Project #1, Hydrologic Impacts of Improved Irrigation Efficiencies and Land Use Changes

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Project Objectives

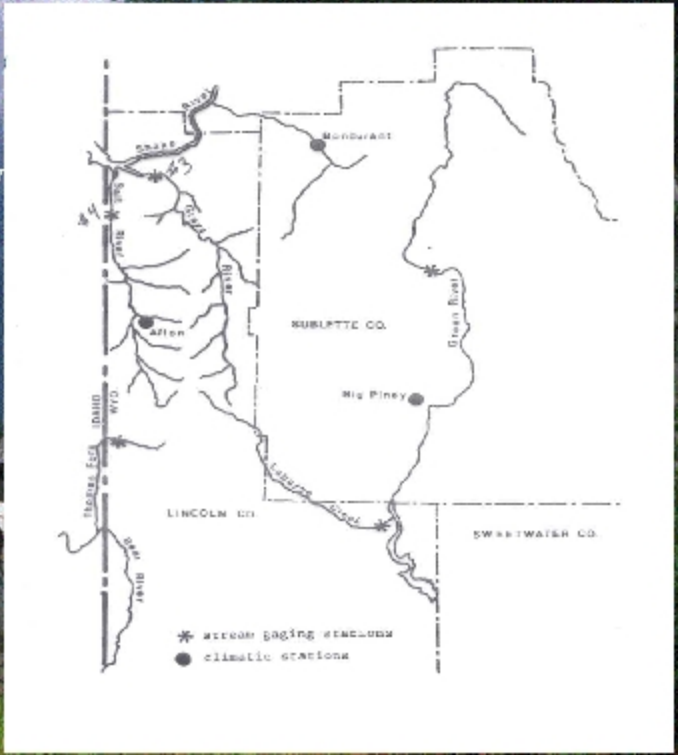
- Investigate the potential hydrologic impacts of irrigation and land use changes.
- In-Stream Flows, Evaporation Losses, Groundwater Hydrology, and Water Quality
- Document all findings.

Literature Review

- Sprinkler and surface irrigation efficiencies did NOT show any significant difference. (Zalidis 1997)
- Project irrigation efficiency increased from 53% (citrus), 42% (vegetables) to 68% to 70% with change from flood irrigation to sprinkler irrigation. (Battikhi 1994)
- Losses due to evaporation and deep percolation.
- Application efficiency rose from 62% to 88%.

Study Area

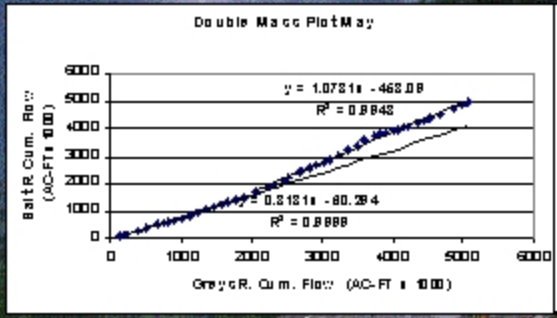
- Star Valley

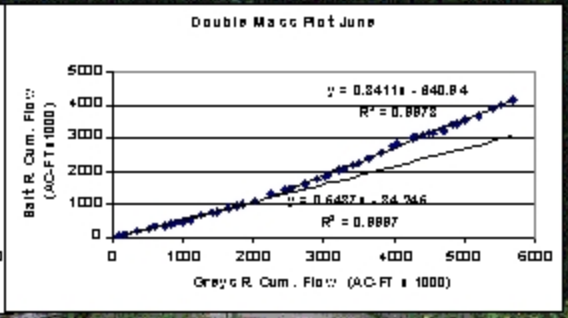


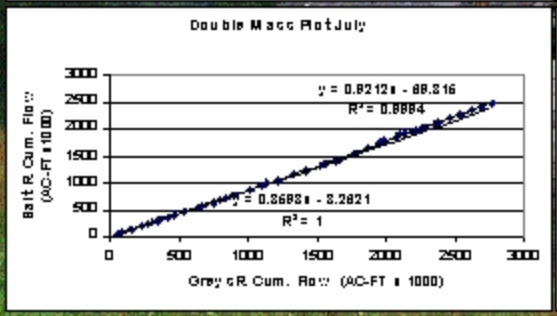
Hydrologic Impact Methodology

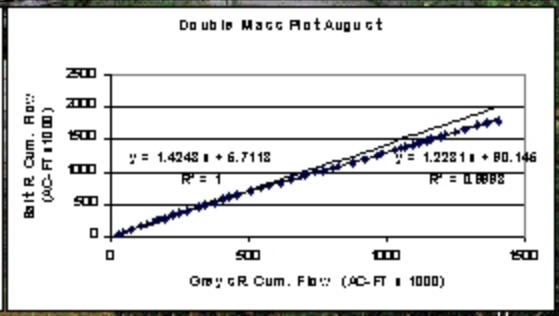
- Double mass balance plots of Greys and Salt River flows.
- Changes in return flows
- Calculation of Losses Due to Evaporation, ET, and Seepage from the Irrigation Canals
- Possible changes in groundwater levels.

Double Mass Balance Analysis

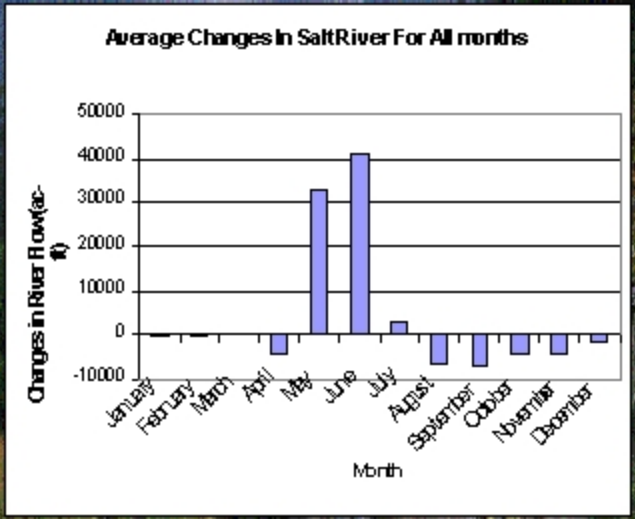


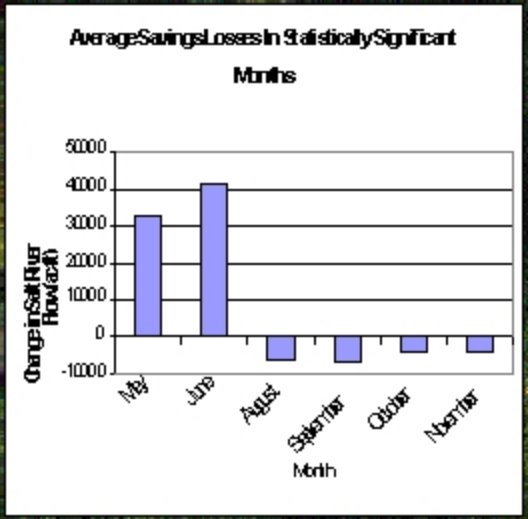




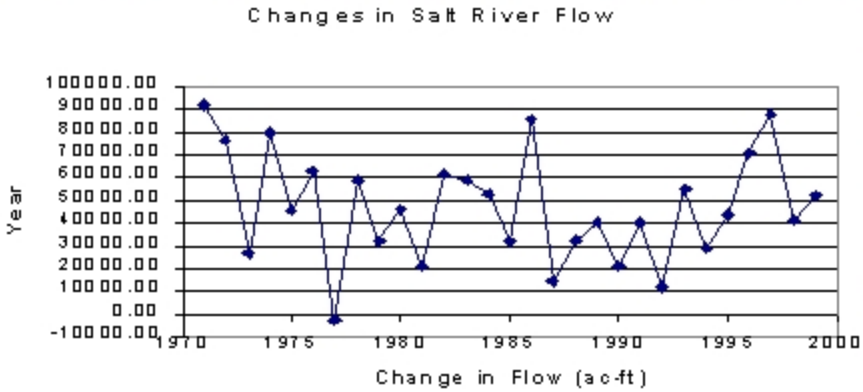


In-stream Flow Changes



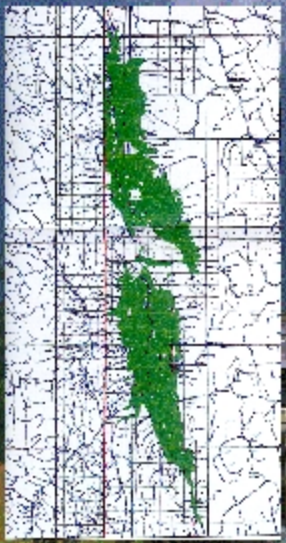


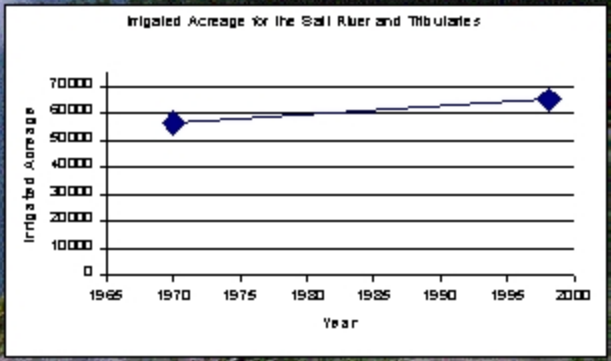
Annual Salt River In-Stream Flow Changes



Average Change/Year	**53,200**

Relative Savings





- Irrigated acreage ~ 65,000 acres
- Consumptive use ~ 65,000 - 130 ,000 acre-ft/yr
- Average annual changes in Salt River Flow ~ 53,200 acre-ft/yr (increase)

Mass Balance

- Approximately 53,200 ac-ft increase of in-stream flow in Salt River.
- How did these savings occur?
- Evaporation
- Evapotranspiration (ET)
- Seepage in unlined canals
- Reduced groundwater recharge

Evaporation Losses

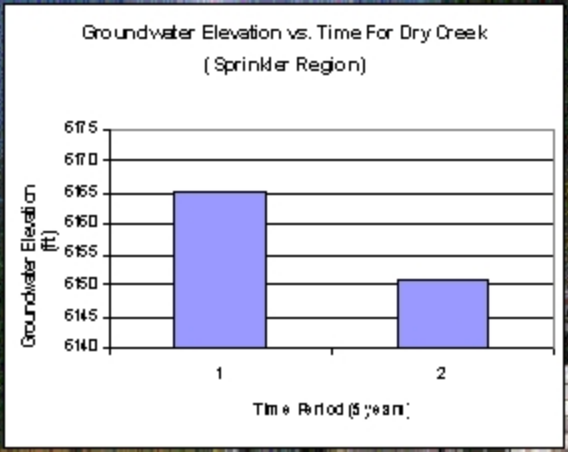
EVAPORATION								
Star Valley; Evap =								
acres	ratio	S.A.		S.A. =	3726096			
56335	301.8692566	17005805	VIII					
	resenv. Evap (in)	(ft)	Table Evap #	evap (in)	(ft)	S.A.	Evap.(cu.ft.)	ac-ft
April	45	3.75	0.08	3.6	0.3	17005805	61220896.44	1405.438
May	45	3.75	0.115	5.175	0.43125	17005805	88005038.64	2020.318
June	45	3.75	0.131	5.895	0.49125	17005805	100249217.9	2301.405
July	45	3.75	0.171	7.695	0.64125	17005805	130859666.1	3004.125
August	45	3.75	0.156	7.02	0.585	17005805	119380748.1	2740.605
Sept.	45	3.75	0.115	5.175	0.43125	17005805	88005038.64	2020.318
				34.56		Sum =	587720605.9	13492
					Approx Evap. Losses AC-FT =			10092
			IX					
	resenv. Evap (in)	(ft)	Table Evap #	evap (in)	(ft)	S.A.	Evap.(cu.ft.)	ac-ft
April	45	3.75	0.08	3.6	0.3	18548725	66775411.24	1532.953
May	45	3.75	0.175	7.875	0.65625	18548725	146071212.1	3353.334
June	45	3.75	0.203	9.135	0.76125	18548725	169442606	3889.867
July	45	3.75	0.244	10.98	0.915	18548725	203665004.3	4675.505
August	45	3.75	0.224	10.08	0.84	18548725	186971151.5	4292.267
Sept.	45	3.75	0.154	6.93	0.5775	18548725	128542666.6	2950.934
				48.6		Sum =	901468051.8	20695

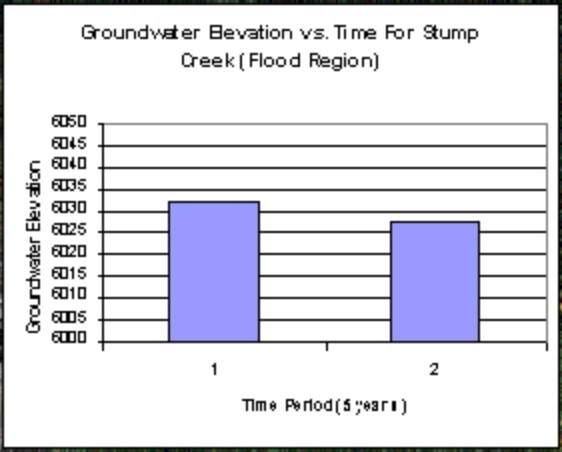
Unlined Canal Seepage

Soil Type	Losses in m^3/m^2 of wetted perimeter in 24 hrs
Medium Clay over hardpan	0.1 to 0.15
Clay loam-slit loam	0.15 to 0.23
Gravelly clay loam, sandy loam, sand and clay	0.23 to 0.30
Sandy Loam	0.30 to 0.45

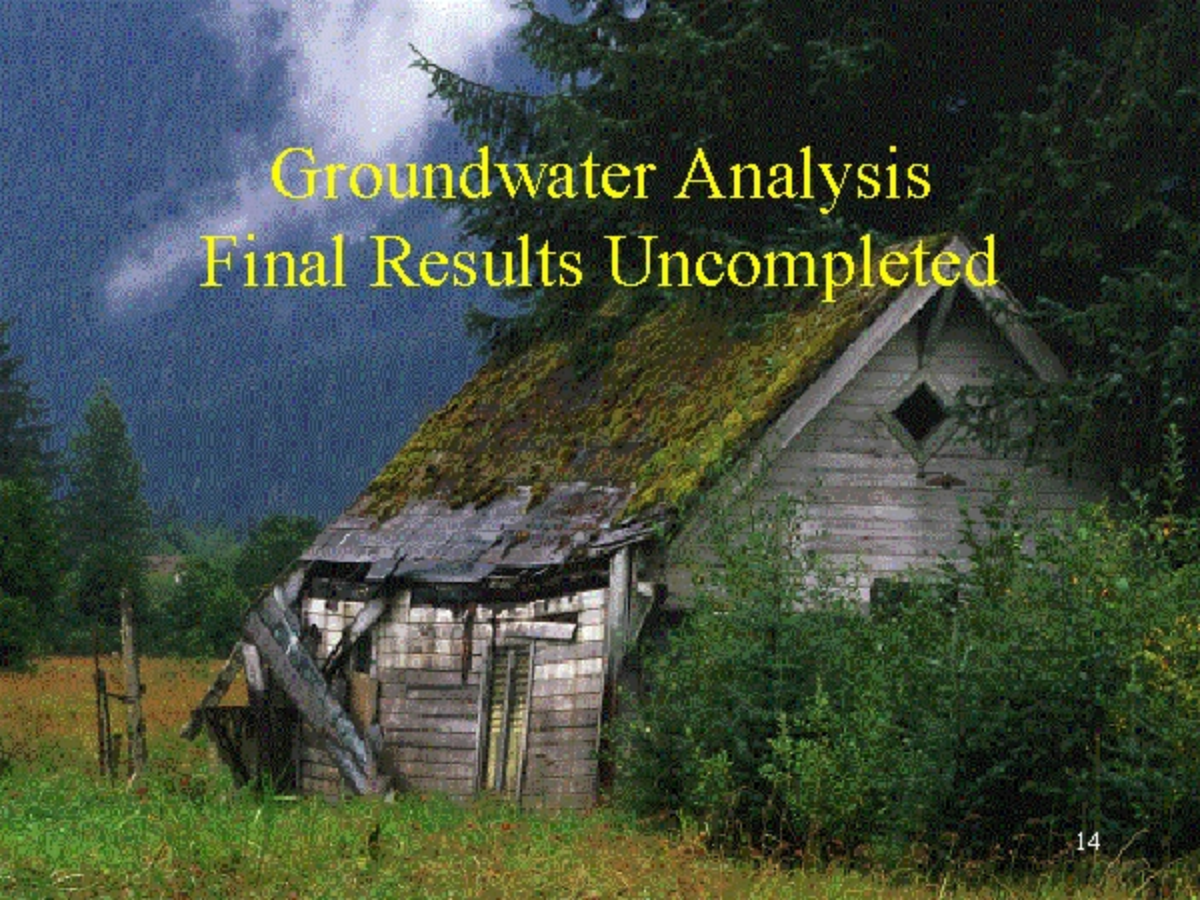
Wetted Perimeter	Table Values	Seepage (AC-FT)
133.5 AC-FT	0.15	20100
	0.23	30820
	0.3	40201
Canals Length appx = 220 miles; (16,400,000 cu.ft)		

Groundwater Analysis





Groundwater Analysis
Final Results Uncompleted



Groundwater Research

- Compilation of all known well information in project area.
- Groundwater analysis of wells in known sprinkler and flood irrigated locations.
- Six 5 sq. mi. cross-sections;
- Dry Creek and Stump Creek areas
- T31-33, R118-119;

Impacts in Study Area Due to Changes in Irrigation Efficiency

Average Increase in In-Stream Flow After 1971 =53,200 ac-ft

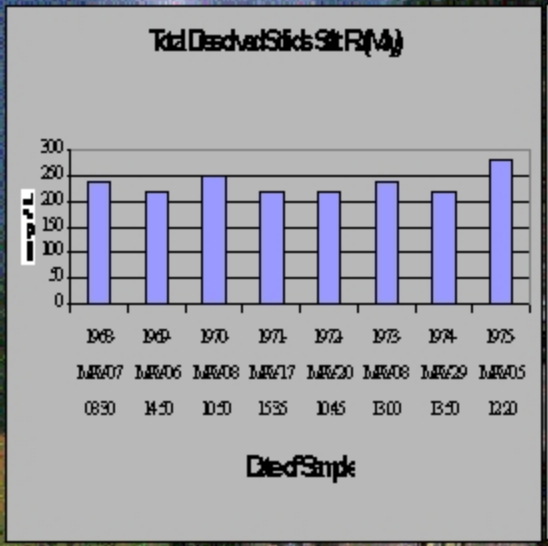
Evaporation Losses = 10,100 ac-ft

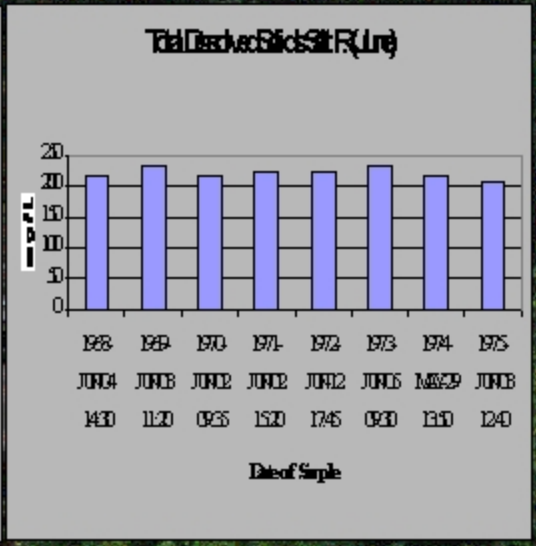
Change in Groundwater Recharge = 30,800 ac-ft

Water Quality Information

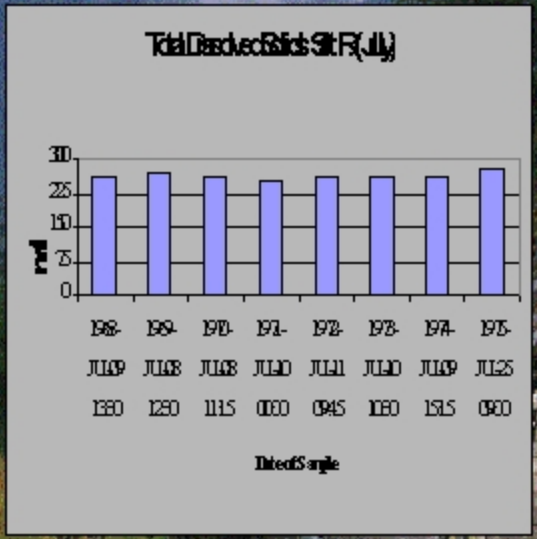
- Total Dissolved Solids
- Salinity concentrations in river increase/decrease
- Sprinkler irrigation should reduce the concentrations of salt loading in the Salt River

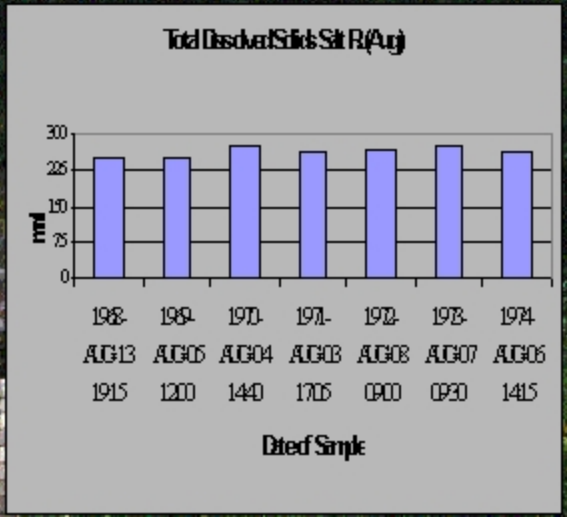
Changes in Water Quality
Dissolved Solids Analysis





Changes in Water Quality
Dissolved Solids Analysis





Summary

- Significant in-stream flow savings documented. (53,200 ac-ft)
- Return flows increased due to reduced losses in evaporation, and changes in groundwater recharge (seepage losses).
- Slight increase in irrigated acreage during the same time period.
- Appears little or no effect to water quality.
- Conclusions are based on limited groundwater data; long-term groundwater monitoring is needed for more accurate assessment of changes in groundwater hydrology.

Acknowledgements

- Financial support provided by:
- USGS
- WWDC