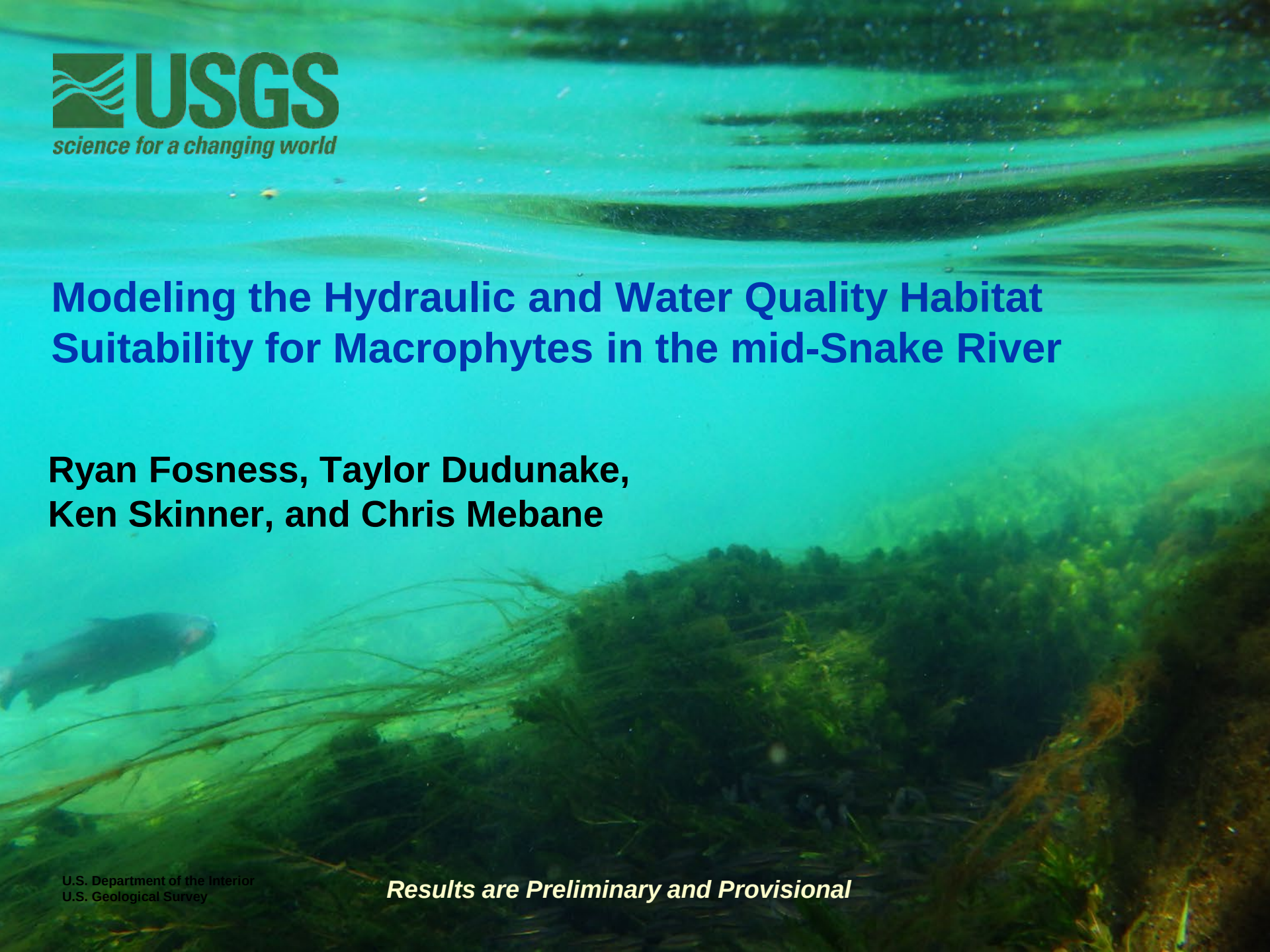


USGS
science for a changing world

Modeling the Hydraulic and Water Quality Habitat Suitability for Macrophytes in the mid-Snake River

**Ryan Fosness, Taylor Dudunake,
Ken Skinner, and Chris Mebane**

U.S. Department of the Interior
U.S. Geological Survey

Results are Preliminary and Provisional

Primary objectives

- 1) map extent of macrophyte beds within the Crystal Springs reach
- 2) develop a two-dimensional hydraulic model to simulate the strea summary for the depth and velocity, and
- 3) develop an integrated habitat suitability model of limiting conditi

Why the interest in macrophytes in the Snake River?

- **Macrophytes aka Aquatic Weeds aka Submerged Aquatic Vegetation**
- **Ecologically important but sometimes a great nuisance**

Photo courtesy of the North Side Canal Company, Jerome, Idaho

Photo courtesy of the North Side Canal Company, Jerome, Idaho

ca. 1890s

Photo courtesy of the Twin Falls Canal Company, Twin Falls, Idaho

ca. 1940s

Photo courtesy of the Twin Falls Canal Company, Twin Falls, Idaho

1953

2007

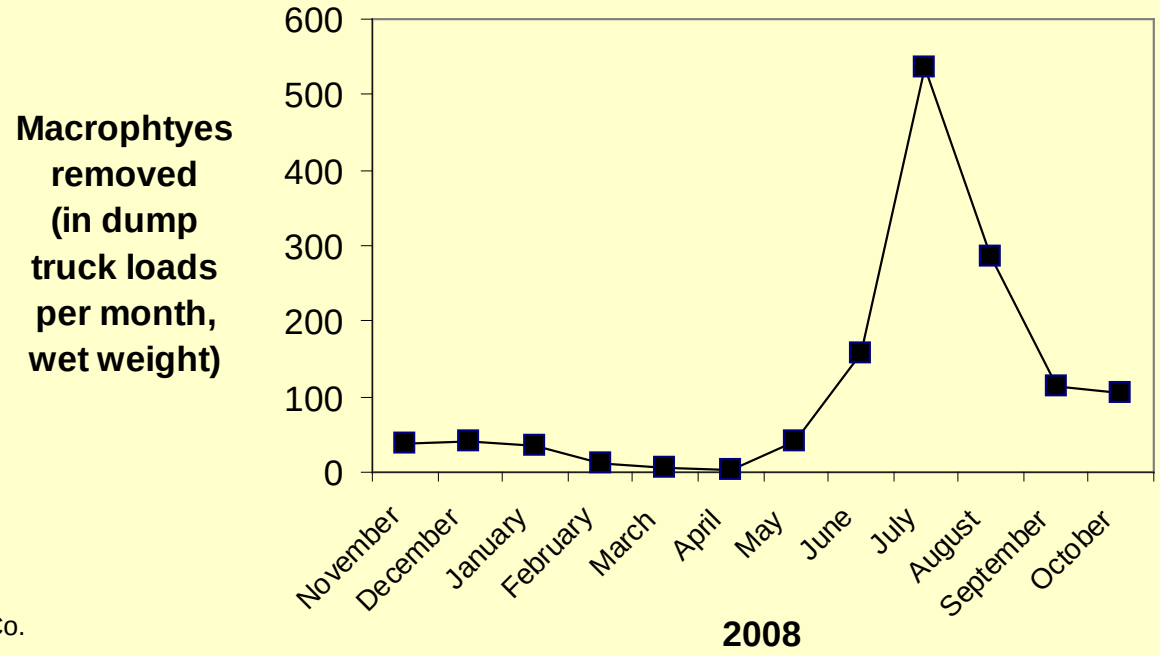
1953

2007

Photos: North Side Canal Company, Jerome, Idaho

Upper Salmon Falls dam “B”, Snake River near Hagerman, Idaho

“Total maximum daily load, (TMDL) = 17 macrophyte dump truck loads/day (July)



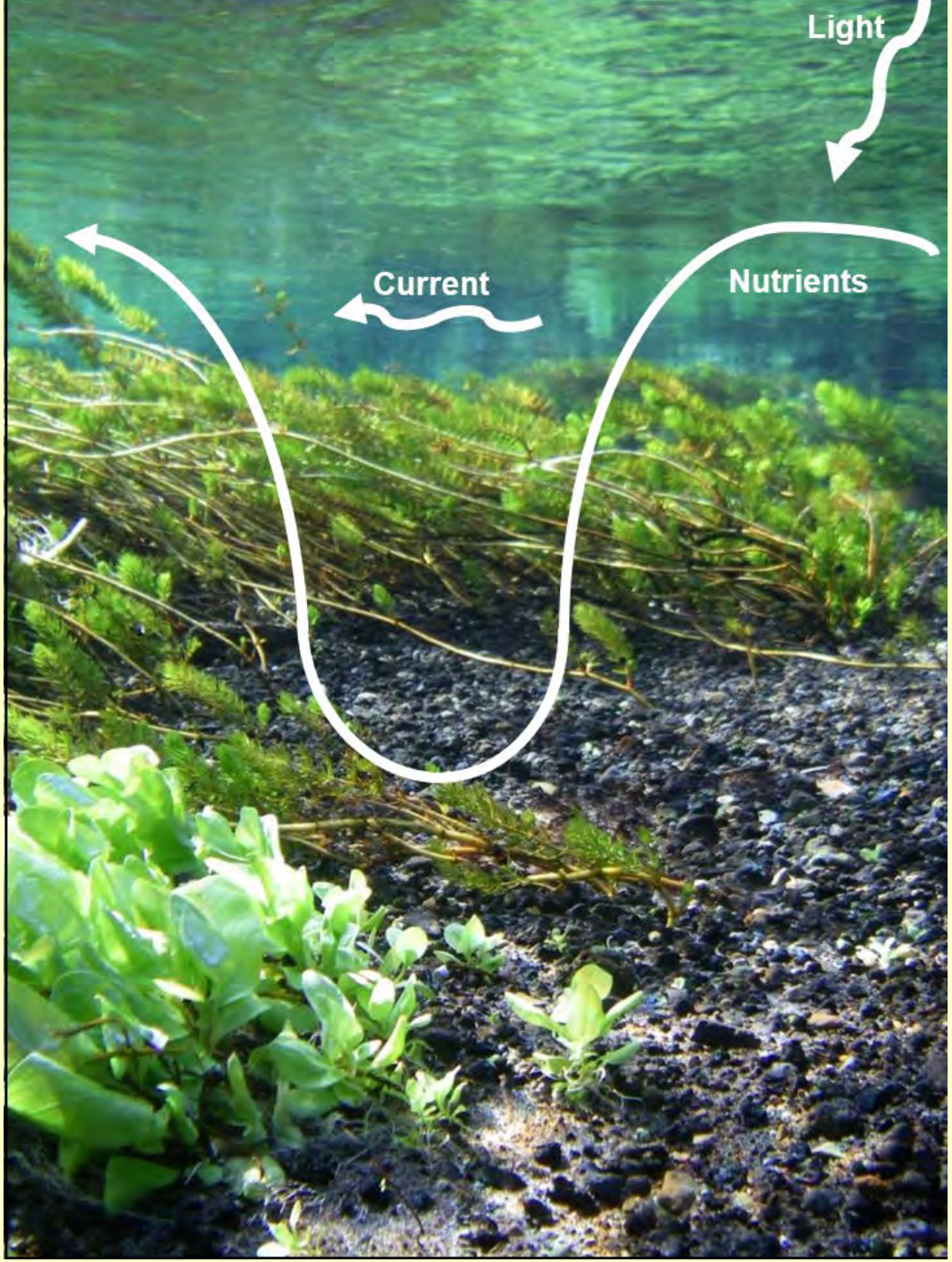
Photos and data courtesy of Brian Hoelscher, Idaho Power Co.

MacMillan (1992)

These plants will not thrive under the following conditions:

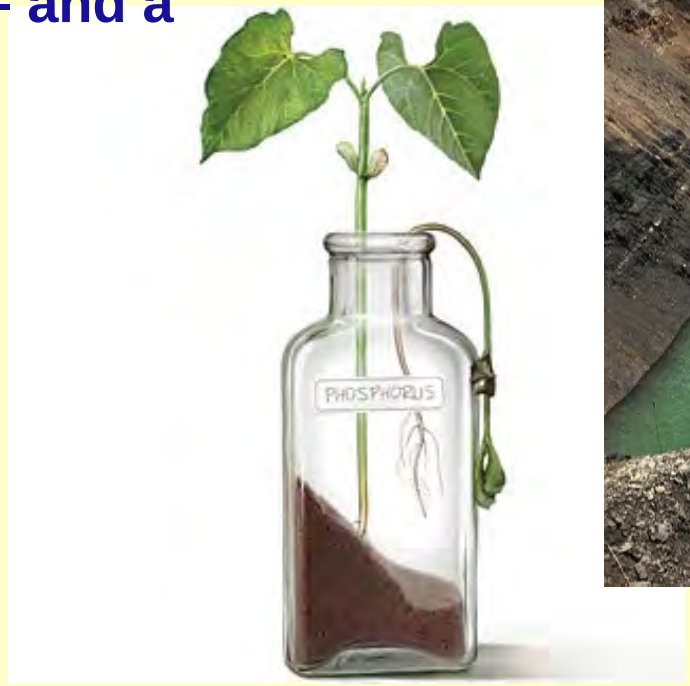
1. High current velocity (≥1 m/sec)
2. Very low or zero nutrients (≤0.01 mg-P/L)
3. Very low sediment nutrients (0.046 mg-P/g)
4. Extensive shade
5. Chronic, cold water temperatures
6. Organic sediments, gravel
7. Very shallow water (≤0.5 m)- applies to macrophytes only

Primary factors expected to influence aquatic plant biomass in flowing waters



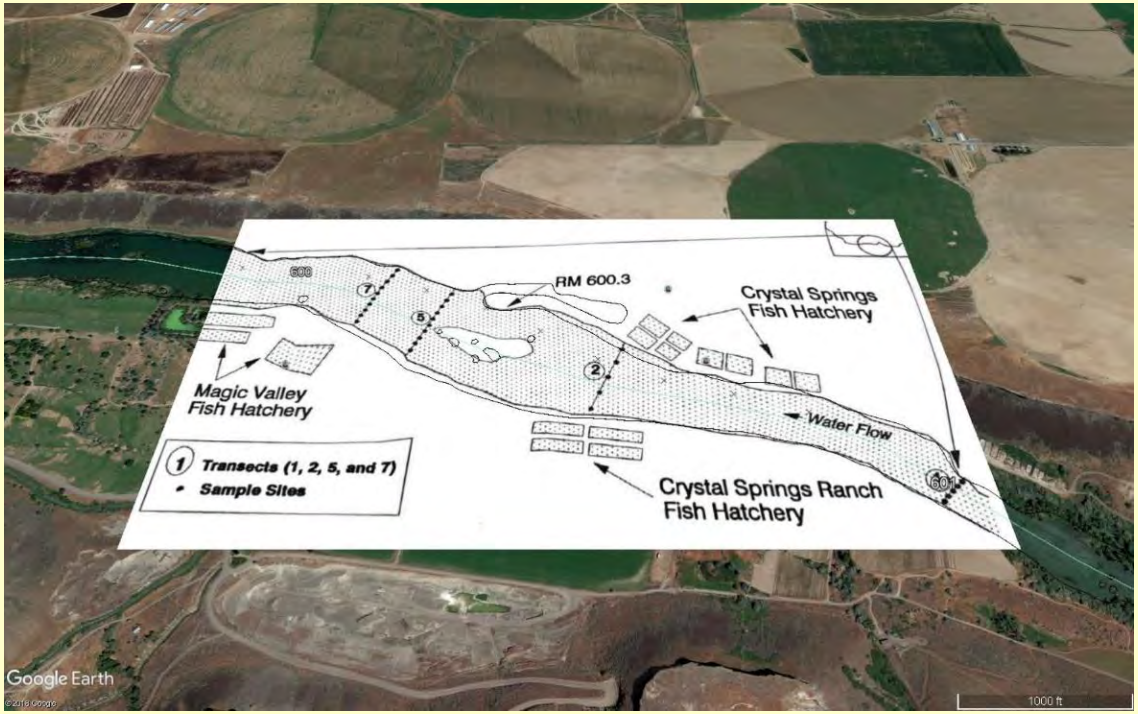
Mebane, C.A., N.S. Simon, and T.R. Maret. 2014. Linking nutrient enrichment and streamflow to macrophytes in agricultural streams. *Hydrobiologia*. http://dx.doi.org/10.1007/s10750-013-1693-4

Phosphorus: essential for all life, a critical strategic resource – and a pollutant



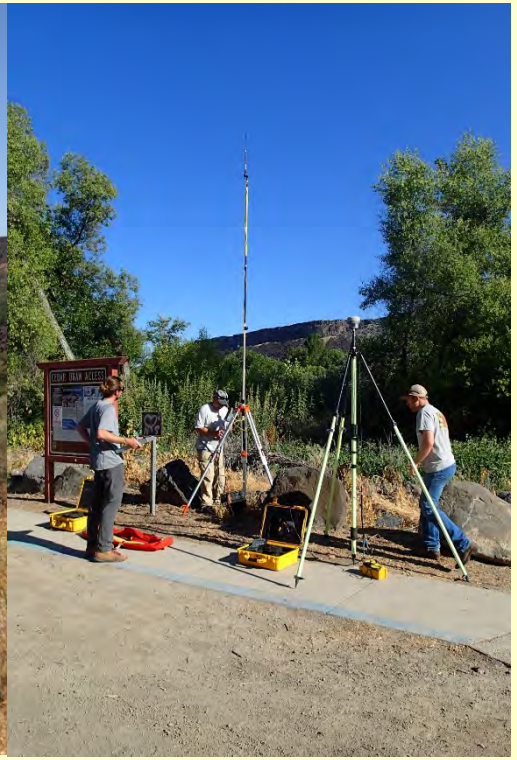
Focus is on the Crystal Springs reach, a slow, shallow section that was extensively studied in the early 1990s (“Falter’s Reach”)

Falter Reach RM 600-601

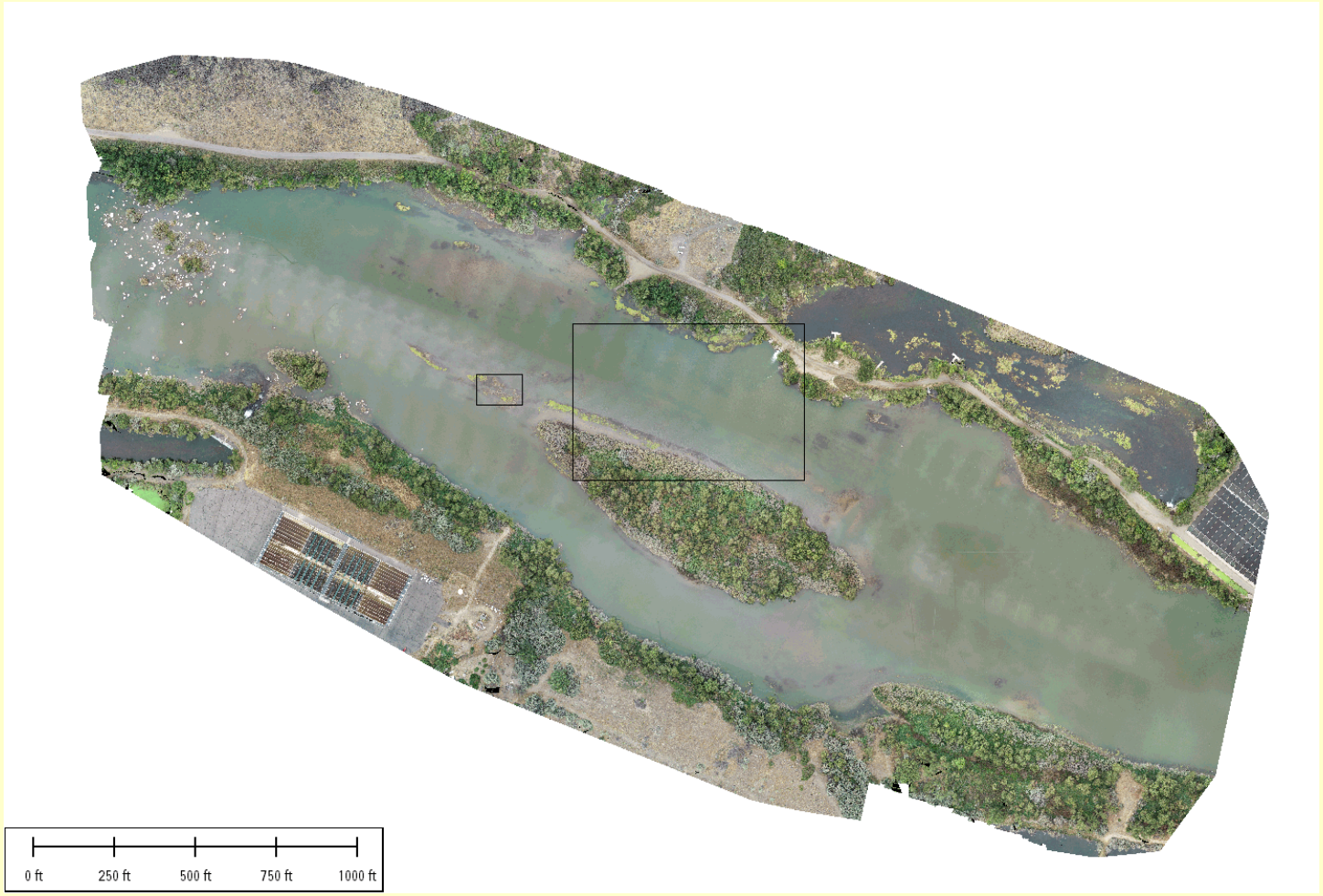


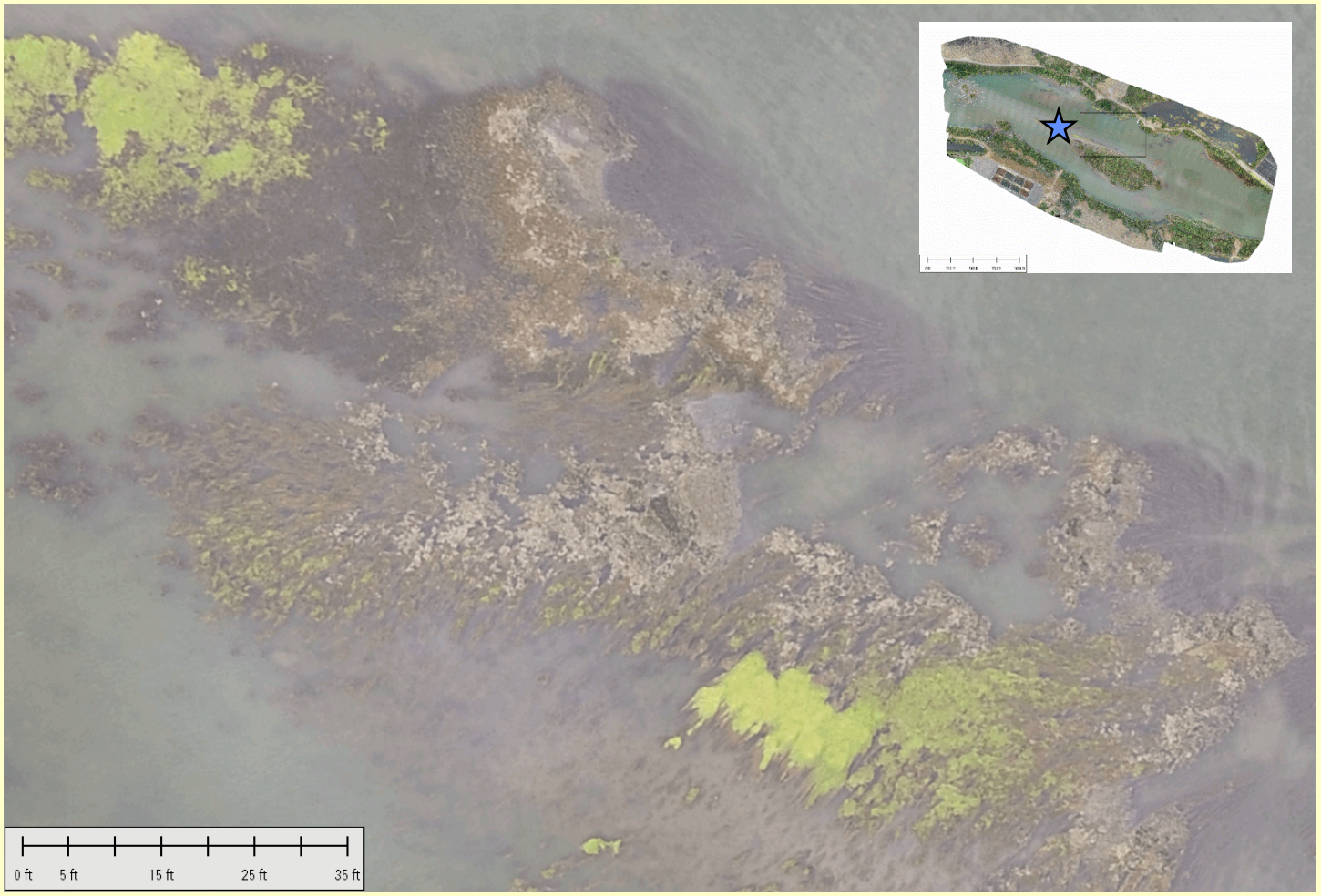

RIVERBOAT

Mapping macrophyte beds: drone (<1m resolution)



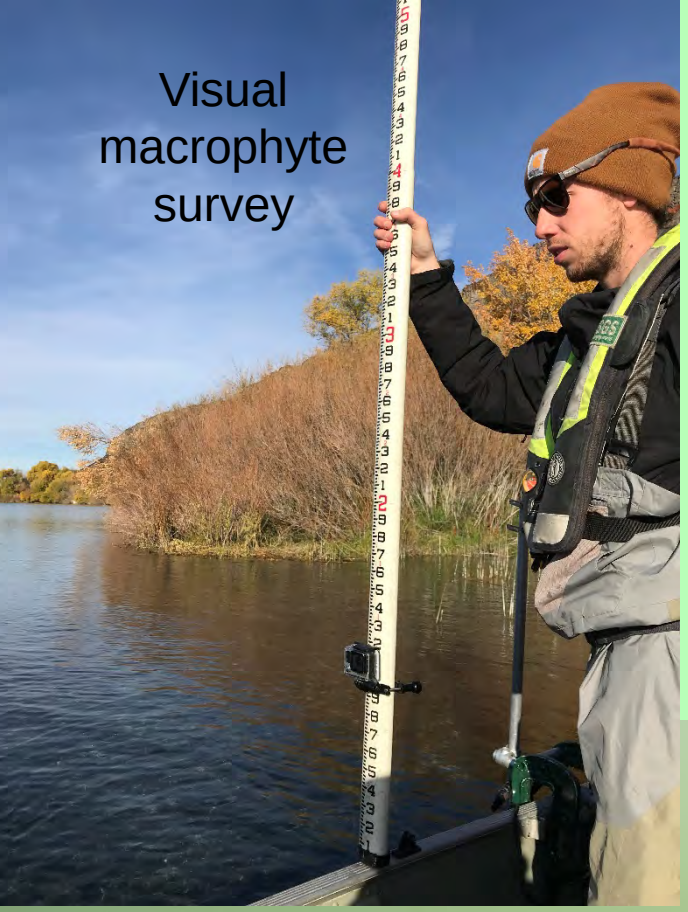
In collaboration with the IPC River Science Team


0 ft
250 ft
500 ft
750 ft
1000 ft

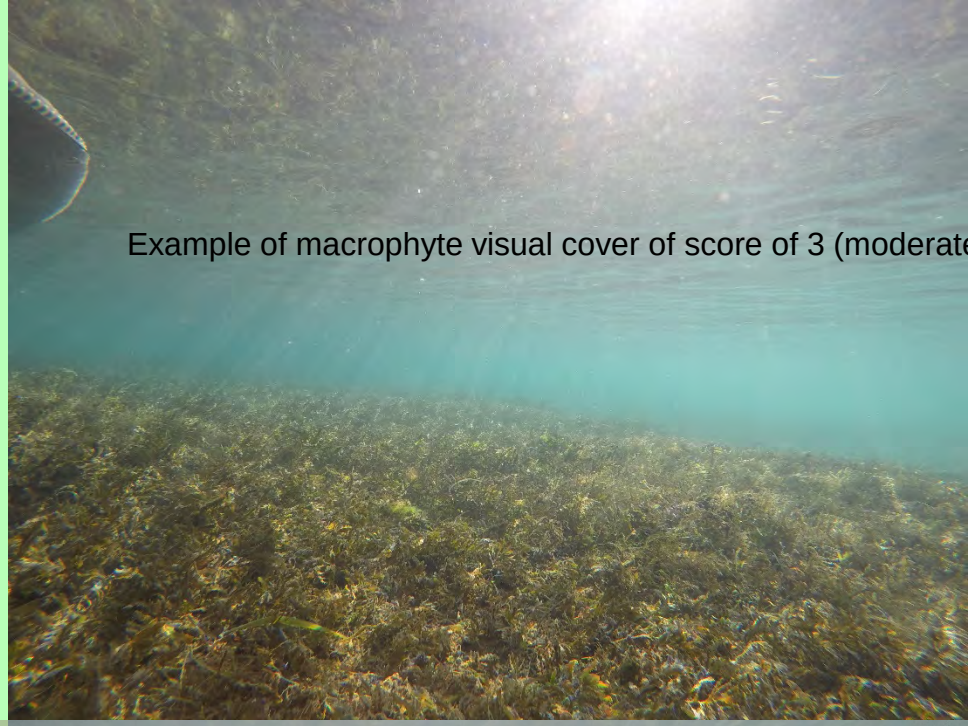

0 ft
5 ft
15 ft
25 ft
35 ft


600.2
Falter Transect #5
600.3
mSR_AOI_V2_Niagra2CrystalSprings
0 ft
25 ft
75 ft
125 ft
175 ft

Visual macrophyte survey



Example of macrophyte visual cover score of 1 (low)



Example of macrophyte visual cover of score of 3 (moderate

<u>Semi-quantitative macrophyte cover scoring:</u>

5 – High (substrate covered, stems reaching surface)

3 – Moderate (substrate mostly covered, stems not reaching surface

1 – Low (plants visible, substrate mostly uncovered)

0 – Absent or very sparse

Example of macrophyte visual cover score of 0 (absent)


CRESTLINER

Underwater survey near Falter's Island, Crystal Springs Reach of the Snake River, October 24, 2019

Falter's Island, Crystal Springs Reach of the Snake River, October 26, 2019

Total P 96 µg/L, Total dissolved P- 30 µg/L, OP 36 µg/L

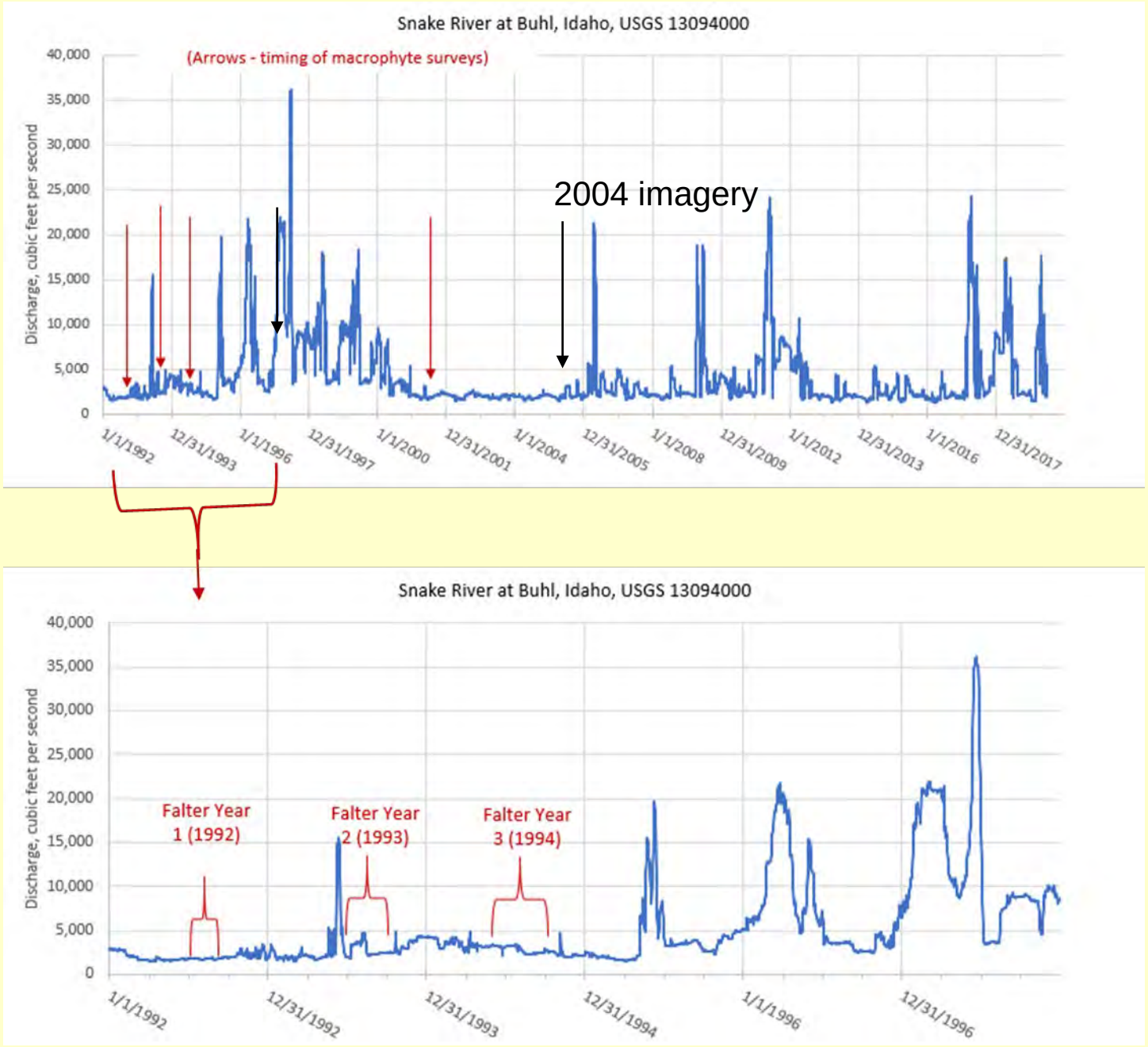
Falter's Island, Crystal Springs Reach of the Snake River, August 29, 1993

Total P, 105 µg/L; Total dissolved P, 60 µg/L, OP 55 µg/L

Falter's Island, Crystal Springs Reach of the Snake River, 9/9/2004

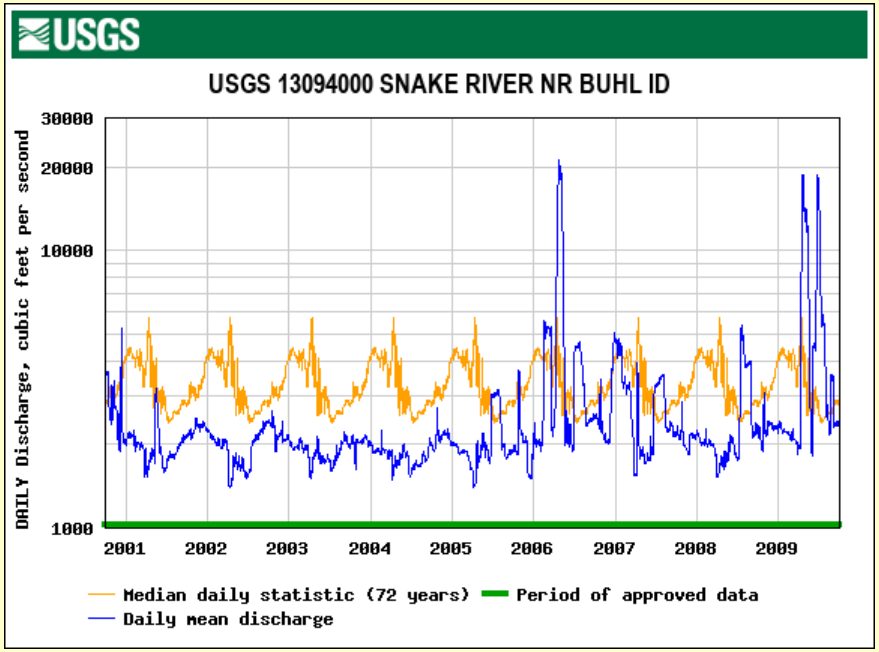
Total P 111 µg/L, OP 73 µg/L

High growth periods were associated with low peak flows

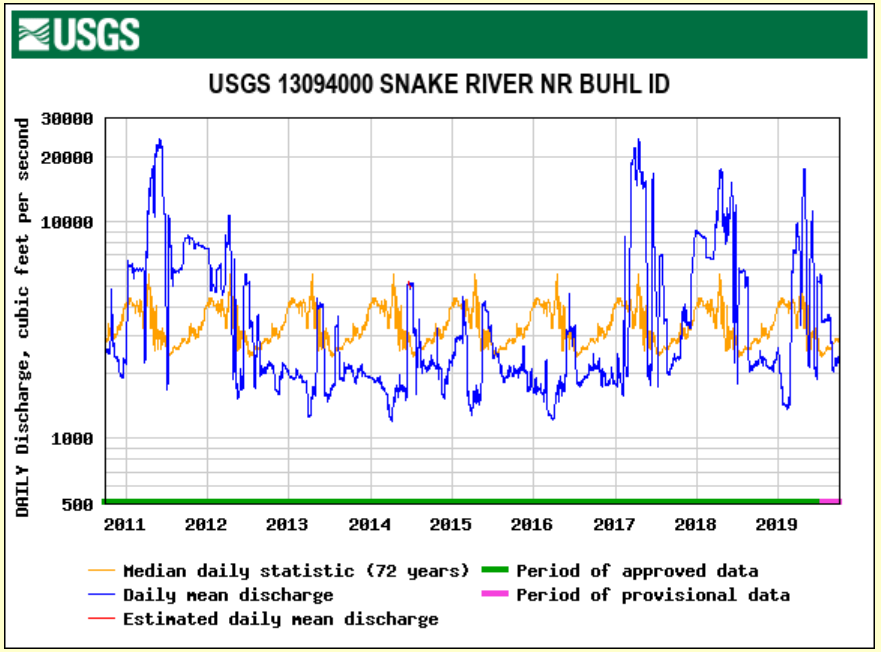


Why is the channel clean now?

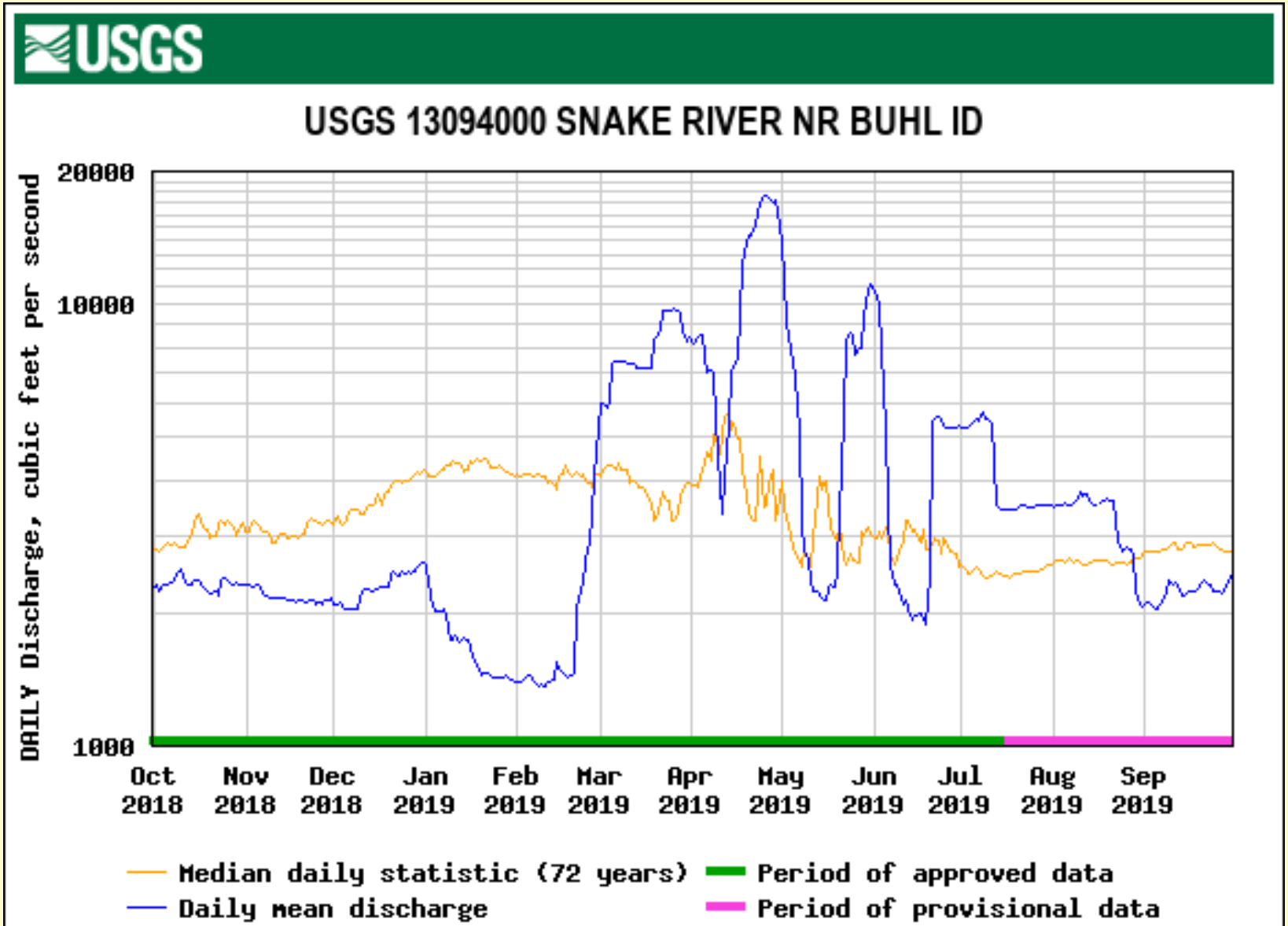
- 2000s – Five years with no significant peak flows; lower than the median



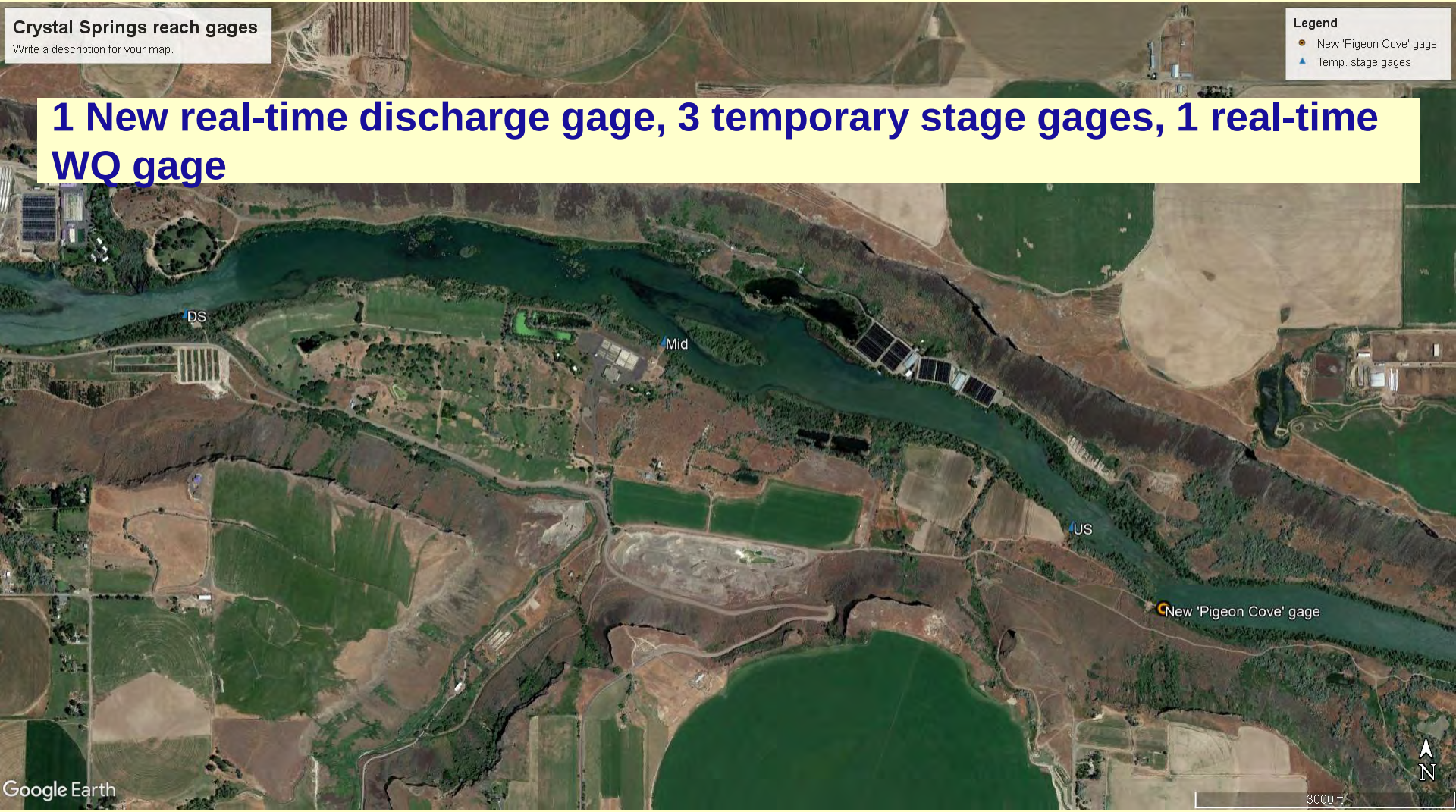
- Last three years had higher than median peak flows, especially 2017



- **In 2019, flows were above the median value for the majority of the macrophyte growing season. Was that important?**



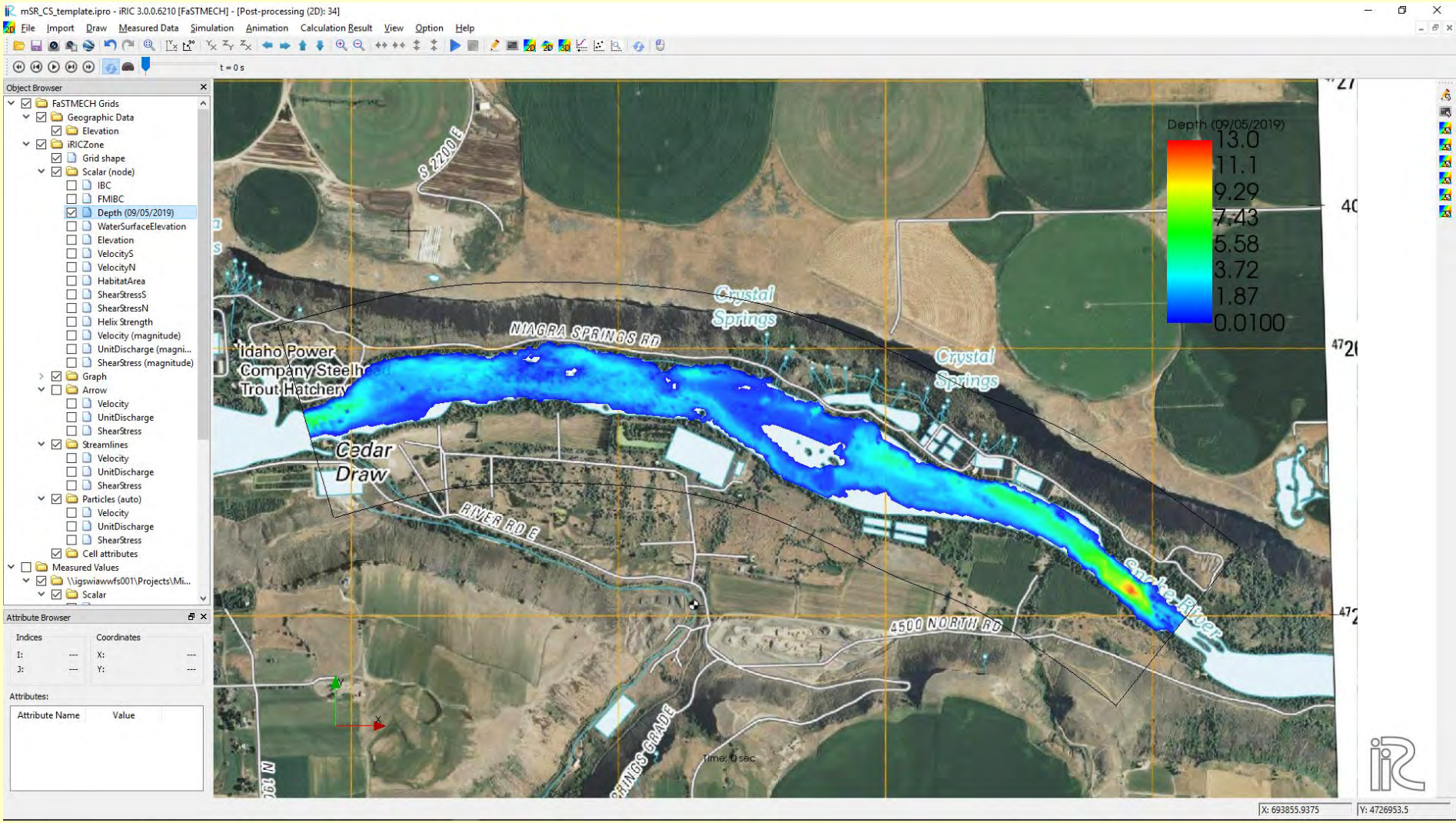
Data Collection



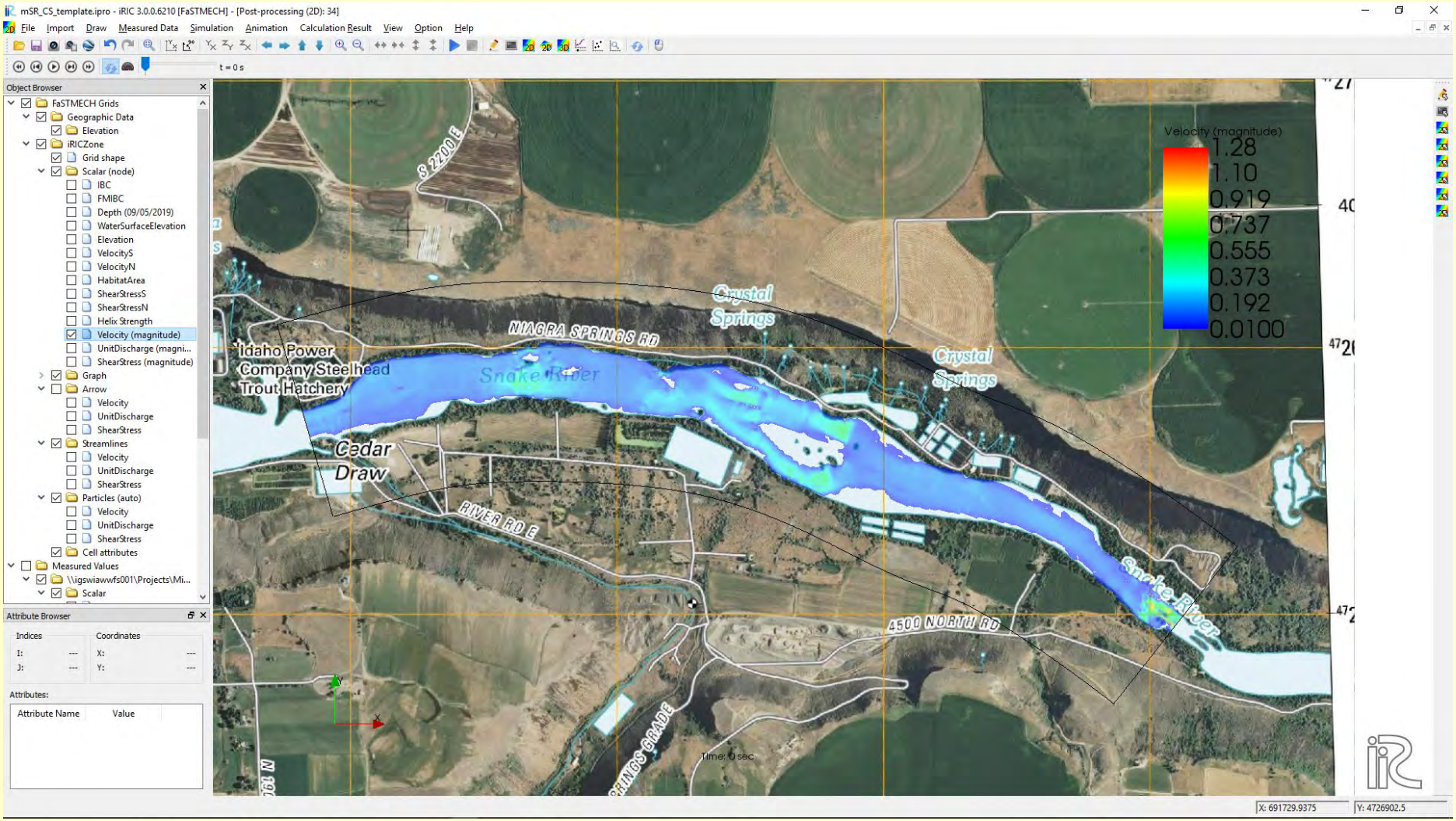
1 New real-time discharge gage, 3 temporary stage gages, 1 real-time WQ gage

Field Surveys, July and September

Modeled Depth profile at 2000 cfs, showing macrophyte suitable areas < 2m depth



Modeled Velocity profile at 2000 cfs

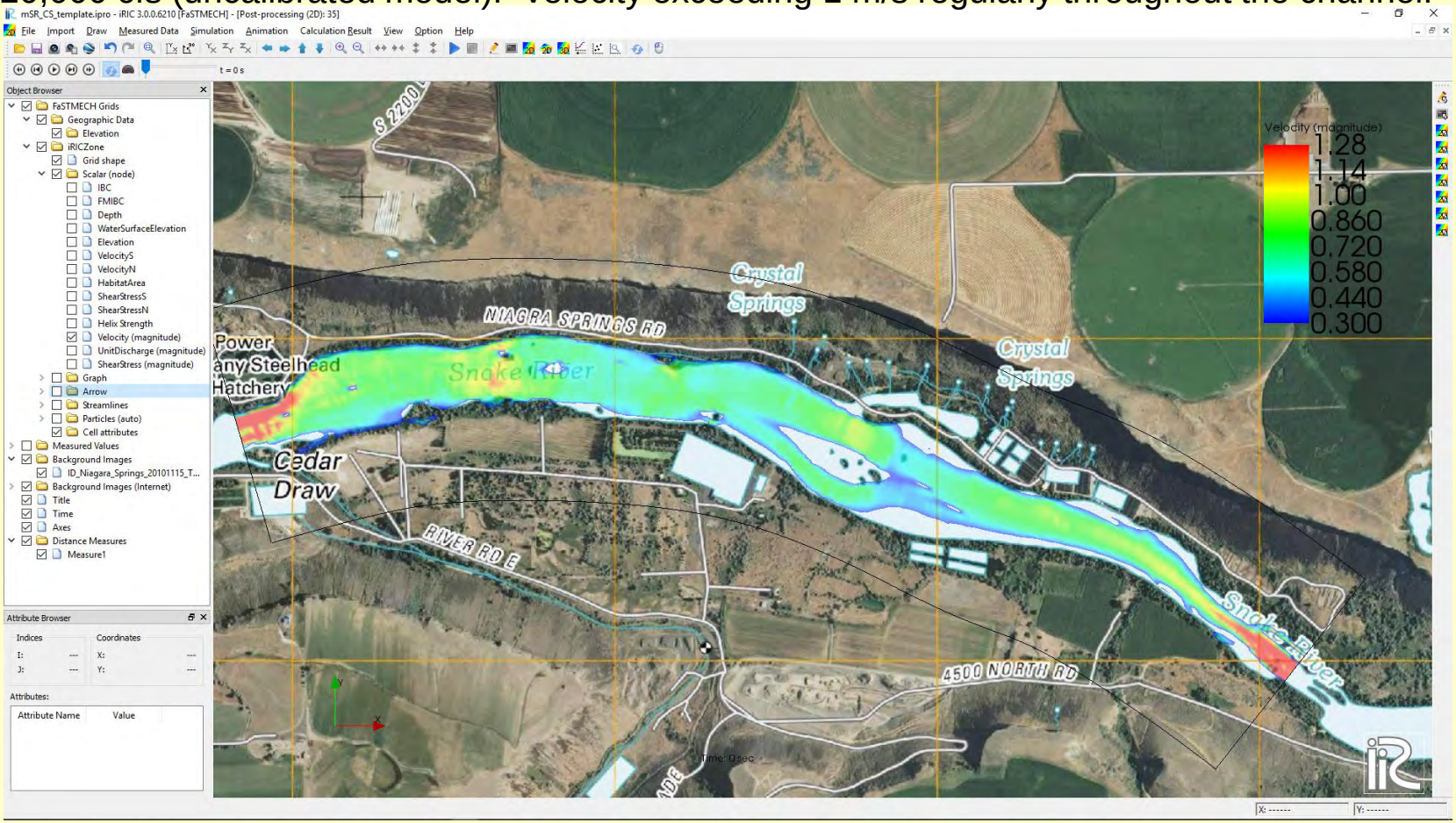


The value of the hydraulic model is it allows us to look at “what if” conditions, instead of waiting for them to happen.

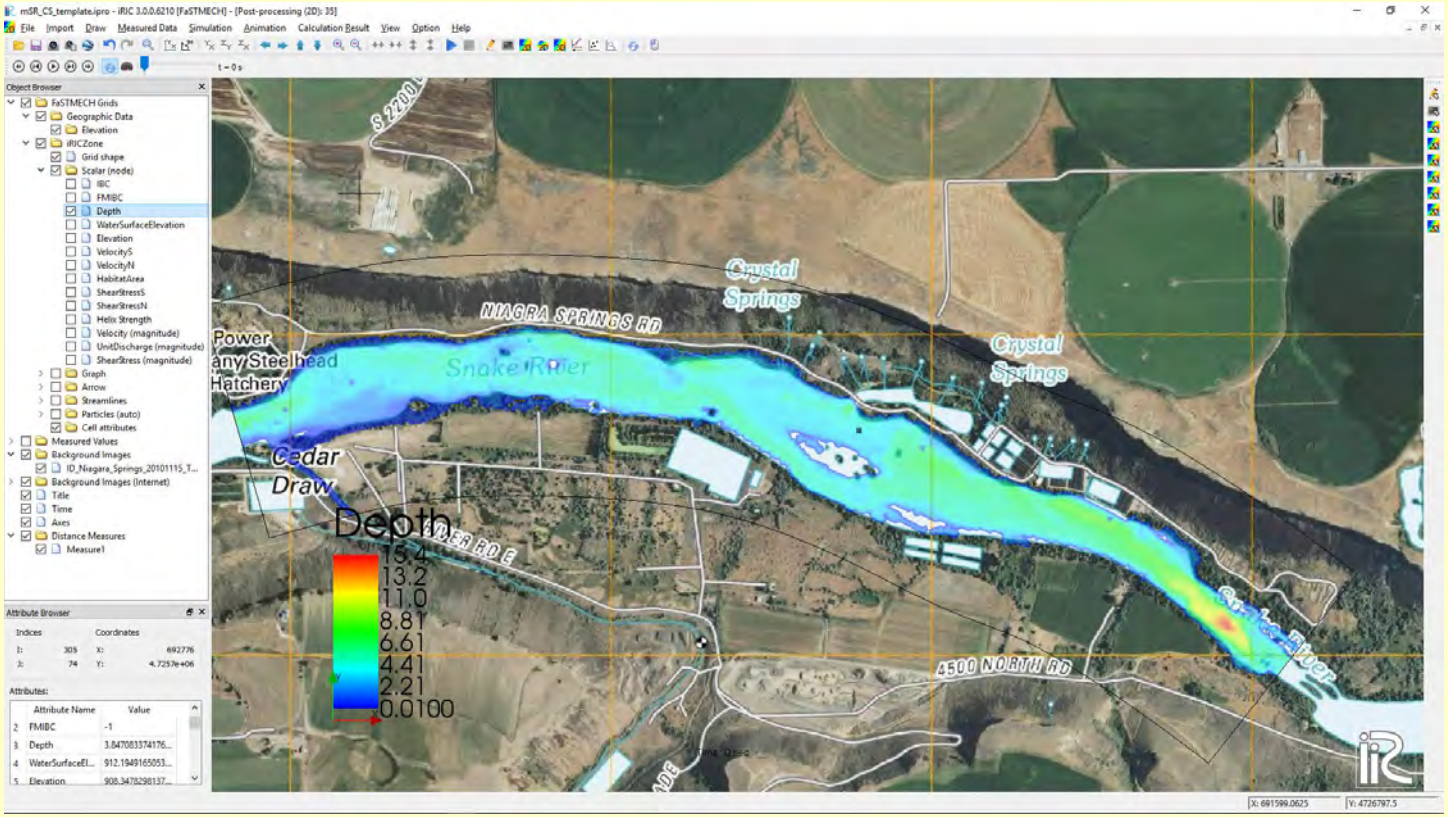
For example:
What might 20,000 cfs look like in terms of depth and velocity?

What might 20kcfs look like in terms of depth and velocity?

At 20,000 cfs (uncalibrated model): Velocity exceeding 1 m/s regularly throughout the channel.

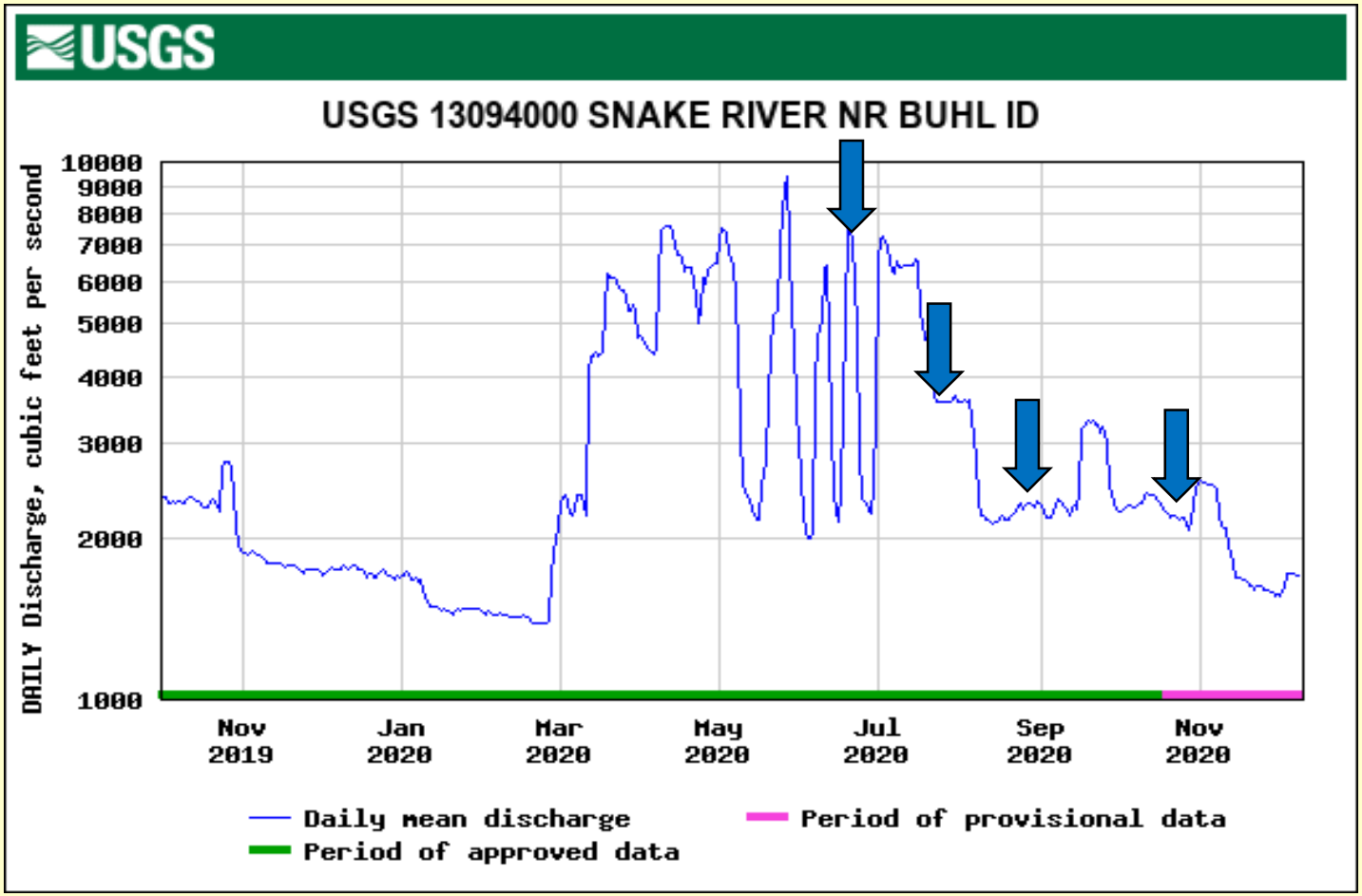


At 20,000 cfs (uncalibrated model): Depths above 3.8 meters in the channel N of the island

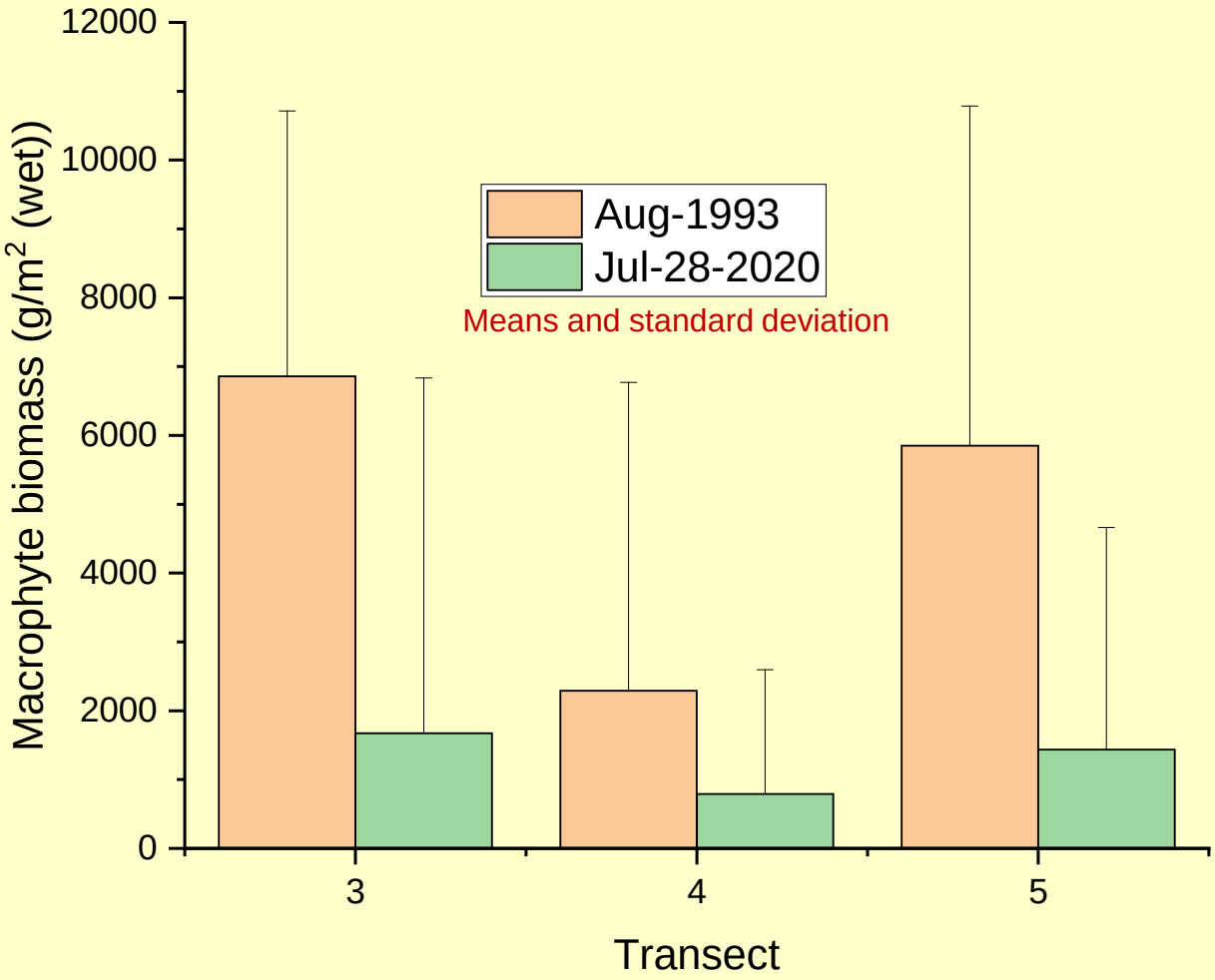


Water Year 2020 Hydrograph

In 2020, peak flows and sustained spring flows were about half that of 2019. Flow wise, 2020 should have been favorable macrophyte grow year

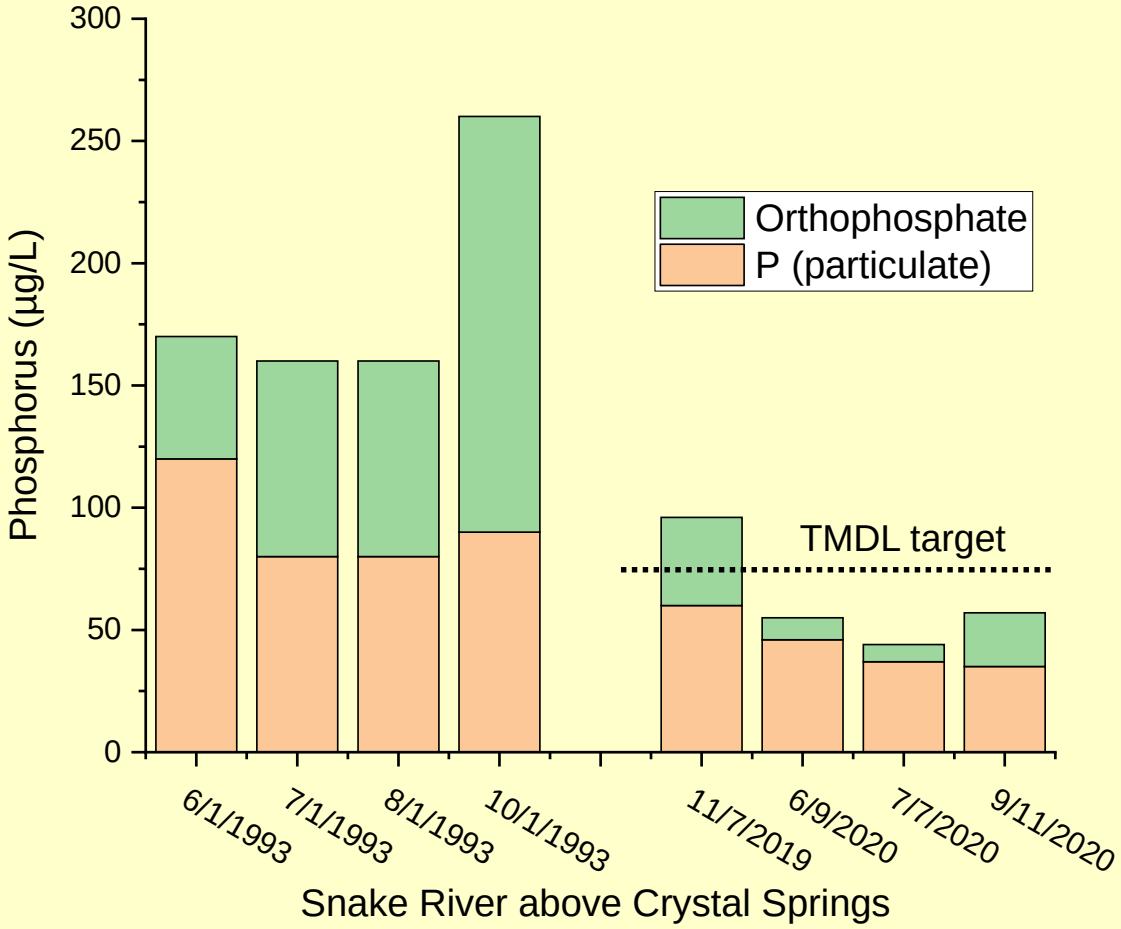


Physical Macrophyte surveys (Ponar dredge)
Summer1993, Summer 2020



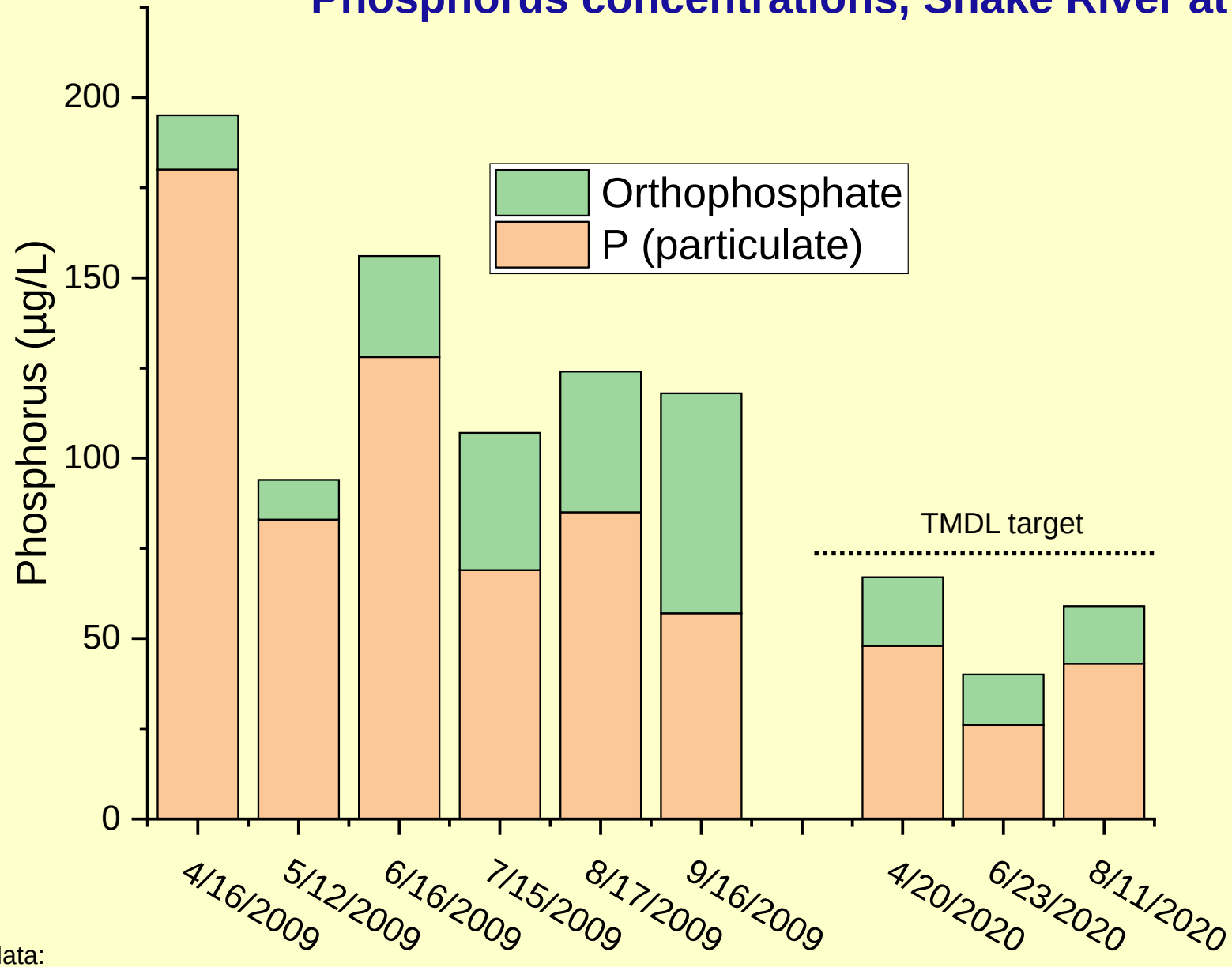
Results are Preliminary and Provisional

Phosphorus concentrations in the ‘Falter Reach’ then and now



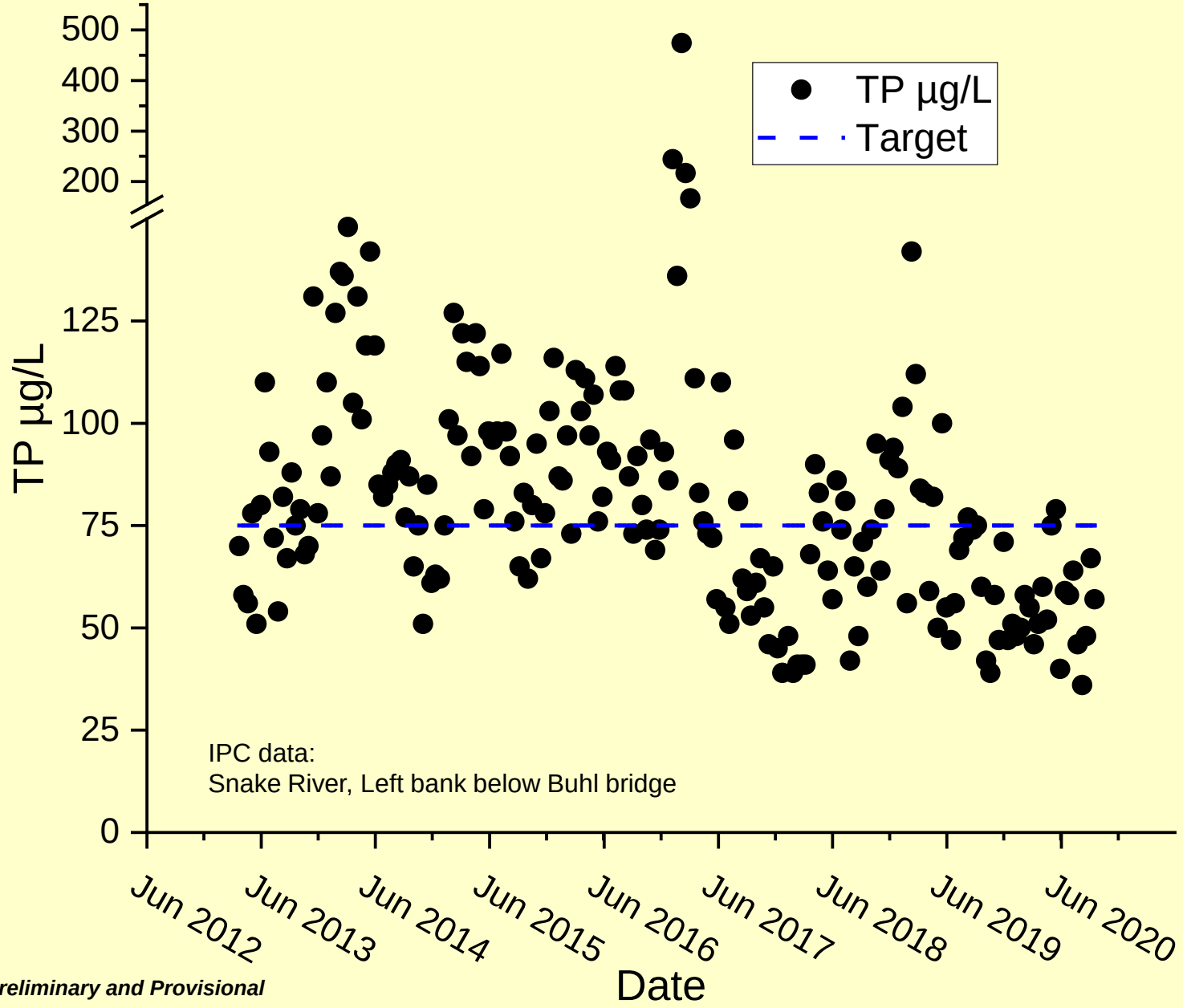
Results are Preliminary and Provisional

Phosphorus concentrations, Snake River at Buhl



USGS data:
Up to 2009, from cableway
2020, left bank below Buhl bridge

Phosphorus concentrations, Snake River at Buhl: was 2020 a one off?



Results are Preliminary and Provisional

Which nutrient(s) is limiting algal growth in the Snake River?

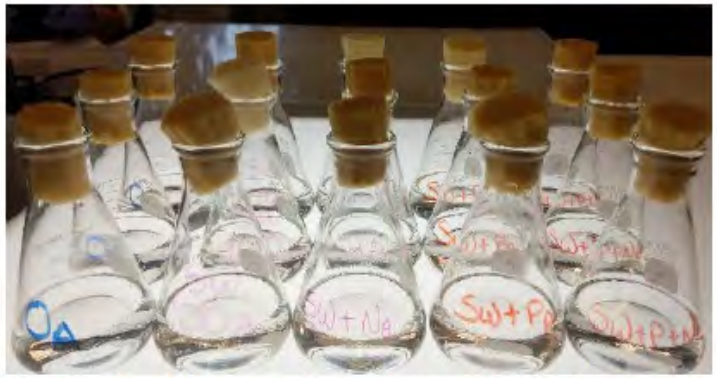


Photo 1: All samples at test initiation, after addition of algae and nutrients.

Photo 2: All samples in the incubator on Day 4.

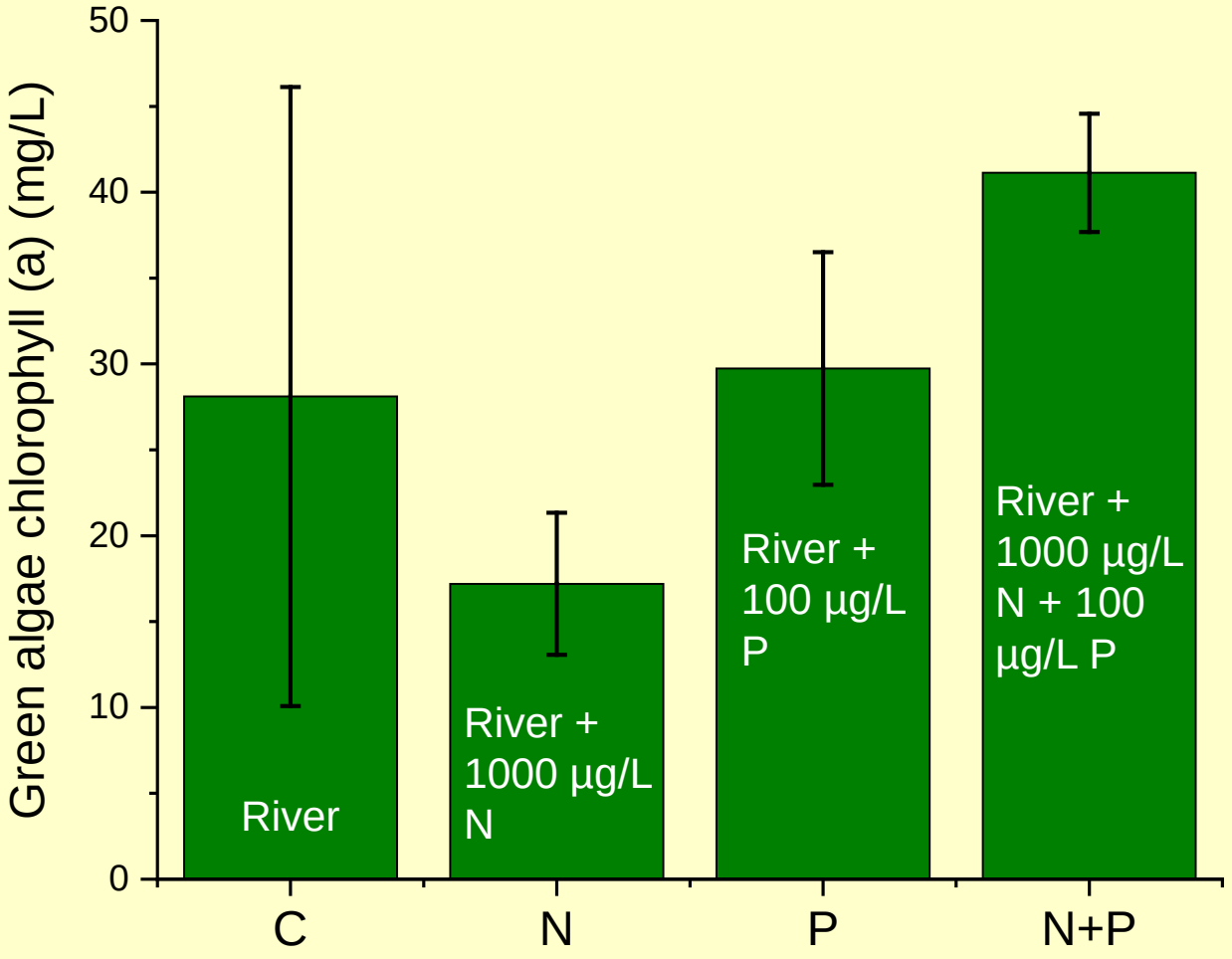
Photo 3: From left to right, site water without nutrients, lab water control, and site water + N and + P on Day 5

Results are Preliminary and Provisional

Which nutrient(s) are limiting algal growth in the Snake River?

TN – total nitrogen (unfiltered)

TP-Total phosphorus (unfiltered)



Results are Preliminary and Provisional

- **2021 Field Season**

- **Hunting for a high flow(s) to measure!**
- **Continued modeling**
- **Continued macrophyte and water quality**

Comments?

Contact:

Chris Mebane, cmebane@usgs.gov