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February 2, 2021

MEMORANDUM

TO: Council Members

FROM: Stacy Horton, Washington Policy Analyst/Biologist

SUBJECT: Presentation on Mitigation and Fish Passage by Mid-Columbia Public Utility Districts

BACKGROUND:

Presenters: Peter Graf, Grant Public Utility District Fisheries Scientist, Tom Kahler, Douglas Public Utility District Fisheries Biologist, and Lance Keller, Chelan Public Utility District Senior Fisheries Biologist

Summary: Douglas County Public Utility District, Chelan County Public Utility District, and Grant County Public Utility District, collectively known as the Mid-C PUDs, own and operate five dams on the Columbia River (Wells Dam, Rocky Reach Dam, Rock Island Dam, Priest Rapids Dam, and Wanapum Dam). The Mid-C PUDs work cooperatively with state and federal agencies and tribes to implement salmon protection and mitigation programs. For Douglas and Chelan PUD, these programs were developed with the nation's first Hydro Power Habitat Conservation Plans. For Grant PUD, the programs are described in the Salmon and Steelhead Settlement Agreement. For all three PUDs, the protection standard is No-Net-Impact, which is unique to the Columbia River and encompasses reservoir and dam survival standards, hatchery mitigation programs, and habitat restoration. In this presentation, the Mid-C PUDs will describe their salmon protection and mitigation programs and how the No-Net-Impact standard is being achieved.

Relevance: The Northwest Power and Conservation Council's *2014/2020 Columbia River Basin Fish and Wildlife Program* calls on hydropower operators of the mid-Columbia Public Utility Districts (PUDs) to implement actions that help manage predator birds, meet Hanford Reach flow measures, evaluate project operations on sturgeon reproductive success in the pools behind FCRPS and Mid-Columbia River dams, and meet specific passage measures and standards identified and agreed to by the operators of the Mid-Columbia PUD projects in FERC licenses and associated agreements.

More Info:

Priest Rapids Project Salmon and Steelhead Settlement Agreement (FERC Project No. 2114)

https://www.grantpud.org/templates/galaxy/images/images/Downloads/ResourceCommittees/OtherLicenses/2006_Salmon_Steelhead_Settlement_Agreement.pdf

Habitat Conservation Plans

Chelan: <https://www.chelanpud.org/environment/habitat-conservation-plans>

Douglas: <https://douglaspu.org/pages/wells-habitat-conservation-plan.aspx>

Mid-Columbia PUDs No-Net-Impact Standard

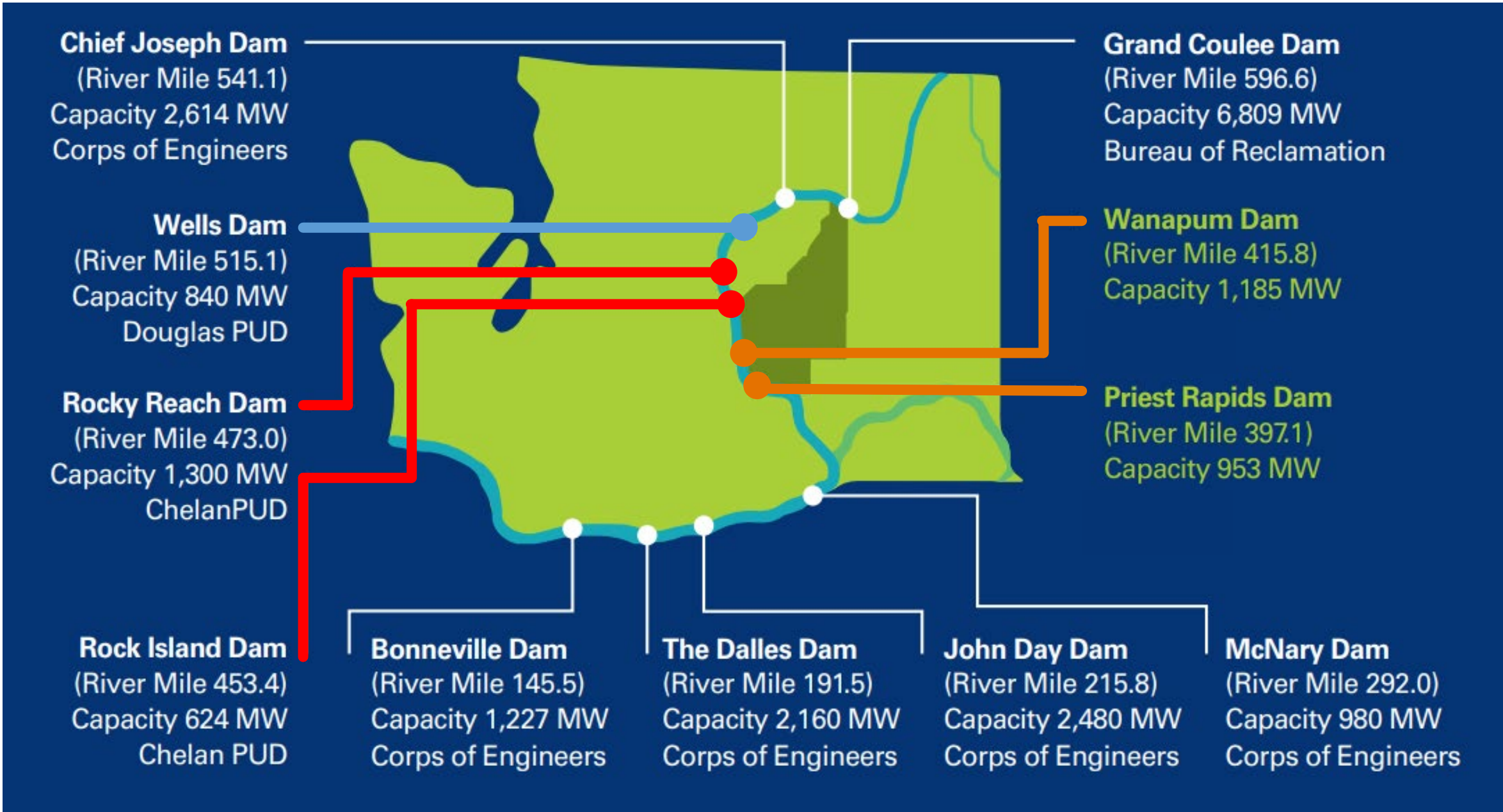
Northwest Power and Conservation Council

February 10, 2021



CHELAN COUNTY





Chief Joseph Dam

(River Mile 541.1)
Capacity 2,614 MW
Corps of Engineers

Grand Coulee Dam

(River Mile 596.6)
Capacity 6,809 MW
Bureau of Reclamation

Wells Dam

(River Mile 515.1)
Capacity 840 MW
Douglas PUD

Wanapum Dam

(River Mile 415.8)
Capacity 1,185 MW

Rocky Reach Dam

(River Mile 473.0)
Capacity 1,300 MW
ChelanPUD

Priest Rapids Dam

(River Mile 397.1)
Capacity 953 MW

Rock Island Dam

(River Mile 453.4)
Capacity 624 MW
Chelan PUD

Bonneville Dam

(River Mile 145.5)
Capacity 1,227 MW
Corps of Engineers

The Dalles Dam

(River Mile 191.5)
Capacity 2,160 MW
Corps of Engineers

John Day Dam

(River Mile 215.8)
Capacity 2,480 MW
Corps of Engineers

McNary Dam

(River Mile 292.0)
Capacity 980 MW
Corps of Engineers

Habitat Conservation Plans (DPUD, CPUD) & Salmon and Steelhead Settlement Agreement (GPUD)

Collaborative Approach to ESA Protection

- Long-term Agreements (40-50 years)
- No surprises clause (HCPs)
- Unanimous decision-making
- Outcome-based standards
- Adaptive approach and using Best Available Science to achieve No-Net Impact for Salmon and Steelhead



No-Net-Impact

Fish Loss



Hydropower
Development/
Operation



Predators
Eating Fish

FISH LOSS

Fish Mitigation



Preserving/
Restoring Habitat



Fish
Hatcheries



Fish
Science



Predator
Management

FISH MITIGATION



A Three-Pronged Approach to Reaching No-Net Impact



7% Hatchery Production



91% Combined Adult/Juvenile Survival
93% Juvenile Survival



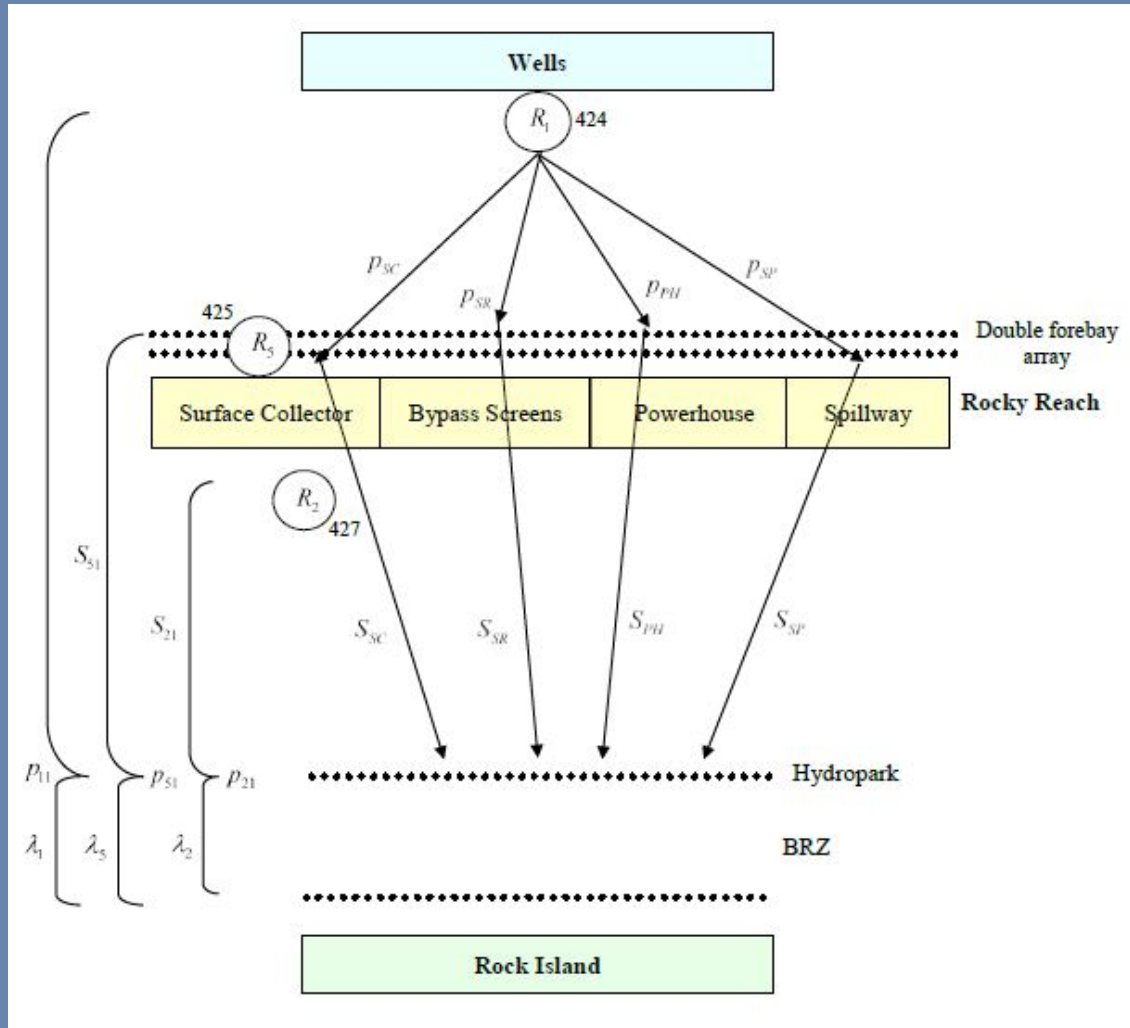
2% Tributary Projects

1. The PUD Smolt Survival Standard:

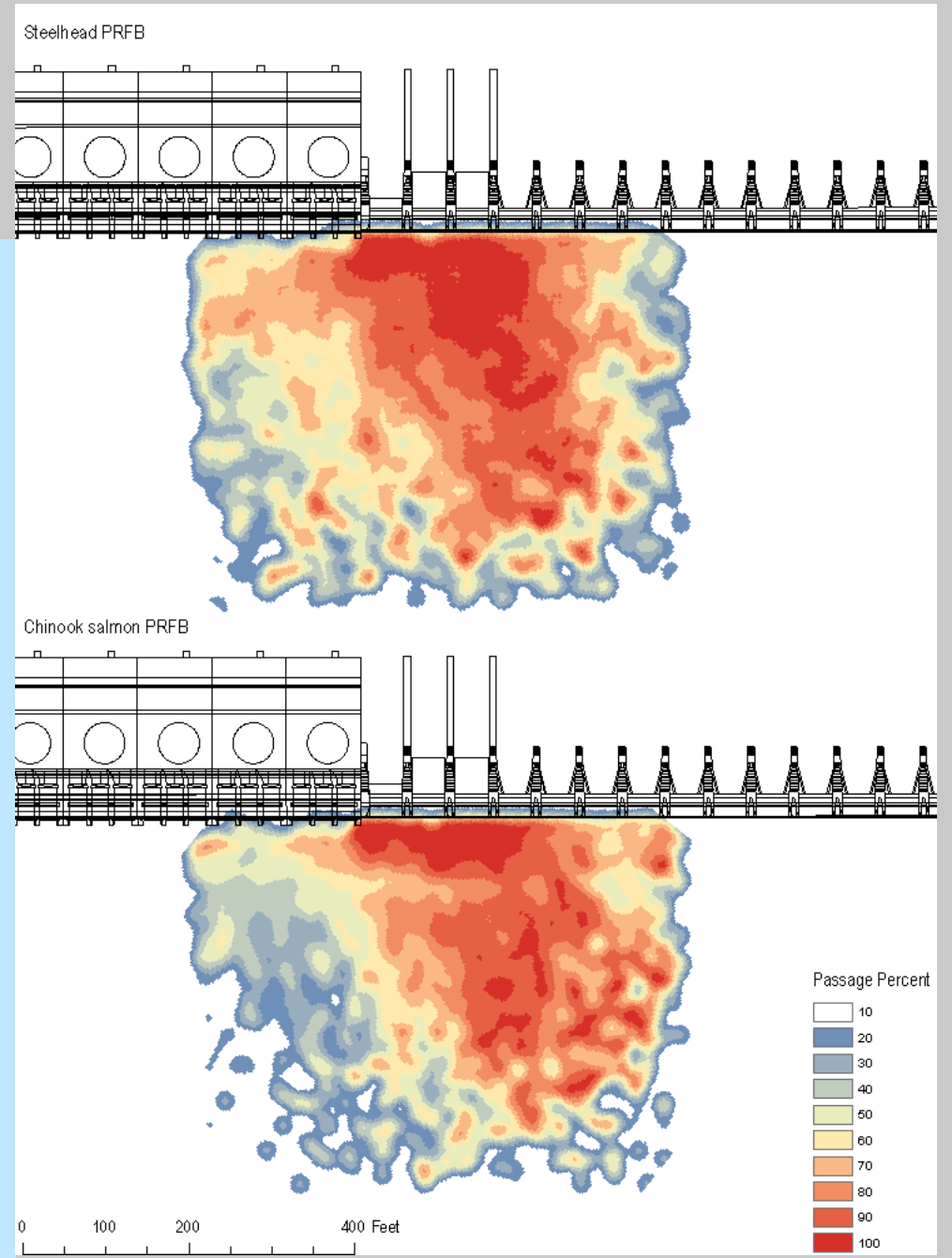
93% Reservoir and Dam

- **The most comprehensive survival standard in the Columbia Basin**
- **143 river miles of intensive survival estimates (5 dams, 5 reservoirs)**

Best Available Science for Evaluating Survival



Site Specific Studies & Solutions



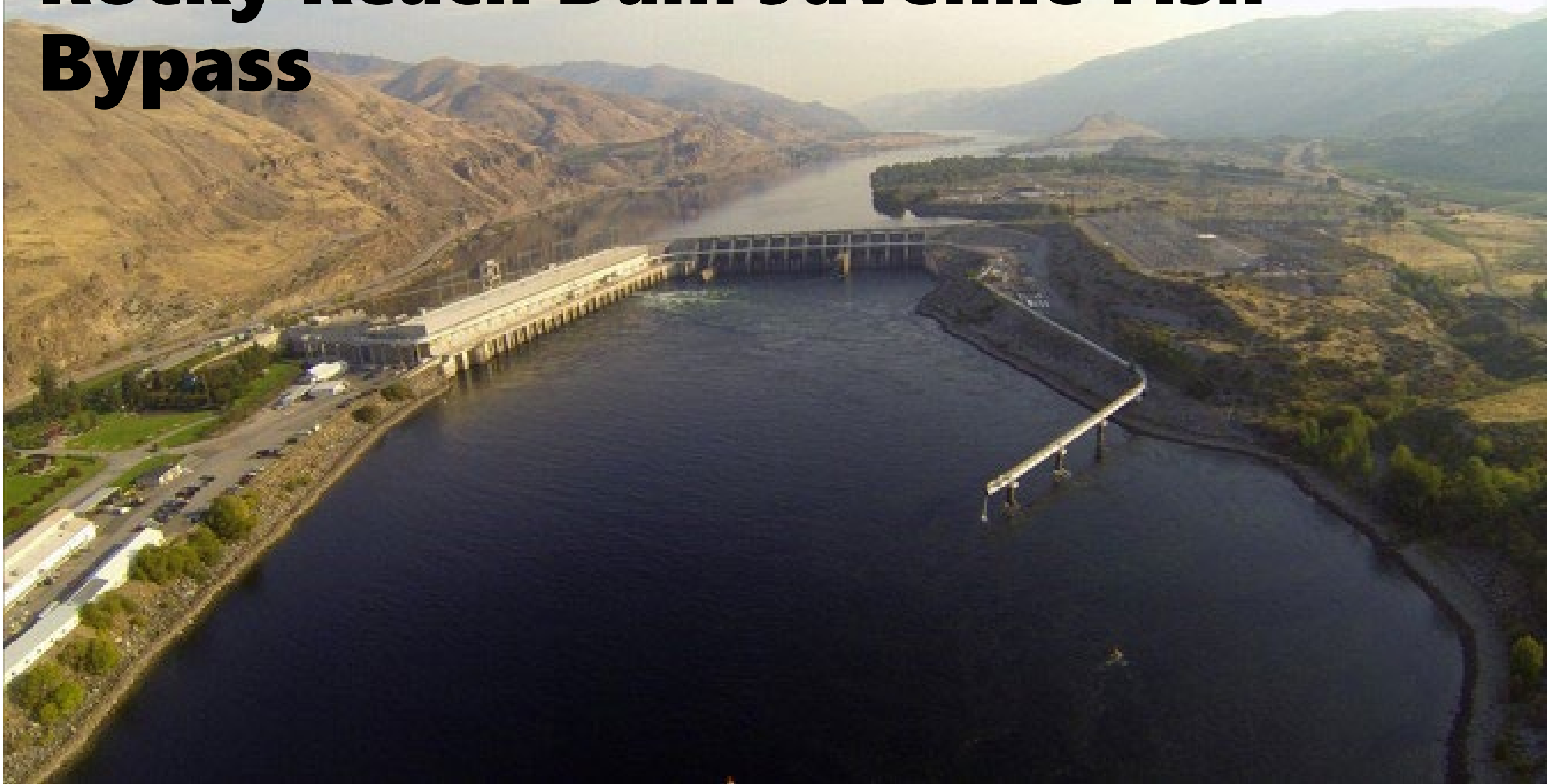
Survival Results – Chelan PUD Projects

Project	Species	Juvenile Survival	Adult Survival	Combined
Rock Island	Steelhead	96.75%	99.31%	96.08%
	Spring Chinook	93.75%	99.89%	93.65%
	Sockeye	93.27%	98.37%	91.75%
Rocky Reach	Steelhead	95.79%	98.93%	94.77%
	Spring Chinook	92.37%	99.90%	92.28%
	Sockeye	93.59%	98.92%	92.58%

Survival Results – Grant PUD Projects

Project	Species	Juvenile Survival (PRD × WAN)	Adult Survival (PRD × WAN)	Combined (82.8% Standard)
Wanapum & Priest Rapids Two Projects Combined	Steelhead	87.0%	98.1%	85.3%
	Spring Chinook	86.6%	99.3%	86.0%
	Summer Chinook	83.4%	99.7%	83.2%
	Sockeye	91.7%	91.9%	84.2%

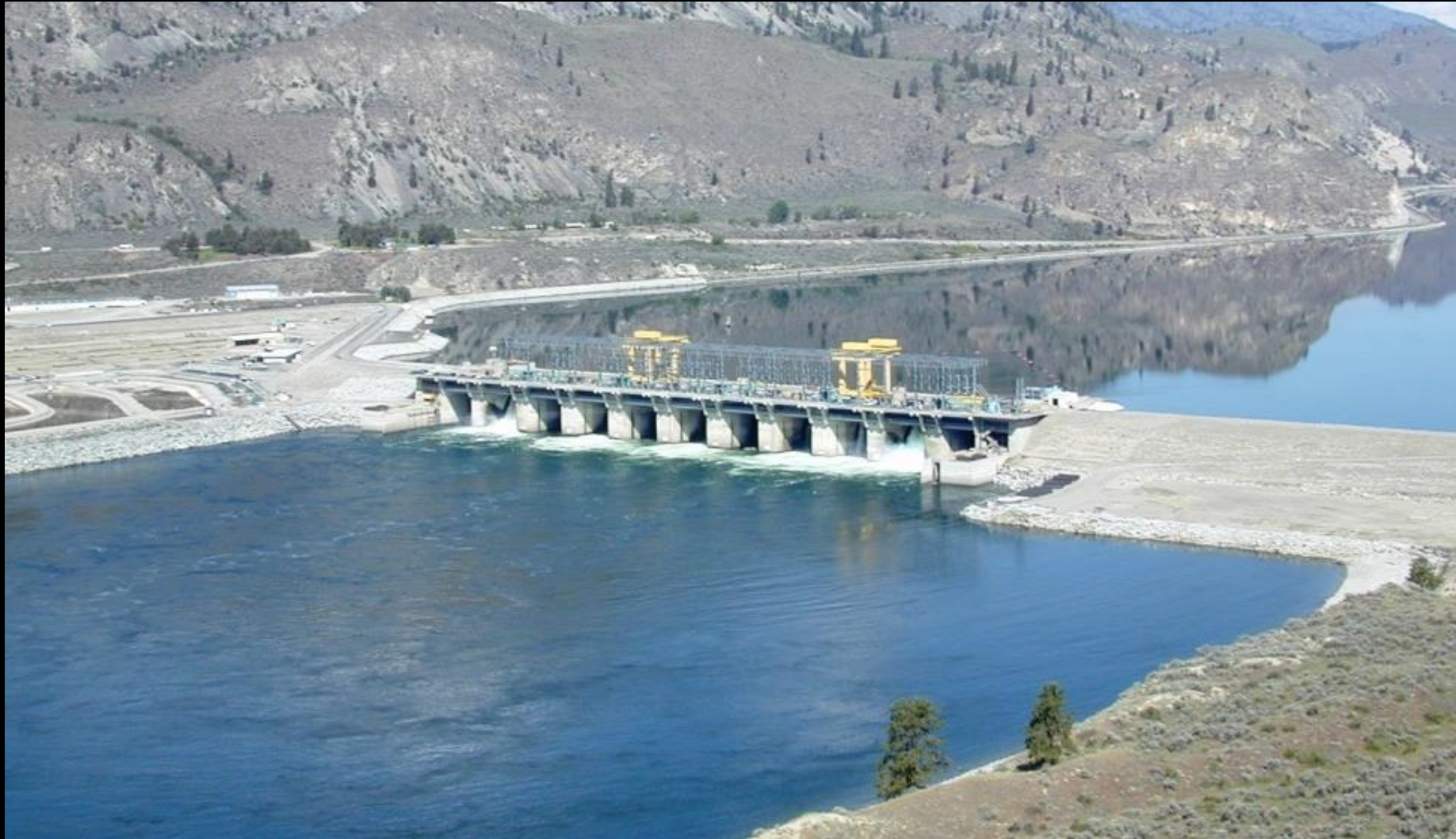
Rocky Reach Dam Juvenile Fish Bypass



Wanapum Dam Juvenile Fish Bypass

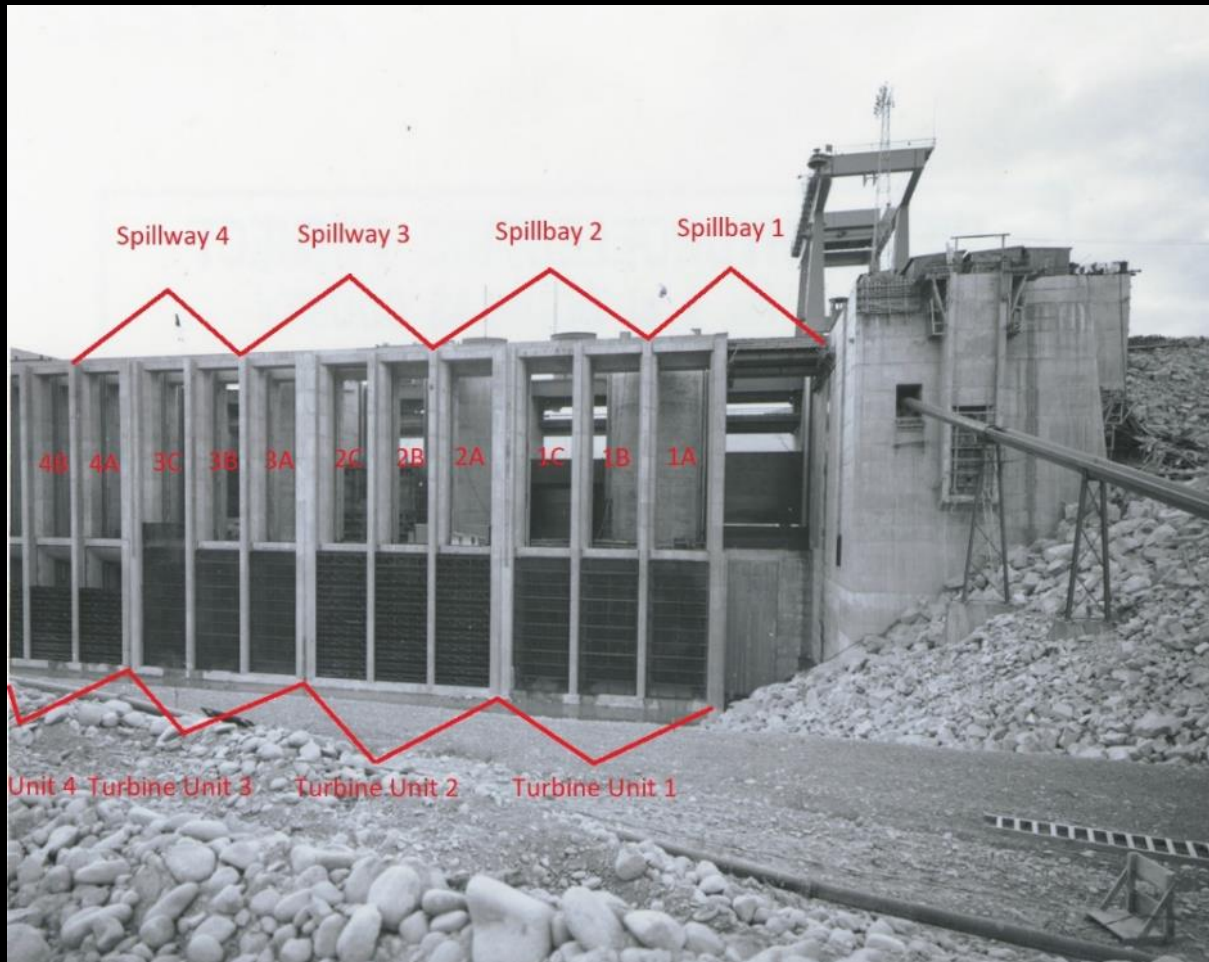


Wells Dam: What's Wrong with this Picture?

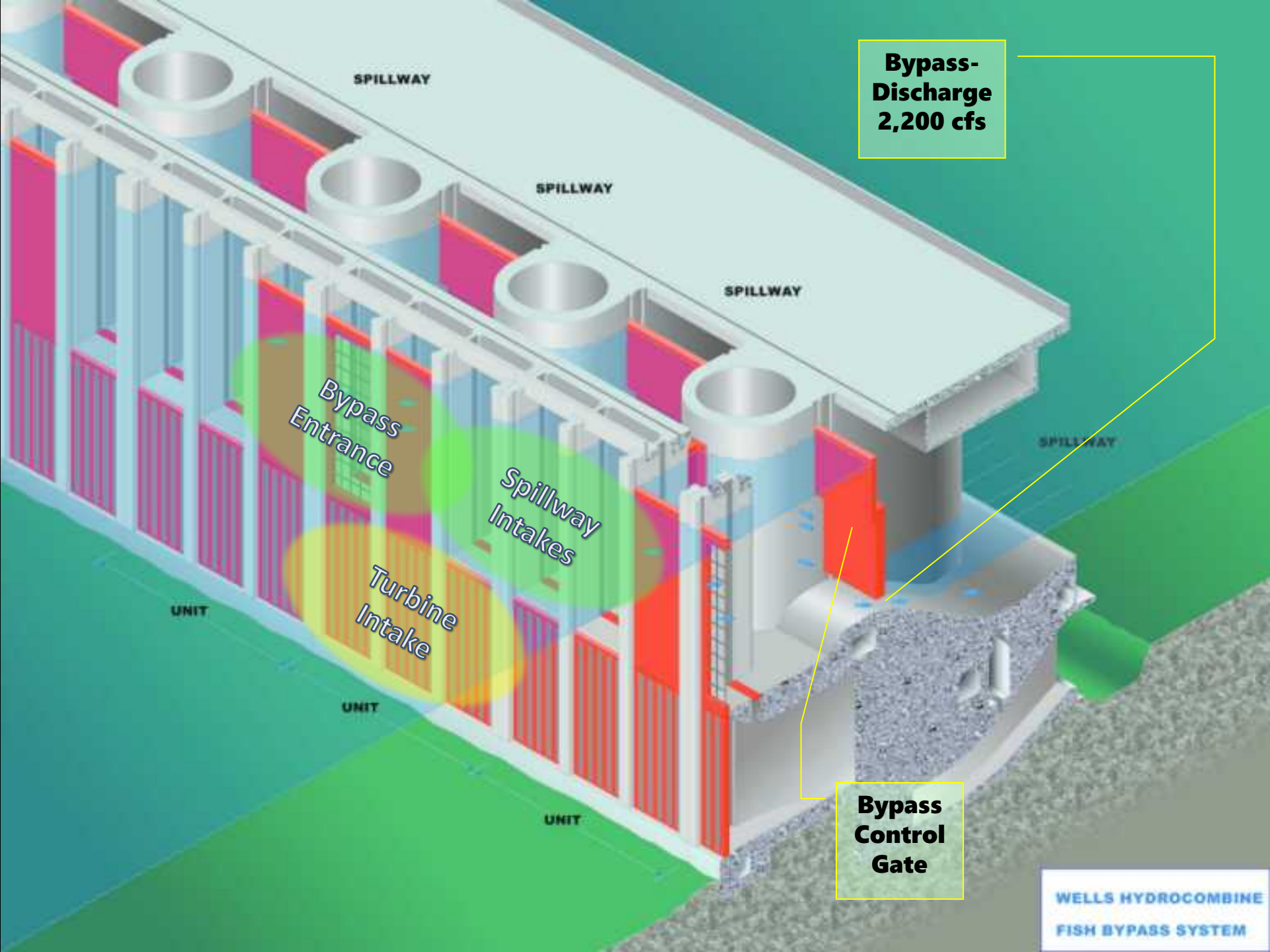


Wells Dam Surface Bypass System

Passage Efficiency



- **Fish Guidance Efficiency (3-year hydroacoustic study):**
 - **92.0% for spring Chinook and steelhead**
 - **95.3% sockeye**
 - **96.2% subyearling Chinook**
- **Balloon-tag studies: no measurable injury or mortality through the Bypass System**



Wells Project Juvenile Survival Rates

Juvenile *Project* Survival of at least 93%

– Yearling Spring Migrants:

- **1998 Chinook 99.7%**
- **1999 Steelhead 94.3%**
- **2000 Steelhead 94.6%**
- **2010 Chinook 96.4%**
- **2020 Chinook 95.17%**
- **5-year average 96.04%**

NNI hatchery mitigation set at 3.96% of spring and summer Chinook, coho, and steelhead (7% for other Plan Species)



Wells Juvenile Survival Rates – Delayed Mortality

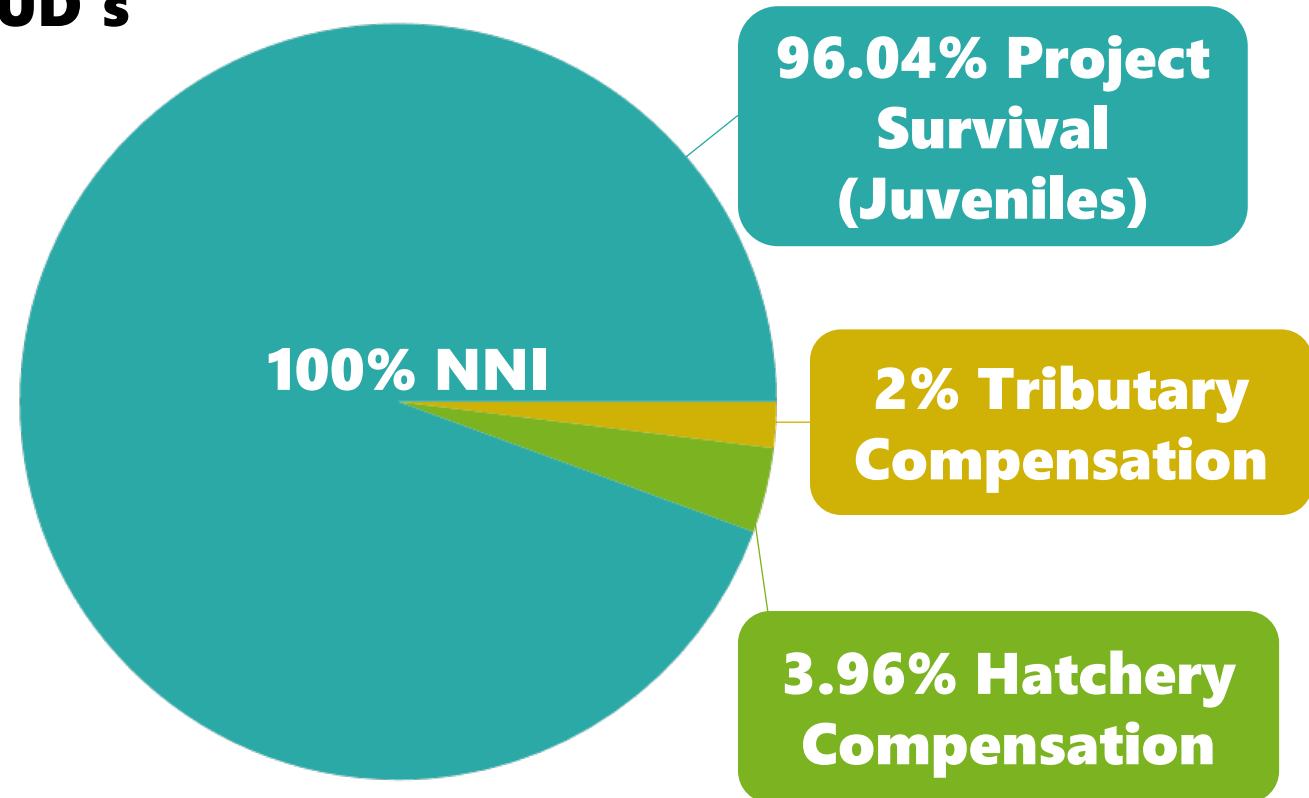
Unique to the Wells HCP: “The testing shall consider direct, indirect and delayed mortality wherever it may occur and can be measured (as it relates to the project) given available mark-recapture technology.”

No evidence of delayed mortality in the five studies to date!



No Net Impact – Achieved Via the Wells HCP

Because the Wells HCP calculates the hatchery mitigation rate as the average of survival studies on both yearling Chinook and steelhead, DPUD's yearling summer and spring Chinook, coho, and steelhead NNI Looks like this...



Rocky Reach and Rock Island HCPs NNI Hatchery Compensation

Species	Basin	Annual Production Number
Spring Chinook	Wenatchee, Methow, Upper Columbia	289,542
Summer Chinook	Wenatchee, Methow, Upper Columbia	1,155,139
Steelhead	Wenatchee	247,300
Sockeye	Skaha	591,050
Coho		Funding to Yakama Nation

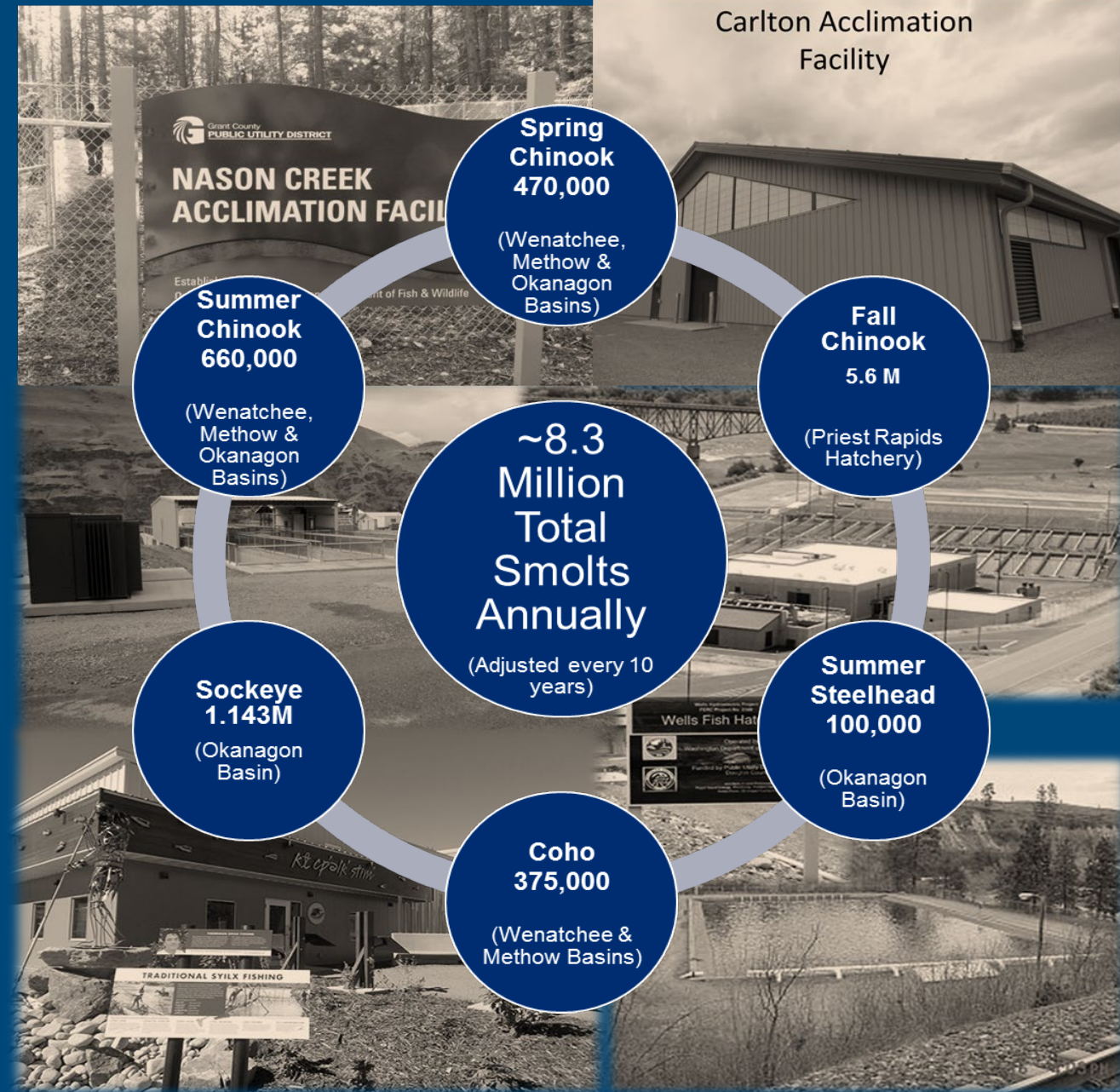
Grant PUD Hatchery Production

✓ District Owned

- ❖ Priest Rapids Hatchery
- ❖ Nason Creek Acclimation Facility (Nason Creek)
- ❖ Carlton Acclimation Facility (Methow River)

✓ Partnerships

- ❖ Eastbank Hatchery (Chelan PUD)
- ❖ Dryden Pond (Chelan PUD)
- ❖ Wells Hatchery (Douglas PUD)
- ❖ Methow Hatchery (Douglas PUD)
- ❖ Chief Joseph Hatchery (Colville Tribe)
- ❖ Omak Creek Acclimation (Colville Tribe)
- ❖ Penticton Hatchery (Okanagan Nation)
- ❖ Columbia Basin Hatchery (WDFW)
- ❖ Marion Drain (Yakama Nation)
- ❖ Leavenworth (USFWS)
- ❖ Winthrop (USFWS)



Wells HCP NNI Hatchery Compensation

Douglas PUD Hatchery Facilities:

- Methow Hatchery on the Methow River near Winthrop WA
- Twisp Acclimation Pond, Twisp River (Methow River tributary)
- Wells Hatchery on the Columbia River at Wells Dam

Spring Chinook (3.96%):

Methow Hatchery (31,169 smolts)

Chief Joseph Hatchery (35,640 smolts)

Steelhead (3.96%)

Wells Hatchery (8,562 smolts)

Summer Chinook (3.96%)

Chief Joseph Hatchery (51,480 yearlings)

Summer Chinook (7%)

Chief Joseph Hatchery (49,000 subyearlings)

Coho (3.96%)

Wells Hatchery (27,720 smolts)

Sockeye (7%) - CANADIAN FLOW MANAGEMENT (FWMT)



Nanaimo

Vancouver

Abbotsford

Bellingham

Victoria

Everett

Vernon

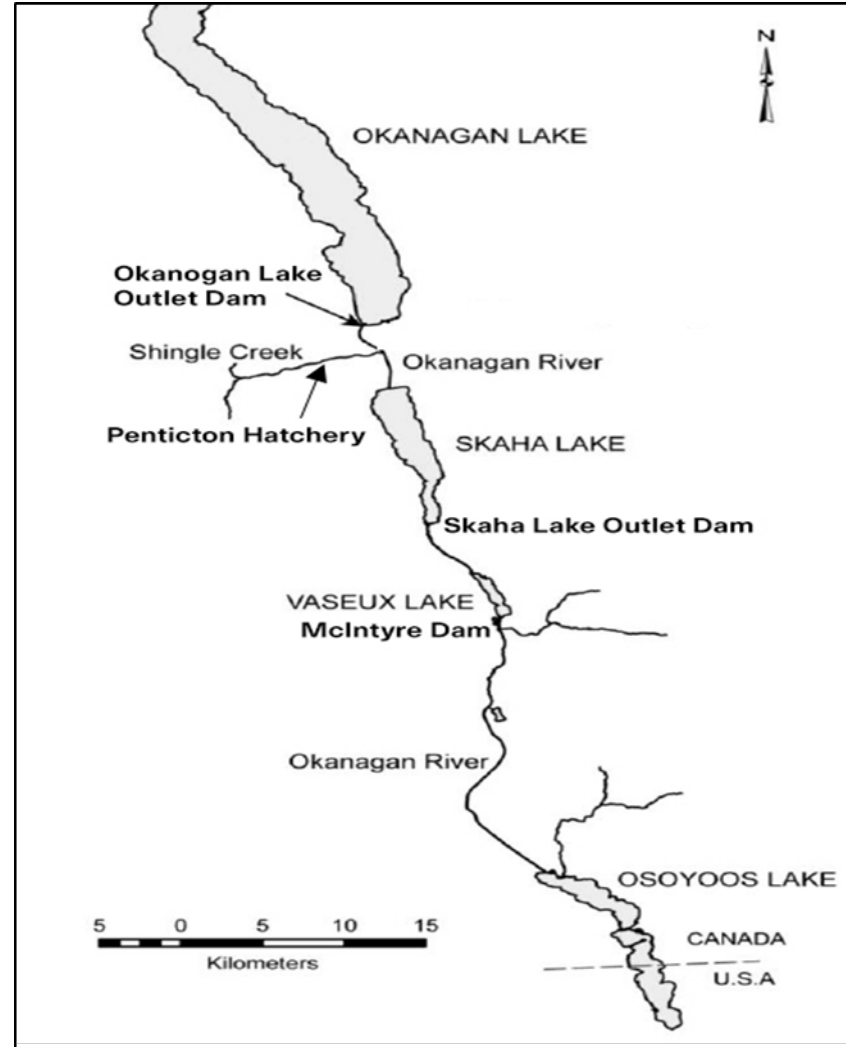
Kelowna

Penticton

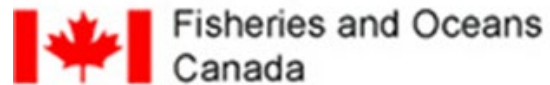
Image Landsat / Copernicus
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2020 Google

Google Earth

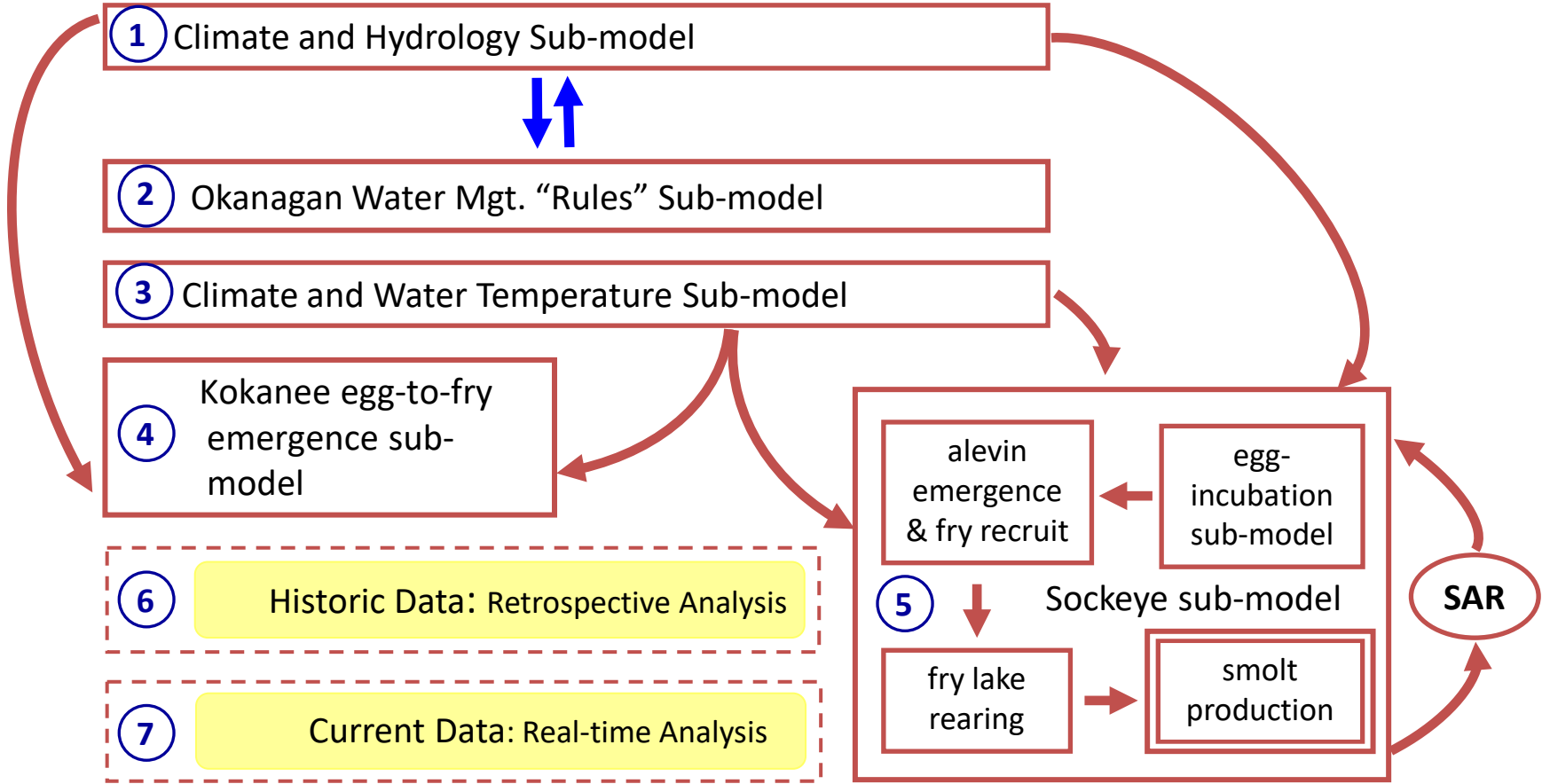
Geographic Extent of Mid-Columbia PUD Programs in British Columbia



FWMT PROGRAM PARTNERS



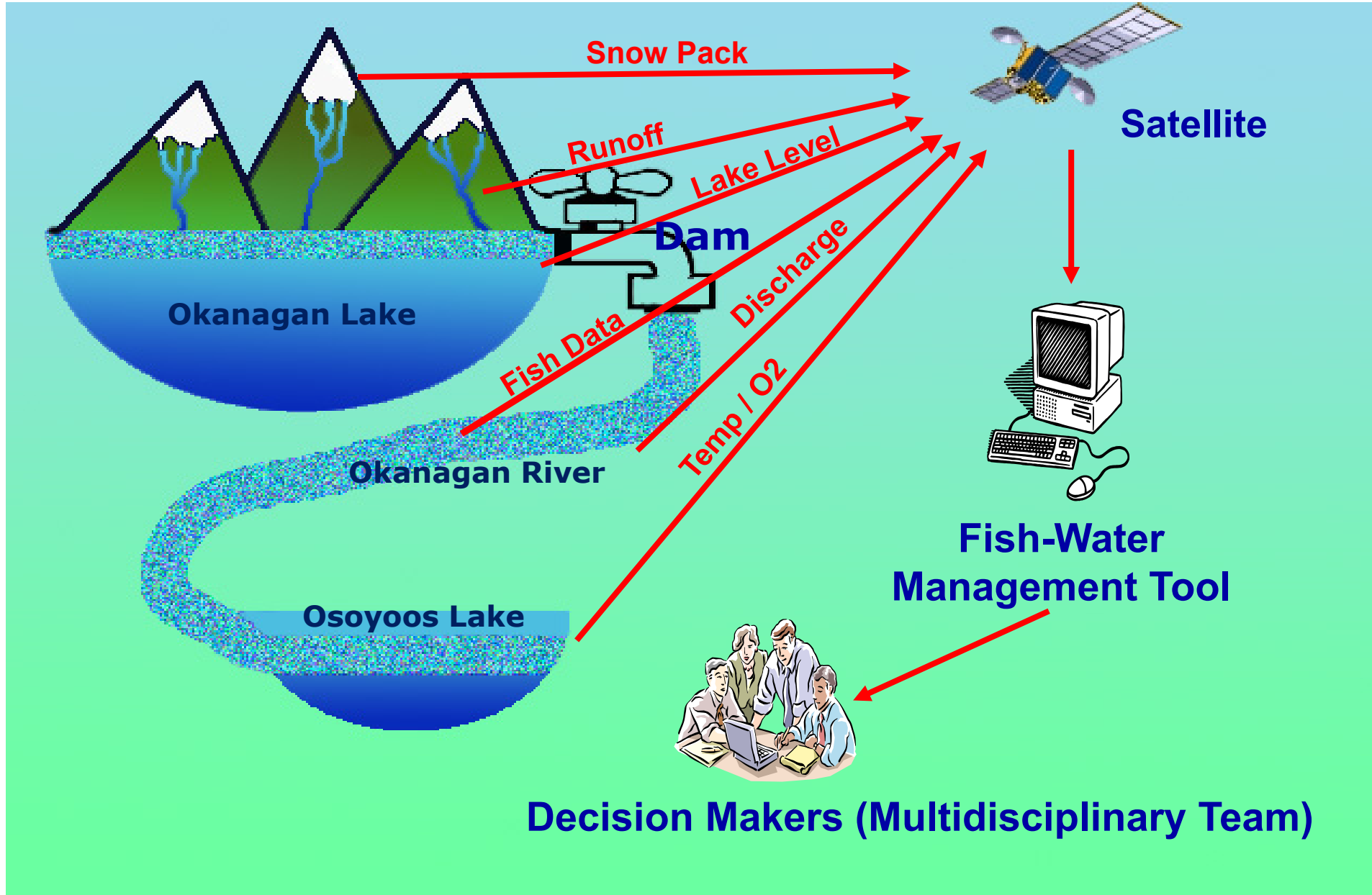
Fish-Water Management Tools – Decision-Support System



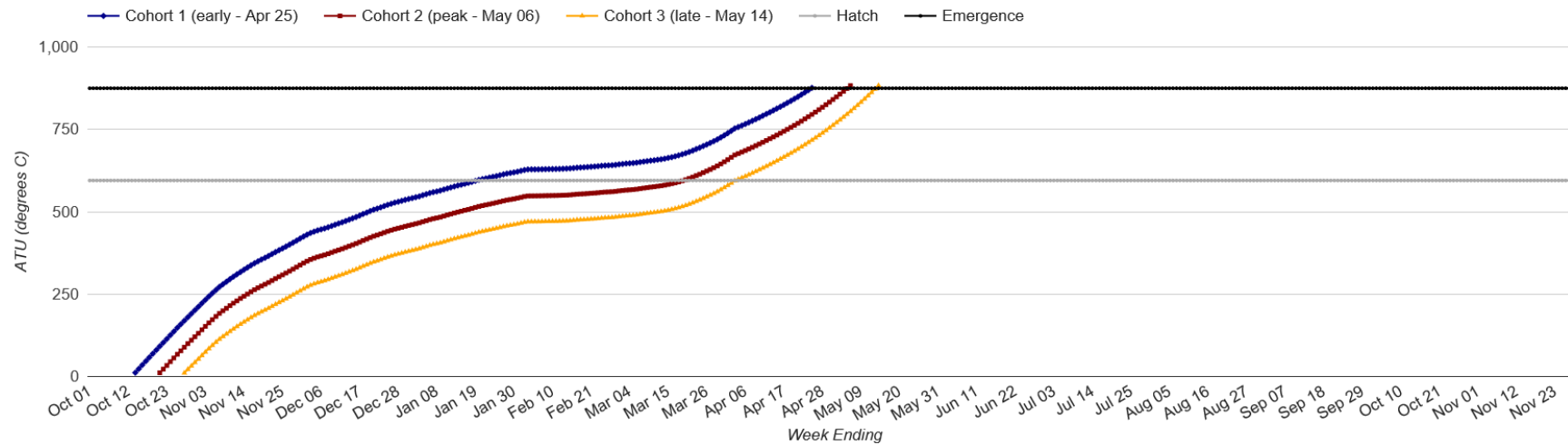
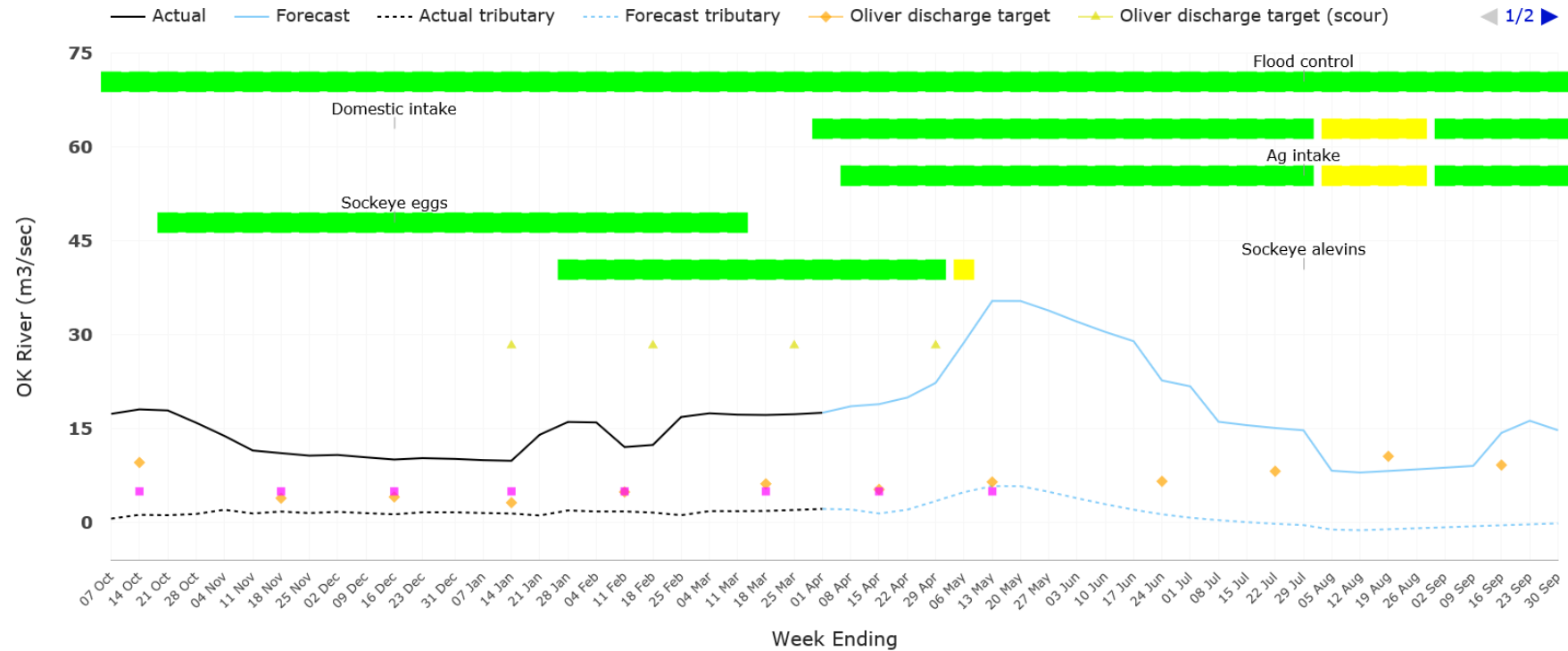
The FWMT System is a coupled set of biophysical models of key relationships (among climate, water, fish, & property) used to predict the consequences of water mgt. decisions for fish & other water users.

The FWMT may be used to explore impacts of water-management decision in an operational mode employing real-time data, a prospective-mode, or in a retrospective-mode using data from historic water supply, climate, & fish years.

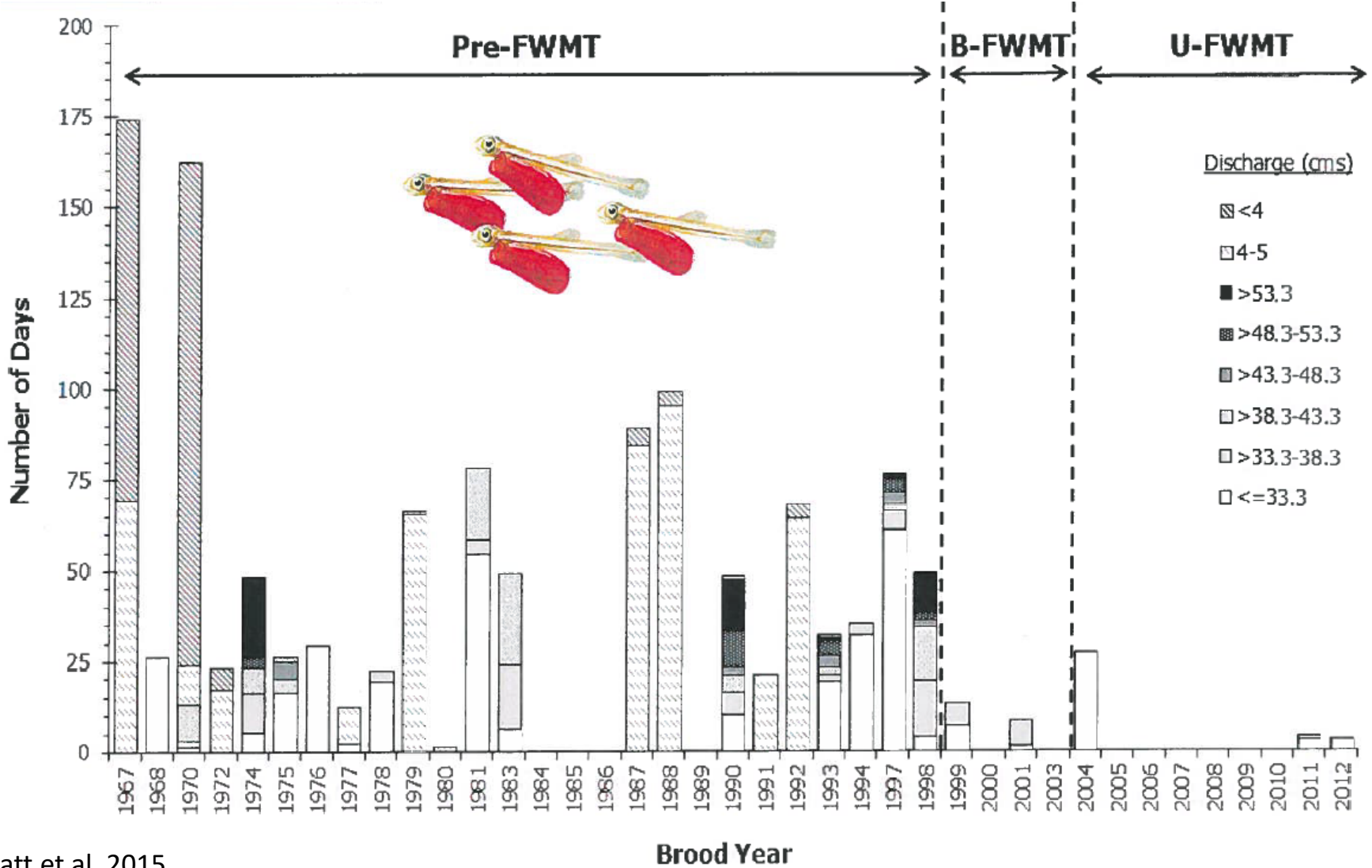
FWMT Mechanics and Data Sources



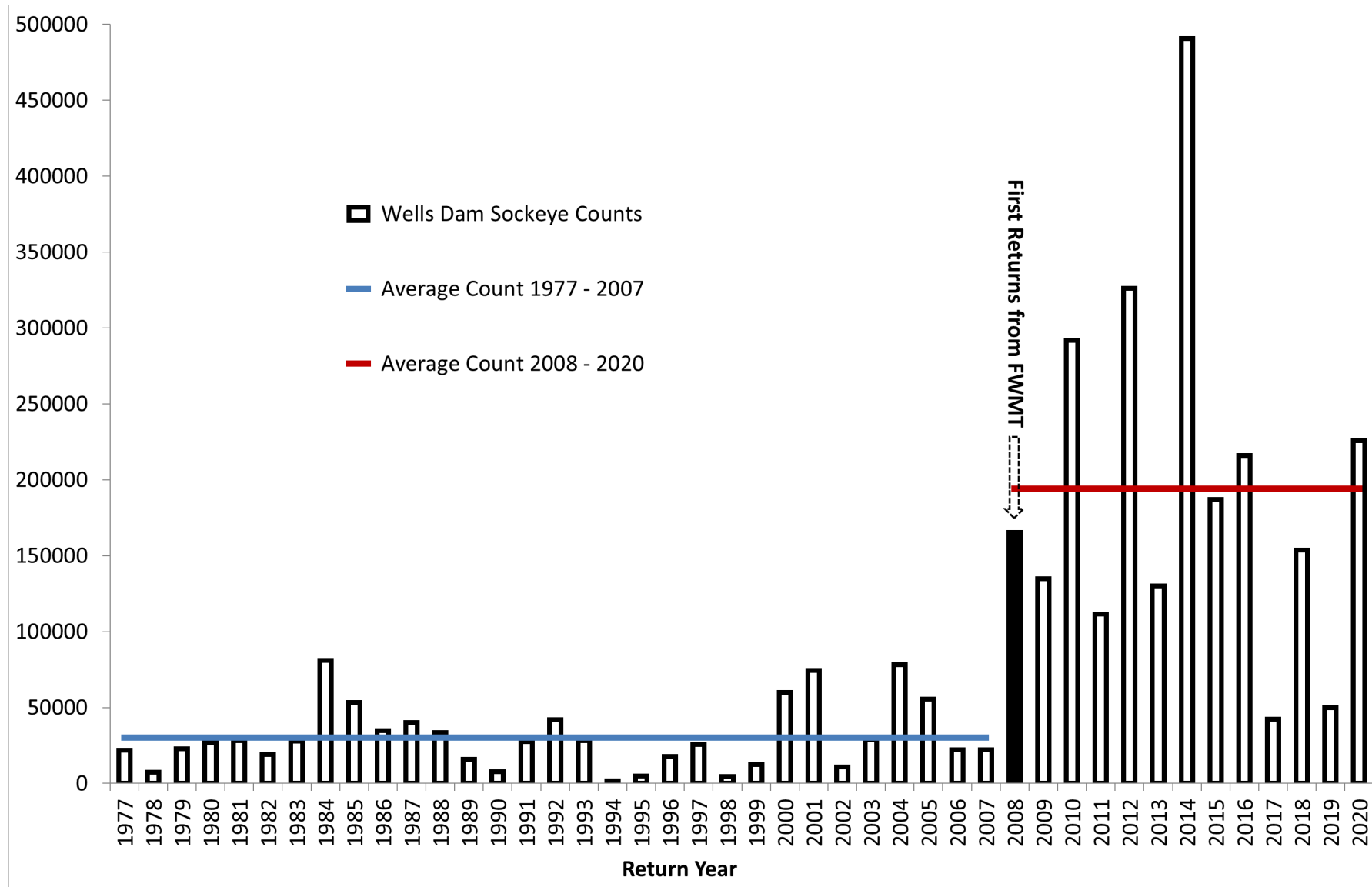
Okanagan (Osoyoos) Sockeye Emergence Timing



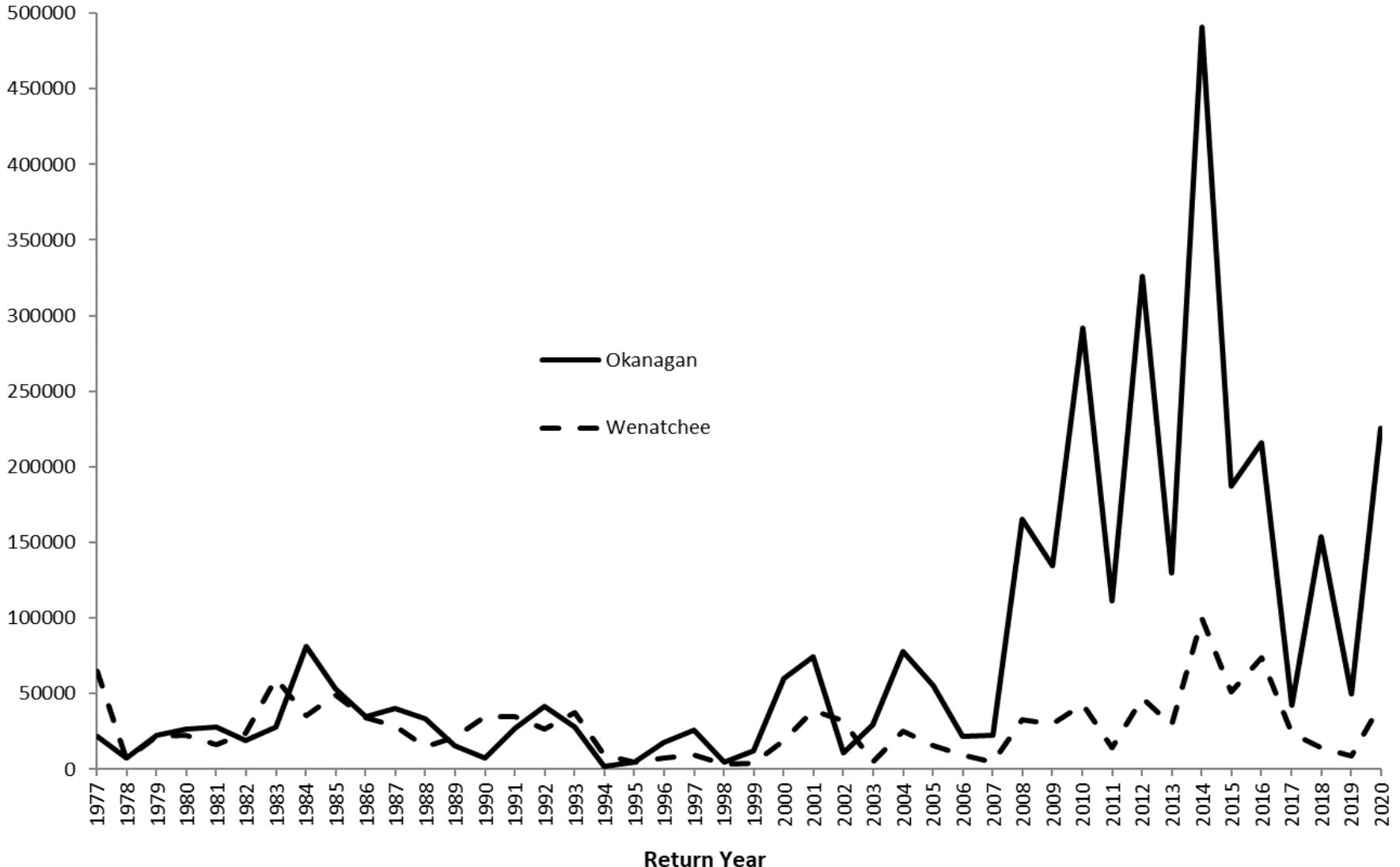
Impact of FWMT on Compliance with “Sockeye Friendly” Flow Requirements



Annual Sockeye Counts at Wells Dam, 1977 - 2020



Annual Sockeye Counts at Tumwater and Wells Dams 1977 - 2020



Program to Reintroduce Sockeye to Skaha and Okanagan Lakes in British Columbia

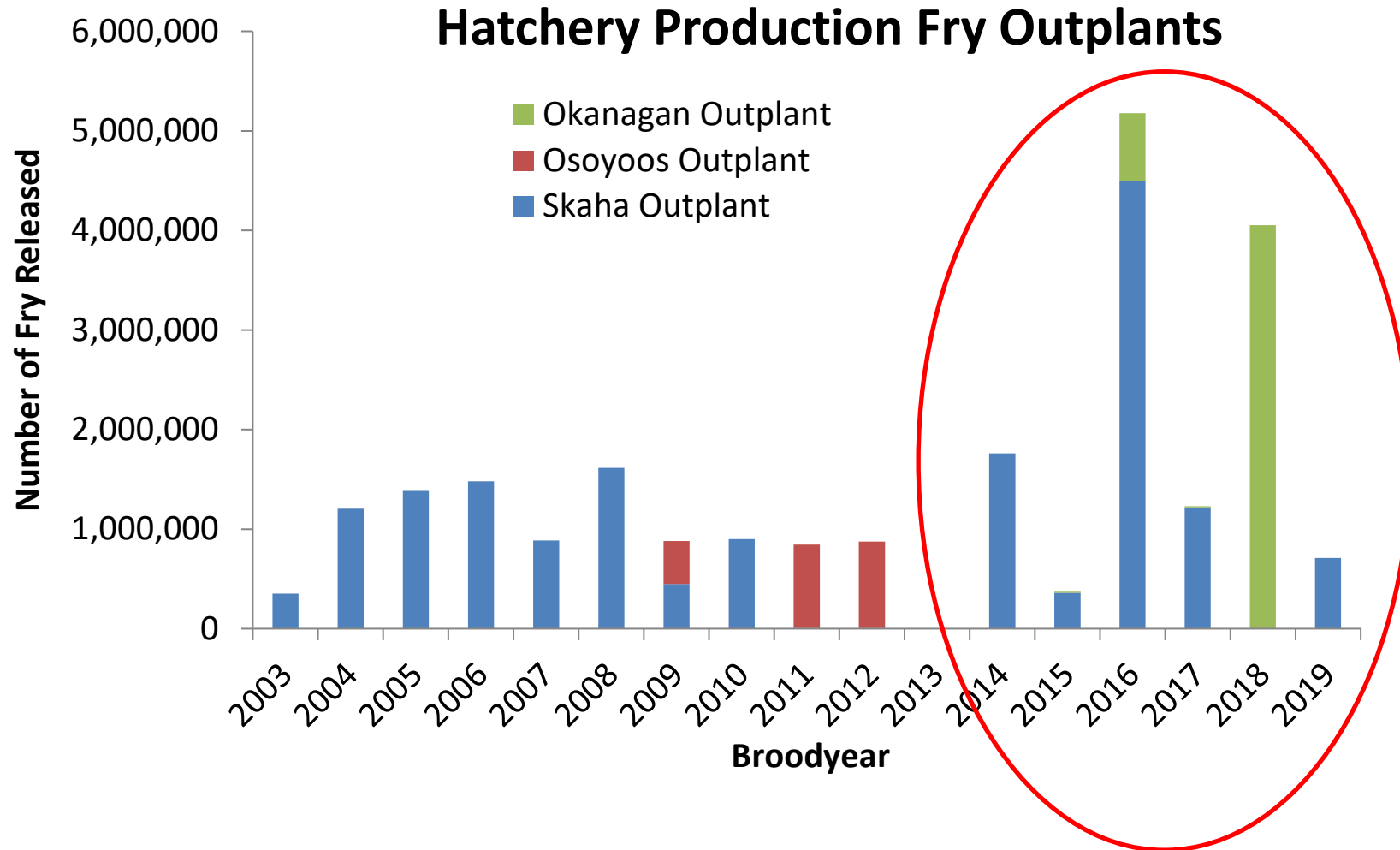
- **Program shared by Chelan & Grant PUDs and Canadian Partners**
 - **Okanagan Nation Alliance**
 - **Department of Fisheries and Oceans Canada**
 - **BC Provincial Government**
- **12-year program to reintroduce sockeye into Skaha Lake**
- **Habitat Conservation Plans, Hatchery Committees Approved Program in 2010**
 - **Credit for natural-origin smolts and fry produced from the PUD funded-hatchery**
- **Penticton Sockeye Hatchery**
 - **PUDs approved funding in 2011**
- **Initial stages of reintroduction into Okanagan Lake**

kt cp'ək' stim' Hatchery



- **Capital costs for Penticton Hatchery construction = \$4,465,700**
- **Average annual hatchery operation and program monitoring costs = \$547,600**

Skaha and Okanagan Lake Sockeye Reintroduction



Skaha and Okanagan Lakes Sockeye Reintroduction Future Look

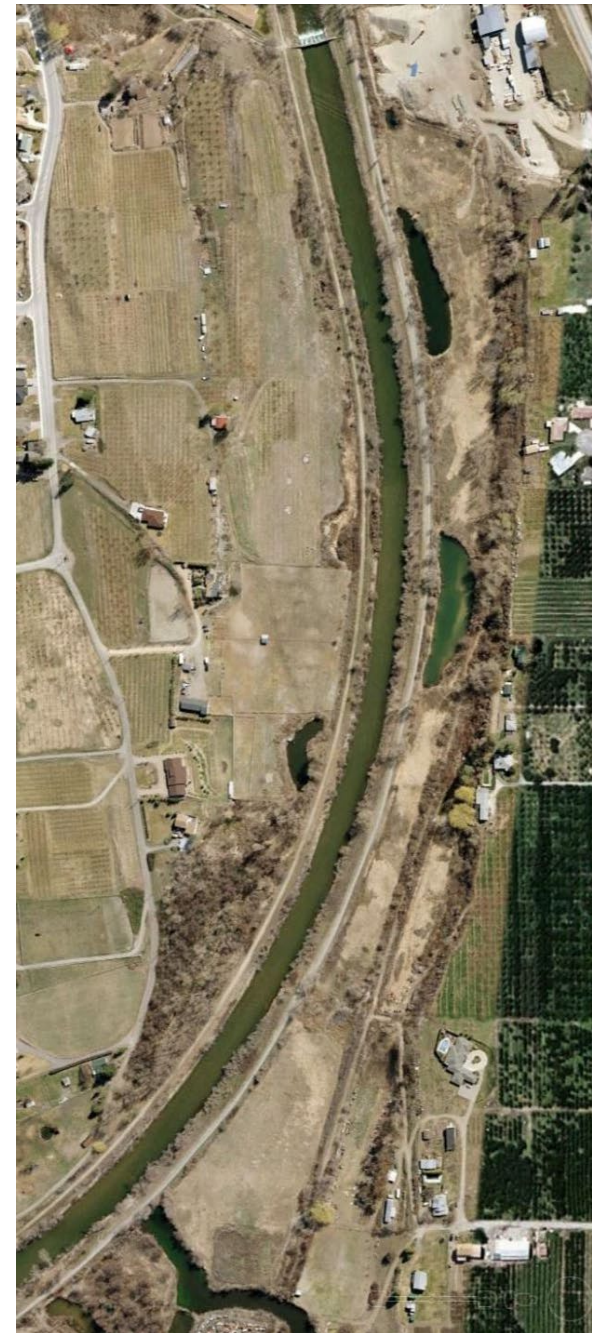


Habitat Funding

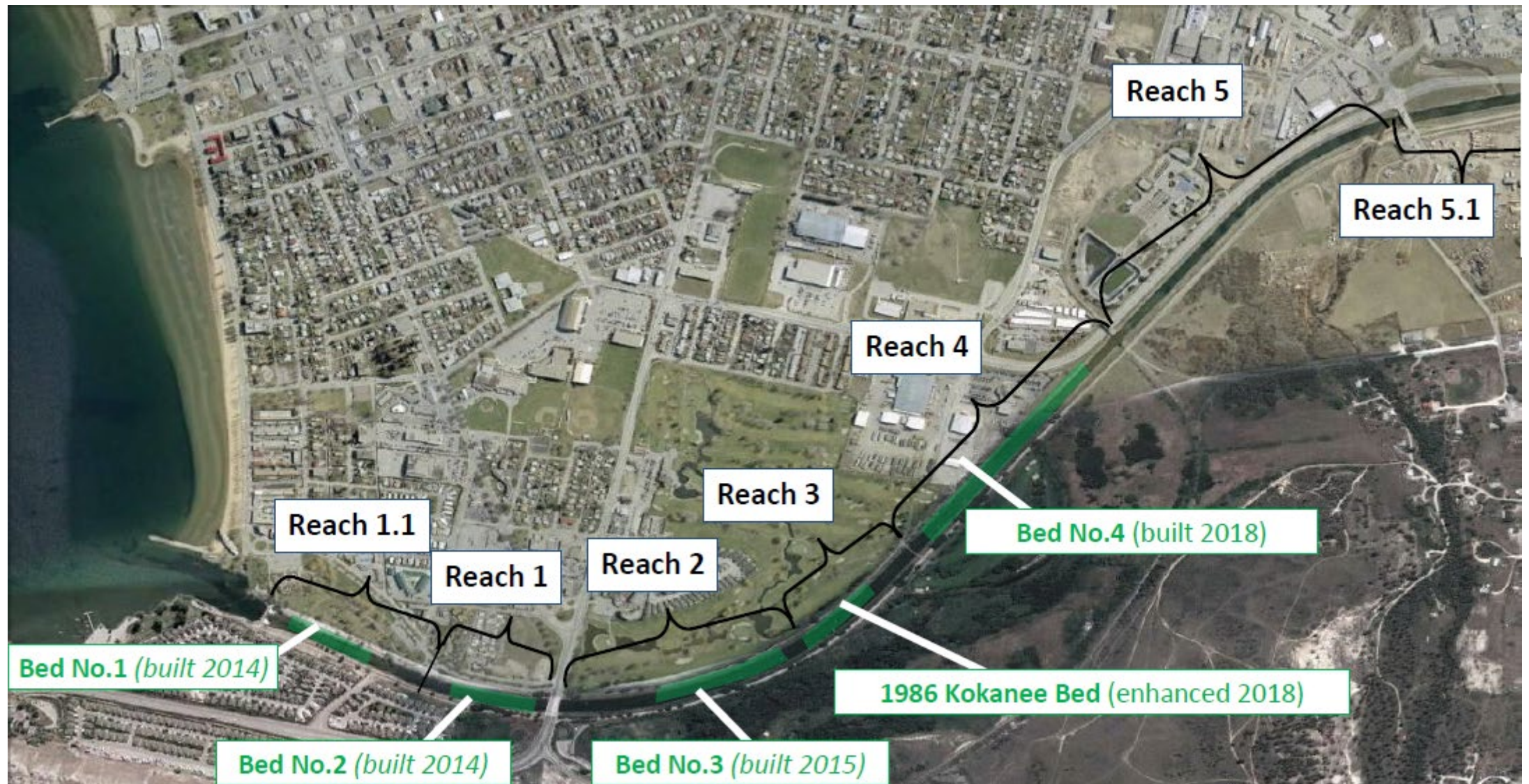
- ✓ Grant PUD contributes annually into three separate accounts for habitat restoration, protection and enhancements projects and to achieve no-net impact.
 - ❖ Priest Rapids Conservation Account - Provides habitat funding for all covered species included in Salmon & Steelhead Settlement Agreement.
 - ❖ BiOp Account - Provides habitat funding for UCR spring Chinook & steelhead.
 - ❖ No-Net-Impact Fund – Provides funding for Project survival shortfalls
- ✓ A total of 113 projects have been approved by the various committees for funding since 2006.
- ✓ **To date, GPUD has contributed > \$43 million to mitigation accounts since Settlement Agreement**



Habitat Actions to Increase Osoyoos Natural Production



Habitat Actions to Increase Skaha Natural Production



HCP Tributary Conservation Plans

Wells, Rocky Reach, and Rock Island HCP Tributary Conservation Funds (Plan Species Accounts)

- **More than \$15 million in direct project funding to date**
- **Leveraged approximately \$83 million in project implementation**
- **Over 100 major enhancement and protection projects implemented since 2004 in the Twisp, Chewuch, Methow, Okanagan (Canada), and Okanogan (US) rivers**

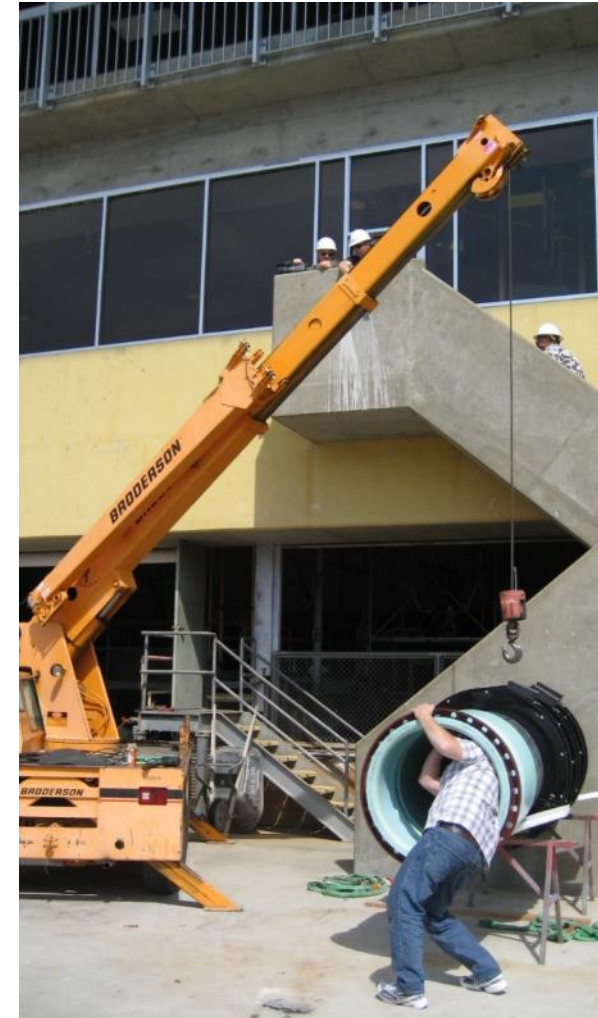


Wells Adult Survival Rates

Five-year Average Adult Passage Survival Estimated via PIT-tag conversion rates 2016-2020

- **Spring Chinook** 99.14%
- **Coho** 96.52%
- **Summer Chinook** 97.64%
- **Steelhead** 99.14%
- **Sockeye** 99.08%

Includes all sources of mortality or missing detections, not just hydro—substantial inter-dam harvest of summer Chinook and sockeye; substantial straying of coho

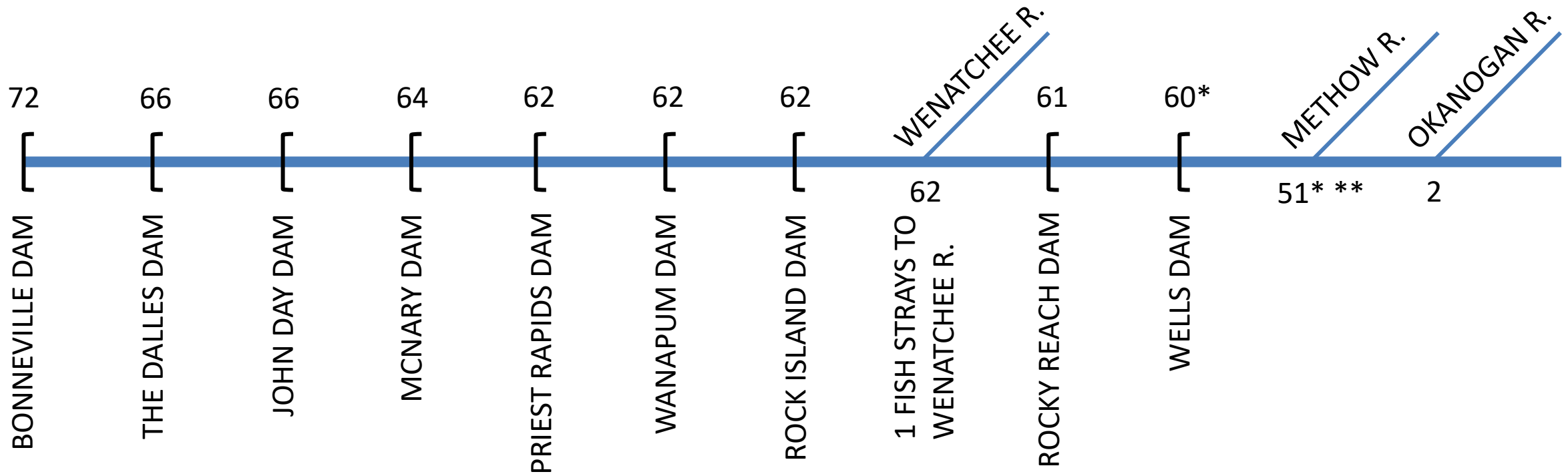




Methow Basin Wild Spring Chinook BY 2009-2013

Tag Code	Brood Year	Mark Site	Mark Date	Last Juvenile S	Last Juv Date	BOA Date	TDA Date	MCA Date	PRA Date	RIA Date	RFF Date	RRE Trap Da	WEA - Wells	Above WEA Last Detection Da	Above WEA Last Detection Sit	Fate
3D9.1C2CFE0D95	2009	CHEWUR	11/9/2010	JDJ		5/16/2013										LOST BETWEEN BONNEVILLE AND THE DALLES
3D9.1C2D135012	2011	TWISPR	11/7/2012	RRJ	4/12/2013	6/2/2015										LOST BETWEEN BONNEVILLE AND THE DALLES
384.36F2B32861	2011	CHEWUR	3/19/2013	RRJ	5/29/2013	4/22/2016										LOST BETWEEN BONNEVILLE AND THE DALLES
3D9.1C2D9368CA	2011	METTRP	3/31/2013			5/5/2015	5/7/2015									LOST BETWEEN THE DALLES AND McNARY
384.36F2B3384D	2011	CHEWUR	4/6/2013			5/1/2016										LOST BETWEEN BONNEVILLE AND THE DALLES
3DD.0038C494D0	2012	METHR	11/14/2013	MCJ	5/18/2014	4/27/2016										LOST BETWEEN BONNEVILLE AND THE DALLES
3DD.00776B4FD9	2013	CHEWUR	9/30/2014	BCC	5/4/2015	5/22/2017	5/24/2017									LOST BETWEEN THE DALLES AND McNARY
384.3B23ACB3C7	2013	METTRP	3/15/2015	MCJ	5/4/2015	4/25/2017										LOST BETWEEN BONNEVILLE AND THE DALLES
3DD.00776B8FD6	2013	CHEWUR	10/6/2014	BCC	5/22/2015	5/23/2017	5/25/2017	5/29/2017								LOST BETWEEN McNARY AND PRIEST RAPIDS
3DD.0038B94757	2013	TWISPR	10/8/2014			5/20/2017	5/22/2017	5/29/2017								LOST BETWEEN McNARY AND PRIEST RAPIDS
3D9.1C2D121EF9	2011	TWISPR	11/8/2012	MCJ	4/17/2013	5/5/2016	5/6/2016	5/14/2016	5/19/2016	5/24/2016						STRAYED TO WENATCHEE BASIN - last detected in icicle Cr. 9/14/2016
3D9.1C2D60DFCA	2010	TWISPR	9/1/2011			4/18/2014	4/20/2014	4/29/2014	5/6/2014	5/16/2014	5/17/2014					LAST DETECTED AT ROCKY REACH
3D9.1C2D946692	2010	CHEWUR	9/2/2011	MCJ	5/18/2012	5/16/2014	5/17/2014	5/22/2014	5/26/2014	5/28/2014	5/31/2014	5/31/2014				TRAPPED AT ROCKY REACH FOR CHEWUCH BROODSTOCK
3D9.1C2D94F30E	2010	CHEWUR	4/17/2012	JDJ	5/2/2012	5/17/2014	5/19/2014	5/23/2014	5/27/2014		5/31/2014	5/31/2014				TRAPPED AT ROCKY REACH FOR CHEWUCH BROODSTOCK
3D9.1C2D920A71	2011	METTRP	4/5/2013	BCC	5/8/2013	5/20/2014	5/22/2014	5/25/2014	5/31/2014		6/4/2014	6/4/2014				TRAPPED AT ROCKY REACH FOR CHEWUCH BROODSTOCK
3D9.1C2DAF7243	2011	CHEWUR	4/3/2013	MCJ	5/9/2013	5/17/2015	5/19/2015	5/22/2015	5/26/2015	5/30/2015			6/2/2015			TRAPPED AT WELLS FOR METHOW BROODSTOCK
3D9.1C2DD88161	2011	TWISPR	9/18/2012	RRJ	4/11/2013	4/30/2015	5/1/2015	5/4/2015	5/8/2015		5/17/2015		5/19/2015			TRAPPED AT WELLS FOR TWISP BROODSTOCK
3D9.1C2D92778C	2011	TWISPR	10/24/2012			4/26/2015	4/28/2015	4/30/2015			5/7/2015		5/11/2015			TRAPPED AT WELLS FOR TWISP BROODSTOCK
3D9.1C2DD9AD08	2012	METTRP	4/11/2014			5/4/2016	5/6/2016	5/9/2016	5/12/2016		5/15/2016		5/16/2016			TRAPPED AT WELLS FOR METHOW BROODSTOCK
3DD.0077642CE	2013	CHEWUR	10/23/2014			5/21/2017	5/24/2017	5/27/2017	6/1/2017		6/4/2017		6/5/2017			TRAPPED AT WELLS FOR METHOW BROODSTOCK
384.3B23AC618B	2013	TWISPR	3/31/2015			5/20/2017	5/23/2017	5/27/2017	5/30/2017		6/3/2017		6/6/2017			TRAPPED AT WELLS FOR TWISP BROODSTOCK
3D9.1C2D616FA2	2009	TWISPR	10/6/2010	RRJ	4/22/2011	5/5/2013	5/6/2013	5/9/2013	5/16/2013	5/18/2013	5/19/2013					LAST DETECTED AT WELLS
3D9.1C2D772BED	2010	METTRP	4/22/2012	RRJ	4/28/2012	5/2/2013	5/2/2013	5/8/2013	5/14/2013	5/17/2013	5/18/2013					LAST DETECTED AT WELLS
384.36F2B33661	2010	CHEWUR	4/20/2012	JDJ	5/18/2012	5/2/2014	5/4/2014	5/7/2014	5/11/2014	5/16/2014	5/18/2014					LAST DETECTED AT WELLS
3D9.1C2CFD877D	2010	CHEWUR	4/11/2012	RRJ	4/17/2012	5/20/2014	5/22/2014	5/25/2014	6/4/2014	6/7/2014	6/8/2014					LAST DETECTED AT WELLS
3D9.1C2D1351C3	2011	TWISPR	11/7/2012			5/21/2014	5/23/2014	5/26/2014	6/2/2014		6/5/2014		6/7/2014			LAST DETECTED AT WELLS
3D9.1C2DD83947	2012	METTRP	4/20/2014			5/25/2016	5/28/2016	6/2/2016	6/6/2016	6/11/2016	6/12/2016		6/2/2016			LAST DETECTED AT WELLS
3DD.0038C4563F	2013	TWISPR	10/10/2014	BCC	5/16/2015	5/22/2017	5/23/2017	5/26/2017	5/29/2017	5/31/2017	6/2/2017		6/3/2017			LAST DETECTED AT WELLS
3D9.1C2CFE5C6	2009	CHEWUR	7/13/2010	RRJ	4/2/2011	5/3/2013	5/5/2013	5/8/2013	5/13/2013	5/16/2013	5/18/2013		5/22/2013			
3D9.1C2D0089D2	2009	TWISPR	4/2/2011	JDJ	5/22/2011	4/26/2013	4/27/2013	5/1/2013	5/7/2013	5/10/2013	5/11/2013		5/14/2013			LOR - Lost River at rkm 0.81
3D9.1C2CE838E	2009	CHEWUR	4/29/2011	RRJ	5/25/2011	5/10/2013	5/12/2013	5/15/2013	5/20/2013	5/27/2013	5/28/2013		5/31/2013			LWR - Lower Methow River at V
3D9.1C2D924997	2010	TWISPR	4/12/2012	MCJ	5/13/2012	5/23/2013	5/25/2013	5/28/2013	6/1/2013	6/3/2013	6/4/2013		6/6/2013			LWR - Lower Methow River at V
3D9.1C2D60C980	2010	CHEWUR	10/10/2011	RRJ	6/2/2014	4/21/2014	4/24/2014	4/29/2014	5/5/2014	5/7/2014	5/9/2014		5/13/2014			LWR - Lower Methow River at V
3D9.1C2D8A641F	2010	TWISPR	11/8/2011	JDJ	5/12/2012	4/28/2014	4/30/2014	5/3/2014	5/8/2014	5/14/2014	5/16/2014		5/18/2014			TWR - Lwr Twisp Rvr near MSR
3D9.1C2D60E002	2010	METTRP	10/28/2011	JDJ	5/10/2012	5/4/2014	5/5/2014	5/9/2014	5/12/2014	5/16/2014	5/17/2014		5/21/2014			TWISPW - Twisp River Weir (V)
3D9.1C2D982270	2010	CHEWUR	8/29/2011			4/30/2014	5/2/2014	5/5/2014	5/9/2014	5/18/2014	5/19/2014		5/22/2014			CRW - Chewuch River above V
3D9.1C2D935D36	2010	METTRP	4/13/2012			5/9/2014	5/13/2014	5/17/2014	5/29/2014		6/3/2014		6/5/2014			CRW - Chewuch River above V
3D9.1C2CF0A6E	2010	TWISPR	4/24/2012			6/7/2014	6/9/2014	6/13/2014	6/18/2014	6/20/2014	6/21/2014		6/22/2014			OKL - Lower Okanogan Intrea
3D9.1C2DAE2FDD	2011	CHEWUR	4/3/2013			5/3/2016	5/4/2016	5/10/2016	5/13/2016	5/18/2016	5/20/2016		5/24/2016			CRU - Upper Chewuch Intrea
3D9.1C2DADC3C9	2011	CHEWUR	4/1/2013	JDJ	5/5/2013	5/4/2016	5/6/2016	5/11/2016	5/14/2016		5/18/2016		5/20/2016			CRU - Upper Chewuch Intrea
384.36F2B3383C	2011	CHEWUR	4/21/2013	B2J	5/25/2013	4/30/2016	5/2/2016	5/5/2016	5/8/2016	5/12/2016	5/18/2016		5/22/2016			CRU - Upper Chewuch Intrea
3D9.1C2DAA35C5	2011	CHEWUR	3/31/2013			5/1/2016	5/3/2016	5/6/2016	5/10/2016		5/17/2016		5/19/2016			MRC - Methow River at Cartoi
384.3B23B18128	2011	CHEWUR	9/28/2012			5/26/2015	5/27/2015	5/31/2015	6/3/2015	6/4/2015	6/5/2015		6/6/2015			CRW - Chewuch River above V
3D9.1C2D133A9A	2011	TWISPR	11/8/2012	RRJ	4/24/2013	5/22/2015	5/23/2015	5/26/2015	5/30/2015		6/2/2015		6/4/2015			TWR - Lwr Twisp Rvr near MSR
3D9.1C2DDC673A	2011	TWISPR	10/15/2012	RRJ	4/17/2013	5/10/2015	5/11/2015	5/14/2015	5/18/2015	5/21/2015	5/24/2015		5/29/2015			TWISPW - Twisp River Weir (V)
3D9.1C2D0A08A2	2011	CHEWUR	3/31/2013	JDJ	4/30/2013	5/10/2015	5/11/2015	5/14/2015	5/17/2015	5/19/2015	5/21/2015		5/23/2015			CRU - Upper Chewuch Intrea
3D9.1C2D133344	2011	TWISPR	11/27/2012			5/1/2015	5/2/2015	5/7/2015	5/11/2015	5/16/2015	5/18/2015		5/21/2015			TWR - Lwr Twisp Rvr near MSR
3D9.1C2D0A8F59	2011	TWISPR	4/16/2013	BCC	5/21/2013	5/5/2015	5/6/2015	5/9/2015	5/12/2015		5/17/2015		5/19/2015			TWR - Lwr Twisp Rvr near MSR
3D9.1C2D128120	2011	TWISPR	11/7/2012			4/30/2015	5/2/2015	5/5/2015	5/9/2015	5/12/2015	5/13/2015		5/15/2015			TWR - Lwr Twisp Rvr near MSR
384.36F2B336F9	2011	CHEWUR	3/13/2013			4/30/2015	5/1/2015	5/4/2015	5/7/2015	5/9/2015	5/11/2015		5/15/2015			CRU - Upper Chewuch Intrea
3D9.1C2DA87A93	2011	CHEWUR	3/31/2013			4/30/2015	5/1/2015	5/4/2015	5/7/2015	5/9/2015	5/10/2015		5/12/2015			CRU - Upper Chewuch Intrea
3D9.239F85D1CB	2011	CHEWUR	8/13/2012	MCJ	5/8/2013	4/27/2015	4/28/2015	5/1/2015	5/4/2015		5/8/2015		5/9/2015			CRU - Upper Chewuch Intrea
384.3B23B10799	2011	CHEWUR	10/3/2012	RRJ	4/3/2013	4/27/2015	4/29/2015	5/1/2015	5/4/2015	5/6/2015	5/8/2015		5/9/2015			CRU - Upper Chewuch Intrea
3D9.1C2D132D10	2011	TWISPR	11/8/2012			4/25/2015	4/26/2015	4/30/2015	5/4/2015	5/7/2015	5/8/2015		5/9/2015			TWR - Lwr Twisp Rvr near MSR
3D9.1C2D777FCB	2011	TWISPR	12/16/2012			4/18/2015	4/20/2015	4/23/2015	4/27/2015		4/30/2015		5/6/2015			TWR - Lwr Twisp Rvr near MSR
3D9.1C2DAF4E96	2011	CHEWUR	4/3/2013			4/19/2015	4/21/2015	4/24/2015	4/28/2015		4/30/2015		5/2/2015			CRU - Upper Chewuch Intrea
3D9.1C2DDC9059	2011	TWISPR	9/25/2012			5/24/2014	5/26/2014	5/29/2014	6/3/2014		6/7/2014		6/9/2014			TWISPW - Twisp River Weir (V)
3D9.1C2DACC18C	2011	CHEWUR	4/3/2013			5/21/2014	5/23/2014	5/26/2014	5/30/2014	6/1/2014	6/2/2014		6/4/2014			CRW - Chewuch River above V
3DD.0038C5288A	2012	METHR	10/17/2013			5/1/2016	5/3/2016	5/7/2016	5/10/2016		5/15/2016		5/17/2016			MRW - Methow River at Wint
3D9.1C2D04F988	2012	TWISPR	10/18/2013	JDJ	5/8/2014	5/3/2016	5/4/2016	5/7/2016	5/10/2016	6/1/2016	6/2/2016		6/4/2016			TWR - Lwr Twisp Rvr near MSR
3DD.0038C51750	2012	CHEWUR	10/18/2013	RRJ	4/13/2014	5/2/2016	5/4/2016	5/7/2016	5/10/2016	5/14/2016	5/16/2016		5/26/2016			MRC - Methow River at Cartoi
3DD.0038C522AD	2012	METHR	10/18/2013			5										

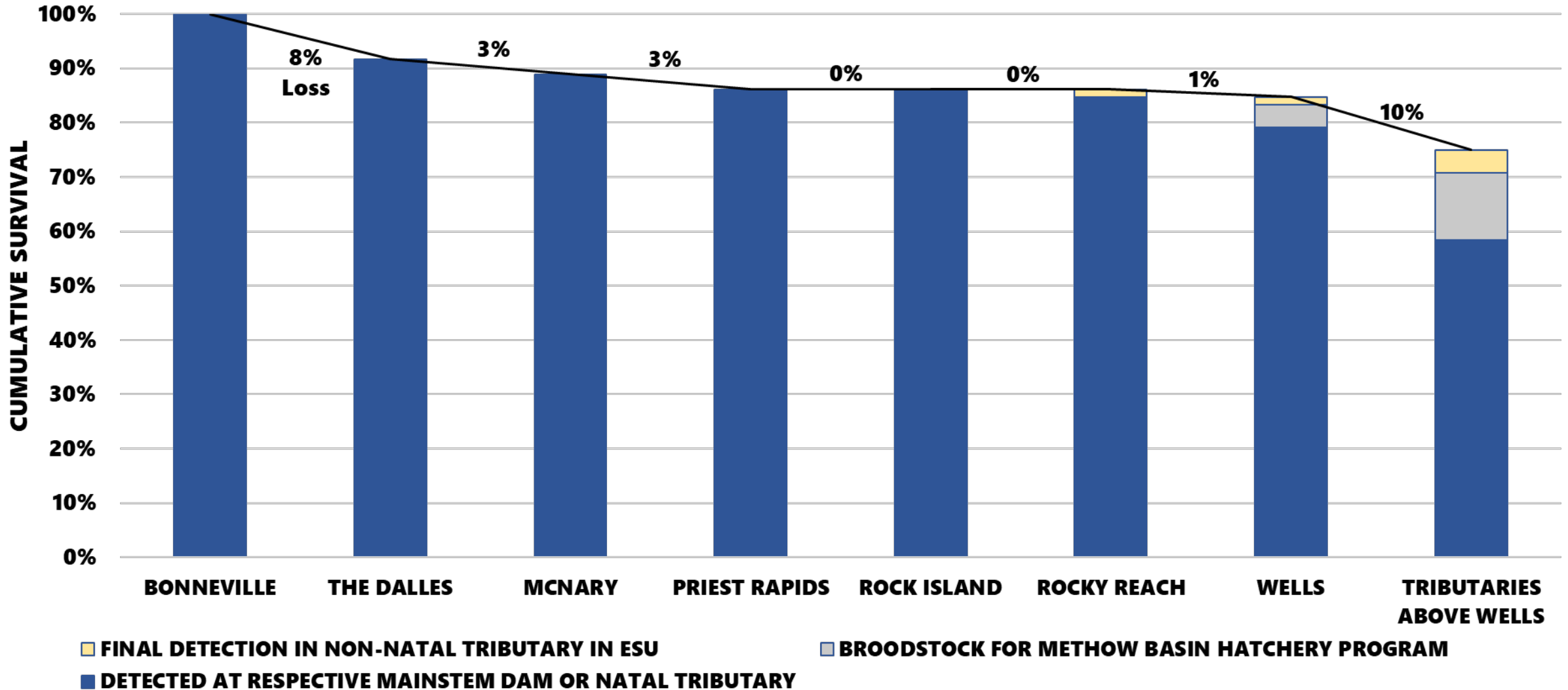
Fates of Adult Methow Basin Wild Spring Chinook from BYs 2009-2013 Returning over Bonneville Dam



UNACCOUNTED FISH BETWEEN BONNEVILLE AND WELLS = 11
 UNACCOUNTED FISH DOWNSTREAM OF PRIEST RAPIDS = 10
 UNACCOUNTED FISH UPSTREAM OF WELLS = 7

*ACCOUNTS FOR 3 FISH TRAPPED AT ROCKY REACH DAM FOR CHEWUCH HATCHERY PROGRAM (METHOW BASIN)
 **ACCOUNTS FOR 6 FISH TRAPPED AT WELLS DAM FOR METHOW HATCHERY

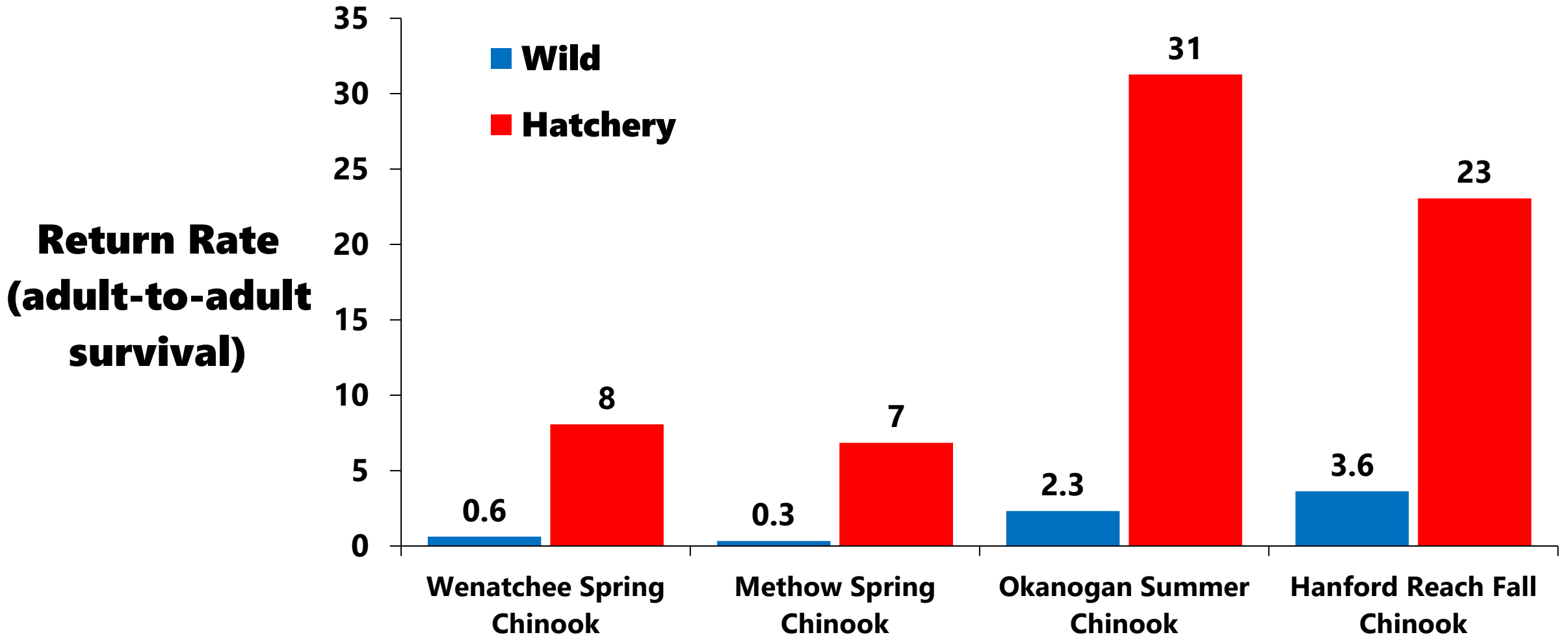
Survival of Adult Methow Basin Wild Spring Chinook from BYs 2009-2013 Returning over Bonneville Dam



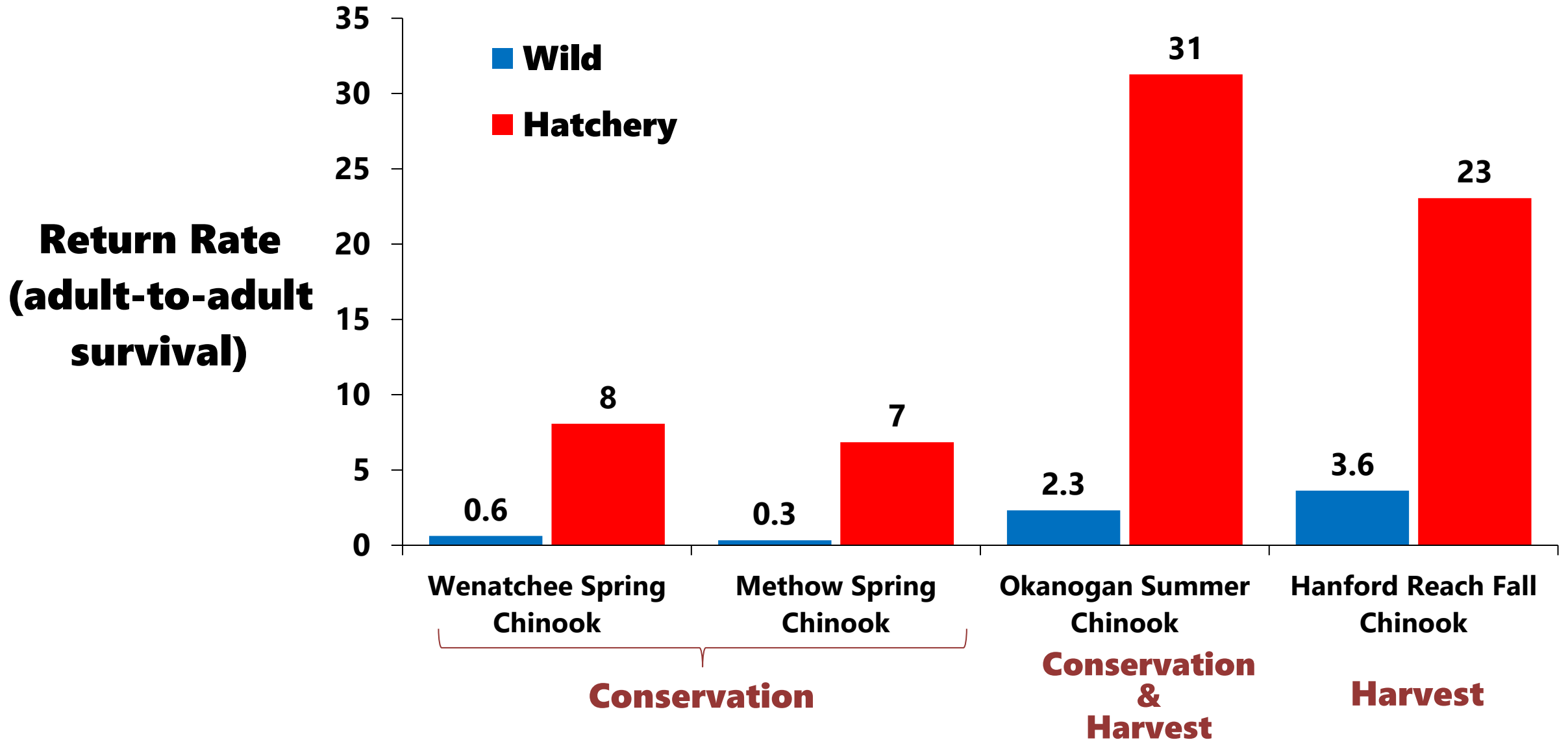
PUD Mitigation Performance and Observations



Hatchery Mitigation: Returning Adults



Hatchery Mitigation: Returning Adults

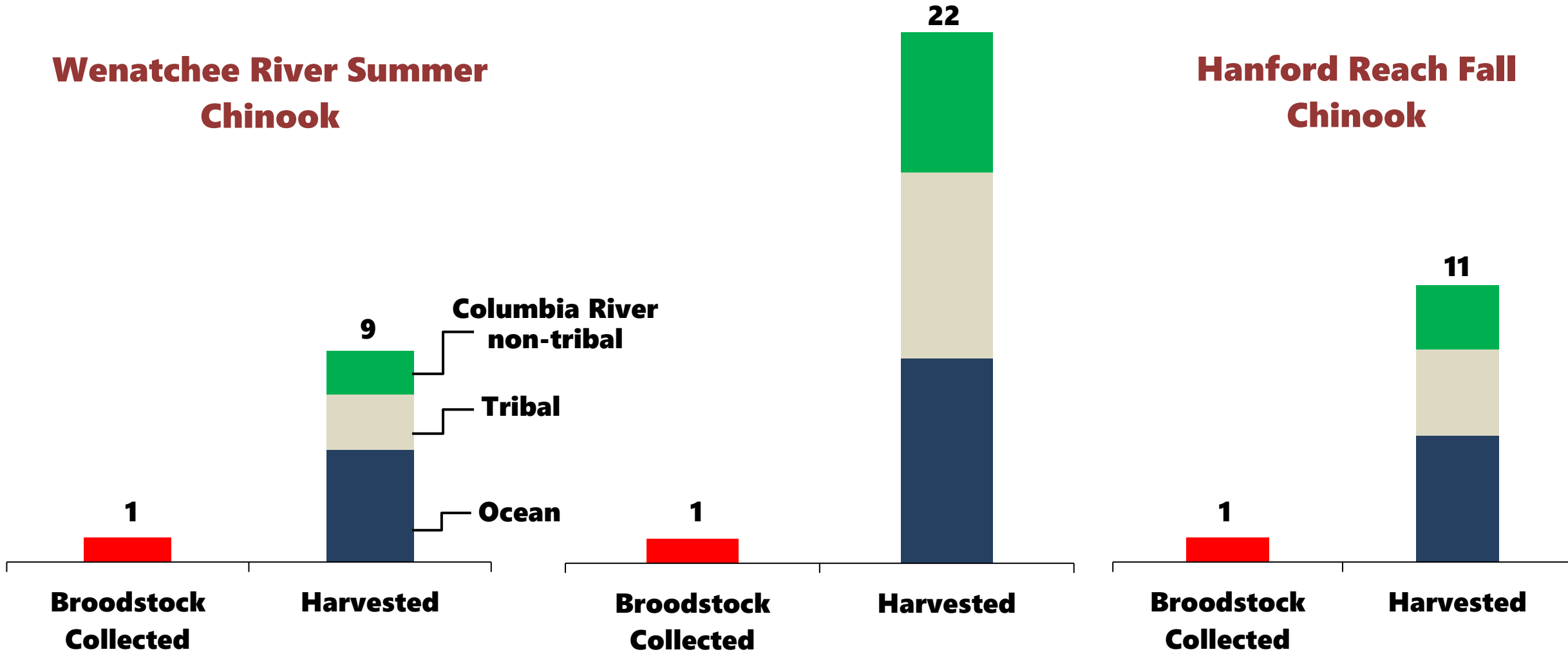


Hatchery Mitigation: Contributing to Harvest

Okanogon Summer Chinook

Wenatchee River Summer Chinook

Hanford Reach Fall Chinook



INDEPENDENT SCIENTIFIC ADVISORY BOARD

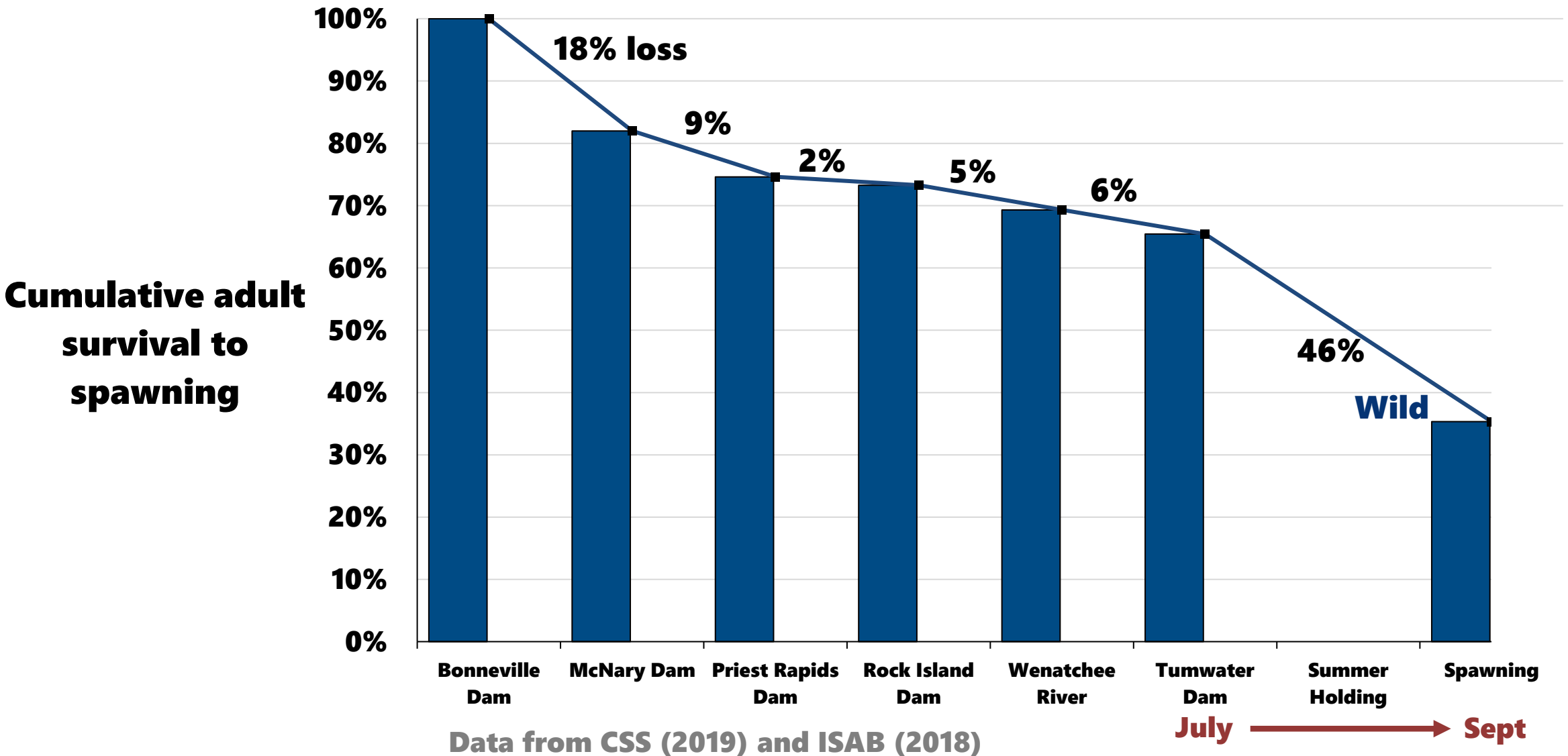
Review of Spring Chinook Salmon in the Upper Columbia River

ISAB 2018-1 FEBRUARY 9, 2018

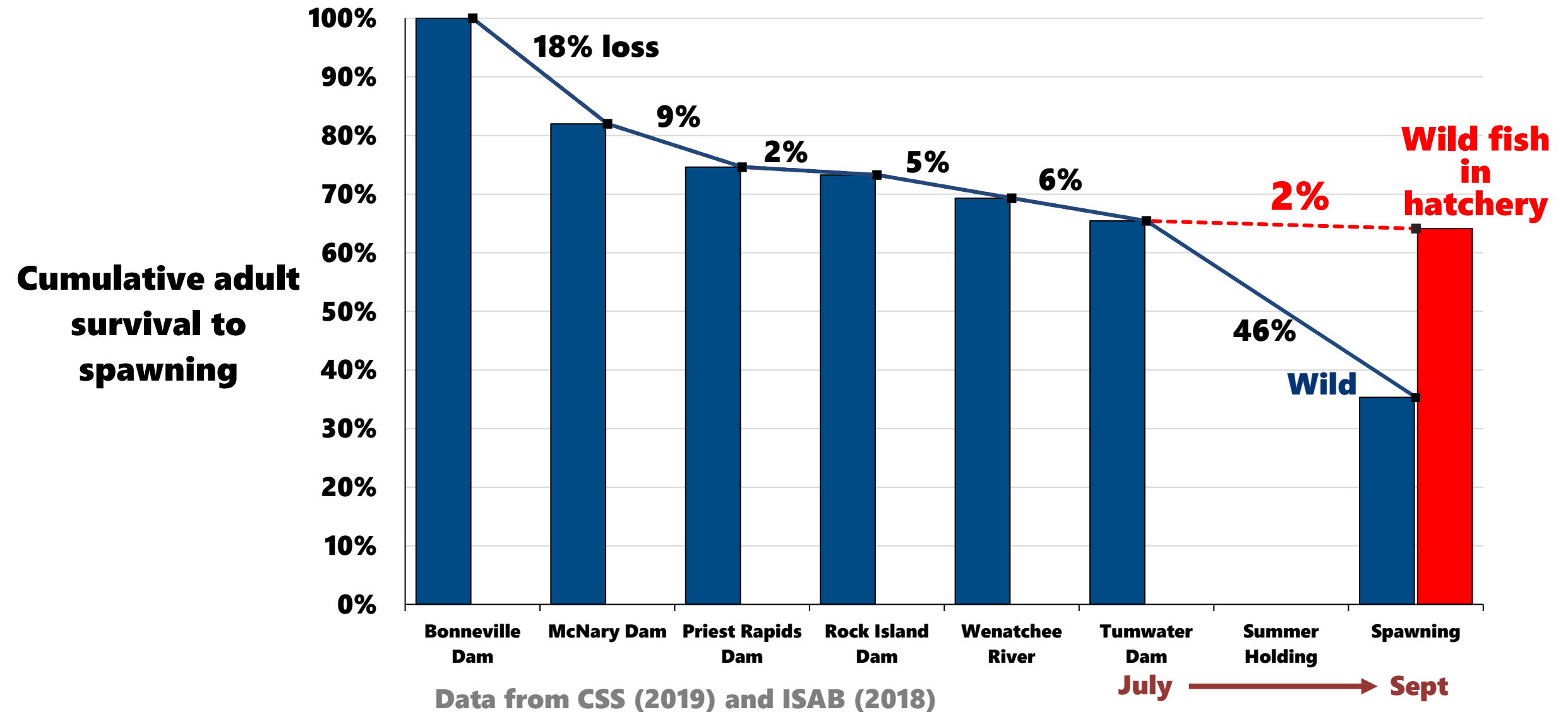
Updated: April 10, 2018 (pages 82-83)



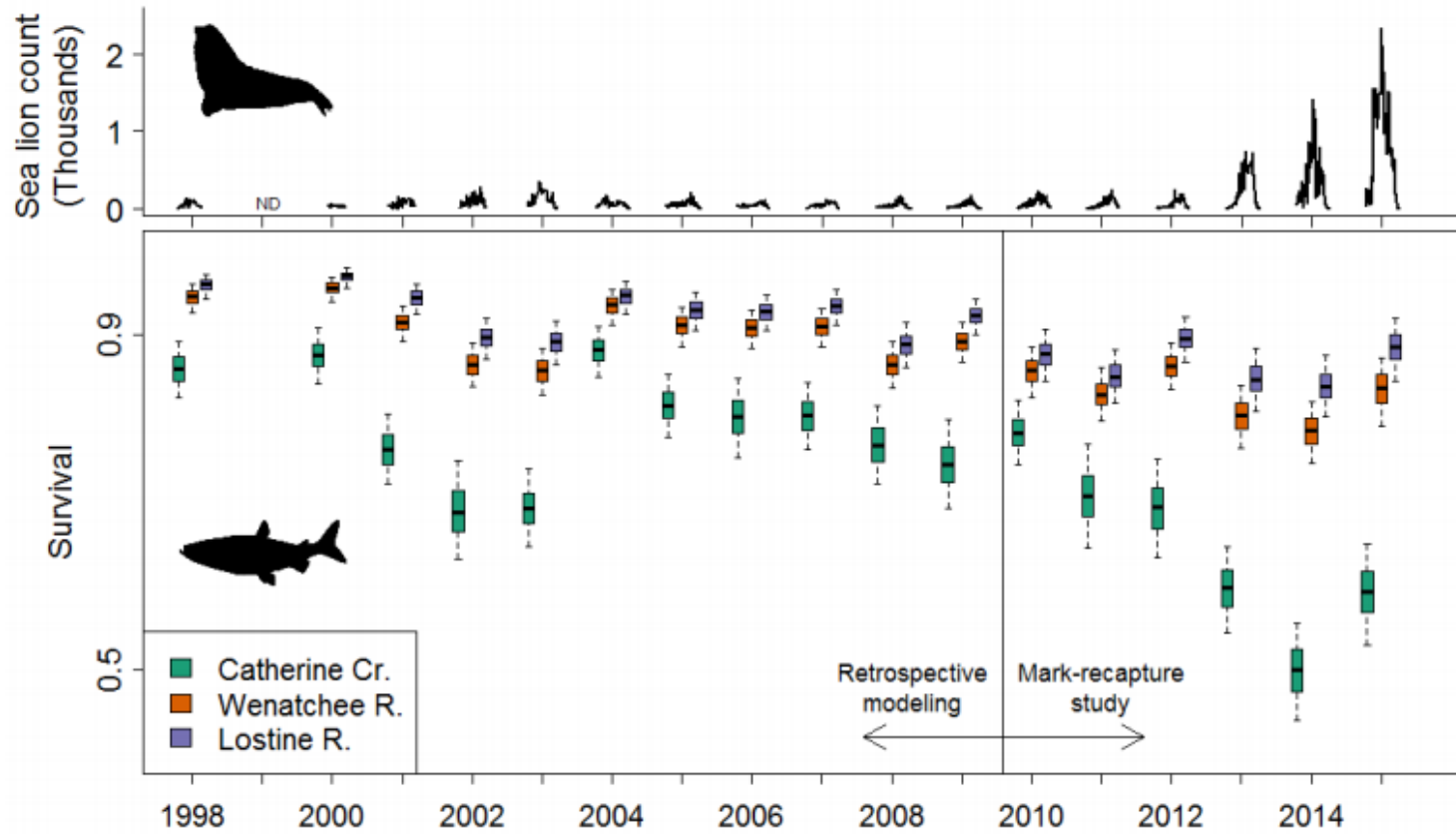
Spring Chinook: Survival to Spawning



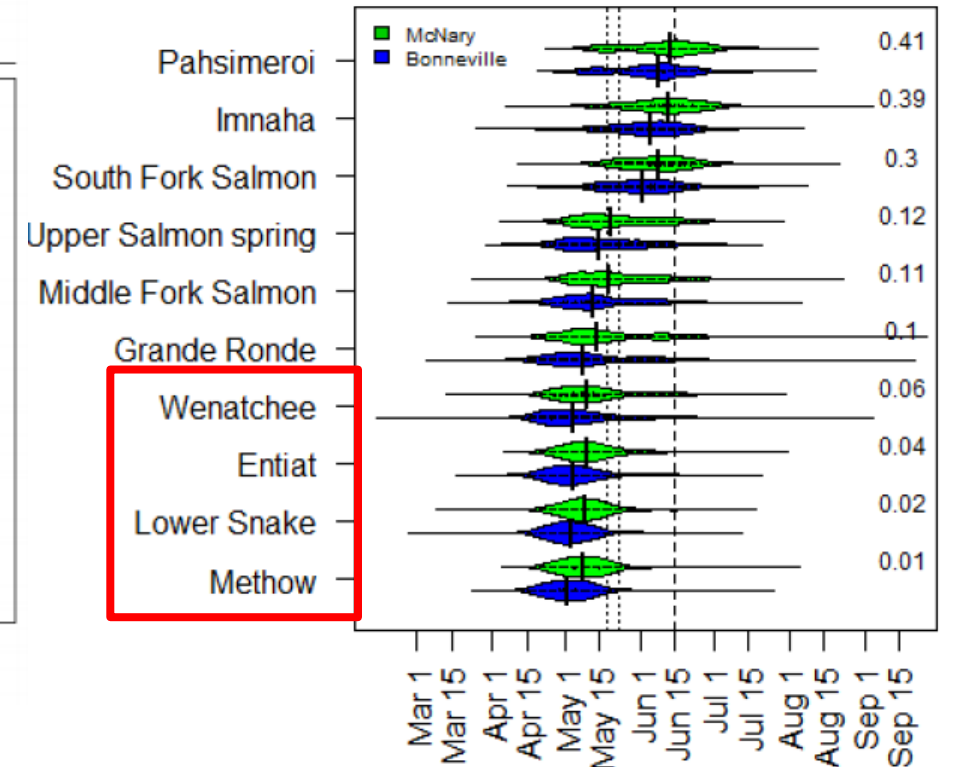
Spring Chinook: Survival to Spawning



Predation: Challenges to Upper Columbia Populations



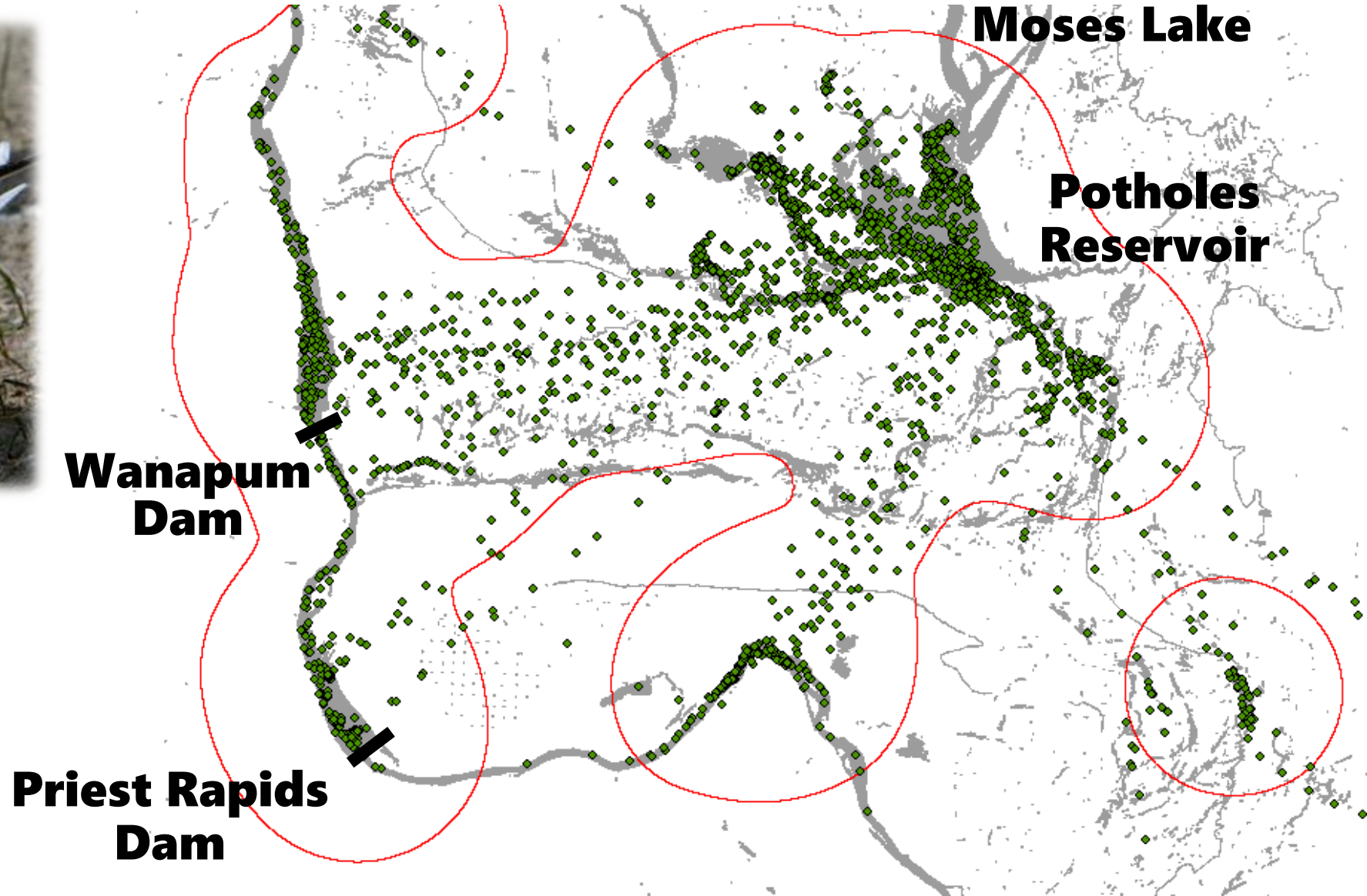
Upper Columbia and Snake River Spring/Summer Chinook



Sorel et al. 2007

Crozier et al. 2016

Predation: Challenges to Upper Columbia Populations



Predation: Challenges to Upper Columbia Populations



- **More Upper Columbia Steelhead were consumed by avian predators than died from all other mortality sources combined.**
- **Birds accounted for 42 – 70% of *all steelhead mortality* from Rock Island to Bonneville Dam.**

Collis et al.



CHELAN COUNTY



Thank you.

