



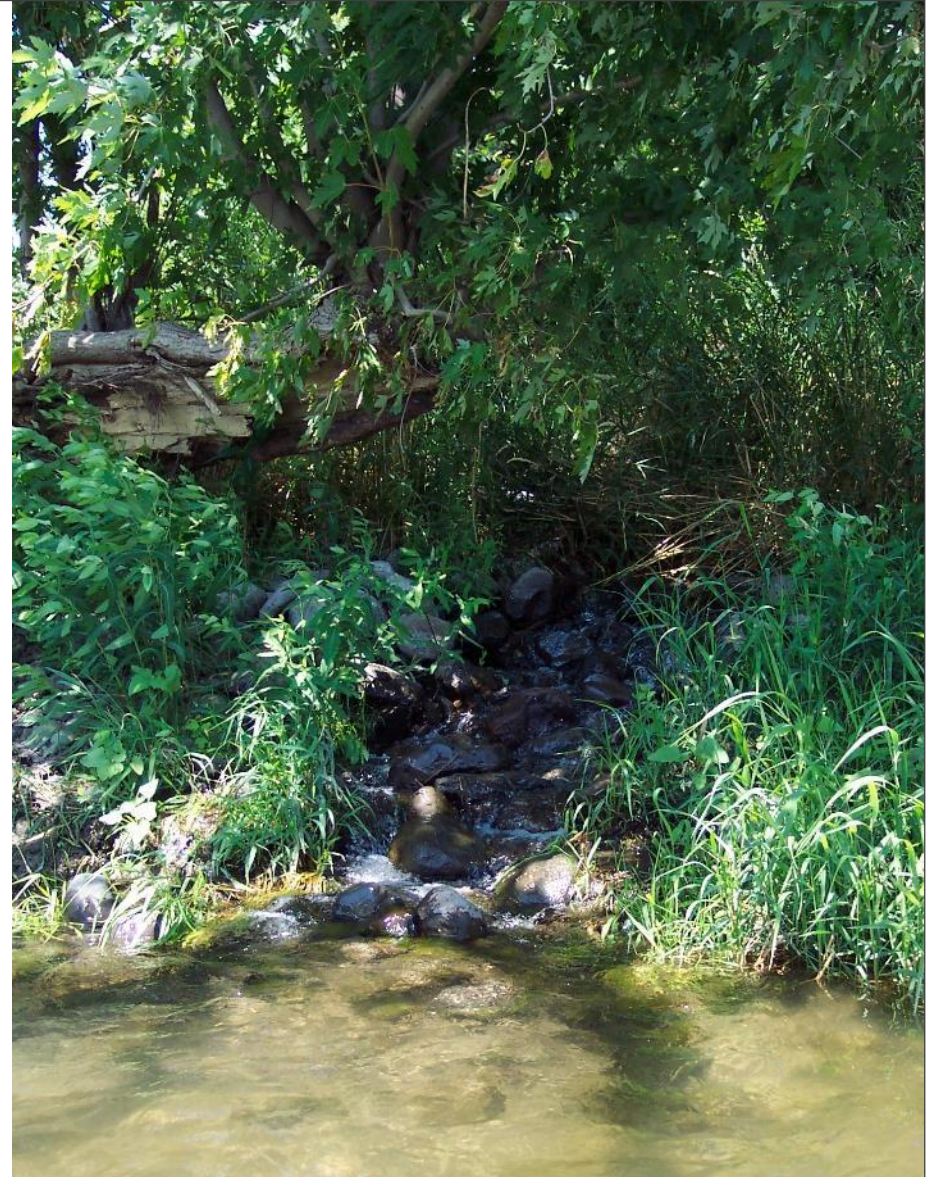
THERMAL REFUGE IN THE LOWER YAKIMA: DEVELOPING COOL PROJECTS ON A HOT RIVER

Marcella Appel, Benton CD

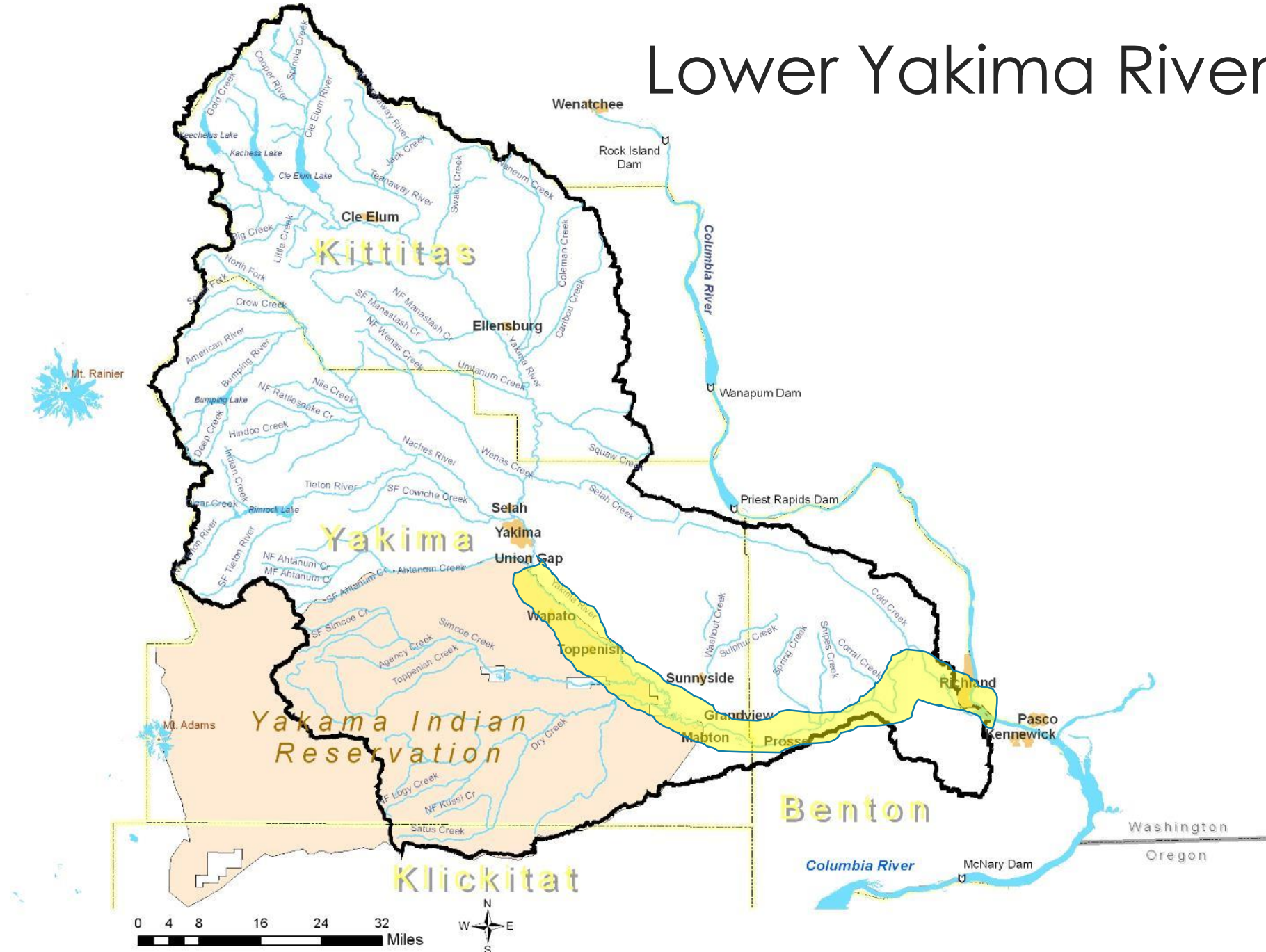
Rebecca Wassell, Mid-Columbia Fisheries

Yakima River Science & Management Conference

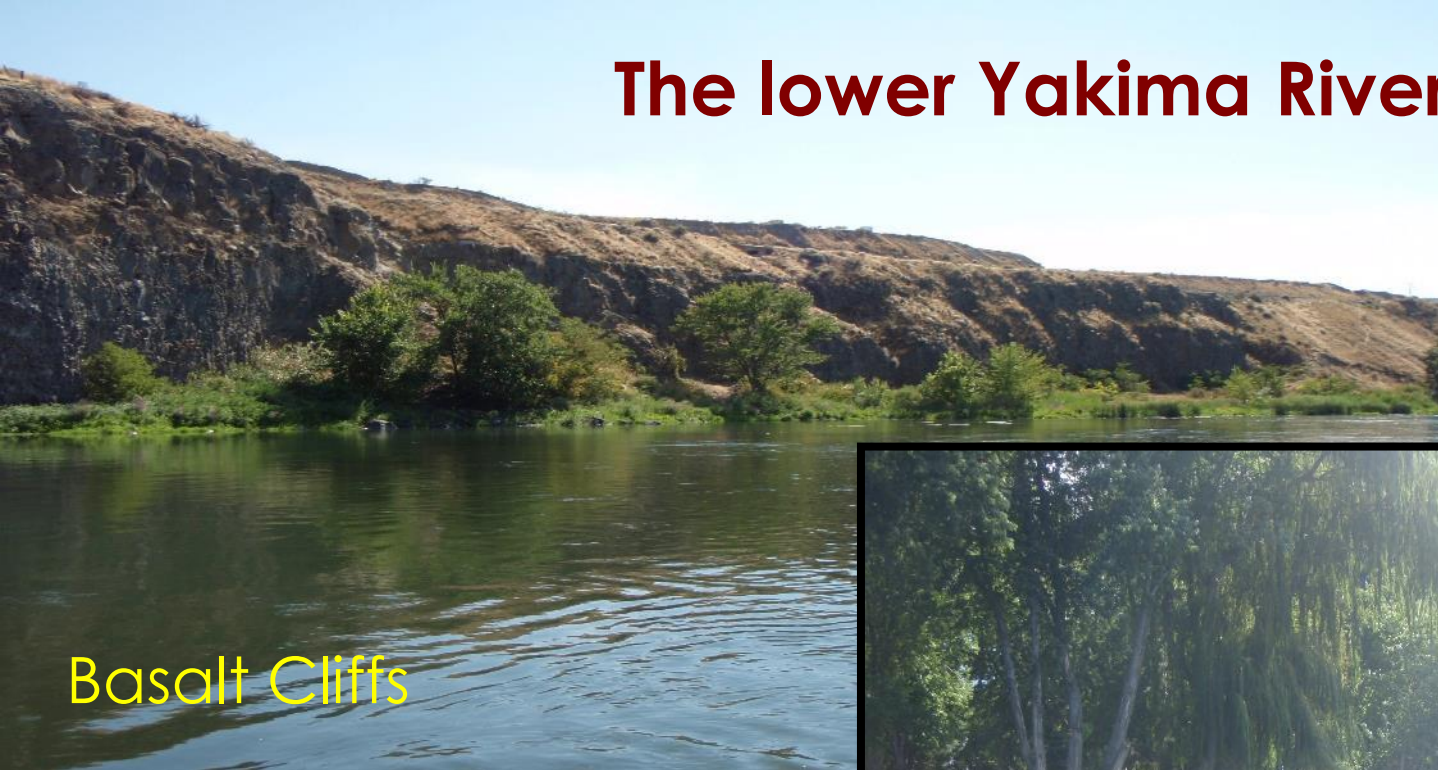
June 14, 2018



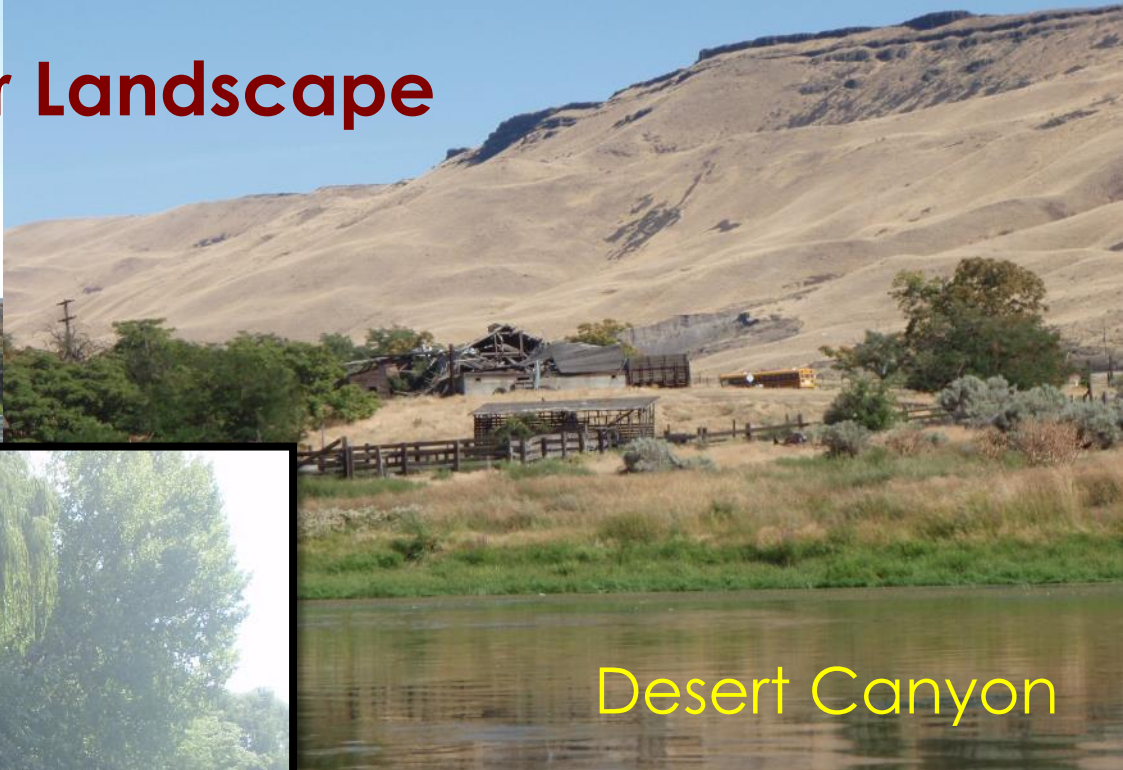
Lower Yakima River



The lower Yakima River Landscape



Basalt Cliffs



Desert Canyon



Private Ownership



Alluvial Floodplains

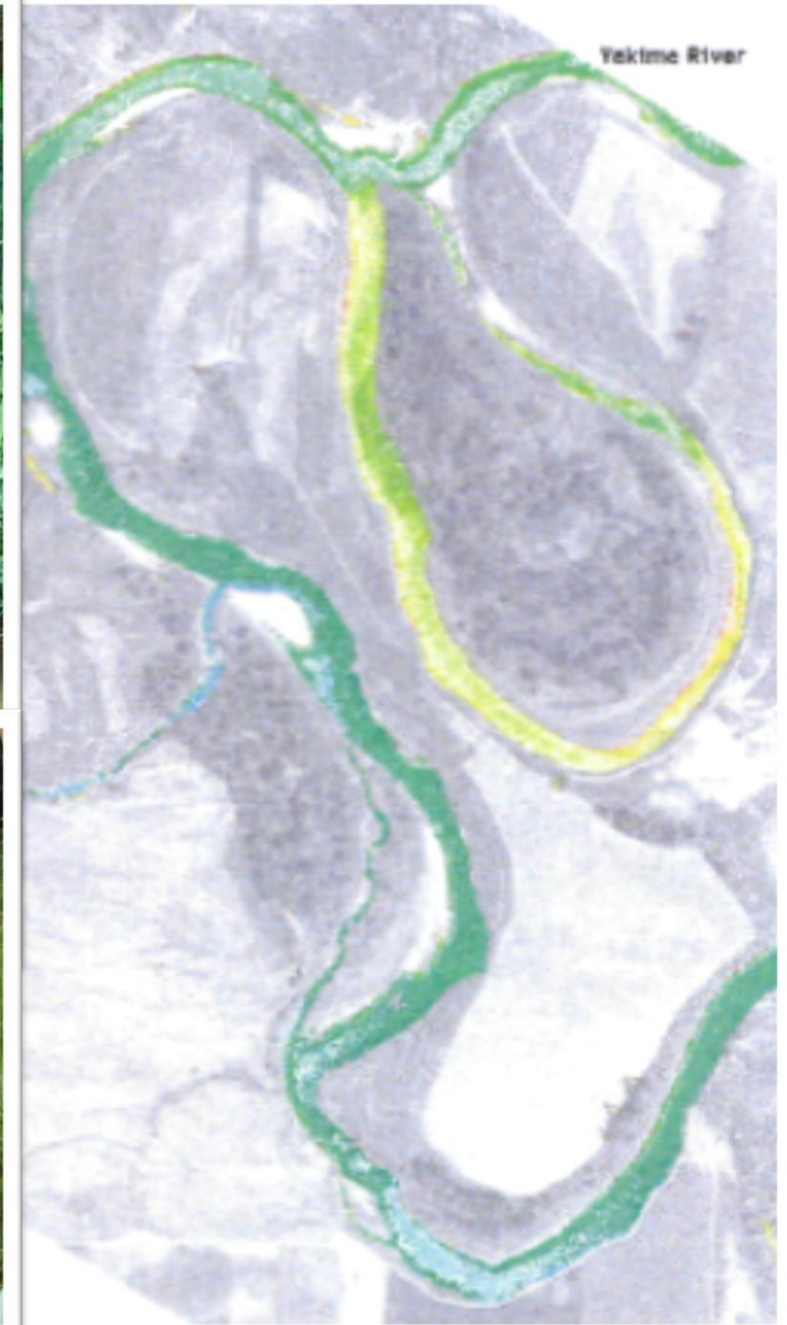


Vegetated Islands and side-channels

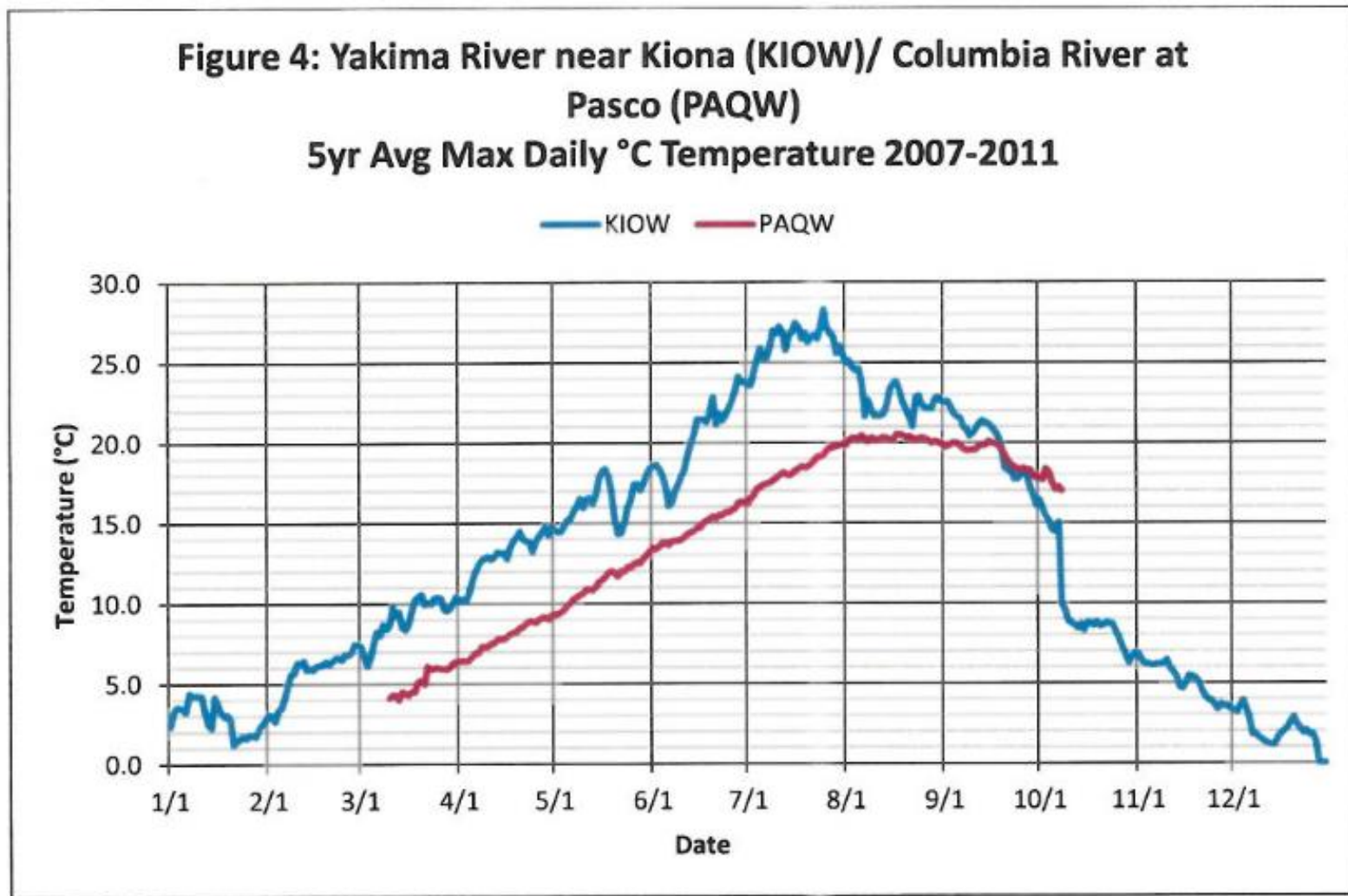
Past work:
what we know

Monitoring:
what we're learning

Projects:
what we're doing



What we know - It's hot!



- River temperatures frequently exceed WA state standard of 21°C from mid-June to Early September (Wise and others 2009)
- Temperature driven by solar radiation and ambient air temperatures (Lilga 1998)
- Summer river is wide, shallow, and slow
- Riparian shading does not mitigate summer warming

What we know – thermal variation

- “. . .thermal patchiness in streams . . . should be **recognized** for **its biological potential** to provide habitat for species existing at the **margin** of their **environmental tolerances.**”

- Torgensen et al. 1999

- “. . . **entry** and **residence** in non-natal areas can be a temporary tactic, possibly a **thermoregulatory response** to **warm water temperatures** in **main stem rivers**, with eventual departure from refuges as fish continue their migration to natal tributaries”

- Keefer and others, 2009

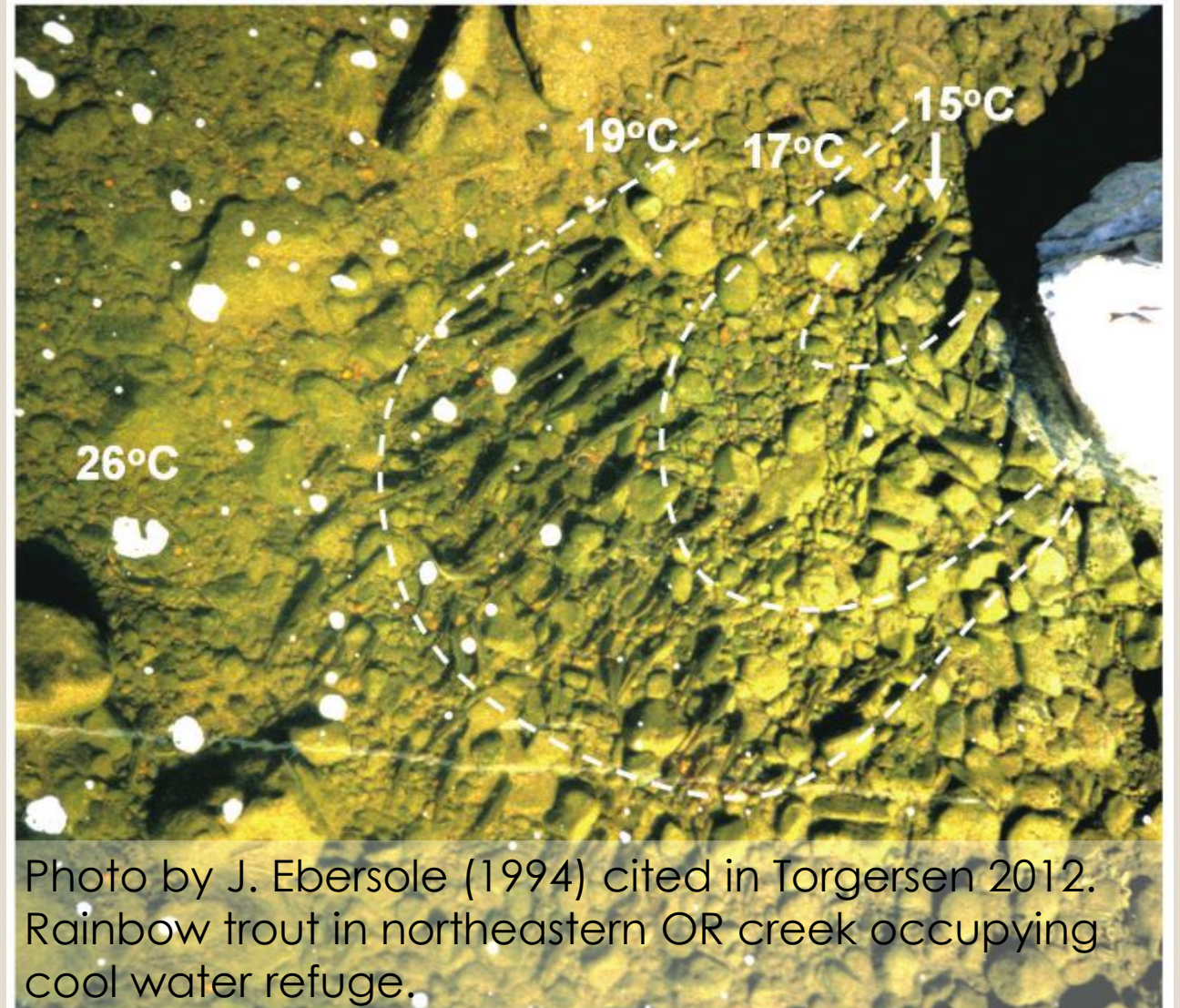


Photo by J. Ebersole (1994) cited in Torgensen 2012. Rainbow trout in northeastern OR creek occupying cool water refuge.

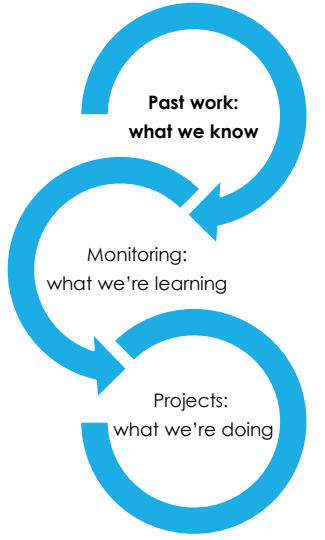
Thermal refuge, lower river-style



Box Canyon Creek, Upper Yakima



Right bank cool water below Prosser, Lower Yakima



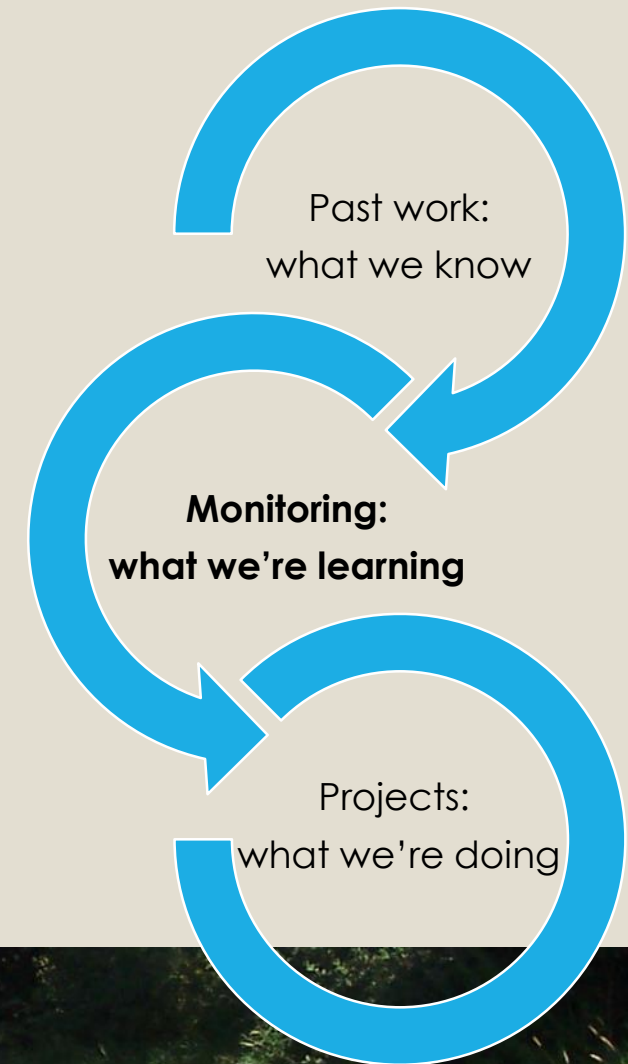
What we are learning . . .

- BOR- **FLIR data** from headwaters to mouth (Holroyd, 1998)
- USGS – **2002 thermal profile** Cle Elum to Prosser (Vaccaro, 2006 & 2011)
- Benton CD – **2008 and 2009 thermal profile** of the lower river Prosser to Mouth
- BCD & MCF - **temperature data** at the mouth of the Yakima River **2009, 2011-present**

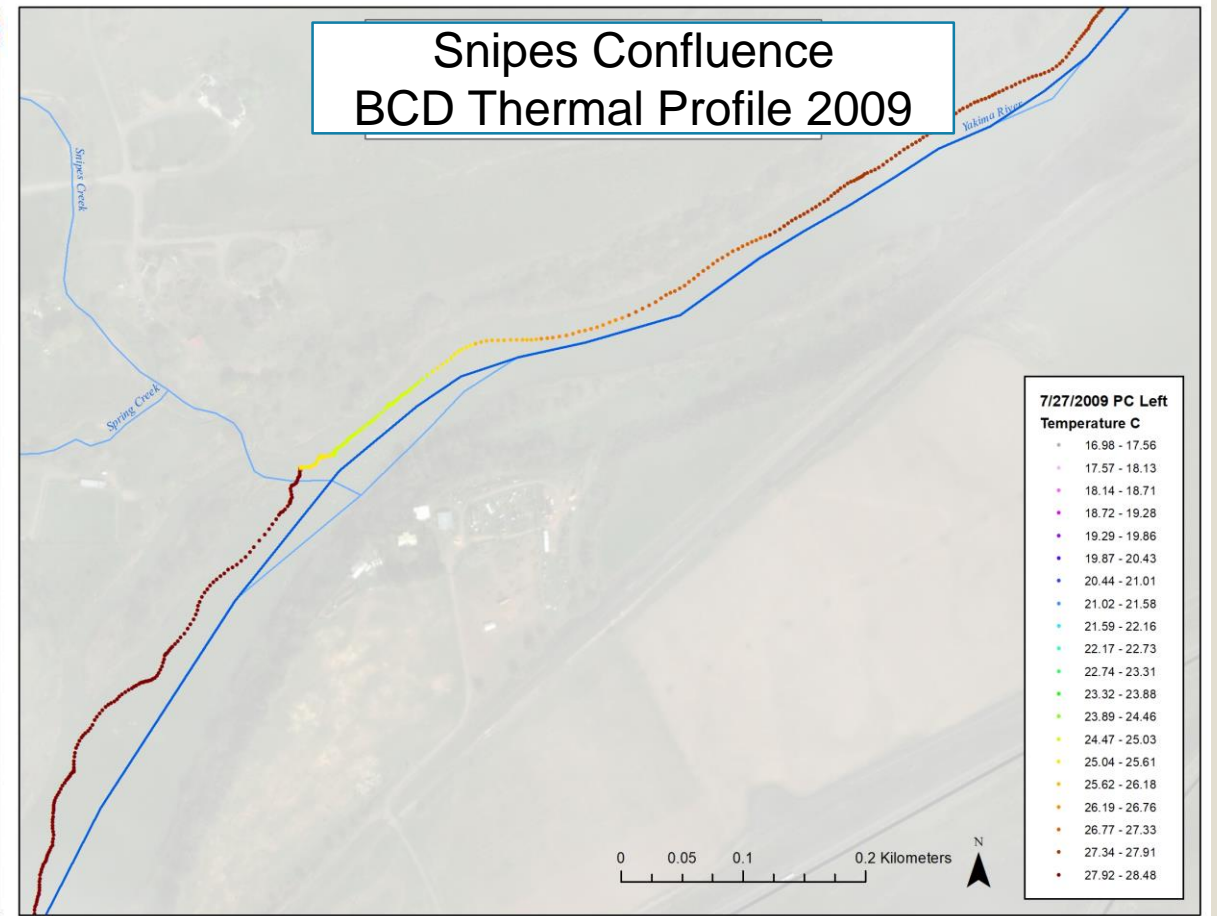
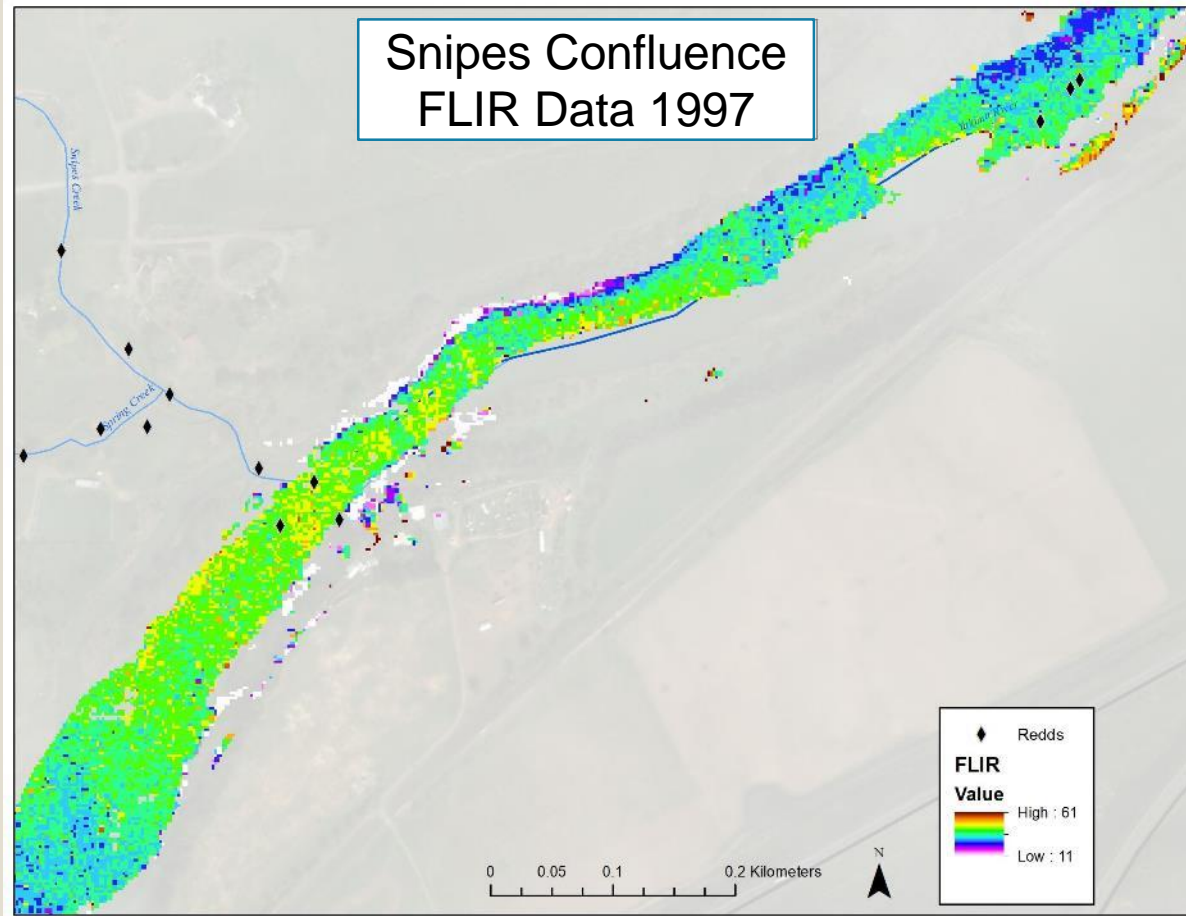


What we are learning . . .

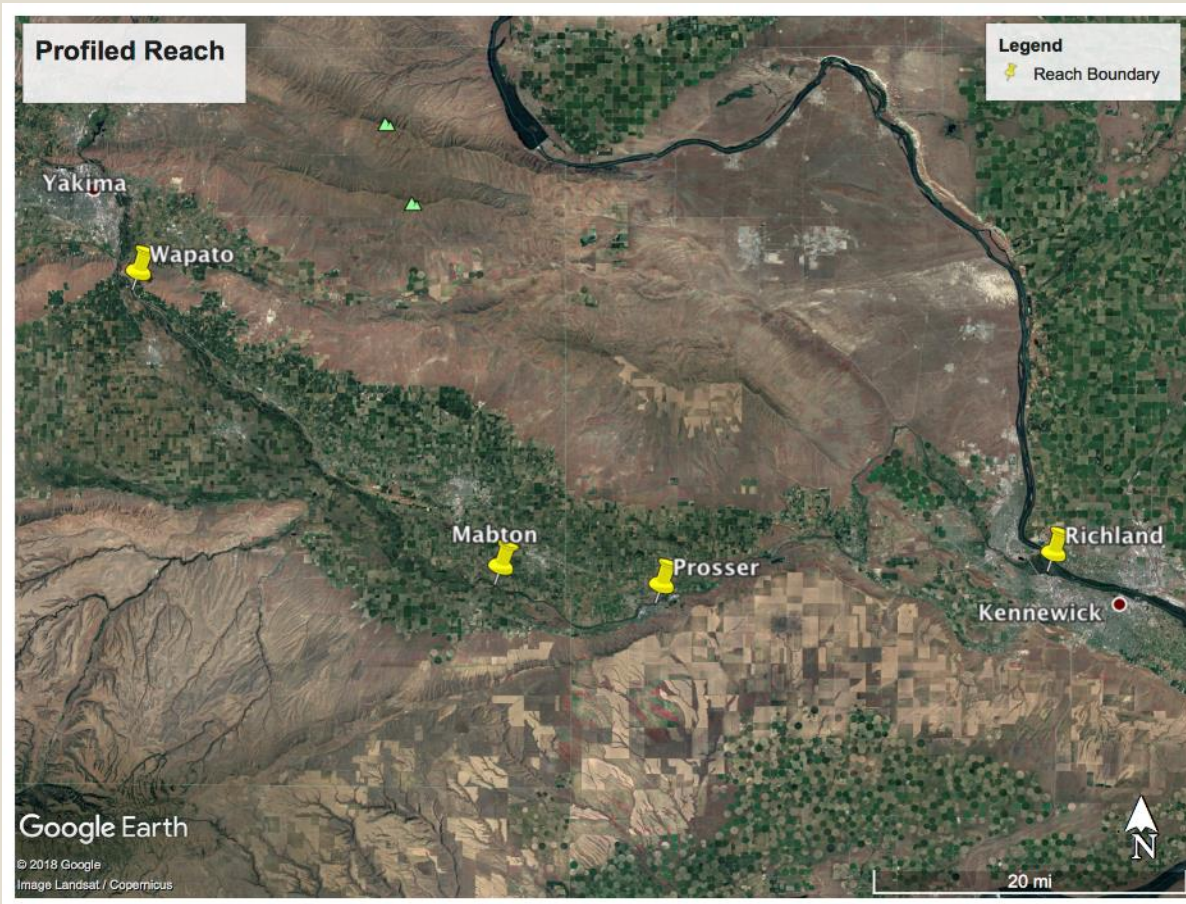
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Cool Study #1: Prelim. results of mapping exercise

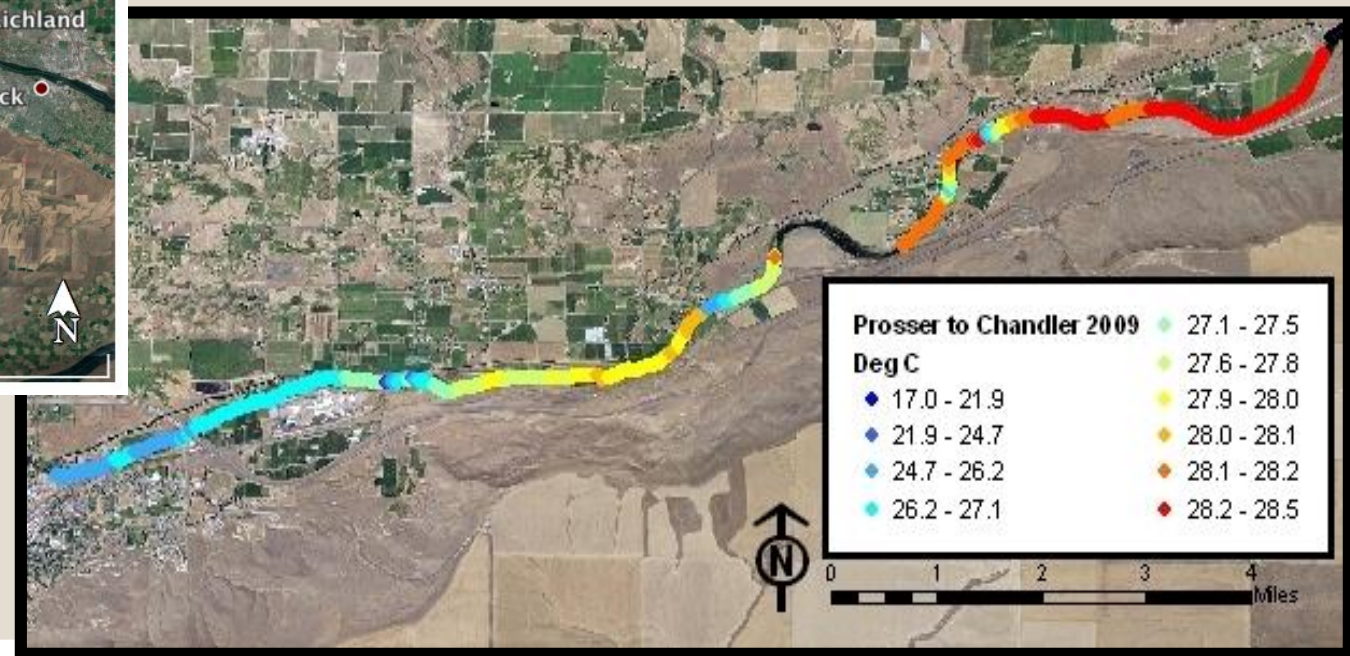


Cool Study #2: Thermal Profiling Lower River



- BCD, YN, and USGS: Measure thermal heterogeneity using 3 boat method (left, center, right) in 2018 and 2019
- Profile ~ 100 miles from Wapato to Mabton and Prosser to Confluence
- Spatial & temporal variability at 3 -4 sites

Generate thermal profile of lower river to identify priority locations for thermal refuge projects





Cool Study #3: Macrophyte Dynamics Study



How does water stargrass (WSG) influence thermal refuge habitat?

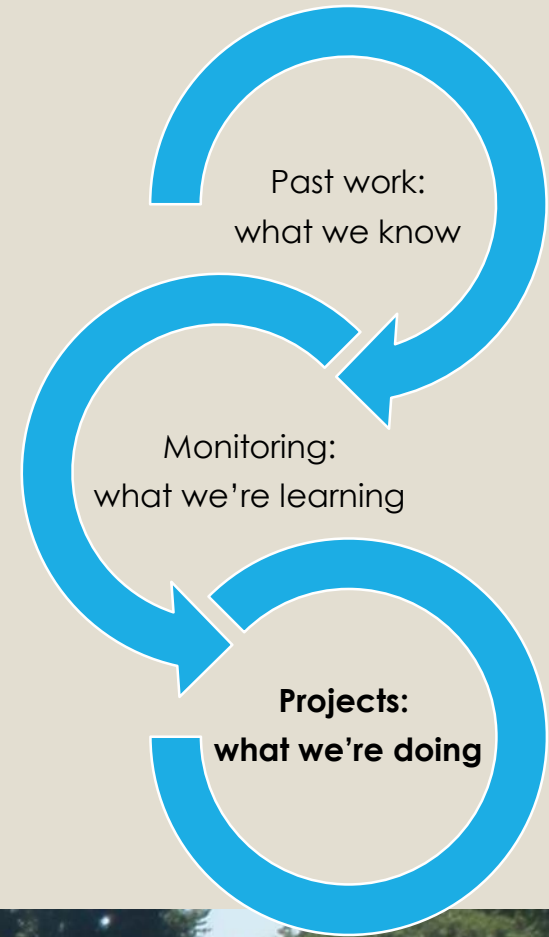
- WSG impacts temperature, DO, pH, and enhances sediment deposition and alters summer flows
- BCD and USGS to investigate relationships between WSG, water quality, nutrients and flow in lower river (2018-2020) at Prosser, Kiona, Richland
- Study temperatures in 2 thermal refuge sites impacted by WSG



What we're doing. . .

Working to implement projects that

- Improve access
- Increase influence
- Increase persistence
- Contribute to cumulative impact



Cool Project #1: Enhancing subsurface flows

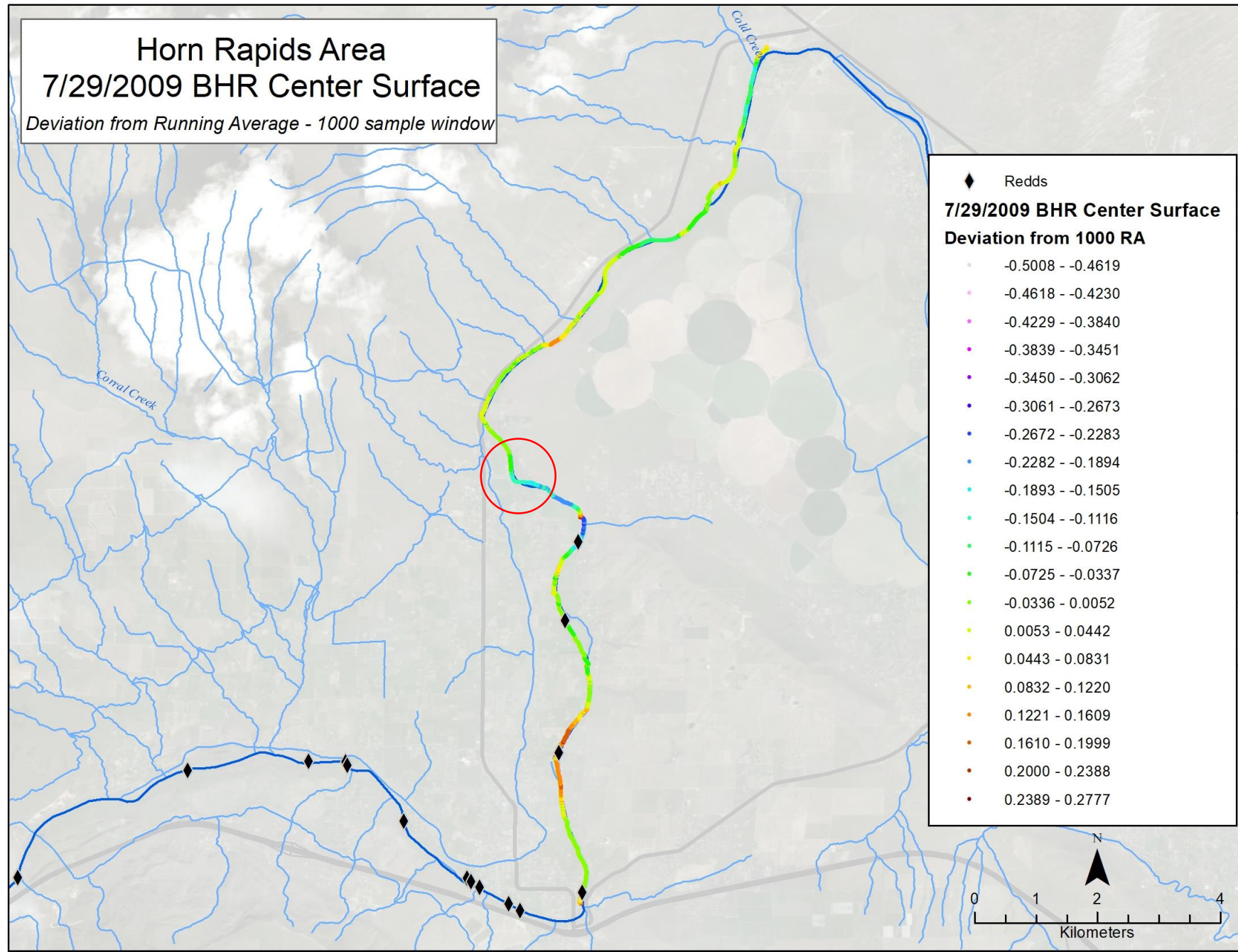
- KID irrigates site off-season 2019
- BCD and USGS measure before and after in-stream temperature returns
- Site Criteria:
 - Down slope of Main Canal
 - Large flat areas
 - Row crops/hay/grass areas
 - Near areas of known existing thermal refuge
 - Near KID headworks
 - Stable geology



Cool Project #2: Opening Thermal Refuge



Horn Rapids Area
7/29/2009 BHR Center Surface
Deviation from Running Average - 1000 sample window

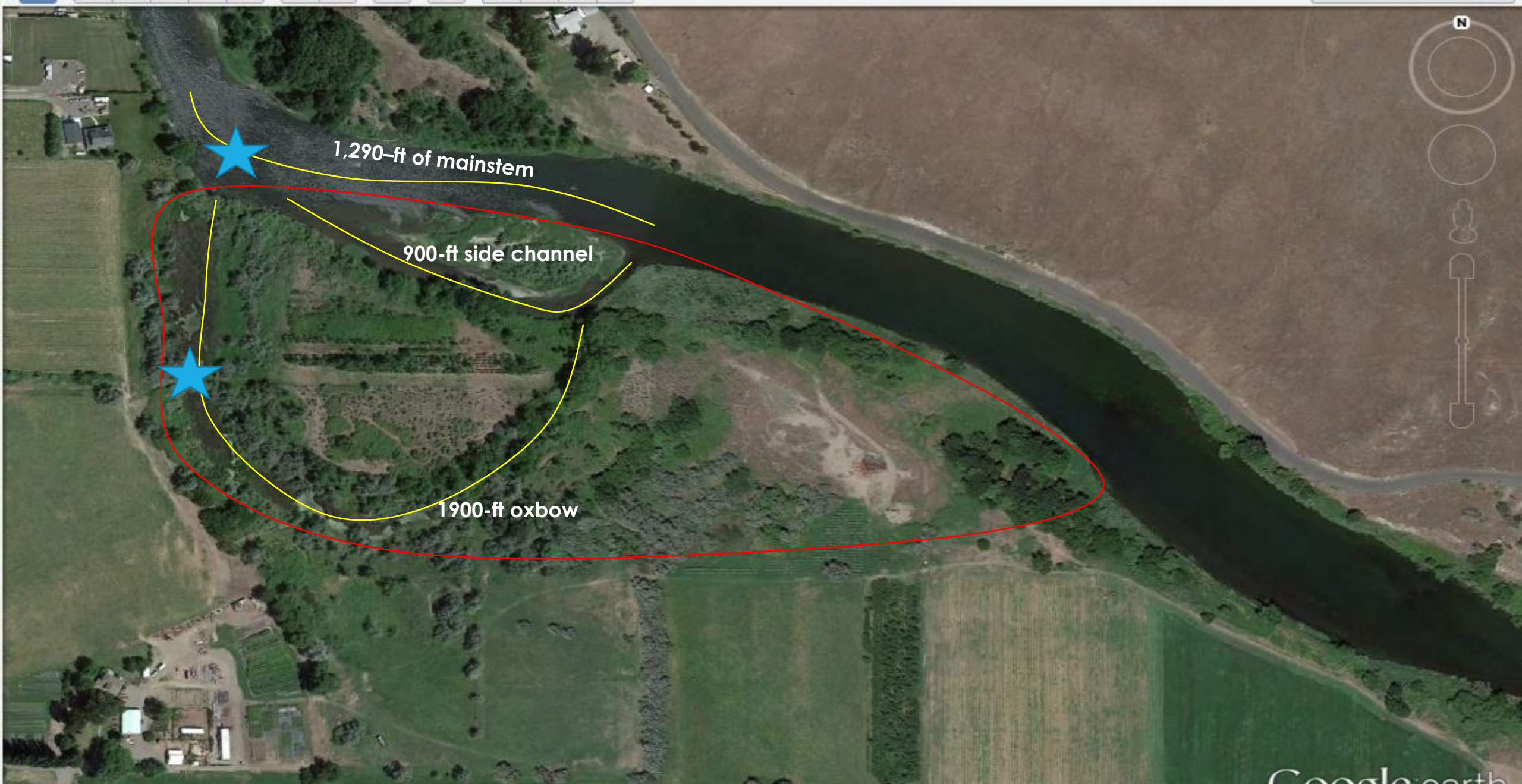


◆ Redds

7/29/2009 BHR Center Surface
Deviation from 1000 RA

- 0.5008 - -0.4619
- 0.4618 - -0.4230
- 0.4229 - -0.3840
- 0.3839 - -0.3451
- 0.3450 - -0.3062
- 0.3061 - -0.2673
- 0.2672 - -0.2283
- 0.2282 - -0.1894
- 0.1893 - -0.1505
- 0.1504 - -0.1116
- 0.1115 - -0.0726
- 0.0725 - -0.0337
- 0.0336 - 0.0052
- 0.0053 - 0.0442
- 0.0443 - 0.0831
- 0.0832 - 0.1220
- 0.1221 - 0.1609
- 0.1610 - 0.1999
- 0.2000 - 0.2388
- 0.2389 - 0.2777

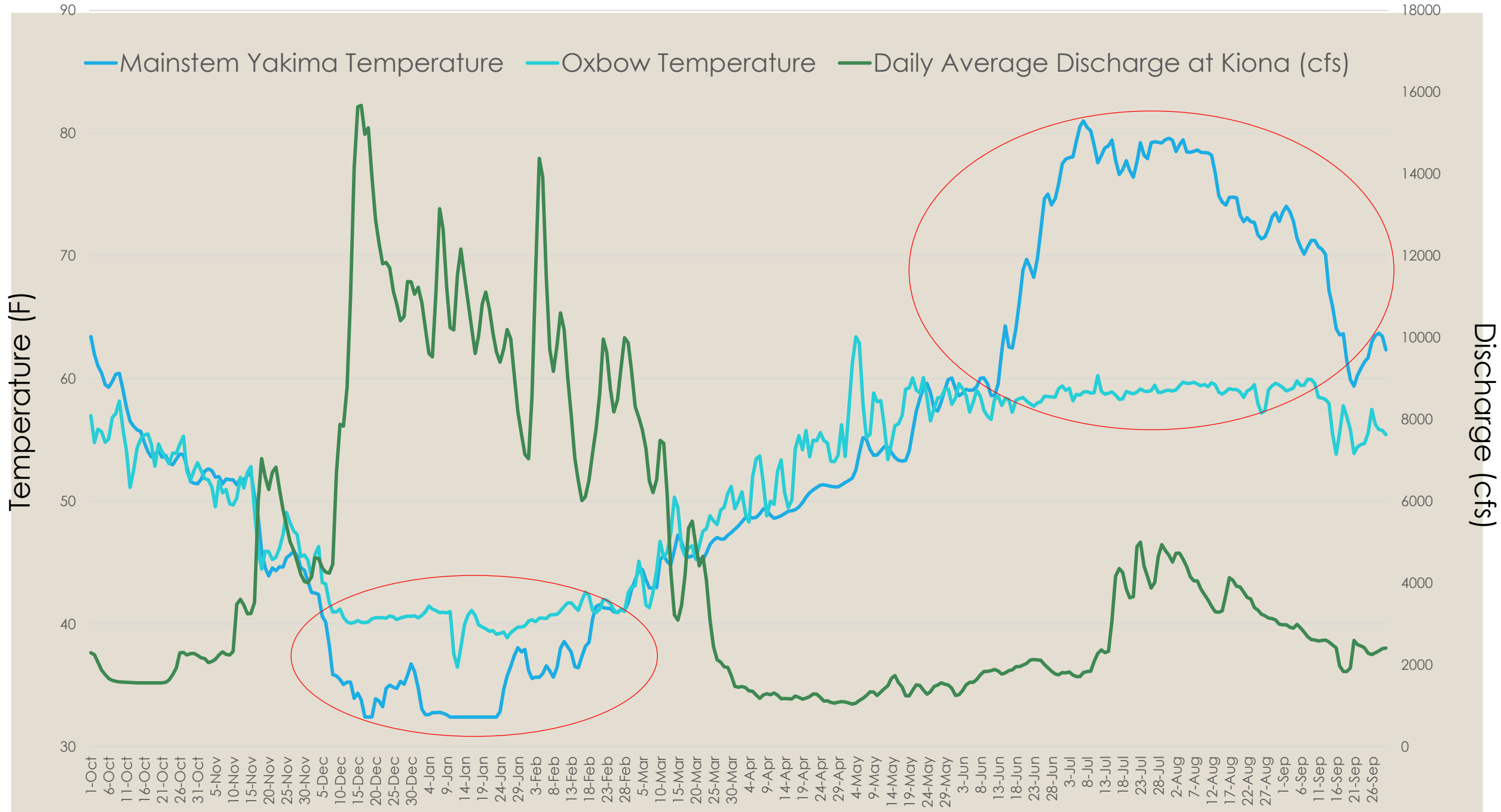


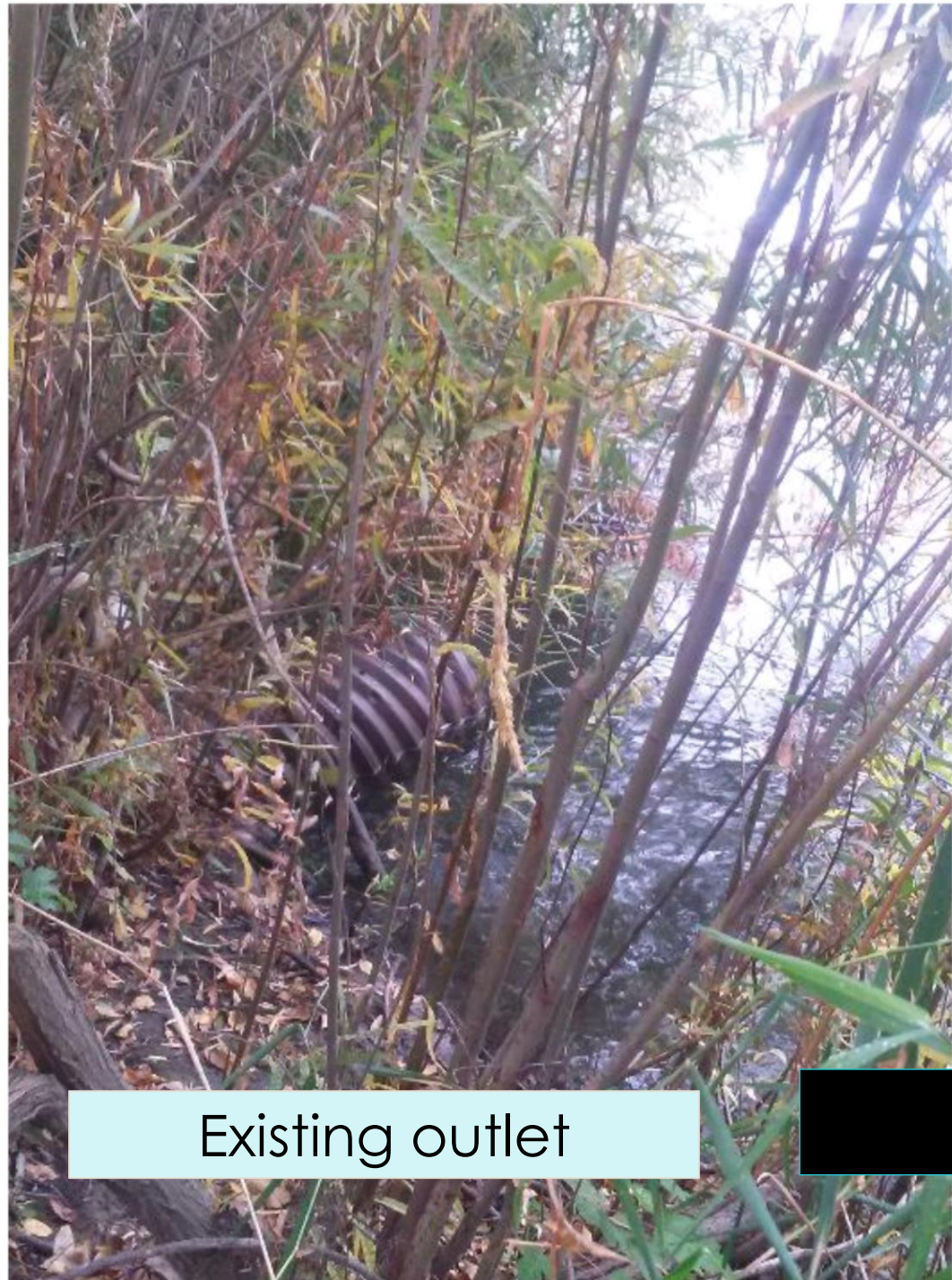


1,290-ft of mainstem

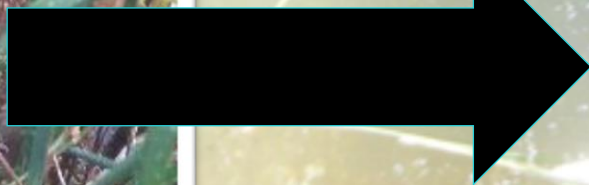
900-ft side channel

1900-ft oxbow





Existing outlet



Proposed outlet

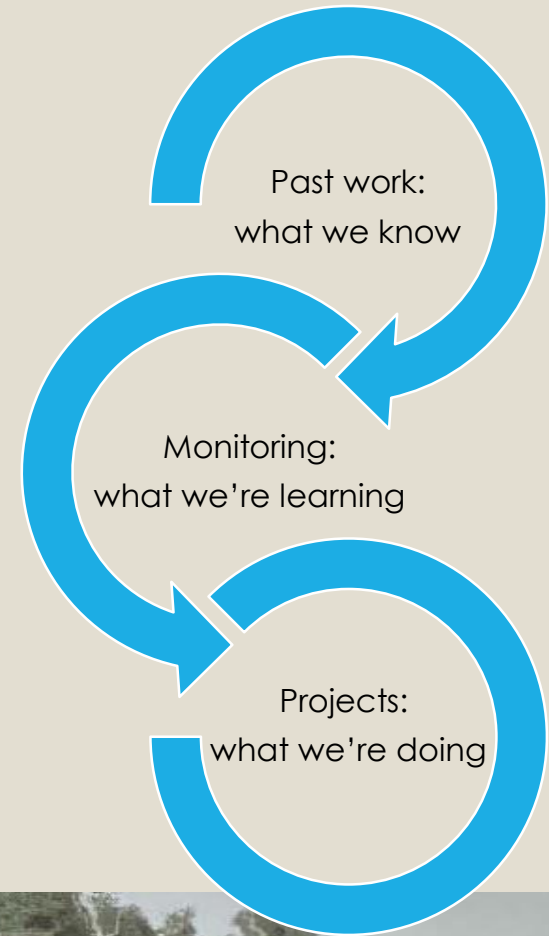


Enhancement :
how do we
know it when
we see it?

- Improves access
- Increases influence
- Increases persistence
- Contributes to cumulative impact

Funding – thanks!

- Washington Department of Ecology, 319 and Centennial
- US Geological Survey
- Yakima Basin Integrated Plan
- Kennewick Irrigation District
- Yakama Nation
- Salmon Recovery Funding Board



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