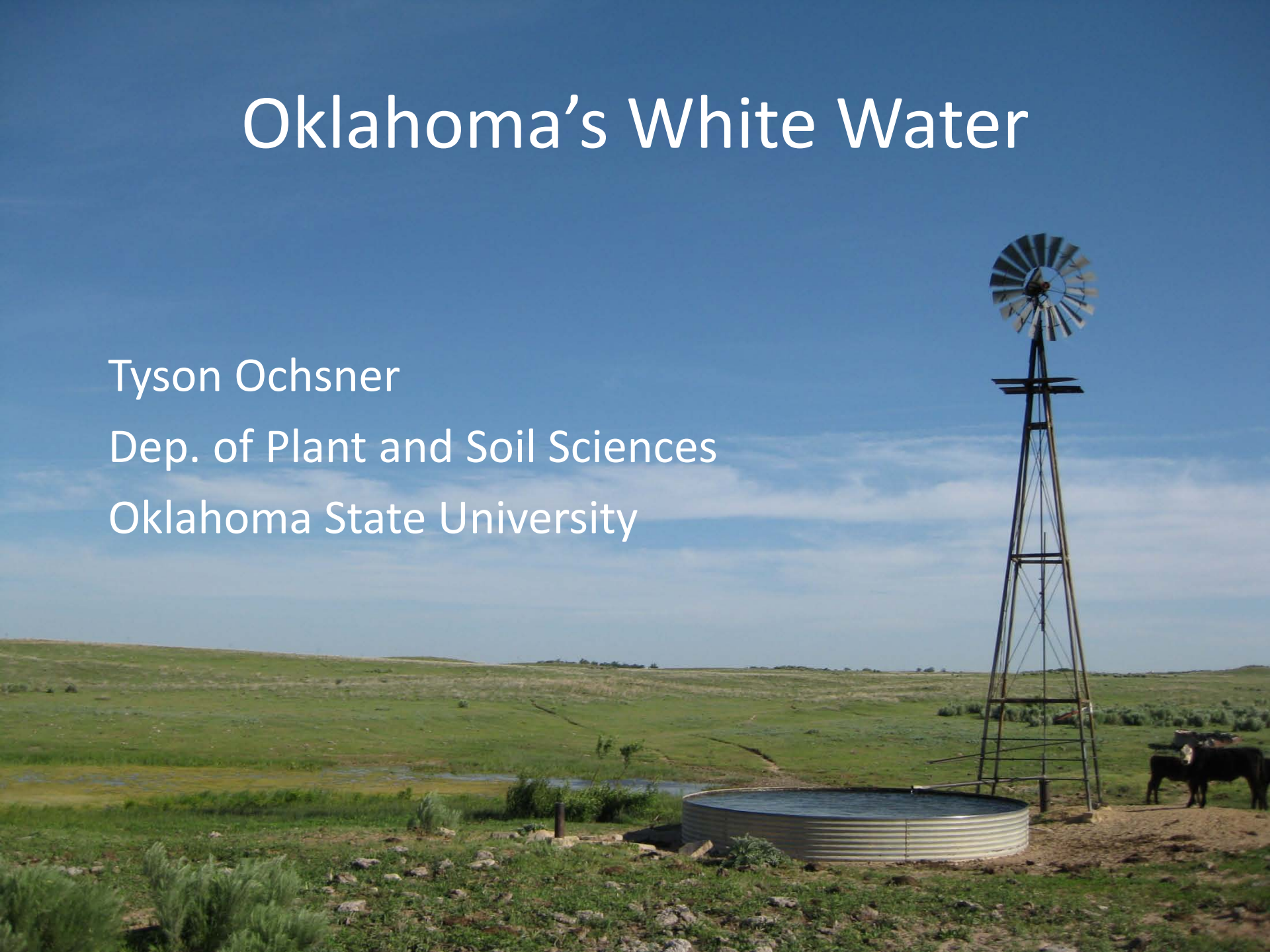
Oklahoma's White Water

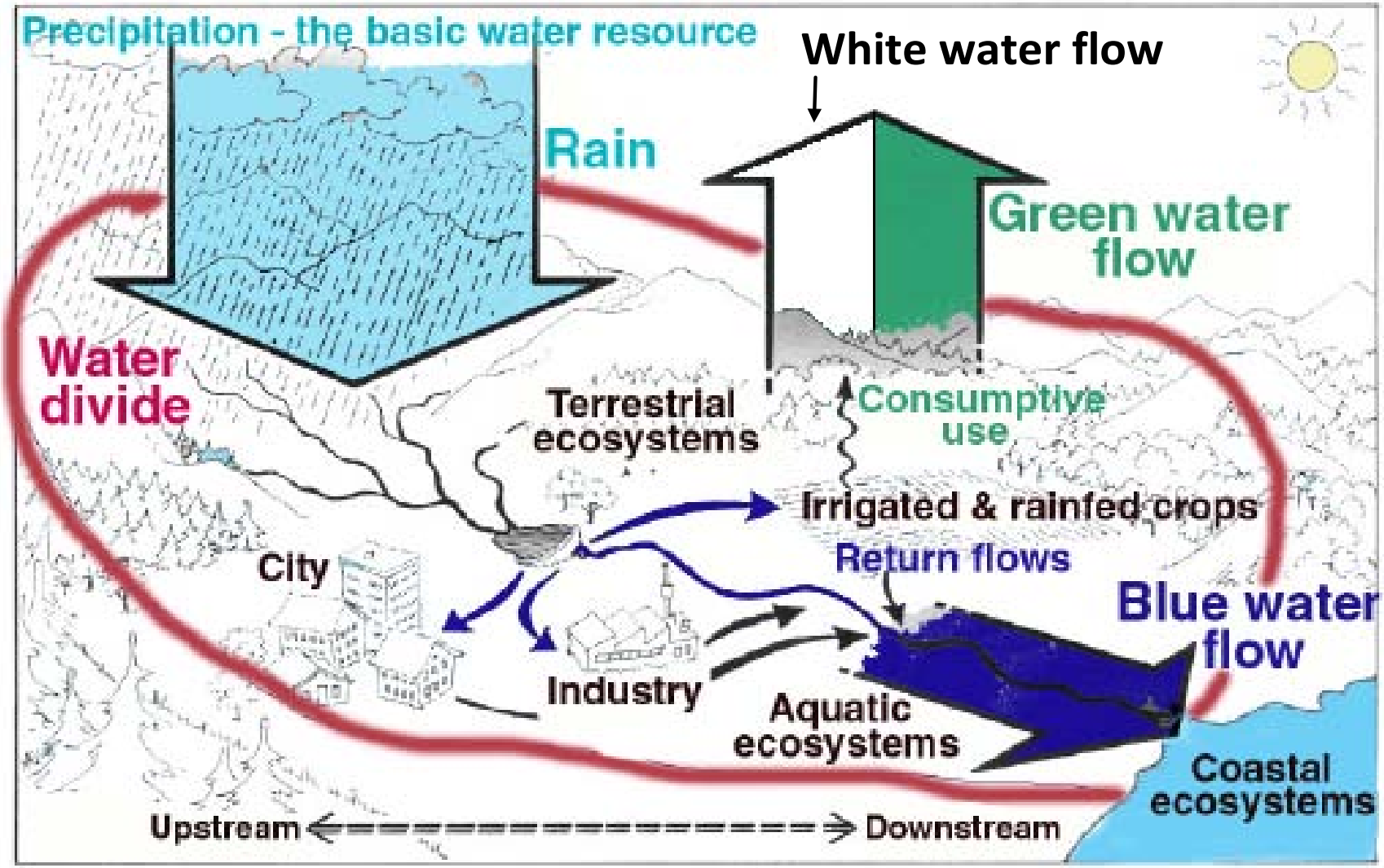


Tyson Ochsner

Dep. of Plant and Soil Sciences

Oklahoma State University

Oklahoma's Renewable Water Resources



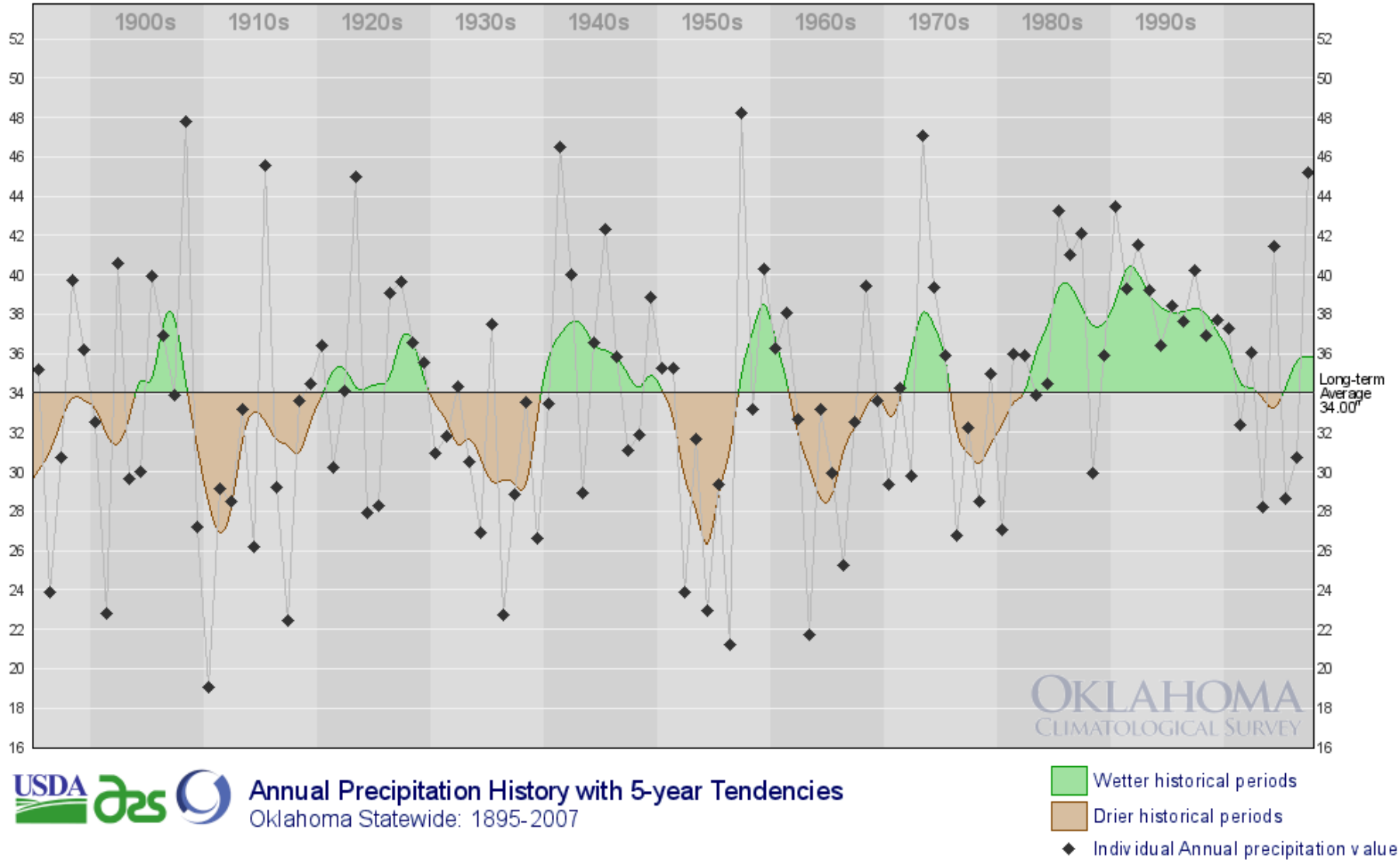
Adapted from Falkenmark and Lannerstad (2005).

Oklahoma's Water Budget

Item	Positive effects?	Size (mm)
Precipitation: the renewable resource	+	?
Blue water: flow through the surface water and groundwater systems	+	?
Green water: transpiration through plants	+	?
White water: evaporation from the land surface (excluding transpiration)	–	?

Precipitation

- Best documented variable in the water budget
- Oklahoma Mesonet
- National Weather Service Cooperative Observer Stations



USDA ars

Annual Precipitation History with 5-year Tendencies

Oklahoma Statewide: 1895-2007

Wetter historical periods

Drier historical periods

Individual Annual precipitation value

Oklahoma's Water Budget

Item	Positive Effects?	Size (mm)
Precipitation: the renewable resource	+	34
Blue water: flow through the surface water and groundwater systems	+	?

Blue water

- Calculated from USGS stream gage data

$$Runoff = \frac{Volume\ of\ water}{Area\ of\ watershed}$$

- Must correct for upstream inflows
  - Arkansas River
  - Cimmaron River
  - Canadian River
  - Red River

Oklahoma's Water Budget

Item	Positive Effects?	Size (in)
Precipitation: the renewable resource	+	34
Blue water: flow through the surface water and groundwater systems	+	7.7
Green water: transpiration through plants	+	?

Green water

- Plant growth is proportional to transpiration

$$Plant\,biomass = Transpiration \times Efficiency$$

- Efficiency depends on plant species and vapor pressure deficit

- Central hypothesis: Biomass data can be used to effectively estimate transpiration.

	Area	Biomass	TE[1]	Transpiration		
	ha	kg x 10^6	kg $ha^{-1}mm^{-1}$	km^3	mm	in
Grasslands (not harvested)	8.58E+06	30563	20	15.28	178	**7.0**
Forests	2.98E+06			8.95	300	**11.8**
Winter wheat	1.73E+06	10585	32	3.33	192	**7.6**
Grass Hay	9.76E+05	3478	20	1.74	178	**7.0**
Winter wheat (not harvested)[2]	7.82E+05	--	32	1.50	192	**7.6**
Fallow or idle cropland	2.39E+05	0	0	0	0	**0.0**
Alfalfa	1.40E+05	1035	21	0.50	354	**13.9**
Sorghum	1.32E+05	997	50	0.20	152	**6.0**
Soybean	1.13E+05	541	33	0.17	147	**5.8**
Corn	8.79E+04	1786	66	0.27	310	**12.2**
Rye (not harvested)[2]	8.46E+04	--	32	0.07	83	**3.3**
Cotton	7.21E+04	71[3]	4.4	0.16	222	**8.7**
Rye	2.66E+04	70	32	0.02	83	**3.3**
Totals	1.59E+07			32.2	**202**	**7.9**

[1] *TE defined as biomass produced per unit of transpiration*

[2] *Transpiration for unharvested (grazed) crop scaled to harvested crop*

[3] *Cotton mass and TE are based on lint yield rather than biomass*

[4] *Forest mass and TE are based on stem growth rather than biomass*

Oklahoma's Water Budget

Item	Positive Effects?	Size (in)
Precipitation: the renewable resource	+	34
Blue water: flow through the surface water and groundwater systems	+	7.6
Green water: transpiration through plants	+	7.9
White water: evaporation from the land surface (excluding transpiration)	–	?

White water

- Evaporation is the rest of the water budget (approximately).

$$Evaporation = Precipitation - Runoff - Transpiration$$

- Neglects fluctuating storage in soil, groundwater, and reservoirs
- Best applied for annual or longer time scale

Oklahoma's Water Budget

Item	Positive Effects?	Size (in)
Precipitation: the renewable resource	+	34
Blue water: flow through the surface water and groundwater systems	+	7.6
Green water: transpiration through plants	+	7.9
White water: evaporation from the land surface (excluding transpiration)	–	18.5

Relevance

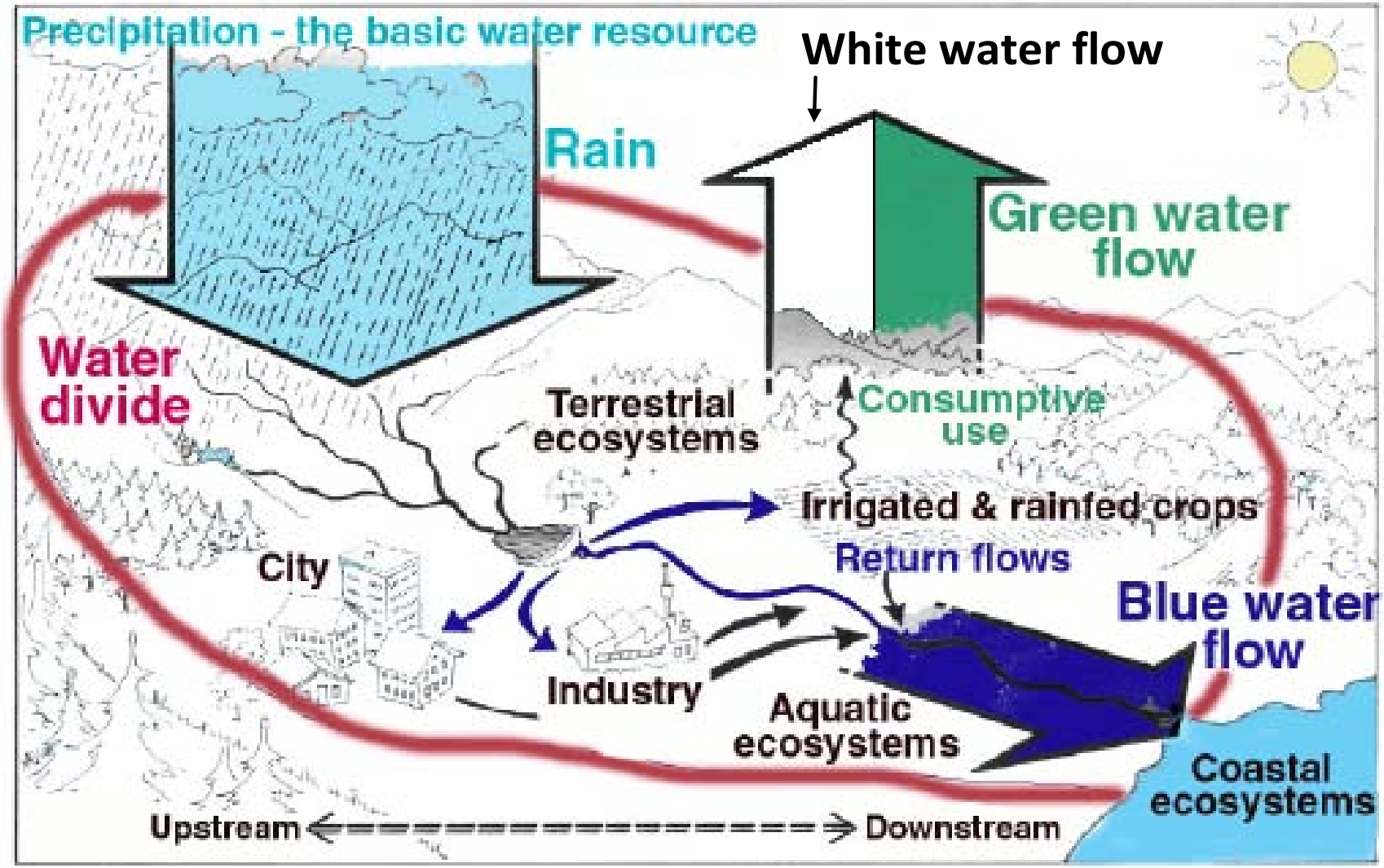
- Economy
  - Crop production valued at $1 billion/yr
  - 10% shift from white water would increase green water by 23%
  - Worth approximately $230 million/yr in crop production alone
- Ecosystems
  - 10% shift from white water would increase blue water resources by 24%
  - Worth?

Next steps

- Discover the factors which control the partitioning between blue, green, and white water
  - what drives the spatial variability?
  - what drives the temporal variability?
  - what are the connections with land use?

- Develop land management practices to reduce white water flows while increasing green and/or blue water flows

Oklahoma's Renewable Water Resources



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