Can Delta Smelt Survive the CHTR Phase of the Fish Salvage Facilities?

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RESOURCES AGENCY CALIFORNIA DEPARTMENT FISH&GAME

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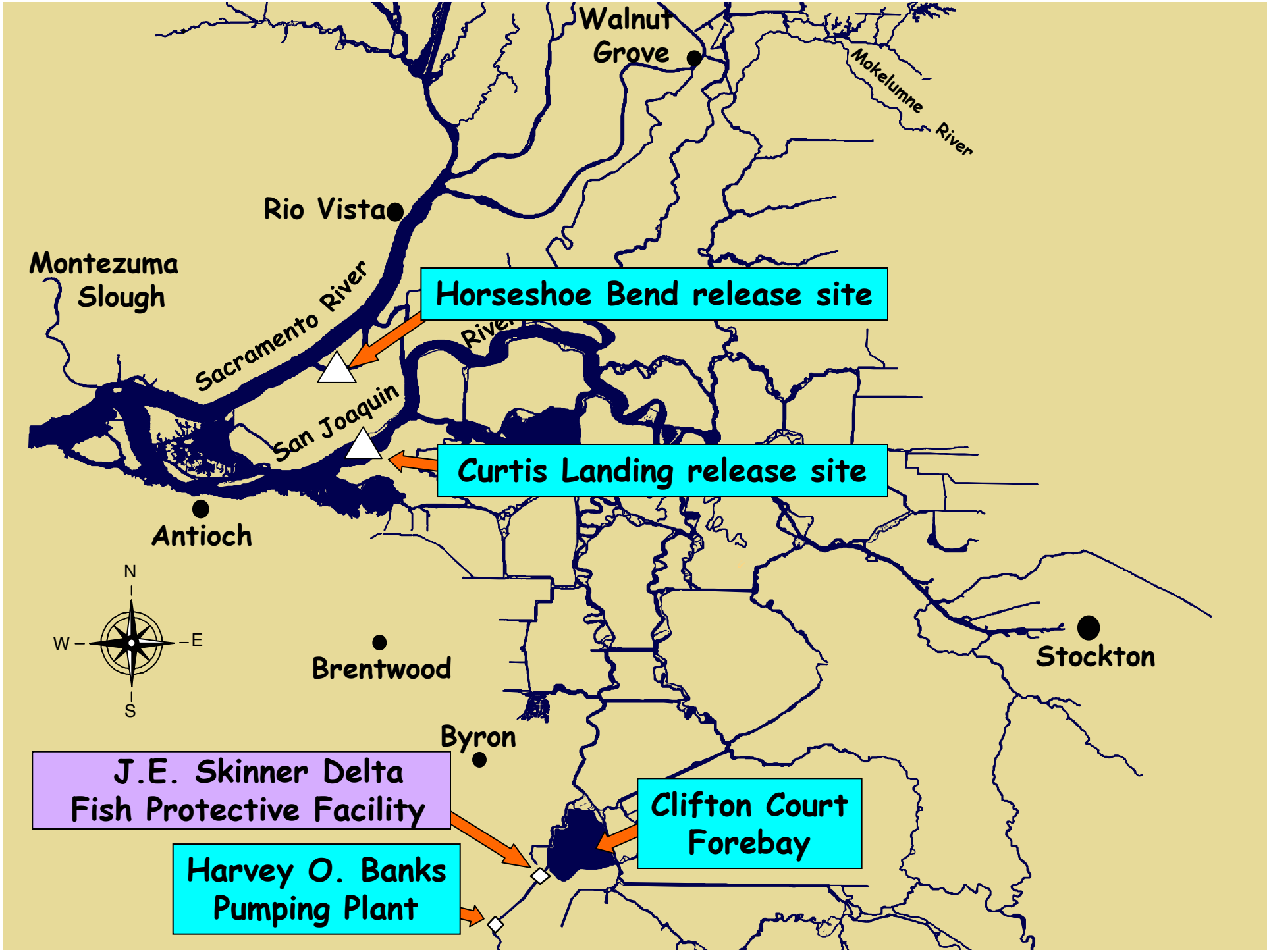

Walnut Grove
Mokelumne River
Rio Vista
Montezuma Slough
Sacramento River
Horseshoe Bend release site
San Joaquin River
Curtis Landing release site
Antioch
N
W
E
S
Brentwood
Stockton
Byron
J.E. Skinner Delta Fish Protective Facility
Clifton Court Forebay
Harvey O. Banks Pumping Plant

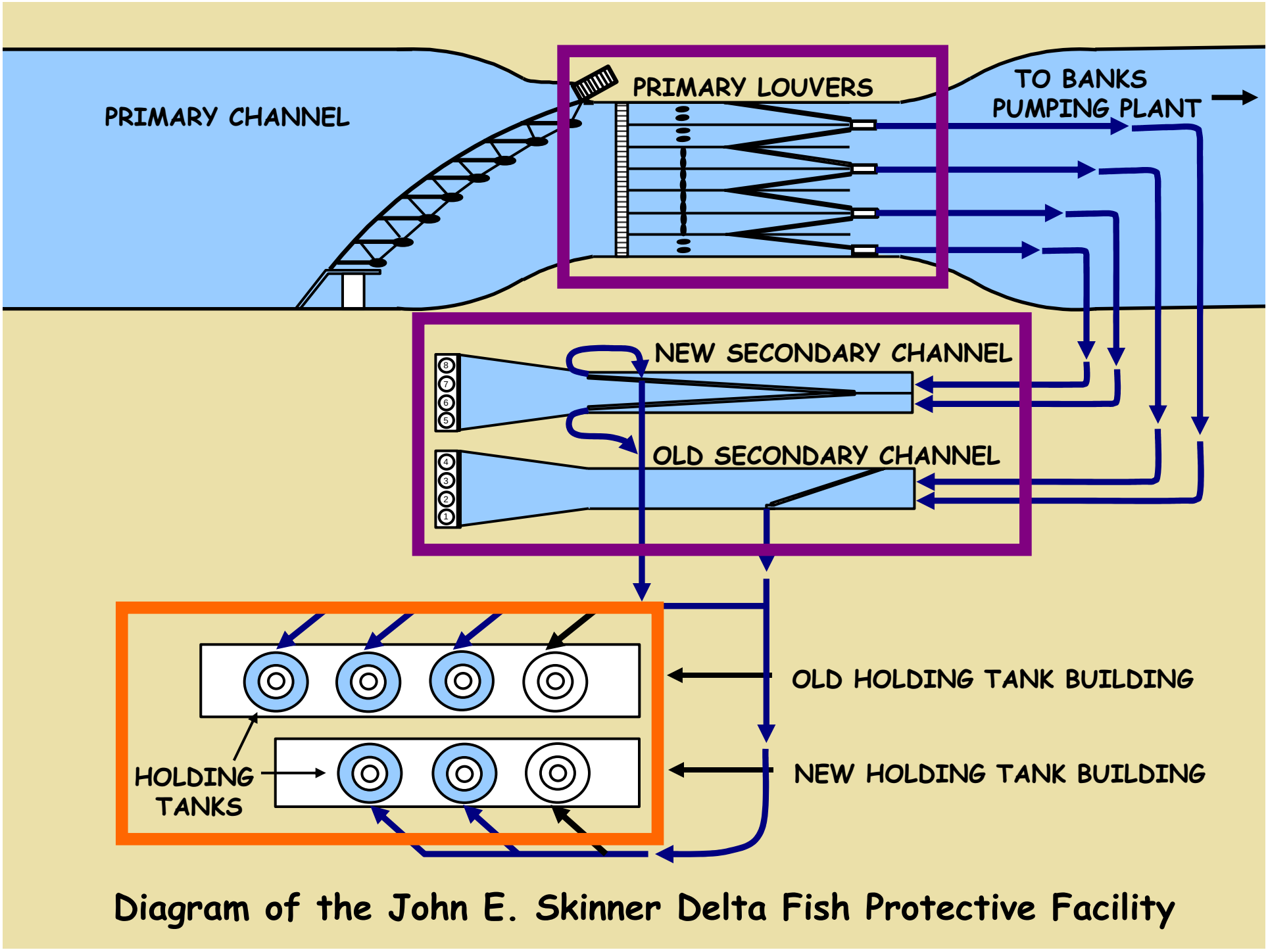


Diagram of the John E. Skinner Delta Fish Protective Facility

What is CHTR?

- Collection, handling, transport and release
- Start: holding tank
- End: release

Components of the CHTR Phase

1. Draining
2. Removing
3. Loading
4. Transporting
5. Releasing

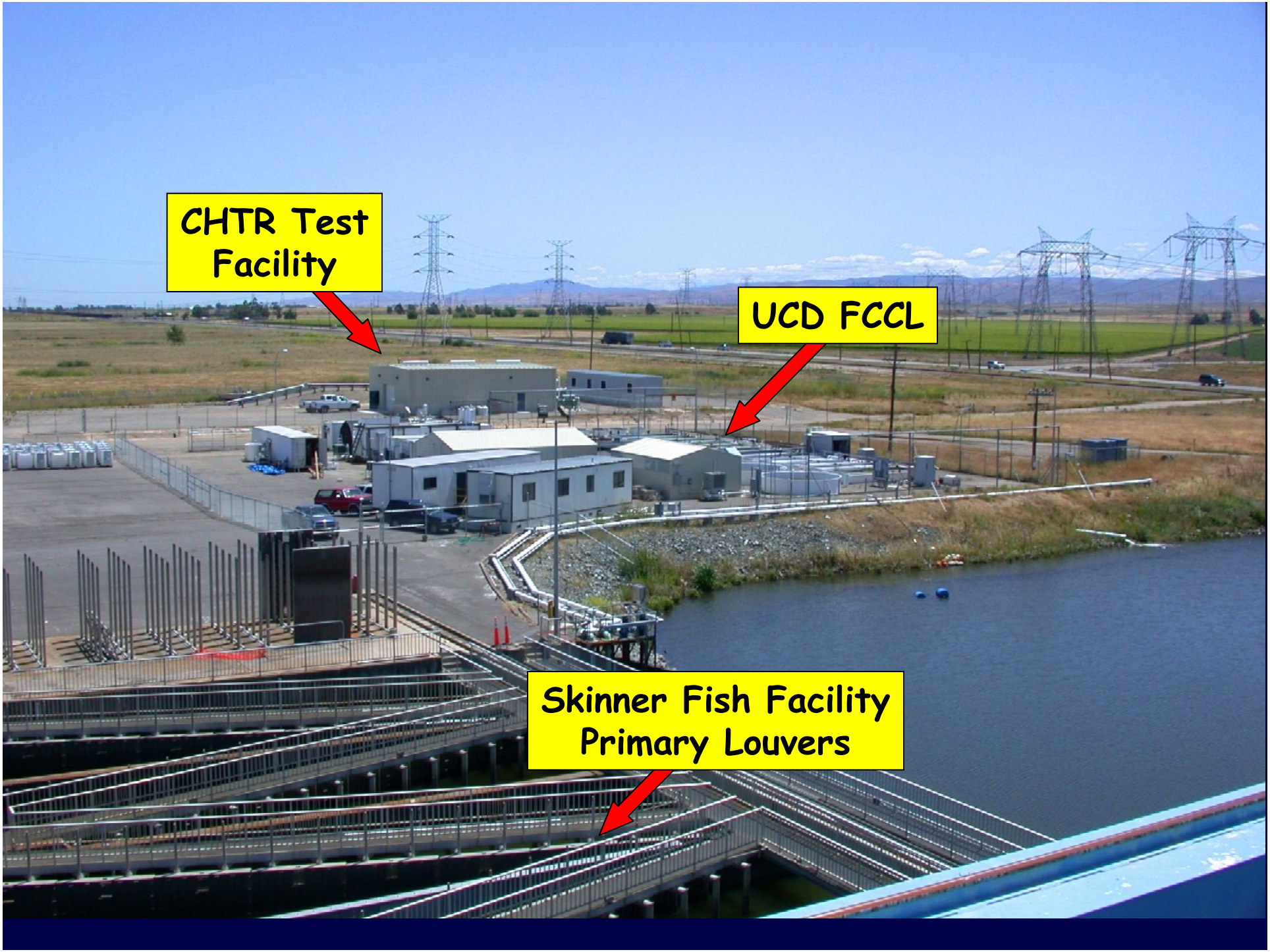
Study Objectives

Measure the acute mortality and injury rates of adult and juvenile delta smelt exposed to the existing CHTR phase of the salvage operations at the SWP's Skinner Fish Facility

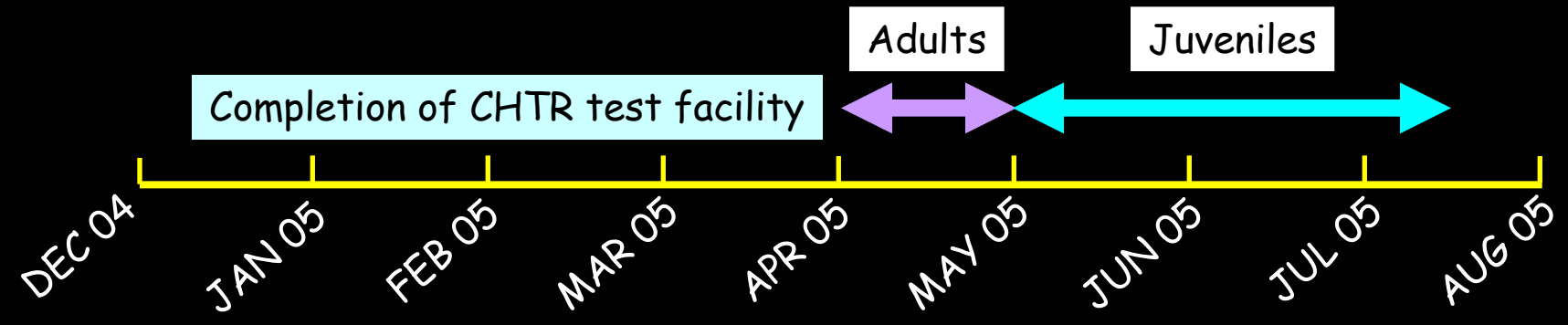
- Wild delta smelt
- Components of the existing CHTR phase
- Key environmental and operational conditions
- Diel period

Methods

- Cultured adult and juvenile delta smelt were used for injection experiments
- Injected known numbers of adult and juvenile delta smelt into a holding tank at the Skinner Fish Facility
- Exposed the delta smelt to two different treatments
  CH – Collection and handling
  CHTR – Collection, handling, transport and release
- Recovered the test fish and held these fish for 48 hours post-treatment
- Conducted injection experiments on a modified schedule

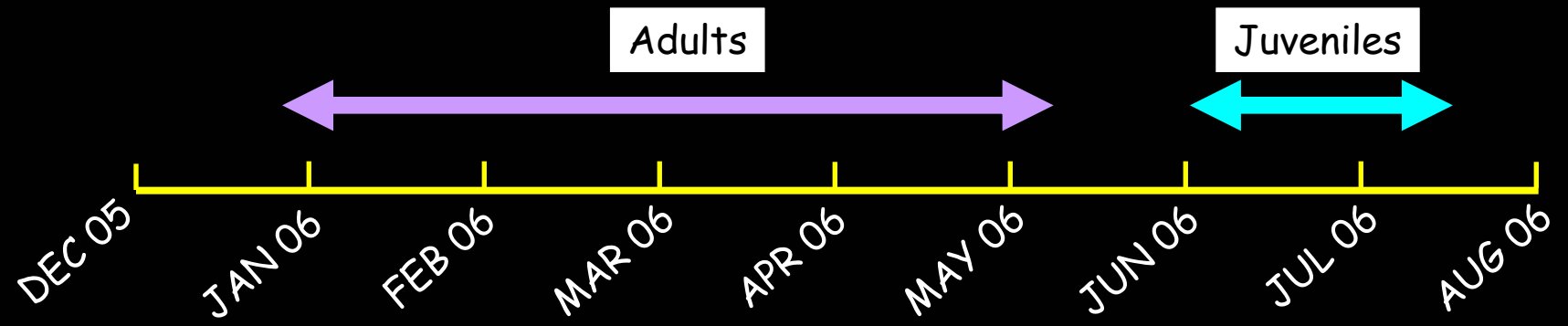

CHTR Test Facility
UCD FCCL
Skinner Fish Facility Primary Louvers

2005 Study Schedule



2005 – all trials conducted with only delta smelt in holding tank

2006 Study Schedule



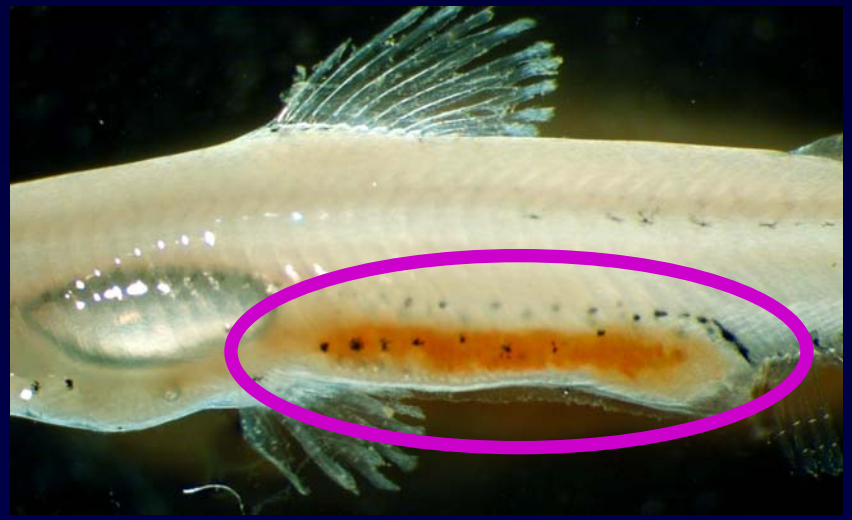
2006 – all trials involved injecting delta smelt into tanks with salvaged fish and debris

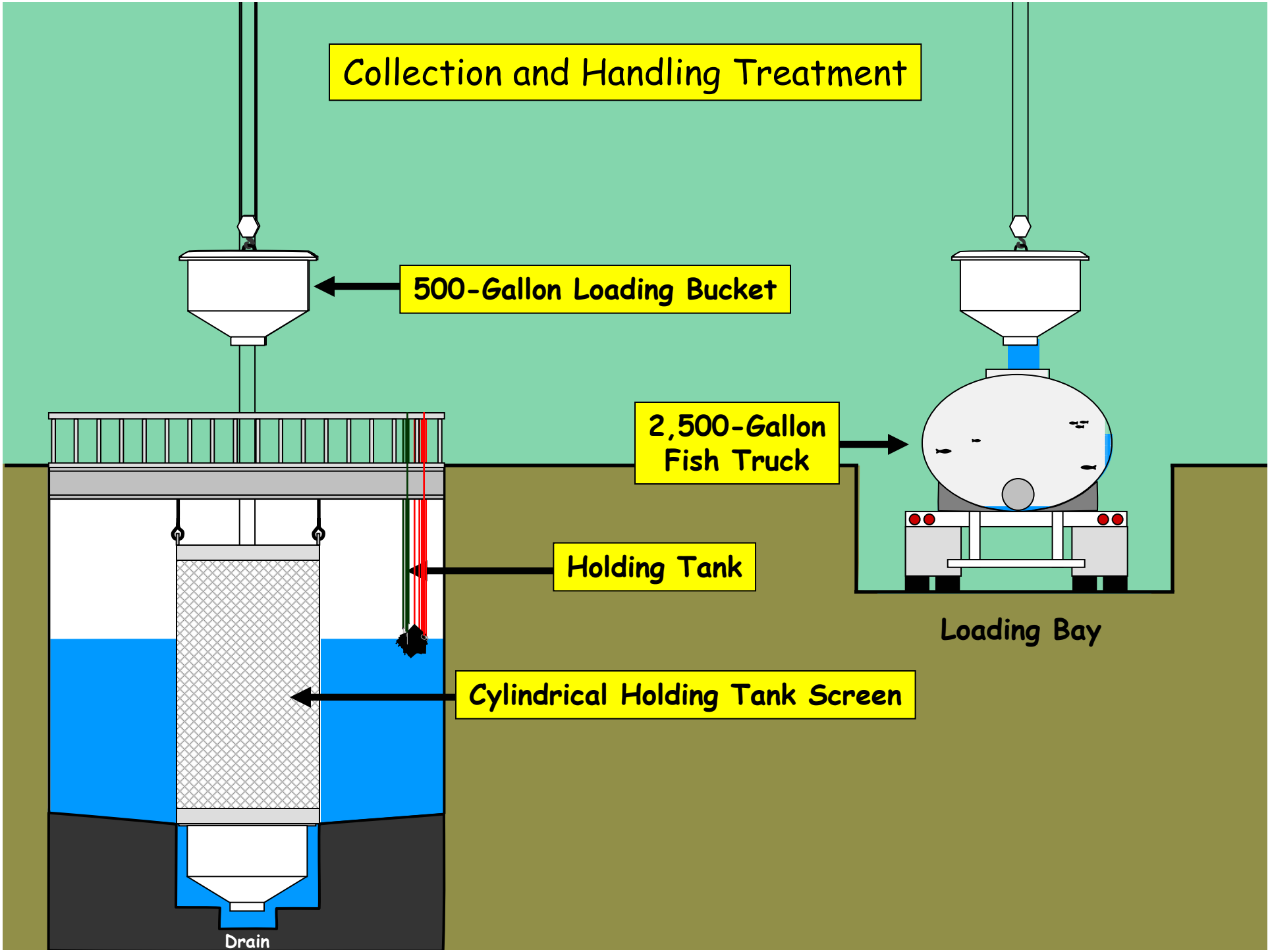
Calcein Marked Adult Delta Smelt

Not Marked

Marked

Juvenile Delta Smelt




Collection and Handling Treatment
500-Gallon Loading Bucket
2,500-Gallon Fish Truck
Holding Tank
Loading Bay
Cylindrical Holding Tank Screen
Drain

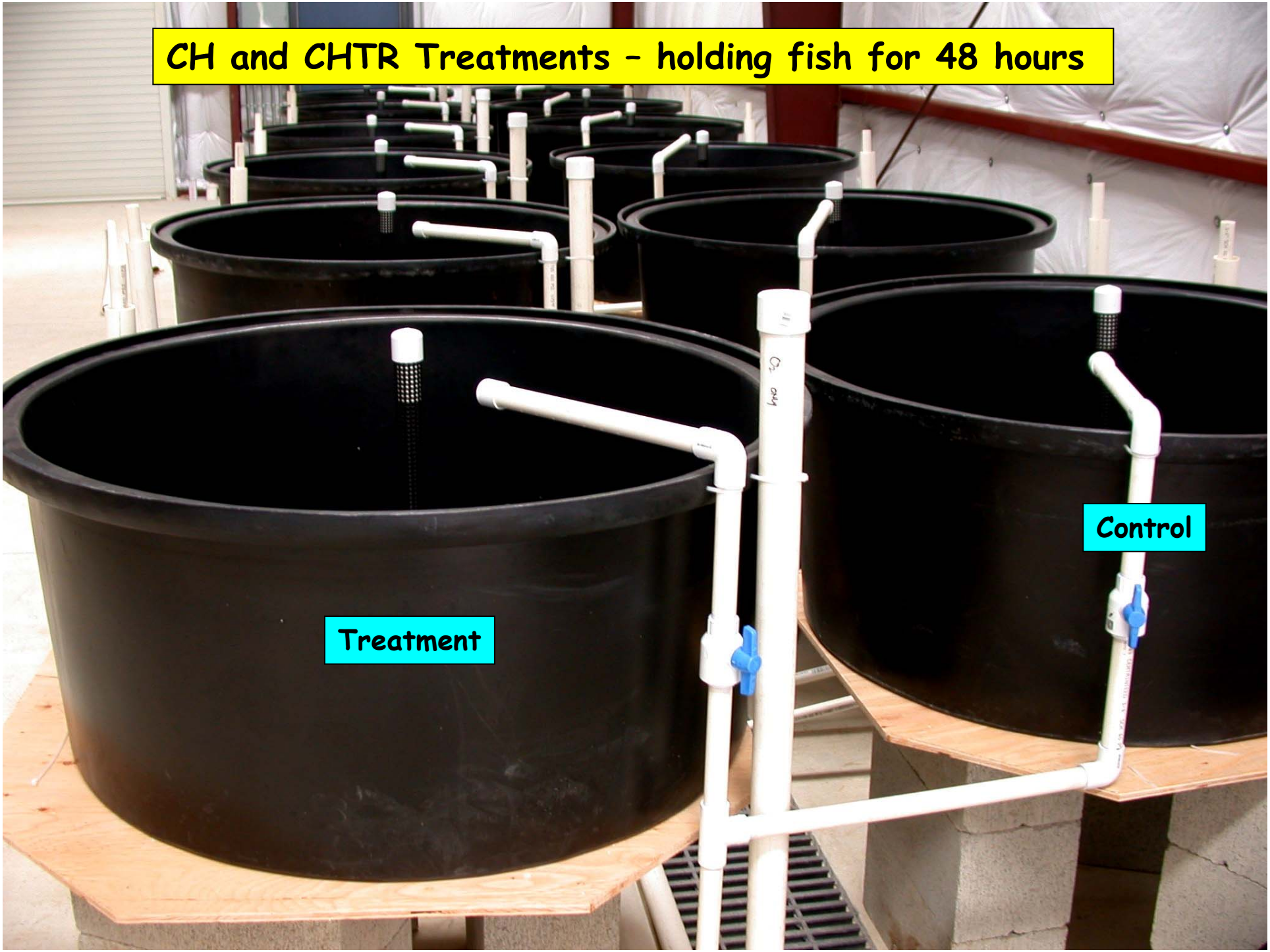
CH Treatment – simulating the truck loading process

CHTR Treatment – loading the fish truck

CHTR Treatment – fish truck returning from the fish haul

CHTR Treatment – releasing transported fish into pool

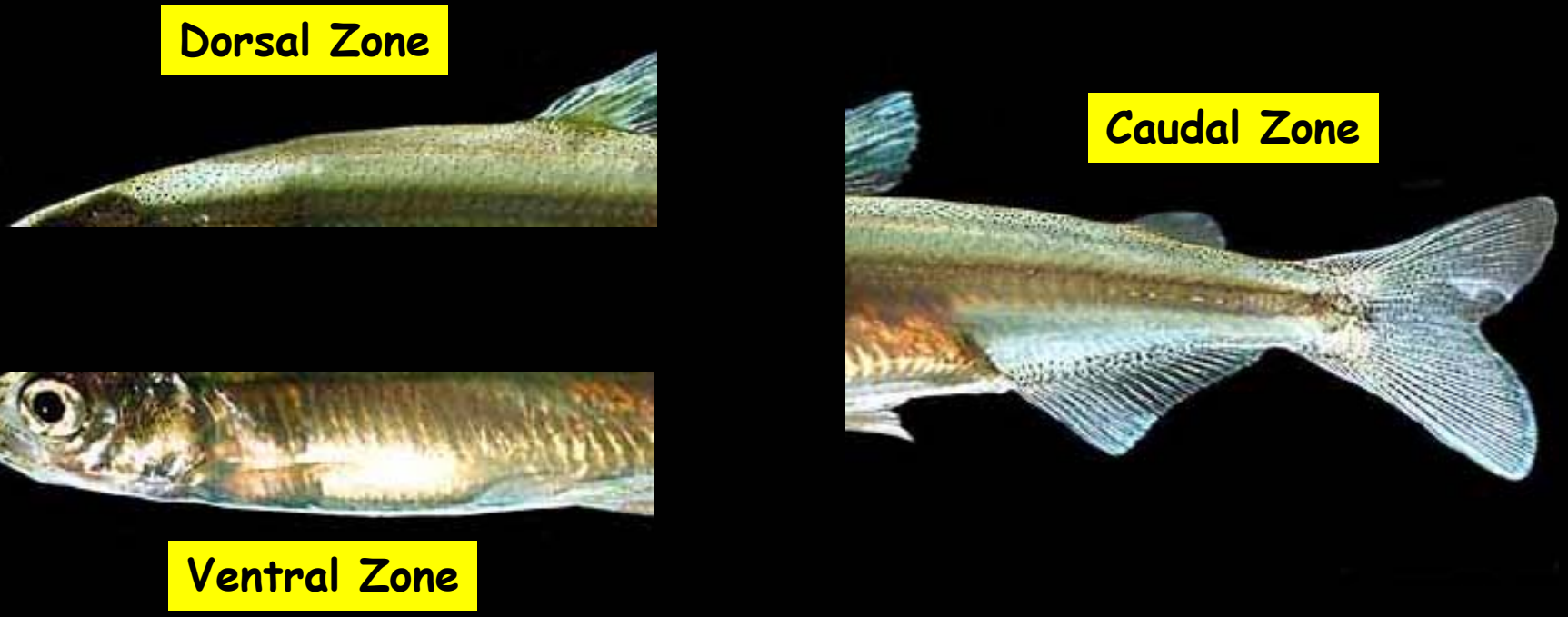

CHTR Treatment – recovering fish from release pool


CH and CHTR Treatments – holding fish for 48 hours
Treatment
Control

Fish Injury Assessment

- Fins
- Head
- Eyes
- Skin

Fish Injury Assessment



Scale Loss

Results

Adult Delta Smelt Recovery

Year	Treatment	No. of Trials (N)	Mean No. of Fish Recovered (%)	Range (%)
2005	Control	10	100	100
	CH	6	96.3	85.7 – 100
	CHTR	4	93.8	85.7 - 100
2006	Control	45	100	100
	CH	32	91.6	21.7 – 100
	CHTR	13	89.6	26.1 - 100

- Observed predation in 5 "CH" and 3 "CHTR" trials in 2006

Results

Adult Delta Smelt 48 Hr. Survival

Year	Treatment	No. of Trials (N)	Treatment Mean 48 Hr. Survival (%)	Range (%)
2005	Control	10	98.7	91.3 - 100
	CH	6	88.0	76.9 - 100
	CHTR	4	86.9	84.6 - 100
2006	Control	45	99.7	94.4 - 100
	CH	32	80.6	9.5 - 100
	CHTR	13	78.0	18.2 - 100

2006

Significant difference
CH and Control
CHTR and Control

No significant difference
CH and CHTR

Results (continued)

Predation observed during adult 2006 CH and CHTR trials

2006	No. of Trials	Observed Mortalities
Predation Mortalities	8 Trials (5 "CH" and 3 "CHTR")	38
Immediate, 24 Hr. and 48 Hr. Mortalities	45 Trials (32 "CH", 13 "CHTR")	29

Results (continued)

Adult Delta Smelt Injury

Year	Group	Fish Injured by Type of Injury (%)			
		Head	Eyes	Skin	Fins
2005	QC	2.6	0.0	0.0	5.3
	Control	0.8	0.0	0.0	6.7
	CH	0.0	0.0	2.9	13.5
	CHTR	0.0	0.0	0.0	12.5
2006	QC	1.1	4.6	2.8	41.1
	Control	3.4	1.9	3.4	33.3
	CH	0.5	1.1	4.9	34.6
	CHTR	6.7	2.7	6.7	41.2

Results (continued)

Adult Delta Smelt Scale Loss

Year	Group	Fish (N)	Mean Descaling (% of body)
2005	QC	38	0.1
	Control	58	0.1
	CH	35	0.1
	CHTR	24	0.3
2006	QC	176	0.4
	Control	264	0.4
	CH	184	0.6
	CHTR	75	0.6

Results (continued)

Wild Adult Delta Smelt Survival

- Wild adult delta smelt collected during the 2006 trials:
  CH = 20
  CHTR = 9

Wild Adult Delta Smelt Injury and Scale Loss

Treatment	Mean Percent of Fish Injured	Mean Descaling (% of body)
CH	40	3.39
CHTR	44	2.61

Results (continued)

Juvenile Delta Smelt Recovery

Year	Treatment	No. of Trials (N)	Mean No. of Fish Recovered (%)	Range (%)
2005	Control	21	100	100
	CH	13	86.2	63.2 - 100
	CHTR	8	72.7	50.0 - 88.9
2006	Control	22	100	100
	CH	15	86.6	69.4 - 100
	CHTR	7	88.8	57.9 - 100

Results (continued)

Juvenile Delta Smelt 48 Hr. Survival

Year	Treatment	No. of Trials (N)	Treatment Mean 48 Hr. Survival (%)	Range (%)
2005	Control	21	82.0	43.5 - 100
	CH	13	57.0	27.8 – 94.4
	CHTR	8	37.4	5.6 – 83.3

2005

Significant difference
CH and Control

No significant difference
CHTR and Control
CH and CHTR

Results (continued)

Juvenile Delta Smelt 48 Hr. Survival

Year	Treatment	No. of Trials (N)	Treatment Mean 48 Hr. Survival (%)	Range (%)
2005	Control	21	82.0	43.5 - 100
	CH	13	57.0	27.8 – 94.4
	CHTR	8	37.4	5.6 – 83.3
2006	Control	22	85.9	52.2 - 100
	CH	15	50.9	16.7 – 77.8
	CHTR	7	57.9	10.5 – 80.6

2006

Significant difference
CH and Control
CHTR and Control

No significant difference
CH and CHTR

Results (continued)

Juvenile Delta Smelt Injury

Year	Group	Fish Injured by Type of Injury (%)			
		Head	Eyes	Skin	Fins
2005	QC	0.0	0.0	0.0	21.4
	Control	0.8	0.0	0.0	14.3
	CH	0.0	0.0	0.0	26.9
	CHTR	0.0	0.0	0.0	25.0
2006	QC	0.0	0.0	1.1	17.0
	Control	0.0	0.0	0.7	11.6
	CH	0.0	0.0	0.0	14.6
	CHTR	0.0	0.0	0.0	19.5

Results (cont'd)

Relationship Between Survival and Environmental Variables

- 2005 adult trials
  Strong relationship
  - DO level in release pool
- 2006 adult trials
  Moderate relationships
  - Skinner holding tank water temperature
  - Fish truck (post-fish haul) DO level
- 2005 juvenile trials
  Moderate relationship
  - Release pool water clarity

Conclusions

- Adult delta smelt can survive the existing CHTR phase at relatively high rates during their entrainment season, however, various factors can influence their survival
- Wild adult delta smelt survive the existing CHTR phase relatively well
- Juvenile delta smelt survival is highly variable when exposed to the existing CHTR phase during their entrainment season
- Survival and injury rates for adult and juvenile delta smelt were not significantly different between the CH and CHTR treatments
- Facility design can have an influence on the survival of adult and juvenile delta smelt during the CHTR phase

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