Term and Condition 2a: A synthesis of recent and historic information to develop loss equations for listed anadromous species.

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2013 LTO BiOp Annual Science Review

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RECLAMATION

Managing Water in the West

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and countless agency personnel who have participated in studies documenting the salvage process at the State and Federal facilities over the past fifty years

Presentation outline

- What is the BiOp Term and Condition 2a?
- Objective and Timeline
- Facility Diagrams
- Chinook Loss Equation
- Steelhead Loss Equation
- Green Sturgeon Loss Equation
- Results of Different Equations
- Potential Research and Continuing Steps

R. Reyes

NMFS BiOp Term and Conditions (p783)

2a. Reclamation shall seek to develop an alternative technique to quantify incidental take of listed anadromous salmonid species at the Federal and State export facilities.

Fund an independent contractor to determine the best technique to quantify incidental take of winter-run, spring-run, CV steelhead, and the Southern DPS of green sturgeon at the CVP/SWP facilities.

Agency timeline for Term and Condition 2a

2011

- Field tour to inform Jahn report
- Jahn report completed
- Reclamation submits plan

2012

- NMFS respond to Reclamation plan
- 1st Year of alternate loss evaluated
- Two workshops and a field tour to inform sensitivity analysis performed by Cramer Fish Sciences (CFS)

2013

- Sensitivity analysis completed
- Technical Team develops equation documentation
- 2nd Year of alternate loss evaluated

Context

Loss:

- Studied for decades, focused on different size classes of Chinook
- Recognized as inherent aspect of export operations
- Agencies and stakeholders perceive loss calculations in different ways

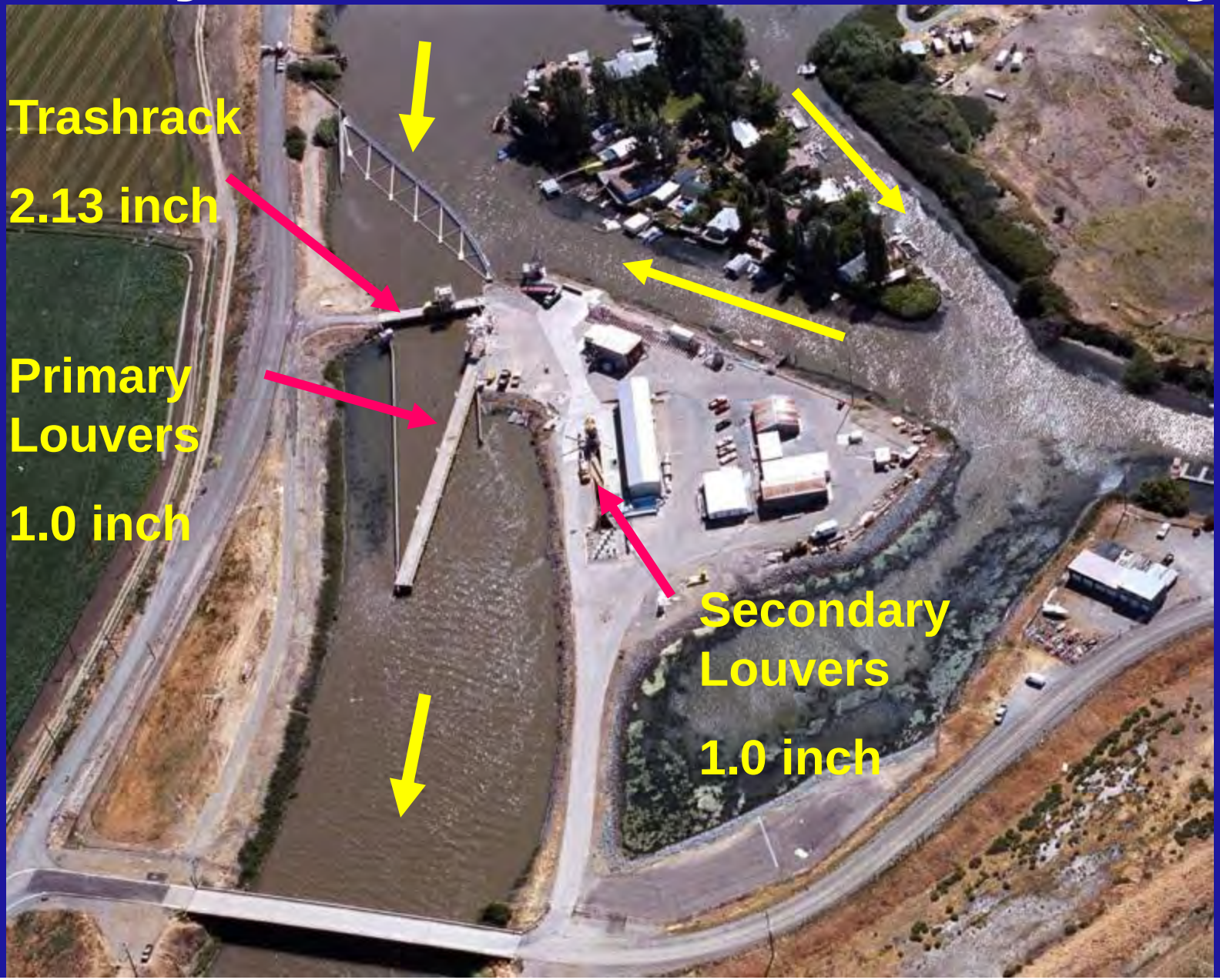
Premise:

- Facility dimensions and operations influence salvage
- Operations do not always reflect optimal salvage conditions
- Behavioral processes can influence salvage equations

Approach:

- Document historic and current studies regarding loss
- Try to keep equations simple
- Explain rationale, record uncertainty, and account for exceptions
- Get to a document that can guide a recommendation: inform loss equations in a meaningful way and focus future studies toward major uncertainties

Tracy Fish Collection Facility



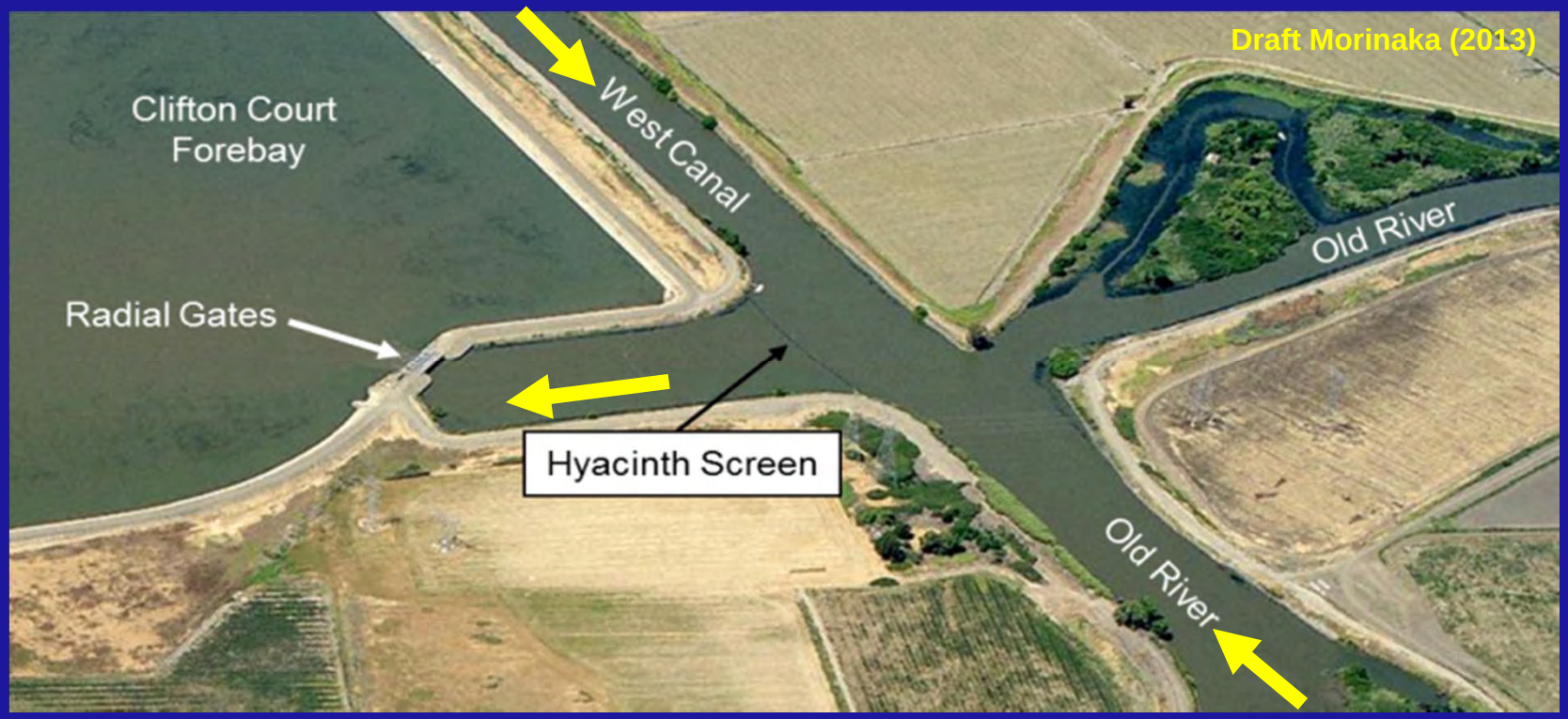
Primary
Louvers

Primary Louver Channel 1956

Secondary
Louvers

Secondary Channel

State Skinner Fish Collection Facility



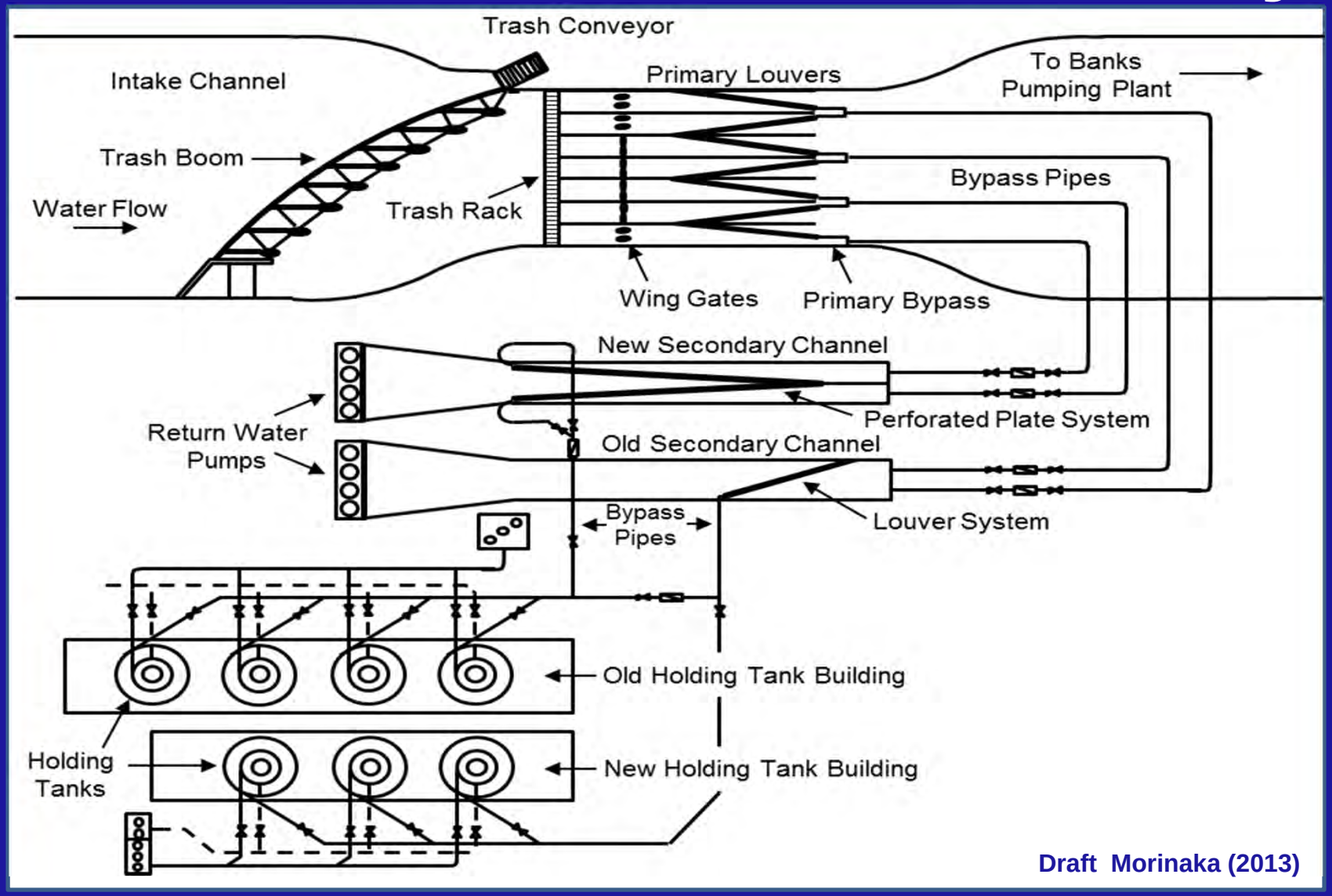
Water from Old River and the West Canal enter Clifton Court Forebay through a series of radial gates.

Clifton Court Forebay

- Water pumped by the Banks Pumping Plant flows through the Forebay and enters the intake channel.

- Afterwards, the water heads towards the Skinner Fish Facility.

Schematic of Skinner Facility

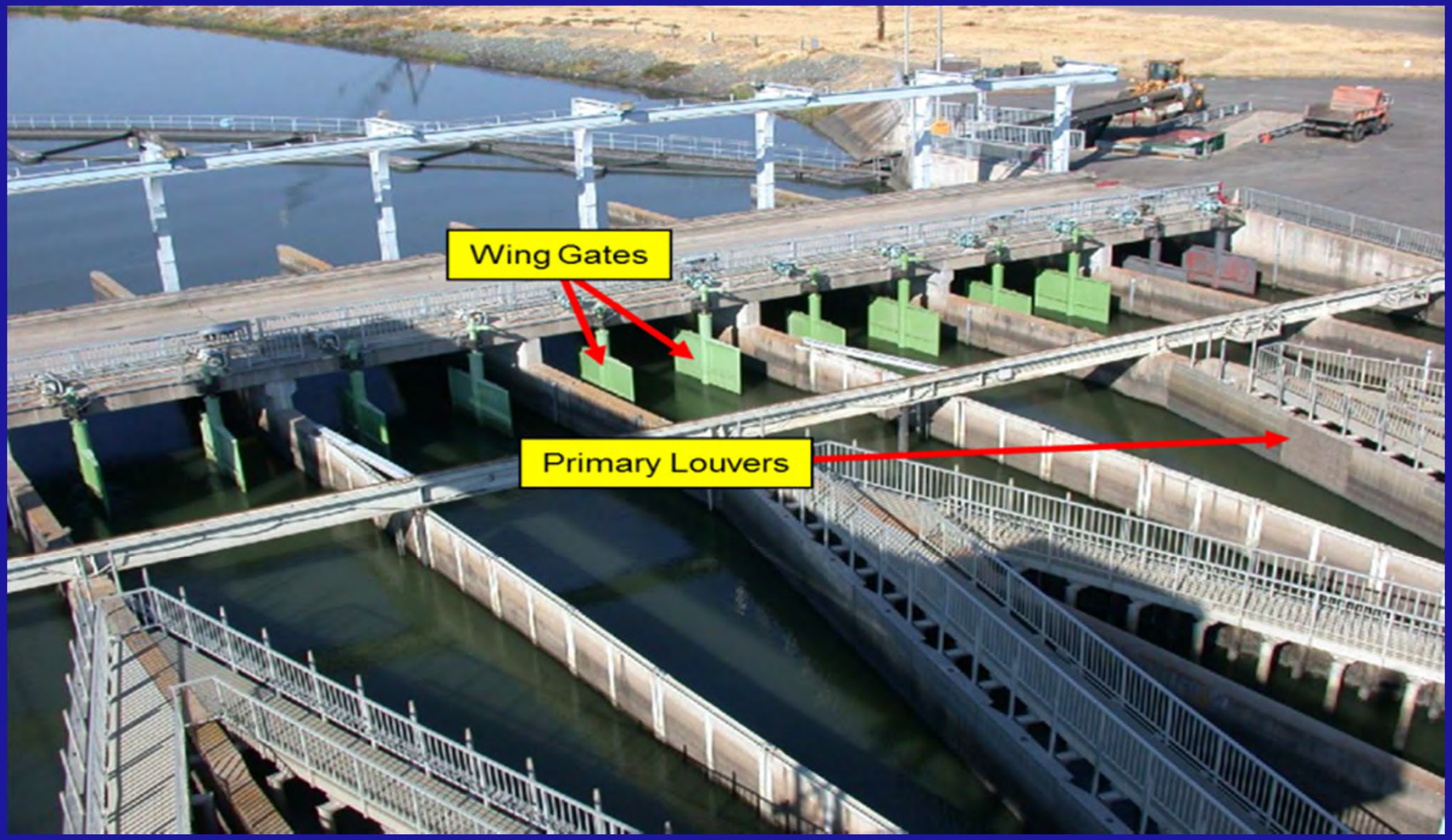


Draft Morinaka (2013)

SWP Trash Rack and Automated Cleaner

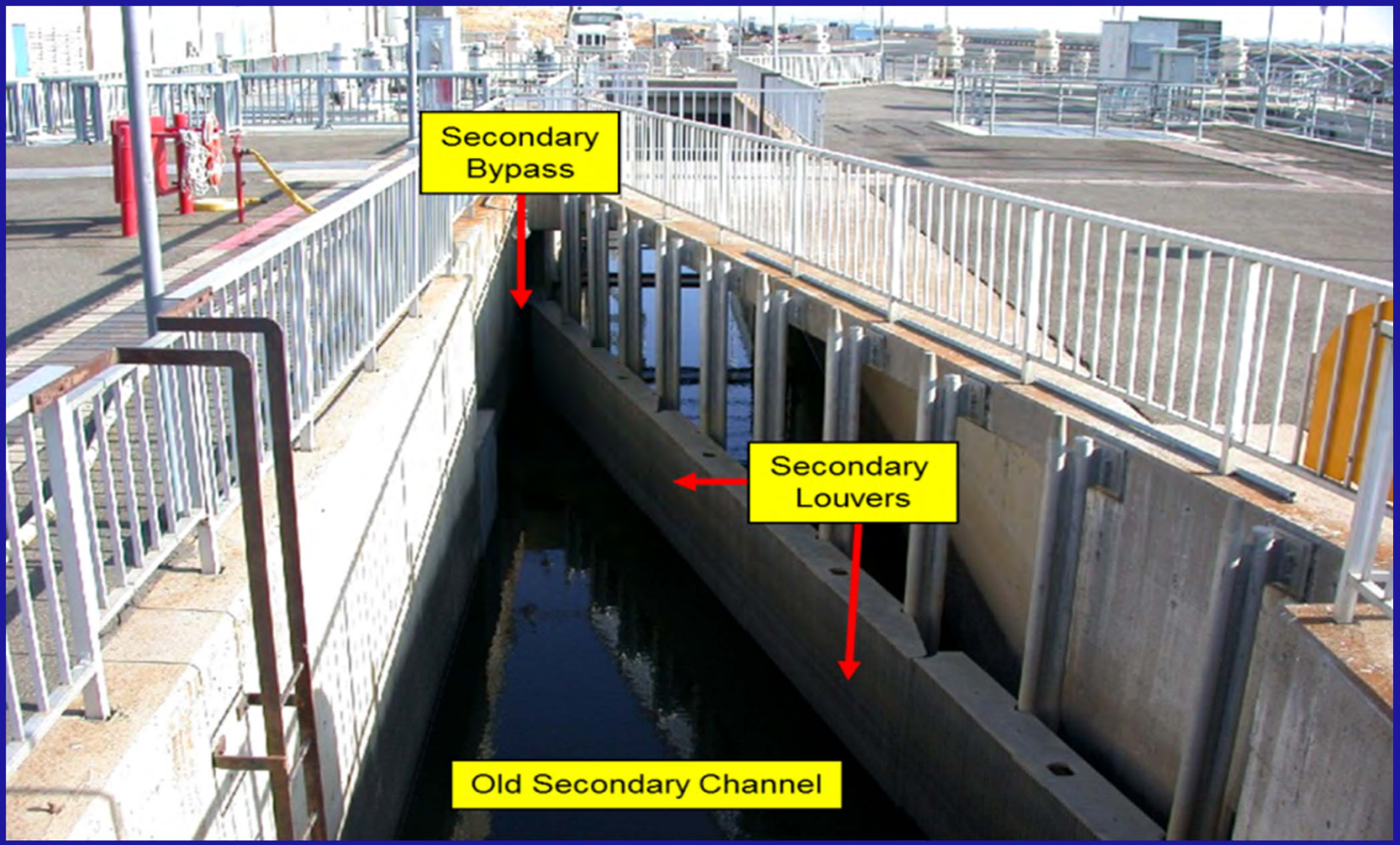
From Draft Morinaka (2013)

SWP Primary Louvers



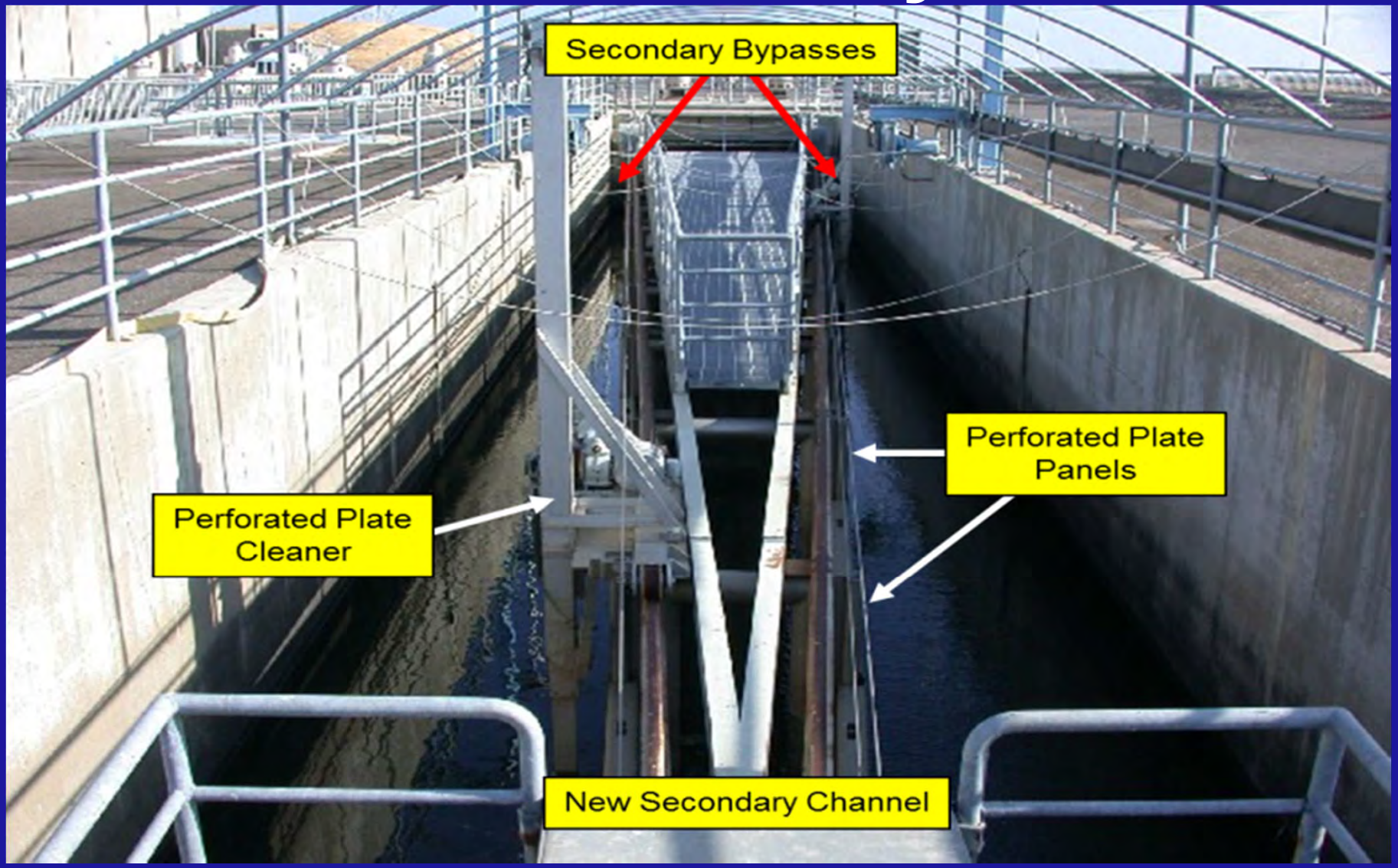
From Draft Morinaka (2013)

SWP Old Secondary Channel



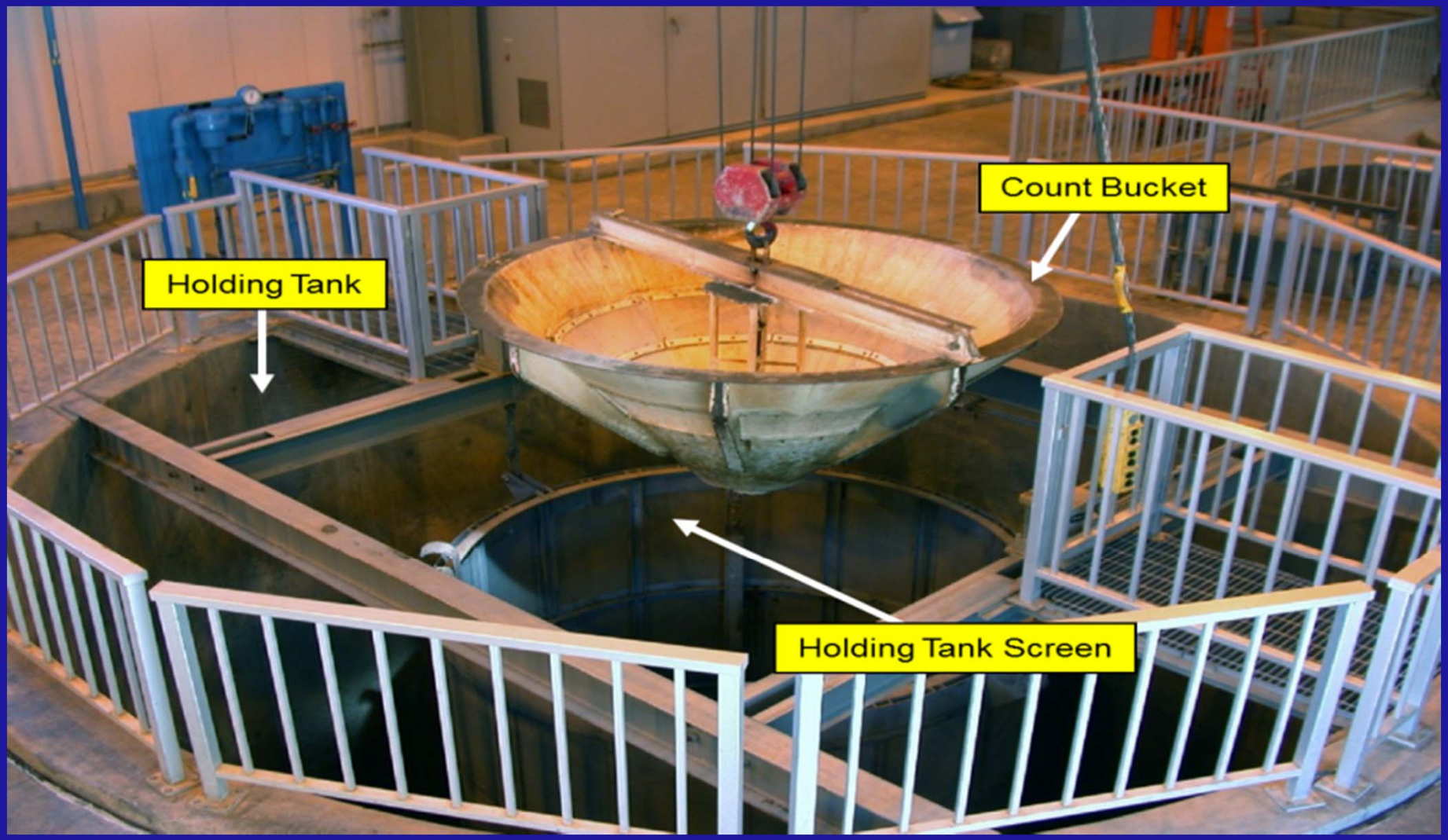
From Draft Morinaka (2013)

SWP New Secondary Channel



From Draft Morinaka (2013)

SWP Holding Tank

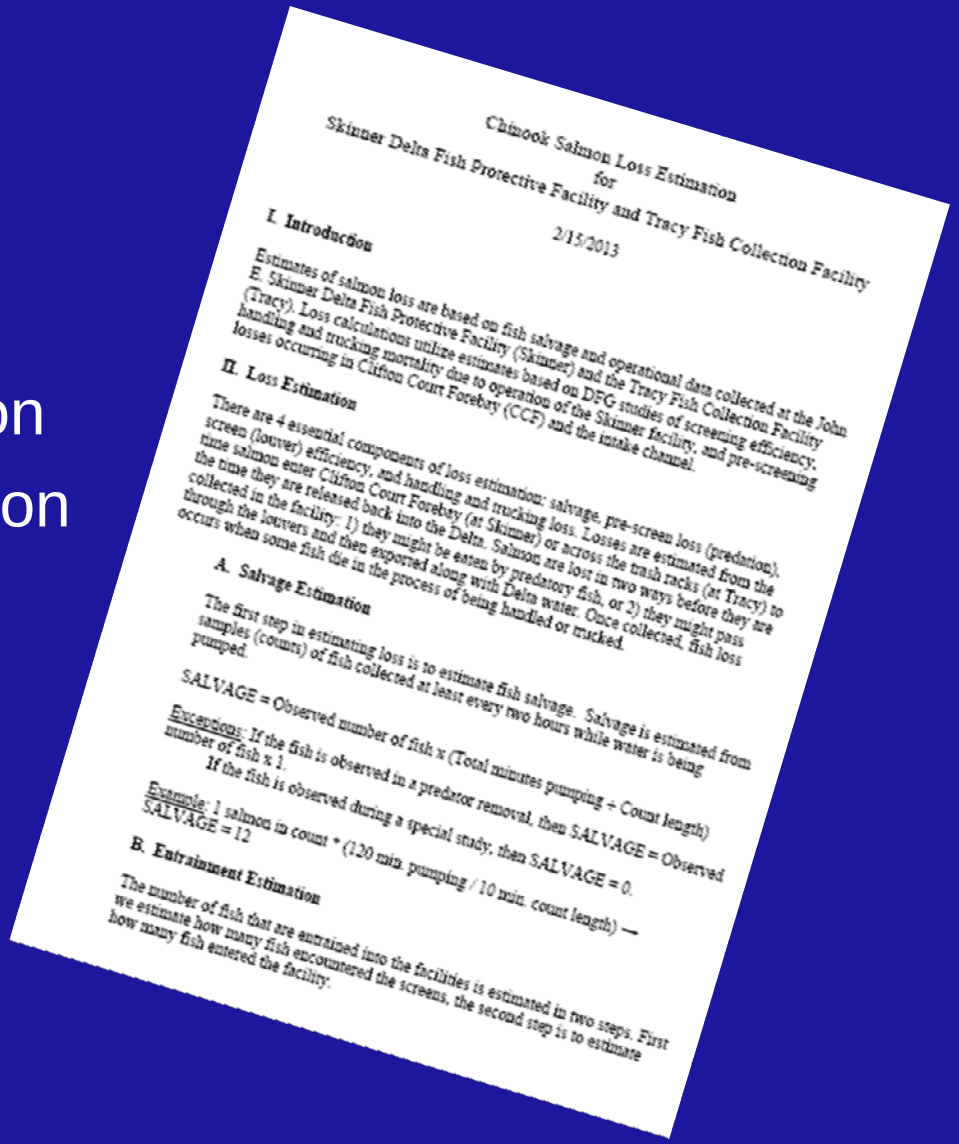


From Draft Morinaka (2013)

Chinook Salmon

Builds on current method

1) Salvage Estimation
2) Entrainment Estimation
3) Live Release Estimation
4) Loss Estimation



Chinook Salmon Loss Estimation
for
Skinner Delta Fish Protective Facility and Tracy Fish Collection Facility

2/15/2013

I. Introduction

Estimates of salmon loss are based on fish salvage and operational data collected at the John E. Skinner Delta Fish Protective Facility (Skinner) and the Tracy Fish Collection Facility (Tracy). Loss calculations utilize estimates based on DFG studies of screening efficiency, handling and trucking mortality due to operation of the Skinner facility, and pre-screening losses occurring in Clifton Court Forebay (CCF) and the intake channel.

II. Loss Estimation

There are 4 essential components of loss estimation: salvage, pre-screen loss (predation), screen (louver) efficiency, and handling and trucking loss. Losses are estimated from the time salmon enter Clifton Court Forebay (at Skinner) or across the trash racks (at Tracy) to the time they are released back into the Delta. Salmon are lost in two ways before they are collected in the facility: 1) they might be eaten by predatory fish, or 2) they might pass through the louvers and then exported along with Delta water. Once collected, fish loss occurs when some fish die in the process of being handled or trucked.

A. Salvage Estimation

The first step in estimating loss is to estimate fish salvage. Salvage is estimated from samples (counts) of fish collected at least every two hours while water is being pumped.

SALVAGE = Observed number of fish x (Total minutes pumping ÷ Count length)

Exception: If the fish is observed in a predator removal, then SALVAGE = Observed number of fish x 1.

If the fish is observed during a special study, then SALVAGE = 0.

Example: 1 salmon in count * (120 min. pumping / 10 min. count length) —
SALVAGE = 12

B. Entrainment Estimation

The number of fish that are entrained into the facilities is estimated in two steps. First we estimate how many fish encountered the screens, the second step is to estimate how many fish entered the facility.

Chinook Salmon Salvage

Facility	Parameter	Tech Team Certainty	Supporting Documents	Rationale
SWP	Salvage	High	McEwan and Collins 1990 Karp et al. 1997	• Past total census collection studies showed that there is normally agreement with expanded salvage and what is observed in 30m counts.
CVP	Salvage	High		

SALVAGE= (Observed number of salvaged fish) * (Minutes pumping/Sample time length)

Salmon Classification Accuracy

Facility	Parameter	Tech Team Certainty	Supporting Documents	Rationale
SWP	CA **(NEW)**	High for winter-run and low for other Chinook runs.	CFS (2013) Hedgecock (2002) Pyper et al. (2013)	• Based on CFS (2013), fish correctly identified to the proper ESU is one of the most important terms in accurately estimating loss. • Nearly all the genetic winter-run Chinook are found in the Delta model winter-run length category. • Less certainty on false positive/negatives for other runs.
CVP	CA **(NEW)**			

SALVAGE= [(Observed number of salvaged fish) * (Minutes pumping/Sample time length)] * CA

Salmon Entrainment (ENTRAIN)

Facility	Parameter	Tech Team Certainty	Supporting Documents	Rationale
SWP	Encounter	Medium	Screen Efficiency Studies: • DWR (1973) • Skinner (1974)	• Uncertainty on whether the same efficiency equation should be used at both SWP and CVP. • It is difficult to meet desired velocity criteria under RPAs at CVP, while louver bays can be closed at SWP.
CVP	Encounter	Low		

ENTRAIN= (ENCOUNTER/(1-P))/CLEADJ

ENCOUNTER= SALVAGE/EFFICIENCY

Salmon Pre-Screen Loss

Facility	Parameter	Tech Team Certainty	Supporting Documents	Rationale
SWP	P= 0.75	Medium	DWR (1986)	Based on adjusted average of measured pre-screen loss at Clifton Court Forebay.
CVP	P= 0.15	Low	Hall (1980) in CDFW (1987)	An agreed upon value at the CVP based on studies at the SWP and at other water diversion facilities with louvered channels.

ENTRAIN= (ENCOUNTER/(1-P))/CLEADJ

Salmon Cleaning Adjustment

Facility	Parameter	Tech Team Certainty	Supporting Documents	Rationale
SWP	CLEADJ= 1 **(NEW)**	High	Personal Communication	• For primary louver cleaning, the bays are isolated during cleaning and there is no fish loss. • For secondary cleaning/screen cleaning, primary bays are not isolated during this process, so a few fish can be lost through the primary louvers. However, the secondary louvers/screens are not raised for cleaning, so no additional fish are lost through them.
CVP	CLEADJ= 1-(cleaning minutes/ pumping minutes) **(NEW)**	Low	Personal Communication	• No empirical studies done to suggest cleaning increases loss to the Delta Mendota Canal. • Parameter of lower importance for increasing accuracy of loss based on CFS (2013).

ENTRAIN= (ENCOUNTER/(1-P))/CLEADJ

Salmon Release Estimation

Facility	Parameter	Tech Team Certainty	Supporting Documents	Rationale
SWP	2% mortality for fish ≤ 100 mm in fork length	High	Raquel (1989)	• Estimate is based on studies at the SWP fish facility.
CVP	2% mortality for fish ≤ 100 mm in fork length	Medium	Raquel (1989)	• Assumes SWP study applicable to CVP.

LOSS= ENTRAIN - RELEASE

Steelhead

Currently, no loss equation documentation

1) Salvage Estimation
2) Entrainment/Survival Estimation
3) Live Release Estimation
4) Loss Estimation

CCFB Radial Gate beyond hyacinth boom

Steelhead Salvage

Facility	Parameter	Tech Team Certainty	Supporting Documents	Rationale
SWP	Salvage	High	McEwan and Collins 1990 Karp et al. 1997	• Past total census collection studies showed that there is normally agreement with expanded salvage and what is observed in 30m counts.
CVP	Salvage	High		

SALVAGE= (Observed number of salvaged fish) * (Minutes pumping/Sample time length)

Steelhead Salvag

Facility	Parameter	Tech Team Certainty	Supporting Docum	
SWP	Salvage	High		otal census collection studies showed that there is normally agreement with expanded salvage and what is observed in 30m counts.
CVP	Sal			

SAME AS CHINOOK SALMON

SA GE= (Observed number of salvaged fish) * (Minutes pumping/Sample time length)

Steelhead Entrainment (WF Survival)

Facility	Parameter	Tech Team Certainty	Supporting Documents	Rationale
SWP	Whole Facility Survival= 0.18 **(NEW)**	Medium	Clark et al. (2009)	• Based on whole facility efficiency study at SWP. • There could be seasonal differences in survival of steelhead at SWP due to different environmental conditions not reflected in point estimate.
CVP	Whole Facility Survival= ? **(NEW)**	Low	See next slide	• Whole facility survival estimate does not exist at CVP. • Jahn (2011) determined the whole facility survival estimate by aggregating 3 elements: pre-screen survival, facility survival, and cleaning adjustment.

ENTRAIN= (SALVAGE/SURVIVAL)

CVP Steelhead WF Survival Estimate

Parameter	Value	Tech Team Certainty	Supporting Documents	Rationale
Pre-Screen Survival **(NEW)**	0.85	Low	Hall (1980) in CDFW (1987)	• Based on pre-screen loss for Chinook salmon at the CVP, which is an agreed upon value.
Facility Survival **(NEW)**	0.74	Low	Clark et al. (2009) Bowen et al. (2004) Karp et al. (1995)	• Based on steelhead louver efficiency trials at the SWP fish facility (Clark et al. 2009). • Chinook might not be a good surrogate for louver efficiency (Murphy et al. 2011). CVP louver efficiencies for Chinook range from 0.09 to 0.82 (Karp et al. 1995; Bowen et al. 2004).
Cleaning Adjustment **(NEW)**	1-(cleaning minutes/ pumping minutes)	Low	Personal Communication	• No empirical studies done to suggest cleaning increases loss to the Delta Mendota Canal. • Parameter of lower importance for increasing accuracy of loss based on CFS (2013).

ENTRAIN= (SALVAGE/SURVIVAL)

Steelhead Release Estimation

Facility	Parameter	Tech Team Certainty	Supporting Documents	Rationale
SWP	No mortality	High	Raquel (1989)	• Found no immediate detrimental effects of handling and trucking on steelhead.
CVP	No mortality	Medium	Raquel (1989)	• Assumes SWP study applicable to CVP.

LOSS= ENTRAIN - RELEASE

Green Sturgeon

Currently, no loss equation documentation

1) Salvage Estimation
2) Entrainment Estimation
3) Live Release Estimation
4) Loss Estimation

Green Sturgeon Salvage

Facility	Parameter	Tech Team Certainty	Supporting Documents	Rationale
SWP	Salvage	Medium	Karp et al. 1997	• Past total census collection studies showed that there is normally agreement with expanded salvage and what is observed with 30m counts. • Counts of larger fishes may be negatively biased in 10m counts
CVP	Salvage	Medium		

SALVAGE= (Observed number of salvaged fish) * (Minutes pumping/Sample time length)

Green Sturgeon S

Facility	Parameter	Tech Team Certainty	Supporting Docume	
SWP	Salvage	Medium		tal census collection udies showed that there is normally agreement with expanded salvage and what is observed with 30m counts. • Counts of larger fishes may be negatively biased in 10m counts
CVP	Salv			

SAME AS CHINOOK AND STEELHEAD

SALVAGE= (Observed number of salvaged fish) * (Minutes pumping/Sample time length)

Green Sturgeon Clean Adjm't

Facility	Parameter	Tech Team Certainty	Supporting Documents	Rationale
SWP	CLEADJ= 1 **(NEW)**	High	Personal Communication	• For primary louver cleaning, the bays are isolated during cleaning and there is no fish loss. • For secondary cleaning/screen cleaning, primary bays are not isolated during this process, so a few fish can be lost through the primary louvers. However, the secondary louvers/screens are not raised for cleaning, so no additional fish are lost through them.
CVP	CLEADJ= 1-(cleaning minutes/ pumping minutes) **(NEW)**	Low	Personal Communication	• No empirical data results to suggest cleaning increases loss to the Delta Mendota Canal. • Parameter of lower importance for increasing accuracy of loss based on CFS (2013).

ENTRAIN= SALVAGE/CLEADJ

Green Sturgeon Clean m't

Facility	Parameter	Tech Team Certainty	Supporting Documents	Rationale
SWP	CLEADJ= 1 **(NEW)**	High	Personal Communi	bays are isolated no fish loss. ing/screen cleaning, primary olated during this process, so a few e lost through the primary louvers. ever, the secondary louvers/screens are not raised for cleaning, so no additional fish are lost through them.
CV	**w)**		nal communication	• No empirical data results to suggest cleaning increases loss to the Delta Mendota Canal. • Parameter of lower importance for increasing accuracy of loss based on CFS (2013).

SAME AS CHINOOK AND STEELHEAD

ENTRAIN= SALVAGE/CLEADJ

Green Sturgeon Release Est'n

Facility	Parameter	Tech Team Certainty	Supporting Documents	Rationale
SWP	Assume no mortality	Low	Scientific Assumptions	• No studies have been completed for green sturgeon. • Mortality assumed to be very low for yearling sized and age 1+ green sturgeon. • Summer conditions could increase stress during handling and trucking. • However, Cech et al. (1984) showed juvenile white sturgeon (a green sturgeon surrogate) to have better or similar tolerances to striped bass for which handling and trucking is implemented in a protective fashion in the summer.
CVP				

LOSS= ENTRAIN – OBSERVED # OF STURGEON

Calculating Confidence Intervals

Jahn developed a method for calculating confidence intervals using survival terms for salmonids. Used this for steelhead.

Technical team did not have survival terms for Chinook salmon or CVP steelhead, so approach modified.

Technical team had to make assumptions about standard error in subterms for SWP/CVP Chinook survival and CVP steelhead survival.

With some types of data, team would prefer to use log normal distribution formula for CIs when the sample number was small (i.e. hatchery release surrogate groups).

Calculating Confidence Intervals

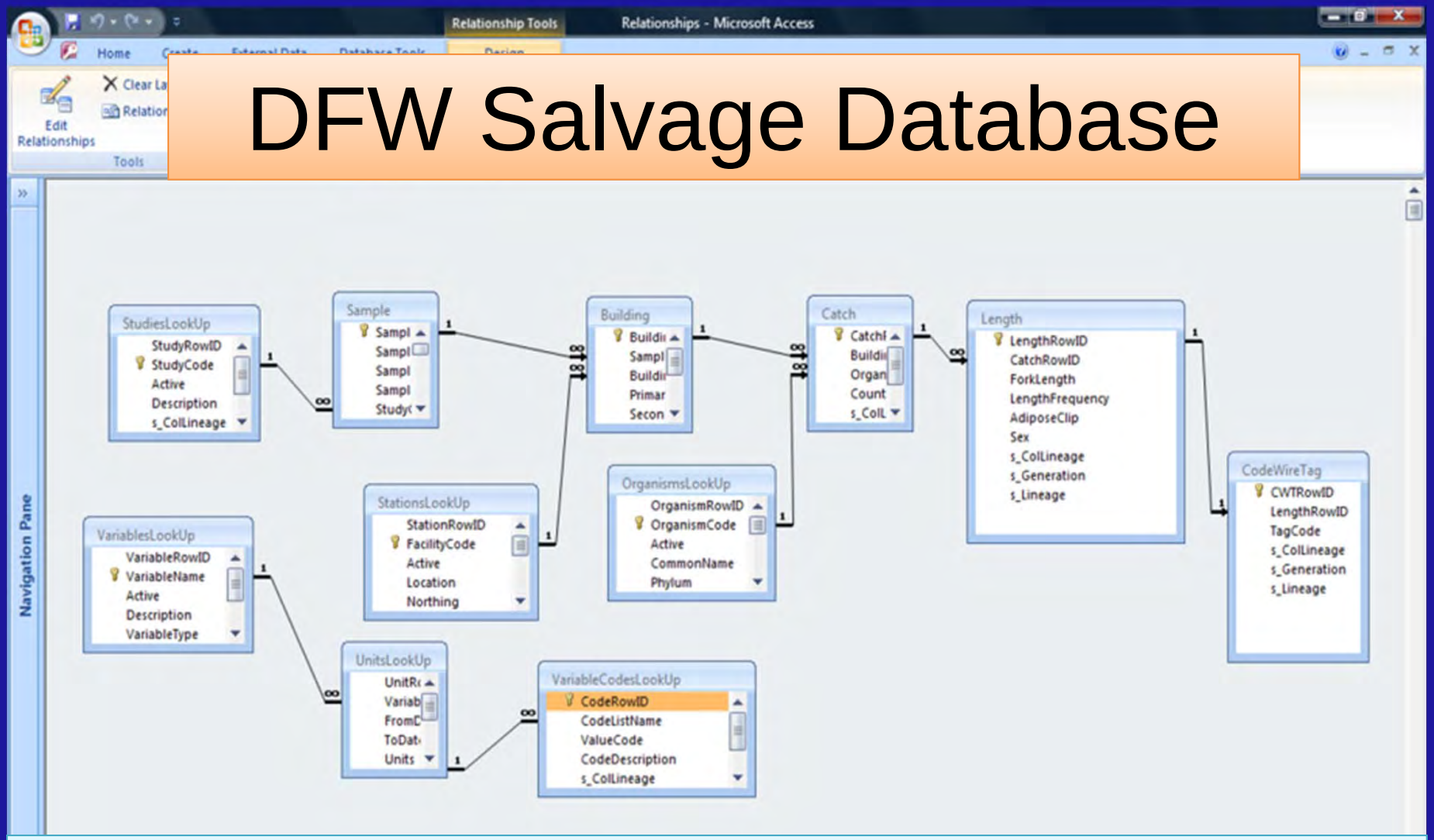
1. Calculate standard measures for sampling domain.
2. Compute standard error for salvage.
3. Compute standard error for survival (estimated survival for Chinook and used modified approach for steelhead).
4. Compute standard error for entrainment.
5. Calculate standard error for loss using estimates from entrainment and salvage.
6. Calculate confidence intervals on total estimated loss using parametric (or log parametric) equations.

Presentation outline

- What is the BiOp Term and Condition 2a?
- Objective and Timeline
- Facility Diagrams
- Chinook Loss Equation
- Steelhead Loss Equation
- Green Sturgeon Loss Equation
- Results of Different Equations
- Potential Research and Continuing Steps

R. Reyes

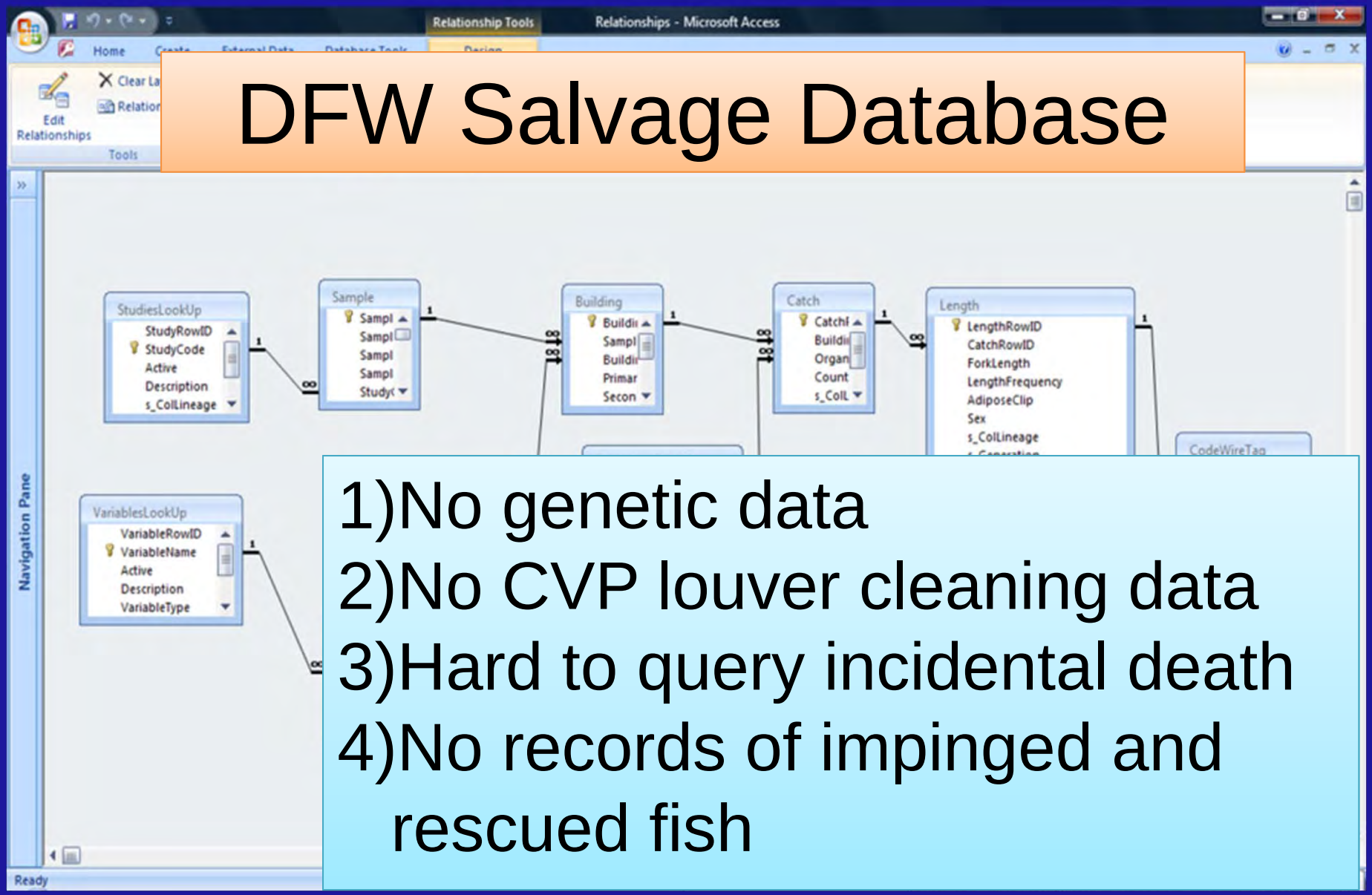
Challenge: Data Acquisition



DFW Salvage Database

Available at ftp://ftp.delta.dfg.ca.gov/salvage/

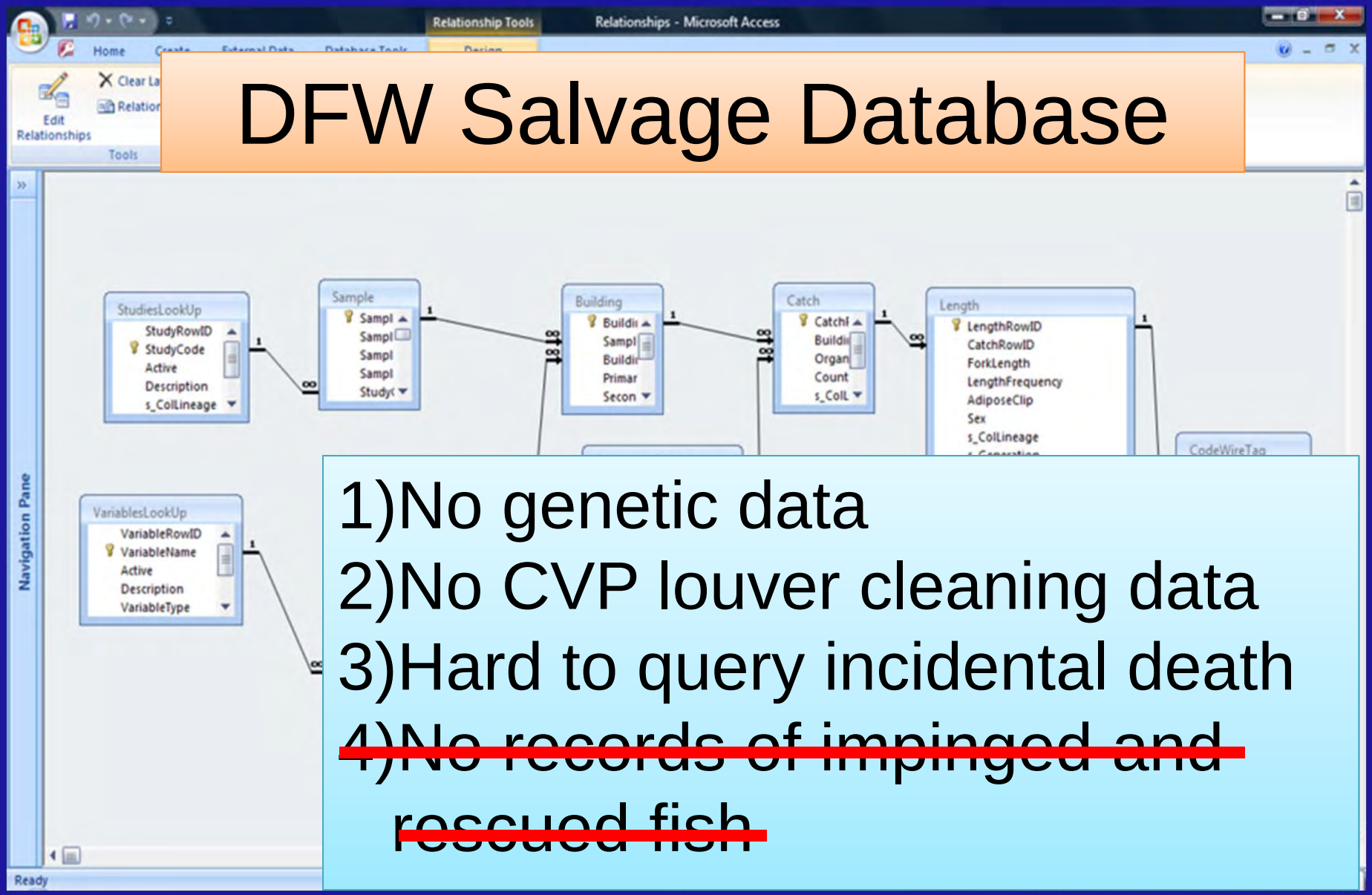
Challenge: Data Acquisition



DFW Salvage Database

1)No genetic data
2)No CVP louver cleaning data
3)Hard to query incidental death
4)No records of impinged and rescued fish

Challenge: Data Acquisition



DFW Salvage Database

1)No genetic data
2)No CVP louver cleaning data
3)Hard to query incidental death
~~4)No records of impinged and rescued fish~~

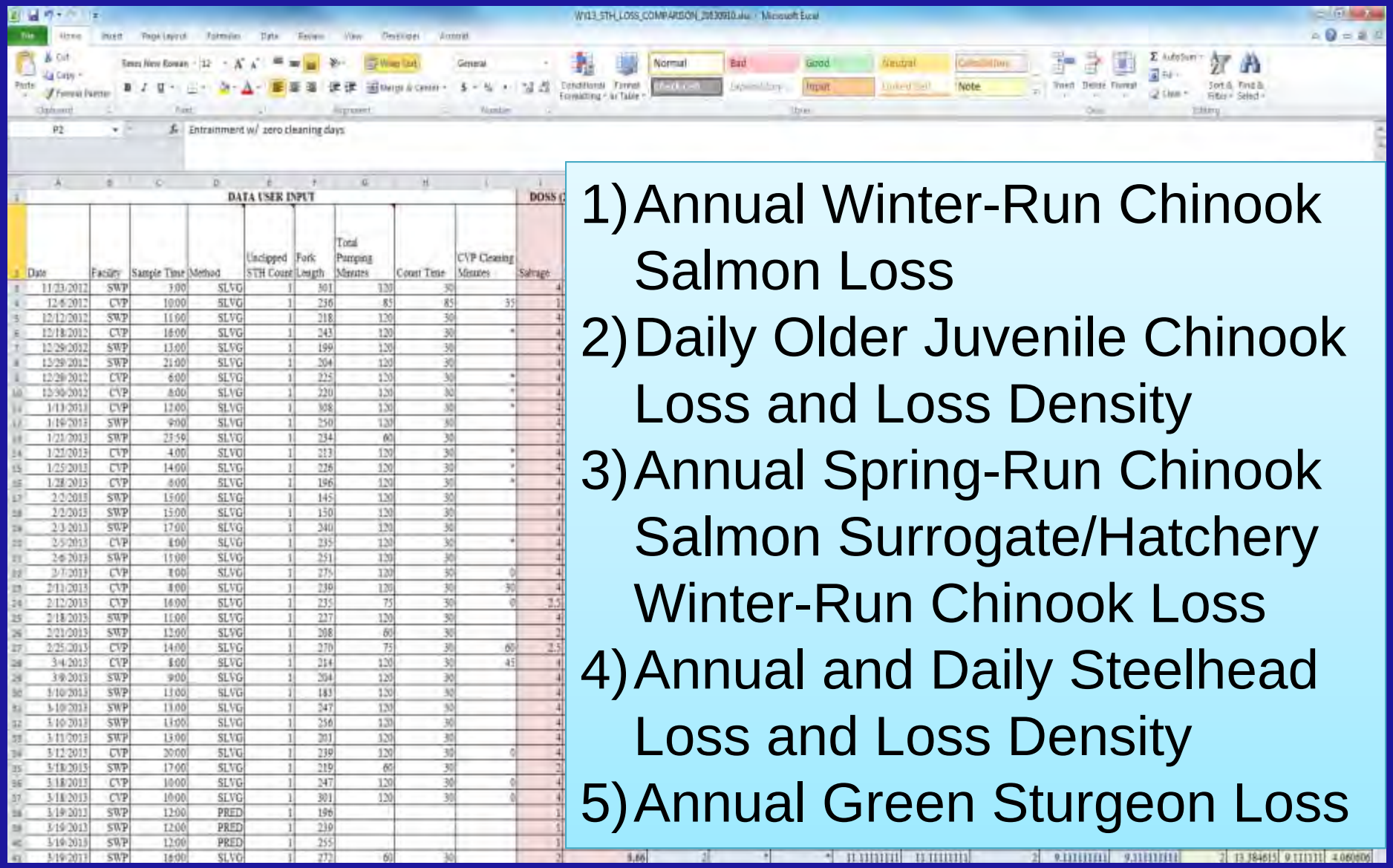
Spreadsheet Models Developed

W13_STH_LOSS_COMPARISON_20130910.xlsx - Microsoft Excel

P2: Entrainment w/ zero cleaning days

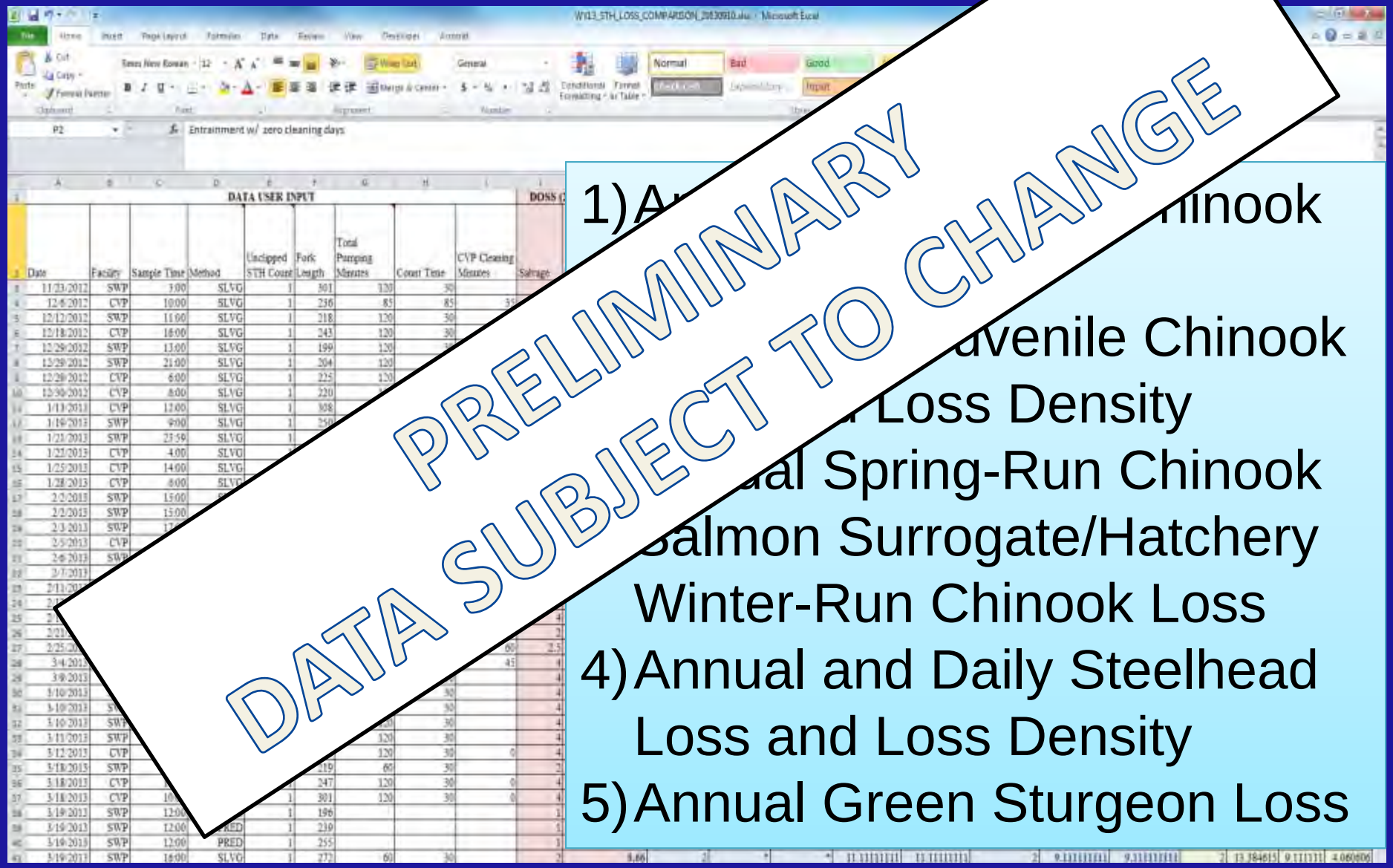
	DATA USER INPUT									DOSS (2011) METHOD		TECH TEAM (2013) METHOD									JAHN (2011) METHOD			
1	Date	Facility	Sample Time	Method	Unclipped STH Count	Fork Length	Total Pumping Minutes	Count Time	CVP Cleaning Minutes	Salvage	DOSS Loss	Salvage	CVP Daily Cleaning Adjustment w/ no zero cleaning days	CVP Daily Cleaning Adjustment w/ zero cleaning days	Entrainment w/ no zero cleaning days	Entrainment w/ zero cleaning days	Released	Tech Team Loss w/ no zero cleaning days	Tech Team Loss w/ zero cleaning days	Salvage	Low Survival Loss	Medium Survival Loss	High Survival Loss
3	11/23/2012	SWP	3:00	SLVG	1	301	120	30		4	17.32	4	*	*	22.22222222	22.22222222	4	18.22222222	18.22222222	4	26.769231	18.22222	8.121212
4	12/6/2012	CVP	10:00	SLVG	1	236	85	85	35	1	8.66	1	0.588235294	0.588235294	2.702702703	2.702702703	1	1.702702703	1.702702703	1	4.5555556	0.818182	0.538462
5	12/12/2012	SWP	11:00	SLVG	1	218	120	30		4	17.32	4	*	*	22.22222222	22.22222222	4	18.22222222	18.22222222	4	26.769231	18.22222	8.121212
6	12/18/2012	CVP	16:00	SLVG	1	243	120	30	*	4	2.72	4	0.88	1	7.226477815	6.359300477	4	3.226477815	2.359300477	4	18.222222	3.272727	2.153846
7	12/29/2012	SWP	13:00	SLVG	1	199	120	30		4	17.32	4	*	*	22.22222222	22.22222222	4	18.22222222	18.22222222	4	26.769231	18.22222	8.121212
8	12/29/2012	SWP	21:00	SLVG	1	204	120	30		4	17.32	4	*	*	22.22222222	22.22222222	4	18.22222222	18.22222222	4	26.769231	18.22222	8.121212
9	12/29/2012	CVP	6:00	SLVG	1	225	120	30	*	4	2.72	4	0.88	1	7.226477815	6.359300477	4	3.226477815	2.359300477	4	18.222222	3.272727	2.153846
10	12/30/2012	CVP	8:00	SLVG	1	220	120	30	*	4	2.72	4	0.88	1	7.226477815	6.359300477	4	3.226477815	2.359300477	4	18.222222	3.272727	2.153846
11	1/13/2013	CVP	12:00	SLVG	1	308	120	30	*	4	2.72	4	0.88	1	7.226477815	6.359300477	4	3.226477815	2.359300477	4	18.222222	3.272727	2.153846
12	1/19/2013	SWP	9:00	SLVG	1	250	120	30		4	17.32	4	*	*	22.22222222	22.22222222	4	18.22222222	18.22222222	4	26.769231	18.22222	8.121212
13	1/21/2013	SWP	23:59	SLVG	1	234	60	30		2	8.66	2	*	*	11.11111111	11.11111111	2	9.111111111	9.111111111	2	13.384615	9.111111	4.060606
14	1/22/2013	CVP	4:00	SLVG	1	213	120	30	*	4	2.72	4	0.88	1	7.226477815	6.359300477	4	3.226477815	2.359300477	4	18.222222	3.272727	2.153846
15	1/25/2013	CVP	14:00	SLVG	1	226	120	30	*	4	2.72	4	0.88	1	7.226477815	6.359300477	4	3.226477815	2.359300477	4	18.222222	3.272727	2.153846
16	1/28/2013	CVP	6:00	SLVG	1	196	120	30	*	4	2.72	4	0.88	1	7.226477815	6.359300477	4	3.226477815	2.359300477	4	18.222222	3.272727	2.153846
17	2/2/2013	SWP	15:00	SLVG	1	145	120	30		4	17.32	4	*	*	22.22222222	22.22222222	4	18.22222222	18.22222222	4	26.769231	18.22222	8.121212
18	2/2/2013	SWP	15:00	SLVG	1	150	120	30		4	17.32	4	*	*	22.22222222	22.22222222	4	18.22222222	18.22222222	4	26.769231	18.22222	8.121212
19	2/3/2013	SWP	17:00	SLVG	1	240	120	30		4	17.32	4	*	*	22.22222222	22.22222222	4	18.22222222	18.22222222	4	26.769231	18.22222	8.121212
20	2/5/2013	CVP	8:00	SLVG	1	235	120	30	*	4	2.72	4	0.88	1	7.226477815	6.359300477	4	3.226477815	2.359300477	4	18.222222	3.272727	2.153846
21	2/6/2013	SWP	11:00	SLVG	1	251	120	30		4	17.32	4	*	*	22.22222222	22.22222222	4	18.22222222	18.22222222	4	26.769231	18.22222	8.121212
22	2/7/2013	CVP	8:00	SLVG	1	275	120	30	0	4	2.72	4	1	1	6.359300477	6.359300477	4	2.359300477	2.359300477	4	18.222222	3.272727	2.153846
23	2/11/2013	CVP	8:00	SLVG	1	239	120	30	30	4	2.72	4	0.75	0.75	8.479067303	8.479067303	4	4.479067303	4.479067303	4	18.222222	3.272727	2.153846
24	2/12/2013	CVP	16:00	SLVG	1	235	75	30	0	2.5	1.7	2.5	1	1	3.974562798	3.974562798	2.5	1.474562798	1.474562798	2.5	11.388889	2.045455	1.346154
25	2/18/2013	SWP	11:00	SLVG	1	227	120	30		4	17.32	4	*	*	22.22222222	22.22222222	4	18.22222222	18.22222222	4	26.769231	18.22222	8.121212
26	2/21/2013	SWP	12:00	SLVG	1	208	60	30		2	8.66	2	*	*	11.11111111	11.11111111	2	9.111111111	9.111111111	2	13.384615	9.111111	4.060606
27	2/25/2013	CVP	14:00	SLVG	1	270	75	30	60	2.5	1.7	2.5	0.2	0.2	19.87281399	19.87281399	2.5	17.37281399	17.37281399	2.5	11.388889	2.045455	1.346154
28	3/4/2013	CVP	8:00	SLVG	1	214	120	30	45	4	2.72	4	0.625	0.625	10.17488076	10.17488076	4	6.174880763	6.174880763	4	18.222222	3.272727	2.153846
29	3/9/2013	SWP	9:00	SLVG	1	204	120	30		4	17.32	4	*	*	22.22222222	22.22222222	4	18.22222222	18.22222222	4	26.769231	18.22222	8.121212
30	3/10/2013	SWP	13:00	SLVG	1	183	120	30		4	17.32	4	*	*	22.22222222	22.22222222	4	18.22222222	18.22222222	4	26.769231	18.22222	8.121212
31	3/10/2013	SWP	13:00	SLVG	1	247	120	30		4	17.32	4	*	*	22.22222222	22.22222222	4	18.22222222	18.22222222	4	26.769231	18.22222	8.121212
32	3/10/2013	SWP	13:00	SLVG	1	256	120	30		4	17.32	4	*	*	22.22222222	22.22222222	4	18.22222222	18.22222222	4	26.769231	18.22222	8.121212
33	3/11/2013	SWP	13:00	SLVG	1	201	120	30		4	17.32	4	*	*	22.22222222	22.22222222	4	18.22222222	18.22222222	4	26.769231	18.22222	8.121212
34	3/12/2013	CVP	20:00	SLVG	1	239	120	30	0	4	2.72	4	1	1	6.359300477	6.359300477	4	2.359300477	2.359300477	4	18.222222	3.272727	2.153846
35	3/18/2013	SWP	17:00	SLVG	1	219	60	30		2	8.66	2	*	*	11.11111111	11.11111111	2	9.111111111	9.111111111	2	13.384615	9.111111	4.060606
36	3/18/2013	CVP	10:00	SLVG	1	247	120	30	0	4	2.72	4	1	1	6.359300477	6.359300477	4	2.359300477	2.359300477	4	18.222222	3.272727	2.153846
37	3/18/2013	CVP	10:00	SLVG	1	301	120	30	0	4	2.72	4	1	1	6.359300477	6.359300477	4	2.359300477	2.359300477	4	18.222222	3.272727	2.153846
38	3/19/2013	SWP	12:00	PRED	1	196				1	4.33	1	*	*	5.555555556	5.555555556	1	4.555555556	4.555555556	1	6.692307	4.555556	2.030303
39	3/19/2013	SWP	12:00	PRED	1	239				1	4.33	1	*	*	5.555555556	5.555555556	1	4.555555556	4.555555556	1	6.692307	4.555556	2.030303
40	3/19/2013	SWP	12:00	PRED	1	255				1	4.33	1	*	*	5.555555556	5.555555556	1	4.555555556	4.555555556	1	6.692307	4.555556	2.030303
41	3/19/2013	SWP	16:00	SLVG	1	272	60	30		2	8.66	2	*	*	11.11111111	11.11111111	2	9.111111111	9.111111111	2	13.384615	9.111111	4.060606

Spreadsheet Models Developed



1) Annual Winter-Run Chinook Salmon Loss
2) Daily Older Juvenile Chinook Loss and Loss Density
3) Annual Spring-Run Chinook Salmon Surrogate/Hatchery Winter-Run Chinook Loss
4) Annual and Daily Steelhead Loss and Loss Density
5) Annual Green Sturgeon Loss

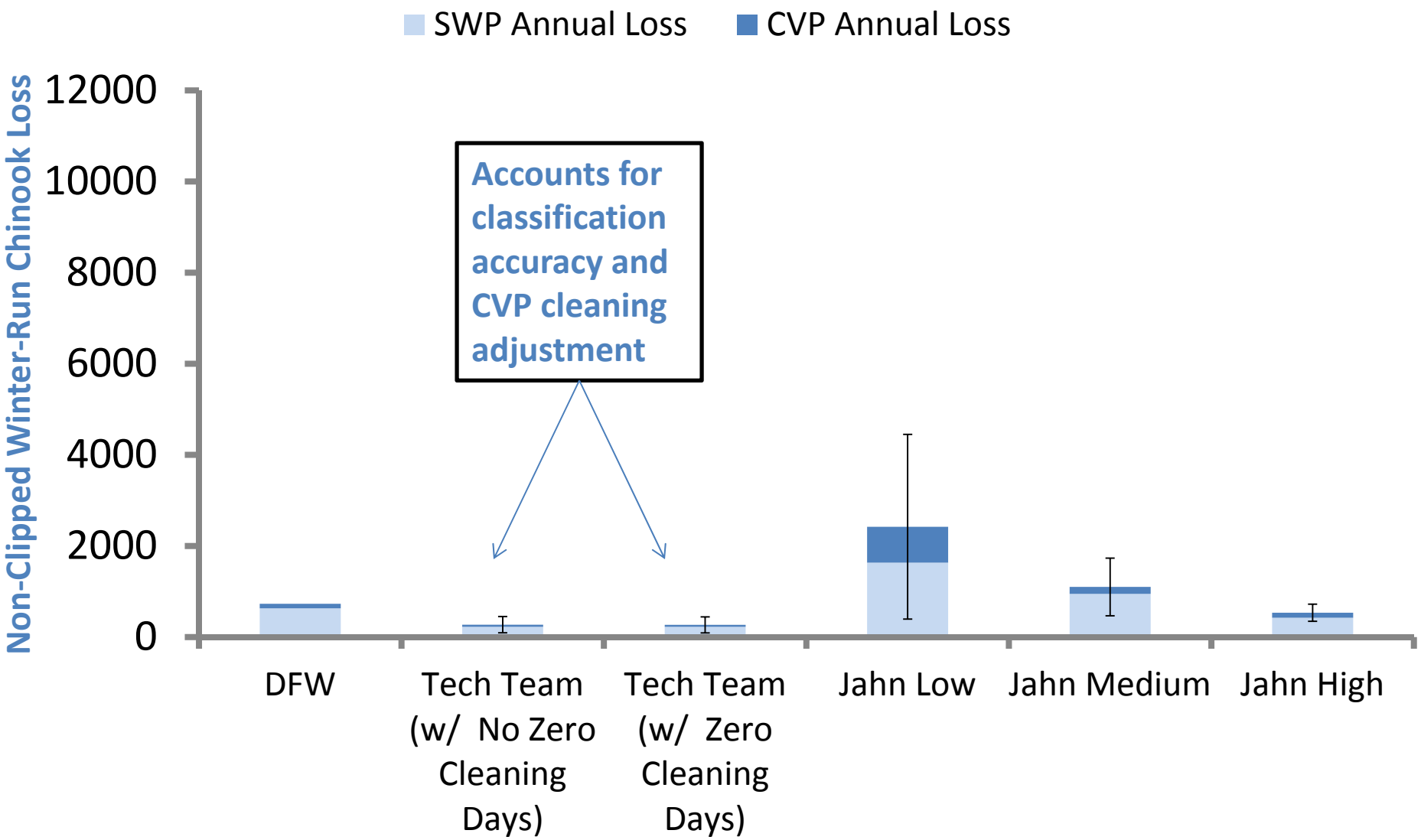
Spreadsheet Models Dev ed



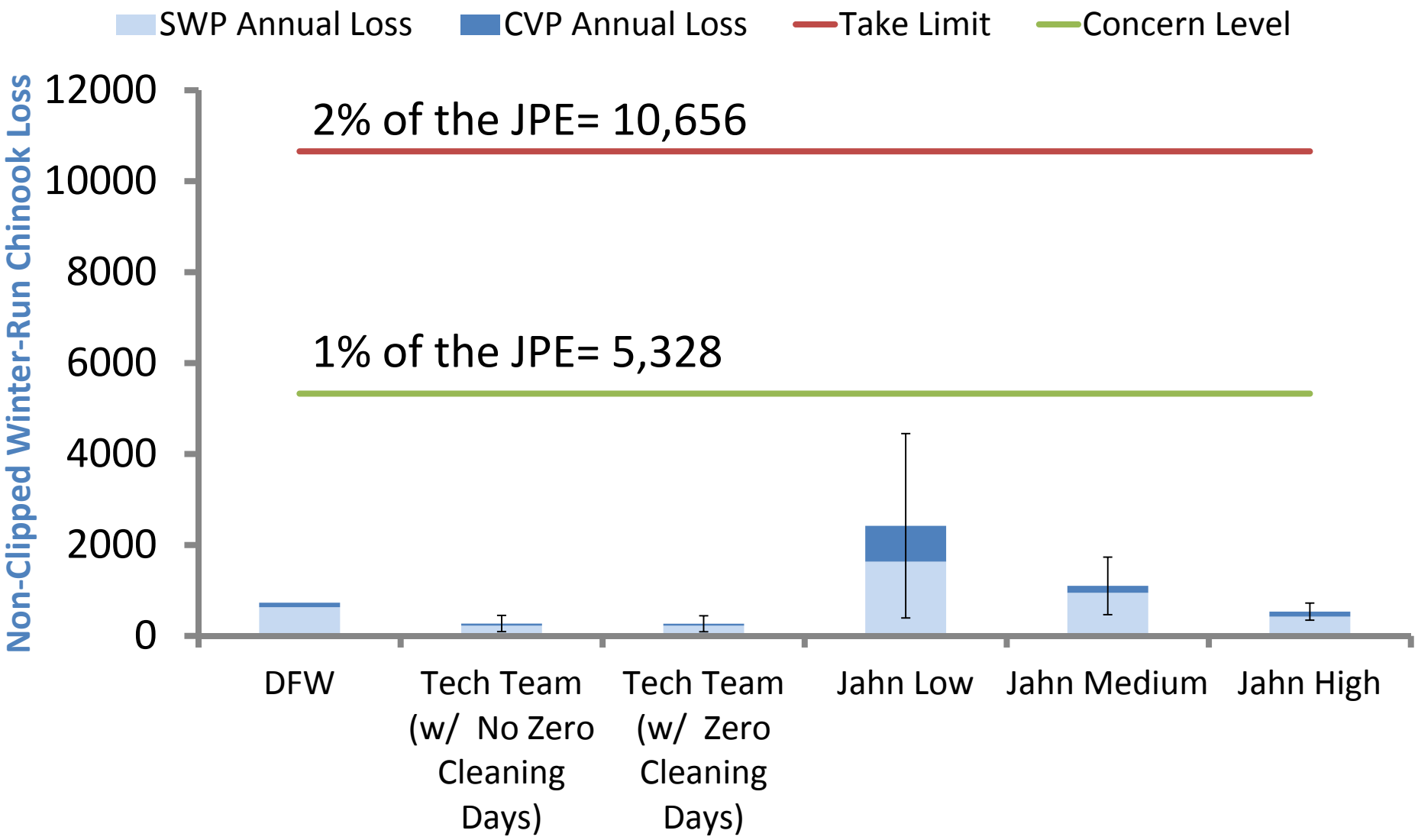
PRELIMINARY
DATA SUBJECT TO CHANGE

1) A hinook
uvenile Chinook
Loss Density
al Spring-Run Chinook
almon Surrogate/Hatchery
Winter-Run Chinook Loss
4) Annual and Daily Steelhead Loss and Loss Density
5) Annual Green Sturgeon Loss

Water Year 2013 Winter Run Loss Comparison



Water Year 2013 Winter Run Loss Comparison



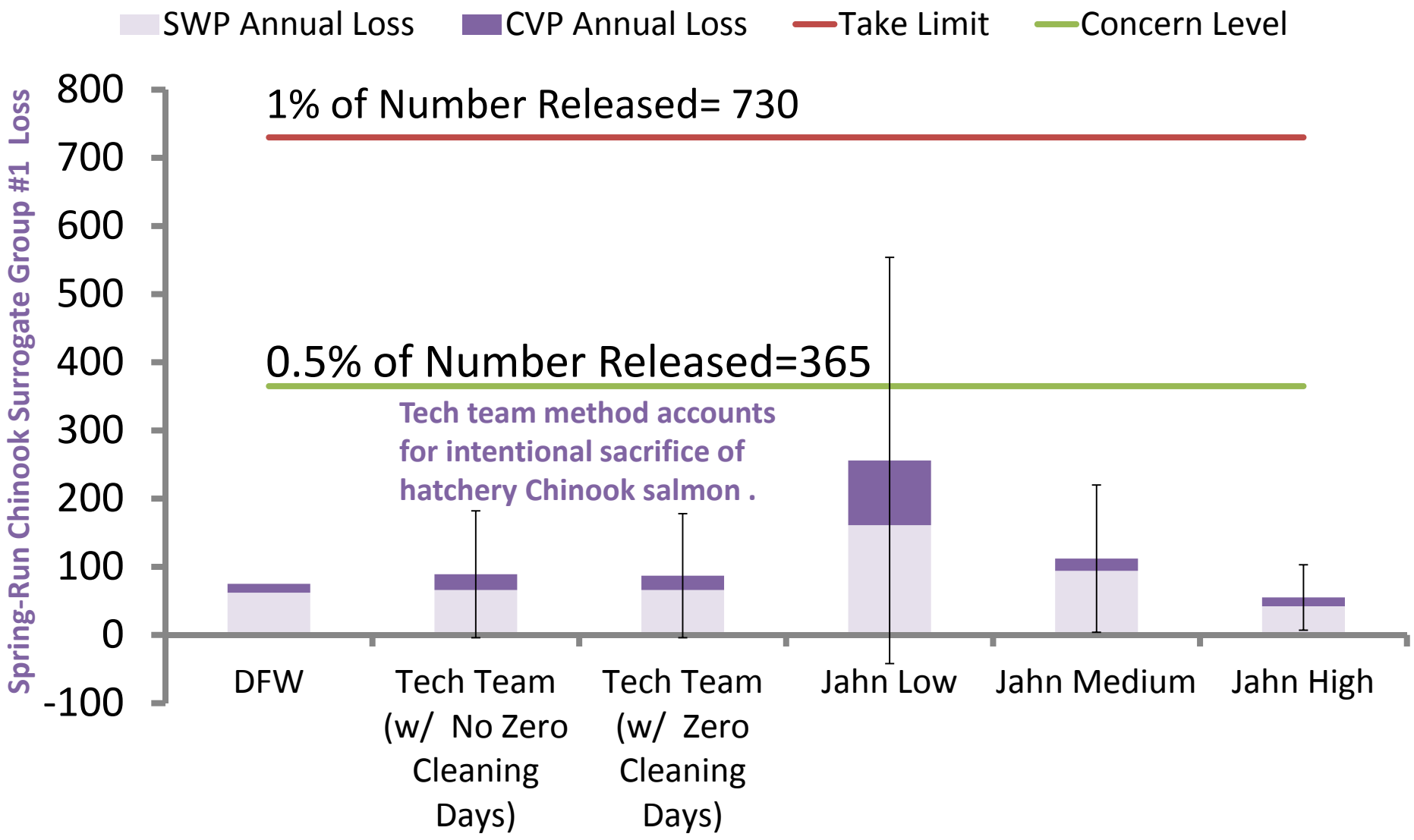
Daily Older Juvenile Chinook Loss Density Comparison: January to June 2013

Method	> 5.33 fish/TAF and < 10.66 fish/TAF	>10.66 fish/TAF	Total
DFW	2	0	2
Tech Team (No Zero Cleaning Days)	3	0	3
Tech Team (With Zero Cleaning Days)	3	0	3
Jahn (Low)	6	5	11
Jahn (Med)	5	0	5
Jahn (High)	0	0	0

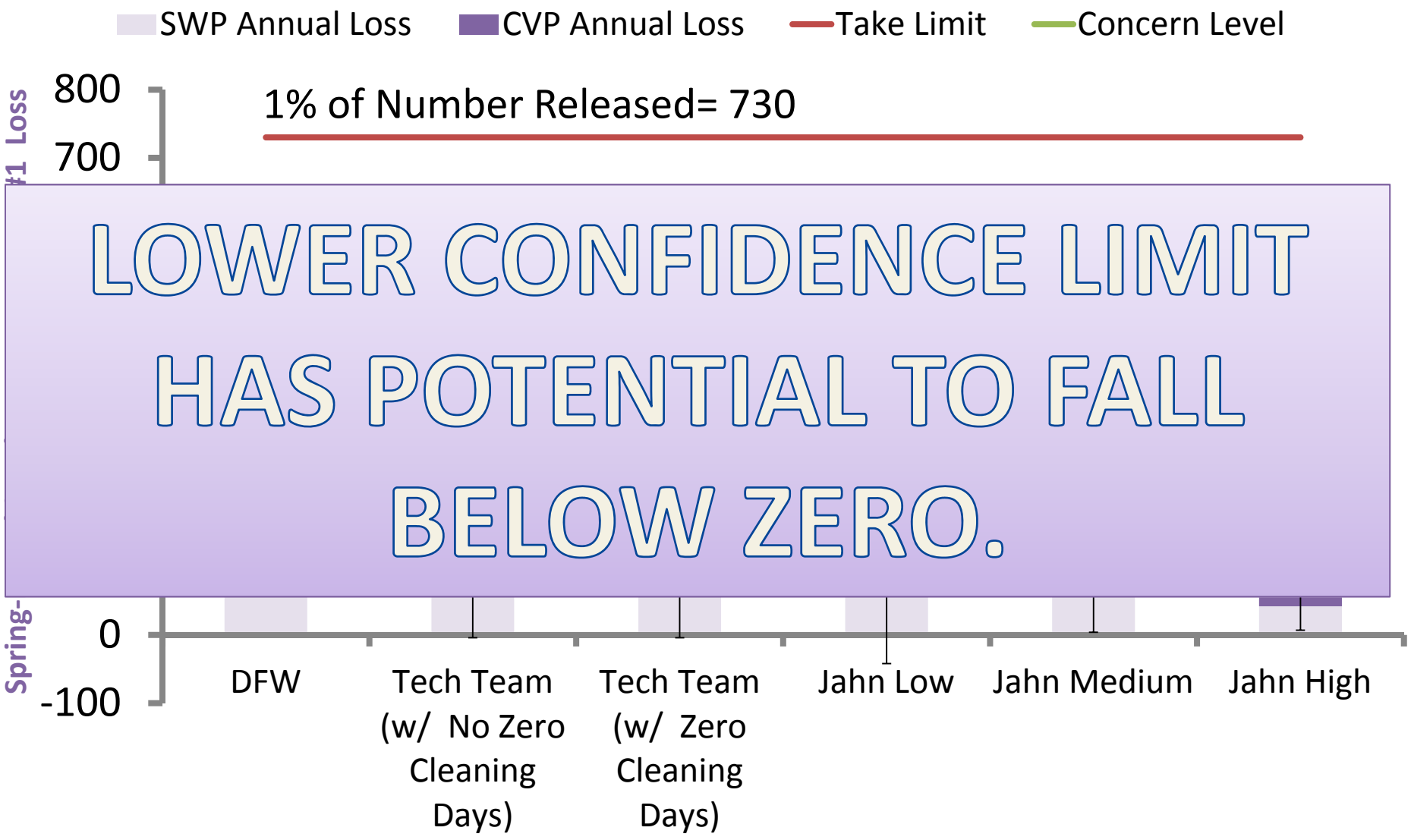
Daily Older Juvenile Chinook Loss Density Comparison: January to June 2013

Method	> 5.33 fish/TAF and < 10.66 fish/TAF	>10.66 fish/TAF	Total
DFW	2	0	2
Tech Team (No Zero Cleaning Days)	3	0	3
Tech Team (With Zero Cleaning Days)	3	0	3
Jahn (Low)	6	5	11
Jahn (Med)	5	0	5
Jahn (High)	0	0	0

Water Year 2013 Spring Run Surrogate Group #1 Loss Comparison

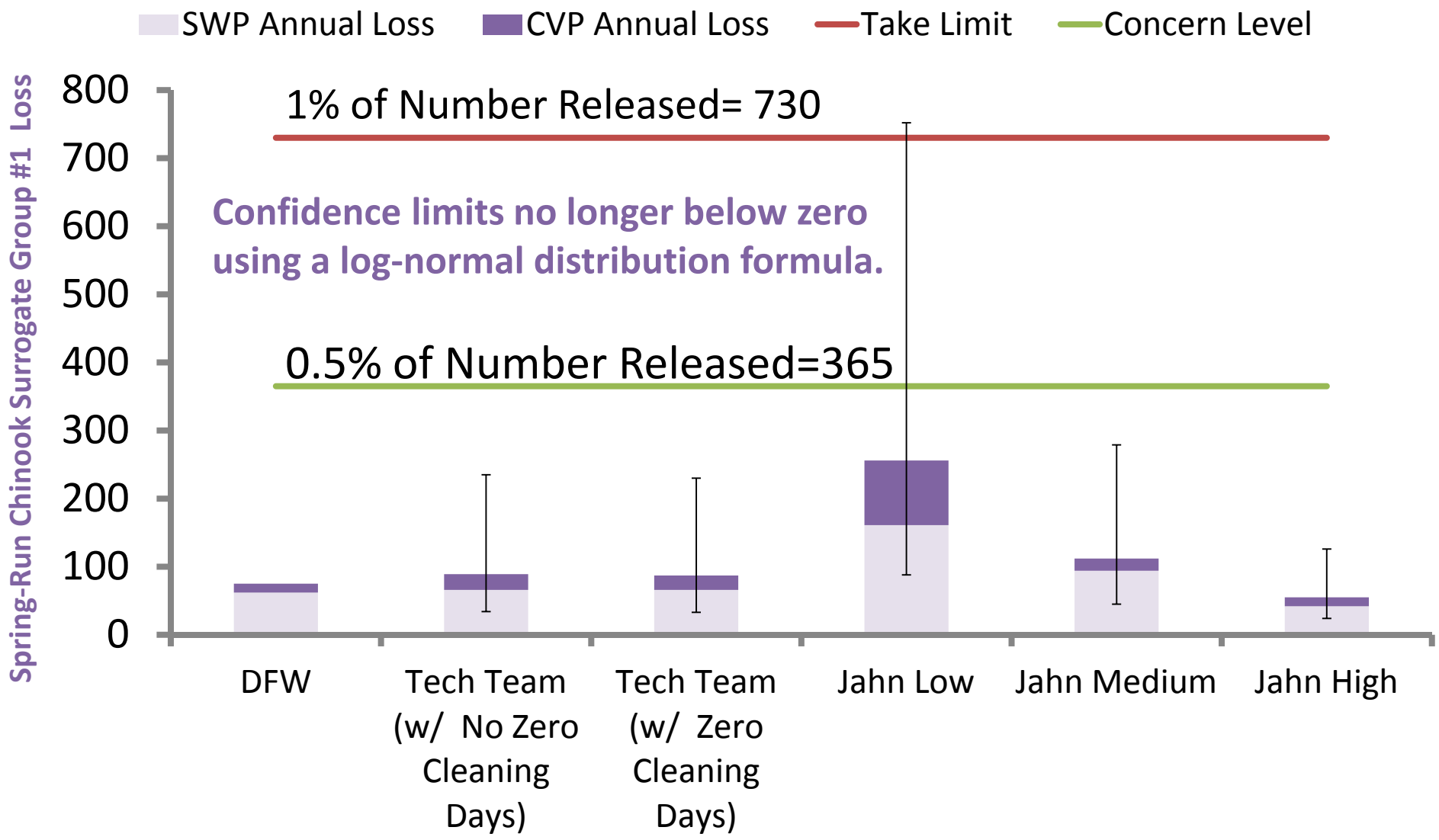


Water Year 2013 Spring Run Surrogate Group #1 Loss Comparison

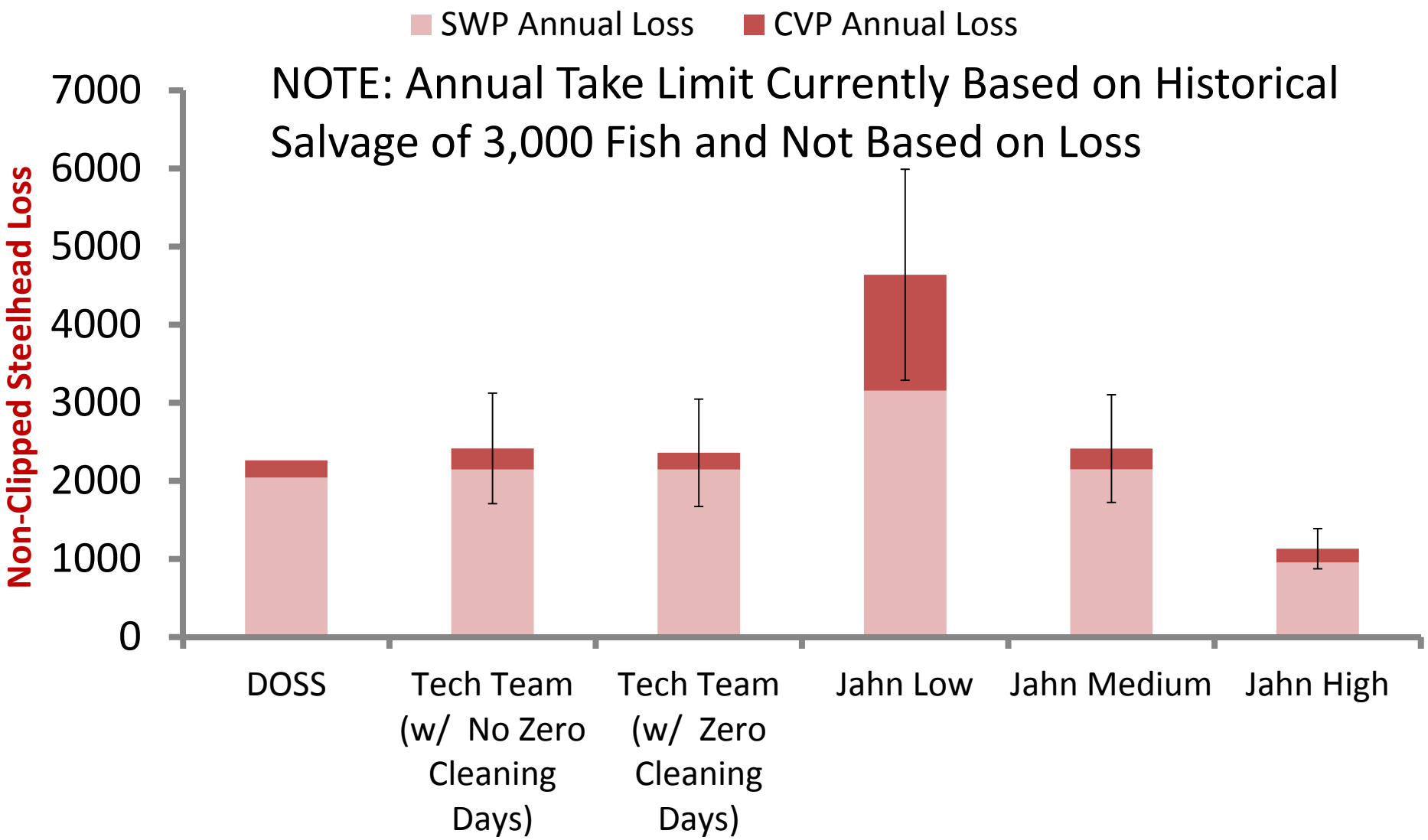


LOWER CONFIDENCE LIMIT HAS POTENTIAL TO FALL BELOW ZERO.

Water Year 2013 Spring Run Surrogate Group #1 Loss Comparison



Water Year 2013 Annual Steelhead Loss Comparison



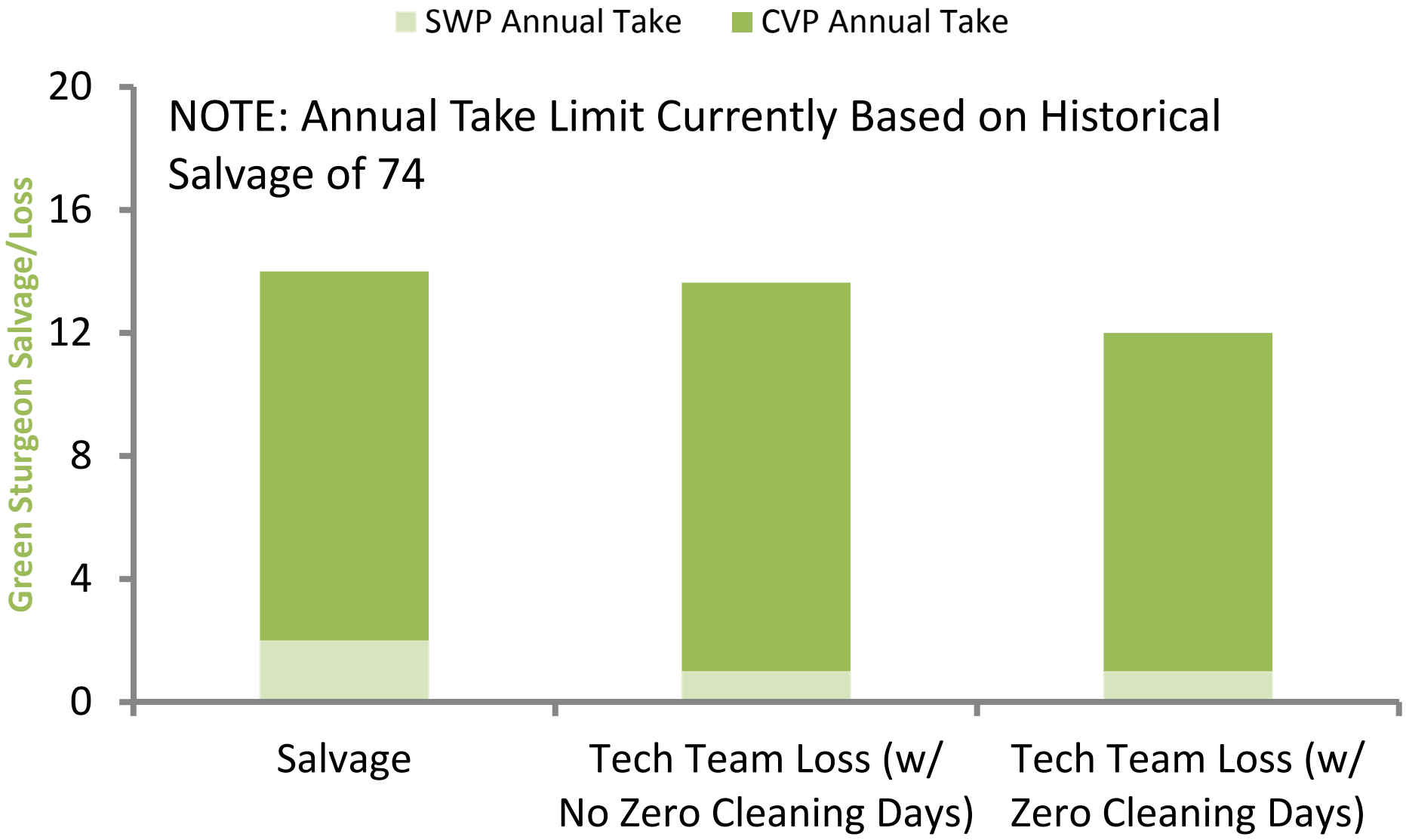
Daily Steelhead Loss Density Comparison: January to June 2013

Method	> 8 fish/TAF and <12 fish/TAF	>12 fish/TAF	Total
DOSS	13	5	18
Tech Team (No Zero Cleaning Days)	9	10	19
Tech Team (With Zero Cleaning Days)	9	10	19
Jahn (Low)	15	25	40
Jahn (Med)	8	11	19
Jahn (High)	3	1	4

Daily Steelhead Loss Density Comparison: January to June 2013

Method	> 8 fish/TAF and <12 fish/TAF	>12 fish/TAF	Total
DOSS	13	5	18
Tech Team (No Zero Cleaning Days)	9	10	19
Tech Team (With Zero Cleaning Days)	9	10	19
Jahn (Low)	15	25	40
Jahn (Med)	8	11	19
Jahn (High)	3	1	4

Water Year 2011 Annual Green Sturgeon Incidental Take



Current Studies to Inform Loss Equation

Species	Studies
Chinook	1) SWP Clifton Court predation reduction study 2) SWP evaluation of salvage efficiency 3) CVP whole facility efficiency study
Steelhead	1) SWP Clifton Court predation reduction study 2) SWP evaluation of salvage efficiency 3) CVP whole facility efficiency study 4) 6 year study
Green Sturgeon	1) UCD louver efficiency testing 2) Incomplete pilot louver efficiency study at the CVP fish facility

Clifton Court Forebay Predation Study (2013 to 2017) (Methods)

- Predatory Fish Mark-Recapture Survey
  - Sampling/PIT tagging of predators within Clifton Court Forebay; twice/week.
- Biotelemetry
  - Acoustic tagging of predatory fish captured inside Clifton Court Forebay and tracking within the Forebay and adjacent waterways.

The surgical implantation of an acoustic tag in a predatory fish captured in the Clifton Court Forebay.

Source: K. Clark (DWR, Personal Communication)

Clifton Court Forebay Predation Study (2013 to 2017) (Methods)

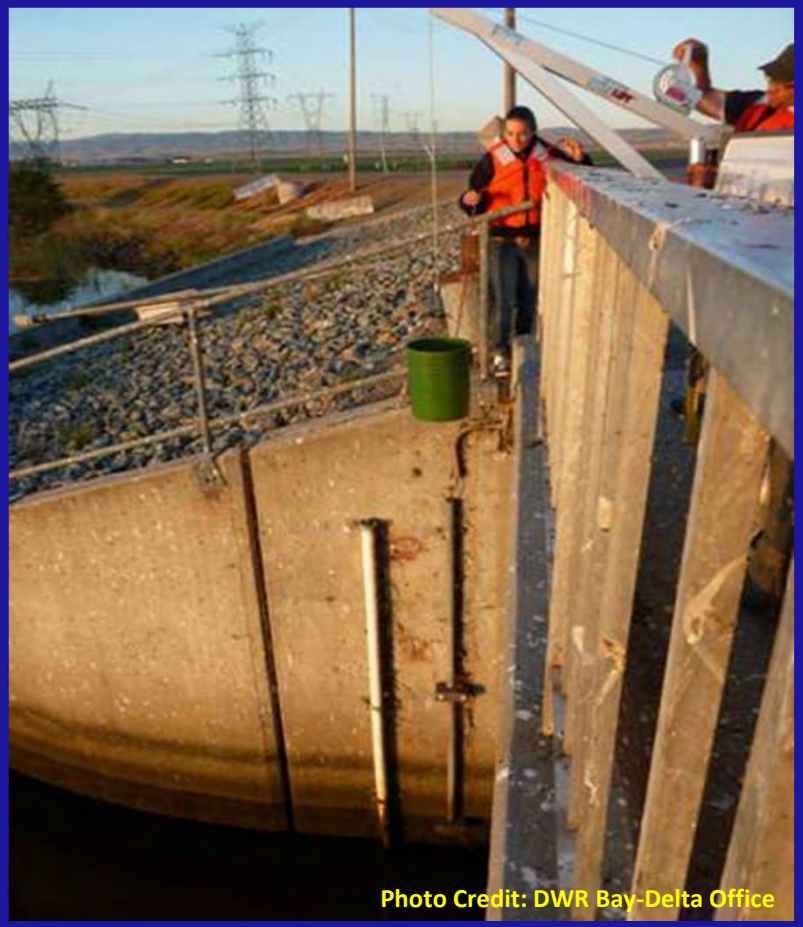
- Creel Surveys
  - Roving angler survey around Clifton Court Forebay; twice/week.
- Avian Surveys
  - Modified point count avian survey around Clifton Court Forebay; twice/week.

Avian predators on the shore of Clifton Court Forebay.

Source: K. Clark (DWR, Personal Communication)

Clifton Court Forebay Predation Study (2013 to 2017) (Methods)

- Salmonid Survival Monitoring
  - Multiple small releases of PIT tagged salmonids (salmon and steelhead) at the Clifton Court Forebay intake with recapture through the salvage process; pre and post construction of a fishing facility.
- Genetic Diet Sampling
  - Genetic analysis of full intestinal tracts of striped bass captured within Clifton Court Forebay; 2014 only.



Release of PIT tagged salmon at the Clifton Court Forebay radial gate intake structure.

Source: K. Clark (DWR, Personal Communication)

Clifton Court Forebay Predation Study (Measures)

- Pre-screen loss of salmonids pre and post fishing facility
- Predatory fish population abundance in Clifton Court Forebay
- Demographics of predatory fish in Clifton Court Forebay
- Avian use and abundance
- Predatory fish residence time
- Predatory fish emigration rate
- Predatory fish immigration rate
- Diet contents of striped bass
- Bioenergetics models for striped bass and primary avian predators in Clifton Court Forebay

Source: K. Clark (DWR, Personal Communication)

Evaluation of Salvage Efficiency at the SWP Skinner Facility (Methods)

- Multiple releases of small groups of PIT tagged salmonids (late-fall and fall-run Chinook salmon, steelhead) at various locations within the Skinner Facility; 2014-2018.

- Recapture of tagged fish through the normal salvage count process and using an autonomous detection system at the SWP salvage release sites.

Source: J. Miranda (DWR, Personal Communication)

Evaluation of Salvage Efficiency at the SWP Skinner Facility (Methods)

- Hydraulic assessment of the Skinner Facility; 2014 to 2016.
- Biotelemetry study of fish approaching and guided into the Skinner Facility; 2015 to 2017.
- DIDSON/SONAR evaluation of predator abundance within the Skinner Facility; 2014 to 2016.

Example of DIDSON camera (http://www.didson.com/)

Source: J. Miranda (DWR, Personal Communication)

Evaluation of Salvage Efficiency at the SWP Skinner Facility (Measures)

- SWP salvage efficiency for salmonids under various operational parameters
- Hydraulic conditions within the primary and secondary louver bays
- Predator abundance within the primary louver bays
- Behavior of fish and predators as they are guided into or interact with the Skinner Facility

Source: J. Miranda (DWR, Personal Communication)

TFCF Whole Facility Survival Study

Method

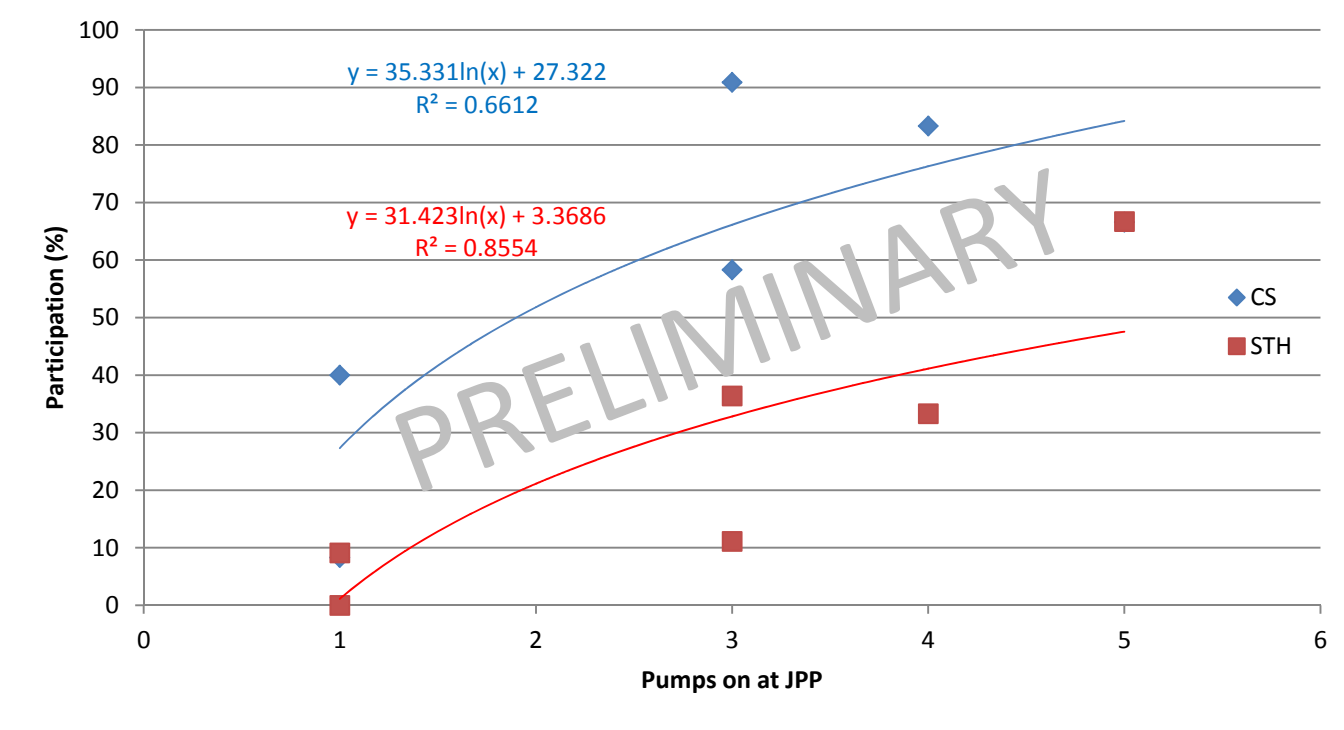
- Spring 2013
- Tested 3 levels of pumping for 24-hour periods
- Released 64 steelhead and 69 Chinook outside facility per period

Measures

Developed 2D tracks to enumerate:

- Participation rates (difficult to tell apart from predation)
- 1° louver efficiency
- 2° louver efficiency
- Holding tank efficiency

TFCF Whole Facility Survival Study



With fewer JPP in operation, there are fewer fish entering the TFCF.

How you count non-participating fish (predation/ swimout) impacts survival estimates.

6-Year Steelhead Survival Study

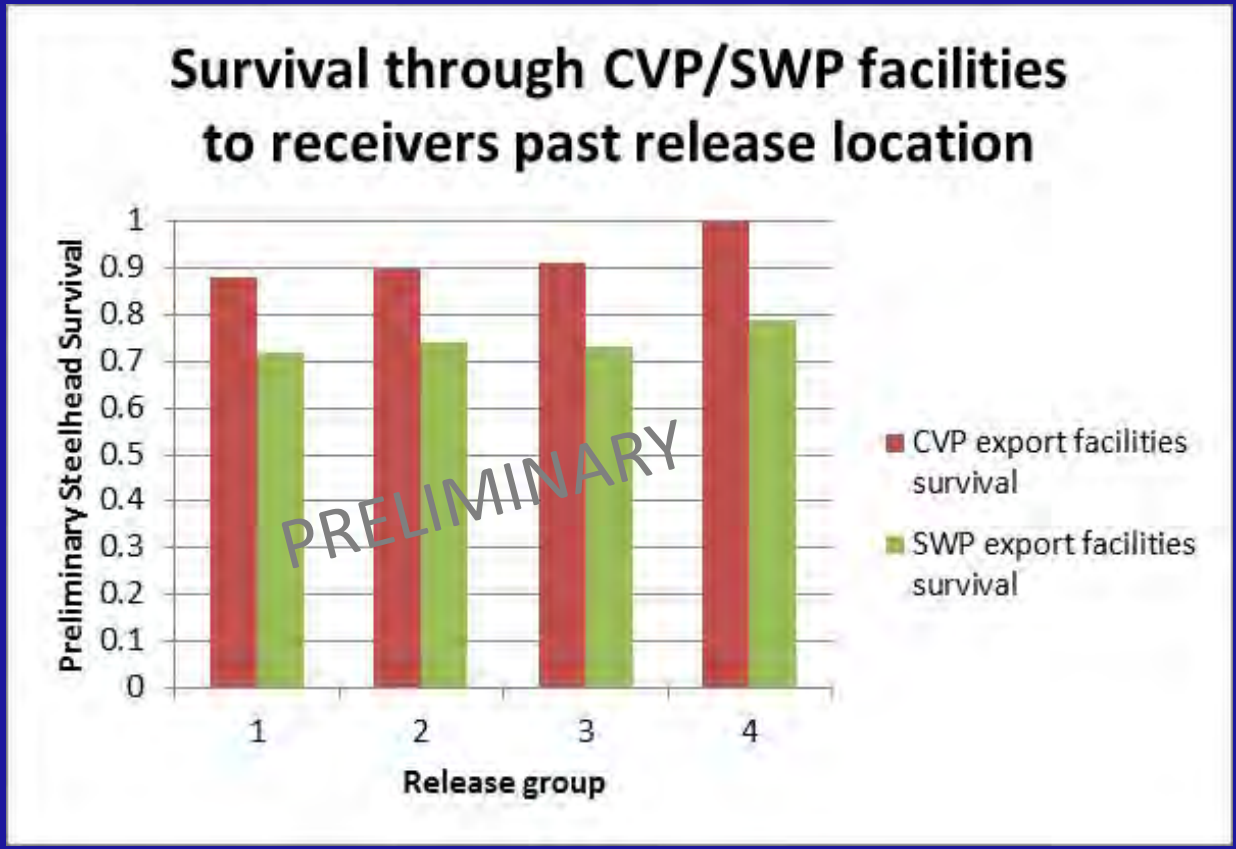
Methods

- 2011 to 2013: 3 releases of 480 steelhead from SJ River to estimate survival and route entrainment as far as Chipps Island
- Multistate branching release-recapture statistical model

Measures

- Survival from each facility to Chipps Island
- Reach-specific survival along Old and Middle Rivers route
- Reach-specific survival along SJ mainstem

2012 6 Year Study Facility Survival Estimates



Requested Green Sturgeon

- DWR and Reclamation working with UCD on laboratory studies to evaluate louver efficiency and predation on captive juvenile green sturgeon.
- Studies should focus on fish in the 200 to 400 mm range.
- Louver efficiency results need to be under a wide range of test conditions.

Previous Green Sturgeon

- Release-recapture experiments of juvenile white sturgeon at the CVP.
- Measure facility efficiency.
- Some data collected, but not available since dataset is incomplete.
  - Reclamation ended study since unable to acquire permits to finish due to concerns about the spread of sturgeon iridiovirus.

Next Steps

- Receive input from Review Panel.
- Revisit input and refine document with Technical Team.
- Review and update Facility SOPs to collect information necessary to evaluate recommended equations.
- Formalize conceptual models linked to equation parameters for loss of each species.
- Reclamation submit recommendation/plan on Term and Condition 2a to NMFS and discuss roles and responsibilities for the next steps.

Questions?