

# Hydrology & Viticulture in the Navarro River Watershed

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March 4, 2011

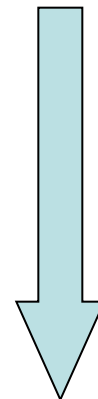
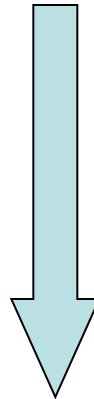
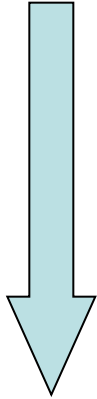


# Outline of the presentation

Overview of  
the Navarro  
watershed

Inputs,  
outputs, and  
storage

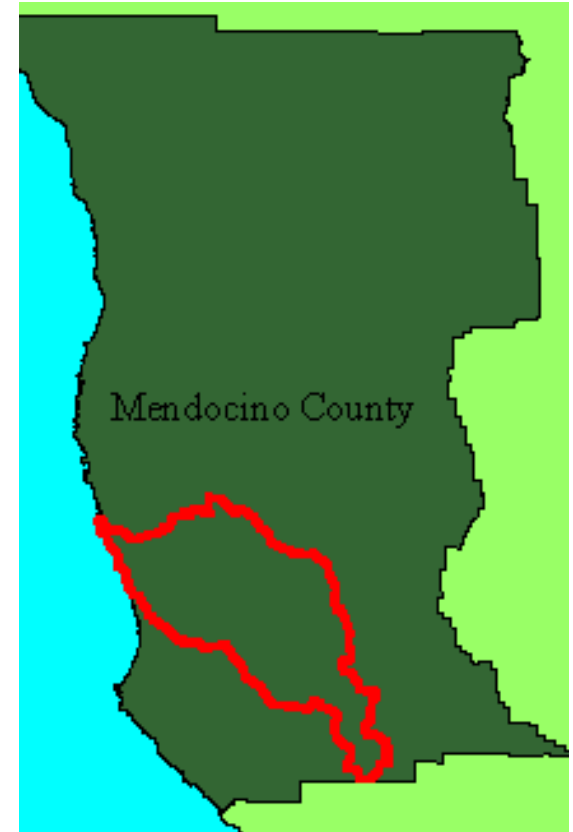
Analyzing  
historical flow  
changes



I am a stereotypical farmer. Do you like the pitchfork and straw in my mouth? I will often detail how viticulture has adapted to the watershed.

# The lay of the land

- Watershed is small
  - 200,000 ac / 315 sq miles
- Minimal bottomland
  - what “valley”?
- Navarro River is short
  - From Philo to the sea

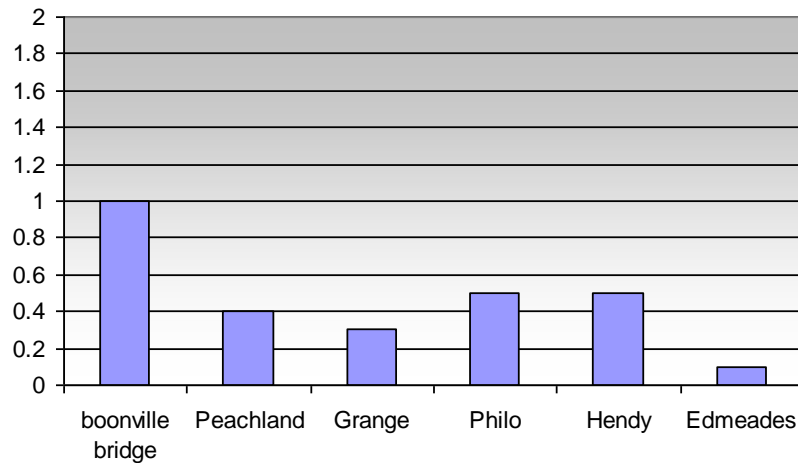


We farmers have planted ~90 vineyard properties in the watershed. Our total acreage is 3000 acres (1.5% of total area). Primary grapes varieties are Pinot Noir and Chardonnay.

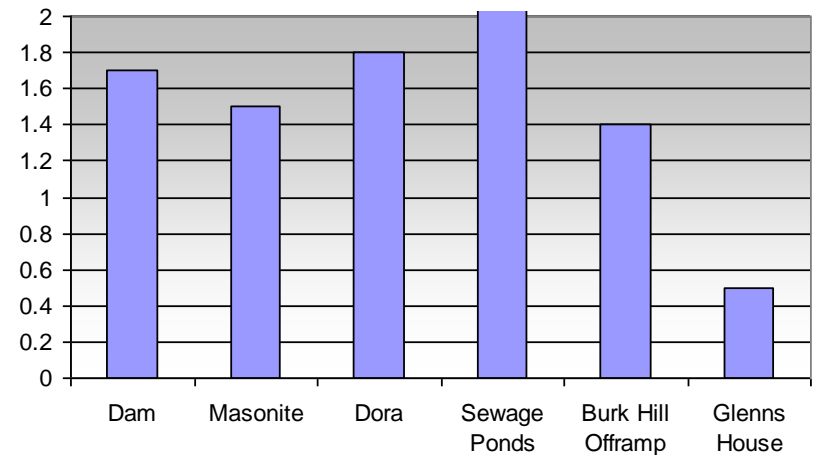
# The lay of the land: Bottomlands

The Navarro watershed has very little bottomland.

Width of "Bottomland" in Anderson Valley  
(based on +50ft each side of river)



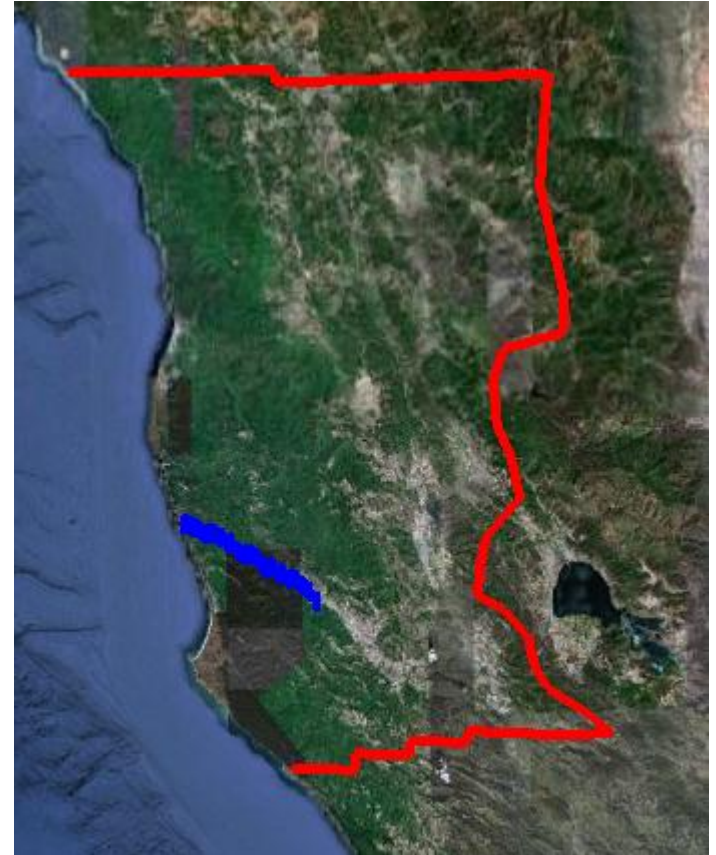
Width of "Bottomland" in Ukiah Valley  
(based on +50ft each side of river)



No bottom lands, no problem. Plant smaller vineyards on the hillsides. The median Anderson Valley vineyard is 8 acres.

# The lay of the land: No river access

- Navarro River is short
  - 26 miles
  - Only about 10% of vineyards have river access



Most Navarro watershed vineyards have no access to a high volume watercourse. Put that 1000gpm suction back in the barn.

# Inputs & Outputs: Navarro River

- Median flow in the Navarro is modest (similar to Russian River @ Talmage)
- Navarro River is more prone to extremes



Only a handful of vineyards have direct access to the Navarro River. Several apple farmers have access as well.

# Inputs & Outputs: Navarro River

## Storm flow:

New Year 2005 =  
62,000 cfs  
(by comparison  
Hopland = 35,600)

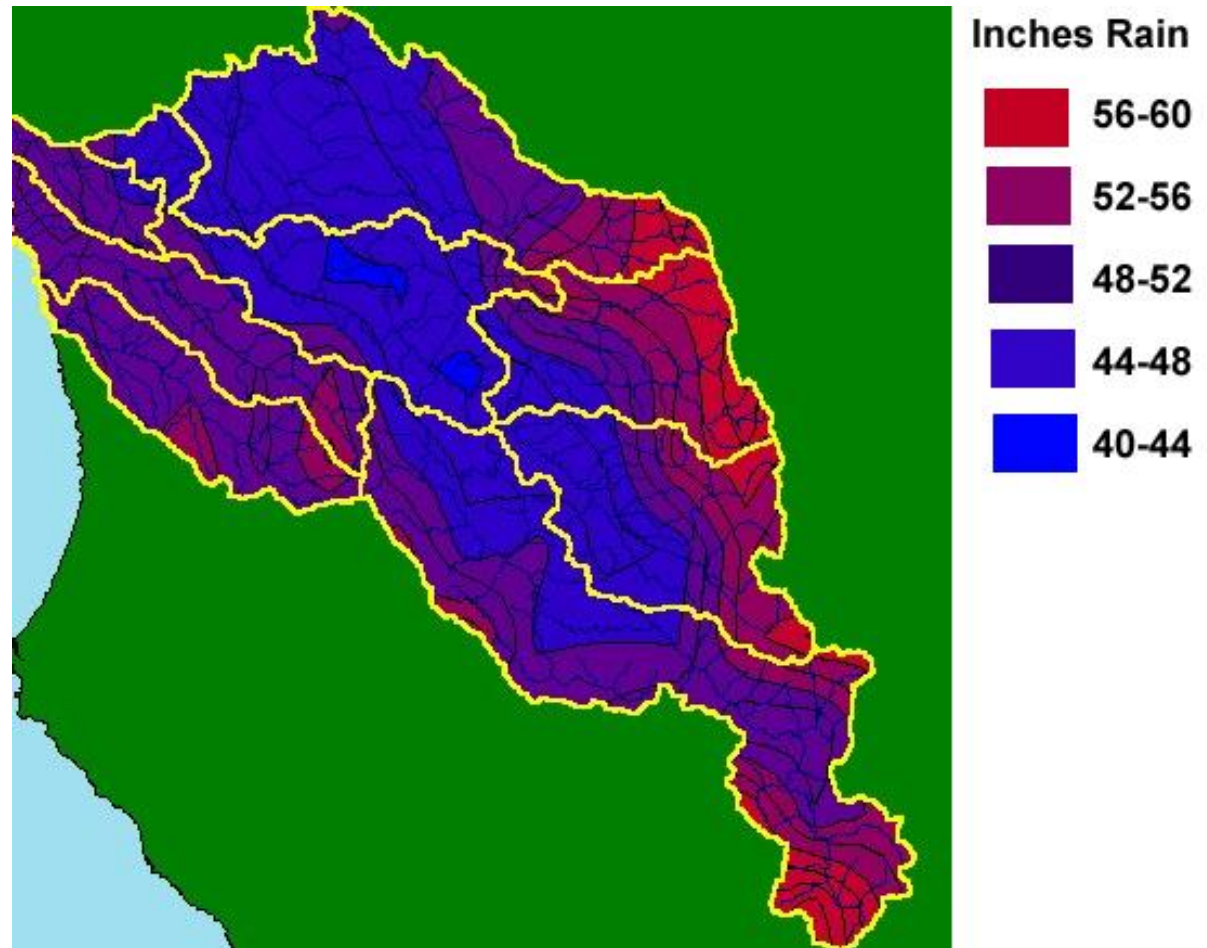
## Summer flow

Trickle



# Inputs and Outputs: Rain

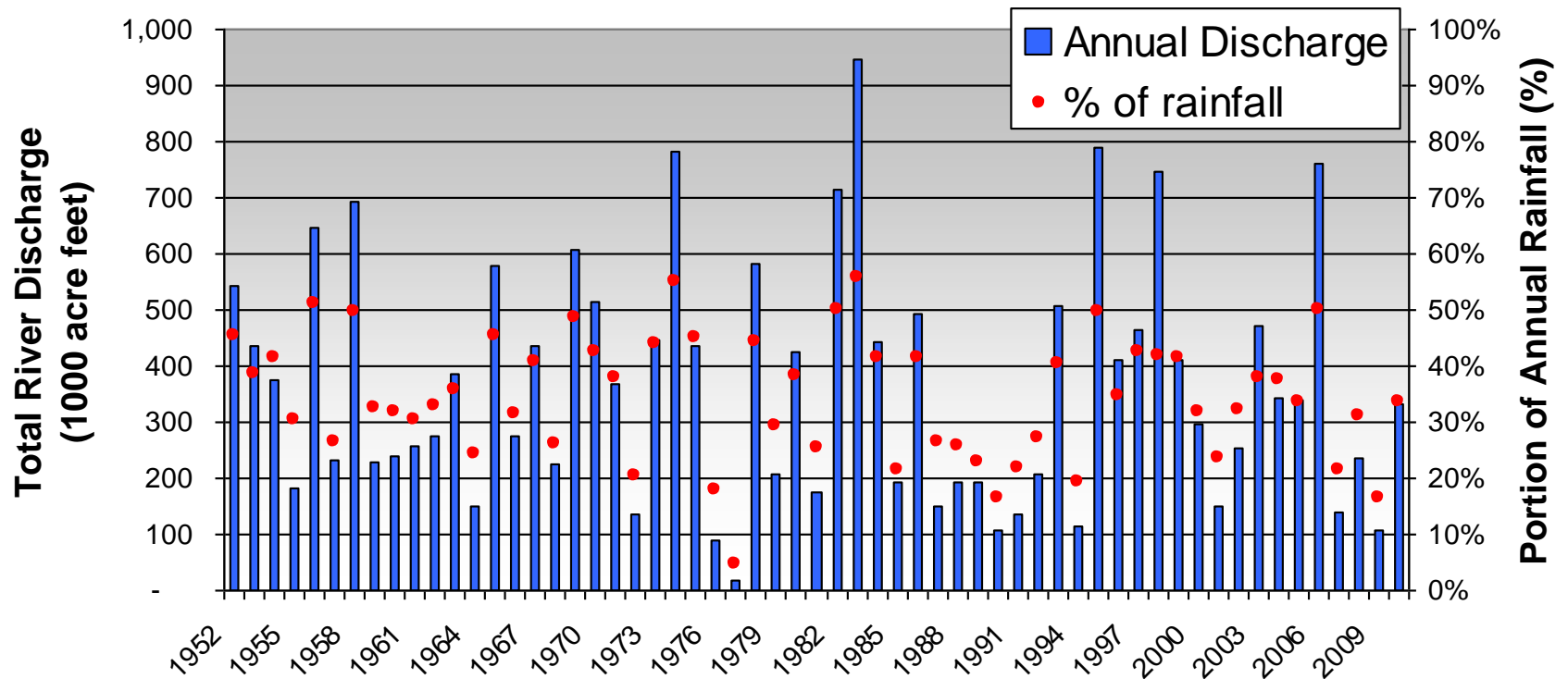
- Lots of rain → 48" average annual"
- However, rain is rare (8% of annual hours)



Source: Krisweb/Oregon State

# Inputs & Outputs: Navarro River

## Navarro River Discharge

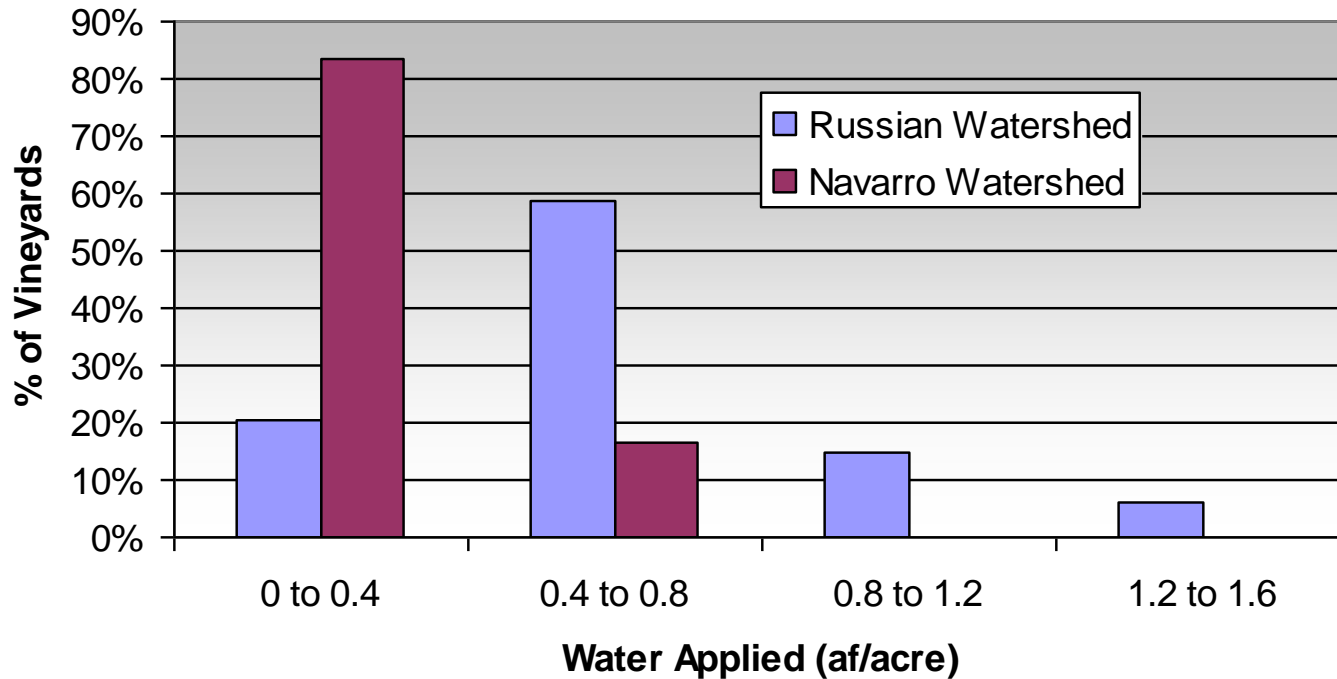


# Inputs & Outputs: ET

- The river outputs 1/3 of total rainfall
- Evaporation
  - Interception → 20% total rainfall
  - Evaporation from water surfaces
- Transpiration
  - Forests & grasslands
  - Crops (Grapes and Apples)

# Inputs & Outputs: Consumptive Use

Consumptive Use Application  
by Watershed



Source: UC Extension, unpublished



Average vineyard use in the Navarro is measured at 3 inches/yr. Over 3000 acres this is 750af (or 1/1000 of avg. watershed rainfall).

# Storage: Short Term

In general, Navarro watershed soils provide good short term storage. For some vineyards it is too much of a good thing.

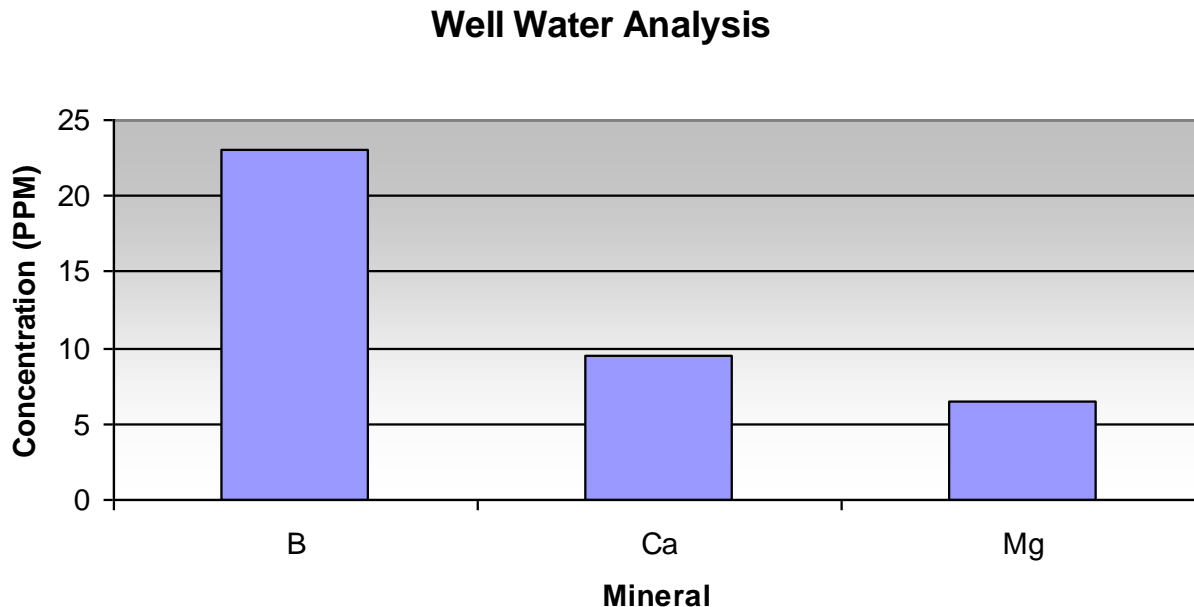


Many vineyards have installed drain lines and sumps to de-water the vineyard

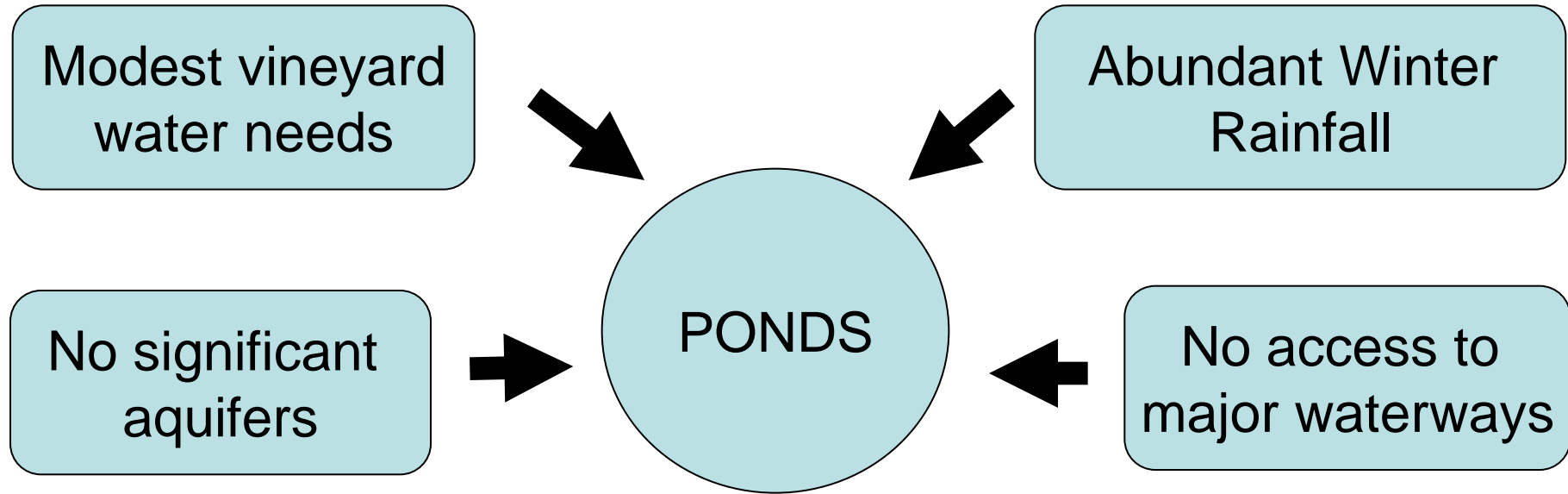
# Storage: Long Term

In many regions aquifers provide abundant and reliable water. Not the Navarro

- One gpm from a well is success!
- Common well test:



# Inputs/Outputs/Storage: Conclusion



An estimated 150 to 200 ponds have been built in the Navarro watershed. In the late 1990's the Water Board began regulatory inquiries for 120 of these ponds

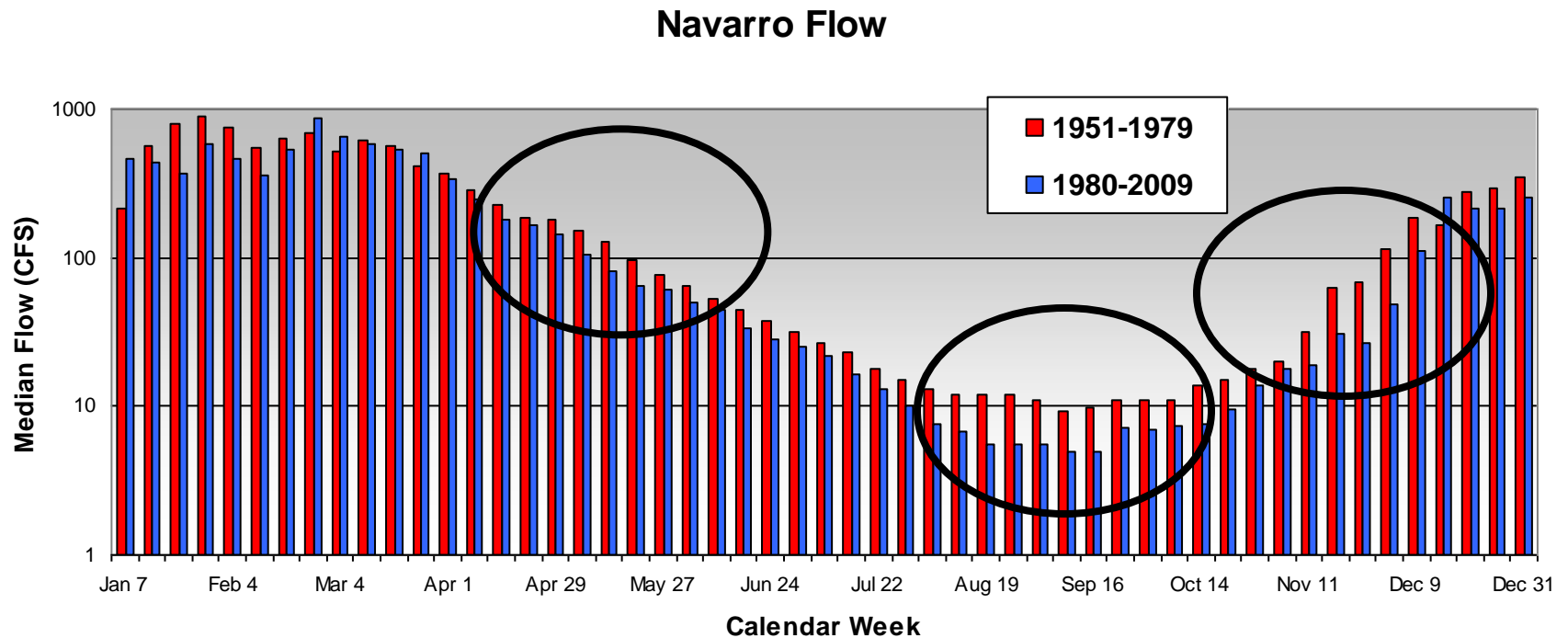
# Studying Navarro River Flow

Measure and analyze Navarro River flows to

- understand factors that influence flow,
- understand changes over time,
- stay ahead of regulations.

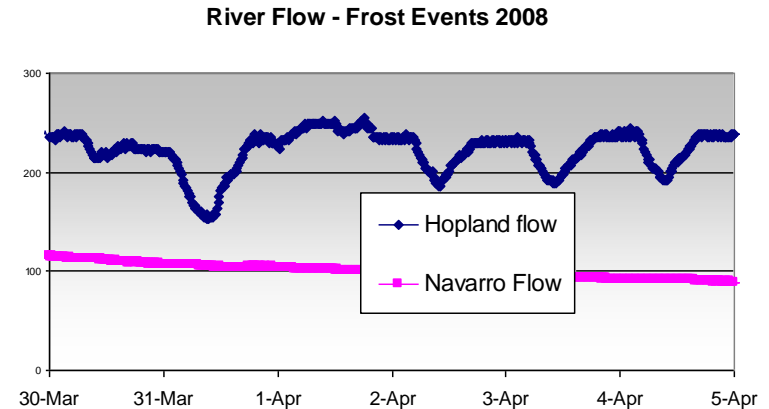
# Declining Flows

- Compared to previous years, flow is declining in the Navarro River



# Declining Flows: Spring

- **Frost protection?**  
Probably not. The declining flow doesn't start until April 1.
- **Weather shifts? Nope.** In fact Spring has more rain now than in the past!
- **Mystery factor**



More rain in the Spring means fewer frost events. However, many vineyards already have passive frost protection because of their hillside locations.

# Declining Flows: Fall

- **Weather related?** Yes. Fall rains arrive 10-14 days later.
- **Pond related?** Maybe. The first rains of the fall are diverted to storage.
- Trouble for Coho... (but good for harbor seals)



Nineteen vineyards in the Navarro watershed are certified “Fish Friendly.”

# Declining Flows: Summer

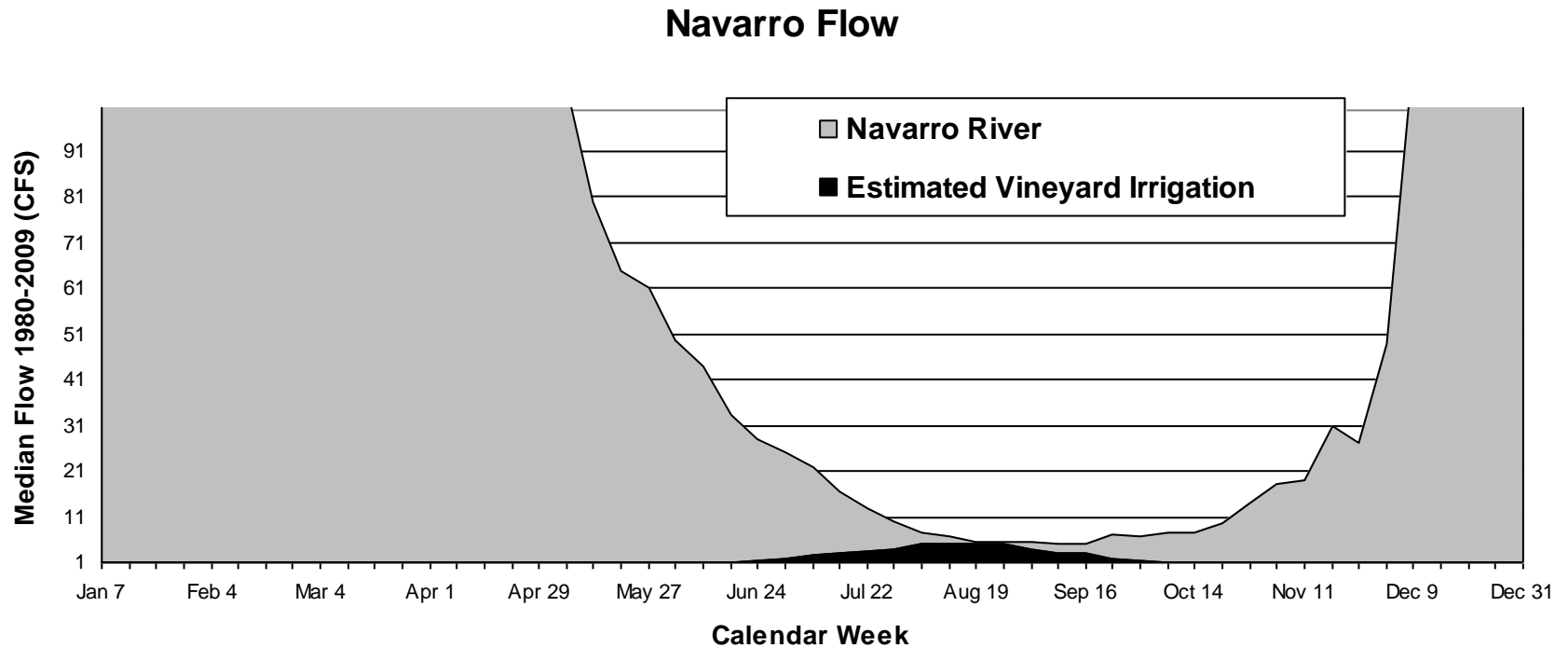
## Statistical Regression 1952-2008 data

1. Rainfall → increases flow (1" = 0.15 cfs)
2. Late Rains → increase flow (1 day = 0.07 cfs)
3. Prev. Year Rainfall → increases flow (1' = 0.07)
4. Summer Heat → decrease flow (100dd = -0.5 cfs)
5. Early fall (arrival cold nights) → inc. flow
6. Mystery factor → decrease flow (1 year = 0.12 cfs)

# Declining Flows: Summer

- **Weather changes?** No, if anything summers are getting cooler.
- **Vineyard irrigation?** Partially. (See next slide).
- **Residential demands on aquifers?** Probably small.
- **Mystery factor?**

# Declining Flows: Vineyard Use



750 af of irrigation water consumed over a 10 week irrigation window is equal to 5 cfs. Fortunately, most of this water is withdrawn from ponds.

# What is the mystery factor?

- Declining flow in Spring and Summer remains unexplained.
- The flow declines are large enough and span so much of the year that the cause is probably systemic.
- Hypothesis: re-growth of the redwood/fir forests is modifying the fundamentals of the watershed
  - Increased winter interception of rainfall
  - Increased demand on soil storage (average demand of 200 gallons per tree per day).

# Conclusion



Pond #201 goes into the Navarro Watershed.