

# What is Stationarity and Nonstationarity in Streamflow?

## Stationarity

- Streamflow\* **varies within a given range**
- Characteristics **remain the same**, or *stationary*, over time
  - For example:
    - ❑ Mean/average,
    - ❑ 100-year flood,
    - ❑ 20% exceedance (diversions),
    - ❑ 50% exceedance (storage)

} Assumed to  
remain  
constant  
over time

- Actually, streamflow\* is *nonstationary*
  - *Inherently* more variable than previously thought

# How Does Nonstationarity Affect the PBP Process?

A goal of place-based planning is to ultimately attain *resilient, sustainable* water resources

Nonstationarity will require greater *flexibility* and *adaptability* in:

- Planning
- Design
- Administration

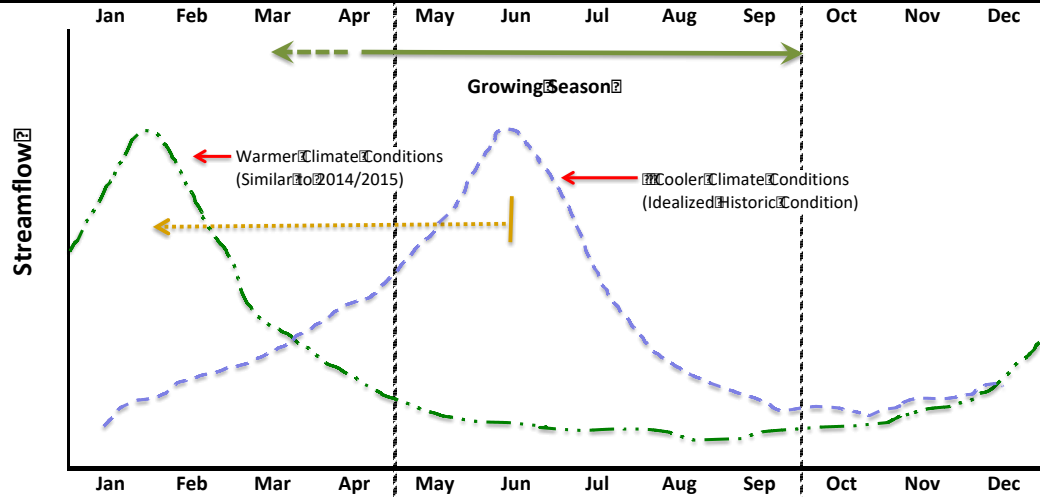
## For example:

- Adaptable irrigation seasons
  - *Ability to shift the time of demand, and supply (to meet the demand)*
- Water markets and infrastructure
  - *Ability to shift the location of supply and demand*
- Updated supply forecasting and administration techniques
  - *Ability to accurately predict and administer supplies*

# Comparison of Water Availability to the Irrigation Season, Growing Season and Changes in Hydrographs

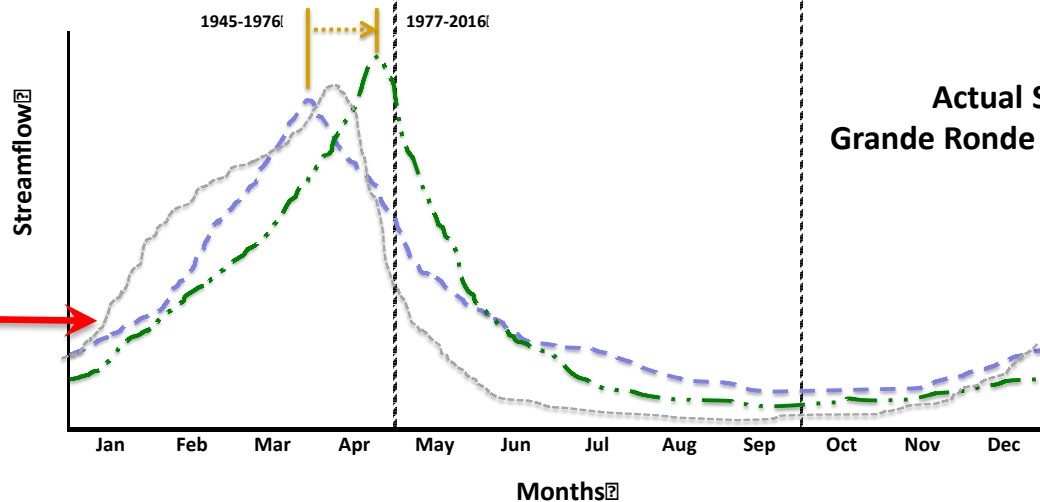
River Basins	Irrigation Season											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
<b>Grande Ronde Basin</b>												
Example Farm, LLC - Example of Irrigation Water Right Holder					x	x	x	x	x			
<b>Grande Ronde R. (Reserv-Storage-50% Exceedance)</b>												
Meadows Creek and Tributaries	11.70	31.00	82.20	94.70	18.30					1.180		8.99
Grande Ronde R. and Tributaries, Including Fly Creek and Tributaries	6.83	20.40	35.60	36.70	89.00	8.70				0.044		1.04
Catherine Creek and Tributaries above Ames Creek	5.15	10.90			79.90	49.60				0.330		3.01
<b>Grande Ronde Basin (Diversion 30% Exceedance)</b>												
Meadows Creek												
Grande Ronde R. above Fly Creek												
Catherine Creek above Ames Creek												

## Projected Shift in Snowmelt hydrographs-PNW (Vano & others 2015)



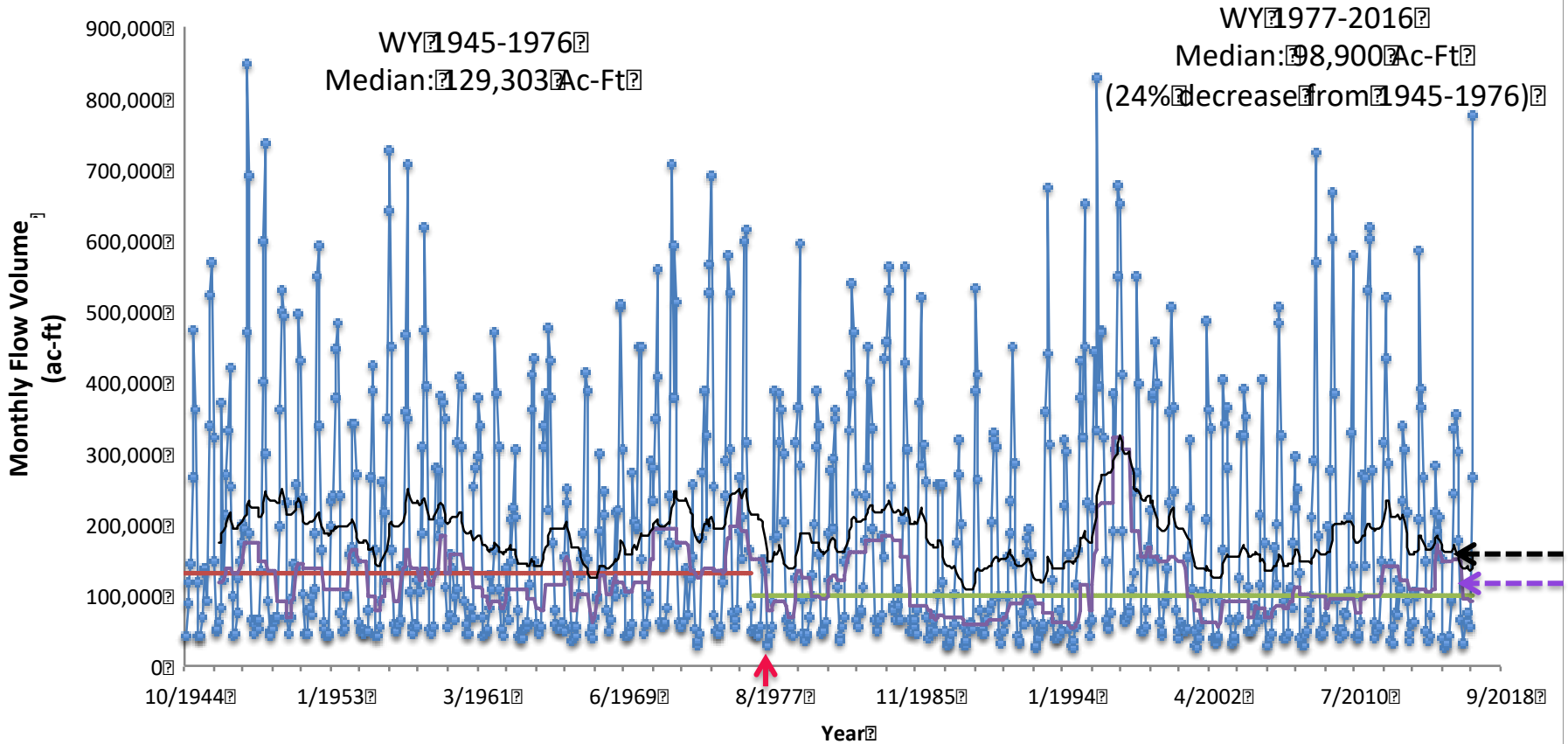
**Please Note:**  
The figures are conceptual, however based on observation scientific projections

## Actual Shift in Grande Ronde R hydrograph

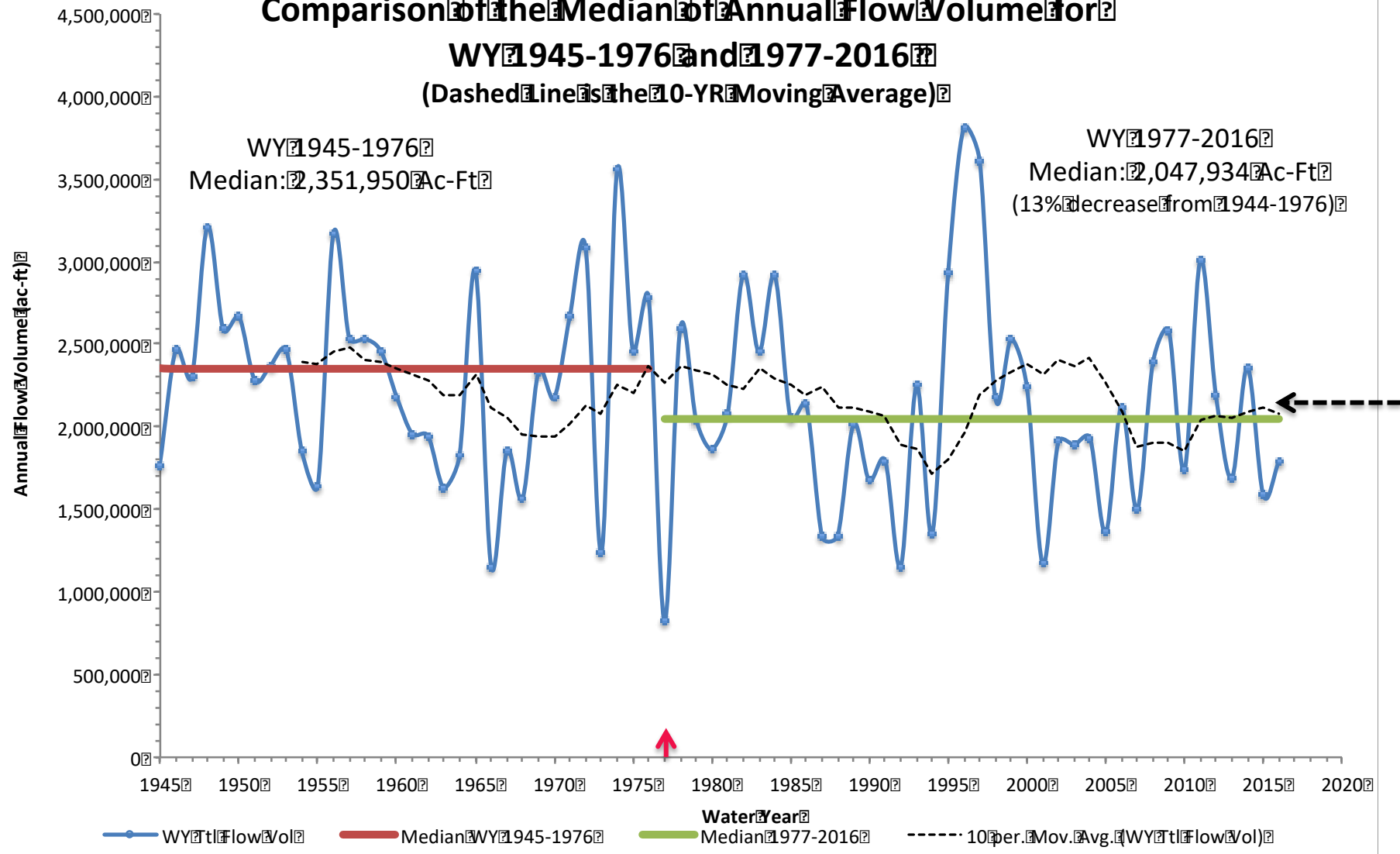


Projected Shift in Hydrograph-Snake R Basin (Vano & others 2015)

USGS Gage Grande Ronde R. at Troy  
Comparison of Median of Monthly Flow Volumes for  
WY 1945-1976 and 1977-2016  
(Black line is 2-YR Moving Avg; Purple line is 2-YR Moving Median)



# USGS Gage Grande Ronde R. at Troy Comparison of the Median of Annual Flow Volume for WY 1945-1976 and 1977-2016 (Dashed Line is the 10-YR Moving Average)



# Questions about Hydrograph Changes

1. How have the flow volumes change by month between 1945-1976 & 1977-2016?
2. Do the changes correspond to projections?
3. Do temperature, precipitation, and/or snow water equivalent show any change?
4. If so, can they explain, at least in part, changes observed in streamflow?
5. Have land use, land cover, water use changes also influenced streamflows?
6. How do we translate between/work with established and water availability?
7. Other questions?
8. \_
9. \_
10. \_