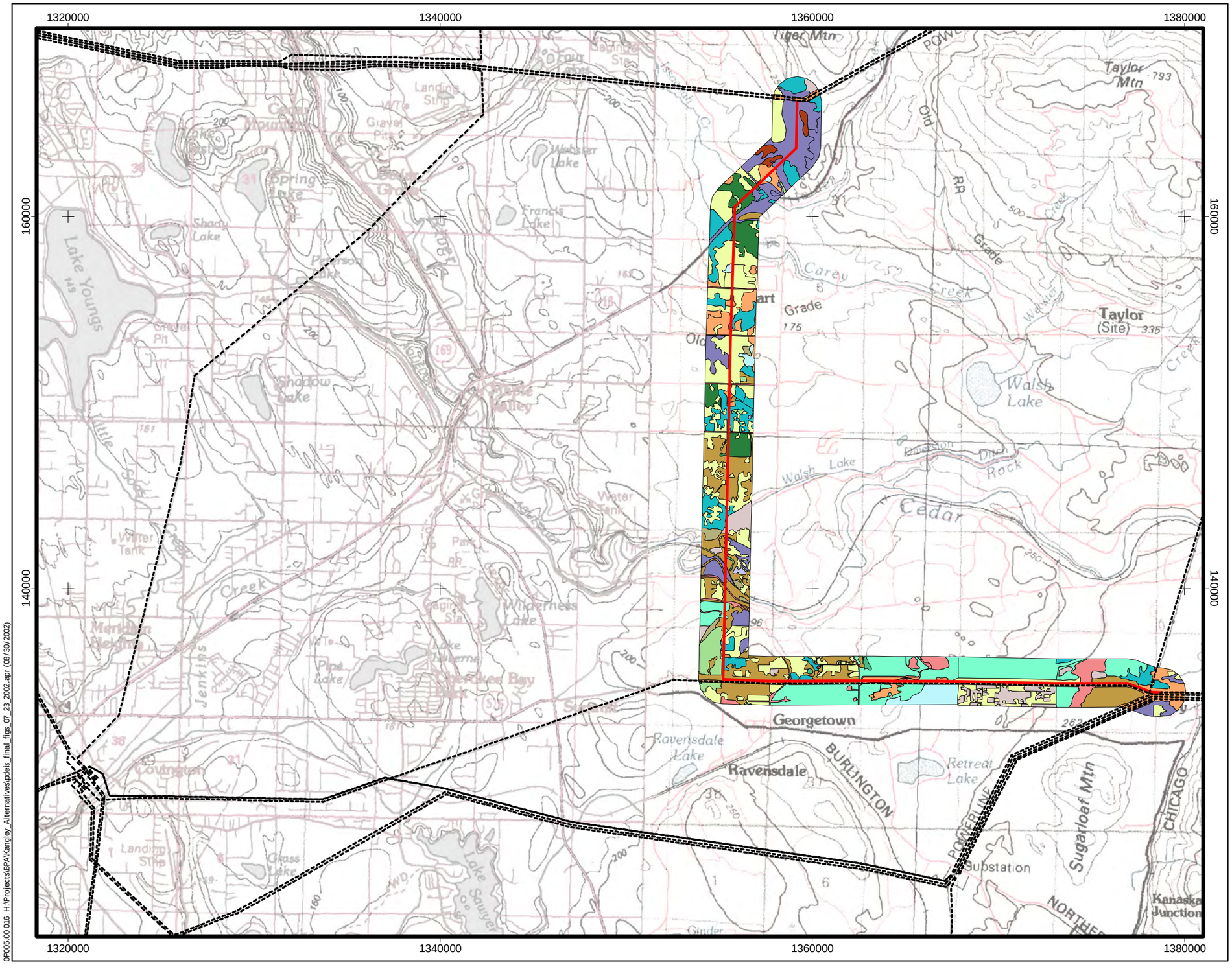
N

0.5 0 0.5 1 1.5 Miles

Scale 1" = 1 Mile

Jones & Stokes

Figure 2-C-2
Alternative C (Option C-2)
Vegetation Cover Types



Legend

- Developed
- Early Regeneration Conifer
- Early Regeneration Mixed
- Lake / River / Stream
- Mature Conifer Regeneration
- Mature Conifer
- Mature Deciduous
- Managed Grass / Forb / Shrub
- Mature Mixed Regeneration
- Mid-Regeneration Conifer
- Mid-Regeneration Deciduous
- Mid-Regeneration Mixed
- Natural Non-Forested Grassland
- Natural Non-Forested Shrubland
- Rural Residential / Managed Landscape
- Existing BPA Transmission Lines
- Alternative C2 Centerline

Source: USGS Tacoma, Snoqualmie Pass, WA 100K Quadrangles.

Projection: Washington State Plane
Zone: North Zone
Datum: NAD83
Units: Feet US

N

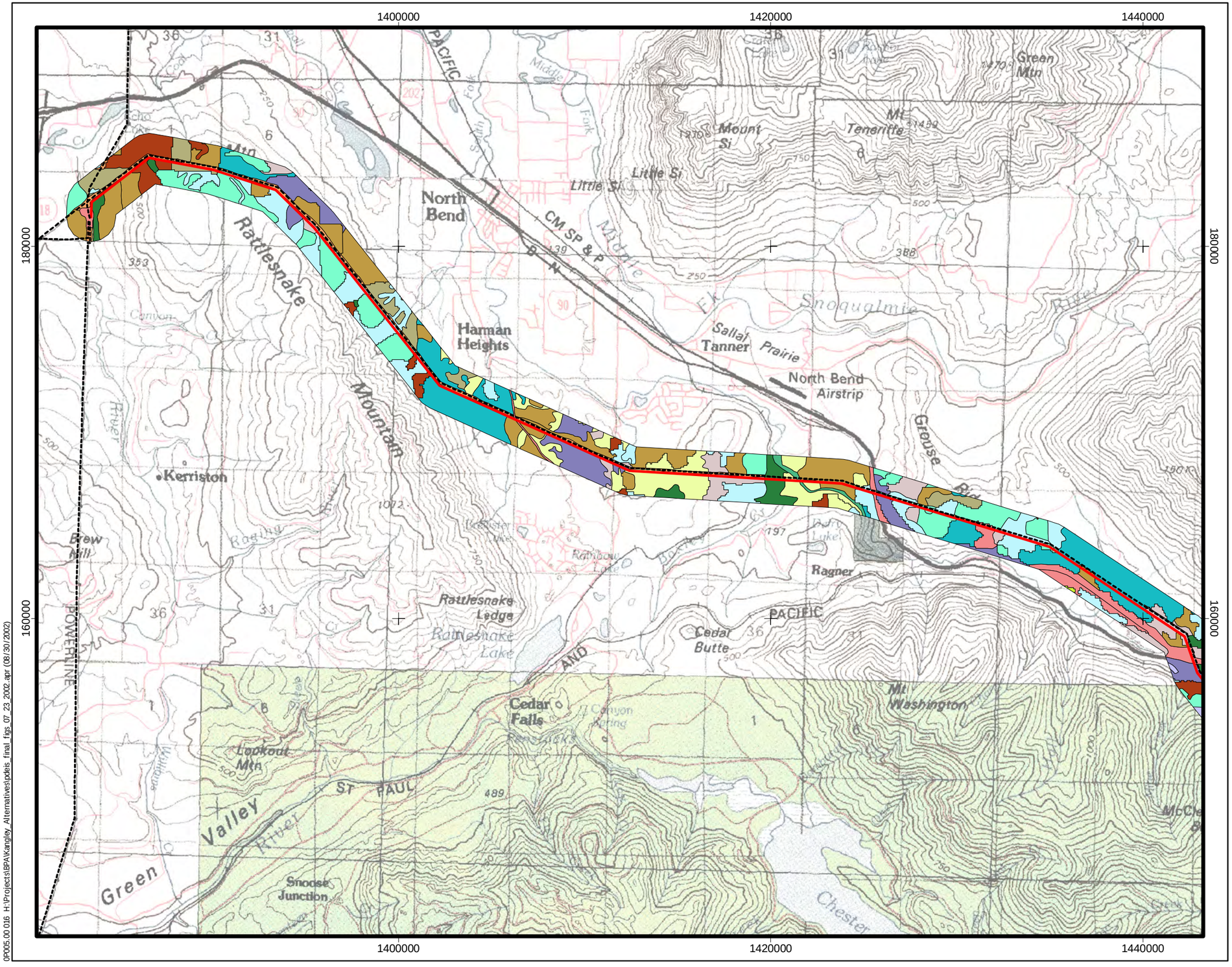
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Scale 1" = 1 Mile

Jones & Stokes

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Figure 2-D-1
Sheet 1 of 3
Alternative D (Option D-1)
Vegetation Cover Types



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Legend

- Developed
- Early Regeneration Conifer
- Managed Early Regeneration Conifer
- Early Regeneration Mixed
- Lake / River / Stream
- Mature Conifer Regeneration
- Mature Conifer
- Mature Deciduous
- Managed Grass / Forb / Shrub
- Mature Mixed Regeneration
- Mid-Regeneration Conifer
- Mid-Regeneration Deciduous
- Mid-Regeneration Mixed
- Natural Non-Forested Grassland
- Natural Non-Forested Shrubland
- Rural Residential / Managed Landscape
- Natural Non-Vegetation
- Existing BPA Transmission Lines
- Alternative B Centerline

Source: USGS Skykomish River, Snoqualmie Pass, WA 100K Quadrangles.

Projection: Washington State Plane
Zone: North Zone
Datum: NAD83
Units: Feet US

N

0.5 0 0.5 1 1.5 Miles

Scale 1" = 1 Mile

Jones & Stokes

Figure 2-D-1
Sheet 2 of 3
Alternative D (Option D-1)
Vegetation Cover Types

1440000 1460000 1480000 1500000

160000 140000

Kaleetan Peak
Melakwa Pass
Snoqualmie Mtn
Bryant Peak
Hemlock Pass
Guye Pk
Mt Defiance
Low Mtn
Snoqualmie Pass
Granite Lookout Mtn
Bandera Mtn
Denny Creek
Ski Area
McClellan Butte
Mt Kent
Tunnel
Humpback Mtn
Mt. Garfield
Silver Peak
Tinkham Peak
Yakima Pass
NAL FOREST
CASCADE
PACIFIC CR
MILWAUKEE
Cedar

Legend

- Developed
- Early Regeneration Conifer
- Managed Early Regeneration Conifer
- Early Regeneration Mixed
- Lake / River / Stream
- Mature Conifer Regeneration
- Mature Conifer
- Mature Deciduous
- Managed Grass / Forb / Shrub
- Mature Mixed Regeneration
- Mid-Regeneration Conifer
- Mid-Regeneration Deciduous
- Mid-Regeneration Mixed
- Natural Non-Forested Grassland
- Natural Non-Forested Shrubland
- Rural Residential / Managed Landscape
- Natural Non-Vegetation
- Existing BPA Transmission Lines
- Alternative B Centerline

Source: USGS Skykomish River, Snoqualmie Pass, WA 100K Quadrangles.

Projection: Washington State Plane
Zone: North Zone
Datum: NAD83
Units: Feet US

N

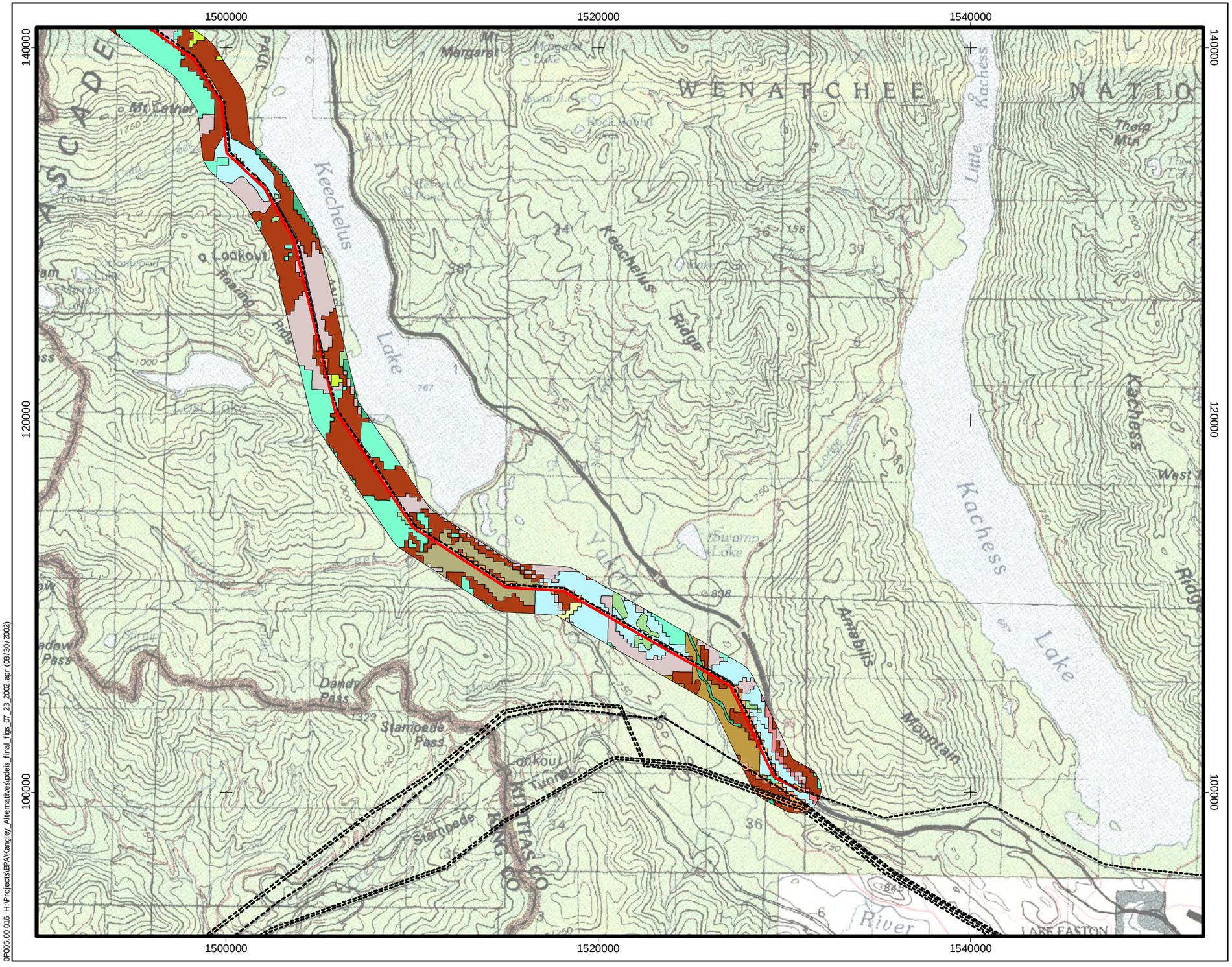
0.5 0 0.5 1 1.5 Miles

Scale 1" = 1 Mile

Jones & Stokes

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Figure 2-D-1
Sheet 3 of 3
Alternative D (Option D-1)
Vegetation Cover Types



Legend

- Developed
- Early Regeneration Conifer
- Managed Early Regeneration Conifer
- Early Regeneration Mixed
- Lake / River / Stream
- Mature Conifer Regeneration
- Mature Conifer
- Mature Deciduous
- Managed Grass / Forb / Shrub
- Mature Mixed Regeneration
- Mid-Regeneration Conifer
- Mid-Regeneration Deciduous
- Mid-Regeneration Mixed
- Natural Non-Forested Grassland
- Natural Non-Forested Shrubland
- Rural Residential / Managed Landscape
- Natural Non-Vegetation
- Existing BPA Transmission Lines
- Alternative B Centerline

Source: USGS Skykomish River, Snoqualmie Pass, WA 100K Quadrangles.

Projection: Washington State Plane
Zone: North Zone
Datum: NAD83
Units: Feet US

N

0.5 0 0.5 1 1.5 Miles

Scale 1" = 1 Mile

Jones & Stokes

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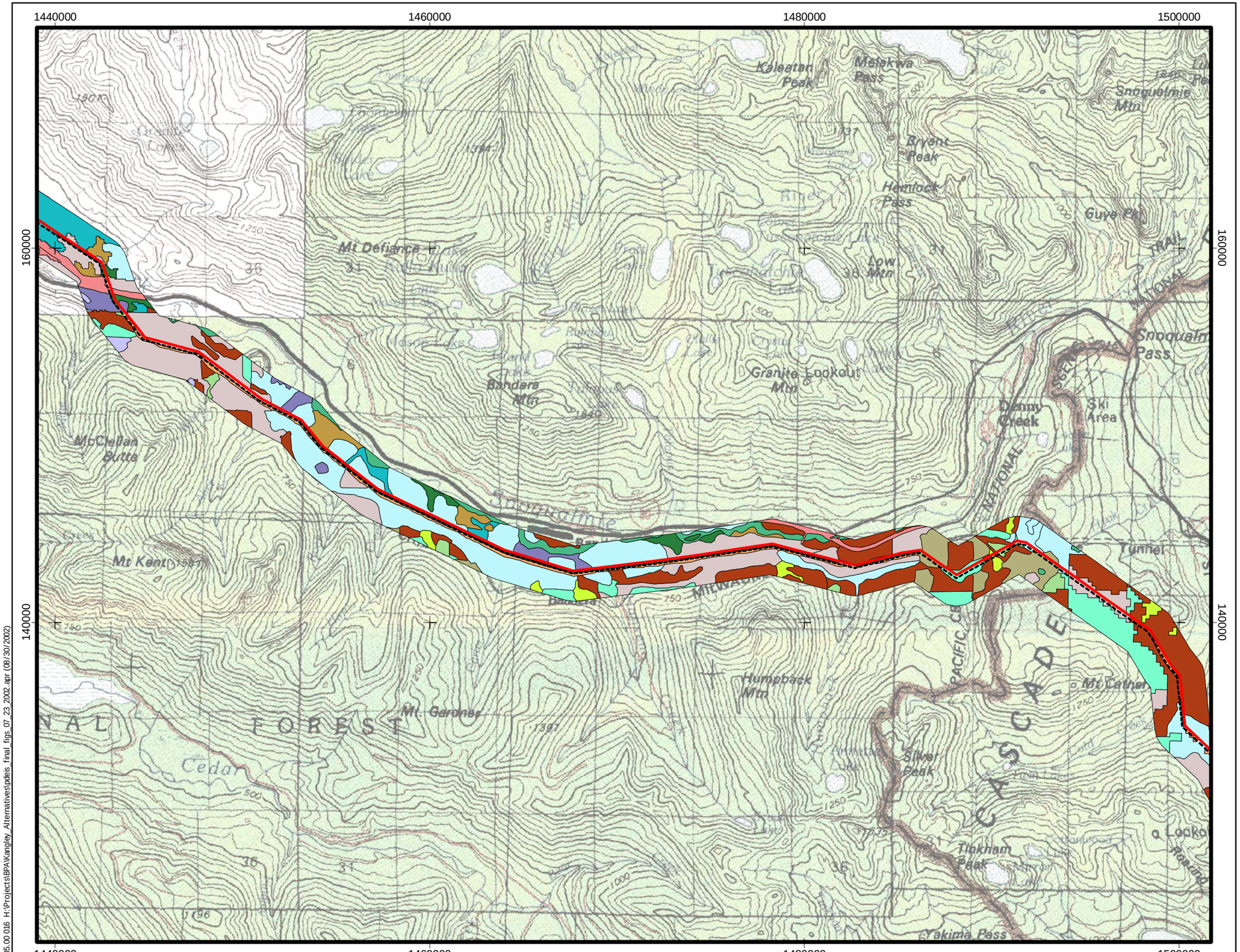
Figure 2-D-2
Sheet 1 of 3
Alternative D (Option D-2)
Vegetation Cover Types

1400000 1420000 1440000

180000 160000

North Bend, Rattlesnake Mountain, Harman Heights, Sallal Prairie, North Bend Airstrip, Grouse, Mount Si, Little Si, Middle Fork Snoqualmie River, Green Mtn, Mt Teneriffe, Kerriston, Brew Mill, Rattlesnake Ledge, Rattlesnake Lake, Ragner, Cedar Butte, Cedar Falls, Lookout Mtn, Snoqualmie Valley, Snoqualmie Junction, Mt Washington, Chester, Green, Rattlesnake Creek, Canyon Spring, Rainbow Lake, Webster Lake, North Lake, Middle Fork Snoqualmie River, Snoqualmie River, Rattlesnake Creek, Rattlesnake Lake, Canyon Spring Creek, Chester Creek, Green River, Brew Mill Creek, Lookout Mtn Creek, Cedar Falls Creek, Snoqualmie Valley Trail, Rattlesnake Ledge Trail, Mount Si Trail, Mt Teneriffe Trail, Cedar Butte Trail, Mt Washington Trail, Chester Trail, Grouse Trail, Green Mtn Trail, Lookout Mtn Trail

Figure 2-D-2
Sheet 2 of 3
Alternative D (Option D-2)
Vegetation Cover Types



Legend

- Developed
- Early Regeneration Conifer
- Managed Early Regeneration Conifer
- Early Regeneration Mixed
- Lake / River / Stream
- Mature Conifer Regeneration
- Mature Conifer
- Mature Deciduous
- Managed Grass / Forb / Shrub
- Mature Mixed Regeneration
- Mid-Regeneration Conifer
- Mid-Regeneration Deciduous
- Mid-Regeneration Mixed
- Natural Non-Forested Grassland
- Natural Non-Forested Shrubland
- Rural Residential / Managed Landscape
- Natural Non-Vegetation
- Existing BPA Transmission Lines
- Alternative B Centerline

Source: USGS Skykomish River, Snoqualmie Pass, WA 100K Quadrangles.

Projection: Washington State Plane
Zone: North Zone
Datum: NAD83
Units: Feet US

N

0.5 0 0.5 1 1.5 Miles

Scale 1" = 1 Mile

Jones & Stokes

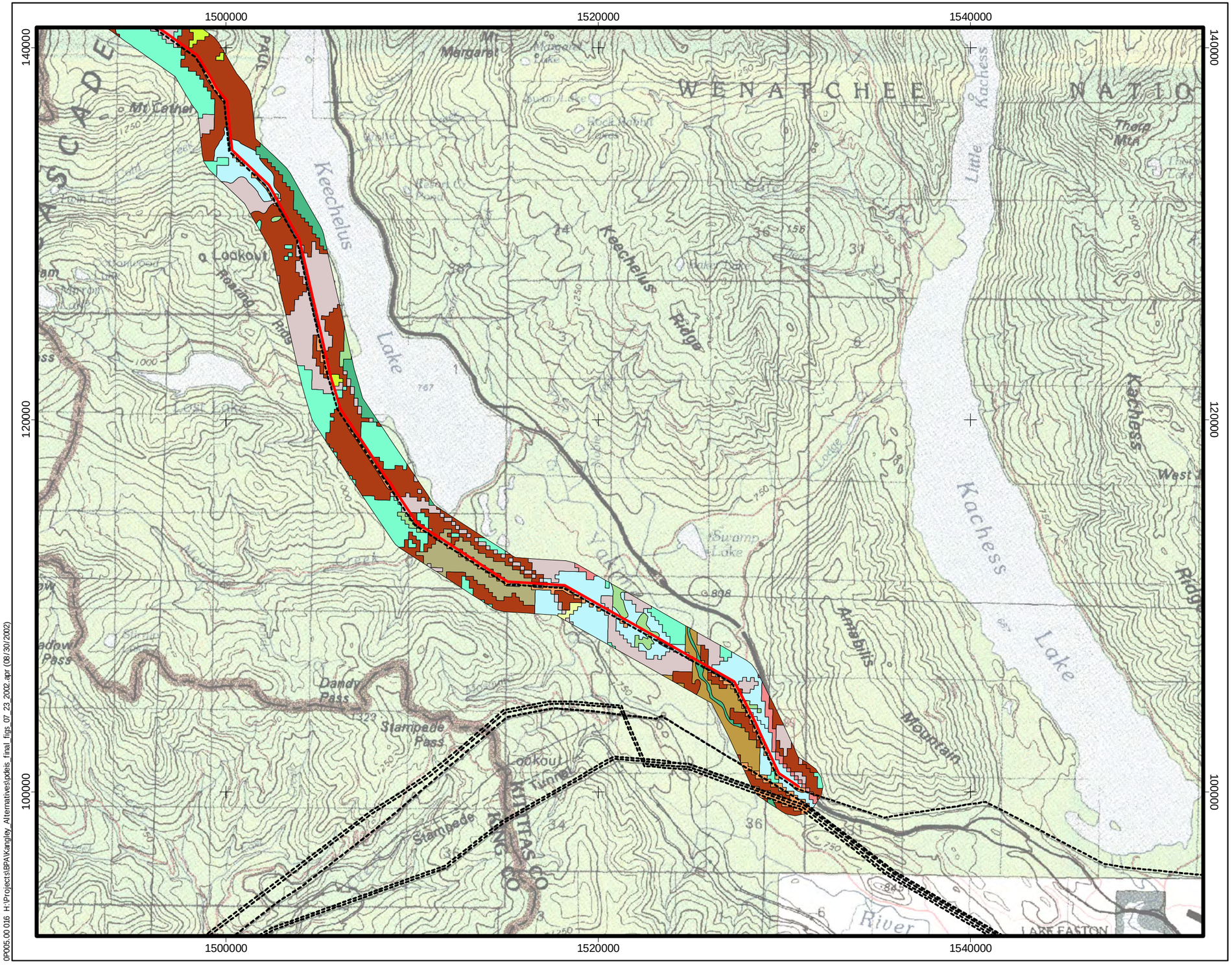


Figure 2-D-2
Sheet 3 of 3
Alternative D (Option D-2)
Vegetation Cover Types

Legend

- Developed
- Early Regeneration Conifer
- Managed Early Regeneration Conifer
- Early Regeneration Mixed
- Lake / River / Stream
- Mature Conifer Regeneration
- Mature Conifer
- Mature Deciduous
- Managed Grass / Forb / Shrub
- Mature Mixed Regeneration
- Mid-Regeneration Conifer
- Mid-Regeneration Deciduous
- Mid-Regeneration Mixed
- Natural Non-Forested Grassland
- Natural Non-Forested Shrubland
- Rural Residential / Managed Landscape
- Natural Non-Vegetation
- Existing BPA Transmission Lines
- Alternative B Centerline

Source: USGS Skykomish River, Snoqualmie Pass, WA 100K Quadrangles.

Projection: Washington State Plane
Zone: North Zone
Datum: NAD83
Units: Feet US

N

0.5 0 0.5 1 1.5 Miles

Scale 1" = 1 Mile

Jones & Stokes

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Table 3. Percent Cover of General Vegetative Cover Types by Alternative

General Vegetative Cover Type	Percent Cover by Alternative						
	1	A	B	C (Option C-1)	C (Option C-2)	D (Option D-1)	D (Option D-2)
All Coniferous Types	55	21	61.5	23	22	62.4	60.5
All Deciduous/Mixed Types	27	28	25.1	42	39	24.7	25.6
Developed/Rural Residential	3	44	5.7	13	12	7.3	8.2
Other (water and nonvegetated)	15	8	7.7	22	27	5.6	5.7

Alternatives 1, B, and D (Options D-1, and D-2) are clearly dominated by coniferous forest stands of varying ages. In these alternatives, coniferous forest communities occupy over 10 times the area that developed or residential uses cover. Alternative A presents nearly opposite conditions. In Alternative A, developed and managed cover types occupy twice the area of coniferous forested communities, and, along with other nonforested cover types, are approximately equivalent in area to all forested types. Alternative C (Options C-1 and C-2) represents a transitional type between these two extremes, with more or less even distribution of coniferous, hardwood, and developed vegetative cover types.

Detailed descriptions of each alternative are provided in the sections to follow.

3.4.1 Alternative 1: Preferred Alternative

Alternative 1, the preferred alternative, is presented for the purpose of comparison only. Please refer to the BPA Final Vegetation Technical Report (Jones & Stokes 2002a) for a detailed description of the preferred alternative.

The study area for Alternative 1 covers just over 3,000 acres (ac.). It is dominated by coniferous forest stands in the mature coniferous regeneration cover type. Alternative 1 parallels a portion of the existing transmission line ROW, to the Echo Lake Substation. As a result, the developed land area is greater here than for other alternatives. The north leg of Alternative 1 tends to be mixed coniferous-deciduous forest. The south leg of Alternative 1 has more conifer-dominated stands.

A thin riparian strip along the Raging River contains several large old conifers, including Douglas-fir and western red cedar trees over 35 in. dbh.

3.4.2 Alternative A

Alternative A (see Figure 2-A) is dominated by rural-residential and suburban development cover types, and by the managed shrubland communities typical of existing transmission line corridors. Over 40% of the study area for Alternative A is in developed or rural-residential cover types. Less than a quarter of the area is in conifer-dominated forest. Of the coniferous forest present, most is under 35 years old, and conifers up to 75 years old dominate only 4% of the total study area. While remnant older trees are likely present in the Alternative A study area, no stands were identified that are dominated by trees older than 75 years.

3.4.3 Alternative B

Alternative B (see Figure 2-B) lies within the existing transmission line corridor that extends westward from Stampede Pass to the Echo Lake Substation. In the eastern two-thirds of Alternative B, vegetation communities adjacent to the existing corridor are dominated by coniferous forest stands. Most of these are mature stands, especially near the eastern end of Alternative B.

Within the portion of Alternative B cleared for operation and maintenance of the transmission line, vegetative cover types are dominated by managed shrublands and patches of managed early regeneration coniferous stands. Most of the young regenerating conifers are Douglas-fir. In higher elevations (generally above 3,500 ft. above sea level), Pacific silver fir seedlings that have volunteered in from adjacent mature stands are also present. Since no transmission line is currently hung from the south side of the tower arms, the need to keep that side of the corridor cleared has not been as great as on the north side of the ROW. As a result, most of the young coniferous regeneration stands in the ROW are found along the southern edge of the transmission line corridor.

3.4.4 Alternative C (Option C-1)

The study area of Alternative C (Option C-1) (see Figure 2-C-1) presents an intermediate condition between the development-dominated Alternative A and the forest-dominated Alternatives 1 and D (Options D-1 and D-2). Total developed and rural residential area is under 25%, and forested communities of any kind account for approximately two-thirds of the study area. However, as with Alternative A, conifer-dominated communities within the Alternative C (Option C-1) study area are primarily young stands under 35 years old. Mid-regeneration coniferous stands (20 to 35 years old), mid-regeneration mixed stands (10 to 30 years old), and early regeneration coniferous stands (less than 20 years old) account for 31% of the study area. Rural residential managed landscape has the highest percentage cover of any type.

3.4.5 Alternative C (Option C-2)

The study area of Alternative C (Option C-2) (see Figure 2-C-2) shares the northern portion of the Alternative C (Option C-1) alignment and also presents an intermediate condition between the development-dominated Alternative A and the forest-dominated Alternatives 1 and D (Options D-1 and D-2). Total developed and rural-residential area is under 25%, and forested communities of any kind account for approximately two-thirds of the study area. However, as with Alternative A, conifer-dominated communities within the Alternative C (Option C-2) study area are primarily young stands under 35 years old. Mid-regeneration coniferous stands (20 to 35 years old), mid-regeneration mixed stands (10 to 30 years old) and early regeneration coniferous stands (less than 20 years old) account for 34% of the study area. Rural residential managed landscape has the highest percent cover of any type.

3.4.6 Alternative D (Options D-1 and D-2)

Most of the study area of Alternative D, (Options D-1 and D-2) (see Figures 2-D-1 and 2-D-2), passes through National Forest land managed by the Okanogan-Wenatchee and Mt. Baker-Snoqualmie National Forests from Stampede Pass heading west toward North Bend. Vegetation within the study area of this alternative is 86% forested, with 61% of the area in coniferous forest. Alternative D (Options D-1 and D-2) contains the oldest and largest conifer stands of all the action alternatives. Almost 18% of the conifer stands are in the range of 75 to 250 years in age,

and another 18% are approaching 75 years old. Development and rural residential areas account for less than 6% of the study area.

3.5 Access Roads

Dirt and gravel roads provide access to existing transmission line corridors associated with Alternatives A, B, and portions of C (Options C-1 and C-2). These roads are currently used for operation and maintenance. Some of the old access roads are not frequently used or maintained, however, and have become impassable because of overgrown vegetation or wash-out. Roads accessing portions of Alternative B would require reconstruction or improvement before use for construction access.

3.6 Substations

The Echo Lake Substation occupies approximately 16 ac. The perimeter area within about 100 ft. around the substation is surrounded by gravel and nonnative grasses. Beyond that are managed grass/forb/shrub areas, with small mixed coniferous-deciduous stands.

3.7 Special-Status Plant Species

3.7.1 Threatened, Endangered, and Candidate Plant Species

For the purpose of this report, the term "special status plant species" includes:

- species listed or proposed for listing as threatened or endangered under the federal ESA (50 CFR 17.12 [listed plants] and various notices in the Federal Register [proposed species]);
- species that are candidates for possible future listing as threatened or endangered under the federal ESA (58 FR 188: 51144-51190, September 30, 1993);
- species listed or proposed for listing by the State of Washington as threatened, endangered, or candidate species;
- plants that are identified by the Washington NHP.

Threatened, endangered, and candidate plant species have been identified by USFWS as plants to be protected under ESA. USFWS has published a list of threatened and endangered wildlife and plant species (50 CFR 17.11 and 17.12); a list of proposed threatened, endangered, and candidate species (61 FR 7596, February 28, 1996; 50 CFR 17.12); and a notice of review for candidate or proposed animals and plants (62 FR 182, September 19, 1997).

USFWS was contacted on May 23, 2002. To date, the agency has not provided official advice on the presence of any listed plant species in the project area.

3.7.2 Forest Service Survey and Manage and Sensitive Species

Survey and Manage species, along with the standards and guidelines for management of these species, were designated in Table 1-1 of the Record of Decision (ROD) Standards and Guidelines for Amendments to the Survey and Manage, Protection Buffer, and other Mitigation Measures Standards and Guidelines (USFS and BLM 2001). The ROD requires surveys to be conducted on U.S. Forest Service (USFS) and Bureau of Land Management (BLM) lands for many of the

species that are to be managed. Botanical resources on the Survey and Manage list include bryophytes (e.g., mosses, liverwort, and hornworts), lichens, and fungi**.** According to Neitlich and McCune (1995), many bryophtyes, lichens, and fungi species appear to be closely associated with late-successional habitat, which provides canopy complexity and a greater diversity of trees and shrubs.

Alternative 1 would be constructed on an easement purchased by BPA and the substation expansion would be on land owned in fee by BPA. No portion of Alternatives 1, A, or C (Option C-1 or C-2) would be on USFS or BLM lands. Therefore, Survey and Manage requirements are not applicable to Alternatives 1, A or C (Option C-1 or C-2).

Significant portions of Alternatives B and D (Options D-1 and D-2) are on National Forest land. For these alternatives, pre-construction surveys for Survey and Manage vascular and nonvascular plants and fungal species would be required. A specific list of species that would be the targets of pre-construction surveys has been prepared based on Survey and Manage species lists provided by USFS Mt. Baker-Snoqualmie and Wenatchee National Forest personnel.

The list of Survey and Manage plant species is provided in Table 4. The table also indicates the vegetative cover types that are most likely to provide suitable habitat for each Survey and Manage species. Since one of the primary intentions of the Northwest Forest Plan is to protect old and late-mature coniferous forest, plant species on the USFS Mt. Baker and Wenatchee National Forest lists tend to be those species found in mature coniferous forests. As a result, Table 4 excludes all early-successional cover types, most nonconiferous forested cover types, and all developed or nonforested cover types.

Table 4. Suitability of Vegetative Cover Types for Survey & Manage Species

Species	Taxa Group	Not Likely to Occur	MCR	MC	MD	MMR
Category A						
Bridgeoporus nobilissimus	Fungi			X		
Bryoria pseudocapillaris	Lichen	X				
B. spiralifer	Lichen	X				
B. tortuosa	Lichen	X				
Dendriscocaulon intricatulum	Lichen		X	X		X
Hypogymnia duplicata	Lichen		X	X		
Leptogium cyanescens	Lichen		X	X		
Lobari linita	Lichen		X	X		
Nephroma occultum	Lichen		X	X		
Niebla cephalota	Lichen	X				
Pseudocyphellaria rainierensis	Lichen			X		
Ramalina thrausta	Lichen		X	X		
Teloschistes flavicans	Lichen	X				
Schistostega pennata	Bryophyte		X	X		
Tetraphis geniculata	Bryophyte		X	X		

Species	Taxa Group	Not Likely to Occur	MCR	MC	MD	MMR
Botrychium montanum	Vascular Plant		X[a]	X[a]		
Coptis asplenifolia	Vascular Plant		X[b]	X[b]		
C. trifolia	Vascular Plant		X[b]	X[b]		
Eucephalus vialis	Vascular Plant	X				
Galium kamtschaticum	Vascular Plant		X[c]	X[c]		
Category C						
Platismatia lacunose	Lichen		X	X		
Corydalis aquae-gelidae	Vascular Plant		X[d]	X[d]	X[d]	X[d]
Cypripedium fasciculatum	Vascular Plant	X				
C. montanum	Vascular Plant	X				
Platanthera orbiculata var. *orbiculata*	Vascular Plant		X	X		

[a] Riparian areas
[b] Within and adjacent to forested wetlands
[c] Near seeps only
[d] Near seeps, springs and streams, in gravelly-sandy soils only

USFS has also provided lists of Forest Service sensitive species that would require surveys prior to construction. These lists are specific to the Mt. Baker-Snoqualmie and Wenatchee National Forests, based on the potential habitat available on each forest. Appendix A lists the Forest Service sensitive species that are documented or suspected to occur in the Mt. Baker-Snoqualmie and Wenatchee National Forests.

Impacts to vegetation on Forest Service lands are described in terms applicable to Forest Plans at a scale equivalent to the current level of analysis on other alternatives. Specific impacts to Northwest Forest Plan components such as survey and manage species on a more detailed level of effort would be addressed should Alternative B or D (Options D-1 or D-2) become the preferred alternative. However, BPA is currently working with the USFS to develop the details of survey methods for Survey and Manage vascular and nonvascular plants and fungal species. Surveys will be determined jointly by BPA and USFS personnel.

3.8 Noxious Weeds and Other Undesirable Vegetation

Noxious weeds, which are formally designated at the county level by noxious weed control boards (RCW 17.10.205), and at the federal level (7 CFR 360.200), typically include species that pose a major threat of spreading or interfering with agriculture or natural plant communities, and whose growth can be managed. Noxious weed species present within the project area include Scotch broom, Himalayan blackberry, cut-leaf blackberry, Canada thistle, knapweeds, orange hawkweed, St. John's wort, tansy ragwort, and small amounts of English holly.

Scotch broom is one of the most pervasive weed species in the project area. It commonly occurs in the highly disturbed areas of clearcuts, as well as along the existing transmission line from the Raver Substation to the Echo Lake Substation. Several other species of noxious or undesirable vegetation occur in the project area.

Provisions for the systematic recognition and control of noxious weeds in BPA transmission line corridors are found in the BPA Transmission System Vegetation Management Program (Bonneville Power Administration 2000). Noxious weeds and other undesirable plant species on the Rocky Reach-Maple Valley line (Alternative B) and a portion of Alternative A are currently managed following this program.

4.0 Environmental Consequences and Mitigation

BPA defines environmental impact levels in four categories: high-level impacts, moderate-level impacts, and low-level impacts.

High-level impacts on vegetation occur when an action would:

- create an unavoidable adverse effect on a federally-listed threatened or endangered plant species;
- significantly reduce the quantity or quality of a regionally or nationally important botanical reserve, plant population, or similar botanical habitat area;
- spread noxious weeds due to construction or maintenance; or
- adversely affect rare or declining species at the regional level. For this project, the regional levels are the Puget Trough and Northern Cascade Provinces.

Moderate-level impacts on vegetation occur if the impacts:

- create an effect on threatened or endangered plant species that could be mitigated partially through interagency consultation with the USFWS under Section 7 of the ESA;
- temporarily disturb sensitive plants during construction but not affect the viability of local populations;
- cause a local reduction in the quantity or quality of vegetation communities (as opposed to regional reductions); or
- marginally reduce the productivity of adjacent vegetation communities or resources (such as wetland plant communities or botanical reserves).

Low-level impacts occur when an action would:

- create an effect that could be largely mitigated;
- reduce the quantity or quality of vegetation communities confined to the site of the action;
- cause no major effect on productivity of adjacent vegetation communities;
- temporarily disturb common plant species;
- reduce plant communities that are very common in the project vicinity;

- adversely affect relatively common species at a local level (i.e., occurring within the immediate vicinity of the project and not affecting regional populations); or

- cause temporary effects or those that can be minimized by site planning or by placing seasonal restrictions on construction activities.

Minimal or no impacts occur when an action creates no impacts or fewer impacts than the low impact level.

4.1 Construction Impacts

4.1.1 Impacts Common to All Transmission Line Alternatives

4.1.1.1 Impacts

Construction impacts include those associated with clearing, those that may affect listed plant species, and those that affect noxious weed coverage and propagation. Given the impact levels defined above, Alternatives 1, B, C (Option C-1), and D (Options D-1 and D-2) would have moderate impacts to coniferous forest communities. Alternatives A and C (Option C-2) would have low impacts on coniferous forest communities. The preferred alternative and all four action alternatives would have potentially high impacts because of noxious weed colonization in disturbed areas.

Vegetation clearing impacts were estimated based on an assumption that the entire length of the 150-foot-wide transmission line corridor would be completely cleared of existing vegetation. This represents a worst-case scenario for clearing. Actual cleared acreage within the proposed transmission line corridors would likely be less than described due to topography and the ability to span trees in low areas. Actual estimated clearing of forest vegetation within Alternative B would include cover types with vegetation that is taller than 5 to 10 ft. within 20 ft. of the northern edge of the existing ROW. The remainder of the ROW has been maintained in a cleared condition.

Table 5 details the acreage from each vegetative cover type within the 150-ft. ROW that would be impacted for each alternative.

Table 5. Vegetative Cover Type Impact Acreage by Alternative

	Impacted Acreage by Alternative						
Cover Type	1	A	B	C (Option C-1)	C (Option C-2)	D (Option D-1)	D (Option D-2)
Early regeneration coniferous	0	6	17	2	8	67	44
Managed early regeneration coniferous	0	0	23	0	0	3	4
Mid-regeneration coniferous	1	9	35	40	3	135	144
Mature coniferous regeneration	85	8	60	4	<1	158	186
Mature coniferous	0	0	29	0	0	108	97
Old forest	0	0	0	0	0	0	0
Mid-regeneration deciduous	9	3	2	16	16	11	9

Cover Type	Impacted Acreage by Alternative						
	1	A	B	C (Option C-1)	C (Option C-2)	D (Option D-1)	D (Option D-2)
Mature deciduous	3	5	11	28	27	28	30
Early regeneration mixed	4	5	12	7	0	43	50
Mid-regeneration mixed	16	45	11	24	47	40	73
Mature mixed regeneration	0	37	10	9	13	39	57
Managed grass/forb/shrub	23	113	31	26	41	97	43
Natural nonforested grassland	0	0	0	0	0	0	0
Natural nonforested shrubland	0	4	3	3	3	9	10
Lake/river/stream	0	3	0	<1	<1	2	2
Developed	11	54	2	10	5	10	7
Natural nonvegetated	0	0	0	0	0	1	2
Rural residential/managed landscape	0	105	4	25	41	18	18
Total	**152**	**397**	**250**	**195**	**206**	**769**	**776**

The total study areas and impact areas of the preferred alternative and the four action alternatives vary widely. As a result, analysis and comparison of impacts between alternatives is difficult using the raw impact acreages in Table 5 alone. To improve comparison of impacts between alternatives, the percent of the total impacted area for each alternative was determined for each vegetative cover type. This approach normalizes impacts across alternatives. The percentage of impacted acreage per vegetative cover type by alternative is provided in Table 6.

Table 6. Percent of Impacted Acreage per Vegetative Cover Type by Alternative

Cover Type	Percent of Total Impacts by Alternative						
	1	A	B	C (Option C-1)	C (Option C-2)	D (Option D-1)	D (Option D-2)
Early regeneration coniferous	0	2	7	1	4	9	6
Managed early regeneration coniferous	0	0	9	0	0	1	1
Mid-regeneration coniferous	1	2	14	21	1	18	19
Mature coniferous regeneration	56	2	24	2	1	20	24
Mature coniferous	0	0	12	0	0	14	13
Old forest	0	0	0	0	0	0	0
Mid-regeneration deciduous	6	1	1	8	8	1	1
Mature deciduous	2	1	4	14	13	4	4
Early regeneration mixed	3	1	5	4	0	6	6
Mid-regeneration mixed	11	11	4	12	23	5	9
Mature mixed regeneration	0	9	4	5	6	5	7
Managed grass/forb/shrub	15	29	12	13	20	13	6

Cover Type	Percent of Total Impacts by Alternative						
	1	A	B	C (Option C-1)	C (Option C-2)	D (Option D-1)	D (Option D-2)
Natural nonforested grassland	0	0	0	0	0	0	0
Natural nonforested shrubland	0	1	1	2	2	1	1
Lake/river/stream	0	1	0	0 [a]	0 [a]	0 [a]	0 [a]
Developed	6	14	1	5	2	1	1
Natural nonvegetated	0	0	0	0	0	0 [a]	0 [a]
Rural residential/managed landscape	0	26	2	13	20	2	2
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**

[a] less than 0.3%; all other "0" values are absolute zeroes, i.e.; no impact to cover type

For Alternatives 1, B, and D (Options D-1 and D-2), at least 57% of the total project impacts will occur in coniferous forest types. For all alternatives except Alternative A, at least 56% of the total project impacts will occur in some type of forested cover type. In Alternative A, 70% of the total project impacts will occur in developed, rural residential or other managed cover types. Alternative C (Option C-2) is the only other alternative with more than 40% of the total project impacts occurring in developed, rural-residential, or other managed cover types.

From the perspective of vegetation community impacts, forested areas are the most affected by placement of a transmission line, because tall growing vegetation must be cut to keep woody plants from interfering with the line. Plant communities that are naturally low-growing are often unaffected by placement of a transmission line. Vegetation in rural residential, managed landscape areas is often modified by the placement of a transmission line, though not to the degree of forested areas. Developed areas tend to have minimal vegetation impacts.

Impacts on vegetation could occur through direct clearing for the transmission line and for construction of roads, transmission-line footings, substations, and other facilities. Additional impacts could occur from the effects of heavy equipment use on local soils, including compaction and physical movement of soils. Compaction of soils could inhibit precipitation from infiltrating over plant root zones. Compaction could also inhibit germination of seeds residing in the upper soil horizon, and it could favor the development of bare-soil areas.

Physical movement of soils could disrupt the seed bank in the upper soil horizon, inhibiting regeneration of desirable species. Physical movement of soils at greater depths could damage the fine root zones of shrubs and trees. The temporary storage of soils and cleared vegetation could also compact soils beneath the storage piles. Decomposition of vegetation within the storage piles could generate sufficient heat to inhibit germination of desirable species in the seed bank of the upper soil horizon beneath the piles.

Trees that grow within the protection of a group of trees (with relatively little exposure to wind) would be exposed when the trees around them were removed, making them vulnerable to wind throw. However, trees that were already growing in the open would have become "wind-hardened" and much less likely to fall. Therefore, trees that grow back within the initial cleared area, but outside of the 150-ft. maintained ROW, would not be as likely to fall because they would have grown adjacent to the maintained ROW and become wind-hardened.

Soil disturbance resulting from construction of the line, towers, roads, and related facilities could change the ability of some plant communities to reestablish. Additionally, trees immediately adjacent to the cleared areas could be injured or killed if large portions of the plant roots or above-ground shoots were cut or damaged, or if soils were excessively compacted by equipment.

Potential impacts to listed plant species are discussed here in the event that individuals or small populations of listed plant species actually occur within the project area. It is important to note that USFWS has not indicated whether listed plant species occur within the study area. Additionally, the presence of Survey and Manage species will be determined through coordination with Forest Service personnel. For all of the action alternatives, potential exists for impacts to special status plants during construction and maintenance, with higher potential along some segments than others. Impacts to special status plants could occur while clearing vegetation within the 150-ft. ROW and additional low-vegetation areas. Impacts could also occur during clearing of vegetation for staging and materials storage, clearing vegetation for work areas, and clearing and grubbing for construction of tower footings.

The project has a potentially high impact resulting from the spread of noxious weeds. Noxious weeds are plant species designated by law at the federal, state, and county jurisdictional levels. Disturbed areas such as transmission line ROWs often become infested with undesirable or nonnative plant species. These species take advantage of disturbed soils and the lack of competing vegetation in areas recently cleared. Construction would disrupt vegetation and disturb soils, increasing the potential for noxious weeds invading new areas. Vehicles could inadvertently transport seeds from infested areas to locations along the ROW and access roads. Without proper mitigation measures in place, the spread of noxious weeds would likely increase.

4.1.1.2 Mitigation

Standard mitigation measures to minimize impacts to vegetation along the selected transmission line alternative would include the following:

- Locate the proposed project within or immediately adjacent to existing ROWs as much as possible to keep clearing to a minimum.

- Keep incidental vegetation clearing to the minimum needed to maintain safety and operational standards. Flag and/or clearly mark clearing limits, and include clear descriptions of clearing limits and place requirements as part of construction contracts.

- Ensure that adequate topsoil depth (minimum of 4 in.) and texture are in place. Promptly reseed or revegetate disturbed areas with native seed mix as soon as construction is completed in an area, if such seed is available. In many cases, locally adapted native plant materials are not available. Many native species available for restoration are actually from other areas, representing different genetics than existing vegetation. BPA would consult with WDNR, Forest Service, and other agencies about the appropriate seed mixtures to use.

- Implement aggressive vegetation management programs to limit colonization by nonnative species and eradicate noxious weeds. This objective can be accomplished within the transmission line ROW Policies and procedures adopted by BPA in the May 2000 Final EIS for the BPA Transmission System Vegetation Management Program and its July 2000 ROD. This program provides adequate mitigation for potential noxious weed invasion along the proposed transmission line.

- Use only certified weed-free straw, where straw is used as mulch or for erosion control.

4.1.1.3 Unavoidable Effects, Irreversible or Irretrievable Commitment of Resources

Unavoidable, irreversible, and irretrievable impacts associated with this project include the effects of short-term uses of resources on long-term productivity, limitations placed on the growth of vegetation in and around the transmission line and substation, and use of nonrenewable resources such as minerals and petroleum-based fuels.

Short-term uses associated with the study area include the clearing of vegetation for the construction of the transmission line and the creation of a low-growing vegetation zone. Long-term productivity refers to the capability of the land to provide resources for future generations. Construction of any of the alternatives under consideration would decrease the amount of land that could be used for other purposes, including various types of production or resource conservation.

Construction of any of the transmission line alternatives would require a long-term conversion of existing forest types to the managed grass/forb/shrub type. Lakes, rivers, and streams would be spanned and, therefore, not converted. Wetlands would be avoided to the extent possible. Existing managed grass/forb/shrub and developed types would be only temporarily impacted, and they would not be converted. New access roads would also be permanently converted to the developed cover type. Table 7 shows the area and percent conversion of forested types to managed grass/forb/shrub cover. As defined at the beginning of Section 4.0, reduction in the quantity of a vegetation community, confined to the site of the action, is a low impact.

Table 7. Summary of Vegetative Cover Type Conversion by Alternative

	Alternative						
General Vegetative Cover Type	1	A	B	C (Option C-1)	C (Option C-2)	D (Option D-1)	D (Option D-2)
Converted Cover Types							
Total impact area (ac.)	118	118	213	130	115	632	694
Total impacted area (ac.)	152	397	250	195	206	769	776
Percent of impact	78	30	85	67	56	82	89
Nonconverted Cover Types							
Total impact area (ac.)	0	279	37	65	91	137	82
Total impact area (ac.)	152	397	250	195	206	769	776
Percent of impact	22	70	15	33	44	18	11

Forested stands currently growing in the areas that BPA cleared would be maintained as low-growing vegetation zones and would not be allowed to grow beyond a height that would endanger the reliable operation of the transmission line. Periodic clearing in these areas would be unavoidable.

Construction of the transmission line would require the use of non-renewable resources such as petroleum-based fuels. Mineral resources would also be expended with construction of the project.

4.1.2 Echo Lake Substation Impacts

Alternatives 1, A, B, C (Options C-1 and C-2), and D (Options D-1 and D-2) would require the expansion of the Echo Lake Substation.

4.1.2.1 Impacts

Clearing a total of 13 ac. would be required to accommodate the 3-ac. expansion of the Echo Lake Substation. This clearing would occur in an early regeneration, closed mixed canopy cover type, with trees approximately 10 to 30 years old. As defined at the beginning of Section 4.0, reduction in quantity of a vegetation community, confined to the site of the action, would be a low impact.

A young (10 to 25 year) Douglas-fir-dominated stand located immediately east of the proposed expansion could also be temporarily impacted by construction activities. Movement of the disturbed area edge eastward to the young Douglas-fir stand would encourage colonization of the stand's edge by nonnative species and/or noxious weeds. Without proper mitigation measures in place, this outcome would be a high impact.

4.1.2.2 Mitigation

Mitigation measures to minimize the impacts to vegetation could include:

- Plant shrubs and trees to provide a buffer between the substation and surrounding vegetated areas and to enhance the diversity of vegetation in the area.

- Use native plant species in buffer areas around the expanded substation to discourage colonization of the substation perimeter by nonnative species.

- BPA could undertake an aggressive noxious weed management program to discourage further colonization of these species around the substation. Management practices regarding noxious weed control and general vegetation management practices have been defined in the BPA Transmission System Vegetation Management Program.

4.1.2.3 Unavoidable Effects, Irreversible or Irretrievable Commitment of Resources

Vegetation would have to be cleared from the land east of the Echo Lake Substation to expand the facility. This would be a permanent use that would affect long-term productivity of that area. Long-term productivity refers to the capability of the land to provide resources for future generations. Expansion of the Echo Lake Substation would preclude the use of this land for any other purpose, including various types of production or resource conservation.

Construction of the expanded substation would result in the permanent conversion of 3 ac. of young forested area into developed land.

Nonrenewable resources such as petroleum-based fuels and certain mineral resources would be used for the construction of the substation.

4.1.3 Alternative Transmission Line Impacts

The following sections discuss impacts to vegetation cover types crossed by the four action alternatives. Alternative 1, the preferred alternative, is presented for comparison purposes only. Please refer to the BPA Final Vegetation Technical Report (Jones & Stokes 2002a) for a detailed description of the preferred alternative.

4.1.3.1 Alternative 1: Preferred Alternative

Impacts—Please refer to Section 4.1.1 for discussion of impacts common to all action alternatives. Alternative 1 would result in impacts to 152 ac. Over half (56%) of this impact would occur in mature coniferous regeneration and mid-regeneration, closed coniferous canopy cover types. These stands are dominated by Douglas-fir, and average 100 to 130 ft. in height. As a result, the clearing of adjacent areas to ensure the reliable operation of the transmission line would be expanded to approximately 120 ft. where the line passes through these stands. As defined at the beginning of Section 4.0, reduction in quantity of a vegetation community, confined to the site of the action, would be a low impact.

Alternative 1 parallels a portion of the existing transmission line and would be constructed to the east of the existing ROW. As a result, there would be no impact to forested communities west of the existing transmission line ROW.

Mitigation—Please refer to Section 4.1.1.2 for discussion of mitigation common to all action alternatives. Additional mitigation for Alternative 1 could include:

- Locating all construction staging, soil stockpiles, and cleared vegetation piles within the existing cleared transmission line ROW. This approach would minimize impacts caused by these activities in forested areas to the east of the existing ROW.

Unavoidable Effects, Irreversible or Irretrievable Commitment of Resources—Alternative 1 would result in the conversion of 118 ac. of forested stands to the managed grass/forb/shrub vegetation types, as found under the existing Raver-Echo Lake Transmission Line (see Table 7). This represents 78% of the total Alternative 1 impact permanently converted to nonforested use. An additional 34 ac. of non-forested land would be temporarily impacted and would remain in nonforested use.

4.1.3.2 Alternative A

Impacts—Please refer to Section 4.1.1 for discussion of impacts common to all action alternatives. Alternative A would result in impacts to 397 ac.; 39% of this impact would occur in developed and rural residential/managed landscape cover types. An additional 29% of the impact area would occur in managed grass/forb/shrub cover, under the existing BPA transmission line corridor. Forested stands impacted by Alternative A are primarily mixed hardwood-conifer communities under 30 years old. This cover type accounts for 11% of the total impact area. Coniferous forested areas impacted by Alternative A are all less than 75 years old, and account for 6% of the total impacted area.

Mitigation—Please refer to Section 4.1.1.2 for discussion of mitigation common to all action alternatives. Additional mitigation for Alternative A could include:

- Minimizing locations of construction staging areas in the newly cleared ROW. Locate equipment storage, soils storage, and cleared vegetation piles in the existing transmission line ROW.

Unavoidable Effects, Irreversible or Irretrievable Commitment of Resources—Alternative A would result in the conversion of 118 ac. of forested stands to the managed grass/forb/shrub vegetation type (see Table 7). This total represents 30% of the total Alternative A impact permanently converted to nonforested use.

4.1.3.3 Alternative B

Impacts—Please refer to Section 4.1.1 for discussion of impacts common to all action alternatives. Alternative B would result in impacts to 250 ac. Approximately 66% of the total impact area would occur in coniferous forested cover types. Of the total impact area, 24% (60 ac.) would occur in mature coniferous regeneration stands, which are 36- to 75-year-old stands dominated by Douglas-fir averaging 100 to 130 ft. in height. Approximately 12% of the Alternative B impacts would occur in the existing managed grass/forb/shrub cover type typical of BPA transmission line corridors.

Mitigation—Please refer to Section 4.1.1.2 for discussion of mitigation common to all action alternatives. Additional mitigation for Alternative B could include:

- Minimizing locations of construction staging areas in the newly cleared ROW. Locate equipment storage, soils storage, and cleared vegetation piles in the existing transmission line ROW.

Unavoidable Effects, Irreversible or Irretrievable Commitment of Resources—Alternative B would result in the conversion of 213 ac. of forested stands to the managed grass/forb/shrub vegetation type (see Table 7). This represents 85% of the total Alternative B impact converted to long-term nonforested use.

4.1.3.4 Alternative C (Option C-1)

Impacts—Please refer to Section 4.1.1 for discussion of impacts common to all action alternatives. Alternative C (Option C-1) would result in impacts to 195 ac. Approximately 24% of the total impact area would occur in coniferous forested cover types; 21% of the total impact area (42 ac.) would be in early or mid-regeneration coniferous regeneration stands, which are 20- to 35-year-old stands dominated by Douglas-fir averaging 40 to 80 ft. in height. Over half (53%) of the total Alternative C (Option C-1) impacts would occur in deciduous or mixed deciduous-conifer forested areas.

Mitigation—Please refer to Section 4.1.1.2 for discussion of mitigation common to all action alternatives.

Unavoidable Effects, Irreversible or Irretrievable Commitment of Resources—Alternative C (Option C-1) would result in the conversion of 130 ac. of forested stands to the managed grass/forb/shrub vegetation type (see Table 7). This represents 67% of the total Alternative C (Option C-1) impact permanently converted to nonforested use.

4.1.3.5 Alternative C (Option C-2)

Impacts—Please refer to Section 4.1.1 for discussion of impacts common to all action alternatives. Alternative C (Option C-2) would result in impacts to 206 ac. Only 6% of the total impact area would occur in coniferous forested cover types. Of the total Alternative C (Option C-2) impacts, 22% would occur in developed or rural-residential/managed landscape cover types. An additional 20% of the Alternative C (Option C-2) impacts would occur in the existing managed grass/forb/shrub cover type typical of BPA transmission line corridors.

Mitigation—Please refer to Section 4.1.1.2 for discussion of mitigation common to all action alternatives.

Unavoidable Effects, Irreversible or Irretrievable Commitment of Resources—Alternative C (Option C-2) would result in the conversion of 115 ac. of forested stands to the managed grass/forb/shrub vegetation type (see Table 7). This represents 56% of the total Alternative C (Option C-2) impact permanently converted to non-forested use.

4.1.3.6 Alternative D (Option D-1)

Impacts—Please refer to Section 4.1.1 for discussion of impacts common to all action alternatives. Alternative D (Option D-1) would result in impacts to 769 ac.; 82% of the total impact area would occur in coniferous forested cover types. This includes the removal of 108 ac. of mature coniferous forest stands, which are 75- to 250-year-old stands dominated by Douglas-fir, mature western hemlock and Pacific silver fir at higher elevations. Alternative D (Options D-1 and D-2) is the only alternative that results in the loss of mature coniferous forest. An additional 20% of the total impact area (158 ac.) would be in mature coniferous regeneration stands, which are 36- to 75-year-old stands dominated by Douglas-fir averaging 100 to 130 ft. in height. Less than 20% of the total Alternative D (Option D-1) impacts would occur in developed or managed cover types.

Construction of Alternative D (Option D-1) would result in a high probability of impacts to Forest Service Survey and Manage vascular and nonvascular plant and fungal species. The locations and extent of populations of these species have not been identified within the project area. However, due to the relatively high percentage of mature coniferous stands in the Alternative D (Option D-1) project area, the likelihood of impacting populations of Forest Service Survey and Manage species is notably higher than for Alternatives 1, A, B, and Alternative C (Options C-1 and C-2). Plant species designated as sensitive by the USFS Mt. Baker-Snoqualmie and Wenatchee National Forests would also have a higher probability of sustaining impact by construction of Alternative D (Option D-1).

Mitigation—Please refer to Section 4.1.1.2 for discussion of mitigation common to all action alternatives.

- Field surveys for Forest Service Survey and Manage and for Mt. Baker-Snoqualmie and Wenatchee National Forest sensitive species would be conducted before construction of Alternative D (Option D-1).

Unavoidable Effects, Irreversible or Irretrievable Commitment of Resources—Alternative D (Option D-1) would result in the conversion of 632 ac. of forested stands to the managed grass/forb/shrub vegetation type (see Table 7). This figure represents 82% of the total impact permanently converted to nonforested use.

4.1.3.7 Alternative D (Option D-2)

Impacts—Please refer to Section 4.1.1 for discussion of impacts common to all action alternatives. Alternative D (Option D-2) would result in impacts to 776 ac.; 64% of the total impact area would occur in coniferous forested cover types. This includes the removal of 100 ac. of mature coniferous forest stands, which are 75- to 250-year-old stands dominated by Douglas-fir, mature western hemlock and Pacific silver fir at higher elevations. Alternative D (Options D-2 and D-1) is the only alternative that results in the loss of mature coniferous forest. An additional 24% of the total impact area (186 ac.) would be in mature coniferous regeneration stands, which are 36- to 75-year-old stands dominated by Douglas-fir averaging 100 to 130 ft. in height. Only 9% of the total Alternative D (Option D-2) impacts would occur in developed or managed cover types.

Construction of Alternative D (Option D-2) would result in a high probability of impacts to Forest Service Survey and Manage vascular and nonvascular plant and fungal species. The locations and extent of populations of these species have not been identified within the project area. However, due to the relatively high percentage of mature coniferous stands in the Alternative D (Option D-2) project area, the likelihood of impacting populations of Forest Service Survey and Manage species is notably higher than for Alternatives 1, A, B, and Alternative C (Options C-1 and C-2). Plant species designated as sensitive by the USFS Mt. Baker-Snoqualmie and Wenatchee National Forests would also have a higher probability of sustaining impact by construction of Alternative D (Option D-2).

Mitigation—Please refer to Section 4.1.1.2 for discussion of mitigation common to all action alternatives.

- Field surveys for Forest Service Survey and Manage and for Mt. Baker-Snoqualmie and Wenatchee National Forest sensitive species would be conducted before construction of Alternative D (Option D-2).

Unavoidable Effects, Irreversible or Irretrievable Commitment of Resources—Alternative D (Option D-2) would result in the conversion of 694 ac. of forested stands to the managed grass/forb/shrub vegetation type (see Table 7). This figure represents 89% of the total Alternative D (Option D-2) impact permanently converted to nonforested use.

4.1.4 Access Roads

4.1.4.1 Impacts—New access roads would be built for the construction, operation, and maintenance of the transmission line. Existing access roads in some areas will need extensive reconstruction or improvement. New roads, including the roadbed and embankments, would be built as spurs from existing roads where possible. Existing access roads are generally 25 ft. across, with the majority of actual use occurring in the central 16 ft. Access roads would be built primarily within the 150-ft. clearing corridor; however, additional access roads will be required outside of the 150-ft. corridor. Table 8 lists the acreages of clearing for new access roads for each alternative, both inside and outside of the 150-ft. clearing corridor.

Table 8. Summary of Access Roads by Alternative

Alternative	Access Road Acreage within 150-ft. Clearing Corridor	Access Road Acreage outside of 150-ft. Clearing Corridor
1	7	[a]
A	20	13
B	7	22
C (Option C-1)	18	5[b]
C (Option C-2)	21	8
D (Option D-1)	20	20
D (Option D-2)	19	22

[a] not available
[b] represents acreage within existing 150-ft. ROW

4.1.4.2 Mitigation—Mitigation measures for construction of new access roads and reconstruction of existing access roads include:

- Keep incidental vegetation clearing to the minimum needed to maintain safety and operational standards. Flag and/or mark clearing limits. Describe clearing limits and applicable buffer requirements as part of construction contracts.

- Promptly reseed or revegetate disturbed areas with native seed mix as soon as construction in an area is completed. However, in many cases, locally adapted native plant materials are not available. Many native species available for restoration are actually from other areas, representing different genetics than existing vegetation. BPA would consult with the WDNR, Forest Service, and others to determine appropriate seed mixtures.

Develop and implement aggressive vegetation management programs to limit colonization by nonnative species and eradicate noxious weeds along new access roads.

- Policies and procedures adopted by BPA in the May 2000 Final EIS for the BPA Transmission System Vegetation Management Program and its July 2000 ROD provide adequate mitigation for potential noxious weed invasion along new access roads.

- Use only certified weed-free straw, where straw is used as mulch or for erosion control.

4.1.4.3 Cumulative Impacts—Construction of new access roads would add to the area already converted to existing access roads for existing BPA transmission lines, and for other projects undertaken by federal, state, county, and local agencies.

4.1.4.4 Unavoidable Effects, Irreversible or Irretrievable Commitment of Resources—Construction of new access roads would have irreversible impacts similar to construction of the transmission line, but to a lesser degree due to the smaller area involved. These impacts include the effects of short-term uses of resources on long-term productivity, limitations placed upon the growth of vegetation in and around the access roads, and use of nonrenewable resources such as minerals and petroleum-based fuels.

Short-term uses associated with construction of new access roads include the clearing of vegetation for the roadbed and the maintenance of a low-vegetation fringe along the road. Long-term productivity refers to the capability of the land to provide resources for future generations. Construction of new access roads would decrease the amount of land that could be used for other purposes, including various types of production or resource conservation.

Construction of new access roads would require the long-term conversion of certain existing vegetative cover types to the developed type. Types to be converted include all forested types and managed grass/forb/shrub areas. Streams and rivers may be culverted or bridged where necessary. Wetlands would be avoided where practical; otherwise they would be spanned or mitigated (see the Wetlands Technical Report for details). Developed vegetation types would be only temporarily impacted and would not be converted. As defined at the beginning of Section 4.0, reduction in the quantity of a vegetation community, confined to the site of the action, would be a low impact.

Construction of the new access roads would require the use of nonrenewable resources such as petroleum-based fuels. Mineral resources would also be consumed in the construction of the roads.

4.1.5 Cumulative Impacts

Cumulative impacts associated with the transmission line include the additional loss of forested area within the Cedar River Watershed (CRW) or the USFS Mt. Baker-Snoqualmie and Wenatchee National Forests, depending on the alternative chosen. The construction of the transmission line in these areas would be one of several causes of the loss of forested area. Other activities resulting in lost forested area include stand thinning and timber harvesting as well as highway widening projects.

Additional access road construction may generally increase colonization by nonnative species within a watershed. For all alternatives except Alternatives 1, B, and a portion of Alternative A, fragmentation of forested stands would increase, as would the number of trees prone to windfall along forest edges.

4.2 Operation and Maintenance Impacts

4.2.1 Impacts Common to All Transmission Line Alternatives

4.2.1.1 Impacts

Impacts associated with operation and maintenance of the transmission line would include continued clearing and trimming of vegetation beneath and adjacent to the transmission line, and continued disturbance of vegetation and soils during maintenance activities.

Vegetation beneath the transmission line would be converted to a managed grass/forb/shrub type. However, new trees would grow in this area, and they would either be removed immediately or cleared as they attain heights that could interfere with the operation of the transmission line. The continued removal and/or suppression of tree growth would be a low-level impact as defined at the beginning of Section 4.0.

Routine and emergency maintenance activities would require visits to tower sites and movement of personnel and vehicles along the transmission line ROW. These activities could result in

additional disturbance to soils. This in turn would favor colonization by nonnative and/or noxious plant species. This is a low-level impact because it could be mitigated.

4.2.1.2 Mitigation

Mitigation measures for impacts associated with operation and maintenance of BPA transmission line systems would follow policies and procedures adopted by BPA in the May 2000 Final EIS for the BPA Transmission System Vegetation Management Program and its July 2000 ROD. In order to reduce the frequency and intensity of maintenance, low-growing plant communities would be favored. A combination of methods would be used where vegetation must be removed, including manual, mechanical, and biological techniques.

4.2.1.3 Unavoidable Effects, Irreversible or Irretrievable Commitment of Resources

Unavoidable, irreversible, or irretrievable impacts associated with the operation and maintenance of the transmission line could include the continued loss of long-term timber productivity and the use of nonrenewable resources. Moreover, vehicles used to transport vegetation management personnel to the transmission line ROW would also use petroleum-based fuels.

4.2.2 Access Roads

4.2.2.1 Impacts

Impacts associated with the operation and maintenance of access roads would include periodic clearing of vegetation; disturbance of soils; and potential spills of fuels, oils, or other compounds toxic to vegetation.

The presence of roads increases the risk of slope failures, particularly on steeper slopes. Slope failures can scour vegetation downstream or downhill from the point of failure.

Vegetation within and adjacent to access roads would need to be cleared periodically to allow passage of maintenance vehicles. This practice would be a low-level impact. Species cleared would include trees and shrubs.

Driving on access roads would disturb soils in the path of the maintenance vehicle. Soil disturbance would favor colonization by nonnative and/or noxious plant species. In extreme cases, soil disturbance would preclude growth of vegetation entirely. This impact would be a low-level.

While driving and parking maintenance vehicles along access roads, occasional small fuel and oil leaks could occur. Petroleum-based compounds being transported by vehicles could also spill or leak, especially on rough or uneven terrain. Any such spills or leaks could kill or injure vegetation in the immediate vicinity of the spill. This outcome would be a low-level impact.

4.2.2.2 Mitigation

Mitigation measures for impacts associated with access roads would be similar to those described in Section 4.2.1.2 for the transmission line. No herbicides would be used in the CRW (Alternative 1).

4.2.2.3 Unavoidable Effects, Irreversible or Irretrievable Commitment of Resources

Unavoidable, irreversible, or irretrievable impacts associated with operation and maintenance of access roads would include long-term damage to soils and the use of nonrenewable resources.

Operation of vehicles on access roads could denude and compact soils. This impact would be greatest on access roads that are most frequently used. In extreme cases, these soils would lose their ability to support vegetation communities altogether, without restoration. This impact would be a low-level.

Vehicles used in the operation and maintenance of access roads along the transmission ROW would use petroleum-based fuels. This use of a nonrenewable resource would be a low-level impact.

4.2.3 Substation

4.2.3.1 Impacts

Impacts associated with the operation and maintenance of the expanded Echo Lake Substation would include periodic clearing of vegetation and potential spills of fuels, oils, or other compounds toxic to vegetation.

4.2.3.2 Mitigation

Mitigation measures for impacts associated with substation operation would be the same as those adopted by BPA in the May 2000 Final EIS for the BPA Transmission System Vegetation Management Program and its July 2000 ROD. Areas would be maintained using a combination of manual methods (hoes, saws, pulling) and herbicides, primarily a pre-emergent herbicide that would be applied to the ground to keep vegetation from germinating.

4.2.3.3 Unavoidable Effects, Irreversible or Irretrievable Commitment of Resources

Unavoidable, irreversible, or irretrievable impacts associated with operation and maintenance of the Echo Lake Substation would include the loss of long-term productivity, and the use of nonrenewable resources.

Long-term productivity refers to the capability of the land to provide resources for future generations. Expansion of the Echo Lake Substation would preclude the use of this land for any other purpose, including various types of production or resource conservation. Historically, this land has been suitable for timber production, although not operated as such. Preclusion of use would be a low-level impact.

Operation and maintenance of the substation may require use of petroleum-based fuels for maintenance activities around the substation. This use of a nonrenewable resource is a low-level impact.

4.2.4 Cumulative Impacts

Cumulative impacts associated with operation and maintenance of the transmission line would include loss of forested area and increased colonization by nonnative species. Increased risk of

wildland fire is associated with transmission lines. A broken line or an arc to the ground provides a source for ignition.

5.0 Environmental Consultation, Review and Permit Requirements

Several federal laws and administrative procedures must be met by the alternatives. This section lists and briefly describes requirements that would apply to the vegetation elements of this project.

5.1 National Environmental Policy Act (NEPA)

This report was prepared in support of documentation required for NEPA (42 USC 4321 et seq.). NEPA is a national law for protection of the environment. NEPA applies to all federal projects or projects that require federal involvement. BPA would take into account potential environmental consequences and would take action to protect, restore, and enhance the environment before making a decision on the proposed action.

5.2 Endangered and Threatened Species (ESA)

5.2.1 Federal

The Endangered Species Act of 1973 (16 USC 1536) provides for conserving endangered and threatened species of fish, wildlife, and plants. Federal agencies must determine whether proposed actions would adversely affect any endangered or threatened species. When conducting an environmental impact analysis for specific projects, agencies must identify practicable alternatives to conserve or enhance such species.

The ESA protects species whose populations are declining to the point where they are now at risk of extinction, or are likely to be in the future. The ESA prohibits "taking" any species listed as endangered. The prohibition against taking can be extended to threatened species under regulations promulgated by USFWS and the National Marine Fisheries Service (NMFS). Under the ESA, "to take" is defined as "to harass, harm, pursue, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct" (16 USC 1532(18)). "Harming" includes any action that reduces an individual species' ability to feed, breed, or seek shelter and can include major habitat modifications that result in killing or injuring wildlife by materially impairing behavioral patterns.

Section 7 of the ESA requires federal agencies to consult with USFWS and/or NMFS on actions leading to activities that might affect listed species. Consultation typically involves preparing a Biological Assessment that describes the expected effects of a proposed action on a listed species. If the Biological Assessment indicates that the action is likely to adversely affect a listed species, then formal consultation with USFWS or NMFS is required. Formal consultation results in the issuance of a Biological Opinion—a formal determination on whether or not an action will jeopardize the continued existence of the species or destroy or adversely modify a species' critical habitat, and if so whether there are reasonable and prudent alternatives that avoid such a result (50 CFR 17.3).

Under Section 10 of the ESA, as amended in 1982, incidental takes (those that are incidental to otherwise lawful activity) of listed species may be authorized through voluntary agreements including Habitat Conservation Plans (HCPs). HCPs must be approved by the Secretary of the listing department. When approving a plan, the Secretary must find that:

1. the plan will minimize and mitigate the impacts of the incidental take to the maximum extent possible;

2. the incidental take will not appreciably reduce the likelihood of the survival and recovery of the species in the wild; and

3. adequate funding for the plan is provided.

HCP agreements must also satisfy consultation requirements specified in Section 7 of the ESA.

A letter issued by USFWS on April 12, 2000 indicated no plant species listed, proposed, or candidate for designation under the ESA occur within the project area.

5.2.1.1 Designated Critical Habitat for Listed Species

The ESA requires that, to the maximum extent determinable, NMFS and USFWS must designate critical habitat for federally-listed species at the time of their listing. Critical habitat designation establishes areas that are to be given special consideration in Section 7 consultations. The study area does not contain any designated critical habitat for plant species.

5.2.2 Survey and Manage Species

Survey and Manage species, along with the standards and guidelines for management of these species, were designated in Table 1-1 of the Record of Decision (ROD) Standards and Guidelines for Amendments to the Survey and Manage, Protection Buffer, and other Mitigation Measures Standards and Guidelines (USFS and BLM 2001). The ROD requires surveys to be conducted on USFS and BLM lands for many of the species that are to be managed. Botanical resources on the Survey and Manage list include bryophytes (e.g., mosses, liverwort, and hornworts), lichens, and fungi**.**

5.2.3 State

Washington State-listed threatened and endangered species are not protected in the same way as federally-listed species, where a "taking" is generally prohibited unless authorized by an Incidental Take Permit or an Incidental Take Statement. Instead, the state uses these classifications to assist with agency management programs and decision-making. The state also defines Priority Habitats as those habitats having unique or significant value to species because they contain a unique vegetation type or a specific habitat element that is key to fish and wildlife.

According to the WDNR Natural Heritage Program, there are no state-listed threatened or endangered plant species present within the study area.

5.3 Federal, State, Areawide, and Local Plan and Program Consistency

BPA would work with agency planners to minimize conflicts between proposed activities and the land use plans of King County and the City of Seattle.

5.3.1 King County Sensitive Areas Ordinance

Wetlands are also protected under the King County Sensitive Areas ordinance and related regulations (King County Code 21.24). Standards have been established for Class 1, 2, and 3 wetlands. Other habitats that are protected under the ordinance include streamside (riparian) vegetation and other important wildlife habitats. King County Code 21A.14.260 also defines specific wildlife habitat corridors. These corridors are to be maintained at a width, wherever possible, of 300 ft. and at a minimum of 150 ft.

5.3.2 King County Department of Development and Environmental Services Conversion Option Harvest Plan

The King County DDES COHP is a voluntary timber-harvesting plan developed by the landowner and approved by King County, indicating limits of timber harvest, road locations, sensitive areas, and vegetation management practices. A COHP defines the local government standards and regulations that the landowner must follow.

5.3.3 Washington Forest Practices Act

The Washington Forest Practices Act has provisions for managing riparian and wetland vegetation and wildlife habitats in areas where timber harvest is planned. It requires landowners to consult with the Washington Department of Fish and Wildlife (WDFW) to protect critical habitats, to preserve wildlife reserve trees, and to avoid disturbance to both spotted owls and marbled murrelets during their nesting seasons.

5.3.4 Washington Department of Natural Resources Forest Practices Rules

The WDNR Forest Practices Rules (WAC 222) describe the types of forest practices allowed under the State of Washington Forest Practices Act (RCW 76.09). They divide forest practices into four classes, based on potential impact to public resources, and outline the processes for permitting of each class.

5.3.5 Washington Department of Natural Resources Habitat Conservation Plan

The WDNR HCP establishes a comprehensive management plan for long-term management of all WDNR-managed timberlands within the range of the northern spotted owl in Washington. The HCP also includes numerous provisions to maintain the quality of fish habitat and the health of fish populations.

6.0 Individuals and Agencies Contacted

None at this time.

7.0 List of Preparers

Randy Edwards, Information Team Leader
More than 20 years of experience in the GIS and environmental industries
B.S., Oceanography, Humboldt State University, 1983

Daniel Jones, Vegetation and Wetlands Biologist
Fourteen years of experience in plant taxonomy, fungal taxonomy, vegetation sampling methodology, and wetland delineation
M.S., Biology (Ecology and Evolution), University of Oregon, 1997

Sean Robertson, CAD/GIS Specialist
Three years of experience in GIS mapping and evaluations
B.S., Environmental and Resource Sciences, University of California – Davis, 1999

John Soden, Project Manager
Five years of experience in wetland delineation and assessment of aquatic resources, resource inventory and classification, riparian and wetlands research, and permitting assistance
M.S., Forestry (Riparian and Wetland Research Program), University of Montana, 1999

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9.0 Glossary and Acronyms

This section contains a list of acronyms, abbreviations, and technical terms used in this report. Words that would be defined in a desk-size dictionary (for example, the College Edition of the American Heritage Dictionary) are not included.

9.1 Glossary

100-year floodplains are areas that have a 1% chance of being flooded in a given year.

Access roads are constructed to each structure site first to build the tower and line and later to maintain and repair it. Access roads are built where no roads exist. Where county roads or other access is already established, short spurs are built to the structure sites. Access roads are maintained after construction, except where they pass through cultivated land where the roads would be removed and crop production would be restored after construction is completed.

Alternatives refer to different choices or means to meet the need for action.

Anthropogenic is of, relating to, or resulting from the influence of human beings on nature.

Aquifers are water-bearing rock or sediments below the surface of the earth.

Best Management Practices are a practice or a combination of practices that are the most effective and practical means of preventing or reducing the amount of pollution generated by non-point sources to a level compatible with water quality goals.

Biological Assessments are documents prepared to fulfill the implementing regulations of the Endangered Species Act, found at 50 CFR, part 402, which require an assessment of potential effects on listed species and critical habitat prior to implementing a proposed action. A proposed action is defined as any activity authorized, funded, or carried out by a federal agency (50 CFR 402.10).

Biological Evaluations are the means by which the U.S. Forest Service conducts a review and documents the findings of the effects of an action or proposed action on any sensitive species.

Culverts are corrugated metal or concrete pipes used to carry or divert runoff water from a discharge. Culverts are usually installed under roads to prevent washouts and erosion.

Cumulative impacts are created by the incremental effect of an action when added to other past, present, and reasonably foreseeable future actions.

Cut and fill is the process by which a road is cut or filled on a side slope. The term refers to the amount of soil that is removed (cut) or added (filled).

CWA signifies the Clean Water Act, a federal law intended to restore and maintain the chemical, physical, and biological integrity of the nation's waters and secure water quality.

Danger trees or high-growing brush occur in or alongside the project right-of-way and are hazardous to the transmission line. These trees are identified by special crews and must be removed to prevent tree-fall into the line or other interference with the wires. The owner of danger trees off the right-of-way is compensated for their value. BPA's Construction Clearing Policy requires that trees be removed that meet either one of two technical categories: Category A contains any tree that in 15 years will grow within about 5 m (18 ft.) of conductors when the conductor is at maximum sag (100°C or 212°F) and is swung by 30 kg per sq/m (6 lb per sq/ft.) of wind (93 kph or 58 mph); Category B represents any tree or high-growing bush that after 8 years of growth will fall within about 2 m (8 ft.) of the conductor when it reaches maximum sag (80°C or 176°F) in a static position.

Deadends are heavy towers designed for use where the transmission line loads the tower primarily in tension rather than compression. Deadends are used in turning large angles along a line or in bringing a line into a substation.

Easement is a grant of certain rights to use a piece of land, which then becomes a "right-of-way." BPA normally acquires easements for its transmission lines. Easement includes the right to enter the ROW to build, maintain, and repair facilities.

Emergent plants have their bases submerged in water.

Endangered species are those species listed as endangered either by the Federal Government or the State of Washington. Federally-listed Endangered Species are those officially designated by the U.S. Fish and Wildlife Service as being in danger of extinction throughout all or a significant portion of their range. These species receive full protection under the Endangered Species Act. State-listed Endangered Species are those species native to the State of Washington that are seriously threatened with extinction throughout all or a significant portion of their range within the state, as designated in Washington Administrative Code 232-12-014.

Floodplain refers to a portion of a river valley adjacent to the stream channel that is covered with water when the stream overflows its banks during flood stage.

Footings are the supporting base for the transmission towers. They are usually steel assemblies buried in the ground for lattice-steel towers.

Forb is any herbaceous plant that is not a grass or grasslike.

Ford is a travelway across a stream where water depth does not prevent vehicle movement. Ford construction can include grading and stabilizing streambanks at the approaches and adding coarse fill material within the channel to stabilize the roadbed.

GIS signifies Geographic Information System, a computer system that analyzes graphical map data.

Ground wire (overhead) is wire strung from the top of one tower to the next; it shields the line against lightning strikes.

HCP is Habitat Conservation Plan.

Hydrology addresses properties, distribution, and circulation of water.

Hydroperiod is the seasonal occurrence of flooding and/or soil saturation.

Insulators are ceramic or other nonconducting materials used to keep electrical circuits from jumping to ground.

Intermittent refers to periodic water flow in creeks or streams.

Internal drainage refers to streams that are not connected to the ocean by surface waters.

Jurisdictional wetlands are areas that are consistently inundated or saturated by surface or ground water at a frequency and duration sufficient to support a prevalence of vegetation typically adapted for life in saturated soil conditions.

Kilovolt is one thousand volts.

Lattice steel refers to a transmission tower constructed of multiple steel members that are connected together to make up the tower's frame.

Low vegetation area is the area where vegetation is kept below a maximum reliable operation height.

Low-gradient refers to gentle slopes.

LWD is large woody debris, defined as any piece of downed wood larger than 4 in. in diameter and 6 ft. long.

Mitigation is the step(s) taken to lessen the potential environmental effects predicted for each resource impacted by the transmission project. Mitigation may reduce the impact, avoid it completely, or compensate for the impact. Some mitigation, such as adjusting the location of a tower to avoid a special resource, is enacted during the design and location process. Other mitigation, such as reseeding access roads with desirable grasses and avoiding weed proliferation, is taken after construction.

Monitor species are those species for which the State of Washington monitors status and distribution either because they have been listed as State-threatened, endangered or sensitive within the previous 5 years; they require a habitat that has limited availability during at least some portion of their life cycle; they are environmental indicators; or their taxonomy is in question and it is unclear whether they should be included as listed species.

Montane areas refer to those occurring in the biogeographic zone of relatively moist, cool upland slopes below timberline dominated by large coniferous trees.

National Environmental Policy Act (NEPA) requires an environmental impact statement on all major federal actions significantly affecting the quality of the human environment.
(42 U.S.C. 4332 2(2)(C))

Noxious weeds are plants that are injurious to public health, crops, livestock, land, or other property.

Perennial streams and creeks have year-round water flows.

Permeability refers to the capability of various materials to transport liquids.

Pulling site is a staging area for machinery used to string conductors.

Revegetation is reestablishment of vegetation on a disturbed site.

Right-of-way (ROW) is an easement for a certain purpose over the land of another owner, such as a strip of land used for a road, electric transmission line, pipeline, etc.

Riparian habitat is a zone of vegetation that extends from the water's edge landward to the edge of the vegetative canopy. The term is associated with watercourses such as streams, rivers, springs, ponds, lakes, or tidewater.

Sensitive species are those species native to Washington State that are vulnerable or declining and are likely to become endangered or threatened in a significant portion of their range within the state without cooperative management or removal of threats, as defined in Washington Administrative Code 232-12-011.

Seral stage designates a given sere, which is a stage of ecological succession. Phases in the growth and development of plant communities from a disturbance or colonization event to the climax community are characterized as seres.

Silt is a designation referring to individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 mm) to the lower limit of very fine sand (0.05 mm).

Sole source aquifer is designated by the U.S. Environmental Protection Agency as an aquifer providing at least half of an area's drinking water.

Substation deadends are towers within the confines of the substation where incoming and outgoing transmission lines end. Deadends are typically the tallest structures in a substation.

Substation is the fenced site that contains the terminal switching and transformation equipment needed at the end of a transmission line.

Survey and manage is a mitigation measure adopted as a standard and guideline within the NFP Record of Decision that is intended to mitigate impacts of land management efforts on species that are closely associated with late-successional or old-growth forests whose long-term persistence is a concern. (U.S. Department of Agriculture, Forest Service, and U.S. Department of Interior, Bureau of Land Management 2000)

Survey protocols are interagency documents describing the survey techniques needed to have a reasonable chance of locating a species when it is present on a site, or needed to make an "equivalent effort" of locating the species when it is present on the site. Survey protocols also identify habitats needing surveys and may identify habitats or circumstances not needing surveys. (U.S. Department of Agriculture, Forest Service, and U.S. Department of Interior, Bureau of Land Management 2000)

Take is to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct (Federal Endangered Species Act, Section 3(18)).

Threatened species are those species listed as threatened either by the Federal Government or the State of Washington. Federally-listed threatened species are those officially designated by the U.S. Fish and Wildlife Service as being in danger of becoming endangered throughout all or a

significant portion of their range. These species receive full protection under the Endangered Species Act. State-listed threatened species are those species native to the State of Washington that are likely to become endangered within the foreseeable future throughout all or a significant portion of their range within the state without cooperative management or removal of threats, as designated in Washington Administrative Code 232-12-011.

Transmission deadend towers are the last transmission line towers on both the incoming and outgoing sides of the substation. These towers are structurally reinforced to reduce conductor tension on substation deadends and provide added reliability to the substation.

Transmission line includes the structures, insulators, conductors, and other equipment used to transmit electrical power from one point to another.

Water bars are smooth, shallow ditches excavated at an angle across a road to decrease water velocity and divert water off and away from the road surface.

Wetlands are areas where the soil experiences anaerobic conditions because of inundation of water during the growing season. Indicators of a wetland include types of plants, soil characteristics, and hydrology of the area.

9.2 Acronyms and Abbreviations

ac. ..... acre or acres
BLM ..... Bureau of Land Management
BMPs ..... Best Management Practices
BPA ..... Bonneville Power Administration
CFR ..... Code of Federal Regulations
COHP ..... Conversion Option Harvest Plan
CRW ..... Cedar River Watershed
dbh ..... diameter at breast height
DDES ..... Department of Development and Environmental Services (King County)
DWM ..... down woody material
EIS ..... environmental impact statement
ESA ..... Endangered Species Act
FR ..... Federal Register
ft. ..... foot or feet
GIS ..... Geographic Information System
HCP ..... Habitat Conservation Plan
in. ..... inch or inches
kV ..... kilovolt
mi. ..... mile or miles
NEPA ..... National Environmental Policy Act
NESC ..... National Electrical Safety Code
NHP ..... Natural Heritage Program
NMFS ..... National Marine Fisheries Service
RCW ..... Revised Code of Washington
ROD ..... Record of Decision
ROW ..... right-of-way
USC ..... U.S. Code
USFS ..... U.S. Forest Service
USGS ..... U.S. Geological Survey

USFWS..... U.S. Fish and Wildlife Service
WAC..... Washington Administrative Code
WDFW ..... Washington Department of Fish and Wildlife
WDNR..... Washington Department of Natural Resources

Appendix A

Threatened, Endangered, and Sensitive Plants on the Wenatchee and Mt. Baker-Snoqualmie National Forests

Appendix A. Threatened, Endangered, and Sensitive Plants on the Wenatchee and Mt. Baker-Snoqualmie National Forests

Scientific Name	Common Name
Mt. Baker-Snoqualmie National Forest	
Agoseris elata	tall agoseris
Aster sibiricus var. *meritus*	arctic aster
Botrychium ascendens	triangular-lobed moonwort
Botrychium paradoxum	two-spiked moonwort
Botrychium pedunculosum	stalked moonwort
Campanula lasiocarpa	Alaska harebell
Carex comosa	bristly sedge
Carex heteroneura	different nerve sedge
Carex pauciflora	few-flowered sedge
Carex pluriflora	several-flowered sedge
Carex proposita	Smoky Mountain sedge
Carex rostrata	beaked sedge
Carex saxatilis var. *major*	russet sedge
Carex scirpoidea var. *scirpoidea*	Canadian single-spiked sedge
Carex stylosa	long-styled sedge
Cassiope lycopodioides	clubmoss cassiope
Castilleja cryptatha	obscure Indian paintbrush
Chaenactis thompsonii	Thompson's chaenactis
Cicuta bulbifera	bulb-bearing waterhemlock
Cimicifuga elata	tall bugbane
Coptis aspleniifolia	spleenwort-leaved goldthread
Cypripedium fasciculatum	clustered lady's slipper

Scientific Name	Common Name
Mt. Baker-Snoqualmie National Forest, continued	
Dryas drummondii	yellow mountain-avens
Erigeron salishii	Salish fleabane
Fritillaria camschaticus	black lily
Galium kamtschaticum	boreal bedstraw
Gaultheria hispidula	creeping snowberry
Gentiana douglasiana	swamp gentian
Gentiana glauca	glaucous gentian
Lobelia dortmanna	water lobelia
Loiseleuria procumbens	alpine azalea
Luzula arcuata	curved woodrush
Lycopediella inundata	bog clubmoss
Lycopodium dendroideum	treelike clubmoss
Microseris borealis	northern microseris
Montia diffusa	branching montia
Pedicularis rainierensis	Mt. Rainier lousewort
Pellaea breweri	Brewer's cliffbrake
Pityopus californica	pine-foot
Platanthera chorisiana	Choris' bog-orchid
Platanthera obtusata	small northern bog-orchid
Platanthera sparsiflora	canyon bog-orchid
Ranunculus cooleyae	Cooley's buttercup

Scientific Name	Common Name
Wenatchee National Forest	
Agoseris elata	tall agoseris
Anemone nuttalliana	pasque flower
Antennaria parvifolia	Nuttal's pussy-toes
Astragalus arrectus	Palouse milkvetch
Botrychium paradoxum	two-spiked moonwort
Botrychium pinnatum	St. John's moonwort
Botrychium simplex	little grape-fern
Carex comosa	bristly sedge
Carex hystericina	Porcupine sedge
Carex macrochaeta	large-awn sedge
Carex pauciflora	few-flowered sedge
Carex proposita	Smoky Mountain sedge
Carex saxatilis var. *major*	russet sedge
Carex stylosa	long-styled sedge
Carex sychnocephala	many-headed sedge
Castilleja cryptantha	obscure indian-paintbrush
Chaenactis thompsonii	Thompson's chaenactis
Cicuta bulbifera	bulb-bearing water hemlock
Coptis aspeniifolia	Spleenwort-leaved goldthread
Cryptogramma stelleri	Stellar's rock-brake
Cypripedium fasciculatum	clustered ladyslipper
Cypripedium parviflorum	yellow ladyslipper
Delphinium viridescens	Wenatchee larkspur
Eleocharis atropurpurea	purple spike-rush
Erigeron salishii	Salish fleabane
Eritrichium nanum var. *elongatum*	pale alpine forget-me-not

Scientific Name	Common Name
Wenatchee National Forest, continued	
Galium kamschaticum	boreal bedstraw
Geum rossii var. *depressum*	Ross' avens
Hackelia hispida var. *disjuncta*	rough stickseed
Hackelia taylorii	Taylor's stickweed
Hackelia venusta	showy stickseed
Iliamma longisepala	longsepal globemallow
Louiseleuria procumbens	alpine alzalea
Mimulus suksdorfii	Suksdorf's monkey flower
Montia diffusa	branching montia
Nicotiana attenuata	wild tobacco
Pedicularis rainierensis	Mt. Rainier lousewort
Pellaea brachyptera	Sierra cliff-brake
Pellaea breweri	Brewer's cliff-brake
Petrophyton cinerascens	Chelan rockmat
Phacelia minutissima	least phacelia
Physaria didymocarpa var. *didymocarpa*	common twinpod
Platanthera chorisiana	Choriso bog-orchid
Platanthera obtusata	small northern bog-orchid
Platanthera sparsiflora	canyon bog-orchid
Salix vestita var. *erecta*	rock willow
Saxifragopsis fragarioides	strawberry saxifrage
Sidalcea oregana var. *calva*	Wenatchee Mtns checker mallow
Silene seelyi	Seely's silene
Spiranthes diluvialis	Ute ladies-tresses
Spiranthes porrifolia	western ladies-tresses
Trifolium thompsonii	Thompson's clover

Source: United States Forest Service, Mt. Baker-Snoqualmie National Forest and Wenatchee National Forest.