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WHEN RECORDED RETURN TO:

Bradley S. Thomas
11100 NE Hwy 99
Vancouver, WA 98686

DOCUMENT TITLE(S)
Wildlife & Habitat Assessment & Mgmt. Plan

REFERENCE NUMBER(S) *of Documents assigned or released:*

[ ] Additional numbers on page _____ of document.

GRANTOR(S):
Marble Creek, LLC

[ ] Additional names on page _____ of document.

GRANTEE(S):
David A. Creagan

[ ] Additional names on page _____ of document.

LEGAL DESCRIPTION *(Abbreviated: i.e. Lot, Block, Plat or Section, Township, Range, Quarter):*
See Attached Sec. 26, T 7N, R 5E

[ ] Complete legal on page _____ of document.

TAX PARCEL NUMBER(S):
07-05-26-0-0-0700-00

[ ] Additional parcel numbers on page _____ of document.

The Auditor/Recorder will rely on the information provided on this form. The staff will not read the document to verify the accuracy or completeness of the indexing information.

Exhibit "A"

PARCEL II

A tract of land in a portion of Government Lot 1 located in the Northwest quarter of Section 26, Township 7 North, Range 5 East, of the Willamette Meridian, in the County of Skamania, State of Washington, and the Southeast quarter of the Southwest quarter of Section 23, Township 7 North, Range 5 East, of the Willamette Meridian, in the County of Skamania, State of Washington, described as follows:

Beginning at the Northeast corner of the Northwest quarter of said Section 26; thence South 00°21'04" West, along the east line of said Northwest quarter of Section 26, for a distance of 1194.80 feet to the meander line as shown in the "Gustin" survey recorded under Auditor's File No. 2004152177, records of Skamania County, Washington; thence along said meander line North 71°08'28" West, for a distance of 574.78 feet; thence leaving said meander line North 31°17'42" East, for a distance of 628.55 feet; thence North 47°30'08" West, for a distance of 151.98 feet; thence North 35°52'30" West, for a distance of 202.15 feet; thence North 30°40'48" West, for a distance of 197.34 feet; thence North 16°30'41" West, for a distance of 55.58 feet; Thence North 01°35'49" West, for a distance of 1.67 feet to a point on the North line of said Northwest quarter of Section 26; thence North 88°04'15" West, along said North line of the Northwest quarter of Section 26 for a distance of 723.33 feet to the Southwest corner of the Southeast quarter of the Southwest quarter of said Section 23; Thence North 01°31'49" East, along the west line of said Southeast quarter of the Southwest quarter of said Section 23 for a distance of 635.92 feet; thence South 88°11'11" East, for a distance of 1296.88 feet to a point on the East line of said Southwest quarter of Section 23; thence South 01°39'24" West, along the east line of said Southwest quarter of Section 23, for a distance of 656.53 feet to the POINT OF BEGINNING.

Basis of bearings: The East line of the Southwest quarter of said Section 23, Township 7 North, Range 5 East, Skamania County Washington as shown on "DIAMOND CREEK COVE SHOT PLAT" recorded under Book 3 of Short Plats, at Page 432, records of Skamania County, Washington.

DC 700
~~600~~

Wildlife and Habitat Assessment and Management Plan

For

DAC Short Plat
Forest Road 90
Skamania County, WA

Prepared for:

Dave Creagan
1805 Howard Way
Woodland, Washington 98674

August 30, 2006

Environmental Technology Consultants
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Vancouver, WA 98662
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E-mail: etc@etcenvironmental.net

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PROJECT AND SITE DATA SUMMARY

Site: Marble Creek

ETC Project: EVA06019

Project Staff: Richard Bublitz, Wildlife Biologist; John McConnaughey, Fisheries Biologist

Applicant / Owner: Dave Creagan
1805 Howard Way
Woodland, WA 98674

Site Location: The subject site is located off of Forest Road 90, just west of the bridge crossing Marble Creek Legal Description: Section 26, T7N, R5E. W.M., Skamania County, Washington

Acreage: The scope of the study area is approximately 20 acres.

Topography: The topography of the site varies throughout the acreage, but typically there is a plateau on top of slopes at approximately 40%. Between the top of the bluff and the bottom of the slope there are generally broad benches.

Land Use History: The land has previously been used for timber harvests. Old timber roads and stumps are located throughout the property to indicate past use.

Adjacent Usage: The adjacent use to the north, east, and west appeared to be timber harvests. To the south is Swift Reservoir.

Waterways: Marble Creek, Swift Reservoir

Floodway: None

Priority Habitats and Species: This site is documented to be within Elk winter range, and swift reservoir contains resident and locally migratory fish populations of Kokanee, Bull Trout, and Cut Throat Trout.

INTRODUCTION

The subject property is located on approximately 30 acres of privately owned timberland, which has been harvested in the past. The project is a low-density recreational cabin (approximately 1000 square feet). There are a total of 4 platted lots on the existing site, lots 1, 2 and 3 are about 2 acres each, and lot 4 is 24 acres and extends down to USFS road 90.. This Short Plat is contingent to, but under a separate and distinct ownership from BST and GTS. This habitat assessment report and wildlife management plan was prepared to assess the current habitat and wildlife usage and address the specific concerns and issues associated with any waterway or water body, wildlife, wildlife habitat, or vegetation found within the subject site. Impacts are identified, and mitigation for those impacts are included in the management plan.

Environmental Technology Consultants (ETC) was contracted to perform the necessary investigations to assess the habitat and develop a management plan. A formal field investigations were performed on June 27, 2006 with a follow up visit to address issues that required more in depth analysis on August 2, 2006. In order to complete the habitat survey the subject site was investigated to the best extent possible by observing the presence of priority wildlife species and critical habitats visually through direct sightings and by indicators of usage (trails, droppings etc). References were made to various publications to determine existing Best Available Science, including maps, WDFW Reports, the Lower Columbia Salmon Recovery and Fish and Wildlife Subbasin Plan, USFS research publications, and PaciCorp's Licensing Settlement Agreement, and documents and others.

This report is designed to address the impacts and mitigation for the DAC short plat, containing a total of 4 lots. Further subdivisions by short platting or subdivisions is unknown and not within the scope of this study. Future subdivision will be considered on their own through Skamania County Developmental authority. Impacts will be determined as required at that time based on scope and any potential additional impacts to the ecosystem as it exists at the time of the application.

This report documents the investigation, best professional judgement and conclusions of the investigators. It is correct and complete to the best of our knowledge. It should be considered a preliminary document and used at your own risk until it has been reviewed, approved, and adopted in writing from Skamania County.

EXISTING CONDITIONS

The site currently is under development; therefore the existing conditions that are reported were determined from our field investigation on June 27, 2006. As per the scope of the contract the existing conditions, development and impacts that were investigated were associated with Elk winter range, Swift Reservoir, and any other priority habitats and species that may be affected by the project. The details of the investigation are described in the categories below.

Summary. These are two acre lots, extending from the shoreline of Swift Reservoir to the centerline of an access road now under construction. That access road is approximately 900 to 1100' inland from the shoreline of Swift Reservoir, (see map). The building sites under construction are accessed from the access road. This arrangement effectively sets the building sites approximately 600' in elevation above Swift Reservoir, and about 1000 feet inland.

SOILS

The Soil Conservation Service Soil Survey of Skamania County identifies three major soil units on the site: Cinnamon sandy loam (map unit 25, 26, & 27), Swift cindery sandy loam (map units 131, 132) Swift-Rock Outcrop Complex (map unit 134), and Yalelake sandy loam (map unit 162).

Cinnamon sandy loam is a very deep, well-drained soil on the back slopes of mountains. It formed in pyroclastic flows of volcanic ash and pumice. The permeability of this soil is moderate (0.6 to 2.0 inches), runoff is medium, and the hazard of water erosion is moderate.

Swift-Rock outcrop complex is very deep and well-drained soil on side slopes of mountains. It formed in colluvium derived dominantly from volcanic ash and basic igneous rock with a mantle of volcanic ash and pumice. Permeability is moderately high (0.6 – 2.0 in/hr), runoff is rapid, and the hazard of water erosion is severe. Rock outcrop consists of exposed areas of dominantly andesite and basalt. Numerous escarpments are in this unit.

Swift cindery sandy loam is a very deep, well drained soil on side slopes of mountains. It formed in colluvium derived from volcanic ash and basic igneous rock with a mantle of volcanic ash and pumice. On less severe slopes (map unit 131) permeability is moderate (0.6 – 2.0 inches/hr), runoff is medium and the hazard of water erosion is moderate. On steeper slopes (map unit 132) permeability is moderately high (0.6 – 2.0 in/hr), runoff is rapid and the hazard of water erosion is severe.

Yalelake sandy loam is a very deep, well drained soil that is located on terraces. It was formed in volcanic ash and pumice over pyroclastic deposits. Permeability of this soil is moderate (6.0 inches to 2.0 inches). Runoff is slow and the hazard of water erosion is slight. (Appendix A, SCS Soil Survey Map)

**Note: All infiltration rates are saturated hydraulic conductivity.*

VEGETATION

The vegetation of the site corresponds well with the vegetation documented as the *Tsuga heterophylla Zone* (Natural Vegetation of Oregon and Washington, Franklin and Dryness), although there may be some overlap into the *Abies amabilis Zone* due to the elevation. The elevation in the area is approximately 1000 – 1800 feet, which is close to the upper limit of the *Tsuga heteropylla zone.* Table I lists vegetation that was observed in the area , or is documented as native to, and may be found at this altitude, however no formal vegetation survey was completed.

Table 1. Vegetation

Genus species	Common name	Genus species	Common name
Abies amabilis	Pacific Silver fir	*Oplopanax horridus*	Devil's-club
Pseudotsuga menziessi	Douglas-fir	*Ribes sp.*	Currents
Tsuga heterophylla	Western Hemlock	*Symphoricarpos albus*	Snowberry

Abies lasiocarpa	Subalpine Fir	*Gaultheria shallon*	Salal
Abies procera	Noble Fir	*Mahonia nervosa*	Dull Oregon-grape
Pinus contorta	Lodgepole Pine	*Athyrium filix-femina*	Lady Fern
Thuja plicata	Western Redcedar	*Luzula glabrata*	Smooth Woodrush
Acer circinatum	Vine Maple	*Oxalis sp.*	Woodsorrel
Rhamnus purshiana	Pursh's Buckthorn	*Lupinus sp.*	Lupine
Vaccinium ovalifolium	Oval-leaf Huckleberry	*Polystichum munitum*	Sword Fern
Vaccinium membranaceum	Big Huckleberry	*Chimaphila umbellata*	Prince's Pine
Vaccinium parvifolium	Red Huckleberry	*Maianthemum dilatatum*	False Lily-of-the-valley
Cornus unalaschkensis	Western Bunchberry	*Valeriana sitchensis*	Sitka Valerian
Streptopus roseus	Twisted-stalk	*Festuca sp.*	Fescue
Blechnum spicant	Deerfern	*Trillium ovatum*	Pacific Trillium

STREAM AND RIPARIAN HABITATS

A healthy riparian zone is essential to the overall water quality, especially in relation to fish habitat. Vegetation stabilizes channel banks, reduces flood velocities, reduces floodplain scour and stream sedimentation and provides the major source of carbon for in stream fauna. Additionally, the input of terrestrial fauna falling into the receiving waters provides a direct source of food for in water organisms and a broad spectrum of essential nutrients.

The building sites for these lots are on steep upland slopes. The area appears to have been logged perhaps 20 years ago, and vegetated areas are dominated by over crowded stands of Douglas fir trees, as is typical of previously logged west slope forests in the Cascade Mountains that are in early successional stages.

No streams were observed within 200' of the subject properties. The only riparian habitat present is along the shoreline of Swift Reservoir, more than 1000' from the building sites.

The closest streams to the subject properties are 1) a small unnamed drainage flowing into Swift Reservoir, 2) Diamond Creek, and 3) Marble Creek. Drainage from these lots will go directly downslope to the USFS road 90, and to the unnamed drainage.

The unnamed drainage was likely a tributary of Diamond Creek before the lower portion of the Diamond Creek drainage was inundated by the reservoir. The surveyor's map shows this drainage as creek, and gives an approximate location paralleling the northern boundary of lot 4, and branching near the North east corner of lot 4, with a small branch going up close to lot 1, and the larger branch turning north and going up slope. We would of not recognized the smaller branch as a drainage, except for the notation on the map. We did locate the larger branch and found it to be dry at the time of this survey, with no sign of recent flow. The bed was covered with forest soil and debris, and there was little evidence of scouring, gravel deposits, or other signs typical of an active stream channel. We also checked this drainage downslope of USFS road 90, and found much the same conditions there as above. It is safe to say that this drainage does not support fish or riparian fauna due to the steep slope, and absence (at least seasonally) of water.

The Lower Columbia River Sub Basin Plan rates streams on the basis of their importance to the preservation and recovery of fish species:

> Tier 1: All high priority reaches (based on EDT) for one or more primary populations.
>
> Tier 2: All reaches not included in Tier 1 and which are medium priority reaches for one or more primary species and/or all high priority reaches for one or more contributing populations.
>
> Tier 3: All reaches not included in Tiers 1 and 2 and which are medium priority reaches for contributing populations and/or high priority reaches for stabilizing populations.
>
> Tier 4: Reaches not included in Tiers 1, 2, and 3 and which are medium priority reaches for stabilizing populations and/or low priority reaches for all populations.

Diamond Creek rated as a Tier "2" and Marble Creek as a Tier "4" in this classification system. For Coho habitat potential in both creeks, the Subbasin plan rates the hydrology and sediment factors as "functional" but the riparian factor as "Moderately impaired". The unnamed creek is not mentioned in the Subbasin plan.

Diamond creek is described as "a high gradient (10% slope) 2nd order stream with a "A" Rosgen[1] channel type. Fish habitat in the accessible portion of Diamond Creek is dominated by shallow, high gradient riffles with occasional pocket pools. Cobble and small boulder are the dominant substrate types. Gravel is extremely limited. Because of its relatively short length, high gradient, and low flow (0.5 cfs), Diamond Creek appears to contain only a limited amount of anadromous fish habitat. It is unlikely that a substantial number of anadromous fish would use this stream" (HARZA 2000)[2].

Pacificorp's Final Settlement Agreement for the Lewis River Relicensing, dated November 30, 2004, does not mention Marble Creek or Diamond Creek. Pacificorp Biologist Erik Lesko stated that they do not have plans for these streams in connection with their fish reintroduction projects, due to the seasonal nature of flows and lack of suitable habitat. Marble creek was completely dry at the time of our survey, and has a reputation for having flashy, seasonal flows.

The WDFW Habitat and Species Map lists Cutthroat Trout as the species of concern for Marble Creek, and does not list anything for Diamond Creek.

FISH

Historically, the Lewis basin supported runs of Coho, Chum and Chinook salmon, Bull Trout, Steelhead, Winter Steelhead, Cutthroat Trout, Pacific and Brook Lamprey. Anadromous runs in

[1] In the Rosgen typing system, an "A" type stream is characterized by steep gradients (between 4 and 10%), with deeply incised channels, and entrenchment ratios <1.4. They have low width/depth ratios (<12) and low sinuosity (<1.2). Local landform and geology dictates channel stability.

[2] This report did not mention the Marble Creek that flows into Swift Reservoir, however does mention the one that flows into Lake Merwin.

the upper Lewis were interrupted by completion of the Merwin Dam in 1932, Yale Dam in 1953, and the Swift Dam in 1959. Coho adults were trapped and passed above Merwin Dam from 1932-1957; the transportation of coho ended after the completion of Yale Dam (1953).

Mountain Whitefish and Large Scale Sucker are the dominant fish species in Swift Reservoir, Stickleback and Bull Trout are also naturally occurring. Brook Trout are not seen in the reservoir, but are found high up in several of the tributaries. Rainbow Trout are currently stocked in Swift, and Coho and Chinook are scheduled to be reintroduced. Of the naturally occurring fish species, Bull Trout are the main species of concern, and are listed as threatened under the ESA.

Coho salmon and steelhead are being re-introduced into the upper watershed above Swift Reservoir based on a settlement agreement for the relicensing of the dams. Spring Chinook, coho, and steelhead, all ESA listed, are returning to the upper watershed.

Cutthroat Trout

Cutthroat Trout, (Oncorhynchus clarki clarki) are documented as utilizing the lower portions of Marble Creek, however this usage is restricted due to the creek often being dry in the summer months. Cutthroat Trout have complex life histories, and trout in coastal streams on the west side of the Cascades are usually considered anadromous. Since the construction of the dams on the Lewis River, Cutthroat, if they were anadromous before, have had to residualize.

The average size of cutthroat is 1 to 4 pounds, and are known to weigh as much as 6 pounds. Upriver migrations start in the late summer and extend into the fall, and they spawn in the spring. Cutthroat were considered for listing under the Endangered Species Act (ESA) as a threatened species, however the USFWS has declined to list them. There are 13 subspecies of cutthroat trout indigenous to North America, only the coastal cutthroat is anadromous, living in both salt and freshwater during its life cycle. But coastal cutthroat have complex life histories, and not all fish are anadromous. In any given body of water, some may migrate to sea, while others become resident fish. In fact, the offspring of resident fish may migrate, while the offspring of anadromous fish may "residualize." The native range of coastal cutthroat trout corresponds remarkably with the Pacific coast rainforest.

Life history Sea-run cutthroat spawn over a long period, from winter through May. They seek smaller streams where the flow is minimal and the streambeds tend toward a sandy texture. They prefer to spawn in the uppermost portions of these streams, areas that are too shallow for most other anadromous salmonids. Most cutthroat rear in-stream for two to three years before venturing into salt water. Emerging fry are less than an inch long and are poorly able to compete with larger coho and steelhead fry for resources. To compensate, cutthroat fry use headwaters and low-flow areas that coho and steelhead avoid. In these areas, cutthroat find their niche within the ecosystem. Unlike other anadromous salmonids that spend multiple years feeding far out at sea, cutthroat prefer to remain within a few miles of where they were born. They do not generally cross large open-water areas. Some will overwinter in freshwater and feed at sea only during the warmer months. In rivers with extensive estuary systems, cutthroat may move around in the intertidal environment to feed. They may also run upriver or out to sea on feeding migrations. (Clark County ESA program 2006).

UPLAND HABITATS

The upland portion of the site is located on a broad ridge running generally north-south, with steep, almost sheer, escarpment to Swift Reservoir on the south side. The vegetation is primarily healthy young reproduction and second growth forest habitat approximately 20 and 50 years old.

Most of the site has a dense understory of coniferous reproduction, Vine Maple, ferns, Salal, Oregon Grape and other common understory plants of the region (See Table I). Between cabin sites, (photo 4), a minimum of 50-60 feet of undisturbed vegetation remains as a screen between sites and is made up entirely of native vegetation, with the only non natives found in small numbers on the abandoned logging road to the north and in open areas near FR 90. The vegetation was so extensive that only a few species were noted continuously. The slope leading to Swift Reservoir is well stocked with coniferous trees, and a dense understory of shrubs, and herbaceous vegetation. The majority of the vegetation on the slope has not been impacted and provides excellent cover and forage for wildlife, however the steep slopes may preclude use by deer and elk as access to the areas near the shoreline of Swift Reservoir. Building sites have had trees removed for views prior to conducting the habitat assessment and recommendations made in this document. (Photo 4)

WILDLIFE SPECIES

A Priority habitat and species map from WDFW was reviewed to determine the extent of priority habitats near the subject site. The Priority Habitat and Species map indicated the presence of elk winter range habitat encompassing the property. Eagle nests and a communal roost are documented on the south side of the reservoir, however they are approximately 1.5 miles southwest of the site. Osprey nests are also noted, however the Osprey is not a listed species in Washington State or on Federal Listings.

Based on information from WDFW that the DAC project would be impacting priority species, specific information on the species and how this project would impact them was investigated. Priority Habitat and species maps from WDFW were reviewed to determine the extent of priority habitats near the subject site. The Priority Habitat and Species map indicated, elk winter range habitat encompassing the property, and bull trout documented as present in Swift Reservoir. Direct and indirect observations of wildlife on the subject site were recorded. Observations included positive sightings, tracks, trails or major travel lanes, and positive identification of fecal pellets or other indicators.

ELK

Cervus elaphus (North American Elk), the subspecies roosevelti range includes areas from the coast through the western cascades. The elk are large animals that range between the size of a deer and a moose. The typical size of a 3 year old male is 500 pounds, while older males weigh twice that much. Antler development only occurs in males and is shortly after birth, but they do not break the skin until the beginning of the second year when the spikes appear. The animal's breed typically from August to November and they typically carry the calves for 8-81/2 months. Elk need to travel due to their need for large amounts of food. The elk at Marble Creek are migratory elk, which means they move to different elevations during the various growing seasons because of the availability of feed at different times of the year. "The year round ranges of the elk varies from 1,500 to 4,000 acres, because they are generally found where the climate is less severe and where food and cover are more readily available." (WDFW, Living With Wildlife). Elk require approximately 0.5 acre of forage per month for 6 months during the winter season, or 3 forage acres per winter period per animal to carry it on a sustained range basis (Trippensee, Wildlife Management). They remain in the lowlands during the winter, generally below 2,500 feet, and move up hill in the spring following the watercourses as the snow recedes. The elk

typically feed on the bottom lands early in the morning and gradually work their way up the hillsides as the day advances, bedding down during the middle of the day. Elk like to alternate between open meadows, bushy undergrowth, and mature timber, depending on the season ("edge habitat"). (NRCS, American Elk) "Apparently elk are not shy and will go out into open lands more freely for forage." (Trippensee, Wildlife Management) In the spring and summer, when food is plentiful, elk are mainly grazers, feeding on grasses, sedges and a variety of flowering plants. In the fall and winter elk increasingly become browsers, feeding on sprouts and branches of shrubs and trees, including conifers as a last resort when snow covers other plants. Vegetation specifically eaten by the elk is *Populus tremuloides, Prunus virginiana, Populus trichocarpa, Acer glabrum, Salix sp., Purshia tridentata, Ribes sp., Ceanothus integerimus, Sambucus sp., Vaccinium sp., Holodiscus sp., Cornus sericea, Amelanchier alnifolia, Symphoicarpos albus, Rosa sp., Medicago sativa, Trifolium sp., Taraxacum sp., Epilobium angustifolium, Melilotus sp., and Tragopogon sp.* (NRCS, American Elk) Elk are primarily active during the time of dawn and dusk, but if temperatures are high or the elk are being harassed they typically become more active at night. "When disturbance levels are low and temperatures mild, elk may be observed feeding in short bouts throughout the day. When not hunted, elk adapt well to humans and find lawns and golf courses excellent places to graze." (WDFW, Living with Wildlife).

"Although North American Elk eat a wide variety of plants that vary from one area to another they are primarily grazing animals. Pederson pointed out that generally speaking grasses form 82% of the diet during the spring, 11 percent during the summer, 62% during the fall and 78% during the winter. In addition to grasses consumed during the summer, forbs (succulent green plants other than grasses) compose 75% of the diet. Forbs such as buttercup and asters are obtained by grazing. (Maser et al) *History of Oregon Coast Mammals*.

Elk winter range encompasses the entire subject site as referenced from the Priority Habitat and Species map. At the time of the investigation the corridors for large wildlife such as elk and deer between developed cabin sites were wide (approximately 50-70') and dense (Optical Density measurements of 73-97%, with an average of 90%, from the center to cleared cabin sites) enough to provide sufficient corridors (Appendix G). Literature searches provided documentation and research findings concerning the required width and type of corridor elk or deer require to utilize them. Wildlife *Habitats in Managed Forests; Thomas, J. Ward, US Dept of Agriculture, Forest Service Sept. 1979, Agriculture Handbook No. 553.* Determined that vegetation with an Ocular Density of approximately 90% at 200 feet or less is required to give the animals sufficient feeling of security to utilize an area for travel or cover (Appendix F). Evidence (observations) seems to suggest the animals will also utilize any available travel ways if conditions at the time make the animal feel secure in their use. Random optical density measurements were take on the BST, DAC and GTS Short Plats, and as the vegetation was relatively uniform throughout the sites, a general recommendation was offered for buffers between disturbed areas. No observation of direct use was noted on the site at the time of the investigations

IMPACT ANALYSIS

This development is on steep slopes that drain directly into Swift Reservoir. Impacts would therefore affect Swift, Yale, and Merwin Reservoirs and the lower reach of the Lewis River. Impacts to any of these systems, although present, are negligible. No direct impacts are likely to fish bearing streams or wetlands.

ETC has assessed the potential impacts from the proposed development at project completion. It is anticipated that the proposed project will have the following impacts: human disturbances to wildlife (ATV's, noise, roads, cabins), fragmentation of upland habitat, including the loss of some free range travel corridors and associated upland sites, the conversion of native vegetation, and conversion of groundwater recharge areas to roads and homesites. As with any development there will be loss of area and the associated natural functions and values, which need to be mitigated.

HYDROLOGY

Impacts to the hydrology (both surface and groundwater) will be negligible. The project site soils are a mixture of Cindery Sandy Loam, and Sandy Loams with permeability rates of 0.6-2.0 in/hr.. Site construction consists of gravel roads and driveways, and natural ditches and waterways. The only impervious surfaces that will be constructed on the site are buildings (cabins, etc.) with small footprints (roughly 1000 sf). Roof water will be directed to native surfaces and allowed to infiltrate. Due to the nature of the soil and it's associated moderate infiltration rate, although redirected by roof surfaces and to some degree road surfaces, all precipitation will return to the subsurface as groundwater as long as adequate recharge basins or other mechanisms are in place. This water will recharge subsurface aquifers and groundwater through flow systems at pre development level.

Rainfall data and peak 1 hour storm precipitation rates for the Three Rivers Recreational project is presented in Appendix D and is based on the isopluvial contour that is the nearest to the subject site. Due to the close proximity of this site to the Three Rivers project, that data is reproduced here as being representative of the DAC Short Plat Projects. Peak 1 hour storm precipitation for AV SCS type 1A distribution using the King County Hydrograph Program is as follows for the 2, 5, 10, 25, 50, and 100 year 24 hour storms.

2y= 0.93in; 5y= 1.10in; 10y= 1.27in; 25y= 1.44in; 50y= 1.52in; 100y= 1.69in.

All of the developed portions of the site are made up of soils with a minimum saturated hydraulic conductivity (infiltration rate) of 0.6-2.0 in/hr. Using a median value of 1.3 in/hr, the site will infiltrate all events up to and including the 10-year storm, and at the high end the soils will infiltrate all storms (i.e. infiltration rate ≥ rainfall rate). This is the peak 1 hour rate for these storms, with the 1 hour prior being approximately 41% of this rate and the 1 hour following being approximately 39% of this rate. During the other 23 hours of the event, the rainfall/hour is less than 0.66 in/hr during the hour before the peak event. We therefore conclude that the soils on the site will adequately infiltrate any local storm event, based on data presented and the fact that the methodology provides a very conservative output.

WATER QUALITY

In the past a major concern for water quality issues for rural development near waterways has been septic systems. In the past, some of these systems were either poorly designed, sited in poor soils, installed without permits, or placed too close to waterways. In addition to siting and design, many problems developed from systems that were poorly maintained or simply failed for a variety of reasons (mishap, tree roots, etc). Systems installed on this project will be fully

permitted and designed around best available science concerning waste treatment systems for this type of site. Good design, siting, permitting, and required maintenance covenants should alleviate any water quality issues associated with these systems.

The project may impact Swift Reservoir during the construction phase, In the course of site preparation the contractor has left a large amount of bare soil exposed, and this could wash into the reservoir during a heavy rain storm. A mulch or blanket should be applied to these soils until vegetation is established.

STREAMS & RIPARIAN HABITAT

Assuming that all construction on this lot occurs on the building pad now being prepared, direct impacts to riparian and aquatic habitats from housing construction on these lots should be minimal to none, due to absence of any riparian habitat in vicinity. The shoreline of Swift Reservoir is the closest riparian habitat to these properties, and it is more than 900 to 1100 feet from the construction now occurring.

This analysis does not cover any possible future activity that may occur on the lower portions of these lots, between USFS Road 90 and Swift Reservoir. It also does not cover any impacts that may occur should a heavy rain cause erosion to nearly cleared areas.

The Marble Creek[3] drainage is to the east of the subject property. Subject property is more than 1000 feet from Marble creek drainage. Drainage from this property goes to the west, and will not affect Marble Creek.

This project is not expected to directly impact any streams or riparian habitat. Indirect impacts of these developments will likely occur, simply due to the increased human activity in the area. The use of off road vehicles and unmuffled vehicles should be prohibited, except on established roadways.

FISH

The subject properties have no direct access to any fish bearing streams. Any fish mitigation efforts would be better spent on projects that will benefit other areas of the basin rather than these properties.

WILDLIFE SPECIES

ELK

Numerous trees have been cleared from the proposed development site. The primary concern for elk habitat is availability of food, travel corridors, domestic animals, outdoor lighting, and overall harassment of the elk. The impacts to the elk natural habitat will be a result of fragmentation and loss of travel corridors, forage areas, and tree cover due to the habitat being converted into roads and building lots. The total area converted to roads, cut/fill slopes, drives and cabin sites is approximately 60,000 to 70,000 SF Recommendations to offset this loss of habitat that originally

[3] Note that another stream called "Marble Creek" drains into Lake Merwin. Because there are two streams with the same name in the Lewis River drainage, there may be some confusion in various documents as to which one is being referenced.

provided travel corridors and and possible forage areas have been included in the Mitigation/Management Plan.

Outdoor lighting or spotlights that shine into the habitat areas at night from the cabin sites may impact the grazing and migration of the elk. The potential for harassment of the elk by humans, domestic dogs, and motor vehicles is possible.

Due to the season (October-April) that the elk typically stay on the winter range, interaction between the cabin owners and elk should be minimal. Private forestland and other private ownerships surround the subject site, these areas are also used by the elk as winter range. The accepted boundary of elk winter range west of the cascades is generally below 2500 feet above sea level (Management Recommendations for Priority Species, WDFW). Therefore this site impacts only an extremely small percentage of the winter range of the Swift Reservoir area. (WDF&W PHS Polygon Map, Appendix B)

Elk and other wildlife will still be able to utilize the remaining corridor areas on the site, along with the buffer areas and the drainages connecting the site with offsite areas. Open areas created by grading for roads and cabin sites, in particular gentle to moderate cut slopes, properly seeded with forage mix can and will be utilized by the local populations via fingers between cabin sites. With adequate mitigation and management there should be no significant affect on the local elk herd.

NATURAL vs. MAN MADE IMPACTS

A few points should be noted as part of the discussion of impacts from the development of rural or recreational developments with relatively small overall impacts. The area in and around Swift Reservoir has in the historical past been modified by wildfire, insect outbreaks, and other natural phenomena that created a multi structured forest environment. These random events created meadows, and every phase of forest succession, forming a patchwork across the region. Man's influence not only has created impacts in the form of development, timber harvest and other forms of modification of the landscape, but at the same time has virtually shut down any natural process of modification except such events as the eruption of Mt. St. Helens. These processes bode well for the maintenance of almost all upland wildlife and bird species by creating the various elements essential to their maximum utilization of the landscape. The early native americans were aware of this fact and used burning to maximize the availability of food and other necessities of life. In today's culture activities such as The BST, DAC and GTS Short Plats can replace, as timber harvest does, some of the elements that natural processes contributed to provide necessary habitat. If done responsibly and with guidance, development can fill a niche no longer provided by natural process.

BALD EAGLE

The priority species and habitat polygons for this species are approximately 1.5 miles away from the project site. This project will have no significant direct or indirect affect on this species (See Mitigation Plan).

OSPREY

No references were found stating that osprey is listed as a priority species, yet they were listed on the Washington State Monitor List from WDFW. The Washington State Monitor List clearly states that the "species are not considered Species of Concern, but are monitored for status and

distribution." (Species of Concern, Washington State Monitor List, WDFW) Therefore, no discussion under Skamania County Critical Area Ordinance is warranted.

MITIGATION AND MANAGEMENT PLAN

The information contained in the preceding sections of this document is based on published information from research documents, reference books, technical papers, and best management practices from a variety of source agencies, academia, and working professionals, including the authors. This information was evaluated and recommendations made by the authors of this report based on their professional experiences, academic training, and input from reviewing and regulatory agencies. This document is designed to fulfill the requirements of the Skamania County Critical Areas Ordinance Title 21A, in particular chapter 21A.05 Fish and Wildlife Protection. Sections 21A.05.010 through 21A.05.030 and 21A.05.050 are administrative rules that regulate new developments in fish and wildlife habitats. This document deals explicitly with 21A.05.040 Wildlife Management Plans for sites that impact, or have the potential to impact, regulated fish and wildlife sites.

STREAMS & RIPARIAN HABITAT

At Pine Creek, WDFW required setbacks of 150 feet for a development, and on the Lewis and Muddy Rivers, 250' setbacks that were a minimum of 20' above these rivers was required. The building sites on the subject lots are more than 560' above, and 900' from the nearest fish bearing stream, wetland or riparian zone, greatly exceeding any known setback requirements. No mitigation actions are deemed necessary.

The road construction does however impact the unnamed drainage that flows into Swift Reservoir. Typically a minimum of a 25' buffer is required to maintain water quality in such instances.

FISH

Due to the distance from shoreline and fish bearing streams, no direct impacts to fish are anticipated with this development, therefore no mitigation actions are deemed necessary.

GENERAL MITIGATION MEASURES

1. Apply jute mats to the major road cuts, fills, and steep slopes (Greater than or equal to 1:.5:1) Hydroseed with organic mulch or Rexius Microblend to a depth of 1-2" for moisture retention and seed germination (seed mix to be Washdot Erosion Control Mix or other as approved by Skamania County). Provide a source of irrigation water (water truck with pump, or other means) to keep seed bank wet until fully germinated.

2. Site septic systems based on "best available science" for this type of site in accordance with DOE guidelines and permitting by Skamania County. Implement and enforce maintenance covenants to protect sensitive areas from septic failure.

3. Discharge roof drains into dry wells, flow spreaders, or other discharge point as per Skamania County review. Place discharge points at a distance from the top of the steep cut/fill slopes a

distance equal to three times the height of any adjacent slope (i.e. to first bench or TOE) or maximum distance allowed by lot configuration.

4. Maintain any existing skid roads for wildlife corridors. Block skid roads with boulders or other means to prevent motorized vehicle use.

5. Allow selective pruning on trees within geotechnical setbacks for views from cabin sites. The top 30% of the tree must be left unpruned so as to not adversely affect the survival of the trees. Removal of vegetation within geotechnical setbacks should be prohibited.

6. Revegetate any areas within geotechnical critical areas upon recommendation of a Geotechnical Engineer. Planting specifications to be provided by project environmental staff.

7. Provide a Kiosk style sign at the entrance to the BST, DAC and GTS Short Plats informing and educating the residents and visitors of the unique nature of the area.

8. Maintain maximum naturally vegetated corridor between cabin sites (50-60 foot minimum recommended). These corridors will be dedicated as open space and left in their natural state, with the exception of unavoidable impacts that are approved by Skamania County (i.e. septic systems). All areas so impacted will be revegetated with forage mix.

9. Riparian buffers should be designated as open space and left in a natural condition. Geotechnical buffers could be left as open space and left in a natural condition if required by Skamania County.

WILDLIFE

ELK

1. Hydro seed and mulch all disturbed areas along the new roadways, ditches, and moderate to minor cut/fill slopes (i.e. less than 1.5:1) with elk forage (native grass forb mix designed specifically for elk grazing). Jute mat application not deemed necessary provided plants are fully established by October 1.

2. Add notifications to deeds or plat maps informing owners or potential buyers that the property is within the range and is utilized habitat by elk and other wildlife. The property could be damaged and the owners are liable for the repairs. Any vegetation planted on the subject site should be native to the area.

3. Establish covenants that limit off road vehicles and snowmobiles to established roads on the subject site. Install signs that inform the homeowners of this requirement.

4. Only rustic wood fences should be allowed on the subject property (per Skamania Code Standards).

5. Keep all dogs on leashes or controlled. Dogs should not be allowed to roam freely and unmanaged on the subject site. All barking should be controlled and not allowed by the owner (control barking by removing the dog from outside).

6. Outdoor lighting should be pointed back onto the cabin site property or have protective shields to cast down the light.

7. Maintain maximum naturally vegetated corridor between cabin sites (50-60 foot minimum recommended). Covenants to be put in place to prevent any vegetation manipulation or impacts in these areas.

BALD EAGLE

1. All windows must have no glare, or 8'-10'eaves/overhangs, or be shaded by natural vegetation. No direct sunlight should fall on window surfaces (unless glare resistant). Building covenants and permit restrictions should be in place to insure compliance.

SUGGESTED SIGN LANGUAGE

ELK AND BALD EAGLES UTILIZE THIS AREA. PLEASE DO NOT APPROACH OR HARRASS THEM IN ANY MANNER

PLEASE BE A GOOD NEIGHBOR AND DO NOT DISTURB THE HABITAT OR WILDLIFE

DOGS MUST BE KEPT ON A LEASH, AND BARKING NEEDS TO BE CONTROLLED

ALL ATV'S SHALL BE KEPT ON ESTABLISHED ROADS OR DESIGNATED ATV TRAILS.

Visual enhancements and species and habitat information on the in a Kiosk style presentation would enhance the effectiveness of the sign program.

SUMMARY AND CONCLUSION

As with all human disturbance and development, impacts to natural systems are a direct result that cannot be avoided. Impacts are predicated on the type of development, location, intensity, prior land use and ownership. Public lands are primarily managed and maintained for their intrinsic values to man, protection of water supplies, recreational opportunities, future raw material supplies, and fish and wildlife habitat. Even on the best managed public lands some impacts are unavoidable in the process of timber removal, recreational access, electrical power generation, right of way easements and a host of other reasons. Many of these processes provide a variety of ecological systems and are, in effect, replacing the natural processes, (i.e., fire, floods (etc)), that man either eliminates or controls to the greatest extent possible. Private property development generally does not get developed for the general good, but for the prime interest of the owner, whatever that interest may be. Under both development scenarios, impacts are inevitable, and mitigation and ongoing management to offset the impacts are the end result. With well designed mitigation and a comprehensive and enforceable management plan, the impacts to natural ecological systems can be brought back into balance. The BST, DAC and GTS project development has complied with existing regulations and oversight as provided by Skamania County, Washington during development, and has provided this document through a third party contract to address issues concerning the impact of their development on the species and habitats on their property.

If the mitigation and management recommendations outlined in this report are implemented and the protective covenants put in place, this project will be in compliance with the requirements of Skamania County Ordinance 21A.

Based on the aforementioned criteria, it is determined as the conclusion of the professionals hired to conduct this Critical Areas Wildlife and Habitat Assessment Report and Management Plan that the DAC project, as proposed, will have insignificant impacts on the priority habitats and species addressed herein.

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APPENDICES

A. VICINTIY& SITE MAPS

Vicinity Map (Figure 1)
Proposed Development Map (Figure 2)

*** Note Topographic and SCS Maps are an approximation of the site**

B. EXISTING CONDITIONS MAPS

Physical Settings Map (Figure 3)
SCS Soil Survey Map (Figure 4)
Priority Habitat and Species Map (Figure 5)

C. SEED SPECIFICATIONS

ETC recommendation:

Combine the following seeds if using Meadowmix Native Mix (by weight):

5 parts Meadowmix
1 part Native Red Fescue
1 part Regreen (sterile wheat grass)

Seed at a rate of 0.7 pounds per 1000 square feet of area.

Combine the following seeds if using Foothills Native Mix (by weight):

40 parts Foothills
1 part Native Red Fescue
1 part Regreen (sterile wheat grass)

Seed at a rate of 4.2 pounds per 1000 square feet of area.

D. HYDROLOGY DATA

E. SITE PHOTOGRAPHS

F. OPTIMIZATION STUDIES OF COVER AND FORAGE HABITAT

G. OPTICAL DENSITY METHODS AND RESULTS

H. DOCUMENTED PHONE CONVERSATIONS

Erik Lesko – PacifiCorp Fisheries Biologist. August 7, 2006

John Weinhiemer – Washington State Department of Fish and Wildlife. August 4, 2006

Jim Byrne – Washington State Department of Fish and Wildlife. Multiple conversations.

Joel Rupley, Clark County Endangered Species Act Program Coordinator: August 8, 2006

I. RESUMES

RICHARD BUBLITZ
Division Manager

Education:
B.S. Forest Management, West Virginia University (1966)
Wildlife Management
Post Baccalaureate Civil and Environmental Engineering, Portland State State University (1987-1991)
Graduate Studies, West Virginia University, Florida Atlantic University, Portland State University

Richard Bublitz is the Division Manager for ETC; he has 25 years experience working in the environmental field. Mr. Bublitz has a broad range of expertise, from working for state and federal agencies in Florida, Ohio and the Pacific Northwest to working the last 13 years as an Environmental Consultant. Mr. Bublitz has been responsible for project management and supervision, client interaction, project mitigation design, and agency coordination at all levels on wetland and environmental resource projects from small urban projects to large private sector projects in most of the Eco-regions in the Pacific Northwest. Recent project include Lincoln City subdivision site, Yacolt Mountain quarry development project, Government Camp mixed use project (Still Creek), Toledo Washington agricultural development, Oregon City wetland mitigation and stream restoration, and Ducks Unlimited in Vancouver Washington.

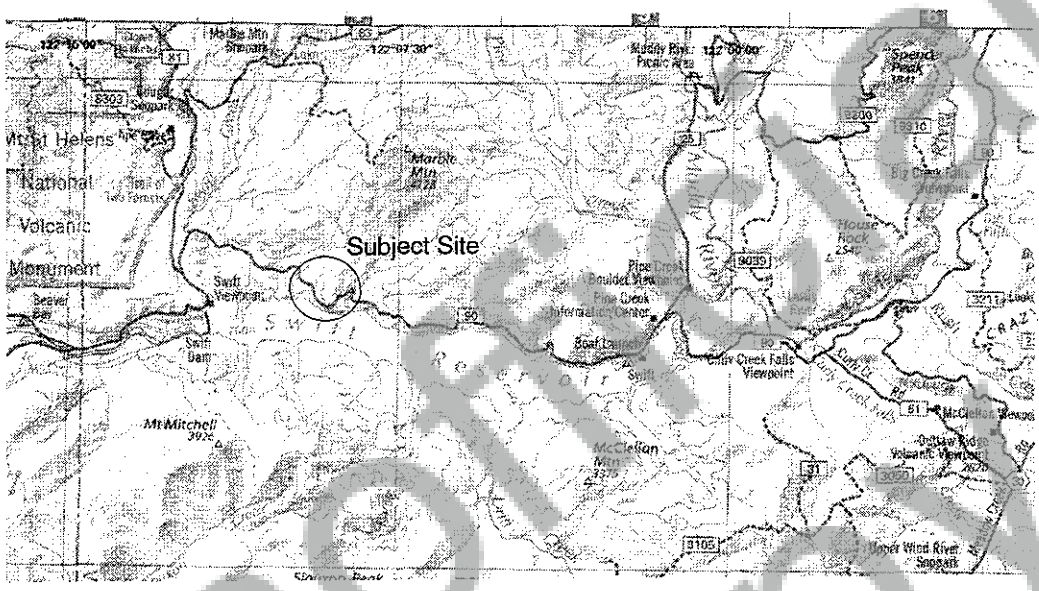
JOHN MCCONNAUGHEY
Senior Fisheries Biologist

Education:
M.S. Fisheries Science, University of Alaska Southeast (1984)
B.S. Biology, University of Oregon (1977)

John McConnaughey is a Senior Fisheries Biologist for Environmental Technology Consultants (ETC). He has 20 years experience working with fisheries and fish habitat issues in the Northwest, Alaska and the South Pacific. Mr. McConnaughey is skilled in sampling design, salmon life history analysis, habitat utilization, and analysis of salmon recovery issues.

His experience is diverse. Before coming to ETC, he served as a member of the Management Implementation Planning Team, (MIPT), an interagency team tasked to study the effects of a salmon supplementation project and related salmon recovery issues in the Yakima Basin in Central Washington. Mr. McConnaughey lead three of the studies recommended by MIPT, and also lead studies investigating smolt passage and migration issues. He has been a member of interagency and international scientific teams to study and recommend policy on commercial and recreational fisheries.

He has project and administrative experience; as the lead biologist on 9 fisheries research studies, as the manager of a giant clam hatchery, and as an analyst for the Alaska Dept of Fish and Game. He is proficient with statistical and data base software, and uses analytical skills to provide reports for agencies, legislators and publication.

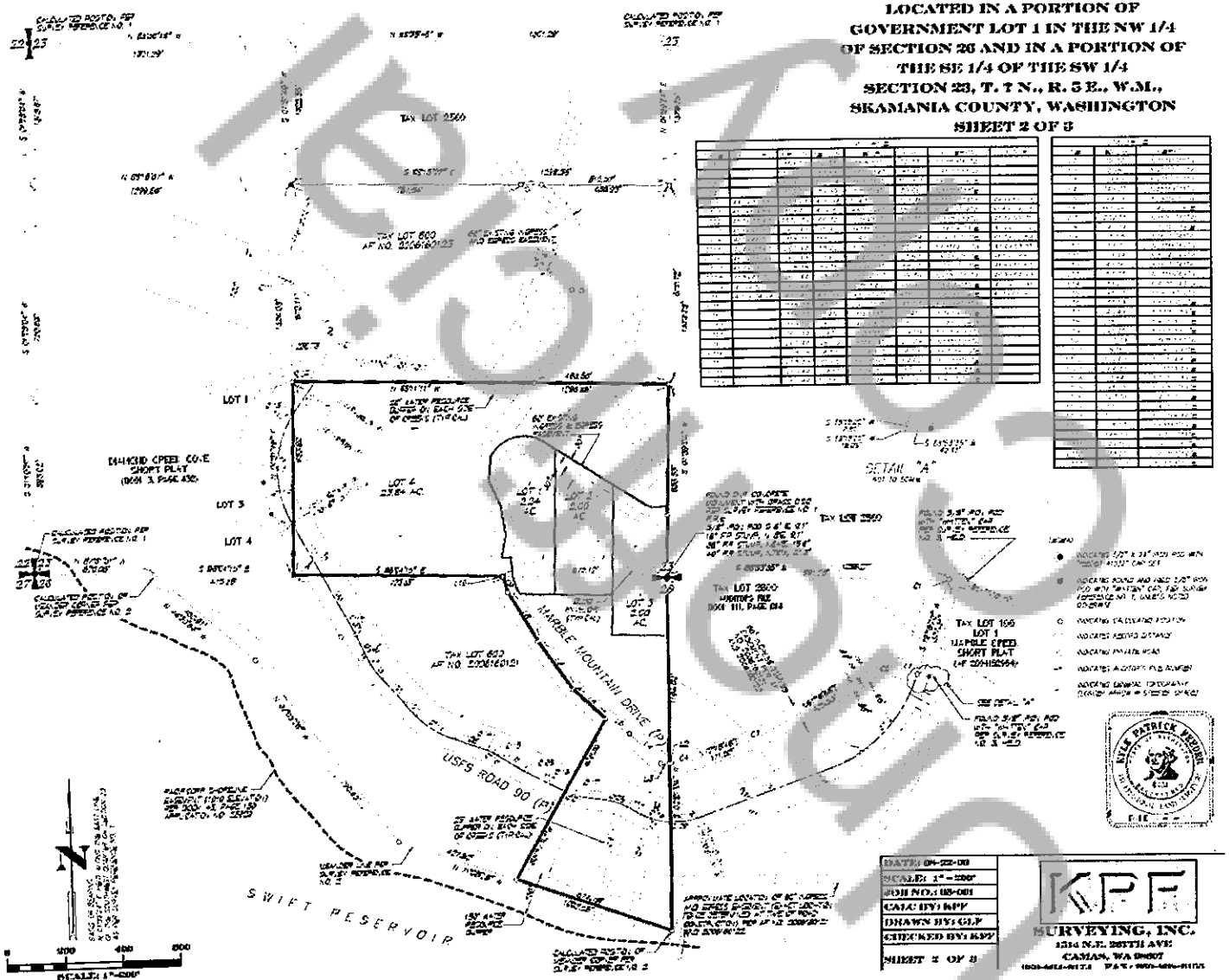


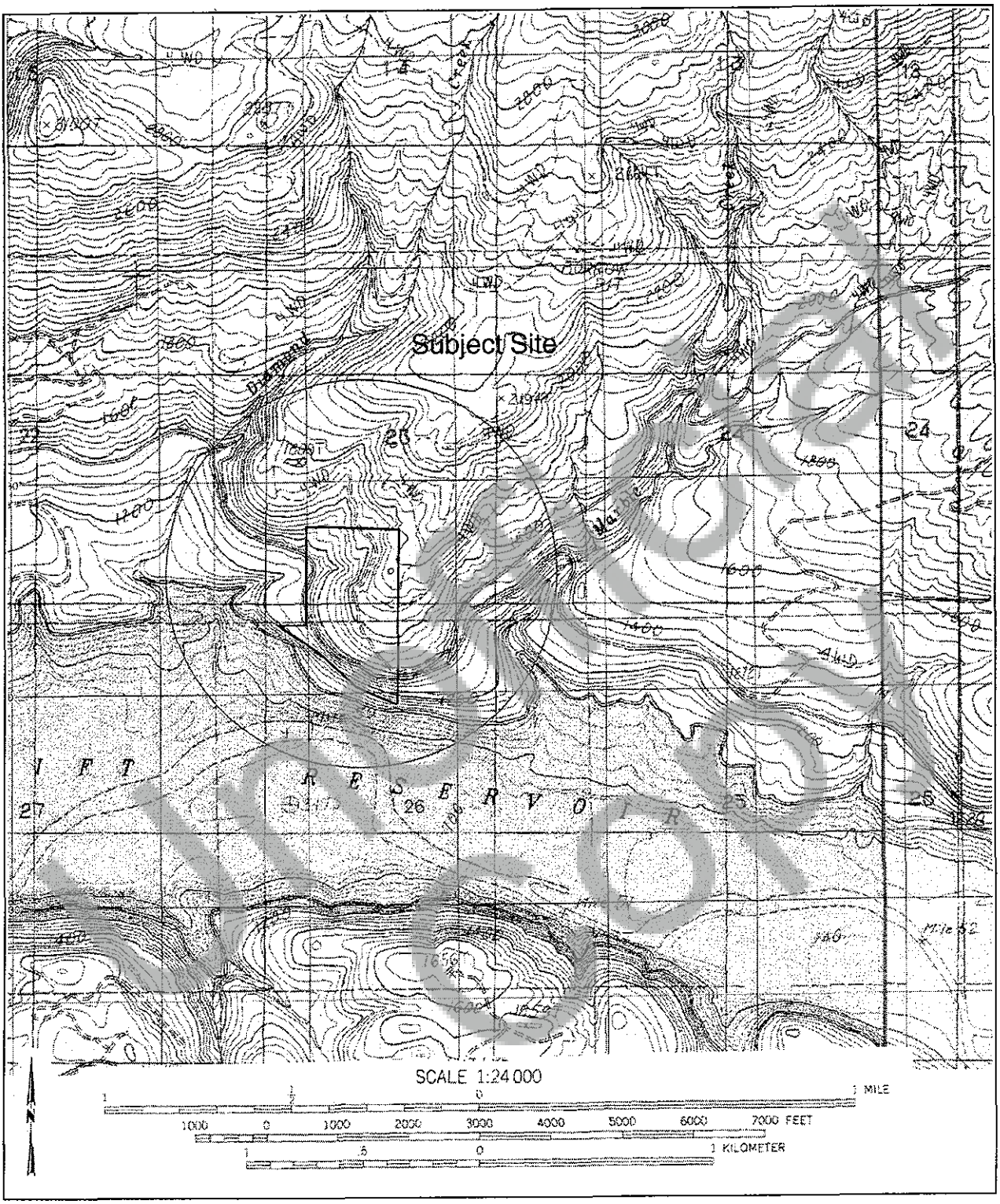
environmental technology consultants SITE VICINITY MAP	**Subject Property:** **Proposed GTS, BST and DAC Short Plats** **Skamania County, Washington**

"DAC" SHORT PLAT

LOCATED IN A PORTION OF GOVERNMENT LOT 1 IN THE NW 1/4 OF SECTION 26 AND IN A PORTION OF THE SE 1/4 OF THE SW 1/4 SECTION 23, T. 7 N., R. 5 E., W.M., SKAMANIA COUNTY, WASHINGTON

SHEET 2 OF 3





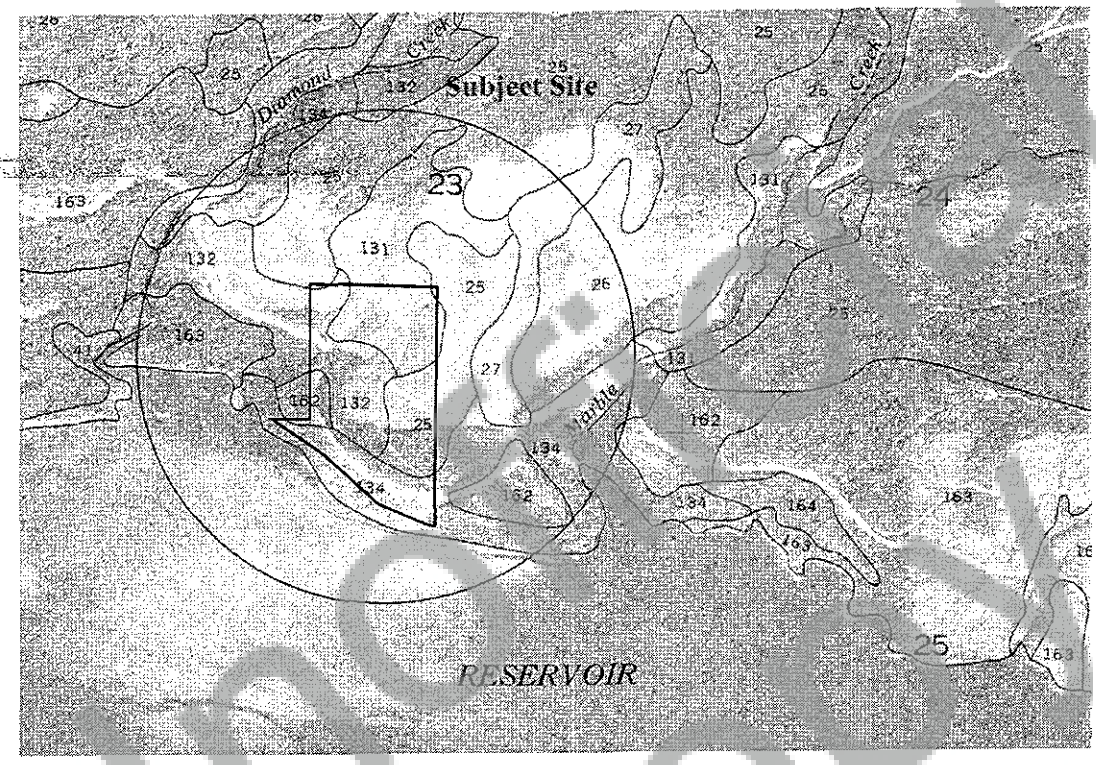
environmental technology consultants

PHYSICAL SETTING

Source: DeLorme 3-D TopoQuads

Subject Property:
Proposed BST, DAC and GTS short plats
Skamania County, Washington

13



LEGEND (SCS Sheet 13)

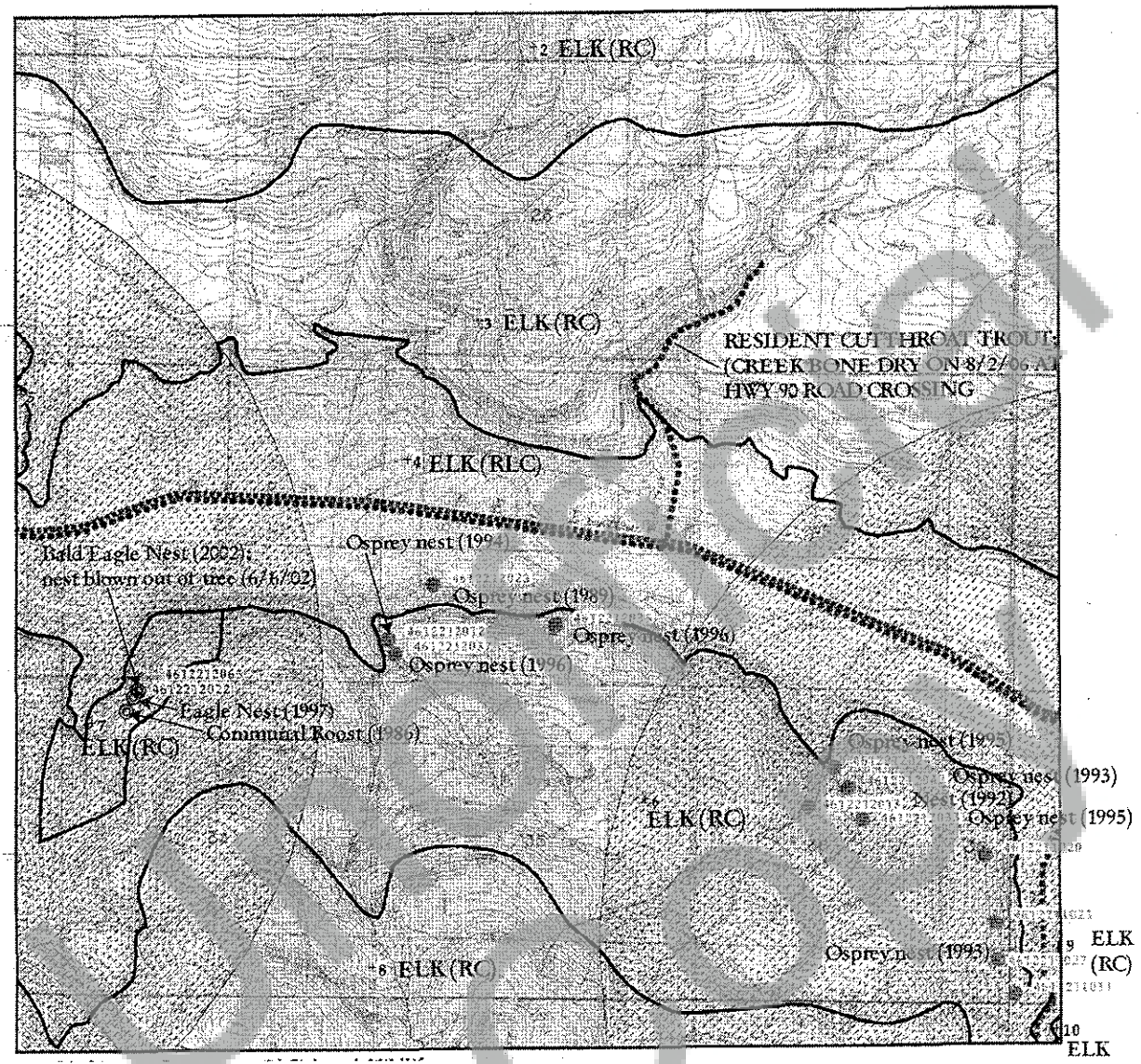
Map unit 25: Cinnamon sandy loam (2-30% slope)
Map unit 131: Swift cindery sandy loam (30-65% slope)
Map unit 132: Swift cindery sandy loam (65-90% slope)
Map unit 134: Swift-Rock outcrop complex (65-90% slope)
Map unit 162: Yalelake sandy loam (2-30% slope)

1 ¾ ½ ¼ 0 1 Mile
5000 4000 3000 2000 1000 0 5000 Feet
Scale 1:20000

environmental technology consultants

SCS SOIL SURVEY Map
Source: Soil Conservation Service, 1990

Subject Property:
Proposed BST, DAC, and GTS short plats
Skamania County, Washington



environmental technology consultants WDFW HABITATS AND SPECIES MAP **Source: Washington Dept of Fish & Wildlife**	**Subject Property:** **Proposed BST, DAC, and GTS short plats** **Skamania County, Washington**

Washington Department Of Fish and Wildlife

HABITATS AND SPECIES MAP

IN THE VICINITY OF T07R05E SECTION 26

Map Scale - 1 : 24,000
Coordinate System - State Plane South Zone 5626 (NAD27)
Production Date - November 07, 2005
Map Designed by WDFW Information Technology Services GIS

PLEASE NOTE

This map and the accompanying reports are not for general distribution. Washington State Law (RCW 42.17.310) exempts Sensitive Fish and Wildlife information from public inspection and copying.

Washington Department of Fish and Wildlife (WDFW) considers sensitive species and habitat locations displayed on this map and accompanying reports to be confidential. WDFW is the exclusive owner of the Sensitive Fish and Wildlife information and locations shall in all respects be treated as proprietary information in accordance with all procedures reasonably necessary to protect WDFW's proprietary rights therein.

This map may contain some species and habitats that are not considered priority. Accompanying this map are reports that provide information on displayed wildlife points and polygons. These reports do not include information for displayed spotted owls and marbled murrelet occurrences.

Some legend classes and symbols may not be present within the mapped area.

DISCLAIMER

This map and the accompanying reports only include information that the Washington Department of Fish and Wildlife (WDFW) maintains in a central computer database. It is not an attempt to provide you with an official agency response as to the impacts of your project on fish and wildlife. This information only documents the location of fish and wildlife resources to the best of our knowledge. It is not a complete inventory and it is important to note that fish and wildlife resources may occur in areas not currently known to WDFW biologists, or in areas for which comprehensive surveys have not been conducted. Site specific surveys are frequently necessary to rule out the presence of priority resources.

Locations of mapped wildlife and habitat features are generally within a quarter mile of the locations displayed on this map. Locations of fish and wildlife resources are subject to variation caused by disturbance, changes in season and weather, and other factors. WDFW does not recommend using maps more than six months old and information should not be used for future projects.

To insure appropriate use of this information, users are encouraged to consult with WDFW biologists.

MAIN DATA SOURCES

Priority Habitats and Species polygon, Habitat point, Klickitat County Oak, Wildlife Heritage, Spotted Owls, Marbled Murrelet, Seal/Sea Lion Haulouts 1:24,000 streams and fish presence data : Wa. Dept. of Fish and Wildlife.
Wetlands data: US Fish and Wildlife Service, National Wetlands Inventory.
Seabird Colony data: US National Oceanic and Atmospheric Administration.
Kelp Bed, Oak Stand, Eelgrass, Turf Algae and Township/Section data: Wa. Dept. of Natural Resources.
Columbia River Tidal Marsh data: Oregon State Service Center for Geographic Information Systems (1988).
7.5-minute quadrangle image from US Geological Survey.

MAP LEGEND

Priority Habitats/Species:

- Priority Habitats and Species (PHS) Polygon Borders
- Priority Wildlife Heritage Points
- Priority Habitat Points
- Marbled Murrelet Points (Occupancy Sites)
- Spotted Owl Site Centers (Official Status 1-3)
- Spotted Owl Site Centers (Official Status 4)
- Priority Anadromous Fish Presence
- Priority Resident Fish Presence
- National Wetlands Inventory

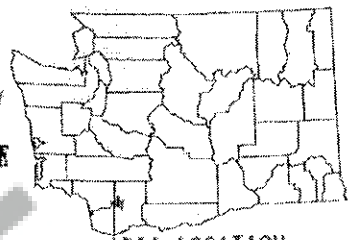
Other Habitats/Species:

- Other Wildlife Heritage Points
- Spotted Owl Management Circles Established Territory
- Spotted Owl Management Circles Insufficient Data To Establish Territory

Other Symbols:

- Rivers and Streams at 1:24,000 Scale Resolution
- Township Lines
- Section Lines

Washington Department of FISH and WILDLIFE



AREA LOCATION

0 0.5 1

MILES

Native Mixes

Meadow

Sunmark's Meadow Mix is designed as a native habitat builder, combining native meadow grasses and wildflowers with an emphasis on blooming season and height compatibility. **Meadow Mix** is a beautiful balance of elegance and grace, a re-creation of the native meadows the settlers discovered on their way west.

Botanical Name	Mixture Composition	Percentage of Mix
Bromus carinatus	California Brome	33%
Festuca ovina	Sheep Fescue	20%
Deschampsia caspitosa	Tufted Hairgrass	10%
Koeleria cristata	Praire Junegrass	10%
Iris missouriensis	Wild Blue Iris	10%
Glardia pulchella	Indian Blanket	10%
Saliva coccinea	Blue Sage	4%
Eschscholzia californica	California Poppy	2%
Linaria maroccana	Spurred Snapdragon	1%

Bromus carinatus, Califronia Brome is a cool season native bunchgrass, adapted to a wide variety of areas; used for erosion protection it establishes well; excellent shade tolerance, with good forage value for wildlife and livestock.

Festuca ovina, Sheep Fescue is a densely tufted low-growing bunchgrass with an extensive root system that provides excellent drought tolerance; slow to establish, but will crowd out weeds. It is used in conservation seedings as a low growing, persistent ground cover.

Deschampsia caspitosa, Tufted Hairgrass is a perennial native bunchgrass ranging from Alaska to Arizona. It is a large, leafy and palatable grass that occurs on wet or damp sites.

Koeleria cristata, Prairie Junegrass is a cool season native perennial bunchgrass. One of the first grasses to recover after spring thaw, providing early forage for wildlife and livestock. Establishes easy and is a excellent choice for re-establishing disturbed sites.

Iris missouriensis, Wild Blue Iris large pale blue-violet flowers bloom March to June along meadows and streambanks from low valleys to 9,000 feet.

Glardia pulchella, Indian Blanket excellent for drier areas, roadsides and meadows, pinyon-juniper, ponderosa pine, aspen, lodgepole pine, and spruce-fir communities, full sun. Red, yellow, white and purple flowers bloom spring to late summer. Fast growing and easily established.

Saliva coccinea, Blue Sage very showy, aromatic, deep blue flowers grows in an elongated series of spears from 12 to 24 inches tall. Blooms from early spring to late summer.

Eschscholzia californica, California Poppy beautiful bright red/orange flowers blooms Spring to Fall on sunny and open hillsides. It is an easily established, and attractive species of poppy.

Linaria maroccana, Spurred Snapdragon fast growing, erect, bushy annual with lanced shaped leaves; small snapdragonlike flowers in shades of pink, purple, yellow, and white; blooms all summer.

Seeding Rate: 10 - 15 Pounds per Acre
1/2 Pound per 1000 sq. feet

Foothills

Sunmark's *Foothills* is an introduced seed mix that provides erosion control and good wildlife forage on low to mid-elevation sites. Quick to establish and very nutritious for deer and elk, Foothills will provide excellent erosion protection and forageability on weak or disturbed sites.

Botanical Name	Mixture Composition	Percentage of Mix
Lolium multiflorium tetraploid	Tetraploid Annual Ryegrass	25.0%
Dactylis glomerata var. tekapo	Tekapo Orchardgrass	25.0%
Trifolium repens var. NZ	NZ White Clover	15.0%
Lolium perenne tetraploid var. tonga	Tonga Tetraploid Perennial Rye	15.0%
Trifolium incarnatum	Crimson Clover	12.0%
Lotus corniculatus	Birdsfoot Trefoil	8.0%

Lolium multiflorium tetraploid, Tetraploid Annual Ryegrass has wider, more succulent leaves and larger plant cells with higher water content than diploid annual ryegrass. Rapid seedlings establishment and root growth are beneficial to aid in recovery of disturbed and erosion-susceptible sites.

Dactylis glomerata var. tekapo, Tekapo Orchardgrass will produce a very thick and dense stand that is able to persist even under hard, continuous grazing. Tekapo is tolerant of heat, moderate drought, low fertility, and most foliar diseases, including rust.

Trifolium repens var. NZ, NZ White Clover is a long-lived perennial suited primarily for pasture, but can be used for high quality hay and silage. White Clover is an important pasture legume in most temperate regions of the world. It can be grown under irrigation or on dry land where the moisture equivalent is comparable to 18 inches or more precipitation. It is best adapted to well-drained silt loam and clay soils, but is tolerant of poor drainage.

Lolium perenne tetraploid var. tonga, Tonga Tetraploid Perennial Ryegrass has demonstrated a very high rate of survivability, indicating it can withstand lack of adequate winter snow cover, summer drought, and excessive heat better than many grasses. Shown to have an alfalfa-equivalent maturity date, Tonga lends itself to excellent spring growth and high forage yields for multiple years. Tonga can be planted with alfalfa, clover, and other forage grasses to achieve an excellent grazing pasture, hay, silage, and green chop.

Trifolium incarnatum, Crimson Clover is a winter annual normally planted in the fall for forage, cover crops, or garden flowering. It grows vigorously on well-drained sandy or clay soils with medium-to-high fertility. Crimson Clover is an important winter annual forage, with growth continuing through winter. It thrives in a mixture with grasses, provides excellent winter grazing, and makes a good hay or cover crop.

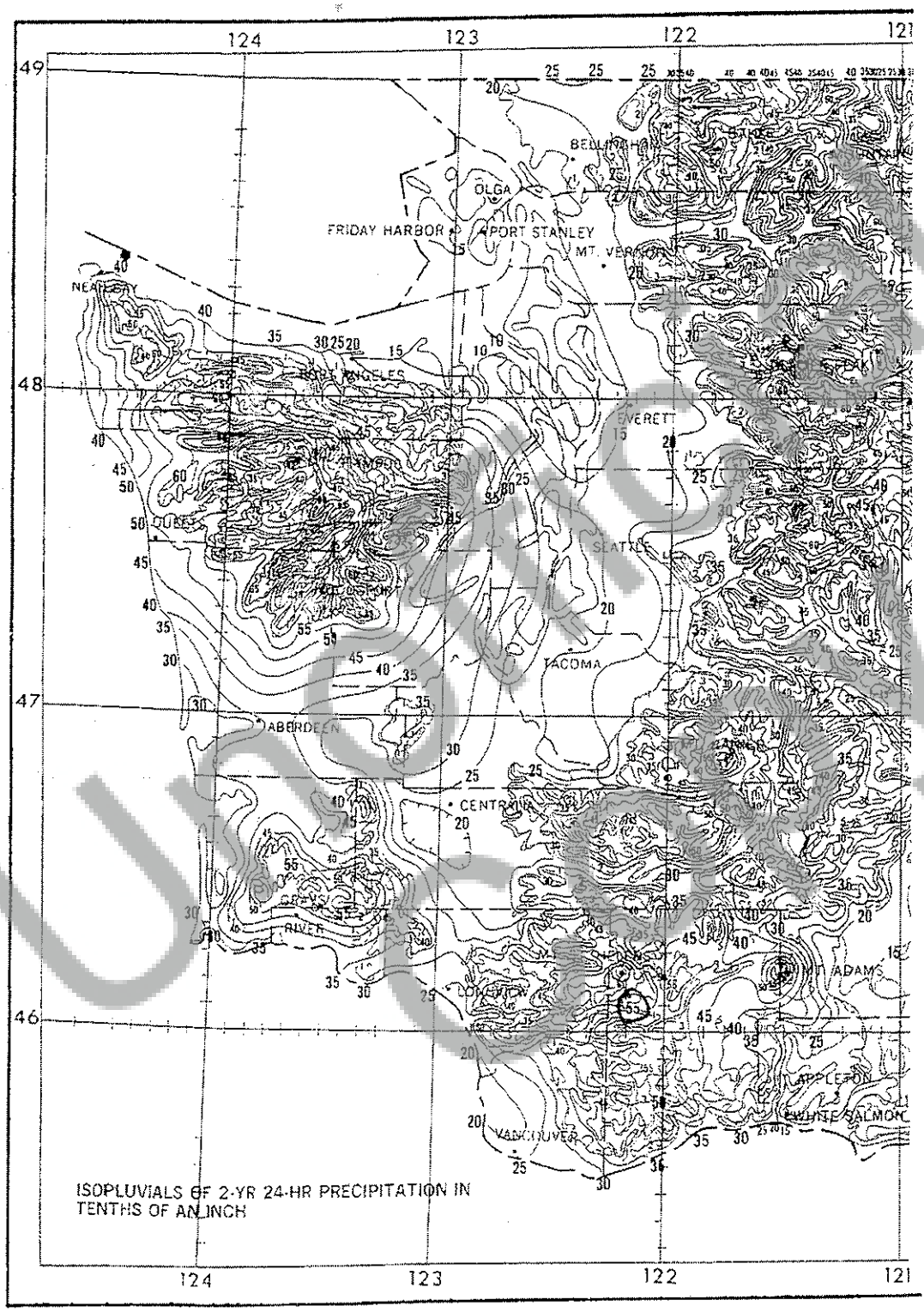
Lotus corniculatus, Birdsfoot Trefoil is a non-bloating legume that is suitable for use in permanent pastures or for use as a hay crop, either alone or sown in combination with grasses. For grazing, Birdsfoot Trefoil is used to best advantage in a rotational grazing system. Birdsfoot Trefoil performs well in areas that are not suitable for alfalfa production because of their acidity, poor drainage, or low fertility.

Seeding Rate: 50 Pounds per Acre
4 Pounds per 1000 sq feet

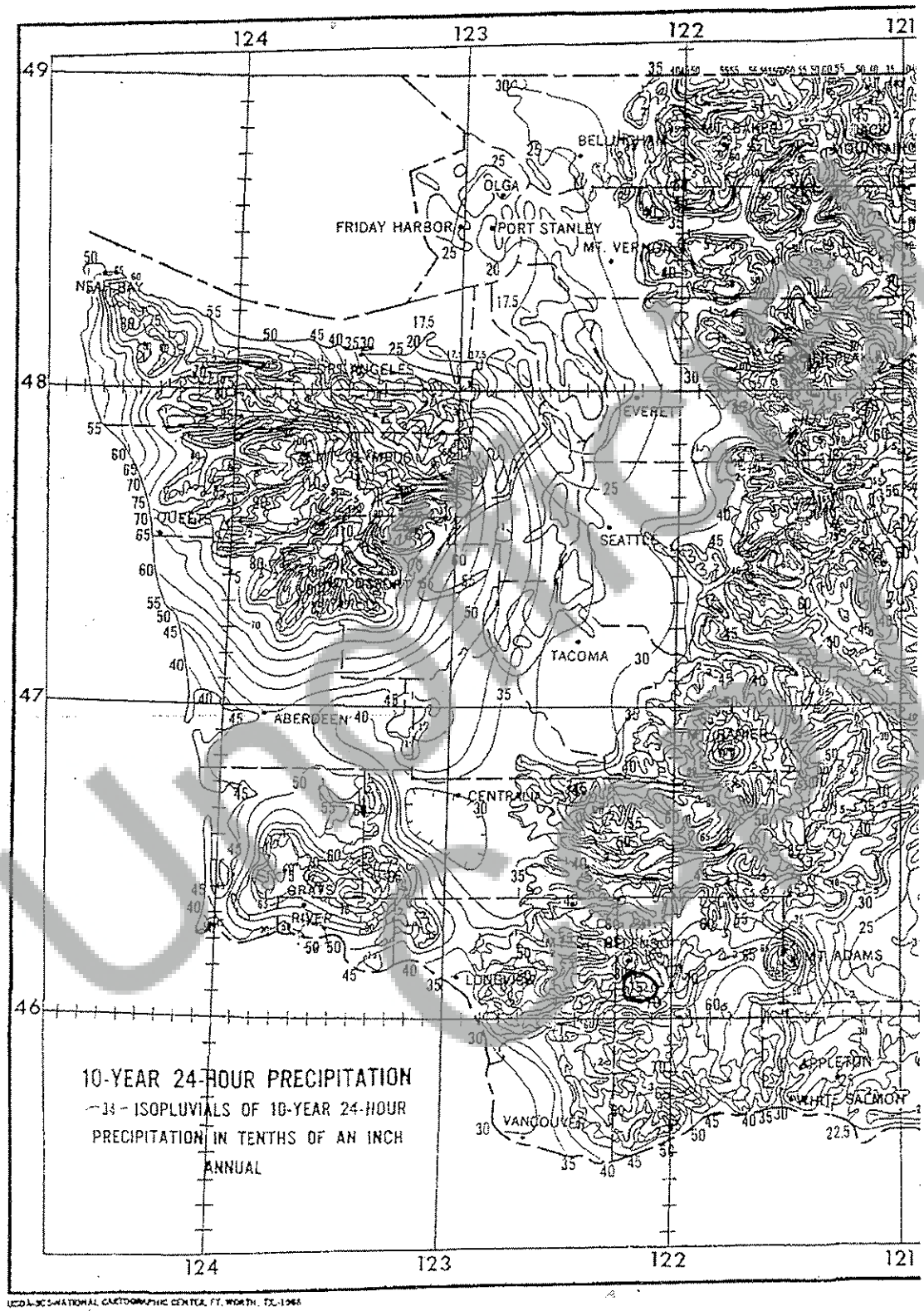
Appendix III-A
Isopluvial Maps for Design Storms

Included in this appendix are the 2, 10 and 100-year, 24-hour design storm and mean annual precipitation isopluvial maps for Western Washington. These have been taken from NOAA Atlas 2 "Precipitation - Frequency Atlas of the Western United States, Volume IX, Washington.

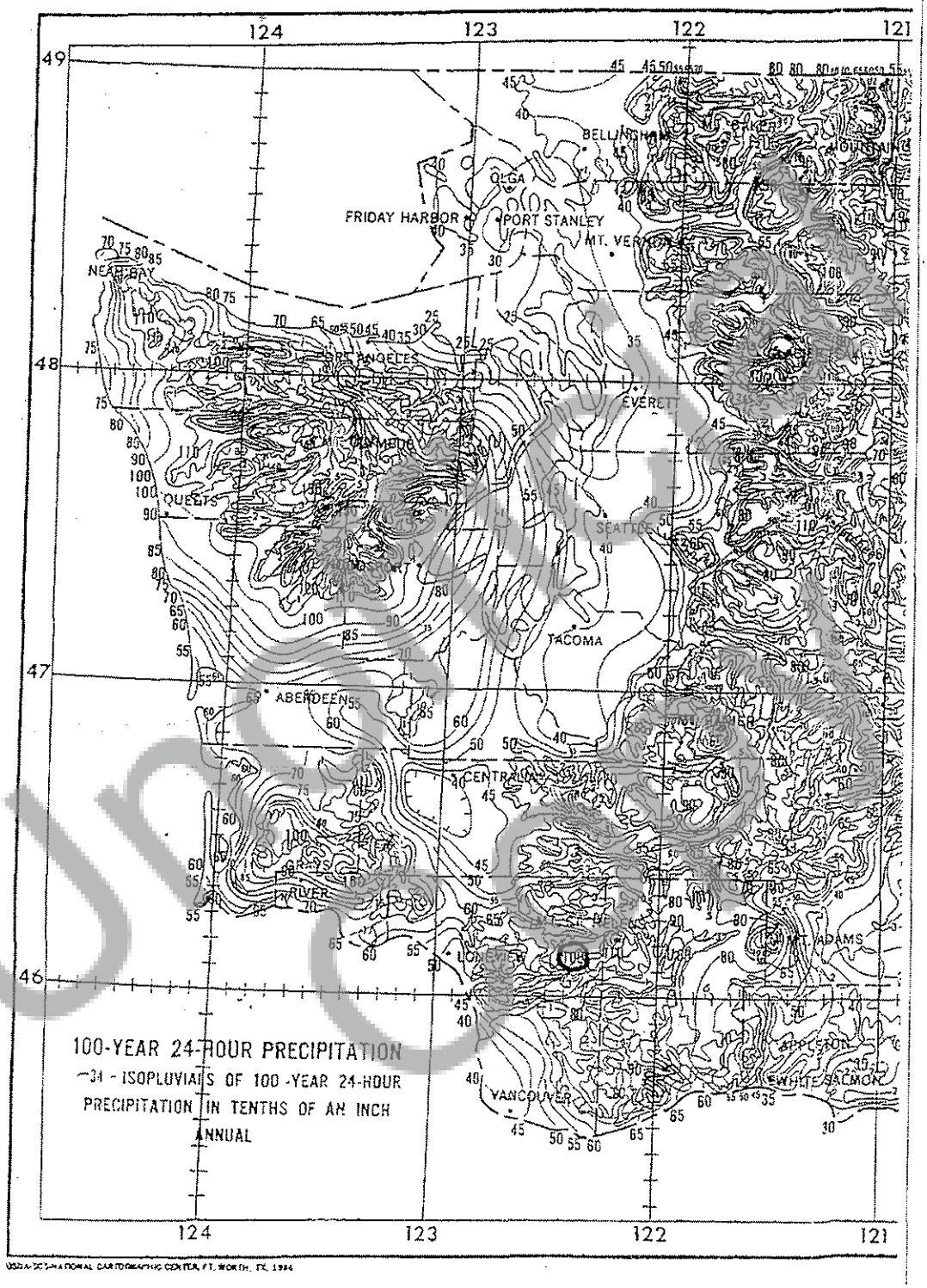
Western Washington Isopluvial 2-year, 24 hour



Western Washington Isopluvial 10-year, 24 hour



Western Washington Isopluvial 100-year, 24 hour



Cumulative Time	Total Precip	10 Min Inc. Precip		2 Year 24-hr-total=	5.5	Inches
0	0.4	0.022				
0.17	0.4	0.022				
0.33	0.4	0.022				
0.5	0.4	0.022				
0.67	0.4	0.022		Source: NOAA Atlas 2		
0.83	0.4	0.022		Precipitation-Frequency Atlas of		
1	0.4	0.022		the Western United States		
1.17	0.4	0.022		Volume IX - Washington		
1.33	0.4	0.022				
1.5	0.4	0.022				
1.67	0.5	0.0275		Methodology: King County Hydrograph Program		
1.83	0.5	0.0275				
2	0.5	0.0275				
2.17	0.5	0.0275				
2.33	0.5	0.0275				
2.5	0.5	0.0275				
2.67	0.6	0.033				
2.83	0.6	0.033				
3	0.6	0.033				
3.17	0.6	0.033				
3.33	0.6	0.033				
3.5	0.6	0.033				
3.67	0.7	0.0385				
3.83	0.7	0.0385				
4	0.7	0.0385				
4.17	0.7	0.0385				
4.33	0.7	0.0385				
4.5	0.7	0.0385				
4.67	0.82	0.0451				
4.83	0.82	0.0451				
5	0.82	0.0451				
5.17	0.82	0.0451				
5.33	0.82	0.0451				
5.5	0.82	0.0451				
5.67	0.95	0.05225				
5.83	0.95	0.05225				
6	0.95	0.05225				
6.17	0.95	0.05225				
6.33	0.95	0.05225				
6.5	0.95	0.05225				
6.67	1.34	0.0737				
6.83	1.34	0.0737				
7	1.34	0.0737				
7.17	1.8	0.099				
7.33	1.8	0.099		PEAK 1 HR PRECIP = 0.9295"		
7.5	3.4	0.187				
7.67	5.4	0.297				

7.83	2.7	0.1485					
8	1.8	0.099					
8.17	1.34	0.0737					
8.33	1.34	0.0737					
8.5	1.34	0.0737					
8.67	0.88	0.0484					
8.83	0.88	0.0484					
9	0.88	0.0484					
9.17	0.88	0.0484					
9.33	0.88	0.0484					
9.5	0.88	0.0484					
9.67	0.88	0.0484					
9.83	0.88	0.0484					
10	0.88	0.0484					
10.17	0.88	0.0484					
10.33	0.88	0.0484					
10.5	0.88	0.0484					
10.67	0.72	0.0396					
10.83	0.72	0.0396					
11	0.72	0.0396					
11.17	0.72	0.0396					
11.33	0.72	0.0396					
11.5	0.72	0.0396					
11.67	0.72	0.0396					
11.83	0.72	0.0396					
12	0.72	0.0396					
12.17	0.72	0.0396					
12.33	0.72	0.0396					
12.5	0.72	0.0396					
12.67	0.57	0.03135					
12.83	0.57	0.03135					
13	0.57	0.03135					
13.17	0.57	0.03135					
13.33	0.57	0.03135					
13.5	0.57	0.03135					
13.67	0.57	0.03135					
13.83	0.57	0.03135					
14	0.57	0.03135					
14.17	0.57	0.03135					
14.33	0.57	0.03135					
14.5	0.57	0.03135					
14.67	0.5	0.0275					
14.83	0.5	0.0275					
15	0.5	0.0275					
15.17	0.5	0.0275					
15.33	0.5	0.0275					
15.5	0.5	0.0275					
15.67	0.5	0.0275					
15.83	0.5	0.0275					

16	0.5	0.0275					
16.17	0.5	0.0275					
16.33	0.5	0.0275					
16.5	0.5	0.0275					
16.67	0.4	0.022					
16.83	0.4	0.022					
17	0.4	0.022					
17.17	0.4	0.022					
17.33	0.4	0.022					
17.5	0.4	0.022					
17.67	0.4	0.022					
17.83	0.4	0.022					
18	0.4	0.022					
18.17	0.4	0.022					
18.33	0.4	0.022					
18.5	0.4	0.022					
18.67	0.4	0.022					
18.83	0.4	0.022					
19	0.4	0.022					
19.17	0.4	0.022					
19.33	0.4	0.022					
19.5	0.4	0.022					
19.67	0.4	0.022					
19.83	0.4	0.022					
20	0.4	0.022					
20.17	0.4	0.022					
20.33	0.4	0.022					
20.5	0.4	0.022					
20.67	0.4	0.022					
20.83	0.4	0.022					
21	0.4	0.022					
21.17	0.4	0.022					
21.33	0.4	0.022					
21.5	0.4	0.022					
21.67	0.4	0.022					
21.83	0.4	0.022					
22	0.4	0.022					
22.17	0.4	0.022					
22.33	0.4	0.022					
22.5	0.4	0.022					
22.67	0.4	0.022					
22.83	0.4	0.022					
23	0.4	0.022					
23.17	0.4	0.022					
23.33	0.4	0.022					
23.5	0.4	0.022					
23.67	0.4	0.022					
23.83	0.4	0.022					

Cumulative Time	Total Precip	10 Min Inc. Precip		10 Year 24-hr-total=	7.5	Inches
0	0.4	0.03				
0.17	0.4	0.03				
0.33	0.4	0.03				
0.5	0.4	0.03				
0.67	0.4	0.03		Source: NOAA Atlas 2		
0.83	0.4	0.03		Precipitation-Frequency Atlas of		
1	0.4	0.03		the Western United States		
1.17	0.4	0.03		Volume IX - Washington		
1.33	0.4	0.03				
1.5	0.4	0.03				
1.67	0.5	0.0375		Methodology: King County Hydrograph Program		
1.83	0.5	0.0375				
2	0.5	0.0375				
2.17	0.5	0.0375				
2.33	0.5	0.0375				
2.5	0.5	0.0375				
2.67	0.6	0.045				
2.83	0.6	0.045				
3	0.6	0.045				
3.17	0.6	0.045				
3.33	0.6	0.045				
3.5	0.6	0.045				
3.67	0.7	0.0525				
3.83	0.7	0.0525				
4	0.7	0.0525				
4.17	0.7	0.0525				
4.33	0.7	0.0525				
4.5	0.7	0.0525				
4.67	0.82	0.0615				
4.83	0.82	0.0615				
5	0.82	0.0615				
5.17	0.82	0.0615				
5.33	0.82	0.0615				
5.5	0.82	0.0615				
5.67	0.95	0.07125				
5.83	0.95	0.07125				
6	0.95	0.07125				
6.17	0.95	0.07125				
6.33	0.95	0.07125				
6.5	0.95	0.07125				
6.67	1.34	0.1005				
6.83	1.34	0.1005				
7	1.34	0.1005				
7.17	1.8	0.135				
7.33	1.8	0.135		PEAK 1 HR PRECIP = 1.2675"		
7.5	3.4	0.255				
7.67	5.4	0.405				

7.83	2.7	0.2025
8	1.8	0.135
8.17	1.34	0.1005
8.33	1.34	0.1005
8.5	1.34	0.1005
8.67	0.88	0.066
8.83	0.88	0.066
9	0.88	0.066
9.17	0.88	0.066
9.33	0.88	0.066
9.5	0.88	0.066
9.67	0.88	0.066
9.83	0.88	0.066
10	0.88	0.066
10.17	0.88	0.066
10.33	0.88	0.066
10.5	0.88	0.066
10.67	0.72	0.054
10.83	0.72	0.054
11	0.72	0.054
11.17	0.72	0.054
11.33	0.72	0.054
11.5	0.72	0.054
11.67	0.72	0.054
11.83	0.72	0.054
12	0.72	0.054
12.17	0.72	0.054
12.33	0.72	0.054
12.5	0.72	0.054
12.67	0.57	0.04275
12.83	0.57	0.04275
13	0.57	0.04275
13.17	0.57	0.04275
13.33	0.57	0.04275
13.5	0.57	0.04275
13.67	0.57	0.04275
13.83	0.57	0.04275
14	0.57	0.04275
14.17	0.57	0.04275
14.33	0.57	0.04275
14.5	0.57	0.04275
14.67	0.5	0.0375
14.83	0.5	0.0375
15	0.5	0.0375
15.17	0.5	0.0375
15.33	0.5	0.0375
15.5	0.5	0.0375
15.67	0.5	0.0375
15.83	0.5	0.0375

16	0.5	0.0375					
16.17	0.5	0.0375					
16.33	0.5	0.0375					
16.5	0.5	0.0375					
16.67	0.4	0.03					
16.83	0.4	0.03					
17	0.4	0.03					
17.17	0.4	0.03					
17.33	0.4	0.03					
17.5	0.4	0.03					
17.67	0.4	0.03					
17.83	0.4	0.03					
18	0.4	0.03					
18.17	0.4	0.03					
18.33	0.4	0.03					
18.5	0.4	0.03					
18.67	0.4	0.03					
18.83	0.4	0.03					
19	0.4	0.03					
19.17	0.4	0.03					
19.33	0.4	0.03					
19.5	0.4	0.03					
19.67	0.4	0.03					
19.83	0.4	0.03					
20	0.4	0.03					
20.17	0.4	0.03					
20.33	0.4	0.03					
20.5	0.4	0.03					
20.67	0.4	0.03					
20.83	0.4	0.03					
21	0.4	0.03					
21.17	0.4	0.03					
21.33	0.4	0.03					
21.5	0.4	0.03					
21.67	0.4	0.03					
21.83	0.4	0.03					
22	0.4	0.03					
22.17	0.4	0.03					
22.33	0.4	0.03					
22.5	0.4	0.03					
22.67	0.4	0.03					
22.83	0.4	0.03					
23	0.4	0.03					
23.17	0.4	0.03					
23.33	0.4	0.03					
23.5	0.4	0.03					
23.67	0.4	0.03					
23.83	0.4	0.03					

Cumulative Time	Total Precip	10 Min Inc. Precip		100 Year 24-hr-total=	10	Inches
0	0.4	0.04				
0.17	0.4	0.04				
0.33	0.4	0.04				
0.5	0.4	0.04				
0.67	0.4	0.04		Source: NOAA Atlas 2		
0.83	0.4	0.04		Precipitation-Frequency Atlas of		
1	0.4	0.04		the Western United States		
1.17	0.4	0.04		Volume IX - Washington		
1.33	0.4	0.04				
1.5	0.4	0.04				
1.67	0.5	0.05		Methodology: King County Hydrograph Program		
1.83	0.5	0.05				
2	0.5	0.05				
2.17	0.5	0.05				
2.33	0.5	0.05				
2.5	0.5	0.05				
2.67	0.6	0.06				
2.83	0.6	0.06				
3	0.6	0.06				
3.17	0.6	0.06				
3.33	0.6	0.06				
3.5	0.6	0.06				
3.67	0.7	0.07				
3.83	0.7	0.07				
4	0.7	0.07				
4.17	0.7	0.07				
4.33	0.7	0.07				
4.5	0.7	0.07				
4.67	0.82	0.082				
4.83	0.82	0.082				
5	0.82	0.082				
5.17	0.82	0.082				
5.33	0.82	0.082				
5.5	0.82	0.082				
5.67	0.95	0.095				
5.83	0.95	0.095				
6	0.95	0.095				
6.17	0.95	0.095				
6.33	0.95	0.095				
6.5	0.95	0.095				
6.67	1.34	0.134				
6.83	1.34	0.134				
7	1.34	0.134				
7.17	1.8	0.18				
7.33	1.8	0.18		PEAK 1 HR PRECIP = 1.69"		
7.5	3.4	0.34				
7.67	5.4	0.54				

7.83	2.7	0.27					
8	1.8	0.18					
8.17	1.34	0.134					
8.33	1.34	0.134					
8.5	1.34	0.134					
8.67	0.88	0.088					
8.83	0.88	0.088					
9	0.88	0.088					
9.17	0.88	0.088					
9.33	0.88	0.088					
9.5	0.88	0.088					
9.67	0.88	0.088					
9.83	0.88	0.088					
10	0.88	0.088					
10.17	0.88	0.088					
10.33	0.88	0.088					
10.5	0.88	0.088					
10.67	0.72	0.072					
10.83	0.72	0.072					
11	0.72	0.072					
11.17	0.72	0.072					
11.33	0.72	0.072					
11.5	0.72	0.072					
11.67	0.72	0.072					
11.83	0.72	0.072					
12	0.72	0.072					
12.17	0.72	0.072					
12.33	0.72	0.072					
12.5	0.72	0.072					
12.67	0.57	0.057					
12.83	0.57	0.057					
13	0.57	0.057					
13.17	0.57	0.057					
13.33	0.57	0.057					
13.5	0.57	0.057					
13.67	0.57	0.057					
13.83	0.57	0.057					
14	0.57	0.057					
14.17	0.57	0.057					
14.33	0.57	0.057					
14.5	0.57	0.057					
14.67	0.5	0.05					
14.83	0.5	0.05					
15	0.5	0.05					
15.17	0.5	0.05					
15.33	0.5	0.05					
15.5	0.5	0.05					
15.67	0.5	0.05					
15.83	0.5	0.05					

16	0.5	0.05					
16.17	0.5	0.05					
16.33	0.5	0.05					
16.5	0.5	0.05					
16.67	0.4	0.04					
16.83	0.4	0.04					
17	0.4	0.04					
17.17	0.4	0.04					
17.33	0.4	0.04					
17.5	0.4	0.04					
17.67	0.4	0.04					
17.83	0.4	0.04					
18	0.4	0.04					
18.17	0.4	0.04					
18.33	0.4	0.04					
18.5	0.4	0.04					
18.67	0.4	0.04					
18.83	0.4	0.04					
19	0.4	0.04					
19.17	0.4	0.04					
19.33	0.4	0.04					
19.5	0.4	0.04					
19.67	0.4	0.04					
19.83	0.4	0.04					
20	0.4	0.04					
20.17	0.4	0.04					
20.33	0.4	0.04					
20.5	0.4	0.04					
20.67	0.4	0.04					
20.83	0.4	0.04					
21	0.4	0.04					
21.17	0.4	0.04					
21.33	0.4	0.04					
21.5	0.4	0.04					
21.67	0.4	0.04					
21.83	0.4	0.04					
22	0.4	0.04					
22.17	0.4	0.04					
22.33	0.4	0.04					
22.5	0.4	0.04					
22.67	0.4	0.04					
22.83	0.4	0.04					
23	0.4	0.04					
23.17	0.4	0.04					
23.33	0.4	0.04					
23.5	0.4	0.04					
23.67	0.4	0.04					
23.83	0.4	0.04					

DAC Short Plat

Photo 1. View from building site of Lot 1, looking west. USFS Highway 90 can be seen.

Photo 2. Same position as Photo 1, but panning to the south to show the access road construction.

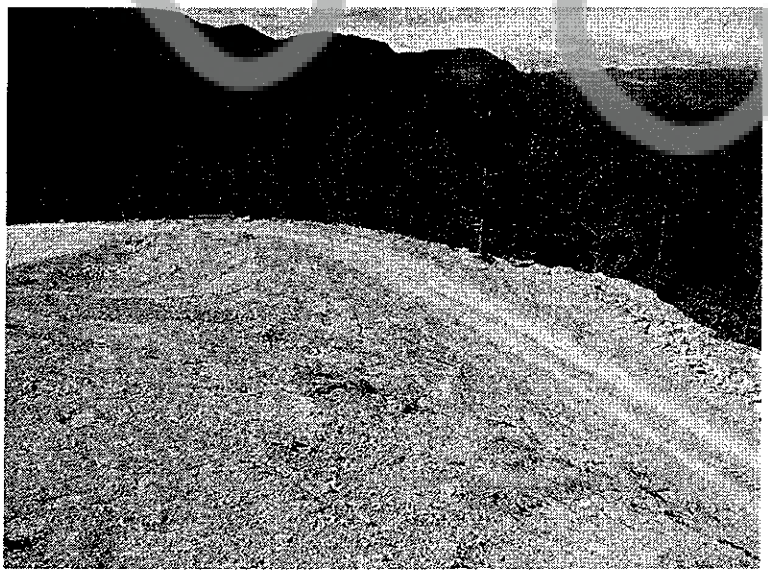


Photo 3. Same position as Photos 1 and 2, panning further south to show access road construction.

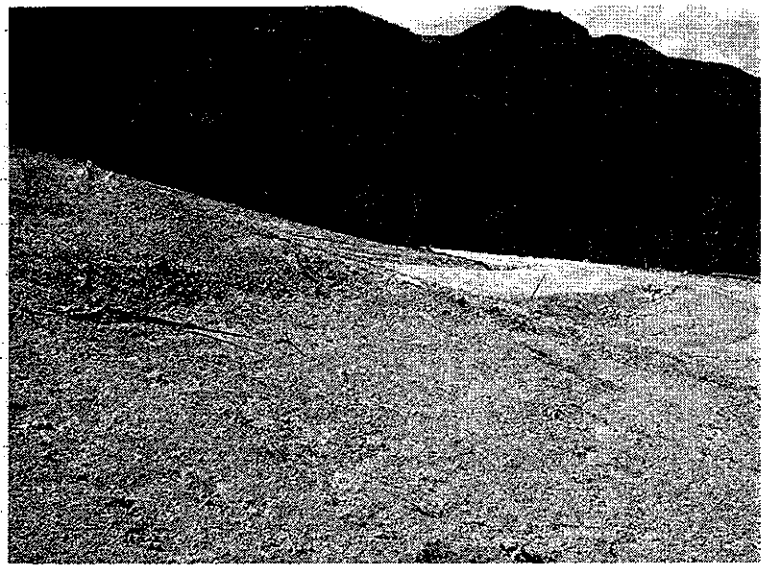


Photo 4. Another view of the access road construction.

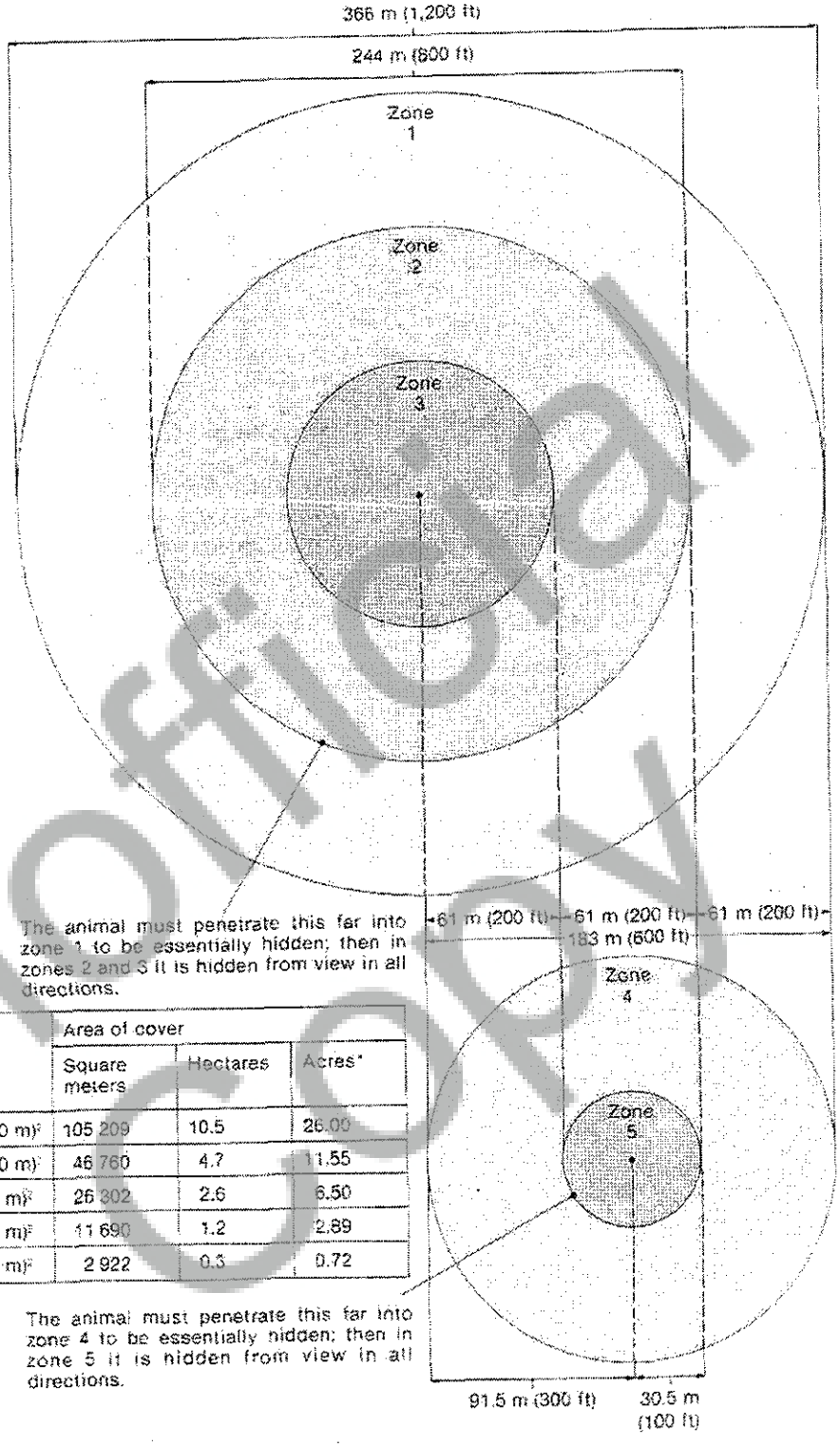
Photo 5. View from the building site of lot 1 looking through the buffer strip towards the building site of lot 2.

Figure 60. Patches of hiding cover can vary in diameter and still be of optimum size.

A circular cover patch with a diameter as large as 366 meters (1,200 ft), above right, could qualify as optimum. All zones within the area are heavily used by deer and elk. This allows maximum use of the maximum area. A larger patch would produce an interior zone of less than maximum use.

A circular cover patch with a diameter as small as 183 meters (600 ft), below, could qualify as optimum. All points in this patch are within the area heavily used by deer and elk and some effective hiding area remains. Smaller patches would have an interior hiding zone of inadequate size.

1 sight distance = 61 meters (200 ft).

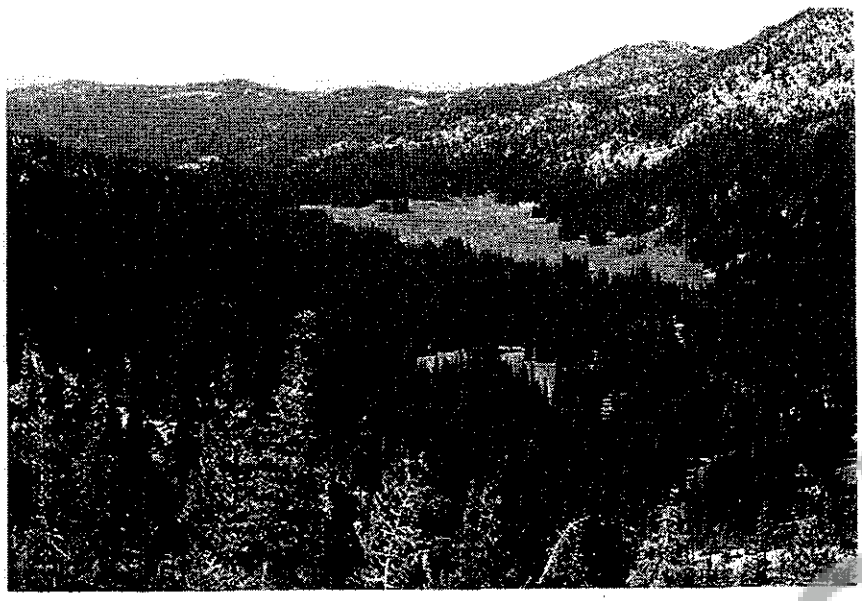


The animal must penetrate this far into zone 1 to be essentially hidden; then in zones 2 and 3 it is hidden from view in all directions.

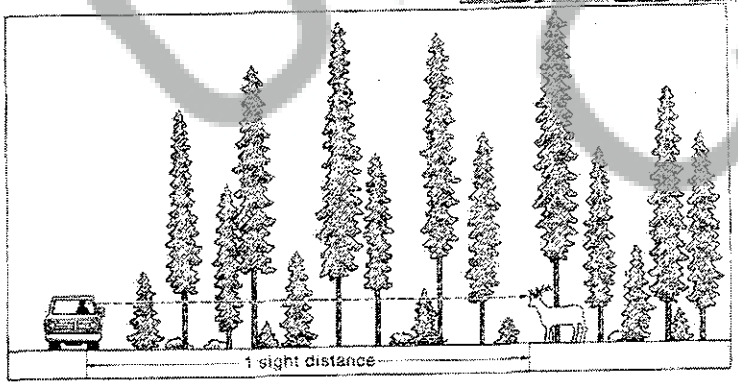
The animal must penetrate this far into zone 4 to be essentially hidden; then in zone 5 it is hidden from view in all directions.

Hiding cover zones	Radius		πr^2 = area	Area of cover		
	Meters	Feet		Square meters	Hectares	Acres*
1 + 2 + 3	183.0	600	(3.1416) (183.0 m)^2	105 209	10.5	26.00
2 + 3	122.0	400	(3.1416) (122.0 m)^2	46 760	4.7	11.55
4 + 5	91.5	300	(3.1416) (91.5 m)^2	26 302	2.6	6.50
3	61.0	200	(3.1416) (61.0 m)^2	11 690	1.2	2.89
5	30.5	100	(3.1416) (30.5 m)^2	2 922	0.3	0.72

*4 047 m^2 = 1 acre



Forage areas for elk. Above: summer range. Below: winter range.



Wet meadows provide water and forage for deer and elk on summer range.

Figure 58. Sight distance is the distance at which 90 percent or more of a deer or elk is hidden from an observer. Hiding cover exists when 90 percent or more of a standing deer or elk is hidden at a distance of 61 meters (200 ft) or less.

Forage Areas

Forage for both deer and elk is produced to some degree in all forest environments. Cover areas also produce forage, but in lesser quantity and often of lower quality. Optimum forage areas are basically different from optimum cover areas. Note in figure 65 that the yield of grasses, forbs, and shrubs is directly related to the percent of canopy closure in a pine forest (McConnell and Smith 1965, 1970; Skovlin et al. 1976; Irwin 1976).

Forage areas include all natural and manmade openings and forest stands that do not qualify as either hiding or thermal cover. In the Blue Mountains natural openings may result from shallow soils or sites that are either too dry or too wet for growing trees.

Deer and elk have been reported to use manmade openings in the forest more than natural openings (Reynolds 1966a). Work by Hershey and Leege (1976) in Idaho indicated that clearcuts were not more heavily used by elk than would be expected from the percent of the area clearcut. In Montana, Marcum (1976) recorded that elk actually avoided clearcuts. In Wyoming, Davis (1977) found significant use of clearcuts by deer and elk but more use in natural openings and burned areas. Information from the Blue Mountains indicates that elk readily use clearcuts, especially in late summer and early fall (Pedersen, unpublished, see "References Cited").

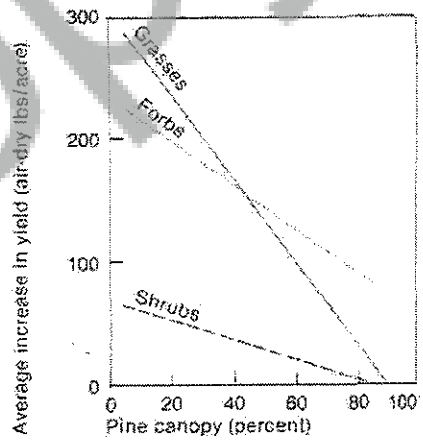


Figure 65. Relationship between percent of canopy closure and amount of grass, forb, and shrub vegetation in a ponderosa pine stand in eastern Washington (McConnell and Smith 1970).

For maximum use by deer and elk, forage areas should have no point farther than 183 meters (600 ft) from the edge of cover (fig. 66); use becomes insignificant beyond that point (fig. 67) (Reynolds 1962, 1966a; Harper 1969; Kirsch 1962; Hershey and Leege 1976). This allows circular forage areas of up to 366 meters (1,200 ft) wide, or 10.5 hectares (26 acres), to qualify as an optimum habitat arrangement (fig. 67). For summer ranges in Montana, Lyon (1976) suggested that openings of from 4 to 16 hectares (10 to 40 acres) would be acceptable to elk if slash were adequately cleaned up after logging.

Responses to Altered Cover-Forage Area Ratios

Forest land managers in the Blue Mountains needed a relatively simple system to help predict the response of deer and elk to forest management practices. The predictive mechanism selected was the changing cover-forage area ratios produced by timber management activities and the potential response of deer and elk to such changes.

Deer and elk are quite mobile and, unfortunately, no one has been able to develop detailed information on their response to changing cover-forage area ratios. In the absence of such data, information was generated by soliciting estimates from 15 wildlife biologists knowledgeable about deer and elk habitat requirements in the Blue Mountains. This approach was a modification of the "Delphi Technique" (Helmer-Hirschberg and Rescher 1960, Gordon and Helmer-Hirschberg 1964). Estimates were based on: (1) information about the way deer and elk use habitat in relation to forest-opening edges, and (2) the definition of optimum habitat as the maximum proper use over the maximum possible area.

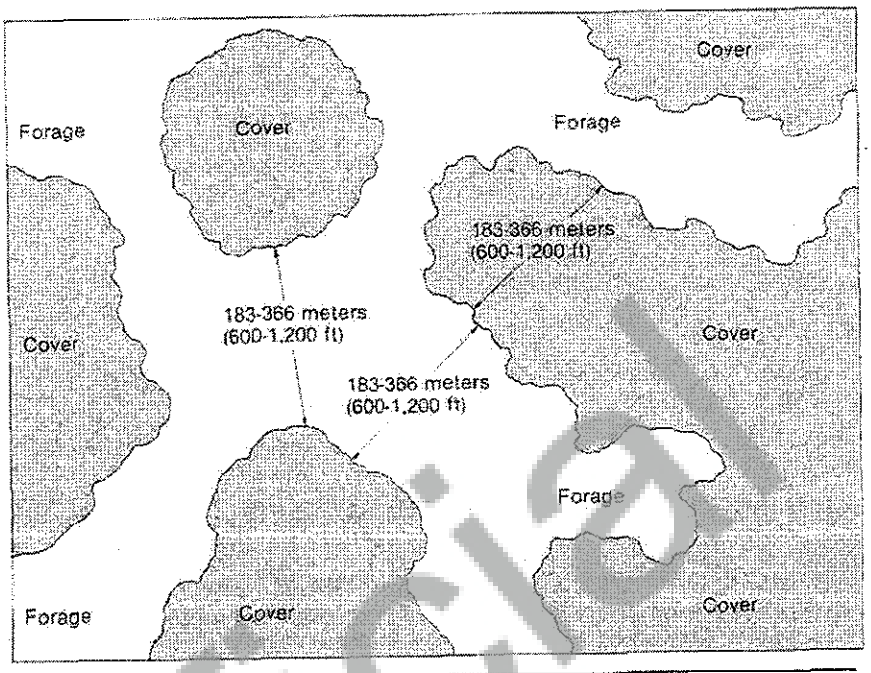


Figure 66. Cover patches properly spaced to obtain maximum possible use of the maximum area by deer and elk.

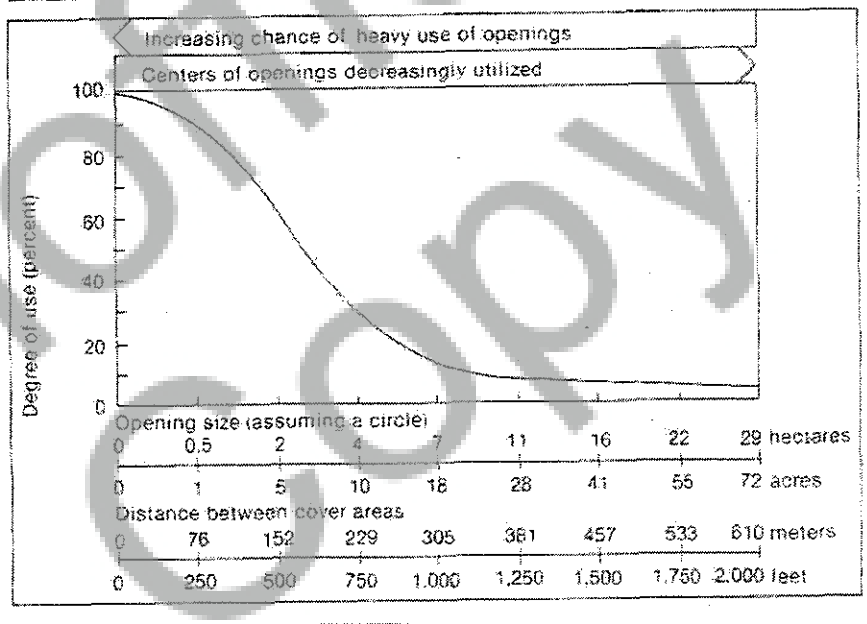


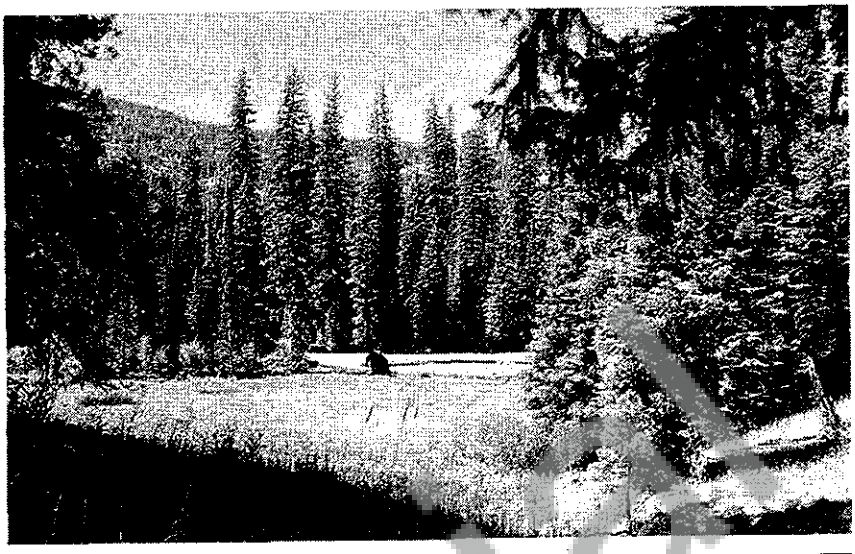
Figure 67. Relationship between the size of forage openings and use by deer and elk (based on data from Harper 1969 and Reynolds 1962, 1966a).

Optimum Mix of Types of Cover

On summer and spring-fall ranges the optimum mix of types of cover for elk is approximately 20-percent hiding cover, 10-percent thermal cover, 10-percent hiding or thermal cover, and 60-percent forage areas (fig. 71). Areas that qualify as either hiding or thermal cover should be counted in the more limited type. For example, if 5 percent is hiding cover, 20 percent thermal cover, and 10 percent either hiding or thermal cover, then the 10 percent should be classed as hiding cover because it is the more limited type. On winter ranges, however, the discretionary balance should always be assigned to thermal cover.

The amount of cover and forage areas for deer on summer and spring-fall ranges should be approximately 20-percent hiding cover; 10-percent thermal cover; 5-percent fawning cover; 5-percent hiding, thermal, or fawning cover; and 60-percent forage areas (fig. 72).

On ranges that are not used for fawning, the 5 percent in fawning cover may be added to either hiding or thermal cover. In such cases, optimum cover would be composed of 20- to 30-percent hiding cover and 10- to 20-percent thermal cover. On winter ranges the discretionary balance should be allocated to thermal cover. If the requirements of elk are met, deer will be adequately cared for if they occupy the same range. These distributions of cover types are not nearly as restrictive as they appear since many areas will qualify as both hiding and thermal cover.



Habitat for deer and elk should contain an optimum mix of thermal and hiding cover and forage areas.

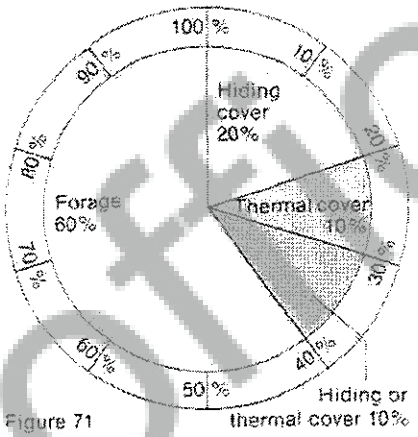


Figure 71. Optimum mix of cover and forage areas for elk.

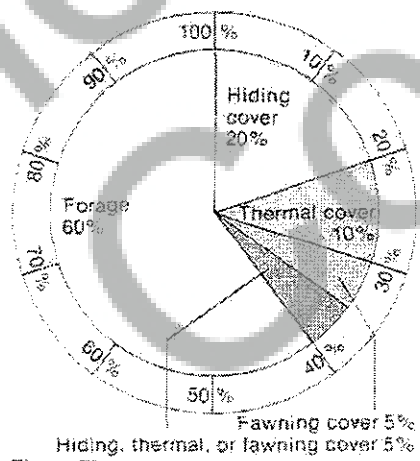


Figure 72. Optimum mix of cover and forage areas for deer.

Figure 71

Figure 72

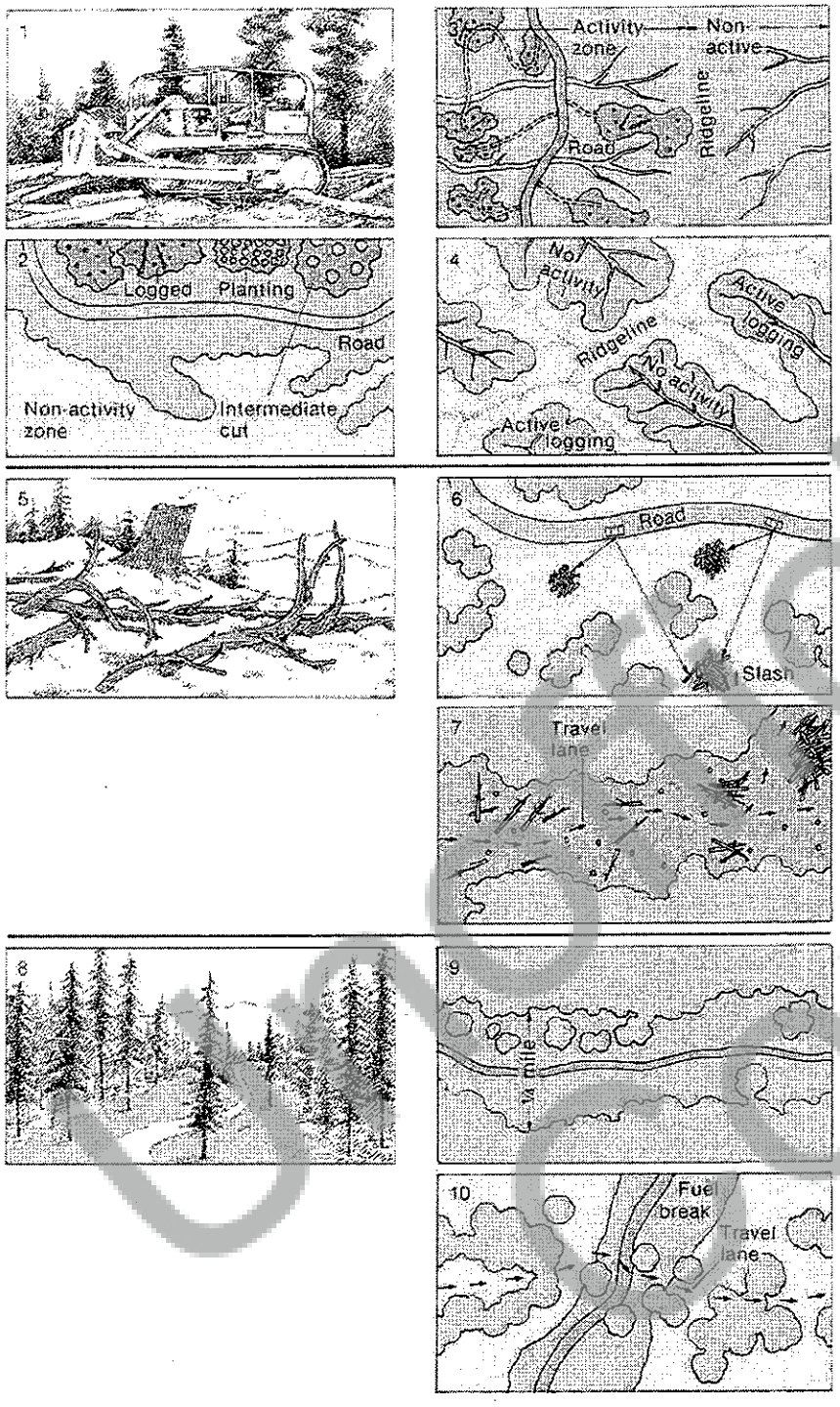


Figure 76. Ways to minimize the adverse impacts of timber management operations on habitat for deer and elk.

Timber Management Operations

1. Timber management operations are a dramatic source of disturbance to deer and elk, particularly elk.

2. Concentrate management activities within the smallest possible area and the shortest possible period of time (Hershey and Leege 1976, Ward 1976). The more severe the disturbance, the more important this becomes.

3. Maintain non-activity zones adjacent to zones of concentrated activity (Montana Cooperative Elk-Logging Study 1975).

4. Confine timber operations to a single drainage at a time. Do not log adjacent drainages simultaneously; disturbance seems to be reduced by ridgelines (Lyon 1975, Ward 1976).

Slash Treatment

5-6. Slash can be windrowed or piled to break long sight distances and provide cover in critical areas.

7. Logging slash or dead and down material can affect the way elk use an area (Wallmo 1969). Depths of more than 0.61 meter (2 ft) decrease use of both timber stands and clearcuts (Lyon 1975, 1976). Reduction of dead and down material to MM standards (USDA Forest Service 1968) will minimize the problem.

Shaded or Other Fuel Breaks

8. Fuel breaks in forest cover may be necessary as part of fire management operations. They are considered forage areas, as they do not meet the definition of cover.

9. Adverse impacts of shaded or other fuel breaks can be minimized by keeping sight distances to less than 0.4 kilometer (0.25 mi).

10. Careful attention should be paid to the place where travel lanes cross fuel breaks. Fuel breaks should be as narrow as possible and still meet fire control objectives.

Cover

The definition of optimum cover as 40 percent of the total area is based on an average need. More cover may be needed in critical areas. Winter ranges, for example, must be considered individually and only after determining how the animals use each area.

Careful long-range planning is essential to maintain the right cover-forage area ratios and to maintain the correct size, shape, and arrangement of cover and forage areas.

Cover is used most heavily when adjacent to wet areas such as meadows, streams, and springs (Montana Cooperative Elk-Logging Study 1975).

Cover is less used when adjacent to, or bisected by, traveled roads (Perry and Overly 1977, Ward 1976).

Travel Lanes

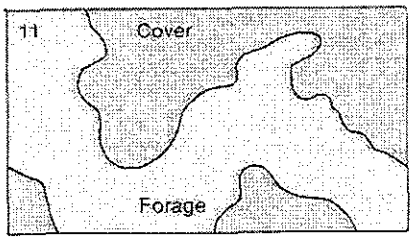
14. Travel lanes conceal deer and elk moving across areas that lack cover. Timbered "stringers" across otherwise open slopes are one example.

15. Cover within known travel routes should be maintained.

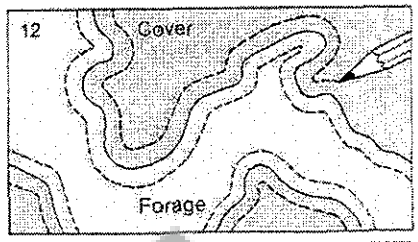
16-17. Prime locations for travel lanes are: (1) areas of least topographic resistance to deer and elk movement such as saddles and gaps, bands around ridges, and stream courses; (2) seeps, springs, and riparian zones; and (3) cover areas in locations that are generally deficient in cover.

18. The size, shape, and distribution of travel lanes should be considered. One primary need is for continuous or relatively continuous cover between timbered drainages. Non-continuous patches of cover separated by 91 meters (300 ft) or less often serve as travel lanes.

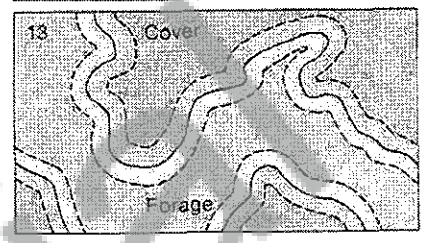
How to Determine Deviation from Optimum Cover-Forage Area Arrangement:



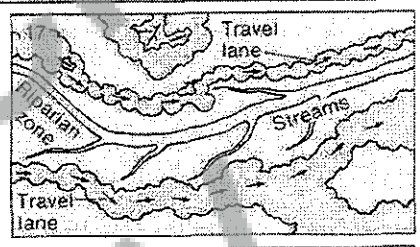
11. The situation—a mixture of forage and cover areas.

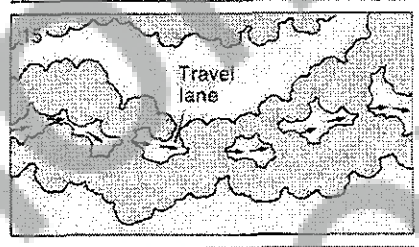


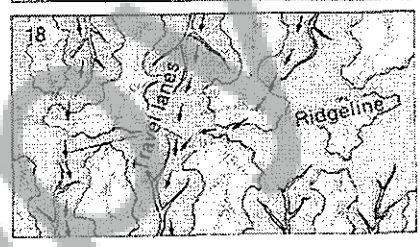
12. Delineate the zone of primary use by drawing dotted lines 183 meters (600 ft) on both sides of the cover edge.

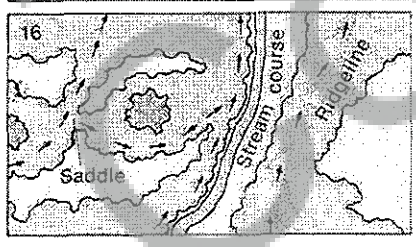


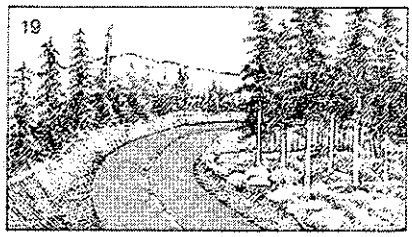
13. Shade all areas greater than 183 meters (600 ft) from the cover edge. These are cover and forage areas of less than maximum use; they may be enhanced by creating new cover in the forage areas and new forage in the cover areas.

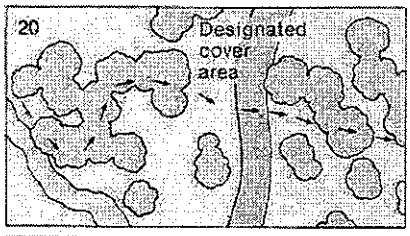


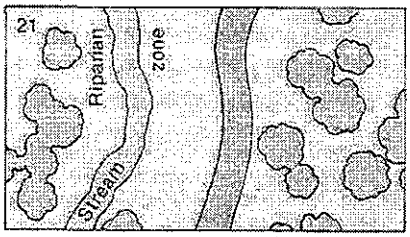


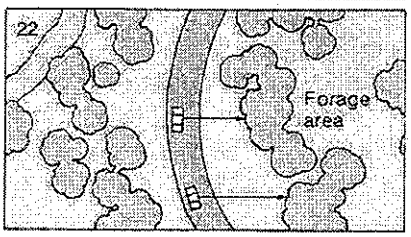


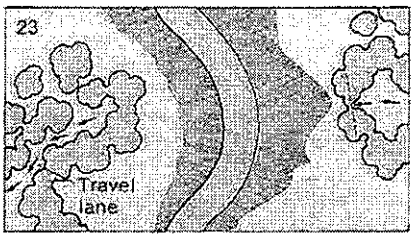


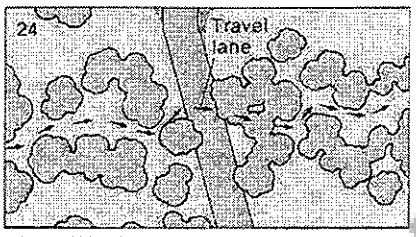


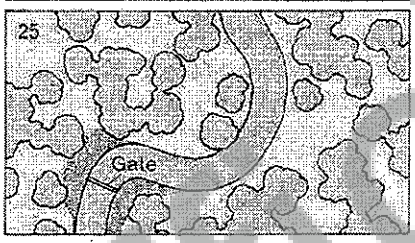


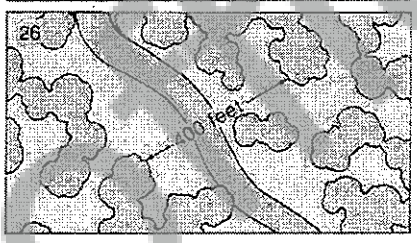


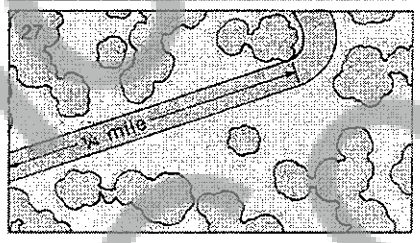












Roads

19-20. Roads reduce the effectiveness of areas for cover.

21. Riparian zones are the most heavily used habitat. Roads that traverse riparian zones reduce use of this important habitat by deer and elk.

22. Insure the usability of forage areas—meadows, clearcuts, and other openings—by screening them from main roads with vegetation or topography (Ward 1976).

23. Cuts and fills near roads should not block travel routes for deer and elk.

24. Where roads cut across areas managed for deer and elk travel routes, a minimum right-of-way or crossing distance should be planned (Montana Cooperative Elk-Logging Study 1975).

25. Roads should be laid out to facilitate closure with gates. It may become necessary to close a road in order to protect elk and deer from harassment or insure quality hunting (Coggins 1976, Perry and Overly 1977).

26. Maintain roadside vegetation as hiding cover wherever possible (Ward 1976). Where silvicultural operations occur in such areas, care should be taken not to open the areas to more than two maximum sight distances (122 meters or 400 feet). This reduces disturbance to deer and elk and makes it more difficult to hunt them from roads.

27. Avoid locating straight stretches of road of more than 0.4 kilometer (0.25 mi) in forested sites. This will increase the cover value for deer and elk and reduce hunting from roads (Montana Cooperative Elk-Logging Study 1975). Roads should be held to a minimum in areas managed for deer and elk. As many roads as possible should be closed (Perry and Overly 1977, Thiessen 1976).

OPTICAL DENSITY METHODS

A modified optical density procedure was used to estimate the approximate cover a vegetated buffer provides a large game animal such as deer or elk. A 3X5 foot rectangular white poster board was placed two to four meters into in a vegetated buffer in a location the wildlife biologist determined that an animal may hide, if it chose to hide in the general vicinity. The poster board was positioned so that it faced a photographer standing in a clearing outside of the buffer, and the photographer then took a picture using a digital camera of the partially obscured wildlife biologist and board.

The optical density was analyzed using PhotoShop. The photo was cropped leaving only poster board and vegetation in front of it. Using PhotoShop tools, the vegetation was turned black, and the portions of the board that could be seen through the vegetation was turned white. Then using the histogram tool, the percentage of the pixels in the picture that were black were computed.

The picture below shows the wildlife biologist holding the poster board in a likely hiding place for a large game animal, and the inset shows the pasteboard and vegetation after being reduced to black and white colors only. In this example, 82% of the board was blocked from view by the vegetation. Table 1 shows the results of all usable measurements that were taken.

Photo 1. Example showing the method used for estimating optical density.

Photo 2. Optical Density measurement showning 92% cover.

Photo 3. Optical Density measruement showing 91% cover.

Photo 4. Optical Density showing 82% cover.

Photo 5. Optical Density showing 91% Cover.

Photo 6. Optical Density showing 85% Cover.

Photo 7. Optical density showing 73% cover.

Photo 8. Optical Density showing 95% cover.

Photo 9. Optical Density showing 87% cover.

Photo 10. Optical Density showing 95% cover.

Photo 11. Optical Density showing 97% cover.

Photo 12. Optical Density showing 95% cover.

Picture Name		% Cover
BST Lot3	OD10	97%
BST Lot3	OD11	95%
BST Lot3	OD4	91%
BST Lot3	OD5	85%
BST Lot3	OD6	73%
BST Lot3	OD7	95%
BST Lot3	OD8	87%
BST Lot4	OD1	95%
BST Lot4	OD2	92%
BST Lot4	OD3	82%
DAC Lot1	OD1	92%
DAC Lot1	OD2	91%
	N=12	**Average=90%**

Table 1. Summary of optical density measurements taken in buffer areas between lots at Marble Creek South, and Marble Creek East short plats.