Effectiveness Monitoring to Inform Willamette River Restoration Programs

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U.S. Geological Survey

Willamette River Restoration Programs

Willamette River Anchor Habitat Investments Program

Willamette Focused Investment Partnership (WFIP)

- Time frame: 2016-2021
- Funding: ~$14.4 million from OWEB, BPA, MMT
- Goals: Sustain and enhance seasonally important resources for native fish

Willamette Special Investment Partnership (WSIP)

- Time frame: 2008-2015
- Funding: ~$8.8 million OWEB, BPA, MMT
- Goals: Expand floodplain forest, re-establish channel complexity and re-connect floodplains

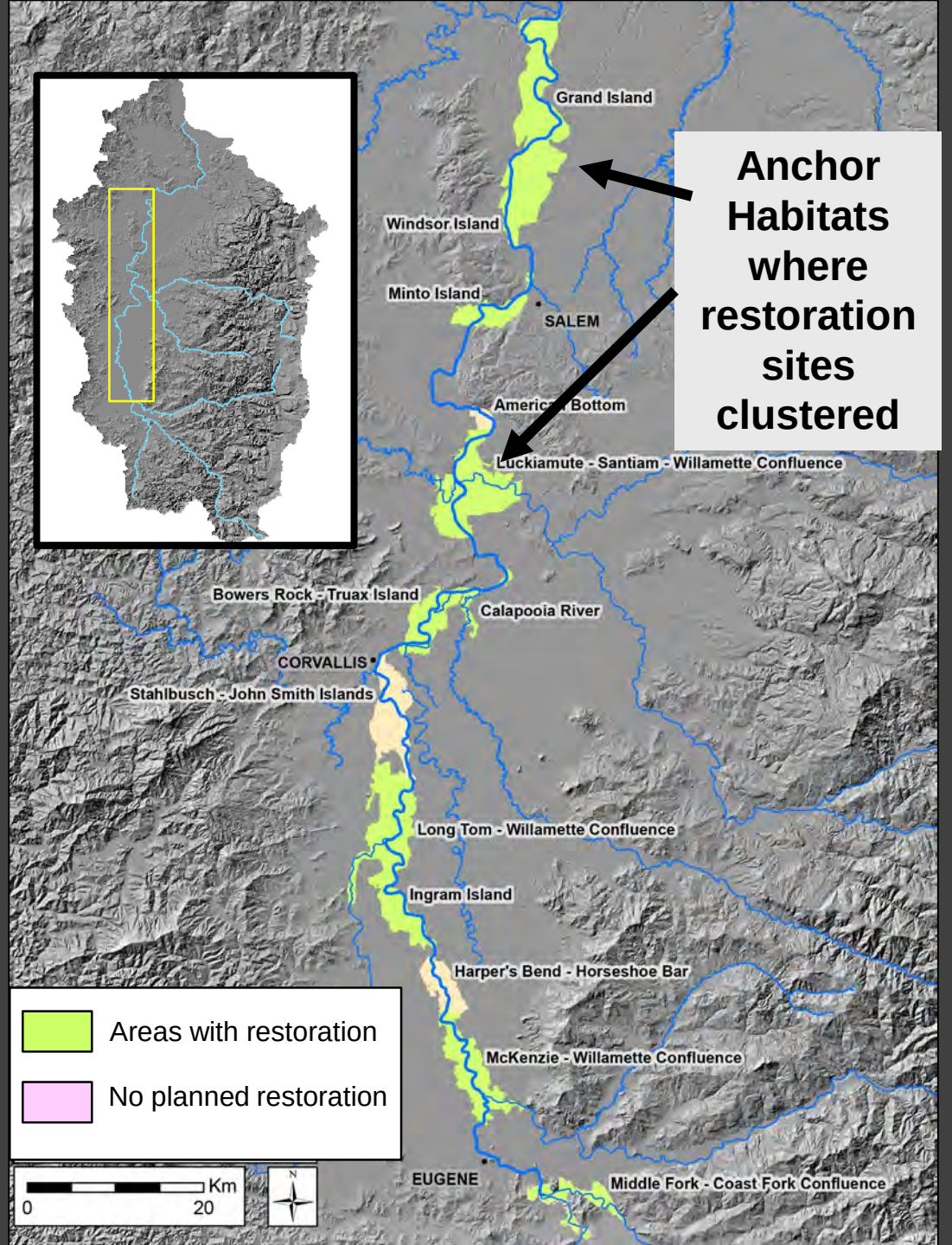
USGS

Source: AHWG, (2015); HTT, MMT, OWEB (2016)

Study Area: Willamette River Anchor Habitats

Individual restoration sites are located within designated Anchor Habitats.

Snag Boat Bend, USFWS restoration site near Harrisburg

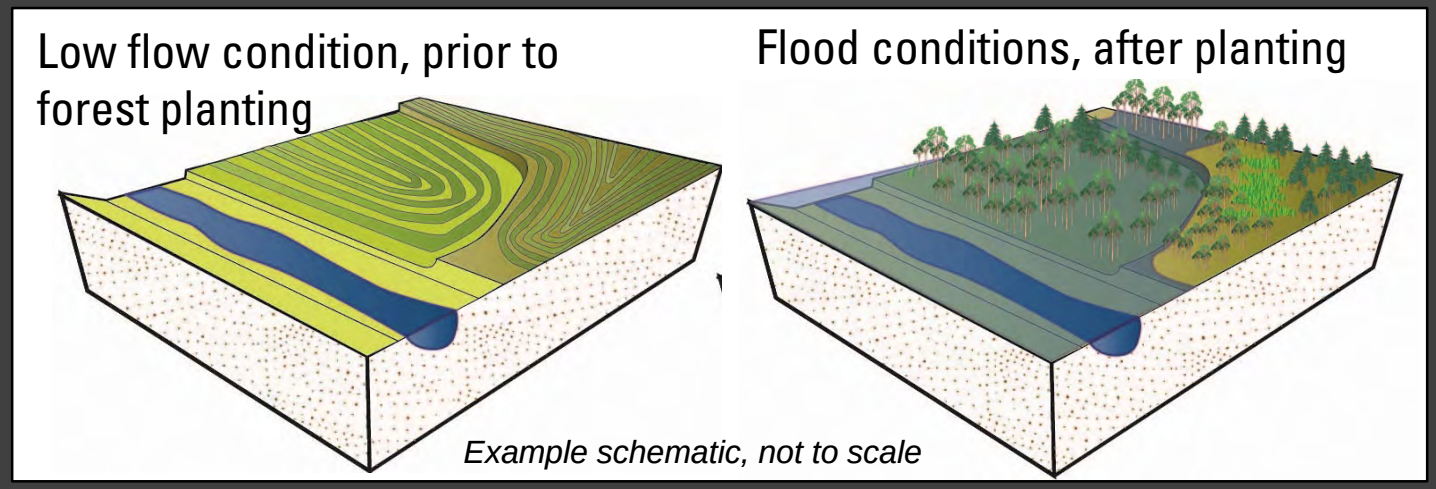


Summary of the Willamette Restoration Strategies

Restoration Strategies *(from Anchor Habitats Working Group Strategic Action Plan)*	**Common Name for Restoration Strategy**
Strategic Actions to Enhance Native Fish Habitats used in Fall-Winter-Spring	
Increase and enhance floodplain plant communities in key habitat areas	Increase floodplain forest
Modify floodplain topography to increase extent and duration of inundation	Increase floodplain inundation
Modify artificial barriers to aid fish passage and increase extent and duration of floodplain inundation	Modify barriers
Enhance former gravel pits by re-connecting shallow pits, re-grading pond boundaries and filling ponds	Enhance gravel pits
Strategic Actions to Enhance Native Fish Habitats used in Summer-Fall	
Control invasive aquatic weeds	Treat aquatic weeds
Remove revetments and levees in reaches likely to experience channel changes	Remove revetments
Plant riparian vegetation along side channels	Increase streamside vegetation
Construct lateral channels in areas with hyporheic flow	Construct lateral channels

Source: AHWG (2015); OWEB (2019)

Restoration Strategies:
Expand and enhance floodplain forest



Restoration goals include:

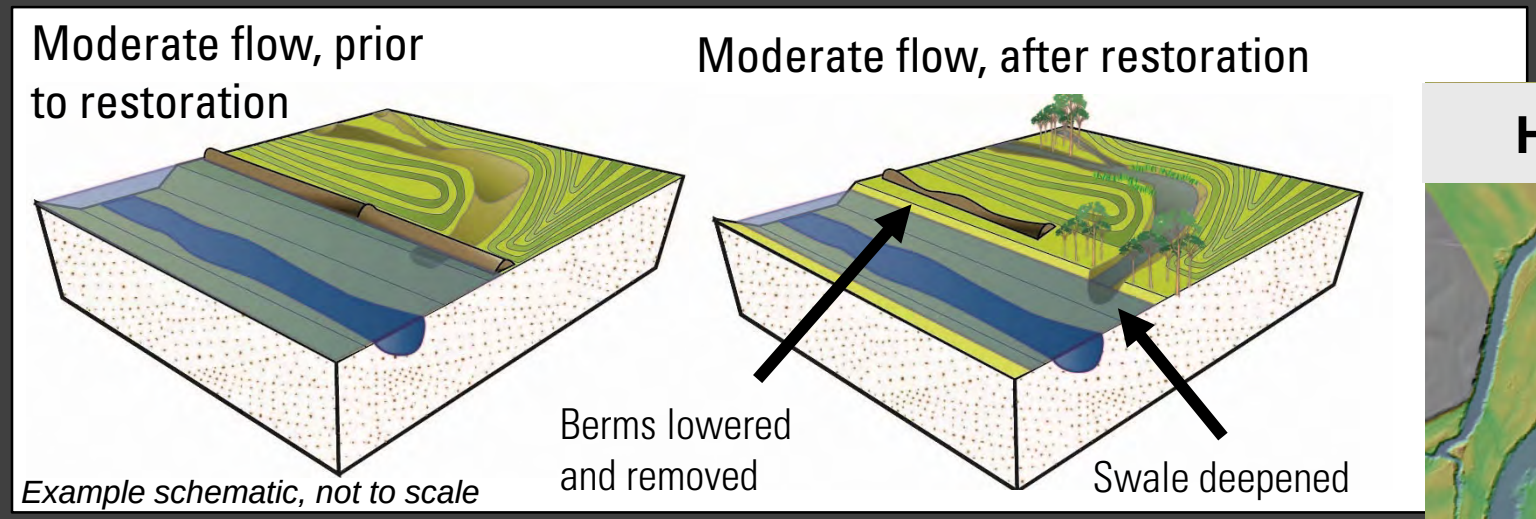
- Increase extent and quality of floodplain forests
- Increase habitat complexity, food resources
- Increase shade along wetted features
- Broader ecosystem benefits

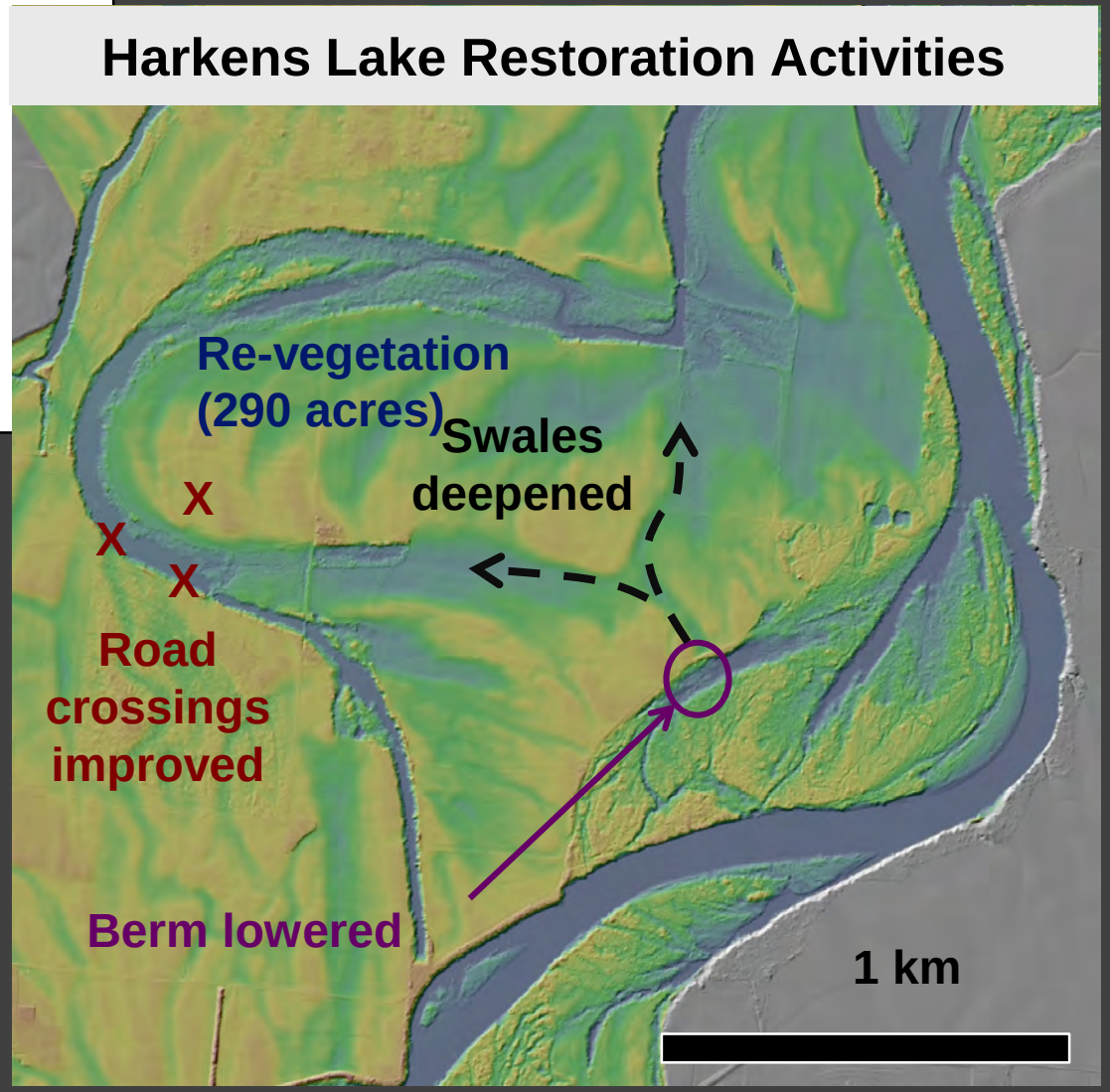
USGS

Source for restoration goals: AHWG, 2015

Harkens Lake Restoration site, April 2019
Courtesy River Design Group and Matt Blakeley Smith

Restoration Strategies:
Increase inundation by modifying topography and barriers





Restoration goals include:

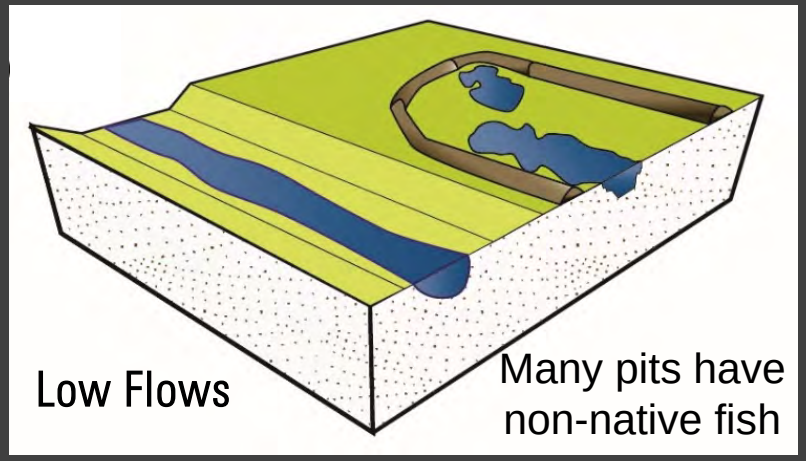
- Increase frequency, spatial extent and duration of inundation
- Expand slow water refuges for native fish
- Provide fish access to food-rich floodplains
- Increase exchange of flow, organisms, nutrients between river and floodplain

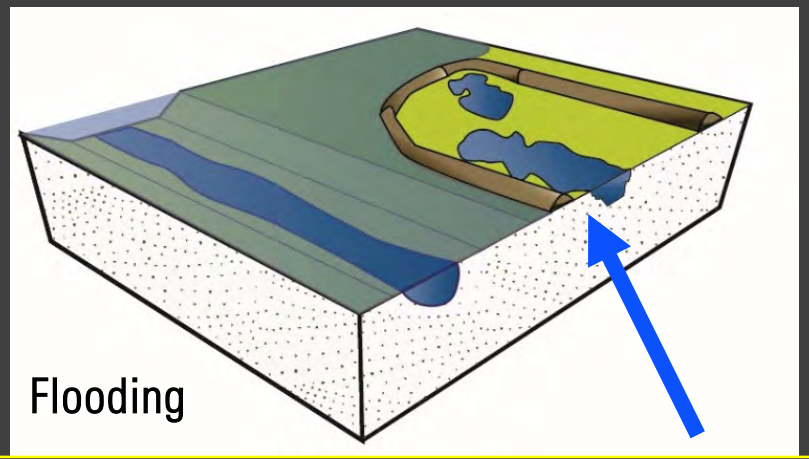
USGS

Source for restoration goals: AHWG, 2015

Restoration Strategies: Enhance gravel pits

Prior to restoration

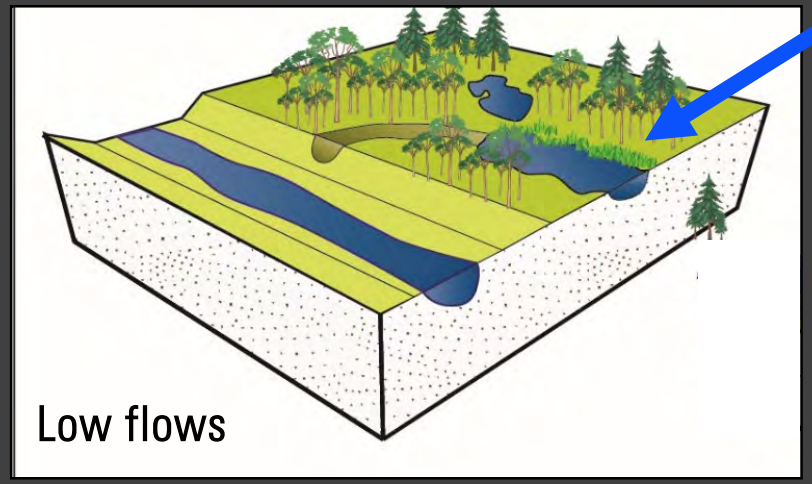


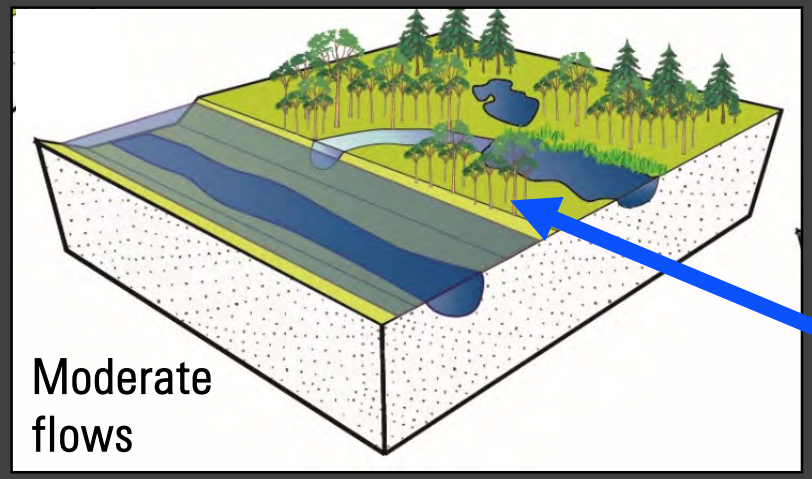


USGS

Some pits rarely flood, others flood annually.

After restoration and planting





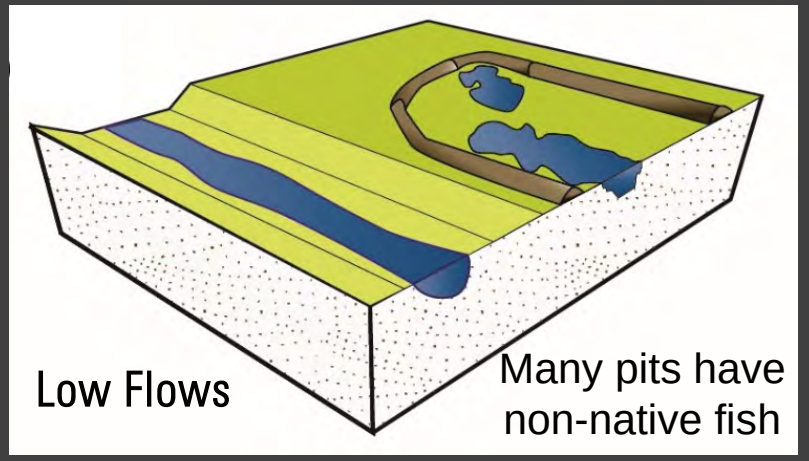
Restored ponds may be isolated from river at low flow

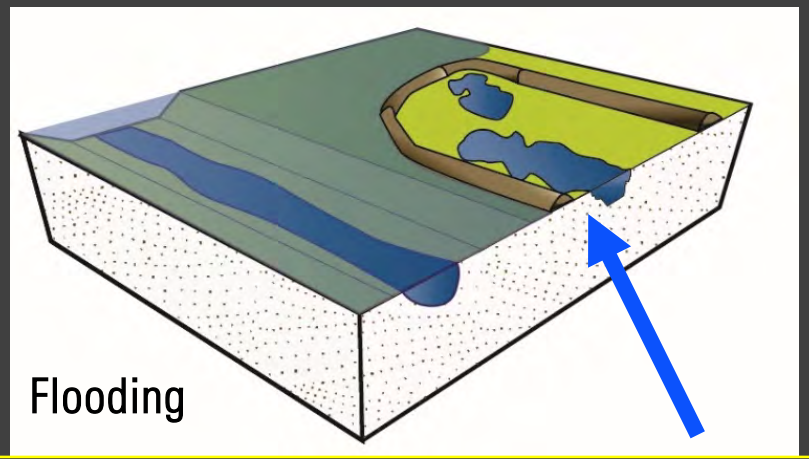
Restored ponds may connect to river at moderate flows

Schematics for illustration purposes, not to scale

Restoration Strategies: Enhance gravel pits

Prior to restoration





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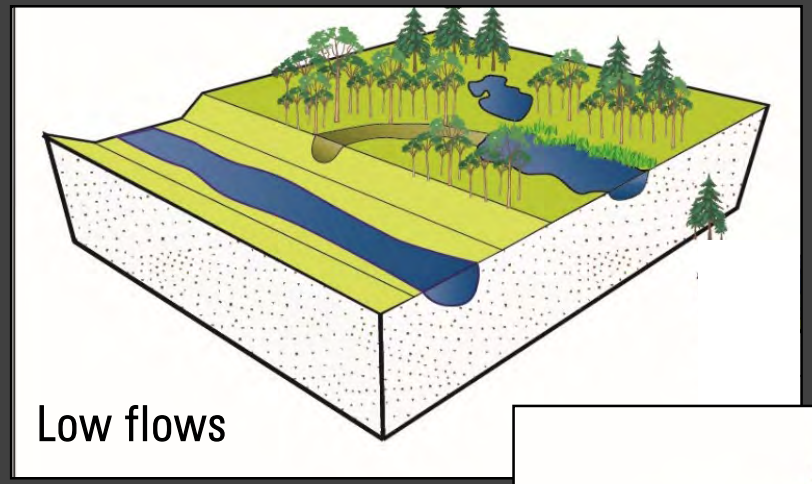
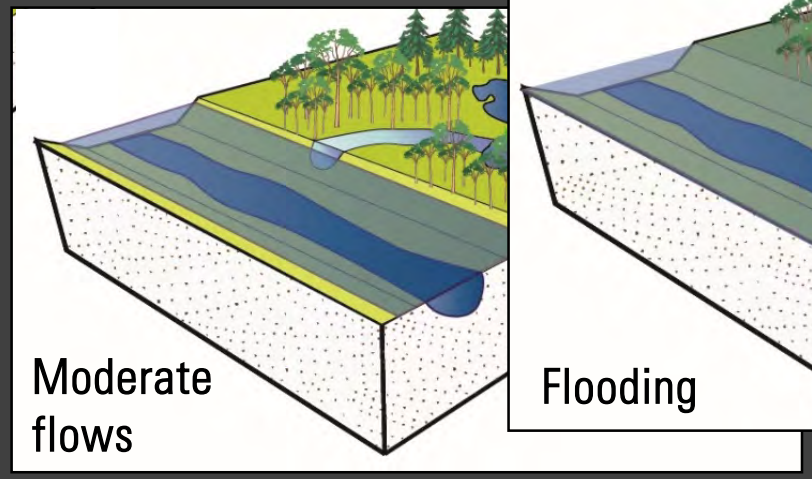
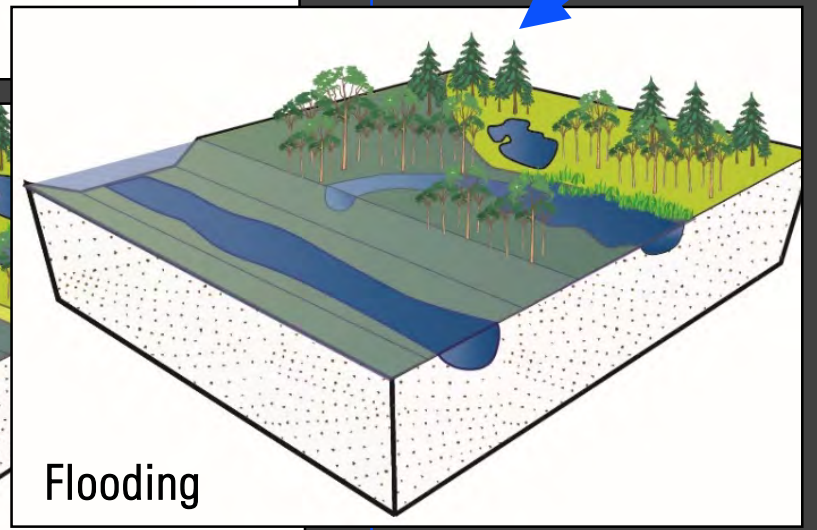






Some restored ponds may rarely connect to river even during floods

Schematics for illustration purposes, not to scale

Gravel Pond Restoration in the Willamette Valley

Restoration goals include:

- Increase winter rearing habitat for juvenile spring Chinook
- Improve egress after flooding
- Create high flow refuges for resident native fish
- Provide benefits to other species

Gravel pond restoration projects completed or underway

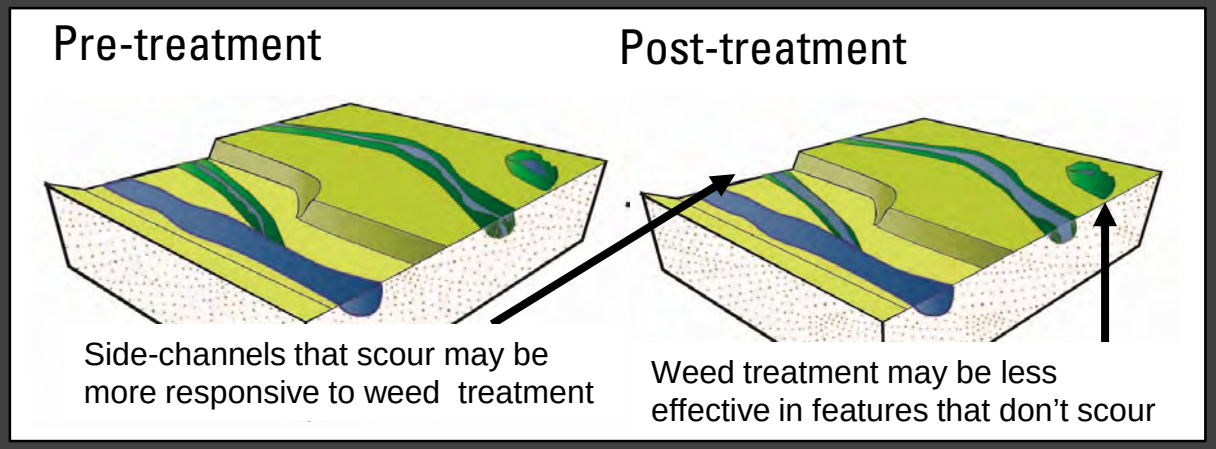
Willamette Confluence Preserve, Delta Ponds, CARP, Bower's Rock
(more than 20 restored gravel ponds since 2012)

USGS

Source for restoration goals: AHWG, 2015

Lower Middle Fork Pond Complex at TNC's Confluence Preserve

Restoration Strategies: Treat aquatic weeds



Restoration goals include:

- Increase open water habitat
- Improve water quality in summer
- Minimize long-term losses in winter inundation
- Benefits for other floodplain species

USGS

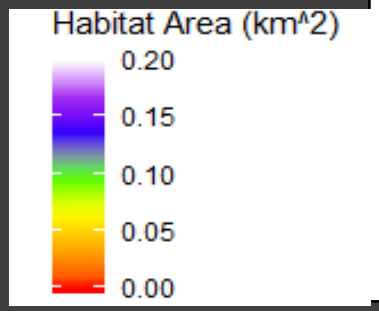
Aquatic herbicide application used in Ludwigia treatment, photo by Crystal Durbecq, BSWCD

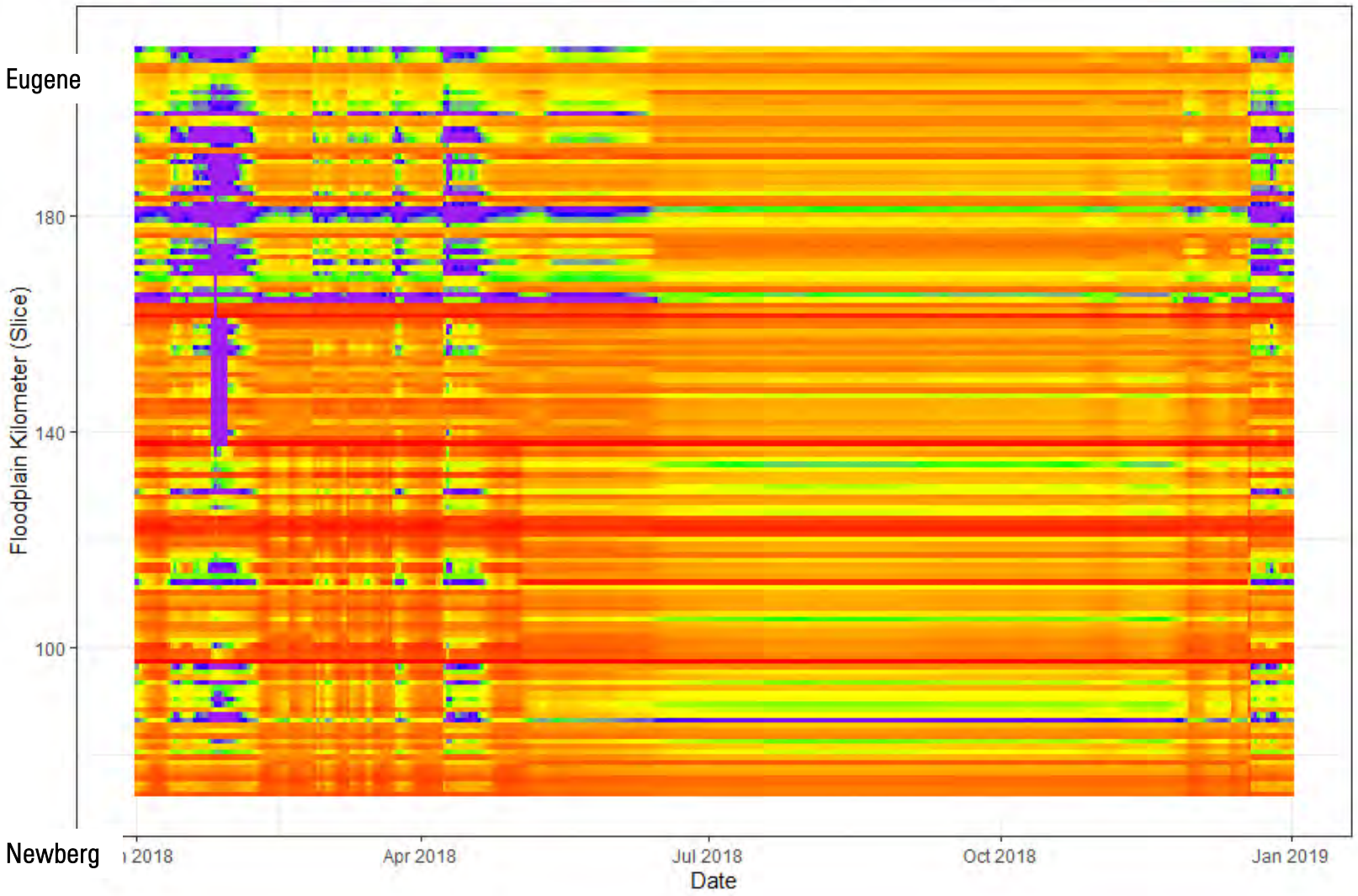
Source for Restoration goals: AHWG, 2015

USACE-funded Research Could Inform Restoration

Major restoration and research progress prompts questions:

- *What have we learned from 12+ years of restoration?*
- *Which restoration actions are most effective?*
- *How could restoration best address seasonal and spatial habitat limitations?*
- *What are realistic goals for restoration programs?*
- *How can we leverage USACE-funded research to inform restoration?*





Modeled Willamette River juvenile spring Chinook rearing habitat: 2018

Provisional results by J. White (USGS)

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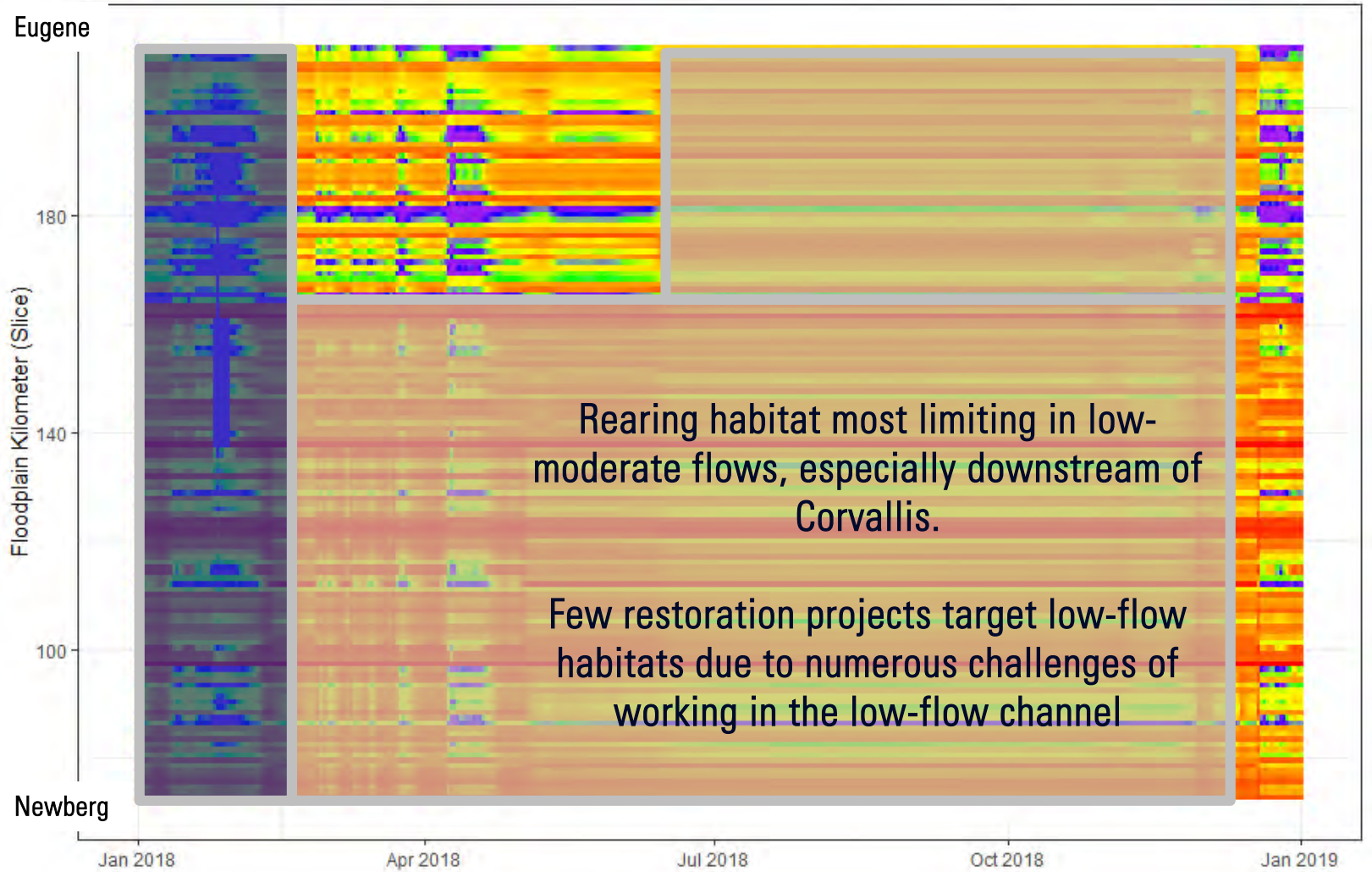
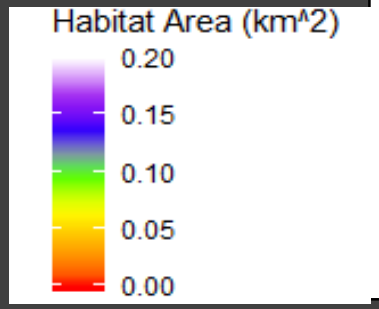
Many of the restoration projects target high-flow periods, when rearing habitat more abundant





Modeled Willamette River juvenile spring Chinook rearing habitat: 2018

Provisional results by J. White (USGS)

USGS

Willamette River Effectiveness Monitoring Program

Goal: Provide applicable, robust science to support adaptive refinement of restoration program goals and strategic actions

Objectives:

- Evaluate effectiveness of restoration actions at increasing fish habitat
- Evaluate uncertainties in theory of change linking restoration actions with fish habitat benefits
- Place site-level findings within broader context

Primary Activities:

- Synthesize existing data to describe ‘State of Science’
- Targeted data collection on restoration actions with greatest uncertainty

USGS

Photograph courtesy of Freshwaters Illustrated

Summary of Program Phases and Next Steps

Phase 1: Develop Monitoring Framework report *Status: draft early 2020*

Phase 2: Monitor hydrogeomorphic, vegetation responses to restoration actions 2019-2020 *Status: underway*

Phase 3: Synthesize 'State of the Science' for interactions between invasive aquatic plants, fish habitat and fish communities *Status: initiate spring 2020*

Phase 4: Synthesize 'State of Science' for gravel pits; monitor hydrogeomorphic and vegetation responses 2020-2021

Status: initiate spring 2020

Phase 5: Summarize all findings in peer-reviewed reports

Status: future phase

USGS

Phase 2 and Phase 4:

Hydrogeomorphic and Vegetation Data Collection in 2019-2022

Monitoring and Syntheses will target five restoration actions:

- Floodplain Forest Expansion
- Gravel Pit Enhancements
- Topographic Modifications that Increase Inundation
- Revetment Modifications
- Aquatic Weed Treatments

PI's: Wallick, Keith, Kock, Hansen

USGS

USGS buoy with nested temperature loggers at TNC's Confluence Preserve

Approach to Evaluating Fisheries Benefits of Floodplain Forest Expansion

1) Synthesize ‘State of Science’ and develop metrics

Literature review to summarize importance of floodplain forests for juvenile Chinook salmon and inform metric selection

2) Data collection to assess knowledge gaps

Monitoring indicators:

- Canopy cover
- Inundation frequency
- Avian community index

Inundation 30,000 cfs
Provisional modeling by James White, USGS

Change in canopy cover, Harkens Lake. Google Earth image.

USGS

Approach to Evaluating Gravel Pond Enhancements

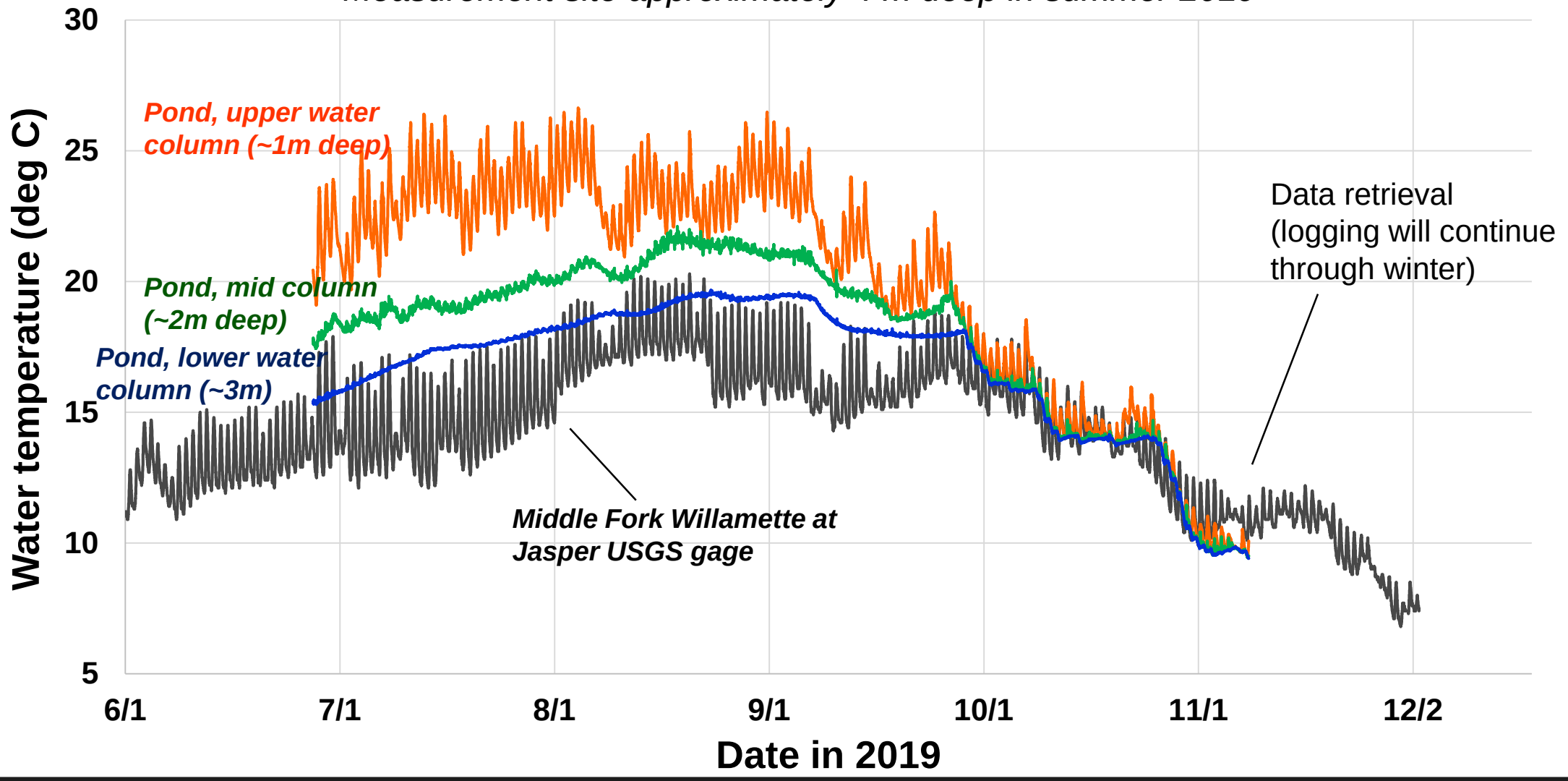
1) Synthesize ‘State of Science’ on gravel pit restoration in Willamette Valley by reviewing existing fisheries and habitat information *(PI’s: Kock, Hansen)*

2) Streamlined new data collection to assess knowledge gaps

The Nature Conservancy’s Confluence Preserve, near Middle Fork and Coast Fork Willamette River, Google Earth Image

Mile Long Pond near Middle Fork Willamette

Measurement site approximately 4 m deep in summer 2019

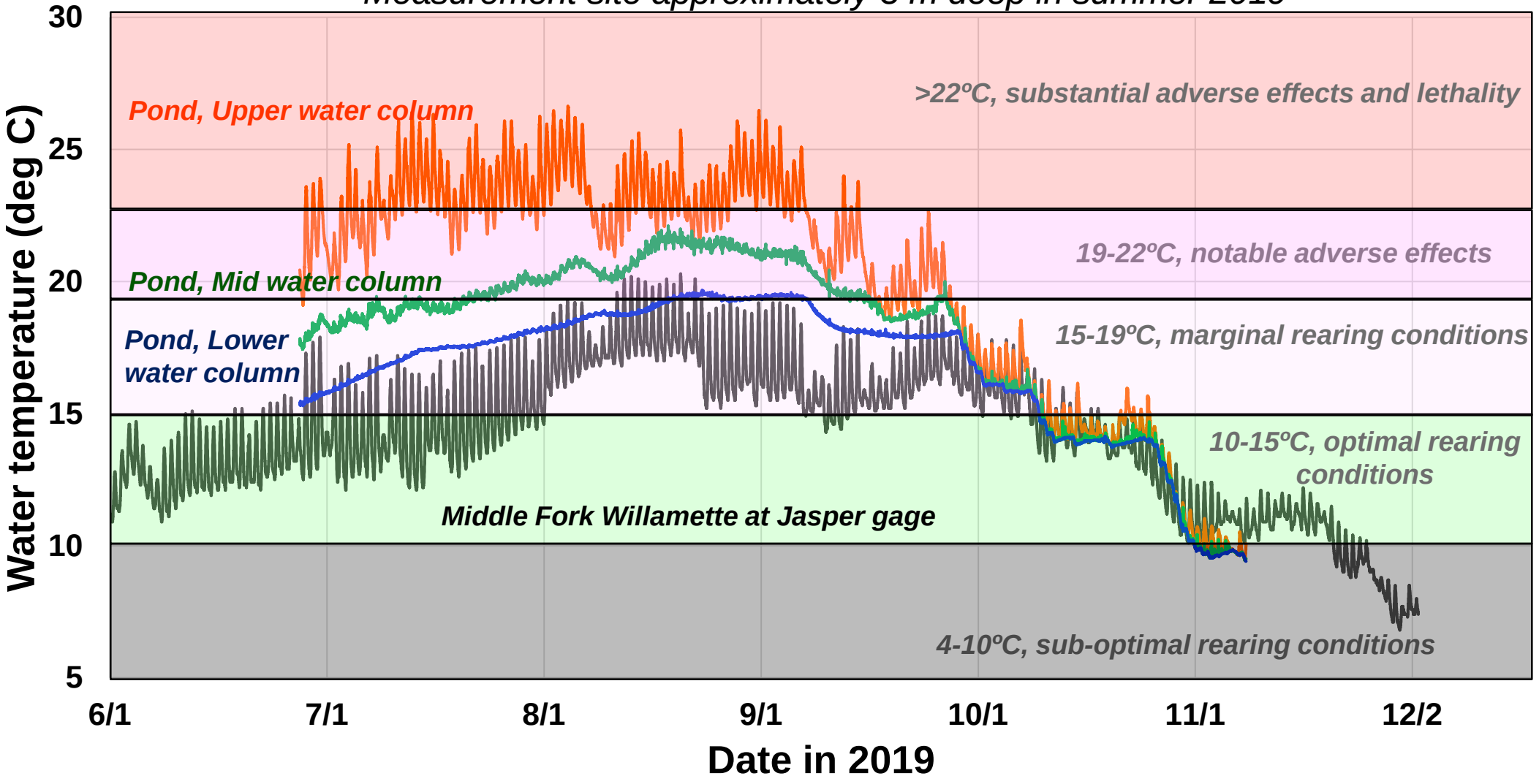


USGS

Provisional pond temperature data, subject to revision;
Jasper temperature data available at: https://waterdata.usgs.gov/or/nwis/

Mile Long Pond near Middle Fork Willamette

Measurement site approximately 3 m deep in summer 2019



USGS

Provisional pond temperature data, subject to revision; Jasper temperature data available at: https://waterdata.usgs.gov/or/nwis/;
Preliminary temperature thresholds for juvenile Chinook based on literature review by G. Hansen, T. Kock, R. Perry

Approaches for Evaluating Modifications to Topography, Barriers and Revetments

Modifying topography or barriers to increase inundation

- Frequency, extent of inundation
- Sediment deposition
- Hydrogeomorphic, habitat context

USGS sedimentation monitoring, Fall Creek

Harkens Lake, April 2019; courtesy River Design Group and Greenbelt Land Trust

Modifying revetments

- Changes in channel morphology
- Increases in inundation and hydraulic connectivity

2017 Revetment modification at TNC's Middle Fork Pond Complex, Google Earth Photo from 2019

Phase 3 of the Monitoring Program: Evaluating Fisheries Benefits of Aquatic Weed Treatments

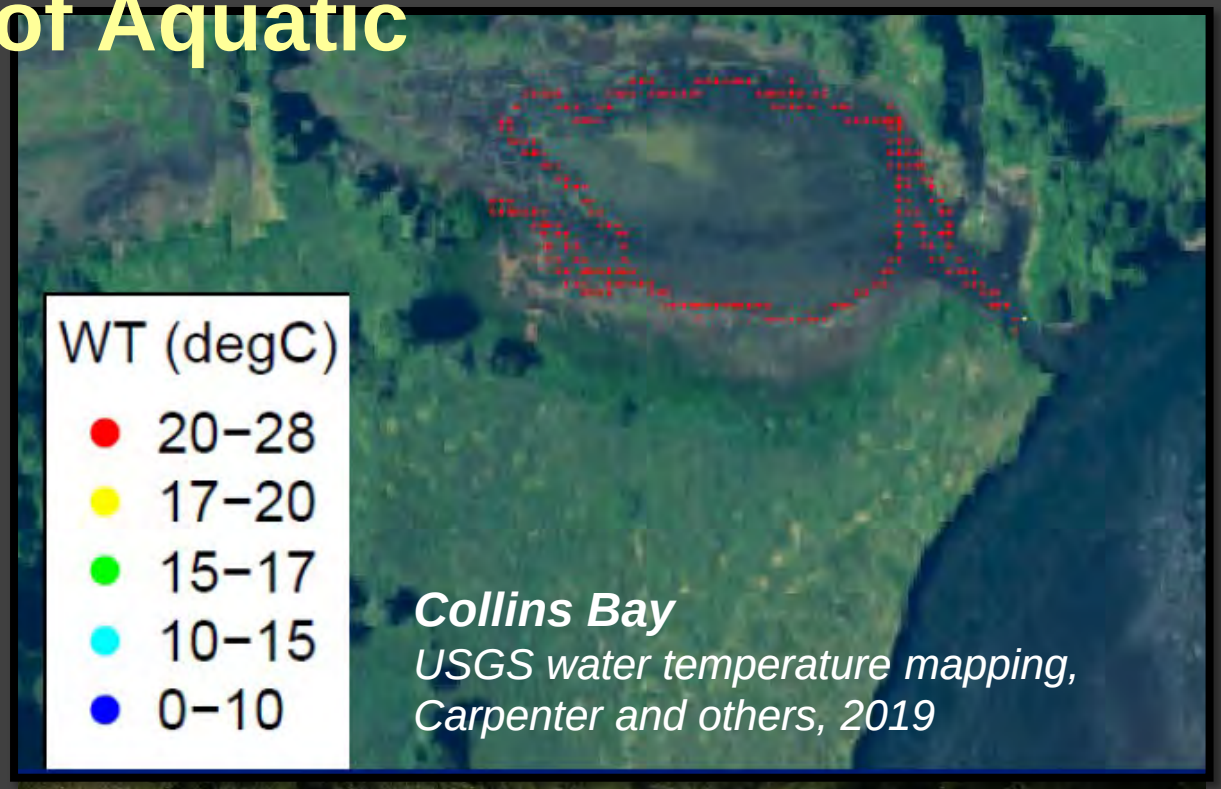
Synthesize 'State of Science' on Aquatic Weeds in the Willamette River and Implications for Fish Habitat

PI's: Brown, Miller, Flitcroft

Review existing datasets to assess:

- Status and trends of Ludwigia in Willamette
- Implications for off-channel aggradation
- Impacts of Ludwigia on water quality
- Linkages between aquatic plants and fish communities
- Effectiveness of herbicide applications

USGS

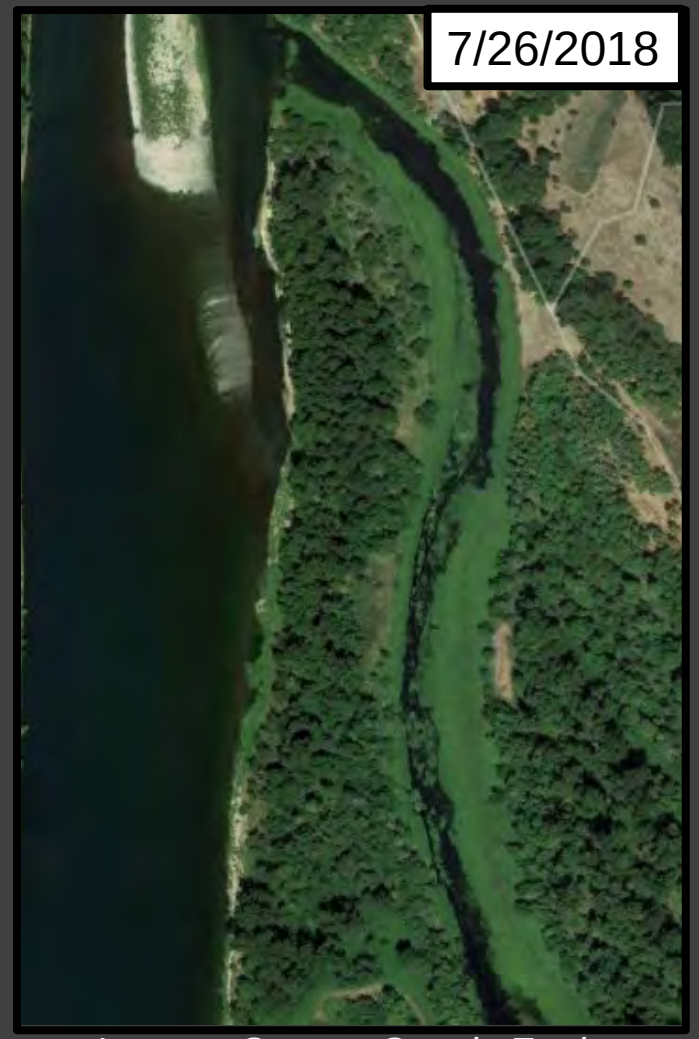


Collins Bay
USGS water temperature mapping, Carpenter and others, 2019

Ludwigia in off-channel area near Corvallis, photograph by L. Brown BSWCD

Aquatic Emergent Plant Expansion 2000-2018:

Example from Winsor Slough, Willamette Mission State Park near Salem;
Phase 3 mapping will quantify river-scale changes in aquatic plant cover.



Imagery Source: Google Earth

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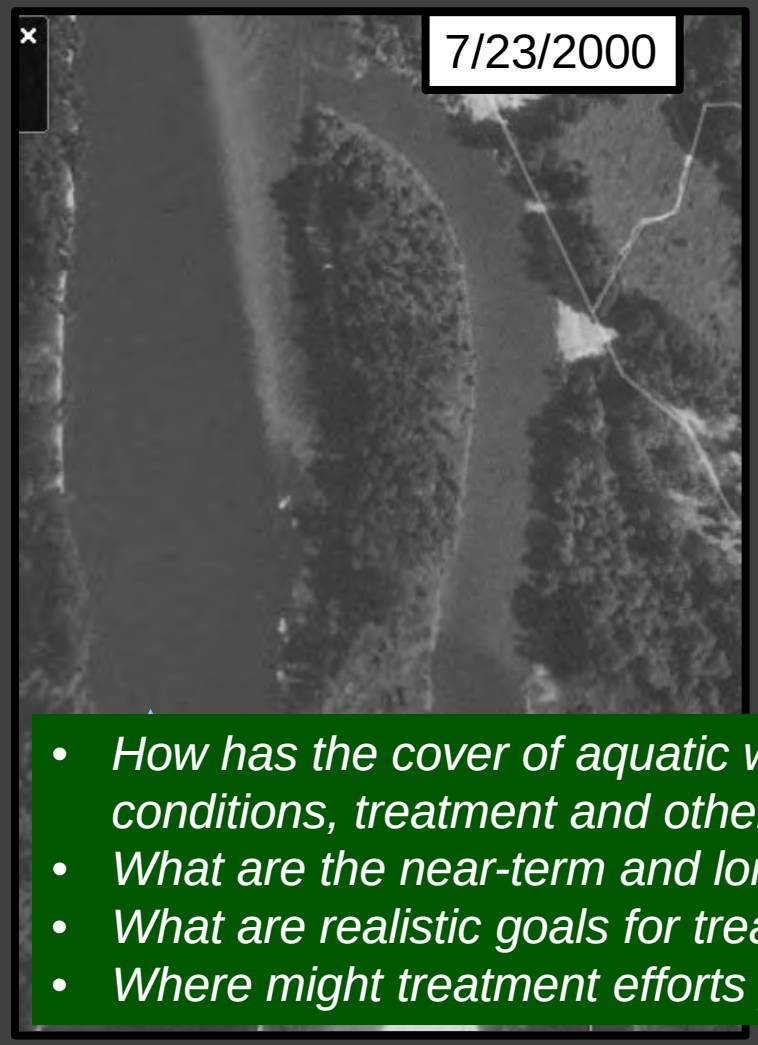
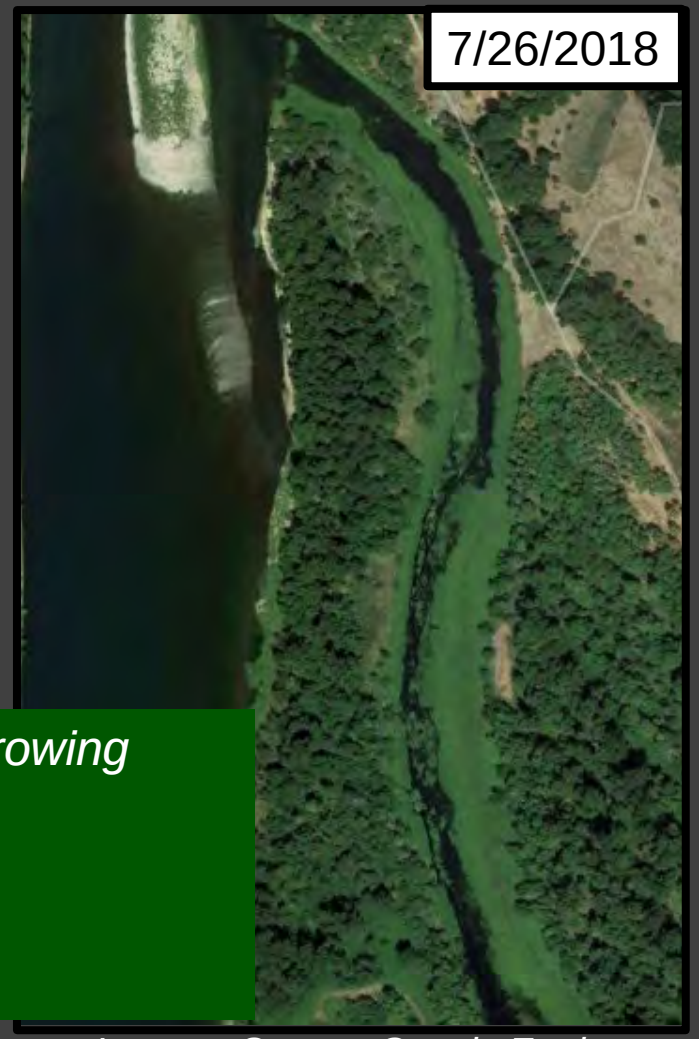


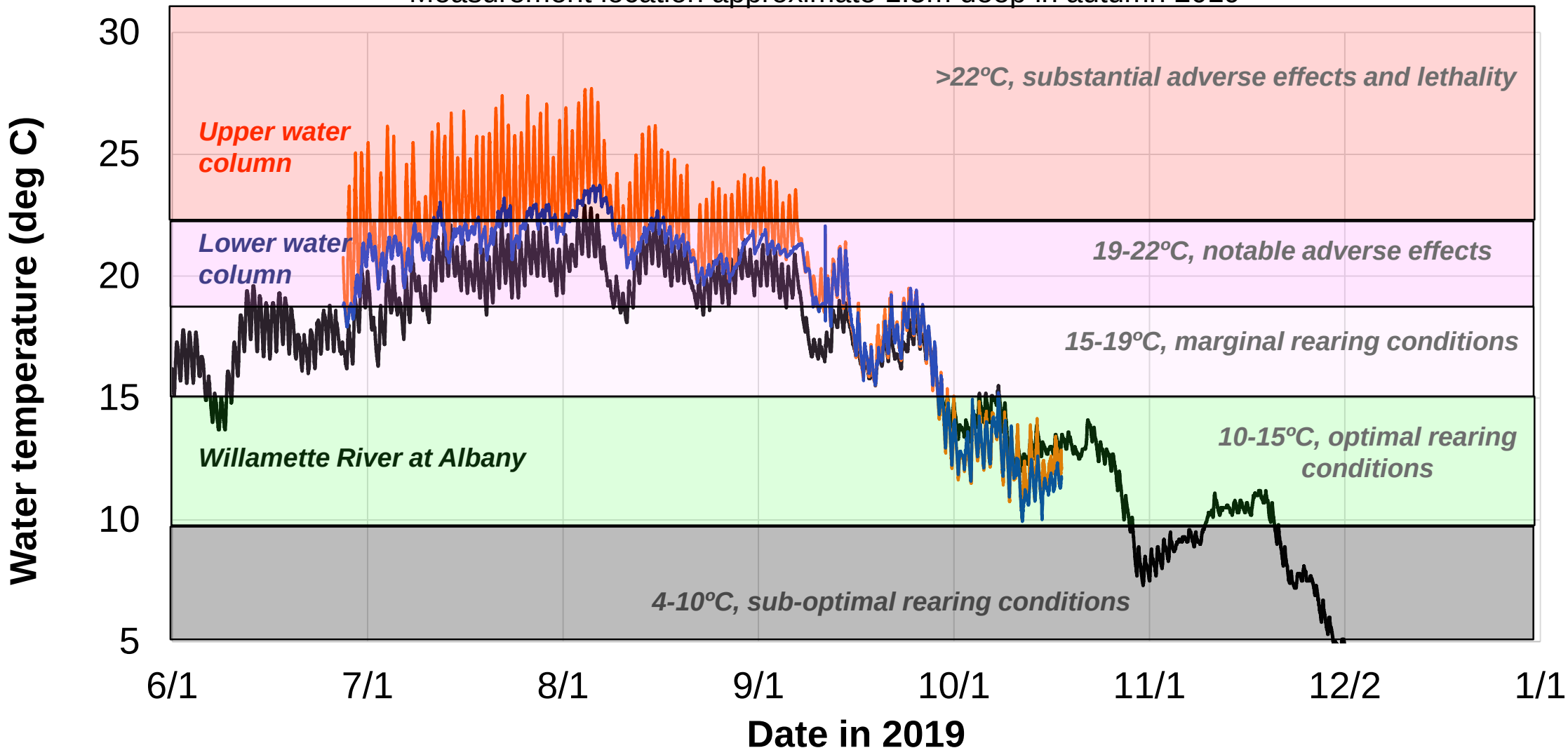


- *How has the cover of aquatic weeds changed over time in response to flows, growing conditions, treatment and other factors?*
- *What are the near-term and long-term impacts of Ludwigia on fish habitats?*
- *What are realistic goals for treatment?*
- *Where might treatment efforts provide greatest benefits for native fish?*

Imagery Source: Google Earth

Stream Temperature in Collins Bay – Willamette River alcove near Albany

Measurement location approximate 1.5m deep in autumn 2019



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Collins Bay temperature data provisional, subject to revision.
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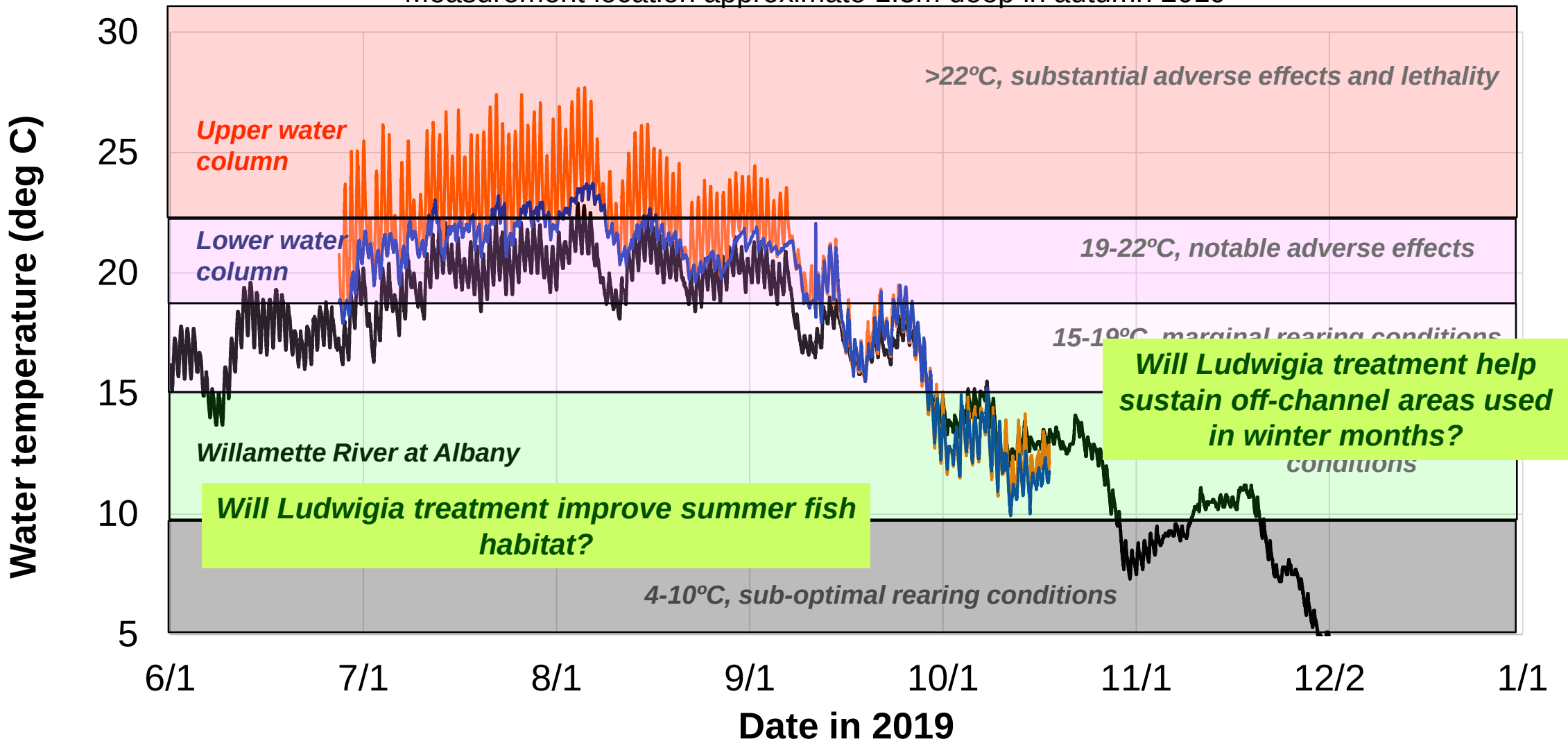

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USGS

Acknowledgements

Funding

OWEB, BPA, USGS Cooperative Matching Program, U.S. Forest Service

Effectiveness Monitoring Team

Mackenzie Keith, Kathleen Guillozet, Laura Brown, Becky Flitcroft, Rich Miller, Mark Sytsma, Toby Kock, Gabriel Hansen, Luke Whitman, Paula Gagnon, Joan Hagar

Oversight and Expert Input

Andrew Dutterer, Ken Fetcho, Holly Crosson, Stan Gregory, Leslie Bach, David Hulse, Janine Castro, Ann Mullan, Chris Vogel, Vaughn Blazar, Nate Richardson, Greg Taylor, Rich Piaskowski, Brian Bangs

Restoration Community and Partners (many more to come)

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James White, Laurel Stratton Garvin, Gabriel Gordon, Kurt Carpenter, Dave Piatt, Heather Bervid

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Questions?

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OWEB Partnerships Coordinator

Andrew Dutterer

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Photograph courtesy of Freshwaters Illustrated

USGS

References

Anchor Habitats Working Group, 2015. Upper and Middle Willamette Mainstem Anchor Habitats Proposal to OWEB for FIP Implementation Funding, submitted October 2015.

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USGS

Extra Slides

USGS

Effectiveness Monitoring Team

Role	Team Members
Technical Coordinator	Rose Wallick (USGS)
Project Management, Overall Monitoring Coordination	Laura Brown (BSWCD)
Adaptive Management, Implementation Coordination	Kathleen Guillozet (BEF)
Hydrogeomorphology	Mackenzie Keith (USGS) and other USGS staff
Fisheries	Becky Flitcroft (USFS) Toby Kock and Gabriel Hansen (USGS)
Riparian Vegetation	Kathleen Guillozet (BEF), Joan Hagar (USGS) Mackenzie Keith, Brandon Overstreet (USGS)
Aquatic Plants and Water Quality	Rich Miller, Mark Sytsma (PSU)
Avian Communities	Joan Hagar (USGS)
OWEB Review	Ken Fetcho, Andrew Dutterer (OWEB)
Expert Reviewers	Stan Gregory (OSU), Leslie Bach (NWPPC), Janine Castro (USFWS), Dave Hulse (UO) WFIP Technical Review Team
Anchor Habitat Working Group Review and Input	AHWG partners and consultants