WATER RESOURCES MANAGEMENT SERIES : 1

Water for Sustainable Development in the Twenty-first Century

Edited by
ASIT K. BISWAS
MOHAMMED JELLALI
GLENN E. STOUT

Proceedings of 7th Session of the World Congress on Water Resources, Rabat, Morocco 13 May 1991

DELHI / New York
OXFORD UNIVERSITY PRESS
BOMBAY CALCUTTA MADRAS
1993

Table 2. Water withdrawals by continent (in litres/capita/day)

Continent	Acutals for 1980				Projections for 2000			
	D/M	Indus-try	Irriga-tion	Sub-total	D/M	Indus-try	Irriga-tion	Sub-total
Africa	47	30	558	635	96	106	514	716
Asia	82	110	1215	1407	152	250	1138	1540
Australia/Oc.	432	148	1686	2260	562	274	1826	2602
Europe	265	1066	608	1939	300	1338	669	2307
North America	440	1960	2200	4620	504	2045	2185	4734
South America	236	295	687	1218	299	784	672	1755
USSR	223	1137	2526	3886	309	1281	2651	4241
World	144	415	1205	1764	203	546	1147	1896

largely agrarian, with irrigated agriculture using 80–90 per cent of the developed water resources. In Egypt, agriculture uses 90 per cent of water supplies, employs one-third the population, and contributes 25 per cent to the Gross Domestic Product, yet food imports in 1975 exceeded 65 per cent of total requirements (Falkenmark, 1976). Egypt depends on the Nile for 95 per cent of its water supply (Hamman, 1990). On a global scale, approximately 70 per cent of total water consumption is used for irrigation of crop lands, 23 per cent for industry, and the remaining 7 per cent for domestic and municipal purposes. The uses of water vary greatly among countries, depending on natural climatic conditions, availability, accessibility and quality of water resources, and their economic and social development.

The variations in water use among continents are demonstrated in Table 2 for the three major requirements—domestic/municipal, industrial, and irrigation—which make up about 95 per cent of total use. Water uses for domestic/municipal (D/M) purposes range from an average of 47 litres/capita/day for Africa to 440 litres/capita/day for North America. The variations for industrial uses are even greater.

INCREASING WATER SUPPLIES

In the 20th century, large water resource projects have been developed to supply water for agricultural expansion and economic growth. By the 1960s, the accelerating pace of water withdrawal was being affected by the changes in socially-acceptable patterns. These changes placed a heavier emphasis on non-structural measures and on patterns of resource development involving greater harmony of technological and environmental aspects. Alternatives to developing additional sources of water supply are frequently mentioned in the literature and by the media, such as: to use water efficiently, to conserve it, to improve irrigation practices, to enhance the yield of reservoirs (Wurbs, 1990), to recycle wastewater, to desalinate sea water, and to pump groundwater. (Outside the polar regions, 94 per cent of all fresh water is stored as groundwater.) In arid regions (e.g. Riyadh, Saudi Arabia), groundwater is often the only stable indigenous supply (Ambroggi, 1980). There is pressure in large arid and semi-arid areas of Africa to base development on supplies of fossil groundwater. However, permanent communities cannot be established on this basis. Temporary use of fossil groundwater can be envisaged while other permanent sources of water supply are developed (e.g. Phoenix, Arizona). Artificial recharge of suitable aquifers is receiving increased attention in the United States (Bouwer, 1990).

Better management of irrigation practices is needed to prevent the detrimental effects of waterlogging and salination, to reduce seepage losses, to improve water distribution among farmers, and to control the amount and timing of water application to the fields. Between 200,000 and 300,000 ha of irrigated land in the world are lost every year as a result of salination and waterlogging (Falkenmark, 1976). It is estimated that a total of 20–25 million ha have been severely damaged by salination. This is about 7.5–9 per cent of the irrigated area in the world. Upgrading is also needed in about 150 million ha (Postel, 1985). Operational efficiencies can be doubled from the 30–40 per cent range to as much as 75–80 per cent.

The four major sources available for increasing water supplies in the African continent are:

1. capturing the uneven and inadequate precipitation;
2. storing more water from the four large rivers: Congo, Niger, Nile, and Zambezi;
3. tapping groundwater resoures, especially from rainfall in the mountains; and
4. desalinating seawater.

IMPORTANCE OF DAMS

Existing water shortages and increasing demands for water cannot be met by the above-mentioned measures, even when they are conjunctively applied. More surface reservoirs are needed to modify the uneven

Water Efficiency Sampler

Scott Chaplin
Rocky Mountain Institute Water Program
December 1991

A revolution is occurring among water management planners as their focus turns away from large supply-side projects such as dams and canals and toward demand-side projects including residential retrofit programs, irrigation efficiency programs, and commercial and industrial reuse and efficiency projects. The following case studies provide just a few examples of the many water efficiency projects actually underway. More detailed information on these and many other case studies, as well as general information on water efficiency, is available from ***Rocky Mountain Institute Water Program, 1739 Snowmass Creek Road, Snowmass CO 81654-9199.***

Water and Energy Utility Partnerships — Two Connecticut water utilities have formed an alliance with a local electrical utility to promote residential water and energy efficiency. In a pilot program of 1,100 home audits, contractors visit homes to install water- and energy-efficient hardware. The utilities split installation cost in an innovative way: if the home has an electric water heater, the electrical utility pays for the labor, and if the home has a gas water heater, the utilities share the labor costs. (Bruce Wall, Northeast Utilities, Box 270, Hartford CT 06141).

Irrigation Improvements — In Lubbock, Texas, utility-financed irrigation efficiency projects have led to savings between 25% and 40% and a reduction in the annual aquifer depletion rate from 1.4 million to 0.2 million gallons per year. These projects include replacing unlined ditches with pipelines, shortening furrows and watering them in surges, recirculating tailwater at a faster rate to reduce evaporation, using soil moisture monitoring devices such as gypsum blocks (which can also increase yields), and switching from high to low pressure sprinkler systems. (Wayne Wyatt, High Plains Water District, 2930 Ave. Q, Lubbock TX 79405)

Composting Toilets and Graywater Systems — In New Jersey, the need for a sewer hookup or a septic system was avoided in the construction of two public restroom facilities which were equipped with composting toilets and graywater systems. The graywater from one of the facilities is used in a solar greenhouse. (William Clothier, "Using Composting Instead of a Septic System: It Works In New Jersey," *P & R Magazine*, June 1987)

Rebate Programs — In Mesa, Arizona, local officials developed a rebate program for landscape water efficiency improvements. As a result, some participants use 40% less water than their turf-intensive neighbors. (Bill Bates, Water Conservation Office, Box 1466, Mesa AZ 85211)

Dual Plumbing Systems — In St. Petersburg, Florida, the local utility developed a dual distribution system to use reclaimed water for non-potable needs, providing approximately 18-21 million gallons per day (1/3 of total city consumption) for use in irrigation and cooling. This system will eliminate the need for new water sources and expansion of water facilities until 2030 - 2050. (Joe Towry, Public Utilities Department, 290 16th St. North, St. Petersburg FL 33713)

Centralized Treatment and Reuse — Sanitation districts in and around Los Angeles, California supply an annual average of 63 million gallons per day of reclaimed water to local customers. This tertiary-treated effluent, which meets or exceeds bacterial and other drinking water standards and is virus-free, is retailed at 45%-85% of the potable water rate, and is used for almost all non-potable purposes, such as irrigation of parks, golf courses, and other landscaped areas, irrigation of food crops, livestock, recreational impoundments, industrial processes, cooling towers, construction, and groundwater recharge. (Chuck W. Carry, Sanitation Districts of Los Angeles County, Box 4998, Whittier CA 90607)

Onsite Treatment and Reuse — In Essex County, New Jersey, the Roseland III office park development, a 360,000 square foot project serving over 1,100 people, uses approximately 62% less water than comparable commercial buildings. These savings are accomplished through the use of an onsite wastewater recycling system which treats the building's wastewater and reuses the reclaimed water for flushing toilets and urinals. Similar projects have resulted in water savings as great as 90%. (John Irwin, Thetford Systems, Inc., Box 1285, Ann Arbor MI 48106)

Low-Income Housing Retrofits — The Lower Colorado River Authority in Austin, Texas, has completed a demonstration project at several low-income public housing sites, retrofitting 1.6 gallon-per-flush toilets in place of 5.0 gallon-per-flush toilets. Water use reductions ranged from 23.0 to 27.5 gallons per person per day at various sites. (Nora Mullarkey, Lower Colorado River Authority Water Efficiency Department, P.O. Box 220, Austin TX 78767)

Commercial and Institutional Efficiency Programs — In Massachusetts, water use audits were conducted for a variety of facilities, including universities, laboratories, hospitals, and businesses. Savings of 10% to 73% were anticipated via fixture modifications, better maintenance practices, flow and pressure controls, and cooling system recirculation. On average, it was found that a facility could reduce water use by 20% to 30% with a simple payback for the investment of 1.3 years. (Laura McGrath, *Demand Management for Industry: Clearing the Hurdles to Implementation*, Massachusetts Water Resources Authority, 100 First Ave., Charlestown MA 02129, 1990, pp.2,3)

Hotel Retrofits — The Lenox Hotel in Boston reduced its average water demand by about 40% (3.6 million gallons per year water savings and $15,000 annual cost savings) by replacing conventional plumbing fixtures in its 220 rooms with high-efficiency fixtures. These savings have been achieved with no reduction in fixture performance or customer satisfaction and with no problems with wastewater flow. (Amy Vickers, Amy Vickers & Associates, 100 Boylston St., Suite 702, Boston MA 02116)

University Efficiency Programs — At Edinboro University in Pennsylvania, dormitories were retrofitted with high-efficiency showerheads, faucet aerators, and other retrofit devices, which led to savings of approximately 11 million gallons per year, or 20% of the University's previous consumption. Utility costs — water, sewer, and energy — were reduced by $52,000 per year, at a total program cost, including labor, of $11,000. (Tom Fidler, State Water Plan Division, Dept. of Environmental Resources, Box 8761, Harrisburg PA 17123-8761)

Agricultural Transfers — Casper, Wyoming obtained 2,000 acre-feet of water per year for municipal use in return for repairing and lining parts of local irrigation canal and lateral systems to reduce seepage. (David Hill, Board of Public Utilities, 200 N. David St., Casper WY 82601)

Hookup Fee Incentives — Builders in Morro Bay, California are given the option to save, in existing structures, twice as much water as they need, or pay the standard hookup fee. As a result, private builders have retrofitted 50% of all homes and businesses with high-efficiency plumbing fixtures. (William Farrell, City of Morro Bay, 595 Harbor St., Morro Bay CA 93442)

Repairing Leaks — In New York City during fiscal year '90-91, 26 full-time workers surveyed over 90% of the city's 57,000 miles of water mains. With a budget of $1.5 million for labor and equipment, they fixed 66 breaks and 671 leaks, yielding an estimated savings of 49 million gallons per day. (Ian Michaels, New York City Department of Environmental Protection, Room 2454, Municipal Building, 1 Center Street, New York NY 10007)

Comprehensive Programs — In Goleta, California, over 17,000 ultra-low-flush toilets have been installed in the last few years, most with a $50-$80 rebate from the local utility. The utility has also distributed 35,000 high-efficiency showerheads, implemented rate structure changes, and conducted onsite water use surveys. These measures, in addition to some emergency drought measures, led to a reduction in water use of 50% and reduction in sewage flow of over 50%, thus eliminating, for now, the need for a multi-million-dollar treatment plant expansion. (Larry Farwell, Dept. of Water Resources, Box 942836, Sacramento CA 94236)

SOURCE -- Bureau of Reclamation (25 May 2000) Horsetooth Reservior, Safety of Dams Activities; Draft EA EC-1300-00-2, Eastern Colorado Area Office, Loveland, Colorado.

p37 Horsetooth Reservoir has total capacity of 156,735 ac-ft with dead storage of 7,000 ac-ft. Filled by deliveries through CBT with maximum capacity fo 550 cfs during November through May. Deliveries from reservoir are from April through October for irrigation. Over 50 year period of use, total annula inflows ranged from 40,000 to 158,000 ac-ft and averaged 106,000 ac-ft. Deliveries ranged from 21,000 to 156,000 ac-ft and averaged 96,000 ac-ft. Recently average delivery has been about 70,000 ac-ft.

p38 Average high water is 5,421 and draw down averages 30 feet - 5420 - 137,067 at 1,894 acres and 5390, 86,303 ac-ft, 1,496 acres.

Recreation

p21 Many boaters who keep boats at reservoir use their boats as cabins and tend to stay at mooring or slip.

p21 Capacity for motorized boating 314 to 484 boats according to Larimer Parks Staff depending on level of reservoir Past 15 years reservoir has fluctuated between 5380 and 5425 feet elevation (p12). Reservoir holds 156,735 ac-ft at 5430 elevation which is top of conservation storage pool (p6). Area-Capacity Table (p38): At 5430 foot elevation, capacity 156,735 ac-ft, area 2040 acres; On average reservoir drops 11 by primary recreation season and 19 feet by end of August. High mid June season (p23). At 5400 elevation, 101,910 ac-ft, 1,626 acres. 5430 is maximum and not achieved. Probable high is 5420, 137,067ac-ft , 1894 acres. And 5390, 86,303 ac-ft, 1,496 acres.

Calculation of Benefits based on difference in water supply due to possible re-operation of reservoir.

p28 Average capacity is 151,800 ac-ft [about 5427 elevation] with about 2,000 acres in prime recreation season. Visitation averages about 500,000 a year.

40% camping - 200,000 @ $48.13 per visit $9.62m
40% boating - 200,000 @ $27.44 per visit $5.48m
10% fishing - 50,000 @ $52.09 per visit $2,60m
10% general - 50,000 @ $30.03 per visit $1.50m
Total 500,000 visits for value of $19,219,000

valuation consumer surplus values for recreation visit as in USFS Publication RM-289 (McCollum et al. (1990) and Colorado Water Resources Institute - Technical Report #54 (Walsh et al. 1988) used for boating estimates. And benefits indexed for inflation to 2000 CPI.

Cost - Value Analysis

p25 Use of Economic and Environmental Principals and Guidelines for Water Releated Land Resources Implementation Studies (March 1983; called P&G). Uses 50 years and Federal Discount rate fro 2000 of 6.625%. Also did sensitivity analysis with "real" interest rate of Calculation of Benefits based on difference in water supply due to possible re-operation of reservoir. 4.0% to capitalize annual values for each of the benefits derived from reservoir.

SOURCE -- Bureau of Reclamation (25 May 2000) Horsetooth Reservior, Safety of Dams

Activities; Draft EA EC-1300-00-2, Eastern Colorado Area Office, Loveland, Colorado.

Calculation of Benefits based on difference in water supply due to possible re-operation of reservoir.

Irrigation Benefits

p26 Crop yield based on Reclamation Annual Summary Reports.

p26 Horsetooth Reservoir delivers 87,700 ac-ft annually to serve about 53,000 acres [1.6 ac-ft/ac]

p27 Crop prices from Economic Research Service of USDA

p27 Value of water based on CSU Extension Service farm budgets, Doanes Reference Manual, and interviews. Representative farm is 550 acres. Irrigation benefit as a difference in income between irrigation and dryland is $134 per acre or about $45 per acre-foot based on average water application of 3.0 ac-ft per acre. Capitalized net worth $11.4m.

Municipal and Industrial Water Benefits

p27 Calculation is based on willingness to pay - market value of M&I water provided by CBT Project. Northern WCD indicates shares traded at capital cost of $20,000 per ac-ft or equivalent of annual cost of about $1,381 per ac-ft when amortized over 50 years at 6.625%. Figures is persumed to be conservative as higher values expected in active market. Growth in M&I is from 10,010 ac-ft in 2000 to about 21,000 ac-ft by 2050. At annual value over period of $1381 the "capitalized present value of annual CBT M&I benefits is $258.8 million.

Hydropower Benefits

p29 Net generation attributed to Horsetooth Reservoir is 77.7 million KWH. Economic value per KWH of generation estimated based on alternative costs of thermal power as provided in P&G procedures. New thermal facilities are combined cycle or combustion turbine because of relatively low cost. Therefore power benefits estimated at $.0656 per kilowatt-hour for marginal or economic cost. This times 77.7m KWH is $5.1m value a year. Capitalized the present worth is $73.8m

p31 3 year construction period for an alternative would impose: irrig at $45 per ac-ft - $.783m; M&I at $1,381 - $21.1m; recreation at 39% of present annual or annual loss of $7.4m capitalized to $17.3m; hydropower loss at 36.6 KWH for 3 years of restricted reservoir use would be $2.4 annually and present value for 3 years of $5.6m.

Cost for dam re-construction is up to $130m and allocation to reimbursable costs is 15% or about $19.5m

Fairplay based Upper South Platte Water Conservancy District recently
1C bought 37 ac-ft for $18,000 from the Resolution Trust Corp. This amount normally costs about $100,000. Water to be used for collateral to buy more water to d reduce development costs in the district. Water provides flexibility to enhance economic development. So far they have about 50 ac-ft or enought for 50 new homes. Mines have played out. Real estate transfers have doubled since last year.

Upper South Park WCD has budget of $24,000 a year. Rights previously owned by Sioux Valley Savings and Loan of Sioux City, Iowa. Came
4C from bankrupt developer near Hartsel. Last year ~~group~~ WCD bought enough water around Bailey for 22 homes for $8,500. Also a Lake George deal in works for 10 ac-ft for $30,000 to be paid over time.

1972 law requires people to buy water rights to surface water for well. So augmentation a plans made by developers at a cost of up to $18,000 per ac-ft. Most augmentation plans never compensate anything because the use is sporatic - two to three weeks a year. Red tape stops initiative to build.

Upper South Platte WCD wants to form a cooperative to share water purchased to augment water taken from wells. Would lease water to homeowners to maximize compensatory value. Compensate only by the amount of water used. If the estimated amount of water used in house is 75 gallons per day for two weeks they do not need to have water for 3.75 people for 365 days.

Offer the extra to local businesses. Would stimulate the economy. Larry Dirks of Denver Water Board says he is surprised that WCD has enough money to do this.

Trend is for ranchers to form OPEC-style groups designed to sell water at the highest price possible; according to Alexander Cruthfield for AWDI.

At least 80% of water in South Park already controlled by downstream water users - mostly in Denver Area. Loss of control has had de devastating effect on their land-based way of life. We regret what has happened. It would have been easier if we had had the foresight 20 years ago. But we didn't says Wissel
Steve Spann, Water Engineer for Colorado and president of Upper S.P. WCD and County Assessor David Wissel,Vice President of 6 WCD.
Source: Bruce Finley (1992) New Aim: To Keep Water In The Hills, The Denver Post, October 18, 1992, pp. 1C and 4C.

Water sales in Crowley County in 1968 were at $380 per ac-ft. Sold to development co. which then sold to Colorado Springs. Now sales to Aurora, Colorado Springs, and Pueblo West of Twin Lakes water is at about $1050 per ac-ft. Arugment that if pay $1500 for ac-ft then compensate for $6.90 per acre lost in property taxes from farmers. Aurora has proposed this but farmers oppose because it would be a barrier on water sales. Latest offer is $7,500 per ac-ft for Twin Lakes water to one farmer.
Source: Bill Scanion (1992) Farms Shrivel As Cities Buy Water Rights, The Rocky Mountain News, October 28, 1992, p. 36

Pueblo City Council rejected request of Pueblo West to purchase a reserve water supply of 2 million to 4 million gallons per day

Deal - $228,000 per year availability / service fee
$1.4 M connection fee - tap fee
$1.1 M a year for 2 million gallons a day $490. per acft

1 million gallons a day is 1,120 acft a year
1 million gallons a day is 3.068 acft

Source Editorial (14 Nov 2001) Pueblo West Water Sale
The Pueblo Chieftain p 4A

Fort Lyon Canal is a big part of the Arkansas River water supply system taking around 300,000 ac-ft of diversions each year or about 40% of the river.

Source: Tom McAvoy (15 Dec 2001) Ex-Lawyer key to Fort Lyon water proposal, Pueblo Chieftain , pp. 1A and 2A.

Proposed sale of Fort Lyons water. Canal is 110 miles long. Proposal is to strip water and sell to cities. Canal provides water for 93,000 acres. Farmers pay $8.00 per acre-foot of project water to irrigate as much as 960 acres. To irrigate more they must pay $130 per acre-foot. Water is stored in Lake Pueblo and released when the canals buy it. High Plains A & M, the project proponent, wants to buy roughly 20,000 acres. If it does, (p. 2A) it will not be eligible to get cheap water. The water will available to others and spread over fewer eligible acres. Share holders who don't sell will not get shorted. Sale will make management of project more difficult. Project water is divided 49% to agriculture and 51% to municipalities. Dry-up would reduce irrigated acres giving more to municipalities - but municipalities are not using their entitlement at present. Agriculture does buy unused municipal wate so that agriculture gets about 75%. Allocation principals written in 1979. Canals water is valuable because of early rights giving it more than 300,000 acre-feet in most years.

James Amos (22Dec2001) Proposed sale could hurt water allocation, Pueblo Chieftain, pp. 1A and 2A.

Calpine Corp. Backed out of water deal in Weld County. Would have provided $220,000 a year in revenues to Greeley and partnering cities of Boulder, and Longmont. Calpine got better deal with Aurora. Plan was to lease Calpine abut 700 ac-ft from the cities wastewater treatment plant. Calpine would use water in gas fired power plant near Hudson. Plan was to draw water from near Kersey on lower South Platte. A20 year lease proposed and company gave Greeley $40,000 earnest money.

Source: Jesse Faniculli (8 Mar 2001) Calpine backs out of Weld water deal, Greeley Tribune, Greeley Co., no page. [$314.28 per acre-foot per year]

LaPlata Electric Association agreed to guarantee a $300,000 loan to the Vallecito Water Co. This was conditioned on a written guarantee from the Pine River Irrigation District which created the water company. If the project fails, the coop will get its money back. Vallicito Water Co. wants to lay 75 miles of pipe to serve 1,400 lots. Vallecito qualified for a $8m federal loan, and additional $4m from communities, Colo Water and Power Development Authority for $1m. Total construction costs is about $11.5 million with planning at $400,000 and $300,000 of this from the CWCB. USDA can do $300,000 loan but only if done through LEPA . Problem of financial viability if City of Durango annexes some of the land to be served.

Source: Tom Sluis (22Feb2001) LPEA OKs loan for water system, Durango Herald, Durango, CO, pp. 1A and 10A.

Victor, Colorado receives on about half the revenues it expected from Cripple Creek and Victor Gold Mining Co. Company had guaranteed to pay $19,000 per month or $230,000 per year. For 2000 it say it would use some $650,000 worth of town water and town budgeted on that. But by years end it had used $360,000. Some say company could plan better and town came up short.

Source: Charles T. Jones (14Mar2001) Gold mine water controversy cools in Victor, Gold Rush, Cripple Creek, CO, pp. 1 and 5).

-p 5A Water bank in California established for more then 800,000 ac-ft in 45 days in 1991. It paid sellers $125 per ac-ft. After heavy rains the price paid for 400,000 ac-ft became $30.00 and more than half was carried into 1992 in storage. -p 6A Farmers could make money from wate without having to sell. Bank helped use 14 million ac-ft that would otherwise have gone to ocean. Bank leads to better water management. Farmers sell water in dry years, perhaps to cities. Bank can lease water back to farmers. Pilot water bank is being set up on Arkansas Valley.

Source: James Amos (23 March 2001) Water banks: Is the time ripe?, the Pueblo Chieftain, pp. 5A and 6A.

Pueblo Reservoir Water Bank — -p1A Proposed enlargement of 75,000 ac-ft to present 250,000 ac-ft would cost about $100 million. To be paid for with Enterprise Water Management Storage space. Not more than 20,000 ac-ft set aside for winter stored farming water, a possible water bank, and for needs of small communities. Big cities have agreed to pay a 15% sur-charge on their own shares of enlarged space but this will pay for only about 7,500 ac-ft of space which guarantees hardly more than 5,000 ac-ft of winter stored water. -p 2A District staff suggests 2 ways to pay - 1) require users to pay for space to Dsitrict; 2) other is by property tax replacing tax to repay Fryingpan-Arkansas assessment of .822 mills. This now costs owner of $100,000 house [house with assessed value of $100,000] $8.22 a year and generates about $4m. Small communities want district wide assessment but ElPaso votes would not approve. Others favor charge for space to users. Others say wrong to have everybody pay own way. Small communities can not afford $2,000 per ac-ft for guaranteed space and will not know for years if they need space. Concern that if space not bought now, it will be gone later. The Arkansas Valley Aquiduct providing clean water to communities in the lower Arkansas Valley is expected to need 3,000 to 5,000 ac-ft in future. So some say property tax financing would be fairer or a rate based cost for each community to spread among its taxpayers. Charging only users makes project almost prohibitively expensive some say.

Source: James Amos (4Apr2001) Decision delayed on Lake Pueblo changes, Pueblo Chieftain, Pueblo, Colorado, pp. 1A and 2A.

Lessons learn from Crowley County, CO, water sales. 3,000 irrigated dried by Aurora. Replacement with grass hard to do, weeds grow faster. Sellers got 3 years to use water to replant grass or Aurora would do it and deduct $264 per acre from purchase price of about $5,600 per acre. Water transfers do not require revegetation but if land left, then problems. Much of Crowley County not revegetated after 40,000 dried up in 1980's. Largest sale was from Foxley Cattle Co. To Colorado Springs. Water buyer says revegetation was sellers responsibility. Continuing users sued seller or new owners of tracts, won, but go so little money for seed that nothing happened. -p 2B Sale in 1981 to Aurora of Rocky Ford Ditch established requirement for revegetation. Aurora bought water from assembler of water rights - Resource Investment Group. It was to revegetate but planted little and that died for lack of water. A water judge in 1989 fined Aurora and RIG. Aurora took over planting. Successful except for prairie dog field. Cattle grazing appears good. They eat weeds when grass young and push in grass seeds. Now Aurora is "good neighbor."

Source: James Amos (6Mar2001) Lessons hard earned from Crowley water sale, The Pueblo Chieftain, Pueblo CO, pp, 1B and2B.

Lessons from water transfers --- -p1A Not constitutional to stop sale of water. [water belongs to public so public can limits it use and perhaps its transfer]. Now places losing water want mitigation. Land left behind is worth less [but can be sold for ranchetts at higher

tax revenues to county - South Park example]. Land produces less, can be left empty [open space]. Local business earn less, farm suppliers close, less money spent in town, loss of farm and off-farm jobs. -p2A Local economy is going to hurt says Marshall Frasier of CSU. CU professor Chuck Howe says inequalities - economic growth distant from economic decline resulting from water transfer in case of Rocky Ford Ditch transfers. In 1970's water transfers remained in valley - from lower to around Pueblo. Later sales to aurora and Colorado Springs were out of valley. Howe said in his 1999 report that dry-up of 40,000 acres resulted in large-sale negative impacts including drop in county tax base when need for social services increased. [boom - bust situation] Impacts of transfers worse because of Arkansas Valley depressed economy and sparse population - 5 to 7 times as severe as sales in South Platte drainage and impact will persist.

So why not change --- -p2A Water law concerned only with quantity, prior appropriation doctrine. Not intended to address community impact. [water belongs to people so people again pay to sort out problems] So talk about addressing pollution concentration impacts of transfers. Is some consideration for revegetation. Local economy has no standing [HB 1041 and Grand County] [Why not look back a while? - Market based resource allocation pits one region against another and regions not able to act together until problem is out of hand] Compensation is compensatory reservoirs in 1937 Conservancy District Act [Gunnison flood flow decrees were to get someone to pay for water]. Therefoe Reudi Reservoir near Basalt to compensate for Fryingpan-Arkansas Project for trasnmountain diversions to the Arkansas River basin. Southeastern Conservancy District Manager says hold cities to this same mitigation standard. Hope do you compensate a farm community for loast water? [tax proceeds of sale] Howe says green Mountain Res. Sat unused fro 50 years. Money - but who gets it and how much? Is a school teacher equal to car dealer or farm implement dealer? State could restrict how much water is transferred - but affects property rights. We do impose no-burn days says Howe. Restrictions would devalue water rights, lowering farmers retirement funds and ability to borrow. [borrow based on assumption will not continue farming] Farmers do not want obligation to pay or absorb mitigation. [only if neighbor sells out] Water sales could be taxed but does the community really deserve a piece of the farmers' water profits. Where were the implement dealers when times were tough asks a farmer. Forced mitigation will drive down value of water rights. Devalued water rights change debt to equity ratios at farmers banks. [so does sale of neighbors' water] Water is worth more t city than to grow corn. Cities pay upwards of $1,000 an ac-ft while farming returns maybe $100 an ac-ft. Industries have changed, relocated, or died off when not needed anymore. Does the government step in to say you have to continue using typewriters. No; that life. Cost of transfer to rural communities is outweighed by benefits to large cities. What does society think is fair?

James Amos (26Feb2001) Paying the Price, The Pueblo Chieftain, Pueblo CO, pp. 1A and 2A.

Aurora willing to pay mitigation. It paid for Rocky Ford Ditch mitigation. It wowed Lake County officials for Hayden Ranch purchase 2,100 acre near Leadville. Aurora offered land, water, and lots of assistance. Aurora offered Lake County [What is relationship to

Aurora project in Park County?] to hold ranch as open space., to boost tourism in Leadville. Lake County has no water rights of its own to attract business. Would help preserve old ranch buildings, donate 60 acres for a fishing pond, pay amount of ranch's property to Lake County. Ayurora has held 2,100 acre ranch as open space as federal agencies assembled money to buy it to create park at top of Arkansas River Headwater Recreation Area. Promised to give 10% of water received to Lake County or allow this for operation of well. Helped raise $770,000 in grants for preservation of buildings on Hayden Ranch. Agreed to donate 60 acres for reservoir and fishing pond. Promised to pay property taxes of $2,600 per year. Optioned the adjoining ranch to review reservoir site, would pay property taxes, and give 20% of storage to Lake County, and optioned the rest of ranch for open space. Aurora offered to loan its engineers to help design industrial park. -p 6A Aurora helped broker a deal for failed Homestake II proejct in Eagle County. Earned local support by agreeing not to develop one third of potential water yield and to allocate one third of remaining water to local uses. With Rocky Ford Ditch purchase, Aurora promised to pay Otero County to make up property taxes whcih started at $10,000 and has gone to $14,000 a year but that does not make up for the $40,000 in property taxes lost by drying up 4,000 acres according to Otero County officials. Recently for dry up of 3,000 acres, Aurora is asked to help with economic development and utilization of dried up land. County is now objector in Water Court over transfer to get leverage in negotiations. Aurora has offered to pay $11,000 for a vision and goal setting process for Rocky Ford's economy. Aurora doing what it feels is right.

James Amos (26Feb2001) Aurora willing to Pay, The Pueblo Chieftain, Pueblo CO, pp. 5A and 6A.

State legislators interested in mitigation for water transfers. Governor Owen's Commission on Saving Open Spaces, Farms, and Ranches recommended the Colorado Water Conservation Board lobby the legislature for compensation in rural to urban transfers. No law has been proposed. Water rights considered private property. Legislature reluctant to interfere with owner's ability to sell water. Legislators say mitigation should be required but it depends on circumstances [yes?] Not sure what form, perhaps enterprise zone credits. If state encourages growth in one area, what about others? -p 6A CWCB rep. For Arkansas says this is part of CWCB's long range mission and leadership. He wants mitigation. Local community deserves as much of a future as Aurora. First Rocky Ford transfer cost county 60 jobs and $1.5m in income and $40,000 in taxes a year. Pending sale to dry up 3,000 is iexpected to cost county $34,000 in taxes.

James Amos (26Feb2001) Legislators officials say mitigation needed, The Pueblo Chieftain, Pueblo CO, pp. 5A and 6A.

Snowpack on Western Slope has lead to lower reservoir levels. This spring 6,500 ac-ft was diverted by Colorado Springs from Green Mountain Reservoir in Summit Count based on stream flow projections by the U.S. Bureau of Reclamation. The projections turned out to be too optimistic and the reservoir has a water shortage. Now the Colorado Springs water department is looking for 600 ac-ft from the Blue River. Denver has to return 9,400 ac-ft. The Colorado River Water Conservation District contends the excess diversions add to what is a critical water shortage. Rather than returning the water, the Colo. Springs officials are thinking of leasing the water from the CRWCD so as to keep water in its own reservoirs. The lease is at $205 per ac-ft and totals $123,000 and requires an agreement between the conservation district, the city, and the Bureau of Reclamation. The CRWCD is urging the cities to plan for how to handle water shortages and the need for storage.
Source: The Associated Press (21 July 2001) Poor snowpack could cost cities, Summit Daily News, page 10.

Copied for water Conservancy

Re: Leasing Values of Water

Arkansas Valley

uses 16,000 acre-feet of Aurora water under lease back after sale;

Pueblo in 1993 leased 13,000 ac-ft earning $189,500 at $10 to $15 per ac-ft;

Southeastern water Conservancy District allocated 37,887 ac-ft of Western Slope water to farmers and 13,810 ac-ft of Western Slope water to municipalities at $8.00;

Colorado Springs leased 22,000 ac-ft of water at $10.00 to farmers and 25,000 ac-ft of water to the CDOW for $500,000 or $20.00 per ac-ft.

10% to 15% of the Arkansas River is imported water but by requirements of the Frying Pan - Arkansas Project 51% of this must go to municipal, industrial and domestic uses.

SOURCE: Chris Woodka (1994) Agriculture Eroding In Ark Valley Pueblo Chieftain, 28 September, pp. 1A - 2A

Pinewood Springs Water District in Larimer County

U.S. Army trucking water from Lyons at $1,000 a day for 50,000 gallons a day to "up-scale" community on Litlle Thompson River.

SOURCE: Anon. (1994) Pinewood Springs - Army Delivering Water The Denver Post, 21 September, no page.

Taylor Talks for the week beginning October 2, 1994

Attending POWER's annual meeting was a delight for this trout. The setting could not have been more beautiful. The river was sparkling and fall colors at their peak. Everyone enjoyed some western songs before the meeting, of course with a mention or two about water, and a flotilla of ducks joined in the chorus.

The major event was discussion of Senator's Campbell's recently proposed legislation for the Black Canyon. A unanimous vote of support for this legislation was given with the hope that this bill would eventually include provisions that: (1) existing federal rights for the Black Canyon National Monument not be weakened, and that (2) historic operations of the Aspinall Unit continue to provide call protection to our Upper Gunnison Basin up to 60,000 acre-feet of upstream depletion or consumption.

Senator Campbell, and other legislators from Colorado's 3rd District, have worked for more than a decade on this Black Canyon legislation. The growing pressures and demands upon water resources coming from our basin emphasize the need for its passage. Threats from transmountain diversion proposals will continue after Union Park disappears. Endangered species recovery, water quality, flood control, and growing demands from downstream in places such as Los Vegas must be considered. We live at the headwaters and the waters are sought by many.

DAILY SENTINEL
Grand Junction, CO
(Mesa County)
M-F(PM), 31,345; S/Su(AM), 36,648

Date ?
1996 ?

Buyers sought for Wolford Mountain water

Heather McGregor
Daily Sentinel

GLENWOOD SPRINGS — Construction of Wolford Mountain Reservoir is nearly done, and the Colorado River Water Conservation District is now seeking Western Slope buyers for the water.

"The price will be heavily subsidized. The full cost would be about $300 an acre-foot, but we're talking somewhere between $70 and $130 an acre-foot," said Eric Kuhn, assistant director of the river district.

An acre-foot is 325,851 gallons, and is the water used in a year by a family of four.

The subsidized fee will cover operation and maintenance costs at the reservoir and provide seed money for other water projects in western Colorado, Kuhn said.

Payments from Denver Water and the Northern Colorado Water Conservancy District are covering the construction costs of the $47 million project, built on Muddy Creek near Kremmling, to compensate for their transmountain water diversions.

The river district is offering 8,000 to 12,000 acre-feet of water, with 40-year contracts and 35-year renewals. It has already committed 3,000 acre-feet to Middle Park water users and 1,000 acre-feet to Fraser Valley water users by exchange, along with a temporary promise to deliver 3,000 acre-feet in three of every five years for endangered fish in the Grand Valley.

Water Supply Costs

Water for Platteville for 1,570 residents to cost $50 or $60 per month with water supply purchased from Central Weld Water District; with defeat of bond election the cost is expected to be $80 to $100 a month.
Source: Jeffery Jones (1993) Platteville Water-Buy Plan Fails By 3 Votes, Greeley Tribune, 3 November, 1993, p. A6.

32 mile water pipeline between Carter Lake and Broomfield proposed by the Northern Colorado Water Conservancy District and called the Southern Water Supply Project. Western Slope water would be delivered into Carter Lake. Pipeline to carry 27,350 gallons per minute. 80% to replace contaminated water for Broomfield, Berthod, Fort Lupton, Hudson, Fort Morgan, and Erie. 60.7 cfs at 450 gal/min = 1 cfs
From Carter Lake pipeline would bring water south to Broomfield. This pipeline to cost $80 million. - Note Greg Hobbs, atty. for Northern District says ready to proceed with $2.5 million to construct outlets at Carter Lake and sign $20 million contract for pipeline construction (presume this is pipeline to Carter, not from Carter to towns.
Source: Mary George (1993) More Say On Water Pipeline Sought, The Denver Post, 17 November, p. 5B

p. 34A Average suburban home serviced by Denver Water pays $390 per year according to the water board and similar coustomer within Denver pays $189 per year. Residents outside Golden pay $791 for city water; Thornton customers pay average of $780.
Source: Thaddeus Herrick (1993) Water Users Afloat In A Pond of Revolt, The Denver Post, 14 November, p. 30A and 34A

6·23·05

DAILY SENTINEL
Grand Junction, CO
(Mesa County)
M-F(PM), 31,345; S/Su(AM), 36,648

80

Buyers stand in line to get 2nd water sales from Ruedi Reservoir

Heather McGregor
Daily Sentinel

GLENWOOD SPRINGS — The U.S. Bureau of Reclamation has buyers lined up for its second round of water sales from Ruedi Reservoir.

But many are questioning the value of their planned purchases in the wake of a court decision that rejected the use of Ruedi water for snowmaking at Aspen Highlands Ski Area.

The bureau has offered 38,650 acre-feet of water from the reservoir on the Fryingpan River east of Basalt. About 20 potential buyers, mostly towns and water conservancy districts, have offered to buy 16,951 acre-feet, according to Tom Gibbens of the bureau.

An acre-foot is 325,851 gallons, and Ruedi holds 102,000 acre-feet.

The one-time price for a 25-year contract is $450 an acre-foot, plus $2 an acre-foot per year for operations and maintenance. With each passing year, the price inches upward as the bureau looks to recoup its construction costs, which are to be repaid in full by 2019.

The rising cost gives buyers an incentive to ink a contract now, although they may not need the water right away.

Many of the present and potential buyers use Ruedi water in what is called an augmentation plan. They have a well or diversion elsewhere, and rely on a release of water from Ruedi to meet downstream needs and make up for the water they have taken.

But in May, Colorado River Basin Water Judge Thomas Ossola rejected a plan filed by the developers of Aspen Highlands to use Ruedi water to augment diversions from Maroon Creek for snowmaking, said Kevin Patrick, Highlands' water lawyer.

Ossola rejected the plan because Ruedi water is a sure thing for only a limited time, while other water rights are permanent, Patrick said.

He has asked Ossola to amend the ruling and approve the augmentation plan. If the judge declines, Patrick said he will appeal to the state Supreme Court.

Ruedi water contracts will also be constrained by minimum streamflow water rights filed to protect trout fisheries, Gibbens said. The bureau won't augment a diversion that would dry up a stream or damage the fishery.

The bureau plans to allocate the remaining 21,699 acre-feet of unsold Ruedi water to boost flows in the Colorado River west of Palisade for endangered fish for the next 15 years.

City proposal for water allocations may impact development in county

ic Hagerman
Assistant City Editor

A water policy statement the city is considering may have the practical effect of putting a moratorium on growth in La Plata County, attorney Doug Shand said on Tuesday.

Representing the Durango Industrial Development Foundation, Shand asked the City Council to table the proposed policy statement presented by City Manager Bob Ledger until the city could investigate its ramifications.

"I'm asking them to consider what the potential impacts will be on development outside the city limits," Shand said.

He contended that given the county's planning policy, in which an assurance of water is required before developments can be given final approval, the county wouldn't be able to approve any new projects. The conflict occurs with projects that would be served by city water, either in the city-county joint service area or in the unincorporated county.

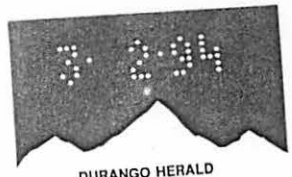
The council tabled a decision on adopting the policy statement until its March 15 meeting.

"We can't make these decisions in a vacuum," Mayor Lynn Shine said. "I think some fair points were brought up tonight, and I think it needs to be examined."

The policy says that the city will not guarantee water service until a building permit is given, rather than at the initial, land-use approval stage.

If adopted, developers will have to sign and submit the policy statement with any land-use application. Ledger said that until the city solves its water storage and pumping capacity problems, potential

■ See WATER, Page 8A



DURANGO HERALD
Durango, CO
(La Plata County)
M-F(PM) 9,704, Sun(AM) 9,117

WATER

Continued from Page 1A

water customers should know there's a limit to the amount of water the city can supply. He said this policy is an alternative to imposing a moratorium or limiting building permits as the city approaches its capacity.

"All we're saying is be advised," Ledger said. "If we continue to grow and we have development continuing at the present rate, there will come a time when we will not be able to provide water."

One effect of the policy, at least within the city limits, may be to speed up development, Ledger acknowledged. Because the city would make no guarantee of water service until developers were ready to build, they would have an incentive to build as soon as possible after the project's land-use plan was approved.

City Attorney David Smith said the ultimate impact would be to get "live, viable" projects in the planning process.

"You wouldn't get projects looking for approval three years before they turn a spade of dirt so they can see what they can get for a lot Smith said.

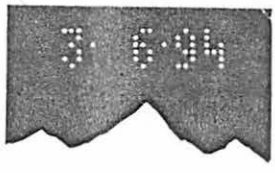
Ledger said that the reactio from the development communi was anticipated, but that if develo ers had their projects ready to go, wouldn't be a problem.

Shand said that the time be tween initial and final approval fo projects is important to market th development. Shand explaine that it would be impossible to ge land use approval from the count in the joint service area because it policy requires the applicant bu water taps first, and the city's ne policy would not allow the land-us applicant to buy the water taps.

"Clearly the county has never gi ven final plat approval until the know that there is an assurance o adequate water being provided,' Shand said today.

County attorney Kane Graves said the staff, which received a draft of the policy at 4 p.m. Tuesday, has had no time to review it and the effects are not yet clear.

"It will have an effect on the county," Graves said. "We're just reviewing what that effect might be."



GREELEY TRIBUNE
Greeley, CO
(Weld County)
M-F(PM), 25,051; S-Su(AM)25,093

Conservancy district ponders next move in Thornton project

By BILL JACKSON
Tribune Staff Writer

Officials at the Northern Colorado Water Conservancy District are pondering their next move in the continuing saga of the city of Thornton's Northern Project.

On Feb. 18, Senior Judge Robert Behrman issued a long-awaited decree on the city's project that would divert water from northern Weld and Larimer county farms to the north Denver suburb.

"The decree was based on many weeks of meetings we participated in. We feel it protects the water interests of area agriculture in regards to return flows," Eric Wilkinson said.

But Wilkinson, NCWCD general manager, as well as other northern water officials question the amount of water that Thornton officials say the decree allows.

Dan Ault, a water resources consultant for Thornton who has worked on the project for the past eight years, said the decree allows the city to withdraw an average of 56,800 acre-feet of water per year.

The decree, he said, represents a firm annual yield of more than 33,000 acre-feet, meaning that even in "very dry years, Thornton can be assured a minimum of 33,000 acre-feet of water."

An acre-foot of water is about the amount of water consumed by a family of four in a year.

> "We feel (the decree) protects the water interests of area agriculture in regards to return flows."
>
> — Eric Wilkinson
> NCWCD general manager

Wilkinson said rights held by Thornton are conditional rights that are junior to rights held by the water district and the city of Fort Collins, among others.

"Our conditional rights to the Poudre Project are senior and we hope to develop that project in the future, which would have an effect on Thornton's rights. Fort Collins also has senior rights to those held by Thornton. Those effects will only be known over time," Wilkinson said.

Bill Brown, a Fort Collins attorney who represented the Cache la Poudre Water Users Association in the court case before Behrman, said there is more to Thornton's project than just the conditional rights.

"What Thornton terms as the backbone of its project is the change of water rights from the 100 or so farms that it bought," Brown said. "These farms, of course, are irrigated with water rights from the Water Supply and Storage Co., which is a good, reliable source even in dry years because of the senior nature of many of the priorities of the company.

"These rights, unlike the more junior conditional rights, won't be much affected by seasonal variations in precipitation," Brown said.

On average, the court determined that the annual consumptive use of the water applied to the Thornton farms is somewhat in excess of 14,000 acre-feet.

"Thornton contends that it will receive a firm annual yield in the area of 33,000 acre-feet. This is more than 18,000 acre-feet a year more than the transferable consumptive use amount from the farms," Brown said. "Although Thornton engaged in extensive engineering studies and computer modeling to arrive at the yields it anticipates, I remain of the opinion that, in a very dry year, or a series of dry years, Thornton will be unable to get these volumes of water from the Poudre."

Brown said, however, that Thornton might be able to take advantage of years when there are high river flows by storing the water in Water Supply and Storage Company's reservoirs for up to one year.

Thornton indicated that it plans to appeal several aspects of Behrman's original decision on the change of use trial.

Wilkinson said the district is studying those appeals to determine what cross appeals it may need to file.

All appeals in water issues go directly to the Colorado Supreme Court. It is estimated it could take one to two years before that court hears the appeals.

Thornton began investigating sources for additional water in the early 1980s, and in 1985 and 1986 the city purchased 21,000 acres of farmland in Weld and Larimer counties, along with the water rights to that land. It owns about half the rights to the Water Supply and Storage Co.

The change of use trial was conducted in 1991 and Behrman issued his decision in 1992.

p109 Theoretical calculations show that at least 2.8 kilowatt-hours (3.8 horsepower-hours) of electrical energy is required to separate 1,000 gallons of pure water from sea water. Thus more than 900 kilowatt-hours (more than 1,200 horsepower hours must be used to obtain 1 acre-foot of freshwater from sea water.

p110 If electri power costs 1 cents a kilowatt-hour, the cost of theoretical separation is 2.8[9] for 1000 gallons or more than 9 dollars for 1 acre-foot of freshwater from sea water. The figures are independant of the type of separation process and represent only the energy necessary to separate pure water from an infinately large body of sea water.

Source: David S. Jenkins, R. J. McKiesh, and Sidney Gottlieb (1955) Conversion of Saline Waters in The Yearbook of Agriculture - 1955 U.S. Department of Agriculture, The United States Government Printing Office, Washington, D.C. pp. 109-117

See file - opportunity costs of Upper Colo River Basin water & Brooker 1990.
pumping costs for Colo River water $76 per ac/ft.

Glen Canyon - Releases range from 3,000 to 31,500 cfs. River level changes up to 13 feet; and desire of environmental community is range from ~~8,000 to~~ 5,000 to 18,000 cfs for operation of dam.

Geln Canyon Dam generates 44 megawatts for every 1,000 cfs of water. It produces 5,000 gigawatts hours each year and an annual income of $50 to $65 million.

Lloyd Greiner of WAPA says the proposed operating range of 8,000 to ~~45~~ 25,000 cfs would reduce income by $15 million.

Issue surfaced when Bof Rec proposed rewinding the turbines at dam and increasing releases to 33,000 cfs.

Water can be delivered downstream in many release patterns. Question is whether to (1) serve needs of park or (2) power customers.

Source: Jim Carrier (1990) Activists Try To Change Course Of Colorado River, The Denver Post, August 15, 1990, p. 2B.

Water Development

p.15 Energy for the removal of salt from sea water is .75 kilowatt/hours for each cubic meter of sea water (about 3 kwh per 1000 gallons)

p. 16 Costs per unit volume decline with size of plant; for the 1 million gallon per day plant the costs about $1.00 per 1000 gallons; new plant near Tijuana reports a cost of 15 cents per cubic meter or $.65 per 1000 gallons

(sources H. C. Pereira, Land Use and Water Resources in Temperate and Tropical Climates, Cambridge University Press, London, 1973, 246 pages)

Costs less to gather water than to store it, and less evaporation loss; high country reservoir evaporation loss is 2 or 3 feet per year and evaporation loss at Lake Powell is 7 feet per year or a loss 1.2 million acre feet

citing report by Glenn Saunders and Robert McWhinnie

(source:"Experts Say Dams No Longer the Answer; Severe Drought Has Hit Area Before, Will Hit Again", Douglas Gill, The Denver Post, Feb. 27, 1977, page 18

Denver assumes a five year drought in planning which is longest reservoir technology for storage can cope with;

Do not need an acre-foot of storage for every acre-foot of new water supply developed, as most of water gathered must be delivered straight through to end users or not at all

above citing Robert McWhinnie, formerly long-range planner for Denver Water Board.

(source: article above in Denver Post, Feb. 27, 1977, page 18)

1976 Denver per capita water usage, including lawn irrigation was 207.5 gallons per day.

(source: Bill Hosokawa, "Ants vs. Grasshoppers in Thirsty California", The Denver Post, March 6, 1977, page 25)

Marin County, California projects for domestic water:

1971 - $35 million for 44,000 ac-ft; @ $795.

1973 - $23 million for 13,400 ac-ft; @ $1716.

1973 - $7.5 million for 8,000 ac-ft; @ $937.

for annual supplies of the above amount by a project. now paying $60.00 per ac-ft for quanity need this year as supplemental supply.

(source: Bill Hosokawa, "Ants vs. Grasshoppers in Thirsty California" The Denver Post, March 6, 1977, page 25)

WATER EQUIVALENTS TABLE

1 cubic foot	7.48 gallons	62.4 pounds
1 acre-foot	43,560 cubic feet	325,829 gallons
1 cubic foot/second (cfs)	449 gallons/minute	
1 cfs	646,272 gallons/day	
For 24 hours	1.983 acre-feet	
For 30 days	59.5 acre-feet	
For 1 year	724 acre-feet	
1 million gallons	3.07 acre-feet	
1 million gallons/day (mgd)	1,121 acre-feet/year	
1,000 gallons/minute (gpm)	2.23 cfs	
1,000 gpm	4.42 acre-feet/day	

One cubic foot per second, for 24 hours is 86,400 cu feet. % by no. of cu feet in acft. gives conversion factor of 1.983471

To supply 100 cfs for 90 days:

100 cfs x 90 x 1.983471 = 17,851.24 acre feet.

COLORADO'S WATER
OUR MOST IMPORTANT RESOURCE

1 cubic foot	7.48 gallons — 62.4 pounds of water
1 acre-foot	43,560 cubic feet — 325,900 gallons
An acre-foot covers 1 acre of land 1 foot deep	
1 cfs for 24 hours = 1.9 ac ft.	
1 cubic foot per second (cfs)	450 gallons per minute
1 cfs	646,360 gallons per day
1 million gallons	3.07 acre-feet
1 million gallons per day (mgd)	1,122 acre-feet per year
1,000 gallons per minute (gpm)	2.23 cfs
1,000 gpm	4.42 acre-feet per day
At 10¢ per 1,000 gallons	$32.59 per acre-foot
Irrigated Colorado Land	2,895,000 acres
Colorado Average Rainfall per year	16 inches
Average Yearly Runoff in Colorado	16 million acre-feet
An acre-foot supplies a family of 5 for 1 year	

1 cfs falling 14 feet = 1 Mw of electrical power Columbia River.

→ acre foot / family for 1 year

Note: Differences in Equivalents

A cubic foot per second is the basic measurement of flowing water, 7.48052 gallons, 646,317 gallons in 24 hours, 235,905,679 gallons or 724 acre-feet in one year.

An adult needs two quarts of water a day in food and drink; a family of two adults and two children needs six quarts a day or 547.5 gallons per year to survive, but uses about one-acre foot or 325,851 gallons: three to four gallons per toilet flush, 30 to 40 gallons per bath, five gallons per minute for a shower, up to 10 gallons to wash dishes, up to 30 gallons per washload of clothes plus washing the car, waste disposal, fire fighting and a host of other desirable, but not critical uses.

One acre-foot of water is needed to produce:
$87 worth of wheat
$2,715 worth of steel
2,281 barrels of shale oil
15,208,143 standard cubic feet of Lurgi coal gas

A miner's inch is:
.02 cubic feet per second
A water inch is:
1.75 gallons per minute

At a penny a gallon, one-half of one percent of the price of milk, an acre-foot would cost $3,258. However, an acre-foot now ranges between $3 and $20, but may eventually reach $300 to $500.

A gallon = 8.34169 pounds • A cubic foot = 62.4 pounds

In one recent year, the Colorado River system with its flow of approximately 13,800,000 acre-feet served more than 22 million people in seven states.

(Figures are offered for relative comparison and may vary with different processes and technological advances.)

COLORADO RIVER WATER CONSERVATION DISTRICT
1984
GLENWOOD SPRINGS, COLORADO
303/945-8522/P.O. BOX 1120/81602

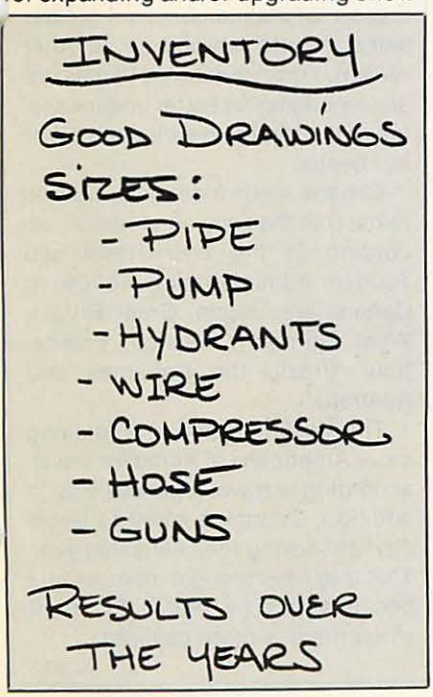
Snowmaking: Is It Adequate?

Expanding and/or upgrading a snowmaking system requires a series of steps before the job gets underway. An analysis may reveal some surprising shortfalls.

by James B. VanderKalen
President, Snow Machines Incorporated

The question used to be: does your ski area have snowmaking? Today, the question is: do you have enough snowmaking of the right type, in the right places in adequate amounts to accomplish your objectives?

The importance and adequacy of snowmaking are becoming primary in most area managers' thinking. At the same time, many snowmaking systems are older and/or inadequate. The need for expanding and/or upgrading snowmaking systems is manifest.



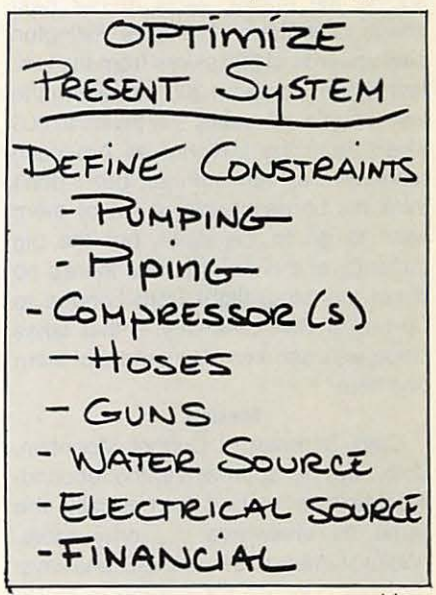
An orderly series of steps leading to changes in a snowmaking system is essential.

Before expanding/upgrading a snowmaking system, an up-to-date and accurate inventory should be done. This should include good drawings of locations and sizes of pipes, hydrants and electrical sources on trails, as well as pump house details. Pump and compressor specifications, number of hoses and sizes, number of guns and capacities (usually measured at 20°F) and recorded results over the years should also be inventoried and cataloged.

An accurate inventory will generate the next step leading to optimizing the present system. But first, several questions must be answered. What are the constraints? Are pumping, piping, compressors, hoses, guns, electrical source, water source and valving adequate? Does noise level need to be considered? Which one is the main constraint? If this constraint were removed, what would be the next constraint?

This process usually requires careful analysis of engineering data as well as an analytical approach. Some examples of constraints are pumps pumping against each other, trying to put 600 gpm through a 2-inch valve, and 100 gpm guns being run on ¾-inch hoses. Such constraints are usually obvious upon a careful analysis of the inventory and operating results.

The next step is to determine which trails are to be covered, how deep, how fast, at what average snowmaking temperature and at what noise level. A careful analysis of these objectives will then define the specific expansion and upgrading that needs to be considered. An example might be 100 acres with 10 inches of snow at an average snowmaking temperature of 20°F in 100 hours. This would be 10 acre-inches of snow per hour or roughly 2,000 gallons of water per minute converted into snow.



night in winter. Clifford says, "There are 60 to 70 dryland ski schools with just a rope tow and some matting where they can work on their skiing, so they can enjoy it more when they get to the Alps, where they traditionally ski. They like the U.S., and they know about our skiing. The English have heard about Aspen, but they don't know where it is; they know Aspen has a different experience from Vail and that Jackson Hole, for interest, is more open than both of them; they know about our luxurious accommodations and also have heard about Utah's powder and, of course, they know a lot about New England. They're keen on the U.S., but now they need to know more now . . ."

Adding increased media exposure during the past year is like the third leg on a stool for Ski USA, according to Clifford. "We've worked with a tour operator, The American Dream, and American Express has been very helpful in trying to network us in with them and expand our contacts. Now," he says, "by adding the media, we're in our best shape over there." He says Killington saw upwards of 600 skiers from the U.K. last winter, up about 200 percent in the last couple of years. "I think 10,000 skiers from the U.K. (for all American resorts) is a high number, but I don't think it's unreasonable. A lot of them want to go to the West, but the big difficulty at this point is that there's no direct (nonstop) flight from London to Denver or Salt Lake City. If that takes place, we'll see a whole lot more of them over here."

Killington saw upwards of 600 skiers from the U.K. last winter, up about 200 percent in the last couple of years.

Mexico

Carol Schmidt of Copper Mountain, Colo. says her approach to the rebounding Mexican market is basically the same as elsewhere . . . only more. "We're still new to this market," she says, "but our concept for Mexico is pretty much the same as all of the other (foreign) markets. We hook-up with one or two major wholesalers to rep for us. In Mexico, though, we have two — one who handles Copper exclusively and a second one which also handles other American areas.

"We help them with co-op dollars and are really putting our energies into this. Every major contact has come through Ski USA; Bernie does the homework for us and we follow up on it."

She adds, "In Mexico, we've found that the client relies heavily on what's in place, so we've started small and we're building. We get a few people to ski here and then they go home and tell their friends, and that keeps growing year after year. Our business was up dramatically last year from Mexico and it's already way up for '88 . . . and we're doing the same thing now in Argentina, which is very big in terms of families skiing."

The major departure for Copper from this key-wholesaler approach, Schmidt says, is in Australia where the resort uses up to seven wholesalers.

Australia

"The Australian market is pretty unique," says Bill O'Connell. "You have to sell them more than just snow and chairlifts." Adds Rene Meyer, president of Snowbird, "One of those Aussies is worth three from anywhere else." Three? "The Aussies come up here for about three weeks, on average, and they're good spenders, so we figure they're worth at least three skiers from anywhere else."

One of the keys to tapping the market Down Under, O'Connell feels, is capitalizing on the gregarious nature of Australians. "They really like the idea of camaraderie," he says. "They have to feel like they're at home. They're fairly wealthy, but they really want their dollar's worth, too, wanting $10 in value for every five they pay. You really have to fill your program for them; if you make it easy — put everything in packages for them, they like it a lot."

He credits aggressive marketing by Continental Airlines with spurring some of the growth in Australian skiers to the U.S. and overcoming the traditional loyalties they have with Qantas, the national airline. "Qantas is difficult for us because it has very fixed ways of doing things, but Continental came up with a $300 fare plus coupons to anywhere and return to Denver, which is an incredible deal."

He adds succinctly, in a comment which all would agree with: "Hey, we're destination people and we live out of the seats of those planes. The airlines advertise, promote and help us."

But the bottom-line, according to O'Connell, usually seems to swirl around that notion of friendship between Yanks and the Aussies. "They really like us; they get along well and they relate to us. We do things in a big way and they really like that.

"They copy us a lot Down Under, too. I

(Continued on page 82)

Foreign Travelers Coming in Record Numbers

The cheaper dollar brought foreigners to the United States in record numbers this past summer. The declining dollar gives foreigners greater incentive to come here and to spend more on travel and shopping.

Last year's record $250 billion spent by foreigners will be topped this year by about five percent, according to the U.S. Travel Data Center. Although foreigners represent only about six percent of all travel spending in the U.S., their numbers have been more visible at all types of travel attractions.

In fact, travel and tourism is one of the few sectors in which the U.S. has a trade surplus with Japan — about $1 billion last year. With the rest of the world, however, the U.S. has a travel and tourism deficit of close to $9 billion.

Attractions as diverse as Independence Hall in Philadelphia to Elvis Presley's Graceland in Memphis reported record numbers of foreign visitors. Universal Studios in Los Angeles had 44 percent more foreign sightseers and Heritage USA in South Carolina (former province of Jim and Tammy Bakker) had increased foreign attendance of 20 percent.

According to officials at these sights, the dollar's weakness is one reason for the increase, but greater sales efforts abroad is another reason. Travel industry officials are also encouraging better understanding of the foreign traveler and his or her needs.

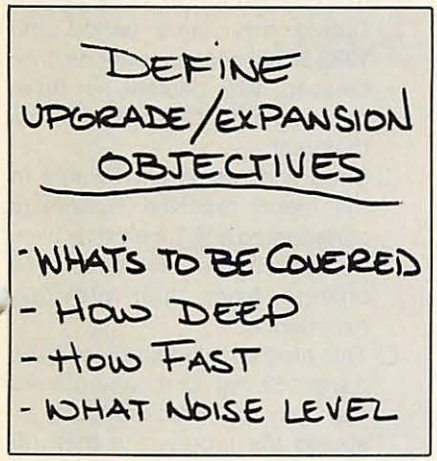
Canada sends more of its citizens to the U.S. than any other nation, according to the U.S. Travel and Tourism Administration. Following Canada are: Japan, Great Britain, West Germany, Mexico, France, Italy, Brazil, the Bahamas and Australia.

The declining dollar is keeping more Americans at home for travel, according to travel organizations. In addition, Congress voted to begin daylight saving time early this year. That may have brought more visitors because people prefer to travel when there is more daylight.

—J.N.

Calculations such as these lead to a consideration of the availability of basics, such as water, energy and money. For example, more water might be available through recovery. That is, 20 gpm recovered for six months results in 5,000,000 gallons or 30 acres of 12-inch cover or 360 acre-inches of snow. If one of these basics is limited, a recycle of the objectives process described is undertaken.

Assuming the present system can be optimized, the objectives are



realistic and the basics are available, the next step is to integrate all these into a detailed program and plan. This includes defining alternatives — a basic one being whether to choose air/water (high pressure) or fan (low pressure) guns or a mixture of the two. Considerations include capital costs (materials and installation), operating costs (fan guns are usually 80 percent cheaper to operate than air/water guns), noise levels (here again fan guns are usually 15 to 20 decibels quieter than air/water guns) and others.

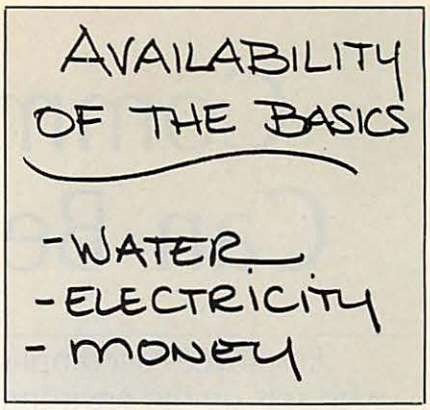
The next step is assembling resources. This means a detailed design including a bill of materials, a definition of who will be responsible for what, who will do what and where the money will come from (cash flow, loans, bonds, leases or a combination of these).

Assuming all the above is properly done, successful projects have two additional elements. The first element is that one person is clearly in charge, dedicated, motivated, with authority and the time to do the job. The second is, "Get in, Get on, Get out" (contractors' rule for successful projects).

An example of the overall process is illustrated by a successful ski area in the Western United States. The area had:

3000 CFM Compressor,
500 GPM Pump,
7500 Feet of trail covered and a limited water supply.

The perceived needs were a 150 percent increase in trail footage, increased water supply, a limited energy supply and a severe noise constraint on some of the trails to be covered with new snowmaking. By following the above procedure the actual needs were found to be:



250 percent increase in trail footage, if possible,
Utilization of all pumping capability at higher snowmaking temperatures,
Additional water supply,
Increased pumping capacity,
Fan snowmakers.

Again, following the procedure, the actual results were:

All snowmaking trails covered by December 15,
Almost unlimited water supply,
Utilization of all existing pumping up to 27°F,
Energy requirements up less than 10 percent,
Noise levels most acceptable to neighbors and employees,
Some of the best skiing ever.

A systematic logical approach to upgrading and/or expanding a snowmaking system can pay big dividends. ■

SOME RULES OF THUMB

Some of these Rules are general and should be used only to scope a project. Detailed engineering before implementation is urged.

- 325,000 gallons of water is an acre-foot of water.
- 162,000 gallons of water will make an acre-foot of snow.
- 20 gpm collected for 6 months is 5,150,000 gallons.
- An acre is 208 feet by 208 feet.
- Pond liners usually cost less than 30 cents per square foot.
- 7.46 gallons of water per cubic foot of water.
- 1 gallon of water weighs 8.33 pounds.
- 1 horsepower is .746 kilowatt but calculation at 0.9 is more realistic.
- At snowmaking temperatures, at 100 PSI and at sea level, about 4.2 CFM per compressor horsepower is realistic.
- Most snowmaking suppliers use as a base for calculation 20°F (−7°C) and 65 percent relative humidity for system design.
- At 20°F and 65 percent relative humidity, an air/water gun might use a 10 to 1 CFM to GPM ratio.
- At 20°F and 65 percent relative humidity, an air/water gun might produce 0.4 gpm/horsepower (air).
- At 20°F and 65 percent relative humidity, a fan snowmaker might produce 2 gpm/horsepower.
- Pump HP =

$$\frac{(\text{GPM}) \times (\text{TDH})}{4000} \times 75\% \text{ (pump efficiency)}$$

GPM = Gallons/Minute
TDH = Total Dynamic Head (height of water in feet)
2.31 TDH = 1 PSI

- Water pipe =

		PSI Drop/100'
4″ up to	400 gpm	3.68
6″ up to	600 gpm	1.02
8″ up to	1,400 gpm	1.28
10″ up to	2,000 gpm	.808
12″ up to	2,800 gpm	

- Air Pipe =

		PSI Drop/1000'
4″ up to	1,000 CMF	2.21
6″ up to	2,500 CFM	1.57
8″ up to	4,500 CFM	1.19
10″ up to	10,000 CFM	1.77
12″ up to	16,000 CFM	1.75

- Typical compressor will cost $40 to $50/CFM installed — or $160 to $200/HP.
- Typical fan snowmaker will cost $500 to $1,000/horsepower.
- Water hydrants = up to $225 for 1½ inch.
- Air hydrants = up to $100 for 1½ inch.
- Electric stations = up to $350 for 30 amp, up to $475 for 60 amp.
- Nominal electric wire cost = 4 wires under $2.25/foot.
- Nominal prices =

4″ pipe	—	$ 2.00-$3.00/foot
6″ pipe	—	$ 3.50-$ 4.50/foot
8″ pipe	—	$ 5.00-$ 6.00/foot
10″ pipe	—	$ 7.00-$ 8.50/foot
12″ pipe	—	$10.00-$11.00/foot

- Quantity of water/100 feet of pipe =

4″	—	65 gallons/100 feet
6″	—	147 gallons/100 feet
8″	—	261 gallons/100 feet
10″	—	408 gallons/100 feet
12″	—	587 gallons/100 feet

Commitment Can Be Created

Employees accomplish goals, but it's the boss who sets up the environment and reinforces behavior to accomplish the job to be done.

by Cathey L. Bernhard
President, Bernhard and Associates

It is obvious that for managers to accomplish their goals, employees must be committed to the work at hand. Committed employees produce fewer maintenance problems, less down time, better safety records, stay in the job longer, save the company money and enjoy work more.

Commitment can be created, but management must provide the proper environment. This can be accomplished through a process that includes understanding factors such as how to be a "best boss," how well the company's vision and goals are understood and how effectively employees' good work is recognized and reinforced.

The Difference

Most corporate executives know the differences between their company and others isn't just equipment and machinery. Anyone with money can buy hardware. What is different is the quality of people. Some managers believe that their employees are inherently better than others or that it is money that motivates people. This may be true in some cases, but many people have great potential and are not primarily motivated by money. The trick is to tap that potential.

Imagine the following scene. Two maintenance managers, Paul and Tom, are comparing the performance of their crews.

Paul complains that his crew comes in half-awake and hungover. They take their time getting started, forcing Paul to push and yell to motivate them. When they do get going, it takes forever to get the maintenance done and then Paul isn't sure if it's been done properly. He's frustrated because his crew seems to do work just to get by; they don't seem to care about things the way he does. Paul is also afraid the crew will let something slide by during inspection, or that an accident or shutdown will occur and he will have to bear the responsibility. He knows that he and his crew are similar in ability and experience to Tom and his crew, but Tom and his men seem to accomplish more, faster and seem to enjoy their work. Paul wonders how Tom does it.

Paul's observations are correct. Tom is not having problems with his crew. His crew is responsible for getting things done right the first time. They don't let little problems become big problems. Communication flows freely and openly and they are proud of their work. They understand their goals and Tom uses frequent opportunities to reinforce these goals. The result for Tom is less turnover, less absenteeism and almost no employee complaints. Tom and his crew are meeting their goals and their safety record is nearly perfect. Tom is the first to acknowledge that his successes in managing his team are not the result of unique factors. On the contrary, he perceives his team to be ordinary, bright, hard-working guys. The difference, Tom knows, is "commitment."

What Tom in this scene has learned is how to tap his people's talents by getting their commitment. Managers who have crews who care are able to produce results such as:

- Lower down-time and less repeat maintenance,
- Reporting and solving little problems before they become big problems,
- Fewer employee relations problems,
- Lower employee turnover and less absenteeism,
- Higher quality work completed faster and with a better safety record,
- Employees acting more responsibly and goals being met,
- Customers are more satisfied.

These skills that Tom knows have been achieved by companies that have trained their managers and supervisors in the methods of obtaining commitment from their staff. For example, Breckenridge, Colorado experienced the following changes:

- ☐ Mid-season employee turnover reduced from 20 percent to 8 percent.
- ☐ End-of-year turnover reduced from 55 percent to 15 percent.
- ☐ During this same period, the 1983-84 ski season, skier days increased 18.5 percent — more than any other Colorado ski area that year.
- ☐ Shop and restaurant owners in the resort reported customers commented how nicely they were treated on the mountain — a change from their previous experience.
- ☐ This program worked so well, the Aspen Skiing Company (parent company of Breckenridge) installed the program in their lift department.

What Is Commitment?

What companies like these and managers like Tom have learned is that employee commitment is critical to the successes of their organizations. They realize that people have a natural desire to be committed to something, to be involved and to productively use their skills. Tom and others recognize this and have learned how to tap into this natural desire.

Committed employees are willing to complete tasks and not let things slide. They are willing to go the extra mile without complaining. They see something that needs to be done and they do it without waiting to be told. They act responsibly. Doing things that aren't specifically in their job description, like picking up trash, comes naturally. They understand their company and department goals and are focused on achieving them.

Creating this commitment is primarily the manager's responsibility and is a function of what the manager does. Managers who clearly share vision and goals, and who reinforce positive behavior create commitment in their employees.

Creating Commitment

As managers, most of us are able to obtain some level of commitment from employees. Too often it works for a select few, but not for the majority of employees; and, it works well when

(Continued on page 78)

conveyor into a rail car. Reclamation for underground mines involves permanently disposing of the spoils mined along with the coal and of the material removed to gain access to the seam. These waste materials are usually stabilized with lime and deposited in sealed landfills.

Coal-Fired Steam-Electric Power Plants. The coal-fired power plants analyzed are the common steam-electric type. An overall efficiency for the plant of 34 percent is assumed, including environmental controls. These environmental controls include a wet limestone scrubber for flue-gas desulfurization (FGD) and an electrostatic precipitator for particulate removal. Because of thermodynamic limitations, almost two-thirds of the heat generated in a power plant boiler must be dissipated. For the basic plant, it is assumed wet cooling towers would be used to dissipate the heat by evaporating water into the atmosphere. To examine the sensitivity of impacts to the cooling technology, a wet-dry cooling system is also examined.

High-Btu Coal Gasification. Two high-Btu coal gasification processes are considered. The Lurgi process was selected for study because it is a presently available commercial-scale technology. The Lurgi gasifier is in commercial operation today in South Africa. The Synthane process was selected as representative of a number of second-generation processes which could be commercially available by 1985 to 1990.

In high-Btu coal gasification, coal is transformed into gas by heating it in the presence of oxygen and steam to produce carbon monoxide and hydrogen. This mixture of gases is then upgraded to create synthetic natural gas (primarily methane) in a separate reactor using a catalyst. Water is used in these facilities both for the gasification process and for cooling. As with the steam-electric power plant, it is assumed wet cooling towers would be used in the basic plant, but wet-dry and all-dry cooling are also examined.

Coal Liquefaction. Coal liquefaction processes are at an earlier stage of development than gasification, and therefore data on liquefaction processes are somewhat limited and uncertain. The liquefaction process considered in this study is the Synthoil process developed by the Bureau of Mines.[2] Water is used both for cooling and as a source of hydrogen for the process.

Source: Ballard S. C., Devine M. D., Chantak M. A., et al. (1982) Water and Western Energy: Impacts, Issues, and Choices. Science and Public Policy Program, University of Oklahoma, Westview Press, Boulder, Colorado, 221 pages. HD/1695/A17 at WSC

Coal Transportation. Two options for transporting coal are analyzed: unit trains and coal-slurry pipelines. For the purposes of this water study, only the slurry pipeline is of interest since train transportation involves negligible amounts of water. In a coal-slurry pipeline, the coal is pulverized, mixed with water, and pumped through a pipeline. Approximately equal parts (by weight) of coal and water are required. It is assumed that the carrying capacity of a "typical" coal-slurry pipeline is 25 million tons per year (MMtpy) of coal.

Oil Shale Development Technologies

The technologies considered for developing oil shale are underground oil shale mining and surface retorting using the TOSCO II process, and modified in situ recovery using the Occidental process.

Underground Oil Shale Mining. Conceptually, underground oil shale mining is similar to underground coal mining and most frequently uses the room-and-pillar method. Compared to coal mines, however, oil shale mines are very large, with roof heights of as great as 60 to 80 feet. These large rooms are mined in two zones. The top zone is mined with equipment extracting the shale from the wall (or face) of the resource, while the bottom zone is mined by extracting the shale from the floor (or bench). Large front-end loaders are used to load the mined shale into trucks which transport it to a sizing and crushing facility. Because of the enormous size of these mines, equipment more commonly seen in surface mines, such as large trucks and drill rigs, is used. A schematic drawing of an underground oil shale mine is shown in Figure 1-2.

Surface Oil Shale Retorting. TOSCO II is the surface retorting process assumed. In the TOSCO II retort, one-half inch diameter ceramic balls are heated to about 900°F and then put into the retort with small pieces of raw shale. The retort vessel is then rotated so that the balls heat the shale by contact and, at the same time, crush it to a powder. The oil is collected, and the pulverized spent shale is separated from the balls with moving screens and carried away for disposal. A low-Btu gas also is generated; it is collected and used as a fuel in the heater for the ceramic balls.

Because the energy content of shale is relatively low (only about 25 to 35 gallons of shale oil can be extracted from a ton of ore), a large quantity of spent

Let's look to beavers for water storage help

LETTERS

Editor:

Much too often grand solutions go in search of problems. Referendum A now placed on Colorado's ballot for this fall would authorize creation of $2 billion in debt for doing something to store more water in Colorado - the "for what's, when's, how's, and especially why's" remain to be determined. We are simply told Colorado must store more water or lose it to downstream states.

However, the easiest traditional water storage projects have already been built. From top to bottom, flows in most of Colorado's streams are already over committed or appropriated. Five major rivers have their headwaters in Colorado but much of their flows must be delivered to downstream states. Colorado is already water limited. For example, some 25 years ago the Exxon Corporation was planning three pipelines to bring 1 million acre-feet of water a year from the Missouri River at the Nebraska border to Grand Junction for oil shale development.

Locally, recent estimates for traditional new storage projects are $8,000 to $12,000 per acre-foot of storage capacity. At these costs, the $2 billion would provide 250,000 acre-feet to only 170,000 acre-feet of storage. Such water storage is simply not affordable for many of Colorado's uses and users.

Perhaps the problem needing a solution is to simply slow down the flow of water through Colorado. Slowing the flow, especially during spring runoff, allows a little more time and opportunity to use this water - in stream and out of stream - before it leaves the state. When water remains longer within Colorado, it provides late summer and fall season flows with particular benefits to agriculture, fishing, wildlife habitat, and rafting. These and other uses cannot or do not pay much for water.

BEST - Beaver Enhanced Storage Technology - was pioneered many years ago. Beaver dams create ponds, wetlands, and recharge for adjacent aquifers. In combination these act as sponges to store and hold back water during peak spring runoff and then release it gradually during the rest of the year. Research at the University of Wyoming found flows through degraded watersheds could be restored and streams brought back to life with the introduction of beavers. And, the beavers could create water storage capacity at about $11 per acre-foot in the late 1980s. This cost was mostly for installing the means for careful monitoring of the beavers' progress. The four-footed engineers did the construction, sometimes with initial provision of materials and food.

Beavers once had built and maintained water storage, and its benefits, from the East to West Coasts and from northern Canada to the Gulf of Mexico, were clear. Then, they were almost entirely eliminated by the fur trade. We knew beavers will cut down trees when available for dams. We have learned recently that when trees are not available and especially along streams at lower elevations and in the southern states, beavers use willows and grasses to build dams. Colorado has thousands of miles of small streams at upper and mid-level elevations. Our state has many hundreds, if not thousands, of now usually dry draws where beaver dams once stored water. Restoration of beavers to watersheds to build dams and ponds within stream banks and thus restore watersheds would offer many benefits to Colorado far beyond simply water storage.

At a present cost of $40 per acre-foot of capacity created, about 1,500,000 acre-feet of water storage could be achieved for $60 million with BEST. Some of this present cost would be for working with beavers to avoid their project conflicting with road culverts, irrigation ditches, landscaping, etc. This is known as mitigation. Extension services at many state universities and information at other websites across the country offer many practical solutions for working productively with beavers.

Passage of Referendum A for $2 billion in debt isn't yet needed for Colorado's water future. Creating 1.5 million acre-feet of storage capacity with BEST offers so much more capacity than Referendum A's proponents have in mind and at $60 million this is already so much more "doable." Coloradans should start with the very BEST for their water future.

Respectfully,
Ralph (Butch) Clark

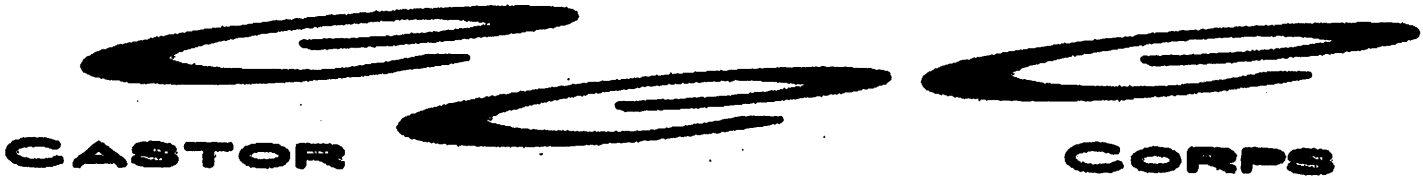
CCC Ltd.

Let us build your next project for: augmentation; fishing hole, stock watering; water fowl, shore and song birds; sediment control; wetlands; and fire protection.

We provide: sub-irrigation; riparian restoration; soil and water conservation; flood control; sediment trapping; water quality improvement; and habitat diversity.

Mission Statement:
To build and maintain -
one dam project after another.

Enquires please to
Lodge on South Bank.



CASTOR CANADENSIS CORPS

City/Region/State

Aquifer may quench water district's thirst

Study shows underground storage could be more efficient than dam

By Mary Ann Lopez
Herald Staff Writer

Storing water underground may be a viable option for the La Plata Water Conservancy District.

Preliminary results of a district study under way since April 2001 show that using an underground aquifer may be an effective and less expensive method of holding water for long-term use, board member and state Sen. Jim Isgar, D-Hesperus, said Tuesday.

An aquifer is an underground layer of earth or stone that yields water. The Redmesa aquifer naturally stores and drains water down into the Lower Long Hollow, an area the district also is considering for a dam. Storing water in the aquifer will help in both good and bad years, Isgar said.

"It's like putting money in the bank. You don't know when you're going to need it, but it's better to have it," Isgar said. "It is cheaper to store water in the aquifer than it is to build a bigger dam."

The study will not be completed until June because Wright Water Engineers, the company conducting the study, was asked to continue its work through the dry year, said Eric Bikis, the company's vice president.

Bikis updated board members on the study at the district's meeting Monday night at Fort Lewis Mesa Elementary School.

The La Plata Water Conservancy board received $440,000 from the Colorado Water Conservation Board in 2002 for the study. While waiting for the funding, it requested a $60,000 loan from the Southwestern Water Conservation District to get the time consuming study under way, Isgar said.

The hydrology study was needed to determine how large the aquifer is in size, where it is located and where it would be feasible to put water into it, Isgar said.

An interim report to the board addressed the amount of water believed to be in the aquifer today and how much water it can hold, Bikis said.

It is estimated that in June 2001 there was 165,000 acre feet of water in the aquifer, he said, adding that the estimate was taken during a high-water period. During a low-water period the amount decreased only a few thousand acre feet.

The maximum amount of water the aquifer is able to hold would be about 200,000 acre feet, but how that storage and withdrawal might affect the Lower Long Hollow needs to be determined, Bikis said.

Bikis recommended that the aquifer and area wells be monitored to see how the drought affected their levels and also to try and understand the way water moves through the aquifer to different points. Using a tracer added to water it is possible to gauge its travel time through the aquifer.

"The hydrology study gives us information on that aquifer: how fast the water moves from there, how much it will hold and how we'll need to feed it," Isgar said.

Through management of the aquifer, storage can be increased without relying on dams, he said. When there is excess water it can be put in the aquifer rather than being left to flow downstream.

"It's pretty simple that we shouldn't be sending the water down the river when we can store it," board President Brice Lee said.

As water flows out of the aquifer and back down toward Lower Long Hollow, a dam will be there to meet flows, thereby acting as another storage tool that will also assist water delivery to New Mexico.

"Instead of excess water going to New Mexico in the winter, we'll be able to store that for times when we need to make compact delivery," Isgar said.

Reach Staff Writer Mary Ann Lopez at maryann@durangoherald.com.

Anon: (1993) Lupton Discusses Pipeline Financing, Greeley Tribune 8 Mar 93, nr p.
Pipeline to deliver mountain water between Fort Lupton and southern weld county. NCWCD plans to secure a $6 M loan of which Fort Lupton would finance $3.9
Pipeline to run from Carter Lake west of Loveland to Broomfield. This pipeline would hook in and go east.
Fort Lupton has offered to buy 7 units of Big Thompson Colorado-water for $1,200 a unit

Mark Obmascik (1993) Water-use fetters Backfires The Denver Post 12 Mar 93, nr p.
Thornton planned $427 M water pipeline supply project. in controversy.
Jim Knopf, hired by city to teach water conservation, criticized the project and was fired.

Anon: (1993) Water Problems May Force Partial Closure of Mesa Verde
The Pueblo Chieftain 14 Mar 93, nr, p.
Problems with $\frac{1}{2}$ M treatment plant for park. Too much grit in water for pressure relief valves. Solution of settling ponds costs $200 th to $300 th.
Montezuma water Co. could provide water and could have done so before construction
Montezuma plant built in Dolores and can treat 8.8 M gal/day. park needs 200,000. Is running at 1/6 capacity and has pipeline passing ½ mile from park.
Source of water is McPhee Reservoir.
Park facility could send its water cost to $7 per 1000 gallons

David Vickers (1993) Wildlife Agency To Lease Surplus Pueblo West Water
The Pueblo Chieftain 10 Mar 93, nr, p.
Does to lease all of Pueblo West's Twin Lakes water. Purpose to make up 3000 acft evaporation of 10,000 permanent pool in Lake Martin
Pueblo West owns more than 5000 shares of Twin Lakes and uses 1,100 to 1,500 shares
Deal - $100,000 option payment for 10 years. at $13 per water share average for 10 year contract.
Meanwhile Does will try to purchase Amity Mutual Ditch Co. water. Irrigation

EPA - Village Safe Water program, for Alaskan villages
a water supply - centralized - to remote villages
places where present has permafrost
electrical cost for pipe heating $.45 per kw
and $100 per month
U.S. & World News May 1973 USW, 45-46

ASSESSING WATER TRANSFERS AND THEIR EFFECTS

To identify and study the impacts of water transfers on third parthe committee developed a strategy to assess the characteristics of fers and transfer opportunities. In particular, the type of transfer, ary motivation and process used, affected parties, and nature of effects were examined (Table S.1). These factors were used to ine the nature of transfer activity in seven western areas:

- Truckee-Carson basins in Nevada
- Colorado Front Range-Arkansas River Valley
- Northern New Mexico
- Yakima basin in Washington
- Central Arizona
- Central Valley of California
- Imperial Valley of California

The case studies strive to (1) identify the incidence of third party cts, (2) identify those effects that were pervasive and those that e unique, (3) understand both the nature and the causes of third y effects, and (4) understand the actions available to mitigate or edy any harmful effects. The committee's objective was not to ge the desirability of actions taken or not taken in a particular e. Rather, the committee used the analyses to highlight broad ons about the nature, scope, and impacts of water transfers in eral and to develop suggestions for improving the processes used valuate and regulate water transfer activity.

THE ROLE OF LAW IN THE TRANSFER PROCESS

Because water is seasonally and geographically limited in the West, ouraging the productive use of water has always been a key polibjective, from the days of the Anasazi to the present. Water use he western United States, as in virtually all arid societies in the rld, is regulated under rules designed to achieve broad public efits. The prior appropriation doctrine—which gives the earliest r the right to take water from a stream and put it to "beneficial " and to continue such use—was adopted during the settlement as a way to allocate water so that it met both private needs and ger societal goals.

As western economies matured, the water rights system proved ptable to increasing and competing demands. The key to adaptlity was that water rights were not restricted to use on a particular cel of land or to a specific type of use. In principle, rights could

TABLE S.1 Factors to Consider When Assessing Potential Water Transfers

Type of Transfer

Change in ownership
Change in point of diversion
Change in use
Change in systems operation
Out-of-basin diversion

Primary Process for Transfer

Voluntary
Involuntary

Primary Market Forces for Transfer

Government
- Local
- State
  - Executive
  - Legislative
  - Judicial
- Federal
  - Executive
  - Legislative
  - Judicial

Affected Parties

Rural communities
- Support services
- Erosion of tax base
- Loss of natural resource base

Agriculture
- Remaining water users
- Reallocation of rights

Ethnic communities and Indian tribes
- Ethnic communities
- Indian communities

Agricultural maintenance and expansion
Other

Environment
- Instream flows
  - Recreation uses
  - Fish and wildlife
  - Hydroelectric power
- Water quality
  - Damages to water users
  - Human health
  - Ecosystem effects
- Ecosystem protection
  - Endangered species
  - Wetlands
  - Riparian habitat
- Estuaries

Urban interests
- Intrastate transfer constraints
- Tax-exempt status changes

Federal taxpayers
- National economic concerns
- Windfall profits

Other water rights holders
- Junior rights
- Senior rights
- Loss of flexibility

Nature of Effects

Economic (national/regional)
- Lost revenue
- Lost opportunities
- New revenue

Environmental
- Instream/fish and wildlife
- Recreation
- Water quality
- Wetlands

Social
- Rural communities
- Municipalities
- Other

liberations. This broad participation is necessary because water is unique resource, different from other commodities, and markets ne cannot accurately reflect all the relevant values of this resource.

The focus of this report is on third party interests that are not fficiently included in existing water allocation processes. This re-rt characterizes the range of existing nonproprietary third party terests and describes the ways in which current water allocation stitutions accommodate these interests. In addition to providing is general analysis of third party effects, the committee has exam-ed a number of areas in the western United States where water ansfers are occurring, or may soon occur, in an attempt to identify aracteristics common to water transfers and to obtain firsthand owledge about when they are considered "positive" and when they e potentially harmful to third parties. A comprehensive assess-ent of benefits and costs of water transfers is premature, because ansfer theory exceeds transfer practice; thus the committee does not nder definitive judgments about the role that water transfers should ay in the future of western water allocation and how third party fects should be weighted by decisionmakers. Rather, the commit-e both acknowledges the merits of water transfers as a mechanism r meeting new demands and recognizes the legitimacy of a wide nge of potentially affected third party interests in the transfer pro-ss.

The committee's basic conclusions are that allocation processes ould accord third parties with water rights—and those without em—legally cognizable interests in transfers and that states should velop new ways to consider these interests. Water has never been located solely by markets, and market transfers are not an end in d of themselves but a means to the end of a water allocation pro-ss that serves both private and public interests.

An expanded set of criteria is needed to evaluate transfers and to commodate the diverse and strongly held economic and cultural alues associated with water use. Accordingly, in preparing this port the committee recognized the relevance of both economic tech-iques, which can be used to measure the value of water use and the sts of transfers, and other methods that permit more subtle and tangible values to be considered. The committee approached its udy of water transfers with an optimistic sense of the role transfers n play in a new era of more efficient use. The committee con-ludes, however, that judicious intervention in water transfer pro-esses will be necessary to avoid or ameliorate the adverse effects of me transfers.

In evaluating third party effects, the committee assumed that

- reallocation of water among uses will be a principal feature in a new era of western water management; increased conservation, increased use efficiency, and improved reservoir operation also will be essential;
- the general direction of reallocation will be from agricultural to municipal, industrial, recreational, and environmental uses;
- water markets involving willing buyer-seller transaction opportunities will continue to expand; and
- new formal and informal constraints on water transfers will be established until all parties are confident that the reallocation process includes consideration of all relevant interests.

THIRD PARTY IMPACTS AND OPPORTUNITIES

The term "third parties" is broad and includes everyone who is not a buyer or seller in a transfer negotiation. The general categories of parties who stand to be affected by transfers are (1) other water rights holders; (2) agriculture (including businesses and farmers in the area of origin); (3) the environment (including instream flows, wetlands and other ecosystems, water quality, and other interests affected by environmental changes); (4) urban interests; (5) ethnic communities and Indian tribes; (6) nonagricultural rural communities; and (7) federal taxpayers.

Third party impacts can stem from changes in the quality and quantity of water available for other uses, changes in the rate and timing of surface flows, and changes in ground water levels and recharge processes. Generally, these impacts are economic, social, or environmental in nature. Economic effects include impacts on incomes, jobs, and business opportunities. Social impacts include changes in community structure, cohesiveness, and control over water resources; such changes can occur in both rural and urban communities. Environmental impacts include effects on instream flow, wetlands and other ecosystems, water quality, recreational opportunities that are dependent on streamflows, and wildlife habitat.

Impacts can be both positive and negative, and assigning value to them is difficult. The underlying challenge of any process used to evaluate transfers is how to determine and balance equitably the relative benefits and costs. Techniques for measuring the impacts of water transfers are more precise for some types of impacts than others. It is difficult and unreliable, for instance, to apply economic measures to those impacts that are not usually measured in market terms, including most social, political, and environmental effects.

(1991)

12 Booker and Young Economic Impacts -

p 12 Interstate Marketing Spurlock and Calif v FERC

13 changes motivated by shortages and high water values.

Equilibrium - no party better off - without making one worse — in terms of

Pareto optimum.

Consideration of direct and indirect benefits and incidence

water projects "sunk costs" financed by fed - so no need to consider secondary impacts.

Kaldor - Hicks compensation principal & better if those gaining compensate those worse so everyone better off

Bird - how to rank social states (Arrow 1951)

Efficiency not same as equity.

Impacts - not all tangible.

Σ $ add more water Hudson Bay]

p 15 Salinity reduced in value

p 24 Total water savings up to 1.2 M acft but — leaving

Cost .4 M acft feed ad cost of $150/acft in Imperial Valley 1990

p 35 Problem - consumption or loss of dilution water has more impact on salinity than return flow — Dilution

p 47 Colorado River water causes damages of about $100/acft in 1990 plus pumping costs at $.04 per kwh a lift of 1,617 feet at Lake Havasu 200 kwh/af.

p 48 economical for 1,800 kwh/acft.

and energy cost then of $76/acft. other cost 20% or $15/acft. Treatment cost $32/acft

Total $120/acft for 1.3 macft/year. to $290/acft by 1990 marginal value.

p 54 Salinity Damage is $130 per acft (1990)

Benefits of Colo River water above equal damages ∝

water books
↓

going over some ground Anderson et al 1976
effects of water transfers to cities Thornton
p30 Windminster. 6.4% of farm land irrigated on Front Range
Called for joint use 8.6% of farms for all Colo irrigated
Pricing of water - burden on poor, older
Need new housing design
Planning time. Land Use Commission
p11 Ideal supply 1.7 acft per acre from Standley Lake.
p13 Lower Clear Creek Ditch Co 3.3 acft per acre
but is larger than 1 acft/acre standard for
other companies. Used for truck crops
p27 Costs in 1976 for sprinkler $3,000 for San Miguel per acre.
Elsewhere 1/2 that
p31 Diversions from W.S. - in 1975 Colo uses about 1/2 of
ind. demand. TMD only new source - or joint urban
farm use. Need to gather all costs and all benefits
Dillon expected to cover everything. TMD complex
and costly.
choices - 1) ag 2) restrict new residents
3) go to West Slope
32 Northglenn FRICO Farmers Res Irrig Co
arrangement

Physical and Economic Effects on Local Agricultural Economy of Water Transfer To Cities
Anderson RL, Wengert NI
Heil R.D. 1976 #75
CSU Completion Series.

evaluate

---

xi Colorado R storage is 4 times annual average
flow 13 m acft. 60 m acft storage.
p1 and 50 m in Mead and Powell.
2 4.3 m acft through Calif Canals; .7 maf to Front Range.
3 at $.035 per kwh $44 per acft for hydropower
p11 Boulding - difference in water and oil
institutions (1980) 'sacredness of water as
symbol of ritual purity exempts it from
dirty rationality of market place

Economic Impacts of alternative Water allocation Institutions in Colorado River Basin
J. F. Booker and R A Young
Aug 1991 #161
CSU CWRRI

(A)

WATER DEVELOPMENT

P. 64 sale of water from South Park of Colorado:

payment to Walt Coil by town of Aurora - ⊄2.3m for about 2000 aft of irrigation water, enough for 12,000 people for year;
similar deal by Jim McDowell with city of Thornton, Colorado.
Twin Lakes water in Arkansas Valley went from ⊄1100 a unit in 1974 to ⊄7500 in 1980.
Big Thompson water has gone for as high as ⊄3,000. per unit (about one acft)
Farmers Reservoir and Irrigation Company (Standley Lake in Jefferson County) offered ⊄2730 per share (about 10 acft) in 1974 and ⊄29,000 in 1980 - both rejected.

Water seen as the one factor which controls the West. Agriculture is the only significant source of water. I don't know what people will eat someday says one of the South Park sellers. Looseness on water deals which makes them hard to follow in the public records. As long as no one else hurt, no one may interfere - but water belongs to the people of the state. Ag. water
65 can be condemned. FRICO deal has water interest payment of 10%.
Source: Sam Maddox, Thirst for Liquid Assets, Rocky Mountain Magazine v 3 n 2, March/April, 1981.

Tax Assessment of Water Rights

Source: Cox, Jack (1982) Assessor's Test Case Taxes Water Rights, *The Denver Post*, August 12, p. 1C.

Teller Count Assessor imposed tax of water rights under Colorado Constitution that permits taxation of all property that is not specifically excluded. Lack of tax seen as subsiddy to non-agricultural developers. State water engineer holds that agricultural and municipal rights are not subject to property tax assessment - 80% of state's 5.2 ac-ft.

Teller C. seeks payment of abot $11,000. in taxes on 345 ac-ft. Water rights owned by D. Smith, developer of Westwood Lakes Estate of about 100 homes near Woodland Park. Value of rights estimate by assessor at $1,000. per ac-ft; "conservative" in view of Smith's offer to sell them at $2,000. per ac-ft to Woodland Park. 1 ac-ft is enough for familynof four for year.

Recent John Huston case held land and deep water inseparable for tax purposes - so is assessor applying double taxation? Asserssor says this case only applys to non-tributary water. Water judge dismissed Huston's claims but said concept is ok. End.

Value of Water

Source: Tony Davis (1985) Arizona Farmers Get A Reprieve As CAP Water Makes Its Debut, *High Country News*, June 24, p. 12.

CAP water will cost about $55 per ac-ft - compared with $60. to $80. for ground water pumping. Farmers will pay a subsidized $2. per ac-ft for their share of the project and municipal-industrial users have a rate of $5. now rising to $40. by 2035. Both groups will pay $50. per ac-ft to cover costs of pumping over 2,000 feet from Colorado River to top of CAP. Over 50 year life the CAP will consume 1.5 million ac-ft per year. Cost of project ot federal government is $3.1 billion.

80

A water solution that's not all wet

For a few minutes on Tuesday evening, I wondered if someone had slipped something into my coffee. Early returns on Referendum A showed an overwhelming defeat for the proposal to borrow $2 billion for unspecified water projects. That seemed impossible. When you're afflicted with my political leanings, you're so accustomed to being on the losing side that it's hard to believe good news.

But the numbers held up, with Colorado defeating Referendum A by a 2-1 margin; last summer, the polls showed it passing comfortably. On Tuesday, the principal supporter, Gov. Bill Owens, did not apologize for promoting a divisive issue. From foreign soil, he said the vote "shows that we have yet to reach a consensus." Given the margin of defeat, it appears that we *have* reached a consensus.

Another supporter in state government, Agriculture Commissioner Don Ament, said, "I'm ready and willing, and I'm sure the governor is, to say, 'Okay guys, what is your plan?' We still have the problem, now I want to talk some other solution."

Referendum A was designed to solve the problem of the south metro area — Arapahoe, Douglas and Elbert counties. They've grown quickly, but rely on a declining aquifer. The groundwater will run out, so they need to find another water supply for both current and future users.

If there were a single entity that supplied water there, it would likely be big enough to construct a supply system with diverted water, in the same way that Denver, Aurora, Colorado Springs and Pueblo have built their water systems.

But there isn't a big single entity there. It's a maze of dozens of little water-and-sanitation districts, special districts, private wells and the like. Politically, it would be difficult, perhaps impossible, to consolidate them into a unified water provider that could grab enough water.

Ed Quillen

So they tried to get the state to step in with Referendum A, which was defeated — it didn't even pass in Arapahoe, Douglas and Elbert counties.

A solution? They should form their own big water district to address their own present and future water supply problems, rather than expect the entire state to address their issues.

As for a statewide solution, here's a suggestion. Get the state engineer's office to draw up a list of "underperforming reservoirs," along with cost estimates to bring them up to their rated capacities, and perhaps expand them.

Thus we'd have a "bang for the buck" rating for improving storage capacity at minimal environmental degradation. Then, to make it more politically salable, parcel out the projects among drainages, so that each basin gets a piece of this pie.

Put this list in front of the voters, along with some in-stream flows based on the increased storage, and it might well pass.

How would this work? We'll assume there's an Example Reservoir, built in 1922, with a capacity of 400 acre-feet to serve the Example Valley Irrigation Co. It could be expanded at reasonable cost to 500 acre-feet, but it currently holds only 300, on account of siltation and some dam-safety problems.

It gets on the list and voters approve the statewide plan. Example Valley irrigators pay part of the cost to bring their reservoir to 500 acre-feet; Colorado pays the rest. Example gets 400 acre-feet of storage and Colorado gets the other 100, which is released for in-stream flows when necessary.

Users would pay much of the cost of improvements; they might have to borrow the money. And if they wanted to borrow it from the state, the mechanisms are already there with the Colorado Water Conservation Board and the Colorado Water Resources and Power Development Authority.

But where would the state get the money for its share? A tax increase would be a hard sell, but since some of "our water" is flowing down to Arizona, Nevada and California anyway, why not arrange to lease it to those states? Instead of us spending billions to develop and transport that water across two or three mountain ranges, let them send us millions each year for letting the water do what it wants to do anyway.

Granted, this solution isn't simple. But it would improve both storage and stream-flows. The projects would be listed, so we'd know what we were buying into. The projects would be divided among basins, so the pork would spread throughout the state. Those who benefit most would pay their fair share, and the rest of the cost would be covered without raising taxes.

So there's one way to proceed, now that we've done right by Referendum A.

Ed Quillen of Salida (ed@cozine.com) is a former newspaper editor whose column appears Tuesday and Sunday.

image/gif: ==>
View Save

image/gif: ==>
View Save

Ralph E. Clark III
519 East Georgia Ave.
unnison, Colorado 81230
970-641-2907

September 1997 Colo

ARP -- A BETTER WAY FOR COLOR

Colorado really must have another transmountain div
ure, and after all alternatives are exhausted, that pro

* protect futures in basins of origin by not di
* be a state water project serving the broade
* have flexibility enough to change with the
* be environmentally responsible; and
* make better use of investment in "plumbin

====

RP is the Colorado Aqueduct Return Project. It's a n

Domestic water in Trinidad now is $15 a month for the first 7,500 gallons or about 85 gallons per day per person per household and 4 cents a gallon for water from commercial drive up water spigot. Source: Mike Garrett (9Aug2002) Trinidad domestic water rates rise, along with fears, The Pueblo Chieftain, no page.

Water Values

October 22, 2003

Restoration of flow on Red Mountain near Ouray achieved after 50 years. Irrigators sent water to Uncompahgre River from Animas River watershed. Project was 6 years and included clean up of old mine sites. The Carbon Lake Ditch was 20 feet wide and 3 feet deep. The 400 acre-feet of water used by irrigators each year was purchased by EPA fro $50,000 or $125 per acre-foot. Water was for sale because there is now a dam closer to place of use. Restoration cost $17,000 and bill split between USFS and Southwestern Conservation District.
Source: Dale Rodebaugh (14Sep03) Red Mountain water flows to Animas again, Durango Herald, pp. 1A and 12A

Deloris Water Conservancy District received a $300,000 grant from the Colorado Dept. of Local Affairs to finance the Dover Creek Lawn and Garden System. The tap fee is $3,200 for minimum of 307 taps in total and commitment of 200 taps to start the project. Each water tap would be allocated 1 acre-foot per year. Water users would alos be charged $.33 per 10,000 gallons of actual water use.
Source: Steve Grazier (6Sep03) Agency grants $300,000 for Dove Creek water, Cortez Journal, no page.

New addition to 40 year old contract with Bureau of Reclamation for Fryingpan - Arkansas Project would allow for increase in capacity of tunnels or use of BoR tunnels. The Carleton Tunnel controlled by the BoR would require $21,690 per year for carrying 750 acre-feet ($28.92 per ac-ft). The Busk-Ivanhoe is smaller but is controlled by Aurora. The Pueblo Board of Water Commissioners wants instead to pay $11m to $12m to improve its tunnel capacity.
Source: Margie Wood (17Sep03) Water board renews contract, Pueblo Chieftain, no page.

Aurora is purchasing more water from Rocky Ford Ditch. In 1983 city bought 8,250 acre-feet and dried up 4,100 acres (2.012 ac-ft per acre irrigated). Now sale is for 5,100 ac-ft drying up 2,539 acres (2.00 ac-ft per ac irrigated).
Source: Margie Wood (20Sep03) Longtime water foes ready to OK settlement, Pueblo Chieftain, pp. 1A and 2A.

More than 6,600 acres on Rocky Ford Canal to be dried up by agreement reached between Southeastern Water Conservancy District and Aurora. Price is $24m paid to District and can be used for anything. for the High Line Canal water. Limit of water is total of 145,000 ac-ft over 40 years ($165.51 per ac-ft).
Source Margie Wood (21Sep03) Rocky Ford Ditch case settlement seems near, Pueblo Chieftain, pp. 1A and 2A.

Price paid by Aurora is $24.2m over time. First $1m is for contracting, administration, and 3.8 million next year. Unless Aurora gets 25 year contract to store in Pueblo Reservoir, money to Southeastern WCyD. would be $50 per ac-ft for water leased from Arkansas Valley and of total $4.8m in this pot, $2m goes to subsidize participation by towns and ditch companies in new reservoir storage regime. Also Aurora would pay $41.3 per ac-ft of $6m over 40 years with money received after 2028 going for development of storage in upper Ark. Valley and is expected to total $2.m . Aurora would pay $1.25 per ac-ft for leasing up to 96,000 ac-ft over 25 years $50,000 there after. Sometime before 2028 Aurora would pay $4.m to the Southeastern WCyD. $24.4 is about ½ the communities cost for the proposed Arkansas Valley Conduit. from Pueblo. Nothing is in agreement for paying farmers to install drip systems. Farmers who have installed drip systems find improved yields with less water. 9At $24.2m for total of 145,200 ac-ft over 40 gives $166.66 pre ac-ft).
Source: Editorial (16Sep03) Peanuts for a water deal, Pueblo Chieftain, p. 4A.

Aurora is expected to pay $50m over 40 years for 145,000 ac-ft or 3,600 ac-ft for an annual average. Aurora has dried up 22,961 in agriculture to transfer 27,000 ac-ft according to Doug Kemper, Water Resources Manager (1.175 ac-ft per acre irrigated). In total water rights changes in the Lower Arkansas Basin have totaled 87,000 ac-ft and dried up 39,135 acres of which 29,381 were for transfers to Colorado Springs (2.22 ac-ft per acre irrigated).

Oct 22, 2003

Aurora expects to spend $800m on water infrastructure over the next ten years regardless of Ref. A. City involved in cooperative projects because over 60% of water from Grand County diverted and over 75% is owned. Front Range owns about 50% of water in Summit County. One project is in Eagle River Basin where the 30,000 ac-ft reservoir would be 1/3 each to Aurora, Colorado Springs, and Western Slope. Aurora currently diverts more than 624,000 ac-ft per year and expect to divert 1.18m ac-ft by 205.
Source: Michael C. Bender (10Sep03) Front Range, Western Slope must met on water issues, Daily Sentinel, no page.

Pueblo residents will be charged a storm water fee beginning in December based on the impervious footprint on each city lot. The fee is $2.00 per month per lot of 2,000 square feet to reach $6.25 for lots with more than 4,000 square feet. Other properties will be charged $1.22 per 1,000 square-feet.
Source: James Amos (16Sep03) Pueblo residents to be charged storm-water fee, Pueblo Chieftain, no page.

Fruita will protect 11 acres along Colorado and open 50 acres to public by purchase of Snooks Bottom property. It has 20 acre lake and now is used for gravel mine. Mesa Land Trust will hold easement which had been identified as proposed park and open space in 2000 plan. Will cost $843,000 of which $489,000 will come from GOCO.
Source: Michael C. Bender (4Sep03) Fruita buys, protects Colorado River acreage, Daily Sentinel, p. 1A.

Security for the Animas-La Plata Project would cost upwards of $5m for construction costs. Question is who is going to pay it and who is responsible for operations. Security will focus on pumping station as reservoir will be open to the public.
Source: Associated Press (13Sep03) Security concerns add $5million to Animas-LaPlata, Pueblo Chieftain, no page.

US Forest Service is renovating water system for Junction Creek Campground near Durango for $1.0m in total. Area is 30 acres with 34 camp sites of which 25 would be open. Will install a well with a 5,000 gallon tank, chlorination system to replace a 3,000 gallon cistern which is spring fed. Cost on the water system is budgeted at $214,000.
Source: Dale Rodebaugh (3Sep03) Campground to close for water system, Durango Herald, p. 11A.

Marvel Springs near Durango provided free water but now will charge $100 user fee plus $4.00 for a key to open the box holding the spigot. About 200 users are eligible to draw water from the spring n the La Plata River drainage. House wells have been going dry. The Bureau of Reclamation provided $20,000 for infrastructure at the spring. The water district receives about $5,000 in tax revenue which is not enough to maintain the spring.
Source: Dale Rodebaugh (13Aug03) Free water dries up, Durango Herald, pp. 1A and 12A.

Durango forecasts a population of 40,000 was planning to buy 3,800 acre-feet from the Animas-LaPlata Project each year. The 19,000 current customers used 6,000 ac-ft in 2002. Phil Doe said the cost overruns for Dallas Creek, Deloris, and Central Arizona Projects all came in 300% over budget. Original cost was $338m and now bumped to $500m.
Source: Dale Rodebaugh (2Aug03) City unsure if A-LP costs may hurt bid, Durango Herald, pp. 1A and 12A.

Proposed new water district in San Luis Valley of almost 8,000 square miles would include about 200,000 acres of irrigated land in Closed Basin and over 5 of 6 counties. Farmers would be assessed $5.00 per acre; plus another $5.00 acre if using well water; plus a variable fee depending on crop and amount of water applied to it to give as much as $23 per acre for a total of $33 per acre. This is $2 to $2.5m to mange the district and to pay farmers to fallow fields to save water. This isn't seen as the total solution to stabilizing the aquifer but a start and better than litigation.
Source: Erin Smith (22Aug03) Water war feared in San Luis Valley, Pueblo Chieftain, no page.

Denver Water expects bills to increase 5% as customers reduced water use by nearly 30%. This is $1.00 to typical monthly bill of $39.00 for residential use. Average Englewood bill is less than Denver's but is increasing bills by 15% and average Los Angeles water bill is $68 per month and $109 in Seattle. Denver grew from 467,000 to 554,000 from 1990 to 2000. Denver is working on recycling water.
Source: Editorial (30Aug03) Denver Water looks ahead, Saturday Rocky Mountain News, no page.

Water Values

August 19, 2003

Greeley planning a water storage project for $20 to $30 million for 8,500 acre-feet of capacity.
Source: Jule Piotraschke (15Jul03) Greeley Tribune, no page ref. [at $30m is $3,529 per ac-ft]

Tapping Denver Aquifers could cost $65m for 29,000 ac-ft per year with 127 wells or enough for 60,000 families for a year. New reports give much less water than Lake Erie and less of this is of acceptable quality. Denver requires 285,000 ac-ft per year for 1.2 million customers.
Source: Jerd Smith (22Jul03) Tapping aquifer could cost $65million, The Rocky Mountain News, pp. 4A and 23A.

Funding raising for water park at mouth of De Beque Canyon (Palisade) for $10,000 hoped for. In Golden 45,000 users attracted and $23 million generated over 3 years. Design would allow for fish passage. Applying for $200,000 from GOCO.
Source: Gary Harmon (9Aug03) Fundraiser to launch water park campaign, The Daily Sentinel, no p.

Ute and Collbran Water Districts hope to buy Upper and Lower Molina power plants, Vega Reservoir, and 13 other small reservoirs from the Bureau of Reclamation. Vega has 33,000 acre-feet and in the late 1990's the price was $12.9 million.
Source: Erin McIntyre (6Aug03) Water Districts hope to buy West Slope reservoirs from feds, The Daily Sentinel, pp. 1B and 9B.

Vega Reservoir project is nearing 50 years old. Power serves 70,000 people. District of Ute
Source: Erin McIntyre (7Aug03) Skeptics meet over Ute Water plans, The Daily Sentinel, no p. .

Welton Reservoir near Rocky Flats was completed for $20m with a capacity of 9,800 ac-ft [about $2,040 per ac-ft]
Source: Associated Press (4Aug03) State works to pick projects for water initiative, Greeley Tribune, no p.

Price for Animas - La Plata Project goes from $338m to $500m from 1999 to 2003. Bureau of Reclamation official says a bunch of small little pieces added up and omissions were made in estimates. Sole source contracting with tribal contractor is adding 24% of increase. 31% is of tribal assistance, contracting costs, and cultural resources. Opponents say project was low-balled when submitted for approval. Halting the project is no an option.
Source: Erin McIntyre (1Aug03) Animas-La Plata price shoots up $162 million, The Daily Sentinel, pp. 1A and 5A.

Aurora is looking to build a reservoir in Lake County with 23,000 acre-feet of capacity for $80 million. Dam would be 150 feet high and 3,400 feet long.
Source: Mike Patty (12Aug03) Aurora aims to double water capacity in next few decades, The Rocky Mountain News, no. p

Commissioner of Agriculture, Don Ament said that Colorado needs to store more of the 16 million acre-feet that snow melt provides to the state and Colorado has only 6.5 million acre-feet of storage.
Margie Wood (9Aug03) Action 22 debates water issue, The Pueblo Chieftain, pp. 1A and 2A.

80% of Colorado's water comes from snowmelt and Colorado is entitled to 400,000 acre-feet more from Colorado River Compact [only in an average year] A private consulting firm was awarded $2.7 million to conduct 81 meetings across the state and come up with a list of potential projects for the $2 billion.
Source: Steven K. Paulson (4Aug03) State working to identify projects for water initiative, The Pueblo Chieftain, no p.

Farmers in San Luis Valley considering formation of sub-district and taxes to conserve water. Requires owners of 51% of land to sign. Farmers would tax themselves to stop irrigating so as to reduce well pumping and to reduce use by acquiring water rights. Plan to raise $1.5m to $2.5m a year on a tax of $5 per acre with groundwater irrigation and an additional $5 per acre for a delivery charge and $10 per acre-foot for each farmer's net depletion of aquifer. Last charge will reflect reduction for use of surface water rights.

Source: Tom McAvoy (9Aug03) Farmers to consider tax to save water resources, The Pueblo Chieftain, no p.

Worse drought in 100 years for San Luis Valley. Problem is increased growing of alfalfa. Crop is shipped to daries in New Mexico and elsewhere. Price last year was $145 a ton and this year is $110 a ton. Crop acreage has increased 30% since 1975. Need to reduce water pumping by 20% in San Luis Valley. Also temperature is important and for last two warm summers they got 3 good crops from center pivot irrigation while this year there was no water for ditches. Some say switch to sudangrass and has less problems with nematodes and verticillium and is a good transition to barley or potatoes. SLV had 167,000 acres in alfalfa with 67,800 acres in potatoes as next largest crop. Alfalfa is popular because one of easiest to harvest and demand is high. Alfalfa makes $15 to $20 per acre-foot of water used. Potatoes make $188 per acre-foot in 2001 and higher last year. But there is a glut and lower prices for this year. Alfalfa production total value was $49.5 m and value for potatoes was $203 m.

Source: Damon Haley (31Jul03) Alfalfa a big user of water, Alamosa Valley Courier, pp. 1 and 3.

Sierra Vista Estates northeast of Durango will pay $60 per month for water, or $31 per month as determined by the La Plata County Commissioners. The developer for 29 built upon home sites was to provide water for free. In 1996 the Colorado Department of Public Health cited the water supply for E-coli. The owner will go into bankruptcy if the monthy chanrge of $60 per house is not adopted. Developer lives in Arizona.

Source: Charles Ashby (29Jul3) Company threatens to cut off water, The Durango Herald, pp. 1A and 12A.

May 18 2003

Colorado Springs plans to drill 8 wells as temporary aid to regular water supply. They would be 750 to 1,400 feet deep inot Denver and Arapahoe Aquifers. Combined they would pump 2.5 mgd. If necessary 35 more wells can be drilled for an additional 7.5 mgd. Each of the 8 is expected to cost $300,000 [2.5mgd is about 7.67 ac-ft a day. Operated for 300 days would produce 2,301 ac-ft. Cost for supply is 8 wells * $300,000 each for $2.4m or $1,04 per ac-ft.
Source: Cate Terwilliger (5May2003) Springs utility drills for water, Denver Post, no page [p. 2 of Denver and West section]

Tankers pay $2.00 per 1,000 gallons for Greeley, CO, water from hydrants and if this water is not replaced the price is $6.10 per 1,000 gallons which is 300% markup over regular city price.
Source: Mike Peters (28Apr2003) Tankers pay high price for water from hydrants, Greeley Tribune, p. A2.

Web site for Front Range water restrictions is www.drought.colostate.edu. Fine for violation can be $500 for repeat offenders. Trucking in water to deep-water big trees. Lawyer Matt Ferguson in Basalt paid $605 quarterly water bill, 3 times normal, for surcharges. Denver Water will charge $.80 for every 1,000 gallons over limit of 18,000 gallons within 2 month period and goers up to $11.84 per 1,000 gallons as maximum surcharge. If household uses 50,000 gallons, the two month bill would double from $92.39 to $186.57.
Source: Joey Bunch (1May2003) Cities test waters with new restrictions, surcharges, Denver Post, pp. 1B and 5B.

Aurora has offered $528 per acre for 1861 water in High Line Canal on Arkansas River for 5,000 to 10,000 acre-feet. City expects to lease 25 to 50% of water in canal for 2 years. Water would be exchanged to be diverted upstream at Otero pumping station near Buena Vista. Aurora bought 60% of Rocky Ford Ditch in 1986 and is leasing much of remaining shares. Expects most farmers will lease only part of their water – that used for 3rd cutting of alfalfa and keep water for vegetables. Payment prorated this year and full amount paid next year. Aurora can renew lease depending on water conditions in 2004.
Source: Margie Wood (1May2003) High Line OKs leases to Aurora, Pueblo Chieftain, pp. 1A and 2A.

Highline Canal has 1869 water rights and is 85 miles long and irrigates 22,500 acres. Water lease would create problems for those using remaining water. About 70 to 80% of use is for alfalfa.
Source: Margie Wood (26Apr2003) Aurora on tap, Pueblo Chieftain, pp. 1A and 2A.

Colorado Springs pipeline would carry 78 mgd and send waste water down Fountain Creek which has base flow of 60 cfs.
Source: Margie Wood (0Apr2003) Springs' population hikes flow of waste in Fountain Creek, Pueblo Chieftain, pp. 1A and 3A.

Irrigators off Fountain Creek finding loss of "crud" and must wear rubber gloves when setting siphon tubes. There is also a bad bank erosion problem. Cost of conduit would be $200 million.
Source: Margie Wood (30Apr2003) Plenty of crud found downstream, Pueblo Chieftain, pp. 1A and 3A.

22 Mar

Water needs must be considered in coordination of planning, SB 92 for 2003, esp. where growth is 5% per year. Rep. Entz felt this was not onerous.
Source: John J. Sanko (7Feb03) Bill calls for close watch on water needs, Rocky Mountain News, no page.

March 5, 2003

Pipeline from Pueblo Reservoir to Lamar estimated at $200m of $35m for operation and maintenance each year. Alternative of no action would cost $185m for individual treatment facilities to cope with declining water quality. Route could follow Bessemer Ditch or Comanche Power pipeline or on north side of Arkansas River. Expect 75% federal cost share.
Source: Anthony A. Mestas (30Jan03) To build or not to build, Pueblo Chieftain, no page.

Statewide agriculture uses 85% of water but community needs to eat so in effect it uses 100$ of water. Last year CBT water was available for lease at $500 per ac-ft and this year $1,660 per ac-ft and not affordable to agriculture says Eric Wilkinson of Northern Colorado Water Conservancy District.
Source: Bill Jackson (21Feb03) Speaker: State drought will end; growth won't, Greeley Tribune., no page.

Development project near Castle Rock has water plan for 2,400 acres. Development is called Headwaters and is for 2 golf courses, 132 single-family units, and 69 cottages for part-time and 28,000 sq-ft club house County standard is 2.5 ac-ft per acre for golf course irrigation and with new technology developer wants to achieve 2.0 ac-ft per acre. A 17.5 acre pond would be built to hold 650 ac-ft and wells drilled for the housing units. Fiscal impact submitted by developers projects average of $187,000 per year for 12 years and $437,000 at completion in 12 years. Opponents say this does not account for road costs.
Source: J. Sebastian Sinisi (9Mar03) Project's plan for water use to be studied, Denver Post, pp. 27A and 32A.

Water Pricing –
Tap fees in Aurora recently increased from $6,846 to $10,711 per single family home.
Source: AP (20Jan03) Restrictions considered for Aurora, Pueblo Chieftain, no page.

When water sold off land, then taxes are lost. Bill offered in legislature would provide compensation. Opposition says that if a conservancy district has to rely on property tax revenue, then once again it's the farmer that winds up footing the bill, according to spokesperson for Colorado Farm Bureau.
Source: Michael C. Bender (30Jan03) Senate committee OKs water legislation, G. J. Daily Sentinel, no page.

Farmers can profit from their water without giving it up entirely by leasing. Greeley has for years leased its water to agriculture. Now there is a turn around.
Editorial (31Jan03) Leasing water good decision, Greeley Tribune, no page.

Like cell phone plans, water users should pay for what they use says David Brookshire of U. of New Mexico economist. Average 10 minute shower uses 15 gallons. Price is so low that no one pays attention at cost of month's showers of $1.16 for 465 gallons. Price in Minneapolis is $2.24. Showers should cost over $1.00 each. Prices for water set on break-even pricing and not economic principal of supply and demand. Elsewhere in economy, price is based on scarcity. It would take increase of 278% to 463% to curb consumption.
Source: Joey Bunch (17Feb03) Water too cheap to conserve, prof. says, Denver Post, p. 3B.

Garfield County is contracting with West Divide Water Conservancy District for water to control dust at $5,000 for 15 ac-ft.
Source: Mike McKibbin (11Feb0) GarCo gets more water to control dust, G. J. Daily Sentinel, no page.

Aurora wants to lease Rocky Ford Ditch water for emergency needs for 90 days. Aurora can not meet normal demand for 54,000 ac-ft without substitute supply. Aurora expects to get 2,281 ac-ft from Rocky Ford Ditch over 90 days – May 1 to Jul 29 – and uses 18,000 ac-ft on golf courses in period. Emergency is questioned. Aurora ill pay $1.5 million or $528 for each ac-ft of 2,800 holders of Rocky ford Ditch water want to sell.

Alamosa will buy water from Price Water District (a private water supply system) at $500,000. System serves 106 household taps with single well producing 1,500 gallons per minute for total of 2,4440ac-ft per year. Well drilled into confined aquifer at 1,630 feet deep. Owner does not want expense of treating for arsenic. [water cost is $205 per ac-ft]
Source: Erin Smith (24Feb03) Alamosa exerts water option, Pueblo Chieftain, no page.

Paying off the $10b bonding for water development would have to be on a user-pays concept to get public support.
Source: Arthur Kane (6Mar03) Panel approves bonding measure, Denver Post, no page.

Pueblo Board of Water Works recommended four tier fee structure for coming year. .Basic monthly service charge includes 2,000 gallons. Second tier is next 4,000 gallons. Third tier is 6,000 gallons a month and the standard indoor use for cooking, cleaning, and bathrooms. Fourth is 15,000 gallons and comes with a surcharge depending on the drought conditions of $1.92 per 1,000 gallons to $2.30 per 1,000 gallons. Last tier is over 21,000 gallons per month and at Stage IV drought would have $6.02 per 1,000 gallons as surcharge.
Source: Editorial (18Feb03) Graduated fees, Pueblo Chieftain, no page.

Southern Ute Indian Tribe will spend $4.9m for water treatment plant with high tech. filtration. Existing capacity is 1.7 million gallons per day or enough to serve 900 people including town of Ignacio. New capacity is 4m gallons per day. Purpose is to filter out sediment and ash from Missionary Ridge Fire in Los Pinos River. Input water reached 2,000 NTU (measure of suspended particles) of appearance of chocolate milk color and Colorado max. is 0.5 NTU at faucet.
Source: Brian Newsome (12Feb03) Utes pour $4.9m into water treatment, Durango Herald, pp. 1A and 12A.

Tamarisk –
Tap roots can go down 50 feet. They have 1% of winter birdlife found in native stand. Thrive on poor soil, take up salt to leaves which fall and deposit salt on surface. Use 70,000 acre-feet of water on Arkansas River or about the yield of Frying Pan – Arkansas Project. Federal legislation is pending to have Mesa State College be tamarisk control center for West. Trees cover about 1 million acres in West and use 2m to 4.5m gallons per day.
Source: Margie Wood (24Feb03) Feds may help fight water-guzzling tree, Pueblo Chieftain, pp. 1A and 2A.

5 Mar 03

Groundwater solutions for water storage – use of sandpits for water storage can result in large evaporation losses. In Greeley ara suggestion is for 60 foot deep trenches around sandpit to bedrock. Fill trench with impervious slurry. Then water is put in for storage. Evaporation then is "reasonable" 10% and slurry wall prevents seepage. Cost is 1/3 of conventional dam storage. Underground water storage in aquifers is best.
Source: David Seckler (15Jan03) letter to editor – Prior to big projects, consider groundwater storage solutions. Greeley Tribune, no page.

Need to assure water supplies for growth. Kaplan report from CU. Public Infrastructure finding – better to prepare for growth by comprehensive planning fund with transferable development rights, with tax sharing to prevent competition for development and to provide money for affordable housing, a poll for acceptance for use of tax dollars to expand housing for low income but opposition to sales tax on real estate transfers with document fees of $.05 per $100.
Source: Steven K. Paulson (14Jan03) Water key factor in future growth, Durango Herald, pp. 1A and 10A.

Water use at car wash is 60 to 100 gallons per wash.
Source: Sheba Wheeler and Jim Kirksey (4Feb03) Metro cities set to tighten taps, Denver Post, pp. 1B and 4 B.

Aspen Ski corp. will send melting snow from slopes through small hydropower generator to provide 60 kilowatts or enough for 35 homes. System will receive $.06 per kw or almost twice what Holy Cross electric pays for conventional coal-fired power. Aspen Ski Corp expects to receive $12,000 per year and pay off the cost of $62,000 in 5 years. Cost of stringing electrical power lines to remote homes is $10,000 per mile. A family's 35 kw system cost $22,000 and based on 2 inch piping 2,500 feet downhill from spring to generate 1 kw or enough for 1 home. Put in a 25 kw unit on Ruedi Creek to generate income.
Source: Steve Raabe (2Feb03) Mining 'white coal", Denver Post, pages 1K and 16 K.

San Luis Valley may have 20% reduction in water use. Water engineer notes drop in aquifer is as much as 10 feet since 1970's. Last year 200,000 acres irrigated with 2,300 center pivots produced $200 million of potatoes, $100 m in alfalfa, $30m in barley and wheat at a 600,000 deficit in water to be made up by taking 37,000 acres out of production. It takes 15 to 20 inches of water to produce a potato crop and 28 to 32 inches to produce two or three cuts of alfalfa. A 20% reduction in ag will result in same reduction in ag-related industries. Farmers told to plant only what you have water for.
Source: Mark H. Hunter (13Feb03) Water-use cut proposed for San Luis Valley, no page.

Aurora's offer to lease High Line Canal water in the Arkansas Valley amounts to $500 per acre-foot if a leasing program can be approved by the Colorado Legislature. $11.25 for entire consumptive use for 2003.
Source: Editorial (2Feb3) No 'emergency', Pueblo Chieftain, no page.

Colorado Springs Utilities expects revenues of $533m in 2003 from all sources and plans to double service to 961,000 in 20 years. Planning the Fountain Valley Conduit with capacity for 13m gallons per day through a 66 inch pipe over 46 miles to give total capacity of 78m with other pipeline systems from Lake Pueblo. Sale at residential value is $30m per year. Heyday of mining, smelting, and manufacturing in Pueblo has passed. Water based recreation is growing with focus on Arkansas River Corridor Legacy Project. Concern is for exchange of water by Colorado Springs with withdrawal above Buena Vista and return of treated sewage water below Pueblo. Colorado Springs intends to finance pipeline by what it calls "off-book financing" with creation of separate entity issuing revenue bonds paid by captive water customers. This avoids public election. CS does not require like other cities that developers dedicate a sufficient supply of water to the city to meet requirements of their projects. No one dared suggest a moratorium on new taps. The Arkansas River has been over-appropriated since before 1900. If CS takes an additional 78m gallons a day of clean water out of Pueblo Reservoir and replaces it with returned sewage through Fountain Creek, Pueblo is left dry and corridor is worthless. CS gain is expense to Pueblo.
Source: Tom Florczak [atty for Pueblo] (2Feb03) That Giant Sucking Sound, op. ed. piece, Pueblo Chieftain, pages 1G and 4G.

5 Mar 03

New pipeline for Colorado Springs would require 150 foot right-of-way for each of three possible routes for pipeline. One roughly follows existing pipeline but need new easement. Another issue is the quality of the flow returned to Fountain Creek which will be of "sufficient quality to meet needs downstream" – primarily agriculture. Sediment in the increased flow is also a problem for fountain Creek which has a sediment load of 66,000 tons in an average year and more than 1m tons in May of 1999.
Source: Margie Wood (20Jan03) Landowners leery of pipeline plans, Pueblo Chieftain, pp. 1A and 2A.

Long-term proposals for San Luis Valley should go to voters, including creation of sub-districts. Manager Ray Wright and David Robbins, Atty., feel all land owners should vote whether they live in valley or not. Pay to play as alternative to well administration. Basis for well augmentation is assessments of property owners and not priority or seniority of water rights.
Source: Ruth Heide (25Jan03) Water subdistricts up to voters, Alamosa Valley Courier, no page.

Reverse osmosis plant at La Junta, CO, to cost $6.8m from a $9.6m loan for Colorado Water and Power Development Authority. Engineering and construction services will run $600,000. City left with less than a 5% contingency which can take project up to the $9.6m figure. No size given.
Source: Anthony A. Mistas (21Jan03) Salida firm to build La Junta plant, Pueblo Chieftain, no page.

A Weld County irrigation company planning $7m water plan with 2 reservoirs to irrigate 35,000 acres as 5 year project for 2,500 acre-feet of capacity with a 300 acre-foot equalizer. [$2,800 per ac-ft].
Source: Bill Jackson (20Jan03) Irrigation firm moving on water storage plan, Greeley Tribune, pages A1 and A10.

Well drilling in Black Forest north of Colorado Springs costing $22,000 for 825 feet [$26.60 per foot]. Each 20 piece of pipe costs $247 which drives the cost up over the base rate of $16 per foot.
Source: Tracy Harmon (22Jan03) Drought has well drillers searching deeper for water, Pueblo Chieftain, pp. 1B and 4B.

Public wants water. Floyd Circuli, pollster, says an extra $2.00 on water bills would be ok to finance projects in worst drought over 350 years. Tap fees served by Denver are $1,000 and recently raised to $20,000 by Parker.
Source: Tom McAvoy (21Jan03) Pueblo Chieftain, pp. 1A and 2A.

Fort Collins considering renting water from farms owned by City of Thornton – 2,000 to 3,000 acre-feet from farms that would replace sources already dried up so the amount obtained would be 500 acre-feet. In 1986 Thornton paid $55m for 21,000 acres of farms and renting water back to farmers. Fort Collinns want to rent the water from Thornton for $300 to $400 per acre-foot or about $1.2 m total. [NOTE] 1,000 acre feet is enough to serve 2,400 households for a year.
Source: The Associated Press (18Jan03) Colorado city considering renting water from Thornton-owned farms, Durango Herald, no page.

With advanced irrigation, better nutrients, better pest management, and other advances – farmers are consuming more water more often throughout the year in San Luis Valley says LeRoy Salazar PE. Used to irrigate fields every 7 – 14 days and now running system every 3 – 4 days. Keeping the soil wet. Alfalfa typically uses 28 – 32 inches or 2.5 acre-feet of water per acre. Cponsumptive use for barley is 17 – 232 inches and for wheat is 22 -23 inches. Potatoes use 15 -20 inches or 1.4 acre-feet per acre. Yields doubled on small grains and it takes more water. Now there is more alfalfa, a crop with higher consumptive use, [but less economic return]. Each center pivot taken out saves 1-2 acre feet. With shallow planting of crops, there is more need to irrigate rather than irrigate deeply by surface irrigation once before plants come up. Conservation strategies -- plant deeper, cut water off earlier on crops without hurting yield, don't do post season irrigation or 3 or 4, change crops from alfalfa to barley or planting earlier potatoes. Grains at best are a break even crop. People do not want to do them. Think strategically – plant 100 acres of wheat rather than 130 acres of barley. Closely monitor evaporation, transpiration, and modify. For bankers – land without water is nearly worthless, so when someone says they want to cut back to fit the water available – be supportive.
Ruth Heide (16Jan03) Water users chart own fate, Alamosa Valley Courier, pp. 1 and 3.

Disputed well operation in the South Platte Valley brings in $131m to farming communities according to a CSU study by 1,500 farmers who earn $80m and plus $51m goes to rural businesses such as farming equipment and services. [This is questioned as to whether farming income is gross or net and same with other income.] [Study released this day.]
The Associated Press (15Jan03) Study: Well water brings in $131m to farming towns, Durango Herald, no page.

5 Mar 03

Water needs must be considered in coordination of planning, SB 92 for 2003, esp. where growth is 5% per year. Rep. Entz felt this was not onerous.
Source: John J. Sanko (7Feb03) Bill calls for close watch on water needs, Rocky Mountain News, no page.

March 5, 2003

The Pine River Irigation District's rate for irrigation water around Bayfield, CO, is $85 for the first acre-foot and $1.30 after that. The District wants the town to pay $220 per acre-foot for domestic water. The average monthly water bill is now $22.80 per 1,000 gallons and the state average is 27.38 per 1,000.
Source: Shane Benjamin (14Jan2003) Bayfield's water may cost more, Durango Herald, pp. 1A and 10A.

Monte Vista now has may unmetered taps. Changing to $5 for first 10,000 gallons per month and $2.46 for each additional 1,000 gallons. Family of three generates average of 4,000 gallons of wastewater per month.
Source: Diana Murphy (13Dec2002) Monte Vista adopts new wastewater rates, Alamosa Valley Courier, no page.

Water rate in Windsor was a flat $14.30 per month and $1.63 per 1,000 gallons. In Weld a typical household uses 8,000 gallons per month and the bill will go from $25.28 to $46.70.
Source: Annie Hundley (1Jan2003) Water bils, water restrictions likely to increase, Greeley Tribune, p. A8.

Water plant investment per household in Greeley will be $8,400 per building. Developers pay a one-time plant investment fee for both supply and treatment capacity. The city's water supply program will pay $36 million for 6,000 acre-feet or enough for 12,000 households [$6,000 per acre-foot].
Source: Jesse Fanciulli (8Jan2003) Greeley water rates going up, Greeley Tribune, pp. A1 and A8.

Greeley has 22,280 shares in the Colorado – Big Thompson and ach share should produce 1 acre-foot in a good year. Present the CBT quota is 70% and may be 30% in 2003. Greeley's reservoirs hold 30,000 acre-feet. Greeley also has 734 shares in the Greeley-Loveland Irrigation Canal which averages a yield of 15 – 20 acre-feet compared with last year's yield of 2 acre-feet.
Source: Jesse Fanciulli (31Dec 2002) Tougher water-use rules likely, Greeley Tribune, pp. A1 and A5.

Agriculture soaks up 85 – 90% of water in state. Value at the farm of agricultural production is $17 billion for Colorado. Water becoming so valuable it doesn't make sense to farm said Tom Cech (Central Colorado Water Conservancy District). Flood irrigation is the least efficient method. Farmers moved from flood irrigation to sprinkler irrigation and eventually to center-pivot sprinklers with nozzles that dropped water 4 feet above the ground. Now farmers are experimenting with drip irrigation . Drip irrigation costs about $1,000 per acre. At state is farming. We need to water to produce income. [But ag in Gunnison County has been a loss for some years.] Without water all aspects of the economy suffer. The Northern Water Conservancy District is funding programs to teach farmers how to be more efficient.
Source: Julio Ochoa (30Dec2002) Where does it go?, Greeley Tribune, pages A1 and A12.

Cost to participate in augmentation plan offered by the Lower South Platte Water Conservancy District for wells is $5,000.
Source: Carol Barrett (8Jan2003) LSPWCD meeting draws a crowd at Tuesday's meeting, Brush News Tribune, no page.

Martin Lind of Windsor is proposing a $40 million project, Raindance Ridge, of 4 reservoirs to store 10,000 acre-feet and be an amenity for 50 homes on a 920 acre site. The water would be pumped up from the delivery system for Colorado - Big Thompson water. "Raindance Ridge preserves our agricultural roots and irrigation methods farmers have used for years," said Lind.
Source: Julie Piotraschke (4Jan2003) Windsor man pitches water storage project, Greeley Tribune, pp. A1 and A6.

American Waterworks Development Inc. (AWDI) said water beneath the Baca Ranch was worth $1 billion and The Nature Conservancy and federal government questions this cost as part of expansion of the Great Sand Dunes Nation Park. An arbitration panel issued a binding decision on a 2 to 1 vote that the worth was 649,000 due to insurmountable cost and legal, political, and practical obstacles to development and transport of the water to a market. These render its future prospects too speculative for valuation.
Source: Editorial (26Jan2003) Dunes ruling critical for park, Denver Post – Sunday, no page.

To 10 Feb 2003

Domestic water in Trinidad now is $15 a month for the first 7,500 gallons or about 85 gallons per day per person per household and 4 cents a gallon for water from commercial drive up water spigot.
Source: Mike Garrett (9Aug2002) Trinidad domestic water rates rise, along with fears, The Pueblo Chieftain, no page.

----- October 24, 2002

Aspen rewards water saving – taps that do not use more than 15,000 gallons per month will get $90; taps with use between 15,000 and 30,000 gallons get $60, and over 30,000 get nothing. This is in contrast with Denver Water which faces a budget shortfall because of conservation. Drought surcharges are expected to provide $11m next year for Denver Water. Rebates for low water use was not received well in Denver.
Source: Ellen Miller (26 Sep 2002) Water use: When it wanes, it pays, The Rocky Mountain News, no page.

Power plants on the Gunnison and Colorado River are offered money by Colorado River Water Conservation District to offset value of power production from winter water. The federal Grand Valley Power Plant and Redlands Water And Power Co. are the plants. Last summer payment to Redlands for not using 150 cfs of 750 cfs water right amounted to $70,000 to $85,000 as compensation for lost revenue. The amount of water for Grand Valley is 5 to 10 cfs but District has no plans for winter compensation on Colorado.

Aurora and Thornton are trying to acquire water from 11 ranches in South Park and bids are $12,000 to $15,000 per acre-foot. By contrast bids for Rocky Ford Ditch water in the lower Arkansas are $5,600 per acre-foot.
Source: Editorial (16Sep02) Help's on the way, The Pueblo Chieftain, no page.

Denver Water will study drilling into Denver Aquifer with 3 million acre-feet of water. Depth is 400 to 2,200 feet [reachable with CBM technology] and extract 20,000 acre-feet a year or 1% of Denver's annual needs. Cost for 1,000 foot deep well is $1m. Denver wants to take the water under the theory that those receiving its services have implicitly given up their right to any groundwater underneath their home business. Source: Theo Stein (23Aug2002) City's water quest goes underground, The Denver Post, page 1B.

Denver will tap 2 aquifers under city by drilling 1,000 feet down to produce 20,000 acre-feet a year at a cost of $1m per well. Source: The Associated Press (24Aug2002) Denver wants to tap 2 aquifers under city, Durango Herald, no page.

In Denver area water rights now sell for $4,000 to $12,000 per ac-ft. Source: Ron Franscell (10Sep2002) Dry years drill home water rights, The Denver Post, no page. These same figures are given. Source Pauline Arrillaga (1Sep2002) Western state's complex water laws are put to test as dry spell worsens, The Denver Post, no page.

City of Golden, Colorado, cut off from water by court ruling. City has population of 19,000 residents and average residential use if 160 gallons per day. Ruling would mean cut back to 40 gallons per person per day. City wants to buy 450 acre-feet from Coors Brewery for $4m [$8888 per acre-foot]. Source: Ann Schrader (10Sep2002) Golden to tighten the spigot, The Denver Post, pp. 1A and 8A

.

The Central Colorado Project (formerly Union Park Project) can build a 1.1million acre-foot reservoir for $500 million [$454.5 per ac-ft]. Source: Dave Miller (15Aug2002) On the Big Straw plan that the state's cooked up ..., Aurora Sentinel, letter to editor, no page and letter to Governor Owens (16Aug 2002) in Colorado Statesman, no page.

Rep. Carl Miller says use water available in Denver Basin Aquifer. According to 1998 report, the Denver Basin Aquifers contain 300 million acre-feet of water, 15 times greater than active storage capacity of Lake Powell and the life of the aquifer with careful use may exceed 1,000 years. Source: Tom McAvoy (12Aug2002) Water laws can be changed, Tracey says, The Pueblo Chieftain, no page.

Water is needed for augmentation in the lower Arkansas River Valley in Colorado. The Arkansas Groundwater Users Association is buying water from municipalities at up to $47 an acre-foot (considered a very high price) for augmentation for 400 wells needing 2,900 or 1,000 acre-feet between mid August and mid September. Source: Margie Wood (14Aug2002) Well augmentation water has high price, The Pueblo Chieftain, no page.

Much of Crowley County had junior water rights from the Arkansas River dating after 1890. Water in the county averaged 1.69 ac-ft per ac when 2.0 ac-ft per ac was consider the minimum for the area. The rocky ford Ditch with an earlier priority produced 5.8 ac-ft per ac. By 1967 the sugar beet facory closed in the county and water began being sold away. Price of Twin Lakes water was $1,050 a share without land in 1972. Now it is $20,000 share. Now dry land for cattle is $300 per acre in Crowley County. Source: Margie Wood (10Aug2002) Water rights and money lure seem to flow together, The Pueblo Chieftain, pp. 1A and 2A.

Trinidad expects to grow 2.5% to 3% a year over the next 20 years. Colorado agencies report that 100 single-family houses results in 250 full-time construction jobs generating $7.9m in annual wages and $4.25m in federal, state, and local revenue. 100 multi-family units generates more than 100 jobs, $3.34m in wages and $1.8m in revenues. Growth must pay its own way in Trinidad. Source: Mike Garrett (19Apr02) Trinidad in good shape for water, says planner, The Pueblo Chieftain, no page.

Pipeline along Arkansas River has projected cost of $160 - $200m and federal government would pay 75%. Cost compares with projected $350 - $640m municipalities would have to pay for federally mandated water water quality treatment. Source: Tom McAvoy (25Jul02) Sen. Allard seeks federal Funds for pipeline project, The Pueblo Chieftain, pp. 1A and 2A.

Arkansas Groundwater Users Association has contract to buy 3,895 ac-ft from the Pueblo Board of Water Works but Board cancelled as it imposed water restrictions on Pueblo residents. Now AGUA is seeking replacement water from the Southeastern Colorado Water conservancy District. The AGUA would have to cut off 400 wells with loss to farmers of $10m to $15m. AGUA believes Pueblo should recognize agriculture's economic contribution. Residents may have agreed to rationing last May to provide water for farmers. Water District has emergency reserve but some towns downstream also need water. District reserved 4,800 ac-ft for emergencies and about 400 ac-ft now used. Source: Margie Wood (31Jul02) Replacement woes increase for farmers, The Pueblo Chieftain, pp. 1A and 2A.

------ to 31Aug02

Doloris Project built in 1980's. Total full service allocation is 55,200 acre-feet to 28,000 acres based on ideal crop rotation of 55% alfalfa, 20% small grains, 15% dry beans, 3% pasture, and 7% corn. Diversion requirement for this allocationis 1.97 ac-f per ac and farm deliver is 1.72 ac-ft per ac based on consumptive use of1.76 ac-ft per ac and farm irrigation efficiency of 70%. Average farm delivery is 1.74 ac-ft per ac from 1987 to 2000. Use of Watermark probes found to be better than calculation of water balance to provide appropriate supply at root zone. Source: A. Berrada, T. M. Hooton, M. W. Stack, and others (2002) Assessment of Irrigation Water Management and Demonstration of Irrigation Scheduling Tools in the Full Service Area of the Deloris Project, in Colorado Water (Colorado State University), August, pp. 13 – 15. Source has other useful citations.

Trickle down irrigation. Farmer in La Junta installed underground drip tape irrigation system to provide water at the root level. Cost is $650 to $800 per acre at depth of 8 inches. This is center of root zone for most crops. Source: cite to The Pueblo Chieftain, July 11, 2002; in Colorado Water (Colorado State University), August, p. 28.

Denver Water to spend $29m to protect drinking water supplies from terrorist attacks. Access to reservoirs is also restricted – for example Blue Mesa. Source: Scripps McClatchy Western Service (31Jul2002) Colorado taps cash for drinking water, The Daily Sentinel, page 7A.

Denver Water will study drilling into Denver Aquifer with 3 million acre-feet of water. Depth is 400 to 2,200 feet [reachable with CBM technology] and extract 20,000 acre-feet a year or 1% of Denver's annual needs. Cost for 1,000 foot deep well is $1m. Denver wants to take the water under the theory that those receiving its services have implicitly given up their right to any groundwater underneath their home business. Source: Theo Stein (23Aug2002) City's water quest goes underground, The Denver Post, page 1B.

Denver will tap 2 aquifers under city by drilling 1,000 feet down to produce 20,000 acre-feet a year at a cost of $1m per well. Source: The Associated Press (24Aug2002) Denver wants to tap 2 aquifers under city, Durango Herald, no page.

In Denver area water rights now sell for $4,000 to $12,000 per ac-ft. Source: Ron Franscell (10Sep2002) Dry years drill home water rights, The Denver Post, no page. These same figures are given. Source Pauline Arrillaga (1Sep2002) Western state's complex water laws are put to test as dry spell worsens, The Denver Post, no page.

City of Golden, Colorado, cut off from water by court ruling. City has population of 19,000 residents and average residential use if 160 gallons per day. Ruling would mean cut back to 40 gallons per person per day. City wants to buy 450 acre-feet from Coors Brewery for $4m [$8888 per acre-foot]. Source: Ann Schrader (10Sep2002) Golden to tighten the spigot, The Denver Post, pp. 1A and 8A

.

The Central Colorado Project (formerly Union Park Project) can build a 1.1million acre-foot reservoir for $500 million [$454.5 per ac-ft]. Source: Dave Miller (15Aug2002) On the Big Straw plan that the state's cooked up ..., Aurora Sentinel, letter to editor, no page and letter to Governor Owens (16Aug 2002) in Colorado Statesman, no page.

Rep. Carl Miller says use water available in Denver Basin Aquifer. According to 1998 report, the Denver Basin Aquifers contain 300 million acre-feet of water, 15 times greater than active storage capacity of Lake Powell and the life of the aquifer with careful use may exceed 1,000 years. Source: Tom McAvoy (12Aug2002) Water laws can be changed, Tracey says, The Pueblo Chieftain, no page.

Water is needed for augmentation in the lower Arkansas River Valley in Colorado. The Arkansas Groundwater Users Association is buying water from municipalities at up to $47 an acre-foot (considered a very high price) for augmentation for 400 wells needing 2,900 or 1,000 acre-feet between mid August and mid September. Source: Margie Wood (14Aug2002) Well augmentation water has high price, The Pueblo Chieftain, no page.

Much of Crowley County had junior water rights from the Arkansas River dating after 1890. Water in the county averaged 1.69 ac-ft per ac when 2.0 ac-ft per ac was consider the minimum for the area. The rocky ford Ditch with an earlier priority produced 5.8 ac-ft per ac. By 1967 the sugar beet facory closed in the county and water began being sold away. Price of Twin Lakes water was $1,050 a share without land in 1972. Now it is $20,000 share. Now dry land for cattle is $300 per acre in Crowley County. Source: Margie Wood (10Aug2002) Water rights and money lure seem to flow together, The Pueblo Chieftain, pp. 1A and 2A.

in winter. Source: Peter Roper (19Apr02) City, Army sign rver legacy contract, The Pueblo Chieftain, no page.

Colorado's 250 golf courses soak up 192m gallons of water on average summer day [about 590 ac-ft]. About equal to entire city of Denver on hot day. Use is about 8,000 gallons per acre per day over the 24,000 acres of golf courses. Average Colorado person uses 160 gallons per day which includes lawn watering. Golf course members pay "green" fees. Source: Nancy Lofholm, Coleman Cornelius, and Erica Draper (9May 02) Drought to rough up fairways, The Denver Post, pp. 1A and 16A.

The Town of Blanca (in San Luis Valley) is placing a moratorium on water exportation. Town has been overusing water allocation. As of May 1 no water other than 10 gallons can be sold or given for transport outside boundaries. Town has rights to 200 ac-ft a year. Usage was 207 in 2000 and 215 in 2001. People outside the city limits have been purchasing water from the RV park not only for domestic use, but to water gardens and livestock. 10 gallons per day is considered enough for routine domestic needs such as drinking, cooking, washing clothes and bathing. Source: Sylvia Lobato (12Apr02) Blanca bans water export, Alamosa Valley Courier, pp. 1 and 3.

Greeley has 30,000 acre-feet of water in storage or about a year's supply and has excess water. The city typically leases 5,000 acre-feet and this year will lease an additional 2,000 ac-ft and also 4,000 ac-ft to the Larimer and Weld reservoir Co. Source: Bill Jackson (19Apr02) Greeley leases water toi irrigation companies, The Greeley Tribune, pp. 1A and 12A.

Angry landowners near Milliken, CO (north of Big Thompson River want water promised. Developer does not now have water; sold them to Greeley and after send sale of these rights, Greeley voided the contract. Subdivision owners can not irrigate because the land has been "dried up and irrigation desisted." The water system was never activated and the developer leased the water as the project was developed. One lot owner pays $225 a month to water his 18,000 sq-ft lawn. Source: Julio Ochoa (25Apr02) Owners seek help in fight for water, The Greeley Tribune, pp. A1 and A7

Trinidad expects to grow 2.5% to 3% a year over the next 20 years. Colorado agencies report that 100 single-family houses results in 250 full-time construction jobs generating $7.9m in annual wages and $4.25m in federal, state, and local revenue. 100 multi-family units generates more than 100 jobs, $3.34m in wages and $1.8m in revenues. Growth must pay its own way in Trinidad. Source: Mike Garrett (19Apr02) Trinidad in good shape for water, says planner, The Pueblo Chieftain, no page.

Pipeline along Arkansas River has projected cost of $160 - $200m and federal government would pay 75%. Cost compares with projected $350 - $640m municipalities would have to pay for federally mandated water water quality treatment. Source: Tom McAvoy (25Jul02) Sen. Allard seeks federal Funds for pipeline project, The Pueblo Chieftain, pp. 1A and 2A.

Arkansas Groundwater Users Association has contract to buy 3,895 ac-ft from the Pueblo Board of Water Works but Board cancelled as it imposed water restrictions on Pueblo residents. Now AGUA is seeking replacement water from the Southeastern Colorado Water conservancy District. The AGUA would have to cut off 400 wells with loss to farmers of $10m to $15m. AGUA believes Pueblo should recognize agriculture's economic contribution. Residents may have agreed to rationing last May to provide water for farmers. Water District has emergency reserve but some towns downstream also need water. District reserved 4,800 ac-ft for emergencies and about 400 ac-ft now used. Source: Margie Wood (31Jul02) Replacement woes increase for farmers, The Pueblo Chieftain, pp. 1A and 2A.

Water Values

Denver Company auctioning 924 million gallons, about 2,928 acre-feet and enough for 3500 new homes. Water is under Fiddleback Ridge in Douglas County and more than 18 miles from nearest proposed pipeline. Price is expected to start at $1,500 per acre-foot and go as high as $10,000 an acre-foot. Source: Anon. (8May02) For sale: 924 million gallons of ranch water, Greeley Tribune, no page number.

Offering from ranch in Elbert County may be largest groundwater sale in Colorado's history. The 924m gallons per year for 100 years or 2928 ac-ft is enough for 3,500 homes and lawns. Water could go anywhere including California, Arizona, or Texas. Well levels have been dropping about 30 feet a year in Douglas County. Source: Deborah Frazier (7May02) Water going up for bids in Elbert County, The Rocky Mountain News, pp. 7A and 13 A.

City of Lafayette is willing to pay farmers for their water. Supply is less than 25% of normal. But city chose not to participate in pipeline from north that opened a secondary source of water for neighboring Louisville. Louisville may spend over $10m on the Southern Water Supply Project to bring water from Carter Lake near Loveland. Lafayette chose to put water from South Boulder Creek in reservoirs such as Baseline Reservoir. Source: Robert Sanchez ad Owen S. Good (17May02) Farmers offered money for water, The Rocky Mountain News, pp. 5A and 28A.

Drought declaration would allow ranchers with land set aside in federal Conservation Reserve Program to use land for grazing if willing to take 25% cut in annual program payment which is typically $40 per acre. Source: Tim Flowers (17Apr02) Water woes could impact fishing, Alamosa Valley Courier, pages 1 and 3.

Allocation for Northern Colorado Water Conservancy District from Colorado-Big Thompson Project set at 70% quota. Average quota over 43 years is 73%. Last year it was 80% with 10% added in July. Source: Tim Flowers (17Apr02) Water woes could impact fishing, Alamosa Valley Courier, pages 1 and 3.

Aurora acquired about ½ the Rocky Ford Ditch about 15 years ago. Colorado Springs sells water to ag. users, last year about 14,000 ac-ft. Colorado Springs would get 19,000 ac-ft from expansion and reoperation of Pueblo Res. And others on Fountain Creek Valley would get 12,500. Colorado Springs wants to expand pipeline to Pueblo Res. And Aurora supports HR 3881 before Congress. With enlargement of Turquoise Res. the Fountain Creek Valley users would get 35,000 ac-ft of storage at a cost of $67 per ac-ft as compared to $1,500 per acre-foot to build new storage reservoirs. El Paso Count pays about 72% of Southeastern Water Conservancy District's revenue. Source: Margie Wood (29Apr02) Water, water, The Pueblo Chieftain, pp. 1A and 2A.

DRCOG predicts a shortage in 9 county area of 207,568 ac-ft by 2025. There are 20 water suppliers. Denver's average annual need is 285,000 ac-ft and it has available 375,000 ac-ft but is expected to need 450,000 by 2050. [Why don't other entities plan so far ahead?] Source: Charlie Brennan (10May03) Metro area facing a watershed, The Rocky Mountain News, pp. 5A and 31A.

Arkansas River Corridor Legacy Project in Pueblo will cost $4.2m and Great Outdoors Colorado is providing $2m and the city and county $400,000 each. Design is for 500 cfs in summer and 100 cfs

Watershed Evaluation Team
— WET —

Watershed Evaluation Team Members - March 1998

Butch Clark - Ph.D. University of London; 1985 Environmental and community planning, energy and water resources assessment. Gunnison County resident since 1970.

Ralph Clark Jr - LL.B. University of Cincinnati Law School; 1940 Receivership, corporate reorganization, bankruptcy, and trusts. Gunnison County resident since 1970.

Lynn Cudlip - M.S. University of Minnesota; 1985 Water resources management and research, wetlands delineation and planning. Gunnison County resident since 1978.

Pamela Hathaway - M.S. University of Arizona Natural resources management, international economic and environmental policy programs. Gunnison County resident since 1997.

Jim Milski - rancher and general contractor, hydropower researcher. Hinsdale and Gunnison resident since 1972.

Marty Moore - M.S. San Diego State University Mechanical engineering, solar design, community planning. Gunnison County resident since 1980.

Pat Moore - M.S. Oregon State University; Electrical and computer engineering, computer drafting. Gunnison County resident since 1980.

George Sibley - B.A. University of Pittsburgh Professor, publisher, writer, community development and humanities program producer. Gunnison county resident since 1968.

Jed Wallace - technical consultant in sound and lighting reinforcements, professional cook, water board commissioner, student. Gunnison county resident since 1997.

Ruth (Scotty) Willey - Ph.D. Harvard, 1956 Professor emeritus, University of Illinois Chicago, researcher RMBL since 1958. Gunnison County resident since 1970.

Robert Willey - Ph.D. Harvard 1958 Professor emeritus, University of Illinois Chicago, researcher RMBL since 1958. Gunnison County resident since 1970.

and with much appreciated advice and encouragement from many others.

DENVER AND THE WEST

p 2B

Cleanup of well water costly

Agency's slow pace angers locals

By Jim Mallory
Special to The Denver Post

WOODLAND PARK — The Teller County Water and Sanitation District probably will have to spend up to $300,000 for a treatment plant to remove a cancer-causing chemical from the water it provides to its customers.

That was the opinion of water district board chairwoman Debra Lamb following a public meeting Wednesday night attended by about 40 people. The district serves about 220 homes in an area known as Paint Pony.

Excessive amounts of ethylene dibromide, or EDB, were discovered in district wells in September, but test results have varied depending on the lab doing the testing and which wells were sampled. District customers are getting their water from the city of Woodland Park until the district wells are declared safe by the Colorado Department of Health and Environment.

Recent tests by several independent labs reportedly showed no trace of EDB. Colorado Department of Health and Environment spokesperson Lorraine Peavy said the state won't re-test the water until its lab completes its move in late February.

Peavy said the wells will have to be tested by the state. If the wells are clean, they can be turned on, she said.

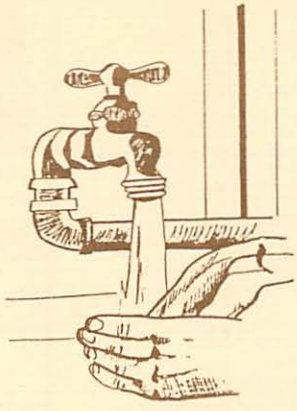
Environmental Protection Agency spokeswoman Joyce Ackerman said that agency doesn't contemplate any additional action. The EPA tested private wells in the area at the owner's request after the presence of EDB was first reported. All those tests were negative.

If the district has to build an activated-charcoal treatment plant, Lamb said, the cost will be $250,000 to $300,000. The district has been offered low-interest loans from the Department of Health and Environment and the Colorado Department of Local Affairs. The loans can be repaid over 20 years.

The cost of the loan would amount to about $1,600 per month. The district currently pays Woodland Park $8,000 to $10,000 a month for the water provided by the city.

Water district residents Diane and Glenn Raleigh said yesterday that they will launch a recall campaign to remove Lamb and board member Richard Specht. "We don't like that it is taking so much time, energy and determination to get this board to do anything," said Glenn Raleigh.

CLARIFYING POLLUTION TERMS



Pollution concentrations are usually defined in terms such as "one part per million"; "one part per billion"; or trace amounts".

How much is each of these amounts?

What is "trace amounts"? Is it dangerous?

Is any substance, even drinking water free of contaminants?

Rapid advancements in technology are making "zero" harder and harder to find. As little as 20 years ago, residues could only be measured in parts per million. Anything less than one part per million was "zero" - it was not detected. Today, elements can be located in parts per trillion and in increasing cases, in parts per quadrillion.

ONE PART PER MILLION (PPM) - equal to one drop in 21,700 gallons - the size of a small garbage pail.

ONE PART PER BILLION (PPB) - equal to one drop in 21,700 gallons - enough to fill a swimming pool 20 by 30 feet, five feet deep.

ONE PART PER TRILLION (PPT) - equal to one drop in 21,700,000 gallons - enough to fill 1,000 swimming pools.

ONE PART PER QUADRILLION (PPQ) - equal to one drop in 21,700,000,000 gallons - enough to fill one million swimming pools.

Or, in terms of time - one part per billion is one second in 32 years.

At one part per quadrillion, scientists say that all elements known to mankind can be found in a single glass of water. The fact that an element is present is not the danger - the hazard is the amount that is present.

Nitrates is ground or surface water are usually measured in parts per million. Pesticide limitations are in parts per billion. The term "traces" is used for parts per trillion or quadrillion.

The good news is that we can do a better job of monitoring our food and water supplies. Early detection allows potential problem areas to be located long before the point of danger. This assures ample time to correct the pending problem.

The bad news is how trace amount detections are presented by the media and reacted to by the public and environmental groups. Whether a part or two per billion of a chemical poses a health risk depends on what the chemical is and the conditions under which is occurs.

REMEMBER, EVEN WATER IN A PRISTINE SETTING CONTAINS A VARIETY OF ELEMENTS - THEY EXIST NATURALLY IN ROCKS AND OTHER PHASES OF NATURE. THERE IS NO SUCH THING AS NATURALLY PURE WATER!

GUNNISON SOIL CONSERVATION DISTRICT
216 NORTH COLORADO
GUNNISON, COLORADO 81230

Ralph Clark III
519 East Georgia
Gunnison, CO 81230

GUNNISON FIELD OFFICE PROGRESS OF WORK FY-90

Practice Name	Reported Amount and Unit
Brush Control	897 acres
Fencing	15,076 feet
Pasture and Hayland Planting	66 acres
Stockwater Ponds	3 each
Water Control Structures	6 each

* * * * * * * * * * * *

Land Benefitted	Reported Amount and Unit
Pasture and Hayland	744 acres
Rangeland	1920 acres

* * * * * * * * * * * *

... time for dinner. Laura Bush usu- ... nah, Ga., where Republicans hope to steal the White House agenda was shelved and the president's most important gains, be- Sen. Max Cleland, a veteran who lost his legs and an arm during the Vietnam War.

Report Backs Using River for Fishing

Wall Street Journal / November 2002 page A4

By Jim Carlton

A U.S. Geological Survey report has found there would be more economic benefits from returning water to the Klamath River for fish and recreation than from continuing to use it to irrigate farms, but the finding hasn't been released.

Interior Secretary Gale Norton drew criticism from environmentalists and leaders of local Indian tribes over her decision seven months ago to redivert water from the river system to about 1,400 farmers, despite warnings from federal biologists that to do so would imperil the river's fish. The U.S. Bureau of Reclamation had earlier shut off the spigots over protests from farmers, saying the water was needed to protect the river's sucker fish and downstream salmon.

As many as 30,000 salmon died in the Klamath River, which originates in southern Oregon and extends into northern California, from as-yet unknown causes in September. Geological Survey officials in the agency's Denver regional office say they held up the report temporarily, despite an initial peer review being complete, after the fish kill because of the report's sensitivity. A USGS spokeswoman in the agency's Reston, Va., headquarters said the report was undergoing normal reviews.

The 32-page report, viewed by The Wall Street Journal, estimates it would cost about $5 billion to remove the farms from the pipeline and take other restoration actions. It says about $36 billion in economic benefits would come over a number of years from more visitors using the Klamath River system for recreational activities such as fishing and boating.

The farms generate about $100 million in revenue a year, compared with almost $800 million generated by recreational activities along the Klamath and its tributaries, the report says. A resurgence in river levels would increase the recreational revenue to about $3 billion annually by prompting more people to visit more often, the report estimates.

The report's lead author, USGS economist Aaron Douglas, was scheduled to present the findings at a conference in California in the summer. But agency officials said it wasn't ready for public release.

In an e-mail on Oct. 7, Larry Ludke, the USGS regional biologist in Denver, wrote a colleague about the delay, which he attributed to USGS regional director Tom Casadevall.

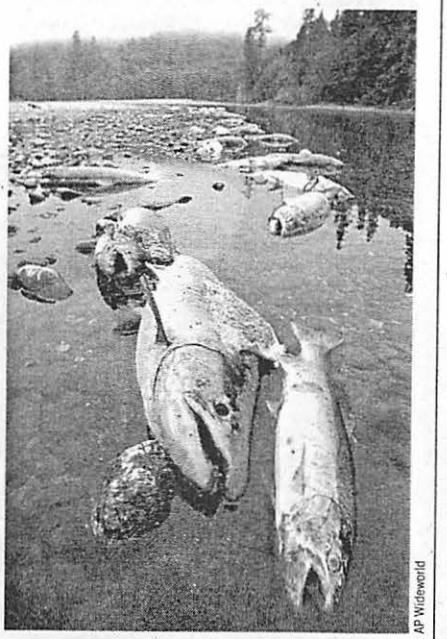
"He wants to slow it down because of high sensitivity in the Dept. right now resulting from the recent fish kill in the Klamath," Mr. Ludke's e-mail says. "... Suffice it to say that this is not a good time to be handing out this document and it will likely be a little while before we get clearance from HQ."

In an interview, Mr. Ludke, who was among the officials in charge of signing off on the report at the regional level, says Mr. Casadevall asked him to delay his review for a week "because of all the sensitivity around the issue." Mr. Ludke says he had to send the report for final review to the USGS's headquarters in Reston, Va., by agency director Charles Groat among others.

Mr. Casadevall was traveling and not available for comment, his office said. A USGS spokeswoman in Reston said the Klamath report's release wasn't expected until after another agency official is scheduled to return from an overseas trip Nov. 12 to check the report for policy implications. "It is not being held up for any reason other than to complete the review process," said the spokeswoman, Carolyn Bell.

Critics questioned the agency's motives. "Given the position the administration took when they tried to help these farmers out, and then with the massive fish kill that followed, of course having a report like this released makes them look bad," said Thomas Power, chairman of the economics department at the University of Montana in Missoula.

Administration officials have said it remains unknown what caused the fish kill and whether the irrigation diversions had any impact. Many environmentalists say they believe the fish died because when water was taken out for irrigation, river levels dropped so much that the water became too warm for the fish. Ms. Norton had originally ordered the farm-water releases earlier this year after a national panel of scientists said there wasn't proof fish would be harmed by the diversions. However, Ms. Norton recently directed that more water be put back in the river temporarily to assist the fish.



AP Wideworld

As many as 30,000 salmon *died in the Klamath River from as yet unknown causes in September, after water was diverted to farms.*

issued in 1978. EPA is to weigh economic and technological as well as health and environmental factors in the standards.

Municipal effluent limitations are less complex than industrial limitations. By July 1, 1977, all municipal plants were required to meet a secondary treatment level. This level of treatment implies the following technologies: mechanical removal of solids by screening and settling; removal of additional organic wastes and solids by treating the waste with air or oxygen and by allowing bacteria to consume organic materials; and chlorination.[53] The 1977 Amendments allow a waiver of secondary treatment in the case of facilities meeting specific pretreatment standards and preconditions. The senior author interprets the waiver to be only for west coast plants discharging into the ocean and islands. Whether this interpretation is correct will probably be tested in the courts. A secondary treatment facility is usually able to remove between 75 and 95 percent of the organics and solids in the waste stream. Much of this material becomes sludge which has been dumped into the oceans. Ocean dumping is reviewed in the solid waste chapter. Land application and reuse alternatives are now receiving a good deal of attention.

Estimating Effluent Discharges. Once they are agreed upon, the federal effluent limitations are relatively easy to apply. The permit application filed by an industry must indicate the quality and quantity of more than seventy physical, chemical, and biological indicators of the effluent quality. The discharger must indicate if the discharge contains any of the pollutants in Exhibit 10A and others which will be added as the toxic regulations are passed. The discharges must be described in detail later in the permit application. The companion list of parameters (Exhibit 10A) is the list of specific industries for which specific effluent limitations have been proposed and in some cases promulgated. In the event that readers wish to examine some of these regulations, the list is in the order of the date the limitations were proposed in the *Federal Register*.

By July 1, 1983, the goal was to introduce new approaches such as re-use of waste water and to upgrade municipal plants to handle wastes from urban runoff and from industries. Secondary treatment is not effective in treating many industrial wastes. Indeed, the introduction of industrial wastes into a municipal plant may kill the bacteria which decompose organic wastes. Accordingly, pretreatment standards for industrial wastes are important if the proposed industry would like to use a public plant. In essence, the goal of pretreatment requirements is to prevent new industries from getting around new source standards by going through a public plant.

As indicated above, EPA has been slow in responding to the hazardous waste provisions of the FWPCAA of 1972. About half of the nation's major

EXHIBIT 10A

EFFLUENT IDENTIFICATION CHECK LIST FOR INDUSTRIAL DISCHARGERS

Parameter Name	Code	Parameter Name	Code
Color	00080		
Turbidity	00070	Chromium	01034
Radioactivity	04050	Copper	01042
Hardness	00900	Iron	01045
Solids	00500	Lead	01051
Ammonia	00610	Magnesium	00927
Organic Nitrogen	00605	Manganese	01055
		Mercury	71900
Nitrate	00620	Molybdenum	01062
Nitrite	00615	Nickel	01067
Phosphorus	00665	Selenium	01147
Sulfate	00945	Silver	01077
Sulfide	00745	Potassium	00937
Sulfite	00740	Sodium	00929
Bromide	71870	Titanium	01152
Chloride	00940	Tin	01102
Cyanide	00720	Zinc	01092
Fluoride	00951	Algicides	74051
Aluminum	01105	Oil and Grease	00550
Antimony	01097	Phenols	32730
Arsenic	01002	Surfactants	38260
Barium	01007	Chlorinated Hydrocarbons	74052
Beryllium	01012		
Boron	01022	Pesticides	74053
Cadmium	01027	Fecal Strepto-cocci Bacteria	74054
Calcium	00916		
Cobalt	01037	Coliform Bacteria	74056

SOURCE: U.S. EPA, Engineering Form 4345-1, page 2, May, 1971.

municipal dischargers (those serving 10,000 or more people) did not meet the July 1, 1977, compliance date. According to an EPA source, the typical reason was the absence of pretreatment standards. In comparison, only about 16 percent of industrial dischargers were not in compliance with their 1977 requirements.

In February, 1977, the EPA proposed rules for the development of pretreatment standards and requested feedback on alternative regulatory

EXHIBIT 10B
INDUSTRIES WITH EFFLUENT GUIDELINES
PROPOSED OR PROMULGATED

Industry	First Proposed Date in *Federal Register*
Insulation, fiberglass	1/22/74
Beet sugar	1/31/74
Feedlots	2/14/74
Glass	2/14/74
Cement	2/20/74
Phosphate	2/20/74
Rubber	2/21/74
Ferroalloys	2/22/74
Asbestos	2/26/74
Meat products	2/28/74
Inorganic chemicals	3/12/74
Cane sugar refining	3/20/74
Grain mills	3/20/74
Fruits and vegetables	3/21/74
Electroplating	3/28/74
Plastics and synthetics	4/5/74
Nonferrous metals	4/8/74
Fertilizer	4/8/74
Leather tanning	4/9/74
Soap and detergent	4/12/74
Timber products	4/18/74

strategies. In addition, the pretreatment mandate has been modified in 1977 and again in 1978 by requiring pretreatment of the previously discussed 65 pollutants produced by 21 industries.

Effluent limitations are set for each pollutant. The nature and discharge frequency of the pollutant will dictate the manner in which the effluent limitation will be expressed. Most of the pollutants are measured as concentrations which can be converted into pounds or kilograms. Some parameters are measured uniquely, for example, temperature, pH, coliform, turbidity, and color.

Continuous discharges are usually limited by assigning a daily average and a maximum load in pounds of pollutant per pound of manufactured product. Discontinuous processes necessitate more complex limitations. The following limitations illustrate the discontinuous discharge limitation: (1) average concentration is not to exceed 30 ppm of total suspended solids and maximum concentration not to exceed 60 ppm; (2) no discharge is

EXHIBIT 10B (Continued)
INDUSTRIES WITH EFFLUENT GUIDELINES
PROPOSED OR PROMULGATED

Industry	First Proposed Date in *Federal Register*
Organic chemicals	4/25/74
Petroleum refining	5/9/74
Builders paper	5/9/74
Dairy	5/28/74
Pulp and paper	5/29/74
Seafood	6/26/74
Iron and steel	6/28/74, 8/21/75
Textiles	7/5/74
Steam electric stations	10/8/74
Wood furniture	11/14/74
Paving and roofing	1/10/75
Paint and ink	2/26/75
Poultry products	4/24/75
Oil and gas extraction	8/15/75
Mineral mining	10/16/75
Coal mining	10/17/75
Ore mining	11/6/75

permitted to exceed 100 pounds of BOD more than once a week; and (3) no continuous discharge of a concentration exceeding 100 ppm of total solids is to occur over a twelve-hour period.

Now, it is appropriate to illustrate the impact of the effluent limitations on existing and new sources. One comparison is between pre-permit discharges and permit limited discharges. A dramatic comparison may be made using state of New Jersey data. New Jersey has the dubious distinction of ranking first in two indicators of economic development: population density and value added by chemical manufacturing. Indeed, the production of chemicals in the 7,521 square miles of New Jersey greatly exceeds the output of chemicals in the more than 1.8 million square miles comprising the eighteen New England, Mountain, and Pacific states taken together.

Thirty-three of the more than one thousand petroleum and chemical plants in New Jersey are major water effluent dischargers. In 1974, the discharges of BOD and suspended solid wastes from these thirty-three plants was the equivalent of the treated discharges from a city of about four million people. In addition, these plants discharged numerous toxic

EXHIBIT 11
DISCHARGES BY THIRTY-THREE MAJOR CHEMICAL AND PETROLEUM PLANTS IN NEW JERSEY

Parameter (all in lbs./day except flow)	(A) Present Discharge Net Fall, 1974	(B) Draft Permit Limitations July 1, 1977	(C) (B)/(A)
Discharge, mgd	764.4	N.A.	—
Biochemical Oxygen Demand (BOD)	357,227	34,520	0.10
Total Suspended Solids	204,832	30,672	0.15
Total Organic Carbon (TOC)	239,306	44,871	0.19
Ammonia	97,830	7,397	0.08
Oil & Grease	86,379	15,670	0.18
Phenols	15,046	165	0.01
Titanium	7,167	1,180	0.16
Chromium	3,130	316	0.10
Zinc	2,980	754	0.25
Lead	1,315	199	0.15
Copper	1,598	228	0.14
Arsenic	125	2.38	0.02

SOURCE: Permit applications and draft permits.

wastes, some of which are summarized in the accompanying table (Exhibit 11, column A).[54] By July 1, 1977, the discharges from these plants were to be reduced to between 25 and 1 percent of the present total (Exhibit 11, columns B and C). These drastic reductions have not yet been carried out by all the industries.

A second comparison is between initial discharges, permit limitations, and new source standards. One of the important industries in resource recovery is corrugated paperboard production. The permitted discharges of an existing plant and allowable initial discharges at a new plant are found in Exhibit 12. The existing plant discharges over 100,000 pounds of BOD_5 into the Mississippi River. The permit calls for a reduction to one-fifth of the initial discharge. A new plant would reduce the discharge to about 1/87 of the BOD_5 discharge from the existing plant. The total suspended solids difference is less, but still substantial.

The U.S.EPA has promulgated new source effluent standards for most of the important direct discharges as well as pretreatment standards for

EXHIBIT 12
EFFLUENT DISCHARGE BY EXISTING AND NEW CORRUGATED MEDIUM FACILITY, SIC 2631

	Existing Plant		New Plant
	Existing Discharge	Initial Permit Discharge	Discharge
BOD_5, lbs/day			
30-day Daily Avg.	100,600	20,000	750
Daily Max.	126,000	40,000	1,500
BOD_5, lbs/ton of product			
30-day Daily Avg.	130	26	1.5*
Daily Max.	164	52	3.0
TSS, lbs/day			
30-day Daily Avg.	20,800	4,200	2,000
Daily Max.	31,200	8,400	4,000
TSS, lbs/ton of product			
30-day Daily Avg.	27	5	4.0*
Daily Max.	41	11	8.0

*Average of daily values for 30 consecutive days shall not be exceeded.

SOURCE: Permits provided by Jack R. Newman, chief, Industrial Unit, Permit Branch, U.S.EPA Region V, and EPA rules and regulations for "Pulp, Paper, and Paperboard Point Source Category, Subpart E—Paperboard from Waste Paper Subcategory," *Federal Register*, vol. 39, no. 104, May 29, 1974, pp. 18751-18752.

new sources which hope to use public facilities. These are published in the *Federal Register* and the *Environment Regulations Handbook*[55] and are available along with expertise in the U.S.EPA regional offices and some state offices. The engineers will be able to assist you with industries for which no limitations exist and industries for which some of the effluents have not been assigned standards. While you are speaking with the engineers, you had better find out if any rules and regulations limit effluents from holding lagoons and other impoundments on the site. Currently runoff from industrial sites is a controversial question.

New source standards are available for specific processes. If your study is long range at the two- or three-digit SIC code levels of aggregation, you will have to aggregate four-digit groups. A reasonable approach is to allow each four-digit SIC group to represent its percent of projected share of

water quality

80

Town will build big water storage tank

BY DONOVAN HENDERSON
Greeley Tribune

Milliken's Town Board doesn't want growth to go in the tank.

Instead, the town wants water — the precious commodity that is necessary for growth to continue — to go in the tank, a 2.25 million gallon tank.

MILLIKEN

A recently completed water study done by engineering firm Tuttle Applegate concluded that Milliken needs to start storing water.

The town has Central Weld Water District treat its water.

During times of high usage, the availability of water gets pretty scarce.

So the town intends to install a ground-level storage tank that holds a three-day supply of water. Once the tank is installed, the unit will be filled during the low-use hours between midnight to 6 a.m. Then if demand from Central Weld users gets high, Milliken can begin drawing from the tank.

Town administrator J.R. Schnelzer said the project is in the 1998 budget and he hopes to have something in place by the end of next year.

The tank itself will cost about $500,000. The town will have to kick in another $300,000 for such costs as land and line installation to and from the tank.

Schnelzer said the town is negotiating with three landowners for possible locations.

One prerequisite for the site is that it be able to handle expansion. "It makes sense to look at land that accommodates two tanks," Schnelzer said.

Milliken's population is about 1,700 and growing. The study said the 2 million-gallon tank should accommodate a population of 5,000 and a 5 million-gallon tank would be feasible for 10,000 people.

"The 5 million-gallon tank is not really doable for the town right now," Schnelzer said.

He indicated that the improvements in the town's water system should meet the community's needs for about 10 years.

DENVER DAILY JOURNAL
Denver, CO
(Denver County)
M-F(AM), 2,072

April 10, 1996

amendment bill makes ...

80

Colorado River salinity under attack

Get the salt out. That's the Bureau of Reclamation's goal in seeking proposals by Aug. 7 for up to $75 million of projects to reduce salinity in the Colorado River.

About 9 million tons of salt, much of it from marine shales, pours each year into the 1,450-mile river and its tributaries from Wyoming, Colorado, Utah, Arizona, New Mexico, Nevada and California. The bureau estimates the resulting damages at $1 billion annually.

High salinity forces farmers to switch from high to low-value crops. And municipal users, who generally pay hundreds of dollars per acre-foot, suffer when salts corrode residential plumbing. Fed up with hard water, voters in Tucson decided last November to quit drinking Colorado River water delivered by the bureau's $4 billion, 335-mile Central Arizona Project.

Meanwhile, Mexico complains that the river's salinity at its border reaches 950 parts per million, nearly double the limit recommended by the World Health Organization. To mollify Mexico, Title I of the federal 1974 Colorado River Salinity Control Act resulted in construction of the world's largest reverse-osmosis desalination plant, near Yuma, Ariz. Completed in 1992 at a cost of $247 million, it sits idle today because of a decision not to spend upwards of $22 million annually on its operation. Annual maintenance costs are still $6 million. For now, the U.S. continues to meet its treaty obligation to Mexico, high as the salinity level is.

At one time it looked like the Yuma plant was going to be needed soon. During filling of the bureau's Lake Powell on the Arizona-Utah border, with less water flowing downstream, it was looking like salinity "would go right through the roof in the 1970s," said David Trueman, manager of the Colorado River Basin Salinity Control Program in the bureau's Salt Lake City office. During the early 1980s, the salinity level dropped because of high rainfall. But now it approaches 879 ppm at Imperial Dam, the last dam on the river. It might be higher, if not for Title II of the 1974 act that resulted in the bureau spending more than $300 million. Affected states have chipped in 25% to 30% of the cost. And the U.S. Department of Agriculture has spent about $100 million for similar controls.

Projects completed last year include a $65 million system for injecting briny spring water with 260,000 ppm of salt into deep wells in Colorado's Paradox Valley. That costs $25 per ton of salt removed, squarely within the range of $9 to $60 for the bureau's other salinity-control projects. They involve lining irrigation canals, leveling crop land and using municipal systems rather than leaky canals to deliver water to livestock. The bureau disagrees with those who contend it would be cheaper to buy some farmers out.

Congress has voted to let the bureau spend an additional $75 million on the most cost-effective salinity controls. For fiscal 1997, President Clinton has requested $5 million to begin.

By David B. Rosenbaum, ENR

80

Water too cheap to conserve, prof says

Higher prices urged as way to cut use in West

By Joey Bunch
Denver Post Environment Writer

People waste water like it grows on trees for a very simple reason, a University of New Mexico economist told scientists, college professors and government regulators Sunday.

It is way too cheap.

Across the Southwest, the average cost for a gallon of tap water is less than one-fourth of a penny, and that price hasn't gone up for homeowners since 1950.

"Has your gas bill gone up since 1950?" David Brookshire asked at an afternoon lecture at the American Association for the Advancement of Science's annual meeting.

Water bills should be like cellphone plans, he said: People should pay rates based on the amount they use and how they use it.

"There is no reason water can't be packaged the same way," he said.

Most people are not likely to cut back until they feel the sting on their water bill, Brookshire said.

The average 10-minute shower sends 15 gallons down the drain. Denver Water has asked its 1.2 million customers to cut back to five-minute showers during the drought.

Most people won't cut back simply because the average 10-minute shower in Denver costs just 3.8 cents.

"The price is so low, you don't even pay attention to it," he said.

A month of showers — at 15 gallons a day for 31 days is 465 gallons a month — cost a total of $1.16, about the same price as one 16-ounce container of bottled drinking water from a convenience store.

The price for a month of daily showers is $2.24 in Minneapolis, in a state called the Land of 10,000 Lakes, where snow falls almost daily in the winter and springtime floods are common.

"The price (of water) is so low, you don't even pay attention to it. . . . We need to get the price of a shower up at least over a buck."

David Brookshire University of New Mexico economist

In the arid West, the price should be even steeper to curb use, Brookshire said.

"We need to get the price of a shower up at least over a buck," he said.

The reason for low prices is that utilities in the West set their rates at break-even prices, not on the normal economic principle of supply and demand.

The price of any other staple of the economy is based on its scarcity, but water bills remain constant regardless of how much water is available.

Denver Water and other utilities tacked on surcharges to curb water use last summer, and they are discussing even steeper prices this summer.

But once the reservoirs fill back up, the surcharges will come off.

Brookshire said it would take water rate increases between 278 percent and 463 percent to curb consumption, but he doubts many politicians would stake their jobs on such an increase.

Roger Bales, a research scientist at the University of Arizona, followed Brookshire's presentation with a call for better tools to forecast and measure snowfall, which provides much of the West's water supply.

He said snowpack data, which takes representational measurements from monitoring stations, can be off the mark by up to 30 percent.

Scientists also have a hard time accounting for absorption and evaporation as snow that falls in the mountains melts, runs into streams and eventually makes it into reservoirs.

However flawed the tools are for assessing how much water they will have, water managers still must rely on whatever snowpack calculations they can get each spring, he said.

"There is a tremendous demand for better information," he said.

Jill Smits, a physical science technician with the Environmental Protection Agency Laboratory in Golden, offered a $2 solution.

Seated in the audience, Smits held up a plastic bucket she uses to catch water in her shower to use on her garden.

"We're always looking for high-tech solutions," she said. "But conservation is the quickest, cheapest, easiest thing we can do."

Ralph E. Clark III
519 East Georgia Ave.
Gunnison, Colorado 81230
tel. 970-641-2907

3 July 2003
Hand Delivered

President, Board of Directors, Manager, and Attorneys
Upper Gunnison River Water Conservancy District
200 East Virginia Ave.
Gunnison, Colorado 81230

Re: For Discussion of Long Range Planning
by the District on 10 July 2003

Below are some thoughts from a personal perspective about what could now be done to develop conditional water rights held by the Upper Gunnison River Water Conservancy District.

1. Several weeks ago I provided the District with a copy of my comments made for the initial meeting for the reconnaissance study of the Colorado River Return Project or Big Straw. Of particular relevance for the Board's discussion of long range planning was reference to a book titled Megaprojects and Risk. It was published several months ago by the Cambridge University Press. One lesson from analysis of planning and implementation of projects is to first identify very clearly and measurably what is wanted by way of performance. Then the project is designed to achieve this performance at least cost. The authors note that too often in project planning a "solution" is in search of a purpose.

2. I also provided a draft assessment of many interconnected issues related to Aspinall Unit Operations. This included considerations for transmountain diversion from the Colorado - Utah state line supported by the Aspinall Unit, achieving a more natural flow or hydrograph through the Black Canyon of the Gunnison, meeting flow requirements for recovery of endangered fish in the lower Gunnison River and in the Colorado River, allowing for future water development and augmentation projects within the upper Gunnison River Basin, determining electrical power production, timing, and capacity relationships, providing for Colorado River Compact obligations, etc. This exercise also suggests measurable performance standards for a long range planning process.

3. The Taylor River Canal right was decreed with an array of possible uses, particularly domestic, municipal, and industrial. The many different kinds of future needs for water in the Upper East River could be addressed by a small diversion under this right located upstream of Almont, or below the Wapiti Ranch, and piping this water to the upper East River Valley in effect using a much shortened version of the Gunnison Ultimate Lateral Project concept presented to the District in the WET Report (1998). For example this would address anticipated water needs associated with expansion of the Crested Butte Ski Area. Over 7,000 acre-feet could be provided in a year. Current cost for water based upon the GULP proposal would be around $280 per acre-foot delivered if the District were to give 12 cfs of its 302 cfs Taylor River Canal water right to a created entity such as an improvement district which would undertake and operate the project. This cost estimate does assume the ability of generally burying the 18 inch pipeline along the highway right-of-way. Alternatively, easements for pipeline placement along the old railroad grade could also be obtained. Also assumed, as in the decree, is the exchange of water to firm up the supply over a year.

4. Future protection from downstream calls can be achieved by transfer of storage for the District's rights to the Aspinall Unit, as was contemplated in the decrees for the Upper Gunnison Project. This could be done in a manner similar to arrangements made with the Bureau of Reclamation for Pueblo Reservoir. Even at a cost of $70 plus per acre-foot per year for storage space this would be much cheaper than constructing new reservoirs to achieve this purpose. The Aspinall Unit can be operated so as to achieve increased storage capacity at virtually no cost for 100,000 acre-feet, or perhaps more, if the November and December management targets

WATERWORLD

The global scarcity of water is overblown. The real problem is sanitation

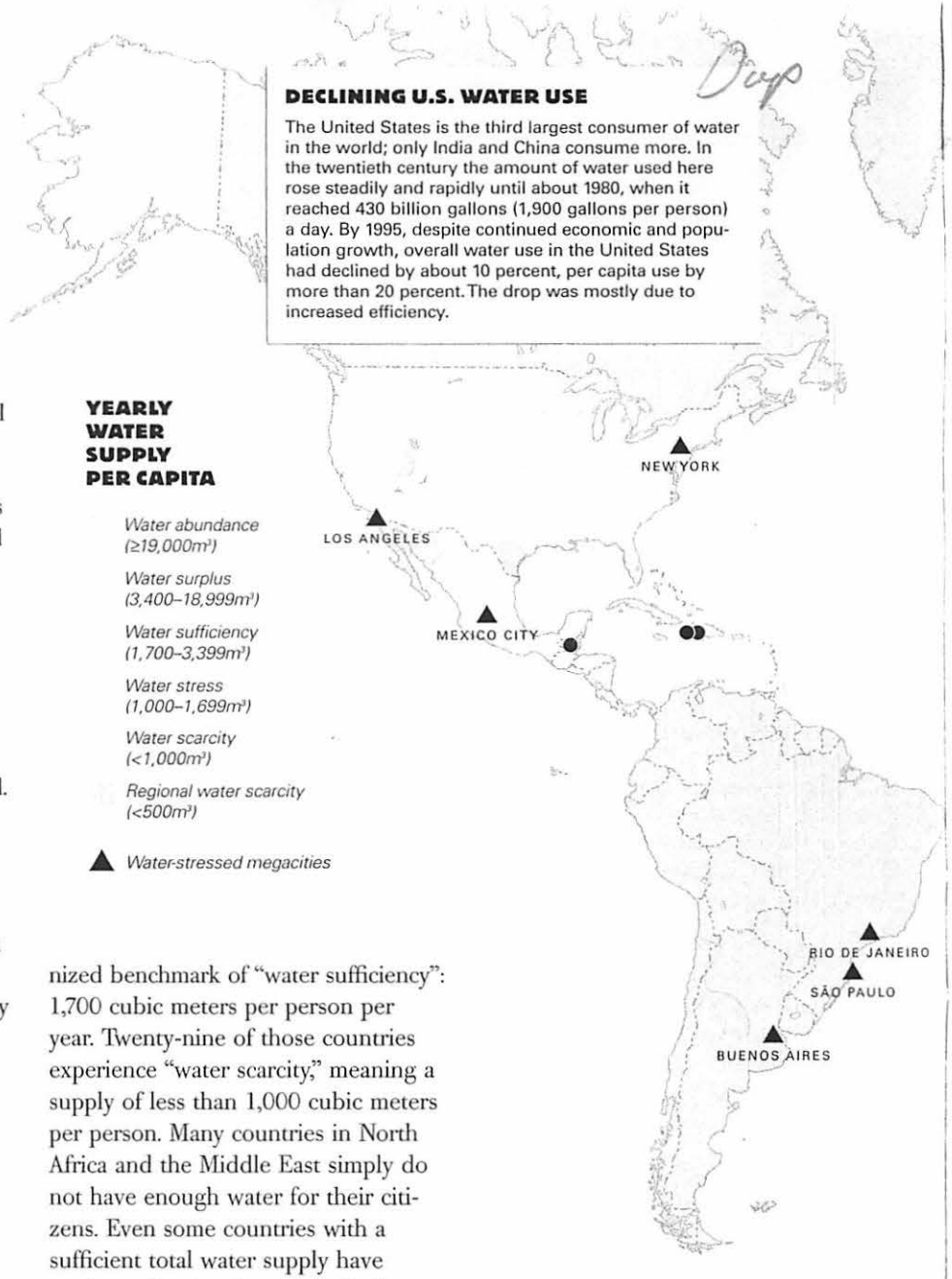
Earth is awash with 35 million cubic kilometers of fresh water. That's about 1.5 billion gallons for every person alive today. The current *effective* supply, however, is only a small fraction of that gargantuan figure. As the pie graphs at the lower left show, 68 percent of the earth's fresh water is locked up in ice caps and glaciers, and more than 31 percent is buried deep underground. Less than one percent of all fresh water on earth is easily accessible runoff—though even that tiny sliver represents about 524,151 gallons annually for each one of us.

The world's water, however abundant, is, of course, unevenly distributed. The amount of water per capita (usually described and compared using the metric system) ranges from a high of more than 10 million cubic meters per year, in Greenland, to a low of ten cubic meters, in Kuwait. As the map indicates, forty-three countries currently fall below the internationally recognized benchmark of "water sufficiency": 1,700 cubic meters per person per year. Twenty-nine of those countries experience "water scarcity," meaning a supply of less than 1,000 cubic meters per person. Many countries in North Africa and the Middle East simply do not have enough water for their citizens. Even some countries with a sufficient total water supply have pockets of regional stress, including areas with large and growing populations, like northern China.

Although the 6.3 billion people on earth today use only about 54 percent of the runoff that becomes readily available each year, those figures are expected to rise to 7.8 billion and 70 percent by 2025. This has prompted dire warnings from scientists and policymakers about an impending water shortage. But constructive steps are being taken to temper demand and expand supply—and there is room to do both. For instance, irrigation, which accounts for nearly half of all water used each year, is notoriously inefficient; in some developing countries only 38 percent of the water put to agricultural use actually helps crops grow. Even a proven but not widespread improvement such as drip irrigation could drastically increase efficiency, thereby lowering demand. On the supply side, building more dams and reservoirs could expand the percentage of runoff that is "caught" for human use; current systems catch only 12,500 of the 40,000 cubic kilometers of runoff available each year. And we haven't really begun to tap the enormous supply of harder-to-reach deep groundwater. Today we use only

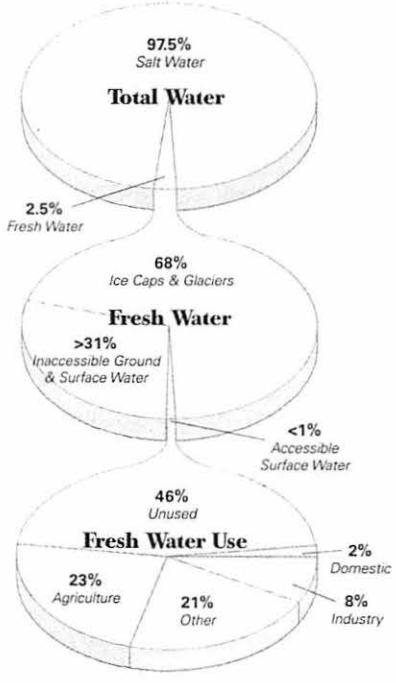
DECLINING U.S. WATER USE

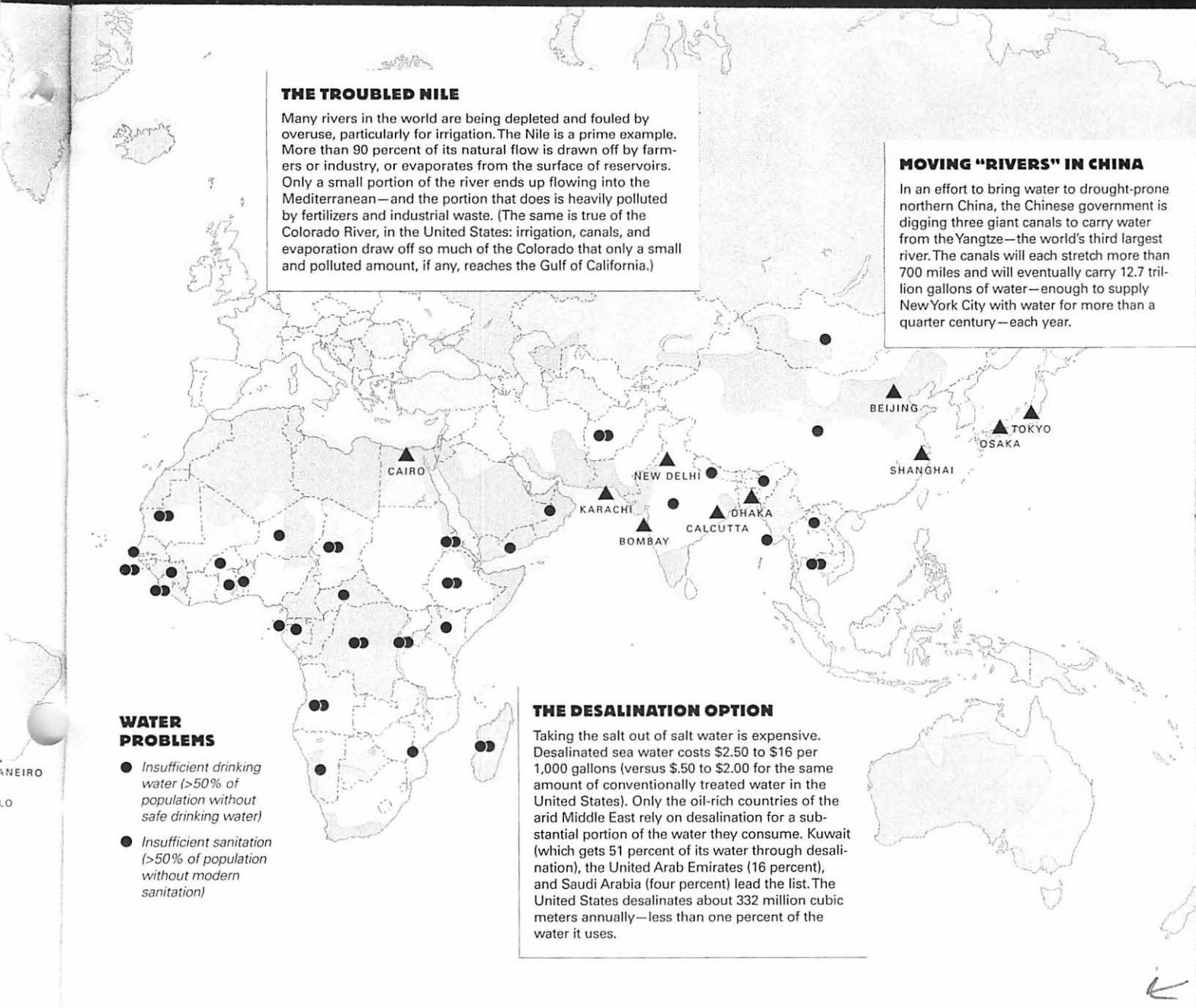
The United States is the third largest consumer of water in the world; only India and China consume more. In the twentieth century the amount of water used here rose steadily and rapidly until about 1980, when it reached 430 billion gallons (1,900 gallons per person) a day. By 1995, despite continued economic and population growth, overall water use in the United States had declined by about 10 percent, per capita use by more than 20 percent. The drop was mostly due to increased efficiency.



THE EARTH'S WATER

Where it is and where it goes





SOURCES: *WATER FOR PEOPLE, WATER FOR LIFE* (UNESCO, 2003); *THE WORLD'S WATER: 2002–2003* BY PETER GLEICK (ISLAND PRESS, 2003); WORLD RESOURCES INSTITUTE

600–700 cubic kilometers of easily accessible groundwater annually, whereas estimates put the amount of total groundwater in the earth at something on the order of 10 million cubic kilometers.

The fact is, dirty water presents a much greater and more intractable problem than water scarcity. About two fifths of the world's population lacks access to modern sanitation. Unsurprisingly, sanitation problems display a distinct geography: rural people suffer more than urban (approximately 80 percent of those who lack access to sanitation live in rural areas), and poor countries suffer more than wealthy ones. In India and China together more than 1.5 billion people live in areas without sanitation facilities.

One of the world's leading pollutants is human and animal excrement. Many countries dump raw sewage into their water supplies; poor, predominantly rural nations are often unable to clean this fouled water before people use it for bathing, cooking, or drinking. Afghanistan is worst off: 87 percent of its population lacks access to clean water. A number of African countries —including Ethiopia (76 percent), Chad (73 percent), and Sierra Leone (72 percent)—are not far behind.

Dirty drinking water causes widespread illness. More than two million people die each year from waterborne diseases, which are almost entirely preventable. The great majority of these deaths come in developing nations, among children under the age of five.

Cleaning dirty water and preventing its myriad consequences is not easy. Sewers to remove fouled water, treatment plants to clean it, and hospitals to treat those sickened by waterborne illness are expensive. And African and South Asian countries, which suffer the most from dirty water, are generally the least able to build a clean-water infrastructure. These nations don't have a shortage of water; they have a shortage of money.

—*JEN JOYNT AND MARSHALL POE*

Comparative % Inflows to Blue Mesa Reservoir
(based on 1985 report which measured flow in these inflows)

Gunnison River - 57%
Lake Fork of the Gunnison - 19%
Cebolla Creek - 17%
Soap Creek - 8%
West Elk Creek - 5%

Below 7930' elevation boat ramps in Blue Mesa are not useable 212,000 ac-ft contained.
Lynn Cudlip NPS (Feb 1985)

Critical Elevations

Blue Mesa

By December 31: 7490 feet for reduction of icing problems

By May 30: at least 7450 feet for boat access

Morrow Point

Cannot go below: 7147 feet for tour boat purposes

Crystal

Maximum elevation: 6755 feet

Full pool at bottom of spillway: 6756 feet

With 5' of head over spillway: 6761 feet

With old dock, cannot go below 6738 feet
With new facility cannot go below 6738 feet

Crystal Creek Campsite: 6765-70 feet (location of vault toilet)

TABLE 4.1 Factors to Consider When Assessing Potential Water Transfers

Type of Transfer

Change in ownership
Change in point of diversion
Change in use
Change in systems operation
Out-of-basin diversion

Primary Process for Transfer

Voluntary
Involuntary

Primary Market Forces for Transfer

Government
- Local
- State
  - Executive
  - Legislative
  - Judicial
- Federal
  - Executive
  - Legislative
  - Judicial

Affected Parties

Rural communities
- Support services
- Erosion of tax base
- Loss of natural resource base

Agriculture
- Remaining water users
- Reallocation of rights

Ethnic communities and Indian tribes
- Ethnic communities
- Indian communities
- Agricultural maintenance and expansion

Other

Environment
- Instream flows
  - Recreation uses
  - Fish and wildlife
  - Hydroelectric power
- Water quality
  - Damages to water users
  - Human health
  - Ecosystem effects
- Ecosystem protection
  - Endangered species
  - Wetlands
  - Riparian habitat
- Estuaries

Urban interests
- Intrastate transfer constraints
- Tax-exempt status changes

Federal taxpayers
- National economic concerns
- Windfall profits

Other water rights holders
- Junior rights
- Senior rights
- Loss of flexibility

Nature of Effects

Economic (national/regional)
- Lost revenue
- Lost opportunities
- New revenue

Environmental
- Instream/fish and wildlife
- Recreation
- Water quality
- Wetlands

Social
- Rural communities
- Municipalities
- Other

sion of the various scenarios. The committee supplemented its interviews with reviews of the appropriate literature and the expertise of individual committee members. The case study approach has both strengths and flaws. Its greatest strength is the honesty of the discussions; its main weakness is a necessary brevity and lack of depth.

Source: National Research Council (1992) Water Transfers In The West, National

For South Platte Basin –
Statistics show that water is reused by agriculture
2 to 2½ times before it reaches Julesburg
Exchanges do not work well says Harry Simpson of
Northern Colo. Water Conservancy District
Source: Rang Randy Marshall (1983) Governor Says
Cooperation Can Solve Water Woes
Greeley Tribune January 5, 1983 4op.

ments.[20] Generally, these economic mineral resources (called "reserves" when discovered and delineated) represent mineral concentrations that are much higher than the crustal average, although for some minerals the lowest grades (degrees of concentration) currently considered economically workable approach the average crustal concentration.[21] Extremely high capital, energy, and environmental costs make it highly unlikely, barring a revolutionary technological breakthrough, that common crustal rock will be mined for its mineral content in the foreseeable future.

Nevertheless, a large supply of mineral resources is physically available in concentrations substantially greater than the crustal average, which, although not currently economical, could conceivably become so with possible increases in price or advances in technology, or both. In the past, such developments have been responsible for the conversion of substantial quantities of previously uneconomic mineral resources into reserves for production. For example, most of the current domestic production of iron and copper comes from previously known low-grade resources that were uneconomical to produce until new mining, processing, and transport technologies were developed.[22] Extensive subeconomic resources of hydrocarbons and aluminum are known to exist in oil shale and clays, respectively, that could be developed given the appropriate economic, technological, and political conditions.

Similarly, increases in price or technological advances could lead to the development of synthetic minerals, the use of less expensive substitute minerals, exploration for deeper hidden deposits, or the mining of mine waste piles or garbage dumps (nonfuel minerals are never destroyed, but rather are recycled or disposed of after use, or dispersed as trace elements in the air, land, or water).

Thus, the location of economic mineral deposits is determined by prices, markets, technology, and time in addition to geologic factors. For society as a whole, the development and production decisions for a particular mineral deposit are not simply "this deposit or none" but rather "this deposit or (eventually) a (possibly) more expensive 1) lower grade, more deeply buried, or more geographically remote mineral deposit, 2) synthetic mineral, or 3) substitute mineral."

The situation for nonmineral resources is in some respects similar to the situation for mineral resources, and in some respects dissimilar. In contrast to the nonfuel minerals, which theoretically at least can be recovered and reused, some (but by no means all) nonmineral resources are subject to permanent loss. Examples include endangered plant and animal species, scenic landforms, and historical and archeological sites and objects. Others, such as wilderness, may take so long to recover, once disturbed, that their destruction is, in a practical sense, irreversible. Still other nonmineral resources recover or can be restored within a reasonable period of time at acceptable cost, analogous to the recovery and reuse of some mineral resources.

Many nonmineral resources are at least as limited in physical supply as most mineral resources, and subject to the same economics of more expensive, lower quality

[20] H.J. Barnett and C. Morse, *Scarcity and Growth: the Economics of Natural Resource Availability* (1963); J.F. McDivitt and G. Manners, *Minerals and Men* 10-12, 72-78 (rev'd ed. 1974); J. Tilton, *The Future of Nonfuel Minerals* 4-23 (1977); Cook, "Limits to Exploitation of Nonrenewable Resources," 191 *Science* 677 (1976).

[21] Cook, note 20, at 678; *DOI Task Force Report*, note 4, at 14-16.

[22] McDivitt and Manners, note 20, at 39-48, 72-78; see ibid., at 128 (sulfur), 148 (nickel).

alternatives. Examples include watersheds and aquifers, potential hydroelectric powersites, old-growth hardwood timber, prime agricultural land, and white-water rivers.

Thus, many nonmineral resources, like currently economic mineral deposits, are "where you find them" only in the sense that alternative sites, although physically available, are of generally lower quality and higher price. Some nonmineral resources, because of uniqueness, are, unlike mineral resources, strictly "where you find them," in the sense that alternative sites are not available at any cost. However, no generally accepted formula exists to identify uniqueness.

b. Value

The long-standing premise that mineral activity is **always** the most valuable use of a tract of land is no longer widely accepted. It was based originally on the high net value of high-grade surface or near-surface mineral deposits in relation to the generally low or minimal commercial land values of the arid, remote, and unpopulated western regions. Today, however, two sets of factors undermine this premise.

First, many, if not most, mineral deposits being discovered today are of much lower grade and are located at greater depth than mineral deposits discovered in the past. They are thus more expensive to find and mine than the high-grade surface deposits formerly developed. As a result, the net value of many deposits being discovered today is lower than the net value of deposits worked in the past.

Second, major changes have occurred on the nonmineral side of the balance sheet. For example, today almost all the consumable nonmineral resource stocks (such as timber, forage, game, and water) are scarce as a result of the increase in demand for such resources and the decrease in the land base from which they are obtained, brought on largely by growth in population and the economy.

Furthermore, increased understanding of ecological processes, together with shifts in private and social values, has led to recognition and appreciation of a host of nonconsumable resource uses and values. There is a large and growing demand for various types of outdoor recreation. To illustrate, in 1976, there were close to 10 million visits to the Great Smoky Mountains National Park. Well over 2 million people a year visit Yosemite Valley in Yosemite National Park. These and other national parks clearly have a very high recreational and esthetic value.

Besides recreational and esthetic values, a natural ecosystem provides stocks of fish, animals, and plants for scientific study and research. It was estimated in 1967 that approximately half of the new drugs currently being developed are obtained from botanical specimens.[23] For example, very recently, a wonder drug for viral diseases was developed from the nucleosides of a Caribbean sponge.[24] The genetic diversity provided by ecosystems thus has immediate substantial practical benefits as well as longer range evolutionary importance.

An ecosystem also provides functions or services that produce tangible benefits without any necessity for direct intervention or use:

[23] Krutilla, "Conservation Reconsidered," 57 *Am. Econ. Rev.* 777, 780 (1967).

[24] Cohn, "Drug Treatment for a Virus is Hailed as 'Major Advance,'" *Washington Post*, Aug. 11, 1977, at A1, A25.

Source: Office of Technology Assessment (1979) Management of Fuel and Nonfuel Minerals in Federal Land, OTA-M-88 U.S. Government Printing Office, Washington D.C., 435 pages

> [These functions] include the absorption and breakdown of pollutants, the cycling of nutrients, the binding of soil, the degradation of organic waste, the maintenance of a balance of gases in the air, the regulation of radiation balance and climate, and the fixation of solar energy—the functions, in short, that maintain clean air, pure water, a green earth, and a balance of creatures; the functions that enable humans to obtain the food, fiber, energy, and other material needs for survival.[25]

Estimates of the value of just a portion of these functions include $83,000 per acre for the water purification and fisheries functions of a wetland (not taking account of other functions such as sulfate reduction, carbon dioxide fixation, oxygen release, and waterflow support) and a minimum of $784 per acre for the ground water storage, soil binding, water purification, and streamside fertilization functions of a Georgian river-swamp-forest.[26]

Finally, apart from any direct use or tangible benefit, many persons attach a value to the preservation of an option, for themselves or others, to view or use a unique resource in the future, or just to know that it is there. The existence of such an "option demand" value is demonstrated by their willingness to give money to nature preservation and conservation organizations, which use the money to protect resources most contributors never expect to see themselves.[27]

When all the mutually consistent consumable and nonconsumable nonmineral resource uses, scientific and evolutionary values, ecological functions, and option preservation values of a tract of land are considered, the value of the mineral resources in the tract may be outweighed by the temporary and permanent losses in nonmineral resource uses and values that would result from developing the mineral resources, even when the social value of a secure domestic mineral supply is added to the private value of the deposit to a mineral producer. An obvious example is a low-grade surface deposit of coal under a skyscraper. A more controversial example is an actual calculation made for a low-grade molybdenum deposit in a highly scenic mountain range.[28] The automatic assumption, in every case, of a higher value for the mineral resource can lead to inefficient resource use, even though a rich mineral resource may outweigh the nonmineral resource values in most areas.

The difficulty of balancing mineral and nonmineral values should not be underestimated. No general formulas can be given. Each case, each site is different. The methodologies for valuing nonmineral resources vary widely in the acceptance they command. Some nonmineral resource values are calculated by established methods with wide acceptance—e.g., those for the commercial value of agricultural and grazing lands and timber resources. Others are valued by methods still being developed but having reasonable scientific and economic bases—e.g., those used to calculate the $83,000-per-acre valuation placed on the water purification and fisheries function of a certain wetland. (See footnote 25.)

The valuation becomes more difficult and more subjective when the nonmineral value is based more upon recreational use and especially so when esthetic and wilderness considerations are taken into account. Great Smoky Mountain National Park, for

[25]Westman, "How Much Are Nature's Services Worth?" 197 *Science* 960, 961 (1977).
[26]Ibid.
[27]Krutilla, note 23, at 780-781.
[28]Krutilla and Fisher, *The Economics of Natural Environments* 151 (1975).

example, would clearly command a very high value, but the value of a remote scenic area, an area of unconventional beauty, or the preservation of an option cannot, at present, be quantified in a way that wins agreement. Indeed, it is likely that such valuations will remain highly subjective and rooted in much larger value systems.

Nevertheless, it is clear that the values of many people in the United States have been changing in favor of nonmineral resource uses as opposed to particular mineral activities. These changing values are partially responsible for increased withdrawals of Federal land from mineral activity that, together with other restrictions, are making it increasingly difficult to explore for and develop minerals on Federal land (see section G). This trend may have serious adverse consequences on the domestic mineral industry and, after a deceptive lag of 10 to 20 years (during which time currently known and available mineral deposits are brought into production but few new deposits are discovered and developed for eventual production), on the U.S. mineral posture in an increasingly tight international minerals environment.

4. The Land Management Dilemma

Land management and planning must proceed on the basis of existing information. This will almost always be deficient with respect to the mineral resources of a tract, as most mineral deposits, unlike almost all nonmineral resources, are hidden beneath the surface. One of the principal goals of Federal land management, therefore, should be to improve such management by obtaining better mineral resource information.

But mineral resource information can be obtained only through exploration, which is both costly and risky. A single mineral exploration project involving the search for only one mineral occurrence type can cost several tens of millions of dollars and yet stand an 80 percent or greater chance of failure to discover significant mineralization (see chapter 2). Clearly, neither Federal land management agencies nor private industry can afford to obtain mineral information that would be adequate for each once-and-for-all, mineral-versus-nonmineral land use decision.[29] Unless practically every cubic foot of land in a particular tract has been excavated and analyzed, we can never be entirely sure of its mineral content. Land in Arizona once classified by the U.S. Geological Survey as not known to be mineralized was later found by drilling through the overburden to be underlain by major copper deposits, and many ore bodies have been discovered in areas previously explored and rejected by others.[30]

An obvious alternative to possible once-and-for-all, mineral-versus-nonmineral land use decisions based on inadequate knowledge of the mineral resources is to leave the land open to mineral exploration so that the existing land use designations can be constantly reappraised in the light of whatever mineral information is produced. But, given the risks and costs of exploration, private firms will invest in exploration only if they are given reasonable assurance that they will be allowed to develop any mineral deposit they discover. If such assurance is provided, the land use decision has been

[29]See O. C. Herfindahl, *Natural Resource Information for Economic Development* (1969).
[30]Bailly, "The Problems of Converting Resources to Reserves," *Mining Eng.*, January 1976, at 1, 3-4.

FERC
Headwaters Benefit Energy Corp
and model "HW BEG" p 6
FDA methodology assistance
FDA(?)

Southern Cal Ed. 22 Apr 96
P.6/4 of 4

N.M. wants water rights near Colo. border

By The Associated Press

SANTA FE — Santa Fe County, seeking additional water to serve developments south of Santa Fe, wants to buy 1,200 acre-feet of Rio Grande water rights from a farm near the Colorado border.

The price: $1.3 million.

The money would come from property taxes. Voters last November approved a general obligation bond that includes $4 million for water projects.

The county has asked the state engineer for permission to use the rights in order to draw up to 588 acre-feet, nearly 200 million gallons of water, out of the Rio Grande.

The city and county hope eventually to begin diverting water directly from the river at a point upstream on San Ildefonso Pueblo land.

The county's bid to deliver additional river water through its own utility lines is part of a shift away from relying on ground water, which hydrologists said is being depleted.

Many environmentalists applaud the move toward using surface water.

"Planners are recognizing that aquifers should be used primarily for water storage for emergencies and times of drought and that surface water should be the primary source," said Doug Wolf, an attorney with the New Mexico Environmental Law Center.

But some conservation groups worry that cities and counties eventually will come to rely too heavily on the river, diminishing its flow and harming habitat for endangered species.

The cumulative effect of cities and counties' long-term plans to divert the Rio Grande would amount to "taking a small mountain stream's worth of water out of the Rio Grande," said Brian Shields of Amigos Bravos, a Taos-based environmental group.

"It would be a major loss to the river," he said.

The rights from the Top of the World farm would represent a doubling of the amount of water in the county's water bank.

But, compared to other potential diversions, the county's proposal is relatively small.

Albuquerque claims rights to 55,000 acre-feet of imported San Juan-Chama water.

And the Middle Rio Grande Conservancy District, a group of farmers in central New Mexico, is claiming rights to 350,000 acre-feet of imported water.

"If all that water is diverted, we're not going to have a river," Shields said.

Page 2A Monday, June 23, 2003

WATER / continued from page 1A

Recreational uses and water quality are two concerns that are getting more attention every year, and the increased regular flow and erosion on the Fountain Creek is another important issue, he said.

He predicted that water quality will be the next big fight in the never-ending Kansas v. Colorado lawsuit, and said, "If you thought the (damages) numbers were big on the quantity issue, I'm telling you the quality issue will have the same impact that the whole environmental movement brought in the 1960s."

Broderick said water resource planning is more important than ever as the region grows. "Colorado Springs' plan for its Southern Delivery System pipeline is a short-term goal," he said. "Everything I'm talking about is long-term."

The PSOP came up several times during the board meeting. Terry Scanga of the Upper Arkansas conservancy district said towns in Chaffee County want to work out a way to move their storage under PSOP to upstream reservoirs from Pueblo. Pat Edelmann of the U.S. Geological Survey said his agency is working on the water-quality monitoring aspect of the plan, with five gauges from Portland to Avondale.

The group planning the Arkansas Valley Conduit — authorized in the original Fry-Ark legislation but never built — asked Southeastern to be the contractor on their proposal. Five Southeastern members were appointed to a special committee on the conduit to work with the Otero County Water/Works committee. They will meet July 1 at the Otero courthouse in La Junta.

Storage plan hot water topic for summer

Water quality may have as big an impact as the environmental movement had in the 1960s, an official says.

By MARGIE WOOD
THE PUEBLO CHIEFTAIN

The Southeastern Colorado Water Conservancy District's Preferred Storage Options Plan, which involves changes in the operation of the Fryingpan-Arkansas Project and possible enlargement of two reservoirs, is the subject of intense negotiations as spring turns to summer.


James Broderick

Earlier this month, a delegation from the conservancy district and cities of Colorado Springs and Aurora went to Washington, D.C., together to talk to congressmen and the Bureau of Reclamation.

"We thought it would be good to have all of us talking to them at the same time," said Southeastern's lobbyist, Ray Kogovsek. "We had good discussions with our Colorado representatives, Commissioner (John) Keys and staff members of committees. We invited them to Colorado for a tour and they accepted."

Southeastern's general manager, James Broderick, said the district's PSOP implementation committee will start meeting again in August. Specific issues will include a memorandum of understanding that will enable Reclamation to begin the environmental studies involved in the reoperation, he said.

Broderick also gave a motivational talk about the Fry-Ark's future from his perspective after six months at the district. He arrived after the district had been through a year of battles over Aurora, the Fry-Ark plans and a battle between Colorado Springs and Pueblo over a flow guarantee through the city — all positions baked hard by the terrible drought of the summer.

"I believe it's time for all the communities along the river to stop and take stock, so that we don't make decisions we'll regret in 50 or 100 years," he said. "We all live in this valley and we all have to talk about the whole watershed. We need a new vision to deal with changed issues, and it will require the willingness of all parties to work for a plan that will satisfy all parties."

PLEASE SEE WATER, 2A

Tamarisks

Continued from Page 1B

The cost of removing tamarisks is estimated at $250 per acre. Stark noted, "The land's not worth that much, but the water is." The Pecos project estimated that tamarisk control after four years brought the cost of water saved down to $6.35 per acre-foot.

In addition to the federal legislative effort, Carlson is preparing a presentation for the Colorado Water Board and the Water Users Association.

Gov. Bill Owens' executive order to eliminate tamarisks will help, Carlson said there is some state money budgeted for that goal this year, and working with the Department of Natural Resources to plan and interweave federal plan."

County commissioners endorse special domestic water district

By Jennifer Kostka
Herald Staff Writer

La Plata County commissioners decided to stay out of the domestic water business in the southeast corner of the county, but they endorsed a plan for residents to form their own special district to provide domestic water.

The commissioners approved a position statement regarding the development of the system in southeastern La Plata County at their business meeting Tuesday. The statement says the county does not want to form a county-managed system, but it will support residents who want to form a water district with a board of directors and a taxation system.

"It is our belief that whether a domestic water system should be developed should rest with the voters in the area to be served," the statement reads. "Therefore, we have encouraged proponents of the water system to pursue the establishment of a special district to provide this service."

The district could serve about 1,500 residents.

Last year, the county funded

See Water, 13A

THE DURANGO HERALD
Since 1881
Winner of the 2003 Sigma Delta Chi Award for Public Service

The First Amendment: Congress shall make no law respecting an establishment of religion, or prohibiting the free exercise thereof; or abridging the freedom of speech, or of the press; or the right of the people peaceably to assemble, and to petition the Government for a redress of grievances.

Water

The West was not meant to be brilliantly green

Every morning lately, residents of Southwest Colorado have been peering out their windows to determine whether clouds or haze are responsible for the muted light. Every morning lately, they have seen copper-colored skies carrying the smoke from western fires and the dust from drought-parched landscapes.

It has been weeks since the few clouds gathered to produce a worthwhile rainstorm. That is a mixed curse. The monsoons often bring more lightning than rain, and lightning is the last thing we need this year. Rain, though, we do need. All eyes are on the west, and so far, the western horizon has been brown, not cloudy. Disappointing as that may be, it is pretty normal.

Meanwhile, a study recently released by Utah State University says many people in the dry, dry West are overwatering their awns. In fact, says the *Deseret News*, some are pplying more water than falls in a rain forest, et alone a desert. One Salt Lake City restau-ant, with an automatic sprinkler system, was sing 300 inches of water on its lawn. In the nore affluent neighborhoods of the Salt Lake rea, some homeowners were applying as nuch as 200 inches.

The average lawn, the Utah State Universi-y says, needs about 30 inches of moisture a ear, which is about twice what falls natural-y in Salt Lake City, and more than half again as much as Durango gets. High-traffic blue-grass lawns take more; drought-resistant grasses take less, and a well-known (and per-haps even accurate) formula suggests that an inch of natural rainfall is worth several appli-cations of city water. Even in a drought year, that means we need to apply, at most, 2 feet of water rather than 25. Slow, infrequent water-ings encourage deep root growth; too much water just encourages grass to need too much water.

Roger Kjelgren, the Utah State professor who helped with the study, is critical of water-ing restrictions that prevent homeowners from watering between 10 a.m. and 6 p.m. They may not leave enough time for people to water responsibly in the evening, he suggests, and the result may be sprinklers that are left on all night.

That may be true, but surely the answer is more education rather than fewer restrictions. Watering restrictions do reduce water use and give utility officials a way to address individ-ual cases of overuse. We simply do not have enough water for everyone to use more than they need.

Pay attention to how much water goes on the lawn. A green lawn is visually pleasing, and it helps keep nearby buildings cool, but it is an amenity, not a necessity. This year – and, in fact, most years here in the arid West – it is a luxury we may not be able to afford.

C

State Land Board

Governor predicts water bonds will pass

Referendum A will ask voters to approve up to $2 billion to finance dam, reservoir and water delivery projects.

By TOM McAVOY
THE PUEBLO CHIEFTAIN

DENVER — Gov. Bill Owens predicts that a $2 billion water bonding referendum will pass on Colorado's Nov. 4 ballot statewide, even on the Western Slope despite early opposition there.

Owens said he will campaign for Referendum A and try to dissuade Club 20, a politically influential group on the West-ern Slope, from opposing it.

Club 20's natural resources committee voted 25-5 against the water-projects proposal on Monday, although it was just a recommendation to the Club 20 board of directors.

The governor said Club 20

Water: Plan must be OK'd by commissioners

Continued from 1A

a study to examine the possi-bilities of providing domestic water to southeast La Plata County. Hired consultants rec-ommended a variety of op-tions, including setting up the special district. They also rec-ommended that the county manage the domestic water system. However, the plan to set up an entity to be controlled by the county was dropped.

The commissioners decided it was in the best interest of the res-idents to form their own district – a more common governing structure for water systems in Colorado.

A citizens' group of about 12 people has been meeting once a month to piece together a district service plan. Steve Harris with Harris Water Engineering has been working with the group and spoke as its representative to commissioners. Harris said the people who live in the area are happy with the commissioners' decision to support a special dis-trict.

The district's southern bound-ary would be the New Mexico state line and its eastern bound-ary the Archuleta County line. The northern and western boundaries have yet to be decid-ed, Harris said.

The district service plan must be approved by county commis-sioners and a district court judge before residents in the district can vote on it. The earliest date for an election is May 2004. It could be 20 years before the wa-ter system is completed, Harris said.

Michael Scannell, La Plata County manager, said the coun-ty's position does not mean it is abandoning the development of domestic water systems.

"The board (of commission-ers) does stand ready to assist in whatever ways it deems appro-priate," Scannell said at the meeting Tuesday.

The county has been working with the U.S. Department of Agriculture Rural Development to ensure that a finance package the federal agency offered to help pay for the water system would be available to the district.

The USDA originally offered the $8 million package to the Vallecito Water Co. when it was attempting to develop a water system. The package includes up to $2 million in federal grant money and $6 million in federal loans. The agency informed the county that it is willing to hold the funds for a new entity as long as plans for the system con-tinue to progress.

Joe Brown, superintendent of Vallecito Dam, said he supports the idea of a special water dis-trict for southeast La Plata County.

"This could be the best way," Brown said. "It is certainly nec-essary for people out in this area to have water that's dependable."

Reach Staff Writer Jennifer Kouba at jennifer@durangoherald.com.

Aurora files application for High Line Canal water

By MARGIE WOOD
THE PUEBLO CHIEFTAIN

Aurora has filed an applica-tion with the state engineer to lease about one-third of the water owned by shareholders of the High Line Canal, proposing to purchase about 37 percent of the ditch water for the remain-der of this year and 2004.

Aurora's water lawyer, John Dingess, indicated the city will apply for a renewal of the "sub-stitute water supply plan" for 2005. Aurora plans to take the water out of the Arkansas basin at its Otero pump station near Buena Vista, through exchanges with the Bureau of Reclamation.

Farmers under the High Line voted overwhelmingly in late April to approve a bylaws

PLEASE SEE AURORA, 2A

National coalition targets tamarisks

By MARGIE WOOD
The Pueblo Chieftain

East is East and West is West — and they both want to eliminate tamarisks from Colorado's river basins. That fact has built the Grand Junction-based Tamarisk Coalition to 300 member organizations from California to Texas, according to the group's executive director, Tim Carlson.

Carlson gave a presentation to the Southeastern Colorado Water Conservancy District on Thursday afternoon and planned to repeat it in Lamar a few hours later.

There are several reasons to get rid of tamarisks, also called salt cedars, Carlson said. But the one that's bringing the issue to public attention now is that "tamarisks steal water."

Throughout the Western states, tamarisks are estimated to have invaded 1 million to 1.5 million acres of land, and the amount of water they are stealing is estimated at 2 million to 4.5 million acre-feet a year more than native trees and plants would use, Carlson said. That amount of water could support 20 million people or irrigate 1 million acres or more.

Chieftain photo/Chris McLean

Tamarisks are in bloom along the Arkansas River near Valco ponds west of Pueblo.

There are various ways to kill tamarisks, depending on other circumstances in particular areas.

On the Pecos River in western Texas, helicopters sprayed herbicide with good results because the tamarisks were the only plants left. In other areas, heavy equipment is used to chop the trees into mulch where native plants can then be seeded.

Whatever method is used, follow-up is needed for three or four years to keep the stumps, roots or seeds from coming back, Carlson said.

The current drought has put tamarisks in a political spotlight, and U.S. Sen. Peter Domenici of New Mexico is sponsoring a bill with $50 million in funding for pilot projects.

James Broderick, Southeastern's general manager, said he already has written to Domenici asking for the district to get one of the demonstration projects. He added that he will make the same request of Interior Secretary Gale Norton as part of her Water 2025 initiative.

"The timing is really good right now, because everybody's coming up with a new deal to solve western water concerns," he said. "I hope we can do something for the whole Arkansas basin in concert with the Water 2025 plan."

Mark Stark, superintendent of John Martin Dam, suggested that Broderick draft another letter appealing for support from neighboring states. "We have river compacts with all these states, so we should try to get regional support for the idea of a panel that could draw all the federal resources into one effort," he said.

Please see Tamarisks, Page 2B

Greeley not planning to relax watering limits

WATER
FROM PAGE A1

80 percent of maximum reservoir storage capacity," said Greeley Water and Sewer Director Jon Monson.

But even with snow in the mountains and water in the buckets, Greeley officials aren't about to relax watering restrictions. Elsewhere, cities such as Boulder and Westminster have lifted restrictions as precipitation poured in. Windsor has said it will consider relaxing its once-a-week watering restrictions.

Greeley leaders say doing that here would be unwise. For one thing, climatologists predict that the hot, dry spell will last another year or so, despite the wet spring. That means free-for-all watering this summer could leave the city with low reservoirs when it needs the water most.

Water managers also worry that rivers and reservoirs could be lower than expected if dry soil sucks up the runoff or the weather turns dry and hot.

Greeley probably won't know how much snowmelt will wind up in the rivers until next month.

In the meantime, hard lessons have shown that counting on water in Colorado is a lot like counting an unhatched chicken.

Last spring, the Greeley Water and Sewer Board agreed to lease city water to area farmers. The board later expressed regret at that decision when it learned of skimpier-than-expected snowmelt yields.

This year the unpredictability of water snagged the city again.

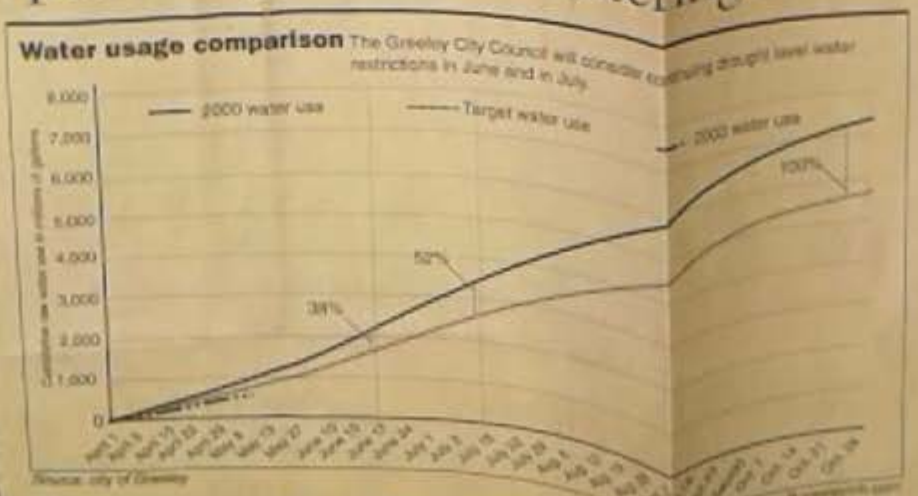
The city spent $885,000 to lease 2,000 acre-feet of water from farmers in March. Then came a string of snow and rainstorms.

Monson said if he had a choice, he wouldn't lease the water today. But the [illegible] isn't going to waste, Monson said. It is helping to fill depleted reservoirs.

And there's plenty to fill. Horsetooth Reservoir is still a "big hole" in the ground, the city said. Officials say large reservoirs such as Granby could take years to refill.

[illegible] contributed to this report.

Water usage comparison The Greeley City Council will consider [illegible] drought level water restrictions in June and in July.



Source: City of Greeley

MONTHLY WATER BILLING

A new once-a-month water billing system should help residents keep better tabs on water use, officials say. The previous system of billing once every two months meant customers had to wait longer to find out about water waste caused by problems such as hidden leaks.

Greeley budgeted about $90,000 to convert the billing system to once a month, hire a new billing clerk and pay for the extra postage costs for the remainder of the year.

The city will spend about $55,000 a year for postage under the once-a month billing system compared to about $47,500 that it costs to bill every two months.

The city converted to once-a-month billing to help with cash flow and to give better water-conservation benchmarks. Once-a month billing is also expected to reduce the number of delinquent accounts, said City Manager Leonard Wiest. That's because bills for a single month are more manageable than bills for two months worth of water.

Water limits will stay

Greeley on way to meeting savings goal

BY JESSE FANCIULLI
fanciulli@greeleytrib.com

Mother Nature has been acting as if she pays a water bill.

Rain or snow has been falling on Greeley lawns this spring just about every weekend, which are designated watering days for most residents.

That means many residents have been able to delay turning on the sprinkler system or are using less water.

Citywide, the heavy spring moisture and residents' conservation efforts have Greeley well on its way to meeting the water-savings goal of 5,000 acre-feet for the summer. An acre-foot is about enough to serve two households for a year.

Between April 1 and May 31, water customers used 1,809 acre-feet less water than they did during the same period in 2000. The goal was to save 1,051 acre-feet during that time period, or 22 percent of the goal. The 1,809 acre-feet amounts to a 38 percent savings.

And there's more good news.

The average statewide snowpack was 87 percent of average May 1, compared to just 19 percent of average last year.

Snowmelt provides 80 percent of the water in Colorado's rivers and reservoirs.

● Comparisons to years past / A8
● Monthly watering bills / A8

Two nonmountain reservoirs that supply water to Greeley, Lake Loveland and Horseshoe, are already full, said Greeley City Manager Leonard Wiest.

"We are really pleased with what's happened so far. We're a little bit over

SEE WATER, PAGE A8

Towns, cities now working on water-use agreements

By THE ASSOCIATED PRESS

DENVER — Once at odds over water use, Front Range cities and mountain resort towns across the Continental Divide are forming cooperative agreements to meet future needs.

During the next 30 years, nearly two dozen fast-growing towns in Summit and Grand counties will face water shortages as Front Range cities take an increasing amount of water to feed their own growth, a new study concluded.

Rather than prompting another water war, however, the governments involved are working on compromises.

"The days of saying, 'It's our water, we're going to take it' are over," said Denver Water Board member Andrew Wallach.

Denver Water and the Loveland-based Northern Colorado Conservancy District are expected to take billions of gallons of Western Slope water in the decades to come. They have owned the water for years but never needed it.

"This is about allocating the last drop," said Dan Luecke, former regional director of the Environmental Defense Fund.

The new study by Boulder-based Hydrosphere and funded by the Colorado River Water Conservation District, says that without quick solutions, Dillon Reservoir's levels could fluctuate more often; water quality could deteriorate as stream flows drop and contaminants become concentrated; and rivers may not be able to support boating and fishing at times.

The study said to solve the problems, water deals involving utilities, ski resorts and mountain towns are likely to emerge.

State officials this week released projections pointing to a Colorado population of 7.15 million, up from the current 4 million, by 2030, and the second fastest growing region will be the central mountains.

Grand County's water needs are expected to quadruple in the next 30 to 50 years, the report said. In Summit County, it projected water use would more than double.

"It's scary," said Ed Moyer, planning director for Winter Park.

"You'd think living next to these pristine headwaters, there would be a lot more water. But there isn't."

On average, 42 percent of the natural river flows in Summit, Grand, Eagle and Pitkin counties are diverted to the Front Range, according to an analysis by the Northwest Colorado Council of Governments. In the next 30 years, average river diversions from the four counties is expected to jump to 60 percent.

In Grand County, officials have had preliminary discussions about cutting back development.

Front Range water utilities have vowed to help meet the needs of mountain counties, and ranchers in Grand County are discussing selling agricultural water rights to help fill new reservoirs.

"We're going to look at every idea," said engineer Don Carlson.

Waterway cleanup pricey, says study

By Philip Brasher
The Associated Press

WASHINGTON — Cleaning up the nation's lakes and rivers won't come cheap. Getting farmers to cut back on their fertilizer use, a major source of water pollution, could cost taxpayers nearly $3 billion a year, the government says.

The $3 billion represents the annual cost of "green payments" to compensate farmers for income losses they would incur in reducing their use of nitrogen fertilizer 20 percent, according to a study being published in May by the Agriculture Department's Economic Research Service.

The study comes as the Clinton administration is taking steps aimed at curbing farm runoff into waterways.

Nitrogen releases from Midwest farms are blamed by government scientists for creating a "dead zone" as big as New Jersey in the Gulf of Mexico. A recent White House study concluded the best ways to repair the damage are reducing fertilizer use by 20 percent and restoring 5 million acres of wetlands to trap runoff.

The Environmental Protection Agency has proposed rules that would require states to submit plans within 15 years to clean up every waterway that fails to meet water-quality standards. The EPA estimates that more than 20,000 streams and lakes don't meet water-quality standards, including long sections of the Mississippi and Colorado rivers.

The Agriculture Department's study considered several ways of getting farmers to reduce their use of fertilizers.

- The green payments, which would compensate growers for the lower crop yields they would get.
- A 75 percent tax on fertilizer, which would raise an estimated $3.3 billion a year, or regulations limiting fertilizer use. Neither idea is considered politically feasible, given the impact on growers.
- A land-retirement program. Farmers would be paid $1.6 billion a year to take land out of production and to plant strips of grass and trees along waterways to prevent chemical runoff.

Idling land would increase commodity prices more than any of the other options, the study said. That, in turn, would drive up feed costs for livestock producers about 2 percent and raise the cost of food to consumers by 0.7 percent.

"No one policy will satisfy all stakeholders," the study said.

Farmers find cities ready to pay for water

The Associated Press

DENVER – Experts say Colorado is far from out of the woods when it comes to drought, and they expect a new state law to make it easier for farms and cities to make deals on water use.

In March, Fort Collins agreed to pay nearly $1 million in a deal that allows about 400 farmers to lease their water rights to the city for a year. The agreement, with two irrigation companies, means farmers will earn up to $40,000 each for a lease that has nothing to do with their crops.

"You could realize more income out of renting your water," said Gary Simpson, president of North Poudre Irrigation Co.

A wet spring and March blizzard left some farmers with unexpected irrigation water. But reservoirs statewide remained at just 45 percent full on average at the end of May, according to the Natural Resources Conservation Service.

"Yes, we are still in a drought," said Jack Byers, deputy state engineer. "Yes, we still have issues with water supply."

Gov. Bill Owens signed a law in early June to create statewide water banks. The law is intended to make it easier for farmers and ranchers to temporarily loan, lease or exchange their water rights without losing rights to their land.

It used to be common for cities to lease excess water rights to farmers, but the drought and the region's growing population have turned things around these days.

Before the drought, it would cost about $25 per acre-foot to rent water rights; now, the price is $300 to $500, said Ted Carlson, a broker with Austin & Austin Real Estate, a Greeley firm that handles farms and ranches.

An acre-foot is about 326,000 gallons, enough water to cover 1 acre of land with 1 foot of water.

JoAnn Baland, 71, who farms near Wellington, said she leased her water rights to Fort Collins after the drought sent crop yields plummeting last year and forced her to sell nearly all her cattle for lack of feed.

Yet she sold the rights reluctantly because she thinks sending water to cities signals the end of agriculture along the fast-grown Front Range.

"We're like dinosaurs," Baland said. "We're a dying breed."

TONJA TWICHELL, CITY EDITOR, 303.892.[illegible] E-MAIL:

80

Mountain towns know it's do or dry

As growth strains water supplies, deals to be crucial

By Jerd Smith
ROCKY MOUNTAIN NEWS

Colorado's crown-jewel mountain resorts — Winter Park, Lake Granby, Dillon, Keystone and Copper Mountain — have just about everything, except enough water.

During the next 30 years, nearly two dozen fast-growing communities in Summit and Grand counties will face water shortages as Front Range cities siphon off larger and larger amounts to quench their thirsts, according to a new report.

Is there a water war in the offing? Surprisingly, no. Drought-weary Front Range cities that have spent millions on legal fees in the past are loathe to waste precious time in court.

"The days of saying, 'It's our water, we're going to take it' are over," said Denver Water Board member Andrew Wallach.

Instead, Western Slope and Eastern Slope water experts have been meeting for months, studying water supplies and trying to determine in advance how everyone's needs can be met.

"We've all had a lot of trust-building to do," said Taylor Hawes, a water specialist at the Northwest Colorado Council of Governments, which represents the mountain counties.

Denver Water and the Loveland-based Northern Colorado Conservancy District will move billions of gallons of water across the mountains in the decades to come — water they've owned for years but never needed.

"This is about allocating the last drop," said Dan Luecke, a water expert and former regional director of the Environmental Defense Fund.

The new study, conducted by Boulder-based Hydrosphere and funded by the Colorado River Water Conservation District, Denver Water and the Northern Colorado Conservancy District, among others, previews a number of potential water problems if solutions aren't found quickly:

- Levels in Dillon Reservoir could fluctuate more often, hampering boat ramp and marina operations.
- Water quality could worsen as stream flows drop and contaminants become more concentrated.
- In-stream flows may not support kayaking and fish at times.
- Breckenridge and Copper Mountain golf courses could run short of water.
- Water for snowmaking at Arapahoe Basin, Keystone and Copper Mountain and Winter Park could be in short supply.

To solve these and other problems, a slew of water deals involving water utilities, ski resorts and mountain towns are likely to emerge, as Colorado looks for ways to keep its people in water.

"We're looking at partnerships

Flip to WATER, page 12A

High country boom

Population in the central mountain resort belt is projected to more than double by 2030.

Year	Estimated population
2000	147,334
2010	180,718
2020	240,840
2030	308,287

Source: Colorado state demographer

River-water diversions to Front Range*

Counties displayed were the focus of an intergovernmental study

Source: Northwest Colorado Council of Governments
*Future diversion estimated based on growth forecasts

ROCKY MOUNTAIN NEWS

■ **More online:** For previous stories about the effects of Colorado's drought, visit **RockyMountainNews.com.**

SATURDAY, JUNE 21, [illegible]

Water: 'Demand way overstated'

Continued from 4A

that have never been done before. It's exciting," said Grand County Commissioner James Newberry.

Not everyone believes the high-country water shortages are as serious as those outlined in the four-year study.

"Frankly, I think there are errors there," said Glenn Porzak, a water attorney who represents Keystone and Breckenridge resorts, among others.

Porzak said the shortages are based on development forecasts that may be too high. "Future demand is way overstated," he said.

According to a report issued this week by the state demographer, Colorado's population will hit 7.15 million by 2030, and the second-fastest-growing region will be the central recreation-belt counties.

And no one argues that these mountain communities are growing at a staggering rate. Summit County added nearly 11,000 new residents between 1990 and 2000, an increase of 83 percent. Grand County added nearly 4,500, a 56 percent jump, according to the U.S. Census Bureau.

Forty years ago, Denver, Fort Collins, Aurora and Colorado Springs were diverting vast amounts of water, but it went almost unnoticed because the mountain counties had minimal water needs.

That's no longer true. Grand County's water needs are expected to quadruple in the next 30 to 50 years, from 3,100 acre-feet to more than 14,300 acre-feet, according to the new report.

In Summit County, water use is expected to more than double, to 17,900 acre-feet from 8,500 acre-feet.

The irony isn't lost on mountain town residents, who've grown used to the rushing sound of the Colorado, Blue and Fraser rivers.

"It's scary," said Ed Moyer, planning director for Winter Park. "You'd think living next to these pristine headwaters, there would be a lot more water. But there isn't."

Today, on average, 42 percent of the natural river flows in Summit, Grand, Eagle and Pitkin counties are diverted to the Front Range, according to an analysis by the Northwest Colorado Council of Governments.

During the next 30 years, average river diversions in the four counties will jump to 60 percent, with counties such as Grand watching 70 percent of the Fraser River being diverted to the Front Range.

So concerned are people in Grand County that, last month, a new group of politicos and water providers formed to examine whether water needs and development — among other things — are on a collision course.

"There have been preliminary discussions about whether to cut back (development)," said Bruce Hutchins, manager of the Grand County Water and Sanitation District. "Theoretically, we have enough water for future growth, but that would mean at times we will dry up the stream. So we've turned the issue over to the town of Winter Park. The people will have to decide whether they want water for people or whether they want water in the stream."

In a county where skiing, rafting and fly-fishing are God's work, it won't be an easy call.

But Front Range water utilities have vowed to help foot the bill.

And ranchers in Grand County, for instance, are already discussing selling agricultural water rights to help fill new reservoirs, according to Don Carlson, an engineer with the Northern Colorado Conservancy District.

"We're going to look at every idea," Carlson said.

Crafting the water deals without drying up the high country will be difficult work, but even environmentalists believe small-scale reservoirs, pipelines and pump stations will do much to help protect streams and fish.

"Will the diversions have a noticeable impact? Yes," said Luecke, the former director of the Rocky Mountain Environmental Defense Fund. "The question is, how much can the natural systems tolerate?"

David Little, a planner at Denver Water, said all parties understand what's at stake, including the health of the tourism economy, which depends on the state's natural beauty.

"We're going to try to help the counties solve their water needs," Little said. "Everyone's trying to finesse this issue in a way that does the least environmental damage."

[illegible]@RockyMountainNews.com or (303) 892-5424

PUEBLO CHIEFTAIN
Pueblo, CO
(Pueblo County)
Daily, 51,408; Sun, 54,355

Colorado Press

80

Fry-Ark water supply better, but still limited

By MARGIE WOOD
The Pueblo Chieftain

Last year, the annual allocation of Fryingpan-Arkansas Project water by Southeastern Colorado Water Conservancy District was a challenge. Only 8,500 acre-feet of water came through the project.

This year, even though a lot more water is expected, the district's staff and allocation committee are again grappling with some tricky questions, as their meeting Thursday showed.

The committee expects to give its final recommendations to the full board next week.

This year the Fry-Ark is expected to produce about 55,000 acre-feet of water.

However, a 6,400 acre-foot shortage in the maximum pool needs to be made up from last year, project

Please see Water, Page 3A

The Pueblo Chieftain ■ Pueblo, Colorado

Water

Continued from Page 1A

manager Tom Musgrove said Thursday.

Also, losses to evaporation and transit will also be greater than usual because the ground is so dry, Musgrove said.

As a result, the committee will recommend allocation of only 35,000 acre-feet — 51 percent to cities and 49 percent to agriculture.

"Before last year, the municipalities always got all the water they asked for, because it never reached 51 percent," district water manager Bob Hamilton remarked.

This year, the cities and towns requested a total of 43,600 acre-feet, well above the 17,850 acre-feet available under the committee's recommendation.

One small city got the most discussion.

Manitou Springs has been a taxpaying member of the district for 40 years but never has requested any water until this year, when it requested 300 acre-feet.

In fact, Manitou Springs isn't even included in the allocation principles, and there isn't any way to get Fry-Ark water to the town of 5,000 west of Colorado Springs.

Mayor Marcy Morrison said she's been trying to negotiate a trade with Colorado Springs or the Fountain Valley Authority but without the Fry-Ark water she has nothing to exchange.

The town's usual water source is a reservoir on Pikes Peak, which was drawn so low last year that Manitou citizens have been restricted to watering only two hours a month since last fall.

Hamilton recommended taking the full 300 acre-feet from the district's emergency reserve, but board member Ron Aschermann of Rocky Ford objected to making an emergency allocation at this point in the year.

After discussion, the committee decided Manitou should get 165 acre-feet in the regular municipal allocation and the other 135 acre-feet from the emergency account.

The agricultural allocation will be even trickier because of changes in circumstances for several canals.

Two canals, Catlin and Holbrook, have asked for permission to use Fry-Ark water for well augmentation, a method that isn't in keeping with the district's policy.

Division Engineer Steve Witte said he understands that shareholders plan to dry up a portion of their fields and dedicate the water they save to augmenting wells and drip irrigation. The Fry-Ark water is critical to make it all work, he said.

Aschermann added, "I'd say 75 percent of the land under the Catlin is not going to be actively farmed this year. The only guys that are farming are the ones who put in drip systems. This is one hell of an issue — they're counting on this and if we turn them down, they're going to have to abandon some acres that they've spent big bucks on."

One of the farmers involved, Chuck Hanagan of Swink, said most of the land is already planted, at an investment of about $2,000 an acre for the drip systems and crops together.

Board member Alan Hamel of Pueblo said the price of the Fry-Ark water should be adjusted higher for such a plan, because the drip irrigators will use the Fry-Ark water without putting return flow back in the river.

The committee apparently agreed with the concept proposed by the two ditch companies, though, and directed the staff to work on the details in the next week.

Another issue involving well augmentation is who gets to claim the acreage for Fry-Ark allocations — the ditch serving the land or the well association supplying augmentation water. The committee agreed with Aschermann's suggestion that the well owner should decide who gets to count his acres, "and let them sort it out."

Finally, shareholders of the High Line Canal voted only last week to allow individual members to lease water to Aurora, but no details have been worked out yet.

Dan Henrichs, the ditch superintendent, said he doubts the legal mechanics of the leases can be worked out before August, and any Fry-Ark water will already have been used by then.

Board members wanted to make sure no project water goes to Aurora, but Henrichs noted that requiring the Fry-Ark water to be used by August might impose a burden on shareholders who don't plan to lease out their water.

Musgrove suggested allocating the water and then reducing it proportionately after a lease is signed. Henrichs said he thought that was a reasonable solution.

Subdivision goes with the flow

With supply drying up, private group contracts for mountain water

BY DONOVAN HENDERSON
Greeley Tribune

For residents of Aristocrat Ranchette subdivision just northeast of Fort Lupton, the well is literally running dry.

The Laramie-Fox Hills Aquifer, which has provided water to the rural subdivision at the northeast corner of Weld County Roads 16 and 31 since the early 1970s, is almost depleted. So homeowners in the development went elsewhere to find a new water supply.

By the end of January, a $1.2 million project that will pipe Colorado-Big Thompson water to the subdivision should be completed.

"Simply put, there isn't enough water," said John Hendrick, engineer for the Aristocrat water project. "The Denver Basin, where most of the metro area gets ground water, isn't available to Aristocrat. All the wells in the world can't pump what's not there."

> "All the wells in the world can't pump what's not there."
> — **John Hendrick,** water project engineer

Cathy Clamp, a resident of the subdivision since 1989 and vice president of the board of Aristocrat Ranchette Water Project Inc., said the new pipeline should solve most of the problems caused by a low water supply.

During the summer, she said, some households can go for up to five days without water. From May to October there are restrictions on water use, from lawn watering to doing laundry.

"That's been going on a number of years. It didn't used to be so bad, but now it's getting worse and worse," Clamp said.

More than 300 homeowners belong to the nonprofit Aristocrat corporation, which is about half of the homes in the subdivision, Clamp said.

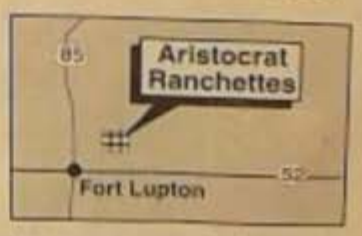
The new pipeline is being installed by Central Weld County Water District. The water district is branching off a main line west of Fort Lupton and running the new line about 4½ miles to the subdivision.

John Zadel of Central Weld said part of the project — crossing the South Platte River and boring under U.S. 85 and the Union Pacific Railroad — is almost done. When the project is completed, the new line will be able to run 400 gallons per minute.

The Aristocrat water project has been in the works for four to five years.

Clamp said her group first approached the city of Fort Lupton, but that never worked out. She said that's still a sore point with her because the city's line runs right by the subdivision.

Instead, the homeowners had to find their own water. Because the subdivision is not a municipality or a special district, it can't issue bonds or levy property taxes. So they sought out some loans.



The Colorado Rural Development Office loaned the corporation $700,000 and awarded it a grant of $1.1 million.

The Colorado Water Conservation Board also kicked in a $400,000 loan for Aristocrat to buy its water rights. It was one of the first times the conservation board, which is a division of the state Department of Natural Resources, loaned money to a private corporation.

"Aristocrat has really broken new ground here for other small subdivisions that are running out of water," said John VanSciver, marketing director of the conservation board.

[WA]TER: Demand from cities creating a drain on farming communities

[CONTIN]UED FROM 1A

[Ex]perts and others fear [suc]h water sales will hasten [the ero]sion of whole farming [commu]nities in Colorado.

[And] the onset of drought has [q]uickened a farming exo[dus]. Over the last decade, Colo[rado] has lost an average of [...]00 farm acres a year to [dro]ught and other reasons; [...]o of the state's 31,000 farm[s] could get out of the business [thi]s year, according to Colorado [St]ate University researchers.

With $17 billion in annual [sa]les, agriculture is the state's [th]ird-leading industry and the [b]iggest consumer of water. [E]ven in the South Platte River [b]asin, home to Denver and most [o]f the state's big cities, farms [u]se about 82 percent of the wa[]ter. In the Yampa, Gunnison and Rio Grande basins, crop irri[]gation accounts for more than 90 percent of water use.

If agriculture used just 10 per[]cent less water, there would be enough water to serve twice the population of the Front Range, experts said.

As the drought enters its fifth year, the Arkansas River basin, home to Rocky Ford and its world-renowned melons, has shown the greatest change.

It also has been a prime shopping ground for cities buying water rights.

Aurora, Colorado Springs and other cities have bought water rights to one-third of the valley's farmland.

That could swell to one-half within a few years, Attorney General Ken Salazar told local leaders at a meeting in Pueblo earlier this year.

Part of the reason: Cities have found that new water supplies are more easily taken from willing sellers in farm country than from lawyered-up communities and environmentalists ...

Water goes with the land

For more than a century, farmers have held sway when it comes to water. ...

Colorado agriculture's big thirst

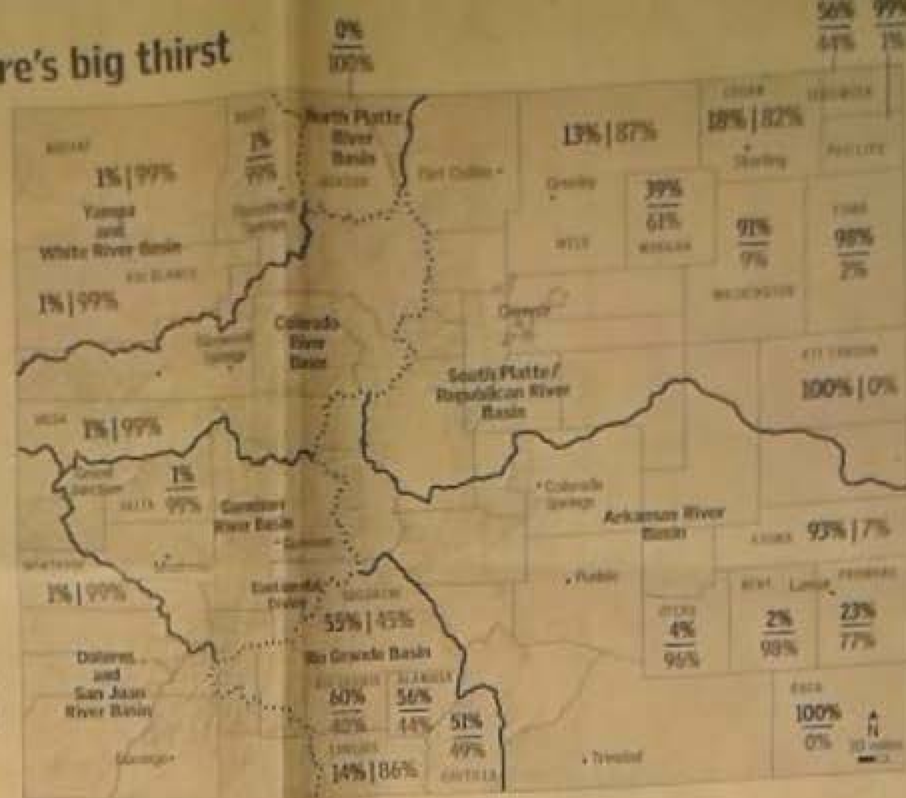
Across Colorado, agriculture is the biggest consumer of water. In every river basin, municipal users account for only a fraction of water used.

Water sources in state's top farming counties

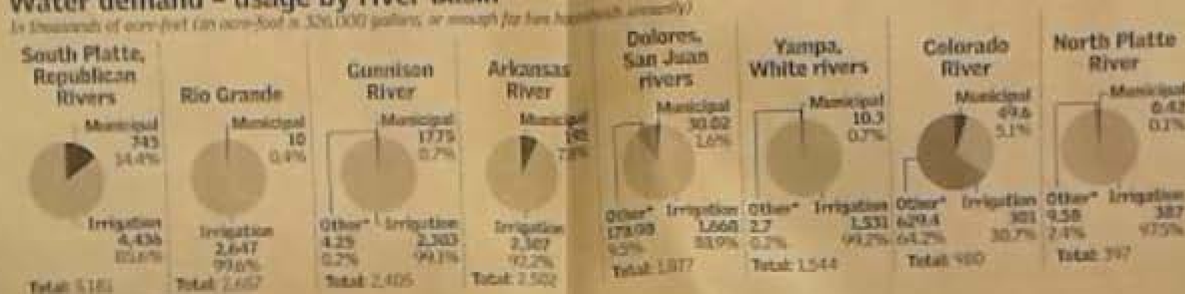
Key to map: Ground water usage 0% | 0% Surface water usage

In the state's mountain areas and river valleys, most of the water supply comes from surface flows – rivers, lakes and reservoirs that feed ditches and canals. In other parts of the state, notably the Eastern Plains and much of the San Luis Valley, water is pumped from wells that tap into aquifers.

The figures below for the state's river basins are for consumptive use – that is, water that is consumed – and not diversions of water by successive rights-holders as water flows and percolates downstream.



Water demand – usage by river basin



Crops by the numbers

Corn, which is heavily irrigated, is the largest user of water, and most of that water comes from the South Platte River and its tributaries. Wheat, including winter wheat, is ... While crops use these amounts of water during their growing season, the average Colorado household uses about 163,000 gallons during an entire year.

Total harvested acres	Percentage irrigated	Average water used per acre	Crop value 2003	Total water used in irrigation, 2003 (in billions of gallons)
Corn** 930,000	78.3%	648,000 gallons	$348 million	495.7
Hay* 1.5 million	80%	513,000 gallons	$352.2 million	372.4
Wheat 2,220,000	8.7%	432,000 gallons	$262 million	83.4
Potatoes 77,400	100%	532,000 gallons	$126.8 million (2002)	38.5
Barley 92,000	94.5%	405,000 gallons	$27.3 million	31.4
Dry beans 73,000	68%	567,000 gallons	$20.4 million	28.4
Sugar beets 27,400	100%	783,000 gallons	$29.2 million (2002)	20.4
Sorghum** 175,000	18%	486,000 gallons	$13.6 million	15.3
Oats 15,000	73.3%	405,000 gallons	$2.03 million	4.5

* Alfalfa and all other hay
** Grain and silage

Where the top crops grow

Sources: Colorado Water Conservation Board; U.S. Geological Survey; U.S. Department of Agriculture; Colorado Agricultural Statistics Service; The Water Center at Colorado State University

Joe Wertz, Andrew Lucas | The Denver Post

Aurora Mayor Ed Tauer said buying from willing sellers ...

Falling prices, rising costs

The drought and water sales to cities are not the only things eroding agriculture in Colorado. ...

... next, he said, because he plans to be in farming for a long time.

But Loutzenhiser could be one of the few who will succeed because he is willing to adapt, said Kristi Gay, district conservationist for the U.S. Department of Agriculture's Natural Resources Conservation Service.

"A lot of older people have made most of their careers with what they have now," she said of equipment and techniques. "It's hard for them to put it down."

A looming cultural loss

With so much land and water dedicated to farming, there will be Colorado crops for a long time to come, said Reagan Waskom, an agricultural water resources specialist at Colorado State University in Fort Collins.

But farm families and rural culture will weed out faster, as farmers sell the water, their land and their lifestyle, experts said. Also, many Colorado farmers benefited from millions of dollars in federal, state and local drought relief in 2002, but that one-time money has run out, said Ament, Colorado's agriculture commissioner.

He said the telephone calls he receives are enough to tell him that an era is passing.

"I'm getting way too many calls from bankers and financiers and long-term families saying, 'Are we going to ever be able to run our wells again? Are we ever going to have sufficient storage for agriculture? Are the municipal and recreation demand for water going to come from agriculture water? Where are we going to be and why should we stay in this?'" Ament said.

John Stencel, president of the Rocky Mountain Farmers Union, has considered each of those questions.

"I look at the future ... and it doesn't look good," said Stencel, who has worked for the Farmers Union for 40 years, including 26 as president.

The tide of rural residents getting out of the farming business and moving to town will be hard to stem, even when the drought subsides, he said.

"I see the whole High Plains area drying up," Stencel said. "There's a consolidation that takes place. The land will be there for production, but it'll be somebody else doing it, and that'll be the larger operations."

Stencel and other experts said water law, which favors farmers and ranchers with the state's older water rights, doesn't need to change.

The state and federal governments also could pony up more money to set aside more acreage in easements to preserve the land for farming in the future. That would temporarily free up some water, Ament said.

Meanwhile, Rocky Ford's farm acreage will continue to go fallow, Bartolo said, expressing hope that the valley will always have its melons.

A few days after he walked around the parched research station and bemoaned the lack of rain and declining farms, showers finally arrived.

But they were ushered in by a hailstorm, he said. It splatted Rocky Ford's melons, however, ...

market

Changing needs determine costs of valley leases

By CHRIS WOODKA
THE PUEBLO CHIEFTAIN

Pueblo leases water to power plants, gravel pits, an Army base and farmers. But there is no one-size-fits-all contract.

In fact, the price of leasing water throughout the Arkansas Valley is an evolving market, determined by changing conditions rather than a set scale.

Earlier this month, the Pueblo Board of Water Works leased water to Colorado Springs for the first time. Pueblo needed the money to make its budget work. Colorado Springs needed the water to replenish storage.

The price was set in an "auction" that brought Pueblo $1.2 million for 4,800 acre-feet of surplus water — about $250 per acre-foot.

While that rate could be about half what Colorado Springs expects to pay for water under a lease with Aurora of High Line Canal, but is $100 more than a long-term lease between Pueblo and Aurora.

So why the variation?

"The bidding process seemed to be a good way to set the price," said Alan Ward, water resource specialist for the Pueblo water works.

In January, the water board assessed its water needs and probable resources for the coming year. It agreed to make 2,000 to 6,000 acre-feet of water available to well users for $9 an acre-foot, the same rate it pays for Fryingpan-Arkansas water. After storage needs were met and long-term leases fulfilled, the board estimated it would have 4,800 acre-feet minimum to lease. The maximum could be as much as 15,000 acre-feet, but the board won't know about that portion until April, when winter snowpack levels are better known.

The next step was to set a minimum price for the water.

"The $170 floor came from the budget. We needed to have about $1.6 million in raw water sales to keep rates low," Ward said. "We had about $300,000 from contracts, so we needed to make up $1.3 million. My best guess was to start the bidding at $170."

That figure is higher than the board's existing raw water leases, which are about $145 per acre-foot.

The water board leased 5,000 acre-feet of water to Aurora for $125 per acre-foot in 1999, but built in increases that are tied to Pueblo's customer rates. Aurora will pay $145 per acre-foot this year.

"When we negotiated the lease in 1997, we we spilling storage or not diverting," Ward said. "It was a great price for the time."

Other long-term contracts to gravel pits, the Transportation Technology Center, Pueblo Chemical Depot and other users were negotiated along the same lines, with about the same rates.

"The drought of 2002 changed things. Then, we said, 'Wait a minute, we need to charge more.'" Ward said.

The board also leases water to Xcel for Comanche Power Plant for $290 an acre-foot, but the situation is different. The contract was first negotiated in the 1970s, and tied to the rates of the largest commercial users, which were billed at a different rate at the time. The contract

PLEASE SEE WATER, 2D

Workers harvest cabbages on the St. Charles Mesa. Agricultural water can be leased for far less than municipal w cases.

Prices, restrictions vary all over map

By CHRIS WOODKA
THE PUEBLO CHIEFTAIN

Water in the Arkansas Valley can be leased anywhere from $0 to $1,000 an acre-foot. The price depends on its purpose, location and even weather conditions.

The Southeastern Colorado Water Conservancy District leases Fryingpan-Arkansas Project water for about $9 per acre-foot. The rate is set by the Bureau of Reclamation's estimates of agricultural users' ability to pay, as well as a surcharge. An acre-foot is about 325,800 gallons.

Allocation is determined by a district committee, based on need. The same rates are given to cities as farmers. Under current allocation principles, water is divided 49 percent to agriculture, 25 percent to Colorado Springs, 10 percent to Pueblo, 12 percent to domestic users east of Pueblo and 4 percent to domestic users west of Pueblo.

Until the drought of 2002, ag users actually used three-fourths of the 50,000 acre-feet brought into the Arkansas Valley each year.

PLEASE SEE LEASE, 2D

RETAIL RATES

Water customers pay more for water b be purchased, stored, treated and deliv rates were figured in terms of acre-feet minimum residential customers in Pueb Springs and Aurora would pay.

City	Price/AF*
Pueblo West	$513.89
Pueblo	$629.78
Colorado Springs	$401.85
Aurora	$921.89

* Price is based on lowest city rates per 1,000 g extrapolated to 325,800 gallons, or 1 acre-foot monthly service charges. Pueblo West, Colorad Aurora customers would pay more if more than minimums were used because of tiered rates. Py customers pay at a fixed rate, regardless of use.

* In gallons per day per person, based on cities' ca of residential use. An acre-foot in Pueblo supports per year, while in Aurora and Colorado Springs, it s * 3 people per year.

Leases a one-way deal in South Plat

Water leases are usually from cities to farms along the South Platte, compared with a variety of possibilities in the Arkansas River basin.

The going rate also is more stable, about $25 to $40 per acre-foot in the north, compared with a wide range of $9 to $1,000 in the valley.

"In the north part of the state, you'll find the best example of a free market in the world," said Brian Werner, spokesman for the Northern Colorado Water Conservancy District. "As long as the water is leased within our service area."

But the stabilization has carried a huge price tag for agriculture in the South Platte. In 1957, Big Thompson Project shares — called "units" — were 85 percent owned by farmers. Now, farmers own just 37 percent.

Many farmers who are left rely on cities to fill some of their water needs.

"The cities act as a water bank in all but the driest years," Werner s

The exception came in 2 year of the drought.

"Early in 2002, the cities sti water to farmers, but the dropped out in mid-May," said.

Farmers began leasing wate to cities later in 2002 — for $ $450 per acre foot.

"That was an anomaly," W said.

— Chris W

80

"The water is much, much, much more valuable than the land."

Cities' water needs uprooting Colorado farm

By Joey Bunch
Denver Post Staff Writer

Rocky Ford — Dust stirred around Mike Bartolo's boots on a day when rain seemingly fell everywhere in Colorado — except in this town of 4,000, home to Colorado's famous-but-thirsty melon crop.

It takes about 120 gallons of water to grow just one melon. That means Rocky Ford's 4,000-acre crop will gulp a 2 billion gallons during growing season — enough to supply a city of almost 65,000 for a year.

For the last 14 years, Bartolo, a Colorado State University horticulturist, has answered a parade of questions posed by farmers who visit his agricultural research center in Rocky Ford. He advises them on planting and tilling patterns. Which fertilizers are best? What crops are most likely to yield a profit?

But there is a question he never gets asked. Should they sell today's most valuable commodity — their water?

With cities offering much higher prices for water than farmers could ever get from crops or selling their

» See WATER on 16A

Colorado State University scientist Mike Bartolo looks ... Rocky Ford Ditch, a water source for the area's famed ... third of the Arkansas River Valley's water rights now ...

80

Greeley staff right on mark in configuring fair water plan

George M. Underwood
Guest columnist

THE TRIBUNE REALLY missed the mark with its May 27 editorial, "Water scheme is all wet."

The city of Greeley staff does not deserve criticism for coming up with an interesting, innovative and equitable plan that would address the water needs of all customers on a fair basis.

The Tribune said implementation of the city's plan would be an administrative nightmare and cited how difficult and expensive it would be to generate the base data regarding lot size, lawn size, sidewalk area and roof area. The assertion is obviously not correct because the data has already been developed and reviewed by property owners for the drainage utility rate determination.

It was very perceptive of the city staff to recognize the analogy between outside runoff and lawn-sprinkling and to come up with a plan that would utilize the same data to evaluate each.

Owners of large lots should not be penalized for using a reasonable amount of water for lawn sprinkling. It is, after all, water that has been furnished by them, or on their behalf, to the city for that purpose.

The policy concerning water service is that three acre-feet of water be furnished to the city for each acre to be incorporated into the city. For a one-acre lot, three acre-feet of water would be contributed. With water currently valued at $11,883, the cost of water provided would be $33,650. It would be grossly unfair that large lot owners would donate water at that cost and then be charged a surcharge for using a reasonable amount of it for sprinkling.

If we want to keep the city attractive, we need to allow for an equitable distribution of the available supply between customers. The city plan does that. The Tribune plan does not. Under the Tribune plan, small-lot owners would be allowed to water water without penalty, while large-lot owners would be unable to water reasonably without incurring penalties for excessive use.

The Tribune asserts that users would have to maintain meter readings is belied by your own statement that 92 percent of those monitored in the trial stayed within probable allotments when they had no knowledge that they were being monitored.

Hats off to the city of Greeley staff for original thinking and interest in promoting an equitable policy rather than following the specific system recommended by the Tribune, and followed by the municipalities of Fresno and Windsor.

George M. Underwood is a retired water engineer and lives in Greeley.

Lyn Alweis | The Denver Post

ngler-area farmers Randy Loutzenhiser, left, and Gene Brouwer walk wheat fields on rouwer's land. The field at right was harvested in 2003; leaving the stalks retains moisture.

Other states have distinct advantage: rain

By Joey Bunch
Denver Post Staff Writer

Farms and rural communities in Colorado and the Interior West may be withering economically because of drought, but that's not the case elsewhere.

The Midwest is going gangbusters in crop production, and the rain can't seem to stop falling on the fertile South.

Meanwhile, farmers in Colorado face lingering drought and grim economic horizons.

"We're losing market share, no question about that, simply because we're not producing and they have rain and they do," said John Stencel, president of the Rocky Mountain Farmers Union in Denver. "Whether we can reclaim it down the road, it's always difficult."

Colorado lost more than 1 million farm acres between 1997 and 2002, according to the U.S. Department of Agriculture's more recent Census of Agriculture.

New Mexico and Texas were the only states to lose more.

Farmers with the lowest cost — such as water supplies and transportation costs — thrive in the marketplace, weeding out disadvantaged producers, said Mark Drabenstott, an economist and director of the Center for the Study of Rural America at the Federal Reserve Bank in Kansas City, Mo.

Whether Colorado has too much or too little agriculture for its climate, "the market knows the answer to that question," he said.

In judging a region's agricultural vitality, economists point to exports as the best yardstick. Colorado ranked 22nd in farm exports in 2003, with $843 million in sales. But almost $440 million of that came from livestock and related products — a troubling figure because cattle herds take years to rebound, state officials said. By comparison, 10th-ranked Indiana exported $1.6 billion in farm products last year, and top-ranked California sold $8.2 billion.

The number of farms in Colorado has hovered around 30,000 for a decade. But those statistics are inflated by Western Slope "gentleman farms" and "ranchettes," rustic resorts that are classified as farms or ranches, but which produce little.

Meanwhile, the number of Colorado farms generating more than $250,000 in annual sales fell from about 2,300 in 1998 to about 1,900 last year, according to the National Agricultural Statistics Service.

WATER / continued from page 1B

was renegotiated at the present rate several years ago. Last year, Xcel paid $2.4 million for 8,250 acre-feet.

Filling storage needs

Colorado Springs for years looked to its own resources to fill water needs, and in many years was able to lease water back to farmers.

Following the drought of 2002, when rationing took effect and stored resources were drawn down, the city has been forced to find alternative sources of water.

So far this year, the city has purchased half of Aurora's lease on the High Line Canal and surplus water from Pueblo.

The prices varied, however — probably more than $400 an acre-foot for the High Line lease, and about $250 an acre-foot for Pueblo's water.

"The High Line price was set by Aurora," said Brett Gracely, water resource planning supervisor for Colorado Springs Utilities. "The Pueblo lease was like an auction and we were willing to pay more than other folks were willing to pay."

The High Line lease does not provide a guaranteed amount of water, but last year Aurora sold $5.4 million for 7,600 acre-feet of water— $710 per acre-foot. Aurora paid farmers $4.4 million, made improvements to the ditch and paid engineering costs. The city paid $850,000, or $110 per acre-foot, to the Southeastern Colorado Water Conservancy District and Bureau of Reclamation to store the water in Fry-Ark facilities.

In renewing the lease this year, Aurora determined it did not need all of the water, so Colorado Springs agreed to pay half the lease, or $27 million. That deal had to be completed by Feb. 1, or two weeks before the Pueblo deal could be finalized.

Gracely said Colorado Springs took the gamble that this year's yields would be better than 2004. Colorado Springs is expecting its share to be 5,500 to 6,500 acre-feet.

"Ultimately, hydrology will

the chances of not fil needs," Gracely said. "I certain amount of m firm up our needs."

Gracely said the city keep 14 years of its needs in storage, and were only about half c was needed.

Aurora likewise ev the cost of water when it tiated its 1999 lease. In a 1992 deal, Aurora pays t an additional amount of $50 per acre-foot to trade Pueblo water for wat upstream reservoirs.

In the short term, the are a bargain, since the ci far has spent about $4,00 acre-foot — $90 million 22,500 acre-feet — for agr tural water rights purchas the Arkansas River basin.

"We do consider what tolerance of cost per acre is," said Doug Kemper, Au water resources manager. " pay what we think it will t to get the deal done."

Market evolving

Gracely sees water leases from agriculture to municipa city-to-city, or cities to farm — as an evolving market.

"We will be in a position i the future to lease water in th future," Gracely said. "Marke conditions in the Pueblo basin are a developing trend."

A wide variation in lease prices is likely, since the tools to forecast short-term needs still are being developed and there are no real brokers. Most deals are negotiated directly between buyers and sellers.

A good example is a pilot water bank in the Arkansas Valley. The Southeastern district voted to bail in the third year of the five-year program last year because there were so few buyers or sellers.

Others are trying to test the waters for marketing. About 40 percent of the owners on the Fort Lyon Canal, including water marketers High Plains A&M, would like to sell water if a buyer could be found. They are in state Supreme Court over an attempt to get a change of use decree even though

Denver Water may consider easing rules

But board members say more rain is needed, even as the utility's reservoirs continue to fill up.

By Joey Bunch
Denver Post Staff Writer

If the weather cooperates with some clouds and rain, Denver Water could relax its water restrictions next month. But that's a big if, even the most optimistic members of the utility's board said Wednesday.

Wet weather might prompt Denver Water to give customers a third day of lawn watering under the utility's drought restrictions program, which the board adopted in April, board members said.

The board was heartened by a report of reservoirs being relatively healthy despite the ongoing drought.

Reservoirs are at 78 percent of capacity, with improvement expected in coming weeks as the mountain snowmelt increases, said Ed Pokorney, Denver Water's director of planning.

"Frankly, our reservoirs have done very, very well," he said. Customers also have used 31 percent less water this year than the average, he said.

At the utility's board meeting, officials passed, as expected, a $1 million rebate program to encourage customers to invest in high-efficiency washing machines, low-flow toilets and water-saving lawn care.

The rebates apply to purchases made next month and in July.

tomers:

- $150 for buying a high-efficiency clothes washer. The utility will give 800 such rebates.
- $200 for a low-flow toilet, with a maximum rebate of $600. The utility will accept 1,000 applications for these rebates.
- 1,000 applications for rebates on soil additives that improve water efficiency in new lawns. Denver Water will pay $15 on each qualifying application, with a maximum of $350.
- 475 landscape audits and repairs to leaky or inefficient systems for customers watering 2 acres or more. The rebate for audits is $50 per application, with a maximum of $1,000 per customer.

The rebate program is funded by a 20 percent surcharge on taps for new homes and businesses.

Inside the city and county of Denver, taps normally are $2,500, plus 34 cents per square foot of the lot size.

Outside the county, Denver Water's customers will pay $2,200, plus 42 cents per square foot of the lot size, before the surcharge applies.

Denver Water sold 3,515 taps in 2003. The surcharge last year applied only for two months. The board has not set an ending date for surcharges this year.

Staff writer Joey Bunch can be reached at 303-820-1940 or at jbunch@denverpost.com.

More information: Denver Water customers can call 303-628-6000 or visit the Web

Forward-thinking Lama

THE CITY of Lamar is embarking on an innovative, forward-thinking approach to conserve water as supplies shrink in the Lower Arkansas Valley. That approach is a secondary water system for irrigating lawns, gardens and parks.

Lamar's water superintendent, Dannie McMillan, says full development of the system will benefit residential users and give farmers an alternative to selling their water. The town began a feasibility study for the pr Colorado State University and Aqua Enginee Fort Collins last fall. The study was complete

In the secondary system, a pressurized deliver untreated irrigation water to homes lawns and other landscape uses.

Aqua's vice president, Steven Smith, sa dual system water would be delivered in two separate, underground pipe systems. system conveys treated water from municipal supply systems, while the o deliver untreated water from the agricultur or other sources.

Mr. McMillan says the source of the second would be shares the city owns in the Fort Bent the event the town is able to install an entire s system, officials there are looking at the poss giving the farmers a chance to sell or lease tha to Lamar for irrigation throughout the city m selling it outright out of the valley.

Furthermore, a lease option would allow far make some money by leasing their water to the dry years, providing them cash flows while avoid horrible, damaging consequences of a permanent water out of the valley.

Mr. McMillan says the system would be develo seven phases starting with irrigation on the city's side. The city plans to spend $400,000 on Phase year. The officials estimate the long-term costs a piete buildout could be $8 million.

As envisioned, the first phase will use a pond low Creek Park as a storage unit and tap and untreated water from the Fort Bent Canal syst water the city's park, part of Lamar Community C and nearby ballparks, as well as the county fairg complex.

As a poll taken before the creation of the new Arkansas Valley Water Conservancy District sh 89 percent of all residents in the area, from Pu the Kansas line, believe not a drop more water be allowed to leave the valley. Lamar is about to on its effort to see that wish come true.

A lease option wo allow farmers to make money by leasing water to city in dry years providing them flows while avo the consequenc a permanent sa

Assessor's Test Case Taxes Water Rights

'Speculative Investments' Targeted

By JACK COX
Denver Post Staff Writer

The Teller County assessor, in a test case that promises to stir up a whirlpool of controversy, is attempting to levy property taxes on water rights owned by a private developer.

Assessor Larry Kallenberger said he imposed the tax under a section of the Colorado Constitution that permits taxation of all property that isn't specifically excluded — including, presumably, water rights obtained for commercial purposes.

If upheld in court, the action would set a precedent that could mean millions of dollars in new revenue for counties all over the state — and much higher tax bills for energy firms and other large industrial users of water, such as the Adolph Coors Co. and CF&I Steel Corp.

The outcome wouldn't affect municipal water districts or bona fide agricultural users, whose water rights are exempted from taxation by Colorado law.

"There are places in the state where the rights to the water under a piece of land may exceed the value of the land itself," Kallenberger said.

"It seems hypocritical to, on the one hand, recognize water as the most precious commodity in a semiarid state, and on the other, fail to tax it as we would other speculative investments."

Kallenberger described the lack of taxation as a "subsidy for non-agricultural development." He called for the passage of a law to require the registration of sales of water rights and to authorize taxes on them.

The concept of taxing water rights has been discussed previously, but Kallenberger is believed to be the first county assessor in Colorado to put it into practice. A first-term Democrat who has been in office since 1978, he has nothing to lose politically, for he isn't running for re-election this fall.

Hal Simpson, assistant state engineer in the Division of Water Resources, said only a small percentage of the water rights in the state would be subject to such a tax.

A water census taken in 1974, Simpson said, showed that roughly 60 percent of the 5.2 million acre-feet available for consumption each year was allocated to agricultural and municipal uses, which couldn't be taxed.

Most of the remaining amount was lost to evaporation, leaving only about 163,000 acre-feet for private commercial use.

But that figure could rise, Simpson added, as energy firms buy up ranchers' water rights for such projects as coal slurry pipelines and oil-shale processing facilities.

The Teller County assessment, which seeks payment of about $11,000 in taxes on the rights to 345 acre-feet of water, was upheld by the county commissioners, sitting as the Teller County Board of Equalization, after a hearing last month. It now appears headed for the Colorado Board of Assessment Appeals, and is almost certain to be given to the Colorado Supreme Court for a final decision.

The water rights in question are owned by Dorrance Smith, a Colorado Springs resident who developed Westwood Lakes Estates, a subdivision of about 100 homes near Woodland Park.

Kallenberger said he estimated the actual value of the rights at $1,000 per acre-foot, a figure he termed "conservative" in view of an offer that Smith made in 1977 to sell the holdings to the town of Woodland Park for $700,000 — or roughly $2,000 per acre-foot.

An acre-foot is the volume of water which would cover an acre to a depth of one foot. It is generally described as the amount needed to supply a family of four for one year.

Smith appealed the assessment, contending at the hearing that the county was trying to exact a "confiscatory tax" that would cost him more to pay than he could get as income from the property.

But Kallenberger said in an interview Wednesday that the use or non-use of the rights shouldn't make any difference. "If you own a house, you still have to pay your property taxes even if you move away and don't rent it for a year," he said.

Smith also argued that the assessment amounted to "double taxation," since both his land and the water rights would be taxed.

He maintained that the decision handed down last year in the John Huston case made the land and the water underneath it inseparable for tax purposes.

Kallenberger, however, said the Huston case applied only to water from deep underground aquifers, and not to tributary ground water like that on the Westwood Lakes property, which eventually flows into the South Platte River.

Huston, a Denver lawyer and geologist, had laid claim to vast amounts of untapped water in bedrock formations. A special water judge dismissed Huston's claims, but ruled that the persons owning the lands above such waters could apply for rights to them.

for Blue Mesa Reservoir are raised accordingly. These targets were set to avoid ice jams upsteam but easements upstream of the reservoir were acquired decades ago in anticipation of ice jams and flooding. Additionally, the current practice of releasing water in winter months to achieve a Second Fill of Taylor Reservoir changes the thermodynamics of the reach between Taylor and Blue Mesa Reservoirs in a manner that reduces the potential for ice jams to occur.

5. Cooperation to provide a more appropriate natural hydrograph to the Black Canyon of the Gunnison River along with call protection could result from partnering with the Uncompahgre Valley Water Users Association (UVWUA) to support construction of a run-of-river power hydroelectric power generation facility at the weir diverting water to the Gunnison Tunnel diversion. An example of this concept was provided in the WET Report. This example specifically references and is based upon the re-licensing application and federal environmental impact statement prepared by the Federal Energy Regulatory Commission for the Pillager Project of Minnesota Power and Light (FERC Project 2663-04, 17 October 1997). The operating height for this power plant is 20 feet and river flows are comparable. Based on the FERC estimate for a replacement cost and the cost estimates for the AB Lateral Project, such a project would now cost around $2 million. While operations can accommodate and promote a more natural hydrograph through the Black Canyon, such a run-of-river electrical power generating facility could provide a small revenue source. It might also commit both the District's and the UVWUA's water rights toward development in a manner attracting federal funding assistance.

6. Within the Upper Gunnison Basin, the District could help existing water users cope with dry years, when they occur, by improving irrigation efficiency. Research on buried drip or weep systems shows their durability and practicality. The objective is to apply water when needed only within the root zone and have a dry surface and no water lost below the root zone. With the piping buried 14 to 24 inches, irrigators successfully produce hay and forage with 2.5 acre-feet or less of water applied per acre irrigated. While some reports have indicated a cost of around $800 to $900 per acre to install this technology, a more reasonable cost estimate would be $1,500 per acre. This amount does remain less expensive than now constructing reservoirs and canals such as described in the District's decrees. For example, the far end of the Ohio Creek Canal with a capacity of 129 cfs would be 20.2 feet wide at the highwater line, 10 feet wide on the bottom and 3.4 feet deep at high water

7. Should the District provide additional water to irrigators or assistance with investments in irrigation technologies, this commitment of public funds should be made with the provision that the whole of the benefitting property be placed in a conservation easement, that water cannot be sold off from the property, and that existing water rights be fully used when water is plentiful in wet years to retain existing water rights and to sustain riparian vegetation and recharge aquifers. In some situations, use of the drip or weep technology for irrigation is reported to have been so much easier and required so much less water that water rights were sold off the property. For example, this is contemplated along the Front Range as a source for water to support new development.

Should more information on these thoughts be helpful, please contact me.

Respectfully,

Ralph E. Clark III

c. to others

Part 4a Flow Requirements Through Black Canyon

in cfs for:

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	Total in acre-fee
	The proposed quantification is for a minimum of 300 cfs with a May 1st through July 25 flow based on unregulated inflow to Blue Mesa Reservoir between April through July and with a peak flow also based on this April through July inflow. (Dept. of Justice 2001, Quantification of Reserved Right For Black Canyon ...)												
(a)	Proposed quantification by month in a projected year of average water supply - WY 2002 (Bureau of Reclamation Jan 2001)												
	300.0	300.0	300.0	300.0	300.0	300.0	300.0	659.0	3,450.3	659.0	300.0	300.0	451,235
(b)	Modification made to proposed quantification for WY 2002 to reduce flashiness of peak and extend shoulder flows by reducing ramping rates to about half those of the proposed quantification and with a peak occuring in late May												
	300.0	300.0	300.0	300.0	300.0	300.0	300.0	4,462.6	1,780.1	659.0	300.0	300.0	580,13
(c)	\\ Compare with average of reported flows in cfs below East Portal of Gunnison Tunnel for years 1910 through 1937 (BOR 1990, AB Lateral FEIS, Table B.1). The Black Canyon was designated as a National Monument in 1933.												
	544.0	599.0	483.0	437.0	457.0	699.0	1,672.0	5,065.0	6,287.0	1,973.0	782.0	469.0	1,176,19
(d)	\\ Compare with: 68.00% of this average as the assumed flow required through the Black Canyon or minimum of 300 cfs. The figure of 68% gives the equivalent yearly amount of flow as under protocols for the Aspinal Unit between 1952 and 1983 but in a manner that mimics the natural hydrograph.												
	369.9	407.3	328.4	300.0	310.8	475.3	1,137.0	3,444.2	4,275.2	1,341.6	531.8	318.9	799,98
(e)	\\ Compare with: 33.50% of this average as the assumed flow required through the Black Canyon or minimum of 300 cfs.												
	300.0	300.0	300.0	300.0	300.0	300.0	560.1	1,696.8	2,106.1	661.0	300.0	300.0	448,55
(f)	\\ Compare with "simulated average flows" between 1952 and 1983 under protocols for operation of the Aspinall Unit (BOR 1990, AB Lateral - FEIS, p. 94).												
	811.0	1,176.0	1,452.0	1,382.0	1,337.0	1,180.0	921.0	1,004.0	1,287.0	1,266.0	844.0	579.0	799,90
(g)	\\ Compare with potential flow which is set prior to spring run-off each year by various water interests and dependent upon factors which include where water is removed from the Gunnison River system, hydrology and timing of expected inflows flows to Aspinall Unit over year, future water demands from the Aspinall Unit, transmountain diversions, reservoir elevation, and avoidance of calls upon junior water users within the Upper Gunnison Basin (Dept. of Justice 2003)												
	300.0	300.0	300.0	300.0	300.0	300.0	300.0	635.0	1,000.0	635.0	300.0	300.0	300,287.4
(i)	\\ Compare with potential flow which is set prior to spring run-off each year by various water interests and dependent upon factors such as given in (g) but where flow through Black Canyon is determined to minimulize "calls" for flows through the cnayon.												
	300.0	300.0	300.0	300.0	300.0	300.0	300.0	400.0	800.0	400.0	300.0	300.0	259,806.0

THE HISTORY

Tree ring findings tell the story

o doubt Colo. in a ought, but it's not orst state has seen

Jim Erickson
CKY MOUNTAIN NEWS

The trees tell Connie Woodouse an epic story: Parts of Colorado are suffering the worst rought in more than 300 years.

Annual growth rings of ponderosa pines reveal that stream lows in some Front Range watersheds are lower this year than at any time since 1685, according to the Boulder tree-ring researcher.

That's two years before Isaac Newton set forth his laws of motion and seven years before 20 alleged witches were executed in Salem, Mass.

And even that is relatively recent history when it comes to Colorado's struggle with drought. The Anasazi civilization built small catchment basins and an irrigation system in the Four Corners area between A.D. 900 and 1200 and may have been forced by drought to abandon the area by 1400.

But 2002 more than holds its own on the historic scale.

"You're looking at one of the driest — if not the driest — years in 300 or more years," said Woodhouse, who specializes in drought studies at the University of Colorado and the National Oceanic and Atmospheric Administration.

Tree rings allow researchers such as Woodhouse to look back to a time before rain gauges, thermometers and stream-flow monitors. In semiarid areas such as Colorado, moisture is often the limiting factor for tree growth, and variations in ring width reflect year-to-year changes in available moisture.

Because trees such as pines normally produce a new growth ring each year, it is possible to count back from the present and determine the climate conditions that prevailed in a specific calendar year centuries ago.

Woodhouse used this technique, called dendroclimatology, to compare 2002 Colorado stream flows — along the Front Range and just west of the Continental Divide — to other drought years. A few of her conclusions:

■ This year is one of the five driest years since 1569 along the Blue River north of Silverthorne

Studying the Colorado drought record: Connie Woodhouse examines a piece of ponderosa pine at the University of Colorado Institute of Arctic and Alpine Research in Boulder on Sept. 17. Woodhouse is analyzing the severity of the current drought by studying tree-ring records dating back more than 300 years.

tershed.

■ Clear Creek is flowing lower this year than at any time since 1685.

■ Boulder Creek and South Boulder Creek are lower this year than at any time since 1685.

"These trees are not rain gauges or thermometers, but they provide a pretty faithful climate record, especially in terms of the dry extremes," Woodhouse said.

State Climatologist Roger A. Pielke Sr., however, isn't quite ready to ascribe epic proportions to this year's drought.

It depends how you define drought, which Colorado locations you study, and what variables you consider, said Pielke.

"We're in a serious drought, but it's not an unprecedented drought, and every place in the state is not at the same level of severity," he said.

"Connie does excellent work, and it could be that the Boulder Creek watershed has had a super-extreme drought, but you can't extrapolate that statewide," said Pielke, a professor of rado State University. "Because that's apparently not the case."

Colorado State researchers just finished looking at precipitation records from eight Colorado weather stations scattered across the state. They examined annual records back to 1940.

The stations they studied are in Grand Lake, Grand Junction, Montrose, Del Norte, Colorado Springs, Rocky Ford, Akron and Kassler, south of Denver near Chatfield Reservoir.

At five of the eight weather stations, the period from Sept. 1, 2001, through Aug. 31, 2002, was drier than any comparable period since 1940.

But at three of the stations — in Grand Junction, Montrose and Kassler — there have been several September-through-August periods drier than the one we just endured, Pielke said.

In Grand Junction, for example, the driest was from Sept. 1, 1955, to Aug. 31, 1956, when the station received 4.13 inches of precipitation.

Western Slope city received 5.54 inches.

The Colorado State researchers plan to extend their study back to the 1930s to see how the 2002 drought compares to the Dust Bowl years, an era from which most of the West's large federal water projects sprang.

The state was struck hard during the Dust Bowl and the 1950s.

"I think this is probably the worst drought since the 1950s, but it hasn't been as long-term as some of the others — at least not yet," Pielke said.

Experts at the National Climatic Data Center have a gloomier view of this year's drought than Pielke.

Colorado was one of six states that recorded the driest September through August period since national records began in 1895, the center said. The others were North Carolina, Virginia, Utah, Arizona and Nevada.

erickson@RockyMountain News.com or (303) 892-5129. News Staffwriter Deborah Frazier

Business.view, our online column on business, appears on Economist.com on Tuesdays. Past and present columns can be viewed at
www.economist.com/businessview

Business and water

Running dry

NEW YORK

Everyone knows industry needs oil. Now people are worrying about water, too

"WATER is the oil of the 21st century," declares Andrew Liveris, the chief executive of Dow, a chemical company. Like oil, water is a critical lubricant of the global economy. And as with oil, supplies of water—at least, the clean, easily accessible sort—are coming under enormous strain because of the growing global population and an emerging middle-class in Asia that hankers for the water-intensive life enjoyed by people in the West.

Oil prices have fallen from their recent peaks, but concerns about the availability of freshwater show no sign of abating. Goldman Sachs, an investment bank, estimates that global water consumption is doubling every 20 years, which it calls an "unsustainable" rate of growth. Water, unlike oil, has no substitute. Climate change is altering the patterns of freshwater availability in complex ways that can lead to more frequent and severe droughts.

Untrammelled industrialisation, particularly in poor countries, is contaminating rivers and aquifers. America's generous subsidies for biofuel have increased the harvest of water-intensive crops that are now used for energy as well as food. And heavy subsidies for water in most parts of the world mean it is often grossly underpriced—and hence squandered.

All of this poses a problem, first and foremost, for human welfare. At the annual World Water Week conference in Stockholm this week, delegates focused on measures to extend access to clean water and sanitation to the world's poor. But it also poses a problem for industry. "For businesses, water is not discretionary," says Dominic Waughray of the World Economic Forum, a think-tank. "Without it, industry and the global economy falter."

Water is an essential ingredient in many of the products that line supermarket shelves. JPMorgan, a bank, reckons that five big food and beverage giants—Nestlé, Unilever, Coca-Cola, Anheuser-Busch and Danone—consume almost 575 billion litres of water a year, enough to satisfy the daily water needs of every person on the planet.

Although agriculture uses most water (see chart on next page), many other products and services also depend on it. It takes around 13 cubic metres of freshwater to produce a single 200mm semiconductor wafer, for example. Chipmaking is thought to account for 25% of water consumption in Silicon Valley. Energy production is also water-intensive: each year around 40% of the freshwater withdrawn from lakes and aquifers in America is used to cool power plants. And separating just one litre of oil from tar sands—a costly alternative fuel made viable by high oil prices—requires up to five litres of water.

Quality matters as much as quantity. According to the World Bank, around 90% of the rivers in China near urban areas are seriously polluted. The overall cost of water scarcity—from pollution and the depletion of groundwater—is estimated to be 147 billion yuan ($21.4 billion) a year, or almost 1% of China's annual output. In 2007 poor water-quality cost China some $12 billion in lost industrial output alone.

Elsewhere, Taipei City in Taiwan no longer allows companies to tap its groundwater, because of shortages. Firms in drought-ridden Australia have lived under stringent water restrictions for years. Southern Company, an electricity utility based in Atlanta, temporarily shut down some of its power plants last summer because of a drought. Indeed, according to a survey by the Marsh Centre for Risk Insights, 40% of *Fortune* 1000 companies said the impact of a water shortage on their business would be "severe" or "catastrophic"—but only 17% said they were prepared for such a crisis.

Not all companies are sitting still. Since 1995 Dow has reduced the amount of water it uses per tonne of output by over a third. Nestlé cut its water consumption by 29% between 1997 and 2006, even as it almost doubled the volume of food it produced. And at Coca-Cola bottling plants from Bogotá to Beijing, schools of fish swim in water tanks filled with treated wastewater, testament to the firm's commitment to clean all its wastewater by 2010 (it is 84% of the way there).

Cynics say such programmes are mere public relations. There is some truth to this. Companies that use freshwater in areas where it is scarce are understandably unpopular. Activists have attacked both Coca-Cola and Pepsi, for instance, for allegedly depleting groundwater in India to make bottled drinks. Coca-Cola took the matter to court and was exonerated by an independent commission, which blamed a regional drought for water shortages, but activists were not mollified. Coca-Cola has responded by redoubling its attention to ▸▸

Car taxes in China

Taking another road

China finds a way to cut car imports without offending the WTO

LESS than a month after losing its first legal dispute with the World Trade Organisation (WTO), China has introduced a new tax that will achieve much of what it originally wanted, only by another route. Moreover, it is a "green" tax. Who could object to that?

For the past few years China has imposed a special 25% tariff on imported car parts, rather than the usual 10%, if the parts made up more than half of the value of a vehicle. (Imported new cars are also subject to a 25% tariff.) This was to encourage foreign carmakers to use more local suppliers and reduce imports. But America, the European Union and Canada argued that the tariff was against WTO rules. In July the WTO, based in Geneva, agreed.

China may yet appeal. In the meantime, the government has found another way to reduce the flow of expensive automotive imports. On August 13th the government announced a new "green" tax that will come into effect on September 1st. The new tax is meant to reduce fuel consumption and fight pollution. Rather than further raising the tax on fuel, which increased by almost 20% in June, the government is taxing gas-guzzling cars. By an amazing coincidence, most such cars are foreign-made.

Cars with engine capacities larger than 4.2 litres will now incur a 40% sales tax—twice the previous level. Cars with engines between 3 and 4.1 litres will be taxed at 25%, up from 15%. The tax on the smallest cars, with engines smaller than 1 litre, will fall from 3% to 1%. The 8% and 10% taxes on other cars will not change.

The government says the new tax will encourage a shift to more fuel-efficient cars. It will also help Chinese carmakers, as they tend to make cars with engines smaller than 2.5 litres. Foreign carmakers, which make most of the cars with larger engines, will suffer. Imported large-engine cars achieved record sales-growth in the first half of 2008, increasing by 26%, to 80,700 units. Imports of cars with 3-litre engines grew by more than 50%, and imports of sport-utility vehicles were up 79%.

But there were signs of a slowdown even before the new tax. Although the Chinese car market bucked the global trend in the first half, higher fuel costs and tumbling stockmarkets are now putting buyers off. Overall sales are still expected to rise this year by 8-10%, but this is half the level predicted at the start of the year, and far less than struggling foreign carmakers were hoping for.

China's new tax is canny. It cuts fuel use, reduces imports, benefits local carmakers and may help to improve air quality. It also prevents any more pesky calls from Geneva.

Jaguar Land Rover

Now it's personal

Despite hard times for the makers of big cars, JLR is happy under its new owner

WHEN Ratan Tata claimed ownership of Jaguar Land Rover (JLR) from Ford in early June, one of the first visits he made was to the Jaguar heritage museum at the British firm's old site near Birmingham. The 71-year-old Mr Tata recalled that his father had bought one of its first XK120 sports cars in the late 1940s. Not only was the museum able to dig out his father's order from the archives, it also took the chairman of the Indian industrial conglomerate for a spin in a similar car. It was the kind of personal touch that both the tradition-steeped car firm, and its new owner, hope will characterise their relations.

Those relations may undergo an early test. When Tata Motors bought JLR for about $2 billion, it looked like a good deal. Thanks to Ford's transformation of Land Rover, JLR had made profits of $650m in 2007. With its well received new mid-sized saloon, the XF, even Jaguar, a perennial lossmaker under Ford, was close to turning the corner into profit. In the first quarter of this year JLR rang up profits of $421m.

But life has since become much harder for makers of large, powerful cars. In America, where petrol at $4 per gallon means big sport utility vehicles have suddenly fallen from favour, Land Rover's sales fell by 31% in the year to July.

So far, booming demand in Russia (up by 106%) and China (up by 151%) have more or less plugged the gap. Land Rover's overall sales are only 2.7% lower year-on-year than in 2007. But JLR's new boss, David Smith, acknowledges that the second half of the year will be much tougher. Land Rover's production is being scaled back by 25-40%, depending on the vehicle model.

A further worry for JLR is tightening environmental rules in most of its big markets. In Europe carmakers with fleets averaging more than 130 grams of CO_2 per kilometre (g/km) are likely to face financial penalties by 2012. JLR is particularly exposed. Its best CO_2 performer is the diesel Jaguar X-Type, which emits 154 g/km. Its worst is the Range Rover Sport which, in supercharged V8 form, chucks out 374 g/km. Even China has started to tax gas-guzzlers (see box).

Even so, the mood within JLR is upbeat. Nobody at the company will say a bad word about Ford which, it is felt, not only did its best, but is still vital to JLR's future as a supplier of powertrains and technology. But there is inevitably a contrast between the bureaucratic ways of an ailing car giant ▸▸

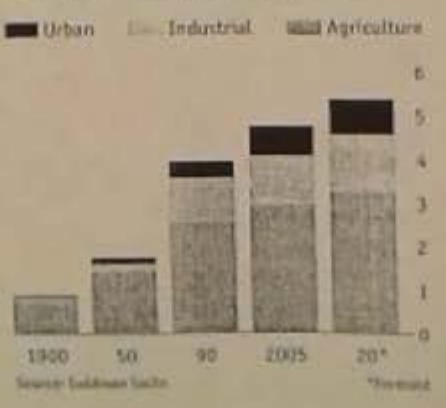
▸ water—for instance, by backing a scheme in Kaladera to teach villagers how to harvest rainwater and irrigate crops more efficiently. "Regulatory licences to water are not enough," says Jeff Seabright of Coca-Cola. "We need a social licence—the OK from the community—to operate."

Cutting water consumption can also make business sense. Using less water reduces spending on water acquisition and treatment, and on the clean-up of wastewater. Some firms have no choice. Elion Chemical in China is working with General Electric to recycle 90% of its wastewater to comply with Beijing's strict new "zero liquid discharge" rules, which bar companies from dumping wastewater into the environment. Of Nestlé's 481 factories worldwide, 49 are in extremely water-stressed regions where water conservation and re-use is the only option.

Such farsightedness is, alas, only a drop in the bucket. In a drought, even water-efficient factories can run into trouble. Moreover, the water used within a factory's walls is often only a tiny fraction of a firm's true dependence on water. José Lopez, the chief operating officer of Nestlé, notes that it takes four litres of water to make one litre of product in Nestle's factories, but 3,000 litres of water to grow the agricultural produce that goes into it. These 3,000 litres may be outside his control, but they are very much a part of his business. ■

Withdrawal symptoms

World water withdrawal, km^3 per year, '000



Source: Goldman Sachs *Forecast

Colorado State University Agricultural Experiment Station

MOUNTAIN MEADOW MANAGEMENT: POTENTIAL IMPACTS TO SURFACE WATER QUALITY

by Joe Brummer
Research Scientist/Scholar III

Mountain meadows are an important forage resource for the livestock industry in western Colorado. Although these meadows are used primarily for hay production and grazing of livestock, they also provide food and habitat for wildlife, delay return flows to streams and rivers through irrigation, and are aesthetically pleasing, which is important for the tourist industry. Forage production from these high elevation grasslands has been improved over time by installing irrigation systems (primarily flood), adding fertilizer and manure, and seeding improved plant species. Return flows from the flood irrigation practices provide a pathway for the added nutrients to reach adjacent waters. Without proper nutrient and grazing management of these meadows, the potential exists to impact surface water quality. To address this issue, two studies were conducted in the Gunnison Basin of western Colorado during the 2000 and 2001 irrigation seasons (White, 2002).

Monitoring Study

The objective of this field scale study was to monitor water quality of irrigation inflows and return flows from three flood irrigated mountain meadows in the Gunnison Basin that had different levels of fertilization and grazing management (White et al., 2004). Site 1 was rotationally grazed from late October to mid May and biennially fertilized with diammonium phosphate (18-46-0), Site 2 was grazed from late October to early June and unfertilized, and Site 3 was grazed for different lengths of time with varying numbers of animals from mid October to mid May and fertilized using various formulations of nitrogen, phosphorus, and sulfur. All three sites were hayed in late July or early August.

Site 3 returned the highest amount of nearly all constituents measured, Site 1 was intermediate in export, and Site 2 ranked lowest in export. Dissolved oxygen concentrations in return flows from all three sites declined over the irrigation season, but river samples were never below the standard, demonstrating re-aeration. Total suspended solids declined quickly and remained at approximately 10 mg L^{-1} throughout the second half of each season, with river samples having the highest levels, inflows having intermediate levels, and return flows having the lowest levels. All three sites were sediment sinks due to the vegetative filtering capacity of mountain meadows. Conversely, total dissolved solids trended upward from very low levels early in the season to maximum levels of approximately 300 mg L^{-1} late in the season. All three sites were sinks for nitrogen because of plant uptake throughout the growing season. The potential for impacts to surface water quality appears to be greatest from fecal coliform and phosphorus additions. A seasonal effect was detected for fecal coliform, with more movement from meadows in the initial flush of irrigation compared to the rest of the season (273 versus 11 cfu 100 mL^{-1} water). At fertilized sites (1 and 3), reactive phosphorus dominated as 70 percent of total phosphorus in runoff, while only 30 percent in return flows at the unfertilized site (2) was as reactive phosphorus. The small amount of reactive phosphorus in return flows from Site 2 was due to the absence of fertilization, creating conditions for a phosphorus sink. Comparing data from this study to data collected 20 years previously revealed phosphorus has increased from 0.004 to 0.061 mg L^{-1} in surface water runoff.

Stream running through a mountain meadow

Use of appropriate best management practices can reduce effects of nonpoint source pollution, and this study determined a need for practices focused on phosphorus and fecal coliform abatement. Specifically, annual soil testing, proper timing and application rates of fertilizer, and appropriate grazing management to keep livestock away from return flow waters during irrigation are recommended.

Fertilizer Runoff Study

Based on results from the monitoring study that pointed to a need to reduce phosphorus runoff, a controlled plot study was conducted to investigate the effects of fertilizer application timing on overland flow water quality (White, 2003). Prior research in mountain meadows has focused on fertilizer use for increased hay yields with little regard for the environmental implications of this practice. Monoammonium phosphate (MAP) fertilizer (11-52-0, N-P-K)

was applied at the rate of 40 kg phosphorus (P) and 19 kg nitrogen (N) ha^{-1} to an irrigated mountain meadow near Gunnison, Colorado in the fall (Oct. 26), early spring (Mar. 20), or late spring (Apr. 23). Overland flow water was applied to each plot for one (1) hour in late April with grab samples of runoff taken for determination of both N and P concentrations.

Application of MAP fertilizer in the fall significantly reduced concentrations of reactive P and ammonium N in irrigation overland flow compared with early or late spring fertilization (Fig. 1). Reactive P loading was nine to almost 16 times greater when fertilizer was applied in the early or late spring, respectively, compared with in the fall. Ammonium N followed a similar trend with early spring loading more than 18 times greater and late spring loading more than 34 times greater than loads from fall-fertilized plots. Losses of 45 percent of the applied P and more than 17 percent of the N were measured in runoff when fertilizer was applied in the late spring.

Previous studies have documented yield advantages for mountain meadow hay production when fertilizers are applied in the fall. Coupled with results from this study, mountain meadow hay producers should apply fertilizer in the fall, especially P-based fertilizers, to improve hay yields, avoid economic losses from loss of applied fertilizers, and reduce the potential for impacts to surface water quality.

Literature Cited

White, S.K. 2002. Mountain meadow management and surface water quality. M.S. Thesis, Colorado State Univ., Fort Collins, Colo.

White, S.K., J.E. Brummer, R.M. Waskom, and W.C. Leininger. 2004. Mountain meadow management as it affects surface water quality in the Gunnison Basin of western Colorado. Colorado Agri. Exp. Sta. Tech. Bull. (In press).

White, S.K., J.E. Brummer, W.C. Leininger, G.W. Frasier, R.M. Waskom, and T.A. Bauder. 2003. Irrigated mountain meadow fertilizer application timing effects on overland flow water quality. J. Environ. Qual. 32:1802-1808.

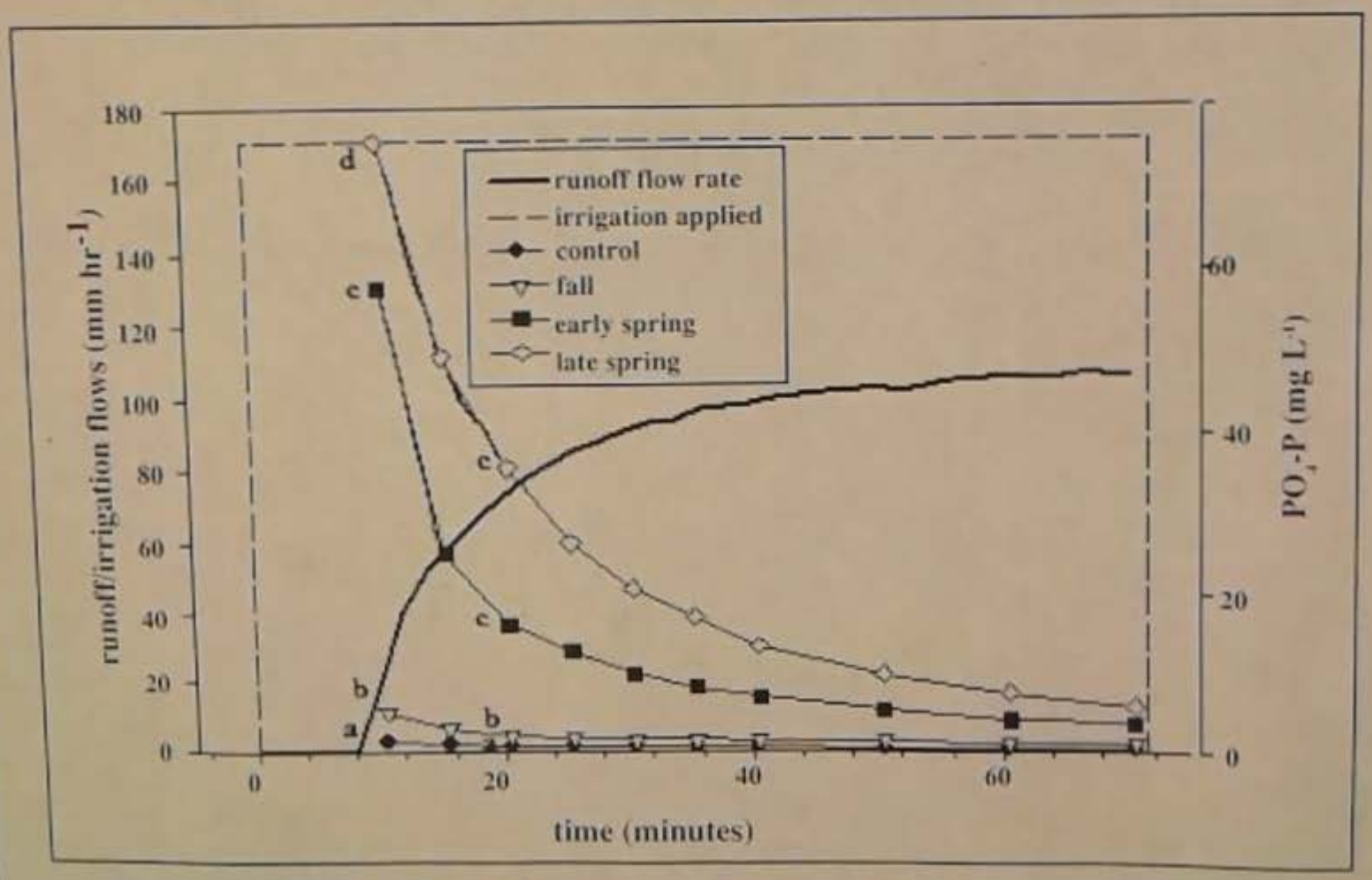


Fig. 1. Runoff hydrograph and reactive phosphorus concentrations in overland flow over the irrigation event as affected by time of application of monoammonium phosphate (11-52-0) fertilizer to a mountain meadow near Gunnison, Colorado. At a given time, means followed by the same letter are not significantly different according to Bonferonni's adjusted probability level of 0.0008 (0.05/60). Mean separations were based on log-transformed data with changes in statistical difference noted by a change in letters.

PUBLICATIONS

ADMINISTRATION UPDATE/WATER RESOURCES

U.S. Geological Survey/Water Use

The U.S. Geological Survey (USGS) has released a report, "Estimated Water Use in the United States in 2000" (USGS Circular 1268, March 2004). The report presents consistent and current water-use estimates by source and by state. The USGS has compiled similar national estimates every five years since 1950. This series of water-use reports serves as one of the few sources of information about regional or national trends in water withdrawals. The report provides information on eight categories of water use – public supply, domestic, irrigation, livestock, aquaculture, industrial, mining, and thermoelectric power. It contains a section on total water use for 2000, followed by more detailed discussions for each category. The final section presents a discussion on trends in water use from 1950 to 2000. Despite growing population and increasing electricity production, water use in the United States remains fairly stable, according to the new report.

The USGS report states that in 2000, Americans used 408 billion gallons of water per day, a number that has remained fairly stable since 1985, which may be a sign that conservation is working. In the report, USGS researchers found that the chief water users for the Nation are power generation, agriculture and public water supply. The report also finds that the personal use of water is rising, but not faster than population change. "It's pretty good news for the nation that despite the increasing need for water, we have been able to maintain our consumption at fairly stable levels for the past 15 years," says USGS Chief Hydrologist Robert Hirsch. "It shows that advances in technology in irrigation and power generation allow us to do more with less water." Power generators make up 48 percent of the usage (withdrawals). Irrigation is 34 percent of the total and public supply (that delivers water to homes, businesses, and industries) accounts for 11 percent of daily water usage. Self-supplied industrial users, livestock, mining, aquaculture and domestic wells, taken together, account for seven percent.

The total quantity of water withdrawn for thermoelectric power for 2000 was an estimated 195,000 Mgal/d, or 219 million acre-feet per year (Maf/yr), with surface sources supplying over 99% of the water. Nearly one-third of that surface water was saline. Thermoelectric-power withdrawals accounted for 48 percent of total water use, 39 percent of total freshwater withdrawals, and 52 percent of fresh surface-water withdrawals. For 2000, public-supply withdrawals were an estimated 43,300 Mgal/d, or 48.5M af/yr, about 13 percent of total freshwater withdrawals. Some 240 million people depended on public water suppliers, with 63 percent from surface sources.

Irrigation withdrawals for 2000 were estimated to be 137,000 Mgal/d, or 153 million af/yr, accounting for some 40 percent of total freshwater withdrawals and 65 percent of total freshwater withdrawals for all categories excluding thermoelectric power. About 61.9M acres were irrigated in 2000 – 29.4M acres with surface flood systems; 28.3M acres with sprinkler systems; and 4.18M acres with micro-irrigation systems. Application rates were calculated by dividing total withdrawals by irrigated acres. The average application rate was 2.48 af/acre. The majority of withdrawals (86 percent) and irrigated acres (75 percent) were in the seventeen Western States. Surface water accounted for 58 percent of withdrawals, and is the primary source in the arid West and the Mountain States. Ground water was the primary source in the Central States. California, Idaho, Colorado and Nebraska combined accounted for one-half of the total irrigation withdrawals. California and Idaho accounted for 40 percent of surface irrigation withdrawals, and California and Nebraska, 33 percent of ground water withdrawals.

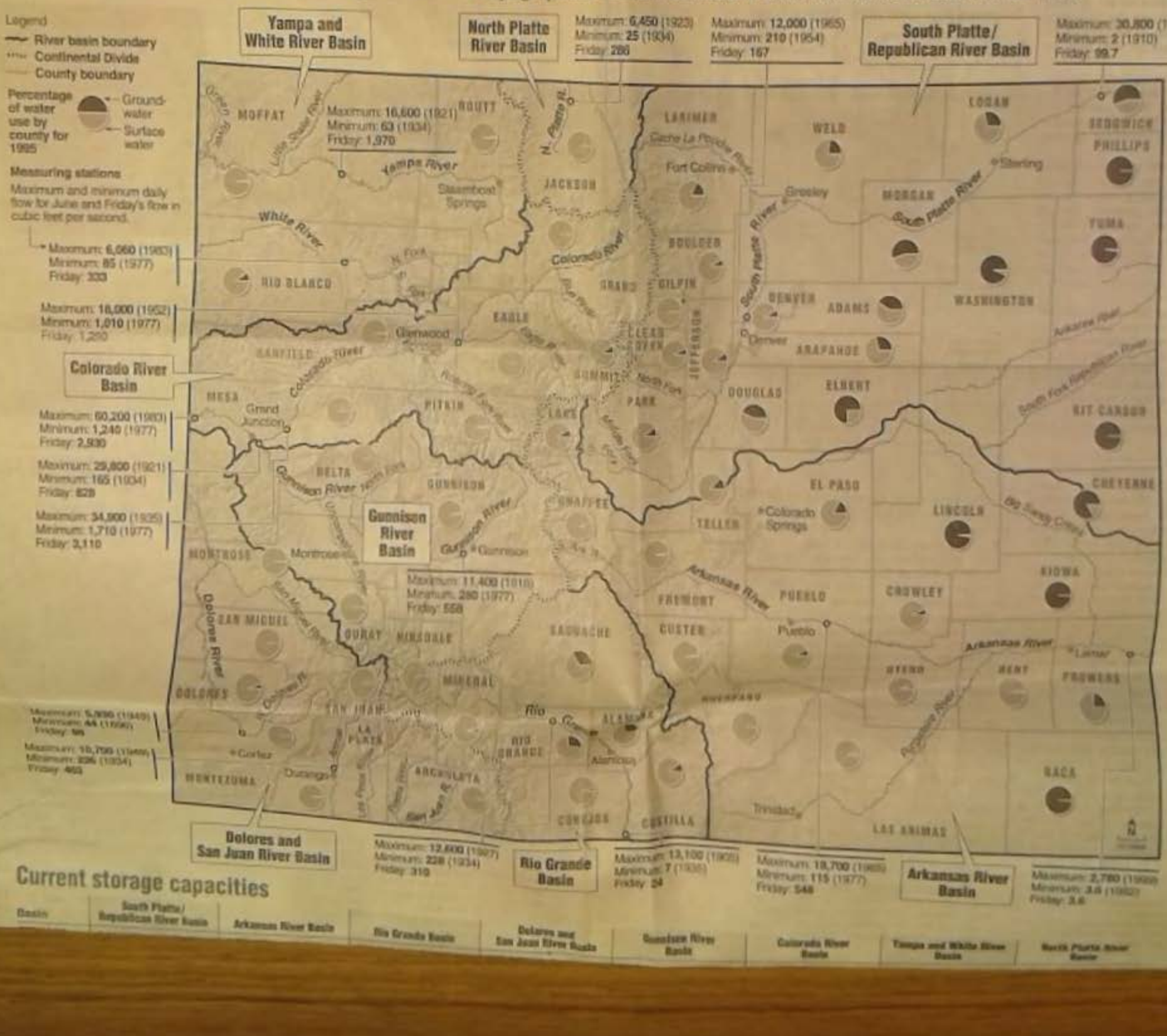
California, Nebraska, Texas, Arkansas, and Idaho accounted for 53 percent of total irrigated acreage. In Arizona, Montana, and Idaho, application rated exceeded five af/acre. States that utilize the High Plains Aquifer (Nebraska, Texas, Kansas, and Oklahoma) for irrigation relied mostly on ground water and had application rated ranging between 1 and 2 af/acre. Estimates of total irrigation withdrawals were about 2% more than 1995. Surface-water withdrawals were about five percent less, but ground-water withdrawals are up 16 percent.

"Sound planning for water depends on a sound understanding of the Nation's water resources and a sound understanding of how people will use water in the future," Hirsch said. "This study will help the public, decision makers, engineers and scientists better understand water use, aid in the development of long-term national water policy and ensure that information is available to take proper steps now to ensure water availability for future generations of Americans."

The report is available at http://pubs.water.usgs.gov/circ1268 and http://water.usgs.gov/pubs/circ/2004/circ1268. Additional waste use information is available at: http://water.usgs.gov/wateuse/
Source: *Western States Water /U.S. Geological Survey/ Special Report #1557 / March 19, 2004*

Colorado: scarce water in a thirsty state

Water that flows from Colorado's mountains is a commodity every bit as valuable and treasured as the ore mined by some of the state's earlie settlers. Farmers and ranchers from the parched Eastern Plains to the high-mountain desert of the Western Slope, along with more and more cit dwellers, depend on water that is banked each winter as snowpack before it begins flowing downhill in the spring. The state has eight major river drainages, each defined by mountain or topographical boundaries. Here is a look at how Colorado's rivers flow.



Current storage capacities

Basin	South Platte/ Republican River Basin	Arkansas River Basin	Rio Grande Basin	Dolores and San Juan River Basin	Gunnison River Basin	Colorado River Basin	Yampa and White River Basin	North Platte River Basin

80

Dams in disrepair

198 dams in Colorado restricted for safety reasons

By ERIN McINTYRE
The Daily Sentinel

Rebuilding a 100-year-old earthen dam is no picnic. But sometimes it's necessary.

That's what the Surface Creek Ditch and Reservoir Co. discovered in its rehabilitation of Hotel Twin Lake's dam on Grand Mesa.

After years of seepage, and increased concern from the Gunnison River Basin's Division of Water Resources Dam Safety Engineer, shareholders in the Surface Creek Ditch and Reservoir Co. decided it was time to dig out the old muck and fix the saturated dam.

The company figured it was the best time to fix the dam, given the drought season and the U.S. Forest Service's plan to resurface Trickle Park Road.

"We thought it might be an opportune time to work on it. We have a lot of traffic across that dam and the dam was not originally designed to carry the traffic," said Jerry Figueroa, Surface Creek Ditch and Reservoir Co. board member.

"Ideally when you have a dam and you have a road structure on it, you want to fix them at the same time," he said.

The rehabilitation of the dam is expected to be completed this fall, and hopefully enough snow will fall this winter to fill the 460 acre-foot reservoir.

Downstream users in the Surface Creek Basin are thirsty enough for the water that they decided it was essential to fork over the $200,000 for the dam repair.

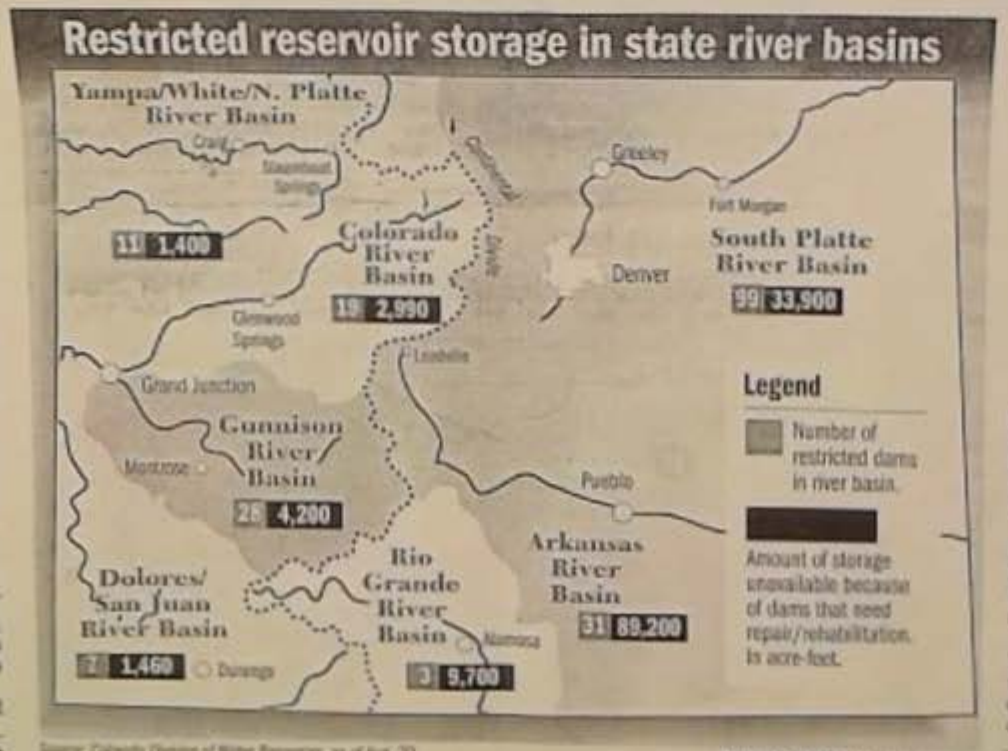
And many of them remember the Lenoux Creek dam breach in spring 1988, when a 12-foot wall of water burst through an earthen dam and rushed downstream, so safety is an important issue to them.

This dam is one of 38 restricted

See DAMS, page 4A ➤

THE HOTEL TWIN LAKE'S dam on Grand Mesa is getting rehabilitated to the tune of $200,000. The drought and the U.S. Forest Service's plan to resurface Trickle Park Road prompted Surface Creek Ditch and Reservoir Co. to update the 100-year-old dam.

CHRISTOPHER TOMLINSON
The Daily Sentinel



Source: Colorado Division of Water Resources, as of Aug. 20

ROBERT GARCIA/The Daily Sentinel

Drought brings fights over rights to last drop

By THE ASSOCIATED PRESS

Not a day goes by when attorney Tim Buchanan isn't deluged with calls from his hundreds of clients. He hears accusations of theft and negligence. He responds with threats of lawsuits and fines.

Yet Buchanan isn't a criminal lawyer. His clients are farmers. His specialty is water, a commodity that grows more precious as drought grows more severe.

"There's a lot of land in the West, but not a lot of land that has water," said Buchanan, of Arvada. "It is crucial to the economy and lifeblood of Colorado and the

See FIGHTS, page 4A ➤

Daily, 30,738; Sun, 34,621
Colorado Press

DAMS: Rehabilitations could increase storage capacity for reservoi

➤ Continued from Page One

storage projects in the Gunnison River Basin, according to the Colorado State Engineer's Office, which monitors water availability, flows and storage throughout the state.

As of Aug. 20, the State Engineer's Office reported that 198 dams across Colorado are restricted, meaning they need to be fixed or rebuilt, mainly for safety reasons.

The cost to repair or rebuild all 198 projects is still being studied. At this point, officials are still examining which projects are worth rehabilitating. The total amount of storage available in those 198 projects adds up to 142,850 acre-feet, according to the State Engineer's Office. An acre-foot is equal to 325,851 gallons.

The State Engineer's Office classified 45 projects across Colorado as "recoverable storage with reasonable repair/rehabilitation" with a cost to fix them of $10 million.

The State Engineer's Office classified the 45 recoverable-storage projects by basin. There are an estimated recoverable 7,750 acre-feet in the Colorado River Basin, and an estimated recoverable 240 acre-feet in the Gunnison River Basin included in those projects.

"It seems to me the drought is hitting everybody, and I think everybody's going to look at these options very, very seriously."

ROBERT WARD
Colorado Water Resources Research Institute director

With the rehabilitation of those 45 projects, Colorado's reservoir storage capacity could increase by an estimated 25,060 acre-feet, according to the State Engineer's Office.

In this drought year with record low precipitation and dwindling supplies of stored water, there are basically three options as far as projects are concerned, said Robert Ward, director of the Colorado Water Resources Research Institute at Colorado State University.

First, there's the list of old projects that need to be fixed. The 198 projects across the state that have a combined 142,850 acre-feet of storage capacity fall into that category.

"I think it oughta be our first priority," said Wayne Schieldt, division engineer for the Gunnison River Basin. Schieldt said fixing existing projects is more cost-effective than embarking on new projects, because of their research, study and start-up costs. However, officials first must determine which projects are cost-effective to rehabilitate.

The second list includes existing projects that could be expanded to hold more water. Officials with the U.S. Bureau of Reclamation are looking at this option in the Fryingpan-Arkansas Project in Pueblo and Turquo reservoirs.

The third list includes n projects — such as the Big Str a proposal to pump water fr the Utah state line back to t Continental Divide. The Colora Water Conservation Boa agreed to move ahead with study of the Big Straw in Jul with an estimated cost of as muc as $500,000. Appropriations cor mittees in the state Legislatu still need to approve the use o those funds.

Ward said the drought wi most likely prompt water user and officials across Colorado t look at all three options, and ther wait for precipitation.

"It seems to me the drought is hitting everybody," said Ward, "and I think everybody's going to look at these options very, very seriously."

"I'll almost bet that some combination of taking care of safety issues (at restricted dams), expanding reservoirs that exist and building new ones will be what happens," Ward said.

■

Erin McIntyre can be reached via e-mail at emcintyre@gjds.com.

FIGHTS: Western water law is simple: First-come, first-served

➤ Continued from Page One

other Western states."

This year his skills are in demand like never before, as dwindling streams leave water users fighting for every last drop under the Western states' complicated water laws.

There are senior water rights and junior rights. Water courts with water judges and even water referees.

It's all meant to help sort out who gets how much water — or, in times of drought, who doesn't get any.

"Now, neighbors tend to fight more," said Gregory Lyman, a water judge in southwestern Colorado. "They're out there farming their land trying desperately to get the water they're entitled to. When they first get into court they're hopping mad."

The basic tenet of Western water law is simple: First-come, first-served, or "first in time, first in right." In other words, the first person to divert water from a stream and put it to good use is entitled to that water regardless of subsequent claims.

The first person to stake a claim is the "senior appropriator," with the most senior water rights. Those who come later are "junior appropriators."

Water rights can be transferred, sold, even rented. In the Denver area, according to Buchanan, water rights sell for $4,000 to $12,000 per acre-foot, the amount of water it takes to cover one acre one foot deep.

It's a uniquely Western tenet.

"It all started with the miners in the Gold Rush period," said David Getches, a water law professor at the University of Colorado. "The first one to get to the gold could develop the gold. They treated water the same way. The first one to stake a claim on water got the water."

In the East, water rights were determined by land ownership. People who owned land next to a stream or lake had a water right.

The Eastern system also considers water communal property and requires sharing. In times of drought, everybody cuts back.

Not so in the West; "first in time, first in right" takes precedence even during dry spells.

That's when things get complicated — and contentious.

"You have this situation in drought where some people with water rights get no water at all," said Getches. "There are more water rights existing on a stream than there is water."

"The value of water is shown by the amount of effort people are willing to take to acquire it," said Ken Beegles, a state engineer charged with managing water use in southwestern Colorado. "We do have violence threatened sometimes."

Several states are reviewing the system. Idaho courts are sorting through 170,000 claims to water rights on the Snake River, while more than 200,000 claims to Montana's river basins are under inspection.

Some, like Getches, say the system must be overhauled to place greater priority on urban needs. He notes that up to 90 percent of the water diverted from streams in the West is for agricultural use.

"Any time you see a city that claims it's short of water, it's not because the stream is dry but because someone else has senior rights," he said. "And that somebody is almost always agriculture."

Others maintain that the system works, if the rules are followed.

"It's not a pleasant thing to do to fight your neighbor over a water right," said Griffith. "But agriculture is here to stay. We have to feed people. This land is worth $2,000 an acre. Without the water, it would be $200. It's something you have to fight for."

TABLE 6-2: Conceptual Water Treatment Alternatives Operations and Maintenance Costs

Treatment Alternative - 230 MGD				
	1	2	3	4
PARAMETERS	**UF/NF/UV**	**C/S/LS/F/UV**	**C/S/F/NF/UV**	**LS/F/UV**
Pretreatment ($/yr)	$13,400,000	$12,500,000	$10,900,000	–
Advanced Treatment ($/yr)	$38,900,000	$26,000,000	$38,900,000	$28,100,000
Post Treatment ($/yr)	$14,900,000	$9,300,000	$14,900,000	$9,300,000
Residuals Handling ($/yr)	$700,000	$5,300,000	$2,200,000	$5,100,000
SUBTOTAL ($/yr)	***$67,900,000***	***$53,100,000***	***$66,900,000***	***$42,500,000***
SUBTOTAL ($/kgal)*	***$0.81***	***$0.63***	***$0.80***	***$0.51***
Treatment Alternative - 460 MGD				
	1	2	3	4
	UF/NF/UV	**C/S/LS/F/UV**	**C/S/F/NF/UV**	**LS/F/UV**
Pretreatment ($/yr)	$23,500,000	$24,700,000	$21,000,000	–
Advanced Treatment ($/yr)	$76,300,000	$51,800,000	$76,300,000	$55,900,000
Post Treatment ($/yr)	$29,000,000	$17,800,000	$29,000,000	$17,800,000
Residuals Handling ($/yr)	$1,400,000	$10,400,000	$4,300,000	$10,200,000
SUBTOTAL ($/yr)	***$130,200,000***	***$104,700,000***	***$130,600,000***	***$83,900,000***
SUBTOTAL ($/kgal)*	***$0.78***	***$0.62***	***$0.78***	***$0.50***
Treatment Alternative - 690 MGD				
	1	2	3	4
	UF/NF/UV	**C/S/LS/F/UV**	**C/S/F/NF/UV**	**LS/F/UV**
Pretreatment ($/yr)	$33,800,000	$37,000,000	$31,200,000	–
Advanced Treatment ($/yr)	$113,700,000	$77,700,000	$113,700,000	$83,800,000
Post Treatment ($/yr)	$43,000,000	$26,200,000	$43,000,000	$26,200,000
Residuals Handling ($/yr)	$2,000,000	$15,400,000	$6,300,000	$15,300,000
SUBTOTAL ($/yr)	***$192,500,000***	***$156,300,000***	***$194,200,000***	***$125,300,000***
SUBTOTAL ($/kgal)*	***$0.76***	***$0.62***	***$0.77***	***$0.50***

* $/Kgal is the cost of treatment operations in dollars per thousand gallons treated.

Capital cost opinions are based on preliminary identification of major equipment and conceptual flow diagrams. Residual storage ponds have been calculated assuming a 3.5 ft/yr evaporation rate and construction of 6' deep lined ponds at $5,200 per af. Capital costs listed in these tables include only direct construction costs. Indirect costs including engineering, legal, financial, are included in the overall project cost summary tables presented later in this chapter. The costs presented in this report are preliminary in nature because equipment selection and engineering design activities have not been performed.

Alternative 1 is the highest cost alternative and is used to compute total project cost in the rest of this chapter. This approach provides a potentially conservative estimate of treatment costs considering that one of the other alternatives or a completely different treatment process may be selected in future studies or in final design.

Multiple alignments were developed in each corridor between the diversion and delivery points. The following sections provide general descriptions of the alignments and the specific issues that affected the alignment development. The alignments are shown on Figures 6-1, 6-3 and 6-5.

North Corridor

Alignments in the north corridor head north from the diversion point towards the Demaree Canyon Wilderness Study Area. The alignments diverge around both the west and east side of the Wilderness Study Area. The alignments include tunnels through the ridge on both sides of Douglass Pass and then continue down drainage draws where they meet between Rangely and Meeker. The alignments in this corridor must travel as far north as Meeker in order to allow passage around the Flat Tops Wilderness area.

Once the alignments reach Meeker they generally follow a power transmission line east and slightly north. These alignments also stay just north of the White River and Routt National Forests, which was not a driving criteria of the alignment selection, but would offer some benefits in permitting.

Near Dunckley the alignments diverge and present several alternatives to get to Kremmling. Some of the alignments follow the railroad, highway and power transmission corridors, while others follow minor roads.

Once the alignments reach Kremmling they generally follow the State Highway 9 corridor past Green Mountain Reservoir to Silverthorne. The alignments then follow the State Highway 91 corridor to Climax over Fremont Pass. The alignments would branch at Climax traveling to both the South Platte Basin and to the Arkansas Basin.

The South Platte Basin alignment would tunnel through Mt. Democrat for delivery into Platte Gulch, which is a tributary to the South Platte River.

The Arkansas River Basin alignment would continue along the State Highway 91 corridor and discharge into the East Fork of the Arkansas River.

Central Corridor

Alignments in the central corridor begin at the diversion point and head generally east towards De Beque and remain north of the Little Bookcliffs Wilderness Study Area. The alignments vary from the I-70 corridor between the diversion point and De Beque. The Bookcliffs are the first major obstacle encountered. The topography generally rises in elevation to the east with increasingly deeper washes along the base of the Bookcliffs. The alignments include tunnels through the Bookcliffs and then continue towards De Beque where they meet up with the I-70 corridor again. The topography is decreasing in elevation from the Bookcliffs to De Beque. Near DeBeque the alignments diverge into a northern and southern set of alignments.

The northern set of alignments within the Central Corridor continue along the I-70 corridor toward the Grand Hogback between Silt and New Castle. At this point the alignments travel southeast to avoid the hogback and Glenwood Canyon. Alignments through Glenwood Canyon were not developed due to the rough terrain and congestion that would require extremely high construction costs. An alignment through Glenwood Canyon would not significantly reduce the length of pipe needed, but would allow a more gradual profile and eliminate the need for several tunnels. Future studies could consider an alignment through Glenwood Canyon, but a great deal of site

investigation to quantify the impacts of congestion and geotechnical issues on the project cost would be required. Alignments to the north of Glenwood Canyon were not evaluated due to the rugged terrain in this area.

From a point south of Glenwood Canyon traveling in a straight line mostly east and a little south would take the alignment straight to the delivery points. However, this straight line would cross through the Holy Cross Wilderness Area. Therefore, to avoid the wilderness area, the alignments generally travel back to the I-70 corridor near Eagle.

East of Eagle the alignments vary from the I-70 corridor to allow passage through Bellyache Ridge. The alignments follow Brush Creek to a tunnel through Bellyache Mountain and then head back toward the I-70 corridor east of Edwards.

The alignments continue along the I-70 corridor to Minturn with relatively gradual rise in topography. At Minturn the alignments head southeast along the US Highway 24 corridor through Redcliff and Gillman to Eagle Park. The stretch between Gillman and Redcliff includes a very narrow canyon that would involve some difficult construction. An existing railroad grade that may not be in use may provide a possible alignment. A tunneling option may also be attractive to get through this area. Additional study would be required to optimize passage through this area.

At Eagle Park the alignments split heading southeast for delivery to the South Platte River Basin and south for delivery to the Arkansas River Basin. The South Platte Basin alignment would travel to the Climax Mine site and then tunnel through Mt. Democrat for Delivery into Platte Gulch which is a tributary to the South Platte River. The Arkansas River Basin alignment would continue along the US Highway 24 corridor with a tunnel through Tennessee Pass and deliver to East Tennessee Creek, which is a tributary to the Arkansas River.

The southern group of alignments in the central corridor generally follow Plateau Creek toward Carbondale. The alignments then generally follow the Roaring Fork River to Basalt. Some alignments continue along the Roaring Fork toward Aspen while others follow the Frying Pan River towards Ruedi Reservoir. Both groups come together and head east towards Leadville, where deliveries can be made into the Arkansas River basin. The alignments continue east through the Mosquito Range allowing delivery to the South Platte River basin.

South Corridor

Alignments in the south corridor travel southeast along the I-70 corridor from the diversion point to about five miles east of Grand Junction. The alignments then travel south toward the US Highway 50 corridor. The alignments follow the US Highway 50 corridor toward Delta staying north of the Dominguez Canyon Wilderness Study Area and south of the Adobe Badlands Wilderness Study area. The alignments diverge around the north and south of Delta.

The northern alignments travel along the State Highway 92 corridor to Paonia. The alignments then travel south of the Oh-Be-Joyful Wilderness Study Area and north of the Fossil Ridge Wilderness Study area toward Crested Butte. These alignments offer two basic passages around the north of the Fossil Ridge Wilderness with a northern alignment heading straight east just south of Taylor Park Reservoir. Two alternatives are identified for travel across the Sawatch Range. One includes tunneling and another option includes traveling over Cottonwood Pass.

From Crested Butte another alternative travels to the south, then up Taylor Canyon and tunnels through the Sawatch Range to join the other alignments described in the previous paragraph.

All of these alignments remain south of the Collegiate Peaks Wilderness Study Area and head toward Buena Vista. At Buena Vista the alignments would discharge into the Arkansas River and continue towards Antero Reservoir allowing delivery into the South Platte River Basin.

Back near Delta, the other southern alignment follows the US Highway 50 corridor to Blue Mesa Reservoir. Several alternatives are evaluated for passage around the south of Blue Mesa Reservoir. On the east side of Blue Mesa Reservoir the alignment diverges to the north and meets up with the previously described northern alignments in this corridor.

Other alternatives continue east along the US Highway 50 corridor south of the Fossil Ridge Wilderness Study Area and then travel northeast with delivery to the Arkansas River just south of Buena Vista and ultimately delivering to the South Platte basin near Antero Reservoir.

Along each pipeline alignment approximate ground elevations were identified and a ground profile of the alignment was created. Pipeline diameters were chosen to maintain fluid velocities at approximately six feet per second. The rationale for the selected fluid velocity and the affect of reducing pipe diameter and increasing fluid velocity is discussed later in this report. Table 6-3 summarizes the pipe diameters and corresponding fluid velocities analyzed for each project delivery capacity.

Table 6-3: Pipe Diameter and Fluid Velocity

Project Delivery Capacity (af/yr)	Inside Pipe Diameter (feet)	Fluid Velocity* (Feet per second)
250,000	8.5	6.3
500,000	12	6.4
750,000	15	6.1

*Based on providing project delivery capacity over 50 weeks during the year

Pump stations and hydropower facilities were added as discussed in Chapter 2. The pipeline alignments include large changes in elevation, which result in large variations in operating pressures ranging from 0-600 psi. For a given pipe diameter, the cost of the pipe varies with operating pressure. Hydraulic grade lines were computed to determine required lengths of pipe for each pressure rating. Headloss through the pipeline was calculated using Mannings equation with a friction coefficient of 0.011 which is a typical value for polyurethane lined pipeline. Lining alternatives are discussed later in this chapter. The operating pressure in each section of pipe was determined as the difference in elevation of the hydraulic grade line and the ground profile. A minimum pressure of 10 psi was maintained in the pipeline. The quantity of pipe in each operating class in 50-psi increments was summarized from the hydraulic calculations in order to allow costing of the pipe. Example profiles representative of alignments in each corridor are shown in Figures 6-2, 6-4, and 6-6.

For the purposes of this reconnaissance study, the use of welded steel pipe has been assumed. Welded steel pipe is manufactured by shaping steel plate to form a cylinder and welding the plates together. The most efficient method of constructing steel pipe is with a machine that bends the steel plate in a spiral manner and welds the seams together. This method is currently utilized by most steel pipe manufacturers for pipe diameters up to twelve feet in diameter and steel plate thicknesses up to one-inch.

Several steel pipe suppliers were contacted during the study to identify manufacturing issues associated with this project. Most suppliers are currently capable of producing spiral welded steel pipe up to 12 feet diameter with

thickness up to one inch. Most suppliers indicated they could likely build machines to spiral weld up to 15 feet diameter, thickness up to one inch.

Thickness over one-inch would have to be fabricated from steel plates and would require a greater amount of fabrication. The additional fabrication would cause slower production rates and handling issues resulting in increased cost and delivery times. During the development of the alignments effort was made to minimize the amount of pipe required that is greater than one-inch thick. This is accomplished by adding pumping stations and hydropower facilities in order to reduce the operating pressure.

Future analysis should be conducted to further reduce the amount of pipe with wall thickness greater than one inch. One possible method to accomplish this would be to utilize higher strength steels, which is a common practice in the design of oil and gas pipelines. However, this tends to reduce the ductility of the steel making the pipe stiffer and can degrade the longevity of the lining. The concept of installing two smaller parallel pipes should also be evaluated as an alternative for the thicker wall pipes. The installation costs of pipe would be higher, but the cost of the pipe itself may be lower. This analysis is discussed in later chapters.

The following assumptions were developed from data provided by the pipe suppliers and were used for calculating the cost of bare steel pipe including raw materials, fabrication and a small allowance for fittings, assuming alignments with mostly gradual direction changes.

- Calculate cost of steel using $0.20 per pound.
- Fabrication for spiral welded pipe equal to 2.2 times the cost of the steel.
- Fabrication of steel plate into "pipe cans" (thickness over one inch) equal to 2.7 times the cost of steel.

There are several options for coating and lining steel piping for this application. Polyurethane linings are higher in cost than conventional cement mortar lining, but may result in lower friction losses and possibly reduced scaling potential. Reduced friction losses would reduce power consumption and/or pipe size that could have significant cost impacts. Cement mortar applied in the factory would add significant weight to the pipe, creating additional handling and shipping costs. Field application of cement mortar would be feasible and coal tar might be an option for lining as well. Analysis for this study is based on polyurethane lining and tape coating as a conservative estimate. More detailed cost-benefit analysis should be conducted to identify the best alternative. The following unit cost assumptions were utilized for the lining and coatings.

- Polyurethane lining (AWWA 222) - $1.75 per sq ft
- Tape coating system (AWWA C214) - $1.60 per sq ft

During discussions with steel pipe suppliers, freight was identified as a significant issue. For the larger diameter pipe, custom designed trucks would be needed to haul the pipe to allow proper clearances and permitting for travel.

Suppliers indicated that it may be cost effective to construct a pipe fabrication plant somewhere on the western slope to reduce the shipping distances of finished pipe. Timing would require about 18 months to get a new plant online. The new plant would require rail service to deliver steel and typical industrial 480 Volt, 3-phase power service.

Costs are based on shipping from less than 500 miles. This would allow pipe to be shipped from several existing suppliers or a new manufacturing facility. Pipe could be shipped from farther away, but may add cost to the project. The following assumptions were utilized for the unit costs for shipping pipe based on data provided by suppliers and are shown in Table 6-4.

Table 6-4: Pipe Shipping Costs

Diameter (Feet)	Shipping Cost per Foot based on Pressure		
	0 - 300 psi	300 – 450 psi	450 – 600 psi
8.5	$8	$10	$12
12	$13	$19	$25
15	$19	$27	$33

Effort has not been made in this study to identify the appurtenance items that are typically required on this type of pipeline. These items would potentially include the following:

- Miscellaneous vaults
- In-line valves
- Air and vacuum valves
- Cathodic protection
- Piping identification

An allowance of five percent of the total pipeline construction cost has been added to each alternative to account for these items. Surge suppression systems for pipeline protection have been included with the pumping stations.

A baseline installation cost is initially calculated that would assume relatively easy pipeline construction. This would include enough access for construction, minimal rock, minimal groundwater and a cover depth not to exceed 10 feet. More challenging construction conditions are discussed in later sections of this chapter.

A typical unrestricted section showing the pipe trench and construction area is detailed in Figure 6-7. Construction easements for each pipe size are as follows:

- 8.5 feet diameter = 210 feet
- 12 feet diameter = 230 feet
- 15 feet diameter = 250 feet

Trench excavation assumes that sidewalls will be constructed at 1:1.5 slopes. Areas required for stockpiling have been calculated assuming the piles will hold at 1:1.5 slopes. Unit costs for installation were derived from industry standard data, and input received from several contractors. The following unit costs are estimated for each pipe size and comprise the total baseline installation cost estimated for the construction:

- Pipe excavation has been estimated at $3.20 per cubic yard
- In order to be conservative, it has been assumed that imported material will be required for pipe bedding. Import material (assuming a squeegee, sand and fine gravel, type material) placed and compacted has been estimated at $23.50 per cubic yard. Future studies, if conducted, should evaluate processing on-site materials which could reduce the material cost and reduce spoils disposal costs.
- Pipe installation, including setting and joint repair, has been estimated at $73/foot.
- Welding is a function of pipe thickness and diameter. The composite rate of $0.35/ft/inch diameter/inch thickness was utilized. This assumes an average length between joints of 40 feet.
- Backfill of the native material including compaction has been estimated at $1.80 per cubic yard.

Due to the large number of alternatives and the long lengths of these alternatives, effort has not been made to identify the costs associated with conditions that differ from the baseline installation case. These conditions would consist of the following items:

- Construction area less than the typical
- Excavation of rock
- Groundwater
- Existing infrastructure (pavement replacement, surface restoration, etc.)
- Stream, canal or utility crossings

An allowance of fifteen percent of the pipeline construction cost has been allocated to account for these items. Future studies would need to perform site and geotechnical investigation to more accurately account for these items.

An annual allowance for pipeline and appurtenance maintenance and replacement has been assumed to be one-half percent of the pipeline initial construction cost has been included in the operations and maintenance cost of each alternative.

The pumping stations were located along the alignments as discussed previously. For each pumping station the total dynamic head was calculated based on the difference in elevation between the pump discharge hydraulic grade line at the pumping station and the ground elevation of the pumping station. This assumes a forebay will be utilized at each pumping station. Utilizing the total dynamic head and the flow rate for each flow scenario the required water horsepower needed was calculated. For planning purposes pumping equipment efficiency of 85 percent was utilized to determine the total motor horsepower required for each station. For calculating power use for operating costs a motor efficiency of 95 percent was utilized.

A conceptual plan was developed for a typical pumping station for the 500,000 af per year alternative, which is shown in Figure 6-8. The number of pumps installed in the pumping station should have sufficient capacity in the event one or more pumps are out of service. The level of redundancy increases with the number of pumps installed. However, the building size and level of maintenance also increases with the number of pumps installed. The minimum number of pumps considered was two pumps and the benefits of adding additional pumps diminish beyond sixteen. Ten pumps were utilized in each station for the purposes of this study. Therefore, if one pump were out of service, the pumping station could still operate at 90 percent capacity. Future studies should identify the optimal number of pumps that should be installed at each pumping station.

Since the delivery capacity of the system has been assumed to be fairly constant, variable frequency drives or pressure/flow control valves would not be needed. Incremental flows could be obtained if needed by running fewer pumps, particularly since the friction losses are fairly small as compared to the static head.

A preliminary cost estimate was prepared for the conceptual pumping station layout shown in Figure 6-8 and 6-9. Manufacturers of pumping and electrical equipment were contacted in order to obtain the budgetary information used in this estimate. The cost estimate indicates a total cost of $72 million for a total pumping station horsepower of 140,000 HP. This results in a unit cost of $515/HP which is consistent with historical costs associated with large pumping station projects. This unit cost for pumping stations was utilized to identify the costs for each pumping station in each alternative.

Additional major items included in the conceptual pumping station include piping, valves, the building and support systems, controls and hydraulic transient mitigation measures. Piping in the pumping station was assumed to be welded steel pipe with polyurethane lining and painted on the exterior. Manufacture of the pipe would be similar to the rest of the piping on the project with the additional fabrication costs due to the large number of fittings such as tees and bends.

Valves would be needed for isolating pumps and preventing water from draining through the pumps when not operating. A combination of manual valves and power actuated valves would likely be utilized. Power actuated valves could be electrical or hydraulic and would be controlled by the pumping station control system. Manual valves would allow isolation in the event the actuated valves were not functioning properly or required maintenance. Valve types would likely be ball, spherical or metal seated butterfly valves. For the purposes of cost estimating, cone valves have been utilized. It should be noted that the piping and valves in and near the pumping station, to any points in the system where a valve could be shut while the pump(s) are operating, would have to be