South Platte River
Importance of Return Flows and Replacing Depletions to Down-Stream Water Users

American Ground Water Trust
Colorado Aquifer Management

November 29th, 2012

Jim Yahn, P.E.
North Sterling Irrigation District & Prewitt Reservoir
The Great American Desert
“a barren region unfit for the habitation of civilized man.” - 1820

“these vast plains of the western hemisphere may become in time equally celebrated with the sandy deserts of Africa.” - 1806
• “The Platte! That’s the sorriest river in America. You’ve heard all the jokes about the Platte. Too thick to drink, too thin to plow. That’s a nothing river.”
• “Good God! I couldn’t help myself. The South Platte was the most miserable river in the West, a trickle in summer when it’s water was needed, a raging torrent in spring. It was muddy, often more island than river, and prior to the introduction of irrigation, it had never served a single useful purpose in it’s halting career.”

- James A. Michener-Centennial

Water Fact…

Average Annual Precipitation….

Northeastern Colorado
14-16 inches

Northeastern United States
40-50 inches
South Platte Water Rights Development

• Mining 1850’s - 1860’s
• Irrigation Direct Ditches 1860’s – 1900’s
• Irrigation Reservoirs 1900’s – 1910’s
• Irrigation Wells 1930’s – 1970’s
• Irrigation Well Augmentation – 1970’s - Today
• Municipal and Industrial - Ongoing
Union Colony (1870) - Irrigation and The Mutual Ditch Company
Colorado Water Law

- Doctrine of Prior Appropriations
  - First In Time = First In Right

- Water Right: a right to put water to beneficial use when available in priority

- Water Rights are decreed in Water Court

- Water Rights may be conditional or absolute
Direct Flow Ditches of the late 1800s
Development of Direct Flow Water Rights
Plains Reservoirs of the early 1900s
These 17 reservoirs total 768,000 AF
Post Surface Irrigation Development
Transbasin Diversions:

1. Adams Tunnel
   231,060 af

2. Roberts Tunnel
   68,767 af

3. Moffat Tunnel
   52,912 af
South Platte River Basin Hydrology

- Native Flows for total basin estimated to be 1,400,000 acre feet annually by the USGS.
- Transbasin water provides approximately another 400,000 acre feet per year.
- Total annual surface water diversions equal approximately 4,000,000 acre feet.

Information taken from Division 1 Engineer power point presentation for CFWE tour of South Platte, July 19, 2008
Alluvial Wells of the 1930’s to 1970’s
Fig. 2. Annual installation and cumulative number of irrigation wells in the South Platte River valley study area
Ralph Parshall in 1922

Return of Seepage Water to the Lower South Platte River in Colorado

Ralph Parshall (Colorado Ag. College now Colorado State University)

December, 1922.
Ralph Parshall in 1922
The Phenomenon of Return Waters

• Return flows were increasing over time and continued to increase, mostly due to the general rise of the water-table over greater areas.

• The water table has risen each year (since the early stages of irrigation development) as much as 100 feet in some areas.

• The artificial application of water to the cultivated fields, caused the ground to be filled with water, resulting in this general rise of the water-table.

• This annual rise and changing slope of the water-table creates a greater pressure on the water beneath, which, in turn, overcomes the normal resistance of the soil and finally permits the displacement of the water in adjacent areas.

• As the practice of irrigation continued and greater areas were affected, it ultimately so increased the pressure that there has resulted, due to the action of gravity, a greater flow through the underground strata; but on account of the great resistance set up by the soil particles, the rate of travel of this underground current is exceedingly slow.”
Ralph Parshall in 1922

Other Findings

• Value of return flows were huge, more than $2,000,000 or $3,000 per second-foot.

• Return flows varied from 2 to 8 ½ second-foot per mile and averaged 5 ¼ second-foot per mile.

• Reservoirs contribute about 20% of return flows.

• Ratio of return seepage to irrigated area is approx 1 second-foot to 275 acres.

• There is a yearly increase in seepage return.

• The diversions from the river after the spring floods have subsided are practically all from seepage or return water, and only during summer floods or freshets is the river flow increased.
Delph Carpenter in 1925

South Platte River Compact

Signed by CO and NE in 1923

Signed by CO Governor Clarence J. Morley in 1925
Nature of return flows in the South Platte

“The flow was excessive in May and June and disappeared entirely during the summer. The river frequently became dry for months of each year to points as far west as the present city of Fort Morgan.” – Prior to surface irrigation.

“The flow of return and seepage waters coming back to the river from irrigation of Colorado lands, has resulted in a constant supply at the interstate line.” – After surface irrigation development.

“This flow is increasing and will soon be sufficient to care for the full demands of Nebraska as determined by the compact, while great quantities of water annually flow to waste across the interstate line, during the flood season and winter months…………………………….”

“The once “disappearing” flood stream has been converted into one of constant flow making possible the development in both states.”

Delph Carpenter, 1925 letter to CO Governor
South Platte Alluvium

EXPLANATION
- Water-table contour—shows altitude of water table, March 1968; contour interval—20 feet; datum is sea level
- Direction of ground-water movement
The Water Problem
Ralph Parshall’s address to Ft. Collins Rotary Club
August 29th, 1956

• Several issues impacting the dwindling river and hydrologic conditions.

• Assisted Bureau of Reclamation with C-BT economic report in 1932-1933 and together concluded: that about one-third of the season use of 300,000 acre-feet (from C-BT) in direct irrigation would result in some 100,000 ac-ft in the return flow.

• Return flows have been investigated since the early 1880s and these past records strongly indicated a steady increase in the return flow to the river.

• In 1956 found that seepage return was practically nil.

• Partly due in the fact, that between Kersey and Julesburg, more than 4000 irrigation wells pumped to deliver enough water to fill Horsetooth Reservoir four times during the season of 1955 (584,000 ac-ft).

• Appeared obvious that we cannot continue depleting the underground reservoir at that rate.
# THE NORTH STERLING IRRIGATION DISTRICT

## Storage in Reservoir

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## Prewitt Reservoir

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Ditch, Reservoir and on-farm seepage - “Recharge” or fill up the aquifer which slowly makes its way back to river. The volume released to the river is the “return flow or “accretion” amount.
An alluvial well used, typically, for irrigation. Pumping “depletes” or “intercepts return flows” which impacts river flow.
South Platte River Basin High/Low Snowpack Summary
Based on Provisional SNOTEL data as of Sep 28, 2012

Current as Pct of Avg: 500%
Current as Pct of Last Year: N/A
Current as Pct of Peak: 0%
Average as Pct of Peak: 0%
Current Peak as Pct of Avg Peak: 68%
Current Peak Date: Mar 06
Average Peak Date: Apr 23
Current Meltout Date: Jun 06
Median Meltout Date: Jun 20

NRCS
Natural Resources Conservation Service
Total Diversions and River Gage Volumes
Districts 1 and 64
June 1st thru Sept 4th (2002 & 2012)
River Gage Volumes
Districts 1 and 64
June 1st - Sept 4th (2002 & 2012)

[Bar Chart]

- South Platte River Near Kersey, CO
- South Platte River Near Weldona, CO
- South Platte River at Cooper Bridge, NR Balzac, CO
- Sum of Channels 1, 2, 4 (Onejurco + Plajurco, CO)
South Platte River Kersey to Julesburg

Return Flow, cfs per mile

River Mile

Parshall Mean 1919-1920
2002 Pt Flow
2012 Pt Flow
SPDSS Irrigated Acreage Water Sources

Ground Water Only
Surface Water Only
Ground and Surface Water

*The North Platte River Basin is not displayed on the maps. The North Platte Basin is irrigated almost entirely by surface water.

Water Source Comparison
South and North Platte River Basins

| Year | N. Platte | N. Platte
67% | N. Platte | N. Platte
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Final Comments

• USGS Report – “Over the time interval from when pumping starts until the system fully recovers to its prepumping levels, the volume of streamflow depletion will equal the volume of water pumped.”

• We are part of the prior appropriation doctrine and it is for times of scarcity.

• All of Colorado was in a drought in 2012.
Final Comments

• Weld County commissioners asked for 25,000 ac-ft of pumping – this is roughly equal to the storage in the Prewitt Reservoir.

• If you pump the top 10 – 15% of the aquifer you directly affect the river and therefore downstream water users.

• We also want only what we’re entitled too.
Solution

• Storage

• Exchange

• Cooperation