Christina Morrisett • Henry’s Fork Foundation

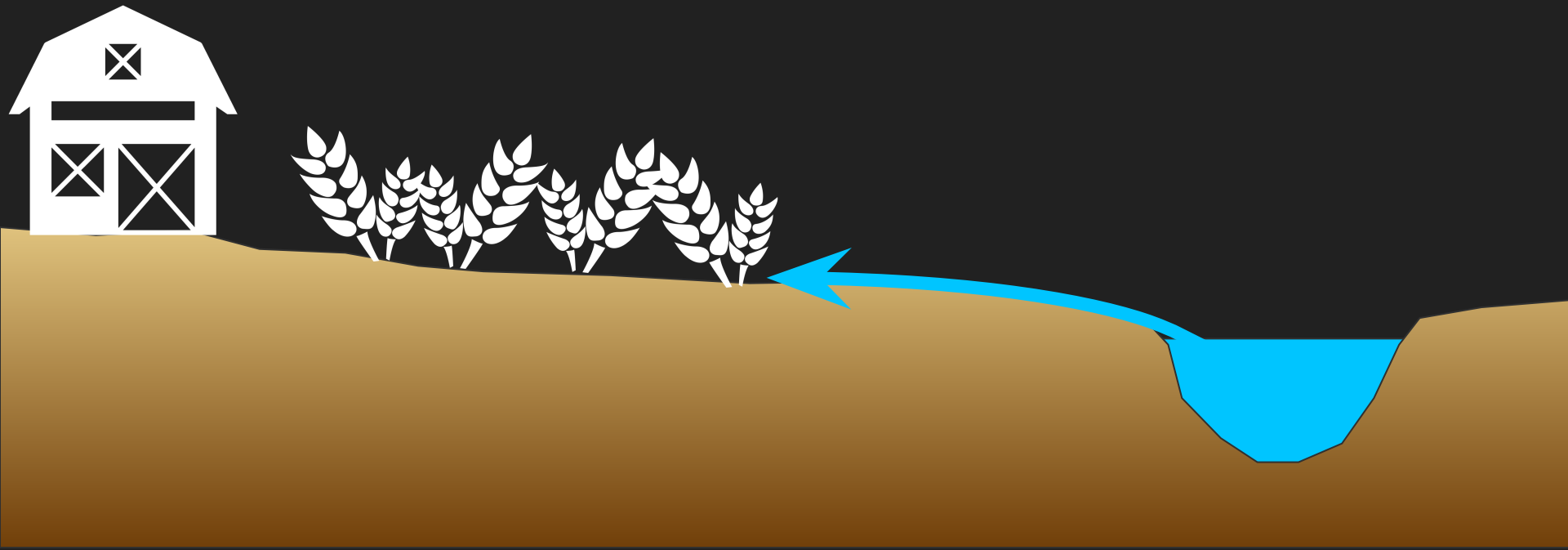
Feasibility of Aquifer Recharge via Flood Irrigation in the Lower Henry’s Fork

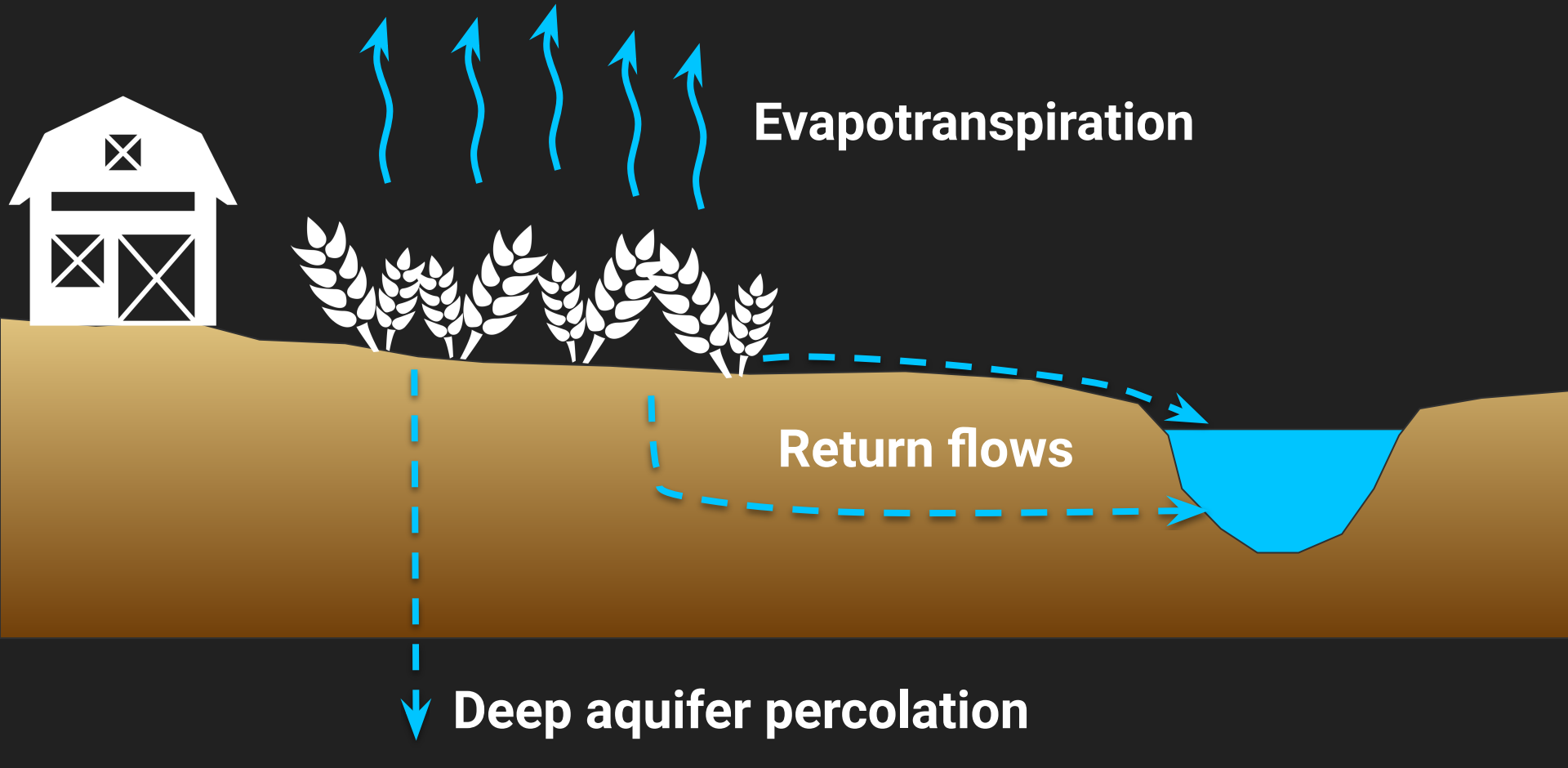
Henry’s Fork Watershed Council • December 5, 2023

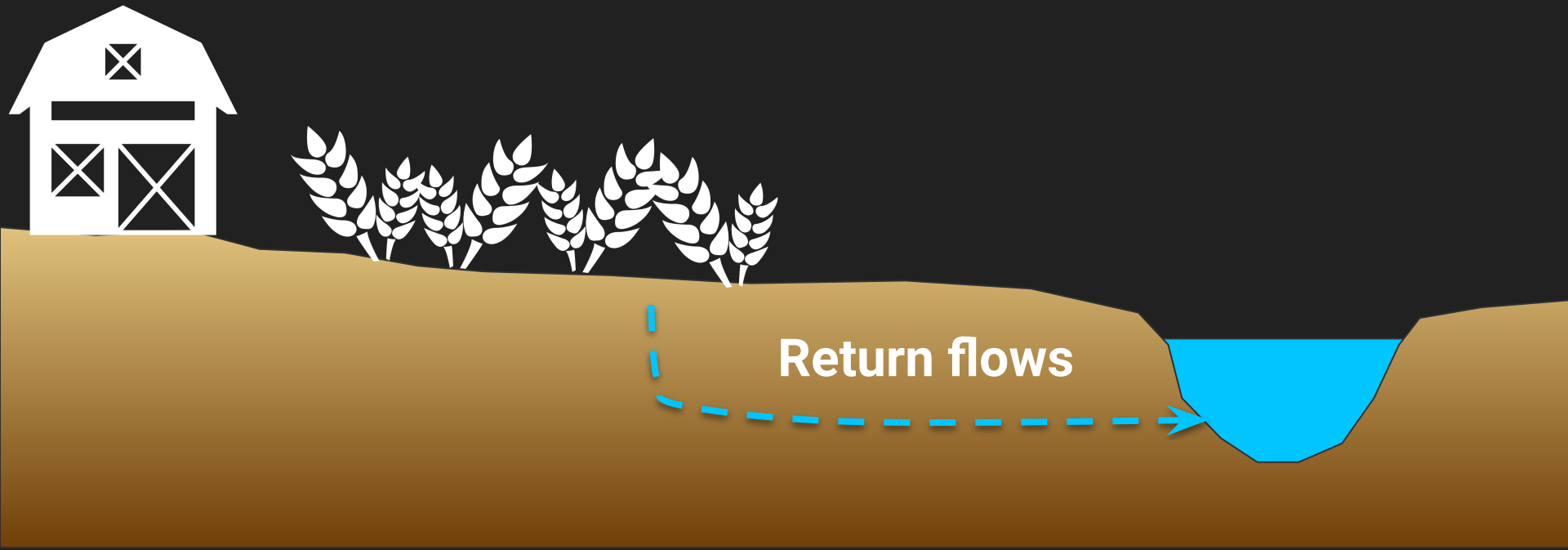
Christina Morrisett
Henry's Fork Foundation

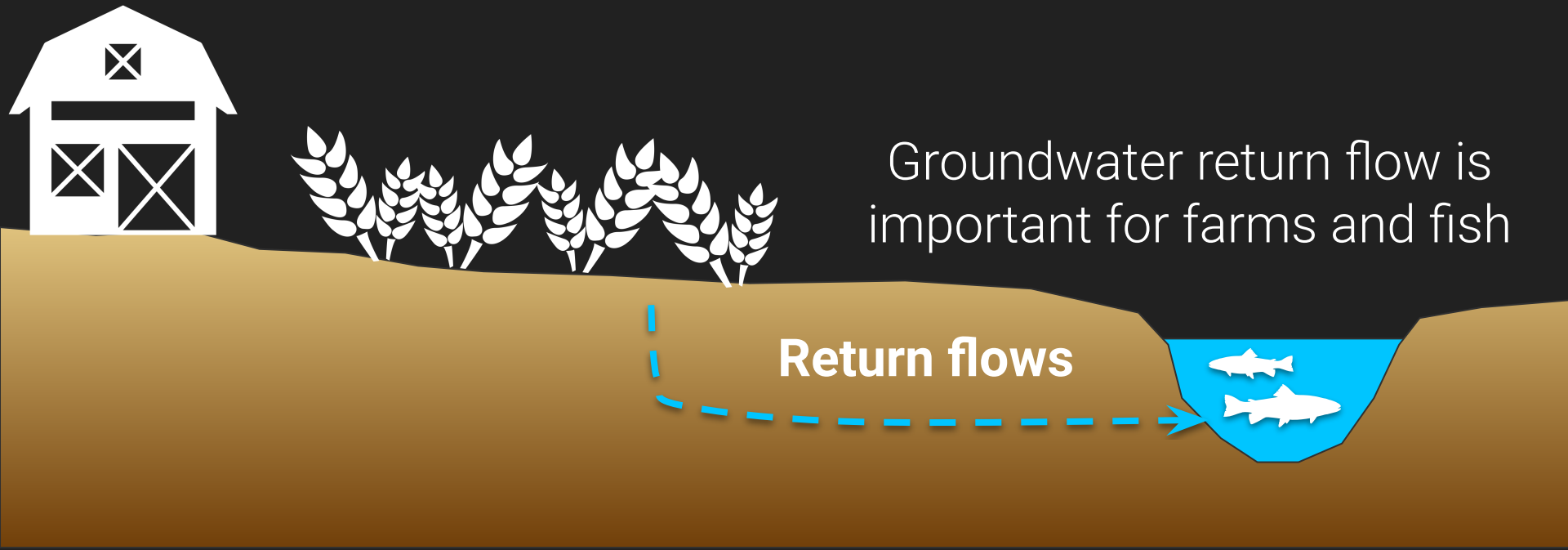
Rob Van Kirk
Henry's Fork Foundation

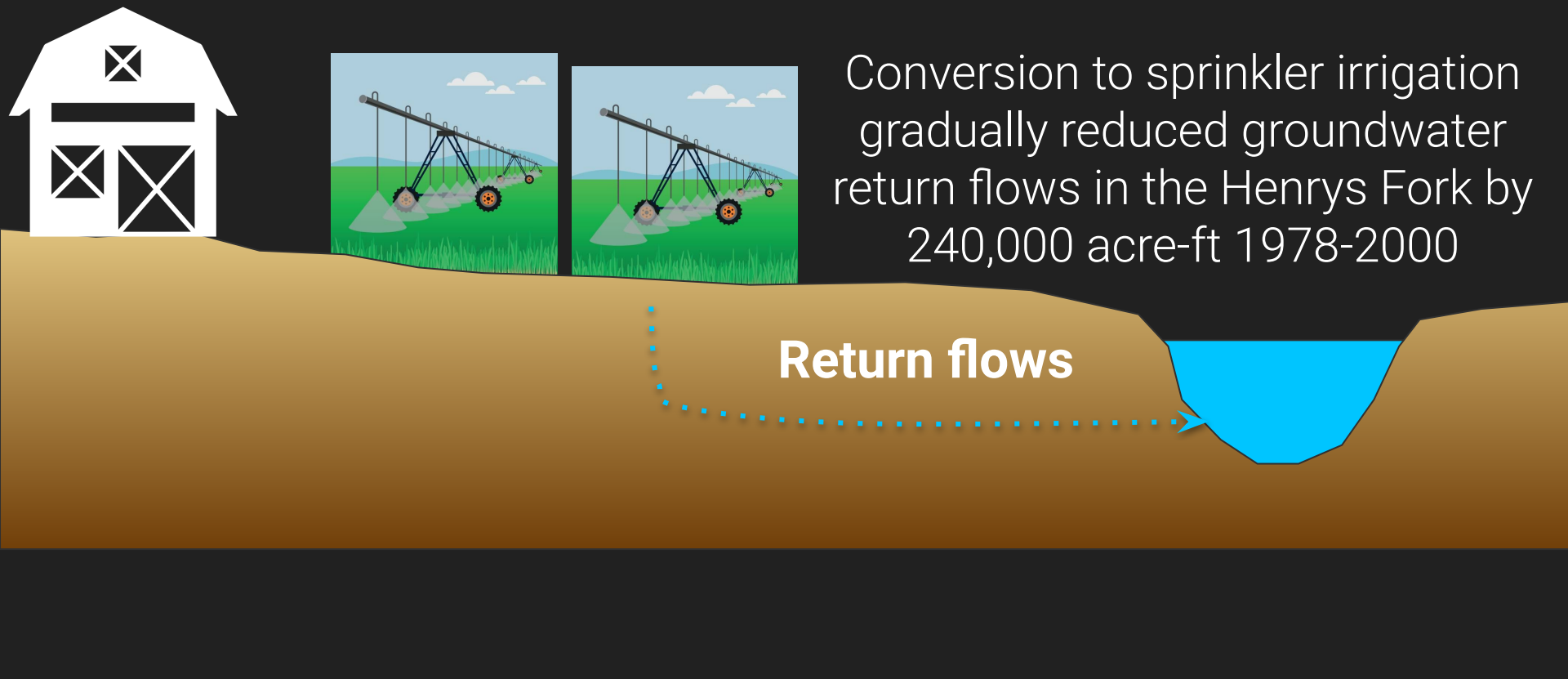
Sarah Null
Utah State University

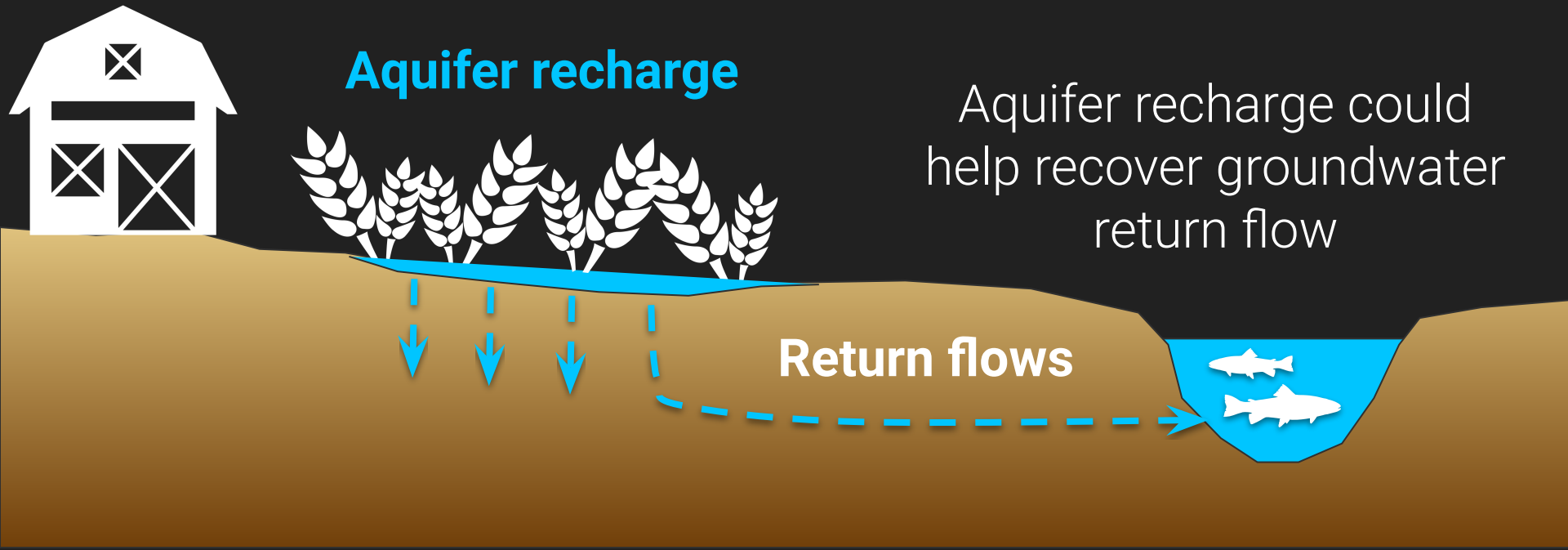



Evapotranspiration
Return flows
Deep aquifer percolation


Return flows


Groundwater return flow is important for farms and fish
Return flows

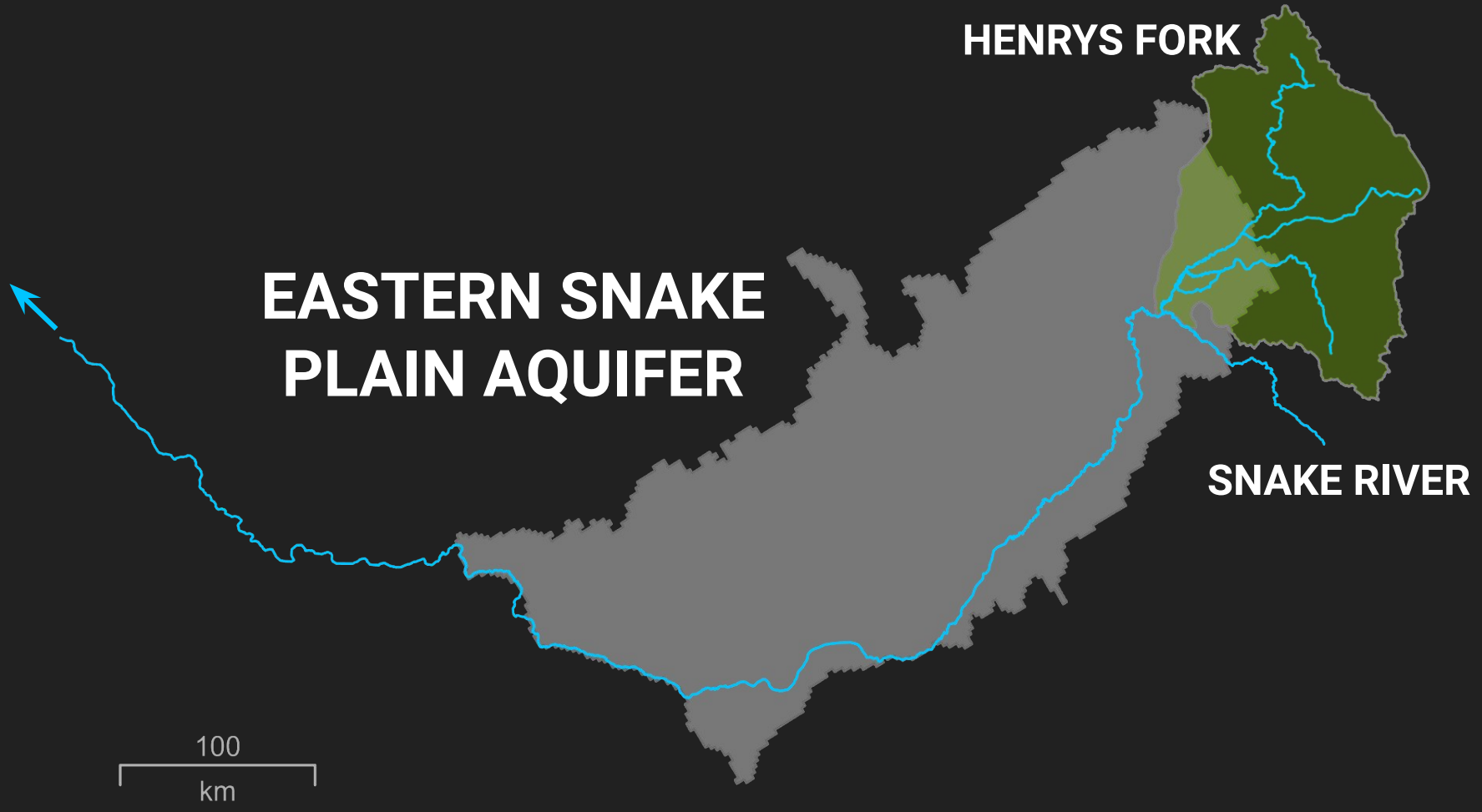

Conversion to sprinkler irrigation gradually reduced groundwater return flows in the Henrys Fork by 240,000 acre-ft 1978-2000
Return flows



Aquifer recharge could help recover groundwater return flow

QUESTION:

In the lower Henry's Fork, can aquifer recharge recover return flows under prior appropriation with future water supply?


HENRYS FORK
EASTERN SNAKE PLAIN AQUIFER
SNAKE RIVER
100
km

BACKGROUND: *Aquifer recharge types in Idaho*

Managed recharge

Incidental recharge

BACKGROUND: *Aquifer recharge types in Idaho*

Managed recharge

- **Uses existing canals to deliver water from rivers to constructed recharge basins**
- **Has a water right for managed aquifer recharge**
- **Water right is junior to irrigation and reservoir storage rights**

BACKGROUND: *Aquifer recharge types in Idaho*

Managed recharge

- **Uses existing canals to deliver water from rivers to constructed recharge basins**
- **Has a water right for managed aquifer recharge**
- **Water right is junior to irrigation and reservoir storage rights**

Defined recharge as recharge under the IWRB 1998 natural flow rights. Considering large-scale availability of recharge to contribute to state's program.

BACKGROUND: *Aquifer recharge types in Idaho*

- Occurs as part of regular flood irrigation operation
- Uses existing natural streamflow rights for irrigation (senior)
- Limited to April-October

Incidental recharge

QUESTION:

In the lower Henry's Fork, can aquifer recharge recover return flows under prior appropriation with future water supply?

METHODS:

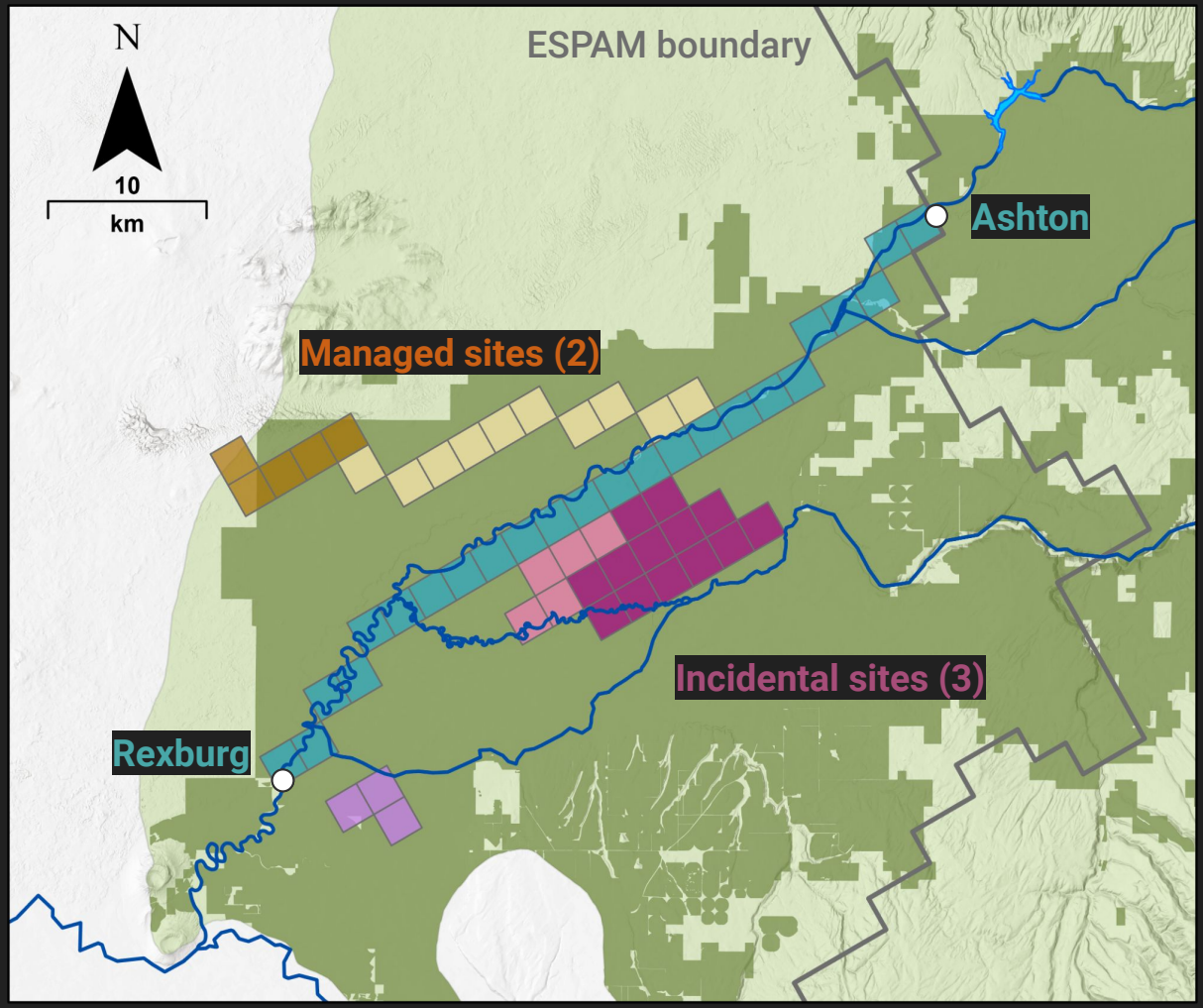
Identify potential recharge sites

Local knowledge + previous work

METHODS:

Identify potential recharge sites

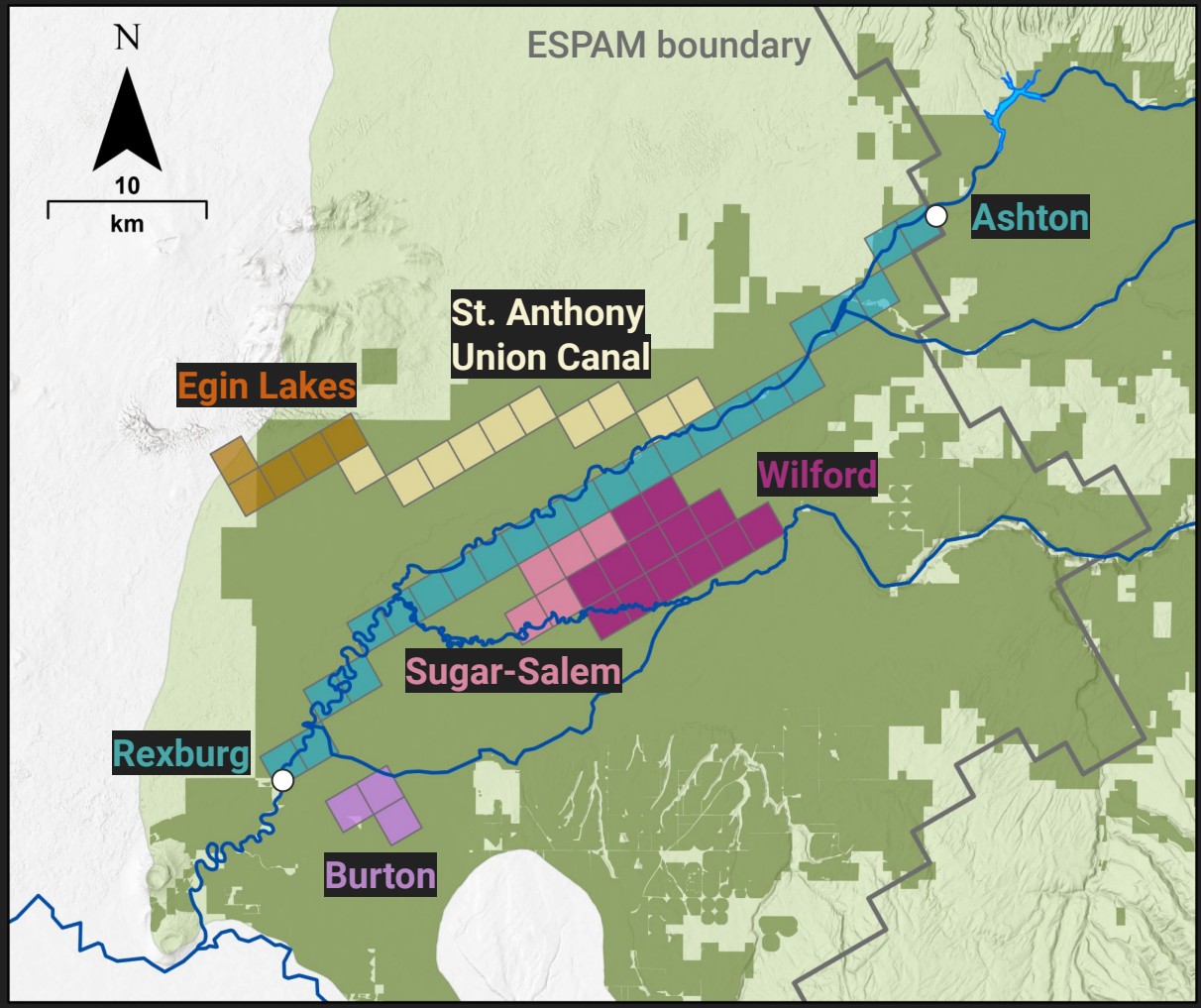
Local knowledge + previous work



METHODS:

Identify potential recharge sites

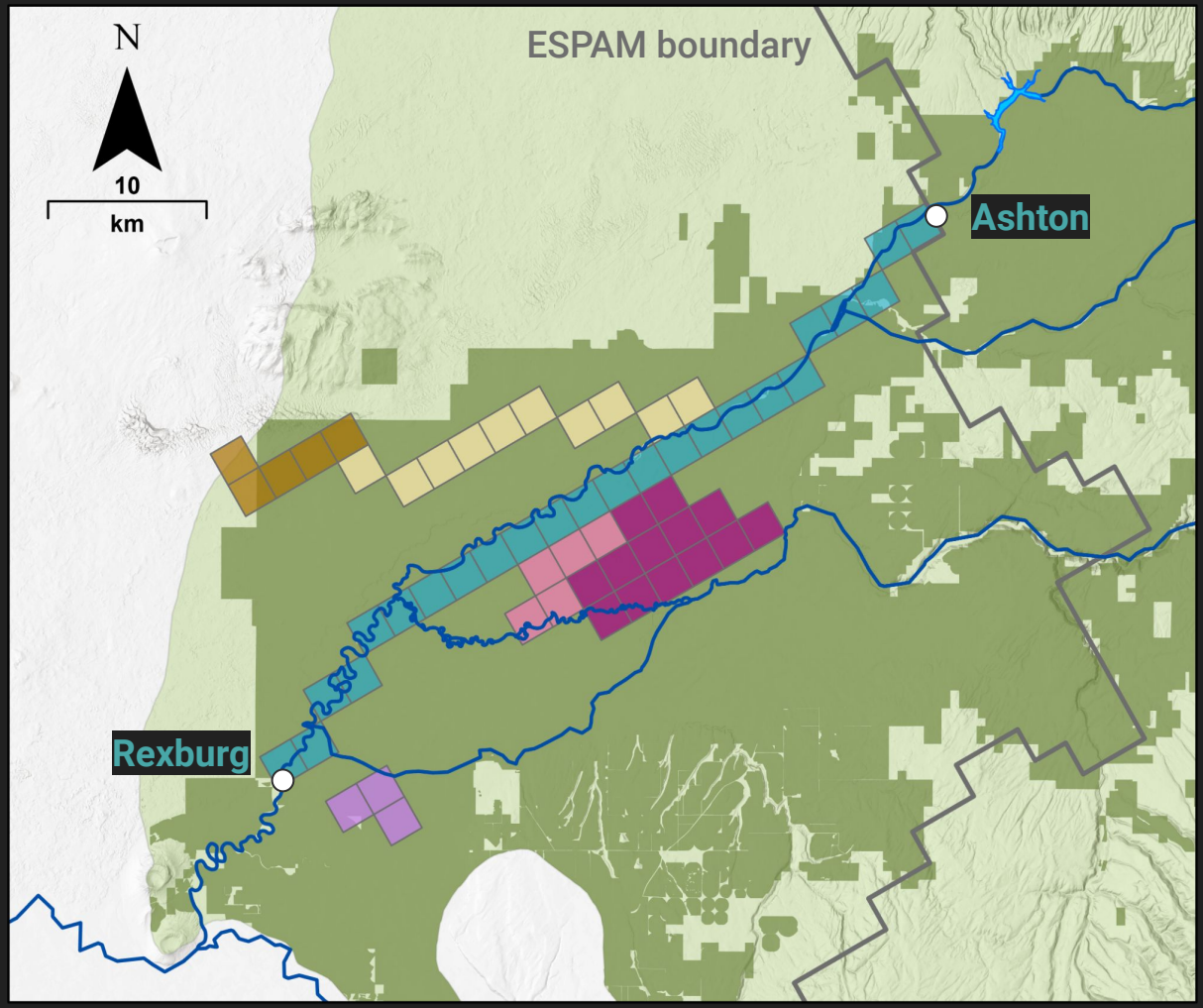
Local knowledge + previous work



METHODS:

Identify potential recharge sites

Local knowledge + previous work



METHODS:

Future streamflow forecasting model

future water supply

Reservoir operations model

prior appropriation

Site-specific GW-SW response model

Lower Henry's Fork

METHODS:

Oct 1 1989-Oct 1 2022
climate + streamflow data

Future streamflow forecasting model

1,000 simulations
30-year daily streamflow

METHODS:

Oct 1 1989-Oct 1 2022
climate + streamflow data

Future streamflow forecasting model

1,000 simulations
30-year daily streamflow

Reservoir operations model

METHODS:

Oct 1 1989-Oct 1 2022
climate + streamflow data

↓

Future streamflow forecasting model

1,000 simulations
30-year daily streamflow

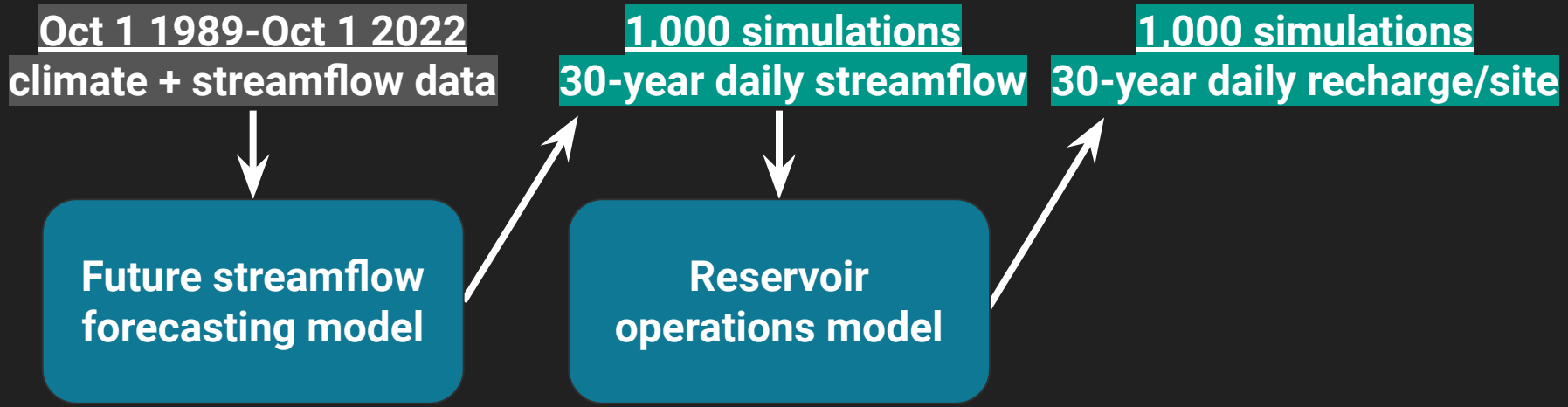
↓

Reservoir operations model

Rules

- *Meet irrigation demand*
- *Incidental recharge Apr-Oct*
- *Managed recharge Mar-Nov*
- *Meet streamflow targets*
- *Adhere to canal capacity above that needed to meet irrigation demand*
- *No recharge during draft*
- *Managed recharge allowed to use storage water when IP Reservoir >126000 af on Oct-1*

METHODS:


Oct 1 1989-Oct 1 2022
climate + streamflow data
Future streamflow forecasting model
1,000 simulations
30-year daily streamflow
Reservoir operations model
1,000 simulations
30-year daily recharge/site

METHODS:

Oct 1 1989-Oct 1 2022
climate + streamflow data

↓

Future streamflow forecasting model

1,000 simulations
30-year daily streamflow

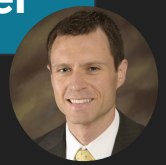
↓

Reservoir operations model

1,000 simulations
30-year daily recharge/site

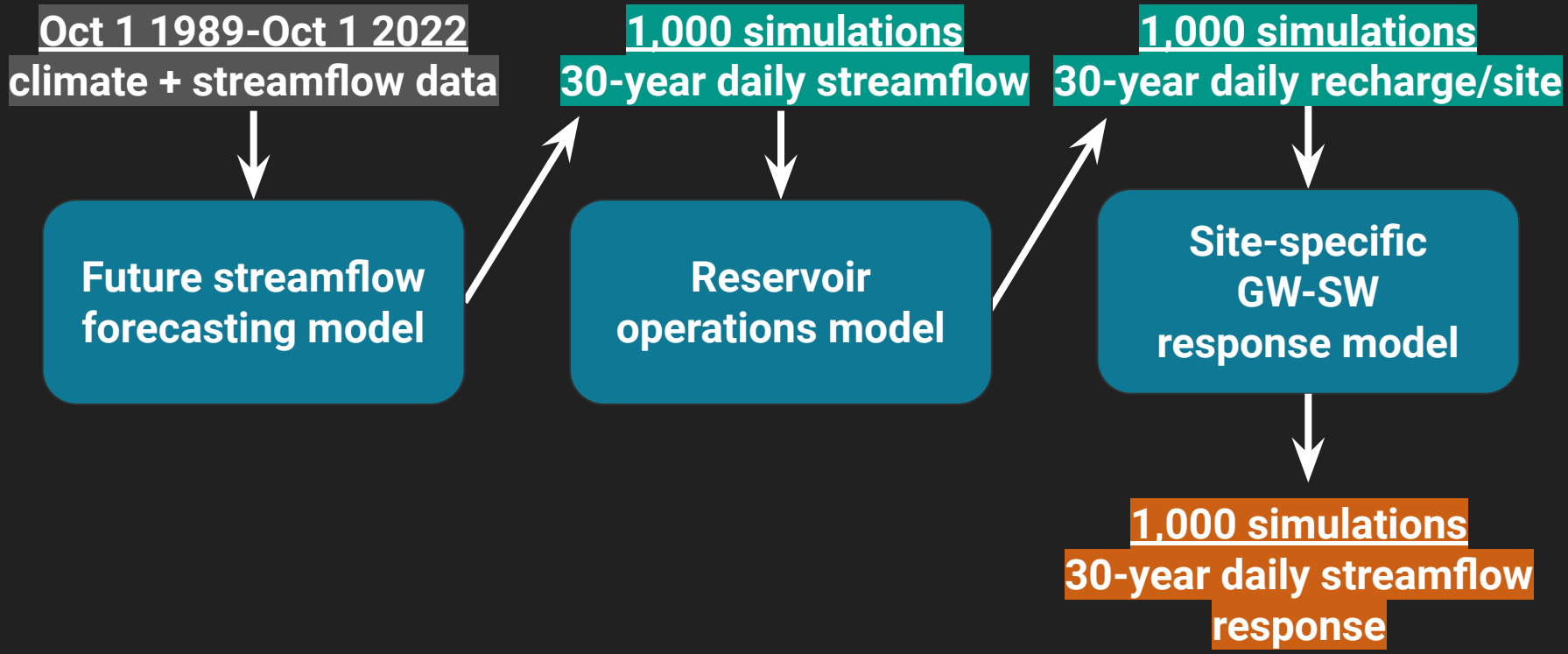
↓

Site-specific GW-SW response model

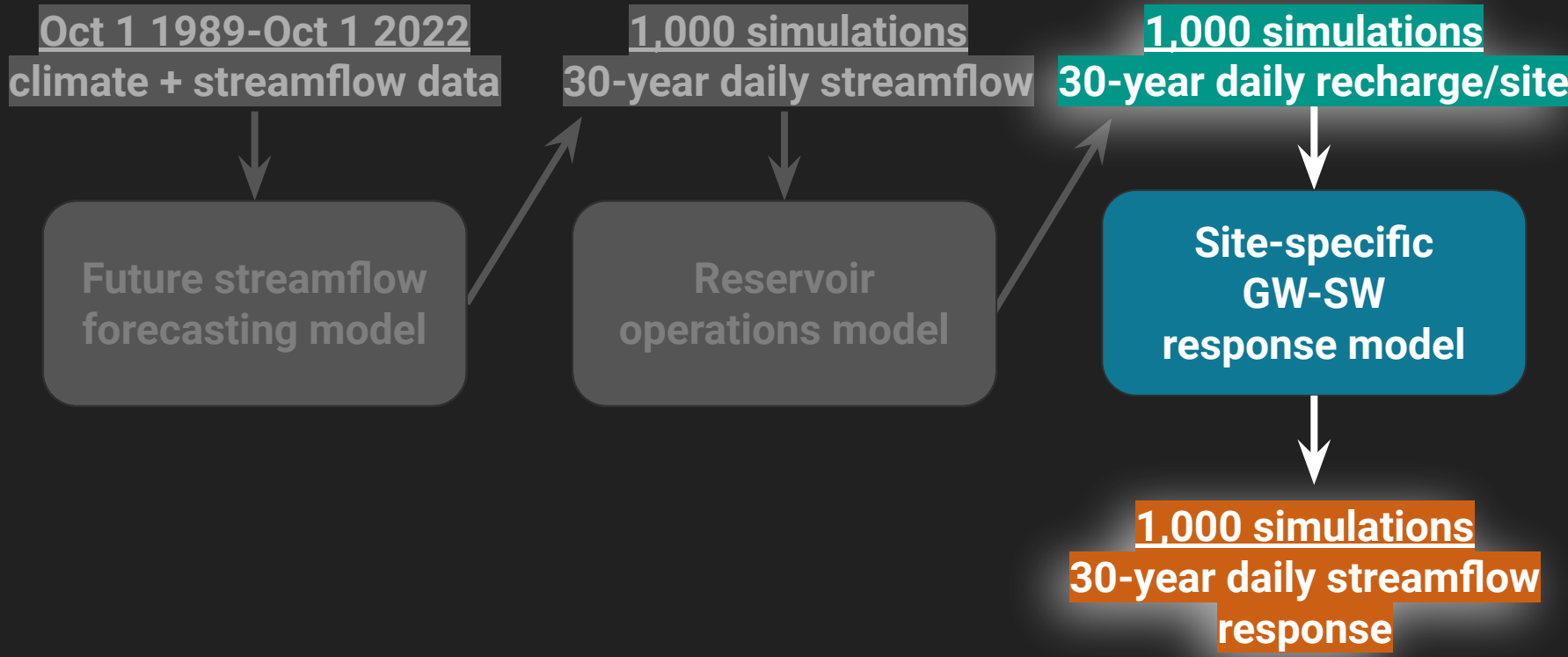


Curtis Nelson
BYU-I

METHODS:


Oct 1 1989-Oct 1 2022
climate + streamflow data
Future streamflow forecasting model
1,000 simulations
30-year daily streamflow
Reservoir operations model
1,000 simulations
30-year daily recharge/site
Site-specific GW-SW response model
1,000 simulations
30-year daily streamflow response

METHODS:

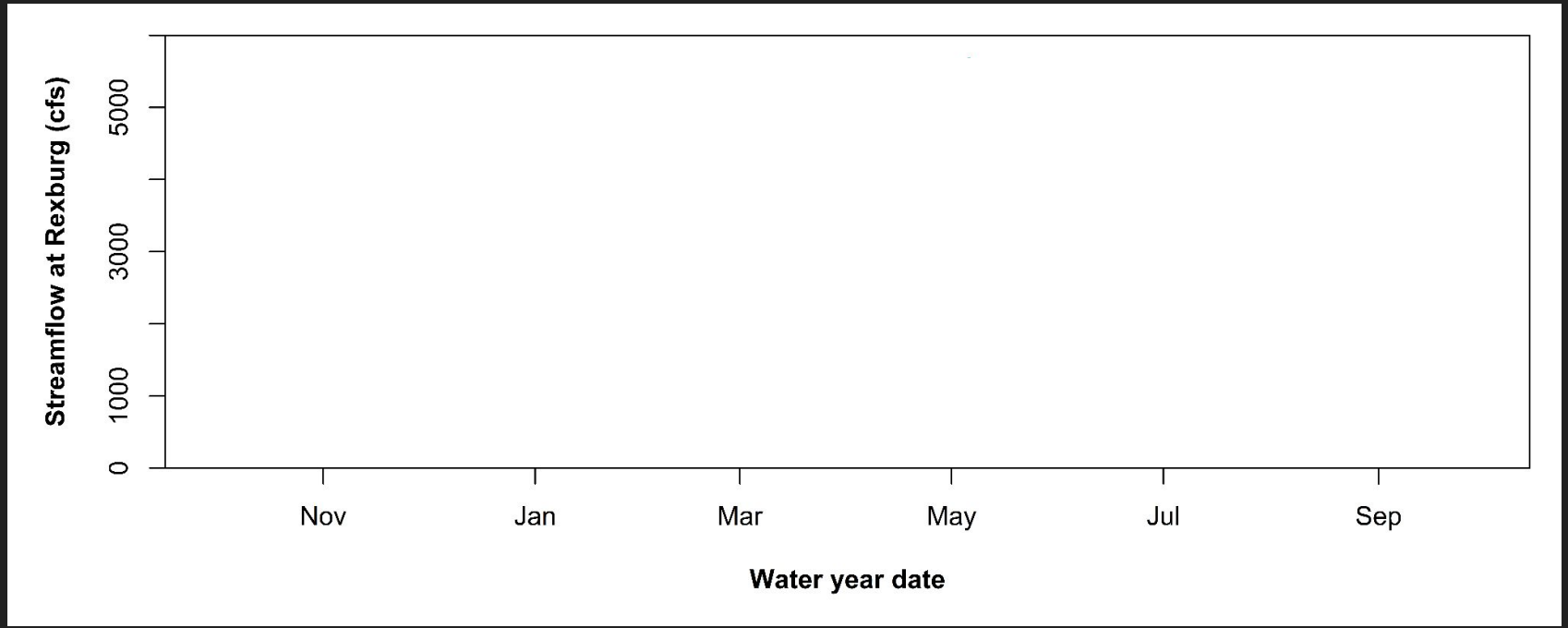

Oct 1 1989-Oct 1 2022
climate + streamflow data
Future streamflow forecasting model
1,000 simulations
30-year daily streamflow
Reservoir operations model
1,000 simulations
30-year daily recharge/site
Site-specific GW-SW response model
1,000 simulations
30-year daily streamflow response

RESULTS:

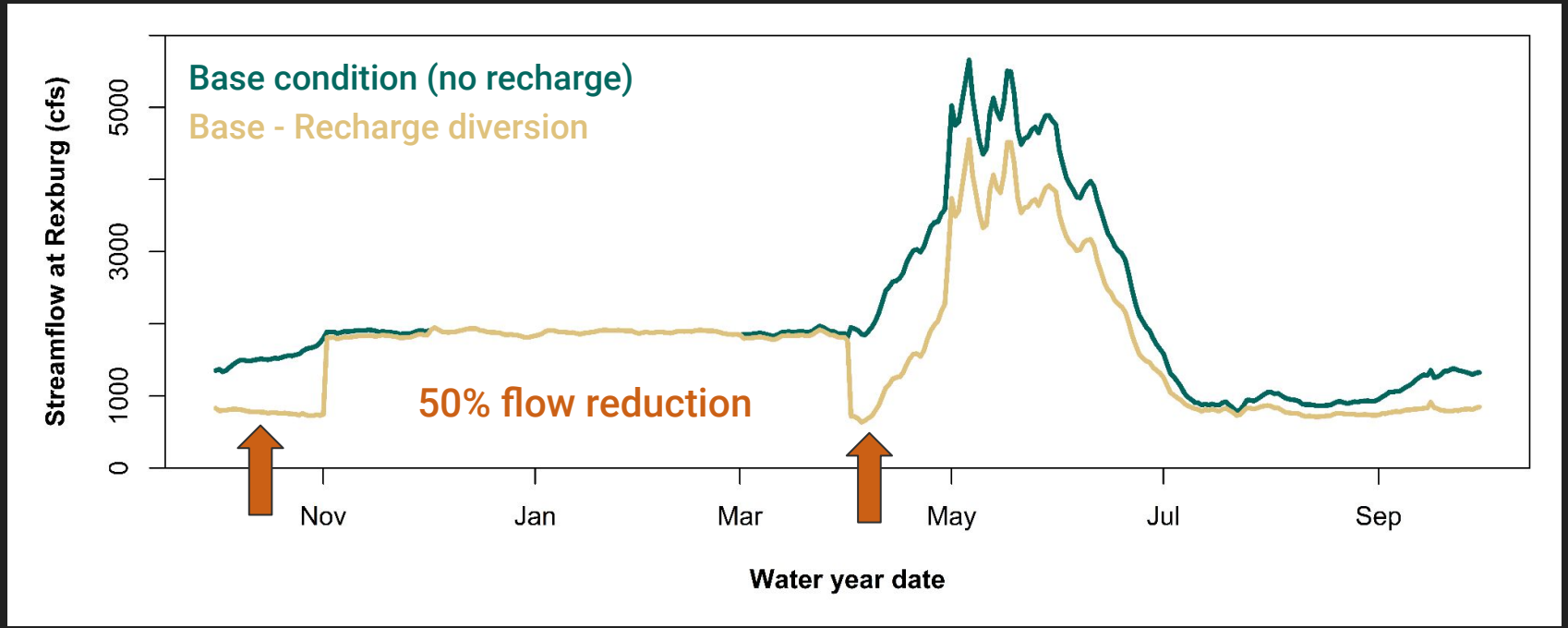
Across all 30,000 simulated water years, on average, 12% of annual streamflow diverted for recharge.

approx. 283,000 acre-ft

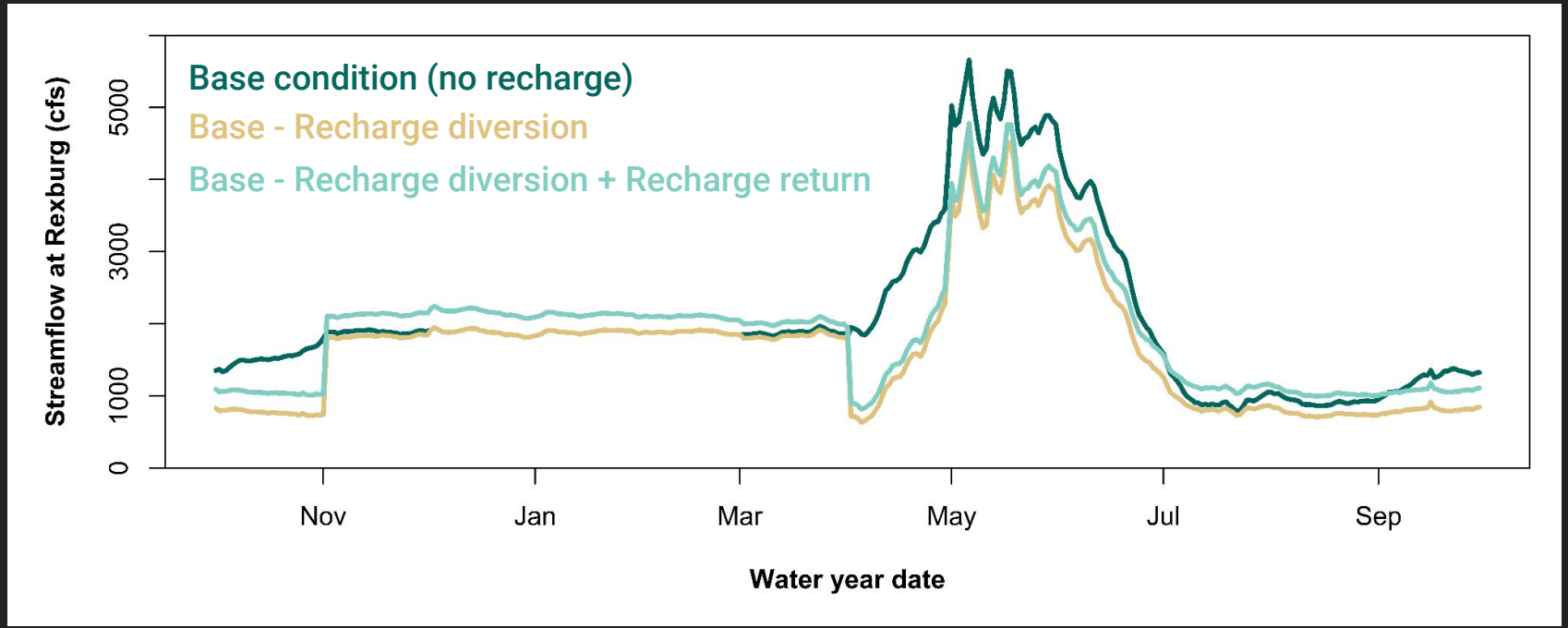
RESULTS:


Streamflow at Rexburg (cfs)
0
1000
3000
5000
Nov
Jan
Mar
May
Jul
Sep
Water year date

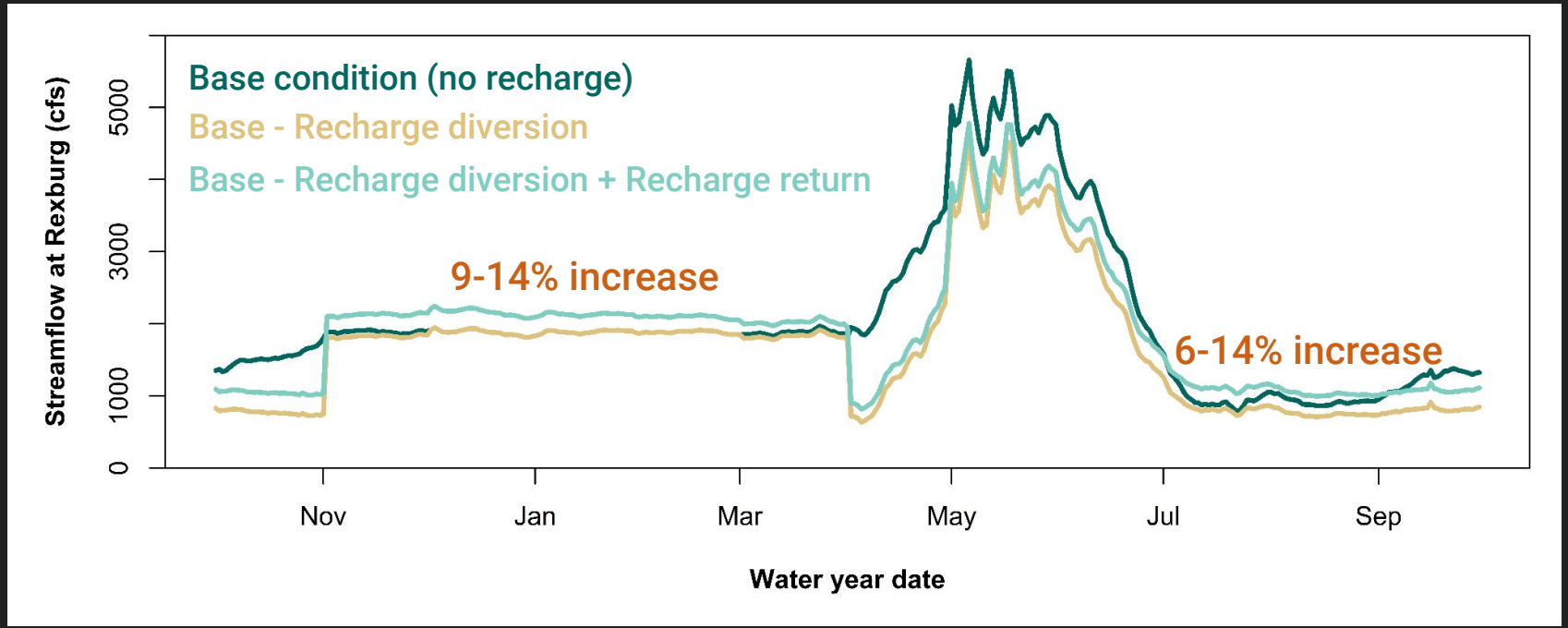
RESULTS: *Natural flow largely available in Oct + Apr*



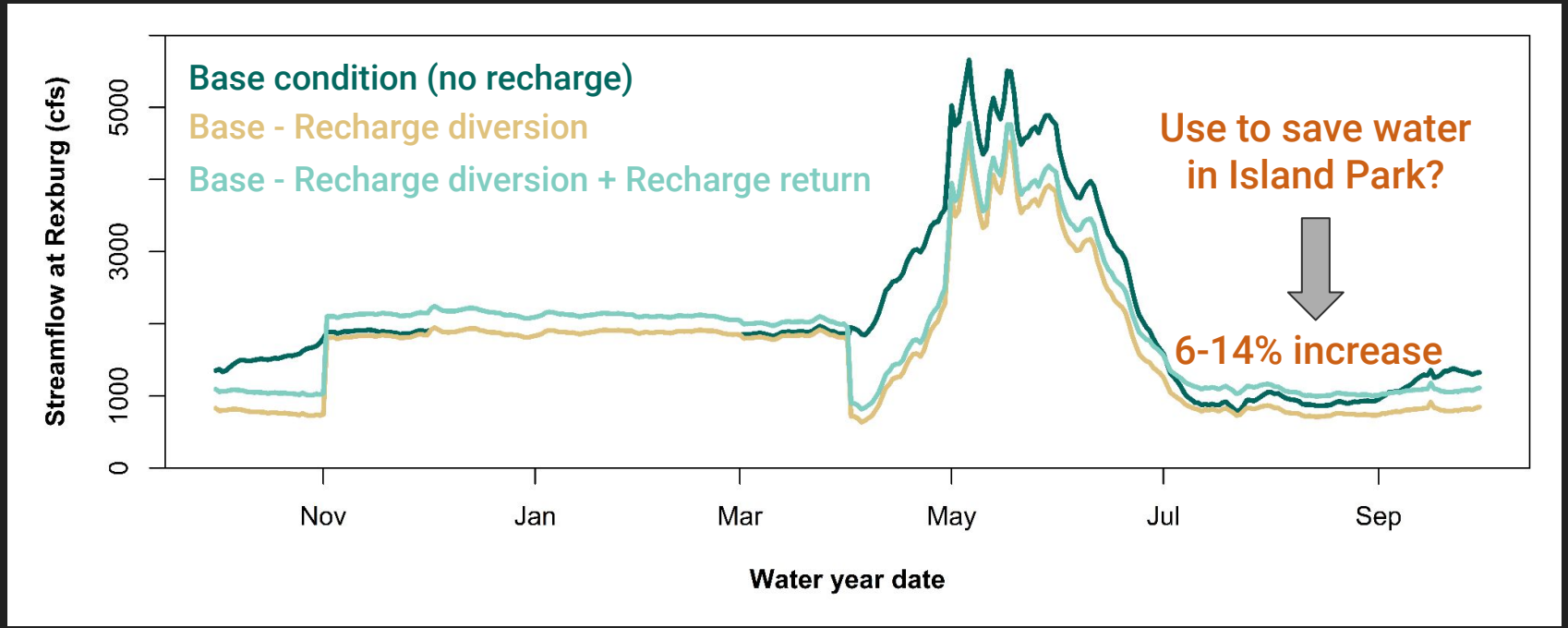
RESULTS: *Return flows increase base flows*



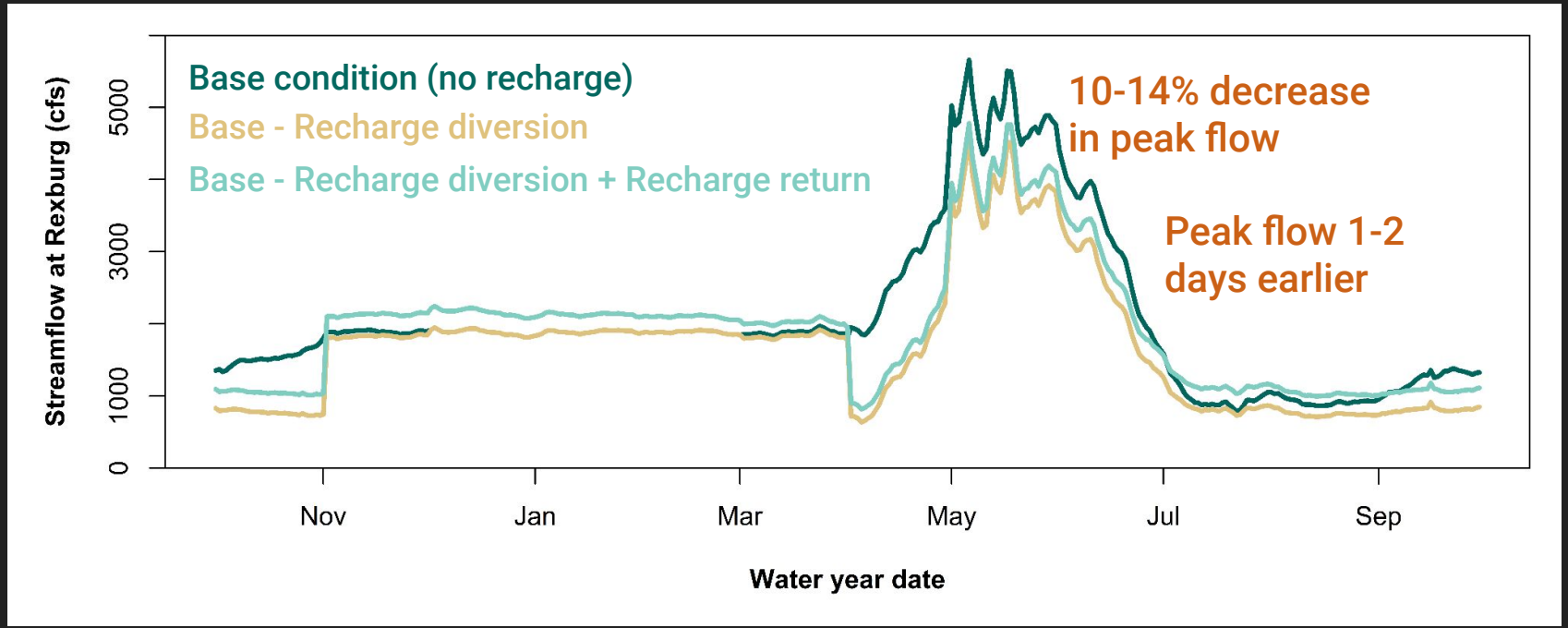
RESULTS: *Return flows increase base flows*



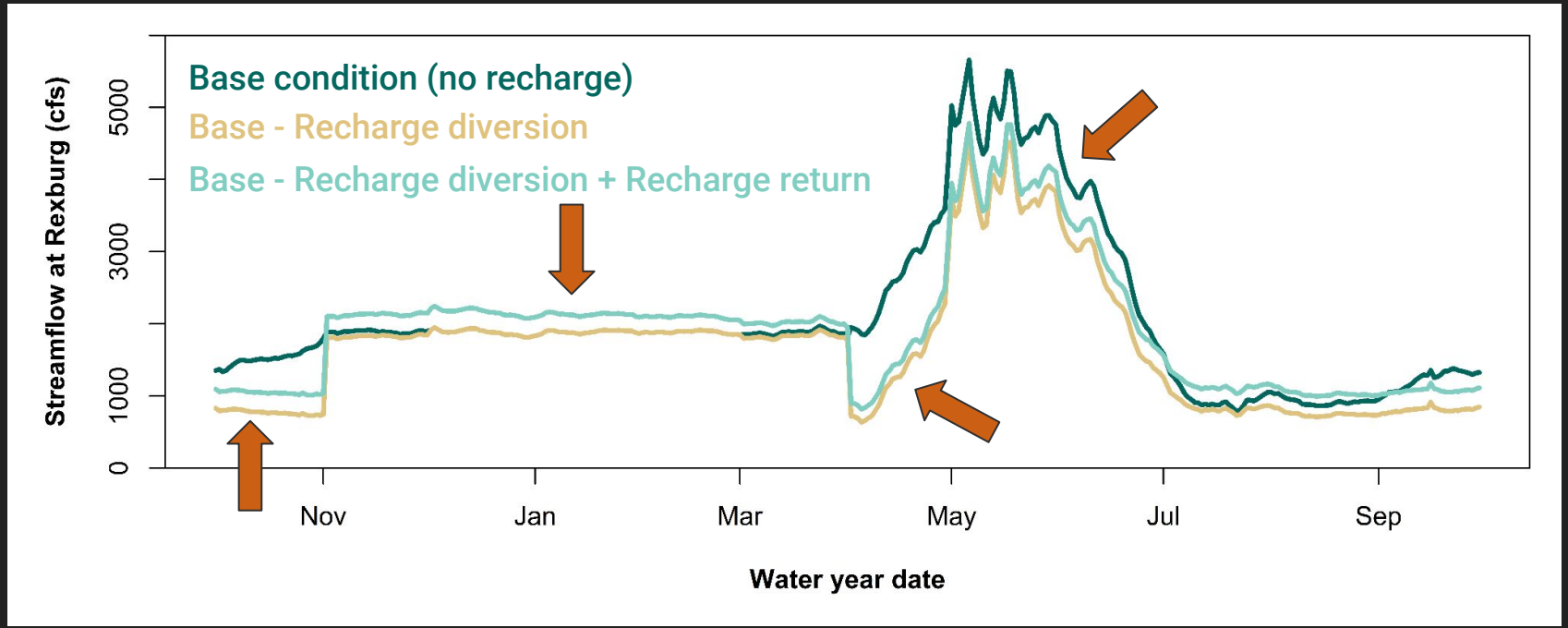
RESULTS: *Return flows increase base flows*



RESULTS: *Recharge impacts peak streamflow*



RESULTS:


Base condition (no recharge)
Base - Recharge diversion
Base - Recharge diversion + Recharge return
Streamflow at Rexburg (cfs)
0
1000
3000
5000
Nov
Jan
Mar
May
Jul
Sep
Water year date

RESULTS:

Junior water rights limit managed recharge

Water available in all years for incidental recharge

RESULTS: *Recharge possible via flood irrigation*

Water was available in all years, regardless of annual natural flow, because of senior water rights

<u>Proportion of annual recharge volume</u>

- Wilford: 43%
- Sugar-Salem: 37%
- Burton: 15%

In total, **95%** of water diverted for recharge was to these three sites

Incidental recharge (3)

Wilford, Sugar-Salem, Burton

RESULTS: *Water rights limit managed recharge*

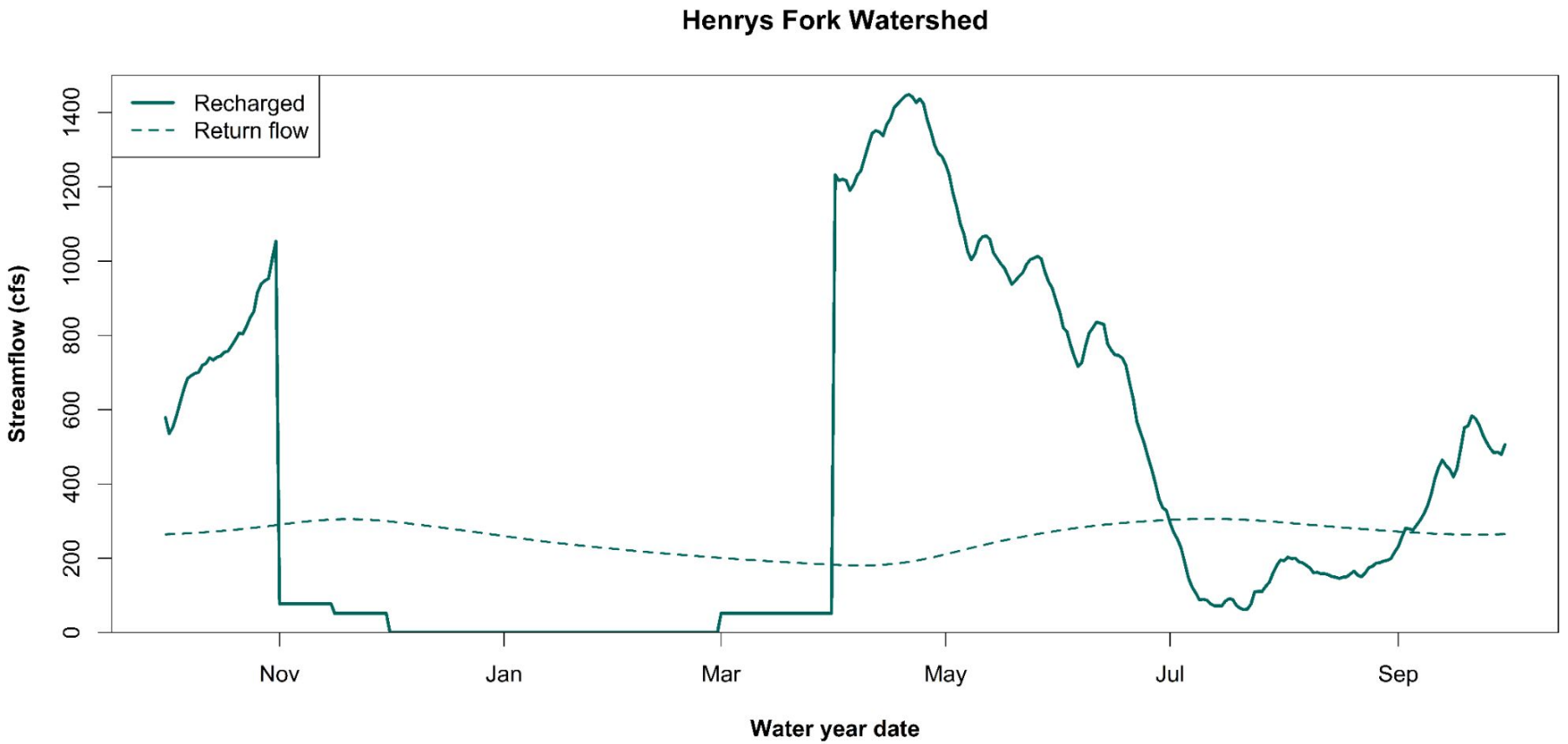
Managed recharge (2)
Egin Lakes and St. Anthony Union Canal

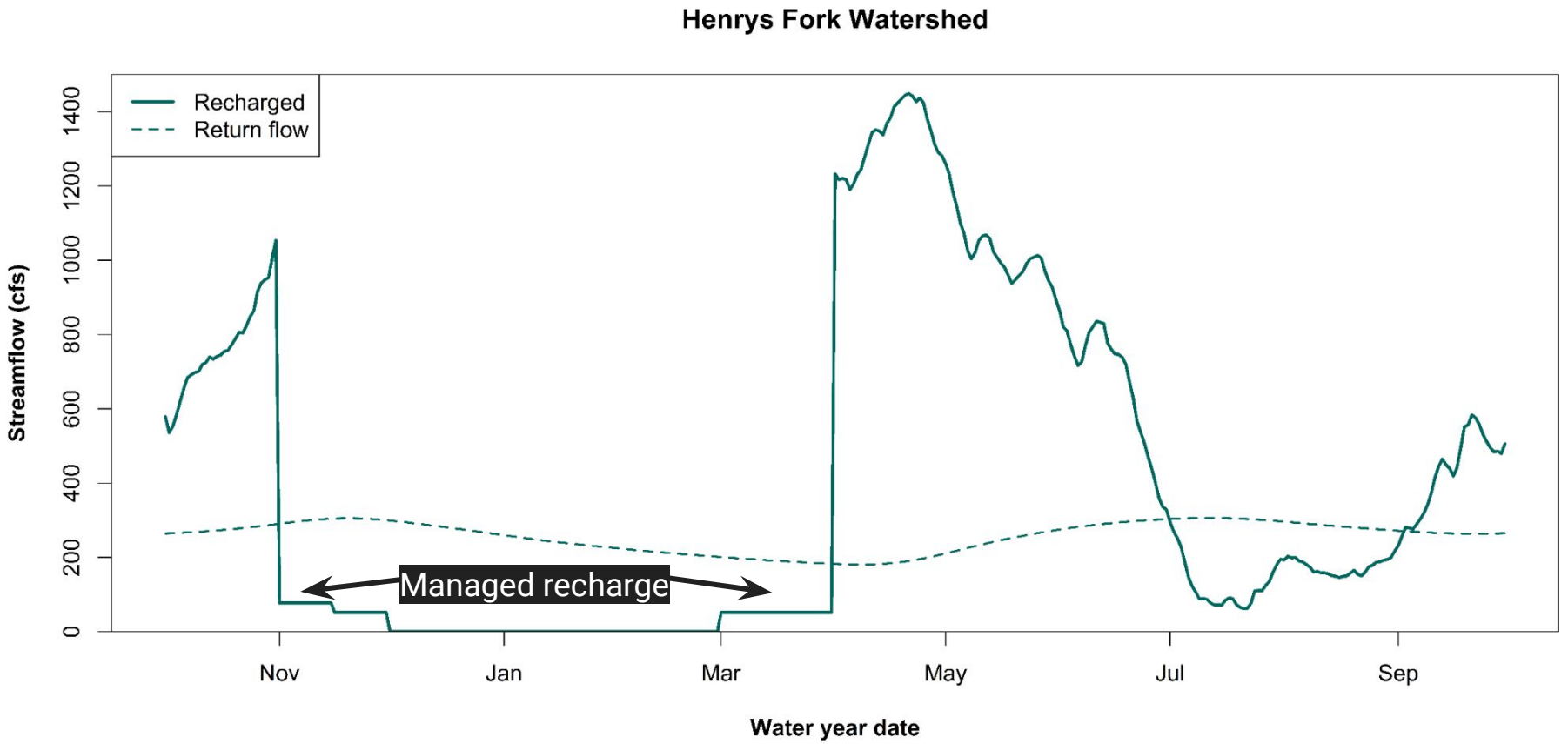
Water was available for managed recharge in 41% of 30,000 simulated water years

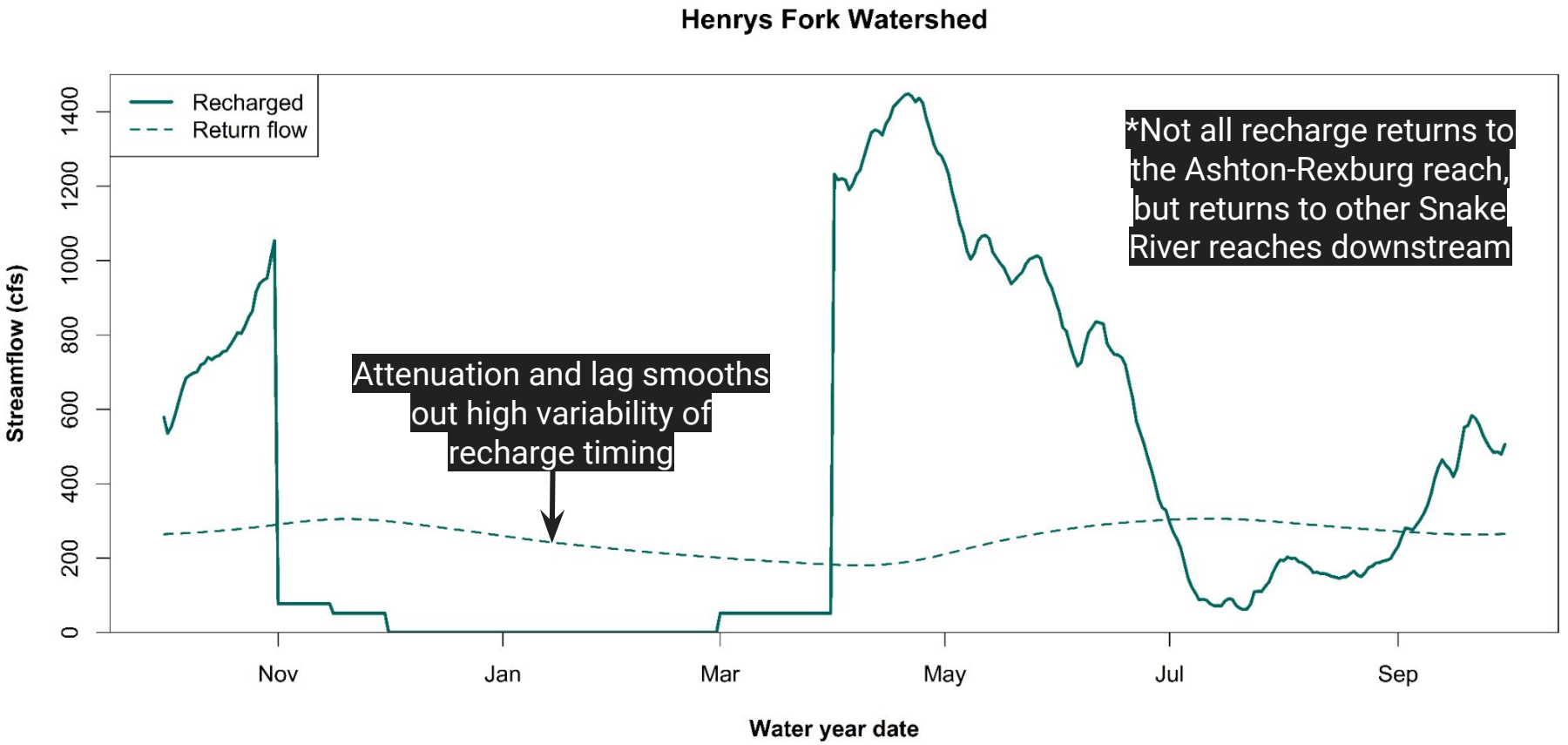
- **26% were wet years (annual streamflow >2,440,000 acre-ft)**
- **15% were fall recharge due to summer reservoir management**

<u>Proportion of annual recharge volume</u>

- **Egin Lakes: 4%**
- **St. Anthony Union Canal: 1%**

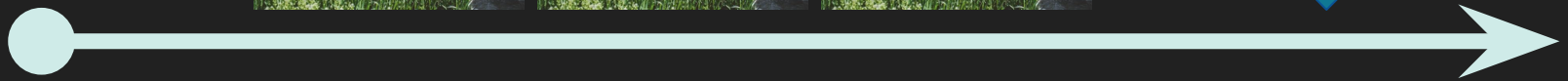

Henrys Fork Watershed
Recharged
Return flow
Streamflow (cfs)
0
200
400
600
800
1000
1200
1400
Nov
Jan
Mar
May
Jul
Sep
Water year date


Henrys Fork Watershed
Recharged
Return flow
Streamflow (cfs)
0
200
400
600
800
1000
1200
1400
Managed recharge
Nov
Jan
Mar
May
Jul
Sep
Water year date


Henrys Fork Watershed
Recharged
Return flow
Streamflow (cfs)
0
200
400
600
800
1000
1200
1400
Nov
Jan
Mar
May
Jul
Sep
Water year date
*Not all recharge returns to the Ashton-Rexburg reach, but returns to other Snake River reaches downstream
Attenuation and lag smooths out high variability of recharge timing

SUMMARY:

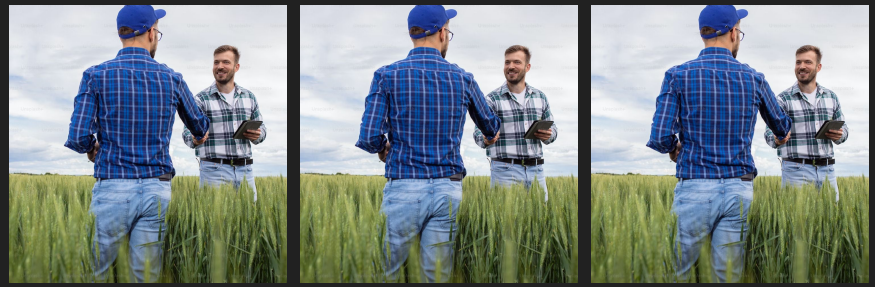
Return flows



We can recover return flows using incidental recharge by flood irrigating with senior water rights

NEXT STEPS

Conducting coordinated incidental recharge will require partnerships & collaboration



LIMITATIONS

But residential development of agricultural land will likely limit recharge feasibility

TAKE-HOME MESSAGE

Flood irrigation paired with senior water rights can be a mechanism for drought resiliency of irrigators + aquatic habitats

Managed aquifer recharge expands recharge capacity during wet years

Christina Morrisett
christina@henrysfork.org

THANK YOU

Funding provided by:
Henry's Fork Foundation
ACWA Lab @ Utah State
NSF Grant No. 1633756
USBR Applied WaterSMART

Collaborators:
Rob Van Kirk
Sarah Null

Research submitted for peer review 11/21/23