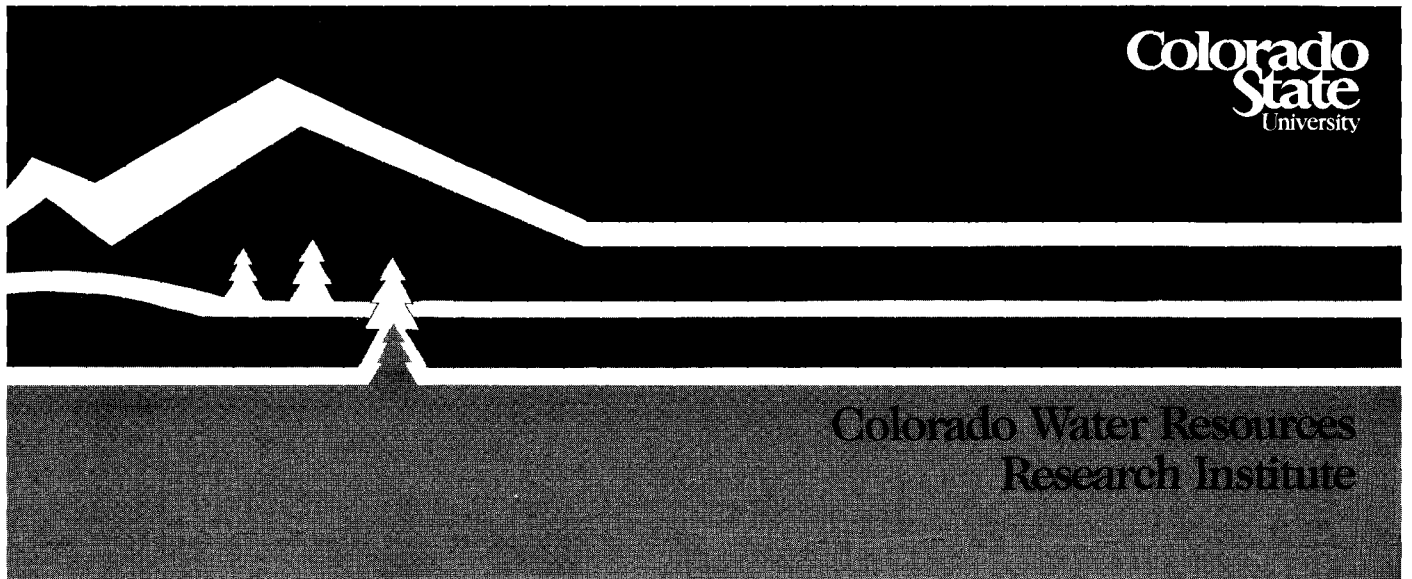


**SOUTH PLATTE RIVER BASIN:
USES, VALUES, RESEARCH AND MANAGEMENT –
CURRENT AND FUTURE**

Conference Proceedings

by
R. Craig Woodring, Editor

June 1992



COLORADO WATER RESOURCES



RESEARCH INSTITUTE

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*The South Platte River Basin:
Uses, Values, Research, and Management
--Current and Future*

R. Craig Woodring, Editor

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Preface

Not unusual for Colorado, 1991 was a year when many issues about water were debated, especially in the South Platte Basin. Water transfers from the north portion of the basin to the south, and federal reserved water rights were issues in the courts. Water quality continued to be a concern everywhere. Water education became a focus as we worked at 'trickle up' theory--educate the children on the importance of our resources and they will educate their parents. The environment became even more a concern of the average citizen. The recap could go on.

At the base of these issues is a society that is diverse in values and understanding. From urban households worried about their lawn and drinking water supply to the rural homeowner watching the well level drop and the pumping bill rise, from fishermen in wading boots to farmers in irrigating boots, citizens ever so slowly further deepened their recognition of the value of the South Platte Basin's water resources.

The 1991 South Platte River Basin Conference, second in a hoped-for annual occurrence, followed the vision of the 1990 version. This conference was organized to be multi-disciplinary and multi-dimensional to allow the wide range of uses of the South Platte Basin water resources to be discussed for greater understanding. Understanding the values of the citizens of the Basin came into the conference this year to help those in management better understand where the people were going. This allows the leaders to lead by following the people. Presentations by researchers, those seeking better and more complete knowledge of the South Platte River System added a valuable dimension to the conference. This publication documents the 1991 conference entitled, *The South Platte River Basin: Uses, Values, Research, and Management-- Current and Future*. For specific information about any talk please refer to the author and address found at the end of each presentation or abstract.

R. Craig Woodring, Editor
Colorado Water Resources Research Institute

Keynote Speakers

When the South Platte is Wet, it's Wet, But When it's Dry it is Very Dry

Donald D. Ament
State Senator, Colorado District 1

What I want to talk about today is balance. I think we lose sight of that sometimes.

Let's talk about who wants our water. I think all of our down-stream neighbors certainly want our water, and probably our up-stream neighbors. You know I used to not worry about the up-stream neighbors because we didn't hear a whole lot about them. But, now our up-stream neighbors are people like federal government, specifically, the Forest Service. The Forest Service is certainly taking a new interest in water. As we all debate the wilderness area, we find out that the head-water areas have a new interest in the water. That kind of worries me. Yet, I hear from time to time, 'well why should that worry you,' or 'They'll just get in line in Colorado's Prior Appropriation Water Law and you shouldn't be worried about that since you have a senior water right,' or 'Don't worry about your federal or junior water right holders.' How many of you have gone to water court? When you're in water court you find out that a junior decree can cause a senior decree holder a whole lot of havoc and more than that a whole lot of money. And so we get real worried about the new junior water right partner. Why? Well we don't have enough water. In other words, we have an over-appropriated river and when someone new takes water, in many cases, someone else loses it, or spends a lot of money on attorney fees.

The South Platte River is a very good example. There isn't enough water in the South Platte River. If the weather doesn't cooperate in the spring after we farmers have turned over the soil. If we've gotten ready to plant a crop and it doesn't rain, if the rain doesn't bring the crop up, then we take that water that our irrigation district management has been storing for us for use later in the irrigation season and irrigate the crop up. After we do that then we don't have enough water to finish it out in the late summer. And so it becomes real critical then. We just don't have enough water to maximize the yield.

People say 'Why would you resist a federal water right?' If the federal government, --the Forest Service or whoever we're talking about--wants more water, they want a right. It is kind of spelled out to those of us who have been irrigating since the 1800s, that they want water for a reason. They don't just want to have the right. They want it for a reason. They probably want it in those dry areas to do something with it and that makes less for us who have developed the water rights through the years.

Now I'm trying to think of not only the State of Colorado, but the nation, and the world. That is something I think is lost sight of. As we sit down to meals and enjoy the food and drink the water, how often do we think about the amount of water that goes into production of that food and the amount of water that we consume. What we need is an understanding of what makes the food chain operate.

Our up-stream neighbors are certainly of concern to us. Because we with senior rights just really don't know how far they're going to go or how it will end up for us who are down stream.

Now, how about our down-stream neighbors? Well, we find as we take a look at our down-stream neighbors that again we have the federal government in the plan. There is some talk of a down-stream wilderness on the South Platte and you hear a lot about whooping cranes. I hear from people farther down the South Platte that whooping cranes are certainly of concern. I have a concern about whooping cranes too.

People that have watched the South Platte through the years have found that as we've developed the Platte and put more dams and did smarter things on the river, we have also improved the stream flow -- especially in the summer time. Now I've had somebody from Environmental Protection Agency get up after I made this statement and jump all over me about what was going on with the South Platte River. The comment was, 'if you go way down along the South Platte you don't notice that change.' You really can't blame that on us in Colorado though because what is going on at the state

line in Colorado has proved my position through the years. I see that as we use that water, we have return flow, I have watched what that river looks like every year of my life.

It's not our fault that Nebraska just figured out that they need to control well pumping such as the State of Colorado has. They just found the words to say, 'Hey, you guys along the river can't sink all those wells and expect that River to run that water down farther into Nebraska.' Nebraska's taking some lessons from Colorado on water law on how to really maximize, I suppose, the use of Colorado water.

When we're talking about our down-stream neighbors, (certainly Nebraska, and Kansas), and the federal government both up- and down-stream, it is going to cost Colorado a lot of money to work through all of the problems we have. Look what's happening right now with the State of Kansas. Our legislature is so short of money and we're wondering how in the world we're going to fund the programs that are expected of us in the State of Colorado. We're going to spend about 8, 9, or 10 million dollars fighting a law suit with the State of Kansas and if we win, the only thing we'll gain is the ability to use water as we have been in the past. If we lose, it won't be two days until Nebraska will file the same law suit on the South Platte River and we'll go through all of that again.

A prime example to learn from is the lawsuit just being completed in the Greeley Water Court concerning the Forest Service. The question is whether or not they have a valid water right. Colorado has spent millions of dollars and when it all comes home to roost, and it's going to come to roost very quickly, this is what will happen. We won't have resolved anything and we won't have anymore water -- just a big bill. When Colorado's state legislature gets together in the beginning of January, we're going to get together and we're going to say "now here's what's going to happen, and here's what's not going to happen and here's what's going to be cut and here are the reasons they're going to be cut, and part of it is going to be all the money we're spending on lawyers and attorneys to protect Colorado's rights.

We're looking at the South Platte as an over-appropriated stream. What about the Colorado River and the water in it which is over and above the compact amount that is going to California, and other places out of the State of Colorado? I'm really worried about it. Especially when I know that California has about 60 Congressmen and we have six. And our six are divided over what to do with our water. And it isn't any different in the United States Senate. Anyway the point is still a good one. California wants our water. We want to be very careful about what happens with the Colorado River.

For example, right now I'm very much concerned about the Glen Canyon Dam. The lowering of water behind Glen Canyon Dam to maintain stream flows has a tremendous impact on the cost of power. It increases it. I'm one of those farmers who has strung all of these new innovative irrigation methods out there with circle sprinklers to pump ditch water through. Then the power company says, "power costs are going to go up 50% because of what we did with the water level in Glen Canyon Dam." I kind of believe that everything is really tied together. Do we all really realize exactly how this all fits together? It is certainly a concern that we have when we're talking about the over all picture and what happens on the South Platte River as well as what happens with all of the other Colorado rivers.

As we're talking about all of this stuff, we also find out now that with environmental awareness that people really don't want to build big water projects. They don't want to risk anything that might endanger our environment or species or whatever. It is almost impossible now to get a permit do build a large dam. And so what happens?

You find out that all of a sudden funny things start going on within the water community because water kind of flows down hill to money. We find out about AWDI in the San Luis Valley, Kiowa Resources on the South Platte River, and the Public Service Company is all ready to cut a little deal on the Shoshone Power Plant so that water might go to the City of Denver. You see all kinds of little plays start to happen when there is a shortage of water.

I guess in my mind it's real similar to what happens at the state legislature when there is a shortage of money. All of a sudden these little games start going on. This guy gets cut and that guy gets a little bit. Usually what happens, the squeakiest wheel, and the one that can put the most power together, will probably get the money.

When one looks at agriculture only being 2% of the population and yet having 90% of the water it doesn't take a rocket scientist to figure out where the water is going to come from or go to. I just hope when it is all being decided that people don't forget that our life style here is accommodated in large part to the low cost of the food that we put on our tables. You can compare Colorado with any place else in the world and I think you'll find that this is true. We must

not forget the value of the 2% who are putting food on the table and fiber in the closet. That is something that really concerns me. I don't think the 2% is a loud-enough voice to make sure that we all understand the balance.

So when we look to the future of water development just exactly what do we expect to happen? I think the metropolitan area will certainly continue to grow. I think in general that people want to see growth in the State of Colorado to help build the tax base and to help pay the bills. It helps make sure that the young people that we raise in the State of Colorado have a place to work and call home. And given that fact, I think we will certainly see the need for increased water in the metropolitan area. That's probably all right.

I used to think that it was great that Denver got more water as long as we were getting the return flow. But now with the state of the art as it is--100% consumptive use every place you look--and a new interest in water conservation, you begin to wonder whether we who are downstream are going to reap the benefits in the South Platte River of return flows and recharge. I don't think that's a given any more. Without new water storage projects, we will see more transfers of Ag water to municipal use, and I think this will in time prove more damaging to the environment and our lifestyles than the projects.

And that leads me to the last thing I want to talk about a little bit -- water quality.

The longer I've been involved in this water business, and the more I hear about water quality, the less interested I am in putting my hands in the water. But it doesn't seem to have a whole lot of impact on what I grow. In fact, maybe it even helps it out a little bit.

You know, it's kind of like the Rocky Mountain Arsenal. We all complain about what's going on at the Arsenal, but we take a look at the wildlife in that area. It certainly isn't disturbing them too much.

But we're talking about water quality here. Quite honestly, I think that will be an issue that the Colorado General Assembly will deal with in depth, not only in the next session, but all through the 90's. Water quality and the environment will certainly be an issue for the Colorado General Assembly. The thing that I kind of worry about is that this puts us in partnership with the Environmental Protection Agency. Just who is going to call the shots on water quality in the State of Colorado? Because of our budget considerations are we going to act slowly, and say, "Okay, federal government you step into this"?

Sometimes we have a tendency to do that. That is why some of us on the hill that are certainly apposed to the AWDI dealings have a little bit of concern about Senate Bill 1812. That bill really says, "Hey Colorado, in certain instances here we'll ask Secretary Lujan to come and make a determination on what should be done". That might be very helpful to the AWDI case we're fighting right now, but in the long run I think the control of as many things as possible should be up to us here at home.

Certainly in water quality issues, I think we're going to have to bite the bullet and fund the studies and determinations. Keep the determinations here at home so you people, Colorado's citizens, can all go down to the Department of Health or the State Legislature and argue your concerns. I don't want to turn any of these issues over to EPA or the federal government.

The Colorado General Assembly in the past has proven that. We try to keep your tax dollars spent as close to home as possible. I think that's why we probably rank about 4th or 5th in the nation on local taxation and yet down at about 46 or somewhere on state taxation. We want the money to be spent close to home, and the control of it close to home. That is why I think we would find the same thing true, as we look to sharing our responsibilities with the federal government.

Water quality will be a big issue. It will be an issue for you all to debate here at the local level in great part. In fact, we could probably spend the whole rest of the afternoon on this today.

Well, as you listen to this, you might think that I really don't have much concern for the environment. I've been accused of that, but, falsely I think. You also might think that those people in agriculture are certainly ruining a lot of water. Well, here is the situation. Right, now and through the last decade probably, the commodity prices are and have been below the cost of production. When we start talking about water quality issues, and how to remedy those situations with

non-point source pollution controls, I think we need to realize something. We have to realize that agricultural industry - probably the most efficient in our economy-- is also the one that is in the most trouble. I would suggest as you look at the national debt in agriculture growing, that probably agriculture is the least able to deal with the problems, yet they provide the commodities that each and everyone us need and use everyday.

As we look at the water quality issues, and how things are going, I think we've got to become partners in improving what happens in water quality effects from agricultural land. That is not to say we're going to have a settling pond of each at the bottom of each and every field and expect the farmers to treat that water. You know, I remember the first time I put a little settling pond as a return project at the bottom of one of my fields. My neighbor was up there in no time saying, "Hey, I was supposed to have the water running out of this field and it belongs to me". It is just so dog gone complicated you can't believe it.

Too many times we react from the limited knowledge that each of us have and don't take a look at the overall good of what we're trying to accomplish. In this water quality situation in the 90's, and through the political process that we have, I really think there's a need for some cooperation. We should approach this like we have business in the past. We really have too much to gain for the future of this country to not open ourselves up to some good healthy debate. We need to understand really what goes on with the food chain and what water means in the State of Colorado.

So for the 90s, I think water and water quality will certainly be at the top of the agenda to Colorado General Assembly. We will certainly see others get involved with federal government looking at water, and the Colorado water law, and I guess I hope that people will become more involved in the political process. And a few might take and impact that in the proper way.

I hope you all take my remarks well, and appreciate the fact that these are straight forward from a person that is involved in production agriculture as well as a being a politician. Lets work together in finding the balance. That's what I really wanted to tell you today.

Since talking I'm reminded of something that I've kept in my pocket. If you'll forgive me, it's called the new simplified wetlands delineation method. Have you all heard of it? I don't know that everybody's heard about it, but it is government at its best or worst depending on your point of view.

1. If it's wet, it's wet.
2. If it's dry, it's dry.
3. If it's wet, but not overly dry, or dry, but not overly wet, refer to items 1 or 2.
4. If it's wet, but could be dry, or dry, but could be wet, refer to item 3.
5. If it is neither wet nor dry, refer to the Atmospheric Delineation Manual.
6. If it is wetter than dry or dryer than wet then it is damp. If it is damper than what would be considered dry then refer to item 1. But if it is dryer than wet, but would still be considered damp, but not as damp as what would be considered wet, or is dryer than a damp wet area then refer to item 2.
7. For wet areas that are sometimes damp but not dry and have standing water except when damp, and would not be classified as dry areas that are sometime damp but not wet, at which time the dampness is dependent upon its wetness; then it would be considered a damp wet area which is not the same as a bay (because a bay is a bay) but would be classified as a damp dry area that is sometimes wet but not enough to be considered a river (because a river is a river) but is wet enough to be considered damp, which is not enough to be considered wet, so it is dry.
8. For dry areas that are sometimes damp but not wet and don't have standing water except when wet, and would not be classified as wet areas that are sometimes damp but not dry, at which time the dampness is dependent upon its dryness; then it would be considered a damp dry area which is not the same as a lake (because a lake is a lake) but would be classified as a damp wet area that is sometimes dry, but not enough to be considered

an ocean (because an ocean is an ocean) but is dry enough to be considered damp, which is not enough to be considered dry, so it is wet.

9. If in doubt about the dryness or wetness of an area, and uncertain if water occurs in a form other than water, then contact your nearest politician.

Thank you very much.

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Is Colorado Backing into Water Planning?

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I want to bring you up to date on what the Colorado Water Conservation Board (CWCB) is doing and let you think about how it relates to what is going on in the South Platte and management issues for the South Platte. Let me start by saying something introductory about the CWCB. It was originally created as sort of the planning agency in Colorado. Now, that may be humorous to those of you who know that we don't have water planning in Colorado; in fact, if you know a little more you know that planning is the "P" word in Colorado.

Bruce Babbitt, former Governor of Arizona, is on the speaking circuit now, and when he talks about water planning in the West he says it is not a new idea. Long-range water planning is an institution in the West, according to Babbitt. He described it as finding a very young, electable member of Congress and then keeping him in Congress for a very long term. When he got a lot of seniority, he brought in a lot of water projects. Babbitt commended Colorado for doing reasonably well with Congressman Aspinall, but he was proud to point out that Arizona surpassed Colorado with Hayden and Mo Udall. They were very good at water planning.

For the CWCB, water planning used to mean helping to politic for federal, pork barrel, water projects. Where would the Bureau of Reclamation build, how big would it be, and how do we get the money to get it built? Now to be sure, the CWCB had another important function, and that had to do with interstate relationships: helping to negotiate compacts; helping to defend compacts; or helping to defend, in the United States Supreme Court, on interstate litigation. Now, things have changed. If you are going to view planning as trying to get federal money for big projects, you are not going to be very busy these days. I think everybody has now come to agree that it's over.

There has been another curious problem related to planning, and it has to do with the environment. Regarding the state instream flow program, the opening language in Colorado legislation is: "In order to correlate the activities of man with the protection of the natural environment to a reasonable degree, the Conservation Board shall..." This is the agency that had always been the water development board for the state of Colorado. Now it is supposed to be the "correlation of man and environment board" in addition to being the water development board - a very interesting shift in basic policy. What does all this mean for the CWCB? It is a time of change.

Some things that are happening on the Colorado River may shed some light on this "P" word that we have to deal with today. First of all, let's talk about the instream flow program. An interesting and absolutely earth shattering-application of it is that this past year Senators Brown and Wirth got together on a wilderness bill and introduced legislation on the Senate side. It has now passed the Senate, and it says that there are not going to be any federal wilderness water rights. But in one case of a downstream wilderness area (actually one of a couple of cases), on the Piedra, there would be a CWCB water right. Now that's really strange. If you were to go back and talk to original sponsors of the instream flow program in the early 1970's, you would find that wilderness applications were not part of what was intended. They were thinking about cold water trout streams and minimum flows, basically low flows during the base flow time of year; they weren't thinking about purposes other than fish - trout, to be specific. So the very thought that the CWCB would appropriate water to protect a wilderness area, in who knows what amounts yet, is a very interesting development. CWCB and Forest Service staff have been working under an "MOU" in the field, trying to quantify some of the requirements. The old days of cold-water minimum flow are gone; it is not so simple anymore.

Another question is: What is the CWCB's thinking on other than cold water streams? What about some of the warm water habitats? Is there any movement in that direction? The short answer is, "Not now." But I do believe that we will move on into an era in which the instream flow statute will be applied beyond cold water fish. The trick here is that it is easier to deal with cold water because it is closer to the top of the system and generally above a lot of the uses. But if you put an instream flow on a warm water segment it might be low in the system, and it could tie everything up in a whole basin. It is going to be a lot more complicated to deal with.

The Endangered Fish Program started in the early '80s when the Fish and Wildlife Service issued a draft recovery program for the squawfish and humpback chub in the Colorado River, saying that endangerment of those fish was caused by water development. Therefore the recovery plan was that there would be no more water development. That was the draft plan. It hasn't gone very far in that direction yet. Instead it has spawned a very interesting negotiation among water developers, environmentalists, federal agencies and state agencies to try to come up with an agreed-upon recovery plan. The initial framework has been agreed upon and has been around since 1988. One of the things it calls for is protection of flows necessary for those endangered fish habitats through state water rights. So now we have made an agreement to protect the flow requirements of those habitats through the state instream law - to protect the natural environment to a reasonable degree.

The Board has been very cautious about it. Those of you who have talked to the Fish and Wildlife Service may know that there is some frustration on their end that the CWCB hasn't moved more quickly, particularly with respect to the so-called 15-mile reach near Grand Junction. USFWS would like to see a big instream flow there to protect the flow regime that currently exists, but that would be a very interesting problem for the future of any water development in the basin. It would essentially say that Colorado could not realize any of its additional compact entitlement on the main stem of the Colorado River. The CWCB's other objective, beyond protecting the natural environment to a reasonable degree and correlating the activities of mankind, is to promote water development and protect the state's compact entitlement. So that has been delegated, if you will, or perhaps lobbed, into the lap of the CWCB.

At the same time, a very serious threat has emerged for Colorado - first, California's drought, and second, completion of the Central Arizona Project - and a realization that the Lower Basin has now fully appropriated its share of Colorado River water and is now utilizing the Upper Basin's share as well. Moreover, it is used not just in a casual way for a little hay now and then, but actually to build Los Angeles. It is very unlikely that once you get a large metropolitan area hooked on a water supply, in excess of its entitlement, that you will ever get it back. This came to a head last summer when California, in the fifth year of drought, started to put pressure on the Bureau of Reclamation for the way it operates the Colorado River - the so-called annual operating plan which is an aspect of the long-term coordinated operating plan. The issue was whether there was a surplus water supply.

You may be aware that last year Governor Romer wrote a letter to the other seven basin states and California suggesting a negotiation wherein Colorado might guarantee that Los Angeles would continue to get its water for some period of time if it began to scale down its dependence on Colorado River water - and more specifically, that California would scale down its dependence. California now uses 5.5 million acre-feet a year, but is entitled to 4.4 million acre-feet per year.

In addition, we began to talk about money, a very complicated topic. I want you to know that the environment for this discussion is really charged. It is as if our children's heritage, from the water developer's standpoint, is on the table right now. At the same time, the CWCB is in the process of appropriating large flows in the Piedra and acquiring water rights to appropriate large flows in the endangered fish segments, principally the Yampa, and we are not at all clear what will happen to that Compact entitlement. Maybe we are in the process of shooting ourselves in the foot. Lately, some have written letters to the Governor and to the Conservation Board arguing that we have done exactly that. At the same time that we are trying to protect our Compact share from California, we are appropriating large instream flows to protect the environment. It is clear that before we appropriate any of these flows we must know what we have done to the opportunity to develop our Compact entitlement. Are there enough dam sites left? Are there places where water can be developed in Colorado that are compatible with endangered fish recovery, wetlands protection, and other site-specific environmental protection? Can it be done? We will have to figure that out before we make those appropriations.

Now, I do not want to say very much about the "P" word, but I would suggest that when we do all those calculations we will have done something very close to water planning. Now, that is the back door. That, to me, is the clearest example of how we are backing into the whole process of basin-wide water planning.

How might this apply on the South Platte? First of all, my observation is that it's more complex on the Platte - not more intense, not harder, but just more complex - with more little pieces. The situation is, in some respects, more subtle. In the Colorado River the issue is: How do we develop and protect endangered fish? If you want to add wetlands, it gets a little more complicated.

On the Platte, you have the question of urban water supply. If Two Forks is down, and I suppose it is, what next? Is Thornton showing us how additional water supplies will be developed, or is there some other plan? How will we protect

the water resource base for agriculture? What is agriculture doing to itself in the basin today in terms of salinity on the lower part of the river and in terms of other nonpoint source runoff issues? How will agriculture cope with the regulation of nonpoint source runoff regulation? I think it's inevitable. How will agriculture cope with that? What will be the economic impacts, and who will regulate? Will there be more water development on the Platte? There is a certain amount of entitlement crossing into Nebraska. Will we be able to develop it or will endangered species issues, specifically in Nebraska, preclude that?

There are more issues that are not as well defined on the Platte, but the overall issue is fundamentally the same. How do we back into water planning, given that it is not something that we do up front in Colorado? I also want to suggest, again, that it is inevitable. You can say, "We are not going to plan in Colorado. We are going to let it run its course." Well, that is a kind of planning. I remember hearing Glenn Saunders often say, "We have a water plan in Colorado. It is called the Prior Appropriation Doctrine." That is the water plan - first come, first served. If you do nothing, that's a form of plan. Today in the Western United States, if you do nothing it is a way of abdicating planning authority to the federal government - witness Two Forks. So how we plan is the only issue, not whether we plan.

Now, let me turn to a real nut-and-bolt issue that the CWCB is dealing with, and suggest that therein is how we will face the water planning task in a back-door way on the South Platte. First of all, understand that the CWCB does not have authority to regulate anything; it is not a regulatory board. It does not have authority to regulate wetlands, water development that would impact fish and endangered species, or decide how much water gets allocated from agriculture to municipal. It does not have authority to do what is generally lumped under the heading of basin- of-origin or area-of-origin protection. It has no authority to require mitigation of socio-economic impacts in an area that is impacted by a water rights transfer. It has no authority to regulate anything, nor does any other agency in the state of Colorado, save on the issue of water quality. And with the Water Quality Control Commission, that authority is largely aimed at point source discharge. Nobody has much authority yet over agricultural runoff or other nonpoint sources.

The Construction Fund, which amounts to 90 million dollars, generates about nine or ten million dollars a year. The statute requires that two-thirds of that amount be allocated to developing new projects that will enable Colorado to utilize its compact entitlements. One-third can go to rehabilitation of existing systems and as to other uses. First of all, let me say something more about the Construction Fund. It is a subsidy - cheap money, the purpose of which is to subsidize water development. Like any subsidy, its purpose is to stimulate state policy in that area. Remember, there is nothing inherently wrong with a subsidy; it is just a policy decision by the governing entity. You may remember the solar energy subsidies during the Carter era; they were an important expression of government policy. And water subsidies are probably one of the oldest and most tradition-bound forms of policy in the United States. (The federal side of that, however, is over.) Under the old act it was very clear and the state policy was simple: develop the compact entitlement. Now, state policy is more complex. Moreover, the policy of developing the compact entitlement is more complex. Development of new compact entitlement has become virtually impossible because of environmental regulations, economic factors, and socio-economic policy debates in the basin of origin. How can one develop any compact entitlement? Why give two-thirds of the money to something that cannot be done? The CWCB is now recommending a major restructuring of the Construction Fund policies. And that basic restructuring is a way of saying, "We take seriously the job of developing and protecting the state's compact entitlement, and if we are going to do it we need more tools." We would like permission to use the Construction Fund for more tasks that are, in the end, supportive of the basic policy. There are four basic recommendations. We will continue to use money for developing new projects. They will tend to be small projects. They are not going to be federally subsidized, for the most part. This subsidy may be the only subsidy. New projects will probably require a great deal of local or private participation and cost sharing by private organizations.

The second aspect is something the CWCB has been doing a great deal of but has not talked about a lot, and that is spending its money on the rehabilitation of the existing water infrastructure. If you are interested in environmental protection, this is one of the most important things that can be done. If you are a dam fighter, one of the most effective strategies you can adopt is to get people to rehabilitate what they already have. There are several hundred thousand acre-feet of reservoir capacity in this state that are currently unusable because of hold orders imposed by the state engineer related to dam safety concerns. At the same time, we are trying to find a place and a way to build a new capacity. It is a lot cheaper to recover existing capacity than it is to build new capacity also more environmentally sound. Typically, there is less environmental impact - perhaps no environmental impact in many cases.

The third element is something called "New Management Initiatives." It is a grab bag of things. It includes the recognition that we have to address some very troubling problems in river management as an element of trying to move forward with development. I think one of the best examples is agricultural runoff. That is going to be expensive. There will be best management practices (BMPs) imposed. They need to be designed sensitively and in a way that is both cost effective and compatible with continued operation of farming in this state. The only way I can think of doing that is to have the farmers do it themselves. I think the purpose of this aspect of the fund would be to stimulate, through demonstration projects and actual developments, best management practices. It is not the CWCB's function to regulate water quality, but it may well be its function to try to respond to the water planning problem of how to comply with water regulations.

Another aspect of this third area of new management initiatives will be basin-of-origin protection. We will not regulate protection. I do not think the legislature will get it done very soon. And yet you are going to see a lot of political issues, a lot of concern, a lot of heat generated over things like the Thorton proposal to export water from Water Supply and Storage. There will be local responses, but I think there also will be a cry for some help from the state. I think that can take the form of asking for state money to help out on projects which are benign, such as, for example, dry-year options. A dry-year option, or interruptable supply contract between a city and a farmer, is a win-win situation. It allows the farmer to keep his water nine years out of ten and to be compensated well for selling it the tenth year. It gives the city a firm water supply for that one-in-ten-year drought. I think it is probably the most cost effective and environmentally benign way of approaching additional increments of urban water supply. And accordingly, I think it is a good approach to area-of- origin protection. I think the state ought to subsidize the development of that through the Construction Fund. The issue of water management initiative, I think, is going to be a wide open thing. We want to have the freedom to address and to stimulate development in whatever is proposed that makes sense and that needs to be done.

The fourth aspect of the Construction Fund will be information. We are going to have the temerity to walk into the legislature and ask for money to build models and databases. We will use them to figure out where we can develop our Compact entitlement, where we are going to have to protect the environment in order to be able to move forward as a society, and how we can correlate the activities of man for the protection of the environment to a reasonable degree. That will initially consist of a Colorado River model, we hope. I expect it will be a basin-wide model to put us on equal footing with the other seven states and with the Bureau of Reclamation on the matter of surplus determinations and protecting our compact entitlement. It will also have an intrastate component so that we can decide, for example, if we put an instream flow on the Yampa, on the Piedra, and on the main stem and the Black Canyon of the Gunnison, are we shooting ourselves in the foot or can we still find places and ways compatible with the environment to develop the next increment of water supply? It will be GIS-based. In the long run, we hope to get a beautiful data set from satellite imagery and to know, in a lot better detail, what actual uses are in terms of locations and quantities. This is a significant departure from tradition. It will require the support of all who are sensitive to the importance of water management and the importance of information systems in supporting water management.

These four purposes for the construction fund are in reality not revolutionary changes. They would essentially allow the CWCB to adapt itself to the immediate needs it faces in its traditional role. But it will require information and management decisions to be made, in order to carry out that role. In that way we will have backed squarely into water planning, the original nominal purpose of the CWCB, but a purpose that has been too long neglected.

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Session I

The Climate of the South Platte River Basin – A 20th Century Perspective

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Abstract

The water resources of the South Platte Basin in Colorado and their subsequent uses are closely associated with the climate of the region. Climatic diversity is great within the basin with climatic conditions that vary both as a function of elevation and geographic location. Seasonal and interannual climate variations add further complexity to the management of basin water supplies.

Characteristics of the climate within the South Platte Basin will be described based on surface observations during the past century. Seasonal temperature and precipitation patterns will be shown which help explain why mountain snowpack measurements are not as well correlated with streamflow in the South Platte compared to many other Rocky Mountain watersheds. Time histories of temperature and precipitation will be displayed to show the climatic fluctuations of the past century and occurrences of drought. Relationships between winter and spring precipitation, which provide most of the surface water supply, and precipitation during the summer water use season will also be described.

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Some Rare and Interesting Fishes of the South Platte Drainage

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Abstract

Several fish species have their southernmost and/or westernmost distribution in the South Platte drainage of Colorado. They occur as disjunct populations hundreds of miles from other populations of their species in the northern Missouri-Mississippi basin. This is explained by climatic history. During the late Pleistocene as glaciers retreated and the climate warmed, species whose obligatory habitat is cool, clean water had their range disrupted, leaving remnant, disjunct populations particularly in the foothill region along the Front Range -- they became glacial relicts.

This fauna is typified by the minnow genus Phoxinus which persists as rare populations of the northern redbelly dace and a peculiar hybrid between the redbelly and finescale dace, has probably not occurred in Colorado for thousands of years. The only fish of the South Platte drainage protected under the Endangered Species Act is the greenback cutthroat trout. Because all of the restoration efforts occur in uppermost headwater areas of the drainage in the Rocky Mountain National Park and Roosevelt National Forest, the greenback trout has not created problems for water development.

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Birds on the South Platte

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Abstract

Richness and diversity of bird life depends upon richness and diversity of bird habitat. The plains river bottoms provide the richest breeding habitat in Colorado for birds, due to the excellent capacity of the riparian areas to provide the essentials of good bird habitat -- shelter, food, and water. However, some species occur in limited numbers because they have quite specific habitat requirements.

Today the South Platte has pockets of woodland (some good habitat, some bad) interspersed with uses which do not benefit most riparian birds: channelized courses, croplands and feed lots, and myriad urban uses like industrial sites, railroad yards, ball parks, and golf courses.

A visionary, ideal, South Platte could consist of several long stretches of undisturbed habitat. These stretches would exclude incompatible human uses, but support non-disturbing human uses like hiking, skating, canoeing, fishing, some hunting, and wildlife watching. More extensive, diverse riparian - dependent birds, particularly those with narrow habitat requirements.

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***Water Quality Aspects
of the
South Platte Basin***

The U.S. Geological Survey's National Water-Quality Assessment Program and the South Platte River Basin

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Abstract

The protection and enhancement of the quality of the Nation's ground- and surface-water resources are high-priority concerns of the public and of local, State and Federal Governments. During the past two decades, several large water-quality related programs have been enacted into law. In addition, many important decisions that will determine the directions of water-quality management for future decades have yet to be made. Many of these decisions will be made with great scientific uncertainty. Thus, nationally consistent information on the status and the trends of the Nation's water quality is needed to assess past investments in water-quality management and to provide a base of knowledge for future decision making. To meet this need, Congress appropriated funds in 1986 for the U.S. Geological Survey (USGS) to test and refine concepts under a National Water-Quality Assessment (NAWQA) Program. The long-term goals of the program are to:

1. Provide a nationally consistent description of current water-quality conditions for a large part of the Nation's water resources;
2. Define long-term trends (or lack of trends) in water-quality; and
3. Identify, describe, and explain the major factors that affect observed water-quality conditions and trends.

At present (1991), the program is nearing the end of a pilot phase and is beginning the implementation phase. During the pilot NAWQA Program, methods useful for a full-scale national water-quality assessment program (Hirsch and others, 1988) were developed, tested, and refined. During the pilot phase, the National Academy of Science's (NAS) Water Science and Technology Board reviewed the NAWQA Program. The NAS Board submitted an interim report, which stated that (1) the implementation of a national water-quality assessment is in the best interest of the Nation, and (2) the USGS is well qualified to establish and implement a NAWQA Program. In late 1989, the Administration determined that the USGS should proceed with implementation of the NAWQA Program in fiscal year (FY) 1991 and requested that Congress appropriate \$18 million to begin the full program, which, in four years will increase to about \$60 million annually. Twenty study units have been identified; the South Platte River basin was one of them.

To achieve the goals of the NAWQA, water-quality concerns of the local, State, regional, and national water planners, managers, and policy makers need to be addressed. In the South Platte River basin, major water-quality issues of concern include:

- Effects of permitted point source discharges on water quality
- Ecological health of streams, lakes, and reservoirs
- Occurrence and concentration of agricultural chemicals in the environment
- Effects of agricultural practices on water quality
- Effects of residential and urban land use on water quality
- Effects of changes in water allocations on water quality
- Effects of artificial recharge on water quality
- Sediment transport and its associated chemistry

Major activities within the South Platte River basin that will be performed as part of the study-unit investigation include the compilation of available water-quality information, sampling and analysis of water quality for an array of physical,

chemical, and biological properties, and the interpretation and reporting of results. Water-quality data collection for the surface-water component of the investigation will include two networks: fixed stations and synoptic sampling surveys. Data will be collected on water, bottom materials, tissue, and biota. The ground-water investigation will include three networks: regional, target (selected constituents), and long-term sampling surveys. Samples will be collected for chemical analysis and for an assessment of in-situ microbial populations. Case studies of selected stream reaches and aquifer segments will be proposed to address specific water-quality problems of concern.

REFERENCE: Hirsch, R. M., Alley, W. M., and Wilber, W. G. 1988. *Concepts for a National Water Quality Assessment Program*: U.S. Geological Survey Circular 1021, 42 p.

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Non-traditional Approaches to Solving Water Quality Problems

Duane E. Humble, Metro Wastewater Reclamation District
Carl Houck, Camp, Dresser, & McKee

Abstract

The Metro Wastewater Reclamation District is under a mandate from the U.S. EPA Region VIII to remedy water quality problems in Segment 15 of the South Platte River. Studies conducted over the last decade have shown the levels of dissolved oxygen (DO) are insufficient, in portions of the segment, to sustain a balanced range of aquatic life forms. Reduced concentrations of DO are the result of natural and man-induced conditions. Studies have implicated the discharge of oxygen consuming materials by the District as a major cause. The principal component in the stream creates a nitrogen oxygen demand. As a result, the District has been required to construct conventional in-plant nitrification and denitrification facilities for half of the wastewater being treated, and further to determine whether additional treatment would be required to meet water quality standards.

Preliminary engineering studies revealed that conventional treatment facilities to remove ammonia from the remaining other half of the flow would cost between \$72 and \$112 million to construct. The increase in operations costs would also be quite significant. Consequently, the District contracted with a consultant team headed by Camp Dresser & McKee (CDM) to evaluate alternatives to conventional treatment to meet water quality standards. The study was begun in October 1990 to determine the level of additional treatment required to meet water quality standards. The backbone of the study was the development and use of a water quality model for Segment 15 of the river which could be used to reliably predict responses of DO, ammonia and other water quality parameters. U.S. EPA and the Colorado Water Quality Control Division participated in selecting the stream model to be used and in reviews of the modeling during the study. The U.S. EPA's STREAMDO water quality model was selected as the tool for assessing treatment requirements and compliance with water quality standards, particularly DO standards. The consultant's team developed a listing of possible techniques for meeting water quality standards in the segment, including both "traditional" and "non-traditional" methods. The traditional method was in-plant biological nitrification/denitrification at the range of costs previously stated. The non-traditional techniques included: discharge of secondary effluent to irrigation ditches; modification of stream channel to prevent stagnation; in-stream aeration (both passive and active); wetlands treatment; increased quantities of upstream dilution water; and filtration of effluent to remove oxygen demanding solids.

The non-traditional techniques were evaluated both individually and in selected combinations for their ability to meet water quality standards. The STREAMDO model was used during the evaluation process. Those alternatives which were capable of meeting water quality standards were carried forward for qualitative evaluation, using the following set of criteria:

- Implementability/Relative Magnitude of Activity;
- Operability/Reliability;
- Environmental Compatibility; and
- Public Support.

Cost was later evaluated as a criteria for evaluating the final eight non-traditional alternatives.

Once completed, the study will provide the District and the regulatory agencies with a range of potential alternatives to the construction of costly, conventional nitrification/denitrification treatment in order to meet Segment 15 water quality standards. Additional information to improve the reliability of the modeling will be gathered during the next couple of years. In addition, environmental, social and cost information will be further evaluated so that the best solution for overall resource management can be selected. Selection of an alternative which incorporates one or more of these non-traditional techniques may allow the District to meet stream standards in a more environmentally compatible manner than continued construction of in-plant conventional facilities.

The District is inviting all South Platte River water management agencies to participate in this continuing study during the next several years.

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Watershed Management Plans Improve Water Quality in the South Platte River Basin

Russ Clayshulte
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Abstract

There are 18 hydrologic basins in the eight-county Denver metropolitan region. Water quality and wastewater management plans have been developed for most of these basins. The basic components of these plans are maintained and updated through the regional Clean Water Plan. These basin plans are developed to balance and regulate loadings from point and nonpoint source discharges into receiving waters so standards and classifications are not exceeded. Many of the major lakes and reservoirs in the metropolitan region are eutrophic. Phosphorus reduction is the primary method used to lessen eutrophication in waterbodies. Therefore, basin management plans have focused on phosphorus reduction and regulation. Control regulations have been adopted by the Water Quality Control Commission for Cherry Creek and Chatfield Basins. A new control regulation is being developed for Bear Creek Basin which will incorporate the better components of existing regulations. The long-term purposes of these management plans and control regulations are to improve water quality in the upper South Platte River Basin and eliminate threatened or use impaired status on stream segments in the metropolitan region.

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Spatial Distribution of Nitrate Leaching “Hot Spots” Along the South Platte River in Colorado Using GIS

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Abstract

This study was recently initiated to identify nitrate leaching “hot spots” along the South Platte river in Colorado. Cropping practices and management that will minimize aquifer nitrate contamination will also be investigated. The Nitrate Leaching and Economic Analysis Package (NLEAP) will be used in conjunction with a GIS (GRASS). A similar of NLEAP was previously conducted for Sycamore Creek watershed, Ingham County Michigan. The primary inputs for NLEAP consist of soil series information, climate data, aquifer vulnerability, an cropping history. Collection and preparation of the respective GIS map layers is currently underway for the South Platte irrigated agricultural zone. Validification of NLEAP will also be conducted at selected study sites

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South Platte Water Transfers

Assessing Hydrologic and Economic Impacts of Rural to Urban Water Transfers: An Interdisciplinary Analysis of the South Platte Stream - Aquifer System

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Abstract

Making the most economical use of water and other resources in the South Platte Basin is important as population continues to increase along the Colorado Front Range, particularly given difficulties in developing new storage projects. This paper presents a model used to estimate the agricultural, hydrologic, and economic impacts of alternative management strategies. We describe a system model (HELM), developed to provide a more complete understanding of policy impacts than is presently available. The model is formulated to simulate likely policies affecting irrigated agriculture along a fifty mile long corridor of the South Platte River mainstem and its tributary aquifer downstream from Denver.

HELM (Hydrologic-Economic-Legal Model) is a system simulation including three components. A hydrologic sub-model simulates stream-aquifer interactions and aquifer recharge and withdrawals from irrigation and canal seepage and pumping. Surface flows are allocated to ditch companies by priority date in the legal sub-model. An economic sub-model simulates irrigator's decisions to predict surface water diversion, groundwater pumping rates, cropping patterns, and irrigation distribution technologies. The model encompasses, therefore, both supply-side and demand-side considerations.

Varied policy scenarios might be evaluated using HELM, including marketing of salvaged water, dry year options on agricultural water, subsidizing irrigation system improvements, and land retirement. Detailed analyses of physical and economic impacts (e.g., timing and magnitude of return flows and net returns to irrigated land) are possible using results generated by the model. Results of an illustrative case study with irrigation water rights as a temporary source of new municipal supplies are presented.

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Water Rights Option Agreements: Cooperation between Cities and Agriculture During Dry Years

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Abstract

The use of water rights option agreements between farmers and urban water utilities has potential to relieve the crisis aspects of water shortage. By having a mechanism to temporarily obtain senior agricultural water in dry years, for just compensation, the water utility may forestall serious consequences. Preliminary findings indicate that the cost and other impacts of the option agreement can be very competitive with permanent acquisition of water rights or the construction of additional carryover storage. A current research project is considering the operational, legal, socio-economic, reliability aspects of such agreements for water utilities in Colorado.

Drought comes to the South Platte River Basin (SPRB) about every 20 years. The most recent episodes of record are in the 1930's, 1950's and the 1970's. [McKee, Doesken and Kleist 1990]

The effects of the 1976-1977 drought in Colorado were widespread in the SPRB and fairly well documented. They are characterized by three main factors: 1) precipitation, 2) streamflow and 3) reservoir levels. The precipitation in the SPRB above Greeley and in the mountain communities declined from below average in 1976 to lower amounts in 1977 (Denver with 67% of normal). In contrast, the lower basin precipitation, including Sterling and Julesburg, markedly improved in 1977. Streamflows on the SPR fell from the 42nd percentile in 1976 to the 18th percentile in 1977. In the upper basin of western Douglas and southern Jefferson Counties, as well as the eastern plains, reservoir levels were reported far below normal. In the east, rains did not significantly improve storage or streamflow.

In summary, the low streamflow and the exhausted reservoirs of the high plains imply that continuation of the meteorological drought into 1977-1978 would have induced much more severe consequences. The essential drought effects on Colorado communities were inability to meet water demands, depleted fire protection reserves and deterioration in quality of both surface and ground waters. Income and expense fluctuations also hit many water utilities. The most prevalent supply-side action taken by utilities was obtaining short-term water by exchange or cooperative agreements. [Howe, et al 1980] Allowing for comparative depletions and the late precipitation, it is possible that a planned shift of storage and/or streamflow to urban water utilities would have better allocated supplies in some areas.

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The Platte River-- How Downstream Decisions Could Impact Upstream Uses

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Abstract

This paper discusses the relationship between downstream Platte River management issues and upstream water uses on the South Platte River. Summarized here are the status of the Platte River instream flow management issues currently being debated in Nebraska and how instream flow needs in the Platte River could potentially affect upstream management and planning.

The South and North Platte Rivers converge in North Platte, Nebraska, forming the Platte River. The Platte River is at the center of a precedent-setting water management controversy involving utility, agricultural, recreation, fisheries and wildlife interests. Two major decision making processes that could impact upstream development opportunities on the South and North Platte Rivers are currently underway. These include the review of a series of instream flow applications submitted by the Central Platte Natural Resources District to the Nebraska Department of Water Resources, and the relicensing of the Central Nebraska Public Power and Irrigation District and Nebraska Public Power District storage and diversion facilities by the Federal Energy Regulatory Commission. The outcome of these two processes will determine the instream flows needed to protect endangered species dependent on the Platte River and the operating criteria for the primary storage and diversion facilities.

If mandated instream flows are in excess of historical flows, then an adjustment of upstream uses will be necessary. Where and how this potential adjustment is made remains to be seen. At issue in the instream flow review process is how much flow is needed to maintain and/or ensure the recovery of several endangered species that depend on the Platte River. The repercussions of downstream flow needs were felt during the Two Forks storage project permitting process. It became evident to South Platte River Basin interests that projects located upstream of the key habitat areas must take into consideration among other things, potential impacts to downstream endangered species.

If instream flows in excess of historical rates on the Platte River become a reality, the flows will have to come from somewhere. Although there are numerous options available for improving the protection of endangered species on the Platte River, one of the obvious solutions involves increasing inflows into the Platte via the South Platte or North Platte rivers. The state of Colorado is undoubtedly watching the decision making process in Nebraska with interest because of this potential issue. South Platte River Basin planning and management efforts have already been, and will continue to be, affected by the downstream decision making process.

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Quantifying Water Resources Issues for a Multi-State River Basin

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Abstract

Two major challenges exist when developing, operating, changing, or maintaining water resources projects in multi-state basins. The first problem is self-evident: satisfying project demands across political and geographic boundaries. Past and present attempts in such cases have frequently led to litigation instead of voluntary compromise and cooperative solutions. The second problem is one of combining information from diffuse and different sources in a way that allows for meaningful comparison. For example, both socioeconomic and ecological factors must be included in the analysis of basin projects. How can such factors as crop production and stream biodiversity be compared? How can the method for combining results be explained to the public? Several federal agencies are undertaking aggressive new data collection programs for regional river basins, but is the proper data being collected? How will it contribute to the solution of water resources allocation conflicts?

A 10-person research team from the University of Nebraska, University of Wyoming, and Colorado State University has been assembled to address these questions as applied to the Platte River basin. Previous studies have been restricted by the geographical and mission-oriented biases inherently found in state and federal agencies, or by the strong views of special interest groups. While we do not presume to overcome all problems, we believe the Universities of the basin, led by their Water Resources Research Institutes, are in a position to provide objective leadership in combining water resources information from socioeconomic and ecological perspectives.

We will demonstrate our research approach by using Composite Programming to combine several levels of basic indicators to build a basin-wide composite index. The index is necessarily subject to uncertainties contained in input data, and is critically dependent on weighting factors used to combine indicators, we will explore the effect of various weighting scenarios on the basin-wide composite index.

The research team and the approach for the Platte River basin is in its formative states. While research results are several years away, the basic principles are now ready to discuss.

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***Water Administration
of the
South Platte Basin***

Mission of the Corps of Engineers on the South Platte River

Tim Carey, Project Manager
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Abstract

The Corps of Engineers operates and maintains three lake projects in the Denver metropolitan area that impact flows on the South Platte River. These projects include Bear Creek, Cherry Creek, and Chatfield Lakes. In addition to the operation of these projects, the Corps is responsible for administration of Section 404 of the Clean Water Act for dredge and fill activities on the River and supervision of Sections 14 and 205 local flood protection projects. The focus of this presentation is on operation of the three lakes.

The mandated operational mission, as related to the South Platte, is flood control. All three lakes operate as a unit during a flood event to protect Denver and the downstream basin, with individual release rates dictated by downstream conditions, channel capacities, and available flood storage at the other lakes. These conditions are evaluated by the Omaha District Office and corresponding release rates are then mathematically computed.

When lake levels are below food control elevations, release rates are dictated by downstream water rights demands. At Bear Creek the normal operational mode is to pass all inflows. The City of Denver owns water storage rights at Chatfield for eleven feet below the conservation pool elevation of 5432' m.s.l. Between May 1st and August 31st, however, the City has agreed not to drop the lake elevation below 5426.85' m.s.l., unless severe drought conditions prevail. At Cherry Creek the Colorado State Engineer's Office administers downstream water rights, normally passing inflows when required.

In this complex environment of mandates and water rights issues, there is a faint light at the end of the tunnel for more advantageous flow releases on the South Platte River. The Corps has identified surplus storage space in both Bear Creek and Chatfield Lakes. Water rights could be purchased or traded with the City of Denver, State of Colorado, or senior rights owners. A recommendation for such storage would have to be initiated with the Colorado Water Conservation Board. The Corps of Engineers, however, is mandated by law to charge for such storage. These charges are based on any increased operational costs, environmental and recreational impacts, relocation of facilities, and any necessary modification to structures.

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Development of a Decision Support System for Water Rights Administration - Phase II

Ernie Flack, David Sieh, and Charlie Haines
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Abstract

Municipal and agricultural water users in the upper South Platte basin have teamed together with the Colorado State Engineer's Office to continue development of a South Platte Water Management Decision Support System. The objectives of this system are to develop a computer-based tool that will support the State Engineer's Office in hourly administration of water rights, enhance communication between water users and the State Engineer's Office, and provide tools for management of water users' supplies. The system is an integrated environment that combines real-time data collection, a relational database management system, a geographic information system, topological search algorithms, a wide area network, and a direct-manipulation style graphical user interface.

The phase I prototype focused on designing and developing databases, algorithms, and interfaces for several of the essential tasks associated with real-time administration and management of water supplies. One set of tasks was monitoring the physical conditions of the basin, i.e., streamflow and precipitation. Another set of tasks dealt with administrative functions such as analyzing the impact of new calls, setting new calls, and administering new calls.

Phase II of the project addresses four goals. First, routing is to be incorporated. Routing will be used to produce hydrographs indicating the impact of alternative administrative calls at user specified diversion structures. The routing methodology being implemented is the State's rule routing. The second goal is the development of algorithms to partition streamflows into components of natural streamflow and non-natural flows such as storage releases and imported water. The ability to partition the total physical flow at a gage will depend upon the ability to route flows originating upstream from the gage. This information can be used to quantify the natural streamflow component which should be administered under the system of water rights. Third, a telecommunications network will be designed and implementation of it will begin. The network will link the State Engineer's Office workstation to the State's satellite data collection system. Furthermore, the State Engineer's Office and the water users will be connected over the network. The State and the water users will be using the same databases via the network, and information, such as reservoir releases, will be transmitted over the network.

The last goal is to prepare the system for thorough and rigorous field testing during the 1992 irrigation season.

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Reservoir Operations: You Make the Call

Marc Waage and Bob Staeger, Denver Water Department

Abstract

Denver's raw water collection system is a complex operation. After a brief overview of the system, the audience participates in a 'real life' example. An actual scenario out of Denver Water Department's history will be given. Operators are to set the Roberts Tunnel and Cheesman releases at 8:00 AM for a following 24 hour period. The audience will be given the same information that faced the operator had when he made his decision. Next, the audience will be given the opportunity to 'make the call.' The consequences of the audience's decisions will be analyzed.

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***Water Education for the Water User's
of the South Platte Basin***

Water Education Needs and Recommendations

Carolyn Early
Colorado Water Resources Research Institute

Abstract

Colorado is a state whose development is dependent on the parallel development and judicial use of its water resources. Important water issues face the citizens of Colorado. Many of these issues will be voted on. A well-informed public is necessary to make these decisions wisely. How can the citizens of Colorado be educated concerning this life given resource? What are the actions that must to be taken? This paper explores some of the recommendations suggested by Colorado's leading water professionals.

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Rivers of Colorado Water Watch Network

Barb Horn
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Abstract

The Colorado Division of Wildlife (CDOW) has developed an exciting, far-reaching new program called the Rivers of Colorado Water Watch Network. This program, directed at middle/junior high and high school youth and their teachers, creates opportunities to learn and value our rivers in a hands-on, direct way.

The students, with supervision and support of their teachers and schools, monitor a stretch of river near their community collecting biological, physical, and chemical data over time. After data collection, the kids learn how these three parameters interact to produce the river ecosystem. They learn that when one of these three components is disturbed, good or bad, the other two benefit or suffer as well. The students also learn ethical approaches to taking action in response to environmental problems.

Each school is provided with computer equipment necessary to "talk" to each other about their rivers. This creates a statewide network of the water quality data to make better decisions concerning the rivers of Colorado.

The technical and material support comes from the Division of Wildlife through the Aquatic Education Five-Year-Plan funded from U.S.F.W.S. Wallop-Breaux funds. Currently 75 schools and 375 plus students are actively monitoring 21 rivers. Participants become informed, knowledgeable citizens who care and are committed to healthy aquatic resources because of their direct involvement with the Rivers of Colorado Water Watch Network.

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Water Education along the South Platte - An Overview

Tom Cech, Executive Director
Central Colorado Water Conservancy District

Abstract

"It's very important, but it's just too complicated to understand."

If you asked someone outside the water establishment what they know about water in Colorado, you would probably hear the above comment. Sure, during times of floods or droughts, or when the water pipes freeze, you'll see a lot of concern about local water issues. But for the most part as long as clean water flows out of the tap, most people do not give a second thought about Colorado's water. Most of our citizens do not know the average annual precipitation in their area, or that they live in a semi-arid region. They do not know what a headgate or diversion dam looks like, they do not know if they use groundwater or snowmelt water, and they've never heard of the Water Court system. Our citizen's need to be given the opportunity to learn about water.

A few groups have started extensive water education projects. Last year, the State Engineer's Office organized the Colorado Water Exhibit - Liquid Gold at the State Fair in Pueblo. Over forty water agencies presented displays on groundwater, water quality, satellite monitoring, wetlands, and much more. It was a very successful event and was viewed by over 100,000 people. In March of this year, Central organized Colorado's first Children's Water Festival at Aims Community College in Greeley. Over 1,800 children and adults attended the one-day event that was geared toward fourth and fifth grade students. A wide variety of water-related classroom presentations, exhibit hall displays, and water trivia contests were inundating the kids and their teachers throughout the day. Presentations were given by 17 water organizations. Also in the past year, Barbara Preskorn of the Front Range Community College in Westminster organized a series of public meetings called "Colorado Water: The Next 100 Years". The purpose was to assemble groups to discuss current water issues and how our system of water management might change. In addition to the public meeting, a layman's guide to Colorado water law was developed. Finally, Central's Board recently obtained a grant from the Colorado Department of Health to develop water-related curriculum materials for grades K - 12. These materials will be developed through the help of water experts, curriculum development experts, and classroom teachers. It will be completed by 1993, and will be useful for school districts around the state.

Should one work on water education activities in your organization? Absolutely! The water community must have the general public as knowledgeable partners in their activities. It's becoming more and more important that everyone become informed on basic water information. Colorado's citizens will need to make learned decisions on hard choices in the future. We need to continue our current efforts and commit to broader-based educational programs.

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***The South Platte
as an Agricultural Resource***

South Platte River Basin Water Resource Management and Development Plan: Resources Inventory

Roger A. Weidelman
U.S. Bureau of Reclamation, Eastern Colorado Projects Office

Abstract

The South Platte River Basin Water Resource Management and Development Plan is a multi-phased, grass roots, study of the basin encompassing the South Platte River. The participants are striving to provide for and assure the timely development and improved management of the basin's water resources in a manner that would best preserve the environment and the quality of life that exists in the basin.

Phase I., Step 1, an inventory of the water and land resources in the study area, is nearly complete and a report is being prepared. The drainage area of the basin between Denver and the Colorado-Nebraska Stateline is approximately 19,000 square miles. The average outflow at the Stateline is about 360,000 acre-feet per year. The average surface water inflow, including 1,500,000 acre- feet per year. Significant groundwater resources occur under portion of the area.

A complex system of facilities is in place to store, divert, and convey water to agricultural, municipal, domestic, and industrial users. These facilities, with associated water rights, are owned operated, and maintained by numerous and diverse private and public entities. Population growth, local water quality problems, and increased emphasis on preserving selected natural resources have led to competition and conflict between various water resource entities and others.

A preliminary array of problems and needs has been developed. A number of potential solutions including nonstructural, minor, and major structural actions or alternatives have been identified. These range from providing adequate equipment and funds for maintaining effective communications and data collection, entry, storage, retrieval, and manipulation, developing additional groundwater recharge facilities, consolidating facilities, enlarging existing conveyance and storage facilities, to building new facilities.

The Stream Aquifer Model for Management by Simulation and Optimization (SAMSON) developed by the Colorado Water Resources Research Institute will be utilized by the participants for simulating various alternatives on the mainstem of the South Platte River. The model has been adapted for PC use. Data verification activities are underway.

The study sponsors are: Central Colorado Water Conservancy District, Lower South Platte Water Conservancy District, Northern Colorado Water Conservancy District and ST. Vrain & Left Hand Water Conservancy District. Cooperators include the Groundwater Appropriators of the South Platte, South Platte Basin Coalition, Denver Water Board, Colorado Division of Water Resources, Colorado Water Resources and Power Development Authority, U.S. Geological Survey, and U.S. Bureau of Reclamation. Various mutual ditch or reservoir companies, irrigation districts, municipal and industrial entities, and individuals have participated in meetings and shared information with the study participation.

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Irrigation Management of the Poudre Valley

Alan C. Early
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Abstract

Analysis of the irrigation institutions of the Poudre Valley utilizes an irrigation management framework with three dimensions: 1) organizational activities, 2) structural or water control activities and 3) water utilization activities. Each of these three dimensions has four activities.

The organizational activities include a) decision making, b) resource mobilization, c) communication on water matters and d) water conflict management.

The water control structural activities include: a) design of irrigation facilities, b) construction of facilities, c) operation of the system and d) maintenance of the irrigation facilities. The design and construction activities of the framework are not pursued in the detailed analysis.

The water use activities encompass: a) acquisition of water supplies, b) allocation of irrigation, c) distribution of water and d) drainage of excess water as necessary.

Analysis of the 10 irrigation management activities in the light of the functions of a mutual ditch company and of a commercial farmer provide matrices of WHO, WHAT, WHERE, AND WHEN each of the management activities are performed in the valley.

A close consideration of the two cases indicates the over-riding importance of ten factors on the management of the irrigation system summarized as follows:

FIRST, the emphasis placed on the water right is paramount. The water right as a private property use right is a sacred part of the Colorado system. The protection of the sanctity of the right leads to the state administrative and judicial structures to assure that these property rights are protected.

SECOND, the ability to transfer these rights in the open marketplace is held in high regard. With the bidding up of the price of water rights, agriculturalists insist on their right to seek the highest bidder. This attitude makes them little different than some of the original speculators and settlers of the area. The principle allows the gradual transfer of the water rights to municipal and industrial uses, and in the long run will force greater efficiency in the use of water. An example is the conversion from surface to automated overhead irrigation.

THIRD, the farm economics of tradeoffs of costs and returns in the labor, capital, land, water and credit use determines the irrigation methods and the resulting efficiency of the system. With farm labor relatively scarce and expensive, the water application techniques and durations favor labor minimization and long set intervals that have low efficiency in surface water application.

FOURTH, the low efficiency of application is compensated by the physiographic and water right factors that allow water to be recaptured and reused downstream. The resulting irrigation system efficiency is exceptionally high for a predominately gravity surface irrigation system. The topography and underground geologic factors often allow the lower level supply ditches to recapture runoff and interflow from higher ditches and their respective irrigated fields in a serendipitous reuse system. The ability of a down-stream water user to file a water right on an upstream users drainage water helps to assure reuse and a high system efficiency, but low farm level efficiencies.

FIFTH, the principle of private farmers' organizations performing the ultimate irrigation management activities, water control structural activities and water utilization activities remains the central concept of irrigation management in this case study of western USA irrigated agriculture. The farmers in this system are proud of their private status and their independence from government control. In fact farmer lobbying led to the state law that permitted the formation

intermediate buffer organizations, known as autonomous, public conservancy our of their private matters. On the other hand, they have been very successful over the years in lobbying for state and federal projects repaid on soft terms for irrigation and water development that are a direct subsidy to irrigated agricultural production and the private farmer-producers.

SIXTH, deliberate technology adaptation by irrigation organizations and by farmers is guided by pragmatism, subsidies, legislative mandates and the farm economics described previously. The basic conservatism of the rural sector does not automatically accept new as always better. Deliberation on selection and application of technology are the norm in the mutual ditch companies.

SEVENTH, natural consolidation of irrigation companies has occurred as a matter of convenience and in the interest of economical operations. As a cost of managing systems has risen with wage increases, the evolution of specialized managers covering wider service areas has been the driving force behind consolidation. Urbanization of the margins of the cities and towns of the norther front range will most likely over take more irrigated area, and small ditch companies will be consumed by the municipalities who are also hungry for more water reserves for the future.

EIGHTH, the long gestation period for new water projects to gain approval for environmental reasons and the need for power revenues to subsidize and amortize investments in new capital facilities are the new realities of further water projects. Sometimes it appears that projects languish due to inconsistencies of policies of the government, either federal or state. One office may attempt to encourage certain types of investment while another department absolutely requires that some environmental standard be fulfilled. This appears to often be the dilemma of democracy.

NINTH, political awareness characterizes the farmer irrigators in the Poudre Valley. They are organized in water users associations to provide a watchdog function to assure that their water rights are not injured by other interests. They have paid lobbyists in the state capitol, who work to get legislation in favor of irrigation and agricultural projects. The lobby and interest group activity reaches a federation at the level and ultimately to a four state level. These techniques were learned from the earlier generations who lobbied for the Colorado Big Thompson Project and all of the associated administrative enabling legislation that resulted in the current administrative system.

TENTH, the principle of integrated groundwater and surface water is one interlinked hydrologic system represented a recognition of reality and has led to a pragmatic solution for the placement of the very junior groundwater rights into the priority system through specially designed augmentation plans. Pragmatism and give-and-take characterize the way that framers in Northern Colorado's Poudre Valley deal with irrigation to serve agricultural interests.

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Irrigation Management Service of NCWCD

Gary Hoffner, Agricultural Resource Specialist,
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Abstract

As part of the Northern Colorado Water Conservancy District's commitment to water conservation, an Irrigation Management Service (IMS) was implemented in 1981. The program is structured to provide area farmers with additional sources of factual information which management decisions can be based. The IMS program continues to grow in scope and recognition. The program currently has four areas of emphasis. These are the weather station network, field by field irrigation scheduling, nonpoint source pollution education, and water quality standards and monitoring.

The District has installed automated weather stations throughout its service area. Station sites are located in fields of irrigated alfalfa hay and are carefully selected to insure representative readings. The stations operate year around and are located near Fort Collins, Loveland, Longmont, Greeley, Wiggins, Brush, Sterling, Crook, and Ovid. Stations are spaced approximately 25 to 30 miles apart to provide the best practical coverage of the District's service area. Each station uses a Sutron data collection platform to measure air temperature, relative humidity, solar radiation, wind speed and direction, and precipitation. The climatic data collected at each station is transmitted hourly via the GOES satellite. Data is received and processed automatically on a VAX computer at the District's headquarters in Loveland.

The irrigation scheduling service provided by District personnel demonstrates irrigation scheduling techniques in approximately 80 fields for 35 to 40 different farmers each year. Farmer participation in the IMS program is normally limited to 3 to 4 fields a year for a period of 3 to 4 years. District personnel demonstrate a variety of field instruments and methods that can be utilized in scheduling irrigations. This provides the farmer with an excellent chance to evaluate improved practices applicable to his operation without risk. At the conclusion of his participation in the program, the farmer must decide if the benefits realized from improved irrigation scheduling justify their continuation at his own cost and initiative, either by himself or by a hired crop consulting firm.

Beginning in 1989 the District initiated an irrigation and defertilization management education program. The education program promotes voluntary adoption of best management practices by area farmers to control nonpoint pollution from irrigated agriculture. The program is a cooperative effort with the Water Quality Control Division of the Colorado Department of Health. The District's field demonstration evaluate and compare the farmer's existing practices with the prescribed best management practices. The purpose of the comparison is to demonstrate how the amount of nitrogen fertilizer entering area water supplies can be reduced through improved irrigation and fertilizer management practices.

The importance of water quality standards for agricultural supplies will increase as concern form improving ground and surface water quality continues to grow. The District shares the major concerns for both the quality of water applied to agricultural crops and quality of tailwater run-off deep percolation leaving irrigated fields. Additionally, increasing use of water exchanges will mandate increased monitoring and regulation of water sources used for irrigation. The emphasis of this area by IMS will continue to be a major focal point of activity in the future.

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***The South Platte
as a Recreation and
Ecological Resource***

Aquatic Biota of the South Platte River and Tributaries in Metropolitan Denver

Steven P. Canton, Don J. Conklin, Jr., and James Chadwick
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Abstract

Fish and benthic invertebrate population was collected in the South Platte River and its tributaries in the Denver Metropolitan area to determine the suitability of these areas for future mitigation and management practices. A total of seven fish sampling stations and ten benthic invertebrate sampling stations were placed on the South Platte River, Bear Creek, Cherry Creek and Clear Creek. A total of 16 species of fish were collected from the seven stations on the South Platte River and Bear Creek. Nongame fish, such as white suckers, longnose suckers, longnose dace and creek chubs were most common at all sites. Game species were rare at all sampling sites, with the exception of rainbow and brown trout at Bear Creek upstream of the reservoir. Game fish collected included: rainbow trout, brown trout, largemouth bass, smallmouth bass, green sunfish and black crappie; with green sunfish being the only game species collected native to the South Platte River basin in Colorado. Oligochaetes increased in importance from near Chatfield Reservoir downstream each season sampled, especially during periods of low flow.

Aquatic biota in the South Platte River and its tributaries in the Metropolitan Denver Area appeared to be limited by combinations of habitat and water quality. In the South Platte River, diverse and abundant fish and invertebrate communities exist upstream of Metropolitan Denver in the relatively undisturbed channel flowing through South Platte Park. While water quality does not appear to be a problem further downstream between Bowles Avenue and Bear Creek, aquatic life is limited by recent extensive channelization activities. Further downstream near Evans Avenue, populations appear to change depending on the seasonal variation in flow and water quality. This site does not appear to be able to support clean-water forms on a year-round basis. From Cherry Creek downstream to Clear Creek, the South Platte River is dominated by pollution tolerant forms indicating water quality problems throughout this section. The tributaries present a combination of environmental conditions. Bear Creek above and below Bear Creek Reservoir contains diverse and quite abundant aquatic life, indicating an enriched environment. Biota in Cherry Creek, on the other hand, are severely limited by a lack of habitat and a shifting sand/gravel substrate. Clear Creek appears to have a fauna dominated by tolerant species suggesting some water quality problems.

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The Platte River Greenway Foundation: Protecting the Past and the Future

Merle Grimes, Greenway Foundation

Abstract

Since 1974, the Platte River Greenway Foundation has taken a variety of waterways in the Denver-Metro area, and through innovative funding and construction methods, has set the standard for the establishment of urban and suburban greenway corridors across the country.

Join Merle Grimes, former Project Director with the Foundation, and current owner of MAG and Associates, a landscape architecture and planning firm, as he presents an overview of this unique foundation and their reclamation efforts along the South Platte River, Bear Creek, Cherry Creek, and more.

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South Platte Park: An Ecological Vision Interactions between Plants, Animals, Man and the Environment

Shawna Crocker, Natural Science Education Specialist
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Abstract

In 1971, the citizens of Littleton were farsighted in their fight to preserve some of the natural open-space beauty of their river front community by opposing the Army Corps of Engineers flood control plan to channelize the South Platte River below Chatfield Dam. In addition to creating new federal water legislation, this vision resulted in the development of a 625 acre floodplain park with two and one half miles of river, several wetlands, and seven lakes and ponds remaining from a gravel mining operation. Home to a great diversity of riparian and wetland species of plants and animals, South Platte Park offers a variety of recreational opportunities including wildlife viewing, photography, hiking, fishing, and canoeing on the river. Additionally, the recently completed Arapahoe Greenway Trail passes through the park, providing bicycling, rollerskating and horseback riding for ever increasing numbers of people.

The challenge is now to extend the vision into the future, as park staff strive to preserve and manage the resources of the park, provide high quality educational programs and nature experiences for visitors, and at the same time, maintain the property as a wildlife refuge. Some of these future dreams and challenges include improving the facilities, enlarging the staff, expanding programming, improving trails, preserving critical wildlife habitats, restoring degraded habitat, controlling weeds, conducting more scientific research, monitoring and influencing peripheral property development, updating the management plan, and educating the public about the need for use without abuse of this wonderful community asset.

Owned by the City of Littleton, managed by South Suburban Park and Recreation District, and overseen by the Army Corps of Engineers, South Platte Park is a model of inter-agency cooperation at all levels. Other involved agencies include the Colorado Division of Wildlife, Urban Drainage, the Greenway Foundation, Cooley Gravel Company, Centennial Water and Sanitation District, and the Arapahoe County Scientific and Cultural Facilities District.

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General Topics

Assessment of Ground Water Quality in South Platte Alluvial Aquifer from Chatfield Reservoir to Brighton, Colorado

Mike Wireman, Hydrogeologist
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Abstract

Existing ground-water quality data was obtained for samples collected from more than 500 wells constructed in the South Platte alluvial aquifer from Chatfield Reservoir to Brighton. The data were obtained from a variety of private and government sources. All inorganic, radionuclide and field parameter data were entered into dBase IV files. The wells from which samples were obtained were plotted on a map of the South Platte alluvial aquifer. The data were analyzed to determine spatial and temporal trends of selected ground-water quality parameters.

This paper describes the results of this ground-water quality assessment study. The study had two primary objectives; to develop a methodology for obtaining and managing existing water-quality data and to use that data to assess ground-water quality. A tremendous amount of water-quality data exists for the South Platte alluvial aquifer. Once the data were entered into an appropriate data base, it was analyzed in a number of ways. These analyses, along with selected geological information were used to develop an understanding of the spatial and temporal variations in ground-water quality.

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Wasteload Allocation Study on Segments 6 and 14 of the South Platte River

Russ Clayshulte
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Abstract

Wasteload allocations are a method for equitably distributing a limited quantity of some discharged constituent among multiple dischargers. The allocation is established so a receiving water can accept the constituent without degrading the designated uses. The study evaluated effects of ammonia-nitrogen and other constituents on acute and chronic stream standards adopted for segment 14 and a portion of segment 6 of the South Platte River as related to discharges from three wastewater treatment facilities and two major stream tributaries. The QUAL2E water quality river model was calibrated and verified to existing conditions using the USGS-QW model data set and other existing data. The model predicted ammonia-nitrogen loading for future conditions in the planning years 1995, 2000 and 2010. Recommendations were made for the ammonia-nitrogen effluent limits at the wastewater treatment facilities. The model also predicted a potential nitrate-nitrogen problem in segment 14 and a low dissolved oxygen problem in segment 6. Additional water data will need to be collected to verify the nitrate-nitrogen and dissolved oxygen problems.

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Changes in Plains Cottonwoods along the Arkansas and South Platte Rivers - Eastern Colorado

Warren D. Snyder and Gary C. Miller
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Abstract

Photo interpretation was used to monitor 31-36 year changes in area occupied, and canopy cover, and size class of plains cottonwoods (*Populus sargentii*) along the Arkansas and South Platte rivers in eastern Colorado. Stands of cottonwoods deteriorated along the lower Arkansas with a loss of 5.6 ha/km (31%) in 31 years. Loss of cottonwoods along the South Platte was slower (3.5 ha/km, 9%). Opening of canopy covers occurred along both rivers, but size class changes were less dramatic. Shrubs increased 5.1 ha/km in area occupied along the Arkansas and declined 2.2 ha/km along the South Platte River. Width of the Arkansas River channel declined (49.8%), whereas the South Platte showed evidence of widening. Land converted to agriculture and development increased 12.1 ha/km along the Arkansas River and 13.9 ha/km along the South Platte River. More dramatic depletion of water, a deeper, more narrow channel stabilized by reservoir releases, and invasion of Tamarisk (*Tamarisk* spp.) have accompanied rapid loss of cottonwoods along the Arkansas River.

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***Attendees of the 1991
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