Appendix A - List of References

Banci, V. 1989. A fisher management strategy for British Columbia. Wildlife Bulletin No. B-63; ISSN 0829-9560 Min. of Env., Victoria, British Columbia. 127 pp.

Banci, V. 1994. Wolverine. Pages 99-127. *in* L.R. Ruggiero, K.B. Aubry, S.W. Buskirk, L.J. Lyon and W.J. Zielinski, eds. The scientific basis for conserving forest carnivores: American marten, fisher, lynx and wolverine in western United States. USDA Forest Service Gen. Tech. Rep. RM-254. 184 pp.

Baxter, C.V. 1997. Geomorphology, land use, and groundwater-surface water interaction: a multi-scale, hierarchical analysis of the distribution and abundance of bull trout (Salvelinus confluentus) spawning. M.S. thesis, University of Montana, Missoula.

Baxter, J.S. 1997. Aspects of the reproductive ecology of bull trout (Salvelinus confluentus) in the Chowade River, British Columbia. M.Sc. thesis, University of British Columbia, Vancouver.

Baxter, J.S., and McPhail J.D. 1999. The influence of redd site selection, groundwater upwelling, and over-winter incubation temperature on survival of bull trout (Salvelinus confluentus) from egg to alvein. Can. J. Zool. 77: 1233-1239.

Beschta, R.L., M.R. Pyles, A.E. Skaugset, C.G. Surfleet. 2000. Peakflow responses to forest practices in the western Cascades of Oregon, USA. Journal of Hydrology. 233, 102-120.

Bisson, P.A., and eight coauthors. 1987. Large woody debris in forested streams in the Pacific Northwest: past, present and future. Pages 143-190 IN E.O. Salo and T. Cundy, editors. Proceedings of the symposium Streamside Management: forestry and fishery interactions. Univ. of Washington Press, Seattle, Washington.

Bryant, M.D. 1983. The role of management of woody debris in west coast salmonid nursery streams. North American Journal of Fisheries Management 3:322-330.

Buchanan, D.V., M.L. Hanson, and R.M. Hooton. 1997. Status of Oregon's bull trout. Oregon Department of Fish and Wildlife, Portland, Oregon. 168pp. +

Burnett, Kelley, Reeves, Gordon, Landslides Through The Fish-Eye Lens, Science Findings, Pacific Northwest Research Station, March, 1998.

Carlton, D.C., D. Gaillard, M. Senatore, M. Friedman, R. Fenner, G. Macfarlane. 2000. Petition for a rule to list the wolverine (*Gulo gulo luscus*) as threatened or endangered under the endangered species act within the contiguous United States. Biodiversity Legal Foundation. July 2000.

Chan, Samuel, Maas-Hebner, Kathleen, Emmingham, Bill, 1996, COPE Report, Thinning Hardwood and Conifer Stands to Increase Light Levels: Have You Thinned Enough?, Vol. 9, Number 4.

Claar, J.J., N. Anderson, D. Boyd, M. Cherry, B. Conard, R. Hompesch, S. Miller, G. Olson, H. Ihsle Pac, J. Waller, T. Wittenger, H. Youmans. 1999. Carnivores. Pages 7.1-7.63 *in* Joslin, G. and H. Youmans,

coordinators. Effects of recreation on Rocky Mountain wildlife: A Review for Montana. Committee on Effects of Recreation on Wildlife. Montana Chapter of The Wildlife Society. 307 pp.

Copeland, J.P. 1996. Biology of the wolverine in central Idaho. M.S. thesis, Univ Idaho, Moscow. 138 pp.

Dean, Thomas, J. Clark Baldwin, V., Jr. Using a Density Management Diagram to Develop Thinning Schedules for Loblolly Pine Plantations, The Forestry Chronicle, 1985.

Ecosystems Northwest, Stream Survey Report, Middle Fork Willamette River, March 2001.

Graham, Russel, T., Harvey, Allen, E., Jain, Theresa, B., Tonn, Jonalea R., The Effects of Thinning and Similar Stand Treatments on Fire Behavior in Western Forests, PNW-GTR-463, September 1999.

Greenwald, D.N., J. Carlton, B. Schneider. 2000. Petition to list fisher (*Martes pennanti*) as an endangered species in its West coast range. Center for Biological Diversity, Sierra Nevada Forest Protection Campaign. November 2000.

Hann, Denise, Shadow Modeling of Big Willow Creek, Reservoir Thin E.A. Aquatics Report, Rigdon Ranger District, April, 1996.

Heinemeyer, K.S. and J.L. Jones. 1994. Fisher biology and management: a literature review and adaptive management strategy. USDA Forest Service Northern Region, Missoula, MT. 108 pp.

Heinemeyer, K.S., B.C. Aber and D.F. Doak. 2001. Aerial surveys for wolverine presence and potential winter recreation impacts to predicted wolverine denning habitats in the southwestern Yellowstone Ecosystem. Unpubl. Report. University of California, Santa Cruz Department of Environmental Studies. 33 pp.

Hunter, Matte, Communique: Management in Young Forests, February, 2001.

in L.R. Ruggiero, K.B. Aubry, S.W. Buskirk, L.J. Lyon and W.J. Zielinski, eds. The scientific basis for conserving forest carnivores: American marten, fisher, lynx and wolverine in western United States. USDA Forest Service Gen. Tech. Rep. RM-254. 184 pp.

Johnson, David H. and T.A. O'Neil (Manag. Dirs.). 2001. Wildlife-habitat relationships in Oregon and Washington. Oregon State University Press, Corvallis, Oregon.

Jones, J.A, F.J. Swanson, B.C. Wemple, and K.U. Snyder. 2000. Effects of Roads on Hydrology, Geomorphology, and Disturbance Patches in Stream Networks. Conservation Biology 14(1) 76-85.

Jones, J.A. 2000. Hydrologic processes and peak discharge response to forest removal, regrowth, and roads in 10 small experimental basins, western Cascades, Oregon. Water Resources Research, 36(9) 2621-2642.

Jones, J.A. 2000. Hydrologic processes and peak discharge response to forest removal, regrowth, and roads in 10 small experimental basins, western Cascades, Oregon. Water Resources Research, 36(9) 2621-2642.

Jones, J.A. and G.E. Grant. 1996. Peak flow responses to clear-cutting and roads in small and large basins, western Cascades, Oregon. Water Resources Research, 32(4) 959-974.

Jones, Julia, A., Swanson, Fredrick, J., Wemple, Beverly, C., and Snyder, Kai, U., Effects of Roads on Hydrology, Geomorphology, and Disturbance Patches in Stream Networks. Conservation Biology, Februrary, 2000, Volume 14, No. 1.

Joslin, G. 1999. Regulation and Policy. Appendix D (21pp.) *in* Joslin, G. and H. Youmans, coordinators. Effects of recreation on Rocky Mountain wildlife: A Review for Montana. Committee on Effects of Recreation on Wildlife. Montana Chapter of The Wildlife Society. 307 pp.

Joslin, G. and H. Youmans, coordinators. 1999. Effects of recreation on Rocky Mountain wildlife: A Review for Montana. Committee on Effects of Recreation on Wildlife. Montana Chapter of The Wildlife Society. 307 pp

Krebs, J.A. and D. Lewis. 1999. Wolverine ecology and habitat use in the North Columbia Mountains: progress report. Columbia Basin Fish and Wildlife Compensation Program. Nelson, British Columbia.
Lyon, J.L., K.B. Aubry, W.J. Zielinski, S.W. Buskirk, and L.F. Ruggiero. 1994. The scientific basis for conserving forest carnivores: considerations for management. Pages 128-137.

Maj, Mary and E.O. Garton. 1994. Fisher, lynx, wolverine: summary of distrubution information. Appendix B (7pp.) *in* L.R. Ruggiero, K.B. Aubry, S.W. Buskirk, L.J. Lyon and W.J. Zielinski, eds. The scientific basis for conserving forest carnivores: American marten, fisher, lynx and wolverine in western United States. USDA Forest Service Gen. Tech. Rep. RM-254. 184 pp.

Marshall, David B. 1988. Status of the wolverine in Oregon. Unpublished Report. Oregon Department of Fish and Wildlife, Portland, OR. Unpublished Report. 18 pp.
Martin, K.M. 2001. Wildlife of alpine and subalpine habitats. Pages 239-260 *in* D. H. Johnson and T.A. O'Neil (Manag. Dirs.) Wildlife-habitat relationships in Oregon and Washington. Oregon State University Press, Corvallis, OR, USA. 2001. 736 pp.
Mattson, C.R. 1948. Spawning ground studies of Willamette River spring chinook salmon. Fish Comm. Oreg. 1(2):21-32.

Myers, J.M., R.G. Kope, G.J. Bryant, D. Teel, L.J. Lierheimer, T.C. Wainwright, W.S. Grant, F.W. Waknitz, K. Neely, S.T. Lindley, and R.S. Waples. 1998. Status review of chinook salmon from Washington, Idaho, Oregon, and California. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-35, 443p.

O'Neil, Thomas A., David H. Johnson, Charley Barrett, Maria Trevithick, Kelly A. Bettinger, Chris Kiilsgaard, Madeleine Vander Heyden, Eva L. Greda, Derek Stinson, Bruce G. Marcot, Patrick J. Doran, Susan Tank, and Laurie Wunder. *Matrixes for Wildlife-Habitat Relationship in Oregon and Washington*. Northwest Habitat Institute. 2001. *in* D. H. Johnson and T.A. O'Neil (Manag. Dirs.) *Wildlife-Habitat Relationships in Oregon and Washington*. Oregon State University Press, Corvallis, OR, USA. 2001. 736 pp.

Olson, D.H., J.C. Hagar, A.B. Carey, J.H. Cissel, and F.J. Swanson. 2001. Wildlife of Westside and high montane forests. Pages 187-212 *in* D. H. Johnson and T.A. O'Neil (Manag. Dirs.) Wildlife-habitat relationships in Oregon and Washington. Oregon State University Press, Corvallis, OR, USA. 2001. 736 pp.

Powell, R.A. 1993. The fisher: Life history, ecology and behavior. 2nd ed. University of Minnesota Press, Minneapolis, MN. 237 pp.

Powell, R.A. and W.J. Zielinski. 1994. Fisher. Pages 38-73. *in* L.R. Ruggiero, K.B. Aubry, S.W. Buskirk, L.J. Lyon and W.J. Zielinski, eds. The scientific basis for conserving forest carnivores: American marten, fisher, lynx and wolverine in western United States. USDA Forest Service Gen. Tech. Rep. RM-254. 184 pp.

Ratliff, D.E., and P.J. Howell. 1992. The status of bull trout in Oregon. Pages 10-17 in P.J. Howell and D.V. Buchanan, editors. Proceedings of the Gearhart Mountain bull trout workshop. Oregon Chapter of the American Fisheries Society, Corvallis.

Reukema, Donald, L. Guidelines for Precommercial Thinning of Douglas-fir. PNW-GTR-30, 1975.

Ruediger, B., J. Claar, S. Gniadek, B. Holt, L. Lewis, S. Mighton, B. Naney, G. Patton, T. Rinaldi, J. Trick, A. Vandehey, F. Wahl, N. Warren, D. Wenger, and A. Williamson. 2000. Canada Lynx Conservation Assessment and Strategy. USDA Forest Service, USDI Fish and Wildlife Service, USDI Bureau of Land Management, and USDI National Park Service. Forest Service Publication #R1-00-53, Missoula, MT. 142 pp.

Ruediger, B., J.J. Claar, and J.F. Gore. 2000. Restoration of carnivore habitat connectivity in the Northern Rocky Mountains. Unpublished Report. USDA Forest Service, Northern Region, Missoula, MT. Unpublished Report. 16 pp.

Ruggiero, L. F., K. B. Aubry, S. W. Buskirk, G. M. Koehler, C. J. Krebs, K. S. McKelvey, and J. R. Squires. 2000*a*. Ecology and conservation of lynx in the United States. Univ. Press of Colorado. Boulder, CO. 480 pp.

Ruggiero, L.R., K.B. Aubry, S.W. Buskirk, L.J. Lyon and W.J. Zielinski, eds. The scientific basis for conserving forest carnivores: American marten, fisher, lynx and wolverine in western United States. USDA Forest Service Gen. Tech. Rep. RM-254. 184 pp.

Sallabanks, R., B.G. Marcot, R.A. Riggs, C.A. Mehl, and E.B. Arnett. 2001. Wildlife of Eastside (interior) forests and woodlands. Pages 213-238 *in* D. H. Johnson and T.A. O'Neil (Manag. Dirs.) Wildlife-habitat relationships in Oregon and Washington. Oregon State University Press, Corvallis, OR, USA. 2001. 736 pp.

Sedell, J.R., P.A. Bisson, F.J. Swanson, and S.V. Gregory. 1988. Chapter 3: What we know about large trees that fall into streams and rivers. IN Maser, C.R., R.F. Tarrant, J.M. Trappe, and J.F. Franklin., tech eds. 1988. From the forest to the sea: a story of fallen trees. USDA Forest Service. Pacific Northwest Forest and Range Experiment Station. Gen. Tech. Rep. PNW-GTR-229. Portland, Oregon.

Swanson, Frederick, J., Johnson, Sheri, L, Gregory, Stanley, V., Acker, Steven, A., Flood Disturbance in a Forested Mountain Landscape, BioScience, Sept., 1998, Vol.48, No. 9.
Tepley, John, Willamette Height-Diameter Relationships; November 15, 1996.

Thomas, J.W. and D.E. Toweill. 1982. Elk of North America: ecology and management. Stackpole Books, Harrisburg, PA. 698pp.

Thomas, J.W.; Forsman, E.D.; Lint, J.B., (and others). 1990. A conservation strategy for the northern spotted owl: a report of the Interagency Scientific Committee to address the conservation of the northern spotted owl. Portland, OR: U.S. Department of Agriculture, Forest Service; U.S. Department of the Interior, Bureau of Land Management, Fish and Wildlife Service, and National Park Service. 427 p.

Thomas, R.B. and W.F. Megahan. 1998. Peak flow responses to clearcutting and roads in small and large basins, western Cascades, Oregon: a second opinion. Water Resources Research 34, 3393-3403.

Tollefson, Jennifer, E. , Fire Severity Patterns in the Watersheds Of Intermittent Streams Following the Warner Creek Fire, Western Cascade Range, Oregon, Masters Of Science Thesis, Department of Botany, University of Vermont, May, 2001.

U.S. Public Law 98-328. Oregon Wilderness Act of 1984. Act of June 26, 1984. 98 Stat. 272.

USDA Forest Service and USDI Bureau of Land Management. 1994. Record of decision for amendments to Forest Service and Bureau of Land Management planning documents within the range of the northern spotted owl.

USDA Forest Service and USDI Bureau of Land Management. 1997. South Cascades Late-Successional Reserve Assessment.

USDA Forest Service Pacific Northwest Region. 2000. Federally Listed or Proposed Species and Proposed or Designated Critical Habitat List. August 30, 2000.

USDA Forest Service, Pacific Northwest Region. 2000. Regional Forester's Sensitive Animal List. November 15, 2000.

USDA Forest Service. 2000. Drinking Water from Forests and Grasslands, A Synthesis of the Scientific Literature. George E. Dissmeyer, Editor. Southern Research Station. General Technical Report SRS-39. p.90.

USDA Forest Service, U.S. Department of Commerce (National Oceanic and Atmospheric Administration), U.S. Department of Interior (Bureau of Land Management, National Park Service, and Fish and Wildlife Service), and the Environmental Protection Agency. 1993. Forest Ecosystem Management: An ecological, economic, and social assessment. Report of the Forest Ecosystem Management Assessment Team (FEMAT). U.S. GPO 1993-793-071.

USDA Forest Service, USDI Bureau of Land Management and US Fish and Wildlife Service. 1998. Mid-Willamette Late-Successional Reserve Assessment
USDA Forest Service. 1990. Willamette National Forest Land and Resource Management Plan, 1990.

USDI Fish and Wildlife Service. 2001a. A Range-Wide Baseline Summary and Evaluation of Data Collected Through Section 7 Consultation for the Northern Spotted Owl and it's Critical Habitat: 1994-2001- Final Report.
USDI Fish and Wildlife Service. 2001b. Environmental Baseline Update for the Northern Spotted Owl in the Willamette Province.

Verts, B.J. and Leslie N. Carraway. 1998. Land mammals of Oregon. University of California Press, Berkeley and Los Angeles, California.

Weavers, M.J., J. Wetherbee, and W. Hunt. 1992. Santiam and Calapooia Subbasin Fish Management Plan. Oregon Department of Fish and wildlife, Salem.

Wemple, B.C. 1994. Hydrologic Integration of Forest Roads with Stream Networks in Two Basins, Western Cascades Oregon. M.S. Thesis, Dept. of Geosci., Oregon State Univ., Corvallis.

Wemple, B.C. 1994. Hydrologic Integration of Forest Roads with Stream Networks in Two Basins, Western Cascades Oregon. M.S. Thesis, Dept. of Geosci., Oregon State Univ., Corvallis.

Youmans, H. 1999. Project overview. Pages 1.1.-1.18 *in* Joslin, G. and H. Youmans, coordinators. Effects of recreation on Rocky Mountain wildlife: A Review for Montana. Committee on Effects of Recreation on Wildlife. Montana Chapter of The Wildlife Society. 307 pp.

Youmans, H. 1999a. Project Planning. Appendix C (12pp.) *in* Joslin, G. and H. Youmans, coordinators. Effects of recreation on Rocky Mountain wildlife: A Review for Montana. Committee on Effects of Recreation on Wildlife. Montana Chapter of The Wildlife Society. 307 pp.

Ziller, J.S., and G.A. Taylor. 2001. Using partnerships for attaining long term sustainability of bull trout (Salvelinus confluentus) populations in the upper Willamette Basin, Oregon. Unpublished Report. Oregon Department of fish and Wildlife. Springfield, Oregon.

Appendix B - Attainment of ACS Objectives with Riparian Density Management

How thinning relates to Northwest Forest Plan Aquatic Conservation Strategy Objectives

This discussion focuses on proposed thinning of young managed stands (from 25 to 50 years of age) created by past clearcut harvest. This past harvest did not treat riparian zones differently than upslope areas and the stands are more or less homogenous across the slope. As of this writing most of the stands in this age range contain moderate to large amounts of large woody debris in and near stream channels as well as in upland areas but they contain essentially no large residual trees or snags. Most of these young stands were planted almost exclusively with Douglas-fir, though other species have naturally established to a greater or lesser extent. These stands were densely planted and those proposed for thinning are quite dense, often to the extent that tree mortality is currently occurring, or soon will, and understory ground vegetation is sparse to non-existent. Tbinning is proposed in the riparian portion of these managed stands generally to create a stand more diverse structurally and biologically, and to assure that riparian stands have comparable stem size distribution and understory composition as adjacent thinned upland stands. How thinning specifically affects the nine Aquatic Conservation Strategy Objectives presented on page B- I I of the Northwest Forest Plan follows below:

1 . Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to assure protection of the aquatic systems to which species, populations and communities are uniquely adapted

Thinning will help to better achieve this objective. Thinning is proposed in these young stands to provide for a more diverse riparian and terrestrial stand by opening up the canopy somewhat such that shade tolerant conifers and ground vegetation can become established or to provide for the more vigorous growth of that which already exists. Thinning will also provide for greater long-term structural diversity by generating larger stem diameters, overall greater variation in stem sizes, a structurally more complex dominant tree crown (deeper, with thicker branches) and future sources of appropriately large snags and down woody material. If these dense, young stands are not thinned there will be, to a large extent, a detrimental impact on aquatic and terrestrial populations and communities in the long-run as these stands may take a very long time to generate large stem calipers and late-successional habitat conditions in general if they remain at their current densities.

2. Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life history requirements of aquatic and riparian dependent species.

T'hinning will not affect the connectivity these recovering riparian stands now provide. While there may be some short- term negative effects in terms of micro-climate changes by reducing the current crown

coverage, or in terms of branches and trees tops creating barriers to animal movement, there is an overall benefit in creating more structurally complex habitat for animals to travel through in the future.

3. Maintain and restore the Physical integrity of the aquatic system, including shorelines, banks and bottom configurations.
Yarding systems and harvest prescriptions would be designed to protect and maintain channel stability in all cases including intermittent stream channels. Riparian areas within 10 to 50 feet of stream channels would generally not be thinned. Trees to be removed will not be transported across stream channels unless an analysis shows that additional road construction needed to avoid yarding across streams would be more harmful than a narrow skyline corridor through the riparian area. Skyline yarding corridors across stream channels would be minimized, however where analysis determined that yarding across a stream channel could be accomplished while protecting stream banks and channels.
.
4. Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.

Thinning would have a neutral effect on water quality in the short run. In the long run it may have a slightly beneficial effect as thinning will speed up the creation of large stems, some of which will eventually fall into the streams to provide for more stable channels. Retention of all trees within 50 feet of perennial stream channels will provide for shade to maintain cool stream temperatures during critical summer months.

5. Maintain and restore the sediment regime under which aquatic ecosystems evolved.

Elements of the sediment regime include the timing, volume, rate and character of sediment input, storage and transport. See the above discussion; thinning will have neutral effect on sediment regimes as long as road construction effects are balanced with the desire to minimize yarding across stream channels. Thinning would enhance development of course woody material which when incorporated into stream channels has beneficial effects on storage and routing of sediment. No harvest areas adjacent to stream channels will reduce the potential for stream bank erosion.

6. Maintain and restore in-stream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.

To a large extent thinning can be thought of as an activity that re-structures, rather than reduces, the vegetation occurring on a site. Thinning would also have a long-term positive effect on sediment, nutrient, and wood routing as discussed in objectives 4.and 5.above.

7. Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.

Thinning will have a neutral effect on the timing and variability of floodplain inundation and wetland water table levels, similar to the effects on in-stream flows as discussed above.

8. Maintain and restore the species composition and structural diversity of plant communities in riparian

areas and wetlands to provide adequate summer and winter thermal regulation, nutrient filtering, appropriate rates of surface erosion, bank erosion, and channel migration to supply amount and distributions of coarse woody debris sufficient to sustain physical complexity and stability.

The young, previously managed stands proposed for thinning do not currently comprise late-successional habitat. One of the primary objectives of this proposed thinning is to make these dense, young stands more diverse from a structural and species composition perspective. Thinning will ultimately produce a more structurally diverse stand that will provide for development of more diverse plant and animal communities.

9. Maintain and restore habitat to support well-distributed populations of native plants invertebrate, and vertebrate riparian species.

Thinning enhances vertical and horizontal diversity by encouraging understories, growing of crop trees, and deepening crown area and leaf area. These stand structures provide niches for native plants, invertebrates, and vertebrate riparian species.

Appendix C - Historic Documents Citing Chemical Treatment Efforts to Remove Undesirable Species of Fish

Form 249

State Game Commission
State of Oregon

INTER-OFFICE CORRESPONDENCE

To: Ralph Swan
Address: Eugene

Date: February 15, 1961

From: Bob Borovicka
Address: Portland

Subject: Hills Creek.

Personnel of the Army Engineers have informed us that the gates at Hills Creek will probably be closed on the first of August. Along with the closure we are informed that no provisions have been made for minimum flows below Hills Creek to the confluence of Salt Creek, approximately one mile downstream. As it looks from here, there will be a period from the first of August to the first of October that the Middle Fork of the Willamette River from the Hills Creek Dam to the confluence of Salt Creek would be dry.

We will make some recommendations with regard to this problem. Considering the aquatic foods and fish that may be lost, do you have any recommendations with regard to the problem during those months? Possibly you may feel that the area in question is not much of a problem.

With the late closure of the Hills Creek Dam it may be necessary to start another rearing program for the initial stocking of the reservoir. I doubt if we can hold many fish until August for the initial stocking.

Bob

RLB:ae

Form 249

State Game Commission
State of Oregon

INTER-OFFICE CORRESPONDENCE

To: Bob Borovicka
Address: Portland

Date: Feb. 20, 1961

From: Ralph Swan
Address: Eugene

Subject: Hills Creek gate closure

Dear Bob:

When you asked me the other day if I had received your letter, I thought you had reference to another one you had written. The letter you were talking about was waiting for me when I got home.

My first question is, will the drying up of the Will. between the dam and Salt Creek be an annual proceedure, or is it just for the initial filling?

Very little angling takes place in the area affected, although there is no doubt that a considerable amount of food and habitat will be destroyed.

I checked on the Geological Survey water records for the late summer months, and by some subtraction of averages, there appears to be about 100 cfs in Salt Creek at that time. Salmon Creek carries about 160 cfs, and the North Fork slightly more. I don't think there will be a serious problem below the North Fork.

The City of Oakridge may be unhappy because of the lack of water at their Green Waters park.

If they plan to dry up the river every year, I think we should try to obtain a minimum flow - somewhere in the vicinity of 100 cfs, but if it is just for one season, I wonder if we should object too strenously

Form 249

State Game Commission
State of Oregon

INTER-OFFICE CORRESPONDENCE

To: Ralph Swan
Address: Eugene

Date: February 15, 1961

From: Bob Borovicka
Address: Portland

Subject: Hills Creek.

Personnel of the Army Engineers have informed us that the gates at Hills Creek will probably be closed on the first of August. Along with the closure we are informed that no provisions have been made for minimum flows below Hills Creek to the confluence of Salt Creek, approximately one mile downstream. As it looks from here, there will be a period from the first of August to the first of October that the Middle Fork of the Willamette River from the Hills Creek Dam to the confluence of Salt Creek would be dry.

We will make some recommendations with regard to this problem. Considering the aquatic foods and fish that may be lost, do you have any recommendations with regard to the problem during those months? Possibly you may feel that the area in question is not much of a problem.

With the late closure of the Hills Creek Dam it may be necessary to start another rearing program for the initial stocking of the reservoir. I doubt if we can hold many fish until August for the initial stocking.

Bob

RLB:ae

U. S. Army Engineer Contrac
No. DA-35-026-CIVENG-61-10
October 13, 1960

PROGRESS REPORT
HILLS CREEK PROJECT

Introduction

Hills Creek Dam and future reservoir is in Lane County, Oregon, on the Middle Fork of the Willamette River. The project area is about three miles southeast of the community of Oakridge, a short distance from Highway 57. The dam is being constructed by the U. S. Army Engineers primarily for flood control with secondary purposes of hydroelectric power production.

The Middle Fork of the Willamette River and tributaries above the Hills Creek Dam have been an important recreation area for campers and trout fishermen. The river and a few important tributaries are annually stocked with rainbow trout. All tributary streams contain good to excellent populations of native cutthroat trout.

In addition to trout the Middle Fork of the Willamette River and the lower sections of some of the larger tributaries contained populations of fine and coarse-scaled suckers, squawfish, redsided shiners, cottids, and dace. Past experience at several upper Willamette reservoirs has shown that small rough fish populations native to the streams exhibit population explosions when reservoir environment covers natural stream sections. Rough fish populations in the upper Willamette reservoirs have competed with normal game species to the extent that even heavy plantings of legal trout have not provided a sport fishery of magnitude to anglers.

The potential rough fish problem in the Hills Creek Reservoir was recognized by the U. S. Fish and Wildlife Service and the Oregon State Game Commission during the preliminary planning stages of the project. A U. S. Fish and Wildlife Service report recommended the chemical treatment of the river and tributaries to remove undesirable species of fish before the impoundment of water in the basin.

The Oregon State Game Commission entered into a contract with the U. S. Army Engineers to chemically treat problem waters above the Hills Creek Dam before water is stored in 1961. The contract for services was completed on the 5th of August, 1960. The U. S. Army Engineers agreed to pay 40 per cent of the actual costs incurred under the contract, but not to exceed the sum of $24,000. A copy of the contract is attached to the progress report.

Preparation

The Middle Fork of the Willamette River above the Hills Creek Dam site drains an area of approximately 400 square miles. It was determined that over 100 miles of tributary streams would be investigated to find the upstream limits of rough fish. Selected streams were spot-checked with rotenone and cresol to study fish populations during the summer of 1959 and in May and June of 1960. The preliminary work was helpful in determining cost estimates of tributary treatment. An intensive survey was made in July 1960 to determine upstream limits of rough fish in tributary streams.

Several field trips were made to the area to inspect the tributary streams and the Middle Fork of the Willamette River to determine methods and type and extent of specialized equipment needed for the chemical treatment.

A cost estimate for the project was made based on average water flows for streams in the area. The information was presented to the Oregon State Game Commission and approval was obtained for the project. A contract, mutually acceptable to the U. S. Army Engineers and the Oregon State Game Commission, was signed August 5, 1960.

The water flows and velocities through the outlet tunnel and spillway of Hills Creek Dam were of a magnitude to be a complete barrier to upstream migrating fish. The barrier permitted chemical treatment to be schedule for August and September of 1960. The late summer treatment was designed to take advantage of low water flows in the streams and the possibility that construction on the dam would be far enough advanced to permit closing of outlet gates in the fall of 1960.

Bids were accepted to obtain the required amount of liquid rotenone. Miscellaneous supplies and several pieces of specialized equipment were ordered. Equipment and materials were moved to a rented warehouse in Oakridge.

Agencies contacted to explain certain phases of the project were the U. S. Forest Service, State Board of Health, U. S. Geological Survey, Lane County Sanitarian, and the Project Engineer, U. S. Army Engineers. Various sportsmen's organizations were apprised of the project and the reasons for the chemical treatment. Local radio, newspaper, and other public media were notified of the project plans.

A test of two rotenone products was made in the lower portion of Hills Creek.

Arrangements were made to quarter Game Commission personnel at the Kitson Hot Springs located on Hills Creek.

Permanent and part-time employees were transferred from other jobs to work on the Hills Creek Project. An airplane reconnaissance was made of the drainage area to be treated, to check on access routes to tributary streams, locate isolated lakes or potholes, and to obtain a broad view of the project area.

Chemical treatment

The first crew was moved into the area in July. Work was started on the treatment of tributary streams to kill all fish from the known upstream limits of rough fish down to fish barriers near the main river. In many instances it was possible to find natural barriers on dry sections of stream near the mouth of the river. In some cases it was necessary to construct small dams high enough to permit the stream to flow over galvanized metal roofing forming a drop impassable to fish.

Tributary streams were treated by using methods successful on other projects. After the upstream limits of rough fish were determined and a barrier was erected the required amount of liquid rotenone was released from a constant flow drip above the area known to contain rough fish. Crews

with backpack cans containing rotenone would follow the flow of rotenone downstream treating all side pockets, channels, isolated pools, and slow-moving areas. Tributary streams were treated in a systematic manner working on the west and then the east side of the Middle Fork of the Willamette River.

Streams were rechecked to determine the effectiveness of the initial kill and to investigate doubtful areas. Approximately 50 miles of tributary streams were treated with rotenone.

Many isolated pools, potholes, and borrow pits were located along the Middle Fork of the Willamette, both in the upriver and the future reservoir areas.

The sloughs and isolated river channels in upriver areas from the head of the reservoir to Swift Creek were treated with rotenone by personnel using backpack cans.

The reservoir construction area contained many small seeps, potholes and large ponds. A 250-gallon John Bean power spray unit with 200 feet of hose was mounted on a 1/2-ton four-wheel-drive pickup. A crew of three to four men operating the equipment chemically treated the majority of the isolated waters in the reservoir area. The larger ponds and borrow areas were sprayed with power equipment and venturi rotenone units operated from a boat.

Many of the borrow areas contained small seeps and puddles over a wide area and in rugged terrain. In these areas it was necessary to use several treatment crews with backpack cans to distribute the rotenone properly.

Prior to chemical treatment of the river it was necessary to determine the location of the major drip stations for introduction of rotenone. Upstream limit of rough fish in the river was determined by making spot checks with liquid rotenone and observing the kill. Game Commission Scuba divers were used to check deep pools for positive identification of the species of fish killed.

Rotenone drip stations were placed from three to four miles apart to obtain effective fish control in the main river. Eight drip stations were plotted starting at three miles above the dam and ending thirty miles upstream

Wood horses were made out of 2" x 6" boards to hold 55-gallon drums of liquid rotenone. Constant flow drips controlled by a gate and needle valve were constructed.

Information received from the U. S. Geological Survey indicated the Middle Fork of the Willamette River within the treatment area was flowing approximately 345 c.f.s. It was determined that rotenone would be applied at the drip stations at a concentration of 1.5 p.p.m. over a 24-hour period. Each station consisted of an empty 55-gallon drum fitted with a constant-flow drip placed on a wooden horse anchored in the stream channel. The full 55-gallon drums of rotenone were placed adjacent to the drip barrel on a high bank. Rotenone was transferred from the full drums to the drip barrel by gravity flow using a length of 100-foot plastic hose.

September 1, 1960, was designated as the day of chemical treatment in the river. On August 31 a crew of approximately 25 men was moved to the Hills Creek area. After orientation, crews were designated specific jobs.

Two crews started the flow of rotenone from the drip barrels at approximately 12:30 a.m., September 1, 1960. Two man crews with backpack cans worked each side of the river from one drip station to the next. The job of each crew was to introduce rotenone from a backpack can to all isolated pools along the river channel. Backpack crews started at approximately 8:00 a.m., September 1, after kill was effective between all rotenone drip stations.

The majority of the work between stations was completed by 5:00 p.m., September 1, and drip stations were removed. Rotenone was introduced at each station for approximately 17 hours.

The following day, September 2, rechecks were made of the entire area, more potholes in the lower reservoir basin were treated, and crews were used to advantage in locations not worked the first day of treatment. A crew of four men was retained at the project area for a period of three weeks to recheck all areas treated.

A second charge of rotenone was dripped in the river through the reservoir basin approximately three weeks after the initial treatment. No fresh fish kills were observed after the second application of rotenone.

Result of treatment

The tributary streams contained few rough fish. The lower reaches of some streams contained suckers and redsided shiners but no squawfish were observed.

The Middle Fork of the Willamette River contained suckers for at least 30 miles upstream from the dam site. Squawfish and redsided shiners were found in only the lower areas generally within the present reservoir site. Hundreds of large suckers were killed in the Middle Fork of the Willamette River within the reservoir area. Many thousands of suckers, squawfish and redsided shiners were killed in the pothole and borrow areas of the impoundment area.

A spectacular kill of large squawfish and suckers was observed in the Willamette River below Hills Creek Dam down to the backwaters of Lookout Point Reservoir.

From the numbers of rough fish killed in the Hills Creek impoundment area it was evident that the reservoir would have been infested with a large population of rough fish. The chemical treatment prior to storage of water should be of benefit to a future fishery.

Miscellaneous

Crews remained in the area to clean all equipment used on the project and conduct an inventory of all materials, supplies, and equipment.

Hills Creek Project

1. General

Hills Creek Dam and future impoundment is in Lane County, Oregon, on the Middle Fork of the Willamette River. The project area is about three miles southeast of the town of Oakridge, a short distance from Highway 57. The dam is being built by the U. S. Army Engineers primarily for flood control but with secondary purposes of electric power production.

The Middle Fork of the Willamette River and tributaries above the Hills Creek Dam now provide excellent angling for trout. In addition to trout, the main stem stream and most of the tributaries contain small populations of rough fish in the form of squawfish and coarse and fine-scaled suckers.

Past experience with several upper Willamette reservoirs has shown that small rough fish populations native to the streams become abundant in a short time when a reservoir environment displaces the natural stream sections. Rough fish populations in the upper Willamette reservoirs have competed with normal game species to the extent that even heavy plantings of legal trout have not provided a sport fishery of magnitude to anglers. The elimination of rough fish from the Middle Willamette drainage above Hills Creek should effectively reduce competition for game fish species in the future Hills Creek Reservoir.

2. Area of waters

Approximately 105 miles of tributary streams above Hills Creek Dam may contain rough fish and must be treated with rotenone to remove fish populations. The work is planned before water is stored in the reservoir so treatment of a pool is not likely to be involved in the project.

Main tributaries to the Middle Fork of the Willamette River are Hills Creek, Larrison Creek, Staley Creek, Swift Creek, Pioneer Gulch Creek, and Willow Creek. There are numerous small tributaries.

3. Species to be controlled

Coarse and fine-scaled suckers, squawfish and whitefish.

4. Type of control planned

Complete chemical treatment with liquid rotenone of all tributaries known to contain rough fish. Several crews of three men with equipment will treat the tributary streams to the confluence of the Middle Willamette River. Small barriers will be placed at the lower end of each tributary to prevent upstream migration of rough fish after chemical treatment. The main stem of the Middle Willamette River above Hills Creek will be chemically treated after all side tributaries have received applications of rotenone.

Attempts will be made to drain all side channels and pockets adjacent to the Middle Fork of the Willamette River. Rotenone used in the project area will have an effect on fish downstream from Hills Creek Dam, possibly to the confluence with the upper reaches of Lookout Point Reservoir. The section of river contains large populations of rough fish that have moved up from Lookout Point and it is felt no harmful effects can be obtained that may not be mitigated by restocking.

5. Amount of materials

Approximately 7,250 gallons of liquid synergized rotenone will be needed to treat the tributary streams. Other materials include protective gear, containers for rotenone, miscellaneous tools, miscellaneous valves and pipe fittings, chain blocks, backpack cans, specialized spray equipment, and lumber and galvanized sheeting for dams.

6. Management

The project will be total treatment of tributary streams known to contain rough fish.

7. Fish stocking

In addition to normal annual stocking of the Middle Fork of the Willamette and tributaries, the following restocking of the Hills Creek Reservoir and tributary system must be considered:

Species	Size	Number/pound	Number
Rainbow trout	Yearling	5	5,000
Rainbow trout	Fingerling	200	1,500,000

Costs: Costs of restocking are based on an expenditure of $1.05 per pound of fish which includes cost of eggs, hatching, rearing, feeding and transportation to stocking site:

Yearling	1,000 lbs. @ $1.05 =	$1,050.00
Fingerling	7,500 lbs. @ $1.05 =	$7,875.00
	Total	$8,925.00

8. Summary of costs and related data

1. Preliminary costs - $300.00

2. Estimated expenditures: Period July 1, 1960 to November 1, 1961

(a) Salaries and Wages:

Name	Title	Period	Rate	Total
1 man as assigned	Biologist	84 man days	$25/day	$ 2,100.00
3 men as assigned	Treatment personnel	190 man days	$22/day	4,180.00
3 men as assigned	Treatment personnel	63 man days	$22/day	1,386.00
1 man as assigned	Staff specialist	10 man days	$30/day	300.00
Total Salaries and Wages				$ 7,966.00

Appendix D - List of Preparers

IDT Participant	Professional Capacity	Team Capacity	Education	Years Of Experience
Dick Davis	Wildlife Biologist	Wildlife Biologist Writer	B.S. Animal	15
Kirk Lunstrum	Wildlife Biologist	Wildlife Biologist Writer	B.S. Wildlife Biology	20
Mark Leverton	Geotechnical Geologist, Soils, Writer	Geotechnical Geologist, Soils, Writer	B.S. Earth Sciences Galactic Exploration	20
Doug Larson	Fisheries Biologist	Fisheries Biologist, Writer	B.S. Fisheries Management	8
John Agar	Silviculturist/ Planner	Silviculturist/ Planner, Writer, Editor	B.S. Forest Resources Management	20
Al Johnson	Hydrologist	Hydrologist, Writer	B.S. Forest Hydrology	20

Appendix E Access and Travel Management

Aquatic Risk Rating Process

Instructions for Aquatic Risk Ratings

Follow the criteria listed below to determine the total aquatic risk rating for any particular road segment. This rating is useful in determining the priority of a given road segment to close, reconstruct, or maintain relative to other road segments. Those roads that are of high risk would be the first priority for these types of activities, followed by those rated as being of moderate risk. While there is still potential risk with those rated as low, these roads are thought to be less likely to negatively impact the aquatic system and are therefore of the lowest priority when funding for closures, maintenance, etc. is limited. The aquatic risk rating is also helpful to determine the type of road closure for that particular road segment. For example it would **never** be recommended that a road of high or moderate risk to the aquatic system be closed in a passive manner, while there may be instances where such a closure type would be an acceptable risk with a road segment that rated low.

Critical Habitat Areas (Maximum = 12)

Proximity to Fish Stocks

3 = Segment not near (>1 mile) from a fish bearing stream (class I or II) and/or mass failure would have a low potential of negatively impacting fish bearing waters (i.e.. slope flattens significantly before a road-related failure originating from this road segment would impact a stream channel)

6 = Segment relatively close (1/2 to 1 mile) to a fish bearing stream (class I or II), but not directly adjacent (mass failures would have moderate to high potential for reaching fish bearing streams)

9 = Segment is very close (1/4 to 1/2 mile) to a fish bearing stream (class I or II) and it is likely that any mass failures originating on this road segment would directly impact the fish bearing segment below

12 = Segment is directly adjacent (<1/4) to a fish bearing stream (class I or II) and it is likely that any mass failures originating on this road segment would directly impact the fish bearing segment below or will likely impact known refugia (low stream temperature, high quality spawning gravels, high numbers of large woody material, or excellent riparian condition).

Stream Crossings and Surface Type (Maximum = 10)

Surface Type

1 = asphalt/concrete

2 = aggregate

3 = improved

4 = native surface

Stream Crossings (class I-IV) per mile

0 = road segment has no stream crossings

3 = road segment has 1-3 stream crossings/mile

6 = road segment has 4 or more stream crossings/mile or > 25% is located in the riparian

reserves

Geologic/Road Failure Hazard (Maximum = 20)

Debris Failure Risk (Sources of Coarse Grain Sediments - category 3 and 4 soils)

2 = low risk (0-10% of road segment length)

4 = moderate risk (10-50% of road segment length)

6 = high risk (50-75% of road segment length)

8 = very high risk (75-100% of road segment length)

Land Flow Area Risk (Sources of Fine Grain Sediments - category 1 and 2 soils)

1 = low risk (0-10% of road segment length)

2 = moderate risk (10-50% of road segment length)

3 = high risk (50-75% of road segment length)

4 = very high risk (75-100% of road segment length)

Percent of road segment with sideslopes >51%

2 = < 10% of road segment

4 = 10-50% of road segment

6 = 50-75% of road segment

8 = >75% of road segment

Total Rating:

The total aquatics rating characterizes the risk associated with each road segment by summing up the above scores. Those segments scoring within the upper third of the range of scores **(31-42) are considered to be of high aquatic risk** and therefore of high priority to close, reconstruct, or receive regular annual maintenance. Road segments with a rating of **moderate (20-30**) are of moderate risk and road segments receiving a rating of **low (9-19))** are considered to be of relatively low risk to the aquatic system.

Information Needed:

GIS Layers*:* * Stream Class Map (I-IV) * Map of Category 3 and 4 Soil Types (Debris Slides) * Map of Category 1 and 2 Soil Types (Landflows) * Map showing refugia areas (from stream surveys) * Map showing road segments on > 51% Slopes * Map of Transportation Layer

Other Useful Information: *WIN Surveys of other field surveys * Road Logs