2019 Feather River Hatchery Chinook Salmon and Steelhead Spawning and Release Protocol

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Background:

The Feather River Hatchery (FRH) conducts two artificial propagation programs for Central Valley (CV) Chinook salmon: CV spring-run and CV fall-run and one artificial propagation program for CV steelhead. CV spring-run Chinook are listed as threatened under both the California Endangered Species Act and the Federal Endangered Species Act. CV fall-run Chinook provide for economically important commercial fisheries as well as popular sport fisheries in the ocean and inland. CV steelhead are listed as threatened under the Federal Endangered Species Act.

The primary purpose of the spring-run program is to conserve and promote phenotypic spring-run Chinook salmon in the Feather River. A coequal purpose of the program is to mitigate for the loss of spawning and rearing habitat due to construction of Oroville Dam. Additionally, due to the threatened status of spring-run it is crucial that hatchery operations are conducted in a way that minimizes impacts to natural spawning populations of CV spring-run populations, including those in Mill, Deer, Clear, and Butte Creeks.

Due to past hatchery spawning practices and overlap in spawning habitat in-river, spring and fall runs on the Feather River are considered introgressed. In 2012, the California Hatchery Scientific Review Group (HSRG) released the California Hatchery Review Report that establishes specific recommendations for all California hatcheries, including the FRH. (See Attachment A) The report states, “Most hatcheries were producing fish for harvest primarily to mitigate for past habitat loss (rather than for conservation of at- risk populations) and were not taking into account the effects of their programs on naturally spawning populations (CA HSRG 2012). With numerous species listed as threatened or endangered under the Endangered Species Act, Congress identified salmon conservation as a high priority.” The document further states, “The goal of this hatchery program review initiative is to ensure that hatchery programs are managed and operated to meet one or both of the primary purposes for hatcheries:

- Helping recover and conserve naturally spawning salmon and steelhead populations, and
- Supporting sustainable fisheries with little or no deleterious consequence to natural populations.”

Since 2012, spawning practices at FRH have been refined and reviewed annually to further meet HSRG recommendations and to specifically minimize introgression between runs on the Feather River.

The primary purpose of the fall-run program is to mitigate for the loss of spawning and rearing habitat due to construction of Oroville Dam and support river and ocean fisheries. Additionally, fall-run are produced and triploided for a small cold-water fishery in Lake Oroville for DWR’s FERC program as well as the statewide Inland Chinook salmon program.

The FRH steelhead program is implemented as an integrated hatchery mitigation program for loss of spawning and rearing habitat due to construction of Oroville Dam. This is an integrated production program and provides recreational fishing opportunities. Both hatchery and natural origin steelhead from the Feather River are considered part of the Central Valley steelhead ESU (NOAA 2006).

Chinook salmon

1.0 Spring-run Chinook Salmon Broodstock Collection and Spawning Protocol:

1.1 Broodstock Identification

Only early-arriving Chinook salmon (phenotypic spring-run) are used as broodstock for the spring-run Chinook program. Typically, fish ascending the fish ladder April through June are trapped, tagged, and a hatchery or natural-origin determination is recorded. The trapping and tagging process typically begins on or about April 1 and continues through June. The process consists of double tagging fish with two sequentially numbered and color-coded Hallprint Dart tags on either side of the dorsal fin. Number sequences are unique to each fish. Water flow into the FRH ladder was reduced on June 28, 2019, to prevent new fish from entering the ladder. Any mortality observed during the broodstock tagging was documented and heads removed for Coded Wire Tag (CWT) extraction from fish with an adipose fin-clip.

During spring of 2019, 5945 adult salmon where tagged and returned to the Feather River. (Table 1). See table 2 for comparison to previous years.

Table 1- 2019 FRH Spring-run Broodstock Tagging

	5/6/2019	5/20/2019	5/24/2019	5/28/2019	5/29/2019	5/30/2019	6/3/2019	6/5/2019	6/10/2019	6/14/2019	6/17/2019	6/19/2019	6/21/2019	6/24/2019	6/26/2019	6/27/2019	6/28/2019	Total
Total#Tagge	3	225	506	521	428	469	381	159	425	196	241	404	429	419	593	407	139	5945
Recaps	0	0	9	20	20	40	33	9	93	58	36	92	107	118	317	429	176	1557
Wild	1	24	45	42	36	34	19	10	26	19	13	37	31	31	42	31	11	452
Morts	0	1	4	0	0	0	0	0	0	0	0	0	0	1	2	1	0	10
Single tags	0	0	0	0	2	1	4	3	3	0	1	2	2	0	10	3	0	32
Acoustictags	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jacks	0	15	28	49	29	54	19	8	38	12	13	39	26	75	96	48	19	561

Table 2- Spring-returning adult Chinook salmon tagged and released to the Feather River as potential spring-run Chinook broodstock, 2004-2019.

Total Spring Run Hallprint Tagged	Year
3650	2004
6021	2005
17438	2006
9755	2007
1915	2008
1462	2009
3502	2010
6023	2011
7494	2012
20057	2013
7289	2014
5355	2015
2917	2016
762	2017
3206	2018
5945	2019
6424	Average

* 2004 was the first year that juvenile spring-run were coded-wire-tagged at a 100% rate.
This likely increased the adipose fin-clip rate observed in returning adults for the subsequent four years.

1.2 Broodstock collection and spawning

For spring-run spawning, the FRH will begin sorting salmon on Monday, September 16, 2019. Fish entering the hatchery are sorted and all Hallprint tagged SRCS broodstock are separated from all other unmarked Chinook. Initially, male and female SRCS will be separated in the alleyways between the tanks on day of spawn, until enough pairs are obtained for spawning. Fish that cannot be spawned on a given day will be placed into round tanks for subsequent spawning. Females and males will be sorted and held separately to reduce stress and mortality in the female broodstock. Spawning will occur whenever enough numbers of ripe spring-run broodstock (Hallprint Dart tagged fish) have accumulated in the round tanks of roughly equal sex ratio. Spawning and egg collection will follow the egg collection model described in Table 3 as closely as logistically possible. If it is determined by hatchery staff that spring-run spawning can be conducted, hatchery staff will notify all individuals involved in tissue and scale collection, and CWT recovery as to when spawning will commence. The head will be removed from any adipose clipped fish for coded-wire tag (CWT) analysis. CWT analysis is used to examine contribution rates of hatchery-origin strays from other CV hatcheries into individual egg trays. CWT analysis will be used to identify stacks and trays with fall-run contribution and/or strays. Trays that include both spring and fall run parentage and/or strays as identified by CWT will be culled. One round tank will be reserved to hold the non-Hallprinted Chinook that have entered the hatchery for the Inland Chinook program. All non-Hallprinted Chinook entering the hatchery during the spring-run spawning period that are excess to the Inland Program goals are counted and excised. No fish are returned to

the river in order to reduce hatchery impacts to the natural spawners and to assure fish will not be counted more than once. Spring-run broodstock collection and spawning will start Thursday, September 19, 2019 and continue through Monday, September 30, 2019.

Spring Run Chinook Spawning Procedures:

1. Fish will be anesthetized using CO_2, lifted into the hatchery, sorted on the table by sex. Each **ad-clipped** fish will be marked with a reusable tag (5 ¾ inch safety pin with uniquely numbered tag attached to the lower jaw or operculum). Males will get an odd numbered tag and females will get an even numbered tag.

    a. As fish are pulled off the table to spawn, the front of house (FOH) data recorder, records sex, indicates grilse or adult based on total length, adipose fin-clip status, and records the unique Hallprint tag number onto a data card. The data card is then attached to the egg tub to track the parentage of the eggs in each tub.

    b. Grilse are incorporated at 2% rate*.

    c. Spring-run Chinook are spawned using a true 1 male: 1 female ratio. FRH staff will attempt to eliminate the reuse of males as much as possible. However, if males are used multiple times, they are treated as new fish each time they are spawned. This is recorded and highlighted on the associated data card for each tub and number is recorded for hatchery files.

    a. If two tubs of eggs will be combined after fertilization, each tub of eggs will be measured before adding the two females. Both data cards will be attached to the egg tub of combined eggs. Fertilized eggs from a maximum of two females can be combined in a tub to avoid confusion and data recording errors, and to maximize separation of families.

    *If 3- and 4-year-old returns are low, discussion and consensus by the Feather River Hatchery Operations Team would determine grilse incorporation rate for the current broodstock collection season.

2. Once a tub is filled with fertilized eggs, the FOH data recorder will attach the data card(s) to the tub. Then the filled tub will be taken to the egg room. Egg weight (in ounces) will be recorded on the data cards and data sheets. The data cards will be removed from the tub and given to the back of house (BOH) data recorder. At the time the eggs are emptied into an incubation tray. Each tub will be measured into the incubation tray and egg data will be recorded on sheet (Attachment C). Egg tubs will be rinsed thoroughly with UV water prior to being reused.

    a. To ensure maximum survival in 2019, eggs will be counted at the collection stage.
        i. First, a 2oz sample of eggs will be taken from each egg tub that are taken to BOH. The eggs will be water hardened and counted at end of day to determine eggs per ounce. The average eggs per ounce is applied to the total weight to provide total ounces taken for the day.

b. If some overripe eggs are observed in the tub, the whole tub will be discarded and the BOH data recorder will check the 'Discarded' box on the data card. The stack and tray fields are left blank on the data card.

3. When the tub of fertilized eggs is emptied into an incubator tray, the stack, tray number, and section within the tray will be recorded on the data card by the BOH data recorder.

    a. The fertilized eggs will be drained of ovarian fluid and milt in a colander and then hardened in incubation trays using 4 oz. iodophor for disinfection.

4. When a data card is filled and complete, it will be grouped with the other cards from the day, scanned and sent to CDFW Ocean Salmon Project (OSP) for entry into a database. All data sheets will need to have quality assurance and quality control measures taken at the end of season. In the interest of time, documents will be shared with OSP on a weekly basis, using One Note. All data sheets used by hatchery staff can be found in Attachment C.

5. All fish carcasses (spawned, killed not spawned, and dead in tank) will be immediately brought to the sampling station. Fish will be prepared for genetic tissue and scale sampling, and CWT collection. Fish condition, adipose status, sex and fork length will be recorded. Hallprint tag numbers will be recorded and tags removed. A caudal fin clip (other fin may be used if caudal is covered in fungus or otherwise unusable, fin type will be recorded in comments field on data sheet) will be collected from each Hallprint tagged fish and given a unique sample ID. A scale sample (skin patch) will be collected from each Hallprint tagged fish and given a unique sample ID. The head will be collected from each adipose fin clipped Hallprint tagged fish, given a unique head tag ID and sealed in a bag with the head tag. Data sheets can be found in Attachment C.

6. CWT analysis will be used to identify stacks and trays with spring-run contribution. Trays that include both spring and fall run parentage as identified by CWT will be culled.

7. Broodstock collection will continue until September 30, 2019. At the end of the day, September 30, 2019 all fish will be euthanized.

1.3 San Joaquin Collection

After FRH spring-run egg collection goals determined to be met, eggs will be collected for the San Joaquin River Restoration Program. The first collection is for broodstock. To achieve enough genetic variability, eggs are collected from the spring run trays ensuring that at least 350 paired crosses are used for a total of 5,470 eggs. Data from each pair will be collected for the San Joaquin program and virology samples will be taken for IHN. This will allow rejection of a significant number of crosses and yet provide substantial genetic variability in the future broodstock population.

Egg collection for the San Joaquin River Restoration Program will be secondary to collection for the FRH spring run Chinook program (see Attachment B) and will be dependent on time constraints and availability of broodstock.

2.0 Fall-run Chinook Broodstock Collection and Spawning Protocol

2.1 Broodstock collection and spawning

Fall-run spawning will commence on Wednesday, October 9, 2019, after the collection for the statewide Inland Chinook program and the San Joaquin collection. Beginning collection of fall-run broodstock in the second week of October has been determined to incorporate few spring-run gametes. The practice of Hallprint tags to identify early arriving salmon and real time CWT analysis has confirmed greater separation in the timing of the runs. All salmon entering the hatchery on or after this date that does not carry a Hallprint tag will be considered a candidate for inclusion in the fall-run broodstock. Broodstock collection and spawning will be conducted in a manner that represents fish arriving from throughout the fall-run spawning period.

During fall-run spawning, broodstock can include all salmon (adipose fin intact and fin-clipped) except Hallprint tagged salmon. Spawning and egg collection will follow the egg collection model described in Table 4 as closely as logistically possible. Fall-run spawning includes both adipose fin intact and fin-clipped fish in the broodstock, CWT analysis will be used to identify stacks and trays with spring-run contribution. Trays that include both spring and fall run parentage as identified by CWT will be culled.

Fall-run Chinook will be collected and held in round tanks until needed for spawning. Fall-run Chinook are spawned using a true 1 male: 1 female ratio. Reuse of males will not occur and may result in not meeting egg collection goals. If the daily egg take goal is not met, the remainder of eggs will be added to the target for the next day. Grisles will be incorporated at no more than 2%.

The head will be removed from any adipose clipped fish for coded-wire tag (CWT) analysis. CWT analysis is used to examine contribution rates of hatchery-origin strays from other CV hatcheries into individual egg trays. The fall run Chinook salmon mitigation production goal is 6 million juveniles. No more than 13.0 million green eggs will be collected throughout the run. This target allows for a buffer to meet fish targets in case of disease or other loss, culling of trays containing eggs from spring run parents. Excess eyed eggs above the eyed egg goal will be culled. The number of culled eggs per season is recorded and kept in hatchery files. Eggs will be collected and culled to represent the spectrum of the run to meet production goals according to the chart provided (Figure 2).

Fall run Chinook Salmon Spawning Procedures:

1. Fish will be anesthetized using CO_2, lifted into the hatchery, sorted on the table by sex. Each **ad-clipped** fish will be marked with a reusable tag (5 ¾ inch safety pin with uniquely numbered tag attached to the lower jaw or operculum). Males will get an odd numbered tag and females will get an even numbered tag.

    a. As fish are pulled off the table to spawn, the front of house (FOH) data recorder will record sex, grisle or adult based on total length, and ad-clip status of each spawned fish on the data card. For non-adipose fin-clipped fish, a line will be drawn through the 'ID Number' field. For ad-clipped fish, the staff member

spawning will read the tag ID number to the data recorder. Completed data cards will be attached to the egg tub. Each tub will have at least one and no more than two data cards associated with it.

b. Grilse are incorporated at 2% rate*.

c. Fall-run Chinook are spawned using a true 1 male: 1 female ratio. Reuse of males will not occur and may result in not meeting egg collection goals.

d. If two tubs of eggs will be combined after fertilization, each tub of eggs will be measured before adding the two females. Both data cards will be attached to the egg tub of combined eggs. Fertilized eggs from a maximum of two females can be combined in a tub to avoid confusion and data recording errors, and to maximize separation of families

*If 3- and 4-year-old returns are low, discussion and consensus by the Feather River Hatchery Operations Team would determine grilse incorporation rate for the current broodstock collection season.

2. Once a tub is filled with fertilized eggs, the FOH data recorder will attach the data card(s) to the tub. Then the filled tub will be taken to the egg room. Egg weight (in ounces) will be recorded on the data cards and data sheets. The data cards will be removed from the tub and given to the back of house (BOH) data recorder. At the time the eggs are emptied into an incubation tray. Each tub will be measured into the incubation tray and egg data will be recorded on sheet (Attachment C). Egg tubs will be rinsed thoroughly with UV water prior to being reused.

3. When the tub is emptied into an egg tray, the back of house (BOH) data recorder will remove the data card and record the stack and tray number. If the tub is split between two trays, the data recorder will record the numbers of both stacks and trays containing that family on the data card. The emptied tub will be rinsed thoroughly with UV water and sent back to the spawning room to be used again.

    a. If some overripe eggs are observed in the tub, the whole tub will be discarded and the BOH data recorder will check the ‘Discarded’ box on the data card. The stack and tray fields are left blank on the data card.

    b. Fertilized eggs will be drained of ovarian fluid and milt in a colander and placed into incubation trays with 4 oz. iodophor for disinfection. Further information on egg incubation procedures can be found in FRH SOP 001 Egg Culture (see Hatchery Manager if more information is requested).

4. When a data card is filled and complete, it will be grouped with the other cards from the day, scanned and sent to CDFW Ocean Salmon Project (OSP) for entry into a database. All data sheets will need to have quality assurance and quality control measures taken at the end of season. In the interest of time, documents will be shared with OSP on a weekly basis, using One Note. All data sheets used by hatchery staff can be found in Attachment C.

5. Carcasses of spawned fish will be brought to the CWT sampling station. Fish ID numbers will be recorded, ID tags removed, and the fish prepared for CWT and scale sampling. Data sheets can be found in Attachment C.

6. All fish carcasses (spawned, killed not spawned, and dead in tank) will be immediately brought to the sampling station. Fish will be prepared for scale sampling and CWT collection. Fish condition, adipose status, sex and fork length will be recorded. Fish ID tag numbers will be recorded, and tags removed. A scale sample (skin patch) will be collected from a percentage of fish and given a unique sample ID. The head will be collected from each adipose fin clipped fish, given a unique head tag ID and sealed in a bag with the head tag. Data sheets can be found in Attachment C

2.2 Lake Oroville Coldwater Fishery and Inland Collection

Adult Chinook, without a Hallprint tag, will be held in two of the four round tanks during the spring-run spawning period from September 16, 2019 through September 30, 2019 to be used as broodstock for the Lake Oroville cold-water fishery and the statewide Inland Chinook program. Also, any excess SRCS ad-clip Hallprint tagged salmon may be used for the Inland Chinook Program collection. The Inland Chinook Program collection will start October 2, 2019 and run through October 7, 2019. The daily goal for inland collection will be approximately 450,000 fall run Chinook eggs per day.

All eggs intended for the Lake Oroville cold-water fishery program and eggs intended for the statewide inland Chinook program will be triploided (100%). Approximately 300,000 green triploid eggs will be collected for the Lake Oroville cold-water fishery. Eggs will be disinfected then isolated in the FRH Inland Hatchery building following procedures outlined in FRH SOP 015(see Hatchery Manager if more information is requested). Once eyed, eggs will be addled and approximately 170,000 good eyed eggs will be kept at the FRH inland building for the Lake Oroville inland Chinook program. Eggs in excess of 170,000 will be culled. Approximately, 1.8 million green eggs will be collected for the statewide inland Chinook program. The statewide inland Chinook will be transferred to the Silverado Fish Base (SFB) after the day of spawning to incubate, hatch, and rear.

All adult Chinook salmon remaining at the hatchery after Monday, October 8th will be excised on Wednesday, October 9th before the beginning of fall-run broodstock collection.

3.0 Chinook Salmon Production Goals:

During the 2019/2020 spawning and rearing season priority is given to improving temporal separation between spring and fall runs.
The current production goals for release or transfer from FRH are as follows:

Spring-Run Chinook Salmon Conservation:	Up to 2 million smolts
Fall-Run Chinook Salmon Lake Oroville:	Up to 155,000 fingerlings*
Fall-Run Chinook Statewide Inland:	Up to 705,000 fingerlings
Fall-Run Chinook Salmon Mitigation:	Up to 6 million smolts

*In-land Lake Oroville plant will be early spring due to FRH being dewatered for repairs. Increasing the number of fingerlings planted was considered and rejected by fish pathologist. Increasing numbers of released salmon poses a greater chance of disease outbreak. Numbers, not size, is the determining factor.

For both spring and fall- runs, assumed survival from green to eyed egg stage is approximately 85 percent, and 92 percent for eyed egg to ponding of fish. Total green egg take for fall-run is approximately 2,500,000 over eyed egg stage goals. This egg take buffer over actual production goals allows for potential mortality in egg trays and culling of trays if necessary. After addling, eggs above the daily eyed egg goals listed in Table 4 and Figure 2 will be culled. When culling, an equal proportion of eggs will be removed from each tray to maintain similar sized family groups.

Survival of eggs from green to hatch for the inland program is assumed to be significantly less than those of the fall and spring run production due to losses incurred in the triploiding process and the additional stress caused by transporting green eggs from FRH to Silverado Fish Base (SFB) for quarantine.

Because triploiding Chinook salmon is still a relatively new process at FRH and for CDFW, we do not have historical data from which to estimate expected mortality. We have conservatively set the assumed green to hatch survival rate at 50%. Currently the statewide inland program is limited by incubation space, therefore the number of green eggs collected will maximize the available space. Loss rates will be tracked for eggs shipped green to SFB to help better refine future production targets in relation to release goals. Annual data and analysis will be included in annual reports.

Table 3- Spring-run Eyed Egg Goal

	Feather River Hatchery 2019																
	Spring-run Eyed Egg Goal			2,000,000													
	Date	Status	Lot #	# of females (assume one spawning pair per incubation tray)	Actual Green Eggs Collection (assume 4,500 eggs/femal	Predicted Percent culling rate	Predicted Egg Collection after culling	Actual Percent culling rate	Actual Egg Collection after culling	Assumed 80% Survivalto eyed after culling basedon Predicted	Assumed 85% Survival to eyed after culling	90% Survival to eyed after culling	Assumed 80% Survival to eyed aftercullingbased on actual Egg collection	Assumed 90% Survivalfrom eyed eggtoponded fish based on columnL Predicted Egg collection	Assumed 90% Survival from eyed egg to ponded fish based on column M Predicted Egg	Assumed 95% Survival from eyed to ponded fish based on Predicted Egg collection
1	9/18	Completed	1	67	301,500	1%	298,485			238,788	253,712	253,712		228,341	228,341	241,027
2	*	Completed	2	133	598,500	1%	592,515			474,012	503,638	503,638		453,274	453,274	478,456
3	*	Expected	3	222	999,000	1%	989,010			791,208	840,659	840,659		756,593	756,593	798,626
4	*	Expected	4	178	801,000	1%	792,990			634,392	674,042	674,042		606,637	606,637	640,339
5	9/30	Expected	5	133	598,500	1%	592,515			474,012	503,638	503,638		453,274	453,274	478,456
		Totals		733	3,298,500		3,265,515		0	2,612,412	2,775,688	2,775,688		2,498,119	2,498,119	2,636,903
	*	Specific spawning dates and lot sizes are variable and depend on availability of ripe fish.															

Figure 1- 2019 Predicted SRCS Egg Collection

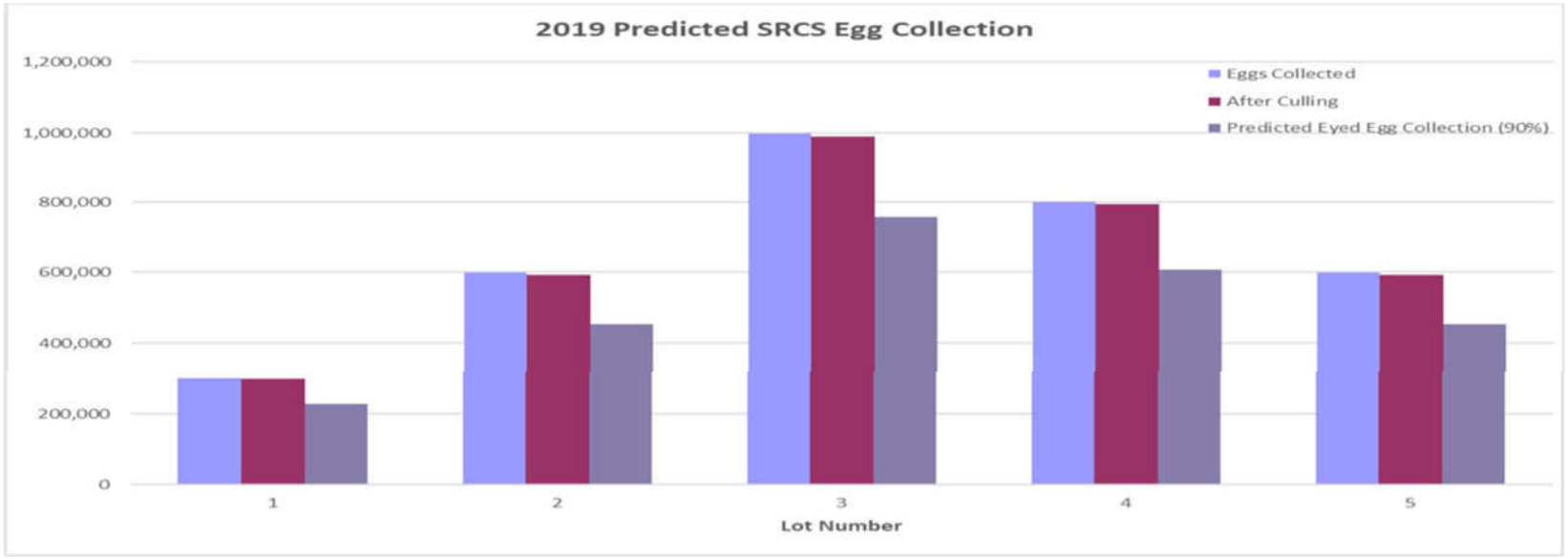
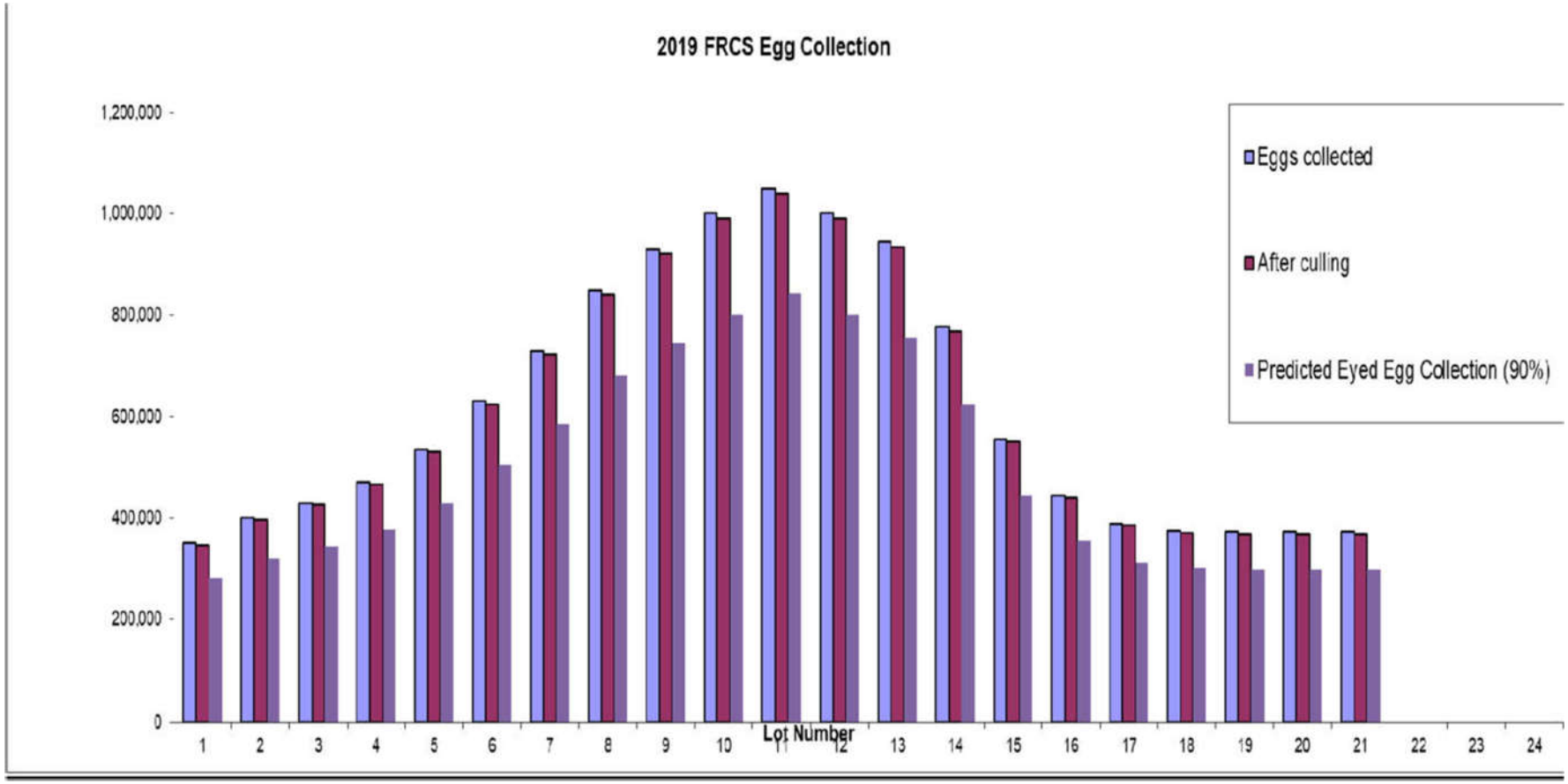


Table 4- FRCS Egg Collection

	Feather River Hatchery 2019														
	Fall-runEyed Egg 7,000,000 (6,000,000 mitigation & 1,000,000 enhancement)														
	Date	Status	Expected GreenEggs Collection (assumes 4500 eggs/female)	Actual Green Eggs Collection	Predicted Percent culling rate	Predicted Egg Collection after culling	Actual Percent culling rate	Actual Egg Collection after culling	Assumed 80% Survival to eyed after culling based on Predicted Egg collection	Assumed 85% Survival to eyed after culling	90% Survival to eyed after culling	Assumed 80% Survival to eyed afterculling based on actual Egg collection	Assumed 90% Survival fromeyed egg to ponded fish based on column L Predicted Egg collection	Assumed 90% Survival from eyed egg to ponded fish based oncolumn M Predicted Egg collection	Assumed 95% Survivalfromeyed topondedfish based on Predicted Egg collection
1	10/9	Expected	350,000		1%	346,500			277,200	294,525	311,850	0	265,073	280,665	296,258
2	*	Expected	400,000		1%	396,000			316,800	336,600	356,400	0	302,940	320,760	338,580
3	*	Expected	430,000		1%	425,700			340,560	361,845	383,130	0	325,661	344,817	363,974
4	*	Expected	470,000		1%	465,300			372,240	395,505	418,770	0	355,955	376,893	397,832
5	*	Expected	535,000		1%	529,650			423,720	450,203	476,685	0	405,182	429,017	452,851
6	*	Expected	630,000		1%	623,700			498,960	530,145	561,330	0	477,131	505,197	533,264
7	*	Expected	730,000		1%	722,700			578,160	614,295	650,430	0	552,866	585,387	617,909
8	*	Expected	850,000		1%	841,500			673,200	715,275	757,350	0	643,748	681,615	719,483
9	*	Expected	930,000		1%	920,700			736,560	782,595	828,630	0	704,336	745,767	787,199
10	*	Expected	1,000,000		1%	990,000			792,000	841,500	891,000	0	757,350	801,900	846,450
11	*	Expected	1,050,000		1%	1,039,500			831,600	883,575	935,550	0	795,218	841,995	888,773
12	*	Expected	1,000,000		1%	990,000			792,000	841,500	891,000	0	757,350	801,900	846,450
13	*	Expected	943,500		1%	934,065			747,252	793,955	840,659	0	714,560	756,593	798,626
14	*	Expected	777,000		1%	769,230			615,384	653,846	692,307	0	588,461	623,076	657,692
15	*	Expected	555,000		1%	549,450			439,560	467,033	494,505	0	420,329	445,055	469,780
16	*	Expected	444,000		1%	439,560			351,648	373,626	395,604	0	336,263	356,044	375,824
17	*	Expected	388,500		1%	384,615			307,692	326,923	346,154	0	294,230	311,538	328,846
18	*	Expected	375,000		1%	371,250			297,000	315,563	334,125	0	284,006	300,713	317,419
19	*	Expected	372,093		1%	368,372			294,698	313,116	331,535	0	281,805	298,381	314,958
20	*	Expected	372,093		1%	368,372			294,698	313,116	331,535	0	281,805	298,381	314,958
21	*	Expected	372,093		1%	368,372			294,698	313,116	331,535	0	281,805	298,381	314,958
		Totals	12,974,279			12,844,536		0	10,275,629	10,917,856	11,560,083	0	9,826,070	10,404,074	10,982,078

Figure 2- 2019 Predicted FRCS Egg Collection



4.0 Chinook Feeding Strategy

When 90-100% of the fish in incubation stacks have buttoned-up, they will be transferred to outdoor concrete raceways. Fry will be hand fed Bio-Oregon Bio-Pro 2, or Bio-Supreme diet, to satiation at each feeding, 4-8 times a day depending on age and size. All spring run will be fed Bio-Pro 2 until release. 1.0 million mitigation fall run designated for San Pablo Bay net pens will be switched to Bio-Supreme transfer diet at least 6 weeks prior to release. Bio-supreme transfer diet has been formulated to help fish ease osmotic regulation when transferring to saltwater. Recent studies shown return rates up to 42% higher than control in Central Valley Chinook. Medicated and antibiotic feeds will be used if necessary, as prescribed by CDFW pathologists.

Fish size (fish/lb.)	Feed Size	Fish Food Type	Fed Times a day
3000 to 570	#0	Bio-Pro	7-8
570 to 300	#1	Bio-Pro	7-8
300 to 150	#2	Bio-Pro	4-6
350 to 150	#2	Bio-Pro	4-6
150 to 60	#3	Bio-Pro	4-6
140 to 60	1.2	Bio-Supreme	4-6
140 to 60	1.2	Bio-Pro	4-6

5.0 Chinook Release Strategy

5.1 Spring-run Release Approach

Releases 2020 will replicate the release strategy that was implemented in 2019. In 2017, only one release was made due to low production of SRCS. The SRCS will be split into 6 groups of 334,000 fish with each group containing a unique Coded Wire Tag (CWT). The first release of SRCS will be the experimental storm event “early” release. These two groups of 334K fish each will be released on the climbing limb of a storm event as soon after tagging as possible with one group going to Boyd’s pump and the other going to Gridley. There is no target size for these fish, however they will need to be at least 120/lb to go through the auto fish tagging trailer. The second release will replicate previous “early” releases and will be in late-March at Boyd’s pump and Gridley. The target release weight is a minimum of 90 fish/lb. The third release will be the “late” release, scheduled for mid to late-April at Boyds pump and Gridley. The target release weight is a minimum of 60 fish/lb. The early releases are being implemented to evaluate survival of spring-run released in-river at a smaller size than past releases (past releases have been approximately 60 fish/lb) and in high flow and turbidity events. Each set of releases will use two in-river release sites (Gridley and Boyd’s Pump Boat Launch) to evaluate differences in survival and stray rate with release location.

Sentinel hatchery fish will be used during the releases and water quality samples will be collected to continue monitoring for the prevalence and severity of *Ceratonova shasta* and its effect on Feather River Chinook salmon.

Table 5. Spring-run Release Strategy

Date	Location	# of Fish	Fish/lb.	With CWT and Mark
Early March	Gridley	334,000	>120	100% Ad Clip
Early March	Boyd's pump	334,000	>120	100% Ad Clip
Late March	Gridley	334,000	90	100% Ad Clip
Late March	Boyd's	334,000	90	100% Ad Clip
Mid-April	Gridley	334,000	60	100% Ad Clip
Mid-April	Boyd's	334,000	60	100% Ad Clip

Criteria and Contingencies In coordination with National Marine Fisheries Service (NMFS), CDFW has developed the following criteria and triggers that will be used to inform decisions on the release strategy to be implemented in 2019/2020. These criteria and triggers were developed based on review of water temperature, river flow, Delta Cross Channel Gate operations. The criteria identified below are designed to minimize the risk of exposing FRH produced FRCS salmon to river conditions that could result in extremely low survival. Each of the criteria indicated below are intended to be independent of the others, meaning that if any one or more of the criteria are anticipated to be met then FRH produced FRCS salmon should be transported to the acclimation net pens for release into San Pablo Bay. If none of the triggers are forecast to be met, then juveniles will be released into Feather River, as describe above in section 5.2.

Delta Cross-channel Gates operations – Survival of juvenile salmon is significantly reduced when gates are open and increased numbers of fish are diverted into the interior Delta.

- Cross-channel gates are forecast* to be open within 21 days** days of the date when the hatchery salmon are ready to be released.

Water Temperature – Increased water temperatures above 70 degrees has been shown to be detrimental to juvenile survival.

- Sustained Daily Average Water temperatures are expected to be greater than 74 F at Verona within 21** days of the date when the hatchery salmon are ready to be released.
- Sustained Daily Average Water temperatures are expected to be greater than 74 F at Freeport within 21** days of the date when the hatchery salmon are ready to be released.

Flow – Decreased flows in the Sacramento River lead to significantly reduced survival of juvenile salmon because of reduced travel times exposing the fish to increased predation and increased risk of diversion into the interior Delta where survival is significantly reduced.

- A Sacramento River flow at Verona of less than 4,000 cfs is forecast* to occur within 21** days of the date when the hatchery salmon are ready to be released.
- A Sacramento River Flow of less than 6,000 cfs at Freeport is forecast to occur within

21** days of the date when the hatchery salmon are ready to be released.
• Delta Outflow is forecast* to be less than 3,000 cfs within 21** days of the date when the hatchery salmon are ready to be released.

If during any of these assessments, existing/predicted conditions are expected to meet the criteria triggering consideration of the alternative release strategy. Alternative release strategy could be 1) an early release of all SRCS into the Feather River at Boyd's pump, 2) Early release during high flow event. And/or 3) Selecting Live Oak Boat Launch facility instead of Gridley.

Ceratanova Shasta- If monitoring shows *C. Shasta* above XX at the Gridley release site, an alternate release site at Live Oak may be used. The Gridley release site is below the confluence of Honcut Creek which offers inflow that often dilutes *C. Shasta* densities.

5.2 Fall-run Release Approach

One million juvenile fall-run Chinook salmon juveniles (mitigation salmon) will be release into the Feather River in late-April. An in-river release of one million juvenile fall-run Chinook salmon (FRCS) from the mitigation production will allow assessment of the behavior, condition, and survival of salmon as well as their return and stray rates of an in-river release. In 2020, the fall-run will be marked at a 25% rate. All fish will be loaded and transported in accordance with FRH SOP's 007 through 013

Table 6. Fall-run In-River Release Strategy

Date	Location	Fish/lb.	Total FRCS	With CWT and Mark
4/30/2019	Boyd's Pump	60	1,000,000	25% Ad Clip

Criteria and Contingencies In coordination with the National Marine Fisheries Service (NMFS) CDFW has developed the following criteria and triggers that will be used to inform decisions on the release strategy to be implemented in 2017. These criteria and triggers were developed based on review of water temperature, river flow, Delta Cross Channel Gate operations. The criteria identified below are designed to minimize the risk of exposing FRH produced FRCS salmon to river conditions that could result in extremely low survival. Each of the criteria indicated below are intended to be independent of the others, meaning that if any one or more of the criteria are anticipated to be met then FRH produced FRCS salmon should be transported to the acclimation net pens for release into San Pablo Bay. If none of the triggers are forecast to be met, then juveniles will be released into Feather River, as describe above in section 4.2.

Delta Cross-channel Gates operations – Survival of juvenile salmon is significantly reduced when gates are open and increased numbers of fish are diverted into the interior Delta.

• Cross-channel gates are forecast* to be open within 21 days** days of the date when the

hatchery salmon are ready to be released.

Water Temperature – Increased water temperatures above 70 degrees has been shown to be detrimental to juvenile survival.

- Sustained Daily Average Water temperatures are expected to be greater than 74 F at Verona within 21** days of the date when the hatchery salmon are ready to be released.
- Sustained Daily Average Water temperatures are expected to be greater than 74 F at Freeport within 21** days of the date when the hatchery salmon are ready to be released.

Flow – Decreased flows in the Sacramento River lead to significantly reduced survival of juvenile salmon because of reduced travel times exposing the fish to increased predation and increased risk of diversion into the interior Delta where survival is significantly reduced.

- A Sacramento River flow at Verona of less than 4,000 cfs is forecast* to occur within 21** days of the date when the hatchery salmon are ready to be released.
- A Sacramento River Flow of less than 6,000 cfs at Freeport is forecast to occur within 21** days of the date when the hatchery salmon are ready to be released.
- Delta Outflow is forecast* to be less than 3,000 cfs within 21** days of the date when the hatchery salmon are ready to be released.

If during any of these assessments, existing/predicted conditions are expected to meet the criteria triggering consideration of the alternative release strategy, then preparations will begin, continue, or be implemented to truck appropriate groups of fish to the acclimation net pens in San Pablo Bay as scheduled.

The remainder of the 5 million FRCS from the mitigation production will be marked at the standard constant fractional marking rate of 25% in groups of 1.0 million or 334,000 fish per tag code depending on raceway logistical needs. Batches of mitigation hatchery produced fish will be released when they reach target size of 60 fish/lb in April through June. Weight counts will be taken as fish are being loaded into transport trucks and recorded on release receipts following standard hatchery practices. Salt will be added to a level of ten parts per thousand to transport tanks prior to loading fish for transport. Transport equipment will not be allowed to contact receiving water to prevent the spread of aquatic invasive species.

The release location will be selected depending on weather, availability of net pens, and CDFW management review. Time of plant, temperature of receiving water and transport tank water, and the condition of the fish during release will be recorded on planting receipts. FRCS will be loaded into net pens at Conoco Phillips then released into the San Pablo Bay.

All net pen releases will be conducted on the outgoing tide and timed such that no more than two days of releases are scheduled in a row from the same location when logistically feasible. Groups of 1.0 million like CWT fish may be split and released over

two consecutive days from the same location as necessary to meet hatchery logistical constraints.

Date	Location	Fish/lb.	Total FRCS	With CWT and Mark
April-June	San Pablo Bay Net Pens	60	5.0 million	25%

Steelhead

Background:

The FRH conducts an artificial propagation program for CV steelhead trout on the lower Feather River. Natural origin CV steelhead are listed as a threatened species by the National Marine Fisheries Service. CV steelhead provide a popular freshwater sport fishery. Ad-intact steelhead are “natural origin” for management purposes since a program goal is to ad-clip all hatchery produced juvenile steelhead.

The FRH is operated by the California Department of Fish and Wildlife (CDFW) The primary purpose of the steelhead hatchery program is to mitigate for salmon and steelhead spawning and rearing habitat eliminated due to construction of Oroville Dam in 1968, and secondarily to support the ocean and freshwater fisheries. Annual mitigation goals for steelhead in the Feather River are to collect 1,000,000 eggs and release 450,000 yearlings (±10 percent) at 3 fish/pound.

6.0 Steelhead Broodstock Collection and Spawning Protocol

The HSRG provided several recommendations for the FRH generally and for steelhead specifically. CDFW continues to incorporate those recommendations when possible. To limit the use of resident (non-anadromous) fish, the current 16-inch minimum length for broodstock will be continued. We acknowledge that resident *Onorhynchus mykiss* may occasionally exceed 16” in length but this target has been refined using otolith markers and represents the best balance of broodstock availability and reduction of resident fish. Per HSRG recommendations, FRH steelhead program will target at least 10% natural origin broodstock. Historically FRH incorporation of natural origin (NO) fish is typically between 1-10% because of a lack of availability of NO fish at the hatchery. If the hatchery has more broodstock than are necessary to meet egg take goals, preference will be given to utilizing NO fish.

Out-of-sub-basin importation of eggs, juveniles or adults will not occur, unless from Mokelumne River, which was heavily supplemented with, and thus genetically similar to, Feather River steelhead on several occasions historically. To catalog genetic and age information, all spawned fish will be immediately brought to the sampling station. Fishwill be prepared for genetic tissue and scale sampling. Fish condition, adipose status, sex and fork length will be recorded. Fish tag color and quantity will be recorded, and tags removed. A caudal fin clip (other fin may be used if caudal is covered in fungus or otherwise unusable, fin type will be recorded in comments field on data sheet) will be

collected from each spawned fish and given a unique sample ID. A scale sample will be collected from a percentage of fish and given a unique sample ID. The percentage is determined at the beginning of season and is dependent on the number of fish returning to the hatchery for spawning. The goal is to collect scales from 20% of the spawning steelhead in the hatchery or at least 100 individuals. There are no specific goals for the number of adult steelhead produced by this program; however, the juvenile production goal is to release 450,000 yearling steelhead annually at
three fish/pound during November.

All natural-origin steelhead are returned to the river (spawned or unspawned), all hatchery-origin females are returned to the river (spawned or eggs removed), and all hatchery-origin males are released back to Feather River at Verona or into the Thermalito Afterbay to supplement the recreational fishery. In years where excess production occurs (greater than 450,000 smolts), the additional smolts may be put in the Thermalito Afterbay for additional recreational opportunity. If additional yearlings are available in Spring 2020, up to 100 will be acoustically tagged prior to release. This study will help managers track behavior and survival of hatchery origin steelhead released into the Thermalito Afterbay.

Because of low steelhead broodstock returns, since winter 2016, a partial factorial mating scheme was used for the steelhead spawning program to help improve the effective and hedge against infertile males and females. In addition, genetic sampling occurred to gather genetic relatedness data on the parents. Broodstock numbers from 2017-2019 were above 1,000 fish so it was deemed returning to a true 1 male: 1 female ratio. FRH staff will eliminate the reuse of males, as much as possible.

Criteria and Contingencies
CDFW has developed the following criteria and triggers that will be used if a small population of steelhead return to the hatchery in 2019/2020. HSRG recommendation 3.13 states that a smaller population of less than 250 females should implement factorial spawning by splitting female eggs into two or more lots and each lot be fertilized from a different male. Hatchery managers rely on this criterion to inform decisions on mating strategy based on hatchery returns. I

If there is reasonable indication that number of available female broodstock will be below 250 adults, the following mating scheme will be used:

1) Spawning incorporates a 2x2 partial factorial mating scheme:

    a. Assuming two males and two females are available and ripe, the eggs from each female are divided into two separate pans. Each male is used to fertilize a separate pan. Thus, for two females (female A and B) and two males (male 1 and 2), a total of four pans are used, creating four individual families (A1, A2, B1, and B2). The individual mattings are recorded

    b. If there are an unequal number of males and females, FRH will perform a 2x3 or 3x2 partial factorial mating system.

    c. Individual crosses are separated and tracked in egg trays if time and space permit (estimated 30-45 days post-fertilization).:

d. FRH measures the approximate number of juveniles produced per family so that an accurate estimate of effective size can be calculated.

2) Limit male re-use:
    a. The number of times each male fish is spawned is documented and tracked. The re-use of males is limited wherever possible.

3) Non-FRH fish should be not be spawned

    a. Candidate broodstock identified as Nimbus or Coleman-produced fish is not be spawned and will be euthanized.

If there is reasonable indication that number of available female broodstock will be at or above 250 adults, the following mating scheme will be used:

6.1 Steelhead Release

All FRH steelhead are marked with an adipose fin-clip prior to release. For 2020, steelhead will all be released into the Feather River at the Boyd's Pump Boat Launch. In response to HSRG recommendations to release steelhead as far upstream as possible upstream (i.e.: Gridley boat launch) in-river release locations will be considered in future years.

If the FRH survival is good and production is greater than 450,000 steelhead at 3 fish/pound, additional yearlings will be stocked for the popular Afterbay Outlet fishery. Up to 100 steelhead yearlings may be tagged with acoustic tags to track behavior and survival.

Attachment A: HSRG recommendations

California Hatchery Scientific Review Group (California HSRG 2012) has established recommendations for the FRH. For reference some of the recommendations that pertain to production are included:

5.6.1 Recommendations for All Feather River Hatchery Programs

- Clear goals should be established for the program. Program production goals should be expressed in terms of the number of age-3 ocean recruits just prior to harvest (Chinook salmon), and the number of adults returning to freshwater (steelhead).

- Transporting and releasing juveniles to areas outside of the Feather River and near or downstream of the confluence of the Yuba River should be discontinued. Juvenile fish should be released at the hatchery, or if not possible, as far upstream in the Feather River from the confluence of the Yuba River as possible to reduce adult straying and increase the number of adult fishes returning to the hatchery. Consider necessary facility modifications or equipment purchases that will facilitate onsite releases. Release locations for steelhead may take into consideration ecological and predation effects on other fish populations but should not compromise homing of adults to the hatchery.

- Managers should investigate the feasibility of collecting natural-origin adult fish at alternate locations. The existing trapping location is very limited in its ability to capture fish representing the entire spectrum of life history diversity. Only fish that migrate to the furthest upstream reaches are susceptible to capture.

- Adult holding facilities should be upgraded and/or expanded to provide adequate space, water flows and temperature regimes to hold the number of adults required for broodstock at high rates of survival (greater than 90 percent). In addition, because of a lack of adult holding space, fall Chinook are returned to the river to make room for late arriving spring Chinook. Evaluate the prospects of using the Thermalito Annex Facility for the long-term holding of spring Chinook broodstock. While the Annex water temperature is relatively high, a pilot study could be used to determine whether any associated increased holding mortality was sufficiently offset by the Annex's otherwise excellent water quality.
- Natural-origin fish should be incorporated into broodstock at a minimum rate of 10 percent to prevent divergence of the hatchery and natural components of the integrated population. This may require auxiliary adult collection facilities or alternative collection methods (e.g., seining or trapping).

- A Monitoring and Evaluation Program should be developed and implemented, and a Hatchery Coordination Team formed for the program. Implementation of these processes will inform hatchery decisions and document compliance with best management practices defined in this report.

- Performance standards for each phase of the fish culture process should be established and tracked annually. Summaries of data collected with comparisons to established targets must be included in annual hatchery reports.

- CDFG should develop and promulgate a formal, written fish health policy for operation of its anadromous hatcheries through the Fish and Game Commission policy review process. Hatchery compliance with this policy should be documented annually as part of a Fish Health Management Plan. The current CDFG fish health policy is inadequate to protect native stocks.

- CDFG should develop an updated Hatchery Procedure Manual which includes performance criteria and culture techniques presented in IHOT (1995), Fish Hatchery Management (Wedemeyer 2001) or comparable publications. The fish culture manual (Leitritz and Lewis 1976) is outdated and does not reflect current research and advancements in fish culture.

5.6.2 Feather River Fall Chinook- Major Program Recommendations

The major recommendations of interest to resource managers for the Feather River fall Chinook salmon hatchery program are provided below. Those selected for presentation may represent major changes in operations, changes in approach or outcomes towards achieving harvest or conservation objectives or will require substantial investment of resources. The California HSRG's evaluation of program compliance with standards and guidelines and the group's comments about this program are presented in their entirety in Appendix VIII.

- Use of the Feather River Annex for rearing should be discontinued unless juveniles are released near the Annex and an adult collection facility is installed in the downstream outlet of the Thermalito Afterbay.

- The program should limit the number of eggs taken to the number necessary to meet production goals (which would include a reasonable overage to account for egg loss and culling of spring x fall crosses). On average, the program takes about 20 million eggs to produce 6 million juveniles.

- Tag analysis should be used to determine the fall and spring hatchery-origin Chinook spawned during the suspected period of run overlap (e.g., fish spawned in the last two weeks of spring Chinook spawning and the first two weeks of fall Chinook spawning). Tags should be read and egg lots tracked and eliminated from production as appropriate to reduce introgression of the two runs. Incubation techniques should therefore allow for separation of eggs from individual parents/families (no more than two families per tray).
- Only unmarked fish should be spawned in the fall brood (FRH spring Chinook are 100 percent adipose fin-clipped, FRH fall Chinook are 25 percent adipose fin-clipped) to reduce the need for culling. Any spring x fall Chinook crosses of hatchery-origin fish (e.g., due to marking or mark detection errors) should be identified by coded wire-tag analysis and eggs should be culled soon after spawning.

- Until all off-site releases of Chinook salmon are eliminated in the entire Central Valley, coded wire tag analysis should be used to identify stray hatchery-origin fish among those fish selected for broodstock. Strays from other hatchery programs should not be used as broodstock, or if eggs are collected from or fertilized by such

fish, they should be culled soon after spawning.

- Program fish should be 100 percent coded wire-tagged and 25 percent adipose fin-clipped.

5.6.3 Feather River Spring Chinook- Major Program Recommendations

The major recommendations of interest to resource managers for the Feather spring Chinook salmon hatchery program are provided below. Those selected for presentation may represent major changes in operations, changes in approach or outcomes towards achieving harvest or conservation goals or will require substantial investment of resources. The California HSRG's evaluation of program compliance with standards and guidelines and the group's comments about this program are presented in their entirety in Appendix VIII.

- Tag analysis should be used to determine the number of fall and spring Chinook spawned during the suspected period of run overlap (e.g., fish spawned in the last two weeks of spring Chinook spawning and the first two weeks of fall Chinook spawning). Tags should be read and egg lots tracked and eliminated from production as appropriate to reduce introgression of the two runs. Incubation techniques should therefore allow for separation of eggs from individual parents/families (no more than two families per tray).

- Until all off-site releases of Chinook salmon are eliminated in the entire Central Valley, coded wire tag analysis should be used to identify stray hatchery-origin fish among those fish selected for broodstock. Strays from other hatchery programs should not be used as broodstock, or if eggs are collected from or fertilized by such fish, they should be culled soon after spawning.

5.6.4 Feather River Steelhead- Major Program Recommendations

The major recommendations of interest to resource managers for the Feather River steelhead hatchery program are provided below. Those selected for presentation may represent major changes in operations, changes in approach or outcomes towards achieving harvest or conservation goals or will require substantial investment of resources. The California HSRG's evaluation of program compliance with standards and guidelines and the group's comments about this program are presented in their entirety in Appendix VIII.

- A Hatchery Coordination Team should be established to review the status of the FRH steelhead program.

- The number of eggs taken annually should be reduced to a level appropriate to produce 450,000 juveniles and the transfer of eggs to other programs terminated. Collection of excess eggs is permissible to increase effective population size as long as culling is done representatively.

- Broodstock for the program should only come from native, locally adapted stocks. Out-of-sub basin importation of eggs, juveniles or adults should not occur, even if it means juvenile production targets will not be achieved in some years.

- Non-anadromous (resident) fish should not be used as broodstock and the current 16-inch minimum length for broodstock should be continued.

- Hatchery-origin adult steelhead returns to the hatchery should be treated as follows: (1) unspawned males should be extended reconditioned and released; (2) unspawned females should be stripped of eggs, extended reconditioned and released; and (3) spawned fish should be removed from the system, or extended reconditioned and released.

- Natural-origin adult steelhead returns to the hatchery, whether spawned or unspawned, should be released. Fish may be reconditioned prior to release.

    - The program should limit the number of eggs taken to the number necessary to meet production goals (which would include a reasonable overage to account for egg loss and culling of spring x fall crosses). On average, the program takes about 20 million eggs to produce 6 million juveniles.

    - Tag analysis should be used to determine the fall and spring hatchery-origin Chinook spawned during the suspected period of run overlap (e.g., fish spawned in the last two weeks of spring Chinook spawning and the first two weeks of fall Chinook spawning). Tags should be read and egg lots tracked and eliminated from production as appropriate to reduce introgression of the two runs. Incubation techniques should therefore allow for separation of eggs from individual parents/families (no more than two families per tray). Only unmarked fish should be spawned in the fall brood (FRH spring Chinook are 100 percent adipose fin-clipped, FRH fall Chinook are 25 percent adipose fin-clipped) to reduce the need for culling. Any spring x fall Chinook crosses of hatchery-origin fish (e.g., due to marking or mark detection errors) should be identified by coded wire-tag analysis and eggs should be culled soon after spawning.

    - Until all off-site releases of Chinook salmon are eliminated in the entire Central Valley, coded wire tag analysis should be used to identify stray hatchery-origin fish among those fish selected for broodstock. Strays from other hatchery programs should not be used as broodstock, or if eggs are collected from or fertilized by such fish, they should be culled soon after spawning.

Attachment B: Draft Conservation Facility Subgroup 2019 Standard Operating Procedures

for the

Reintroduction of Central Valley
Spring-Run Chinook Salmon into the San Joaquin River

1.0 Title: Egg Collection for Broodstock and Translocation at Feather River Hatchery

SOP #: COL-SOP-09-10-19
Effective Date: September 10, 2019

2.0 Introduction

This is a Standard Operating Procedure (SOP) for spawning and egg collection of spring-run Chinook Salmon at Feather River Hatchery (FRH) as it relates to San Joaquin River Restoration Program (SJRRP).

2.1 Purpose

The intent of this SOP is to outline how the SJRRP will collect eggs, track data, describe tissue/CWTs collection and disposition, who will complete the work, and how the information will be compiled.

3.0 Planning

Early planning and coordination will occur within the Program between NMFS, CDFW and USFWS; and with the CDFG staff at the Feather River Fish Hatchery, CDFG Tissue Archive laboratory and CDFG Pathology.

4.0 Summary of methods

Feather River Hatchery Personnel will sort fish, spawn adults, and collect and process eggs. Program staff will be responsible for data collection, tracking individual crosses, monitor quality control and assist FRH staff where appropriate. Ovarian fluid collection will be conducted by the CDFW Fish Health Lab unless assigned to other staff. The Program will also observe for quality control issues and discuss concerns with FRH management when needed.

5.0 Procedure

5.1 FRH staff transfer Hallprint tagged fish from a circular holding tank to a sedation tank, where fish are sedated with CO2.

5.2 After anesthetization, the fish are placed on a sorting table and examined by FRH personnel for the degree of sexual maturation. Sexually immature fish are returned to the holding tank and Chinook salmon that expel free flowing eggs or milt are euthanized with a pneumatic knife inserted into the spinal cord posterior to the head or a single forceful blow to the cranium.

5.3 Eggs are collected with the incision method described by Leitritz and Lewis (1976). The ventral wall of the abdominal cavity of each female Chinook salmon is slit open with a Wyoming style knife and eggs allowed to freely flow into a metal spawning pan.

5.4 Ovarian fluid is collected by Fish Health Lab personnel or other staff and a batch number is recorded by Program staff. Four samples will be combined into a single batch. Samples are sent to UC Davis within 72 hours for health clearance for virology and the Fish Health Lab will test for BKD.

5.5 The eggs from a single female Chinook salmon are fertilized by combining the sperm expressed from a single male by palpating the male's abdomen. Program staff remove one of the two Hallprints from each male and female that is spawned.

The tag from each fish is placed in a coin envelope and the spawn number is recorded on the envelope. If there is only one tag on the fish, the tag is not removed, and the tag number is recorded. This process usually uses 4 staff, with two staff working on male collections, and two on female collections.

5.6 Flaccid eggs from two crosses are measured and placed into individual incubator trays, where eggs are disinfected with iodine for about 30 minutes. Program staff record the tray, stack, row numbers and egg volume which corresponds to an individual cross.

5.7 Throughout the day, or at the end of the day, program staff will transfer the tag data from the coin envelopes to the appropriate data sheet.

5.8 Two ounces of eggs are taken from each tray (up to 100 oz) and water hardened, this provides an expansion factor that is applied to females spawned that day to calculate egg totals.

5.9 After fish are spawned, they are placed in tubs and CDFG Central Valley Tissue Archive staff then collect heads (for CWT extraction) and tissue samples. CDFG CVTA staff records date and location of sample, collectors ID, tissue archive ID, adipose fin presence, sex, fork length, head tag number, Hallprint number and associated comments. At the end of the day, Program staff receive copies of data sheets.

5.10 Process is repeated each day of spawning until a total of 350 crosses are collected.

5.11 Once placed in incubator trays, eggs are left alone for 30 days, but receive daily iodine treatments per vertical incubator stack.

5.12 Lots that test positive for IHN or BKD will **not** be used for broodstock, nor will the program use the previous two lots of eggs and all eggs lots following a positive test.

5.13 After approximately 30 days, a target number of eyed eggs are removed from selected crosses for broodstock and translocation. Eggs will be wrapped in water soaked cheesecloth or burlap, to keep moist, and placed in a specialized Styrofoam shipping container, and will be cooled using non-chlorinated ice and transported in a dark environment. Eggs will be shipped according to SOP SCF-TRN-002-01

6.0 Data Collection, Analysis, and Reporting

All tissue samples and heads will be sent to the CDFW Tissue Archive. The CDFG Tissue Archive is in charge of the following: CWT extraction, data entry of tissue samples and CWT data, long-term storage of tissue samples, splitting tissue samples for distribution, tracking distribution of samples, and ensuring researchers have proper State and Federal permits before distributing samples to them. The CDFW Tissue Archive will distribute tissue to the geneticists. Geneticists will process samples and produce a report that will help determine relatedness, and will be the first step in Parentage Based Tagging. The CDFW Tissue Archive will also send SJRRP staff a spreadsheet of CWT data associated with the segregated crosses. This information will help guide SJRRP staff in selecting preferred crosses.

Ovarian fluid will be sent to UC Davis Aquatic Animal Health program within 72 hours for testing. Results from ovarian fluid and, CWT analysis must be reported within 30 days, at least one week prior to hatching and prior to transfer to Silverado Fisheries base.

7.0 Roles and responsibilities

Project Leads:

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Name	Department	Title	Role	Responsibilities
Lori Smith	USFWS	Senior Fisheries Biologist	Project Lead	Assists will data collection, project development and reporting
Paul Adelizi	CDFG	Environmental Scientist	Hatchery Technical Lead and Tissue Archive liaison for Program	Assists will data collection, project development and reporting
Brian Erlandsen	CDFG	Environmental Scientist	Project Lead	Assists will data collection, project development and reporting
Anna Kastner	CDFG	Hatchery Manager	Feather River Fish Hatchery Manager	Supervises the Feather River Fish Hatchery.
Rob Titus	CDFG	Senior Environmental Scientist	Supervisor of the CDFG Tissue Archive Lab	Supervises the CDFG Tissue Archive Lab.
Mark Adkison, PhD	CDFG	Senior Pathologist Supervisor	Fish Health Analysis	Coordinating ovarian fluid sample analysis
Carlos Garza and Anthony Clemento	NMFS Southwest Science Center	Geneticists	Genetic Analysis	SNPs analysis of parents and offspring and sex determination of juveniles
Lea Koerber	CDFG	Environmental Scientist	Tissue Archive Lab lead	Coordinates tissue and head collections, collects tissues and heads, inventories tissue and CWT data, and distributes tissue and CWT data.

8.0 References

9.0 Appendixes: All field forms/data sheets

Attachment C: Data Sheets Used during Broodstock Collection and Biological Data Collection

CSSR 2019 PAGE 3

		BROUGHT FORWARD								RECEIVED								SPAWNED							
		MALE		FEMALE		JACK		JILL		MALE		FEMALE		JACK		JILL		MALE		FEMALE		JACK		JILL	
DATE	LOT	NCWT	CWT	NCWT	CWT	NCWT	CWT	NCWT	CWT	NCWT	CWT	NCWT	CWT	NCWT	CWT	NCWT	CWT	NCWT	CWT	NCWT	CWT	NCWT	CWT	NCWT	CWT

		KILLED (NOT SPAWNED)								DIT								NEW BALANCE							
		MALE		FEMALE		JACK		JILL		MALE		FEMALE		JACK		JILL		MALE		FEMALE		JACK		JILL	
DATE	LOT	NCWT	CWT	NCWT	CWT	NCWT	CWT	NCWT	CWT	NCWT	CWT	NCWT	CWT	NCWT	CWT	NCWT	CWT	NCWT	CWT	NCWT	CWT	NCWT	CWT	NCWT	CWT

Spring _____ Fall _____

Date _____

Row _____

Stack _____

LOT _____

TRAY	Female 1	Female 2	Total OZ
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			

Spring _____ Fall _____

Date _____

Row _____

Stack _____

LOT _____

TRAY	Female 1	Female 2	Total OZ
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			

Repick Loss Dec 2019

LOT	Sh 1	Sh 2	Sh 3	Sh 4	Sh 5	Sh 6	FR 1	FR 2	FR 3	FR 4	FR 5	FR 6	FR 7	FR 8	FR 9	FR 10	FR 11	FR 12
DATE																		
1																		
2																		
3																		
4																		
5																		
6																		
7																		
8																		
9																		
10																		
11																		
12																		
13																		
14																		
15																		
16																		
17																		
18																		
19																		
20																		
21																		
22																		
23																		
24																		
25																		
26																		
27																		
28																		
29																		
30																		
31																		
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

EGG COUNTS		EGG COUNTS	
DATE_____ LOT_____		DATE_____ LOT_____	
1		1	
2		2	
3		3	
4		4	
5		5	
6		6	
7		7	
8		8	
9		9	
10		10	
11		11	
12		12	
13		13	
14		14	
15		15	
16		16	
17		17	
18		18	
19		19	
20		20	
21		21	
22		22	
23		23	
24		24	

Date_____ CSFR_____

Lot_____

	Male		Female		Jack		Jill	
	NCWT	CWT	NCWT	CWT	NCWT	CWT	NCWT	CWT
Brought Forward								
Fish Received								
Fish Spawned								
Fish Killed(not spawned)								
DITs								
New Balance								
RT 1								
RT 2								
RT 3								
RT 4								

#Eggs/oz.		
Exansion Factor		
Incubated Ounces		
Trashed Ounces		
Daily Total Ounces		
Daily Eggs Incubated		
Daily Eggs Trashed		
Daily Egg Total		
Total Eggs Incubated		
Total Eggs Trashed		
	Over Ripe Females	
A.M Temp	Green Females	
DTU:		

FOH Duties		BOH Duties	
Trap		Put Away	
Sorters		Rinser	
Sorters		Data	
Sorters			
Spawner		Comments:	
Male			
Female			
Data			
Steelhead Released			
Male			
Female			

ADDLE RECORD

DATE_____ TEMP._____

# Eggs Before Bouncing	
Ounces of Bounced Eggs	
Bouced Eggs Per Ounce	
# of Bounced Eggs	
Egg Loss	
Percent Eggg Loss	
# Bounced Eggs Shipped	
# Of Bounced Eggs Culled	
Ounces This Lot On Hand	
# Eggs This Lot On Hand	
Total # Of Eggs On Hand	

Addle Duties	
Addler	
Bouncer	
Picker	
Picker	
Picker	
Measurer	
Egg Packer	

Date Hatched	
Date Ponded	
Number Ponded	
Location Ponded	

Date:____/____/_____

Feather River Hatchery

Daily Totals Data Sheet

Sampling Crew: CDFW

Spring-run Only

	Kills		DITs		Spawns		Total
	Male	Female	Male	Female	Male	Female	
Ad-clip							
Non-clip							
					Spring-run Grand Total		

Ad-clips Only

	Kills		DITs		Spawns		Total
	Male	Female	Male	Female	Male	Female	
Spring							
Fall							
					Ad-clip Grand Total		

Totals Checked by: CDFW _____

CA DFW CVTA and CWT Data Sheet

Col. Loc.: Feather River Hatchery
Col. Date:____/____/_____

Page____of____
Collectors:_____

ALL SPRING-RUN CHINOOK

	CVTA ID	Condition	Ad-clip	Sex	FL (mm)	Head Tag	Tag # (Hallprint = SR)	Comment
1		K D S	Y N	M F				
2		K D S	Y N	M F				
3		K D S	Y N	M F				
4		K D S	Y N	M F				
5		K D S	Y N	M F				
6		K D S	Y N	M F				
7		K D S	Y N	M F				
8		K D S	Y N	M F				
9		K D S	Y N	M F				
10		K D S	Y N	M F				
11		K D S	Y N	M F				
12		K D S	Y N	M F				
13		K D S	Y N	M F				
14		K D S	Y N	M F				
15		K D S	Y N	M F				
16		K D S	Y N	M F				
17		K D S	Y N	M F				
18		K D S	Y N	M F				
19		K D S	Y N	M F				
20		K D S	Y N	M F				
21		K D S	Y N	M F				
22		K D S	Y N	M F				
23		K D S	Y N	M F				
24		K D S	Y N	M F				
25		K D S	Y N	M F				
26		K D S	Y N	M F				
27		K D S	Y N	M F				
28		K D S	Y N	M F				
29		K D S	Y N	M F				
30		K D S	Y N	M F				
31		K D S	Y N	M F				
32		K D S	Y N	M F				
33		K D S	Y N	M F				
34		K D S	Y N	M F				
35		K D S	Y N	M F				

Grilse FL : _____

			Killed	DITs	Spawned
Date:	Page Totals	Ad-clip	M: F:	M: F:	M: F:
		Non-clip	M: F:	M: F:	M: F:
Date:	Page Totals	Ad-clip	M: F:	M: F:	M: F:
		Non-clip	M: F:	M: F:	M: F:

CA DFW CWT Data Sheet

Col. Loc.: Feather River Hatchery
Col. Date:____/____/_____

Collectors:_____

ALL <u>Ad-clipped</u> FALL-RUN CHINOOK

	Condition	Sex	FL (mm)	Head Tag	Tag # (Jaw Tag = FR)	Comment
1	K D S	M F				
2	K D S	M F				
3	K D S	M F				
4	K D S	M F				
5	K D S	M F				
6	K D S	M F				
7	K D S	M F				
8	K D S	M F				
9	K D S	M F				
10	K D S	M F				
11	K D S	M F				
12	K D S	M F				
13	K D S	M F				
14	K D S	M F				
15	K D S	M F				
16	K D S	M F				
17	K D S	M F				
18	K D S	M F				
19	K D S	M F				
20	K D S	M F				
21	K D S	M F				
22	K D S	M F				
23	K D S	M F				
24	K D S	M F				
25	K D S	M F				
26	K D S	M F				
27	K D S	M F				
28	K D S	M F				
29	K D S	M F				
30	K D S	M F				
31	K D S	M F				
32	K D S	M F				
33	K D S	M F				
34	K D S	M F				
35	K D S	M F				

Grilse FL : ≤ 650 mm

*** ALL fish ad-clipped**

	Killed	DITs	Spawned
Page Totals	M: F:	M: F:	M: F:

California Department of Fish and Wildlife
Central Valley Tissue Archive

Col. Loc. : Feather River Hatchery
Col. Date : ___/___/_____

Collectors:_____

STEELHEAD DATA SHEET

Incoming Tub #		Tissue ID	Scale ID	Spawned	Ad-Clip	Sex	Fork Length (mm)	Tag Color	Tag #	Field Otolith Vial #	Archive Otolith Vial #	Comments / Floy & P.I.T. Tag #s
	1			Y N	Y N	M F			1 2 3			
	2			Y N	Y N	M F			1 2 3			
	3			Y N	Y N	M F			1 2 3			
	4			Y N	Y N	M F			1 2 3			
	5			Y N	Y N	M F			1 2 3			
	6			Y N	Y N	M F			1 2 3			
	7			Y N	Y N	M F			1 2 3			
	8			Y N	Y N	M F			1 2 3			
	9			Y N	Y N	M F			1 2 3			
	10			Y N	Y N	M F			1 2 3			
	11			Y N	Y N	M F			1 2 3			
	12			Y N	Y N	M F			1 2 3			
	13			Y N	Y N	M F			1 2 3			
	14			Y N	Y N	M F			1 2 3			
	15			Y N	Y N	M F			1 2 3			
	16			Y N	Y N	M F			1 2 3			
	17			Y N	Y N	M F			1 2 3			
	18			Y N	Y N	M F			1 2 3			
	19			Y N	Y N	M F			1 2 3			
	20			Y N	Y N	M F			1 2 3			

Scale Sampling Rate
Spawned SH:
Non-Clipped SH: 100%

All Samples Air Dried

* = previously sampled

San Joaquin River Restoration Program
Feather River Fish Hatchery Spawning
Spring-run Chinook Salmon – BY 2019

SJRRP Spawned Crosses & Ovarian Fluid Collections

Date: ______________ Start Time: ___________ End Time: _________

Crew: ____

Data Recorder:____________________ Ovarian Fluid Collector: ________________________

Comments: ____

Cross #	Hallprint Tags		Ovarian Fluid Batch #	Bin	Reject	Non Ad Clip	Comments
	Female Hallprint	Male Hallprint					

San Joaquin River Restoration Program
Feather River Fish Hatchery Spawning
Spring-run Chinook Salmon – BY 2019

SJRRP Segregated Spring-run Crosses Egg Information

Date: _________ Data Recorder: ___________ Expansion Factor: ____________

Comments: ____

Cross #	Total oz.	Bin #	Tray Location		Comments
			Stack #	Tray #	