

# **Water and nitrogen export from the UNH Organic Dairy Research Farm Lee, New Hampshire**

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**USDA Sustainable Agriculture Research and Education (SARE)**

**Aber, McDowell, Davis**

**Thanks!**

**Allison Price, Brian Godbois, Adam Bauman, Jennifer Campbell, Scott  
Arndt, Rich Brereton, Alix Contosta, Weike Yao, Michelle Galvin,  
Catherine Dunlap**

**Nicole Guindon, Trent Schriefer and Everyone at the Farm!**

# UNH Organic Dairy Research Farm

## Aqueous Nitrogen Balance:

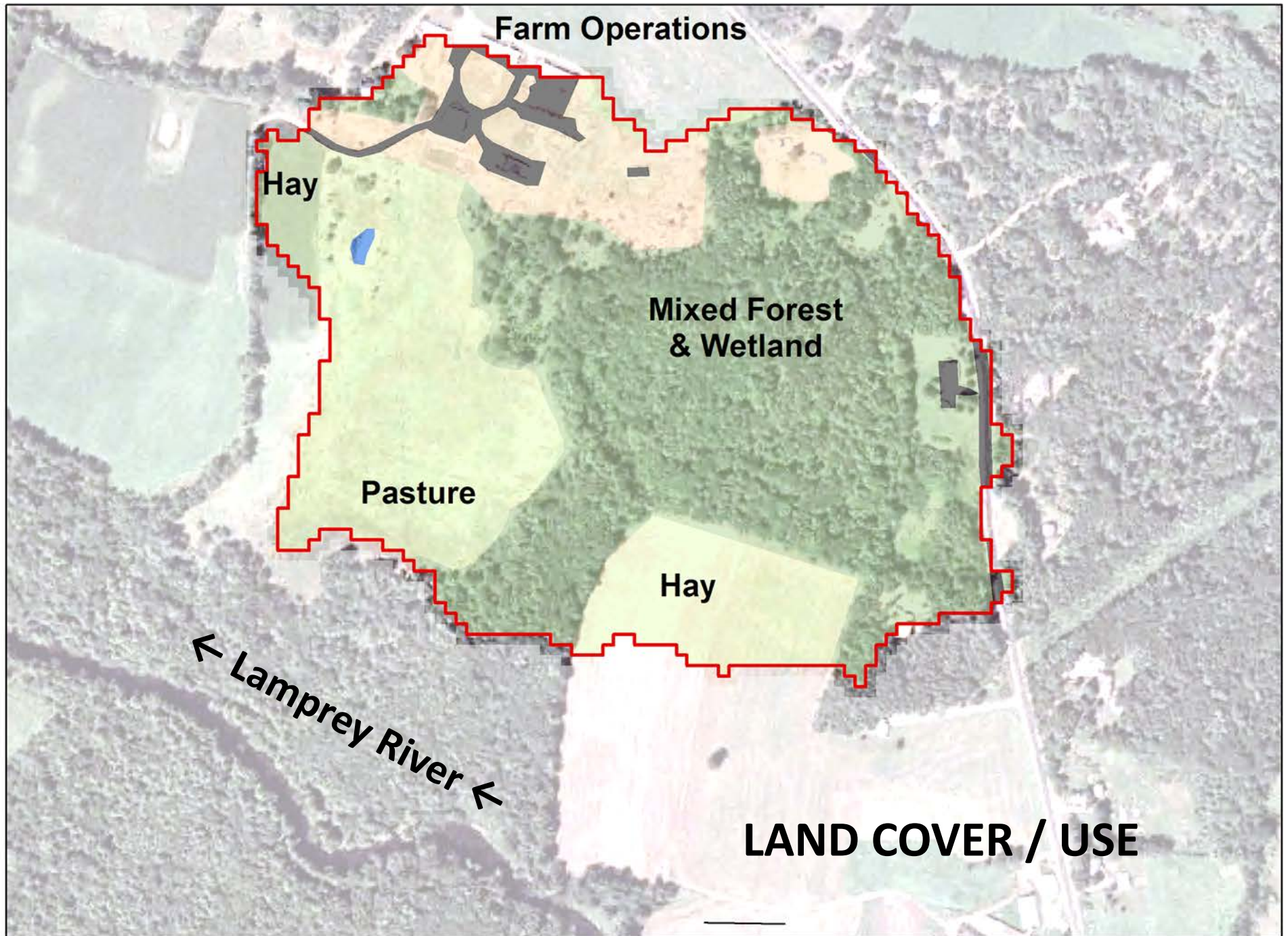
- How does farm use interact with the ecosystem?
- What are the major inputs, transformations, and **outputs** of nitrogen to, in, and from the farm?

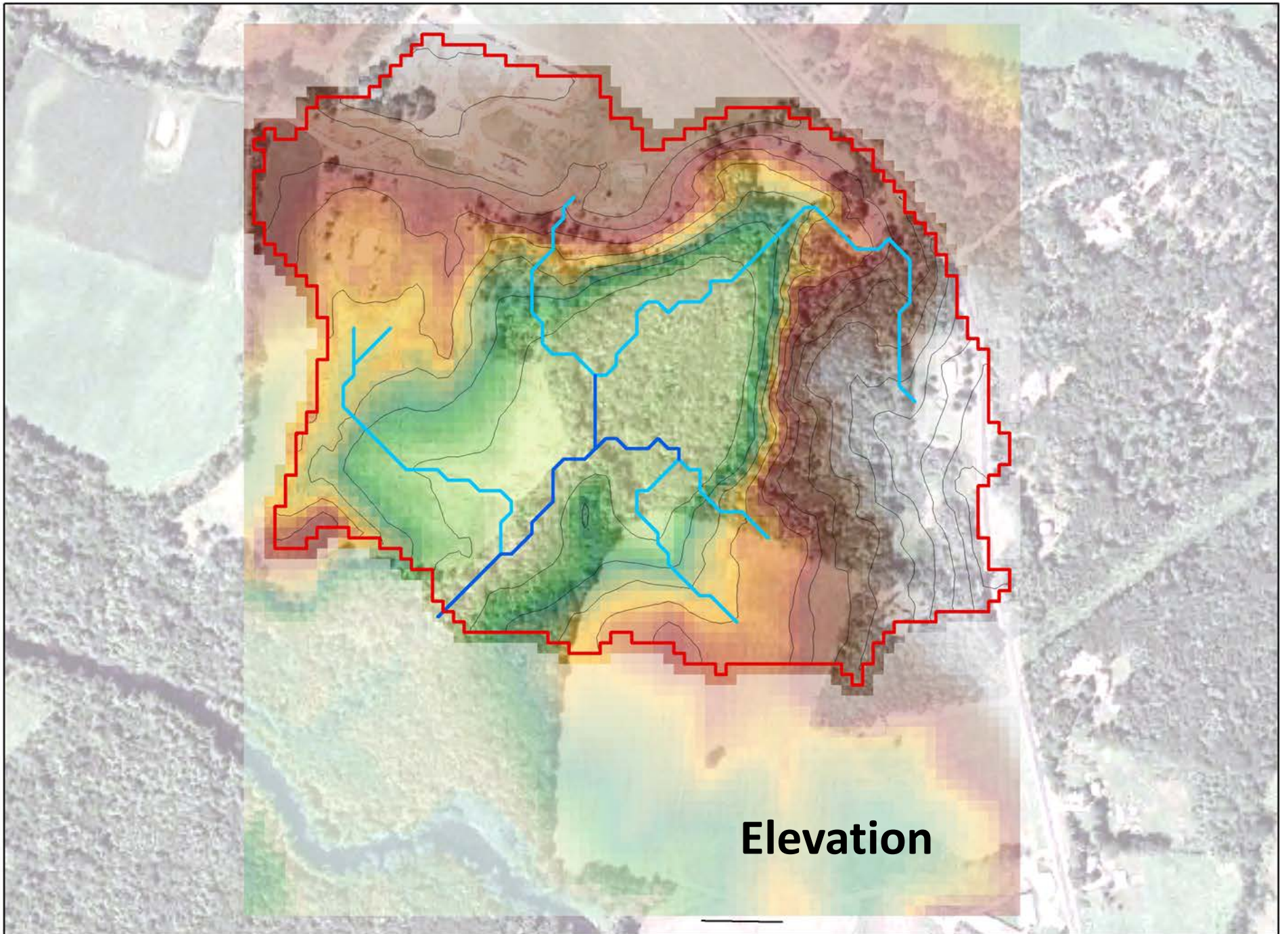
**N balance → Water balance → Water balance model**

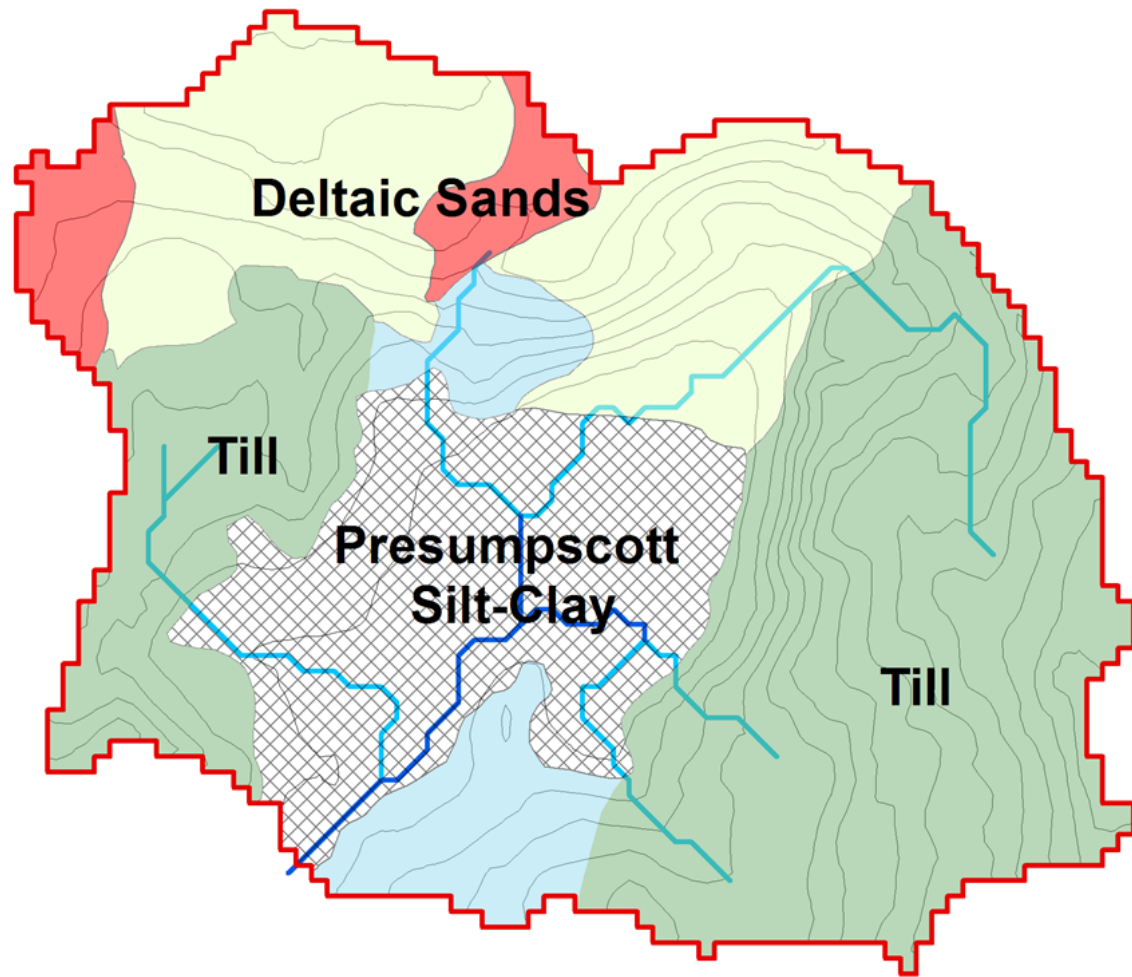
**Overview** of Farm setting, measurements, model.

**Predictions** of two major flow paths from farm ...

... and the **Nitrogen export** through them.

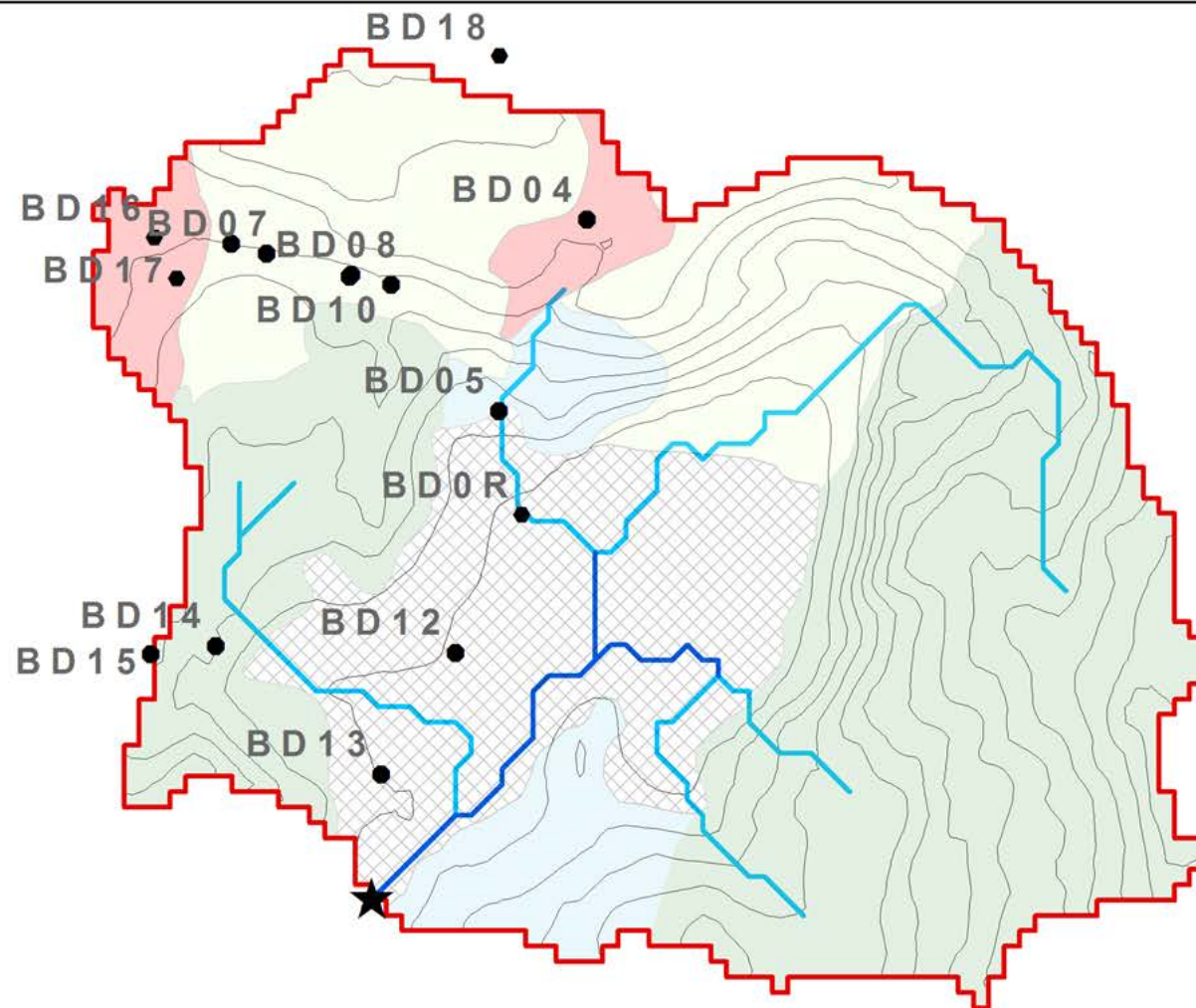






**Glacial Geology**

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**Well Network /  
Stream Gauge**



**The mighty Burley DeMeritt!**

**MODFLOW-NWT**

**+ Unsaturated  
Zone Flow**

**Streamflow:**

**Drains**

**+ UZ Runoff**

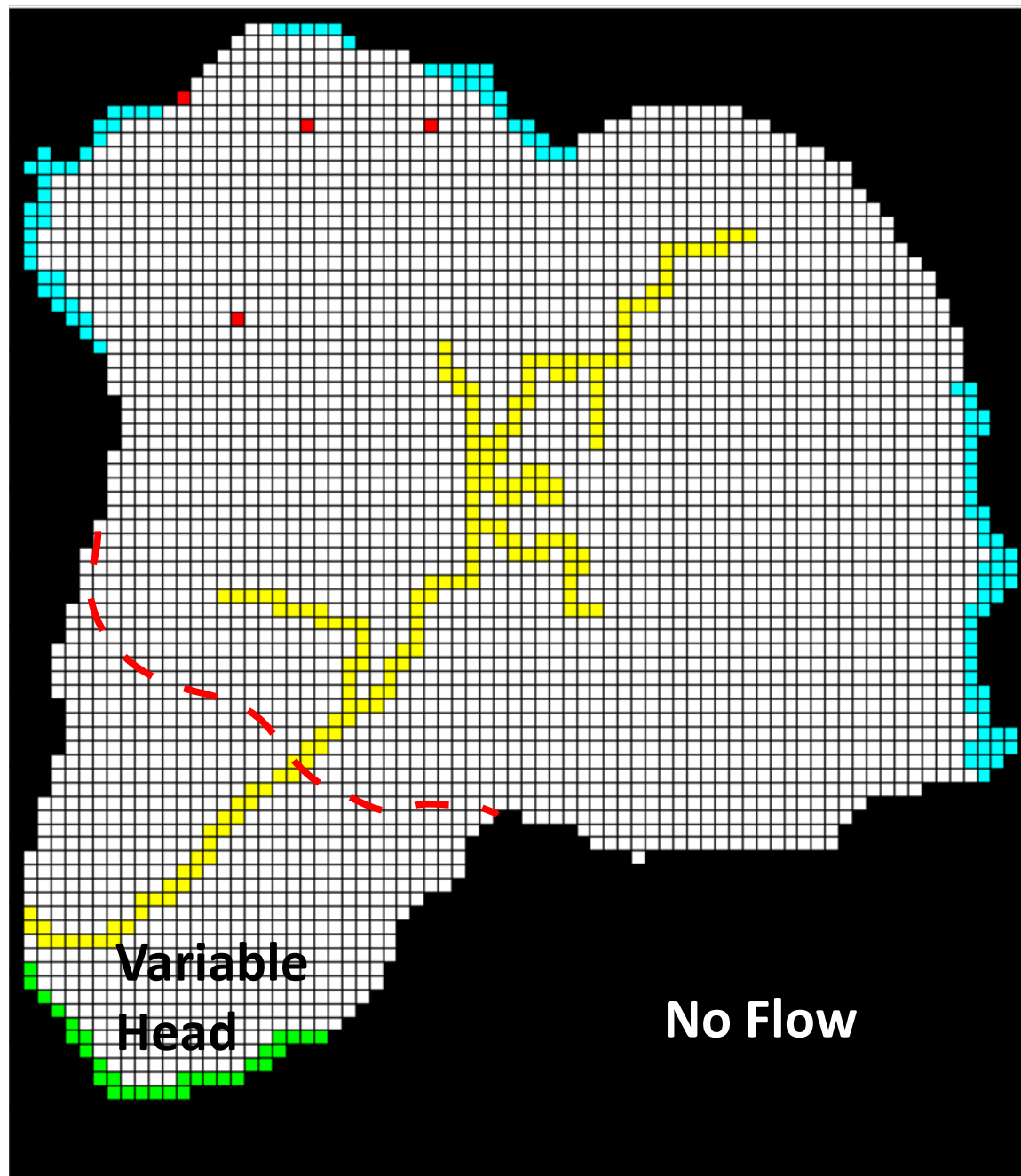
**Lamprey River**

**Time Varying Head**

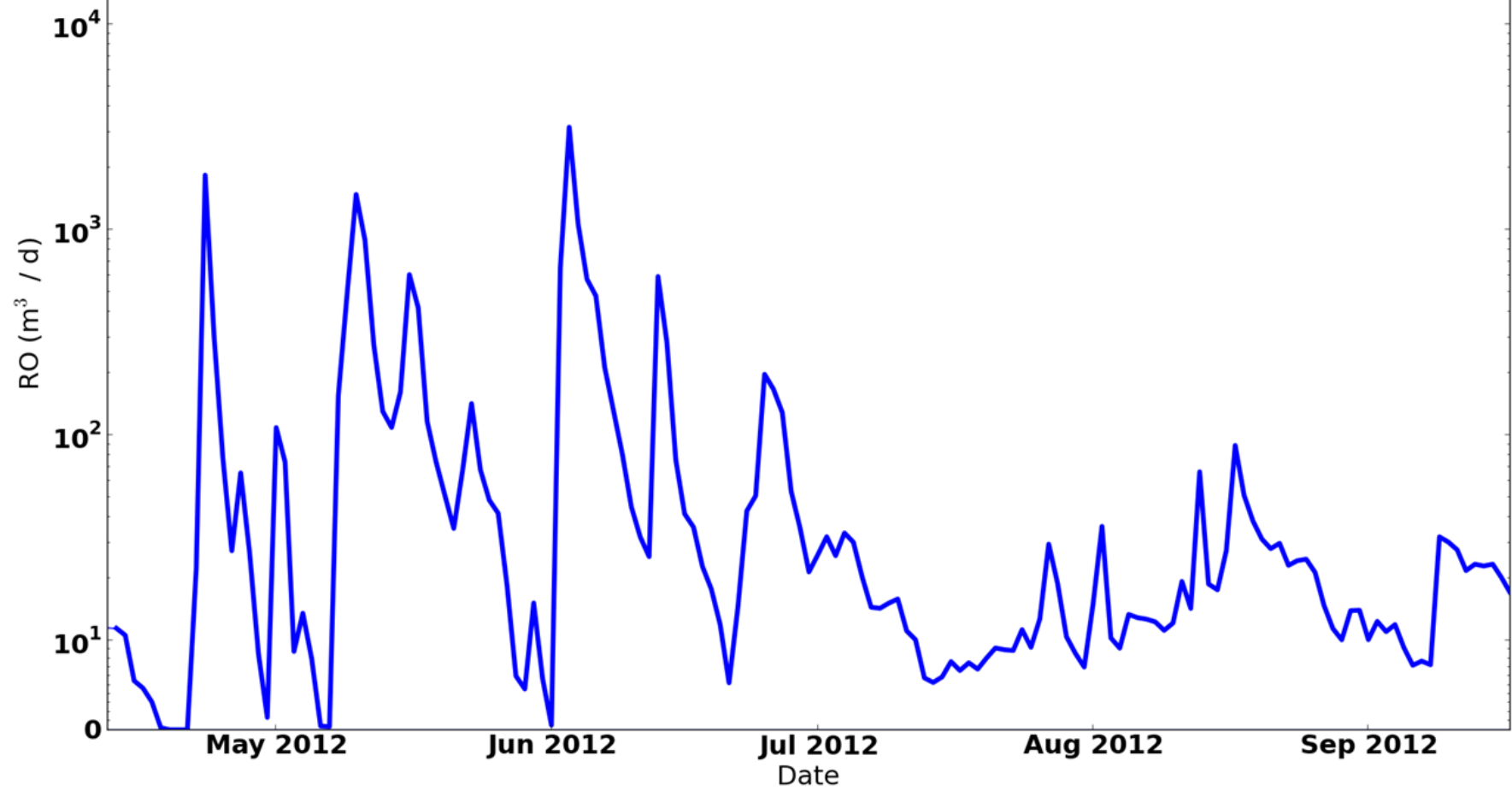
**Why?**

**Extend runoff record  
annually.**

**Explain ~30% deficit  
in water balance.**



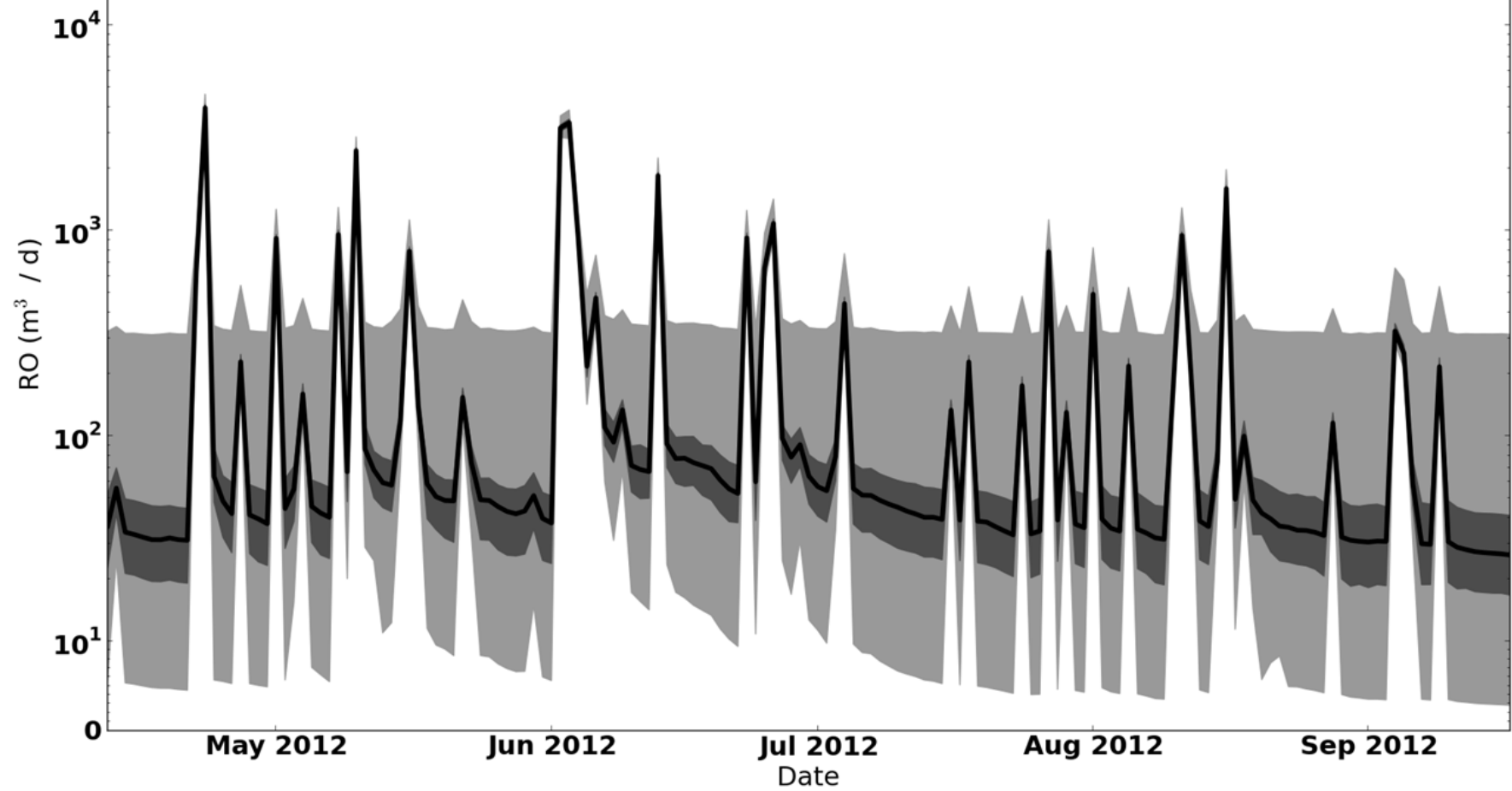
# Streamflow Summer 2012



Parshall Flume

Weir – In – Flume

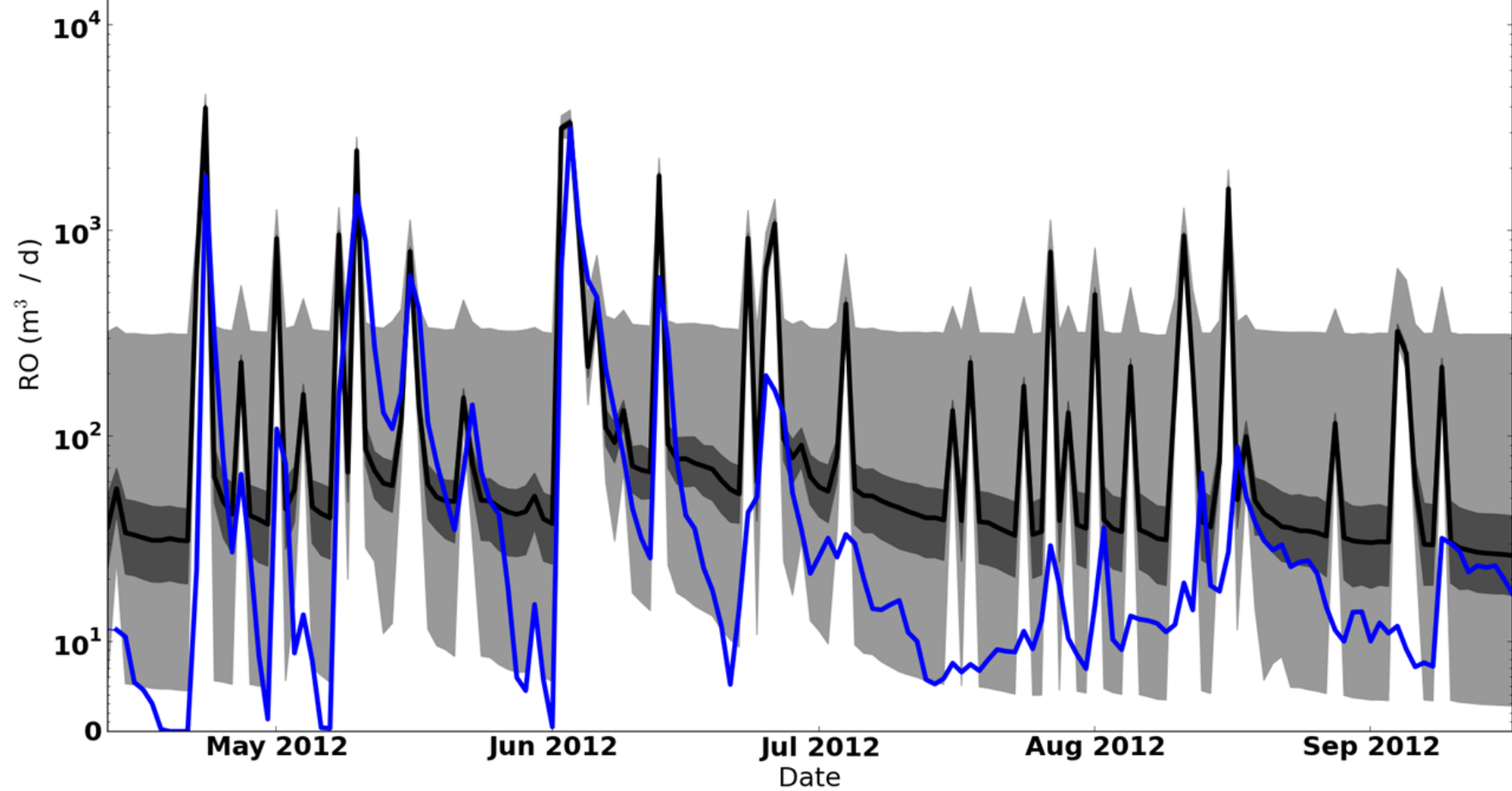
# Streamflow Summer 2012



Parshall Flume

Weir – In – Flume

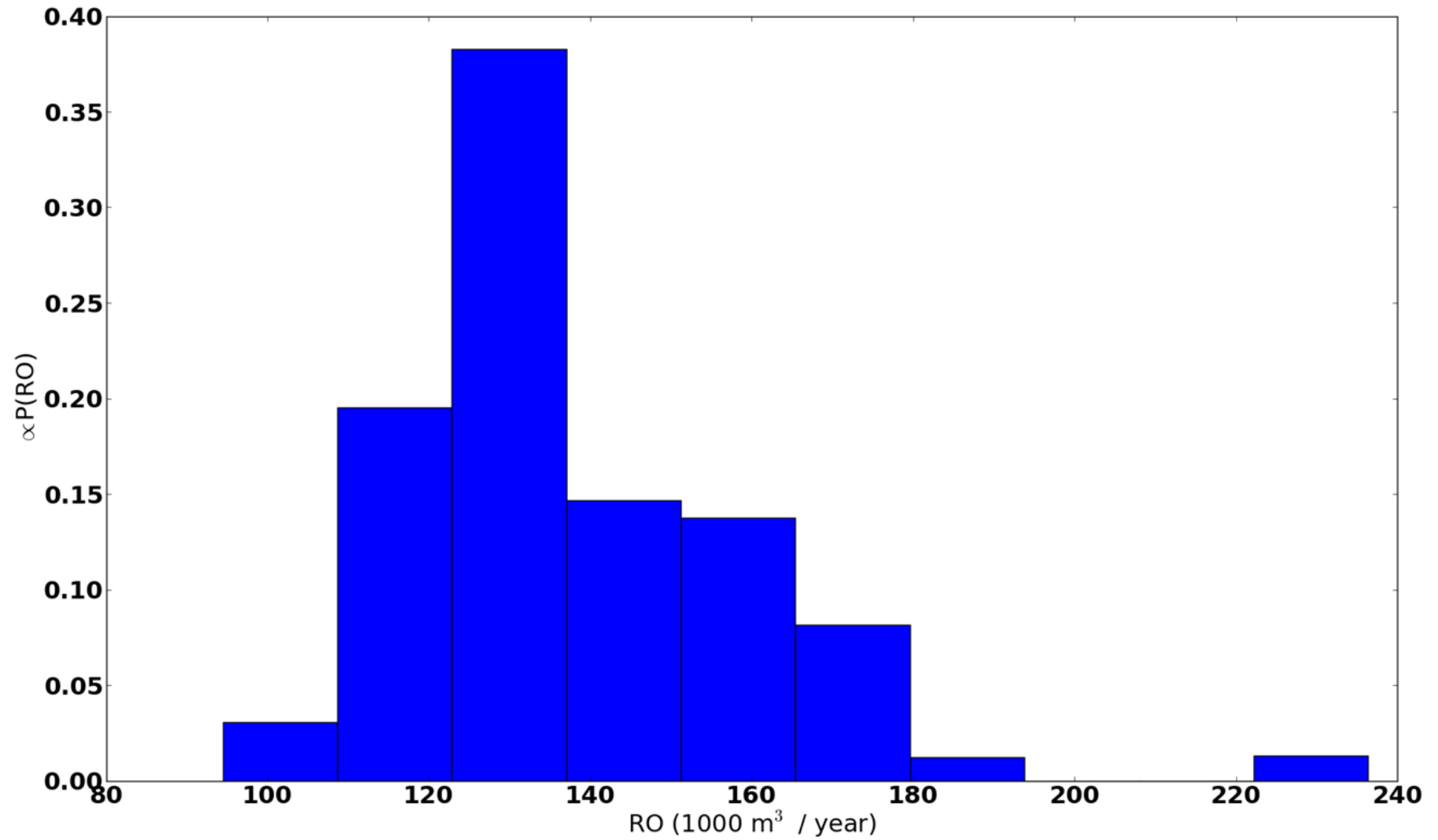
# Streamflow Summer 2012



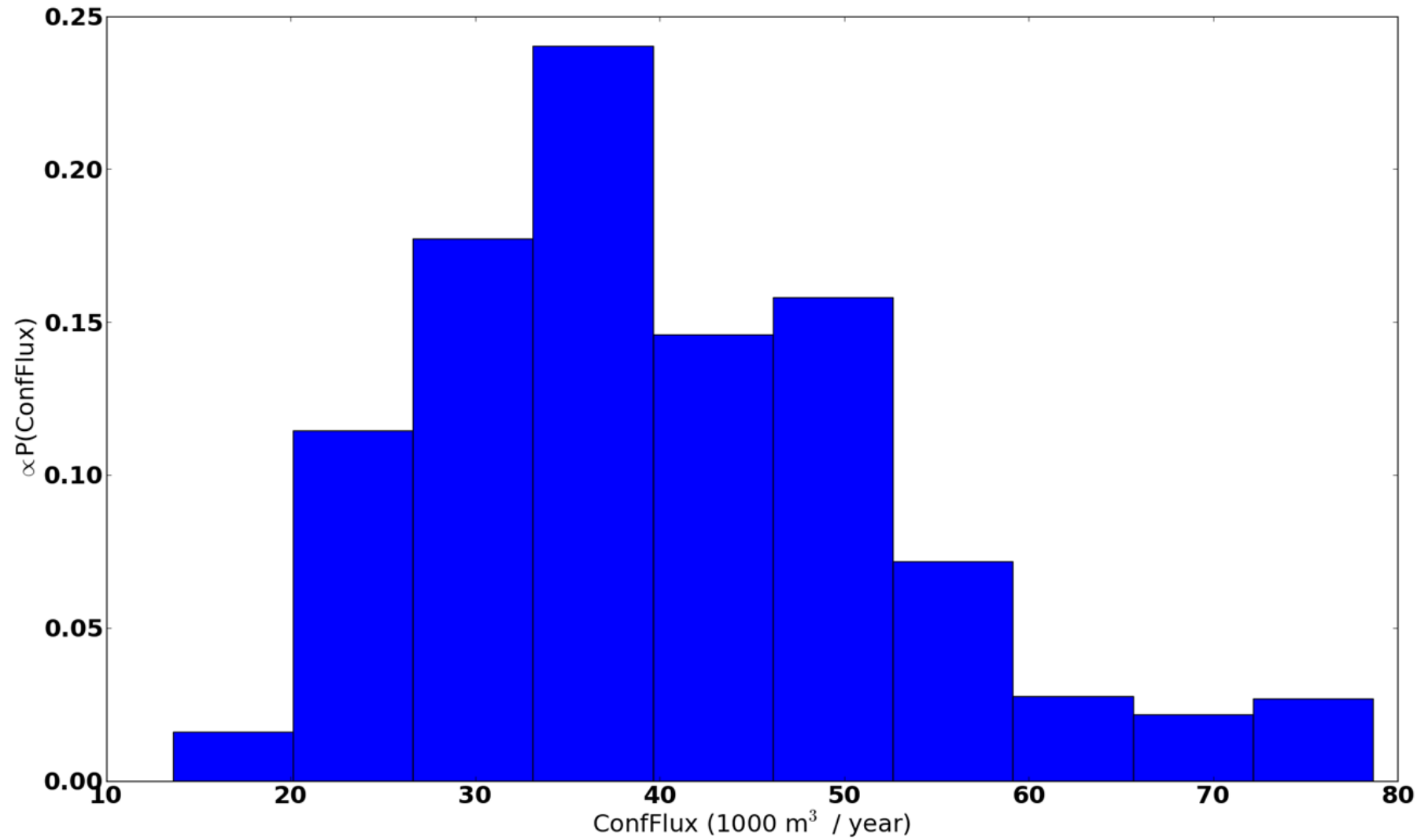
Parshall Flume

Weir – In – Flume

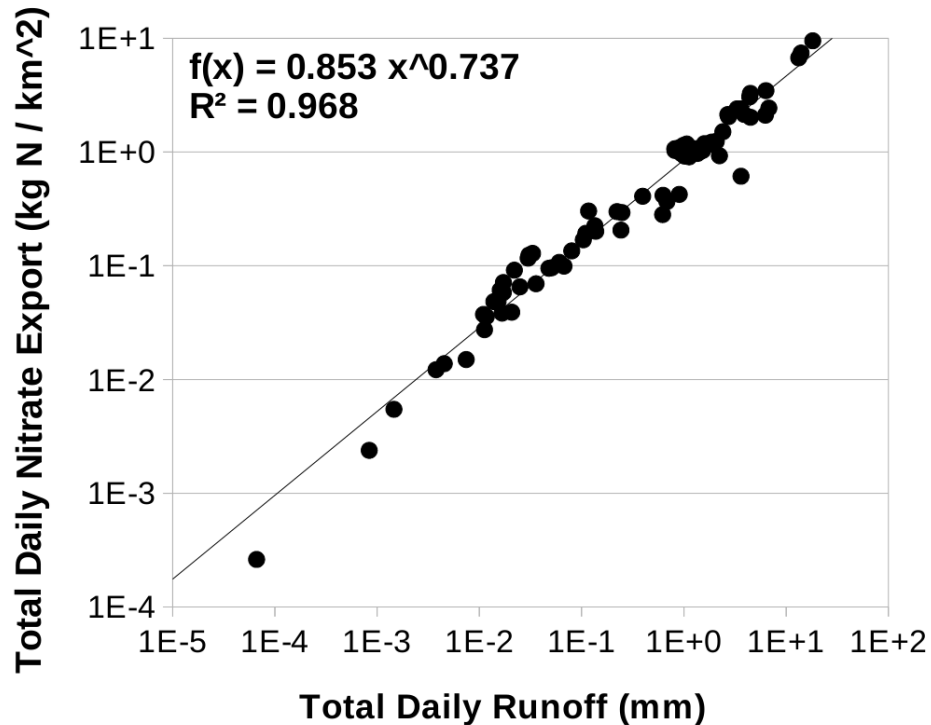
## Distribution of annual runoff: 430 mm



## Distribution of annual confined flow: 125 mm



# Estimating Nitrogen Flux



## STREAM EXPORT

Daily total nitrate stream export is tightly coupled to total daily runoff.

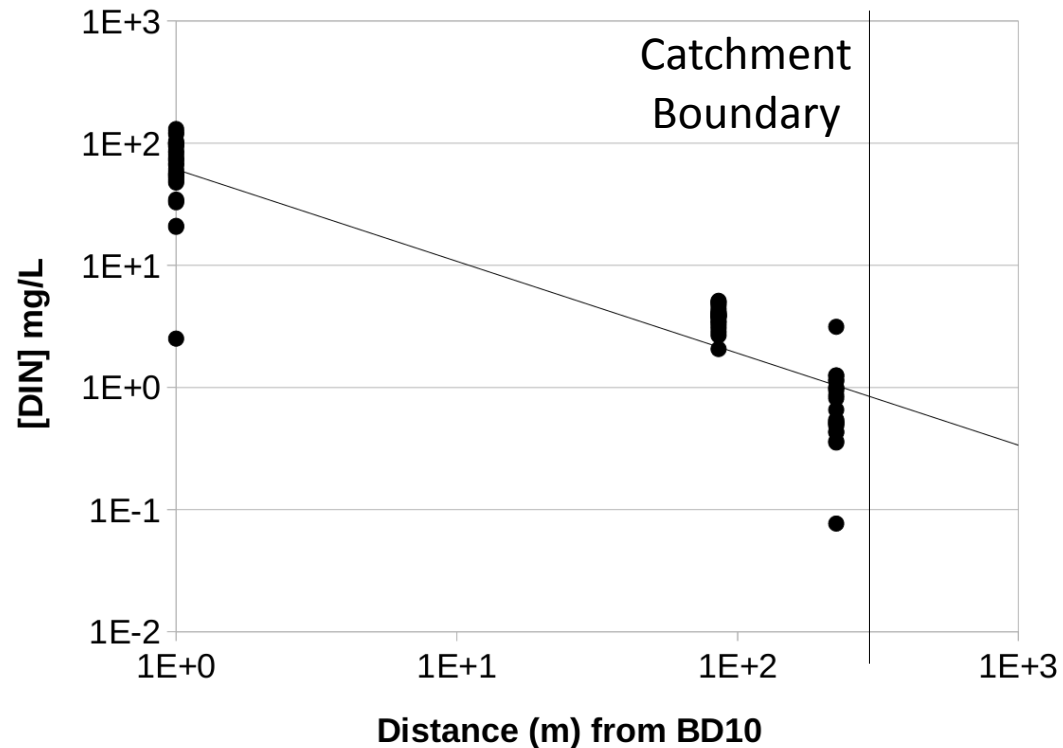
(Price, 2013, Pers.Comm.)

## SUBSURFACE EXPORT

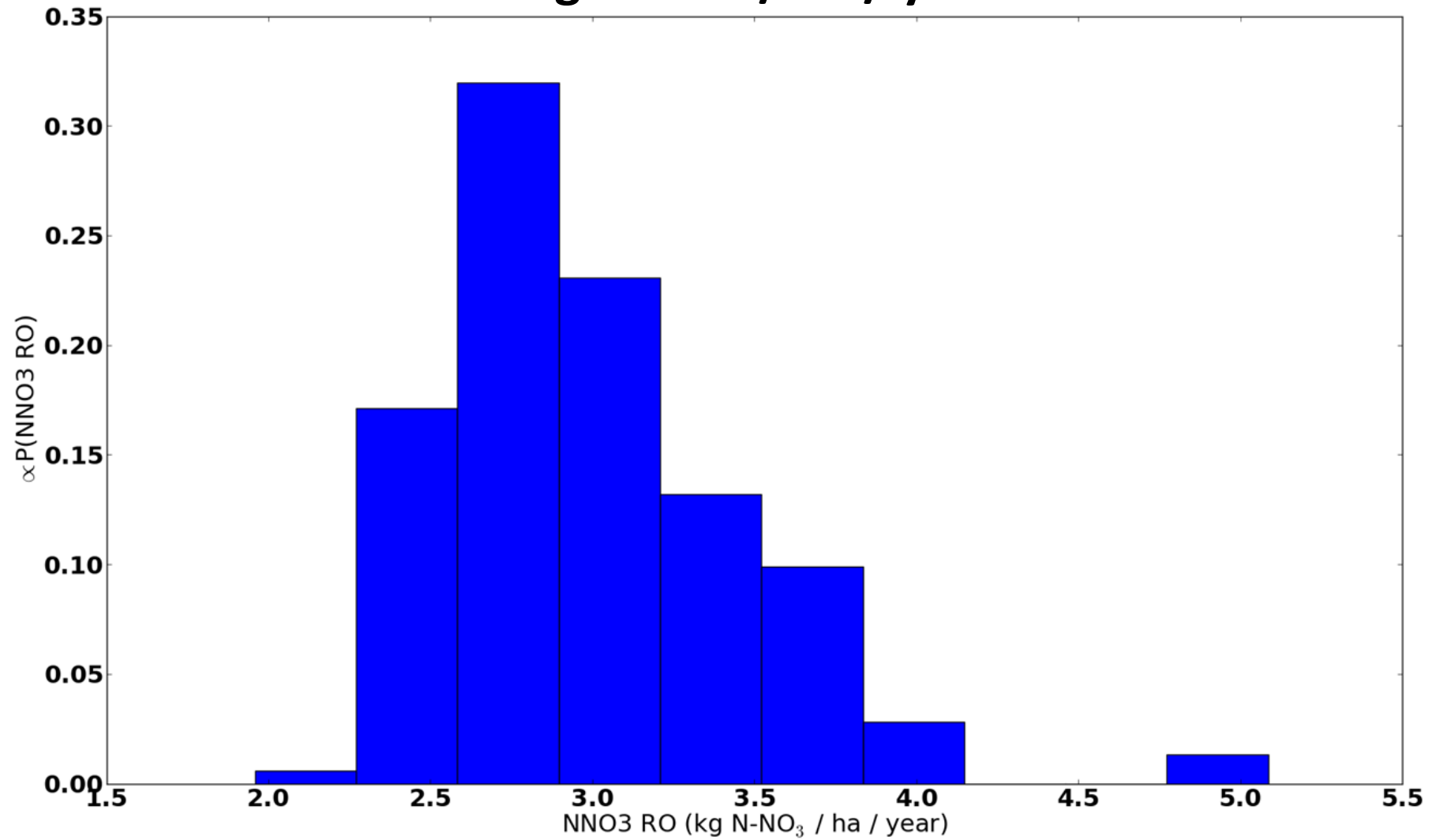
Attenuation along the dominant flow-path from source to boundary.

$$[DIN] = 0.81 \text{ g/m}^3$$

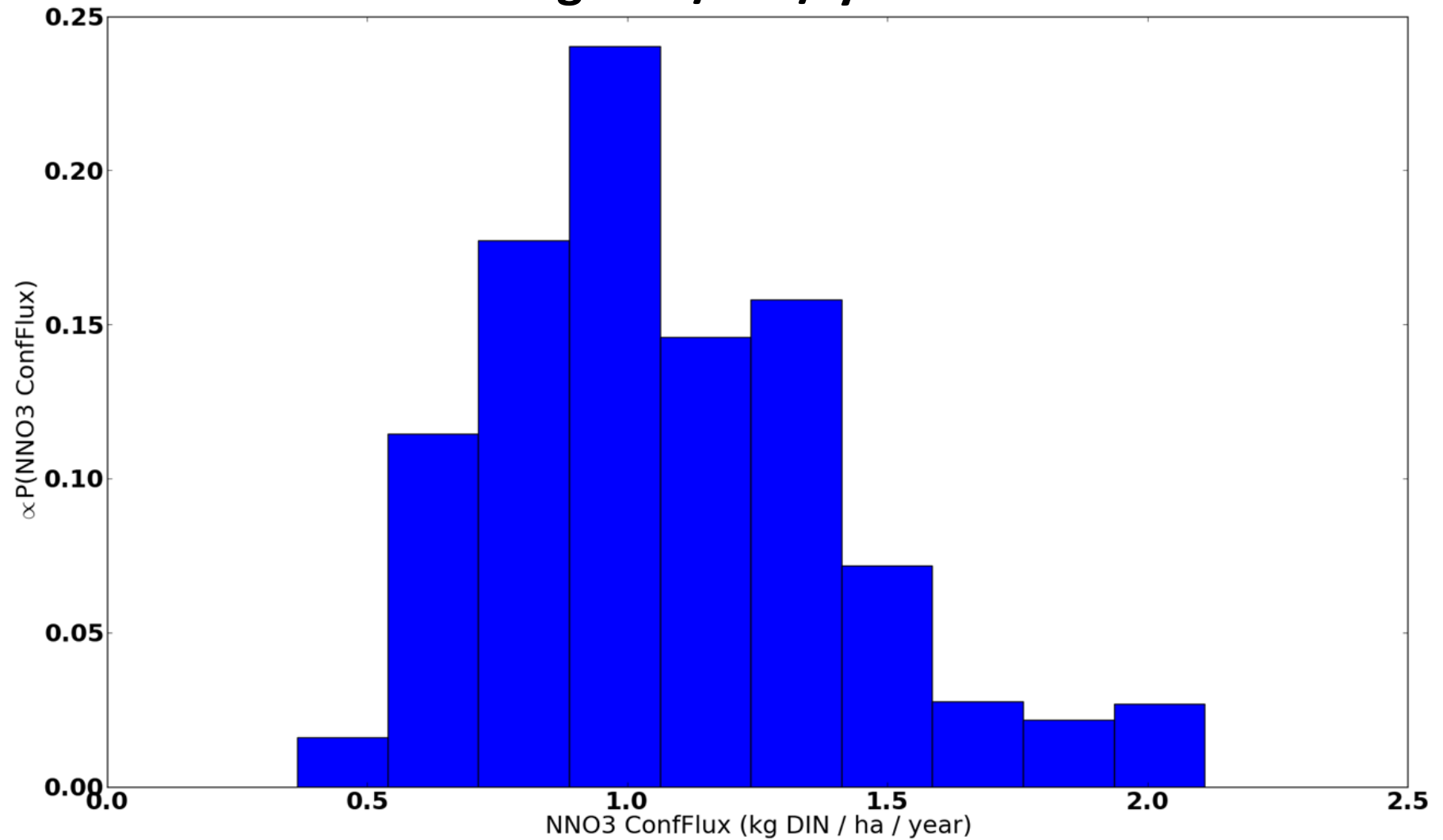
(From UNH WQAL data)

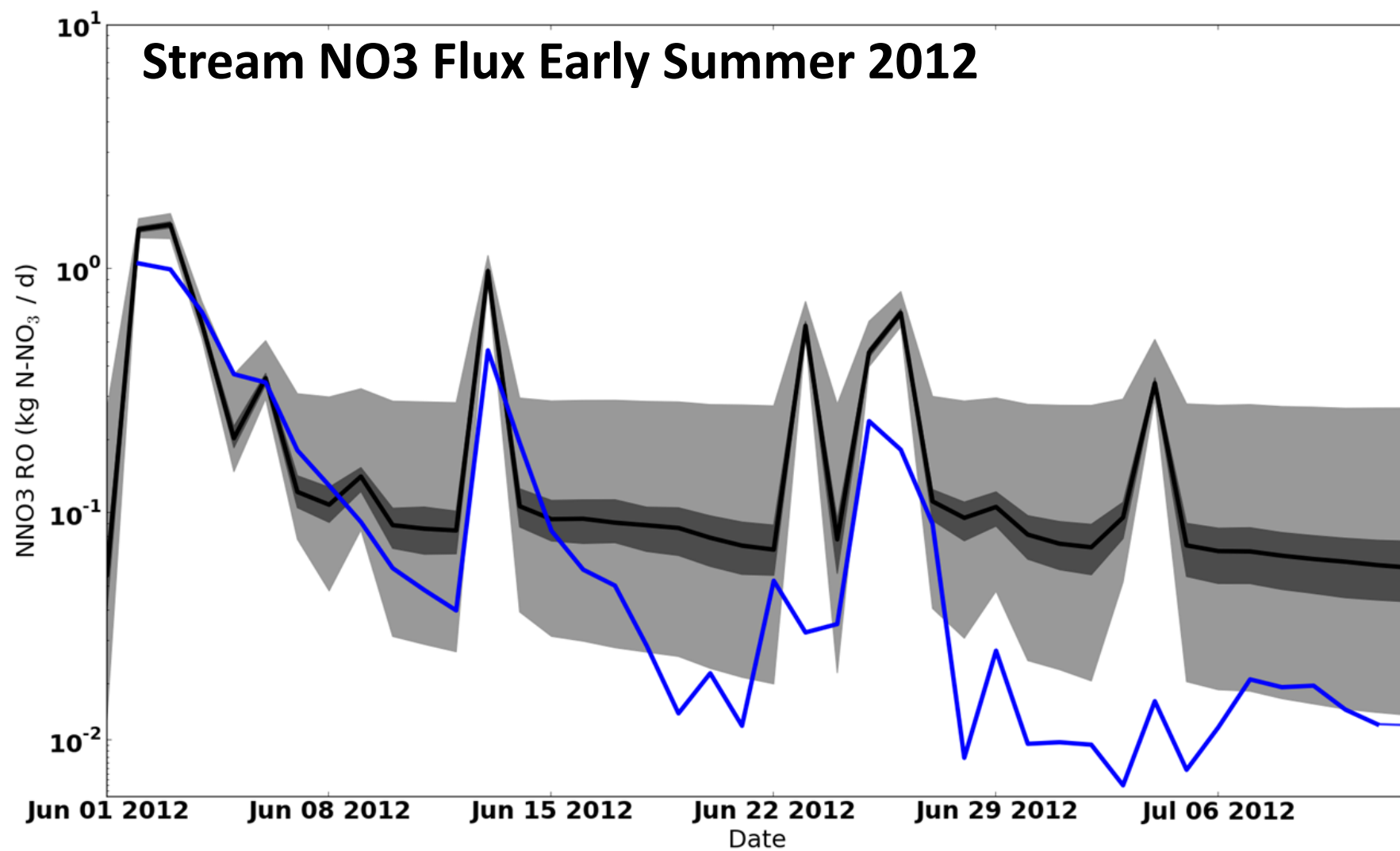


**Annual NO<sub>3</sub> export via runoff:**  
**2.7 kg N-NO<sub>3</sub> / ha / yr**



**Annual DIN export via confined flow:  
1.0 kg DIN / ha / yr**





Parshall Flume

Weir – In – Flume

(Price, 2013, Pers.Comm.)

# Water Export from BDODRF

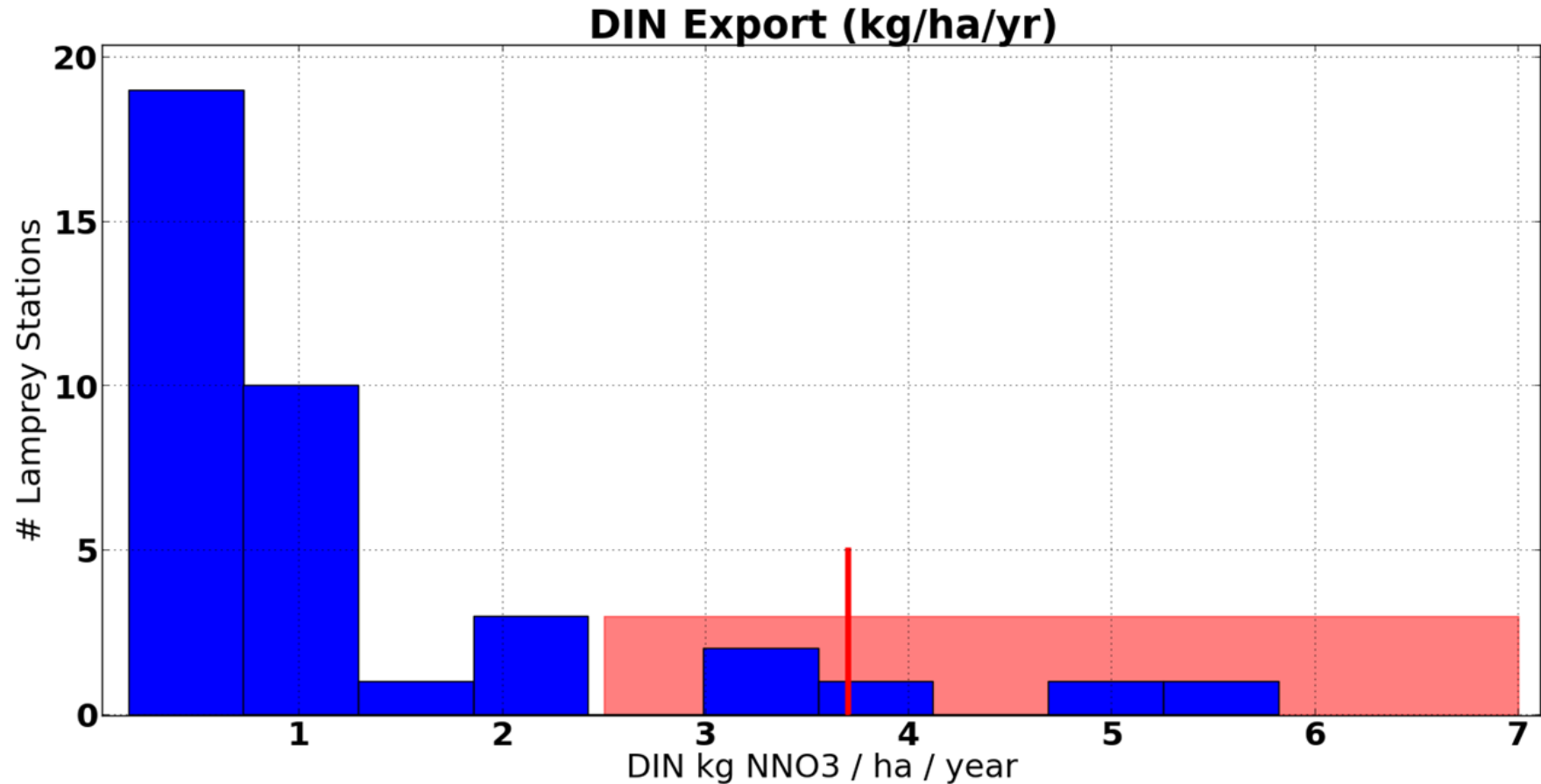
- Annual Average Throughfall: 1070 mm
- Annual Average ET: 610 mm
- Streamflow: 330 – **430** – 760 mm (High)
- Confined Flow: 66 – **125** – 250 mm
- Greatest source of uncertainty to N export.
- Data/Model integration
  - Local Precipitation - Mid-Winter/Early Spring Melt Q

# DIN Export from BDODRF

- Streamflow: 2.0 – **2.7** – 5.0 kg DIN / ha / yr
  - High estimate → Discharge overestimated
- Confined Flow: 0.5 – **1.0** – 2.0 kg DIN / ha / yr
  - ~33% of Stream export → Likely lower bound
- Retention (neglecting organic N) ? 0.99-0.97
  - Need better constraint on input to aqueous systems
  - High retention for sub-basins of the Lamprey.
  - Long confined flow-path

# DIN Export from BDODRF

- Consistent with other 'hot-spots' in Lamprey



(Daley et al. 2010)



**Thanks!**

