SURVEY OF ARTIFICIAL PRODUCTION OF ANADROMOUS SALMONIDS IN THE COLUMBIA RIVER BASIN

Final Report 1985

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U.S. Department of Energy

Bonneville Power Administration

Division of Fish and Wildlife

Contract No. DE-AI-7984BP17100

Project No. 84-51

November 25, 1985

Acknowledgments

This project could not have been completed without the cooperation and interest of the various agencies concerned with the anadromous fish runs of the Columbia River system. Agency personnel devoted a considerable amount of effort to assembling information for the project, even though each person involved had other important responsibilities, We especially thank the hatchery supervisors and staffs for the time they expended in providing data. Without their advice and assistance there could have been no project. Agencies most active in providing data and their liaison representative for the project were:

Chelan County PUD, Steven Hayes
Washington Department of Game, James Gearheard
Washington Department of Fisheries, Robert W. Foster
Oregon Department of Fish and Wildlife, Michael Stratton and Jerry Bauer
National Marine Fisheries Service, Einar Wold
Idaho Department of Fish and Game, Evan Parrish
US Army Corps of Engineers, Joseph McMichael
Douglas County PUD, Michael Erho
Grant County PUD, Michael Dell
Idaho Power Company, Larry Wimer
US Fish and Wildlife Service, Henry E. Forner

Others who provided assistance at various stages of the project include Kenneth Kral and Donald Caha, City of Tacoma Department of Utilities; Tom Scribner, Yakima Indian Nation; James Warren, US Fish and Wildlife Service; John Schandl and James Wood, Washington Department of Fisheries; and Wallace Hublou, Oregon Department of Fish and Wildlife (retired).

We also thank the many support personnel of the various agencies who answered our questions and searched for the information we needed for the project,

Finally we wish to thank Gerald Bouck and Ron Morinaka, Technical Representatives for BPA, for their patience and encouragement in solving the problems that inevitably arise during the course of a large contract.

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TABLES

I. Introduction

The salmon and steelhead runs of the Columbia River system partially, and in some instances entirely, result from releases of fish from hatchery facilities and rearing sites. All of the propagation stations in Table 1 are operated by the US Fish and Wildlife Service and by the states of Oregon, Washington, or Idaho. Funding for these facilities is by the states and the federal government, public utility districts, and private electric utilities. Federal funds are provided primarily to mitigate the effects of federal dams.

Because the fish propagation facilities are so important to aintaining and increasing salmon and steelhead runs in the Columbia River system and because building and maintaining the hatcheries is so costly,it is essential that basic data are made available about fish production, quality and quantity of water, cost and condition of facilities, and potential for expansion. The states of Oregon, Washington, and Idaho and the US Fish anh Wildlife Service have collected much information of this type. This report summarizes such information In a single data archive available for use by various public entities.

The overall objective of this project is to collect, organize, and summarize data concerning anadromous fish culture stations of the Columbia River system for 1981, 1982, and 1983 and to create a data archive system with a means of making this information available to the public.

Immediately after each of the following specific objectives is a reference number (or numbers) in parentheses which relates each objective to task numbers in the Request for Proposal (KFP). These reference numbers also appear in the body of this report. Specific objectives of the project are to:

1. Keview the significant literature relating to hatchery production of salmon and steelhead and discuss factors that control fish production. (1.1)
2. Describe each hatchery facility, prepare a site plan, and record current level of personnel. (2.6, 3.1, 3.4)
3. Keport on water quality and quantity at each station. (2.4,2.4.1, 2.4.2, 2.5)
4. Keport fish culture data for each station for 1981-1983 and record recent available production goals. (2.7, 3.2)
5. Kecord financial profiles for each station for 1981-1983. (2.8)
6. Estimate full propagation potential for each station. (3.1, 3.2)
7. Estimate capital and operational costs to achieve full propagation potential at each station. (3.1)
8. Kecord published and unpublished technical documents relating to the fish-rearing operation at each site. (1.0, 1.3)
9. List potential sites for hatchery facilities identified by fishery agencies. (2.10)
10. Provide a computerized data archive of all information collected at each station and at agency headquarters. (5.0)

TABLE 1

PROPAGATION FACILITIES

REGION I (Columbia Kiver below Bonneville Dam)

	Facility	Location	Operating agency*
1.	Abernathy National Fish Hatchery	Longvi ew, WA	us F. d w. s.
2.	Alder Creek Pond	Tout le, WA	WA D. of G.
3.	beaver Creek Hatchery	Cat hlamet , WA	WA D. of G.
4.	Big Creek Fish Hatchery	Astoria, OK	OK D. of F. & W.
5.	Big White Salmon Kearing Pond	Underwood, WA	us F. & w. s.
6.	Bonneville Fish Hatchery	Bonneville, OK	OK D. of F. & W.
7.	Cascade Fish Hatchery	Uonnevi l le, OK	OK D. of F. & w.
8.	Clackamas Hatchery	Clackamas, OK	OK D. of F. & W.
9.	Cowlitz Salmon Hatchery	Salkum, WA	WA D. of F.
10.	Cowlitz Trout Hatchery and Keari ng Ponds	Winlock, WA	WA D. of G.
Il.	Deer Springs	Tout le , WA	WA D. of G.
12.	Eagle Creek National Fish Hatchery	Estacada, OK	us F. & w. s.
13;	Elokomin Salmon Hatchery	Cathlanet, WA	WA D. of F.
14.	a. Gnat Creek Fish Hatchery b. Trojan Rearing Pond	Cla tskanie, OR	OK D. of F. & W.
15.	Gobar Pond	Kalarna, WA	WA D. of G.
lb.	Grays River Salmon Hatchery	Grays Kiver, WA	WA D. of F.
17.	Grays Kiver Salmon Pond (Meyco Pond)	Grays Kiver, WA	WA D. of F.
18.	Kalama Falls Salmon llatchery	KA lama, WA	WA D. of F.
19.	Klaskanine Fish Hatchery	Astoria, OK	OK D. of F. 6 W.
20.	Leaburg Fish Hatchery	Leaburg, OK	OK D. of F. & W.

* Agency names are given in full at the end of Table 1.

TABLE 1 (continued)

	Facility	Location	Operating agency
21.	Lewis River Salmon Hatchery	Woodland, WA	WA D. of F.
22.	Lower Kalama Salmon Hatchery	Kalama, WA	WA D. of F.
23.	Marion Forks Fish Hatchery	Idanha, OR	OR D. of F. & W.
24.	McKenzie Fish Hatchery	Leaburg, OR	OR D. of F. & W.
25.	Mossyrock Trout Hatchery	Mossyrock, WA	WA D. of G.
26.	a. Oxbow Fish Hatchery, Herman Creek Rearing Pond	Cascade Locks, OR	OR D. of F. & W.
	b. Wahkenna Rearing Pond		
27.	Roaring River Fish Hatchery	Scio, OR	OR D. of F. & W.
28.	Sandy Fish Hatchery	Sandy, OR	OR D. of F. 6 W.
29.	Slcamania Trout Hatchery	Washougal, WA	WA D. of G.
30.	a. South Santiam Fish Hatchery	Sweet Home, OR	OR D. of F. 7 W.
	b. Stayton Rearing Ponds		
	c. Aumsville Pond		
31.	Speelyai Salmon Hatchery	Ariel, WA	WA D. of F.
32.	Toutle Hatchery	Toutle, WA	WA D. of F.
33.	Vancouver Trout Hatchery and Rearing Pond	Vancouver, WA	WA D. of G.
34.	Washougal Salmon Hatchery	Washougal, WA	WA D. of F.
35.	a. Willamette Fish Hatchery	Oakridge, OR	OR D. of F. & W.
	b. Dexter Rearing Pond		
	REGION II (Columbia River between Bonneville Dam and Snake River confluence)		
36.	Carson National Fish Hatchery	Carson, WA	US F. & W. S.
37.	Fall River Fish Hatchery	La Pine, OR	OR D. of F. d W.
38.	Goldendale Trout Hatchery	Goldendale, WA	WA D. of G.

TABLE 1 (continued)

	Facility	Location	Operating agency
39.	Irrigon Hatchery	Irrigon, OR	Ok D. of F. & W.
40.	Klickitat Salmon Hatchery	Glenwood, WA	WA D. of F.
41.	Little White Salmon National Fish Hatchery	Cook, WA	US F. & W. S.
42.	Oak Springs Fish Hatchery	Maupin, OR	OR D. of F. & W.
43.	Round Butte Fish Hatchery	Madras, OR	OR D. of F. & W.
44.	Spring Creek National Fish Hatchery	Underwood, WA	US F. & W. S.
45.	Warm Springs National Fish Hatchery	Warm Springs, OR	US F. & W. S.
46.	Willard National Fish Hatchery	Cook, WA	US F. & W. S.
47.	Wizard Falls Fish Hatchery	Camp Sherman, OR	OR D. of F. & W.
	REGION III (Columbia River System above the Snake River Confluence)		
48.	Chelan Trout Hatchery	Chelan Falls, WA	WA D. of G.
49.	Entiat National Fish Hatchery	Entiat, WA	US F. & W. S.
50.	Leavenworth National Fish Hatchery	Leavenworth, WA	US F. & W. S.
51.	a. Naches Trout Hatchery	Naches, WA	WA D. of G.
	b. Nelson Springs	Naches, WA	WA D. of G.
52.	Nile Spring Hatchery	Yakima, WA	Yakima Indian Nation
53.	Omak Trout Hatchery	Omak, WA	WA D. of G.
54.	Priest Rapids Salmon Hatchery	Mattawa, WA	WA D. of F.
55.	a. Ringold Springs Salmon Rearing Pond	Mesa, WA	WA D. of F.
	L. Rlngold Springs Steelhead Rearing Pond		WA D. of G.

TABLE 1 (continued)

	Facility	Location y	
56.	a. Rocky Reach Channel and Annex	E. Wenatchee, WA	WA D. of F.
	b. Turtle Rock Rearing Pond	E. Wenatchee, WA	WA D. of G
57.	Spokane Hatchery	Spokane, WA	WA D. of G.
58.	Washburn Island Rearing Facility	Brewster, WA	WA D. of G.
59.	Wells Salmon and Trout Hatchery	Pateros, WA	WA D. of F. and WA D. of G.
60.	Winthrop National Fish Hatchery	Winthrop, WA	US F. & W. S.
61.	Yakima Trout Hatchery	Yakima, WA	WA D. of G.
	REGION IV (Snake River System)		
62.	Dworshak National Fish Hatchery	Ahsahka, ID	US F. & W. S.
63.	Eagle Hatchery	Eagle, ID	ID D. of F. & G.
64.	Hagerman National Fish Hatchery	Hagerman, ID	US F. & W. S.
65.	Hagerman State Fish Hatchery	Hagerman, ID.	ID D. of F. & G.
66.	Hayden Creek Hatchery	Lemhi, ID	ID D. of F. & G.
67.	Kooskia National Fish Hatchery	Kooskia, ID	US F. & W. S.
68.	Lookingglass Hatchery	Elgin, OR	OR D. of F. & W.
69.	Lyons Ferry Salmon Hatchery	Lyons Ferry, WA	WA D. of F.
70.	Lyons Ferry Trout Hatchery	Lyons Ferry, WA	WA D. of G.
71.	McCall Hatchery	McCall, ID	ID D. of F. & G.
72.	Niagara Springs Hatchery	Wendell, ID	ID D. of F. & G.
73.	Oxbow Hatchery	Oxbow, OR	ID D. of F. & G.
74.	Pahsimeroi Hatchery	Ellis, ID	ID D. of F. & G.
75.	Rapid River	Riggins, ID	ID D. of F. & G.
76.	Red River Rearing and Spawning Station	Red River,ID	ID D. of F. & G.
77.	Sawtooth Hatchery	Stanley, ID	ID D. of F. & G.

TABLE 1 (continued)

	Facility	Location	Operating agency
78.	Tucannon Salmon and Trout Hatchery	Pomeroy, WA	WA D. of F. and WA D. of G.
79.	a. Wallowa Fish Hatchery	Enterprise, OR	OR D. of F. & W.
	b. Imnaha (Trap Acclimation) Pond		
	c. Little Sheep (Trap Acclimation) Pond		

Operating agencies:

US F. & W. S.	United States Fish and Wildlife Service
ID D. of F. 6 G.	Idaho Department of Fish and Game
OR D. of F. & W.	Oregon Department of Fish and Wildlife
WA D. of F.	Washington Department of Fisheries
WA D. of G.	Washington Department of Game

II. Literature review

Over the past two decades, investigators have intensified research on factors affecting salmonid production at hatcheries on the Columbia River system. Klontz et al.(1979) and Downey and Klontz (1981) proposed general categories of factors affecting salmonid production at fish-rearing facilities. The following review of major factors affecting hatchery production is based on the Downey and Klontz (1981) categories. References to the literature are provided under categories of particular relevance to this hatchery survey project.

A. Fish

The fish category includes factors that relate directly to the requirements of the organism.

1. Environmental factors

Environmental factors refer to basic physical and chemical requirements of salmonids such as spawning substrate, stream-flow needs at various stages of development, water quality, and rearing habitat. These factors, as they relate to hatchery production, are discussed in sections B, C, and D. See Brett (1979) for a general discussion on the relation of environmental factors to growth.

2. Behavior/physiological factors

Salmonid behavior affecting production after hatchery release includes feeding, migrating, and predator-prey interactions. Of primary concern are behaviors that result from hatchery management practices and influence fish returns (see Sections E.1 and E.2). Salmonid physiological research hasconcentrated on the use of sex and growth hormones to increase production (Schreck and Fowler 1982

and Schreck 1982). Plasma and gill Na+ – K+ ATP activity and thyroid hormone levels have been used to predict release times (Folmar and Dickhoff 1891). Development of osmoregulatory ability during smoltification and smolt-parr reversal was discussed by Yolmar et al. (1982).

3. Factors related to fragility of the organism

Researchers have recently given attention to quantifying embryo mortality and sensitivity caused by handling techniques and effects of incubators (Jensen and Alderdice 1983 and Johnson et al.1983).

b. Water

The "water" category refers to water quantity (minimal flow needs of hatcheries) and quality (such as pollutants, temperature, and dissolved gases). This review emphasizes water characteristics (quality).

1. Temperature factors

Research on salmonid sensitivity to temperature ranges has been related to dissolved oxygen availability and rate of oxygen uptake; embryonic development; protein, lipid and fatty acid composition in muscle tissue; feeding; growth; acclimatization and tolerance; and such factors as mobility, aggression and stress (Akepshire et al. 1983, brett 1952, Goff and Yorsyth 1979, and Hemming et al. 1982).

2. Dissolved gases as factors

Specific references to nitrogen supersaturation, dissolved ammonia, and carbonic acid are found in those references listed in the section on polluting factors (U.3). Many investigators have studied dissolved oxygen requirements in relation to temperature and the carrying capacities of rearing Facilities..There has been

little agreement among hatchery managers about the optimum carrying capacity of troughs or ponds. Haskell's (1955) equations for optimum biomass of brown trout per volume of pond may have overlooked several factors that influence the amount of water needed for fish propagation, such as the oxygen uptake of fish at given activity and water temperatures. beamish and Dickie (1967) reported that oxygen consumption increased wi th increased activity and temperature. Oxygen uptake for active fish decreased as ambient oxygen levels decreased, and as carbon dioxide and loading density increased (Wells 1935, Privone 1950, and beamish 1964). Basu (1959) demonstrated that the logarithm of the rate of activity vs. oxygen consumption decreased linearly with increased partial pressure of carbon dioxide.

burrows and Combs (1968) reported that pond carrying; capacity for fingerling chinook salmon (biomass per flow) was inversely proportional to water temperature and proportional to fish size. Willoughby (1968), usingHaskell's (1955) assumption, proposed that a daily food ration for fish could be estimated using their body weight and water temperature. This equation could then be used to calculate the flow required for a given fish biomass. The equation in Willoughby (1968) did not specify species or loading density. Westers (1970) considered water exchange important and reported an equation that related fish density (biomass per cubic foot of water), carrying capacity (biomass per gallon per minute), and water exchange rate (change per hour). Westers'(1970) equation accounted for most major factors except that ambient oxygen was not considered.

Equations in Elliot (1969) for the oxygen uptake by chinook salmon seemed to apply only to the weight range tested (1.85 – 17.5 grams). Elliot did not specify loading density, which Liao (1971) contended "affects activity levels." Liao (1971) reported the inadequacy of loading density and water exchange rates when determining carrying capacity "because hydraulic patterns affect the oxygen consumption." He plotted rates of oxygen uptake at different water temperatures vs. fish sizes and derived the "saturated dissolved oxygen concentration," which is dependent upon temperature and altitude.

Other researchers have concentrated on artificial aeration systems, growth and stress dynamics at various air saturation levels, nitrogen supersaturation, and ammonia effects upon survival (Bailey et al. 1980, Brett and Blackburn 1981, Colt and Westers 1982, and Thruston et al. 1981).

3. Polluting factors

Polluting factors can be natural (such as sediment transport and deposition, water hardness, high mineral seepage into streams) or associated with human contaminants (agrlcultral, Industrial, and domestic). The effect on stress and growth of hatchery fish when transferred into water of varying pH has been investigated by Peterson et al. (1980) and Saunders et al. (1983). General toxicity tests relating to hatchery production have received attention as well as investigations into alkalinity and ammonia conditions (Eicher 1946,Finlayson and Verrue 1983, Jordan and Lloyd 1964, and Thompson and Paton 1976).

c. Container-related factors

Hatchery tanks, raceways, substrate type, transport tanks, water velocity, and water replacement time are all examples of this category.

1. Container type

Fry biomass, feeding dynamics, and survival have been studied In enhanced natural channels and hatchery containers (Leon and Bonney 1979 and Acara 1977). Rearing cage and spawning substrate optimization were researched by Barns and Simpson (1976), boydstun and Hopelain (1977), and Hickey et al. (1979).

2. Water

Mundle and Taber (1983) examined the effects of various discharge rates on steelhead smolt yield. Literature on water flow and exchange rate requirements is reviewed in the following sections on nutrition and hatchery management.

D. Nutritlon

Factors in the "nutrition" category Include: 1.) percent diet composition of the basic food groups; 2.) supplements to the commercial diets to enhance growth and survival; and 3.) hormonal treatment to speed growth, increase adult returns, and facilitate saltwater transfer. The ultimate goal Is increased marine survival and returns. Salmonld culturlsts have developed fish diets based on the National Research Council (1981) publication. Still more recent research at hatcheries and academic Institutions has led to Improved nutritional techniques.

1. Basic diet

Much research has concentrated on percent protein and lipid and on carbohydrate quality In fish diets and in the resulting composition and performance of the developing fish. Lemm and Hendrix (1981) examined Atlantic salmonld growth and survival from varlous starter diets. Fouler (1980) researched starter diets for chinook fry and later Fowler (1981) looked at which protein and energy relations in the starting diets could improve growth. The effect of the major food groups on growth, tissue composition, and food conversion in rainbow trout was studied by Bronley and Smart (1981). Steffens (1981) found a direct relation between ration amount and oxygen consumption at various temperatures while observing daily metabolic rates of fingerling sockeye. Clarke, et al. (1982) conducted a long-term study of the effects of varying the protein-to-lipid ratio in dry diets on coho body composition and growth rates; tests were performed at various temperatures and compared to groups fed only Oregon Moist Pellets (OMP). Markert et al. (1984) found that dry diets were suitable in coho culture if a similar balance of nutrients was maintained as was found in OMP. In an analysis of various types of carbohydrates, Aklyama et al. (1982) found that chum salmon fry were not efficient at utilizing more complex sugars but that simple carbohydrates such as glucose were relatively well metabolized. Of the carbohydrates studied, gelatinized potato starch was utilized the best.

2. Diet supplements

Supplements to standard diets have been a popular research subject. Fowler (1991) found better weight gains in chinook fry when cottonseed meal or brewer's grains were replaced with herring meal or poultry/feather meal; also, dogfish liver oil proved to be equivalent to tuna oil as a lipid source. Rapeseed products of the carlola type were determined to be good protein supplements for chinook fry. Rapeseed products alone could comprise 13-16 percent of the dictary protein (Higgs et al. 1982). When Akiyana et al. (1934) sullolmented chum salmon fish meal with silkworm pupae, dried beef liver, and krill or earthworm powder, they found that the earthworm supplement gave the best growth results.

3. Hormones

The addition of hormones to the diet, as well as manipulation of nutrient composjtions, has altered the performance of salmonids. fagerlund et al. (1983) studied the effects of eight dietary treatments on juvenile coho treatments included various concentrations of protein, lipid, and 17-methyltestosterone (MT hormone). Fish fed high-density lipidproteins gained weight faster than either those fish on low-density lipidproteins or those fish fed with lipidprotein mixes found in traditional diets. The protef n efficiency ratio was inversely related to dietary protein and directly related to lipid content. The authors concluded that food costs in coho culture could be lowered through manipulation of dietary protein, lipid, and MT content. MT hormone and T_3 (3,5,3'-triisdo-L-thyronjne) were found to enhance growth of coho in freshwater but only T_3 faci litated saltwater transfer (Fagerlund et al. 1980, Fagerlund et al. 1979). Howeve r,, Higgs et al. (1983)

found that dietary and hormonal' treatment (T_3) In freshwater did not influence chinook performance in seawater. Stimulation of growth by T_3 was demonstrated when the chinook's dietary protein level was around 50 percent; growth enhancement by T_3 was positively correlated with the dietary concentration of canola meal and T_3 as well. Thyroid and steroid hormone treatments were also examined by Higgs et al. (1982). Experiments with steelhead diets showed that diet composition had a pronounced influence on the anabolic efficacy of T_3 and that T_3 stimulates grouth through increasing carbohydrate utilization. In thyroid hormone feeding experiments on Atlantic salmon, Xefstie (1981) found that T_3 was better than T_4 for saltwater tolerance and grouth; however, both hormones could induce snoltification in underyearlings.

4. Marine survival

Researchers recognize the need to relate growth improvement and saltwater transfer to marine survival and conribution to the fishery. Fowler (1983) examined grouth and survival of fry fall chinook salmon when dietary protein and energy utilization were manipulated. plotnikoff, et al.(1983) tried to relate nutrition to marine survival of chinook salmon. Chinook growth and food, protein, and energy utilization were best for fish fed diets with high lipid content. The body composition of wild smotl counterparts had a higher percentage of moisture, protein, and ash but a much lower percentage of body lipid (Platnikoff, et al. 1984). These rcsearchcrs tagged and released smolts of varying percentages of protein and lipid body composition. Unfortunately, marine survival and return data were incomplete atthe time of publication.

E. Management

Management is a very broad category that includes all research relating to general hatchery management techniques. Piper et al. (1982) gave an extensive description of hatchery management techniques. Washington (1982) thoroughly reviewed hatchery wwanagement practices and how these practices might affect hatchery producton. A few key factors that have received attention in the recent literature are as follows.

1. Feeding techniques

Statler (1962) investigated food-to-flesh conversion in steelhead trout-rearing experiments where self feeders were compared to hand feeders. Also compared were two diet types. Self-feeding was more cost effective and food-to-flesh conversion was about twice that of the hand-fed group.

2. Fish sizing and grading techniques in relation to time of release and density

These factors have been grouped together because many researchers investigated more than one factor, such as salmonld density in hatcheries along with timing of releases, or grading techniques with rearing time.

Time of release has been identified as an important factor influencing survival rates of salmonid releases in test lots. Hatchery fish survived at higher rates when released after May (Senn et al. 1974, Seidel and Mathews 1977, and Bilton 1980, 1981). However, wild salmon (particularly coho) migrated during the first two weeks of May (Thompson and Paulik 1967). Coho release times during the 1960's were very early, between November and March, and

survival was higher then than in recent years. Coho releases of the early 1960's migrated during the first two weeks of May (Durkln and Sims 1975). Roth catch and escapement from such releases were following an increasing trend (Bureau of Commercial Fisheries 1969-1971). The apparent Influence of time of release on survival rates was perhaps a sympton of something that occurred before release.

The size of individual salmonids released from Columbia River hatcheries has increased dramatically over the past ten years. There has been a great increase in numbers and average release size, and a relatively minor increase In total tearing space. The only new hatchery built during this period was on the Cowlitz River (Whale and Smith 1979, and Smith and Wold 1981). Bell (1973) developed guidlines for determining loading densities at Columbia River hatcheries.

Cunnes (1976) reported the effects of grading b-7.5 and 9 month Atlantic salmon fingerlings by size. Earlier separation by grading had the best effect on growth. Those graded at later ages showed little difference in growth rate from ungraded control lots. The advantages of grading were greater growth and fewer unexplained losses.

burrows (1969) indicated that increased survival to adulthood could result from released chinook fingerlings that had greater stamina, larger size, increased protein and energy reserves, and a lower incidence of disease. All these factors are influenced by chronic stress related to density.

Fin erosion, inadequate weight gain, relatively low protein content in muscle tissue, and outbreaks of diseases caused by stress may be correlated with long rearing time and density (Moring 1982,

and Specker and Schreck 1980). Ocean survival of salmonids and age composition of adult populations can be influenced by size select Ion at time of release (Fagerlund et al. 1983, and Kitter 1975). Bilton (1978, 1983),Bilton and Jenkinson (1980) and Brannon et al. (1982) examined the effects of time and size of release as a separate production issue from rearing density factors. Mahnken et al. (1982) suggested that the critical size at release for optimal adult survival and return of coho salmon release has increased.

Fall chinook salmon survival rates, as determined by commercial catches and hatchery returns, were found to be best in the largest of three size groups, all of which were released at the same time (Yowler and Banks 1980); Fowler et al. (1980) also demonstrated that fall chinook reared for a longer duration and to a larger size survived at higher rates than those released at an earlier time and at a smaller size. Bilton et al. (1982) analyzed four release times (with three size groups for each time) for coho salmon. The maximum adult returns were for large juveniles from the late release group.

Blaxter (1975) reported that intraspecific survival factors usually predominate in hatcheries and interspecific factors in the natural environment. "Fish density is ultimately the key factor in both environments because high density induces stress and competion for food as well as enhancing predation." He offered a generalization about flatflsh that is probably true for other fishes: "Growth comparisons of wild and hatchery fish stocks are difficult because of the dependence of (wild fish) growth on food supply and fish density." Other6 have reported poor performances by hatchery salmonids in comparing their stamina with that of wild fish

of the same species (Vincent 1960, Miller and Miler 1962, Green 1964,,and Barns 1967).

Blaxter (1975) reported that low densities produced more uniform and larger fish than high densities. Size hierarchies as a result of high density increased variance in size and caused an increase in size-dependent mortality. Blaxter listed symptoms of high density as abnormal pigmentation, bitten fins, and impaired locomotor performance In addition to size hierarchies.

Ejike and Schreck (1980) studied the effect6 of dominance hierarchy on parr coho salmon. stress levels were inversely related to social dominance poei tion. They concluded, "It is plausible that dominance status is inversely related to a low-level, chronic state of stress in the fish, the dominant individual being the least stressed.

Fenderson and Carpenter (1971) reported that wild salmonids were most aggressive at low densities while hatchery fish aggressiveness Increased at intermediate and high density levels.

li and Brolenson (1977) found that increases in metabolic rates of rainbow trout at higher population densities were attributable to three factors:(1) starvation, (2) increased subordinate fish exercise level6 (dominant fish took the most suitable areas), and (3) increased levels of excitation. The "variance of energetic factors of routine metabolism, growth rate, consumption rate, and growth efficiency tended to increase with density." All of the above were indicator6 of Intraspecific competition. Dominant individuals grew faster and contained more lipids at each density. "At higher densities, dominance conferred less benefits than was observed at lower population levels."

Refsite and Kittelsen (1976) found that high densities of salmonids depressed growth rate and "that compensatory growth occured when the densities were standardized." High density considerably decreased Atlantic salmon growth rates. refsite (1977) reported similar finding6 for rainbow trout. High density groups exhibited the lowest growth rates.

Wedeaeyer (1976) reported that density levels greater than six pound6 per cubic foot in soft water caused significant increase in stress-related hormone levels among presmolt coho salmon. This abnormal condition required at least a week for recovery. Wedemeyer recommended densities of 0.6 to 3.1 pound per cubic foot in distribution trucks, ponde, or raceway to minimize handling and the stress of crowding in soft water.

Fagerlund et al. (1983) concluded that at high densities, smoltificatlon in small coho salmon may be retarded and consequently, small fish may suffer the greatest relative loss after release. Sandercock and Stone (undated) reported that low-density release lots of coho survived at sea 1.8 time6 better than high-density lots. Pagerlund et al. (1979) reported similar result6 in studies of rearing density of salmon. These studies demonstrated that the effects of crowding salmon during rearing were similar to those mentioned in the review of Blaxter (1975).

Additional information on density, release time, and rearing method and how such factor relate to hatchery production can be found in Beuer (1982), Brett et al.(1978), Clarke and Blackburn (1978), Corey (1983), Ewing et al. (1980) Iwama and Tautz (1981), Nlkinmaa et al. (1983), Papst et al. (1982), and Shelbourn (1980).

3. Disease control

With the increased reliance on hatchery-reared salmonids for the maintenance of populations, the potential for major upset in production from diseases has Increased. Many hatchery diseases have been recognized since the1930's when furunculosis was first diagnosed (Duff and Stewart 1933).

Gould and Wedemeyer (undated) noted that the most troublesome diseases affecting both wild and hatchery stocks of the upper Columbia Kiver basin fish are furunculosls (Aeromonas salmonlcida), columnaris (Flexlbactor columnaris),gill diseases (possibly four or five species of bacteria), bacterial kidney disease (Renibacterium salmonlnarum), enteric redmouth disease (Yerslnia rucheri), saprolegnia (Saprolegnla sp.) and infectious hematopoietlc necrosis (IHN). Wood (1974) states that the most prevalent bacterial dieeases of Salmon are furunculosis bacterial gill disease, columnaris and kidney disease. For each of these diseases he gives the causative agent, type of infection, species infected, symptoms, optimum temperature, prevention, and treatment.

Many factors contribute to the onset and duration of diseases. Physical features such as crowding, low flow, temperature, and chemical factors such as low diesolved oxygen, un-ionized anmonia, and pH can have a strong Influence on the virulence and impact of an infectious agent. When a pathogen is present and the environment is favorable for disease,serious fish losses may occur (Wood 1974).

Disease organisms are commonly found in hatchery water and perhaps in a latent state in the fish themselves. Generally, in a hatchery , the environment is the controlling factor in determining whether a disease occures. For example, Yersinia rucheri has been.

found In wild salmon stocks but not as an eplzootic. However, in hatcheries under conditions of crowding and high temperatures, high mortalities due to redmouth disease have been reported (Dulin et al. 1976). Similarly, columnarls occurs in scrap fish which may act as a reservoir. Under conditions of stress (i.e. with high temperature6 and high densities) mortalities increase significantly (Becker and Fugihara 1978).

Development of diseases within a hatchery can have profound and immediate effects. Wood (1974) notes that explosive outbreaks of bacterial gill disease can lead to mortalities as high as 20 percent within 24 hours and as high as 50 percent within 48 hours. Katliff et al. (1982) reported 90 percent mortality within three weeks in fisn with infectious hetnatopoietic necrosis (IHN).

hatchery management practice can play a significant role In the effect6 elicited by particular epizootics. Wedemeyer and Wood (1974) related the occurrence of epizootics to stress. Disease outbreaks occurred with reduced environmental quality and caused the deterioration of fish immunal systems which combat disease organisms that are always present. Management of the environmental condition6 is the first line of defense and can minimize disease-induced losses. Management of such factors as pH, dissolved oxygen, un-ionized ammonia (through pH management), temperature, density, and release timing, will affect not only disease susceptibility but more generally the overall well-being of hatchery fish.

Rapid diagnosis and treatment reduces the adverse effects of disease. Typically medicine6 are either Introduced through the food, or a drug or chemical Is introduced directly into the pond

water. These methods are effective in the control of bacterial protozoan and fungal diseases. No treatment other than destruction of the infected population has been developed for IHN.

Saunders et al.(1972) discuss various methods of water treatment which may be useful in the control of infectious agents. Mortalities were reduced by ultraviolet irradiation, chlorination, and microfloc sand filtration.

Development of vaccines for control of infectious diseases has been slow, primarily because of US Food and Drug Administration regulations relating to veterinary pharmaceuticals and because of the effectiveness of chemical treatment and environmental management (Antipa and Croy 1379).

Generally data on specific outbreaks at specific hatcheries are not available in the published literature. Thus, it is difficult to evaluate the impact of diseases upon the productivity of these facilities. Gould and Wedemeyer (undated) suggest that, although disease may play a role in the overall decline on middle Columbia Kiver basin anadromous fish runs, this role is not a particularly significant one. They note, however, that stress from a variety of factors can be responsible for low levels of diseases, which in turn may be one of the several subtle factors contributing to the decline.

III. Methods and materials

A. Field program

Specific methods and procedures were required to satisfy the objectives of this project. Examples Include methods of calculating water quantity, water quality, condition of facilities, and financial profiles for each station. The methods used to obtain the required data are as follows.

1. Water quantity

Each agency participating in this study was asked to furnish stream flow data which were incorporated into the water quality file. Any such data was incorporated into the water quantity file.

Many of the hatcheries obtain water from streams that do not have a substantial stream flow data base. In these situations, where practical, an on-site measurement or estimate of stream flow wae made under the supervision of a licensed professional engineer. The preferred method of flow measurement was by current meter or weir. An acceptable technique involved velocity measurements utilizing drogues, or flow calculations using standard hydraulic equations.

Water withdrawal and use volumes were obtained for each hatchery that maintains this type of record. When practical, on-site measurements or estimates of water withdrawal and use were made for each significant water source at each hatchery. Where possible, withdrawal measurements were made at the intake using a current meter or weir. Pumped water flows were estimated using manufacturers' pump curves, running time curves, or flow meters, weirs, or volumetric measurements.

2. Water quality

Each agency participating in the study was asked to furnish water characteristic data not included in the STORET file.

On-site measurements for selected water characteristics were made for each significant water source at each hatchery. Duplicate grab samples were taken at the hatchery where possible. Dissolved oxygen samples were taken at the inlet and outlet of hatchery aeration facilities, where applicable. All water sampling and analyses were performed under the supervision of a licensed professional engineer and In accordance with the procedures described in Standard Methods, 15th Edition. Water characteristics collected on site were entered into the data archive developed for this project. (2.4 and 2.4.1)

TABLE 2

ON-SITE WATER CHARACTERISTICS AND METHODS OF ANALYSIS

Water characteristic	Method of analysis
(for all sources)	
Dissolved oxygen	Modified Winkler
PH	Standardized glass electrode
Total alkalinity (mg/l CO3)	Acid titration
Total hardness (mg/l CaC03)	EDTA titration
Temperature (F and C>	Calibrated temperature probe
(for groundwater sources only)	
Barometric pressure (mm Hg)	Calibrated aneroid barometer
Differential dissolved gas pressure (mm Hg)	D'Aoust and Clark

3. Hatchery facilities

Compilation of data on existing facilities required obtaining site, building, and facility drawings from the fishery agencies. Information obtained from these drawings was supplemented with visual observations at the facilities and conversations with persons knowledgeable about the facilities (2.6 and 3.1).

Building materiels and conditions of buildings were coded as follows:

Material	Index No.	Condition	Index No.
concrete	1	excellent	1
concrete block	2	good	2
brick	3	fair	3
stone	4	poor	4
wood	5		
steel	6		
aluminum	7		
asphalt	8		
earth	9		
gravel	10		
fiberglass	11		
plastic	12		

Example of comblnat ions:

l/5 concrete and wood

Example:

2.4 means closer to good than fair

4. Financial profile for each station

A financial profile was prepared for each site, using the Financial Profile Form I-16. The financial profile is Intended to show operating expenditures.

Financial data were obtained from the respective operating agencies for fiscal years 1981, 1982, 1983. This information was reviewed and some changes were made i the financial categories. In most Instances satellite ponds and rearing stations were not budgeted individually but were included with the primary hatchery. These instances are noted. Because there is no uniform system of cost allocation and each agency aggregates costs according to Its unique system of cost categories, the data are presented in the most general system available, and are annotated where cost allocation may differ from the standard allocation. To provide comparable results no agency overhead was included in any costs, but personnel benefits were included as a personnel cost.

For several Idaho hatcheries, feed is purchased by Idaho Power, while the hatcheries are operated by Idaho Fish and Game. The two agencies use different fiscal years. Since the feed costs are relatively constant, the listed operating costs reasonably reflect the actual costs but may vary from true annualized costs.

We reported actual hatchery operating costs, excluding general management and overhead costs. We asked that the agency-supplied figures represent salaries and costs associated only with personnel regularly assigned to a hatchery site. Although there are some differences between agencies in assignments of managemeut and

overhead costs, we believe that the data reflect, in the case of each agency, the actual operating costs for each hatchery. Each agency was provided with a copy of the allocated costs for each hatchery, and comments and notations were incorporated Into the final draft.

5. Standard calculation to achieve full production

Full production is estimated with three procedures. These are: 1.) the "flow method" (weight of fish per gallons per minute (CPM) of Inflow), 2.) the "density method (weight of fish per cubic foot of pond volume), and 3). a method derived from agency production goals.

The formula for the "flow" estimation procedure was:

$$P = F \times L \times G$$

where:

P - production in pounds per GPM

F - load factor to convert altitude and water temperature into fish production values (see Bell 1973, Piper et al. 1982)

L - length of fish in Inches

G - gallons per minute of water inflow

The load factors to be used are derived from Bell (1973) and Piper et al. (1982) and are a function of pond temperatures and altitude.

The formula for the "density" estimation procedure is after the formula in Piper et al. (1982), and follows:

D = .5 X L X V

where:

D – density in pounds of fish per cubic foot

L – length of fish in inches

v – volume of rearing space in cubic feet

For the purposes of this project, a uniform procedure was used to estimate fish length (Piper et al. 1982). For each species, the length at release was determined by estimating the average fish pet pound released at a facility, then converting that estimate to a length eet imate by use of tables in Piper et al. (1982) most closely approximating the species condition factor rounded to the nearest 5 x 10 (exp -5).

Further examination of the data revealed a third method, and possibly the best method, derived from agency production goal statements. The formula for this method is:

P – D X V

where:

P – productionin pounds per cubic foot

D – density in pounds per cubic foot; densities used were .8 and 2 pounds per cubic foot which provides an appropriate and reasonable range of rearing densities

v - volume of rearing ponds in cubic feet

The density range of from .8 to 2 pounds per cubic foot provides a usable range of production density goals. This range is based upon agency production goal statements (Lower Snake River

Fish and Wildlife Compensation Plan 1983) of 8 pounds per cubic foot (Washington Department of Fisheries) and 2 pounds per cubic foot (Idaho Department of Fish and Came and US Fish and Wildlife Service). The density range of .8 to 2 pounds per cubic foot provides a usable range of production density goals. Actual production estimates (Table 3) are based upon pounds released and are designated as pounds pet cubic foot per year.

This range is based upon agency production goal statements (Lower Snake Kiver Fish and Wildlife Compensation Plan 1983) of .8 pounds per cubic foot (Washington Department of Fisheries) and 2 pounds per cubic foot (Idaho Department of Fish and Came and US Fish and Wildlife Service). The density range of .8 to 2 pounds per cubic foot provides a usable range of production density goals. Actual production estimates (Table 3) are based upon pounds released and are designated as pounds per cubic foot per year.

Production at the Columbia Kiver Basin facilities examined in this project ranged from 2.36 pounds per cubic foot at Abernathy National Fish Hatchery to 0.02 pounds per cubic foot at the Kingold Steelhead rearing facility. During the three year period examined, an average of 6.1 million pounds of anadromous salmonids were released from Columbia Basin facilities with a rearing volume of 33.5 Million cubic feet. This represents an average annual production at release of U.18 pounds per cubic foot.

The reasons for the great differences in densities at release include the limitations imposed by water quantity and quality, differences in agency policy on rearing density, density reductions due to disease, predation or other natural mortality factors, and limits to available eggs (specifically spring and summer chinook

stocks). In a number of cases non-endemic stocks were subjected to rearing conditions such as disease abd high temperatures that resulted in low production. Disease resulted in the total or partial loss of several years of production at several of the facilities. Mortality among adult spring chinook was extremely high at all facilities, resulting In a 30% to 50% mortality prior to spawning, and significantly reducing spring chinook smolt production.

In order to make the full production estimation procedure as uniform as possible, a “full production/cost of modifications” form (Table 3) was developed that summarizes for each station fishery and facilities data, estimates theoretical production by the methods described,designates productionlimiting factors, and estimates with comments construction coats and increases In operating costs.

TABLE 3
FULL PRODUCTION/FACILITY MODIFICATIOINS/COSTS

HATCHERY LOCATION CODE DATE NAME

1. ACTUAL PKODUCTION:

SPECIES	A. POUNDS	B. I'EKCENT
SP. CHINOOK		
SP.CHINNOK		
F. CHINOOK		
COHO		
S . STHD		
W . STHD		
SK. CUT.		
RES. TROUT		
TOTAL		

2. THEOKETICAL PRODUCTION-based on existing facilities and:
- DENSITY FORMULA (05 x L x VOL.) =
- FLOW FORMULA (F X L X GPH) -
- AGENCY CRITERIA RANGE (.8 X VOL) -
AND (2 x VOL) =

3. FACTORS CONTROLLING PKODUCTION
A. POND VOLUME
i. facilities not fully utilized
il. new facilities
B. WATER
i. increased amt. available
ii. reuse
iii. enhance quality
-temperature
-aeration
-treatment-6 recirc.
c.FISH Biomass
I. Increase density
ii. decrease density
iii. Increase feed
iv. rearing density
-lb/CP
-lb/CPr4

MODIFICATION COMMENTS:

4. ESTIMATED INCREASED PRODUCTION (TOTAL):

5. ESTIMATED CONSTRUCTION COSTS:

6 ESTIMATED INCREASE IN OPERATIONS COSTS.

* Volume of currently used ponds
O Volume of total available pond space

6. Summary of facilities and costs to achieve full propagation potential

Data concerning the minimum available amount of water and its characteristics were recorded for each propagation site, based on available historical data, use restrictions, and on-site investigation (Table 3). The amount of unused water was determined by on-site investigation, available records, and communication with the hatchery operators.

Where there is potential for expansion, the estimates of capital and operating costs (in terms of 1984 dollars) were determined by relating the original construction costs (if available) and operating costs (corrected to 1984 dollars) to the pounds of fish produced.

Where the costs for the original capital constructions were not available, the replacement value of the facility was determlned from costs of similar facilities and that figure used to calculate the price per pound.
(3.1 and 3.2)

The additional pounds of fish the expansion could produce were multiplied by the price per pound, for capital and operating costs, to obtain the total cost of the expansion.

7. Station personnel by category

Station staffing is reported to the nearest man-month. In general, staffing is recorded for primary hatcheries only, not ponds and rearing stations, although non-agency personnel are listed for satellite locations.

B. Data entry

1. Data forms

Collecting and organizating information about fish culture stations in the Columbia River basin required data forma for recording information about operations at each station and about the condition of the physical facilities. Forms previously developed were reviewed.and in some cases modified: new information requests were added to some forms, and some requests that were trivial, unnecessary, or duplicative were deleted. The modified forms were submitted and approved by BPA.

The original data summary and comment summary forms were modified to make them more useful, especially for persons who do not need the detailed data. The hatchery summary form was expanded to include the summary comments form. A summary of important Information about each hatchery is thereby included in one section. There is no change in the upper portion of the hatchery summary form, but the synopsis section of the lower portion is combined with the summary comments form. The information requested at the bottom of the hatchery summary form under the heading “Facility and Operating Synopsis”Includes the following:

1. Site description.
2. Description, condition, and adequacy of main buildings and facilities.
3. Source, amount, and quality of water.
4. Species raised in hatchery.
5. Diseases and how serious they are.
6. Interrelationship with other hatcheries.
7. Other significant comments.

Following the preceding section is a discussion of opportunities for increased product ion, taken from the summary comments form.

2. Computer program

The data base management system MicroRIM, developed for micro-computers, was used on IBM-compatible micro-computers. The original program, RIM (Relational Information Management system), was developed in 1979 for NASA by Wayne J. Erickson and Dennis L. Comfort, who, at that time,were with the Boeing Computer Service Company. RIM was originally written for main-frame computers. Erickson left Boeing and joined the staff of the University of Washington Academic Computer Center (ACC) and further refined RIM for main-frame computers. RIM is available from the ACC for use on many main-frame computers. Subsequently, Erickson left the ACC to form MicroRIM, Inc., where he developed MicroRIM for use on micro-computers.

RIM and MicroRIM were written expressly for engineers and scientiata, whose requirements are considerably different from those of business. The program is f lexlble and is capable of handling both numeric (Integer and real) and text (string) data.

MicroRIM is capable of handling over 50 fields (numeric or text) per record. The maximum length of a text field is 1,500 characters, which is more than adequate. Data stored by MicroRIM may be manipulated and compared without modifying the original entries. An additional advantage of MicroRIM is that the data can be readily retrieved and printed in a desired format. Data entered into a micro-computer using MicroRIM are readily available for use on a main-frame computer using the program RIM.

3. Method of data entry

Using MicroRIM, masks were developed so the data collected In the field could be entered directly into the data base with only minimal manipulation of the data prior to entry.

Because of the large number of entries per hatchery (over 1,500) the data was divided into nine different files as follows:

Name of file	Data type	Forms referenced
BIODATl BlODAT2 BIODAT3	All fish production, biological data, and nutrient data	2, 9, 10, 12, 13
ENVDATI ENVDAT2 ENVDAT3	Water supply and climate data	8, 14, 15
INVDATI INVDAT2 INVDAT3	Hatchery equipment and physical plant	3, 6, 11
MSCDATl MSCDAT2 MSCDAT3	Personnel, financial	7, 16

MicroRIM permits easy access to related data in different files.

Prior to entry, all the field forms were checked for legibility and obvious errors. The data were then entered into the data base system. Printouts of the data were compared with the field forms, typing and factual errors were noted, and corrections were then entered Into the data base. The data were also presented to the various agencies for review. Errors noted by agency reviewers were first corrected on the original data form and then entered into the data base as corrections. After the field data had been entered and verified, further checks determined that the values fell within known limits and that the data for a given hatchery were internally consistent.

IV. Project plan

The plan for satisfying the terms of the contract was arranged into 12 units as follows:

Unit 1. Identify data in central repositories.

Unit 2. Kecord data from central repositories.

Unit 3. Test field procedures.

Unit 4. Acquire data from Kegion IV, Snake River system.

Unit 5. Acquire data from Region III, Columbia River above the Snake Kiver confluence.

Unit 6. Acquire data from Region II, Columbia Kiver between Bonneville Dam and the Snake River.

Unit 7. Acquire data from Region I, Columbia River below Bonneville Dam.

Unit 8. Kecord data in data archive system.

Unit 9. Analyze and summarize data.

Unit 10. Provide data appendices and data archive.

Unit il. Prepare facility site plans.

Unit 12. Prepare final report.

Unit 1. Identify data in central repositories

This unit identified data available from fishery agency central repositories for recording on the forms described under '*Methods and materials." The work was accomplished through a subcontract with Richard Noble and Roy Wahle. Wahle identified Information available from the US Fish and Wildlife Service, the Oregon Department of Fish and Wildlife, and the Idaho Department of Fish and Came. The unit partially satisfies requirements of KFP tasks 2.4 through 3.4.

Unit 2. Record data from central repositories

Gala personnel will acquire at the central repositories of the various fishery agencies Information identified in Task 1.0 which is available at these repositories. Computer printouts will be obtained where available and in other instances it will be necessary to make copies of data. At Caia headquarters, this Information will be entered into the data archives.

Unit 3. Test field procedures

Before beginning full-scale field operations, Gala personnel tested the procedure6 for obtaining and recording the Information required under the terms of the contract at the Washington State Department of Fisheries hatchery on the Columbia River. Personnel reeponsible for collecting or analyzing data present for this test.

Unit 4. Acquire data from Region IV

Information required under the terms of the BPA contract and not available at agency central repositories will be obtained from actual on-site visits to the various hatcheries listed in Table 1. Initial contact was made by telephone with each hatchery manager at least 24 hours prior to the on-site visit. when each team arrlved at a given site, the hatchery manager was appraised of the project objective and the purpose In visiting the hatchery.

The engineer and biologist were responsibile for specific data and usually collected those data independently. However, when needed for such tasks as flow measurements and water sampling, the team worked together. Following completion of data collection, the team reviewed the information with the hatchery

manager to clarify any anomalies or discrepancies. Analyses of the water samples were completed as soon as feasible. A check list for each hatchery visit is provided in Table 4.

TABLE 4

SITE VISIT PROTOCOL CHECK LIST

A. _____ Call hatchery manager at least 24 hours before visit.

B. Biologist and engineer

_____ Introduce themselves.

_____ Explain project and data collection efforts.

_____ Tour facility with manager and/or hatchery personnel.

c. Engineer completes the following forms:

_____ Site data

_____ Equipment inventory

_____ Water quantity

_____ Water quality

_____ Facility inventory

D. Biologist completes the following forms:

_____ Staffing summary

_____ Feed supply data

_____ Disease data

_____ Fish handling data

E. Engineer and biologist together

_____ Prepare any summary comments

_____ Review data with hatchery manager

_____ Complete water analyses

_____ Review and complete data forms

The hatcheries of the Columbia River basin were grouped into four regions as listed in Table 1. Information required by RFP tasks 2.4 through 3.4 and not obtained from central repositories was obtained at the hatcheries.

Because of the harsher weather conditions to be expected in Region IV (Snake River system) during the winter, field operations started there. Two teams (each consisting of an engineer and a biologist) collected data from the facilities in the region. Standard operating procedures, revised after test operations at the Cowlitz River Salmon hatchery, were followed in obtaining information. Information was recorded on BPA-approved forms.

Units 5-7. Acquire data from Regions I-III

Following completion of data collection in Region IV, survey teams moved operations to the Columbia River and tributaries other than the Snake River. The procedure for collecting information in Region IV was repeated for the hatcheries in Regions I-III.

Unit 8. Record data in data archive system

All data forms were filed at Gaia headquarters in Seattle, checked for accuracy, and then recorded in the data archive system as described in the section on Methods and materials. This unit satisfies the requirements of RFP 2.11.

Unit 9. Analyze and summarize data

The RFP requires some analysis and summary of the information recorded from fishery agency headquarters and from hatcheries. These requirements were grouped into four sub-units as follows:

Sub-unit 1. Develop an operating financial profile for each station for 1981-1983

Data for this Sub-unit were obtained from agency report6 and adapted to the financial profile form. Categories included cost6 for personnel, fish food, transportation, supplies, equipment, energy, capital improvements, and total annual budget. The procedures for developing. the financial profile are described in "Method6 and materials." This sub-unit satisfied the requirement6 of KFP task 2.1

Sub-unit 2. Estimate costs to achieve full propagation potential

The capital and operating cost6 required to achieve full propagation potential were estimated after data concerning the Original cost Of facilities and Operating costs were obtained. These costs were evaluated according to the procedure described in the section on Methods and materials. This sub-unit satisfies the requirements of RFP task 3.1.

Sub-unit 3. Record current production level by species and estimate full propagation level

Current and estimated full production and materials were recorded in accordance with the procedure6 described in the "Methods" section. This sub-unit satisfies the requirements of KYP task 3.1.

Sub-unit 4. Summarize for each station current personnel by category

Personnel information personnel was recorded during visits to hatchery facilities and checked against agency records. This sub-unit fulfill6 the requirements of RFP task 3.4. Station staffign is

reported to the nearest man-month. In general, staffing is recorded for primary hatcheries only, not ponds and rearing stations, although non-agency personnel are listed for satellite locations.

Unit 10. Provide data appendices and data archive

Four data appendices (A-D, one of each region), contain all information about each hatchery. Data from each facility listed in Table 1 were archived as described in the section on Methods and materials and are recorded on floppy disks as Appendix E. This unit fulfills requirements of RFP tasks 4.0 and 5.0.

Two requirement6 of the RFP do not readily fit into these units. These are:

(1) List potential hatchery sites

Through discussion with the BPA technical representative, it was decided to limit the list of potential hatchery sites to those provided by the fishery agencies. This Information was obtained by mail, telephone, or personal visit. Appendix A is a summary of information about these sites and satisfies the requirements of RFP task 2.10.

(2) Report technical documents

Technical documents cited in the report relating to fish-rearing operations at each hatchery are included In the "Literature cited" section. Technical document6 not cited are listed as Additional Technical Reports. This Unit satisfies requirement6 of KFP tasks 1.0and 1.3.

Unit 11. Prepare facility site plans

Site plans of facilities were prepared from plans submitted by state and federal agencies and PUD's and modified as a result of visits to facilities and agency review (Appendix I).

Unit 12.. Prepare final report

This draft report is being submitted to BPA for comment. The final report will incorporate BPA suggestions and suggestions received from fishery agencies.

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Appendix A

Potential hatchery sites

Potential Hatchery Sites

This appendix is a compolation of information currently available about potential sites for new hatcheries to rear anadrowous species in the Columbia Kiver basin. Government and private agencies concerned with the fisheries of the Columbia Kiver basin were asked for information on hand regarding potential aquaculture sites. Information obtained from these agencies ranged from detailed site studies to notes mentioning locations with a potential for development as fish rearing facilities.

In the late 1970's the US Corps of Engineers carried out detailed studies of the Snake Kiver system to locate potential hatchery sites as part of the Lower Snake Kiver Fish and Wildlife Compensation Plan. The Corps published the results of these studies in a series of reports that identified and compared potential sites for fish hatcheries in the Snake Kiver system.

Ground-Water Reconnasissance in Southeast Idaho

This Corps report recommends five sites for steelhead trout and gives information regarding an additional 134 potential sites. (US Army Engineer District, Walla Walla Corps of Engineers, July, 1978). For chinook salmon, five sites were recommended with three other potential sites listed. The report gives detailed information about the recommended sites and summarizes information as follows:

I. Recommended sites for steelhcad trout.

A. Banbury Springs

The springsissue along a l/4-mile-long face of the Snake Kiver Canyon wall, discharging from the shallow permeable basalts at the contact with the underlying dense Banbury basalt. The line of springs is generally about 100 feet below the plateau rim. Spring flows are quite constant, usually ranging between 110 and 135 cfs; water temperature is essentially constant at 55-56 degrees F (12.8-13.3 degrees C). There is no significant existing water use at the springs. The area around the springs, from the canyon rim to the Snake Kiver, is leased from Idaho Power Co. by the Snake Kiver Area Council Boy Scouts of America. Land on the plateau, immediately east of the springs, is privately owned--and land to the south is owned by the Idaho Department of Fish and Game. An adequate area near river level, which is not presently developed by the Boy Scouts is probably adequate for a hatchery site using spring water by gravity on a once-through basis. Effluent could discharge directly to the Snake Kiver. Access could be by improvement of an existing road, or construction of a new road.

B. Malan Springs

The canyon of the Big Wood (Malad) Kiver below elevation about 3,100 feet contains very large springs. The uppermost are collected with the river flow and diverted by flume for power generation farther down the canyon. Additional springs (with apparent discharges adequate for hatchery needs) issue below the upper diversion, discharge into the river channel to join the upper powerplant tailwater, and are diverted again to a flume for the King Hill Irrigation District Main Canal and the lower power plant. Although not investigated in detail, it appears that sufficient spring flow could be obtained above elevation 2,920 feet, exclusive of river runoff, to meet hatchery needs. In mid-March 1978 the temperature of spring water at the upper diversion was 58 degrees F (14.4 degrees C), 54) degrees F (15.U degrees C) at an unused spring below the diversion, and 56 degrees F (13.3 degrees C) in the river below the diversion. Summer flow of the river receives irrigation return flow at higher temperatures and may not be useable. Idaho Power Co. owns land on either side of the river, a narrow strip on the south side above the highway bridge, and a large parcel on the north side below the bridge. Hatchery supplies could be obtained by gravity flow, and the effluent probably returned to the King Hill Canal and Idaho Power Co. flume by gravity. Private property adjacent to Idaho Power property on the south side above the bridge is now used only for pasture.

c. Thousand Springs

Numerous spring outlets along the cliff face, at and near the contact with underlying less permeable Banbury basalt, discharge into the Idaho Power Co. flume about 120 feet below the rim. Several of the individual outlets discharge more than 100 cfs each. The flow collected for power generation averages about 600 cfs each, with a total flow in the area of about 1,000 cfs. Water temperatura in the flume at the larger inflow points is essentially 57 degrees F (13.Y degrees C), although the temperature is nearer 52 degrees P (11.1 degrees C) at the Sand Springs diversion inlet point during cold winter periods. The temperature of the powerplanttailrace water averagages 55 degrees F (12.8 degrees C), or warmer. The land surrounding the Idaho Power Co. property at the springs is privately owned and does not appear to he readily obtainable. Idaho Power Co. owns sufficient land for hatchery needs on the rim immediately above (east of) the springs. Water lifted about 120 feet from the flume could be returned to the flume above the power plant or could be dropped back about 300 feet to river level. Access to a rim site on Idaho Power Co. land would require acquisition of right-of-way along a section line for a distance of one-quarter mile, or across private land from the existing Thousand Springs road at the south.

D. Sand Springs

Most of the spring discharge occurs at the northwest end of the existing spring pond and in the large spring alcove a few hundred feet toward the east. The springs are on the sloping shoulder of the upland, and represent discharge from the top of the regional water table. The total spring flow varies seasonally with irrigation and pumping on the plain to the north and east, ranging from about 80 to 115 cf s. Idaho Power Co.diverts part of the flow downstream into the flume to their Thousand Springs Power plant, and some irrigation return water enters the spring discharge channel below the springs. kater temperature is nearly constant at 57.5 degrees P (14.2 degrees C).

The springs and surrounding land are privately owned, except for two 40-*acre parcels of US-owned land about one mile south and southwest of the springs. A hatchery at either parcel, but especially the southwest, would be at essentially the elevation of the springs and some pumping would be required. Effluent discharge would be possible to the Idaho Power Co. pick-up point, or to Sand Springs Creek and the Snake Kiver. A hatchery could probably obtain gravity water if it were located on the private land along the creek.

E. Briggs Springs

The majority of the spring discharge occurs within a large pool and nearby smaller outlets, and then flows westward in a single channel. The springs issue f rum t he talus near the contact between Snake Kiver basalt and older, probably Banbury,basalts in a relatively flat area. f1ow has been nearly constant in recent years, ranging between 105 and 115 cfs. Flow of as much as 150 cfs has been reported. Water temperature is nearly constant at 57 degrees F (13.9 degrees C). Satisfaction of all existing water rights, including pending applications, would require diversion of essentially all the flow, although there is no use from the springs downstream for several hundred feet. The springs and immediately adjacent land are owned by Idao Power Co., with probably sufficient area for a hatchery to the south and southwest of the springs. because of the established diversion point for some existing water rights, some tailwater may need to be pumped. Otherwise, discharge could be directly to the Snake Kiver. Access would be easily provided by improvement of an existing road.

Forty acres immediately north of the springs on the bluff are US-owned and are adjacent to Idaho Power Co. land. The spring flows can be collected 100 feet above river level. A lift of about 200 feet would be required to the rim, with 300 feet of drop hack to the river.

II. Other potential sites for steelhead trout.

A. Bickel Springs-Riley Creek-Billingsley Creek

Most of the water from these sources is already appropriated and used extensively for private, state, and federal hatcheries as well as for irrigation.

B. Blue Springs

The flow at these springs (about 60-65 cfs) discharges at or below the level of the Snake River and would be difficult to collect and utilize.

C. box Canyon Springs

The flow at these springs (about 400 cfs) is largely used for an existing private hatchery which occupies the only nearby land (which is across the river) suitable for a large hatchery.

D. Blue Lakes Springs

An average of about 200 cfs issues from basalt and talus and flows through a well-developed recreational area, a private residential area, and country club grounds with subsequent diversion for a large private hatchery west of the golf course.

E. Clear Lake Springs

Flow from several large spring areas making up the Clear Lakes group is used heavily for private trout hatcheries. Water is also used for irrigation and for power generat ion. Total discharge averages more than 500 cfs;. water temperature is about 5b.6 degree F. There is a heavy commitment to existing development.

F. Niagara Springs

These springs are totally used by Idaho Power for a hatchery. Flow is 250 cfs or greater at 56.6-57 degrees F (13.7-13.9 degrees C).

G. Crystal Springs

Nearly all the spring dischargeis collected in a Flume and used by a private trout hatchery. Several spring outlets at the west end bypass the hatchery and flow through pond areas to the river. These flows are unmeasured, but appear to total less than 50 cfs. Water temperature in the flume is 57-58 degrees f (13.9-14.4 degrees C).

h. Devils Corral Springs

Several springs in deep alcoves discharge through two channels to the Snake Kiver. The principal discharge is through the upstream channel and averages about 38-45 cfs. The lower channel has only about 8 cfs. Water temperature varies from 57-60 degrees F (13.9-15.6 degrees C) seasonally. The springs are unused, but are privately owned. The present owner holds filings on the total flow for hatchery and other uses. No site is available for a hatchery except about five acres on the alcove floor.

I. Jerome Area

The lava plateau area south and west of Jerome between Interstate Highway I-80N and the Snake Kiver canyon rim is underlain by the SnakePlain aquifer with the potential for wells yielding an average of 3-5 cfs per well. The ground is little used in the area because of the extensive delivery system of the Twin Falls North Side Canal.

A well field of 15 wells capable of producing about 50 cfs could be constructed in most parts of the area. Depth to static water level would be from about 100 to 350 feet below land surface, depending upon land-surface elevation at the well site. If wells were spaced about 500 feet apart, the pumping and interferencedrawdown would be only a few feet, so lifts would be essentially the same as depth to water. Seasonal area water-level fluctuations would be in the range of 3-6 feet. Pumping the required 5U cfs from a field of 15-wells within 10,000 feet of the springs below the canyon rim should be expected to cause up to two feet of head decline at some of the springs, with some consequent reduction of spring flow. If about 704 is assumed for overall pumping efficiency, it would require about 13.25 million Kwh of electricity annually to lift 50 cfs an average of 250 feet (Figure 2).

Water temperature would be essentially constant at about 58 to 62 degrees F (14.4-16.7 degrees C), with relatively uniform quality. Potential for contaminants from return water off agricultural and industrial lands would be of the same order as that at the canyon springs. Effluent discharge might be to irrigation canals or to the Snake Kiver through drainageways. A large part of the area is privately owned.

J. Shoshone Area

West of the Milner-Gooding canal,and southwest of the Snoshone-Diet ri chq area, the potential for large capacity wells is similar to that near Jerome. Depth to water is about 250-325 feet, however, and seasonal variations of water level are slightly higher--10 to 25 feet. Propc rly constructed wells about 400 feet deep should yield up to 5

cfs each with only a few feet to drawdown. Ground water in this area is Influenced by recharge from the canal and from the big Wood and Little Wood Kiver systems. As a result, water temperature and quality may be somewhat more variable. Water at 60 degrees F (15.b degrees C) and of adequate quality for hatchery use would be expected, however. Effluent discharge might be to irrigation canals or laterals, or to recharge spreading ponds on the permeable lava surf ace.

K. Minidoka-Paul Area

Wells about 275-300 feet deep drilled into the Snake Plain' aquifer west and northwest of Minidoka and Paul are capable of yields up to about 4 cfs. The groundwater in the area is heavily developed for agriculture, but static water levels fluctuate through only a few feet seasonally and are from 130 to 150 feet below land surface. Water temperature is somewhat cooler than west of the Milner-Gooding Canal, ranging from about 54 to 59 degrees F (12.2-15.0 degrees C). Water quality would be good, subject only to return-water contaminants as with all areas on the south margin of the plain. Effluent discharge might be to irrigation canals and laterals. Most of the land in the area is privately owned.

L. Mud Lake Area

North of Mud Lake and east of Plonteview ground water occurs in highly permeable lava and gravels near land surface. Wells capable of 5 to 8 cfs each, with good quality water at temperatures of 52 to 56 degree F (11.1-13.3 degree C), may be obtained. At proper locations wells only 150 to 200 feet deep may yield large quantities with small drawdown from static water levels that are only a few feet below land surface. Discharge of effluent to irrigation canals and to irrigation storage reservoirs would appear feasible most of the year. During November to March, however, low air temperature and heavy snow might restrict or hamper operations.

M. Kexburg Area

Snake Kiver gravels and interbedded lavas, west' of the Henrys Fork Kiver west of Kexburg, yield large volumes of ground water to wells. Wells capable of 5 to 8 cfs, discharging from only 10 to 150 feet below land surface, can be obtained with well depth of 250 to 300 feet. The water temperature ranges from 50 to 54 degrees F (10.0-12.2 degrees C) possibly too cold for steelhead, but usable for Chinook salmon. Water is of excellent quality, and effluent discharge could be to the Snake River or irrigation canals. Large use is made of surface water in the area for irrigation, but the ground water is not so heavily developed.

Elk Creek rises in large springs near the railroad siding of Trude, and flows south to Buffalo Kiver. Good access, Forest Service land for sites, and adequate flows and temperatures are available.

Toms Creek is tributaryto Buffalo Kiver and offers a potential for hatchery use. Sites on US Forest Service land appear feasible, but streamflow below spring outlets will be subject to large temperature ranges. Temperature control may be possible if spring discharge can be picked up and protected by pipeline.

IV. Other potential sites for chinook salmon.

A. Chilly Sinks-Mackay Keservoir Area

Streamflow of the big Lost Kiver sinks into permeable gravels just below Chilly Buttes, above MacKay, to maintain the ground-water reservoir full to overflowing. The ground water moves at shallow depth down-valley to reappear in a multitude of marshy seep and spring areas in the backwaters of Mackay Dam and reservoir. This emerging ground water is too broadly distributed to economically collect for hatchery use. Wells with low lift and potential for large yields offer a better potential, although the ground-water conditions of the area have not been adequately explored. There appears a potential, however, for a hatchery supply with no apparent quality problems and probable water temperature range of about 4U to 55 degrees F (4.4-12.8 degrees C). The effluent could be discharged directly to MacKay Keservoir.

B. Big Sprint; Creek (Little Lost Kiver Valley)

Ground water in the valley fill moves down-valley below Clyde at a gradient flatter than that of the land surface. At the head of Big Spring Creek the ground water discharges to land surface in several springs, moving down-valley in two or more surface channels separate from Little Lost Kiver. The combined flow of the two largest and most prominent springs is about 25 cfs, varying seasonally through a small range. The springs are on private property, but the channels combine on public land a mile or more downstream. Water temperature at the main spring outlet was 43 degrees F (6.1 degrees C) in March 1978, and is expected to range upward to about 54 degrees F 12.2 degrees C) in late summer or fall. Other outlets are expected to be the same.

Beaver ponds immediately below the springs restrict the streamflow and large variations in water temperature occur downstream. For hatchery use, flow of the spring would need to be picked up at the outlet and conveyed in a protective manner to maintain uniform temperature. Access would be easy,and effluent discharge could be back to Big Spring

Creek.

Farming immediately upstream, with major sheep and cattle populations, might pose contaminant problems. Up-valley pumping is minimal and should not affect spring flow seriously.

C. Snake River Ground Water Near Kexburg

West of the Henrys Fork River, near Kexburg, the gravel and lava sequences readily recharged from the Snake Kiver and Henrys Fork yield ground water in large quantities to wells. Large diameter wells 25U to 300 feet deep, with water levels near land surface, are capable of yielding 5 to 8 cfs each, at a temperature of about 50 to 54 degrees F (10.0-12.2 degrees C). Effluent discharge would be to irrigation canals or back to the Snake Kiver.

III. Recommended sites for chinook salmon.

A. Hamilton Springs (Big Lost Kiver Valley)

Two or three principal discharges and several smaller ones issue from moderately metamorphosed limestone and Limey sandstone at the west valley margin. One principal channel flows from the spring area, carrying a relatively uniform 25 cfs or greater at a water temperature ranging from 46 to 54 degrees F (7.8-11.7 degrees C). The springs and surrounding land are privately owned. Access is by well-maintained gravel road. Effluent discharge is readily available back to the creek that is tributary to Mackay Keservoir. Pick-up of spring flow at the source would be easily and cheaply accomplished, and an ideal site for once-through gravity operation.

B. Birch Creek Above blue Dome

The headwater drainage area of Birch Creek feeds the broad, alluvial valley above Kaufman Guard Station. A basalt ridge, underlying fanglomerate, and cross-basin faulting all restrict down-valley ground-water flow, forcing ground water to the surface in several springs upstream of the basalt constriction. The collected spring flow averages about 70 cfs with water temperature ranging from about 40 to 55 degrees F (4.4-12.8 degrees C>. both US Forest Service and ldaho State Fish and Came property are usable for hatchery siting. Access is good, and effluent could be returned to Birch Creek. To maintain acceptable temperature, spring flow must be collected near outlets and conveyed under protection. There is essentially no present activity above the springs that would threaten water quality. A recent application has been made' to appropriate essentially all of the flow of the two channels of birch Creek at a point about 3/4 mile above the Forest Service 160-acre tract. The application is for fish propagation with return of the water immediately to the Birch Creek channel. These fish ponds, if constructed, should not have any adverse effect on the availabliity or quality of water to the proposed facility.

C. Big Springs Creek Near Leadore (Lemhi River Valley)

Down-valley of Leadore the valley-fil 1 alluvium narrows and thins so that both the Lemhi River and big Springs Creek become ground-water drains. Ground water moving down valley appears at the land surface in a number of seeps and streamed springs, furnishing a flow of 25 cfs or greater to Big Springs Creek. The Flow accumulates over a broad area, and derives from relatively shallow circulation of ground water. Consequently, the water temperature may reflect the considerable range of air temperatures. If the discharges could be collected and protected, a water temperature range

of about 40 to 54 degrees F (4.4-12.2 degrees C) could be maintained. Because of agricultural activity and mining up-valley, there may be potential for contamination.

D. Pahsimeroi Valley Ground Water Near May

Valley-fill alluvial sand and gravels near Play and below big Creek contain largesupplies of ground water. Wells 50 to 300 feet in depth, depending on location and land surface elevation, yield as much as 7 cfs. Average yields of 3 to 5 cfs are possible in several areas, where existing wells have water levels only a few feet below land surface. Pumping drawdowns of 10 to 25 feet can be expected. Water is of excellent quality with little threat of contamination, and would maintain a uniform temperature of about 50 to 55 degrees F (10.0-12.6 degrees C). A well field yielding up to 25 cfs would have a significant impact on water levels in the vicinity, however, and would require further detailed study for siting. Effluent discharge would be to irrigation or to the Pahsimeroi Kiver. Sulphur Creek Spring has the only large ground-water discharge in the area, but has a temperature of about 58 degree F; the flow is only about 15 cfs.

E. Springs In The Henrys Fork-Island Park Area

Several spring-fed sources from the lava plateau area between Henrys Fork and Warm Kiver at the Wyoming boundary, in extreme northeast Idaho, offer potentially useable hatchery supplies. The area is remote from planting sites and winter climatic contlitions may cause severe operating problems.

Big Springs near Island Park discharges up to 200 cfs at a relatively constant 50 to 53 degrees F (10.0-11.7 degrees C). The spring area itself is not accessible for hatchery use, but within a mile downstream there are potential sites on US Forest Service land that appear useable. The large flow rate and short surface-flow distance probably would permit control of temperature within useable range.

Moose Creek and its principal tributary, Lucky Dog Creek, are tributary to henrys Fork just downstream of big Springs. These have sufficient flow of good quality water and several possible sites on US Forest Service land. Temperature variation during winter months may be large unless the supply is obtained very near the spring outlet.

Moose Creek springs are in a canyon area without hatchery sites, but sites exist downstream where water temperature ranges may not be extreme.

Site Selection Study for a Steelhead Hatchery.

The Corps of Engineers followed up the preceding study with a site-selection reportfor a steelhead hatchery on the Snake River in central Idaho (US Army, Engineer District, Walla Walla, Corps of Engineers,. October, 1978). The site-selection study concluded that the best location for a steelhead hatchery is the Malad River site. An adequate supply of good quality water is available from springs along the south bank of the Malad Kiver between the Upper and Lower Idaho Power Company dams. Land may be available, there is ready access to the site, and environmental factors are favorable.

Ground-Water Investigation of the Upper Crande Ronde River Basin

The: objective of this investigation was to determine whether there is an adequate water supply for a steelhead hatchery in the Crande Konde valley (US Army, Engineer District, Walla Walla, Corps of Engineers, August, 1978). Two perennial streams were considered for a hatchery site, the Grande Konde Kiver and Catherine Creek. Both streams have annual flow although at times the flow is minimal.

Two potential sources of ground water for a hatchery are basalt aquifers and the valley fill alluvium. The contractor concluded that aquifers in basalt strata are not sufficiently defined for location or yield characteristics to be considered a water source for a steelhead hatchery, with the exception of the Elgin area which should be investigated further.

The Grande Konde valley isfilled with allulvial sediments to varying and unknown depths, and wells have been constructed which indicate that aquifers exist to a depth of 300-400 feet. The conclusion of this study is that ground water exists in the alluvium with sufficient quantity, quality, and temperature to fulfill the requirements of a steelhead hatchery, but that the success of the project revolves around a favorable ruling for the farmers relative to hatchery water use.

Ground-Water Reconnaissance in Northern Idaho.

The US Corps of Engineers also made a study under a contract to investigate ground water supplies in northern Idaho as a source of water for new fish hatcheries (US Army, Engineer Distrisct,Walla Walla,Corps of Engineers, September, 1978). This study recommended three potential sites and commented on them as follows.

Mathdrum Prairie

Coarse gravels underlie most of the Rathrum Prairie in Idaho with a capability of yielding large amounts of water (4-7 cfs) to individual wells with little drawdown. The water table is at an elevation of about 2,000 feet;depths to water are about 150 to 200 feet in the area from the

Washington-Idaho boundary to Post fal ls. There is ample recharge to the aqulifer, from infiltration of rainfall and seepage loss from lakes bordering the prairie, to sustain a subsurface flow through the aquifer of possibly 1,000 cfs at the state line. Water quality is good, with temperatures expected to be essentlally constant in the range of 47-51 degrees F (8.5-11 degrees C). Essentially all property suitable for a well field and hatchery site is in private ownership. Effluent from a hatchery could probably be reused for irrigation during summer months. In the non-irrigation season, however, it would probably have to be conveyed to the Spokane River channel.

Cabinet Gorge Area

In the vicinity of Cabinet Gorge Dam, on the Clark Fork river near the Idaho-Montana border, a deep gravel-f il led ancient river channel is a potential area for large-scale ground-water development from wells. Natural ground-water flow westward through the old, buried channel was greatly augmented by the construction in 1952 of Cabinet Gorge Dam along a reach of about 3 miles of the south bank below the 150 feet, depending upon the ground elevation at the site. Essentially all of the land suitable for a hatchery site in the vicinity is in private ownership. Water quality should be excellent,with temperatures probably in the range of 40-55 degrees F (4.5-13 degrees C). Effluent from a hatchery could be returned directly to the river without difficulty. The valley-floor area across the river from the town of Clark Fork is another potential for a well field and hatchery site,with anticipated pumping lifts lessthan 50 feet. The area is also entirely in private ownership.

St. Maries Area

Although there is no direct information on ground-water availability near St. Maries,,there should be a buried river channel (near the confluence of the St. Mries and St. Joe rivers) that is 300 to 500 feet with as much as 100 feet or more of coarse, water-bearing sands and gravels in the lower part. Water levels in wells should stand at or above land surface with individual wells expected to yield from 3.5 to 5 cfs of good quality water. Temperatures should be constant at about 45-513 degrees F (7.5-10 degrees C). Some exploratory drilling, possibly supplemented by some geophysical surveys, would be required to confirm the anticipated conditions. The area of land suitable for development outside the Coeur d'Alene Indian Keservation, is limited in extent and all in private ownershop. Ha t che ry effluent could be returned directly to the river channel.

Hid-Columbia Kiver Study.

An extensive survey for hatchery sites in the mid-Columbia Kiver area was carried out by the Public Utility District of Chelan, Douglas, and Grant counties through a contract with Frederiksen,Kamine and Associates, Inc. -(Chelan County PUD, Douglas County POD, Grant County PUD, 1981). Fifty-three sites were identified and rated in Table 1. The best 16 of these sites and their water potential are listed in Table 2. Excerpts from the report on the top 16 sites follow.

TABLE 1

LISTING AND RATING OF SITES IDENTIFIES FOR FISH CULTURE PROGRAM IN MID-COLUMBIA AREA

Site	County	Full Hatchery			Satellite		
		1	2	3	1	2	3
Pasco Drain	Franklin			X	X		
Kingold Di t ch	Franklin			X	X		
Priest Kapids Hatchery	Grant	X			X		
Richland Canal	Henton						X
Baker Pond	Benton						X
Horseshoe Pond	Yakima				X		
Kichland Pond	Benton						X
Kiona Canal	Benton					x	
Ahtanum Creek	Yakima					X	
Wide Hollow Creek	Yakima					X	
Nile Spring	Yakima					x	
Naches Hatchery	Yakima						X
Tieton Dam Spring	Yakima						X
Gold Creek	Yakima						X
Wildcat Creek	Yakima						X
Nelson Springs	Yakima		X			x	
Cle Elum Ponds	Kittitas	X					
Cle Glum Pits	Kittitas	X				X	
Easton Ponds	Kittitas	X					
Tjossen Pond	Kittitas					X	
Shea Creek	Kittitas				X		
Unnamed Creek	Kittitas						X
Manastash Creek	Kittitas						X
Parke Creek	Kittitas						X
Carl bou Creek	Kittitas						X
Coleman Creek	Kittitas						X

1 Kating: 1 = Good, 2 = Acceptable, 3 = poor

Pasco Drains.

Nanum Creek	Kittitas						X
Unnamed Spring, Caribou Creek	Kittitas						X
Umtanum Creek	Kittitas						X
Wilson Creek	Kittitas						X
Colockum Creek	Chelan					X	
Rocky Ford Creek (WL)G)	Grant	X			X		
Kocky Ford Creek, Trout Lodge	Grant	X			X		
Collin Skane	Crant		X		X		
Seep Lakes Spring	Crant		X			X	
Drain 239 (Qulncy)	Grant			X		X	
Drain Well (D-86-1)	Grant			X		X	
Quincy Drain Wells 1, 2, 4, 5	Grant			X	X		
Lower Crab Creek	Grant			X		X	
Kocky Reach (Turtle Rock)	Douglas			x	X		
Kocky Reach (Annex)	Douglas		X			X	
Rock) Island Creek	Douglas			X			
Douglas Creek	Douglas			X			
Dryden Power Canal	Chelan						
Schmi t ten Pond	Chelan						
Leavenworth NYH	Chelan	X			X		
Entiat NFH	Chelan				x		
Wells Hatchery	Chelan	X					
Chelan Hatchery	Chclan			X			
Winthrop NFH	Okanogan	X			X		
Methow Kiver Pens	Okanogan				X		
Pateros Hatchery	Okanogan			X			
Chief Joseph Dam	Okanogan	x			X		

TAHLE 2
WATER POTENTIALLY AVAILABLE POK EXPANDED FISH PRODUCTION PROGRAMS IN THE MID-COLUMBIA AREA

Site	Surface Water (cfs)	Ground water (cfs)
Pasco Drains		40
Ringold Springs Ditch		20
Priest Kapids Hatchery	50	17
Horses hoe Pond	20	
Nelson Springs		5
Cle Elum/Eastonl/	50	20
Kocky Ford Creek		50
Collin Skane Hatchery		12
Kocky Reack (Turtle Rock)	30	10
Kocky Reach (Annex)		6
Leavenworth NFh	30	10
Entiat NFH	30	2/
Wells Hatchery	100	2/
Winthrop NFH	30	10
Methow Kiver Pens		
Chief Joseph Hatchery		27
Total	340	227

1. The potential for ground water is speculative. FM believes that more than 20 cfs could be developed in this area.
2. Aqulifer development

Pasco Drains.

The drains are located in and around Pasco, Washingtion, in the drain ditches behind the river levees. Drain water similar to Rngold Springs water consists of irrigation return flows that filter through the soil from the adjacent farmlands to the drain ditches. The drain water is now being pumped over the levees to maintain a lower water table in the area. In a recent search for hatchery sites for Snake River salmon and steelhead, the drain water in the Pasco area was considered but it was dropped from consideration in favor of the Lyons Perry site.

The river levees raise concerns about the quality of the water for use in a complete hatchery facility; however, the quality appears to be similar to that of the Ringold Springs supply. Therefore,the contractor believes that, within the scheme of an expandedfish cultural program water from three or four of the levees' ditches could be used to great advantage for satellite rearing stations.

Ringold Springs Ditch.

Ringold Springs is a rearing area for steelhead and chinook salmon. Salmon ponds were constructed and they are operated by the Washington Department of fisheries (WDF). The downstream steelhead ponds were constructed and they are operated by Washington Department of Came (WDG). The spri ng water used originates from a shallow aquifer being supplied by irrigated farming at higher elevations. The National Marine Fisheries Service provides annual funding for both facilities; however,Grant County has provided some funding.

While the hatching of eggs should not be considered, the expansion of the Ringold Springs area,similar to the existing program,has been proposed for many years by WDG and WDY. WDC has been satisfied with it6 steelhead program (Ayerst, personal communication) as is WDY with the spring chinook survival and catch rates associated with this operation (Hopley, personal communication).

Priest Kapids Hatchery.

Priest Kapids Hatchery is located on the left bank immediately downstreamfrom the Priest Rapids Dam. It is owned by Grant County PUD and operated by WDF.

This site has one of the greater potentials of those identified during the study. Mike Del 1,,biologist for Grant County PUD, informed the contractor that approximately 20 cfs of water was obtained from five shallow wells developed in November of 1980; however,the long-term projection level of water production is still unknown. Two of the wells four cfs each) will be capped for future expansion. Dell further stated that the water aquifer might yield another nine cfs from additional well drilling, for a total of 17 cfs for future expansion. This water along with the 18 cfs now developed and programmed could result in up to 35 cfs of high-quality ground water at this site.

Horseshoe Pond.

AS a satellite to a larger hatchery complex, Horseshoe Pond, located near Mabton along the Yakima Kiver, may afford a great opportunity to rear fish economically (Rose, 1971, and Bakkala and Gangmark, 1965). The horeshoe Pond operation would be similar to the WDF rearing program at the Olympia, Washington, Percival Cove facility. This 26-acre pond with its 10 to 20 cfs flow has reared up to 8.0 million fall chinook. WUP is again programming fall chinook rearing of this magnitude in this pond (Antipa, 1980). The general production concept would be to eradicate all fish within tlorseshoe Pond, screen the inlet and outlet, develop a flow

of 10 to 30 cfs with pond drainage capabilities,import hatchery-incubated two-week-old fall chinook, and rear them until they reach 80 to 100 per lb;then they will be released by draining the pond.

Nelson Springs.

These two springs are located between Naches and Yakima,Washington. WDG has constructed a 100-foot-long wooden raceway at the site utilizing only the northernmost spring. The two springs combine immediately downstream from the raceway. Fish rearing at this location has been terminated because of funding shortages.

Concerns by contractor staff centered around the expanding housing development within the several-square-mile watershed of Nelson Springs upstream of i ts two major forks near Nelson Bridg on the Naches Kiver.

Looking on the positive side, this gravity water source is equal in volume to that at the Naches Trout Hatchery. Area for a rearing facility on County property at this site is adequate. Additional groundwater may be present, and pumping Naches Kiver water should not be ruled out as a means to further enhance this development.

Cle Elum/Easton.

In the upper Yakima system near the towns of Cle Elum and Easton, a very shallow ground water aquifer exists in areas adjacent to the river (personal communication with employees of the Cle Elum City Water System). All areas between Ellensburg and Easton where gravel was removed for highway construction have standing water, with many ponds having flowing outlet6 (Larry brown). The abandoned salmon rearing pond areas at Cle Elum and Easton for example, have outlets flowing at 4 to 15 cfs and 2 to 8 cfs, respectively (Ptrinney and Kral, 1965). In October and November of 1980 the contractor noted flowing outlets on the above two sites and others in the area between Ellensburg and Easton. In addition, many of these ponds were observed to freeze over very slowly, indicating they were being warmed by ground water.

Land availability is another plus. The majority of these gravel borrow pits are owned by the Washington State highway Department. Host areas will lend themseles to easy access and construction.

Kocky Ford Creek.

The springs that constitute the headwaters for Kocky Ford Creek provide morethan 50 cfs of high-quality spring water. The WDG, which owns the water source and surrounding

land on which the old Trout Lodge is located, has been prevented by court action from developing and operating a hatchery complex upon the site because of the lack of a water right (Cearheard).

One mile downstream from the old Trout Lodge Hatchery, a new hatchery was built by E&l McEeary. The contractor understand6 that the court's concern over degradation of the water supply upstream of McLeary' operation prevented WDG from developing it own fish culture program.

Collin Shane Hatchery.

A spring water supply of 10 to 15 cfs located seven miles north of Moses Lake is used by a private owner, Co1 lin Skane of Moses Lake, to supply a medium-sized rainbow hatchery.

Mr. Skane formerly worked at the Trout Lodge facility (Rocky Ford Creek). About eight years ago he began developing his own site. He related that his rainbow production (kamloops variety) is mainly sold in Canada and that his station is certified to be disease free, with a slightly warmer temperaturethan the 53-degrees-P water at Trout Lodge. Mr. Skane has applied for a water right on his spring and now appears to be awaiting approval by the Washington Department of Ecology. The contractor considers him to be very knowledgeable about trout culture.

Mr. Shane also reported that a second spring exists one and one-half to the miles north on state property. This spring flows at about five cfs and it could supply a satellite to this station.

Kocky Reach (Turtle Rock).

The Kocky Reach fish facilities are located on Turtle rock Island in the Kocky Reach Chelan County PUD reseroir approximately 1.5 miles upstream from the dam. The existing fish facilities were constructed and are now maintained by the Chellan County PUD but they arc operated by WDF.

Regarding the facilities, the contractor supports the pond modification concept at Turtle Rock designed by CH2M Hill. Present water quality at this station, however, is marginal (Antipa, 1980).

Turtle Rock has a pumping capacity of 15 cfs from each of four pumps, or 60 cfs of surface water from the reservoir (Entiat Lake) for the fish facilities. Only half of this water and half of the facilities are used. MR. Hauck informed the contractor that a test well was to be immediately drilled on the island in hope of intercepting an aquifer and eventually leading to the development of 20 cfs of ground water.

Kocky Keach Annex.

Kocky Keach Annex fish facilities are located immediately downstream of the Kocky Keach Chelan County PUD Dam on the left bank of the Columbia River. Existing fish facilities are maintained and owned by the Chelan County PUD and operated by WDF.

Messrs. Hauck, Leman, and Hays of Chelan County PUI) informed the contractor that approximately 10 cfs of toe drain water exists on the left bank immediately downstream of Kocky Keach Dam. Four cfs of this water is now in use, and plans are in progress to develop the additional six cfs (Hauck).

Leavenworth National Fish Hatchery Expansion.

The Leavenworth NFH is located three miles southwest of the town of Leavennworth along the left bank of Icicle Kivrr. The present complex is supplied with water from Icicle Kiver and six shallow wells.

Based on the success in obtaining water from the existing wells, the contractor believes an additional 10 cfs could be obtained similarly. In addition, up to 30 to 550 cfs of Icicle Kiver water could be obtained from March through Play from an abandoned adult holding area.

Entiat Natinal Fish Hatchery Expansion.

The Entiat National Fish Hatchery is located on the right bank of the Entiat River sevenmiles upstream from its confluence with the Columbia Kivet. It is supplied with water from a small spring:, wells, and the river. Further development of ground water does not appear feasible.

From March through June of each year, up to 30 cfs of additional Entiat Kiver water can be delivered by gravity through an existing unused 30-inch steel pipeline. The contractor recomorends that several one-half-acre ponds be developed to use this additional river water.

Well Salmon and Trout tlotchery Expansion.

The Wells Salmon fish facilities are located immediately downstream of the Douglas County PUD Dam on the right bank of the Columbia Kiver. The fish facilities were constructed by the PUD. They are responsible for maintenance, but WDF and WDG conduct the operations.

Confusion exists on the amount of well water availahale at the Well Hatchery. Mike Erho biologist for the Douglas County PUI) reports their inflow meters show up to 18 cfs,while both agencies believe the amount coming

into the pond is far less -- more like ten cfs. The PUDs and agencies should determine the actual volume available.

Kiver water is supplied to the facilities by a gravity flow siphon from Wells Dam (Lake Pateros). The siphon's capacity is estimated at 142 cfs (Erho), with less than 30 cfs being used in the present rearing program. Additional reservoir water is therefore available for fish rearing programs without siphon modifications. Since the siphon is simple and the capital investment has already been made to complete the water delivery system and supporting fish facilities, continued utilization and expansion of facilities appears to he very worthy of consideration.

Winthrop National Fish Hatchery Expansion.

The Wintrop National Fish Hatchery Is located on the right hank of the Methow Kivcr one mile from the town of Winthrop. Evidence suggests that ground water in the vicinity of the town is abundant. W.M. Chapman in 1938 reported to B.M. Brennan, Director of WF< on the potential hatchery sites in the upper Methow Valley. Five springs were documented in this area: Upper More's Spring; Lower More's Spring; Auto Park Spring, Schaefer's Place Spring; and Foghorn Springs. The latter is the present hatchery site. Sill Wallien, manager at Winthrop KFH, informed the contractor of two large springs approximately six miles upstream of his station. These springs are similar in size to Foghorn Springs.

The Winthrop NFH site has a developed infiltration gallery that can deliver 10 cfs of water at 49 degree F. The lift is approximately 14 feet and pumping equipment is needed to make the gallery functional. Additional surface water (30 cfs or more) is available from the river; however, the ditch to the hatchery would have to be enlarged.

The contractor's engineer judged that within a reasonable distance of the existing infiltration galleries additional galleries could be developed to produce an additional 10 cfs of 49-degrees-F water with a low head lift. The area between Winthrop and Twisp also is thought to have good potential for shallow aquifers with abundant water supplies.

Methow Kiver Net Pen Site.

Establishment of a pen site is recommended at the mouth of the Methow Kiver where it enters Lake Pateros upstream from Highway 47. The quiet forcbay water at this location appears suitable for new pen rearing. The cont ractor proposes that pens be used in small numbers at first to further test the suitability of the site. Steel head production would be recomende from March to May, whe n smolt release would occur.

Two pens would have the effect of making three cfs of additional water available from Harch through May at production hatcheries and also would free rearing space. Use of pens during the frozen period would not be recommended.

Chief Joseph Hatchery

The proposed Chief Joseph Hatchery would be located immediately downstream from the Corps of Engineers' Chief Joseph Dam on the right hank of the Columbia River.

The hatchery has the quality and quantity of water to allow this site to be listed as potentially good. The proximity to Bridgeport presents advantages in living conditions for employees. The soi 1 type and topography are suitable for construction.

The water supply could be from three sources: (1) Chief Joseph Dam's toe drain water collected in an infiltration gallery along the north river bank with a minimum 22 cfs water available, (2) a possible five cfs of water available from well field development along the north bank, (3) and unlimited river water (Koch and Cochran, 1977).

Nes Perce Fish Production Facility.

The US Fish and Wildlife Service has conducted several studies for Indian tribes to determine potential for anadronous fish production on Indian lands. The Nez Perce Tribe of Idaho requested a survey of the Clearwater River, the major stream flowing through the Nez Perce Reservation. The conclusion in the report by the US Fish and Wildlife Service is that all the surface waters investigated within the study area were found to have characteristics making them inadequate for a perennial rearing program under the study criteria (US Department of the Interior, Fish and Wildlife Service, September, 1980).

However, spring water at Old Hatchery Springs along Lapwai Creek met the site criteria of the Fish and Wildlife Service. Water chemistry of the springs indicated that dissolved lead concentrations and filterable residue were near the upper limits for anadronous fish rearing. Water quantity ranged from a summer low of .5 cubic feet/second to 3.2 cubic feet/second in the winter. At this site Idaho State Fish and Game Department began to construct a rearing facility in the 1960's. The facility was not completed and never operated. A concrete raceway was constructed and could be utililzed.

Umatilla Indian Reservation Study.

The US Fish and Wildlife Service also conducted an anadromous fish enhancement study on the Umatilla Indian Reservation on behalf of the Confederated Tribes of the Umatilla Indian Reservation (US Department of the Interior, Fish and Wildlife Service, August, 1960). Upon evaluation of the data and associated operating costs developed during this study, Minthorn Springs and Bonifer Springs sites were the areas recommended as most economically feasible for fish production facilities on the Reservation.

The Minthorn Springs hatchery site is located on private land along the bank of the Umatilla River at river mile 05.4. Development is restricted by the quantity of water available and the limited hydraulic head. The Service estimated that for a single species only, not cumulative, the facility could produce 95,000 steellhead smolts, 49,000 spring chinook smolts, 64,000 fell chinook smolts, or 49,000 coho smolts.

The Bonifer Springs hatchery site is located on private land along the bank of Meachem Creek 1.5 miles upstream from its confluence with the Umatilla River Estimated production levels are based on the entire available flow and a single-pass facility. smolt production figures for a single species only, not cumulative, are as follows: steelhead, 146,000 ; spring chinook, 69,000; fall chinook, 100,000; or coho 93,000.

As a result of these studies the Bonifer springs facility was completedin 1983 and Minthorn Springs is now under construction.

Yakima Indian Reservation Klickitat River Hatchery.

In 1978 and 1979 the US Fish and Wildlife Service conducted an anadromous fish enhancement study of the Klickitat River system on behalf of the Yakima Indian Tribe (US Department of the Interior, Fish and Wildlife Service, December 1979). Field investigations were confined to the watershed within the confines of the Yakima Indian reservation. All surface waters within the study area had characteristics making them inadequate for perennial rearing. However, two excellent spring water supplies within 1,000 feet of each other were investigated. Cascade Springs is located on the west side of the Klickitat Kiver about 1,000 feet north of Outlet Creek. A conservative estimate of the flow is 20 cfs. Outlet Creek has several springs which enter the creek in the last mile of the stream above it confluence with the Klickitat Kiver. Flow f rom these springs total about 80 cfs. The water temperature of the springs averages 43 to 45 degrees F. Estimated smolt production for a single species only, not cumulative is as follows: steelhead, 2,100,00; spring chinook, 4,200,000;

fall chinook, 6,00.00; or coho 5,700,000.

In addition to the Klickitat study, the Confederated Tribes and Bands of the Yakima Indian Nation have expressed interest in a number of other hatchery facility sites. In response to an inquiry from Gala, the Yakima Indian Nation sent the following list of such sites.

Potential Hatchery Facility Sites

I. Adult Trapping
   A. Prosser Division Dam – right bank ladder
   B. Roza Division Dam – ladder
   c. Cowiche Diversion Dam – ladder

II. Adult Holding; Egg Incubation; Pond/Raceway Kearing
   A. WUC Yakima Trout Hatcher5y (Yakima Airport)
   I). Buckski n Creek (Naches Ri ver)
   c. Nile Pond (near Kattlesnake Creek)
   D. Naches trout farm (commercial facility) (Naches Kiver)
   E. Cle Elum Hiver (below dam)
   F. WL)S Naches Trout ilatchery (Naches Kiver)
   G. Union Cap ponds
   H. Outlet Springs (Klicki tat Kiver)
   I. Upper Satus Creek
   J. Toppenish Creek (Dan Olney's
   K. Simcoe Creek (near guard station)
   L. Lost Creek (Naches Kiver)

III. Net Pen Kearing
   1. Gravel pits – Baston to Cle Elum
   2. Gravel pits – Sclah to Yakima
   3. Crave1 pits – lower basin
   4. Gravel pits – Union Cap
   5. Keservoir – Cle Elum
   b. Kese rvoi r – Keeclielus Dam
   7. Keservoir – Kacheso
   8. Keservoir – Rimrock
   9. Keservoi r – Bumping

IV. Other Kearing Sites
   1. Oxbow ponds – Yakima Keservat ion below Sunnyside Dam
   2. Pasco NMFS raceways.

No other supporting information was sent with the preceding list.

Potential Hatchery Site Information from State Fishery Agencies.

The state fisheries agencies of Oregon, Washington and Idaho have obtained some information regarding potential hatchery sites. The files of the Oregon Department of Fish and Wildlife dating from the early 1970's yielded the following information.

OREGON DEPARTMENT OF FISHERIES AND WILDLIFE

Date	Site	Remarks
1985		ODFW is presently looking for sites to set up egg incubation facilities to solve virus problems
1984	Genge Salmon Private Farm, Corvallis, OR	Chinook and silver salmon raised since 1978; for sale or lease; 15 wells, 4-9,000 gpm, 51-53 degrees summer to spring, 10 concrete circulars, 1 conc. raceway, 11 Doughboy swimming pools with conc. bottoms, 1 vinyl lined pond.
1981	Crooked River Hatchery	Proposed steelhead facility, as part of the Lower Snake River Compensation Program
1980	Lower Snake River Compensation Plan:	
	Lostine-Wallowa Site No. 1:	no further study (nfs); water problems (wp).
	Wallowa Hatchery	nfs, wp
	Grande Rhonde	nfs, wp
	Wallowa Lake	nfs, no local support
	Opal Springs	nfs
	Crooked River	nfs
	Oak Springs	not enough water to expand
	Snipe Creek	nfs, wp
1977	Van Hulzen Ranch Bonanza, OR	5,000 gpm spring, 53 degree all year
1976	Upper Malheur drainage	Spring-fed streams: Big Creek, Lake Creek, Summit Creek
1975	Arra Wanna Estates 1 mi. N of Welches Salmon River, Sandy system	Rearing pond, spring chinook
1974	Marmot Pond, Sandy River, Old Sandy River Hatchery	Water problems Further study

The Oregon files also mention the potential for ground water in the Portland area to produce from 2-4 million coho salmon smolt.

The Washington State Department of Game reports an interest in the following potential hatchery sites in the Columbia River system.

1. Ellsworth Springs: This site is located east of Vancouver near the WDC Vancouver hatchery. This spring water site may have potential for a small hatchery. The site is owned by the City of Vancouver.

2. Stimson Flat: This site on the Klickitat River has potential for an imprinting pond. WDC owns the site. Water would have to be diverted from the Klickitat Kiver.

3. Kockly Ford Creek: This site has potential if differences with a downstream private grower can be ironed out. WL)G owns this site near Ephrata.

4. Waikiki Springs: This site north of Spokane is owned by WDG. WDG hopes some day to develop a trout hatchery here. There may be space and water for anadromous production as well.

The response of the Washington State Department of Fisheries to inquiries was that the Department has made *no* recent surveys for potential hatchery facilities in the Columbia River system.

The Idaho Department of Fish and Game has made extensive surveys for new anadroarous fish hatchery sites with little success. The Warm Kiver site has 2U0 cfs of 52 degree spring water. These springs are near Ashton and the Warm River is a tributary of the Henry's Fork of the snake Kiver. Smolts would have to be transported about 15U miles for access to the ocean. Winter access to the site is difficult and the road would have *to* be improved and kept open during heavy winter snows.

Several private commercial hatcheries in Idaho have potential for rearing anadromous species but would require purchasing the present operations.

TABLE A-3. I **ESTIMATION** OF THE POTENTIAL **ANADROMOUS FISH PRODUCTION FROM** SITES IDENTIFIED IN IDAHO, OREGON, AND WASHINGTON STATES. **ESTIMATES** ARE BASED UPON **8 LB/GPM** AT **MINIMUM** FLOW.

POTENTIAL HATCHAVAILABLE SITES	AVAILABLE **FLOW** CFS SURFACE	GROUND	AVAILABLE **FLOW (GPM)** SURFACE	GROUND	TOTAL **FLOW ESTIMATE** OF PRODUCTION **(GPM)**	BASED UPON **8 LB/GPM**
IN IDAHO						
BANABURY SPRING	**110**	0	**822.8**		**822.8** *b502.4*	
MALAD SPRINGS	100		**748**	0	*740*	5904
THOUSAND SPRINGS	1000	0	**7480**		7400	59040
SAND SPRINGS	**80**	0	598.4		**598.4** 4707.2	
BRIGGS SPRINGS	105	0	105.4		705.4 *b203.2*	
BICKEL SPRINGS	NO **DATA**					
BLUE SPRINGS	**60**	0	**448.8**		**448.8** 3590.4	
BOX CANYON SPRINGS	IN USE	0	0		0	0
BLUE LAKES SPRINGS	IN USE	0	0		0	0
CLEAR LAKE SPRINGS	IN USE	0	0		0	0
NIAGARA SPRINGS	IN USE	0	0		0	0
CRYSTAL SPRINGS	IN USE	0	0		0	0
DEVILS CORRAL SPRINGS	NO SITE	0	0		0	0
JEROME AREA WELLS	50	0	374		374	2992
SHOSHONE AREA HELLS	50	0	374		374	2992
HINIDOKA-PAUL AREA	40	0	299.2		**299.2** *2393.6*	
MUD LAKE AREA	**50**	0	374		374	2992
REXBURG AREA	50	0	374		374	2992
HAMILTON SPRINGS	PRIVATE 0	0	0		0	0
BIRCH CREEK	70		**523.***b*	0	*523.6*	4100.0
BIG SPRINGS **(LEADORE)**	25	*0*	107		**187**	1496
PAHSIMERDI GROUND HATER	25	*0*	**187**		**187**	*1496*
HENRYS FORK ARE TOO **REMOTE FROM**		*0*	0		*0*	*0*
CHILLY **SINKS-MACKAY** RES.	NO DATA					
BIG SPRING CREEK	25	*0*	187		107	1496
SNAKE WELLS NEAR **REXBURG**	50	*0*	374		**374**	2992

TABLE A-3.2 ESTIMATION OF THE POTENTIAL ANADROMOUS FISH PRODUCTION FROM SITES IDENTIFIED IN IDAHO, OREGON, AND WASHINGTON STATES. ESTIMATES ARE BASED UPON 8 LB/GPM AT MINIMUM FLOW.

POTENTIAL HATCHAVAILABLE FLOW CFS		AVAILABLE FLOW (GPM)		TOTAL FLOW	ESTIMATE OF PRODUCTION
SITES	SURFACE GROUND	SURFACE	GROUND	(GPM)	BASED UPON 8 LB/GPM
IN OREGON					
UPPER GRANDE RONDE	NO DATA				
MINTHORN SPRINGS	1.3	0	9.724	9.724	77.792
BONIFER SPRINGS	1.5	0	11.22	11.22	89.76
THORN HOLLOW SPRINGS	0.45	0	3.366	3.366	26.928
GENGE SALMON FARM		0	4000	4000	32000
CROOKED RIVER HATCHERY	NO DATA				
OPAL SPRINGS	NO DATA				
SNIPE CREEK	NO DATA				
VAN HULZEN RANCH		0	5000	5000	40000
PORTLAND AREA WELLS	NO DATA				

TABLE A-3.3 ESTIMATION OF THE POTENTIAL ANADROMOUS FISH PRODUCTION FROM SITES IDENTIFIED IN IDAHO, OREGON, AND WASHINGTON STATES. ESTIMATES ARE BASED UPON 8 LB/GPM AT MINIMUM FLOW.

POTENTIAL HATCH SITES	AVAILABLE FLOW CFS SURFACE	GROUND	AVAILABLE FLOW (GPM) SURFACE	GROUND	TOTAL FLOW (GPM)	ESTIMATE OF PRODUCTION BASED UPON 8 LB/GPM
IN WASHINGTON						
PASCO DRAIN		60	0	448.8	448.8	3590.4
RINGOLD DITCH		20	0	149.6	149.6	1196.8
PRIEST RAPIDS H	50	17	374	127.16	501.16	4009.28
RICHLAND CANAL NO DATA			0	0	0	0
BARKER POND	1		7.48	0	7.48	59.84
HORSESHOE POND	20		149.6	0	149.6	1196.8
RICHLAND POND	6.7		50.116	0	50.116	400.928
CIONA CANAL	15		112.2	0	112.2	897.6
AHTANUM	6		44.88	0	44.88	359.04
WIDE HALLOW CRE	3.6		26.928	0	26.928	215.424
NILE SPRING		3	0	22.44	22.44	179.52
NACHES HATCHERY		1.1	0	8.228	8.228	65.824
TIETON DAM SPRING		0.75	0	5.61	5.61	44.88
GOLD CREEK	NO FLOW IN WINTER		0	0	0	0
WILDCAT CREEK	12		89.76	0	89.76	718.08
NELSON SPRINGS	7		52.36	0	52.36	418.88
CLE ELUM PONDS	30	5	224.4	37.4	261.8	2094.4
CLE ELUM PITS		10	0	74.8	74.8	598.4
EASTON PONDS	20	2	149.6	14.96	164.56	1316.48
TJOSSEN POND		2	0	14.96	14.96	119.68
SHEA CREEK	10		74.8	0	74.8	598.4
UNNAMED CREEK	0.85		6.358	0	6.358	50.864
MANASTASH CREEK	1.5		11.22	0	11.22	89.76
PARKE CREEK	3.5		26.18	0	26.18	209.44
CARIBOU CREEK	2		14.96	0	14.96	119.68
COLEMAN CREEK	2		14.96	0	14.96	119.68
NANUM CREEK	1.5		11.22	0	11.22	89.76
UNNAMED SPRING	4		29.92	0	29.92	239.36
UMTANUM CREEK	3		22.44	0	22.44	179.52
WILSON CREEK	1.5		11.22	0	11.22	89.76

TABLE A-3.4 ESTIMATION OF THE POTENTIAL ANADROMOUS FISH PRODUCTION FROM SITES IDENTIFIED IN IDAHO, OREGON, AND WASHINGTON STATES. ESTIMATES ARE BASED UPON 8 LB/GPM AT MINIMUM FLOW.

POTENTIAL HATCHA SITES	VAILABLE FLOW CFS SURFACE	GROUND	AVAILABLE FLOW (GPM) SURFACE	GROUND	TOTAL FLOW (GPM)	ESTIMATE OF PRODUCTION BASED UPON 8 LB/GPM
WASHINGTON (CONTINUED)						
COLOCKUM CREEK	2		14.96	0	14.96	119.68
ROCKY FORD CREE		50	0	374	374	2992
COLLIN SHANE		10	0	74.8	74.8	598.4
SEEP LAKES SPRING	DATA NO DATA					
DRAIN 239 (QUINCY)		10	0	74.8	74.8	598.4
DRAIN WELL (D-86-1)		6	0	44.88	44.88	359.04
DRAIN WELLS 1,2,4,5		9	0	67.32	67.32	538.56
LOWER CRAB CREEK		15	0	112.2	112.2	897.6
TURTLE ROCK	30	10	224.4	74.8	299.2	2393.6
ROCKY REACH ANNEX		6	0	44.88	44.88	359.04
ROCK ISLAND CRENO	DATA					
DOUGLAS CREEK	NO DATA					
DRYDEN POWER CA	75		561	0	561	4488
SCHMITTEN POND		2	0	14.96	14.96	119.68
LEAVENWORTH NFH	30	10	224.4	74.8	299.2	2393.6
ENTIAT NFH	30		224.4	0	224.4	1795.2
WELLS HATCHERY	100		748	0	748	5984
CHELAN TROUT HATCHERY		12	0	89.76	89.76	718.08
WINTHROP NFH	30	10	224.4	74.8	299.2	2393.6
METHOW RIVER PE	4		29.92	0	29.92	239.36
PATEROS HATCHERNO	DATA					
CHIEF JOSEPH DAM		27	0	201.96	201.96	1615.68
CASCADE SP/OUTLET CRK		100	0	748	748	5984
ELLSWORTH SPRIN	NO DATA					
STIMSON FLAT	NO DATA					

Appendix B

Full production and costs of required modifications

Standard Calculation to Achieve Full Production

Full production was estimated using the "flow''--e.g. weight of fish per gallons per minute (GPM) of inflow, and "density"-- weight of fish per cubic foot of pond volume. The formula for the" f 1 ow " estimation procedure is P = F x L x G as described in the Methods and Materils section . The load factors (F) used are from tables in Bell (1973) and Piper et al. (1982) are a function of water temperature (55 degrees farenheit) and altltude.

The formula for the "density" estimation proceedure was after the formula in Piper et al. (1982), e.g., D - .5 X L X V

A range of full production levels was developed based upon agency production goal statements (Lower Snake River Fish and Wildlife Compensation Plan 1983) of .8 pounds per cubic foot (WDF) and 2 pounds per cubic foot (IFG and USFWS). The formula for the full production estimation was P = D X V. The use of the density range of from .8 t.o 2 pounds per cubic foot provides a usable range of production density goals that are useable (densities in excess of 1 pound per cubic foot is considered excessive and probably detrimental to anadromous salmonids). Actual production estimates were based upon pounds released and represent a pounds per cubic foot per year figure.

Production at the Columbia River Basin facilities examined in this project ranged from 2.36 pounds per cubic foot at

Abernathy National Fish Hatchery to 0.02 pounds per cubic foot at +the Ringold Steelhead rearing facility. During the three year period examined, an average of 6.1 million pounds of anadromous salmonids were released from Columbia Basin facilities with a rearing volume of 33.5 million cubic feet. This represents an average annual actual production at release of 0.18 pounds per cubic foot. Actual rearing space is 35.7 cubic feet. Several new facilities were comming on line during this project and a number of facilities produce resident fish in part or in total (Table B-1.0).

The reasons for the great differences in densities at release for the facilities included the limitations imposed by water quantity and quality, differences in agency policy on rearing density, density reductions due to disease, predation or other natural mortality factors, and limits to available eggs (specifically spring and summer chinook stocks). In a number of cases non-endemic stocks were subjected to rearing conditions that resulted in low production potential (high mortality due to disease, high temperature extremes, etc.). Disease resulted in the total or partial loss of several years of production at several of the facilities. Mortality among adult spring chinook was extremely high at all facilities resulting in 30 to 50% mortalities prior to spawning, and significantly reducing spring chinook smolt production potential.

Estimates of full production are provided for each facility of interest in the Columbia River Basin, and can be found in Table A-2.0 for potential sites and in Table B-1.0 -- under various density related criteria (Piper et al (1982) density,

Piper et al. (1982) flow, 0.8 pounds per cubic foot and 2.0 pounds per cubic foot density range). A form was filled out for each facility with pertinent data that led to the full production estimate(s), additlonal facilities or means of achieving full production, and capital and O&M estimates were provided where pertintent.

TABLE B-1.1 Summary of Hatchery Site Information, Production Data, and Full Production Estimates.

HATCHERY NAME	FLOW (CFS)	VOLUME (CF)	PRODUCTION ACTUAL AVERAGE FISH/LB	LB/YEAR	SPECIES	PERCENT	DENSITY	ESTIMATE FLOW	.8 LB/CF	2.0 LB/CR
1 ABERNATHY	240	17,280	42.99	40,800	F.CH.	100	40,800		13,800	34,600
2 ALDER CRK PND	ND	386,000	5.0	15,930	W.ST.	100	15,930		308,800	7,720
3 BEAVER CRK	13	125,695	5.8	11,200	S.CT	10.4	107,850		100,600	251,400
			8.3	96,650	W.ST	89.6		61,915		
4 BIG CRK	51.3	144,000	6.2	11,400	W.ST	7.4				
			2.9	1,967	S.CT	1.3				
			72.3	83,470	F.CH.	54.2	154,037			
			16.5	57,200	COHO	37.1		163,057	115,200	288,000
5 BIG WHT SALMON	7.1	13,920	NO DATA		F.CH.				11,000	27,800
6 BONNEVILLE	45.7	299,384	46.1	238,194	F.CH.	65.4	364,216			
			19.2	126,022	CO	34.6		140,787	239,500	598,800
7 CASCADE	35	22,050	33.1	16,404	F.CH.	37.0	44,303			
			65.8	27,899	CO	63.0		92,758	68,900	172,200
8 CLAKAMAS	34-45	144,320	7.1	143,078	SP.CH.	100.0	143,078	176,103	115,500	288,600
9 COWLITZ SAL.	167	222,720	19.8	202,121	CO	42.9				
			76.1	153,208	F.CH	32.5	470,779			
			27.4	115,450	SP.CH.	24.5		513,357	593,300	1,483,200
10 COWLITZ TROUT	61	747,000	9.2	19,071	S.CT.	13.1				
			16.4	24,777	S.ST	16.9	146,133			
11 REARING PONDS			9.3	102,285	W.ST	69.9		267,112	597,600	1,494,000
12 DEER SPRINGS										
13 EAGLE CREEK	78.1	120,000	12.3	15,918.5	ST	13.3	120,127			
			18.2	51,566.6	CO	42.9		301,137	96,900	240,000
			12.9	52,640	SP.CH	43.8				
14 ELKOMIN	44.65	278,800	22.7	143,000	CO	83				
			91.7	29,400	F.CH	17		120,134	223,000	557,600
15 GNAT CREEK	1.23	96,000	6.9	32,435	S.ST.	34.7				
			6.5	60,516	W.ST.	64.7	93,624			
			1175	673	CO	0.7		6,197	76,800	192,000
16 TROJAN POND	6.6	28,800	5.0	25,441	S.ST	1981	21550			
			15.6	17,660	CO	1982		31,076	23,000	57,600
17 GOBAR POND	4.9	518,400	5.2	12,986	S.ST	51.7	25,132			
			5.2	12,146	W.ST	48.3		27,027	414,700	
18 GRAYS R.	10	74,350	96.3	21,782	F.CH	50.7	42,940	(43,285)		
			18.9	21,158	CO	49.3		28,857	95,900	239,900
19 WEYCO POND		1,001,880	96.7	44,895	F.CH		44,895		801,500	

HATCHERY NAME	FLOW (CFS)	VOLUME (CF)	PRODUCTION ACTUAL AVERAGE FISH/LB	LB/YEAR	SPECIES	PERCENT	DENSITY	ESTIMATE FLOW	.8 LB/CF	2.0 LB/CR
20 KALAMA FALLS	13.37	134,640	14.3	20,438	SF.CH	27.8				
		134,640	35.4	52,050	F.CH	70.9	73,466			
			1359.0	978	COHO	1.3		44,067	107,700	269,300
21 KLASKANIN	2.67-22	236,370	15.1	117,842	COHO	66.8			189,100	472,700
			81.0	45,782	F.CH.	26.0				
			510.0	1,478	CH.S	0.8	176,433	(91292)		
			5.3	11,337	W.ST.	6.4		77247		
22 LEABURG	1.2-1.5	262,045	4.9	35,950	CUT		31154			
			7.4	26,358	S.ST.			6,127	209,600	524,000
23 LEWIS R.	14.5	325,320	17.3	245,049	CO.	74.8			325,400	813,600
			10.6	80,054	SFCH	24.4	227,508		260,000	650,600
			226.1	2,405	FCA	0.7		564,716		
24 LOWER KALAMA	18.5		14.0	16,285	SPEN					
		92,440	23.0	78,536	COHO	73.9	106,200			
			104.7	27,676	F.CH	26.1		55,998	73,900	184,800
25 MARION FKS	17.1	85,904	12.9	21,561	W.ST	36.4				
			13.6	3,200	S.ST	5.4	59,285			
			35.1	34,524	SP.CH.	58.2			68,700	171,800
26 MCKENZIE	15.6	138,600	5.9	15,703	S.ST	11.1	141,950			
			8.3	126,247	SP.CH.	88.9		70,582	110,800	277,200
27 MOSSY ROCK	2.68	42,000	89.2	533	CT	1.0				
			232.3	2029	W.ST					
			12.4	13,990	S.CT.	24.8	58,380	9733		
			16.5	41,828	RBW	74.2		(12166)	33,600	84,000
28 OXBOW (ODFW)	115	67,200	40.6	48,816	CO	53.3				
			12.2	25,018	SP.CH.	27.3	91,664			
			132.99	17,830	F.CH	19.		350415	53,800	134,400
29 WAKKENA PND	5.9	14,810,040			CO				11,848,000	
30 HERMAN CRK	15	108,244						86.6	86,600	216,400
31 ROARING R.	5.9-22.5	97,540	7.95	25,831	W.ST	63.9	40,369			
		97,537	8.2	14,538	S.ST	36.1		27 105K	78	195
32 SANDY	6.2	122,920	33.26	49,450	CO		49,450	1804	98,000	245,800
33 SKAMANIA	16.7	53,392	9.7	54,170	S.ST.	56.3				
			5.45	35,199	W.ST.	36.6	96,135			
			4.99	6,766	CT	7.1		80527	42,700	106,800
34 SO.SANTIAM	20.1	60,590	5.57	29,090	S.ST	45.7				
			7.78	34,542	SP.CH	54.3	63,632	100,374	48,500	121,200
35 STAYTON PND	50	3,833,280	76.5	81,197	F.CH.		81,197	115,986	3,066,600	

HATCHERY NAME	FLOW (CFS)	VOLUME (CF)	PRODUCTION ACTUAL AVERAGE FISH/LB	LB/YEAR	SPECIES	PERCENT	DENSITY	ESTIMATE FLOW	.8 LB/CF	2.0 LB/CR
36 SPEELYAI	16.52-	80,200	31.0	73,194	CO	81.2				
	23.12		57.4	16,031	SP.CH	17.8	90,102	48-77,000	65,800	164,400
			961.8	877	F.CH	0.9				
37 TOUTLE		324,000							259,200	648,000
38 VANCOUVER	2.36-	464,456	152.9	1,215	W.ST	0.9				
	4.2		33.9	119,333	S.ST	98.0	121,713			
			54.5	1,165	CT	0.9		43-23,000	371,600	928,900
39 WASHOUGAL	50.16-	480,000	81.06	81,310	F.CH	46.3	175,660	127.5-129.7	435,000	1087,600
	51.1		40.41	94,350	CO	53.7		255-259,000	3846	961,600
40 WILLAMETTE	45.1-	268,800	57.45	74,171	SP.CH	76.7	96,766			
	53.3		5.47	22,595	S.ST.	23.3		141-167,000	215,000	537,600
41 DEXTER POND	69	151,710	6.85	20,882	SP.CH.		20,882	354,437	121,400	303,400
42 CARSON	45.3	137,200	22.0	28,136	CO	29.5		151,338		
			20.0	111,755	SP.CH.	70.5	139,891	302,676	109,800	274,400
43 FALL RIVER		120,000							96,000	240,000
44 GOLDENDALE	10	32,000			TROUT				25,600	64,000
45 IRRIGON	55	224,000	6.33	5,733	S.ST.		5733	284,866	179,200	448,000
46 KLICKITAT	11.1-	279,360	16.7	55,872	CO	31.7				
	17.8		31.5	65,092	SP.CH	36.9		32-52,000	241,400	603,500
			86.1	55,069	F.CH.	31.3	176,033	65-104		
47 LTL WH SAL	58.6	93,710	25.9	32,289	SP.CH	26.6				
			77.6	88,982	F.CH	73.4	121,271	153-726	74,900	187,410
48 OAK SPRINGS		116,100	7.6	46,256	S.ST.		46,256		92,800	232,200
49 ROUND BUTTE		36,000	9.33	27,141	SP.CH	35.3	76,851			
			12.43	49,710	S.ST.	64.7			28,800	72,000
50 SPRING CREEK	6.68		68.16	194,510	F.CH.		194,570	16176	136,000	340,200
51 WARM SPRINGS	8.9-27.9	133,860	11.87	33,700	SP.CH		33700	36,915	107,100	267,700
52 WILLARD		96,000	19.14	147,611	CO		147,611		76,800	192,000
53 WIZARD FALLS		379,000							303,200	758,000
54 CHELAN TROUT	9.98									
55 CHELAN FALLS	5.13	38,240	6.76	83,154	S.ST.		83,154		30,600	76,400
56 ENTIAT NFH		83,688	19.50	51,159	SP.CH.		51159		66,900	167,400
57 LEAVENWORTH	6.2	283,440	8.0	125,000	W.ST	4.89	255,546			
			16.98	130,546				956190	226,700	566,800
58 NELSON SPR		2,400	6.05	14,922	S.ST		14922		1,900	4,800
59 NACHES		65,520	8.72	17,105	S.ST.		17105		54,200	131,000
60 NILES SPR	1.5	43,560			T					
61 OMAK	6.2	13,824			T				11,000	27,600

HATCHERY NAME	FLOW (CFS)	VOLUME (CF)	PRODUCTION ACTUAL AVERAGE FISH/LB	LB/YEAR	SPECIES	PERCENT	DENSITY	ESTIMATE FLOW	.8 LB/CF	2.0 LB/CR
62 PRIEST RAP	111.1	177,680	83.14	105,979	F.CH		105979	250189	142,100	355,400
63 RINGOLD SAL	25.1-	1,716,716	12.89	131,850	SP.CH.	74.6	105,032	96.5-115,300		
	30		54.99	38,182	F.CH	25.4			1,437,400	3,593,400
64 ROCKY REACH										
65 TURTLE ROCK	9	105,560							84,400	211,100
66 SPOKANE T	14.5	43,557			T				34,800	87,100
67 WASHBURN IS										
68 WELLS	26.5-		6.27	97,617	S.ST	68.7		115.1-141.6		
	32.6		550.2	922	F.CH	0.6				
			41.96	43,577	S.CH	30.7	142,116			
69 WINTHROP		74,200	71.1	56,511	SP.CH		56,511		59,400	148,400
70 YAKIMA	4.1		750.7	533	S.ST.					
		72,570			T.				75,600	189,100
71 DWORSHAK	135	315,792	8.4	314,743	S.ST.		314743	614462	252,600	631,600
72 EAGLE	1.97	52,720			RESIDENT				42,200	105,400
73 HAGERMAN N.	203-881									
74 HAGERMAN ST	.87	563,680	86.4	5156	CO	35.8			450,900	1,127,400
			22.4	9237	F.CH.	64.2				
					RESIDENT					
75 HAYDEN CRK	8	612,176							489,700	1,224,400
76 KOOSKIA	35	36,158	18.98	22,134	SP.CH.	558				
		(31,422)	7.83	17,506	S.ST	44.2	39640	133,996	25,100	62,800
77 LOOKINGGLASS	50	54,000							43,200	108,000
78 LYONS FERRY	43	158,000			FCH				126,400	316,000
					SPCH					
79 LYONS TROUT	177.3	140,550	6.72	107,092	S.ST		107,092		112,400	281,100
80 MCCALL	20	64,000			RESIDENT				51,200	128,000
			18.44	10,034	S.CH		15,884			
			28.7	5,850	SP.CH.				128,800	332,000
81 NIAGARA SP	132	161,000			RESIDENT					
					S.ST.					

HATCHERY NAME	FLOW (CFS)	VOLUME (CF)	PRODUCTION ACTUAL AVERAGE FISH/LB	LB/YEAR	SPECIES	PERCENT	DENSITY	ESTIMATE FLOW	.8 LB/CF	2.0 LB/CR
82 DIXBOW (ID)	17.9	59,148							47,300	118,300
83 PAHSIMEROI	86	156,665		622	S. CH	3.0				
				19,900	SP.CH	97.0			125,000	313,000
84 RAPID RVR	52	320,000							256,000	640,000
85 RED RIVER	15	430,100	21.0	12,762	SP.CH				344,100	860,200
86 SAWTOOTH	48	149,800			SP.CH				119,800	299,600
87 TUCANNON	75-90	307,786	50.2	6,497	S.ST				246,200	615,600
88 WALLOWA		110,257							88,200	220,600
89 IMNAHA										
90 RINGOLD-STHD	6-15	1,672,704	6.8	35,798	S.ST		35,798	35,798	138,200	3,345,400

FULL PRODUCTION/FACILITY MODIFICATIONS/COSTS

HATCHEKY: ABEKNATHY NFH LOCATION CODE: 1

1. ACTUAL PRODUCTION:

SPRCIES	A. POUNDS	B. PERCENT
F. CHINOOK	40,800	100
TOTAL	40,801)	----

2. THEOKETICAL PRODUCTION--based on existing facilities :
- DENSITY POKMULA (.5 X L X VOL.)- 37,152 LB: lb/CY- 2.15
- FLOW YOKMULA (F X L X GPM)= 1,548 LB: lb/C+ 0.09
- AGENCY CRITERIA KANGE (.8 X VOL)= 13,800 LB
and (2 X VOL)= 34,600 LB

3. FACTORS CONTKOLLING PRODUCITON:
A. POND VOL.: *17,281 (23312) cf
i. facilities not fully utilized *x*
B. WATEK: 240-300 CPM
i. enhance quality
-aeration *x*
-treatment 6 reclrc. *95X
C. FISH BIOMASS:
i. decrease density *X*
ii. rearing density
-lb/CY: 2.36
-lb/GPM: 170

MODIFICATION COMMENTS: Adult holding facilities are currently not used for rearing. Additional production could be realized by utilizing existing adult holding ponds, and recirculated water when rearing. None recommended.

* Currently used volumes
() Available Volumes
"X" Action item

HATCHERY: ALDEK CKEEK POND LOCATION CODE: 2

1. ACTUAL PKODUCTION:

SPECIES	A. POUNDS	B. PEKCENT
w. STHD	15,950	100
TOTAL	15,930	----

2. THEORETICAL PRODUCTION--based on existing facilities:
- DENSITY FORMULA (.5 X L X VOL.)= 1,601,900 lb: 4.15LB/CF
- FLOW FORMULA (F X L X GPM)= No flow data
- AGENCY CRITERIA KANGE (.8 X VOL)= 308,800 lb
and (2 x VOL)- 772,000 lb

3. FACTORS CONTKOLLING PKODUCTION:
A. POND VOL.: 386,000 cf
I. facilities not fully utilized *x*
B. WATER: NO DATA
I. increase amnt. available
ii. enhance quality
-aeration *x*
c. FISH BIOMASS:
i. increase density *X*
II. increase feed *x*
iii. rearing density
-1 b/CP 0.04

MODIFICATION COMMENTS: NONE KECOMMENDED. Aeration and an increase in food could allow a large increase in density/production. No flow data were available, however the creek which was darned to produce this pond is relatively small. There is a great disparity in the actual and the calculated production. This probably has to do with the fact that the facility has no support facilities for food storage and no housing for personnel. Feeding is probably speradic under these circumstances and therefore, density Is kept low to enhance the probability of survival.

*Currently used volumes
() Available Volumes
X Action item

HATCHERY: HEAVER CKEEK LOCATION CODE: 3

1. ACTUAL PKODUCTION:

SPECIES	A. POUNDS	B. PERCENT
W. STHD	96,650	89.6
SK. CUT.	11,200	10.4
TOTAL	107,850	----

2. THEOKETICAL PRODUCTION--based on existing facilities:
- DENSITY FORMULA (.5 X L X VOL.)= 445,200 lb: lb/cf 3.5
- FLOW FORMULA (F X L X CPM)= 61,915 lb: lb/cf 0.5
- AGENCY CKITERIA RANGE (.8 X VOL)= 100,600 lb
and (2 x VOL) 251,400 lb

3. FACTORS CONTKOLLING PKODUCTION:
A. POND VOL.: *(125,695) 135,275 cf total
b. WATEK: 5830 gpm
c. FISH HIOMASS:
I. increase density *X*
Ii. current rearing density
-lb/CF 0.85
-lb/tiPH 111.5

MODIFICATION COMMENTS: The potential for facility expansion is constrained by the rights to the available ground water and water in the creek. Only 20% of the available 40 acres of WDG land are presently in use. Additional water could be made available by using a recirculation system to provide an Increase in production. Use of adult holding ponds as rearing pond6 during off season would increase space by 8%.

4.ESTIMATED INCREASED PKODUCTION (TOTAL): 16,000 lb.

5. ESTIMATED CONSTKUCTION COSTS: $330,000 would be used to develope additional water sources, build large rearing ponds, and upgrade holding Ponds to be used a6 rearing ponds.

6. ESTIMATED INCREASES IN OPERATIONS COSTS: At a 1.5:1 conversion rate, an additional 24,000 lb. of feed, 1/2 man year.

*Currently used volume6
() Available Volumes
X Action Item

HATCHEKY: BIG CREEK LOCATION CODE: 4

1. ACTUAL PRODUCTION:

SPECIES	A. POUNDS	B. PERCENT
F. CHINOOK	83,470	54.2
COMO	57,200	37.1
W. STHD	11,400	7.4
SR. CUT.	1,967	1.3
TOTAL	154,037	----

2. THEORETICAL PRODUCTION--based on existing facilities:
- DENSITY FORMULA (.5 X L X VOL.)- 340,400 lb: lb/cf 2.36
- FLOW FOKMULA (F X L X CPM)- 163,057 lb: lb/cf 1.1
- AGENCY CRITERIA KANGE (.8 X VOL)= 115,2Oc) lb
  and (2 x VOL) 288,000 1 b

3. FACTORS CONTKOLLING PKODUCTION:
   A. POND VOL.: *(144,000) 156,750 cf total
   B.WATEK: 51.25 CFS
   c. FISH BIOMASS:
      i. current rearing density
         -lb/CF 1.07
         -lb/CPM 6.7

MODIFICATION COMMENTS: Potential facility expansion is constrained by the topography. Some additional water sources may be available, however, increased production would probably have to rely on a reuse system for any additional ponds. None recommended.

*Currently used volumes
() Available Volumes

HATCHEKY: BIG WHITE SALMON LOCATION CODE: 5

1. ACTUAL PRODUCTION:

SPECIES	A. POUNDS	B. PEKCENT
F. CHINOOK	12,300	100
TOTAL	12,300*	----

* Note: 1982 brood reared at Spring Creek and released for imprinting in Big White Salmon Pond in 1983.

2. THEORETICAL PRODUCTION--based on existing facilities :
- AGENCY CRITERIA RANGE (.8 X VOL)' 11,100 LB
and (2 X VOL)' 27,800 LB

3. FACTOKS CONTROLLING PKODUCTION:
A. POND VOL.: 13920 cf
B. WATEK: 3184 GPM

MODIFICATION COMMENTS: None recommended, according to the hatchery manager, there ha6 been a proposal to construct new pond6 at a higher elevation 60 that pond6 can be utilized at all river flows.

HATCHERY: BONNEVILLE LOCATION CODE: 6

1. ACTUAL PRODUCTION:

SPECIES	A. POUNDS	B. PERCENT
F. CHINOOK	238,194	65.4
COHO	126,022	34.6
TOTAL	364.216	

2. THEORETICAL PRODUCTION--based on existing facilities :
- DENSITY FORMULA (.5 X L X VOL.)= 685,700 lb: lb/cf 2.29
- FLOW FORMULA (F X L X CPM)= 140,800 lb: lb/cf 0.85
- AGENCY CRITERIA RANGE (.8 X VOL)= 239,500 lb
and (2 x VOL) 598,800 lb

3. FACTORS CONTROLLING PRODUCTION:
A. POND VOL.: 299,384 cf
I. new facilities *x*
B. WATER: 20493 gpm
i.enhance quality
-temperature
-aeration
-treatment 6 recirc. *x*
c. FISH BIOMASS:
IV. rearing density
-lb/CF 1.22
-lb/GPM 17.7

MODIFICATION COMMENTS: Land is available for the construction of new facilities. The hatchery manager stated that with adequate new well water and additional facilities the production at this facility could be doubled. We recommend an increase in the well water supply (14,000 gpm) and rearing capacity (300,OOO.O cf).

4.ESTIMATED INCREASED PRODUCTION (TOTAL): 250,000 lb.

5. ESTIMATED CONSTRUCTION COSTS: $2,550,000

6. ESTIMATED INCREASES IN OPERATIONS COSTS: Additional 375,000 lb feed, and 3 man years labor.

X Action Item

ESTIMATED PRODUCTION INCREASE, CONSTRUCTION COSTS, AND OPERATIONAL COSTS BASED ON HATCHERY MANAGERS IMPROVEMENT IDEAS

HATCHERY: BONNEVILLE FISH HATCHERY LOCATION CODE: 6
PRODUCTION INCREASE: 250,000 LBS. NAME: FARR/PW

CONSTRUCTION COSTS:

	SIZE	NUMBER	COSTS
A. FACILITIES			
1.INCUBATIORS			
2.START TANKS			
3.REARING			
RACEWAYS			
PONDS	1/2 ACRE X 5 FT	3	$600,000
4.HOLDING			
5.AERATORS			$100,000
6.SITE WORK			$1,000,000
B. WATER SYSTEMS:			
l.INTAKE			
2.PUMPING AND WELLS	4100 GPM	4	$350,000
3.HEATING/ CHILLING			
4.OUTSIDE PIPING			$500,000
C. BUILDINGS			
l.HATCHING			
2.PUMP HOUSE			
3.GARAGE			
4. SHOP			
5.REFRIDGERATION			
6.STORAGE			
7.RESIDENCE			

SUBTOTAL $2,550,000

HATCHEKY: CLACKAMAS LOCATION CODE: 8

1. ACTUAL PHODUCTION:

SPECIES	A. POUNDS	t3. PERCENT
SP. CHINOOK	143,100	100
TOTAL	143,100	----

2. THEORETICAL PRODUCTION--based on existing facilities:
- DENSITY FOKMULA (.5 X L X VOL.)= 277,816 lb: lb/cf 1.92
- FLOW FOKMULA (F X L X CPM)= 173,250 lb: lb/cf 0.99
- AGENCY CRITERIA KANGE (.8 X VOL)- 115,456
and (2 X VOL)= 288,640

3. FACTOKS CONTROLLING PRODUCITON:
A. POND VOL.: *144,320 (167,000) cf
B. WATER: 15,000 gpm
i. increase amnt. available "X"
c. FISH BIOMASS:
i current rearing density
-lb/CF 0.99
-lb/GPM 9.54

MODIFICATION COMMENTS: Existing plan calls for increasing production by l,OOO,OOO to 1,5000,000 smolts (dependent upon the species reared). Well water for tempering would enhance production. At recommended densities, additional volume (212,500 cf) and water (18,000 gpm) would be required.

4.ESTIMATED INCREASED PRODUCTION (TOTAL): 170,000 lb.

5. ESTIMATED CONSTRUCTION COSTS: $3,500,000 (to include additional hatching and pond rearing space, development of additional water sources, construction of support facilities).

6. ESTIMATED INCKEASES IN OPERATIONS COSTS: 255,000 lb feed and 3 man years labor.

*Currently used volumes
() Available Volumes

HATCHEKY: COWLITZ SALMON LOCATION CODE: 9

1. ACTUAL PKODUCTION:

SPECIES	A. POUNDS	B. PEKCENT
SP. CHINOOK	115,450	24.5
F. CHINOOK	153,288	32.5
COHO	202,121	43.0
TOTAL	470,859	----

2. THEORETICAL PRODUCTION--based on existing facilities:
- DENSITY FOKMULA (.5 X L X VOL.)= 1,694,558 lb: lb/cf 2.29
- FLOW FORMULA (F X L X CPM)' 513,357 lb: lb/cf 0.69
- AGENCY CRITEKIA KANCE (.B X VOL)- 593,280 lb
  and (2 x VOL)- 1,483,200 l b

3. FACTORS CONTROLLING PKODUCTION:
   A. POND VOL.: 741,600 (964,320) cf
   B. WATER 74,888 gpm
   C. FISH BIOMASS:
      i rearing density
      -lb/cf 0.63
      -lb/cf 6.29

MODIFICATION COMMENTS: REDUCE the flow, and the depth of the pond's coho and reared in to 4 ft. Land space and water are available for facility expansion. Currently there is no pollution abatement due to hydraulic constraints. We recommend the use of microbial treatment to reduce organic wastes and elevated BUD. Problems exist from small hydro projects on Butter, Johnson, and Mill Creeks which negatively impact young salmon. Negative impacts are expected in terms of elevated temperatures if the Cowlitz Falls Hydro Facility is constructed.

* Currently used volumes
(> Available Volumes

HATCHERY: COWLITZ TKOUT LOCATION CODE: 10 NAME: PMW

1. ACTUAL PKODUCTION:

SPECIES	A. POUNDS	B. PEKCENT
S. STHD	24,800	16.9
w. STHD	102,300	69.9
SK. CUT.	19,100	13.1
TOTAL	146,100	

2. PRODUCTION--based on existing facilities:

- DENSITY FORMULA (.5 X L X VOL.)- 2,430,500 lb: lb/cf 3.25
- FLOW FORMULA (F X L X GPM)= 267,100 lb: lb/cf 0.36
- AGENCY CRITEKIA KANGE (.8 X VOL)- 597,600
  and (2 x VOL)= 1,494,OOO

3. FACTOKS CONTROLLING PKODUCTION:
   A. POND VOL.: 747,000 cf
   B. WATEK: 27354 gpm
   C. FISH BIOMASS:
      I. rearing density
      -lb/cf 0.2
      -lb/gpm 5.34

MODIFICATION COMMENTS: 1. By using an endemic steelhead stock, production could be doubled without adding water or facilities. Endemic summer run stocks may not be available, but winter runs are. Also, spring chinook could be used In a polyculture mlxture. 2. If additional water is available, considerably more fish could be reared If disease problems in water system can be solved. 3. Pollution abatement problems could he approached by use of microbial methods which would reduce organic materials and elevated HOD.

4. ESTIMATED INCREASED PKODUCTION (TOTAL): (1) 146,101) lb.
(2) 60,000 lb.

5. ESTIMATED CONSTRUTION COSTS: (1) Without new water or facilities, $0. (2) With 20 cfs new water, $320,000.

6. ESTIMATED INCREASES IN OPEKATIONS COSTS: NO additional cost as large annual losses are experienced annually in WDG's attempt to produce non-endemic summer steelhead.

* Currently used volumes
() Available Volumes

HATCHEKY: DEER SPRINGS LOCATION CODE: 11

1. ACTUAL PRODUCTION:

SPECIES	A. POUNDS	B. PEKCENT
TOTAL: FACILITY NOT IN PRODUCTION		

2. THEORETICAL PKODUCTION: based on existing facilities:
* NOT A VIABLE FACILITY

FACTOKS CONTKOLLING PKODUCTION:
A.
B. WATER:
FISH BIOMASS:

MODIFICATION COMMENTS:
by Mt. St. Helens eruption in 1980.
to reactivate the facility.

* Volume of currently used ponds

HATCHERY: EAGLE CREEK NFH LOCATION CODE: 12

1. ACTUAL PRODUCTION:

SPECIES	A. POUNDS	B. PERCENT
SP. CHINOOK	52,640	43.8
COHO	51,600	42.9
W. STHD	15,900	13.3
TOTAL	120,127	

2. THEORETICAL PRODUCTION based on existing facilities:
- DENSITY FOKMULA (.5 x L x VOL.) 355,800 lb:2.97 lb/cf
- FLOW FORMULA (F X L X CPM)- 216,098 lb:l.8 lb/cf
- AGENCY CRITERIA RANGE (.8 X VOL)- 96,000 lb:
and (2 x VOL) 240,000 1 b:

3. YACTOKS CONTROLLING PKODUCTION:
A. POND VOL.: *(120,000) c f
B. WATEK: 25132 gpm
c. FISH BIOMASS:
I. rearing density
-lb/cf 1 . 0
-lb/gpm 4 . 8

MODIFICTION COMMENTS: Low creek flows and high temperatures limit production. It may be possible to Increase production with an enlarged recirculated water system complete with chillers and heaters. This would allow reduced summer growth and more natural growth rates in WINTER and spring.

4.ESTIHATED INCREASED PKODUCTION (TOTAL): 10,000 1 b.

5.. ESTIMATED CONSTRUCITON COSTS: $50,000 for chillers and enlarged recirc. (no estimates for heating).

6. ESTIMATED INCREASES IN OPERATIONS COSTS: 15,000 lb feed .

* Volume of currently used ponds
( ) Volulme of total available pond space

HATCHEKY: ELOKOMIN LOCATION CODE: 13

1. ACTUAL PRODUCTION:

SPECIES	A. POUNDS	B. PEKCENT
E'. CHINOOK	29_,400	17
COHO	143,200	83
TOTAL	172,600	

2. THEORETICAL PRODUCTION--based on existing facilities:
- DENSITY FORMULA (.5 X L X VOL.)= 557,600 lb:2.0 lb/cf
- FLOW FORMULA (F X L X GPM)= 120,100 lb:0.43 lb/cf
- AGENCY CRITERIA RANGE (.8 X VOL)'= 223,000 lb:
and (2 x VOL)- 557,600 lb:

3. FACTORS CONTROLLING PKODUCTION:
A. POND VOL.: *278,800 c f
B. WATEK: 200022.4 gpm
C. FISH BIOMASS:
i. rearing density
-lb/cf .62
-lb/gpm 8.62

MODIFICATION COMMENTS: March-April yearling mortalities indicate that densities are perhaps too high. The space and water for expansion exists. There are problems with the quality of the water seasonally In terms of silt loads, seasonal temperatures and pH. The manager indicated that fiscal constraints were a limiting factor in current production.
* Volume of currently used ponds
( ) Volume of total available pond space.

HATCHEKY: GNAT CKEEK LOCATION CODE: 14A

1. ACTUAL PKODUCTION:

SPECIES	A. POUNDS	B PEKCENT
COHO	700	0.7
s. STHD	60,500	64.7
w. STHD	32,400	34.6
TOTAL	93,700	----

2. THEORETICAL PRODUCTION--based on existing facilities:
- DENSITY FOKMULA (.5 X L X VOL.)- 353,400 lb: lb/cf 3.74
- FLOW POHMULA (F X L X CPM)- 50,556 1 b: lb/cf 0.53

and (2 x VOL)= 192,000

3. FACTORS CONTROLLING PKODUCTION:
   A. POND VOL.: *96,000 c f
   B. WATER: 3000 gpm
   C. FISH BIOMASS:
      i. rearing density
         -lb/cf 0.98
         -lb/gpm 31.2

MODIFICATION COMMENTS: None recommended. Summer water availability is limiting for this facility.

* Currently used volumes
O Available Volumes

HATCHEKY: THOJAN POND LOCATION CODE: 14B

1. ACTUAL PRODUCTION;

SPECIES	A. POUNDS	B. PEKCENT
COHO	17,700	100
S. STHD	25,400	100

(two different years) TOTAL Average - 21,550 em--

2. THEORETICAL PRODUCTION--based on existing facilities:
- DENSITY FOKMULA (.5 X L X VOL.)= 100,800 lb: lb/cf 3.5
- FLOW FORMULA (F X L X GPM)= 31,100 lb: lb/cf 1.08
- AGENCY CKITEKIA KANGE (.s X VOL)= 23,000
  and (2 X VOL)= 57,600

3. PACTOKS CONTROLLING PRODUCITONL
   A. POND VOL.: *28,800 c f
   B. WATER: 2959.6 gpm
   C. FISH BIOMASS:
      i. rearing density
      -lb/cf 0.75
      -lb/gpm 7.28

MODIFICATION COMMENTS: None recommended.

* Currently used volumes
(> Available Volumes

HATCHEKY: GOBAR POND LOCATION CODE: 15

1. ACTUAL PKOUUCTION:

SPECIES	A. POUNDS	B. PEKCENT
S. STHD	13,000	51.2
W. STHD	12,100	48.3
TOTAL	25,100	----

2. THEORETICAL PRODUCTION--based on existing facilities:
- DENSITY FORMULA (.5 X L X VOL.)= 2,125,400 lb: lb/cf 4.1
- FLOW FOKMULA (F X L X CPM)= 27,000 lb: lb/cf .05
- AGENCY CKITEKIA RANGE (.8 X VOL)- 414,700

3. FACTORS CONTKOLLINC PKODUCTION:
   A. POND VOL.: *51ti,400 c f
   B. WATEK: 2197.3 gpm
   C. FISH BIOMASS:
      i. rearing density
      -lb/cf 0.05
      -lb/gpm 11.42

MODIFICATION COMMENTS: Unless the amount of water can be increased (which does not appear possible) it does not appear that additional enhancement is practical. None recommended.
* Currently used volumes
() Available Volumes

HATCHEKY: CKAYS K. LOCATION CODE: 16

1. ACTUAL PRODUCTION:

SPECIES	A. POUNDS	b. PEKCENT
F. CGUBOOK	21,800	50.7
COHO	21,200	49.3
TOTAL	43,000	-a--

2. THEUKETICAL PRODUCTION--based on existing facilities:
- DENSITY FORMULA (.5 X L X VOL.)= 257,101): 2.14 lb/cf
- FLOW FOKMULA (Y x L x CMP)= 28,900:0.24 lD/Cf
- AGENCY CRITERIA RANGE (.8 X VOL>= 95,900
  and (2 x VOL)= 239,9ou

3. FACTOKS CONTROLLING PKODUCTIUN:
   A. POND VOL.: "119,950 cf
   B. WATER: 4484.3 gpm
   C. FISH BIOMASS:
      i. rearing density
      -lb/cf 0.36
      -lb/gpm 9.59

MODlFICATION COMMENTS: None recommended. Land not available, sources of available quality water in question.

* Currently used volumes
() Available Volumes

HATCHEKY: WEYCO POND LOCATION CODE: 17

1. ACTUAL YKODUCTION:

SPECIES	A. POUNDS	B. PERCENT
F. CHINOOK	44,900	100
TOTAL	44,900	----

2. THEOKETICAL PRODUCTION--based on existing facilities:
- DENSITY FORMULA (.5 X L X VOL.)= 1,603,OOO lb: lb/cf 1.6
- AGENCY CKITEKIA RANGE (.8 X VOL)'= 801,500 lb:
and (2 x VOL)= 2,003,OOO lb:

3. FACTORS CONTROLLING PRODUCITON:
A. POND VOL.: 1,001),880 c f
B. WATEK: No Data
c. FISH BIOMASS:
i. rearing density
-lb/cf .045
-lb/gpm

MODIFICATION COMMENTS: Increased production may be achieved by improving the water quality through aeration (no water data was available) and feeding.

4.ESTIMATED INCKEASED PKODUCTION (TOTAL): 50,000

6. ESTIMATED INCKEASES IN OPERATIONS COSTS: 75,000 lb of feed

* Volume of currently used ponds
(› Volume of total available pond space

HATCHEKY: KALAMA FALLS HATCHEKY LOCATION CODE: 18

1. ACTUAL PRODUCTION:

SPECIES	A. POUNDS	B. PEKCENT
SP. CHINOOK	20,400	27.8
F. CHINOOK	52,100	70.9
COHO	1,000	
TOTAL	73,500	

2. THEORETICAL PRODUCTION--based on existing facilities:
- DENSITY FORMULA (.5 X L X VOL.)= 330,100 lb: lb/cf 2.45
- FLOW FOKMULA (F x L X GPM)- 44,100 lb: Ib/cf 7.36
- AGENCY CRITERIA KANGE (.8 X VOL)= 107,700 lb
  and (2 x VOL) 269,300 lb

3. FACTORS CONTKOLLINC PRODUCITON
   A. POND VOL.: * 134,640 (145,280) cf
   B. WATER: 5995.5 gpm
   c. FISH BIOMASS:
      i. rearing density
         -1 b/cf 0.55
         -lb/gpm 12.26

MODIFICATION COMMENTS: Alteration of existing facilities to include an Increase in water by 20 cfs and an increase in rearing pond space. According to the hatchery manager, an increase in the water supply from the Kalama Kiver would allow maximum utilization of the existing facilities. This increase production by 50,000 pounds. Additional requirements are a modernization of the existing facilities, and moving the existing shop and garage to provide room for the construction of a large adult holding pond. This would allow the existing holding ponds to be used for fish rearing. The new pond could be used for holding and rearing an additional 50,000 pounds of fall chinook.

4.ESTIMATRED INCREASED PRODUCTION (TOTAL): 100,000 lbs.

5. ESTIMATED CONSTRUCTION COSTS: $955,000

6. ESTIMATED INCKEASES IN OPERATIONS COSTS: 150,00 lb feed, l-l.5 man years of labor.

* Volume of currently used ponds
( ) Volume of total available pond space

ESTIMATED PKODUCTION INCREASE, CONSTKUCTION COSTS, AND OPEKATIONAL COSTS BASED ON HATCHEKY MANAGEKS IMPROVEMENT IDEAS

HATCHERY: KALAMA FALLS LOCATION CODE: 18
PKODUCTION INCREASE: 100,000 LBS. NAME FARRE/PW

CONSTRUCTION COSTS:

	SIZE	NUMBEK	COSTS
A. FACILITIES			
l.INCUBATOKS			$25,000
2.STAKT TANKS			
3.REARIGN KACEWAYS			
PONDS	1/2ACKFXS'	1	200,0000
(KEMODEL EXISTING ADULT HOLDING PONDS FOK REARING)		6	250,000
4 .HOLDINC			
5.aERATORS			
6.bIOFILTERS			
B. WATEK SYSTEMS:			
l.INTAKE			S180,OOU
2.PUMPING			$60,OOU
3,HEATING/ CHILLlNG			
4.0UTSIDE - PIPING			S175,UUO
c . BUILDINGS			
l.HATCHING			
2.PUMP HOUSE			
3.GARAGE	30' X 6 0 '	1	$36,000
4.SHOP	20 ' x 30'	1	$15,000
5,DEMOLITION	OF EXISTING STKUCTUKES		$15,000
6. STORAGE			
7.rESIDENCE			

SUBTOTAL $ 955,000

HATCHERY: KLASKANINE LOCATION CODE: 19

1. ACTUAL PRODUCTION:

SPECIES	A. POUNDS	B. PERCENT
SP. CHINOOK	1,5000	0.8
F. CHINOOK	45,800	26.0
COHO	117.800	6b.8
W. STHD	11,300	6.4
TOTAL	176,400	----

2. THEOKETICAL PRODUCTION--0based on existing facilities:
- DENSITY FORMULA (.5 X L X VOL.)= 616,900 lb: lb/cf 2.6
- FLOU FORMULA (F X L X CPM)- 9,130 lb: lb/cf 0.04
- ACENCY CKITERIA RANGE (.8 X VOL)= lB9,100 l b
and (2 x VOL)= 472,701) lb

3. FACTORS CONTRLLING PRODUCTION:
A. POND VOL.: "236,370 cf
B WATEK: 11.97.3 gpm
c. FISH BIOMASS:
iv rearing density
-1b.cf 0.75
-lb/gpm 147.3

MODIFICATION COMMENTS: Additional water is apparently not available because of the reuse. It may be possible to increase production by rearing more fall chinook and chum salmon.

* Currently used volumes
O Available Volumes

HATCHEKY: LEABURG HATCHEKY LOCATION CODE: 20

1. ACTUAL PRODUCTION:

SPECIES	A. POUNDS	B. pERCNET
S. STHD	26,400	100
SK. CUT.	35,000	100
TOTAL	31,150	----

2. THEORETICAL PRODUCTION--based on existing facilities:
- DENSITY FOKMULA (.5 X L X VOL.)= 1,021,975 lb: lb/cf 3.9
- FLOW 'FORMULA (F X L X GYM)= 6,100 lb: lb/cf 0.02
- AGENCY CKITEKIA KANGE (.8 X VOL)- 2051,600 1 b
and (2 x VOL)= 524,000 lb

3. FACTORS CONTROLLING PRODUCTION:
A. POND VOL.: 262,045 cf
B. WATEK: 25,442 - 31,881 gpm
C. FISH BIOMASS:
i. rearing density
-lb/cf u.12
-lb/gpm 1.22-U.YU

MODIFICATION COMMENTS: The ponds are apparently not being fully utilized from the standpoint of both biomass per volume and biomass per flow. The densities could be increased (132,000 lb). The original plans included the construction of 12 additional raceways. There exists sufficient land and water for expansion.

4.ESTIMATED INCREASED PRODUCTION (TOTAL): 163,000 lb.

5. ESTIMATED CONSTRUCTION COSTS: $865,000

6. ESTIMATED INCREASES IN OPERATIONS COSTS: 244,500 lb feed and 2 man years of labor.

* Volume of currently used ponds
( ) Volume of total available pond space

ESTIMATED PKODUCTION INCREASE, CONSTRUCTION COSTS, AND OPERATIONAL COSTS BASED ON HATCHEKY MANAGEKS IMPROVEMNET IDEAS

HATCHEKY: LEABURG LOCATION CODE 20
PKODUCTION INCREASE: 70,000 LBS. NAME: FAKK/PW

CONSTRUCTION COSTS:

	SIZE	NUMBER	COSTS
A. FACILITIES			
l.INCUBATORS			$17,500
2.START TANKS			
3.REAKING KACEWAYS	20X98.5X3'	12	$600,000
PONDS			
4,HOLDING			
5.AEKATOKS			
6.BIOFILTERSA			
B. WATER SYSTEMS:			
l.INTAKE			$67,500
2.PUMPING			
3.HEATING/ CHILLING			
4.OUTSIDE PIPING			$18O,OUO
C. BUILDINGS			
1.HATCHING			
2.PUMP HOUSE			
3.GARAGE			
4.SHOP			
5.KEFKI DGER.ATION	--		
6.STOKA.GE			
7.KESID ENCG			

SUBTOTAL $ 865,000

HATCHEKY: LEWIS RIVER HATCHERY LOCATION CODE: 21

1. ACTUAL PKODUCTION:

SPECIES	A. POUNDS	B. PERCENT
SP. CHINOOK	80,100	24.4
F. CHINOOK	2,400	0.7
COHO	245,000	74.8
TOTAL	327,500	----

2. THEORETICAL PRODUCTION--based on existing facilities:
- DENSITY FOKMULA (.5 X L X VOL.)= 941,800 lb: lb/cf 2.9
- FLOW FORMUAL (F X L X CPM)= 564,700 lb: lb/cf 1.7
- AGENCY CKITEKIA RANG (.tl X VOL)= 260,000 lb
  and (2 X VOL)=650,600 lb

3. FACTORS CONTROLLING PRODUCTION:
   A. POND VOL.: 325,320 cf (4136,820)
   B. WATER: 65022 gpm
   C. FISH BIOMASS:
      i. rearing density
         -lb/cf 1.0
         -lb/gpm 5.0

MODIFICATION COMMENTS: Production at this facility could be achieved by construction of three off station rearing ponds. Land is available about one mile downstream on Johnson Creek for a 70-80,000 cubic foot rearing pond. Water would be supplied by gravity from the creek.

Land is available above the existing Davis Creek Pond for an additional 70,000 cubic foot rearing pond. A small dam is recommended to impound water on Davis Creek upstream of the recommended pond site. This would allow both the existing pond and the recommended facility to be supplied water by gravity from the recommended impoundment.

Land adjacent to Colvin Creek could be used to construct a 70,000 cubic foot rearing pond. Water could be supplied from a source developed on Colvin Creek or from the existing Lewis Kiver Hatchery water supply system.

4.ESTfMATED INCREASED PRODUCTION (TOTAL): 168,000 1 b.

5. ESTIMATED CONSTRUCTION COSTS: $1,152,500

6. ESTIMATED INCKEASES IN iperations COSTS: 252,500 lb. feed, 3 man years of labor.

* Volume of currently used ponds
( ) Volume of total available pond space

ESTIMATED PKODUCTION INCKEASE, CONSTRUCTION COSTS, AND OPERATIONAL COSTS BASED ON HATCHEKY MANAGEKS IMPKOVENENT IDEAS

HATCHEKY: LEWIS KIVEK LOCATION CODE 23
PKODUCTION INCKEASE: 63,000 LBS. NAME: FARK/l'W

CONSTKUCTION COSTS:

	SIZE	NUMBER	COSTS
A. FACILITIES			
1.INCUBATORS			
2.STAKT TANKS			
3.REARING RACEWAYS			
P O N D	20X80X70X5(FT)	3	~$700,00~
4.HOLDING			
5,AEKATOKS			
6.BIOFILTERS			
B. WATER SYSTEMS:			
1.INTAKE		3	$120,000
2.PUMPING			
3.HEATING/ CHILLING			
4OUTSIDE PIPING			$270,0011
5.SMALL DAM		1	$45,000
c. BUILDINGS			
1.HATCHING			
2.PUMP HOUSE			
3.GAKACE			
4.SHOP			
5.REFRIDGERATION			
6.STORAGE			
7.RESIDENCE			
		SUBTOTAL	$1,152,500

HATCHEKY: LOWER KALAMA KIVEK HATCHEKY LOCATION CODE: 22

1. ACTUAL PKODUCTION:

SPECIES	A. POUNDS	B. PEKCENT
SP CHINOOK	16,300	---
F. CHINOOK	27,700	26.1
COHO	78,500	73.9
TOTAL	106,200	----

2. THEUKETICAL PRODUCTION--based on existing facilities:
- DENSITY FORMULA (.5 X L X VOL.)= 208,180 lb: lb/cf 2.25
- FLOW FORMULA (F X L X CPM)= 56,000 lb: lb/cf 0.6
- AGENCY CRITERIA KANCE (.tl X VOL)- 73,901) l b
  and (2 x VOL)' ld4,t100 l b

3. FACTORS CONTROLLING PKODUCTION:
   A. POND VOL.: "92,440 cf
   B. WATEK: 8296 gpm
   c. FISH BIOMASS:
      Iv. rearing density
      -lb/cf 1.15
      -lb/gpm 12.8

MODIFICATION COMMENTS: We recommemd a decrease in the rearing density to increase net production. Production can also be increased at this facility by the construction of two 1/4 acre rearing ponds and an increase in the available water supply (see hatchery summary for details).

4.ESTIMATED INCREASED PRODUCTION (TOTAL): 70,0000 1 b

5. ESTIMATED CONSTRUCITON COSTS: $542,500

6. ESTIMATED INCREASES IN OPERATIONS COSTS: 105,000 lb feed, and one additional man year labor.

* Volume of currently used ponds
( ) Volume of total available pond space

ESTIMATED PKODUCTION INCKEASE, CONSTKUCTION COSTS, AND OPERATIONAL COSTS BASED ON HATCHEKY MANAGEKS IMPROVEMENT IDEAS

HATCHEKY: LOWER KALAMA LOCATION CODE: 22
PKODUCTION INCKEASE: 70,000 LBS. NAME FARR/PW

CONSTKUCTION COSTS:

	SIZE	NUMBER	COSTS
A. FACILITIES			
1.INCUBATRS			$17,500
2.START TANKS			
3.REARING KACEWAYS			
PONDS	1/4ACKE X 6'	2	$195,000
4,HOLDING			
5.AEKATOKS			
6.BIOFILTERS			
B. WATEK SYSTEMS:			
l.INTAKE			$14c),000
2,PUMPING			$75,000
3.HEATING/ CHILLING			
4,OUTSIDE PIPING			$80,000
c. BUILDINGS			
l.HATCHING			
2. PUMP HOU SE			$35,000
3. GAKA GE			
4. s HOP			
5. KEFR IDGE KATION			
6. STORAGE			
7RESUDEBCE			

SUBTOTAL $ 542,500

HATCHEKY: MAKION FORKS HATCHERY LOCATION CODE: 23

1. ACTUAL PKODUCTION:

SPECIES	A. POUNDS	B. PERCENT
SP. CH INOOK	34,500	58.2
s . STHD	3,200	5.4
W. STHD	21,600	36.4
TOTAL	59,300	----

2. THEOKETICAL PKODUCTION--based on existing facilities:
- DENSITY FOKMULA (.5 X L X VOL.)= 222,500 lb : 2.6 lb/cf
- FLOW FOKMULA (F X L X GPM)= 54,500 lb : 0.6 lb/cf
- AGENCY CRITEKIA KANGE (.8 X VOL)= 68,700 lb
and (2 x VOL> 171,800 lb

3. FACTORS CONTROLLIGN PKODUCTION
A. POND VOL.: 85,904 cf
B. WATEK: 7680 gpm
c. FISH BIOMASS:
i. rearing density
-lb/cf 0.69
-lb/gpm 7.7

MODIFICATION COMMENTS: Construct additional rearing capacity. Increase the available water supply, and increase the incubation water heating capacity. Land and water are available for 5-6400 cubic foot raceways.

4.ESTIMATED INCKEASED PKODUCTION (TOTAL): 25,600 lb.

5. ESTIMATED CONSTRUCTION COSTS: $425,000

6. ESTIMATED INCREASES IN OPERATIONS COSTS: Increased O&M costs will include the cost of 384130 lb of feed and 1/2 man year of labor.

* Volume of currently used ponds
( ) Volume of total available pond space

ESTIMATED PRODUCTION INCREASE, CONSTRUCTION COST AND OPEKATIONAL COSTS BASED ON HATCHEKY MANAGERS IMPKOVEMENT IDEAS

HATCHEKY: MARION FOKKS LOCATION CODE: 23
PKODUCTION INCKEASE: 26,400 LBS. NAME: FAKR/PW

CONSTKUCTION COSTS:

	SIZE	NUMBEK	COSTS
A. FACILITIES			
l.INCUBATORS			
2.STAKT TANKS			
3.REARING			
KACEWAYS	2OX8UX3'	5	$300,000
PONDS			
4.HOLDING			
5.AEKATOKS			
6.BIOFILTERS			
B. WATEK SYSTEMS:			
l.INTAKE			
2. PUMYING			
3.HEATING/			
CHILLING (HEATING)			$50,000
4.0UTSIDE			
PIPING			75,000
c. BUILDINGS			
l.HATCHING			
2 .PUMP HOUSE			
3.GAKAGE			
4.SHOP			
5.REFRIDGERATIN			
6.STORAGE			
7.KESIDENCE			

SUBTOTAL $ 425,000

HATCHEKY: McKENZIE FISH HATCHERY LOCATION CODE: 24

1. ACTUAL PKODUCTION:

SPECIES	A. POUNDS	B. PERCNET
SP. CHINOOK	126,2OO	86.9
s. STHD	15,7OO	11.1
TOTAL	141,950	----

2. THEOKETICAL PRODUCTION--based on existing facilities:
- DENSITY YOKMULA (.5 X L X VOL.)= 5O9,7OO lb: lb/cf 3.6
- FLOW FOKMULA (F X L X CPM)= 152,032 lb: lb/cf 1.1
- AtiENCY' CRITERIA KANCE (.8 X VOL)= 110,880 lb
and (2 x VOL>= 277,200 lb

3. FACTOKS CONTKOLLING PRODUCTION:
A. POND VOL.: 138,600 cf
B. WATER: 14,100 gpm
c. FISH BIOMASS:
i. rearing density
-lb/cf 1.O2
-lb/gpm 10.1

MODIFICATION COMMENTS: See modification comment based on hatchery managers ideas in the Hatchery Summary.

4.ESTIMATED INCREASED PRODUCITON (TOTAL): 14O,OOO lb.

5. ESTIMATED CONSTRUCTION COSTS: $1,905,000

6. ESTIMATED INCREASES IN OPERATIONS COSTS: Funds for 210,000 lb. of feed and 1.5 man years of labor.

* Currently used volumes
() Available Volumes

ESTIMATED PKODUCTION INCREASE, CONSTKUCTION COSTS, AND OPEKATIONAL COSTS BASED ON HATCHEKY MANAGEKS IMPKOVEMENT IDEAS

HATCHERY: MCKENZIE LOCATION CODE: 24
PKODUCTION INCKEASE: 140,000 LBS. NAME: FARR/PW

CONSTKUCTION COSTS:

	SIZE	NUMBER	COSTS
A. FACILITIES			
l.INCUBATOKS			$35,000
2.STAKT TANKS			
3.REARIGN			
KACEWAYS	16X75X2.5'	15	$675,000
PONDS	3/4 AC X5'	2	$425,000
4.HOLDINC			
5.AEdATOKS			
6.BIOFILTERS			
B. WATEK SYSTEMS:			
l.INTAKE			Sli35,OOO
2. PUMPING			
3.HEATINC/ CHILLING			
4.0UTSIDE PIPING			$36S,OOO
c. BUILDINGS			
l.HATCHING	30 x 80	1	$160,000
2.PUMP HOUSE			
3.GARAGE			
4.SHOP			
5.REFRIDGERATION			$60,000
6.STROAGE			
7.RESIDENCE			

SUBTOTAL $ 1,905,OOO

HATCHEKY: MOSSYKOCK TROUT HATCHEKY LOCATION CODE: 25

1. ACTUAL PKODUCTION:

SPECIES	A. POUNDS	B. PEKCENT
W. STHD	2,029	- -
SK. CUT.	13,990	- -
RES. TROUT	42,400	- -
TOTAL	58,380	----

2. THEOKETICAL PRODUCTION--based on existing facilities:
- DENSITY FORMULA (.5 X L X VOL.)= 115,025 lb: lb/cf 2.7
- FLOW FORMUAL (F X L X CPM)= 12,200 lb: lb/cf 0.3
- AGENCY CKITERIA RANGE (.8 X VOL)= 33,600 lb
  and (2 x VOL)= 84,000 lb

3. FACTORS CONTKOLLING PKODUCTION:
   A. POND VOL.: 42,000 cf
   B. WATER: 1200 gpm
   c. FISH BIOMASS:
      i. rearing density
      -lb/cf 2.39
      -lb/gpm 48.7

MODIFICATION COMMENTS: None recommended. Land is available, but the water supply is limited.

* Currently used volumes
O Available Volumes

HATCHEKY: HERMAN CREEK POND (OXBOW HATCHEKY) LOCATION CODE: 26A

1. ACTUAL PKODUCTION:

SPECIES	A. POUNDS	B. PEKCENT
TOTAL	NO DATA AVAILABLE	----

2. THEORETICAL PRODUCITON--based on existing facilities:
- ACENCY CKITEKIA KANGE (.8 X VOL)= 86,600 lo
and (2 x VOL) 216,400 lb

3. FACTORS CONTROLLING PKODUCTION:
A. POND VOL.: 108,244 CF
B. WATER: 8976 CPM

MODIFICATION COMMENTS: SEE HATCHERY SUMMARY.

* Currently used volumes
(> Available Volumes

HATCHEKY: WAHKEENA POND LOCATION CODE: 26B

1. ACTUAL PKODUCTION:

SPECIES	A. POUNDS	B. PEKCENT
COHO	NO DATA	100
TOTAL	NO DATA	----

2. THEOKETICAL PRODUCTION--based on existing facilities:
- AGENCY CKITEKIA RANGE (.L) X VOL)= 11,848,OOO lb:
and (2 x VOL)= 28,000,OUO lb:

3. FACTORS CONTROLLLIGN PRODUCIONl
A. POND VOL.: 14,810,040 CY
B. WATEK: 2645.7--10089.7 CPM
I enhance quality
-temperature *X*
-aeration *x*
C. FISH BIOMASS
i increase density *X*

MODIFICATION COMMENTS: Modifications would include aeration equiptment. Increased loading will perhaps require an increase in feed. Otherwise no modifications are recommended for increased production.

* Volume of currently used ponds
(› Volume of total available pond apace
X Action item

HATCHERY: KOARINC KIVEK FISH HATCHEKY LOCATION CODE: 27

1. ACTUAL PKODUCTION:

SPECIES	A. POUNDS	B. PEKCENT
S. STHD	14,500	36.1
W. STHD	25,800	63.9
KES. TKOUT	No Data	- -
TOTAL	40,300	----

2. THEOKETICAL PRODUCTION--baaed on existing facilities :
- DENSITY FOKMULA (.5 X L X VOL.)- 344,500 lb: 3.5 lb/cf
- FLOW FORMULA (F X L X OPM)= 27,000 lb: 0.3 lb/cf
- AGENCY CKITEKIA RANGE (.8 X VOL)= 78,000 lb
  and (2 x VOL)= 195,000 l b

3. FACTORS CONTROLLINC PRODUCTION:
   A. POND VOL.: 97,540 cf
   B. WATEK: 2645.7 - 1008Y.2 gpm
   c. FISH BIOMASS:
      iv. rearing density
         -1 b/CY 0.41
         -lb/CPM 15.26

MODIFICATION COMMENTS: A number of the ponds need to be replaced. Perhaps they should be replaced with large rearing ponds. Recommend the consideration of the use of fall chinook to coincide with the availability of additional water.

* Currently used volumes
() Available Volumes

HATCHEKY: SANDY RIVER FISH HATCHERY LOCATION CODE: 28

1. ACTUAL PRODUCTION:

SPECIES	A. POUNDS	8. PEKCENT
COHO	49,450	
TOTAL	49,450	

2. THEORETICAL PRODUCTION--based on existing facilities :
- DENSITY FORMAULA (.5 X L X VOL.) = 270,040 lb: 2.2 lb/cf
- FLOW FOKMULA (F x L x CPI4)= 111,042 lb: 0.15 lb/cf
- AGENCY CKITEKIA KANGE (.8 X VOL)= 98,000 lb
and (2 x VOL)- 245,&+00 lb

3. FACTORS CONTROLLING PRODUCITON:
A. POND VOL.: 122,920 cf
B. WATER: 2780.3 gpm
i. increase amnt. available *X*
ii. reuse *x*
iii.enhance quality
-temperature *X*
C. FISH BIOMASS
i. rearing density
-lb/cf 0.40
-lb/gpm 17.8

C. FISH BIOMASS:
iv. rearing density
-lb/CF 0.40
-lb/CPM 17.8

MODIFICATION COMMENTS: None recommended.

* Currently used volumes
(> Available volumes
X Action item

HATCHEKY: SKAMANIA HATCHEKY LOCATION CODE: 29

1. ACTUAL PKODUCTION:

SPECIES	A. POUNDS	B. PEKCENT
S. STHD	54,170	56.3
w. STHU	35,200	36.6
SK. CUT.	6,800	7.1
TOTAL	96,170	----

2. THEROETICAL PRODUCTION based on existing facilities :
- DENSITY FORMULA (.5 X L X VOL.)= 194,600 lb: 3.6 lb/cf
- FLOW FORULA (F X L X Gl'M)= 80,527 lb: 1.51 lb/cf
- AGENCY CRITEKIA RANGE (.8 X VOL)- 42,700 lb
  and (2 x VOL) 106,800 lb

3. FACTORS CONTKOLLINC PRODUCTION:
   A. POND VOL.: *53,392 c f
      i. new facilities *X*
   B. WATER: 7488.8 CPM
      i. increase amnt. available *X*
      ii. reuse 1005 (seriel)
   c. FISH BIOMASSS
      i. decrease density *X*
      iv. rearing density

-lb/CP 1 . 8
-lb/GYM 12.8

MODIFICATION COMMENTS: Recommend the replacement of (10) 4'x30' raceways with (2) 20'x801x4' ponds. The room and water exists for up to a 1 acre rearing pond on the site. The water source would be from the river for 8 months of the year, and augmented by reuse for 4 months.

4. ESTIMATED INCREASED PRODUCITON (TOTAL): 47,400 lb.

5. ESTIMATED CONSTRUCTIO COSTS: $620,000.

6. ESTIMATED INCKEASES IN OPERATIONS COSTS: Would include costs for 71,100 lb of feed and 1/2 man year of labor.

* Volume of currently usea ponds
( ) Volume of total available pond space
X Action Item

ESTIMATED PRODUCTION INCREASE, CONSTRUCTION COSTS, AND OPERATIONAL COSTS BASED ON HATCHEKY MANAGERS IMPROVEMENT IDEAS

HATCHEKY: SKAMANIA LOCATION CODE: 29
PKODUCTION INCREASE: 47,400 LBS. NAME: FARR/PW

CONSTKUCTION COSTS:

	SIZE	NUMBER	COSTS
A. FACILITIES			
l.INCUBATORS			
2.STAKT TANKS			
3.REARING			
RACEWAYS	ZO'XkiO'X3'	2	$120,000
PONDS	35U'X6O'X4'	1	$180,001)
4,REMOVAL OF EXISTING PONDS			$15,000
5.AEKATOKS			
6.BIOFILTERS			
B. WATER SYSTEMS:			
l.INTAKE			$65,OOc,
2 .PUMPING			
3.HEATINC/ CHILLING			
4.OUTSIDE PIPLNG			$170,000
5.REUSE SYSTEM			$5O,OUO
c . BUILDINGS			
1.HATCHING			
2 .PUMP HOUSE			
3.FARAGE			
4,SHOP			
5.REFRIDGERATIO			20,000
6,STORAGE			
7.RESIDENCE			

SUBTOTAL $ 620,000

HATCHEKY: SOUTH SANTIAM FISH HATCHEKY LOCATION CODE: 30A

1. ACTUAL PRODUCTION:

SPECIES	A. POUNDS	B. PEKCENT
SP. CHINOOK	34,500	54.3
S. STHD	29,100	45.7
TOTAL	63,600	----

2. THEORETICAL PRODUCITON--based on existing facilities :
- DENSITY FIRNYKA (.5 X L X VOL.)= 232,750 lb: 3.8 lb/cf
- FLOW FORMULA (F X L X CPM)= lOO,370 lb: 1.7 lb/cf
- AGENCY CKITEKIA RANGE (.8 X VOL)- 48,500 lb
and (2 x VOL) 121,200 lb

3. FACTOKS CONTROLLING PKODUCTION:
A. POND VOL.: *60,590 (81,9OU) CF
i. new facilities *X*
B. WATEK: 9013.5 GPM
C. FISH BIOMASS:
IV. rearing density
-1 b/CY 1.05
-lb/CPM 7.06

MODIFICATION COMMENTS: We recommend the construction of a new adult holding pond, retrofitting of the old adult holding pond for use as a rearing pond. In addition, the space and water exists for the construction and operation of new rearing ponds.

4. ESTIMATED INCREASED PKODUCTION (TOTAL): 40,000 1 b.

5. ESTIMATED CONSTRUCTION COSTS: $740,000.

6. ESTIMATED INCREASED IN OPERATIONS COSTS: Operations costs would include that for an additional 60,000 lb of feed and l/2 man years of labor.

* Volume of currently used ponds
( ) Volume of total available pond space
X Action item

ESTIMATED PRODUCTION INCKEASE, CONSTKUCTION COSTS, AND OA'EKATIONAL COSTS BASED ON HATCHEKY MANAGERS IMPKOVEMENT IDEAS

HATCHEKY: SO. SANTIAM LOCATION CODE: 30A
[RPDICTOPM INCREASE: 40,000 LB. NAME: FARR/PW

CONSTRUCTION COSTS:

	SIZE	NUMBEK	COSTS
A. FACILITIES			
l.INCUBATOKS			$10,000
2.START TANKS			
3.HEAROMG KACEWAYS			
PONDS	20X80X3'	8	$40O,O00
4.HOLDINC	150X20X6	I	$180,000
5.AEKATOKS			
6.BIOFILTERS			
B. WATEK SYSTEMS:			
1.INTAKE			
2.PUMPING			
3.HEATING/ CHILLING			
4.0UTSIDE PIPING			$15O,O00
c. BUILDINGS			
1 HATCHING			
2.PUMP HOUSE			
3.GARAGE			
4.SHOP			
5. REFRIDGE RATION			
6. STOKAGE			
7. KESIDENC E			

SUBTOTAL $ 740,000

HATCHERY: STAYTON REAKING POND LOCATION CODE: 308

1. ACTUAL PKODUCTION:

SPECIES	A. POUNDS	B PEKCENT
F. CHINOOK	81,200	100
TOTAL	81,200	----

2. THEORETICAL PRODUCTION--based on existing facilities :
- DENSITY FORMULA (.5 X L X VOL.)= 6,708,2UU lb: 1.75 lb/cf
- FLOW FORMUAL (Y x L x GPM)- 116,000 lb: 0.03 lb/cf
- AGENCY CKITEKIA RANGE (.8 X VOL)= 3,066,600 lb

3. FACTORS CONTKOLLING PRODUCTION;
   A. POND VOL.: 3,833,280 cf
      i. facilities not fully utilized *X*
   b. WATER: 22421.5 CPM
      i. enhance quality
         -aeration *X*
   C. FISH BIOMASS:
      i. increase density *x*
      ii. increase feed *x*
      iii. rearing density
         -lb/CP 0.02
         -lb/CPM 3.6

MODIFICATION COMMENTS: There is no potential for physical plant expansion at this site. The production of this facility apparently could be increased by one third without any additional water or construction. This can be accomplished with aeration and increased supplemental feed.

4. ESTIMATED INCREASED PRODUCTION (TOTAL): 27,000 lb.

5. ESTIMATED INCKEASES IN IOERATIONS COSTS: Include the costs of 40,200 lb of feed and one half man year of labor.

* Volume of currently used ponds
( ) Volume of total available pond space
X Action item

HATCHERY: SPEELYAI SALMON HATCHERY LOCATION CODE: 31

1. ACTUAL PKODUCTION:

SPECIES	A. POUNDS	B. PERCENT
SP. CHINOOK	16,000	17.8
F. CHINOOK	YOU	0.9
co HO	73,200	81.2
TOTAL	90,100	----

2. THEORETICAL PRODUCTION--based on existing facilities :
- DENSITY YOKMULA (.5 X L X VOL.)= 179,200 lb: 2 lb/cf
- FLOW FORMULA (Y X L X *GPM)'* 48,000-77,000 lb: 0.6-.9 lb/cf
- AGENCY CKITERIA RANGE (.8 X VOL)= 65,800 l b
  and (2 x VOL) 164,400 lb

3. FACTOKS CONTKOLLING PRODUCITON;
   A. POND VOL.: 82,200 cf
      i. new facilities *X*
   B. WATER: 7408.1-10367.7 GPM
   c. FISH BIOMASS:
      iv. rearing density
         -lb/CP 1 . 1
         -lb/CPM 12.2

MODIFICATION COMMENTS: The construction of a rearing pond at the lower end of Speelyai Creek is suggested as a means of increasing rearing space (see Hatchery Summary).

4. ESTIMATED INCREASED PRODUCION (TOTAL): 12,000 lb

5 ESTIMATED CONSTKUCTION COSTS: $50,000

6. ESTIMATED INCREASES IN OPEKATIONS COSTS: costs to include those for 18,000 lb of feed and 1/2 man year of labor.

* Volume of currently used ponds
( ) Volume of total available pond space.
X Action item

ESTIMATED PRODUCITON INCKEASE, CONSTRUCTION COSTS, AND OPEKATIONAL COSTS BASED ON HATCHEKY MANAGERS IMPKOVEMENT IDEAS

HATCHEKY: SPEELYAI LOCATION CODE: 31
PKODUCTION INCREASE: 12,000 LBS. NAME FARR/PW

CONSTRUCTION COSTS:

	SIZE	NUMBEK	COSTS
A. FACILITIES			
l.INCUBATOKS			
2.STAKT TANKS			
3.REARING			
RACEWAYS			
PONDS	150'X30'X5'	1	$5u,00
4.HOLDING			
5.AEKATUKS			
6.BIOFILTERS			
B. WATEK SYSTEMS:			
1.INTAKE			
2.PUMPINC			
3.HEATING/ CHILLING			
4.OUTSIDE PIPING			
C. BUILDINGS			
1.HATCHIGN			
2.PUMP HOUSE			
3.CAKAGE			
4.SHOP			
5.REFRIDGERATION			
b.STORAGE			
7.RESIDENCE			

SUBTOTAL $ 50,000

HATCHERY: TOUTLE RIVEK HATCHERY (BEAK SPKINGS) LOCATION CODE: 32

1. ACTUAL PRODUCTION:

SPECIES	A. POUNDS	B. PEKCENT
	NO PKODUCTION SINCE 1980	

2. THEORETICAL PRODUCDTION--based on existing facilities :
- AGENCY CKITERIA RANGE (.8 X VOL)= 259,201) LB
and (2 x VOL> 648,000 LB

3. PACTOKS CONTKOLLING PRODUCITON;
A. POND VOL.: 324,OUU cf (total at old site)
d WATE'K: UNKNOWN
C. FISH BIOMASS: UNKNOWN

MODIFICASTION COMMENTS: Suggest that the facility be rebuilt and runs reestablished (see SUMMARY for hatchery). We have been informed my WDF that the agency intends to reactivate the Bear Springs facility to produce, Initially, 140,000 smolt coho at 20/lb.

* Currently used volumes
O Available Volumes

HATCHEKY: VANCOUVER TKOUT HATCHEKY LOCATION CODE: 33

1. ACTUAL PRODUCTION:

SPECIES	A. POUNDS	B. PEKCENT
s. STHD	lN,3UO	98.0
W. STHD	1,200	0.9
SK. CUT.	1,200	0.9
TOTAL	121,700	----

2. THEOKETICAL PRODUCITON--based on existing facilities :
- DENSITY FOKMULA (.5 X L X VOL.)= 1,014,500 lb: 2.18 lb/cf
- PLOW POKMULA (F X L X GPM)- 13,000 lb: 0.03 lb/cf
- AGENCY CKITERIA RANGE (.8 X VOL)= 371,600 lb
and (2 x VOL)= 928.900 l b

3. FACTORS CONTROLLING PKODUCTION:
A. POND VOL.: *464,500 c f
1. new facilities *X*
B. WATER: 1058.3-1883.4 CPM
i. increase amnt. available *X*
ii. reuse 90%
C. FISH BIOMASS:
I. rearing density
-lb/CF 0.26
-lb/GPM 64.6

MODIFICATION COMMENTS: Additional water is needed (see Hatchery Summary). Space exists for facility expansion, however no expansion should be attempted without additional water or the installation of recirculation facilities. Additional water could be obtained by drilling new wells or constructing recirculation facilities.

4.ESTIMATED INCREASED PRODUCTION (TOTAL): 60,000 lb.

5. ESTIMATED CONSTRUCTION COSTS: $1,12O,UUO.

6. ESTIMATED INCREASES IN OPEKATIONS COSTS: Include the cost of 90,000 lb of feed and one man year labor.

* Volume of currently used ponds
( ) Volume of total available pond space
X Action item

ESTIMATED PKODUCTION INCKEASE, CONSTKLJCTION COSTS, AND OPERATIONAL COSTS BASED ON HATCHERY MANAGEKS IMFKOVEMENT IDEAS

HATCHEKY: VANCOUVEK TROUT LOCATION CODE: 33
PKODUCTION INCREASE: 60,000 LBS. NAME: FAKK/PW

CONSTRUCITON COSTS:

	SIZE	NUMBEK	COSTS
A. FACILITIES			
1 INCUBATORS		6 STAKS	15,00
2. START TANKS			40,000
3,REARITN			
KACEWAYS	lO'X8O'X3'	10	$2565,000
PONDS	200'X6O'XS'	2	$180,000
4.HOLDING			
5.AEKATOKS			
6.BIOFILTERA			
B. WATER SYSTEMS:			
l.INTAKE			
2.PUMPING			$350,000
3.HEATING/ CHILLING			
4.0UTSIDE PIPING			$300,000
C. BUILDINGS			
l.HATCHING			
2, PUMP HOUSE			
3.GARAGE			
4.SHOP			
5.REFRIFGERATION			
6.STORAGE			
7.RESIDENCE (FENCLNG)			$80,000

$1,120,000

HATCHERY: WASHOUGAL SALMON HATCHERY LOCATION CODE: 34

1. ACTUAL PRODUCTIO:

SPECIES	A. POUNDS	B. PERCENT
F. CHINOOK	81,300	46.3
COHO	94,400	53.7
TOTAL	175,700	----

2. THEORETICAL PRODUCTOIN--based on existing facilities :
- DENSITY FOKMULA (.5 X L X VOL.)- 907,700 lb: 1.67 lb/cf
- FLOW FOKMULA (F X L X GFM)- 127,573 lb: 0.23 lb/cf
- AGENCY CKITERIA RANGE (.8 X VOL)- 384,600 lb
  and (2 x Q 961,60U l b

3. FACTORS CONTKOLLING PRODUCITON:
   A. POND VOL.: 543,800 c f
   B. WATEK: 22493.3 - 22879 gpm
      i. reuse 100%
   c. FISH BIOMASS:
      i rearing density
      -1 b/CY 0.32
      -lb/GPM 7 . 8

MODIFICATION COMMENTS: Additional water would help but is not available all year. Perhaps fall chinook production could be increased when water is available. This would require additional pumps. Part of Bayles Creek could be diverted to raceways.

* Currently used volumes
(> Available Volumes
X Action item

HATCHEKY: WILLAMETTE FISH HATCHEKY LOCATION CODE: 35A

1. ACTUAL PKODUCTION:

SPECIES	A. POUNDS	B. PEKCENT
SP. CHINOOK	74,200	76.7
s. STHD	22,600	23.3
TOTAL	*96,800*	----

2. THEOKETICAL PRODUCTION--based on existing facilities :
- DENSITY FOKMULA (.5 X L X VOL.)= 652,552 lb: 2.4 lb/cf
- FLOW FOKMULA (F X L X GPM)= 148,738 lb: 0.55 lb/cf
- AGENCY CKITEKIA RANGE (.8 X VOL>= 215,000 lb
  and (2 x VOL)= *537,600* lb

3. FACTOKS CONTKOLLING PKODUCTION:
A. POND VOL.: **268,800* cf
i. new facilities *X*
B. WATER: *20,540* gpm
i Increase amnt. available *X*
c. FISH BIOMASS
i. rearing density
-lb/CF *0.36*
-lb/GPM 4 . 7

MODIFICATION *COMMENTS:* Perhaps density could be increased. With additional water the production could be significantly increased. The use of fall chinook should be considered. The intake structure requires improvement (see Hatchery Summary).

The major differences between actual and estimated production are probably the result of insufficient adult returns, high adult pre-spawning mortality, and/or insufficient young to fill to capacity.

4.ESTIMATED INCREASED PKODUCTION (TOTAL): 90,000 lb.

5. ESTIMATED CONSTSSRUCITON COSTS: $1,037,000.

6. ESTIMATED INCKEASES IN OPERATIONS COSTS: Include 135,000 lb of feed and one man year labor.

* Volume of currently used ponds
( ) Volume of total available pond space
X Action item

ESTIMATED PRODUCTION INCREASE, CONSTKUCTION COSTS, AND OPERATIONAL COSTS BASED ON HATCHEKY MANAGERS IMPROVEMENT IDEAS

HATCHEKY: WILLAMETTE LOCATION CODE: 35A
PKODUCTION INCREASE: 90,000 LBS. NAME: FARRR/PW

CONSTKUCTION COSTS:

	SIZE	NUMBEK	COSTS
A. FACILITIES			
1.INCUBATORS			$22,500
2.STAKT TANKS			
3.REAKING KACEWAYS			
PONDS	3/4 AC X5'	3	$640,000
4.HOLDING			
5.AERATOKS			
6.BIOFILTERS			
B. WATEK SYSTEMS:			
l.INTAKE			$175,000
2.PUMPING			
3.HEATING/ CHILLING			
4.0UTSIDE PIPING			$200,000
C. BUILDINGS			
l.HATCHING			
2.PUMP HOUSE			
3 .GARAGE			
.SHOP			
5,REFRIDGERATION			
6.STORAGE			
7.RESIDENCE			

SUBTOTAL $ 1,037,500

HATCHEKY: DEXTER POND LOCATION CODE: 25B

1. ACTUAL PKODUCTION:

SPECIES	A. POUNDS	B. PERCENT
SP CHINOOK	20,900	100
TOTAL	20,901)	----

2. THEORETICAL PRODUCITON--based on existing facilities :
- DENSITY ,FORMULA (.5 X L X VOL.)= 599,300 lb: 3.95 lb/cf
- FLOW FORMULA (F X L X CPM)= 354,400 lb: 2.34 lb/cf
- AGENCY CKITERIA RANCE (8. X VOL)= 121,400 lb
  and (2 x VOL)= **3133,400** lb

3. FACTORS CONTROLLING PKODUCTION:
   A. POND VOL.: 151,700 cf
      i.
   B. WATEK: 30941.7 gpm
   C. FISH BIOMASS:
      i. increase density
      ii. *x*
      iii. rearing density
           -lb/CF 0.14
           -lb/GPM 0.68

MODIFICATION COMMENTS: Apparently, density could be increased. Supplemental feed should be increased as a percent of fish biomass.

The major differences between actual production and estimated production is probably the result of high predation levels and lower than necessary supplemental feeding.

4.ESTIMATEl.J INCKEASED PKODUCTION (TOTAL): 20,000 1

5. INCREASED IN OPERATIONS COSTS: Include costs for **30,000** lb of feed and 1/2 man year labor.

( ) Volume of total available pond space

HATCHERY: CARSON NATIONAL FISH HATCHERY LOCATION CODE: 36

1. ACTUAL PKODUCTLON:

SPECIES	A. POUNDS	B. PEKCENT
SP. CHINOOK	111,800	70.5
COHO	28,000	29.5
TOTAL	139,900	----

2. THEORETICAL PRODUCTION--based on existing facilities :
- DENSITY FOKMULA (.5 X L X VOL.)= 354,701) lb: 2.6 lb/cf
- FLOW FOKMULA (Y X L X GPM) 302,700 lb: 2.21 lb/cf
- AGENCY CRTERIA RANGE (.8 X VOL)- 109),8OU l b
and (2 x VOL) 274,400 lb

3. FACTORS CONTROLLING PRODUCTION:
A. POND VOL.: *137,200
i.
B. WATEK:
i. *X*
100%

i. *X*

-lb/CF

Fish Wildlife

4.ESTIMATED INCREASED PRODUCTION (TOTAL): 96,000

$1,810,000.

A

ESTIMATED YKODUCTION INCREASE, CONSTKUCTION COSTS, AND OPERATIONAL C O S T S BASED O N HATCHERY MANAGERS IMPROVEMENT IDEAS

HATCHERY: CARSON NFH LOCATION CODE: 36
PRODUCITON INCKEASE: 96,000 LBS. NAME FARR/PW

CONSTRUCTION COSTS:

	SIZE	NUMBER	COSTS
A. FACILITIES			
l.INCUBATOKS			$25,000
2.START TANKS			
3.REARIGN KACEWAYS	lO'XtsO'X3'	40	$900,000
PONDS			
4. HOLDIGN			
5,AERATORS			
6,BIOFILTERS			
B. WATER SYSTEM:			
l.INTAKE (TYEE CKEEK;)			$85,000
2.PUMPING			
3.HETING/ CHILLING			
4.0UTSIDE PIPING			$400,000
5.REUSE			$250,000
C. BUILL)INC;S			
1.HATCHING			
2 .PUMP HOUSE			
3.GARAGE			
4 SHOP			
5.REFRIDGERATION			$150,000
6.STOKACE			
7.RESIDENCE			

SUBTOTAL $1,810,000

HATCHERY: FALL KIVEK HATCHERY LOCATION CODE: 37

1. ACTUAL PRODUCTION:

SPECIES	A. POUNDS	B. PEKCENT
KES. TKUUT	NO DATA	100
TOTAL	NO DATA	----

2. THEROKETICAL PRODUCTION--based on existing facilities:
-AGENCY CKITEKIA RANGE (.8 X VOL>= 96,000 lb
and (2 x VOL) - 240,000 l b

3. FACTORS CONTROLLING PRODUCTION
A. POND VOL.: 120,000 CF
1. new facilities *x*
B. WATEK: NO DATA

MODIFICATION COMMENTS: This hatchery produces exclusively resident trout for the sport fishery. three high dams are downstream of THIS facility; fish passage facilities are inadequate for anadromous salmonid adults to return to this facility. Water and space are available for expansion projects. None recommended.

* Volume of currently used ponds
(› Volume of total available pond space
X Action item

HATCHEKY: GOLDENDALE TROUT HATCHEKY LOCATION CODE: 38

1. ACTUAL PKODUCTLON:

SPECIES	A. POUNDS	B. PEKCENT
KES. TKOUT	NO DATA	100
TOTAL	NO DATA	----

2. THEORETICAL PRODUCTION--based on existing facilities and:
-AGENCY CKITEKIA KANGE (.8 X VOL)= 25,600 lb
and (2 X VOL)= 64,001) lb

3. FACTOKS CONTKOLLINC PRODUCITON:
A. POND VOL.: *32,000* CF
i new facilities *x*
WATEK: *4500* GPM

MODIFICATION COMMENTS: Recommended modification6 are based upon 1978 facilities report (Gray and osborne, Inc. P.S., consulting engineers, Yakima, Washington, 1978) which would incorporate facilities for rearing steelhead trout.

4,ESTIMATED INCREASED PKODUCTION (TOTAL): *27,300* lb

5. ESTIMATED CONSTKUCTION COSTS: *$3,500,000*

6. ESTIMATED INCREASES *IN* OPEKATIONS COSTS: Include the cost of 41,000 lb of feed and 1/2 man year.

* Volume of currently used pond6
(› Volume of total available pond space
X Action item

ESTIMATED PKOIJUCTION INCREASE, CONSTRUCTION COSTS, AND OPERATIONAL COSTS BASED ON HATCHEKY MANAGEKS IMPROVEMENT IDEAS

HATCHEKY: GOLDENDALE TKOUT LOCATION CODE: 38
PRODUCTION INCREASE: 27,301) LBS. NAME: FARR/PW

CONSTKUCTION COSTS:

	SIZE	NUMBEK	COSTS
A. FACILITIES			
l.INCUBATORS			
2.START TANKS			
3.REARING			
KACEWAY'S			
PONDS			
4. HOLDING			
5. AEKATORS			
6. BIOFILTE KS			
B. WATEK SYSTEMS:			
l.INTAKE			
2.PUMPINC			
3.HEATING/ CHILLING			
4.0UTSIDE PIPING			
C. BUILDINGS			
l.HATCHINC			
2.PUMP HOUSE			
3.GARAGE			
4.SHOP			
5.REFRIDGERATION			
6.STORAGE			
7.RESIFENCE			

SUBTOTAL $ 3,500,000

* SEE HATCHEKY SUMMAKY, TAKEN FROM WDG FACILITIES PLAN.

HATCHEKY: IRRIGON HATCHERY LOCATION CODEl 39

1. ACTUAL PRODUCTION:

SPECIES	A. POUNDS	B. PERCNET
S. STHD	5730	?
TOTAL	UNKNOWN	---

2. THEORETICAL PRODUCTION--based on existing facilities and:
-DENSITY FOKMULA *t.5* x L x VOL.) = *862,400* lb: 3.85 **lb/cf**
-FLOW FOKMULA (F x L x GPM) = *284,900* lb: 1.27 **lb/cf**
-AGENCY CKITEKIA KANCE (.8 X VOL) = 179,200 lb
and (2 x VOL) = *448,000* lb

3. FACTORS CONTROLLING PRODUCTION:
A. POND VOL.: *224,000* CF
B. WATEK: 24663.7 GPM

MODIFICATION COMMENTS: This is a new facility and while ample land and additional water are available, further expansion is not an issue. The facility is apparently not up to full production yet.

* Volume of currently used ponds
(› Volume of total available pond space
X Action Item

HATCHERY: KLICKITAT SALMON HATCHERY LOCATION CODE: 40

1. ACTUAL PRODUCTION:

SPECIES	A. POUNDS	B. PERCNET
SY. CHINOOK	65,100	36.9
F . CHINOOK	55,100	31.3
CUHO	55,900	31.7
TOTAL	176,000	----

2. THEORETICAL PKODUCTIUN--based on existing facilities and:
- DENSITY FORMULA (.5 x L x VOL.) = 685,300 lb: 2.27 lb/cf
- FLOW FOKMULA (F X L X CPM) = 65,000 lb: 0.22 lb/cf
- AGENCY CKITEKIA KANGE (.8 X VOL) = 241,4OU lb
  and (2 x VOL)=630,500 l b

3. FACTORS CUNTKOLLINC PRODUCITON:
   A. POND VOL.: "301 ,760 cf
   B, WATEK: 4977.6 - 7982.1 gpm
   1 reuse: (100X)
   c. FISH tiIOMASS
   i. rearing density:
   -lb/cf 0.58
   -lb/gpm 35.4

MODIFICATION COMMENTS: Need more water and it is unavailable, except from the river. Water resources are presently being used twice (100% blo reuse). No expansion is possible. None recommended.

* Volume of currently used ponds
(› Volume of total available pond space
X Action item

HATCHEKY: LITTLE WHITE SALMON NFH LOCATION CODE: 41

1. ACTUAL PKODUCTION:

SPECIES	A. P0UNDS	B. PERCENT
SP. CHINOOK	32,300	26.6
F. CHINOOK	89,000	73.4
TOTAL	121,300	----

2. THEORETICAL PRODUCTION--based on existing facilities and:
- DENSITY FOKMULA (.5 X L X VOL.)= 365,400 lb: 3.9 lb/cf
- FLOW YOKNULA (F X L X GPM) - 153,700 lb: 1.64 lb/cf
- AGENCY CKITEKIA KANGE (.8 X VOL)- 74,900 lb
  and (2 x VOL)= 187,400 lb

3. FACTORS CONTKOLLING PKODUCTION:
   A. POND VOL.: "93,710 (105,960) cf
   B. WATBK: 26278 gpm
   C. FISH BIOMASS:
      i. rearing density:
         -lb/CF 1.23
         -lb/CPM 4.62

MODIFICATION COMMENTS: At capacity, none recommended.

* Volume of currently used ponds
( ) Volume of total available pond space

HATCHEKY: OAK SPRINGS LOCATION CODE: 42

1. ACTUAL PKODUCTION:

SPECIES	A. POUNDS	B. PEKCENT
s. STHD	46,300	100
TOTAL	46.3013	----

2. THEORETICAL PRODUCTION--based on existing facilities and:
- DENSITY FOKMULA (.5 X L X VOL.)= 417,960 lb: 3.6 lb/cf
- AGENCY CRITERIA RANGE (.B X VOL)" 92,800 lb
and (2 X VOL)= 232,200 lb

3. FACTOKS CONTROLLING PRODUCTION:
A. POND VOL.: *116,100 CF
B. WATEK: NO DATA
C. FISH BIOMASS:
i. rearing density:
-lb/CF 0.4

MODIFICATION COMMENTS: NONE KECOMMENDED. Land available, additional water questionable due to agricultural irrigation (see Hatchery Summary).

* Volume of currently used ponds
( ) Volume of total available pond space

HATCHERY: KOUND BUTTE LOCATION CODE: 43

1. ACTUAL PKODUCTION:

SPECIES	A. POUNDS	B. PEKCENT
SP. CHINOOK	27,100	35.3
S. STHD	49,700	64.7
TOTAL	76,800	----

2. THEORETICAL PRODUCTION--based on existing facilities:
- DENSITY FORMULA (.5 X L X VOL.) = 116,200 lb: 3.23 1 b/cf
- ACENCY CKITEKIA KANGE (.8 X VOL)' = 28,800 lb
and (2 x VOL)= 72,801) l b

3. FACTORS CONTKOLLINC PKODUCTION:
A. POND VOL.: *36,000 CF
B. WATEK: NO DATA

MODICICATION COMMENTS: NONE RECOMMENDED. Water is available, but space is limited.

* Volume of currently used ponds
(› Volume of total available pond space

HATCHEKY: SPRING CREEK NATIONAL FISH HATCHERY LOCATION CODE: 44

1. ACTUAL PRODUCTION:

SPECIES	A. POUNDS	B. PERCENT
F. CHINOOK	194,600	
TOTAL	194,600	----

2. THEORETICAL PRODUCTION--based on existing facilities:
- DENSITY YOKMULA (.5 X L X VOL.)= 306,100 lb: 1.8 lb/cf
- FLOW YOKMULA (F X L X CPM)= 30,800 lb: 0.18 lb/cf
- AGENCY CRITERIA RANGE (.8 X VOL)= 136,000 lb
  and (2 x VOL)= 340,000 lb

3. FACTOKS CONTKOLLING PKODUCTION:
   A. P'OND VOL.: *170,078 c f
   B. WATEK: 2995.5 gpm
      i.enhance quality
         -treatment & recirc.: (90%)
   c. FISH BIOMASS:
      i decrease density: *X*
         -lb/CF: 1 . 1
         -lb/CPM: 64.9

MODIFICATION COMMENTS: Perhaps the current rearing density is too high. Construction of a settling pond to treat waste water prior to recirculation through filter beds and modification of the Spring Creek intake structure to collect all of the available water. This would allow a decrease in density. Ponds should be covered to decrease bird predation.

* Volume of currently used ponds
( ) Volume of total available pond space
X Action item

HATCHEHY: WARM SPRINGS NATIONAL FISH HATCHEKY LOCATION CODE: 45

1. ACTUAL PRODUCTION:

SPECIES	A. POUNDS	B. PEKCENT
SP. CHINOOK	33,700	UNKNOWN
S. STHD	2,482	UNKNOWN
TOTAL	33,700	----

2. THEUKETICAL PRODUCTION--based on existing facilities:
   DENSITY FOKMULA (.5 X L X VOL.)= 435,000 1 b: 3.2 lb/cf
   FLOW FORMULA (F x L x GPM)= 36,900 lb: 0.28 lb/cf
   AGENCY CKITEKIA RANGE (.8 X VOL)= 107,100 l b
   and (2 x VOL)" 267,700 lb

3. FACTOKS CONTROLLING PKODUCTION:
   A. POND VOL.: *133,860 (142,563) cf
      i. facilities not fully utilized *X*
   B. WATER: 3991 gpm
      I increase amnt. available: *X*
      ii.enhance quality
         -treatment and recirculation *X*
   C. FISH BIOMASS:
      i. rearing density
         -lb/cf: 0.25
         -lb/CPM: 8.4

MODIFICATION COMMENTS: Perhaps production could be increased if more water were available. Recirculation and temperature control may allow a three fold increase in production. Sources of additional land and water are available, however, existing facilities should be fully utilized before costly modifications are undertaken.

* Volume of currently used ponds
( ) Volume of total available pond space
X Action item

HATCHEKY: WILLAKD NATIONAL FISH HATCHERY LOCATION CODE: 46

1. ACTUAL PRODUCTION:

SPECIES	A. POUNDS	B. PERCENT
COHO	147,600	100
TOTAL	147,600	mm--

2. THEORETICAL PRODUCTION--based on existing facilities:
- DENSITY FORMULA (.5 X L X VOL.)- 254,400 lb: 2.65 lb/cf
- FLOW FOKMULA (F X L X GPM)- 187,327 lb: 1.95 lb/cf
- AGENCY CRITERIA RANGE (.8 X VOL)=' 76,800 lb
and (2 x VOL)= 192,000 lb

3. FACTORS CONTKOLLING PKODUCTION:
A. POND VOL.: *96,000 (96,472) cf
B. WATEK: 24,460 gpm
i.enhance quality
-temperature: *X*
C. FISH BIOMASS:
i. decrease density *X*
ii. rearing density:
-lb/CF: 1.5
-lb/GPM: 6.0

MODIFICATION COMMENTS: Perhaps densities are too high. Production of species reared may be enhanced by elevating water temperatures during winter and spring.

* Volume of currently used ponds
( ) Volume of total available pond space
X Action item

HATCHERY: WIZARD FALLS TKOUT HATCHEKY LOCATION CODE: 47

1. ACTUAL PRODUCITON:

SPECIES	A. POUNDS	B. PERCNET
KES. TKOUT	NO DATA	
TOTAL	NO DATA	

2. THEORETICAL PRODUCTION--based on existing facilities:
- AGENCY CRITERIA RANGE (.8 X VOL)= 303,200 lb
and (2 x VOL)= 756,000 lb

3. FACTORS CONTROLLING PKODLJCTION:
A. POND VOL.: 379,000 CF
B. WATEK: NO DATA

MODIFICATION COMMENTS: Wizard Falls Trout Hatchery produces no anadromous fish. Three dams exist on the Hetolius River, down river from the facility. Land is available for hatchery production: however most of the ten large raceways added in 1972 are not used because of IHN contamination, believed to be of river origin, and limited spring water. NONE RECOMMENDED.

* Volume of currently used ponds
( ) Volume of total available pond space
X Action item

HATCHEKY: CHELAN FALLS/ TROUT HATCHERY LOCATION CODE 48

1. ACTUAL PKODUCTLON:

SPECIES	A. POUNDS	B. PERCENT
TOTAL	NO DATA	

2. THEORETICAL PRODUCTION--based on existing facilities:
- DENSITY FOKMULA (.5 X L X VOL.)= NO DATA

3. FACTORS CONTROLLING PKODUCTLON:
   A. POND VOL.: No Data
   B. WATEK: 4475.3 gpm
      i. reuse: *x*

MODIFICATION COMMENTS: Chelan Falls and Chelan Trout are a joint facility funded by Chelan County PUD as mitigation for WDF and WDG. Land is available for expansion; however, spring water supplies are questionable due to ground water demands by local orchards. No modifications are recommended.

* Volume of currently used ponds
(› Volume of total available pond space.
X Action item

HATCHERY: ENTIAT NATIONAL FISH HATCHERY LOCATION CODE: 49

1. ACTUAL PKODUCTION:

SPECIES	A. POUNDS	B. PERCENT
SP. CHINOOK	51,200	100
TOTAL	51,200	----

2. THEOKETICAL PRODUCTION--based on existing facilities:
- DENSITY FOKMULA (.5 X L X VOL.)= 234,300 lb: 2.9 lb/cf
- AGENCY CRITERIA KANGE (.8 X VOL)= 66,800 lb
and (2 x VOL)' 167,400 lb

3. FACTORS CONTKOLLINC PRODUCTION:
A. POND VOL.: 83688 cf
B. WATEK: No data
c. FISH BIOMASS:
i. rearing density
-lb/CY: 0 . 6

MODIFICATION COMMENTS: NONE KECOMMENDED. Land is available, however, the availability of additional water is limiting. Groundwater development is not feasable, and additional river water is available In spring only.

* Volume of currently used ponds
( ) Volume of total available pond space
X Action item

HATCHEKY: LEAVENWOKTH NATIONAL FISH HATCHEKY LOCATION CODE: 50

1. ACTUAL PKODUCTION:

SPECIES	A. POUNDS	B. PEKCENT
SP. CHINOOK	130,500	51.1
w. STHD	125,000	48.Y
TOTAL	255,500	----

2. THEORETICAL PRODUCTION--based on existing facilities:

- DENSITY FORMULA (.5 X L X VOL.)= 905,100 lb: 3.2 lb/cf
- FLOW FORMULA (F X L X GPM)= 25,620 lb: 0.9 lb/cf
- ACENCY CKITEKIA KANGE (.8 X VOL)= 226,100 l b
  and (2 x VOL)= 566,8000 1 b

3. FACTORS CONTKOLLING PKODUCTION:
   A. POND VOL.: 283,440 c f
   B. WATEK: 2780.3 gpm
   C. FISH BIOMASS:
      i rearing density
      -lb/CF: 0 . 9
      -lb/GPM:91.9

MODIFICATION COMMENTS: Space exists for facility expansion, however, it appears unlikely that enough water is available. Theoretically, an additional 10 cfs of ground water should be available through additional wells; also, more river water is available In the spring. Those alternatives do not provide year arround sources. NONE RECOMMENDED.

* Volume of currently used ponds
( ) Volume of total available pond space
X Action item

HATCHERY: NACHES TROUT HATCHERY LOCATION CODE: 51A

1. ACTUAL PKODUCTKON:

SPECIES	A. POUNDS	B. PEKCENT
s. STHD	17,100	- -
TOTAL	17,100	----

2. THEOKETICAL PRODUCTION--based on existing facilities:
- DENSITY FORMULA (.5 X L X VOL.)= 222,800 lb: 3.4 lb/cf
- AGENCY-CRITERIA RANGE (.8 X VOL)= 54,200 lb
and (2 x VOL)= 131,000 lb

3. FACTORS CONTKOLLING PKODUCTION:
A. POND VOL.: 65,520 cf
B. WATER: No Data
c. FISH BIOMASS:
i rearing density
-lb/CY: 0.26

MODIFICATION COMMENTS: None recommended. Land is available and water could possibly be supplied by additional wells.

* Volume of currently used pond6
( ) Volume of total available pond space
X Action item

HATCHERY: NELSON SPRINGS POND LOCATION CODE: 51B

1. ACTUAL PKODUCTION:

SPECIES	A. POUNDS	B. PEKCENT
S. STHU	14,900	
TOTAL	-14,900	

2. THEOKETICAL PRODUCTION--based on existing facilities:
- DENSITY FOKMULA (.5 X L X VOL.)= 9,240 lb: 3.85 lb/cf
- AGENCY CKITEKIA KANGE (.8 X VOL)= 1,900 lb
and (2 X VOL)- 4,800 lb

3. FACTOKS CONTKOLLING PKODUCTION:
A. POND VOL.: 2,4000 cf
B. WATEK: No Data
C. FISH BIOMASS:
i. decrease density: *X*
il. rearing density
-lb/CF: 6.2

MODIFICATION COMMENTS: None recommended. Current densities are, perhaps, too high.

* Volume of currently used pond6
( ) Volume of total available pond space
X Action item

HATCHEKY: NILE SPRINGS LOCATION CODE: 52

1. ACTUAL PKODUCTION:

SPECIES	A. POUNDS	B. PEKCENT
TOTAL	NO DATA	----

2. THEOKETICAL PRODUCTION--based on existing facilities:
- DENSITY FOKMULA (.5 X L X VOL.)= NO DATA

3. FACTOKS CONTKOLLINC PKODUCTION:
   A. POND VOL.: NO DATA
   B. WATER: 672.6 GPM

MODIFICATION COMMENTS: NONE RECOMMENDED.

* Volume of currently used ponds
( ) Volume of total available pond space
X Action item

HATCHERY: OMAK TROUT HATCHEKY LOCATION CODE: 53

1. ACTUAL PKODUCTION:

SPECIES	A. POUNDS	B. PEKCENT
KES. TKOUT	NO DATA	100
TOTAL	NO DATA	----

2. THEORETIAL PRODUCTION--based on existing facilities:
- AGENCY CRITERIA RANGE (.8 X VOL)= 11,000 lb
and (2 X VOL)- 27,600 lb

3. FACTORS CONTKOLLING PKODUCTION:
A. POND VOLUME: 13,824 cf
B. WATER: 278 CPM

MODIFICATION COMMENTS: None recommended. No additional water is available. There is the possibility of reusing or recirculating that which is available.

* Volume of currently used ponds
( ) Volume of total available pond space
X Action item

HATCHEKY: PKIEST RAPIDS HATCHEKY LOCATION CODE: 54

1. ACTUAL PKODUCTION:

SPECIES	A. POUNDS	B. PEKCENT
F. CHINOOK	106,000	UNKNOWN
TOTAL	106,000	----

2. THEOKETICAL PRODUCTION--based on existing facilities:
- DENSITY FOKMULA (.5 X L X VOL.)- 302,100 lb: 1.7 lb/cf
- FLOW FORMULA (F X L X GPM)- 250,200 lb: 1.4 lb/cf
- AGENCY CKiTERIA KANGE (.8 X VOL)= 142,100 lb
  and (2 x VOL)= 355,400 lb

3. FACTOKS CONTKOLLING PKODUCTION:
   A. POND VOLUME: * 177,680 cf
   B. WATEK: 49820.6 gpm
      ii.enhance quality
         -temperature: *x*
   C. FISH BIOMASS:
      i. rearing density
         -lb/CF: 0.6
         -lb/CPM: 21.3

MODIFICATION COMMENTS: There is perhaps a need for additional well water for fish rearing and tempering the temperature of river water used for holding adults. This would result in higher adult survival to spawning and ultimately greater smolt production.

4,ESTIMATED INCREASED PRODUCTION (TOTAL): 40,000 lb

5. ESTIMATED CONSTRUCTION COSTS: $150,000

6. ESTIMATED INCREASES IN OPERATIONS COSTS: Funds for 60,000 lb of feed and 1/2 man year of labor.

* Volume of currently used ponds
( ) Volume of total available pond space
X Action item

HATCHEKY: RINGOLD SALMON REARING POND LOCATION CODE: 55

1. ACTUAL PKODUCTION:

SPECIES	A. POUNDS	B. PEKCENT
SP CHINOOK	111,900	74.6
F. CHINOOK	38,200	25.4
TOTAL	150,000	----

2. THEORETICAL PRODUCTION--based on existing facilities:
- DENSITY FOKMULA (.5 X L X VOL.)= 5,179,000 lb: 2.9 lb/cf
- FLOW FORMULA (F X L X GPM)= 96,500 lb: 0.05 lb/cf
- AGENCY CKITEKIA KANGE (.8 X VOL)- 1,437,400 lb
  and (2 x VOL)= 3.593.400 l b

3. FACTORS CONTROLLING PKODUCTION:
   A. POND VOL.: *1,796,700 c f
      i, facilities not fully utilized *X*
   B. WATEK: 11255.6 - 13452.9 gpm
      1. reuse: *x*
   C. FISH BIOMASS:
      i. rearing density
         -1 b/CF: 0.08
         -lb/CPM:13.3

MODIFICATION COMMENTS: None recommended until current site is fully utilized. With the additional water recently added to the facilities the production could be increased. Additional land and water are available for expansion of the site rearing capacity. Combined with a recirculation system, production could be further increased. The water source is agricultural return flow and should not be considered for egg hatching.

* Volume of currently used ponds
(› Volume of total available pond space
X Action item

HATCHEKY: ROCKY KEACH HATCHERY LOCATION CODE: 56A

1. ACTUAL PRODUCTION:

SPECIES	A. POUNDS	B. PERCENT
TOTAL	NO DATA	----

2. THEORETICAL PRODUCTION--based on existing facilities:
   * DATA WERE NOT AVAILABLE TO BASE A CALCULATION UPON.

3. FACTOKS CONTROLLING YKODUCTION:
   A. POND VOLUME: NO DATA
   B. WATE K: NO DATA
   C. FISH BIOMASS NO: DATA

MODIFICATION COMMENTS: Space and water from the Columbia Kiver are available for facility expansion. There are currently plans to develop the remaining 6 cfs of the 10 cfs of dam toe drain water, Warm river water during the summer may preclude attempts to increase production. Available rearing space for increased numbers of facility produced fingerlings is limited at the Turtle Rock Satellite.

* Volume of currently used ponds
(› Volume of total available pond space
X Action item

HATCHERY: TURTLE ROCK SATELLITE LOCATION CODE: 56B

1. ACTUAL PRODUCTION:

SPECIES	A. POUNDS	B. PEKCENT
TOTAL	NO DATA	----

2. THEORETICAL PRODUCTION--based on existing facilities:
- AGENCY CRITERIA RANGE (.8 X VOL)= 84,400 lb
and (2 x VOL) 211,101) lb

3. FACTOKS CONTROLLING PKODUCTION:
A. POND VOLUME: 105,560 cf
B. WATEK: 4035.9 CPM
C. FISH BIOMASS: NO DATA

MODIFICATION COMMENTS: Land may be available, but not certain due to a proposed park site on the island. Water is available from the river, although temperatures may be too high seasonally. None recommended.

* Volume of currently used ponds
( ) Volume of total available pond space
X Action item

HATCHERY: SPOKANE TKOUT HATCHEKY LOCATION CODE: 57

1. ACTUAL PKODUCTION:

SPECIES	A. POUNDS	B. PEKCENT
RES. TKOUT	NO DATA	
TOTAL	NO DATA	----

2. THEOKETICAL PRODUCTION--based on existing facilities:
- AGENCY CKITEKIA KANGE (.8 X VOL)= 34,800 lb
and (2 X VOL)= 87,100 lb

3. FACTORS CONTKOLLING PRODUCITON:
A. POND VOLUME : 43,537 cf
B. WATEK: 6502.2 GPM
C. FISH BIOMASS: NO DATA

MODIFICATION COMMENTS: NONE RECOMMENDED. No additional water is available.

* Volume of currently used ponds
( ) Volume of total available pond space
X Action item

HATCHERY: WASHBUKN ISLAND LOCATION CODE: 58

1. ACTUAL PRODUCTION:

SPECIES	A. POUNDS	B. PERCENT
TOTAL	NO. DATA	----

2. THEORETICAL PRODUCTION--based on existing facilities:
*NO DATA AVAILABLE TO BASE ESTIMATES UPON

3. FACTORS CONTKOLLINC PRODUCTION:
A. POND VOLUME: **NO DATA**
B. WATEK: NO DATA
c. FISH BIOMASS: NO DATA

MODIFICATION COMMENTS: NONE RECOMMENDED.

* Volume of currently used ponds
(› Volume of total available pond space
X Action item

HATCHEKY: WELLS HATCHEKY LOCATION CODE: 59

1. ACTUAL PKODUCTION:

SPECIES	A. POUNDS	B. PEKCENT
SP. CHINOOL	43,600	3u.7
F. CHI NOOK	900	0.6
S. STHD	97,600	68.7
TOTAL	142,100	----

2. THEOKETXCAL PRODUCTION--based on existing facilities:
- FLOW FORMULA (F X L X CPM › = 115,100 lb:

3. FACTORS CONTROLLING PRODUCTION:
   A. POND VOLUME : NO DATA
   B. WATEK: 11883.4 - 14618.8 CPM
   C. FISH BIOMASS:
      i. rearing density
         -1 b/CPM 12

MODIFICATION COMMENTS: Facility expansion is in progress based upon ample space and **water (approximately** 100 cfs).

* Volume of currently used ponds
( ) Volume of total available pond space
X Action item

HATCHEKY: WINTHROP NATIONAL FISH HATCHERY LOCATION CODE: 60

1. ACTUAL PKODUCTION:

SPECIES	A. POUNDS	B. PEKCENT
SP. CHINOOK	56,500	UNKNOWN
su. CHINOOK	13,540*(BY1980)	UNKNOWN
TOTAL	70,040	----

2. THEORETICAL PRODUCTION--based on existing facilities:
- DENSITY FORMULA (.5 X L X VOL. › = 215,200 lb: 2.9 lb/cf
- AGENCY CRITEKIA RANGE (.8 X VOL.)= 59,400 lb
and (2 X VOL.)= 148,400 lb

3. FACTOKS CONTKOLLINC PRODUCTION:
A. POND VOLUME: 74,200 cf
B. WATEK: NO DATA
C. FISH BIOMASS:
i. rearing density
-lb/CF 0.76

MODIFICATION COMMENTS: The Winthrop site has additional ground water and surface water potentials of 10 cfs and 30 cfs respectively. The ground water is about 49 degrees F and would require a low head lift, while the additional surface water would require additional ditch capacity. The area between Winthrop and Twisp is also thought to have good potential for shallow aquifers with abundant water supplies.

New adult collection and holding facilities were under construction at the time of our visit. USFWS had plans in 1981 to increase the station's production of spring chinook by constructing four 140' x 25' dirt rearing ponds operated with infiltration gallery groundwater (Frederiksen et al. 1981). The Washington Department of Natural Hesources voiced some oposition to the plan at that time.

* Volume of currently used ponds
( ) Volume of total available pond space
X Action item

HATCHEKY: YAKIMA TKOUT HATCHRY LOCATION CODE: 61

1. ACTUAL PRODUCTION:

SPECIES	A. POUNDS	B. PEKCENT
w. STHD	500	UNKNOWN
KES. TROUT	NO DATA	
TOTAL	*NO RECENT PRODUCTION DUE TO IHN	

2. THEOKETICAL PRODUCTION--based on existing facilities:
- AGENCY CRITRIA RANGE (.8 X VOL)= 75,600 lb
and (2 x VOL)= 189,100 l b

3. FACTORS CONTKOLLINC PRODUCTION:
A. POND VOLUME: 94,600 cf
u WATEK: 11138.6 GPM

MODLFICATION COMMENTS: Closure contemplated due to extremely poor condition of facility. Agency may instead opt. for transfer of facility to the Yaklma Indian Tribe. See the hatchery summary for details of hatchery condition. Maintaining water quality is a problem. No quality water available. The present practice of producing non-salmonid species may introduce new diseases and other problems.

* Volume of currently used ponds
( ) Volume of total available pond space
X Action item

HATCHEKY: DWORSHAK NATIONAL FISH HATCHEKY LOCATION CODE: 62

1. ACTUAL PKODUCTION:

SPECIES	A. POUNDS	B. PEKCENT
SP. CHINOOK	109,337*	
S. STHD	314,700	
TOTAL	314,700	

(* BY 1981)

2. THEOKETICAL PROSUCTION--based on existing facilities:
- DENSITY FOKMULA (.5 X L X VOL.)= 1,105,300 lb: 3.5 lb/cf
- FLOW FORMULA (F X L X GPIl)= 614,500 lb: 1 b/cf
- AGENCY CKITEKIA KANCE (.8 X VOL)-' 252,600 lb
and (2 x VOL)= 631,600 lb

3. FACTORS CONTKOLLINC PKODUCTION:
A. POND VOL.: "315,792 (373,542) cf
B. WATEK: 60,588 gpm
i. enhance quality
-treatment and recirculation --90X
c. FISH BIOMASS:
i. decrease density *X*
ii. rearing density
-lb/CF 1
-lb/GYM 5.2

MODIFICATION COMMENTS: NONE RECOMMENDED.

* Volume of currently used ponds
( ) Volume of total available pond space
X Action item

HATCHERY: EAGLE HATCHEKY (IDAHO FISH AND GAME) LOCATION CODE: 63

1. ACTUAL PRODUCTION;

SPECIES	A. POUNDS	B. PERCENT
KES. TROUT	NO DATA	
TOTAL	NO DATA	

2. THEORETICAL PRODUCTION--based on existing facilities:
- AGENCY CKITEKIA RANGE (.8 X VOL)= 42,200 lb
and (2 x VOL)= 105,400 lb

3. FACTORS CONTROLLING PRODUCTION:
A. POND VOL.: 52,720 cf
B. WATEK: 883.4 gpm
i. increase amnt. available: "X"

MODIFICATION COMMENTS: These facilities are near capacity trout production. Kemodeling with additions to the racewys is needed. Idaho Fish and Came owns ample land for expansion, but water availability and quality are major obstacles to increased production. NONE RECOMMENDED.

* Volume of currently used ponds
( ) Volume of total available pond space
X Action item

HATCHERY: HACERMAN NATIONAL FISH HATCHEKY LOCATION CODE: 64

1. ACTUAL PKODUCTION:

SPECIES	A. POUNDS	B. PEKCENT
SP. CHINOOK	7,610	N/A
F. CHINOOK	l-3, 5 78	N/A
S. STHD	135,629	N/A
TOTAL	183,700	----

* Sp.Chinook produced for BY82; F.Chinook produced for BY81; S.Sthd produced for BY79-BY82.

2. THEUKETICAL PRODUCTION--based on existing facilities:
* SEE COMMENTS IN MODIFICATIONS SECTION

3. FACTORS CONTROLLING PKODUCTION:
   A. POND VOLUME: NO DATA
   B. WATEK: 31524.7 - 39506.1 GPM

MODIFICATION COMMENTS: These facilities were recently expanded and there is a need for time to evaluate the production potential of the site.

* Volume of currently used ponds
( ) Volume of total available pond space
X Action item

HATCHERY: HACERMAN STATE HATCHEKY LOCATION CODE: 65

1. ACTUAL PRODUCTION:

SPECIES	A. POUNDS	B. PEKCENT
F. CHINOOK	9,200	UNKNOWN
COHO	5,200	UNKNOWN
KES. TKOUT	NO DATA	
TOTAL	NO DATA	

2. THEOKETICAL PRODUCTION--based on existing facilities:
- AGENCY CKITEKIA KANGE (.8 X VOL)= 450,900 1 b
and (2 x VOL>= 1,127,400 l b

3. FACTORS CONTROLLING PRODCUTION:
A. POND VOLUME: 563,680 c f
B. WATER: 39013.5 CPM
i. increase amnt. available: *X*

MODIFICATION COMMENTS: This site has land available, however water is limiting. Perhaps water could be reused or recirculated and tempered. The facility could use a total rehabilitation.

* Volume of currently used ponds
( ) Volume of total available pond space
X Action Item

HATCHEKY: HAYDEN CREEK LOCATION CODE: 66 NAME: PMW

1. ACTUAL PKOOUCTION:

SPECIES	A. POUNDS	B. PEKCENT
TOTAL	Hatchery No-Longer in Production	

2. THEORETICAL PRODUCTION--based on existing facilities:
- AGENCY CRITERIA RANGE (.8 X VOL>'= 489,700 lb
and (2 x VOL)= 1,224,490 lb

3. FACTOKS CONTKOLLING PRODUCTIONl
A. POND VOLUME: 612,176 cf
B. WATEK: 3587.4 gpm

MODIFICATION COMMENTS: Problems with the location of facility make improvements of dubious value. Need solution to Lemhi Kiver water rights issues. None recommended at present.

* Volume of currently used ponds
( ) Volume of total available pond space
X Action item

HATCHERY: KOOSKIA NATIONAL FISH HATCHEKY LOCATION CODE: 67

1. ACTUAL PKODUCTION:

SPECIES	A. POUNDS	B. PEKCENT
SP. CHINOOK	22,100	55.8
s. STHD	17,500	44.2-
TOTAL	39,600	----

2. THEOKETICAL PRODUCTION--based on existing facilities:
- DENSITY FOKMULA (.5 X L X VOL.)= 99,100 lb: 3.15 lb/cf
- FLOW FOKMULA (F X L X CPM>= 134,000 lb: 4.3 lb/cf
- ACENCY CKITEKIA KANGE (.8 X VOL)= 25,100 lb
  and (2 x VOL)= 62,800 lb

3. FACTOKS CONTROLLIGN PRODUCTION:
   A. POND VOLUME: 31,422 cf *; 36,158 cf **
   B. WATEK: 15.695.1 gpm
      i. enhance quality
         -treatment C recirc.: 90x
   c. FISH BIOMASS:
      i. decrease density *X*
      ii. rearing density
         -lb/CF 1.3
         -lb/CPM 2.5

MODIFICATION COMMENTS: Twelve acres of land are available for facilities expansion. Additional rearing capacity is limited by the available water supply and at present the supply of water is inadequate to provide for additional rearing capacity.
* Volume of currently used ponds
** Volume of total available pond space
X Action item

HATCHEKY: LOOKINGCLASS HATCHEKY LOCATION CODE: 68

1. ACTUAL PKODUCTION:

SPECIES	A. POUNDS	B. PEKCENT
TOTAL	New Facility	

2. THEORETICAL PRODUCTION--based on existing facilities:
- AGENCY CKITEKIA KANGE (.8 X VOL)= 43,200 lb
and (2 x VOL> 108,000 lb

3. FACTORS CONTKOLLING PKODUCTION:
A. POND VOL.: 54,000 cf
B. WATEK: 22421.5 gpm

MODIFICATION COMMENTS: NONE KECOMMENDED, NEW FACILITY.

* Volume of currently used ponds
( ) Volume of total available pond space
X Action item

HATCHERY: LYONS FEKKY SALMON HATCHEKY LOCATION CODE: 69

1. ACTUAL PKODUCTION:

SPECIES	A. POUNDS	B. PEKCENT
SP. CHINOOK	NO DATA	
COHO	NO DATA	
TOTAL	New Facility	----

2. THEORETICAL PKODUCTION--based on existing facilities:
- AGENCY CRITERIA KANGE (.8 X VOL)'= 126,400 lb
and (2 x VOL) 316,000 lb

3. FACTOKS CONTKOLLING PKODUCTION:
A. POND VOLUME: 158,000 cf
B. WATER: 19.282.5 gpm

MODIFICATION COMMENTS: This is a recently constructed facility. Any expansion should wait until the productivity of the station can be established. Expansion prospects depend on the availability of additional land and water. NONE RECOMMENDED.

* Volume of currently used ponds
( ) Volume of total available pond space
X Action item

HATCHERY: McCALL HATCHERY LOCATION CODE: 70

1. ACTUAL PRODUCTION:

SPECIES	A. POUNDS	B. PERCENT
SP. CHINOOK	10,034	UNKNOWN
su. CHINO0K	5,850	UNKNOWN
KES. TROUT	NO DATA	
TOTLA	NO DATA	

2. THEORETICAL PRODUCTION--based on existing facilities:
- AGENCY CRITERIA KANGE (.8 X VOL)= 51,200 lb
and (2 x VOL)- 128,000 l b

3. FACTOKS CONTROLLING PRODUCTION;
A. POND VOLUME: 64,000 cf
B. WATEK: 8968.6 CPM

MODIFICATION COMMENTS: NONE RECOMMENED> Additional facilities for summer chinook were planned for in the Lower Snake River Compensation Plan.

* Volume of currently used ponds
( ) Volume of total available pond space
X Action item

HATCHERY: NIACAKA SPKINCS HATCHERY LOCATION CODE: 71

1. ACTUAL PRODUCTION:

SPECIES	A. POUNDS	B. PERCENT
S. STHD	181,150	100
TOTAL	181,150	----

2. THEORETICAL PRODUCTION--based on existing facilities:
- ACENCY CRITERIA RANGE (.8 X VOL)= 128,800 l b
and (2 X VOL>= 322,000 lb

3. FACTORS CONTROLLING PRODUCTION:
A. POND VOLUME: 161,000 cf
B. WATEK: 59192.8 GPM
C. FISH BIOMASS:
i. rearing density
-lb/CF 1.13
-1 b/GYP1 3.06

MODIFIATION COMMENTS: NONE RECOMMENDNDENDED Water is limiting as there is extreme competition for water rights (all available water is tied up, including hatchery waste water).

* Volume of currently used ponds
( ) Volume of total available pond space
X Action item

HATCHERY: OXBOW (IDAHO FISH AND GAME) LOCATION CODE: 72

1. ACTUAL PRODUCTION:

SPECIES	A. POUNDS	B. PEKCENT
S. STHl)	N/A	
TOTAL	TKAP AND RELEASE SITE	----

2. THEORETICAL PRODUCTION based on existing facilities:
- AGENCY CRITERIA RANGE (.8 X VOL)= 47,300 lb
and (2 x VOL) 118,300 lb

3. FACTOKS CONTKOLLING PRODUCTION:
A. POND VOLUME: 59,148 cf
B. WATEK: 8026.9 gpm

MODIFICATION COMMENTS: Increase and improve adult holding facilities. This is presently a adult trap and juvenile release slte. Space is limited. None recommended.

* Volume of currently used ponds
( ) Volume of total available pond space
X Action item

HATCHEKY: PAHSIMEROL HATCHEKY LOCATION CODE: 73

1. ACTUAL PRODUCTION:

SPECIES	A. POUNDS	B. PERCENT
S.CHINOOK	622	3.0
SP. CHINOOK	19,900	97.0
TOTAL	20,522*	----

*Note: BY1981 release only

2. THEORETICAL PRODUCTION--based on existing facilities:
- AGENCY CKITEKIA KANCE (.8 X VOL)= 125,000 1b
and (2 x VOL> 313,000 lb

3. FACTORS CONTROLLING PRODUCTION:
A. POND VOLUME: 156,565 cf
B. WATER: 38565 gpm C. FISH BIOMASS:

MODIFICATION COMMENTS: Expansion is limited by. Idaho Power intends to increase production as needed. Facility is used as an adult trap, collection and spawning facility for Summer Steelhead, Summer Chinook and Spring Chinook. Steelhead are hatched and transfered to Niagara, Hagerman NPH, and Buhl facilities for rearing, then returned to be planted as smolts. Chinook are reared and released as smolts. None recommended.

* Volume of currently used ponds
( ) Volume of total available pond space
X Action item

HATCHEKY: RAPID RIVER HATCHERY LOCATION CODE: 74

ACTUAL PRODUCTION:

SPECIES	A. POUNDS	B. PERCENT
SP. CHINOOK		UNKNOWN
TOTAL	No data	----

2. THEORETICAL PRODUCTION--based on existing facilities:
- ACENCY CKITEKIA KANCE (.8 X VOL>= 256,000 1 b
and (2 x VOL)= 640,000 1 b

3. FACTORS CONTROLLING PKODUCTION:
A. POND VOLUME: 320,000 cf
B. WATEK: 23,318.4 gpm

MODIFICATION COMMENTS: Increases In production ar probably limited by the availability of eggs. Spring chinook adult survival is critically low and increased efforts must be made to improve their survival to spawning. This may be accomplished by use of medication, hormone treatments or improved handling methods and facilities. Space for expansion is limited. Facilities are not presently producing to capacity because of the above mentioned egg shortage. None recommeded.

* Volume of currently used ponds
( ) Volume of total available pond space
X Action item

HATCHERY: RED RIVER POND

PRODUCTION:

	POUNDS	B. PEKCENT
SP. CH NOOK	12,8OO	
TOTAL	12,800	

2. THEORETICAL PRODUCTION--based on existing facilities:
- AGENCY CKITEKIA RANGE (.I(X VOL)= 344,100 lb
and (2 x VOL)= 860,200 1 b

3. FACTORS CONTROLLING PRODUCTION:
A. POND VOLUME: 430,lOO cf
B. WATEK: 6,726.5 gpm
c. FISH BIOMASS:
1. rearing density
-lb/CF 0.03
-lb/CPM 1.9

MODIFICATION COMMENTS: If the amount of water shown on permit (7,726 gpm) is available during the rearing period, production can be increased by 24,OOO lb by simply increasing density and supplemental food.

4 .ESTIMATED INCREASED PRODUCTION (TOTAL): 24,000 lbs.

5. ESTIMATED INCREASES IN OPERATIONS COSTS: 36,000 lb feed

* Volume of currently used ponds
(› Volume of total available pond space
X Action item

HATCHERY: SAWTOOTH HATCHERY LOCATION CODE: 76

1. ACTUAL PKODUCTION:

SPECIES	A. POUNDS	B. PEKCENT
SP. CHINOOK	149,000	100
TOTAL		

*NEW FACILITY, FIGURES AKE PLANNED PKODUCTION.

2. THEORETICAL PRODUCTION--based on existing facilities:
   * NEW FACILITIES, N/A

3. FACTOKS CONTKOLLINC PKODUCTION:
   A. POND VOLUME: NO DATA
   B. WATER: NO DATA
   C. FISH BIOMASS: NO DATA

MODIFICATION COMMENTS: N/A NEW FACILITIES UNDER LOWER SNAKE COMPENSATION PLAN.

* Volume of currently used ponds
( ) Volume of total available pond space
X Action item

HATCHERY: TUCANNON LOCATION CODE: 77 NAME: PMW

1. ACTUAL PRODUCTION: SPECIES	A. POUNDS	B. PEKCENT
SP. CHINOOK	NO DATA	
F. CHINOOK	NO DATA	UNKNOWN
S. STHD	6,497	UNKNOWN
TOTAL	NO DATA	----

2. THEORETICAL PRODUCITON--based on existing facilities:
- AGENCY CRITERIA RANGE (.8 X VOL)= 246,200 lb
and (2 x VOL>= 615,600 lb

3. FACTORS CONTKOLLING PRODUCTION:
A. POND VOLUME: 307,786 cf
b. WATER: 33,632.3 - 40,358.7 gpm

MODIFICATION COMMENTS: Land and water are available for expansion. Expansion plans are underway as part of the Lower Snake Compensation Plan. None recommended.

* Volume of currently used ponds
( ) Volume of total available pond space
X Action item

HATCHEKY: WALLOWA HATCHEKY LOCATION CODE: 18A

1. ACTUAL PKODUCTION:

SPECIES	A. POUNDS	B. PEKCENT
SP. CHINOOK	NO DATA	
S. STHD	NO DATA	
TOTAL	*NEW FACILITY, NO DATA	- ---

2. THEORETICAL PRODUCITON--based on existing facilities:
PRODUCITON

3. FACTORS CONTKOLLINC PRODUCTION:
A. POND VOLUME: 110,257 cf
WATER:

MODIFICATION COMMENTS: NONE RECOMMENDED. Expansion under THE
A

* Volume of currently used ponds
(1 Volume of total available pond space
X Action item

HATCHERY: IMNAHA TRAPPING SATELLITE LOCATION CODE: 786

1. ACTUAL PKODUCTION:

SYECIES	A. POUNDS	B. PEKCENT
TOTAL	*N/A	TRAP, ACLIMATION, KELEASE FACILITY

2. THEORETICAL PRODUCITON--based on existing facilities:
* N/A

3. FACTORS CONTKOLLING PKODUCTION:
* NO DATA

MODIFICATION COMMENTS: NONE RECOMMENDED.

* Volume of currently used ponds
( ) Volume of total available pond space
X

HATCHEKY: LYONS FEKKY TROUT LOCATION CODE: 79

1. ACTUAL PKODUCTION:

SPECIES	A. POUNDS	B. PEKCENT
s. STHD	107,100	100
TOTAL	107,100	----

2. THEORETICAL PRODUCTION based on existing facilities:
- DENSITY FOKMULA (.5 X L X VOL.)= 527,062 Ib: 3.7 lb/cf
- FLOW FOKMULA (F X L X CPM)= 449,358 lb: 3.4 lb/cf
- AGENCY CKITEKIA RANGE (.8 X VOL)- 112,400 lb
  and (2 x VOL) 281,100 lb

3. FACTOKS CONTKOLLING PKODUCTION:
   A. POND VOLUME: 140,550 cf
   B. WATEK: 39,943 gpm
   c. FISH BIOMASS:
      i. rearing density
         -lb/CF 0.76
         -lb/CPM 2.7

MODIFICATION COMMENTS: New facilities are planned for under the Lower Snake Compensation Plan. None recommended;

* Volume of currently used ponds
( ) Volume of total available pond space
X Action item

HATCHERY: RINGOLD SPRINGS STEELHEAD POND LOCATION CODE: 80

1. ACTUAL PKODUCTION:

SPECIES	A. POUNDS	B. PERCENT
s. STHD	35,798	100
TOTAL	35,798	

2. THEORETICAL PRODUCTION--based on existing facilities:
- AGENCY CKITEKIA RANGE (.8 X VOL)' 1,338,200 lb
and (2 x VOL)= 3,345,400 lb

3. PACTOKS CONTKOLLING PRODUCTION:
A. POND VOLUME: 1,672,704 cf
B. WATER: 2690.6 GPM
c. FISH BIOMASS:
i. increase density *x*
ii. rearing density
-lb/CF 0.02
-1 b/Cl'14 13.3

MODIFICATION COMMENTS:J Under the circumstances, this facility should be capable of considerably greater production of anadromous salmonids with an increase in water. The water is available. Because of the location of the facility, and the seasonal extremes in temperature, we recommend a doubling of the production. This will allow an evaluation of capacity.

4.ESTIMATED INCREASED PRODUCTION (TOTAL): 40,000 lb

5. ESTIMATED CONSTRUCTION COSTS: $120,000

6. ESTIMATED INCKEASES IN OPERATIONS COSTS: Funding for 60,000 lb. of feed and 1/2 man year labor.

* Volume of currently used ponds
( ) Volume of total available pond space
X Action item

HATCHERY: LITTLE SHEEP TKAPPINC SATELLITE LOCATION CODE: 81

1. ACTUAL PKODUCTION:

SPECIES	A. POUNDS	B. PERCENT
TOTAL	N/A * FACILITY IS A TRAPPING, ACCLIMATION, AND RELEASE SITE.	

2. THEORECTICAL PRODUCITON--based on existing Facilities:
*N/A

3. FACTORS CONTROLLING PRODUCITON:
A. POND VOLUME: NO DATA
B. WATEK: NO DATA

MODIFICATION COMMENTS: Modifications to this facility will be undertaken as part of the Lower Snake Compensation Plan. **NO** RECOMMENDATIONS.

* Volume of currently used ponds
(1 Volume of total available pond space
X Action item