United States Department of the Interior

FISH AND WILDLIFE SERVICE
Klamath Basin Ecosystem Restoration Office
6600 Washburn Way
Klamath Falls, OR 97603
(541) 885-8481 FAX: (541) 885-7837

In Reply Refer To: 1-10-96-F-039 July 15, 1996

Memorandum

To: Area Manager, Bureau of Reclamation, Klamath Basin Area Office
Klamath Falls, OR

From: Project Leader, Ecosystem Restoration Office, Klamath Falls, OR

Subject: Formal Consultation on PacifiCorp and The New Earth Corporation Operations, as Permitted by Bureau of Reclamation, for the Lost River Sucker and Shortnose Sucker

Attached is the U.S. Fish and Wildlife Service, Ecosystem Restoration Office's (Service), biological and conference opinions for PacifiCorp's and The New Earth Company's proposed operations and actions, as permitted by Bureau of Reclamation (Reclamation), on Klamath Project (Project) lands and facilities. These actions effect the endangered shortnose sucker *Chasmistes brevirostris* and endangered Lost River sucker *Deltistes luxatus*, and proposed critical habitat for shortnose and Lost River suckers.

Important assumptions were made by the Service in completing these biological and conference opinions: 1) The Service assumed, in the interim between this consultation and completion of the Upper Klamath Lake endangered sucker consultation by spring 1997, water elevations and corresponding target dates in Reclamation's "low range elevations" proposal would be achieved during 1996; 2) The Service assumed Reclamation will complete the anticipated Upper Klamath Lake endangered sucker consultation by spring 1997. The Service anticipates the Upper Klamath Lake endangered sucker consultation will address other Project impacts and summarize and/or update new data not addressed in these PacifiCorp and The New Earth Company biological and conference opinions; 3) The Service assumed new information presented in the Upper Klamath Lake consultation would be integrated into Reclamation's and PacifiCorp's management of Upper Klamath Lake water elevations. These operations should provide annual lake levels in 1997 and beyond that are conducive to enhanced endangered sucker survival while proposed long-term habitat restoration activities are implemented and biotic response is monitored; 4) The Service assumed all ongoing research and monitoring, as specified under the July 22, 1992 Project long-term biological opinion, would continue; 5) The Service assumed that, in the long term, Lower Williamson River restoration efforts would prove successful and benefit all life stages of endangered suckers, reducing the need for short-term protections; 6) The Service assumed proposed short-term actions will remain valid until long-term Lower Williamson River restoration efforts are determined successful and Service analysis of species recovery potential validates relaxation of short-term measures.

The Incidental Take Statement (ITS) contained in these biological and conference opinions estimates incidental take of Lost River suckers and shortnose suckers resulting from operations of PacifiCorp and The New Earth Company facilities and exempts the Applicants from the Endangered Species Act's section 9 prohibitions. This exemption is specific to PacifiCorp and The New Earth Company operations and does not supersede or otherwise replace Reclamation's responsibilities under ITS's in previous Project biological opinions. Additionally, all pre-existing Reasonable and Prudent Alternative elements from previous Project biological opinions remain in effect for Reclamation.

The biological opinion and ITS define specific timeframes for proposed activities and take reduction guidelines. The following table summarizes these actions.

Responsible Entity	Action	Timeframe/Due Date
PacifiCorp	Develop Entrainment Study Plan	August 31, 1996
PacifiCorp	Complete Entrainment Study	May 31, 1999
PacifiCorp	Entrainment Study Annual Report	October 15 (2 years)
PacifiCorp	Genetics Funding	To Be Determined
PacifiCorp	Klamath Reservoirs Study Report	December 31, 1999
PacifiCorp	Flood Operations Plan	October 31, 1996
PacifiCorp	ESA O&M Activity Plan	September 30, 1996
PacifiCorp	ESA O&M Report	December 31 Annually
PacifiCorp/BOR	Identify Fish Ladder Ownership	December 31, 1996
PacifiCorp or BOR	Fish Ladder Report	December 31, 1998
New Earth	Implement Entrainment Reduction at East/West Hydros	June 1, 1997
New Earth	Annual Entrainment Report	February 28 (2 years)
New Earth	Annual Salvage Report	Annual If Salvage Occurs
LWRRT	Draft Long Range Restoration Plan	December 31, 1996
LWRRT	Final Long Range Restoration Plan	April, 1997
LWRRT	Annual Restoration Plans	Prior to Annual Activities
PacifiCorp/New Earth	Assist with Land Purchase	January 1, 1997
PacifiCorp/New Earth	Land O&M Payments	Annually
Agricultural Land Owners	Annual Agricultural Operations Plans	Prior to Annual Activities

The ERO compliments Reclamation, PacifiCorp, and The New Earth Company for cooperatively and proactively participating in this consultation process. The proposed Lower Williamson River restoration action is an outstanding example of Federal government and private industry partnership opportunities to cooperatively benefit endangered species. If you have any questions please contact Steve Lewis, Project Leader, Marcus Horton, Supervisor Ecological Services, or Doug Young, Fish and Wildlife Biologist, at the above letterhead address/phone.

cc:
Stoel Rives, attn: Barb Craig
PacifiCorp: Frank Shrier, Tim O'Connor, Terry Flores
New Earth Company: Jim Carpenter, Brandt Gutermuth
Larry Salata
Dale Hall
Russell D. Peterson, OSO, attn: Rollie White
Randy Brown
Yreka
Arcata
ODFW: Roger Smith
Klamath Tribes, attn: Craig Bienz

Formal Consultation on PacifiCorp and The New Earth Company Operations, as Permitted by Bureau of Reclamation, for the Lost River Sucker and Shortnose Sucker

INTRODUCTION

The U.S. Fish and Wildlife Service (Service), Ecosystem Restoration Office (ERO), has reviewed PacifiCorp's and The New Earth Company's proposed operations and actions, as permitted by Bureau of Reclamation (Reclamation), on Klamath Project (Project) lands and facilities, located in California and Oregon. Reclamation's biological assessment (Assessment) requesting initiation of formal consultation and conference for these operations and actions was received on June 7, 1996. This document represents the Service's biological opinion on the effects of the proposed operations and actions on shortnose sucker (*Chasmistes brevirostris*) and Lost River sucker (*Deltistes luxatus*), and conference opinion on the effects of the proposed operations and actions on proposed critical habitat for shortnose and Lost River suckers, in accordance with section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.)(Act).

These biological and conference opinions are based on the following information: 1) the June 7, 1996 Assessment (Reclamation 1996a); 2) previous Project Assessments and their appendices; 3) information presented in all previously released biological opinions addressing Project operations; 4) results of previous and current field and laboratory research activities; 5) information provided in published and non-published literature pertaining to the listed species; 6) file information in this office; 7) documents provided by PacifiCorp and The New Earth Company; 8) personal communication between ERO staff and researchers familiar with these listed species; 9) the Klamath Tribes; 10) discussions with members of the informal Lower Williamson River Restoration Team (LWRRT); 11) phone and direct communication between ERO, PacifiCorp, The New Earth Company, and Reclamation staffs and representatives; and 12) a July 11, 1996 letter from The New Earth Company clarifying the intent of the proposed Cooperative Agreement between The New Earth Company and the Service for future Upper Klamath Lake algae harvest (described below).

Important assumptions made by the Service in analyzing these data and developing these opinions included: 1) The Service assumed, in the interim between this consultation and completion of the Upper Klamath Lake endangered sucker consultation by spring 1997, water elevations and corresponding target dates in Reclamation's "low range elevations" proposal (Reclamation 1996b) would be achieved during 1996; 2) The Service assumed Reclamation will complete the anticipated Upper Klamath Lake endangered sucker consultation by spring 1997. The Service anticipates the Upper Klamath Lake endangered sucker consultation will address other Project impacts and summarize and/or update new data not addressed in these PacifiCorp

and The New Earth Company biological and conference opinions; 3) The Service assumed new information presented in the Upper Klamath Lake consultation would be integrated into Reclamation's and PacifiCorp's management of Upper Klamath Lake water elevations. These operations should provide annual lake levels in 1997 and beyond that are conducive to enhanced endangered sucker survival while proposed long-term habitat restoration activities are implemented and biotic response is monitored; 4) The Service assumed all ongoing research and monitoring, as specified under the July 22, 1992 Project long-term biological opinion (LTBO), would continue; 5) The Service assumed that, in the long term, Lower Williamson River restoration efforts would prove successful and benefit all life stages of endangered suckers, reducing the need for short-term protections; 6) The Service assumed proposed short-term actions will remain valid until long-term Lower Williamson River restoration efforts are determined successful and Service analysis of species recovery potential validates relaxation of short-term measures. Should any of these assumptions not hold true, Reclamation, on behalf of PacifiCorp and The New Earth Company, will be required to reinitiate section 7 consultation. A complete administrative record of this consultation is on file in the ERO.

The New Earth Company is proposing, under a separate Cooperative Agreement and consultation with the Service, to implement an Upper Klamath Lake algae harvesting operation. The New Earth Company will propose to offset any unavoidable impacts to endangered suckers through, in part, annual contributions to a Tulana Farms operations and maintenance fund. While The New Earth Company's proposed financial contribution for purchase of Tulana Farms for canal harvest impacts (identified in this consultation) is separate from The New Earth Company's proposed contribution for lake harvest impacts (proposed in the Cooperative Agreement), both proposed actions are analyzed together in this consultation to ensure a full review of this long-term restoration action.

ERO and Reclamation staff worked to "streamline" this consultation process by cooperatively developing the proposed operations and actions, then negotiating and proposing measures deemed necessary to avoid jeopardy to these species and to reduce take of listed suckers. This progressive approach involved describing PacifiCorp/The New Earth Company actions, identifying and analyzing effects by action and endangered sucker life stage, and proposing biologically sound jeopardy avoidance actions and additional conservation measures to help facilitate survival and recovery of the species under review. Proposed jeopardy avoidance actions and conservation measures include research, monitoring, review of flood control rules, habitat enhancement, and entrainment reduction activities. Research and operational reviews do not, in and of themselves, reduce impacts to endangered species, reduce take, or enact corrective measures. However, Reclamation has stated in its Assessment that Service review of research and results with subsequent determination if reinitiation of consultation is required will be expected in the future. Therefore, research may eventually bring about changes in actions to avoid jeopardy or assist species conservation in ways not previously considered.

CONSULTATION HISTORY

The shortnose sucker and Lost River sucker were listed as endangered species on July 18, 1988. Reclamation initially consulted with the Service on the use of Acrolein on Project lands (biological opinion dated June 14, 1989). Several subsequent short-term consultations were completed for Project operations (biological opinions dated August 14, 1991, January 6, 1992, March 27, 1992, and May 1, 1992). On July 22, 1992, a jeopardy biological opinion was transmitted for the long-term operations of the Project. This LTBO's Reasonable and Prudent Alternative (RPA) and Incidental Take Statement (ITS) superseded all previous Project RPA's and ITS's. In April, 1993, the Service published a Recovery Plan for the shortnose and Lost River suckers. On August 11, 1994, a jeopardy biological opinion was transmitted for Project operations at Clear Lake Reservoir. The 1994 opinion's RPA requirements superseded the portions of the 1992 LTBO's RPA that referred to Clear Lake Reservoir, and provided an updated ITS for the entire Klamath Project operations. On December 1, 1994, critical habitat was proposed for Lost River and shortnose suckers. On February 9, 1995, a non-jeopardy biological opinion was completed, including an ITS, for Reclamation's Lease Lands pesticides applications. On February 2, 1996, additional Lease Lands pesticides were addressed in another non-jeopardy biological opinion and new ITS requirements were provided. On April 19, 1996, a consultation was completed that amended the February 2, 1996 opinion.

Reclamation's February 28, 1992 Assessment discussed PacifiCorp and The New Earth Company's activities within the Project area. Due to modified operations and actions, PacifiCorp and The New Earth Company have requested review of their impacts with a desire to receive an exemption to the section 9 prohibitions against take of endangered species under the Act. The 1992 LTBO addressed effects of The New Earth Company's algae harvest, estimated in 1992 at 20% of the flow of Reclamation's C-Canal. The New Earth Company's new proposed activity, as described below, has been expanded to include harvest from the entire flow of the C-Canal and all flows of the B-Canal (during algae harvest season only) and flows into the Eastside and Westside hydroproject diversions on the Link River (also during algae harvest season only). The 1992 LTBO addressed Reclamation's agreements with PacifiCorp for operating Link River Dam on Upper Klamath Lake and described a flood control operational "envelope". Due to lack of other specific information regarding the impacts of PacifiCorp's operations, other impacts and incidental take were not analyzed in the 1992 LTBO or ITS. New information and additional analysis regarding PacifiCorp's and New Earth Company's potential impacts and incidental take is therefore provided in this consultation.

Reclamation has been developing a long-term operations plan (KPOP) for the Project that will provide a template for water distribution to protect endangered suckers, provide agricultural supplies, maintain flows to the Tule Lake and Lower Klamath National Wildlife Refuges, protect anadromous fisheries below Iron Gate Dam, and support Tribal Trust resources. The Service anticipates a biological assessment on effects of the Project on Upper Klamath Lake water

elevations will be finalized with a biological opinion completed by spring 1997. In the interim period, Reclamation has provided a "low range elevations" proposal (Reclamation 1996b), to identify target Upper Klamath Lake elevations and corresponding dates during 1996. These water elevations are more protective for listed suckers than the requirements of the 1992 LTBO. The anticipated Upper Klamath Lake water elevations consultation will address other Project impacts, both beneficial and detrimental, and summarize new data that are not addressed in these PacifiCorp and The New Earth Company biological and conference opinions. Water operation impacts associated with PacifiCorp's activities, as addressed in this document, will be analyzed fully in the anticipated Upper Klamath Lake water elevations consultation.

BIOLOGICAL AND CONFERENCE OPINIONS

DESCRIPTION OF THE PROPOSED ACTION

PacifiCorp's and The New Earth Company's proposed action is a combination of historic and new operational activities, specific research and review, endangered species jeopardy avoidance and take reduction actions, and associated conservation measures. The action area encompasses Upper Klamath Lake downstream to Iron Gate Dam on the Klamath River, Oregon and California.

As described below, New Earth proposes to operate algae harvest facilities within the Klamath Project at sites near the junction of Reclamation's B- and C-Canals and at the Eastside and Westside Canals at the Link River Dam. They have requested issuance of a license to operate on these Reclamation facilities. Reclamation has made operation of these facilities contingent on the completion of this consultation and subsequent implementation of the necessary measures required in the opinions.

As described below, PacifiCorp proposes to operate Link River Dam and associated facilities in compliance with the 1992 LTBO and the contract with Reclamation. Continued operation of five hydrofacilities on the Klamath River are also proposed. Reclamation has made future operation of these facilities contingent on the completion of this consultation and subsequent implementation of the necessary measures required in the opinions. A subsequent Upper Klamath Lake water elevation consultation between the Service and Reclamation, to be completed by spring, 1997, will update PacifiCorp's 1992 LTBO lake level commitment identified above.

Operational Activities

PacifiCorp's facilities are comprised of six hydroelectric and/or re-regulating dams on the Link and Klamath Rivers, Oregon and California. Operations at these facilities occurs 24 hours a day, all year long. The Project Description and Proposed Action section of Reclamation's

Assessment describes the various hydrofacilities' locations, purposes, designs, features, and associated operational information. Description of PacifiCorp's Flood Control "envelope" and operations based on water year scenario is provided in Reclamation's 1992 biological assessment. The Service incorporates those descriptions by reference in these biological and conference opinions.

The New Earth Company's existing algae harvest facilities are located on Reclamation's C-Canal, below the A-Canal diversion from Upper Klamath Lake, Oregon. Harvest operations at this facility occur 24 hours a day, from approximately June 1 to October 15, and utilize approximately 20% of C-Canal flows. Harvest activities cease at the end of the irrigation season when the A-Canal headworks are closed. The Project Description and Proposed Action section of Reclamation's Assessment describes the purposes, designs, features, and associated operational information. The Service incorporates those descriptions by reference in these biological and conference opinions.

The New Earth Company's proposed new activity would include harvesting algae from the entire flow of the C-Canal and all flows of the B-Canal (during algae harvest season only, ending when irrigation season ceases). Debris Reduction Devices will be employed at both B- and C-Canal facilities only during actual harvest periods. However, unlike the C-Canal where all flows would be screened via Debris Reduction Devices, only the pumping facilities would be screened with Debris Reduction Devices at the B-Canal, potentially allowing some unimpeded flow down the middle of the canal and therefore some incidental movement of suckers past this facility without site-specific entrainment impacts. Additionally, The New Earth Company proposes to expand harvest activities in 1997-1998 to the Eastside and Westside hydroproject diversions at Reclamation's Link River Dam, where all flows passing through the diversion channels would eventually be harvested. Entrainment reduction devices, described below, would be operated at the Eastside and Westside facilities during all algae harvest activities or between June 1 through October 15, whichever is a greater period of time. Reclamation's Assessment, Project Description and Proposed Action section, describes the purposes, designs, features, and associated operational information for these new actions. The Service incorporates those descriptions by reference in these biological and conference opinions.

Existing Protections

PacifiCorp currently operates fish ladders on the following facilities: Link River Dam, Keno Dam, and J.C. Boyle Dam. A fish entrainment reduction device is provided at J.C. Boyle Dam. Fish entrainment reduction devices are not installed at the Link River Dam spillway or either of the Link River Dam powerhouse intakes. Minimum flows are provided downstream of Link River Dam (80 cfs), Keno Dam (200 cfs), and J.C. Boyle Dam (a combination of up to 500 cfs of various accretions). Ramp rates have been developed for the Link River below Link River Dam to reduce fish stranding. PacifiCorp's Standard Operating Procedures includes a salvage plan for salvaging endangered suckers from the Link River and from various hydrofacilities. The Link River salvage plan directs PacifiCorp to collect all suckers in dewatered areas and return them

safely, after biological evaluation and data collection, to their water of origin. During 1995 and 1996, PacifiCorp implemented salvage activities after spill termination under Reclamation's section 10(a)(1)(A) Recovery Permit.

The New Earth Company currently operates coarse (3/8" mesh) debris screens at its C-Canal algae harvest facility. These debris screens may incidentally serve to reduce The New Earth Company's entrainment of juvenile and adult fish.

Future Research, Review, Jeopardy Avoidance Measures, and Conservation Measures

Discussions between the Service, Reclamation, PacifiCorp, and The New Earth Company identified PacifiCorp and The New Earth Company operational impacts to endangered suckers from Upper Klamath Lake downstream to Iron Gate Reservoir. The impacts are identified and discussed in Effects of Action section of these opinions. As a result of these discussions, PacifiCorp and New Earth Company, in consultation with Reclamation and the Service, agreed upon a combination of long-term and short-term measures intended to avoid jeopardizing the continued existence of the listed Lost River and shortnose suckers. The purchase of Tulana Farms as offsite habitat is the primary jeopardy-avoidance measure, and Service, Reclamation, tribal, PacifiCorp, and New Earth biologists expect that the restoration of off site habitat at Tulana Farms in the Williamson River Delta will significantly benefit the Lost River and shortnose suckers in the long term. *See* Lower Williamson River Restoration Project - Tulana Farms Initial Biological Justification (PacifiCorp 1996). The above-mentioned scientists collectively project the restoration effort will significantly increase the number of surviving sucker larvae which should, in turn, benefit each species as a whole.

The purchase of, and provision of operation and maintenance funds for, Tulana Farms is the major jeopardy-avoidance measure in this consultation, however, because the restoration of Tulana Farms is a long-term project, the following short-term measures were included in the consultation: entrainment reduction study (PacifiCorp), entrainment reduction devices at Link River power canal headgates during algae harvest season (New Earth Company), flood control study (PacifiCorp), genetics management study (PacifiCorp), and reservoir sucker population status studies (PacifiCorp). In addition, New Earth Company has agreed to a number of conservation measures including: endangered sucker and water quality monitoring and assisting PacifiCorp with the entrainment reduction study.

Reclamation, PacifiCorp, and The New Earth Company understand the Service or Reclamation may determine it necessary to reinitiate consultation on the Lost River and shortnose suckers at some future date if there is significant new information and after a thorough consideration of the status of the species overall.

PacifiCorp Action Items - PacifiCorp agrees to include the following action items that demonstrate their commitment to the survival and recovery of the endangered suckers. These items also are incorporated as conditions of the contract issued by Reclamation.

1) Entrainment Reduction Study - Data on sucker entrainment rates into the unscreened hydropower diversions at Link River Dam are lacking. The primary goal of this study is to determine the timing, size, magnitude, and duration of juvenile (age 1 and older or > 75mm) and adult sucker entrainment into the Eastside and Westside diversion canals. Entrainment will be evaluated during the period when entrainment reduction devices are not in operation, October 15 through May 31 (season). This study will be conducted in coordination with New Earth, Reclamation, Oregon Department of Fish and Wildlife and the Service. A study design will be "Service-approved" prior to implementation. It is anticipated that these studies will be conducted over two seasons and will be completed by May 31, 1999, with the intent of beginning field activity during 1996.

2) Genetics Management Plan - Management of endangered Lost River sucker and shortnose sucker populations has been complicated by the lack of genetic information and potentially conflicting taxonomic status. These species also display highly variable morphological characteristics that have lead to concern over potential hybridization/introgression among sucker species. This study is designed to determine the genetic relationships among four Klamath Basin sucker species, differences within the endangered species, and whether or not these species are presently hybridizing or may have hybridized in the past. This information will be used to improve management of the different stocks of endangered suckers and is essential for any future hatchery operations.

Although the Service listed the Lost River and shortnose suckers as taxonomic species and not distinct population segments, the Service believes there are important spawning subpopulations of suckers found in Upper Klamath Lake. As a result, PacifiCorp has agreed to cost share with Reclamation and other agencies to perform additional taxonomic and genetic studies. Reclamation made a collection of suckers throughout the Upper Klamath Basin in 1993 that can be used for these additional taxonomic and genetic studies. Findings from this research will be used to develop a genetics management plan that will guide management of sucker populations and potential future hatchery supplementation. This work is tentatively scheduled to begin in October 1996 and continue for 3-4 years. PacifiCorp will fund these studies in a pro rata share amount, based on the financial contributions of other research participants, not to exceed $80,000 total.

3) Sucker Population Status in Mainstem Reservoirs - Very little information is known about the endangered sucker populations in the Klamath mainstem reservoirs (J.C. Boyle, Copco, and Iron Gate). PacifiCorp will coordinate with Reclamation, Oregon Department of Fish and Wildlife, California Department of Fish and Game, and the Service to develop a scope of work for sucker studies on the mainstem reservoirs. Study objectives are likely to include: determination of distribution and abundance, age class structure, recruitment success and habitat use by different life stages. A study design will be "Service-approved" prior to implementation. It is anticipated that the study period would be from 1997 to 1999. PacifiCorp will fund these studies and analyses, which are expected not to exceed $120,000.

4) Sucker Nursery Habitat Restoration - Recent research on factors limiting sucker populations in Upper Klamath Lake indicates that a bottleneck exists at the larval life stage. Poor larval survival in sucker nursery habitat areas appears to be related to degraded water quality, predation, and lack of emergent vegetation habitat. The 1992 LTBO analyzed a Conservation Measure for marsh restoration construction and assessment. Based on this commitment, Reclamation, the Service, The Nature Conservancy (TNC), NRCS, PacifiCorp, and New Earth have cooperatively proposed funding, restoring and maintaining a property on the Lower Williamson River. The NRCS proposes to enroll a large portion of the property under a permanent easement in the Wetlands Reserve Program. This proposed action also includes any future federal funds transferred for restoration activities. This restored habitat would be designed and managed to benefit riverine and lake water quality, reduce larval predation, and substantially increase larval sucker habitat in historic locations. This type of habitat restoration action is strongly supported within the Recovery Plan for the two sucker species (Service 1993).

PacifiCorp and New Earth propose to invest 1.8 million dollars combined in the purchase of Tulana Farms with TNC and NRCS, and PacifiCorp proposes to commit $75,000 each per year for ten years or the equivalent present net worth in lump sum to the operation and maintenance of the property. If unforeseen circumstances occur, and the purchase of Tulana Farms with TNC and NRCS does not materialize, PacifiCorp and New Earth agree to pursue the option to purchase Tulana Farms or other offsite habitat mitigation. PacifiCorp and New Earth agree to acquire property identified for offsite mitigation by January 1, 1997. If an acquisition is not facilitated, the Incidental Take Statement will become invalid and reinitiation of consultation will be required.

As proposed, approximately 1,150 acres of Tulana Farms would be excluded from the perpetual NRCS conservation easement to allow for agricultural use. The NRCS and TNC, with assistance of the LWRRT, will determine the precise location of these agricultural lands to be excluded from the easement. PacifiCorp, The New Earth Company, and TNC ("the parties"), or some combination of these parties, may hold an interest in the agricultural inholdings. The parties who ultimately acquire an interest in the agricultural inholdings will work with the Service to ensure that the management of these lands are consistent with the protection of the suckers under the Act. The Service maintains the ability to reinitiate consultation with the parties via Reclamation if agricultural practices are still occurring on these lands after 10 years.

PacifiCorp and The New Earth Company will assist in formation of, and also participate in, the LWRRT for the Lower Williamson River restoration program. The LWRRT will include representatives from Reclamation, Service, Oregon Department of Fish and Wildlife (ODFW), TNC, NRCS, and the Klamath Tribes. This technical team would, among other activities, develop a recommended long-range restoration plan for the property and provide annual work plans to the Management Committee. The Management Committee will be made up of representatives from PacifiCorp, The New Earth Company, Reclamation, Service, ODFW, TNC, NRCS, and the Klamath Tribes. The Management Committee would oversee the LWRRT's activities and also address non-technical issues. TNC would operate Tulana Farms and would

act in good faith to implement the recommendations of the LWRRT. If the LWRRT is unable to reach consensus on the Restoration Plan, TNC and NRCS may nonetheless continue to take reasonable steps to restore Tulana Farms, consistent with the ITS requirements applicable to PacifiCorp and The New Earth Company. Restoration project success will be annually monitored via specific habitat and larval and early juvenile production criteria, as developed by the LWRRT. The Service would review the long-range restoration plan and the annual work plans to ensure consistency with this consultation. The annual and long-range restoration plans will be developed to meet NRCS restoration program guidelines.

5) Re-evaluate Flood Operations Plan for Upper Klamath Lake - A review of scientific data pertaining to endangered suckers in Upper Klamath Lake suggests that elevations higher than those listed as an element of the Reasonable and Prudent Alternative in the 1992 LTBO are necessary to provide habitat for sucker spawning, larval and juvenile rearing, and also provide water quality protection. Some of these elevations, particularly those during late winter and early spring, are outside of PacifiCorp's operating envelope for Upper Klamath Lake.

PacifiCorp will develop a scope of work that includes consideration of the flood control rule curves, operational constraints, hydropower, and shoreline habitat benefits to the suckers. The scope of work will be reviewed by Reclamation and the Service. PacifiCorp will complete the re-analysis of the Flood Operations Plan by October 1996.

The New Earth Company Action Items - New Earth agrees to include the following action items that demonstrate their commitment to the survival and recovery of the endangered suckers. These items also are incorporated as conditions of the amended licence issued by Reclamation.

1) Sucker Nursery Habitat Restoration - Same as #4 PacifiCorp action item above for property acquisition, agricultural inholdings, and restoration planning and implementation. Additionally, The New Earth Company will provide, at final closing of the Tulana Farms property, $75,000 for the first year's operation and maintenance of the property. As noted in the Introduction section, The New Earth Company will provide $75,000 per year, for years two through ten, or the equivalent present net worth in lump sum, for the operation and maintenance of the property via the proposed Cooperative Agreement with the Service. This total contribution of $675,000 is proposed to offset The New Earth Company's future Upper Klamath Lake algae harvest operations, and is a separate action from this consultation. If the Cooperative Agreement is not completed by December 31, 1996, The New Earth Company commits to providing $75,000 per year, for years two through ten, or the equivalent present net worth in lump sum, for the operation and maintenance of the property , under the same process proposed above by PacifiCorp.

2) Entrainment Reduction Devices - New Earth will install and maintain entrainment reduction devices that maintain exclusion of suckers greater than 75 mm, at the Eastside and Westside diversion canals at the Link River Dam during all algae harvest activities or between June 1 through October 15, whichever is a greater period of time, for ten years or the remaining

life of the Federal Energy Regulatory Commission (FERC) permit, beginning in June 1, 1997 regardless of whether algae harvest activities have commenced. The entrainment reduction devices will be operated 24 hours a day. They will be manually removed, cleaned, and replaced several times a day.

The New Earth Company Conservation Measures - The following are additional research and conservation measures proposed by The New Earth Company. None of the three actions described below will require reinitiation of this consultation upon completion of the individual activity. Reclamation and the Service believe these activities are important in developing additional information on the endangered suckers and therefore support their progressive implementation by The New Earth Company.

1) Endangered Sucker Monitoring - Endangered sucker research will be conducted in relation to algae harvest activities at the B- and C-Canal harvest facilities. Life stages targeted include larval, juvenile, and adult forms. In coordination with the Service and Reclamation, The New Earth Company proposes a study to determine the extent to which fish respond to algae harvest operations and associated debris reduction devices. Research will focus on identifying species composition, timing, and magnitude during entrainment. It is anticipated that this study will be initiated in 1996 and conducted over two years.

2) Water Quality Monitoring - The New Earth Company will be harvesting large quantities of algae from the B- and C-canals and has plans to expand its harvest operations to PacifiCorp's Eastside and Westside power diversions. These activities are expected to improve water quality conditions in the Lost and Klamath rivers below their operations. The New Earth Company will begin monitoring water quality conditions (DO, pH, temperature, specific conductivity, turbidity) above and below harvest operations at the B- and C-canals in 1996. Link River monitoring will be initiated during the 1997 harvest season.

3) Entrainment Reduction Study - The New Earth Company will participate in a study to determine the timing, size, magnitude, and duration of juvenile (age 1 and older or >75mm) and adult sucker entrainment into the Eastside and Westside diversion canals and guide development of additional entrainment reduction methods and operating periods if required in reinitiation. Entrainment will be evaluated during the period when entrainment reduction devices are not in operation, October 15 through May 31 (season). This study will be conducted in coordination with PacifiCorp, Reclamation, ODFW, and the Service. A study design will be "Service-approved" prior to implementation. It is anticipated that these studies will be conducted over two seasons and will be completed by May 31, 1999, with the intent of beginning field activity during 1996.

STATUS OF THE SPECIES

Historically, populations of shortnose and Lost River suckers occupied the Upper Klamath River basin and the seasonally-connected Lost River drainage. A complete description of known historic distribution is provided in Reclamation's February 28, 1992 Assessment. Current distribution is reduced from historic due to damming of rivers, diversions, loss of marsh habitat (FR 53 27130), and poor water quality (Kann and Smith 1993). Sucker populations in the Lost River are segregated without passage facilities between water developments; Tule Lake supports limited sucker populations due to historic habitat loss and continued habitat degradation due to sedimentation of the sumps and poor water quality (D. Mauser, Service, pers. comm., 1996). Sucker populations in Clear Lake and Gerber Reservoir, while more stable than other populations (Scoppettone et al. 1995; M. Buettner, Reclamation, pers. comm.), are still faced with restricted distribution, lack of genetic connectivity with other populations, and, in the case of Clear Lake, limitation to one spawning tributary system. Numerous spawning populations in Upper Klamath Lake and its tributaries have been extirpated; spawning populations that historically utilized Seven Mile Creek, Four Mile Creek, tributaries to the Wood and Sprague Rivers, Barkley Springs, Odessa Springs, Harriman Springs and at least four other springs in Upper Klamath Lake have disappeared (Reclamation 1996a; Simon et al. 1995). Spawning activity is greatly reduced in the Sprague River, especially above Chiloquin Dam, in the Wood River and its tributaries, and springs in Upper Klamath Lake. Historic habitat conditions in Upper Klamath Lake and its tributaries have been altered; wetland habitats around Upper Klamath Lake, critical to survival of all life stages, have been reduced approximately 35,000 acres in the last 80 years (Gearhart et al. 1995). Remaining Upper Klamath Lake wetland areas are affected by Project water level management.

These types of data were originally used to determine these two sucker species to be endangered, to develop these species' Recovery Plan, and to propose critical habitat. These conditions, which led to the listing of these species in 1988, still exist and continue to endanger the Lost River and shortnose suckers. These conditions will require long time periods for their resolution. However, numerous activities have been initiated and/or completed, mainly supported by Reclamation, since the 1992 LTBO. These activities include development of water elevation requirements, within the 1992 LTBO and 1994 Project biological opinion, for Gerber Reservoir, Clear Lake, Tule Lake, and Upper Klamath Lake. Minimum flows have been established for the Lost River below Anderson-Rose Dam during sucker spawning periods. The 20 conservation measures proposed in the February 28, 1992 biological assessment have been initiated or completed. These activities have been necessary to ensure Project operations do not jeopardize the continued existence of the suckers. Additionally, a total of 51 recovery actions from the 1993 Recovery Plan, including those listed above as required under the 1992 LTBO and 1994 Project biological opinion, have been initiated, are in various ongoing stages, and/or completed by Reclamation or with cooperation from Reclamation.

Major summaries of endangered suckers' general biology, habitats, distribution and abundance, taxonomy, reasons for decline, life history, and reproduction are found in Reclamation's February 28, 1992 biological assessment, the Service's 1992 LTBO and 1994 Project biological opinion, the Lost River Sucker and Shortnose Sucker Recovery Plan (Service 1993), and the

Proposed Critical Habitat Biological Support Document (Service 1994). These data are incorporated into these biological and conference opinions by reference.

ENVIRONMENTAL BASELINE

The Environmental Baseline is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the species or its habitat. This analysis describes the status of the shortnose and Lost River suckers and factors, including the proposed action, affecting the environment of the two suckers and their proposed critical habitat in the proposed action area.

Status of Species Within Action Area

Significant new research, monitoring, and management actions have been conducted throughout the range of the listed suckers since the 1992 LTBO. These new data will be considered under the forthcoming Upper Klamath Lake water elevations consultation, which will address all other Reclamation impacts specific to the entire range of these species. The following provides new scientific data for the current consultation's action area, Upper Klamath Lake downstream to Iron Gate Reservoir on the Klamath River. A complete list of new scientific data citations for Upper Klamath Lake, if not cited below, is provided in Reclamation's Assessment, Literature Cited section.

Areas Below Upper Klamath Lake

The following includes a summary of new endangered sucker information provided in Reclamation's Assessment. This new information from the Assessment is incorporated by reference.

Limited endangered sucker sampling has occurred since 1992 in the Link River, Lake Ewauna, the Klamath River, and PacifiCorp reservoirs downstream to Iron Gate Dam. Few juvenile and adult suckers were collected during this period. Efforts to collect larval stages in this area have not been attempted since 1992 (M. Buettner, Reclamation, pers. comm.). Water quality is a limiting factor in the Link River to Keno Dam reach; summer and fall dissolved oxygen concentrations throughout this reach are reduced to lethal levels.

In 1993, Reclamation sampled J.C. Boyle Reservoir eight times collecting 20 shortnose suckers, one Lost River sucker, 30 Klamath smallscale suckers, and 6 Klamath largescale suckers. The ODFW conducted an eletrofishing survey at J.C. Boyle Reservoir on June 14, 1995. They captured 32 juvenile suckers but did not identify them. In 1993, Reclamation sampled Copco Reservoir and captured 10 adult shortnose suckers ranging from 427-500 mm fork length (FL). PacifiCorp's salvage activities during 1994 and 1995 in the Link River have collected between 0 and 138 suckers. In May 1994, a fish salvage of the Link River found no suckers. Fish salvage

efforts in April, 1995, collected 12 suckers; 10 shortnose and 2 Lost River. · A fish salvage conducted at the conclusion of spill in May 1995 collected 132 shortnose suckers, 5 Lost River suckers, and 1 Klamath largescale sucker. In December, 1995, only one 100 mm sucker was salvaged in a side channel and was returned to Link River. Salvage operations at J.C. Boyle hydrofacility since 1992 have resulted in observation of only 2 juvenile suckers (Reclamation 1996a).

As noted in the February 28, 1992 Assessment, limited spawning occurs in the Klamath River above Copco Reservoir. It is possible limited spawning also occurs in the Klamath River above J.C. Boyle Reservoir.

Upper Klamath Lake

Substantial new information has been collected from Upper Klamath Lake since the 1992 LTBO. Reclamation's Assessment summarizes this new information in the following 12 categories: age and growth; hybridization and genetics; reproduction; population status; condition; sucker die-offs; entrainment; freshwater inflow area use; larval habitat; juvenile ecology; juvenile habitat; and adult habitat. The following includes a summary of new information provided in Reclamation's Assessment, and includes new information not addressed in Reclamation's Assessment on larval ecology and habitat, larval and juvenile sucker water quality tolerances, Upper Klamath Lake water quality, and endangered sucker passage at PacifiCorp's facilities. The new information addressed in the Assessment is incorporated by reference, with additional citations from other sources provided to complement this newly-summarized information.

Age and Growth

New information collected since 1992 indicates that both shortnose and Lost River sucker maturation can occur at an earlier age than was previously determined. Faster growth rates also have been documented from recent shortnose and Lost River sucker year classes compared to those from the 1960's and 1970's (Buettner and Scoppettone 1990). Age at maturity for shortnose and Lost River suckers appears to be related to growth rate, with faster growing fish maturing earlier than slower growing fish. This phenomenon has been well documented with the cui-ui, a species closely related to the shortnose sucker (Scoppettone pers. comm., cited in Reclamation 1996a). Growth rate and sexual maturity appears to be density dependent in cui-ui with fast growth and earlier sexual maturation related to lower population size. As the cui-ui population increased substantially in recent years, growth rates decreased markedly and correspondingly age of maturity shifted to older ages. Unfortunately, population size data for shortnose and Lost River suckers are not available to evaluate whether the recently-recorded faster growth rates and earlier sexual maturation are density dependent. These age and growth data and comparisons are addressed in detail within the Assessment, and are included herein by reference.

Hybridization and Genetics

Recent studies by Buth and Haglund (1994) focus on shortnose suckers. This study supports previous protein electrophoresis work (Harris and Markle 1991, Moyle and Berg 1991) indicating that substantial hybridization has not occurred in shortnose sucker populations. Buth and Haglund's 1994 data support the hypothesis that the wide range of morphological variation observed in the wild reflect differences in phenotypic expression as a response to differing physical environments, or the age of the individual (Moyle and Berg 1991). However, Buth and Haglund (1994) determined that there was genetic variation separating Upper Klamath Lake shortnose suckers from those in Clear Lake, Gerber Reservoir, and Copco Reservoir. Shortnose expressed similar genetic variation in the latter three reservoirs.

Buth and Haglund (1994), and a recent abstract by Buth et al. (1996), indicate the Upper Klamath Lake shortnose sucker population should be managed as a separate genetic unit. Buth et al. (1996) indicate shortnose and Lost River suckers, throughout their ranges, do not exhibit inbreeding depression and, for Lost River sucker, this was the first study to indicate Lost River sucker do not exhibit hybridization. These studies did not include different sucker age classes or different Upper Klamath Lake spawning populations in their analyses. A thorough, basinwide analysis, utilizing allozyme electrophoresis, mtDNA, and meristics/morphometrics data collected simultaneously from the same individual fishes, must be completed to adequately address hybridization, introgression, and genetic structuring of sub-populations (L. Dunsmoor, Klamath Tribes, pers. comm.).

Reproduction

In 1995, Klamath Tribal biologists captured mature Lost River suckers during late March at Kirk Springs, 128 km upstream from Upper Klamath Lake (L. Dunsmoor, Klamath Tribes, pers. comm.). Mature Lost River suckers were again collected in this location in 1996. Unit 5 of the proposed sucker critical habitat extends to just downstream of this location (Service 1994). Klamath Tribes collected 157 shortnose suckers and 139 Lost River suckers at the Sprague River Dam fish ladder during 1996 (L. Dunsmoor, Klamath Tribes, pers. comm.). These data verify that some individuals of this species successfully negotiate the Sprague River Dam fish ladder and migrate long distances upstream to spawn. Previous scientific literature indicates only Klamath largescale suckers as having migrated through the ladder and spawning at Kirk Springs (Buettner and Scoppettone 1990), although Klamath Tribes biologists have recorded shortnose and Lost River sucker passage at the Sprague River Dam in past years (L. Dunsmoor, Klamath Tribes, pers. comm.). Of additional interest are data collected at Sprague River Dam in 1996 that indicate a temporal spawning separation between largescale sucker upstream migration (migration in March) and shortnose/Lost River suckers upstream migration (migration in April/May) (L. Dunsmoor, Klamath Tribes, pers. comm.). Lost River and shortnose suckers were collected during downstream migration at the Sprague River Dam in 1996; numerous individuals had completed spawning, verifying spawning was occurring upstream of the Sprague River Dam (L. Dunsmoor, Klamath Tribes, pers. comm.).

Intensified monitoring of lake spawning since 1993 by Reclamation and the Klamath Tribes have identified Lost River sucker spawning at six spring and two non-spring sites along the east shoreline of Upper Klamath Lake. Shortnose sucker spawning has been identified since 1992 at three sites: Sucker Springs, Silver Building Spring, and Ouxy Springs. Since 1993, small numbers of shortnose and Lost River suckers have been observed spawning in gravelly shoreline sites with no detectable spring influence.

The Klamath Tribes has been qualitatively monitoring spawning runs in the Williamson and Sprague Rivers since 1988 (L. Dunsmoor pers. comm., cited in Reclamation 1996a). Beginning in 1992, a substantial increase in small Lost River and shortnose suckers was observed. During May 1993, small-sized shortnose and Lost River suckers dominated the catch on the Williamson and Sprague Rivers. Radiotracking studies indicated suckers were spawning in historic sites in the lower Williamson River and the Sprague River below Sprague River Dam (M. Buettner, Reclamation, pers. comm.). Presumed pre-spawning aggregations of suckers have been collected at the mouth of the Williamson River (M. Buettner, Reclamation, pers. comm.). During 1995, adult shortnose and Lost River suckers were collected at the mouth of the Williamson River beginning February 23, whereas in 1996 few adult suckers were collected at this location until April.

During March to mid-May, 1996, Reclamation sampled Agency Lake at the mouth of the Wood River (M. Buettner, Reclamation, pers. comm.). A total of three adult Lost River and 15 adult shortnose suckers were captured. One Lost River and six shortnose suckers were implanted with radiotags. Most radiotagged suckers migrated into the lower Wood River in May and early June, presumably to spawn. On May 17, 1996, Reclamation, assisted by ODFW, conducted an electrofishing survey of the lower Wood River and captured 11 adult shortnose suckers. Larval suckers were collected in late June and early July, 1996, in the lower Wood River (M. Green, Reclamation, pers. comm.).

Population Status

Monitoring of distinct Lost River spawning aggregations at Sucker Springs in Upper Klamath Lake has resulted in updated population estimates since 1992. In 1993, 900 Lost River sucker adults were estimated to be using this spring complex. This estimate is similar to estimates in 1987 (1,038 adults), 1988 (817 adults), and 1989 (960 adults). Recaptured suckers comprised approximately 46% of all suckers collected at Sucker Springs in 1993.

Reclamation has captured, tagged and released several hundred juvenile and adult shortnose and Lost River suckers in Upper Klamath Lake between 1993 and 1995. Specifically, 305 shortnose suckers have been PIT and/or Floy anchor-tagged and 15 radio-tagged. Twelve Lost River suckers were radio-tagged and 355 PIT and/or Floy tagged. During the spring of 1995, NBS PIT tagged 60 Lost River sucker adults and 405 shortnose sucker adults at the mouth of the Williamson River, and approximately 1,300 additional Lost River and shortnose suckers

were collected in 1996. Recapture rate for both these marked groups has been extremely low. Reclamation recaptured one PIT tagged Lost River sucker in 1994 and one in 1995. One PIT tagged shortnose sucker was recaptured at Ouxy Springs in 1995. Out of the approximately 900 adult shortnose and Lost River suckers collected at the mouth of the Williamson River in 1996, only one 1995 shortnose sucker recapture occurred. Suckers collected at the Sprague River Dam fish ladder in 1996 could not be checked for PIT tags due to equipment failure (L. Dunsmoor, Klamath Tribes, pers. comm.). In 1993, 60 Lost River suckers were recaptured at Sucker Springs; all these fish had been tagged with Floy anchor tags. Preliminary 1996 data indicates a 30% recapture rate at Sucker Springs (M. Buettner, Reclamation, pers. comm.).

A widespread sucker die-off (described below) provided some insight regarding current population levels in Upper Klamath Lake. A total of 526 suckers, including 378 Lost River suckers (72% of total collected), 124 shortnose suckers (24% of total collected), and 24 unidentified (5% of total collected), were recovered. No recaptures of previously tagged fish were recorded from the carcasses collected. These data indicate the 1990 and 1991 age classes were successful; approximately 42% of the Lost River suckers and 62% of the shortnose suckers were age 4 (1991 cohort) and 29% of the Lost River suckers and 15% of the shortnose suckers were age 5 (1990 cohort). These data from smaller-sized shortnose and Lost River suckers suggests that their population numbers are at least in the thousands of fish. However, a carcass condition index, identifying the relative decomposition state for each sucker, revealed approximately 35% of the carcasses were badly decomposed, increasing the chance of tag loss (M. Green, Reclamation, pers. comm.). These data may indicate bias in utilizing a mark-recapture method of estimating Upper Klamath Lake sucker populations exclusively from sucker die-off data. Additionally, it is noted that three of 14 radiotagged fish perished during the die-off event, indicating substantial mortality in the overall sucker population and providing a conflicting cross reference to the above mark-recapture population estimate. Additional research and further analyses of these data are necessary, such as stratification of mark-recapture analysis based on size of fish recaptured, not on total fish recaptured, comparison of sampling methodologies to standard mark-recapture assumptions, and determination of total recapture sampling effort required, before definitive statements on current sucker abundance in Upper Klamath Lake can be made.

Population monitoring conducted in the 1980's (Buettner and Scoppettone 1990; Bienz and Ziller 1987) indicated that recruitment of Lost River and shortnose suckers to adult-size age classes was inconsistent, as evidenced by gaps in known year classes of spawning adults. Reclamation's Assessment discusses continued, recent losses of older sucker cohorts, and increases in relative abundance of younger (1990 and 1991) cohorts. These recent data are discussed in more detail under Reproduction (above) and Sucker Die-Offs (below).

Condition

Fulton condition factors were calculated for younger age shortnose and Lost River suckers to assess interannual differences during spring and fall in wet and critically dry years. In general,

shortnose and Lost River suckers exhibited minor condition factor differences between these two water year types. These data might indicate the suckers maintain "condition" regardless of water year. Alternatively, two biases may be occurring in these condition factor data. First, environmental stressors can cause up to 25% weight gain, due to osmoregulatory imbalances causing water retention, which would result in higher condition factor values (R. Goede, UDWR, pers. comm.). Second, if mortality is occurring during stressful water quality periods, density dependant mechanisms could be effecting the condition of surviving fish, thereby providing the perception of similar condition factors between water year types. A better and less biased measure of sucker condition would be based on physiological and "abnormality" indices (R. Goede, UDWR, pers. comm.). These data are currently unavailable. Another less biased measure of condition would be based on relative weight; however, a "standard weight" calculation for various sizes of Lost River and shortnose sucker has not been developed.

Sucker Die-offs

Between mid-September through late October, 1995, a widespread fish die-off occurred in Upper Klamath Lake, from which 378 Lost River suckers and 124 shortnose suckers were collected. Suckers collected during the die-off included mostly young fish (ages determined using opercle bones, M. Buettner, Reclamation, pers. comm.). Several suckers displaying lethargic and unresponsive behavior were collected during the die-off event and taken to Oregon State University (OSU) for pathological examination. All were acutely infected by a bacterial disease, columnaris (*Flexibacter columnaris*) (Banner 1995). This pathogen was also documented as a primary causative agent in the death of suckers collected during the 1971 and 1986 die-offs (Logan and Markle 1993). Ninety-five percent of the Lost River and shortnose suckers from the 1995 die-off event were age 7 years and younger. A total of only 14 and 9 year classes were documented for Lost River and shortnose suckers, respectively. For comparison, a similar fish die-off in 1986 reflected 26 Lost River sucker age classes represented. Only eight shortnose suckers were collected during the 1986 die off. Lost River suckers have been aged to 43 years while shortnose have been aged to 33 years (Scoppettone 1988); these data indicate many more cohorts should be present in a healthy population than were collected in recent die-off events. In 1995, Age 4 and 5 fish, representing the 1991 and 1990 year classes respectively, numerically dominated the collection for both species. Population surveys conducted on Upper Klamath Lake using trap nets and trammel nets from 1993-1995 has documented very few large adults, and Williamson and Sprague River spawning data during this same time period also have noted a similar decline in larger sized suckers. These data seem to substantiate 1995 fish die-off data which suggest loss of numerous, older age classes of both sucker species. Reclamation's Assessment provides these cohort-loss data in graphical form; these data are incorporated herein by reference.

Recent large-scale Upper Klamath Lake fish die-offs have been documented from 1971, 1986, 1994, and 1995. Because of the long history of blooms of blue-green algae (*Aphanizomenon flos-aquae*) and associated poor water quality conditions, other fish kills most certainly have occurred. Fish kills involving native, non-game fish, including chubs and suckers, may have not

been reported by the public. Also, with the large populations of fish eating birds (cormorants, gulls, pelicans, grebes, terns) present at Upper Klamath Lake, sick and dead fish can be quickly consumed leaving no evidence of a fish kill. Large concentrations of fish eating birds were observed feeding on local fish kills during summer 1994 (L. Dunsmoor pers. comm., cited in Reclamation 1996a) and 1995 (D. Simon pers. comm., cited in Reclamation 1996a).

Entrainment

Entrainment of all Upper Klamath Lake endangered sucker life stages occurs at Reclamation's A-Canal, and PacifiCorp's East and Westside diversions, Link River Dam. Juvenile suckers have been salvaged from Klamath Project canals receiving water from Upper Klamath Lake yearly since 1991. The number of suckers salvaged from 1991-1995 were 3,166; 2,618; 788; 334; and 4,072, respectively. Most suckers salvaged were small juveniles less than 250 mm FL. Canal salvage data represent only a qualitative index of year class strength in Upper Klamath Lake for the following reasons: 1) Since some irrigation water originates from the Lost River, suckers from Gerber, Clear Lake, and the Lost River are likely included in the salvage sample. 2) Many irrigation canals are treated with Acrolein during the summer to control aquatic plants and this herbicide is highly toxic to fish. 3) Several practices have been implemented since 1992 to reduce the number of suckers that have to be salvaged. Most of these practices lead to draining of canals into the Lost River or Klamath River. 4) Patchy distribution of stranded suckers can also effect salvage success since not all potential holding habitat is sampled. 5) Sampling effort and personnel has also varied during annual salvage operations.

The large salvage collection in 1991 (3,166 suckers) supports OSU juvenile sucker survival data for the same year indicating establishment of a 1991 year class. In 1992, although the overall catch was high (2,618 suckers), about 95% of suckers collected, based on length frequency, were 1991 year class fish. This lack of age 0 suckers in salvage collections also correlated with OSU juvenile sucker survey data indicating Lost River and shortnose sucker year class failure in 1992. In 1993, only 788 juvenile suckers were salvaged even though sampling effort was similar to 1992. However, OSU survey data from 1993 indicated that survival for both juvenile shortnose and Lost River suckers occurred. This is the only year since salvage operations began where salvage numbers and annual recruitment data didn't correlate. Possible explanations for lower numbers of entrained suckers include better quality habitat maintained by higher lake levels reduced larval sucker emigration; lower A-Canal entrainment occurred due to lower irrigation demands; biased canal sampling methods; and successful canal "flushing" methods (Reclamation 1996a). In 1994 low numbers of suckers were salvaged (334), with about 90% age 0. This low number was consistent with OSU recruitment data from Upper Klamath Lake indicate poor 1994 year class survival. In 1995, over 4,000 suckers were salvaged, the largest salvage total numbers for the 5 years of effort, including about 50% age 0 and 50% age 1. OSU juvenile sucker recruitment estimates were high in the fall, relative to other years, from cast net and trawl surveys indicating year class establishment.

In 1995, The New Earth Company intermittently monitored sucker entrainment at the C-Canal Drop for a period of about 8 weeks (July and August). This sampling period was too late to intercept the earlier, and greater magnitude, sucker migration. Seven larval suckers were collected during several sample days. These data further substantiate entrainment of suckers into the A-Canal, as was first documented in 1990 and 1991 (Markle and Simon 1993), and discussed in detail within the 1992 LTBO.

No larval entrainment work has been conducted at Eastside or Westside Diversions since 1992. On May 11, 1995, PacifiCorp dewatered the Eastside forebay. A total of 41 juvenile suckers (3 Lost River, 37 shortnose and 1 Klamath largescale sucker) were collected from the forebay and returned to Upper Klamath Lake. All fish were less than 200 mm FL. On December 11, 1995, the Eastside forebay was again dewatered. A fish salvage collected 78 suckers. All suckers were less than 200 mm FL, and were not identified to species.

Freshwater Inflow Area Use

Reclamation's Assessment summarizes sucker "refugial" habitat use and water quality measurements in tributaries to and freshwater interfaces within Upper Klamath Lake. These data are incorporated by reference. Previously, researchers believed freshwater "refugial" areas served as a place of sanctuary during poor water quality events (Service 1992; 1994); these freshwater sources are important to maintenance of water quality in the northern portion of Upper Klamath Lake (J. Kann, Klamath Tribes, pers. comm.). Recent investigations indicate freshwater inflow areas are infrequently used by adult suckers, unless these fish are stressed or dying (M. Buettner, Reclamation, pers. comm.). Mobile and fixed-station radiotelemetry studies described in Reclamation's Assessment did not identify, other than for spawning migration purposes, any use of freshwater "refugial" areas by adult suckers. However, adult suckers have been observed utilizing the low-visibility interface between Upper Klamath Lake and freshwater inflow areas, including the mouth of Pelican Bay and Fish Banks. A review of movements by radiotagged suckers indicates, during extremely poor water quality events, even areas such as Fish Banks, a low-visibility interface area, are abandoned, further invalidating the original belief that freshwater inflow areas provide consistent "refugial" habitat (L. Dunsmoor, Klamath Tribes, pers. comm.).

Larval suckers utilize the freshwater inflow area in the lower Williamson River for rearing habitat (Markle and Simon 1994, Simon et al. 1995; Logan and Markle 1993; Klamath Tribes 1992, 1995). The above studies generally indicate juvenile suckers utilize shoreline habitats in Upper Klamath Lake instead of inflow areas. Reclamation's Assessment cites lack of food, cooler water temperatures, and increased susceptibility to predation by avian and fish predators, including rainbow trout and yellow perch, in the clear water inflow areas as likely factors limiting use of these areas by juvenile suckers. However, clearwater shoreline areas influenced by Barkley Springs are occupied by both larval and juvenile sucker life stages (Reclamation 1996a).

Upper Klamath Lake Water Quality

Annual occurrences of blue-green alga blooms within Upper Klamath Lake have been associated with poor water quality conditions (Kann and Smith 1993). Likely causes for this increase in eutrophication include agricultural practices, loss of wetlands, and elevated background levels of nutrients in surface and groundwater (Gearhart et al. 1995). Effects of algal blooms include photosynthetically-elevated pH during bloom events, both supersaturated and low dissolved oxygen concentrations (Kann 1993a,b), and increased ammonia concentrations (Bortelson and Fretwell 1993). Water quality impacts to endangered sucker early life stages are addressed in Larval and Juvenile Water Quality Tolerances, below.

Significant water quality data have been reported for Upper Klamath Lake since 1992 (Bortelson and Fretwell 1993; Kann 1993a,b; Kann and Smith 1993; Jassby and Goldman 1995; Kann 1995; Laenen and LeTourneau 1995; Gearhart et al. 1995). Kann (1995) identified relationships between low Upper Klamath Lake elevations and poor water quality conditions. Investigations by Gearhart et al. (1995) and Jassby and Goldman (1995) support Kann's observations. Reclamation contracted with U.S. Geological Survey to analyze pertinent Upper Klamath Lake water quality data, collected between 1990 and 1994, to determine if year-to-year differences in water quality parameters are correlated with year-to-year differences in lake elevation. Results of this analysis are provided in Wood et al. (1996). Significant findings by Wood et al. (1996) include: 1) periods of poor water quality occurred between June and September for all study years; 2) no apparent relation between lake level and water quality was obvious when dates were analyzed on a season-long (May through October) basis; 3) lake level was related to timing of initiation of first algae bloom, which created poorer June water quality conditions; 4) climatic events also exhibited significant relationship with water quality during the early season period. Further analyses and review of these and other water quality data is currently ongoing and will be addressed in the upcoming Upper Klamath Lake water elevations consultation.

Larval and Juvenile Water Quality Tolerances

Larval and juvenile suckers are less water quality tolerant, and, especially for the larval life stage, less able to avoid poor water quality events than adult suckers (based on adult radio telemetry and associated water quality measurements, M. Buettner, Reclamation, pers. comm.). Monda and Saiki (1993, 1994) and Bellerud and Saiki (1995) conducted water quality tolerance tests to assess acutely toxic levels of temperature, dissolved oxygen (DO), pH, and un-ionized ammonia on larval and juvenile shortnose and Lost River suckers. The 96-hr LC50 values (lethal concentration where 50% of the test organisms die within 96 hours, lower 95% confidence interval for pH, un-ionized ammonia, and temperature, upper 95% confidence interval DO) for larval and juvenile shortnose and Lost River suckers is provided (Table 1). It is important to note that sub-lethal effects commonly occur prior to reaching the lethal levels provided below (Kann and Smith 1993; Markle and Simon 1994). It also is important to note that these tests were "single parameter" tests; it is currently unknown what LC50 values would result from combined testing of pH, DO, temperature, and un-ionized ammonia.

Table 1. Acute water quality tolerance levels from 96 hour LC50 studies (from Monda and Saiki 1993, 1994; and Bellerud and Saiki 1995).

Water Quality Parameter	Shortnose Sucker Larval	Shortnose Sucker Juvenile	Lost River Sucker Larval	Lost River Sucker Juvenile
Temperature °C	31.2	29.4	30.5	29.9
Dissolved Oxygen (mg/l)	1.7	2.4	2.3	2.0
pH	10.01	9.76	9.77	9.87
Un-ionized Ammonia (mg/l)	0.73	0.32	0.43	0.70

Of these four water quality parameters, only temperature is not a significant threat to larval and juvenile suckers based on current water quality conditions in Upper Klamath Lake. Bellerud and Saiki (1995) concluded that current DO and pH levels in Upper Klamath Lake can be acutely lethal to larval and juvenile Lost River and shortnose suckers. Moreover, stressful water quality conditions that curtail successful survival of early life stages could explain the long-term decline of sucker populations in Upper Klamath Lake.

Water quality associations with larval sucker distribution were monitored in 1995 by OSU during larval fish towing and larval searches. Larval suckers were found in pH ranging from 7 to 10 (Simon pers. comm., cited in Reclamation's Assessment). Larval suckers were captured at DO ranging from 4.5-14.5 mg/l. A Hydrolab Datasonde 3 was placed at Goose Bay from June 15 to August 11, 1995 (The Klamath Tribes 1995). Goose Bay water quality seldom exceeded acute toxicity thresholds in the *Polygonum* beds where abundant sucker larvae were located. DO infrequently decreased below 4 mg/l or 50% saturation and pH seldom rose above 9.7. However, pH values of 9.6 were very common and are only slightly below the 96 hr LC 50 for larval and juvenile suckers (Bellerud and Saiki 1995). DO concentrations at the Goose Bay location exceeded saturation in almost half of the measurements (The Klamath Tribes 1995). Chronic effects of poor water quality are most likely occurring at these locations; presence of suckers in these instantaneous samples collected from poor water quality areas noted in the OSU and Klamath Tribes data does not necessarily mean those fish survived the ambient conditions. Acute and chronic toxicity to early sucker life stages from supersaturated water have not been evaluated, however, loss of appetite and reduction in growth during supersaturated conditions has

been noted in other fish species (Stewart et al. 1967). Stewart et al. (1967) also noted decreased growth in dissolved oxygen <70% saturation.

Water quality associations with Age 0 juvenile sucker distribution were monitored in 1994 and 1995 by OSU researchers (Simon et al. 1995; Reclamation 1996a). Generally, juvenile suckers were collected in DO concentrations between 6.0 and 15 mg/l, with the greatest number collected at approximately 8.0 mg/l. DO concentrations in study sites often ranged from 4-6 mg/l, however, very few juveniles were collected in this lower DO range. Juvenile suckers appear to avoid DO concentrations less than 6.0 mg/l. Juvenile suckers were collected over the entire range of recorded pH values, with the majority of 1995 captures occurring in pH of 9-10. Juvenile suckers were regularly collected in pH within the lethal ranges for juvenile shortnose and Lost River suckers (> 9.8). However, instantaneous sampling occurred when diel pH levels are at maximum levels, whereas diel fluctuations in pH in Upper Klamath Lake can be as high as 1 pH unit (Kann and Smith 1993). Chronic effects are expected to occur at these lower pH levels, however, the juvenile suckers may not experience immediately lethal effects. Reclamation's Assessment indicates juvenile sucker near-shore abundance in 1995 decreased between August and October samples, whereas offshore sample abundance remained high. These data may reflect chronic effects to juvenile suckers in areas experiencing non-acute pH levels, or simply ontogenetic movement to offshore rearing areas with an increase in fish size.

Larval Ecology

Klamath Tribes (1995) investigated flatworm predation on sucker larvae. Past monitoring of incubating embryos in several springs within Upper Klamath Lake indicated low embryo survival and high concentrations of flatworms present. Additional experimental data indicates flatworm predation on sucker embryos does occur. Substrate may play a significant role in reducing flatworm predation; Tribal biologists determined that flatworms were less effective in preying upon embryos placed in fine substrate vs. medium and coarse substrates (Klamath Tribes 1995).

Dunsmoor (1993) determined that introduced fathead minnow (*Pimephales promelas*) readily prey on larval suckers in a laboratory experiment. Dunsmoor (1993) also determined that vegetative structure reduced the predation rate in shallow water. Klamath Tribes (1995) therefore expanded the Dunsmoor (1993) studies to investigate micro-distributional dynamics of, and interaction between, sucker larvae and fathead minnows. Laboratory results indicated fathead predation on sucker larvae: a) increases with decreasing water depth; b) increases in the absence of structure in shallow water; and, c) decreases with age/size of larvae. Klamath Tribes (1995) laboratory studies conclude, using various depth and vegetation treatments using experimental stocking rates of 10 sucker larvae and 20 fathead minnows per tank, fathead minnows were capable of consuming up to 90% of sucker larvae present in less than 24 hours, with an average of 80% consumed for all trials where structure was absent, water depth was 0.3 m, and larvae were less than 30 days old. These predation rates are significantly reduced when simple structure is present or when water depths are greater than 0.6 m. Field validation of these

data has not occurred. However, these preliminary data indicate strong associations between water elevation, structure, and the ability of larval suckers to avoid potentially-significant fathead minnow predation.

Larval Habitat

Vogel (pers. comm., cited in Reclamation's Assessment) and OSU (Markle and Simon 1994) report similar observation of larval sucker habitat use. These researchers noted, in the lower Williamson River area, that larvae oriented in, or adjacent to, emergent vegetation, submerged aquatic plants and instream woody debris. Within Upper Klamath Lake, larval suckers occupied habitats in and near vegetation and physical structures, such as logs or rocks. Larval suckers generally are surface-oriented (Reclamation 1996a). Klamath Tribes (1995) found larval suckers in emergent vegetation consisting of *Scirpus*, *Polygonum*, *Sparganium*, and willows. Additionally, higher densities of larval suckers were found in emergent vegetation than in open water areas (Goose Bay) or submergent vegetation (lower Williamson River)(Klamath Tribes 1995). These data are especially strong for the lower Williamson River, where very few sucker larvae were collected outside of emergent vegetation habitats.

Klamath Tribes (1995) investigated relationships between Upper Klamath Lake elevation and availability of emergent vegetation. Tribal investigators quantified the amount of emergent habitat available at different water elevations in Goose Bay and in the Lower Williamson River. These data indicate important relationships between Reclamation and PacifiCorp's water operations and the quality of larval habitat in Upper Klamath Lake. These data will be further addressed during the Upper Klamath Lake water elevations consultation in spring 1997.

Larval sucker utilization of offshore habitats has not been investigated thoroughly, due to sampling problems created by blue-green algae abundances. However, Klamath Tribes (1995) determined that larval suckers were several times more abundant in vegetated habitats than immediately adjacent open water, non-vegetated habitats of similar depth.

Temporal and spatial larval sucker distribution in Upper Klamath and Agency Lakes has been documented by OSU (Markle and Simon 1993, 1994; Simon et al. 1995). Lower Williamson River contained the most larvae (emigration densities), with larvae found distributed along shoreline areas throughout Upper Klamath Lake during 1994 and 1995 (post-emigration densities). Higher numbers of sucker larvae were captured on the east shore of Upper Klamath Lake; west shore and Agency Lake sampling locations had few larvae. Most larvae were collected in May and June. Klamath Tribes (1995) determined that the majority of larvae had developed into juvenile life stage by mid to late July.

Juvenile Ecology

Preliminary investigations between 1990 and 1993 indicated frequent trematode infestation in young suckers from Upper Klamath Lake. Simon et al. (1995) reported on an infestation of

juvenile suckers in 1994 by trematodes, possibly of the genus *Neascus*. Further review, described in Reclamation's Assessment, indicates infestation rates of 12.5-14% for juveniles < 49 mm and 2.2 % for juveniles 50-125 mm. Of concern is the life cycle of the trematode, which may spend several years in a fish. Based on the infestation rates provided above, researchers expect infestation rates to be similar between sucker size classes or greater as fish mature. Because of infestation rate differences, negative effects might be experienced by young suckers from trematode infestation. Other stressors, such as annual chronic and lethal water quality conditions, may reduce suckers' ability to resist trematode infestations (Reclamation 1996a). Additional research is necessary to address these concerns.

Shortnose and Lost River suckers transform from larvae to juveniles between 17 and 25 mm (Buettner and Scoppettone 1990). In 1993, OSU determined larval suckers were present during early June, whereas, by mid-July, small juvenile suckers were collected (Reclamation 1996a). Additional data from Klamath Tribes (1995) indicates the majority of suckers collected in late July were juveniles. Inter-annual differences in transformation from larval to juvenile stage are possible, however, a conservative approach would indicate mid-July as the period when larval transformation is complete.

Markle and Simon (1993) determined that larval and juvenile sucker otoliths could potentially be used to distinguish between cohorts, determine date of birth, and document growth. Additionally, preliminary research indicates these techniques can be used to distinguish between lake and river-spawned individuals. Additional verification of these techniques has been completed recently, including validation experiments that determined otolith rings were deposited daily and depositional patterns were constant (Hoff, OSU, pers. comm., cited in Reclamation 1996a). Interesting application of these otolith techniques has led to further experimentation and review, including determination of larval and juvenile sucker ages, date of birth, and growth (Logan pers. comm., cited in Reclamation 1996a). One important discovery, utilizing otolith techniques developed at OSU, was documentation that age 0 juvenile suckers collected in fall 1994 were all late-spawned fish. These late-spawned fish were most likely river-spawned, but without additional information, such as otolith microchemistry, there is less certainty of natal origin.

Juvenile Habitat

During the summer, juvenile suckers are most commonly collected in shoreline habitats (Simon et al. 1995). Greatest density occurred at the mouth of and within a few miles (east shore of Upper Klamath Lake) of the Williamson River. Juvenile distribution is patchy elsewhere, including Agency Lake. Juvenile suckers are generally less surface-oriented during the summer period than larval forms, however, both are mainly found associated with aquatic vegetation habitat features (D. Simon, OSU, pers. comm.). Klamath Tribes (1995) found juvenile suckers associated with emergent vegetation through late July, when sampling techniques and vegetative conditions precluded further efforts in emergent zone. However, researchers continued to capture juveniles with dip nets in emergent vegetation after late July. Juvenile suckers appear to

gradually occupy deeper, off-shore habitats as they grow larger (approximately 80 mm for shortnose suckers and 90 mm for Lost River suckers). Simon et al. (1995) noted that juveniles collected during fall sampling in offshore trawls were larger than those juveniles collected in inshore cast nets. In 1991, offshore sampling began in early September and continued through mid-October. During these fall trawling efforts, juvenile suckers were first collected in late September, and increased in density through the October sampling period (Simon et al. 1995).

Juvenile suckers exhibit a relationship between density and substrate type. Excluding emergent vegetation, where high numbers of juveniles occur, juveniles in open water areas were most associated with gravel or muck (unconsolidated organic material, silt, etc.) substrates (Markle and Simon 1994). In 1995, highest densities of age 0 suckers were found on small-sized mixture of substrates, gravels, and cobbles (Simon et al. 1996).

Age 0 juvenile sucker survival has been monitored by OSU since 1991 (Simon et al. 1995). Both cast nets (shoreline occupation) and trawls (offshore, deepwater) have been used in the monitoring effort. Cast nets have been more consistent and successful in capturing juvenile suckers. Cast net data indicate year class survival during 1991, 1993, and 1995 for both Lost River and shortnose suckers, while no juveniles were collected in 1992 and very few were collected in 1994. Trawl data correlate poorly with cast net data, with trawl data only corresponding to cast net data during 1991. Trawl and cast net data, when combined, indicate year class survival through fall during 1991, 1993, 1994, and 1995 (Lost River suckers) and 1991, 1993, and 1995 (shortnose suckers). These data, however, do not reflect sucker recruitment to a reproductive age.

Adult Habitat and Ecology

Reclamation's Assessment is the first document to describe the following radiotelemetry and trammel netting data. All information, except for personal communication, was described in the Assessment.

Reclamation has implanted radiotags into shortnose and Lost River suckers, captured mainly in pre-spawning aggregations from Sucker Springs and mouth of Williamson River, between 1993 and 1996. Radiotracking methodology varied by season, with more intensive efforts occurring between June and October. Fish locations were initially determined by plane with boats used to establish more exact locations. Geographic coordinates, water quality, depth, and substrate were determined for each instantaneous fish location. Preliminary data analysis has occurred to establish spatial and temporal distribution and associated water quality parameters in Upper Klamath and Agency lakes and their tributaries (Reclamation 1996a). Further analysis of water quality data and fish location relationships throughout Upper Klamath Lake is ongoing and will be reported in the Upper Klamath Lake water elevations consultation. The radiotracking data have not been analyzed in reference to sucker movements based on water surface elevation changes. A trammel net survey was conducted throughout Upper Klamath Lake in fall, 1994. Water elevations during this trammel net survey were at a historic low (4,136.8 ft).

Trammel net data revealed suckers occupying the northern 2/3 of Upper Klamath Lake; only one adult sucker was collected in the southern end of the lake. Ball Bay had the highest capture rates. Sucker catch rates were similar between near-shore and open water sites, and suckers were captured in a wide range of total water column depths, from 1 m to 12 m. Suckers were captured at and above the lake bottom, indicating a water column orientation that is variable; these data may be reflective of sucker avoidance of poor water quality conditions near the bottom. Unfortunately, lake-wide trammel net surveys have not been conducted during different periods of the year, specifically during spring run-off, when juvenile and adult sucker movement and migration is believed to be at its greatest activity level (G. Scoppettone, NBS, pers. comm.). Further investigations may reveal a greater movement of suckers in the lower 1/3 of Upper Klamath Lake.

Similar to trammel net data, telemetry data also indicated adult sucker occupation of the northern 2/3 of Upper Klamath Lake (north of Howard Bay). No fish were radiotracked from Agency Lake, freshwater inflow areas, Pelican Bay, or the Williamson River (except for spawning migrations up the Williamson River). During 1996, Reclamation captured and implanted radiotags in seven shortnose suckers and one Lost River sucker from Agency Lake and Wood River (M. Green, Reclamation, pers. comm.). Data collected from these fish should expand knowledge of suckers occupying Agency Lake and its tributaries.

Post-spawning suckers displayed movements to Shoalwater Bay (45%) and near the Williamson River mouth (27%). In June, Shoalwater Bay continued to exhibit the greatest use by radiotagged suckers (34%). By July, suckers later moved from Shoalwater Bay and other areas to locations associated with the mouth of Pelican Bay and Fish Banks. This is believed to be a result of *Aphanizomenon* blooms and associated poor water quality during summer and early fall months. The low-visibility interface areas of Pelican Bay and Fish Banks contained the most radiotagged suckers during August as well. Shoalwater Bay was not used between July and October, whereas Ball Bay was occasionally used between July and August. By September, radiotagged suckers began to occupy a wider area, and by October, radiotagged suckers were distributed throughout the northern 2/3 of Upper Klamath Lake. Wood et al. (1996) believe that frequent degraded water quality conditions in Agency Lake and the southern portion of Upper Klamath Lake might be related to limited fish occurrences in these locations.

Reclamation (1996a) provided a brief summary of water quality parameters associated with radiotagged suckers. Results indicated adult radiotagged suckers generally occupied habitats with dissolved oxygen > 4.0 mg/l and pH < 10.0. Thirteen of 39 radiotagged suckers died two to six months after implantation. Reclamation (1996a) believes this mortality is due to infection developed during or after exposure to poor water quality or from poor water quality conditions. Water quality data in relation to sucker distribution will be further analyzed during the Upper Klamath Lake water elevations consultation.

Unlike trammel net data, telemetry data indicated adult suckers occupying more open water habitats. Total water column depths ranged from 1-9 m, with most fish occupying areas with

depths of 2-3 m. Reclamation (1996a) indicated that areas with depths < 1 m and > 5 m are generally avoided by suckers. This may be due, in part to bird predation in shallow depths and generally poorer water quality in deeper areas.

Telemetry validated occurrence of Williamson River spawning areas where previously identified in Bienz and Ziller (1987) and Buettner and Scoppettone (1990). No radiotagged fish were tracked above Sprague River Dam. Telemetry also revealed that individual suckers often repeat spawning on an annual basis. Fidelity to initial tagging location was exhibited by all fish.

Fish Passage

PacifiCorp currently operates fish ladders on the following facilities: Link River Dam, Keno Dam, and J.C. Boyle Dam. Suckers have been observed utilizing both the Link River and Keno ladders. The Link River ladder is a pool and weir type structure, approximately 105 feet long, gaining 13 feet in elevation, with 11 pools. Flow through the ladder is approximately 15 cfs. The weir exits into Upper Klamath Lake at elevation 4,138.5 ft. When lake elevations are below 4,138.5 ft, passage is unavailable.

Between 1988 and 1991, fish passage through the ladders at Link River, Keno, and J.C. Boyle dams were monitored (F. Shrier, PacifiCorp, pers. comm.). During the study period, only four adult shortnose suckers and two adult Lost River suckers were collected at Link River ladder. All six were collected in April and May, 1989. Seven adult Lost River suckers and five adult shortnose suckers were collected at the Keno Dam ladder during the study period. Olson (PacifiCorp, pers. comm.) noted one adult shortnose sucker and several other large, unidentified suckers in the Link River Dam ladder on June 4, 1996.

Effects of Action

Reclamation's Assessment identified entrainment, spill termination at Link River Dam, peaking power operations at J.C. Boyle, fish passage, instream flow, reservoir fluctuations, Klamath River water quality, exotic fish, and habitat modification as PacifiCorp's endangered sucker effects. Reclamation's Assessment identified entrainment as The New Earth Company's endangered sucker effect. The following includes a summary of direct, including interrelated and interdependent effects, and indirect effects of the proposed action. Reclamation's effects analysis for this consultation is supplemented herein with additional analysis including effects of Reclamation and PacifiCorp's Upper Klamath Lake water operations and impacts to specific endangered sucker life stages. The effects addressed in the Assessment are incorporated by reference, with additional citations from other sources provided to complement the Assessment's information.

The Service summarizes PacifiCorp and The New Earth Company's effects under the following seven categories: entrainment; Upper Klamath Lake water elevations, Klamath River reservoir

operations; sucker population segregation; other effects to the species; proposed critical habitat; and jeopardy avoidance measures.

Entrainment

Entrainment at PacifiCorp and The New Earth Company's facilities has the potential to significantly impact all life stages of endangered suckers. Currently, only PacifiCorp's J.C. Boyle facility has effective fish screening devices; this location has lower abundance of endangered suckers than upstream, especially Upper Klamath Lake. Other PacifiCorp facilities have few records of endangered suckers, therefore, the Service believes minor chance of entrainment exists at Keno, PacifiCorp ranchlands, Copco, and Iron Gate facilities. Link River Dam and its associated powerhouses have not been outfitted with entrainment reduction devices. Neither has Reclamation's A-Canal diversion.

In this proposed action, The New Earth Company will construct and operate entrainment reduction devices, comparable to the debris reduction devices used on the B- and C-Canals, during algae harvest season at PacifiCorp's Eastside and Westside diversions. Operations for all New Earth Company facilities would commence, depending upon length of annual harvest season, on or before June 1 each year, with full deployment until or after October 15, and, for Link River Eastside and Westside diversions, occur for 10 years or the life of the FERC license. Under the current proposal, no additional entrainment reduction activities would occur during non-algae harvest periods at PacifiCorp's Eastside and Westside facilities. Reclamation is responsible to implement entrainment reduction methodology at the A-Canal under the 1992 LTBO.

All life stages have been collected in both Reclamation's canal system and in association with PacifiCorp's Link River Dam and powerhouse facilities. These data are summarized in Reclamation's Assessment and incorporated by reference herein. Of note are the 40 juvenile suckers collected May 11, 1995, and 78 juvenile suckers collected December 11, 1995, during dewatering events at the Eastside facility (barrier net in place to reduce entrainment during salvage). Both these dates are outside the period (June 1-October 15) when The New Earth Company is proposing to operate its entrainment reduction devices. In contrast, the only dewatering salvage activity occurring during the proposed entrainment reduction period (June 1-October 15) took place in September, 1989. Four different Eastside forebay dewatering events occurred in September, 1989, with a total of 87 juvenile and one adult sucker collected (no barrier net in place during salvage).

The East- and Westside powerhouses utilize Francis-type turbines. According to Reclamation's entrainment mortality analysis, based on Eicher Associates (1987), between 10 and 26 percent of entrained fish at Eastside and 20 to 26 percent of entrained fish at Westside will perish. Mortality is related to size, with larger fish generally suffering higher rates of turbine mortality. Entrainment injury rates and delayed mortality are unknown. Later mortality is likely for most fish entrained at PacifiCorp's facility and passing downstream due to poor downstream water

quality and habitat conditions in Link River and Lake Ewauna. Relatively better water quality (Campbell 1995) and habitat condition occur in the Klamath River and its reservoirs than in the Link River and Lake Ewauna (T. Olson, PacifiCorp, pers. comm.). Upstream passage, while provided at Link River Dam, is rarely used by suckers and other fish species (Reclamation 1996a). Immediate turbine mortality, poor downstream conditions immediately downstream of Link River Dam, and almost-complete lack of passage activity by fish upstream into Upper Klamath Lake, indicates an almost complete loss of suckers entrained in the East- and Westside facilities from the Upper Klamath Lake populations. Entrainment and associated direct or later mortality at these facilities can cause near-term effects, such as loss of a certain percentage of a cohort, and have the potential to create more indirect, long-term effects from loss of individuals, such as inbreeding and hybridization.

In 1989, approximately 70 million larval suckers were estimated to migrate past river mile 6 on the Williamson River and 5 million larval suckers were estimated to survive and enter Upper Klamath Lake (Klamath Tribes 1993). Markle and Simon (1993) estimated approximately 800,000 larvae and early juvenile suckers entrained into the A-Canal, equating to approximately 16% of the 5 million larvae entering Upper Klamath Lake. Link River Dam diverts a greater volume of water than A-Canal (approximately 1,000 cfs in Eastside and 200 cfs in Westside diversions vs. 750 cfs for A-Canal), and thus may entrain more larvae. Reclamation's Assessment estimates larval entrainment for Link River Dam at these average flows to equal approximately 1,300,000 larvae annually. Total entrainment at these two features is estimated at approximately 2,100,000 larvae, or approximately 40% of larvae that were estimated to migrate into Upper Klamath Lake from the Williamson River during 1989. Under the proposed action, no operational or physical measures would be taken to reduce larval and early juvenile sucker entrainment at the Link River Dam diversions.

Larval suckers can appear as early in the year as March (M. Buettner, Reclamation, pers. comm.), indicating larval entrainment occurs at Reclamation's A-Canal and PacifiCorp's Eastside and Westside facilities during non-algae harvest periods (March through May). Both PacifiCorp and The New Earth Company's operations will entrain larval and early juvenile suckers during algae harvest season. Larval and early juvenile suckers will be entrained during algae harvest operations (approximately June 1 - October 15, depending on the quality and quantity of available algae) by The New Earth Company's pumps located on the B-Canal, pumps at the Eastside and Westside hydrofacilities, and at the C-Canal. Total entrainment of all larvae and early juveniles entering the C-Canal during this time period is anticipated. However, based on harvest facility configuration, larvae and early juveniles may successfully avoid pumps at the B-Canal, and Eastside and Westside facilities. Those avoiding The New Earth Company's pumping plant entrainment at Eastside and Westside facilities will be entrained in PacifiCorp's hydroelectric facilities. Individuals avoiding entrainment at B-Canal most likely perish in agricultural diversions, however, a few may be transported to the Lost River, be salvaged at the end of irrigation season in the B-Canal, or eventually be transported to Tule Lake or the Klamath River (M. Buettner, Reclamation, pers. comm.). Prior to full installation of The New Earth Company's algae harvest screens at B- and C-Canals, all A-Canal larval and early juvenile

mortality occurred downstream in Reclamation's canal system. The New Earth Company's proposed activities simply isolate a portion of the mortality at one quantifiable location. In the sense that larval and early juvenile entrainment into the A-Canal likely leads to eventual mortality, regardless of the cause of mortality, Reclamation is still ultimately responsible for addressing larval and early juvenile sucker take in the A-Canal not resulting from The New Earth Company's operations (including those individuals entrained in the A-Canal prior to annual algae harvest, and those that avoid entrainment in The New Earth Company's B-Canal facility during harvest activities).

Juvenile and adult suckers may be entrained into the Link River Dam diversion throughout the year, whereas, entrainment of these life stages into the A-Canal occurs only during A-Canal operations (approximately April 1-October 15). The employment of Debris Reduction Devices across the C-Canal drop, pumps at the B-Canal, and Entrainment Reduction Devices at the Eastside and Westside hydrofacilities by The New Earth Company, from June 1-October 15, may incidentally reduce the entry of these life stages into the C-Canal and the Link River powerhouses during that operating period. Similar to larval and early juvenile forms addressed above, B-Canal harvest facility configuration may allow some older suckers to avoid entrainment. However, impingement of age 1 and older sucker life stages on screens may still occur at all facilities. During a large portion of the period representing highest sucker movement (generally spring run-off event and post-spawning)(G. Scoppettone, NBS, pers. comm.), no entrainment reduction activities will occur at Link River diversions or the B- and C-Canals. As noted elsewhere in these opinions, The New Earth Company's debris reduction devices at B- and C-Canals may not function to eliminate fish entrainment, further, their location downstream of the initial diversion point from Upper Klamath Lake is not effective to promote maximum entrainment reduction goals to retain these sucker life stages in Upper Klamath Lake. The location for entrainment reduction must occur at the source of entrainment, the A-Canal headworks, to maximize entrainment reduction activity benefits. Reclamation is still ultimately responsible for addressing juvenile and adult sucker take in the A-Canal.

The New Earth Company's proposed debris and entrainment reduction devices may or may not be of an effective mesh size or configuration to be effective fish entrainment reduction devices. Preliminary investigations by The New Earth Company in 1995 did not collect any fish greater than 75 mm downstream of the debris reduction devices installed at the C-Canal. However, no observations were made of the timing or magnitude of impingement by juvenile and adult suckers on the 3/8" mesh debris reduction devices. Reclamation is currently working with the Klamath Irrigation District to develop plans for reducing entrainment at the A-Canal headworks. The plans will utilize sucker life history and swimming speed data and site specific physical information from Upper Klamath Lake and the A-Canal to define effective entrainment reduction and impingement avoidance methods for the A-Canal. These data and plans were requested by The New Earth Company prior to development of proposed entrainment reduction plans, however the analysis and final report was not complete and no preliminary findings were provided. The Service therefore anticipates, as per the New Earth Company's proposed action, that The New Earth Company shall use the Klamath Irrigation District's A-Canal entrainment

reduction planning document, when it becomes available, to modify its existing proposed action to effectively exclude fish greater than 75 mm.

Proposed entrainment research activities will involve intentional take of individual suckers. Because the PacifiCorp entrainment study and The New Earth Company entrainment monitoring efforts occur in areas where entrainment has already or will likely ultimately occur (ie, B- and C-Canals, and the Eastside and Westside hydrofacilities), intentional take of suckers related to proposed research activities is not expected to increase the effect to shortnose and Lost River suckers above those impacts identified above.

The entrainment effect of greatest concern to the Service is loss of age 1 and older suckers. These fish have survived the age 0 mortality "bottleneck" and are critical to future reproduction and population stability of Upper Klamath Lake suckers. This entrainment impact is of immediate concern due to recent data indicating a substantial loss of older sucker age classes (Reclamation 1996a) and almost-complete loss of 1992 and 1994 cohorts (Simon et al. 1996). Larval and early juvenile entrainment, while greater in magnitude than that for age 1 and older suckers and therefore of significant concern to the Service, is more readily offset through mitigative actions, as proposed by PacifiCorp and The New Earth Company. In the interim between reestablishment of historic larval habitat features in areas such as the Lower Williamson River and associated reduction of annual lethal water quality events, the Service believes preservation of age 1 and older suckers is critical to the continued survival and future recovery of these two species.

Upper Klamath Lake Water Elevations

Operation of Link River Dam has the ability to effect Upper Klamath Lake water elevations, thereby having the ability to both negatively and positively effect endangered suckers and their habitats. Direct, indirect, positive, and negative effects from Link River Dam operations may include, but is not limited to, the following: availability and quality of in-lake habitat (emergent, littoral, riverine or other freshwater inflow, spawning, etc), water quality and quantity, winter kill, predation, sucker distribution; and sucker passage. As noted in prior chapters, Reclamation will reinitiate and complete consultation on Upper Klamath Lake water elevations by spring 1997. These and other Upper Klamath Lake water management effects will be fully analyzed and jeopardy avoidance measures determined within the Upper Klamath Lake water elevations consultation.

Interrelated with PacifiCorp's Upper Klamath Lake operations are PacifiCorp's contractual agreements with certain landowners around Upper Klamath Lake. These agreements delegate responsibility for certain dike maintenance activities and require PacifiCorp to compensate for flood damage events. PacifiCorp's current flood control plan is designed to minimize flooding events and resultant compensation. These effects will be fully analyzed within the Upper Klamath Lake water elevations consultation.

Klamath River and Reservoir Operations

PacifiCorp operates its' Klamath River reservoirs to generate hydropower; this action requires fluctuations in both reservoir water elevations and river discharges. Fluctuation in reservoir water elevations may affect early sucker life stages by increasing or reducing available emergent habitat. Reservoir fluctuation at J.C. Boyle averages 1-2.5 ft per day. The Assessment did not indicate similar daily fluctuations at any other Klamath River reservoir. These elevation fluctuations may effect the amount of emergent vegetation available to larval and juvenile suckers. As determined by the Klamath Tribes (1995), emergent habitat serves to reduce non-native fish predation on larval suckers. Aquatic habitat in J.C. Boyle Reservoir experiences large daily fluctuations, with associated impacts to sucker larvae (Reclamation 1996a). Impacts include increased predation by numerous non-native fish, loss of sucker food organisms, loss of cover, and stranding.

J.C. Boyle is a power peaking facility. Shortnose sucker spawning has been documented below J.C. Boyle powerhouse, in the vicinity of Copco Reservoir (M. Buettner, pers. obs., as cited in Assessment). Daily power peaking activities (restricted to a 9 inch per hour ramp rate) would be most detrimental to suckers during spring spawning activity. Reclamation identified potential and observed effects including desiccation of eggs, movement of eggs by high flows, fish predation on eggs and larvae, and stranding of suckers. Stranding of larvae has been observed in this reach, with Beak Consultants (1987) estimating that less than 10% of the Klamath River from the Oregon-California state line to Copco Reservoir was subject to stranding events during peaking. Beak Consultants (1987) concluded that stranding was a minor impact.

Instream flows, as required by FERC license, are identified in the Assessment. Minimum flows, including accretions, in known sucker spawning areas below J.C. Boyle average approximately 400 cfs. No research has been conducted in the Klamath River to determine the relationship between flow and fish habitat. Low flows in the Klamath River were experienced during the drought of 1992. No dead or dying fish were observed, however, as with salvage operations, bird predation in shallow water can be extensive, biasing these observations.

Introduced non-native fish occupy the Klamath River and its reservoirs. Reclamation (1996a) reported high percentages of predaceous non-native fishes, including yellow perch, largemouth bass, and pumpkinseed, occupying mainstem reservoirs; of specific concern is the similar timing of sucker larvae emigration and yellow perch spawning migrations upstream from Copco Reservoir into the Klamath River. Reclamation (1992) suspected high predation on larval suckers by yellow perch. Non-native fish introductions are a major cause of native fish endangerment throughout the western United States (Williams et al. 1989).

PacifiCorp's operational impacts to Klamath River and reservoirs' water quality is poorly understood. The Klamath River Basin Fisheries Task Force (1991) indicated that impoundment of nutrient-rich waters in Klamath River reservoirs is known to contribute to algal blooms and associated poor water quality conditions in the reservoirs. Little data, other than temperature and

flow, has been recorded near hydrofacilities. Water surface temperature in Klamath River reservoirs is similar to Upper Klamath Lake; these temperatures are not considered problematic to endangered suckers. Water quality conditions of concern to sucker survival in the Klamath River include dissolved oxygen, pH, ammonia, and high levels of ortho-phosphorus, an algal growth stimulant (Campbell 1995). Overall Klamath River water quality conditions appear to be most affected by Upper Klamath Lake conditions (Bartholow 1995). Reservoir water quality conditions were not discussed in detail within the Assessment. Depth of water withdrawal inlets in reservoirs might have influence on downstream water quality in both river and reservoirs.

Proposed reservoir research activities may involve intentional take of individual suckers. The Service estimates the amount of intentional take related to the proposed lower Klamath River reservoirs study to be 5,000 larval, 1,000 juvenile, and 500 adult shortnose and Lost River suckers combined. Juvenile and adult sucker take will occur in the form of handling. All larval forms are considered taken from direct sampling mortality, due to their fragile nature. The Service believes that intentional take of these various life stages, though either direct mortality or handling stress, is necessary to the long-term management of these species in the lower Klamath River reservoirs. Additionally, because intentional take of adults and juveniles is anticipated to occur in a non-lethal fashion, the Service anticipates the overall effect of this research action to the continued survival and eventual recovery of these species will be negligible.

Sucker Population Segregation

Fish population segregation has been identified as a causative factor in endangerment of western fish faunas (Williams et al. 1989). PacifiCorp's construction and operation of facilities on the Link and Klamath rivers has created sucker population segregation for Lost River and shortnose suckers (Reclamation 1996a). Limited definitive data are available to quantify the impact of sucker population segregation from construction and operation of the Link and Klamath River facilities, however, Reclamation (1996a) identified reduced passage opportunities and potential for long-term population impacts from genetic isolation as impacts. Under the Act, and as addressed in the Recovery Plan (Service 1993), the Service strives to maintain a well distributed population; sucker population segregation effects Lost River and shortnose sucker distribution.

As noted in Reclamation (1996a), PacifiCorp's sucker population segregation may be one cause of genetic isolation within the Lost River and shortnose sucker populations. Location of PacifiCorp's features and lack of effective passage may isolate portions of the population, increasing the probability of hybridization, introgression, and inbreeding (Klamath Tribes 1996). Finally, operations may effect genetic makeup of Upper Klamath Lake populations of shortnose and Lost River suckers via water level manipulations during spawning, and entrainment of various life stages into downstream locations.

New information provided in Reclamation (1996a) and in the Baseline, Species Account section of these opinions, indicates endangered sucker passage at PacifiCorp's facilities may be limited. While sucker population numbers are believed to be low at Keno and J.C. Boyle facilities,

perhaps explaining low numbers of suckers observed utilizing these two passage features, the Link River ladder is adjacent to the main endangered sucker populations in the Klamath River drainage. Passage is unavailable at the Link River ladder during periods when Upper Klamath Lake elevations are below 4,138.5 ft. Water levels were below this elevation in 1992 (August - October) and 1994 (August - December) (Reclamation 1996a). Review of Reclamation (1992) end of month water elevation data for Upper Klamath Lake indicates lake elevations were below 4,138.5 ft for at least one period of the year in 1926, 1928-1931, 1934, 1939-1940, 1942, 1944-1947, 1949, 1979, 1981, and 1991. Combined, these data indicate lack of passage for a period each year during 18 years between construction of the ladder in 1926 and present. Using end of month elevation calculations probably underestimates the number of times Upper Klamath Lake elevations were below 4,138.5 ft each year. Nine years additionally exhibited end of month elevations between 4,138.5 and 4,139.0 (1927, 1936, 1941, 1959-1961, 1968, 1988, and 1990), indicating less than ½ ft of water for fish passage from the ladder during that period. Using 4,139.0 ft as an elevation that also precludes ladder use, Link river Dam fish passage has been restricted or precluded for a period of time in 27 of 70 years.

Based on past research, successful Link River ladder use appears minimal (only 6 suckers were observed using the Link River ladder during 1988-1991 study). However, PacifiCorp biologists observed an adult shortnose sucker and several other large, unidentified suckers in the Link River Dam ladder on June 4, 1996. No information is currently available to identify cause of lack of Link River ladder use by endangered suckers. Lack of use could be caused by inadequate design, steep gradient, sucker avoidance, low sucker numbers in the Link River, lack of upstream migratory behavior (Reclamation 1996a), or natural Link River migration barriers below the Link River ladder. Cui-ui passage experts indicate suitable slope for cui-ui passage is at least 1 on 20, with a pool and orifice or slotted weir design (M. Buettner, Reclamation, pers. comm.); Link River ladder has an approximately 1 on 8 slope with a pool and weir design, suggesting potential design problems for sucker passage.

Future collection and potential sacrifice of shortnose and Lost River suckers is proposed for genetic studies. These studies will be, in part, funded by PacifiCorp. A total of 200 shortnose suckers (9 different locations) and 135 Lost River suckers (8 different locations) are needed for these studies to augment existing specimens. All these individuals will be sacrificed. An additional total of 100 shortnose suckers (7 locations) and 135 Lost River suckers (7 locations) will have tissue samples removed using non-lethal techniques. The Service anticipates, due to the small number of specimens collected at a large number sample locations across the range of these species, that the overall effect of this research action to the continued survival and eventual recovery of these species will be discountable.

Other Effects to Species

PacifiCorp and The New Earth Company will construct proposed features and conduct routine and unplanned maintenance on their facilities. These activities often necessitate dewatering of occupied canals or diversion features. Currently, PacifiCorp salvages endangered suckers during

dewatering and spill cessation events. Reclamation is responsible for end-of-irrigation salvage efforts at the B- and C-Canals. PacifiCorp's salvage efforts have regularly captured suckers at the Link River facilities, however, only two small suckers have been observed in the diversion canal at the J.C. Boyle facility. Dewatering activities affect suckers through increased incidence of bird predation, stranding, and entrainment (however, as of 1995, a block net is placed over the intake structure to reduce entrainment of larger fish prior to forebay closure and dewatering). Impacts associated with salvage operations include injury or death from collection gear, especially electro-fishing equipment, and other handling impacts.

Ramp rates to avoid fish stranding during flow reduction and dewatering events are provided at all PacifiCorp facilities. Reclamation's Assessment reported that the incidence of Link River stranding became greater as length of spill increased. However, these data do not justify increased incidence of shorter-duration spills.

Hydrofacility operations may experience spills of hazardous chemicals or liquids. No information was provided in the Assessment that addressed spill avoidance or spill response methods.

Reclamation's Assessment addressed potential benefits of The New Earth Company's algae harvest operations on water quality below harvest facilities. Removal of algae during harvest season from the majority or all flows leaving Upper Klamath Lake should result in beneficial effects to aquatic habitat and its inhabitants in the Link River, Lake Ewauna, the Klamath River and its reservoirs, the Lost River, and Tule Lake.

Proposed Critical Habitat

On December 1, 1994, the Service published a proposed rule for Lost River and shortnose suckers critical habitat (59 FR 61744). The proposed action has effects within or adjacent to three of the proposed critical habitat units: Unit #3 (Klamath River); Unit #4 (Upper Klamath Lake and Watershed); and Unit #5 (Williamson and Sprague Rivers). Primary constituent elements associated directly and indirectly with the proposed action for these units are as follows:

Klamath River: Unit #3's primary constituent elements might be affected by PacifiCorp's operations through alterations in flow timing, magnitude, and duration; establishment of non-native fish species; and water quality degradation (temperatures, pH, dissolved oxygen). Additionally, peaking releases from downstream reservoirs might impact sucker spawning and subsequent larval/juvenile life stage activities. These impacts were specifically addressed elsewhere in this consultation.

Upper Klamath Lake and Watershed: PacifiCorp and Reclamation's management of Upper Klamath Lake's water surface elevations has numerous potential direct and indirect affects to Unit #4's primary constituent elements. Of greatest concern are potential impacts to spawning

areas near in-lake spring sources, water quality degradation (pH, dissolved oxygen), fish kills, loss of water quality refugial areas, impacts to young-of-the-year rearing areas, fragmentation of habitats, and impacts (predation, competition) from non-native fish species. These impacts will be addressed in detail within the Upper Klamath Lake water elevations consultation.

Williamson and Sprague Rivers: The proposed action's relationship to Unit #5's primary constituent elements would be water level management and its associated impacts on the lower Williamson River restoration efforts, and the mainly beneficial activities surrounding PacifiCorp's and The New Earth Company's proposed habitat restoration effort. Beneficial effects should include increased habitat availability, increased food availability, and improved water quality.

Jeopardy Avoidance Measures

Implementation of these jeopardy avoidance measures should have an overall positive effect, especially the long-term habitat restoration, to endangered suckers. However, implementation of jeopardy avoidance measures may lead to additional effects to suckers from handling stress or direct mortality during research or restoration activities, habitat impacts during restoration activities, effects to suckers and/or habitat during agricultural activities, or impingement of suckers during Entrainment Reduction Device operation.

Impacts anticipated from restoration activities include short-term increases in sedimentation and turbidity from earth-moving activities, nutrient loading from draining fields, stranding of various life stages during water manipulation, colonization of restoration features by non-native fishes, increased predation in the restoration area, and direct mortality during restoration activities. PacifiCorp, The New Earth Company, and TNC, or some combination of these parties, may hold an interest in the agricultural inholdings within Tulana Farms. Agricultural activities could impact the suckers from nutrient loading during draining of agricultural fields, application of chemicals (fertilizers and pesticides), and entrainment of suckers into the irrigation system.

Cumulative Effects

Cumulative effects include the effects of future State, local or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of ESA.

The 1992 LTBO reviewed cumulative effects throughout the Klamath Project area, including those identified in the current action area. Those action area cumulative effects are still reasonably certain to occur in the future, and are incorporated herein by reference.

As new data are generated and analyzed, further concern is placed upon cumulative effects as key impacts to the continued survival and recovery of endangered suckers. Of specific concern are high levels of nutrient loading to Agency and Upper Klamath lakes. New information is currently available (for instance, Gearhart et al. 1995; Wood et al. 1996) that document sources and amount of nutrients from various geographic locations and land use practices. These data validate concerns listed in the 1992 LTBO regarding nutrient loading, hydrologic cycle, and loss of habitat in the action area. Nutrient loading is comprised of external loading (land use impacts and naturally-high nutrient loads in water) and internal loading (nutrients released due to high pH and wind-induced suspension of bed materials). Cumulative effects which increase external loading, and past external loads that exist as bed materials or in suspension in Upper Klamath and Agency lakes, add to the annual magnitude, duration, and initial timing of blue-green algae blooms and associated poor water quality events in Upper Klamath and Agency lakes. These poor water quality events have been closely tied to chronic and lethal effects including loss of individual suckers and/or complete mortality of young-of-the-year cohorts (Reclamation 1996a; D. Markle, OSU, pers. comm.).

CONCLUSION

Lost River and shortnose sucker are highly fecund, long-lived species. The current sucker populations are distributed throughout the Upper Klamath and Lost River basins, but are generally isolated by upstream and downstream impediments to migration. While some populations (ie, Clear Lake and Gerber Reservoir) appear to have multiple age classes indicating regular, successful recruitment, these populations are isolated, occupying habitats altered from historic conditions, and are vulnerable to stochastic events. Additionally, Gerber Reservoir and Clear Lake populations of shortnose suckers are of questionable taxonomic status, and are currently considered shortnose due to conservative taxonomic classifications of the past. While it is comforting to know these populations exist, indicating the overall extinction probability for these species is reduced, the stability of these species across their range is still highly endangered by, at a minimum, existing degraded habitat conditions, restricted spawning distribution, chance events, inbreeding depression from low population numbers, and additional environmental disturbance. Any one of these broad impact categories could irreversibly lower these species' population sizes to a point where it can no longer recover. The Service therefore desires, in the short-term, to protect the wide diversity of shortnose and Lost River suckers' characteristics and behaviors as well as maintain a well distributed population across species range, while, in the long-term, restoring as much connectivity and historic form, function, and composition to important sucker habitat features as possible.

Within Upper Klamath Lake, the Service is concerned that adult sucker age class distribution is greatly diminished since listing in 1988. Early loss of multiple adult suckers cohorts can have significant impacts to the long-term viability and persistence of these species. Additionally, based on new data, bottlenecks to sucker recruitment occur at the larval life stage. Annual poor water quality events and reduced habitat complexity probably have a great influence on both

adult age class stability and larval survival. Long-term habitat restoration and short-term water level management are two key actions that must be implemented to ensure the survival of Upper Klamath Lake populations. Additionally, until adult populations are reestablished and stabilized, and larval survival is increased through amelioration of water quality and habitat issues, all suckers that have successfully survived their first year in the wild must be protected from other impacts to allow them to recruit and spawn multiple times.

PacifiCorp and The New Earth Company operations have specific impacts on specific life stages of endangered suckers. The Service has worked with PacifiCorp, The New Earth Company, and Reclamation to progressively identify specific jeopardy avoidance measures to attempt to offset operational impacts. These jeopardy avoidance measures address the need for increased larval survival via long-term habitat restoration, and preservation of age 1 and older suckers via entrainment reduction devices. Additionally, research will be conducted to determine if operational impacts are greater than currently identified. It is believed by participants in this consultation that restoration of important lower Williamson River wetland habitat will benefit all sucker life stages, and may provide, in the long-term, benefits that equal or exceed current impacts.

After reviewing the current status of the Lost River and shortnose suckers, the environmental baseline for the action area, the effects of PacifiCorp and The New Earth Company's proposed actions and jeopardy-avoidance activities, and the cumulative effects, it is the Service's biological opinion that the proposed action is not likely to jeopardize the continued existence of the Lost River and shortnose suckers, and is not likely to adversely modify or destroy proposed critical habitat.

INCIDENTAL TAKE STATEMENT

Sections 4(d) and 9 of ESA, as amended, prohibit taking (harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in any such conduct) of listed species of fish or wildlife without a special exemption. Harm is further defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering. Harass is defined as actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. Incidental take is any take of listed animal species that results from, but is not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or the applicant. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered a prohibited taking provided that such taking is in compliance with the terms and conditions of this incidental take statement.

The measures described below are non-discretionary, and must be implemented by Reclamation so that they become binding conditions of any grant or permit issued to the applicant, as appropriate, in order for the exemption in section 7(o)(2) to apply. Reclamation has a continuing duty to regulate the activity covered by this incidental take statement. If Reclamation (1) fails to require the applicants to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to The New Earth Company's permit or PacifiCorp's contract, and/or (2) fails to retain oversight to ensure compliance with these terms and conditions, the protective coverage of section 7(o)(2) may lapse. Additionally, this incidental take statement applies to the applicants' actions and does not negate or reduce Reclamation's existing responsibilities to implement existing terms and conditions provided in Reclamation's previous consultations (identified in the Consultation History section).

Amount or Extent of Take:

Under the proposed action, a Lower Williamson River habitat restoration project will be accomplished that is believed to be beneficial to all life stages of the endangered suckers. At some point in the future, as defined by monitoring of habitat and larval sucker production goals developed by the LWRRT, and approved by the Service, this restoration project is believed to be able to greatly offset PacifiCorp's and The New Earth Company's impacts. In the short-term, until these production goals are met, actions beneficial to endangered suckers must be accomplished. Such actions include protective water levels in Upper Klamath Lake (such as those identified in Reclamation 1996b), and initiation of studies and reviews as proposed in this consultation. Additionally, as required by the Act, incidental take levels from this proposed action must be identified and Reasonable and Prudent Measures provided to minimize the incidental take.

Endangered sucker incidental take due to entrainment from PacifiCorp's Link River hydrofacility and New Earth Company's harvest operations, based on movement and migration data, larval

and early juvenile drift and entrainment studies, and sucker salvage records, can be reasonably estimated, however, incidental take due to PacifiCorp's Upper Klamath Lake water elevation management, habitat segregation, and Klamath River and reservoirs operations, is more difficult to quantify. Because of the inherent biological characteristics of these aquatic species, the likelihood of discovering an individual death or other taking attributable to habitat segregation and operations of Upper Klamath Lake, Klamath River, and Klamath River reservoirs is small. For example, small size of younger sucker life stages, abundance of piscivorous birds, rapid rates of decomposition, presence of algae and aquatic vegetation, and remote locations make finding an incidentally taken sucker extremely unlikely. Furthermore, some effects of water project operations are largely unquantifiable in the short-term, and may only be measurable in the long-term as effects on species' habitat, genetic integrity, and age structure. Therefore, even though the Service expects incidental take to occur for Upper Klamath Lake water elevation management, habitat fragmentation, and Klamath River and reservoirs operations, the best scientific and commercial data available are not sufficient to allow the Service to estimate a specific amount of incidental take to the species themselves. In instances such as this, incidental take may be quantified in terms other than numbers of individuals.

Entrainment

Reclamation (1996a) estimated entrainment of larval and early juvenile suckers into the Eastside diversion to be 1,012,200 individuals and Westside diversion to be 202,400 individuals. Larval and early juvenile sucker incidental take from entrainment may occur at Link River hydrofacility from March through mid-July. Entrainment is defined as those fish that are passed through the respective powerhouses. The Service therefore anticipates an annual total of 1,214,600 larval and early juvenile suckers may be entrained by the Eastside and Westside hydrofacilities.

Entrainment of larvae and early juveniles attributable to The New Earth Company's proposed operations on the B- and C- Canals is based on harvest period and percentage of A-Canal flow harvested. Larval entrainment in the A-Canal may occur as early as annual operations commencement (approximately April 1)(Reclamation 1992). The New Earth Company's algae harvest operations commence approximately June 1. The New Earth Company's entrainment of larvae and early juveniles is therefore anticipated to occur between June 1 and mid-July. Under the proposed action, some larvae and early juveniles may escape entrainment at the B-Canal. Therefore, based on harvest period, timing of entrainment described in Markle and Simon (1993), and percent of canal volume harvested, a large percentage of the overall annual larval and early juvenile entrainment into the A-Canal will be attributable to The New Earth Company's operations. Markle and Simon (1993) estimated, from May 13 to July 15, a total of 759,150 larvae and early juveniles were entrained, with an initial peak from late May through mid-June (majority of larvae were Lost River suckers) and a second peak in early July (shortnose suckers). Researchers did not collect larvae between mid-April and early May, however, larvae are present in Upper Klamath Lake during this period. Additional sampling will be necessary to refine early season entrainment rates. Reclamation's Assessment attributed all larval take to The New Earth Company and estimated between 400,000 and 800,000 larvae and early juveniles annually

entrained into the A-Canal. Using the Markle and Simon (1993) estimate of 759,150 larvae and early juveniles, the Service believes approximately 600,000 of the entrained larvae and early juveniles are attributable to The New Earth Company's operations, with the remainder attributable to Reclamations' A-Canal operations.

Entrainment of adult and juvenile (post-July 15 and older) suckers into the Eastside and Westside hydrofacilities may occur year round. Reclamation (1996a) believes high mortality to entrained suckers occurs based on turbine impacts, poor downstream water quality, lack of habitat, and upstream passage impediments. Entrainment is expected to be greater during spring run-off events, when older juvenile and adult suckers appear to be more active. Limited salvage data in Reclamation's Assessment cannot be related to actual entrainment, therefore the Service must estimate take of juvenile and adult suckers based on relative abundance during salvage operations, and inferences from juvenile and adult sucker movement and migration data. The Service believes minimal adult sucker entrainment occurs, based on radiotelemetry and trammel nets surveys that indicate a northern distribution for adults in Upper Klamath Lake, and a total of one adult Lost River sucker collected in seven different forebay salvage operations. The Service therefore anticipates a combined annual total of 100 adult Lost River and shortnose suckers may be entrained by the Eastside and Westside hydrofacilities. Older juvenile suckers are more widespread, occurring relatively more frequently in the lower portions of Upper Klamath Lake (Markle and Simon 1994; Simon et al. 1995, 1996) and were captured in higher relative numbers during forebay dewatering activities. The Service therefore anticipates a combined annual total of 5,000 juvenile (post-July 15 and older) Lost River and shortnose suckers may be entrained by the Eastside and Westside hydrofacilities.

Juvenile and adult entrainment into the A-Canal is currently addressed under the 1992 LTBO, with a requirement for Reclamation to reduce entrainment at the A-Canal within five years of 1992. The debris reduction devices at the B- and C-Canals are not located to effectively reduce juvenile and adult entrainment from Upper Klamath Lake, and therefore do not serve to reduce the need for entrainment reduction at the A-Canal headworks. The Service does not anticipate any older juvenile or adult take from The New Earth Company's operations at the B- and C-Canal harvest facilities, therefore all age 1 and older juvenile and adult sucker take is still attributable to Reclamation's A-Canal operations.

Upper Klamath Lake Water Elevations

The Service assumed, for purposes of analysis of effects for these opinions, Reclamation and PacifiCorp would cooperatively implement Reclamation's "low range elevations" proposal (Reclamation 1996b), and, after completion of the Upper Klamath Lake water elevation consultation, Reclamation and PacifiCorp would cooperatively implement the new protective lake elevation requirements. Therefore the Service will assume that any Upper Klamath Lake water operation that fulfills the above Service water operations assumptions shall have resulted in incidental take allowed under the Act's section 7(o)(2) exception to the section 9 prohibition against take of a listed species. This amount of take will apply to PacifiCorp's operations until

the Upper Klamath Lake water elevation consultation is completed in spring 1997, wherein a new Upper Klamath Lake water elevation incidental take analysis will be provided to Reclamation that amends PacifiCorp's authorization on this requirement. The Service understands that Reclamation will be involved in future consultations and that Reclamation and PacifiCorp will address operational limitations at those times.

Klamath River and Reservoir Operations

Klamath River and reservoir data pertaining to endangered suckers is limited, however, small populations are known to occur, especially in Copco and J.C. Boyle reservoirs, with limited spawning occurring in the Klamath River above Copco Reservoir and possibly elsewhere. Larval suckers and their emergent habitats that occur in these facilities may be affected by daily reservoir elevation fluctuations and, during spawning, adult fish and their progeny may be affected by peaking flows. Due to low adult population numbers, the Service anticipates low levels of take in the Klamath River and reservoirs due to changes in reservoir elevations, stranding, egg desiccation, flushing of larvae during peaking flows, water quality impacts, and predaceous fish impacts due to non-native fish occupation in PacifiCorp's facilities. The Service anticipates an unquantifiable level of take from Klamath River and reservoir operations.

Sucker Population Segregation

Construction and operation of facilities on the Link and Klamath rivers has resulted in sucker population segregation for Lost River and shortnose suckers. The Service believes take occurs at the structures that inhibit sucker movement and migration. Additionally, the Service believes take occurs at the Link River, Keno, and J.C. Boyle fish ladders. Passage under current conditions is limited at Link River during periods when Upper Klamath Lake elevations are below approximately 4,139.0 ft. Based on past research, Link River ladder use appears minimal (only 6 suckers were observed using the Link River ladder during a three year study, and several suckers were observed in the fish ladder in 1996), possibly indicating passage restrictions. Greater take could be occurring from reduced passage opportunities at these ladders. The Service anticipates an unquantifiable level of take due to inhibited sucker movement and passage impacts.

Incidental take in the form of genetic isolation may occur due to PacifiCorp's project sucker population segregation, passage, and operations. Passage at these ladders, described above, may isolate populations, increasing the probability of hybridization, introgression, and inbreeding (Klamath Tribes 1996). Buth and Haglund (1994) determined that populations of shortnose suckers above Link River Dam were genetically separate from lower Klamath River reservoir and Lost River reservoir populations. Finally, operations may effect Upper Klamath Lake populations via water level manipulations during spawning, and entrainment of various life stages into downstream locations. The Service anticipates an unquantifiable level of take due to genetic isolation impacts.

Jeopardy Avoidance Measures

Restoration of property on the lower Williamson River, while beneficial to endangered suckers in the long-term, will have specific, short-term impacts. The Service anticipates, based on Reclamation's Assessment and communication with the LWRRT, incidental take during restoration and operations on the property to include short-term increases in sedimentation and turbidity from earth-moving activities, nutrient loading from draining fields, stranding of various life stages during water manipulation, colonization of restoration features by non-native fishes, increased predation in the restoration area, and direct mortality during restoration activities. The above types of incidental take from restoration and operation activities would occur under the direction of the Long Range or Annual Restoration Plans. These types of incidental take would occur from the LWRRT, PacifiCorp, The New Earth Company, TNC, NRCS, or their contractors' restoration activities. PacifiCorp, The New Earth Company, and TNC, or some combination of these parties, may hold an interest in the agricultural inholdings within the proposed property. Incidental take from agricultural activities could occur in the form of nutrient loading from draining agricultural fields, application of chemicals (fertilizers and pesticides), and entrainment of suckers into the irrigation system. The Service anticipates an unquantifiable level of take from lower Williamson River restoration activities.

Operations and Maintenance

Down ramping flows below PacifiCorp's facilities has the ability to incidentally take suckers through stranding. Ramp rates for PacifiCorp's hydroproject operations were described in Reclamation's Assessment. These rates were designed to minimize fish stranding events during flow-reduction activities. The Service anticipates an unquantifiable level of incidental take from ramping activities. Fish salvage during normal and unscheduled operations and maintenance activities has the ability to incidentally take suckers through handling. A salvage plan is in place that directs salvage operations and disposition of salvaged fish. Past salvage efforts have collected minor numbers of adult and juvenile suckers, therefore the Service anticipates 1,000 adult and juvenile shortnose and Lost River suckers combined will be taken during annual salvage activities.

Effect of the Take:

In the accompanying biological and conference opinions, the Service determined that these levels of anticipated take are not likely to result in jeopardy to the species or destruction or adverse modification to proposed critical habitat.

Reasonable and Prudent Measures

As noted above, the proposed action includes project operations, habitat restoration (long-term timescale), and short-term research and review activities. The Service believes that the proposed habitat restoration will ultimately offset a a major portion of PacifiCorp and The New Earth

Company's impacts. Take of individual fish, as identified above, is not believed to result in jeopardy to the species as a whole. However, in the short-term, effective minimization of incidental take, as required by the Act, must be implemented within the ITS. These measures are consistent with the proposed action and its' associated impacts, and are based on current Service concerns regarding recent loss of numerous, older sucker age classes and ongoing annual poor water quality events, including stressful dissolved oxygen, pH, and ammonia levels, leading to loss of young sucker age classes in Upper Klamath Lake.

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize incidental take of Lost River and shortnose suckers.

1. Monitor incidence of sucker entrainment and review effectiveness of Entrainment Reduction Devices at PacifiCorp and The New Earth Company facilities.

2. Develop methods for PacifiCorp and Reclamation to cooperatively implement Upper Klamath Lake water operations for the benefit of endangered suckers.

3. Cooperatively develop methods to reduce sucker population segregation impacts from the Link River and Klamath River facilities.

4. Determine status of endangered suckers in PacifiCorp's Klamath River reservoirs.

5. Restore Lower Williamson River property to benefit larval suckers and Upper Klamath Lake water quality with an emphasis on historic habitat form (habitat configuration), function (habitat benefits), and composition (community structure), within unalterable constraints, using the best science and adequate protective measures.

6. Implement PacifiCorp and The New Earth Company operation and maintenance activities in a fashion that protects endangered species.

Terms and Conditions

To be exempt from the prohibitions of section 9 of the Act, PacifiCorp and The New Earth Company must comply with the following Terms and Conditions, which implement the reasonable and prudent measures described above. These terms and conditions are non-discretionary. Numbers correspond to Reasonable and Prudent Measures listed above.

1.1. **PacifiCorp** shall develop the Link River Dam entrainment study plan, using Service-approved methodology, by August 31, 1996. This completion date will allow, if possible, an October 16, 1996, initiation of studies. The study plan shall identify methodology that quantifies entrainment of larval (March 1-May 31 only), juvenile, and adult fish (October 16 to May 31). Larval sampling will be conducted at locations immediately above hydrofacilities in the Eastside and Westside Canals, whereas juvenile

and adult sampling will occur at locations immediately below the hydrofacilities. Additional study design will be developed to identify "pulses" of fish or other migratory behavior that wouldn't be identified through standard random sampling schemes.

1.2. To ensure the Service can continually review effectiveness of Entrainment Reduction Devices at the Link River diversions, **The New Earth Company** shall implement Service-approved entrainment and impingement monitoring for all age classes of suckers at both B- and C- Canals and Link River diversions. Monitoring activities shall be conducted during the algae harvest period (June 1-October 15). These monitoring efforts will supplement and compliment monitoring studies already proposed by The New Earth Company at their facilities. The New Earth Company shall strive to coordinate Link River entrainment and impingement studies with PacifiCorp's Term and Condition 1.1 studies above.

1.3. **PacifiCorp** shall provide annual entrainment study reports by October 15 for each year's activities. A final report shall be submitted six months after completion of the two season study. **The New Earth Company** shall annually submit, by February 28, a report of larval, juvenile, and adult entrainment and impingement occurrences for the previous year at B- and C-Canals and the Link River diversions.

2.1. **PacifiCorp** shall re-evaluate its flood operations plan by October 31, 1996. **PacifiCorp shall** request input from the Service and Reclamation on analysis methodologies. Copies of the updated flood operations plan shall be provided to the Service and Reclamation for use in the Upper Klamath Lake water elevation consultation.

2.2. During the Upper Klamath Lake water elevation consultation, **PacifiCorp** shall cooperate with the Service and Reclamation to analyze the relationships between the new flood operations plan, various project operational constraints, hydropower, and habitat and water quality benefits to endangered species.

2.3. **PacifiCorp** will assist Reclamation to implement, in 1996, water levels as defined by Reclamation's "low range elevations" proposal (Reclamation 1996b). In the future, after Reclamation's consultation on Upper Klamath Lake water levels is complete, **PacifiCorp** shall assist Reclamation to implement new protective water elevations. The Service understands that Reclamation will be involved in future consultations and that Reclamation and PacifiCorp will address operational limitations at those times.

3.1. **PacifiCorp** and Reclamation shall determine ownership of the Link River fish ladder by December 31, 1996 and report ownership responsibility to the Service. The responsible entity shall implement a Service-approved study to identify reasons for lack of use of Link River fish ladder by endangered suckers. ODFW shall be involved in

study design and implementation. The study should take into account current ladder and entry/exit configurations, gradient, velocities, and juvenile and adult sucker behavior, including swimming attributes, and any other measures determined to contribute to lack of use by endangered suckers.

3.2. The responsible entity, as determined in 3.1 above, shall submit a final report documenting results of the study (3.1 above), and identifying alternatives to increase passage, to the Service by December 31, 1998.

4.1. **PacifiCorp** shall submit a final report on lower Klamath River reservoirs study by December 31, 1999. The report shall document distribution and abundance, age class structure, recruitment success, and habitat use by different life stages of shortnose and Lost River suckers in J.C. Boyle, Copco, and Iron Gate reservoirs. Data collected shall be related to actual water elevations and discharges at the time of study. The report also shall qualitatively identify alternative operations or enhancements that would reduce incidental take in Klamath River and reservoirs' sucker populations.

5.1. **PacifiCorp and The New Earth Company** shall participate in the LWRRT, with membership as defined in the Description of Proposed Action section. LWRRT's main purpose is to develop a Long Range Restoration Plan, to be recommended to the Management Committee. The goal of the plan is restoration of the property with a focus on historic form (habitat configuration), function (habitat benefits), and composition (community structure), within unalterable constraints, for the specific objective of increasing larval endangered sucker survival via habitat creation and water quality enhancement.

5.2. The Management Team shall identify and communicate all "unalterable constraints" to the LWRRT. The **LWRRT** shall subsequently complete a draft Long Range Restoration Plan by December 31, 1996, and submit a final recommended Long Range Restoration Plan to the Management Committee by April, 1997. The **LWRRT** shall use outside experts to assist in development of Restoration Plan. The Restoration Plan shall include specific information on endangered fish needs, historic form, function, and composition, of the lower Williamson River and surrounding area, constraints to return to historic conditions, phased plans and timelines for restoration, specific incidental take reduction activities during restoration activities, research needs, monitoring plans, and specific production targets for larval survival and habitat features (emergent and submerged habitat; woody features; riverine habitat). **LWRRT** decisions shall be made by consensus, with abstaining opinions provided in an appendix to the Restoration Plan. The Restoration Plan will be reviewed by the Service to assure it meets the intent of these biological and conference opinions and ITS.

5.3. The **LWRRT** shall develop annual restoration work/research/monitoring plans for submission to property managers and the Management Committee. Annual restoration plans must have Service review and concurrence to assure they meet the intent of these biological and conference opinions and ITS.

5.4. If restoration funds become available and must be spent prior to completion of the Long Range Restoration Plan, proposed activities shall be reviewed by the LWRRT and the Service prior to implementation. Review shall ensure that unplanned activities do not preclude long range activities.

5.5. If PacifiCorp, The New Earth Company, and TNC, or some combination of these parties, hold an interest in the agricultural inholdings, this entity(s) shall develop, in cooperation with the Service, annual operating plans designed to reduce impacts to endangered species and surrounding restoration activities. Plans should specifically address pesticide/herbicide use, entrainment reduction, and draining/pumping plans, and seek to minimize the impacts of such actions on endangered suckers and their ecosystem. Annual operating plans shall be developed prior to annual activities on agricultural lands.

5.6. The **LWRRT** shall provide the Management Committee and Service with an annual activity report by December 31.

6.1. **PacifiCorp** shall develop a Service-approved endangered species operations and maintenance plan for PacifiCorp's Klamath hydrofacilities' activities, including handling and storage of hazardous materials, hydrofacility ramp rates, and fish salvage operations. This plan shall be developed and implemented by September 30, 1996.

6.2. **PacifiCorp** shall document its annual operations, as related to endangered species decisions, in a report due by December 31 of each water year. The report shall identify actions taken to benefit endangered suckers (coordination points with the Service and/or Reclamation, lake and reservoir elevations, discharges, and key operational decisions), for the following life history periods (as defined in Reclamation 1996b): 1) spring spawning period (Feb 15-April 15); 2) larval habitat occupation (April 16-July 15); 3) juvenile and adult habitat occupation (July 16-September 30); and winter period (October 1-February 14). The report also shall report annual actions taken under Term and Condition 6.1, including number of suckers collected and their disposition during salvage, identify date and magnitude of spill and ramping activities, and any hazardous spills, and remedial actions taken.

6.3. In the event that The New Earth Company is required to dewater algae harvest facilities on the Eastside or Westside canals, **The New Earth Company** shall salvage canal facilities under the guidelines of the PacifiCorp salvage plan identified in 6.1 above.

A report shall be completed by December 31 following each dewatering event that documents the date(s) of the event, number of fish salvaged, and disposition of fish.

Review Requirement

The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize incidental take that might otherwise result from the proposed action. With implementation of these measures the Service believes that no more than the above-described amounts will be incidentally taken. If, during the course of the action, this minimized level of incidental take is exceeded, such incidental take would represent new information requiring review of the reasonable and prudent measures provided. The Federal agency must immediately provide an explanation of the causes of the taking and review with the Service the need for reinitiation and possible modification of the reasonable and prudent measures.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of ESA directs Federal agencies to utilize their authorities to further the purposes of ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

1. Reduction of nutrient loading is an important tool in minimizing water quality-induced impacts to native aquatic species, including suckers, in Upper Klamath Lake. Nutrient loading reduction is identified in the Recovery Plan for Lost River and shortnose suckers as a critical recovery need. One method of implementing the Recovery Plan's priority of reducing nutrient loading is through creation of "wetland cells" (Gearhart et al. 1995). The **New Earth Company and PacifiCorp** should retain qualified researchers to help develop wetland cell pilot projects in high priority nutrient loading source areas. Results of these efforts will be important in reducing the long-term need for strict protective measures for endangered species.

2. Restoration of habitat at the lower Williamson River for native species, including suckers, could be enhanced in the future by purchase and eventual conversion of additional historic wetland areas. Wetland restoration is identified in the Recovery Plan for Lost River and shortnose suckers as a critical need. **PacifiCorp and The New Earth Company** should investigate opportunities to cooperate in acquisition and restoration of other important properties along the lower Williamson River for the benefits of the Klamath Basin's native wildlife populations.

3. Protection of the greatest genetic diversity within the endangered suckers is of paramount importance to the continued survival of the species as a whole. The Recovery Plan for Lost River and shortnose suckers defines the need for studies involving genetic structuring of Klamath

Basin suckers. Given The New Earth Company's plans for expansion of algae harvest to other areas within Upper Klamath Lake, and associated increased potential of wider impact to these species, it is important to understand the relative impacts to sucker populations between harvest locations. The Service recommends **The New Earth Company** should actively assist in funding genetic studies to increase the overall knowledge and future operational sensitivity.

4. Entrainment of various sucker life stages may, in part, be a result of lack of suitable water quality and vegetated habitat in lower portions of Upper Klamath Lake. **PacifiCorp and The New Earth Company** should investigate methods to enhance larval and juvenile habitat in the Link River Dam area to benefit suckers. These actions would supplement The New Earth Company's Fremont Bridge wetland site. Methods may include artificial floating habitat structures (see Reclamation's review of artificial structures), submerged shoreline woody structure, and shoreline emergent habitat creation. Water quality enhancement should be investigated; aeration or other enhancements may be beneficial at certain periods of the year for maintaining water quality attributes, thereby reducing entrainment incidents.

5. Larval suckers may annually occupy Klamath River reservoirs from March to July. These vulnerable life stages require, especially in environments densely populated with predaceous non-native fishes, vegetated nursery habitat, such as emergent shoreline marsh areas. Stabilization of reservoir elevations, especially in Keno, J.C. Boyle, and Copco reservoirs, would benefit colonization of emergent vegetation habitats, and increase larval survival. The Recovery Plan for Lost River and shortnose suckers identifies offsetting lack of recruitment in Klamath River reservoirs as a high recovery priority. **PacifiCorp** should investigate operational opportunities to enhance emergent vegetation habitats in Klamath River reservoirs via water level management or other actions.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, the Service requests PacifiCorp and/or The New Earth Company notification of the implementation of any conservation recommendations.

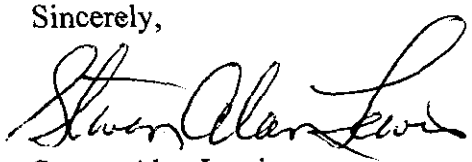
REINITIATION - CLOSING STATEMENT

This concludes formal consultation on the action outlined in Reclamation's Assessment. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been maintained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation. Additionally, if assumptions presented in the

Introduction section should prove to not be valid, the analyses for these biological and conference opinions also are invalid, and consultation should therefore be reinitiated by Reclamation, on the behalf of the applicants, PacifiCorp and The New Earth Company.

We appreciate your efforts to conserve Federally listed species and proposed critical habitat. If you have any questions regarding this biological opinion, please contact Doug Young, Marcus Horton, or Steve Lewis at (541) 885-8481.

Sincerely,



Steven Alan Lewis
Project Leader

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Personal Communication

Mark Buettner, Fisheries Biologist, Reclamation, Klamath Falls, Oregon.

Larry Dunsmoor, Fisheries Biologist, The Klamath Tribes, Chiloquin, Oregon.

Ron Goede, Fish Health Specialist, Utah Division of Wildlife Resources, Logan, Utah.

Mike Green, Fisheries Biologist, Reclamation, Klamath Falls, Oregon.

Jacob Kann, Aquatic Ecologist, The Klamath Tribes, Chiloquin, Oregon.

Douglas Markle, Professor, Oregon State University, Corvallis, Oregon.

Dave Mauser, Fish and Wildlife Biologist, Klamath Basin National Wildlife Refuges, Tulelake, California.

Todd Olson, Biologist, PacifiCorp, Portland, Oregon.

Gary Scoppettone, Lead Scientist, National Biological Survey, Reno, Nevada.

Frank Shrier, Biologist, PacifiCorp, Portland, Oregon.

David Simon, Research Associate, Oregon State University, Corvallis, Oregon.