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Ripple Effect
As knowledge of ancient droughts trickles down, water managers prepare for a statewide shortage

December 9, 2007
By Joe Hanel | Herald Denver Bureau

CORTEZ - T he ashes from the last meal are still in the hearth some 700 years later.

The players

Keeping track of every board that makes water decisions in Colorado isn't always easy. The major ones:

- Colorado River Water Conservation District. Chartered by the Legislature in 1937 to protect and develop water across most of the Western Slope. It oversees the Colorado River, as well as the Yampa, White and Gunnison rivers. It can hold water rights.

•Southwestern Water Conservation District. The equivalent of the Colorado River Water Conservation District for Southwest Colorado. Its major rivers include the San Juan, Animas, La Plata and Dolores. This board collects property taxes and oversees smaller water districts. Southwestern was the driving force behind the Animas-La Plata Project.

- Colorado Water Conservation Board. This governor-appointed board protects and develops water on a statewide basis. This year it funded $150 million in water projects, paid for by the tax on oil and gas production. The CWCB holds rights to keep water in rivers for the benefit of fish and the environment.

- Interbasin Compact Committee and Basin Roundtables. The newest force in water politics. The state's seven major river basins plus metro Denver have roundtables that attempt to get diverse people -farmers, city utilities and environmentalists - to sit down at the same table and reach a consensus. The Interbasin Compact Committee seeks to do the same thing on a statewide basis. Eventually, it is supposed to work toward long-term solutions to Colorado's water dilemma.

- State engineer (also known as Division of Water Resources). Administers water rights. Division engineers (Division 7 in Durango) oversee each of the state's major river basins.

- Colorado Water Congress. A nongovernmental group of water providers and experts. The CWC reviews legislation and lobbies at the Capitol, where it is an influential voice.

The menu was mostly wild plants and wild game - deer, pronghorn, a bighorn sheep. It was quite a change for these farmers who over the centuries had become experts at raising corn and turkeys on the dry mesas of Southwest Colorado.

But in 1276, a drought hit. The crop failed. They ran out of turkey meat.

Kristin Kuckelman has spent 19 years at the Crow Canyon Archaeological Center studying the ancestral Puebloan people. She has studied the desertion of Sand Canyon Pueblo, a village of 400 to 600, about the year 1280.

She found that the pueblo lasted only about 25 years, but by the very end its residents had a change in their diet: from farming to hunting and gathering.

It was an unusual shift. Times had been good. They had successful crops, and many babies. But as their civilization grew, they put themselves at risk by depending on one crop.

Kuckelman thinks the village was abandoned by 1280, after attackers killed many of the inhabitants who tried to stick out the drought.

"If that crop fails - maize - the whole system falls apart because they can't feed themselves on their turkeys," Kuckelman said.

She thinks the crop failure and diet changes were "very likely the result of climatic deterioration."

Warmer, drier times

Seven centuries later, the climate seems to be changing again.

The days are getting hotter, and the snow is melting faster. The North American growing season has extended an average of two days a decade since the 1950s, mostly because of springtime warming, according to the Intergovernmental Panel on Climate Change. The Southwest has been in a drought for seven years, and 2002 was one of the two or three driest years since the 1500s.

That's not good news for the Colorado River Basin - which includes the Four Corners.

Some water managers have started to say what was once unspeakable: We might be running out of water.

"You don't have to look too deeply to give yourself a good scare," said Mark Waage, Denver Water's manager of raw water supply. "It's hard to ignore, all the evidence and projections coming out, particularly in the last year."

About 1.1 million people count on Waage for their water. Almost half of that water comes from the Colorado River Basin. He has read several studies that say global warming will harm the river.

"A few years ago, it was almost a taboo subject in the water field," he said.

According to the latest report from the Intergovernmental Panel on Climate Change, a group of 2,500 scientists, the Earth probably will get hotter and less snow will fall by the middle of the century.

The scientific panel relies on global computer models, which are difficult to apply to specific rivers. But half a dozen studies have examined the effects of climate change on the Colorado River. All of them say the river will have less water.

Today, it looks like there is plenty of water left in Colorado's streams. But we might owe all of it to California, Arizona and Nevada.

Law of Nature, Law of the River

From Wolf Creek Pass in the southern part of the state to the Eisenhower Tunnel to Steamboat Springs in the north, all the water on the Western Slope eventually blends into the Colorado River.

That water is governed by two forces: the Law of Nature and the Law of the River.

Mother Nature decides how much water will be in the river every year. The Law of the River dictates who gets that water.

The Law of the River dates to The Colorado River Compact of 1922, which divided the Colorado River into the Upper Basin - Colorado, Wyoming, Utah and New Mexico - and Lower Basin - California, Arizona and Nevada. The compact also governs southwestern rivers like the Animas and Dolores, which flow into the Colorado River.

Court cases and other pacts have added to the Law of the River, but the basic law hasn't changed: Each basin gets 7.5 million acre-feet a year, for a total of 15 million acre-feet.

However, a University of Arizona study of tree rings show the average yearly volume of the river is 14.2 million acre-feet.

And the compact has a catch: The Upper Basin has to deliver 7.5 million acre-feet a year on a 10-year average to Lees Ferry, Ariz., just below Lake Powell where the flow is measured. So if the Colorado River suffers a long drought, the shortage - perhaps 800,000 acre-feet a year on average - comes out of our end.

Is anything left?

It's a tricky business to determine how much water the Law of Nature gives Colorado.

Anyone who has lived in a house with old plumbing can sympathize: some days, the water pressure is fine. Other mornings, only a trickle comes out of the shower.

It's the same with the Colorado River Basin. Some years see lots of water, and some years a trickle.

To help them plan, water managers look to the past. All of their assumptions for how much water the state can expect come from the experience of the last 100 years.

But the drought that started in 1999 is almost certain to be worse than any 10-year period during the 20th century. And research into tree rings has uncovered much worse droughts in the last several hundred years.

At the same time, scientists are predicting that global warming will leave less water in the rivers.

On paper, Colorado should get 3.8 million acre-feet a year - giving the state more than 1 million acre-feet of surplus water.

But the state's true share might be more like 2.6 million acre-feet, said Eric Kuhn, head of the Colorado River Water Conservation District, an organization set up by the Legislature to protect and develop the river basin.

Once the Animas-La Plata project opens, Colorado will be using about 2.6 million acre-feet a year, Kuhn told Southwestern water experts in November.

If he is right, then new water projects could push Colorado into violation of the 1922 compact, forcing people across the state to cut back on their water use.

"If we want to have very low risk in our water supply, then there's none left," Kuhn said in an interview.

Amid talk of a shortage, some people are scrambling to get whatever is left.

State demographers estimate 3 million people will move to Colorado within 30 years, mostly to the Front Range. To serve them, a Fort Collins man wants to build a 400-mile pipeline from Southwest Wyoming to the Front Range. A water district on the northern plains has plans for a 250-mile pipeline to send part of the Yampa River east across the mountains. International oil companies own massive rights in Western Colorado that they have never used, but could if they start mining for oil shale.

If Colorado's share of the river is almost used up, any one of these projects could take the rest of the water legally available and limit the ability of people in Southwest Colorado to use more water.

Colorado gets ready

The state engineer's office, which administers water rights, is studying ways to cut back water use in Colorado if the downstream states call for more.

The Colorado Water Conservation Board has started a study, due by 2009, to figure out how much water we can expect from the Colorado River.

The debate gets at a fundamental question: Since water is the building block of any community, what kind of a civilization can we expect to have in this dry part of the world?

Ken Wright, a renowned Denver water engineer, has studied the waterworks of ancient civilizations in Mesa Verde and South America.

He discovered that once a reliable source of water disappears, civilizations tend to quickly fall apart. "I'm talking about empires that were prosperous and grew for 600, 800 years, and then collapsed overnight," he said.

The South Americans were good engineers, like the ancestral Puebloans, but they were done in by long droughts and floods.

"What happens is this: If you can't provide security and food for your citizens, they lose their loyalty to the central government," Wright said.

Sand Canyon Pueblo appears to have been an attempt to provide that security - for the people as well as the precious water. Many large pueblos sprang up around 1250, drawing farmers from the open mesas into the walled villages. All were built to defend a water source, said Kuckelman, the Crow Canyon archaeologist.

Their civilization had survived droughts before. Bad ones. But by 1250, many years of success had created a huge population. And as the population grew, so did the risk that a drought would cripple the society.

"It's possible they even knew it and didn't know what to do about it," Kuckelman said. "It's possible they saw it coming."

New dimension makes water decisions challenging in Colorado
1922 agreement could be tested with new projects

December 12, 2007
By Joe Hanel | Herald Denver Bureau

DENVER - Next time you water the garden, take a shower or eat a Palisade peach, thank Delphus Carpenter.

Courtesy of Colorado State University Water Resources Archive
Delphus Carpenter sits at his desk on the Republican side of the Colorado Senate in 1911. After leaving the Senate, Carpenter became the lead proponent of the Colorado River Compact, which ensured that Colorado had enough water to grow throughout the 20th century.
The Source

Colorado calls itself the Headwaters State because it is the source of several major rivers. The Colorado River and its tributaries drain the Western Slope, making their way to the Sea of Cortez in Mexico. The Rio Grande starts above the San Luis Valley and spills into the Gulf of Mexico. And on the Front Range, the Platte and Arkansas rivers start in Colorado and flow into the Mississippi.

Part oracle, part master craftsman, Carpenter saw the future: California would grow faster than Colorado and might use all the water in the Colorado River. So he framed the Colorado River Compact of 1922, a seven-state agreement.

His foresight earned Colorado a large share of the river, and for 85 years, no one has had to test the limits of the compact. Yet.

But now, water officials worry that Colorado is running out of room in the house that Carpenter built, and they are delicately working out ways to handle a "call" from downstream - the possibility that Arizona, Nevada or California will demand more water from Colorado and other upriver states.

A call could clamp down on most of the people who use the Colorado River's main channel and also its tributaries, like the San Juan, Animas and Dolores rivers.

Few think a call is likely within the next five years. But Deputy State Engineer Ken Knox is concerned enough that he's drafting rules on how to handle one.

"I do think (a call) will come sometime, but no one knows when," said Knox, who speaks slowly and softly, answering questions with a "sir" or "ma'am."

He pledged to hold several public meetings in every river basin to accept comments and criticism of his draft rules.

"It warrants careful, thoughtful action. It also takes time to work through," he said.

That's because a call would require some people to turn off their water. Crops would die. Reservoirs and fisheries could be sucked dry.

In it together

The threat of a call has brought a new dimension to water decisions in Colorado.

Now more than ever, what happens in one part of the state affects every other place.

If a major new project - like oil shale or two proposed pipelines from northwestern rivers to the Front Range - claims the rest of the water available under the compact, then new projects couldn't happen in Southwest Colorado.

State Sen. Jim Isgar thinks it's time to put conditions on new uses of water.

New projects should be put on notice that they could be turned off during dry years in order to meet the compact, he said.

"By letting people come in and file (for water rights), we're accelerating the possibility of a compact call. When that happens, we're going to be shutting off post-compact users (rights filed after 1922)," said Isgar, D-Hesperus, chairman of the Senate committee that handles water matters.

Cooperation, for now

Scott Balcomb has spent the last four years trying to delay a call on the river. As Colorado's representative to the Upper Colorado River Compact Commission, he helped broker an agreement in April among the seven states that use the river. The federal government approved the agreement last week.

The plan asks downstream states to look for water outside the Colorado Basin, and gives state water managers more flexibility in responding to a drought.

Although the pact should make a call less likely, there's no guarantee, Balcomb said.

A call would happen in slow motion.

First, a downstream state like Arizona would file a lawsuit saying the Upper Basin states failed to deliver enough water over a 10-year period.

As of 2007, the Upper Basin is well ahead of its 10-year requirement, according to the Colorado Water Conservation Board. So, barring a historic dry-up of the river, a call probably won't happen for at least 10 years.

That gives new projects more than a decade to start using water.

The long lag is like a broken speedometer that tells you the speed of your car five minutes ago. By the time you realize you're going too fast, you might have blown through a speed trap.

"If we overdevelop the river, which seems to be the human condition - it's happened on the Arkansas and other rivers - then we will have to pay the piper later," Balcomb said.

First in time, first in right

Colorado's water laws might be complicated, but they were written to encourage development.

Western water rights run on the prior-appropriation system, or "first in time, first in right." If you're the first person to get to the water, you can claim as much as you can put to a beneficial use.

In the 1920s, Carpenter was concerned that judges would apply the "first in time, first in right" system to the whole river, leaving the best water rights in the hands of Californians.

So he pushed for the compact, which splits the river in half. Colorado, Utah, Wyoming and New Mexico take 7.5 million acre-feet, and California, Arizona and Nevada get another 7.5 million acre-feet. A 1944 treaty with Mexico sent 1.5 million acre-feet south of the border.

But a crucial paragraph in the compact gives priority to the downstream states. Their share has to be satisfied first, and the upstream states get whatever is left.

The compact signers thought the river had at least 15 million acre-feet - plenty for everyone.

Carpenter didn't know it, but he couldn't have picked a worse time in 400 years to divvy up the river. Tree-ring studies show the 1920s were one of the wettest decades on record in the region.

Today, no one knows how much truly is left for Colorado, Balcomb said.

"I can't give you a number. There are serious water-user organizations that are concerned about this question now," he said.

The Colorado Water Conservation Board is working on a model to give a better answer, but it won't be ready until 2009 at the earliest, said board member Dan McAuliffe.

Winners and losers

Not everyone would suffer during a call. While a call would be potentially disastrous for upper-basin states, a select few people would prosper.

Water rights claimed before 1922 are not subject to the compact. Those rights would be worth lots of money during a call.

In Southwest Colorado, most of the pre-1922 rights belong to farmers. Cities have a mix of senior and junior rights, said Steve Harris, chairman of the Southwest basin water roundtable.

Durango is typical of most area towns, Harris said. Its year-round rights on the Florida River were established before 1922. But in the summer, it relies on extra rights on the Animas that could be shut off by a compact call.

The Front Range could be in trouble, too. The major tunnels that take water to the east were built after 1922, meaning cities would have to buy senior water rights from Western Slope farmers. Many of those rights exist in the Montezuma Valley, said Eric Kuhn, head of the Colorado River Water Conservation District.

"I think we need to be upfront about that," Kuhn said. "The Front Range providers are saying if there's less water available to us because of a curtailment of the compact, they say, 'OK, we'll just go out and buy pre-1922 rights.'"

Western Slope farmers might not be ready.

"Do they realize they're a target of something like that? Will they be surprised, and will they think that's positive or negative?" Kuhn said.

Harris thinks farmers could profit by charging cities a fee every year for the promise to turn over their senior rights during an emergency.

"There's a standby charge, and then there's a big charge if (cities) ever need the water," Harris said.

But the scheme can't be set up until the state engineer writes rules on the call, Harris said.

Looking for good rules, good neighbors

Knox will have to decide how to meet a call. The shortage could be divided by river basin, or the prior-appropriation system could be applied across the whole Western Slope.

When John Porter of Cortez started working in the water field, he was taught not to worry about a call because so many of Southwest Colorado's rights are senior compared to the rest of the state. Now, he thinks differently.

"We don't have the political clout to cause the state to go by seniority on a statewide basis," said Porter, one of Southwest Colorado's two representatives to the Interbasin Compact Committee.

He thinks a call will be allocated by basin, not by seniority. Even so, Southwest Colorado wouldn't suffer greatly, Porter said.

Knox isn't favoring one approach, but he thinks prior appropriation has a rich history.

"There's some measure of equity. We have a 120-, 130-year history of first in time, first in right," Knox said.

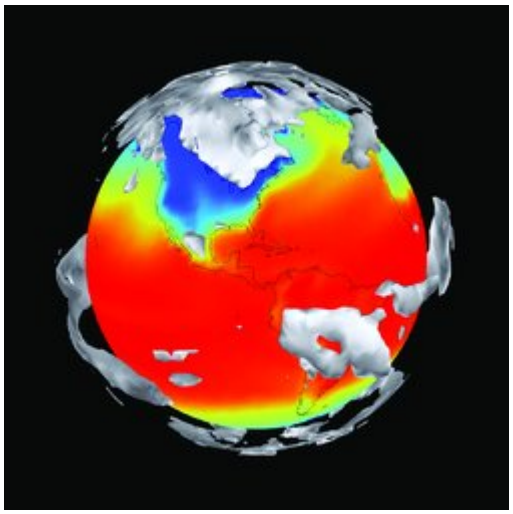
Knox is counting on the better side of human nature to help Coloradans get through the compact-call debate. He saw the potential for good during the great drought of 2002, when neighbors helped each other survive.

"Water wars - we always talk about the negative. Why? Because there's a lot to talk about," Knox said. "But once in a while, the human spirit can get pretty positive."

Climate science boils down to hot, dry
Three Springs homeowner arrives; neighbors reactions are mixed

December 16, 2007
By Joe Hanel | Herald Denver Bureau

BOULDER - A humming noise is coming from the basement of the National Center for Atmospheric Research, a laboratory on a mesa overlooking Boulder.



Courtesy of University Corporation for Atmospheric Research
The Community Climate System Model attempts to predict the Earth's future climate. Scientists at Boulder's National Center for Atmospheric Research designed and run the model.

Courtesy of University Corporation for Atmospheric Research
Boulder's National Center for Atmospheric Research has installed an IBM supercomputer known as Blueice that nearly triples the center's sustained computing capacity. With a peak speed of 12 teraflops (12 trillion floating-point operations per second), the machine will enable scientists to enhance the resolution and complexity of Earth system models, improve climate and weather research, and provide more accurate data to decision makers.

A peek through a glass wall reveals the source - rows and rows of dark blue supercomputers, each as big as an oversized refrigerator. Green lights blink on and off, and wires dangle out the back.

Among other tasks, these computers are helping run the center's Community Climate System Model, which makes predictions about global warming.

The model requires the computers to do 3 trillion math problems to simulate a single day of weather on Planet Earth. The model covers decades, and scientists run it repeatedly. It is just one of the models used by 2,500 scientists around the world on the Intergovernmental Panel on Climate Change.

Over and over, they come to the same conclusion: It's very likely that Earth is getting hotter because of extra greenhouse gases, caused by human use of fossil fuels and agriculture. Average temperatures around the globe are likely to rise 1.5 degrees Fahrenheit by 2029, even if we cut back our greenhouse gas emissions today, according to the IPCC.

And for the Western United States, there's a simple conclusion: hotter means drier.

Summer temperatures in the Southwest are expected to rise. And winter snows probably will melt earlier. That poses a problem for farmers, who will get a rush of water earlier than normal, then have to cope with dry summers.

Models break down

Brad Udall works down the road from the National Center for Atmospheric Research in another federal lab. As head of Western Water Assessment, it's his job to translate the climate models into useful information for water providers.

"You've got to love these things and you've got to hate 'em," Udall said of the climate models. "We have a good sense of what's coming at us now in terms of temperature. What they don't do well is precipitation."

Not even the best global computers can make predictions for individual rivers. That's a problem for anyone concerned about the Colorado River Basin, which encompasses the Southwest and includes Colorado's Four Corners.

So Udall closely monitors other researchers who focus on the Colorado River. All six major studies Udall has tracked show a reduction in Colorado River flows.

The studies vary widely, but share a common element: The river is drying up. The latest two are from 2006. One predicts a 10 percent reduction by the end of the century. The other predicts a 45 percent drop by 2060.

But Udall - brother of U.S. Rep. Mark Udall, D-Boulder - sees all the studies pointing in the same unhappy direction.

"In the last two years, increasingly these studies point to less runoff," he said. "If you had to play the odds right now, the odds do not favor more flow in this river."

'The question of the decade'

Eric Kuhn has to play the odds.

As head of the Colorado River Water Conservation District, it's Kuhn's job to safeguard the water on most of the Western Slope. He started getting worried during 2002, which tree ring records show was one of the driest years in five centuries.

Since then, he's stayed up-to-date on the same studies Udall follows. And every chance he gets, he warns his fellow water managers about the big new risk to Colorado's water supply. In fact, he believes that any new water project runs the risk of using more water than Colorado legally owns.

"I'm not creating anything," Kuhn said. "I'm just putting two and two together. The science studies are out there. You can't ignore them."

The Colorado Water Congress is worried enough that it devoted its summer convention to climate change.

"That's the question of the decade. How do we look at our vulnerability, how do we assess our risks, and how do we adapt?" said Doug Kemper, executive director of the Water Congress, the state's main water lobbying group.

John Porter of Cortez attended the Water Congress meeting.

"I got my eyes opened. I had to rethink some of my thoughts on climate change," he said.

Unconvinced

But Kuhn hasn't convinced every water provider.

Northern Colorado Water Conservancy District is studying a pipeline route from Northwest Colorado to the Front Range to provide water for growing cities. There's a lively debate about climate change on Northern's staff, said spokesman Brian Werner.

Werner has brought in an IPCC critic, Roger Pielke Sr., to talk to Northern's board.

Pielke argues that climate models overstate the role humans play in warming the globe. And the models aren't useful for long-term local climate predictions, says Pielke, a professor at the University of Colorado's Cooperative Institute for Research in Environmental Sciences.

Northern managers pay close attention to the issue, Werner said, but he's not sold on the certainty of a drier future.

"I'm not sure anybody can say we're going to have 14 percent less water, and there's some out there saying that," Werner said.

The physics of drought

Other researchers try for a simpler approach and don't try to predict rainfall.

Pat Flood with Wright Water Engineers in Denver examined how a 1-degree Celsius rise in temperature would affect the Colorado River Basin, even if the same amount of rain and snow fell every year.

She found it would suck an average of 1.7 million acre-feet a year out of the four upstream states. That's a lot for a basin that is legally entitled to 7.5 million acre-feet at best.

Blame it on thirsty trees.

When the summers are longer, plants sprout earlier and take more water. It's true for forests, farms and suburban lawns.

Flood wants to have her study peer-reviewed and published. Her boss, Ken Wright, hopes to call attention to the simple calculations that led to the alarming conclusion. Wright has an office in Durango and has done research on the ancient waterworks at Mesa Verde National Park.

"We wanted to make sure we didn't get into arguments and politics," Wright said. "We didn't want to get into global warming. We said we'd stick with physics."

Southwestern exposure

Southwest Colorado is a tricky place to study the climate. The mountains make the science more complicated, and the region doesn't get as much attention from researchers as the Front Range or the West Coast.

But Koren Nydick with the Mountain Studies Institute is paying attention. From offices in Durango and Silverton, she is leading a study of alpine plants. She's also organizing the San Juan Mountain Climate Initiative, a community group that hopes to produce a plan for mitigating and coping with climate change in Southwest Colorado.

Next June, MSI will bring 120 of the region's top researchers to Silverton for a conference.

The institute is working with a Rutgers University graduate student on a detailed look at area streamflows, rain, snow and temperature - something that's never been done for the local mountains, Nydick said. The results should be ready in time for the Silverton conference, she said.

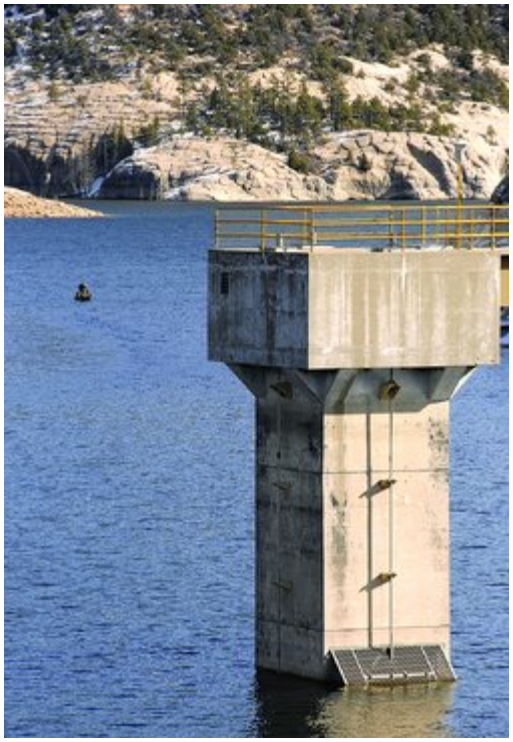
Nydick expects to find several clues to climate change in her research - animals fleeing the heat by migrating up mountains; earlier snowmelt; earlier flowering of plants.

"Some things, we're going to have a hard time," Nydick said. "In terms of water, we'll have a hard time. Ecosystems will change. But I also think there's a lot of room for us to figure out how to adapt and eventually halt these changes."

Warming prompts debate: Dams vs. conservation

December 16, 2007
By Joe Hanel | Herald Denver Bureau

DENVER - Many water managers have started to agree with environmentalists about the likelihood of global warming. They disagree about how to respond.



SAM GREEN/Cortez Journal
Water managers say more reservoirs like McPhee Reservoir will be needed to cope with global warming, but environmentalists say less water will be available to store, making more dams potentially obsolete before they are even built.

We should build more dams, water managers say. Global warming might melt the snow earlier, making it all the more important to store water through the longer, hotter summers.

But environmentalists remain critical of dams. The Natural Resources Defense Council's report on global warming and the water supply - titled "In Hot Water" - argues against reservoirs.

New dams might not be effective, said Brad Udall, head of Western Water Assessment, a federal office in Boulder.

The problem, Udall said, is global warming will reduce the average - or mean - flow of rivers.

"No amount of storage is going to recover that lost mean amount," Udall said.

Besides, he said, the Colorado is one of the world's most heavily dammed rivers already, with 60 million acre feet of reservoir storage on a river that carries less than 15 million acre feet a year. If the river gets drier, there will be extra space available in current reservoirs, he said.

But Marc Waage, head of raw water supply for Denver Water, said dams bring some certainty for water managers in the unpredictable era of global warming.

"There's always going to be the need to shift where water's available to where it's needed for societal or environmental purposes. It usually takes a reservoir to do that," Waage said.

The "In Hot Water" report urges utilities to put conservation first in their global-warming plans. Cities should switch their landscapes from grass to less water-hogging plants, it says.

Waage doesn't argue against the importance of conservation. But its benefits are lost if you use the savings to hook up new customers, he said.

During the 2002 drought, Denverites quit watering their bluegrass lawns. This helped give Denver the cushion it needed to survive the drought without cutting off more important uses, Waage said.

"The more efficient you become, without adding new supply to your system, the more susceptible you are going to be to climate change," Waage said. "It's a tough dilemma for water providers."

Colorado governor appoints aide to work on climate plan

December 16, 2007
By Joe Hanel | Herald Denver Bureau

DENVER - Gov. Bill Ritter rolled out a plan Nov. 5 to help Colorado cut back its greenhouse gas emissions.

Ritter hired Heidi Van Genderen to develop the Climate Action Plan, which relies mostly on incentives to get citizens and businesses to reduce their carbon dioxide output. The ultimate goal is to reduce Colorado's greenhouse gas output 20 percent by 2020 and 80 percent by 2050.

"A sustainable energy future is going to come building by building, house by house, vehicle by vehicle," Van Genderen said in an interview.

Several recent studies show that warming temperatures will reduce winter snowpacks, which feed rivers in the West. The Intergovernmental Panel on Climate Change says it is very likely that human-caused emissions of greenhouse gases like carbon dioxide are causing warming.

Buildings cause 40 percent of U.S. greenhouse gas emissions, Van Genderen said. In Colorado, cars and trucks cause just 23 percent - below the national average - but it will be hardest to cut carbon emissions from transportation, she said. In Southwest Colorado and many other rural areas, the only way to get around is by car.

One of the few mandates in Ritter's plan targets vehicles. He wants the Air Quality Control Commission to require new cars to meet strict emission standards starting early next decade.

"Time is of the essence on this issue," Van Genderen said. "We would be wise to act within a 10-year time frame here."

Ritter pledged to hire a climate adviser when he was running for governor. He hired Van Genderen in April.

Several states have started their own global-warming program. In February, governors of five Western states signed an agreement to start working on limits to greenhouse gas emissions. The plan will cap emissions and then let businesses trade pollution permits.

Ritter prefers to wait for federal action and keep on the sidelines of the Western governors' plan until at least 2009, Van Genderen told the Colorado Water Congress in August. A mandatory carbon-trading scheme would work best on a nationwide basis, she said.

The federal government does not regulate emissions of carbon dioxide, the No. 1 greenhouse gas. But at least seven bills have been introduced in Congress to regulate carbon emissions.

Van Genderen thinks Coloradans will get behind the Climate Action Plan.

"I think, basically, people want to do the right thing," Van Genderen said.

Faraway water pipelines hold future

December 23, 2007
By Joe Hanel | Herald Denver Bureau

MAYBELL - A Labrador retriever trots along the Yampa River, weaving around clusters of sagebrush. It wades in. As it swims to the north bank, its friend, a collie, tests the water and then follows.

JOE HANEL/Herald photos
The Yampa River west of Craig is one of the longest free-flowing stretches of water left in Colorado. Northern Colorado Water Conservancy District has proposed a pipeline to take water from near the site of this picture, north of Maybell, to the Front Range

JOE HANEL/Herald photos
State Sen. Jim Isgar, D-Hesperus, left, and Rep. Al White, R-Winter Park, look over a proposal to build a 250-mile pipeline from the Yampa River to the Front Range near the site of the proposed pump north of Maybell on Aug. 22.

They pay no attention to the group of Colorado legislators standing next to a tour bus 50 yards upstream.

The dogs are running free, just like the river here. And that's why the legislators have come to this sparsely inhabited corner of the state.

The Yampa River west of Craig is one of the last rivers in Colorado with no major dams or diversions. But now, a water district from the northern Front Range wants to throw a leash on the river. It has proposed a 250-mile pipeline to claim some of the Yampa's flow for the Front Range.

Meanwhile, a Fort Collins man named Aaron Million is pressing for a 400-mile pipeline from Flaming Gorge Reservoir in Southwest Wyoming to the Front Range. Either pipeline would affect the Four Corners and the rest of the state, because Colorado doesn't have much water left under the Colorado River Compact of 1922.

"A project like this could well take all the rest of the water that's remaining in the system," said state Sen. Jim Isgar, D-Hesperus.

The two pipeline plans were devised after the failure of the Big Straw, a pipeline that would have taken Colorado River water from the Utah state line to Denver. The compact's limits mean that if either proposed pipeline is built, it would be the last straw.

The Northern straw

In August, Isgar and his colleagues on the Legislature's water committee visited the area that Northern Colorado Water Conservancy District has proposed for its 250-mile pipeline.

The district - known as Northern - is coping with a farming crisis on the Platte River. The cities around Denver keep buying agricultural water, using their big budgets to make farmers an offer they can't refuse. Water in the area sells for $13,000 an acre-foot, said Northern spokesman Brian Werner.

The region north of Denver is expected to double its population by 2035, according to the state demographer's office. Part of the water for those new residents will come from drying up as much as 428,000 acres of farmland, according to the Colorado Water Conservation Board.

Some Front Range cities are trying to be more frugal with water. Denver Water customers have reduced their demand by 18 percent compared with 2001. Aurora, Denver's largest suburb, is building a water recycling project called Prairie Waters. Aurora leaders say it can meet the city's demands through the 2020s.

Northern's board wanted to look for ways to cope with Front Range population growth without drying up farms, said General Manager Eric Wilkinson.

"If you look around the state, long story short, there are few places where there's available water," he said.

One of those places is the Yampa.

So Northern wrote a study on pumping Yampa River water east, tunneling through the mountains to the Front Range.

The highlights: A 250-mile pipeline. About $4 billion to build it. Up and running by 2023.

Northern's study envisions piping 300,000 acre-feet of water per year and building a 500,000 acre-foot reservoir north of Maybell. That's four times the size of Animas-La Plata south of Durango.

Wilkinson is quick to say the numbers are for discussion only. Northern leaders studied a 300,000 acre-foot diversion because that's how much water they estimate is left under the Colorado River Compact.

The project would be too big for Northern alone. Wilkinson hopes for help from other utilities or maybe the state.

The next five years will be spent in a "getting to know you" period with the people of the Yampa Basin.

"We investigated this project to look at the possibility," Wilkinson told legislators on the Maybell tour. "It deserves additional discussion."

The Million straw

Aaron Million, though, has a much quicker plan in mind.

When he was a graduate student at Colorado State University, he looked at a map in the library and contemplated the short section of the Green River that runs into Northwest Colorado. He remembered working as a cowboy on the Green.

Soon, he hatched the idea to build a pipeline to use Colorado's share of the Green, which blends with the Colorado River in Utah. His pipeline would start upstream at Wyoming's Flaming Gorge Reservoir and follow Interstate 80 through southern Wyoming before dipping south to the Front Range.

Million says he can start running water through his pipeline within five years. He's been working on it for three years.

"No one has found any fatal flaws," he said.

However, the project would require a federal environmental impact statement, which Million would have to pay for, and so far, no agency has volunteered to coordinate the analysis.

He plans to take 165,000 to 250,000 acre-feet a year from Flaming Gorge Reservoir. Windmills and solar power could run the pumps, he said. Plus, there's a net elevation loss from Flaming Gorge to the Front Range, so the pipeline could generate hydroelectricity.

Million is talking to potential customers, but he knows there's enough demand for the water on the Front Range. He thinks the water could be recycled many times and be used for cities, farms and the environment.

Both Million and Northern say their pipelines would help the Western Slope by relieving the pressure to pump more water from the Colorado River mainstem to Denver.

The last straw

On the campaign trail in 2006, Gov. Bill Ritter said Colorado shouldn't undertake big new water projects until it has done all it can to save water through conservation, re-use and water-sharing agreements between cities and farmers.

A Ritter aide said conservation would be maxed out by the time the Northern pipeline is built, at least 20 years from now.

"Long-term planning is important, and there is no reason to wait until you need the water to investigate projects, determine feasibility and complete the legal, environmental and other procedures necessary to put a project into place," said Alex Davis, assistant director for water at the Department of Natural Resources.

Million met with Ritter in late June. The administration is still trying to understand "the many different impacts and facets of Million's project," including its effects on the compact, Davis said.

Northern doesn't want to compete with Million and will abandon its plans if Million's pipeline gets under way first, said Werner, Northern's spokesman.

"If he gets it built as quickly as he thinks he can, more power to him," Werner said.

But five years?

"We think that that's a little optimistic, to tell you the truth," Werner said.

Wilkinson is waiting for a study by the state's Water Conservation Board - due by 2009 at the earliest - to find out how much water is left under the Colorado River Compact.

"It is a concern," Wilkinson said. "We have to go into a project like this with our eyes wide open."

Million knows about the compact controversy, too.

"I understand there's disagreement over what is remaining," he said. "But we will be just a portion of Colorado's remaining compact obligation. Obviously, we will be junior in the system to existing conditional rights, such as oil shale. But that's fine. That's our risk."

Eric Kuhn, head of the Colorado River Water Conservation District, thinks the pipelines are maybe too risky.

If global warming sucks water out of the rivers, a big new pipeline could make Colorado violate the compact, and the whole state would suffer. Meanwhile, new residents will depend on the pipelines for their household water.

"That's the issue with the Aaron Million project. They say, 'Well, we'll accept a 2007 right.' Well, baloney," Kuhn said.

But someone has to provide water for the 3 million people expected to move here by 2035. The time to plan and build is now, said Jim Eddy, Million's business partner.

"The (CRWCD) wants to wait, but waiting is what caused all the problems today," Eddy said.

Three million reasons to worry about water in Colorado

Every drop counts
December 30, 2007
By Joe Hanel | Herald Denver Bureau

DENVER - More than 4.7 million people live in Colorado today. By 2035, an additional 3 million people are expected to move here.

And there are no plans to make sure they all have water.

That's because cities and counties decide how and where to grow. Water providers don't have veto power over growth. They just look for more water to serve the newcomers.

But a small number of water experts is starting to speak up about growth.

Jenny Russell, a Telluride water attorney, criticizes Front Range cities that assume the Western Slope will send them water for their future residents.

"That's irresponsible to say you have enough for now and you're going to grow until you come to a deficit," Russell said.

The Gap

The problem became apparent in 2003, with the release of a report by the Statewide Water Supply Initiative, or SWSI. Water people pronounce it SWAH-sea.

The initiative predicted that current or planned water projects could handle only 80 percent of the new urban growth by 2030. The missing 20 percent became known in the water business as The Gap.

Many cities are counting on farmers to sell their water rights, according to the SWSI report. Rural residents complain the practice is killing the farm economy.

Looking for a way to save agriculture, the Northern Colorado Water Conservancy District has proposed building a 250-mile pipeline from Northwest Colorado to the Front Range. The pipeline would plug The Gap and take the pressure off farmers to sell their water.

A Fort Collins entrepreneur, Aaron Million, has proposed his own pipeline to cover The Gap. It would stretch 400 miles from Flaming Gorge Reservoir on the Wyoming-Utah border to the Denver area.

Not their job

Most water managers are reluctant to tell county commissioners how to plan for growth.

"If you're not a municipality, you really don't have land-use control," said Eric Wilkinson, general manager of NCWCD.

Eric Kuhn, head of the Colorado River Water Conservation District, voiced his frustration in August at a Colorado Water Congress meeting.

The water supply should be part of the debate about foreign immigration, Kuhn said.

"It's obvious that issue isn't being discussed and we're not connecting all the dots. As water managers, we're not supposed to, but that issue has to be discussed at the general government level," he said.

But water managers have to start talking about it, too, said Russell, the Telluride attorney who represents Southwest Colorado on the Interbasin Compact Committee.

"How is it that you're allowed to grow until you come to a (water) deficit?" she said. "Water providers have always been told, 'Keep your hands off.' I think the time has come to change that, because all of Colorado is growing."

But water managers don't have legal control over land use. Russell thinks it will take an act of the Legislature to either require or encourage cities to match their land-use plans to their water supplies.

Locally, La Plata and Montezuma counties are expected to grow at least 75 percent by 2035. The population of the Four Corners will double, to 160,000 people by 2035, according to the state demographer.

In Durango, more than 100 construction projects are under way or expected to be built within city limits. Together, the projects could add as many as 4,400 new housing units in the city in the next 10 to 20 years.

Public Works Director Jack Rogers said the city has adequate water rights for its growth plans, and future water supplies will be more secure once the Animas-La Plata Project is finished.

Western Slope growth

As Russell said, growth is expected all over, not just the Front Range.

On a tour of Northwest Colorado in August, Sen. Jack Taylor pointed to several planned subdivisions west of Steamboat Springs - 2,000 home sites here, 2,400 there. Three-acre patches on the banks of the Yampa River are selling for $5 million, he said.

"When you start adding it up, where's the water going to come from for all these home sites?" said Taylor, R-Steamboat Springs.

Others say there's room - and water - for 3 million new Coloradans.

"Colorado can handle that kind of growth, but it is going to come through smart management of our water supply," said U.S. Sen. Ken Salazar.

Harris Sherman, director of the state Department of Natural Resources, expanded on the idea.

"We can handle another 3 million people, but it will involve serious tradeoffs," Sherman said.

Those tradeoffs include a loss of farmland, and less water in the rivers for fish, recreation and scenic beauty. Water managers, counties and the state have to do a better job of helping each other understand the constraints, Sherman said.

"We need to be more realistic about where these future water resources will come from," he said.

Baja Denver

In 1970, Douglas County was a rural spread south of Denver with about 8,500 people, much less than the population of Montezuma County at the time.

Thirty years later, it had 175,000 people - more than twice as many as every county in Southwest Colorado combined. Its population nearly tripled in the 1990s, when it routinely made the list of America's fastest-growing counties.

Douglas County wasn't alone. The Front Range's population doubled from 1970 to 2000. Almost 4 million people live there today.

Many of the new suburbs south of Denver rely on groundwater, which is being depleted a little more every year. This rattles water managers like Kuhn.

At a Water Congress meeting in August, Kuhn railed against "Baja Denver" and said the construction of suburbs without a sustainable water supply will be remembered as a historic failure of Colorado's leaders.

The consequences will be felt far away from the Front Range, Kuhn said in an interview.

"You don't build hundreds of thousands of homes ... and then shut them off when it comes to a dry period," he said. City and county leaders have to do whatever it takes to look for water.

And there's just one place left to find it, Kuhn said.

"Western Slope agriculture. That's it."

The same growth patterns are happening across the thirsty Western states, said Shaun McGrath with the Western Governors' Association in a speech to the Water Congress.

"In the West, we go from 93 million to 133 million," McGrath said, citing U.S. Census Bureau projections. "That's 40 million more people in the West in 2030. And the most scary one to me - Texas - 12 million. Imagine all the RVs we're going to have on the road."

Southwest Colorado wrestles with New Mexico over water issues

January 2, 2008
By Joe Hanel | Herald Denver Bureau

The Colorado River Compact binds all parts of the state together in a struggle for water against the downstream states - California, Arizona and Nevada.

SAM GREEN /Cortez Journal
Icicles cover the side-roll irrigation at the Ertel pasture on Montezuma County Road 26 when temperatures dropped below freezing in September when farmers and ranchers were still irrigating.

But Southwest Colorado wrestles with its own particular water issues, thanks to its geography.

The region is home to a dozen rivers and Colorado-only Indian reservations. And three other states sit nearby.

"We view our competition for water as the state of New Mexico," said John Porter, president of the Southwestern Water Conservation District. "They get 11.25 percent of the Colorado River. Well, that all has to come out of the San Juan River."

Porter was talking about the Upper Colorado River Compact of 1948, which divided the top half of the river among Colorado, Utah, Wyoming and New Mexico.

La Plata River Compact

A separate agreement, the La Plata River Compact, governs the small river southwest of Durango. Every day, Colorado has to deliver half of the river's flow at Hesperus to the state line. That's been difficult to do in dry seasons.

To help meet the obligation, SWWCD wants to build Long Hollow Reservoir. It would be five miles north of the state line.

The Animas-La Plata Project should resolve a long fight over water rights for the two Ute Indian reservations, but New Mexico is still solving its own Indian water problems, and they spill over into Southwest Colorado.

New Mexico plans to pipe San Juan River water to Gallup to settle a dispute with the Navajo Nation. But the state was already using its share of the Upper Colorado River Basin, so it first had to get the federal government to agree that water was available. The result was the June 2006 "Hydrologic Determination" by the Bureau of Reclamation.

It recalculated the amount of water available to the whole Upper Colorado Basin - Utah and Wyoming, Colorado and New Mexico.

"Oddly enough, from our suspicious minds, the Bureau came up with 21,000 acre-feet (for New Mexico), which is exactly what the Gallup pipeline needs," Porter said.

There's no question New Mexicans need the water supply, he said. But some of Porter's fellow water managers from the north side of the border are worried that New Mexico's various projects will use too much of the San Juan, he said. Overuse of the river could harm sensitive fish species.

Conflicts with New Mexico are just one way that Southwest Colorado is unique. Unlike Colorado's other river systems, no one stream connects the whole area.

"We have 12 rivers. We don't have one basin," Porter said.

In general, most rivers in the region rise in the mountains and quickly flow south to New Mexico. The Dolores River flows north and joins the Colorado after it crosses into Utah.

Population will nearly double

The region isn't immune to the population pressures more common to the Front Range.

Southwest Colorado is home to about 90,000 people, with more arriving every week. And the regional population will grow almost 90 percent by 2035, according to the Office of the State Demographer.

A 2005 study called the Statewide Water Supply Initiative predicted that Southwest Colorado could meet most of its future demands, but unless it builds new water projects, some shortfalls are expected in every county except Dolores and San Juan.

La Plata County's municipal demand is expected to grow nearly 70 percent by 2030, with an 800 acre-foot shortfall.

In the face of this growth, the region is trying to protect its history of farming and ranching.

"That's a very important issue for us - preserving our agricultural lands and agricultural heritage," said Jenny Russell, a Telluride water lawyer who represents the area on the Interbasin Compact Committee.

And a growing recreational economy needs water in the rivers, too, Russell said. The city of Durango has applied for the region's first recreational water right, to the dismay of the Southwestern Water Conservation District. If the two can't find an agreement, the case will go to a trial this month.

Durango uses area rivers, awaits A-LP completion

January 2, 2008
By Joe Hanel | Herald Denver Bureau

The city of Durango holds a series of rights on the Animas and Florida rivers to provide the water that flows through residents' faucets and bathtubs.

The city owns the rights to 9 cubic feet per second on the Florida River, about nine miles upstream from town, said Jack Rogers, director of public works. In the summer, Durango supplements its supply with water from the Animas River. It owns 50 cfs but uses only about 10 cfs at once. The rest is available for future growth.

Some of Durango's rights date to 1877, which means they take precedence over junior water users.

"We have the first, second and third priority on the Florida River, so those rights are pretty secure," Rogers said.

The city sends water straight out of the river and into its treatment plant.

It has only a small reservoir, called Terminal Reservoir, which holds 75 million gallons just east of Fort Lewis College for use at the water-treatment plant. The city will get storage space in the Animas-La Plata Project.

The dry year of 2002 was tough, Rogers said. The Missionary Ridge Fire made Florida water unusable, and the Animas got down to 120 cfs.

"That's as low as we've known it to have been," Rogers said. "There are old-timers who say the river's gone dry in the past."

Animas-La Plata will give the city a place to store water, in case the rivers ever dry up again.

The city's water system serves 19,000 people in the city limits and nearby areas, such as the unincorporated land around Wal-Mart, Rogers said. The city's growth projections show the water system will have to serve 40,000 people at some undetermined time in the future.

Big oil casts big shadow over Colorado's water future

January 6, 2008
By Joe Hanel | Herald Denver Bureau

MEEKER - No one has ever rowed a boat across Stillwater Reservoir. Or caught a fish at Fourteenmile Reservoir. Or stood on the beach of Roan Creek Reservoir.

JOE HANEL/Herald
Shell’s logo marks a test site in 2006 at the Mahogany Research Project in Rio Blanco County. Shell has successfully made oil from shale at the site, and the results have encouraged the company to think the nearby land might yield 1 million barrels of oil per acre.
Shell’s water shopping spree

Shell's water shopping spree

Shell's recent water acquisitions in oil-shale country. All the rights except the former DOW rights and Wyatt rights are conditional (which means no one is using the water right now).

• 2002: Former Exxon rights.

670 cubic feet per second flow rights, 183,000 acre-feet reservoir rights.

Appropriation dates: 1955, 1964.

• 2007: Land swap with Colorado Division of Wildlife.

Various wells and ditches lining Piceance Creek, the major stream in the oil shale basin. Rights total 19 cubic feet per second.

Appropriation dates: Some of the rights are from the late 1800s.

• 2007: Mack property.

116 cubic feet per second on the Colorado River and a tributary west of Grand Junction; 30,000 acre-feet reservoir rights.

Appropriation dates: 1980.

• 2007: Wyatt property.

A $2 million land purchase with unspecified water rights.

Appropriation dates: Some of Oscar Wyatt's water rights date to the late 1800s, although public records don't specify what water rights Shell bought.

Sources: Division 5 water court, Office of the State Engineer, Mesa County Clerk and Recorder, Rio Blanco County Clerk and Recorder, Capital Development Committee of the state Legislature.

Best oil-shale deposits in Western Colorado

By Joe Hanel

Herald Denver Bureau

The U.S. Department of Energy proclaims that America has 2 trillion barrels of oil locked in shale - more than all the proven reserves in the world. The best deposits are in Western Colorado.

So far, no one has been able to do anything with American shale. The 20th century saw three oil-shale booms, but each time, the industry folded after it couldn't make its projects work economically.

But thanks to previous booms, Chevron, Shell, Exxon and Conoco, among others, own water rights dating to the 1950s and 1970s. Most of the rights are "conditional," which means the oil companies aren't using them now and have to prove to a judge every six years that they still intend to use the water. It's known as a diligence case.

Northern Colorado Water Conservancy District sued the state in the late 1990s for approving Chevron's conditional rights. Northern worried that if Chevron ever exercised its rights, it could take water away from Northern's Windy Gap project, which has junior rights to Chevron.

But the state Supreme Court ruled in Chevron's favor in 1999. Water courts continue to approve six-year diligence cases for oil companies.

"We've kind of set a low bar on conditional water rights," said Eric Wilkinson, general manager of Northern.

MEEKER - No one has ever rowed a boat across Stillwater Reservoir. Or caught a fish at Fourteenmile Reservoir. Or stood on the beach of Roan Creek Reservoir.

These are all imaginary lakes. They exist only in the minds of oil company executives and attorneys.

But the oil companies own legal rights to build and fill these reservoirs, which would be in Garfield and Rio Blanco counties. And as the companies take another look at Colorado's oil- shale deposits, which would require vast amounts of water to develop, they might make those imaginary lakes a reality.

Their water rights are huge, and getting bigger. Shell has been buying large water rights on the Western Slope for the last five years and just completed a major purchase in July.

State leaders are watching.

"I've seen estimates that oil shale, if it is developed, would consume 100 percent of the remaining water in the Colorado River system," said U.S. Sen. Ken Salazar.

Harris Sherman, director of the state's Department of Natural Resources, has seen the draft of an upcoming federal study on oil shale, although he can't divulge its details because of a confidentiality agreement. But he let something slip to members of the Water Conservation Board in Craig this summer.

"I assure you there will be numbers associated with water for oil-shale development that will gain our attention," Sherman said.

But no one has an answer to the big question: How much water will the oil industry take?

Holding their cards

International oil companies own some of the largest private water rights on the Western Slope. If they used all the rights they own, they might force Colorado to violate the Colorado River Compact of 1922, and then water users around the state would have to cut back.

"The difficulty and the problem is everybody's playing their cards pretty close to their vest. Or they don't have a good idea what their water needs will be," said Dan Birch, who is leading a study into the question for the local river basins.

"I think on the low end, we're talking about 10,000 acre-feet a year. On the upper end, we're talking about hundreds of thousands of acre-feet a year, maybe 500,000, which by all estimates is everything Colorado has left to develop," Birch said.

Colorado uses about 2.1 million acre-feet a year from the Colorado River Basin, which includes southwestern rivers like the Animas and Dolores, according to the U.S. Bureau of Reclamation.

On paper, Colorado gets 3.8 million acre-feet a year under the 1922 compact and subsequent agreements. But few water experts believe Colorado will get anything close to that much, because of climate change and natural dry cycles. Birch's boss at the river district, Eric Kuhn, thinks Colorado already might be using all the water to which it is legally entitled.

Birch thinks it will take a year to finish the study, which will look at the water needs of many forms of energy, not just shale mining.

Technology goes underground

Birch has a frustrating task. Most of the studies on oil shale and water are at least 20 years old, and they are maddeningly vague.

A U.S. Bureau of Mines report from the late '70s said the industry would need two to five barrels of water per barrel of oil. A 1981 blue-ribbon panel for then-Gov. Richard Lamm said the industry would need anywhere from 81,000 acre-feet to 868,000 acre-feet, depending on how much oil it was producing.

But both of those studies were done when oil companies planned to build the world's largest strip mines to get the shale. Today's "in-situ," or underground methods, might take less water. Three companies - Shell, Chevron and EGL - have won federal leases to demonstrate their in-situ methods on 160-acre parcels in Colorado.

The companies plan to melt the rocks 2,000 feet below the surface. They would need water to process the shale oil in a plant that resembles a refinery, to spray on the ground for dust control and, in some methods, to wash the underground rock formations of leftover oil.

Shell believes its whole process, from construction to processing on the surface, would take two or three barrels of water per barrel of oil produced, said company spokeswoman Jill Davis. But Shell's prediction does not include water for the extra work force that would move to area towns, she said.

And Shell does not yet know how much oil, if any, it expects to produce and sell.

Chevron does not have an estimate on how much water its process will use, said spokesman Dan Johnson.

Shell amasses water rights

Chevron owns the biggest water rights of the oil companies, but Shell has been the most aggressive in snapping up new water for its research project.

In 2002, it bought Exxon's old rights from a ranch in Northwest Colorado. That purchase forms the core of Shell's future water system. It includes three large reservoirs.

This year, Shell bought Piceance State Wildlife Area, which sits on the creek bottom near its research project. The land came with several small water rights, some of which are from the late 19th century. In return, Shell gave the state land to expand a different wildlife refuge plus $444,000 cash.

And in July, Shell closed the books on a purchase of land and water rights west of Grand Junction.

Davis, the Shell spokeswoman, said she's not at liberty to say why the company bought those water rights. It may or may not be for the oil-shale project, she said.

But an oil-shale critic, Cathy Kay with the Western Colorado Congress, said the land is next to a coal mine. Shell will need electricity to run its oil-shale project, and Kay worries that the area could be used for a coal power plant.

Altogether, it's just too much water for an industry that hasn't proven itself, Kay said.

"Surely, the lawmakers cannot allow one industry to chew up the rest of the compact for something that's so elusive," she said.

Davis takes issue with environmental groups that criticize the oil industry's water plans. "The whole implication is that the industry is going to be so big and bad that it's going to dry up the rivers," Davis said.

In fact, the industry's size will be limited by the water supply, the work force, air quality and the oil market, she said.

By 2009 or 2010, Shell will have to decide whether its technology is ready to be used at a larger scale, Davis said. Johnson said his company, Chevron, needs another three to seven years to work on its research and development project.

Feds play key role

The federal government will play a crucial role in oil shale.

Three companies have won federal research and development leases on 160-acre tracts west of Meeker. As many as 23 companies might be interested in oil-shale development, according to the state Department of Natural Resources.

The federal government itself holds water rights for oil shale. It has the right to use 49,000 acre-feet a year for the oil-shale reserve it set aside in 1916. At least some of those rights, however, are for national defense purposes and not for commercial oil-shale development, said Roy Smith with the Bureau of Land Management.

The Department of Energy's 2004 Oil Shale Development Roadmap says water availability might be a significant problem for a large shale industry - one that satisfied 10 percent to 20 percent of U.S. oil demand.

"Alternate water sources, including interbasin transfers and new gathering and storage projects, need to be identified," the report says.

It does not specify a source for the interbasin transfers, but such a project would make history. The rivers surrounding the Colorado Basin are small, and water has always been transferred out of the Colorado to cities from Denver to Los Angeles.

Large volumes of water never have been imported into the Colorado Basin.

Even though the shale industry might not get going for 10 years, water projects take 10 or 20 years to build. The critical time to examine oil shale is now, said Birch, who is leading the energy and water study.

"Who knows if it's going to happen? But it seems to me the prudent thing to do is for state and local interests to do the planning right now as if it's going to happen at some level," Birch said.

Oil shale rises again in Western Colorado

January 6, 2008
By Joe Hanel | Herald Denver Bureau

MEEKER - Like any good story of buried treasure, X marks the spot.

JOE HANEL/Herald
The Mahogany formation crops stick out of the ground next to Rio Blanco County Road 5, west of Meeker. The rock is kerogen, which, given enough time, heat and pressure, will turn into oil. The Mahogany formation gets thicker and richer as it plunges underground, underneath federal land in the Piceance Basin.

In this story, it's a couple dozen Xes, taped to the side of an ordinary rock face on a corner of Rio Blanco County Road 5, west of Meeker.

The Xes mark the outcrop of the Mahogany formation, which gets thicker as it plunges underground. The rocks are made of kerogen, otherwise known as oil shale.

Companies have produced oil from these rocks in the past, but they have never done it in a way that makes sense economically. Now, with oil prices at $100 a barrel, oil companies - big and small - are back in Colorado, eyeing a payoff that could be hundreds of billions of dollars.

Netherlands-based Shell is taking the lead. Although the company dropped its state mining permit application this summer, it is still very serious about its project, said Shell's Denver-based spokeswoman Jill Davis.

"We just know there's a huge benefit to our national security and our oil supply if we can do it. That's why we're sticking with it," Davis said.

But memories of Black Sunday still linger. It was May 2, 1982, when Exxon pulled out of its Colony oil-shale project, immediately putting 2,100 people out of work and effectively ending Colorado's oil-shale boom.

Today, skepticism greets the companies that have returned to give shale one more try.

"I am still fascinated that somebody would spend that amount of money to get something that is so elusive," said Cathy Kay, an oil-shale critic from Western Colorado Congress, based in Grand Junction.

Randy Udall, a renewable-energy advocate from Carbondale, wrote a critique of shale's comeback. Measured in amount of energy per ton, oil shale has one-third the energy density of Cap'n Crunch cereal, Udall wrote.

Two federal programs move ahead

Private companies own some oil-shale lands in Colorado, but they need to lease federal land to get the best oil-shale deposits.

The federal government plans to lease the lands to oil companies by moving ahead on two separate - critics say contradictory - tracks.

Last year, the Bureau of Land Management awarded leases for five, 160-acre tracts in the Piceance Basin (pronounced PEA-ahns) to companies for research and demonstration projects. Shell got three tracts, and Chevron and EGL each got one.

But the agency also plans to offer commercial oil-shale leases well before the research work is done on the five tracts.

The BLM released a draft Environmental Impact Statement for the commercial leasing program last month. In late 2007, congressional Democrats tried unsuccessfully to delay the study and leasing program, which were mandated in the 2005 Energy Policy Act, passed when Republicans controlled Congress.

Freezing and melting

Shell, Chevron and EGL all plan some form of "in-situ," or underground, shale processing. Shell is the most public about its idea. It plans to put coolers into the ground to build a "freeze wall," then pump out the groundwater inside the wall and bake the rocks at 650-750 degrees Fahrenheit for a few years before pumping out the liquids and gases.

Shell expects to get natural gas, gasoline, diesel and jet fuel once it runs the shale oil through a processing plant on the surface. The plant will be like a refinery, but smaller, Davis said.

"It's not going to need a major refinery," Davis said. "It's still columns and parts and pieces - don't get me wrong. But it's slightly more efficient."

Shell will be working on its freeze-wall test for the next few years. By 2010, the company will be at a major decision point for its project, Davis said.

Chevron spokesman Dan Johnson said the California-based company needs three to seven years to work on its tests.

"We have a very go-slow approach. We are supporting research and demonstration," Johnson said. "We know that we have to do this right, or we shouldn't do it at all."

Chevron is working with Los Alamos National Laboratory on its technology. It involves drilling into the shale formation and passing hot and cold gases over the rock to melt the oil out of it, Johnson said. The process is not heavily dependent on water, he said.

Black Sunday veteran

This is Johnson's second time around with oil shale. He was one of the first three or four employees of Chevron's oil-shale division in 1980. He left in late 1982, several months after Exxon pulled the plug on its operation - and the whole industry - on Black Sunday.

"I remember getting the call," Johnson said. "I think the immediate reaction was - we just didn't know. The predictions had been so rosy, so positive."

But those predictions turned sour as the price of oil kept falling. "I was thinking, I hope we can hold on, because this was an important resource," Johnson said.

He's happy to see that Western Colorado has recovered today, and is booming with retirees, natural gas and commercial development. "This place is running on all cylinders," he said. "That's different. It's a much more diversified boom than it was 25 years ago."

1 million barrels per acre

Oil shale's fortunes rise and fall with the price of oil.

In 1981, oil was selling for $93 a barrel, adjusted for inflation. By Black Sunday, it had fallen to $71 a barrel. It kept falling through the late 1990s, except for a few spikes. But last week, oil reached $100 a barrel.

At these prices, companies see the potential for profits to make the big projects worthwhile.

Shell estimates that its method can wring 1 million barrels of oil out of a single acre of ground. That's more than $40 billion from the three 160-acre leases Shell already owns.

If its demonstration projects work and it wins federal approval to expand its leases to 27 square miles, then it takes a calculator with extra digits to show how much all that oil might be worth.

In the best case, "That's the sort of manageable prize that Shell is looking at from this potential," said Davis. But, she said, Shell has to prove its technology first. It has already produced oil from shale, but now it has to prove it can protect the environment, she said.

Chevron officials look at the size of tomorrow's market. Six billion people live on Earth, and there might be 9 billion by the middle of the century. "We're probably going to need every molecule of energy going forward that we can get to meet the needs of that growing population," Johnson said.

That's what brings Chevron back to Colorado's notoriously difficult oil-shale deposits. "The easy oil, we pretty much have used up," he said.

The military is involved in Colorado, too. The 2005 energy bill required the secretary of defense to write a strategy for using fuel made from oil shale, coal and tar sands in American military vehicles.

Global politics have a direct effect on Colorado in this case. And Coloradans might not get to choose their fate, said Dan Birch, who is leading a study on oil shale and water for the local river basins.

"Because of what's going on in the world and what's going on with oil demand, there could be a strong pressure to do this that is beyond Colorado's control," Birch said.

Water, energy share symbiotic relationship

January 6, 2008
By Joe Hanel | Herald Denver Bureau

DENVER - An old adage says oil and water don't mix.

But they do. So do coal and water, and ethanol and water.

There's a connection between water and energy that many water planners don't appreciate, said Melinda Kassen with Trout Unlimited.

"It goes both ways. There's water needed to produce energy. But there's energy needed to develop and deliver water," said Kassen, who sits on a high-level water panel called the Interbasin Compact Committee. "If you talk about this, I think, you need to talk about both sides."

Coal power plants need water to generate steam for their turbines and to cool off excess heat in their towers. Ethanol requires water for irrigation and to process corn into a useable fuel. Oil shale needs water to scour the underground rocks and refine the product into fuel for vehicles and jets.

Fast-growing Phoenix will build five more power plants, Kassen said, yet none of the water demand estimates she's seen for the Western United States take the increased demand for power into account.

By 2030, U.S. power plants could be using as much water as all domestic users in the country were in 1995, according to a Department of Energy report called "Energy Demands on Water Resources."

Closer to home, water planners are keeping their eyes on the large conditional water rights of Shell and Chevron, but the largest conditional water right in Colorado is for a future power plant. The Colorado River Water Conservation District owns the right to store more than 1 million acre-feet of water a year in Juniper Reservoir. Like the oil companies' reservoirs, Juniper does not exist yet.

The Eastern Plains are producing energy, too, thanks to the ethanol boom. But today's ethanol plants use corn, and Colorado corn usually requires irrigation.

Ethanol made from irrigated corn takes about 1,400 gallons of water per one gallon of ethanol produced, according to the Department of Energy's report.

However, a lot of the acres used for ethanol are already under cultivation, and some of the water used for irrigation seeps into the ground and eventually migrates back into the river for use downstream.

It takes energy to move water, too, Kassen said. Farmers and suburbs need power to run their well pumps.

Fort Collins entrepreneur Aaron Million has plans for a 400-mile pipeline from Southwest Wyoming to the Front Range. It will require lots of energy to run the pumps, Kassen said. Million, though, said he's looking at using wind turbines and solar cells. And because the pipeline loses elevation on its way into Colorado, he can use it for hydroelectric power.

Originally, he estimated the yearly operation costs would be $50 million to $75 million, but that cost will drop if the project uses renewable energy, Million told state legislators in September.

Old problems, new approach
State panels look for way out of water shortage

January 13, 2008
By Joe Hanel | Herald Denver Bureau

MESA VERDE NATIONAL PARK - This story ends where it began, on a dry mesa in the southwest corner of Colorado.

For the last six weeks, *The Durango Herald* has examined water availability in the Colorado River Basin. The river and its tributaries are the last good source of water for the entire state.

But how much is left? Is the state near the end of its legally allotted water from interstate treaties? Will oil companies claim most of Colorado's remaining water under their decades-old water rights? Will climate change cause drier years than we experienced in the 20th century? Should the Front Range be allowed to support its population growth with another pipeline from the Western Slope?

The answer to these questions will determine what kind of a society Colorado will be.

There's a history for this sort of long-term thinking, right here in Southwest Colorado.

The original inhabitants of Mesa Verde National Park knew how to capture water in reservoirs. Morefield Reservoir operated for 350 years - longer than the United States has been a country, said Ken Wright, a water engineer who has written books about Mesa Verde's waterworks.

"These people were industrious, and they had a social organization that was pretty darn good, with a hierarchy. Someone had to keep the reservoir in operation over 20 generations or so," Wright said.

Millions need Colorado's water

But today's Coloradans face problems on a much bigger scale.

Millions of people depend on the Colorado River. The complicated legal arrangements that govern the river mean all Coloradans are in it together - the first person to take water in violation of the Colorado River Compact will bring punishment upon the whole state.

If downstream states sued upstream states for violating the compact, and Colorado lost, the state engineer would have to order many users to cut back on their water use.

It remains an open question as to how much water Colorado really has left under the compact.

A new approach

The ancestral Puebloans found their answers in the reservoirs they built under gnarled juniper trees on red mesa tops, with a view that stretched far to the south.

Today, Colorado's water experts are more likely to be found in a beige conference room of a Holiday Inn Express.

For two years now, hundreds of Coloradans have been working on committees set up under the Colorado Water for the 21st Century Act, passed in 2005 at the urging of Russ George, former director of the Department of Natural Resources.

Their goal is to find long-term ways for Coloradans to use their water. With the state nearing the end of its legally available water under the 1922 compact, the people on these committees want to use what's left without touching off a Western Slope-Front Range water war.

Every month or two, they get together in a different town, using whatever room can hold several dozen people. It's usually the plain conference room of a chain hotel.

The 2005 act set up roundtables in each major river basin. Southwest Colorado's roundtable covers everything from Pagosa Springs to the Four Corners and north along the Dolores River. The act also established a central

group known as the Interbasin Compact Committee, or IBCC, which is supposed to look for a long-term solution for the state.

For the first time, people from all corners of Colorado are getting to know each other's hopes and fears for their water.

"The era of one basin imposing its will on another is over. There's got to be a win-win," said Harris Sherman, who took over as chairman of the IBCC when Bill Ritter became governor after the 2006 election.

Local needs first

It's all about helping local basins figure out their water needs and finding ways to meet those needs, said state Sen. Jim Isgar, D-Hesperus, sponsor of the bills that created and funded the roundtables.

"This wasn't created just to move water from one basin to another. It was created to meet the needs one basin at a time," Isgar said.

The IBCC is waiting on each basin to finish an assessment of its own needs. Only then will the group start talking about moving water. Sherman wants the needs assessments to be done by the end of 2008.

The IBCC has not overcome the skepticism of some of its own members.

John Porter of Cortez represents Southwest Colorado on the IBCC. He's enthusiastic about the local roundtables, which he says have people from the Four Corners getting to know each other in ways they haven't before.

"In terms of the IBCC, I think the jury's still out on that. It's a much slower process," he said.

But he sees the group's value.

"If you can begin to build trust, a working relationship, then some positive things can come out of that," Porter said.

Diane Hoppe, a former state legislator who follows the IBCC, thinks the process can work, but it depends on the willingness of the participants.

"Even though there are some of the best minds in the state at this table, I don't get the sense that there's a willingness to come away with solutions," Hoppe said.

The group has not yet dealt with a major new water project. But leaders of the Northern Colorado Water Conservancy District, who have proposed a long pipeline from the Yampa River to the Front Range, said the IBCC would be a good place to talk about the plan.

Gambling with Colorado

Others see a chance to discuss the big picture.

"Is muddling through with our current arrangement good enough, and if not, what else do we have? Well, we have the IBCC and the roundtable process," said Chips Barry, head of Denver Water and a member of the IBCC.

"The issue at the heart of all these discussions is risk. How much risk are you willing to bear?" Barry said.

The risk comes from the Colorado River Compact, which calculates the state's obligations to downstream states on a 10-year moving average. It's like a scale that tells you how much you weighed 10 years ago. You can pack on the pounds for a decade before you realize you're in trouble.

Today in Colorado, the next big water project - maybe a pipeline, maybe oil-shale development - could push Colorado into violation of the compact.

But it could take a decade or more for Colorado to discover it has taken too much water. Then, all parts of the state would have to cut back their water use.

All of these choices eventually get into the hands of elected officials, and thus to the voters, Sherman said.

The first way that citizens can get involved is by learning more, he said.

"I think people in Colorado need to have a better understanding of how water works," Sherman said. "It's really important for people to become more knowledgeable in where water comes from."