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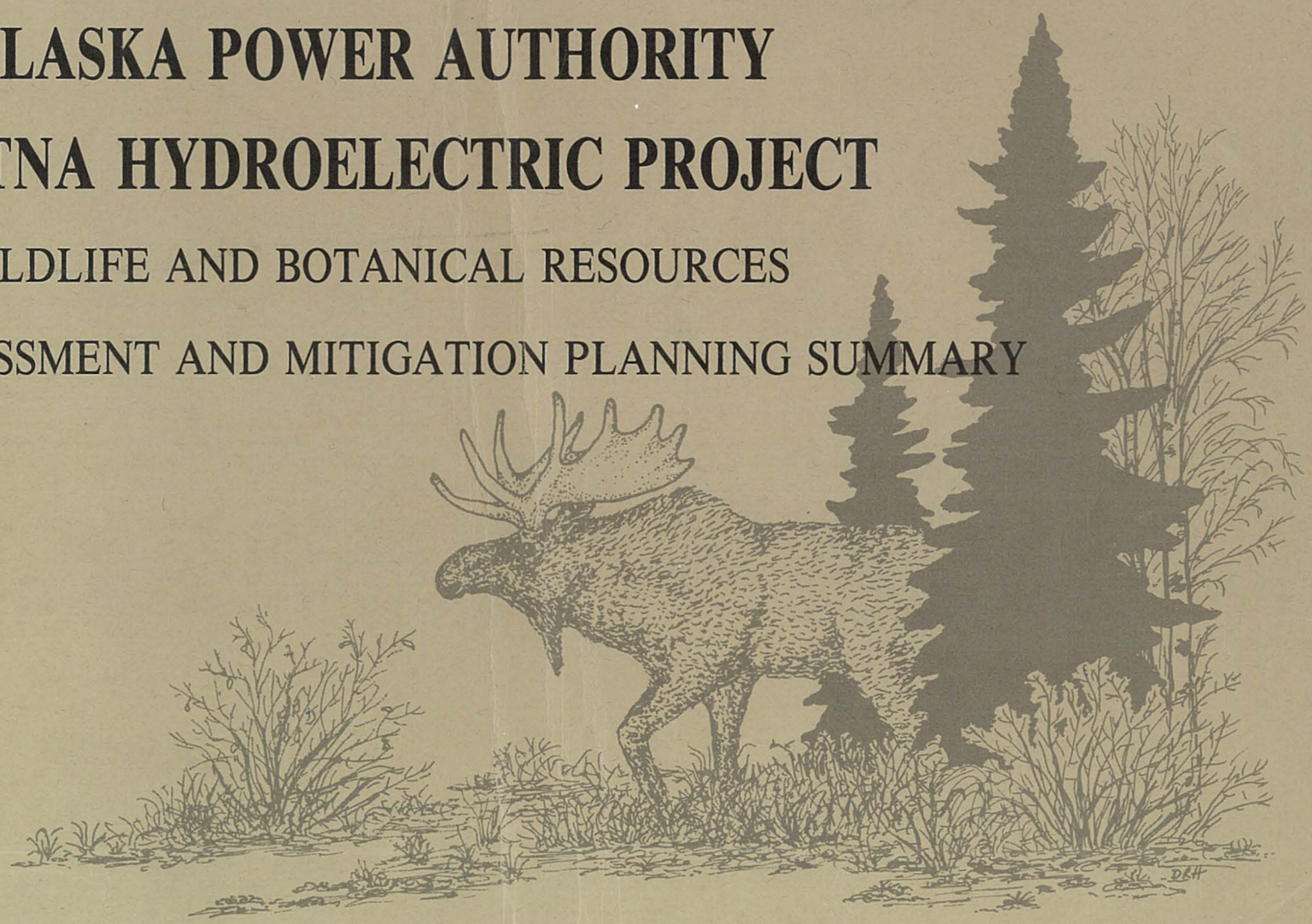
ALASKA POWER AUTHORITY

SUSITNA HYDROELECTRIC PROJECT

WILDLIFE AND BOTANICAL RESOURCES

IMPACT ASSESSMENT AND MITIGATION PLANNING SUMMARY



FOR:

HARZA-EBASCO SUSITNA JOINT VENTURE

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Impact Assessment and Mitigation Planning Summary

for

Wildlife and Botanical Resources

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P R E F A C E

This document provides an overview of potential impacts of the Susitna Hydroelectric Project on wildlife and botanical resources of the project area, and indicates the status of planning to mitigate those impacts. The intended purpose is to provide a working record of impact assessment and mitigation planning as summaries which are updated at periodic (30-60 day) intervals. During the course of many major energy development projects, the tracking of concerns from impact assessment through mitigation proposals and subsequent action can become a cumbersome process. The following summary is organized in matrix format to facilitate this process and to provide quick reference to impact and mitigation reasoning as it exists to date. This record is presented to encourage input by all interested parties and to inform decision makers on the current state of thought concerning relevant resource issues.

Much of the information contained in the matrix is summarized from Exhibit E of the February 1983 FERC license application. Additional impact scenarios and mitigation options were taken from agency comments on the November 1982 draft license application. Ideas are continually being developed through ongoing discussions with resource managers, from review and evaluation of published and unpublished literature, and from original proposals by the authors. As impact assessment and mitigation planning is refined, new information is added and cited by source and date. Thus each successive revision is intended to replace the preceding version.

The matrix is organized so that the evolution of impact assessment and mitigation planning can be followed horizontally across the page. The major column headings describe the steps in the planning process as follows:

I) Affected Species or Group: lists the species or groups of species of concern in the project area and surrounding region.

II) Impact Mechanism: describes the effects of various aspects of the project on wildlife and botanical resources.

III) Impact Assessment Status: provides an evaluation of the extent of the impact, including its viewed importance to wildlife and botanical resources, and the extent of quantification developed.

IV) Additional Information Required: contains a synopsis of baseline data that are forthcoming or may still be required to assess more fully the impact of concern or to refine mitigation strategies.

V) Proposed Mitigation Options (FERC License Application): includes only those mitigation options listed in the February 1983 FERC license application.

VI) Mitigation Plan Refinement: shows the most current state of mitigation planning if options other than those presented in the FERC license application are being considered.

(I) Affected Species or Group	(II) Impact Mechanism	(III) Impact Assessment Status	(IV) Additional Information Required	(V) Proposed Mitigation Options (F.E.R.C. License Application)	(VI) Mitigation Plan Refinement
A) Moose	1) Permanent habitat loss due to the impoundments and other permanent facilities	Preliminary estimate of 2400 moose displaced (p. E-3-397); numbers of affected moose will be refined, see following column.	Refinement of population and carrying capacity models to better estimate impacts on moose and determine acreage of habitat compensation needed.	-Acquisition of 20,400 acres of compensation land for habitat replacement or improvement (p. E-3-527 to 529). -Transmission corridors would provide almost 78,100 acres (30,000 ha) of winter habitat of reasonable quality (p. E-3-528; Table E.3.145).	
	2) Permanent habitat loss and habitat alteration due to the access corridor.	Small area of habitat loss, although regeneration of woody plants will eventually provide additional areas of high quality browse along the corridor (p. E-3-398).		Included in option A)1).	
	3) Alteration of moose distribution due to corridor traffic and disturbance.	Traffic and other neutral or predictable disturbances can be habituated to by moose over time (Table E.3.145), but may cause some initial displacement of a small number of animals; not expected to be significant.			
	4) Clearing of the impoundment area will reduce winter capacity prior to flooding.	Clearing will reduce winter carrying capacity of the impoundment zone 1-2 years prior to filling (p. E-3-398; Table E.3.145).		Habitat loss could be minimized by: a) scheduling clearing as close to reservoir filling as possible, b) leaving relatively large "islands" of riparian vegetation uncleared, and/or c) clearing only trees and tall shrubs, leaving the browse species preferred by moose (p. E-3-509).	
	5) Temporary loss of winter habitat on borrow sites.	Winter habitat for an estimated 38 moose will be affected. Revegetation is likely to restore these areas as moose habitat from 2-20 years following disturbance (Table E.3.145).		Use of side-borrow techniques and consolidation of borrow sites will minimize impacts on moose habitat (p. E-3-510).	
	6) Continued habitat loss due to erosion of impoundment shores.	Erosion will be most prevalent on steep slopes of little value to moose; not expected to be significant (Table E.3.145).			

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A) Moose	7) Habitat improvement will occur along the transmission line corridor due to maintenance of vegetation at early successional stages.	The transmission corridors would provide almost 78,100 acres (30,000 ha) of winter habitat of reasonable quality (p. E-3-528; Table E.3.145); representing a beneficial impact on moose.			
	8)Drifting snow from the impoundment surface may preclude use of a narrow band of winter browse along the impoundment shore.	Snow drifting is unlikely to extend far into wooded winter habitats. The drawdown zone and ice shelves will catch much windblown snow and further drifting will occur at the edge of open and wooded habitats (Table E.3.145).			
	9) Drifting snow in the transmission line corridor may preclude use of winter browse.	Impact not quantified but not expected to be significant (Table E.3.145).			
	10) Delayed melt-off of snow drifts in a narrow band along the impoundment shore and transmission corridor may reduce availability of spring forage.	Availability will be delayed in this zone but forage will eventually become usable as the spring thaw progresses. Actual area of early spring forage loss will be a narrow band along the impoundment shore and impacts are not expected to be significant (Table E.3.145).			
	11) Climatic changes due to the impoundments (increased summer rainfall, increased winds, and cooler summer temperatures) may reduce habitat carrying capacity; (p. E-3-406).	Available data from Williston Reservoir, B.C., indicate that these subtle climatic effects will likely be undetectable and of little impact on moose habitats (Table E.3.145).			
	12) Delayed plant phenology may occur immediately adjacent to the reservoir due to its cooling effect, reducing spring forage for moose; (p. E-3-400).	Impact not quantified and limited in extent to areas immediately adjacent to the impoundment. Effects on moose would be difficult to detect (Table E.3.145).			

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A) Moose	13) Decreased river flows downstream may lower water tables, affecting willow colonization.	Due to the moist environment of river floodplains and the wide tolerance of moisture conditions by willows, this impact is not expected to be significant (Table E.3.145).			
	14) Vegetation icing downstream may render some browse unavailable, and metabolic demands of moose may increase.	Impact not quantified (Table E.3.145). Icing will likely be heaviest within the steep canyon and may not preclude use of browse by moose. Impacts of increased metabolism for moose eating ice would be difficult to detect (p. E-3-408).			
	15) Alteration of downstream habitats will occur due to altered river flow regimes.	Impact not quantified. Reduced size of river islands and possible loss of some early successional habitats may lessen habitat values for moose (p. E-3-408). See impact category R)11).	Refinement of downstream vegetation models to better assess effects on moose habitat will continue.		
	16) Open water and/or ice shelving may block access to traditional calving and wintering areas.	Some moose are expected to not cross the impoundment due to ice blockage and visual barrier effects. Open water stretches below the dams may also block some movement (p. E-3-409). Moose will probably alter seasonal movements and crossings to maximize use of surrounding browse and forage supplies (p. E-3-410); not expected to be significant.			
	17) Ice shelving or floating debris may cause limited direct mortality to moose attempting to cross the impoundment.	Impact not quantified but not expected to be significant (Table E.3.145).			

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A) Moose	18) Prior to filling, clearcut areas in the impoundment may inhibit movements due to slash piles and human disturbance.	Noisy and unpredictable activities will probably cause avoidance of the area and extend the range of effective habitat loss during clearing beyond the mechanically disturbed area (Table E.3.145).		Included in option A)1).	
	19) Snow drifts may impede movements south and southwest of the reservoir and reduce the value of the Fog Lakes area as winter range.	Impact not quantified but not expected to be significant (Table E.3.145).			
	20) Construction activities along the transmission corridor may impede movements between summer and winter range, especially in the Watana-Deadman Creek areas.	Impact not quantified (p. E-3-410, Table E.3.145).	Additional information on the availability of critical winter range and calving habitats is being obtained.		
	21) Increase in mortality due to train and automobile collisions caused by increase in traffic levels.	Impact not quantified, likely to be most severe during construction phases (Table E.3.145).			
	22) Open water downstream may restrict movements to island calving sites (as far downstream as Gold Creek [Watana] and Talkeetna [Devil Canyon]).	Impact not quantified, effects on moose survival would be difficult to measure (p. E-3-410).			
	23) Attempted crossings of open river areas in winter may lead to mortality from thermal stress.	Moose are unlikely to cross open water in winter (most crossings were from May to November (p. E-3-409). Impact not expected to be significant.			
	24) Increased ice cover and aufeis downstream may result in some mortality from animals falling down.	Impact not quantified but not expected to be significant (Table E.3.145).			

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A) Moose	25) Drifted snow along railroad and road access corridors and roadway berms may impede movements of moose and/or subject them to higher risk of collision mortality.	Impact not quantified.			
	26) Impeded drainage caused by road berms may alter moose habitat due to flooding of forest or shrubland areas.	Impeded drainage in certain areas could also improve moose habitat, although some habitat loss would occur due to flooding.		Avoidance of this impact can be achieved through strict adherence to culvert placement and maintenance techniques during construction.	
	27) Displacement of moose during reservoir filling years could increase predation rates, driving moose populations to low levels which may be maintained there by continued predation.	Impact not quantified (Appendix E11J).		Avoidance may be achieved through a controlled hunt on moose during impoundment filling years.	
	28) Decrease in habitat quality may occur near the impoundments due to locally high densities of moose dispersing from impounded areas.	Impact not quantified (Appendix E11J).		See option A)27).	
	29) Increase in ground-based human activity (road traffic, village activities, dam construction) may preclude use of some areas by moose (particularly sensitive areas such as calving sites and winter habitat).	Impact not quantified; some habituation can be expected (Table E.3.145).			
	30) Increase in aircraft overflights may stress animals or preclude use of some areas.	Impact not quantified but not expected to be significant unless direct harassment occurs. Habituation is possible to neutral and predictable disturbance as near airports (Table E.3.145).		Instructional workshops for all project aircraft operators and possible ceiling regulations.	
	31) Increase in mortality due to hunting and poaching.	Impact not quantified. Hunting can be regulated (Table E.3.145) but increased poaching due to increased access may represent an unavoidable adverse impact.			

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A) Moose	32) Increase in risk of fires due to human activities.	Fires may destroy some moose habitat over the short term but regenerated burns may provide productive moose habitat several years later (Table E.3.145).			
	33) Increase in disturbance over the entire basin due to increases in human recreational activities.	Impact not quantified (Appendix E11J).			
B) Caribou	1) Permanent loss of 0.3% of total range, (low quality grazing habitat) due to the impoundments and transmission corridors.	Impact not expected to be significant (p. E-3-416; Table E.3.147).			
	2) Temporary alteration and permanent loss of 0.3% of summer range for bulls due to borrow sites.	Impact not expected to be significant (p. E-3-415; Table E.3.147).			
	3) Effects of the impoundment as a barrier to movements include: a) altered movement patterns reduce the frequency of crossing of the Watana impoundment area with consequent decreases in use of portions of the range, reducing carrying capacity, b) isolation of subherds having separate calving grounds, c) increase in accident mortality associated with ice shelving, drifting ice flows, floating debris, and extensive mud flats.	Impact difficult to quantify or predict but may be serious (pp. E-3-416 to 417, Table E.3.147), or may result in little adverse impact.	Monitoring of caribou movements should occur to document adverse effects.	Purchase of compensation lands in areas used by the Nelchina caribou herd if adverse effects are demonstrated (p. E-3-511).	
	4) Drifted snow south and southwest of the reservoir may block movements to portions of the range.	Impact not quantified but not expected to be significant (Table E.3.147).			
	5) Increased mortality (accidents, easier access for wolves) and alteration of movements due to the access corridor.	Impact not quantified (Table E.3.147).	Monitoring of caribou movements should occur to document adverse effects.	Minimization of effects could be achieved through realignment to avoid the center of the calving ground and through design changes to minimize physical and visual barrier effects. Compensation may be required if adverse effects are demonstrated (p. E-3-511).	

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B) Caribou	6) Avoidance of construction sites, particularly by cows and calves due to human disturbance.	Impact not quantified but not expected to result in any population effects (p. E-3-415).			
	7) Increased energy demands (particularly to pregnant cows or cows with calves) due to disturbance by construction traffic on the access road between the Denali Highway and Watana.	Impact not quantified (Table E.3.147).			
	8) Intentional harassment by aircraft could lead to some direct mortality, particularly for young animals.	Project not expected to significantly increase harassment, particularly if regulation of project aircraft occurs (p. E.3.415).		Intructional workshops for all project aircraft operators and possible ceiling regulations.	
	9) Regular overflights by aircraft may adversely impact caribou through increased energy costs. High levels of disturbance may affect productivity (groups with females and calves most sensitive).	Impact not quantified (Table E.3.147).		Included in B)8) option.	
	10) Increased levels of hunting and poaching mortality due to increased access to caribou use areas.	Effects may be lessened by hunting regulations, although increase in poaching may represent an unvoidable adverse impact (Table E.3.147).			
	11) Increase in collision mortality due to construction traffic and increased recreational traffic.	Impact not quantified but not expected to be significant (Table e.3.147).			
	12) Changes in range use, disruption of migration patterns and abandonment of traditional calving areas due to an increase in recreational activities.	Impact not quantified (Table E.3.147).			
	13) Decrease in range values due to increased risk of fire.	Difficult to quantify; caribou are less likely than moose to benefit from occurrence of fire (Table E.3.147).			

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C) Dall Sheep	1) Partial inundation of the Jay Creek mineral lick. Inundation will cover over 22% of the lick surface area during the months of maximum use. At maximum impoundment level in October, 42% of lick surface will be flooded.	Unlikely that sheep will discontinue use of the lick due to partial inundation (pp. E-3-419 to 420).			
	2) Increase in accident mortality due to ice shelves on lower sections of the Jay Creek mineral lick in early spring.	Impact not quantified (Table E.3.148).			
	3) Areas of the lick below maximum fill level may suffer some leaching, making this area less valuable as a lick site.	Erosion here may also increase availability of minerals, however, some leaching will also occur (pp. E-3-419 to 420).	Continued observations and testing before and after impoundment flooding to determine levels of sheep use and available minerals.	Replacement of minerals lost due to leaching and/or erosion.	
	4) Increased metabolic energy requirements and abandonment of some areas due to uncontrolled aircraft overflights and harassment.	Serious effects on sheep may occur if uncontrolled overflights and harassment take place (pp. E-3-418 to 419, Table E.3.148).		Instructional workshops for all project aircraft operators and possible ceiling regulations.	
	5) Disturbance of sheep utilizing low elevation winter and spring habitats due to impoundment clearing activities.	Impact not quantified. Disturbance will occur only over the short-term period of impoundment clearing and will probably not produce a serious population effect (Table E.3.148).		Avoidance of areas used by sheep on the part of clearing crews in spring may lessen the impact.	
	6) Disturbance from recreational boat and plane traffic near the Jay Creek mineral lick may affect its use by sheep.	Impact not quantified, however, abandonment of the lick may result in distributional shifts and alteration of local population levels of sheep (p. E-3-418; Table E.3.148).	Monitoring of sheep use of the lick and reactions to human disturbance before and after impoundment filling.	Restriction of recreation along the reservoir shoreline near the mineral lick, if needed.	
D) Brown Bear	1) Permanent loss of some spring feeding habitat due to impoundments.	Of radio-collared bears present in the project area, 25% in 1980 and 54% in 1981 moved into the future impoundment zone in spring (p. E-3-420 to 422, Table E.3.149).		Habitat enhancement and/or protection for moose will also benefit bears, see Section A)1).	
	2) Effects on ungulate prey populations may have subsequent effects on brown bears.	Impact not quantified (p. E-3-425 to 426).		Mitigation measures for ungulates would benefit bears as well (p. E-3-513).	

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D) Brown Bear	3) Access corridors, villages, and airstrips may affect den site use.	Extent of impact not determinable from current den and access road maps (Table E.3.149).			
	4) Impoundment clearing may affect habitat quality for brown bears in spring.	Impact not quantified (Table E.3.149).		Included in A)4) option.	
	5) Loss or alteration of habitat due to borrow sites.	Impact not quantified, although habitat values may increase on reclaimed areas during early stages of plant succession (p. E-421 to 422).		Included in A)5) option.	
	6) Potential impact on denning areas due to impoundment shore erosion.	Impacts may occur on potential or unknown den sites but has not been quantified; not expected to be significant (Table E.3.149).			
	7) Broken ice and ice shelving may block or hinder access to habitually used areas in early spring.	Impact not quantified but not expected to be significant (Table E.3.149).			
	8) Avoidance of traditional use areas caused by increase in human activity at construction sites and from recreational use of the area.	Impact not quantified (p. E-3-424, Table E.3.149).			
	9) Increase in mortality of bears due to attraction to human refuse and revegetated areas near construction sites, and the resultant increase in the incidence of human/bear encounters, resulting in destruction of the "offending bear".	Impact not quantified and difficult to predict (p. E3-423 to 424, Table E.3.149).		Instructional workshops and regulations on the feeding of bears and disposal of refuse for all project personnel.	
	10) Greater susceptibility of habituated bears to hunting and poaching mortality.	Impact not quantified; hunting can be regulated but poaching losses may represent an unavoidable adverse impact (Table E.3.149).		Possible restrictions on hunting by project personnel.	
	11) Disturbance of bears in winter dens may lead to increase in mortality of affected bears.	Impact not quantified but mostly restricted to the construction period (Table E.3.149).	Determination of the location of den sites during construction phases may facilitate avoidance of these areas.	Information on den use and instructions for protection of denning bears can be included in instructional workshops.	

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E) Black Bear	1) Permanent loss of high quality spruce forest habitats due to impoundments.	Will exclude black bears upstream from Watana Creek and significantly lower populations in the project area (p. E-3-427, Table E.3.150).		Habitat enhancement and/or replacement measures designed for ungulates may also benefit black bears; see Section A)1).	
	2) Permanent loss of some den sites due to impoundments.	Of radio-collared bears in the project area, 69% had den sites in future impoundment zones (Table E.3.150).		Habitat mitigation measures for ungulates may also attract black bears, which will then establish dens in these new areas.	
	3) Loss of spruce forest habitats due to impoundment clearing.	Impact quantified in section E)1), which will be realized prior to impoundment filling due to clearing activities (p. E-3-428, Table E.3.150).		See option E)1).	
	4) Temporary loss of spruce forest habitats in borrow sites.	Impact represents a temporary loss of habitat for black bears. Revegetation will provide spring forage during early successional stages, and regrowth of forest will provide continued habitat for bears (p. E-3-427, Table E.3.150).			
	5) Possible impact on den sites due to impoundment shore erosion.	Impact not quantified; potential or unknown den sites may be affected but impacts are not expected to be significant (Table E.3.150).			
	6) Habitat alteration along the transmission corridor.	Positive and negative impacts on black bears. Loss of spruce forest habitats along the corridor will constitute some habitat loss, although spring forage within the corridors will provide added food (Table E.3.150).		Alignment of the corridor through tundra vegetation types and design changes which would leave as much spruce forest as possible (p. E-3-513).	
	7) Reduction in availability of low shrub habitats in spring due to delayed melting of snow drifts south and southwest of the impoundment.	Impact not quantified but not expected to be significant (Table E.3.150).			

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E) Black Bear	8) Reductions in prey populations (if they occur, e.g., salmon) would negatively impact black bears.	Project impacts on food resources of black bears are as yet uncertain, and bears may not be adversely affected (p. E-3-429, Table E.3.150).	Continued investigations of bear food habits will better determine the value of salmon as food for black bears.		
	9) Increased availability of early spring forage downstream from impoundments due to alteration of vegetation phenology.	Positive impact on black bears (p. E-3-429).			
	10) Decreased availability of early successional vegetation types due to river hydrologic changes.	Impact not quantified but not expected to be significant (p. E-3-429, Table E.3.150).	Continued refinement of downstream hydrology modeling may better enable prediction of effects on black bears.		
	11) Broken ice and/or shelving may block or hinder access to habitually used areas for some individuals in early spring.	Impact not quantified but not expected to be significant (Table E.3.150).			
	12) Increase in intra-specific competition and direct mortality from brown bears during dispersal from impoundment zones.	Impact not quantified (Table E.3.150).			
	13) Some indirect habitat loss due to avoidance of construction sites, impoundment clearing activities, and recreational use of the area.	Impact not quantified, although some habituation to human activities will occur (Table E.3.150).			
	14) Increase in mortality of bears due to attraction to human refuse, revegetated areas near construction sites, and increase in human/bear encounters, resulting in destruction of the "offending bear".	Destruction of some black bears likely during construction phases (Table E.3.150).		Instructional workshops on the feeding of bears and disposal of refuse should be presented to all project personnel.	
	15) Greater susceptibility of habituated bears to hunting and poaching mortality.	Hunting mortality can be regulated, although increased poaching losses may represent an unavoidable adverse impact (Table E.3.150).			

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F) Wolf	1) Permanent loss of a portion of one pack's territory.	Impact represents an absolute habitat loss for wolves but is unlikely to affect local wolf populations. Wolf numbers are currently highly regulated by trapping and removal for game management purposes (Table E.3.151).			
	2) Inundation of part of one pack's range will cause upheaval of the historical distribution of packs due to associated social strife.	Impact will occur over the short-term when ungulate prey populations are also undergoing shifts; effects are not expected to be significant (Table E.3.151).			
	3) Reduction of carrying capacity of wolves due to reduction of moose (and other prey) carrying capacities.	Impact not quantified (Table E.3.151).		Mitigation measures designed to increase or protect moose populations in nearby areas will also benefit wolves (p. E-3-514).	
	4) Increase in wolf numbers near the impoundment zones due to displacement of moose caused by impoundment clearing activities.	Short-term beneficial impact (Table E.3.151).			
	5) Presence of the impoundment and dam facilities may hinder movement of some packs to caribou and moose calving areas.	Habituation of wolves to human activities will likely occur; impact not expected to be significant.			
	6) Wolves may use the access road to their benefit when hunting ungulate prey.	Beneficial impact not quantified; not expected to be significant (Table E.3.151).			
	7) Open water downstream from the dams may hinder movements of wolves.	Impact not quantified; not expected to be significant (Table E.3.151).			
	8) Wolves are likely to avoid areas of intense human activity (e.g., construction areas), at least initially.	Some habituation will likely occur; impact not expected to be significant (Table E.3.151).			

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F) Wolf	9) Disturbance of wolves by human activities or aircraft at den sites could lead to pup mortality if the dens are abandoned during the first week of a pup's life.	Impact not quantified (Table E.3.151).	Identification of wolf den sites near human access areas.	Information on the location of known den sites could be included in project planning preparations.	
	10) Wolves may habituate to human use areas and have the potential to become nuisance animals, increasing the likelihood of destruction of the "offending wolf".	Destruction of some nuisance wolves will likely occur if mitigation measures are not enforced (Table E.3.151).		Instructional workshops on feeding of wolves and disposal of refuse should be presented to all project personnel.	
	11) Increased mortality of wolves due to hunting, poaching, and trapping.	Hunting of wolves can be regulated, although increased poaching losses may represent an unavoidable adverse impact (Table E.3.151).			
G) Coyote	1) Increase in coyote population may occur near developed areas.	Impact represents a beneficial effect on coyotes (p. E-3-439).			
H) Wolverine	1) Permanent loss of winter foraging habitat due to impoundments.	Winter habitat for several wolverines will be lost; changes in movements, densities and productivity will affect surrounding populations (p. E-3-432 to 433, Table E.3.152).		Minimization of project impacts through consolidation of facilities, spoil disposal in the impoundment zone, and side-borrow techniques is possible.	
	2) Secondary loss of small mammal and grouse prey bases. Changes in prey density will affect movements, population densities, and productivity.	Difficult to predict whether increases in ungulate carrion availability will offset losses of smaller prey (p. E-3-433, Table E.3.152).		Some compensation may occur through an anticipated increase in availability of carrion due to hazards created by the impoundment, access roads, and other facilities.	
	3) Increase in availability of prey in areas adjacent to impoundment clearing zones.	Impact represents a short-term beneficial effect.			
	4) Disturbance and habitat loss due to impoundment clearing will displace wolverines, particularly in winter.	Impact will be similar to H)1), although will occur 1-2 years prior to impoundment filling (Table E.3.152).			

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H) Wolverine	5) Increase in carrying capacity of the transmission corridor for moose and ptarmigan may beneficially impact wolverines.	Impact represents a beneficial effect on wolverines (Table E.3.152).			
	6) Alteration of use patterns due to presence of the impoundments and changes in home range boundaries.	Conflicting data on home range boundaries of wolverines and terrain features make this impact difficult to predict; not expected to be significant (p. E-3-432).			
	7) Avoidance of all areas of human activity, at least initially, causing some changes in use patterns or preclusion of use in some areas.	Impact not quantified; not expected to be significant unless high levels of recreational disturbances occur (Table E.3.152).			
	8) Increase in mortality due to hunting, trapping, and poaching.	Impact not quantified but likely the most important impact on wolverines. Hunting and trapping can be regulated although poaching may represent an unavoidable adverse impact (Table E.3.152).			
I) Belukha	1) Water temperature changes at the mouth of the Susitna River due to the project may affect calving.	Water temperatures will not change significantly at the river's mouth; impact not expected to occur (p. E-3-422).			
	2) Food supplies of belukhas may be decreased due to alterations or blockage in the availability of spawning streams for salmon.	Salmon decreases would at most be 5-8% of Susitna river stocks; impact not expected to be significant (p. E-3-434).			
J) Beaver and Muskrat	1) Permanent loss of habitat for 5-10 muskrats due to impoundments and other permanent facilities.	Impact not considered significant to area populations due to the small numbers affected (Table E.3.153).		Some compensation will occur through improved habitat downstream from the dams (p. E-3-514).	
	2) Loss of some habitat for both species due to siltation of ponds, alteration of drainage patterns, and disturbance near access roads and borrow pits (primarily in the Deadman Creek area).	Impact not considered significant to area populations due to the small numbers affected (pp. E-3-434 to 436).		Partial avoidance is possible through realignment of the access route and design changes to reduce disturbance to beaver habitats (p. E-3-514).	

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J) Beaver and Muskrat	3) Increased winter flows, stabilized flows, and lack of ice cover will benefit beaver and muskrat downstream.	Impact represents a beneficial effect on beavers and will probably compensate for losses due to the impoundments and other facilities (p.E-3-434 to 436, Table E.3.153).			
	4) Increase in mortality due to hunting, trapping, and poaching.	Hunting and trapping can be regulated, although poaching losses may represent an unavoidable adverse impact (Table E.3.153).			
K) Mink and Otter	1) Permanent habitat loss due to impoundments.	Elimination of a substantial portion of good quality habitat for both species (85 km of mainstem plus 15.6 km of stream habitat) will occur (Table E.3.155).		Partial compensation through use of impoundment shore habitats (pp. E-3-437 to 438, Table E.3.155) and improved habitat downstream (p. E-3-514).	
	2) Habitat loss due to impoundment clearing activities and resultant decrease in cover and prey availability.	Short-term impact affecting the same populations affected by impoundment filling, impact will occur 1-2 years prior to filling (Table E.3.155).			
	3) Habitat loss due to the access corridor.	Proposed road route will remove 12.3 miles (18.4 km) of stream shore habitats along Deadman Creek (p. E-3-438).		Partial avoidance is possible through realignment of the road and design changes to reduce the area disturbed. Additional loss may be avoided by obtaining road material from outside Deadman Creek (p. E-3-514).	
	4) Increase in small mammal prey in reclaimed areas.	This impact represents a beneficial impact to mink, although benefits will likely be insignificant (Table E.3.155).			
	5) Increase in beaver population, stabilization, and open water downstream will benefit mink and otter.	Impact represents a beneficial effect on mink and otter (Table E.3.155).			
	6) Abandonment of habitat near construction zones and recreation areas due to human disturbance.	Effects would be most noticeable on the remaining habitat areas along the upper reaches of tributary creeks near the impoundment (p. E-3-438, Table E.3.155).			

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K) Mink and Otter	7) Increase in mortality due to hunting, trapping, and poaching.	Hunting and trapping can be regulated, although poaching losses may represent an unavoidable adverse impact (Table E.3.155).			
L) Red Fox	1) Habitat alterations due to impoundment clearing and reclaimed lands will increase prey availability.	Impact represents a beneficial effect on foxes (Table E.3.156).			
	2) Open water downstream may hinder movements in winter.	Impact not quantified but not expected to be significant (Table E.3.156).			
	3) Habituation of foxes to human presence may lead to increase in mortality due to destruction of problem animals.	May represent an important impact on local fox populations (Table E.3.156).		Instructional workshops on feeding foxes and refuse disposal should be presented to all project personnel.	
	4) Abandonment of some den sites may occur due to human disturbance.	Some negative effects may occur but habituation to human activities is very likely; impact not expected to be significant (p. E-3-434; Table E.3.156).			
	5) Increase in mortality due to hunting, trapping, and poaching.	Hunting and trapping can be regulated, although poaching losses may represent an unavoidable adverse impact (Table E.3.156).			
M) Marten, Weasel, and Lynx	1) Permanent habitat loss for all species due to impoundments.	Impact will result in loss of habitat for probably all lynx (a few animals), approximately 100 marten, and an unknown number of weasels within the project area (p. E-3-440 to 442).		Protection of forest habitats for ungulates will also benefit these furbearers.	
	2) Permanent loss of some habitat for marten and weasel due to the access corridor.	Impact will likely result in redistribution of home ranges of affected furbearers; not expected to be significant (Table E.3.157).			
	3) Loss of habitat in impoundment areas due to clearing operations.	Short-term impact that will precede habitat loss due to impoundment filling (Table E.3.157).		Included in M)1) option.	

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M) Marten, Weasel, and Lynx	4) Loss of habitat due to reclaimed lands.	Removal of 11,118 acres of spruce forest habitats, revegetation will probably not return habitat to spruce communities during the license period (Table E.3.157).			
	5) Impoundments will block movements of marten and impede dispersal of weasel and lynx.	Redistribution of home ranges to conform to impoundment shores will occur; impact not expected to be significant (Table E.3.157).			
	6) Increase in the incidence of road kills due to presence of the access corridor.	Impact not quantified but not expected to be significant (Table E.3.157).			
	7) Open water downstream will block movements of marten.	Impact not quantified but not expected to be significant (Appendix E11J).			
	8) Avoidance of some areas near intense human activities (e.g., construction zones) due to disturbance, especially for lynx.	Marten and weasel are unlikely to be affected, lynx are uncommon and will be able to avoid developed areas; not expected to be a significant impact (Table E.3.157).			
	9) Increase in mortality due to hunting, trapping, and poaching.	Hunting and trapping can be regulated although poaching losses may represent an unavoidable adverse impact (Table E.3.157).			
N) Raptors and Ravens	1) Permanent loss of some nest sites and feeding habitat for bald and golden eagles, goshawks, ravens, and smaller raptors due to impoundments.	Some nesting locations of all raptors on cliffs and large trees will be lost. Quantification includes 7 of 16 known golden eagle nesting locations, 4 of 8 bald eagle, 2 of 3 goshawk, and a considerable number of raven nesting locations will be lost. Some hunting habitat will also be lost although this is not expected to be a significant impact on any of the raptor species (pp. E-3-443 to 451, Table E.3.159).		Compensation could be provided through cliff site enhancement, repositioning of some nests, and creation of artificial nesting locations in surrounding areas; construction of cavities and nest platforms for tree-nesters could occur (p. E-3-515; Appendix 3I).	

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N) Raptors and Ravens	2) Loss of one nesting location of bald eagle on Deadman Creek and some ground nesting locations due to the access corridor.	The forest stand containing this nest is the best (and possibly only) bald eagle nesting habitat on Deadman Creek (Table E.3.159).		Repositioning of the access road could prevent this impact from occurring.	
	3) Loss of nest sites due to impoundment clearing.	Three of the bald eagle and all of the goshawk nests are tree nests within the impoundment zone which would be lost early due to impoundment clearing (Table E.3.159).		Temporary avoidance could occur by not cutting nest trees (and adjacent perch sites for bald eagles; p. E-3-515).	
	4) Loss of a golden eagle nesting location and a possible gyrfalcon nesting location due to borrow pits and reclaimed lands.	The nesting location is within Borrow Site E (Table E.3.159).		Avoidance could occur through use of side-borrow techniques and/or design changes to avoid use of Borrow Site E.	
	5) Potential abandonment of gyrfalcon nesting locations due to disturbance along the transmission corridor.	Traffic close to the nesting locations (within 0.6 km) may cause abandonment of the sites (Table E.3.159).			
	6) Increase in electrocution of large raptors on transmission poles.	Impact difficult to quantify but may be significant (Table E.3.159).			
	7) Potential abandonment of several raptor and raven nests or nesting locations (including a peregrine falcon nest) due to human activities along the transmission corridor.	Impact not completely quantified but will effect at least 1 peregrine falcon and 2 gyrfalcon nesting locations if construction activities occur during nest site attendance periods (pp. E-3-452 to 454, Table E.3.159).			
	8) Detrimental impacts on salmon and other fish prey in downstream areas could affect bald eagle habitat quality.	Proposed mitigation of impacts to salmon should also lessen impacts on bald eagles; not expected to be significant (Appendix E11J).			
	9) Increase in disturbance due to aircraft traffic and recreationists.	Impact not quantified but may cause abandonment of nests or nest failure (Table E.3.159).		Instructional workshops for all project aircraft operators and possible aircraft height restrictions and/or avoidance of sensitive areas.	

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N) Raptors and Ravens	10) Loss of nest sites and habitat alteration due to secondary impacts of erosion, blowdowns, etc., on forest vegetation.	Impacts not quantified but not expected to be significant (Appendix E11J).			
O) Waterbirds	1) Permanent loss of river and stream habitats for waterfowl, shorebirds, and dippers due to impoundments.	Numbers of birds affected have not been estimated but unlikely to have a major effect on regional populations. Effects will be greatest on riverine species, particularly: harlequin duck, common and red-breasted mergansers, spotted sandpiper, semipalmated plover, and American dipper (pp. E-3-454 to 455).			
	2) Alteration of shoreline nesting habitats due to impoundment clearing and facility site clearing.	Temporary impact; in most areas preceding impoundment filling by 1 to 2 years (p. E-3-455).			
	3) Avoidance by waterbirds of areas of intense human activity (e.g., construction zones, impoundment clearing activities).	Impact not quantified but not expected to be significant (p. E-3-455).			
	4) Transmission corridor may cross waterfowl nesting areas or movement corridors, resulting in displacement of breeding birds (particularly trumpeter swans) or mortality due to transmission line collisions (particularly sandhill cranes).	Impact not quantified.	Surveys of all affected areas for trumpeter swans and nests, including the transmission corridor.		
	5) Increased mortality of gamebirds due to hunting and poaching.	Hunting can be regulated but poaching losses may represent an unavoidable adverse impact.			
P) Other Birds	1) Permanent habitat loss due to the impoundments and other permanent project facilities.	Loss of 10,136 ha of habitats used by birds, resulting in loss and displacement of breeding, migrating, and resident birds (pp. E-3-456 to 459; Table E.3.165).			
	2) Loss of habitats for birds due to the access corridor.	A rough estimate of 2000 breeding birds will be lost or displaced.	Habitats containing the highest densities and/or diversity of birds should be identified.	Minimization of some losses could occur through alignment of corridor around important habitats (p. E-3-516).	

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P) Other Birds	3) Loss of forested habitats for birds due to borrow sites and transmission corridors.	Loss included in above figure (Table E.3.165).		Habitats will be replaced (in part) by early successional habitats of use to other bird species. Minimization could occur through alignment of the corridor around important habitats (p. E-3-516).	
	4) Avoidance of areas of intense human activity (e.g., construction zones, impoundment clearing activities due to disturbance).	Impact not quantified (p. E-3-460).			
	5) Increase in breeding habitat for some species due to vegetation encroachment on downstream river floodplains.	Impact represents a beneficial effect on birds (p. E-3-459).			
	6) Increase in mortality due to collisions with transmission lines and towers.	Impact not quantified.			
	7) Loss of nest sites and habitat alteration due to secondary effects of erosion, blowdowns, etc., on forest vegetation.	Impact not quantified but not expected to be significant (Appendix E11J).			
Q) Small Mammals	1) Permanent habitat loss due to impoundments and other permanent project facilities.	Habitats lost are identical to those of birds, see Section P)1). Normally rapid population turnover rates and reshuffling of territories by small mammals will minimize immediate impacts; however, long-term loss of habitat will reduce overall regional populations (p. E-3-461).		Habitat protection and/or enhancement measure designed for ungulates will also benefit small mammals.	
	2) Increase in numbers of certain species in revegetated areas of reclaimed borrow sites.	Impact represents a beneficial effect on most small mammal species (p. E-3-462).			
	3) Displacement of small mammals which have recolonized disturbed areas in the impoundment clearing zone, during impoundment filling.	Temporary adverse impact which resulted from a previously beneficial effect on small mammal populations (Appendix E11J).			

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R) Botanical Resources	1) Permanent loss of a variety of vegetation types due to impoundments, access roads, transmission line facilities, and other permanent facilities.	Loss of approximately 45,581 acres of primarily forest and shrub vegetation types (pp. E-3-225, 240, 243, 244 and 253).		Mitigation plan provides for minimization, rectification, reduction, and compensation of impacts in a variety of ways, see pp. E-3-252 to E-3-285.	
	2) Temporary loss and alteration of vegetation types due to forest clearing operations in the impoundment zone.	Impacts similar to R)1) will occur 1 to 2 years earlier; effects will be most prevalent on forest vegetation types (p. E-3-225).			
	3) Loss and alteration of vegetation types due to erosion along impoundment shores and permanent facilities.	Approximately 1,379 acres of vegetation near the Watana Dam site and a small acreage near Devil Canyon will be subject to loss and alteration through: a) destabilization of till, b) blowdowns; c) thawing of permafrost, d) desiccation of exposed soils; and e) changes in drainage patterns (pp. E-3-226 and 240).			
	4) Damage to remaining vegetation due to wind and dust.	Blowdowns of trees may occur near cleared areas and along impoundment shores, mainly affecting black spruce stands. Windblown dust may affect vegetation through alteration of snowmelt regimes and changes in the chemical composition of soils (p. E-3-226).			
	5) Damage and alteration of vegetation along the access roads due to dust deposition, erosion, leaching of nutrients in drained areas, and waterlogging in areas of blocked drainage.	Impacts will accrue within a few hundred meters of a road and within zones of blocked or altered drainage, which may extend to several kilometers from a road (p. E-3-227).		Placement and maintenance of culverts as needed will reduce effects on drainage patterns. In addition, alteration of access routes and silting modifications will reduce impacts.	
	6) Alteration of soil surface albedo in cleared areas may affect vegetation.	Impact not quantified; changes in albedo will result in changes in surface hydrology, affecting the type of vegetation that will become established but should not prevent revegetation (p. E-3-227).			

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R) Botanical Resources	7) Increased incidence of disease or insect infestations due to clearing activities.	Impact not quantified (p. E-3-227).		Burning of slash piles will minimize effects of insects and disease.	
	8) Increased risk of fire due to increased human populations.	Impact not quantified (p. E-3-227).		Restrictions of certain construction activities during high risk periods may reduce incidence of fires during construction phases.	
	9) Alteration of vegetation along hillsides adjacent to impoundments due to impoundment waters heating surrounding soils and melting permafrost, causing slides and soil slumpages.	Impacts may occur along over 50 miles of impoundment shores (pp. E-3-285 to 286).			
	10) Alteration of vegetation due to flooding along impoundment shores and delta formation where creeks enter the impoundments.	Impact not quantified but not expected to be a significant loss; some alteration of vegetation types will occur (p. E-3-230).			
	11) Alteration of vegetation successional patterns in downstream floodplains due to flow regulation and resultant changes in stream morphology and ice scouring effects.	Impact not quantified and difficult to predict.	Continued modeling of downstream floodplain changes and other additional information will refine understanding of effects on vegetation.		
	12) Alteration of vegetation communities due to climatic changes near the reservoirs.	Effects would extend 2 mi (3 km) from the reservoirs and would be most noticeable along the south shore of the reservoirs. Extent of effects on vegetation itself has not been quantified (pp. E-3-236 to 237).			
	13) Damage to understory vegetation due to hoar frost and heavy icing caused by persistent fog banks near the reservoirs.	Impact not quantified but will be limited to the immediate area around the spillways; not expected to be significant (pp. E-3-236 to 237).			
	14) Increase in damage and alteration of vegetation communities due to increase in use of off-road vehicles near all project facilities.	Impact not quantified (pp. E-3-237 to 238).		Placement of gates along access roads to the transmission corridor and other facilities will lessen traffic to some degree.	

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R) Botanical Resources	15) Removal of overstory vegetation in forested portions of the transmission line corridor.	Will result in removal of approximately 8,295 acres (5,650 from Healy to Fairbanks and 2,645 from Willow to Cook Inlet) of habitats containing trees, changing these areas to shrub or tundra vegetation types (p. E-3-244, Table E.3.86).		Restriction of tree removal to areas beneath the transmission lines, for access to the corridor, and removal of "danger" trees which could fall on lines or guy wires.	
	16) Blockage of sediment travel by the impoundments may increase erosion downstream, affecting vegetation islands in the floodplain.	Impact not quantified.	Refinement of downstream modeling will better enable prediction of erosion effects.		
	17) Potential removal or alteration of habitats for endangered plant species along the transmission line corridor.	Impact not quantified.	Identification of sites containing endangered plant species.		
S) All Species	1) Changes in local climate (air temperatures, precipitation, etc.) may have subtle direct effects on distribution or habitat use by wildlife and more profound effects on vegetation, which in turn may affect wildlife use of the area.	Impact not quantified but unlikely to extend more than 2 mi (3 km) from the reservoirs (pp. E-3-236 to 237).			
	2) Minor or insignificant impacts may prove to be major impacts when considering the cumulative effects of all project facilities and the impact of nearby developments on wildlife and their habitats.	Cumulative impacts not quantified.			