



2009 Water Conference

**How Can the Irrigation Industry Take a
Leadership Role in Addressing Our Challenges?**

What We Learned

Acknowledgements

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The Association

The Irrigation Association® is the leading membership organization for irrigation equipment and system manufacturers, dealers, distributors, designers, consultants, contractors and end users. Their mission is to promote efficient irrigation to ensure water is available for irrigation for future generations.

The Conference

The Irrigation Association – Smart Practices, Sustainable Solutions. Taking its new tagline seriously, IA’s executive committee launched its first Water Conference. The Water Conference brought together irrigation practitioners from both agriculture and landscape to meet with presenters—strategists, academics, environmentalists and water managers – to address head on the water challenges we face. The conference was facilitated and interactive – not a series of monologues but filled with meaningful dialogue. One-hundred-and-fifty water professionals met in the inspiring setting of Park City, Utah, rolled up their sleeves, and went to work.

The Report

The following pages strive to capture the questions and the dialogue, if not the answers to today’s water problems. Indeed, answers are few and far between. To begin carving out the needed answers, we determined we have a great deal of work ahead of us. But getting clarity on what we face is a critical first step – one that we often miss. Read in these pages what we discovered, what we pondered, what we debated, and what we decided to be necessary next steps.



The Presenters

Presenters were selected to challenge us with viewpoints we may not have earlier considered.

Wayne Nastri, Senior Vice President, Dutko Worldwide, former Region 9 Administrator U.S. Environmental Protection Agency

Robert Johnson, Partner, Water Consult Engineering and Planning Consultants, former Commissioner of the Bureau of Reclamation

Mark Smith, Director, Eastern U.S. Freshwater Program, The Nature Conservancy

Mike Young, Professor of Water Economics and Management, University of Adelaide, School of Earth and Environmental Science

John Eckhardt, Assistant General Manager, Imperial Irrigation District

Kelly Kopp, Assistant Professor, Utah State University Cooperative Extension

David Yocca, Principal Architect/Planner, Conservation Design Forum

Sarah Stokes Alexander, Director of Sustainability and Leadership Programs, The Keystone Center

Peter Binney, Director of Sustainable Planning, Black and Veatch Corporation

The Sponsors



The Facilitator

MaryLou Smith, Vice President, Aqua Engineering, Inc.



The Participants

The conference drew a diverse group of participants, both geographically and in terms of their roles in the industry.

... from the owner of Around the Grounds in The Woodlands, **Texas** to the owner of Clarks Soil Desalination from Alberta, **Canada**.

... from a director of external affairs from John Deere Water Technologies in Cary, **North Carolina** to the president of Irrigation by Design from Plymouth, **Minnesota**.

... from the district manager of Nelson Irrigation Corporation in Fremont, **Nebraska** to a landscape architect for the LDS Church Physical Facilities in Salt Lake City, **Utah**.

... from the president of Clark Irrigation Design and Consulting in Lavonia, **Georgia** to a representative of The Dow Chemical Company in Midland, **Michigan**.

... from a vice president of Energy and Water Segments IDEX Corporation in Northbrook, **Illinois**, to a consultant with the Utah Nursery and Landscape Association.

... from a professor at Kansas State University in Manhattan, **Kansas** to a representative of Stanworth Crop Consultants in Blythe, **California**.

... from the president of Ewing Irrigation Products in Phoenix, **Arizona** to the president of Irrigation Consulting, Inc. in Pepperell, **Massachusetts**.

... from the president of the Irrigation Association from Fort Collins, **Colorado** to the IA executive director from Falls Church, **Virginia**.

... from the Bureau of Reclamation to the California Landscape Contractors and the Agri-business Council of Arizona.

Though many participants are members of the Irrigation Association, almost one-fourth are not – signifying that the conference drew attention from outside the organization.

Agriculture was listed as the primary area of business for 41 percent of participants, while 69 percent specified turf/landscape as their primary area of business – the overlap signifying that some participants are involved in both. (And 93 percent of all participants in the post conference evaluation said sessions provided a good balance between the two.)



What Did We Learn?

Participants completing a post conference evaluation had this to say:

On the Need for Change in Water Policy

- We in the irrigation industry need to become better informed on water policy issues – to stay abreast of what’s happening in other parts of the world. The divergent interests, needs, and opinions about water use will make it extremely difficult for policy makers to set effective water policy.
- We need to realize that under prevalent water law, increasing irrigation efficiency does not necessarily increase water availability.
- The Australia example shows us that there are free market solutions, which can inform water policy.



On Leadership

- We need to make critical decisions very soon. They will be controversial but we need to just do it!
- This conference is just one more indicator to me that the IA is VERY serious about conservation and water efficiency.
- The water trading model from Australia tells us that the “impossible” can be done.
- The tremendous engagement of folks at this conference was impressive. Dialogue is informative – an important first step toward solutions.
- The diversity between those of us in agricultural irrigation and those in landscape/turf is not as broad as is believed. We are in this water challenge together and we must work together to seek solutions.

On Climate Change and Drought

- Australia believes their water shortage is not so much the result of drought as the result of a climate shift. We, too, may learn that what we have been experiencing this decade comes to be the new “normal.” That would affect all preconceptions of irrigation for agriculture or landscapes.
- Water scarcity and tree ring monitoring may be telling us that what we are interpreting as drought is actually normal climate.

On the Severity of the Situation

- America has difficult times ahead in the ownership, management and allocation of its water resources.
- This conference confirmed for me that we have an impending water crisis, yet if we begin to act rationally and quickly, there are numerous solutions available.
- We are enjoying the benefits of past projects like Hoover Dam, but now we need more futuristic planning to keep our water supply viable into the next century.
- We all must address this serious situation in our own corner of the world. We need to act now.
- The speaker from Australia saying the U.S. is in trouble over water and we are not even aware of it served as a real wakeup call.



What Did We Hear?



The presenters we chose for the conference are individuals from diverse backgrounds, folks who have big ideas but are also good listeners. The formula worked well. Speaker/participant interaction made for lively dialogue all day. Here are some highlights of what our presenters had to say.

Wayne Nastri, Dutko Worldwide

Speaking on dynamics and predictions for U.S. water, Mr. Nastri spanned a number of current issues. Among his points:

We have to think, “I have a dream instead of I have a problem.”

To build trust between divergent interests we have to address problems in new ways. We need multiple objective solutions – solutions that meet the objectives of others, not just the irrigation industry. If you have a good solution ready to go, it needs to be teed up before the crisis – and strategize ahead of time about how to address potential pushback. We often know what should be done, but political reality holds us up.

We need leadership that forces us to look to the greater good. It would help if courts were to require water cases to go to mediation. Judges often don’t know enough about water to make the best decisions.

EPA is developing an urban water initiative including best practices and a benchmark for measuring success.

Increased enforcement of water conservation measures creates greater awareness. It would be ideal if folks would not just see a penalty as motivation to patch up their system, but as a prompt to look for a comprehensive long-term fix.

We all know what to do, but political reality holds us up.



We need metrics to show improved benefit from irrigation efficiency. Could the irrigation industry take a lead?

Where water utilities are struggling to recover infrastructure costs in light of decreasing revenue due to conservation, Congress needs to take action. The same is true of the issue of the disincentive to conserve on the part of private water purveyors. But in both cases, it's a firestorm because it's very local.

The irrigation industry is viewed positively on the tech side. But IA should work with energy providers to meet standards and establish benchmarks and position the industry to a broader audience.

Bob Johnson, Water Consult Engineering and Planning Consultants

Having just retired after 33 years with the Bureau of Reclamation, Bob Johnson was in a perfect position to frame the issues.

The water problems Mr. Johnson identified were drought, climate change, population growth, environment/endangered species, Native American water right claims and the aging water infrastructure.



As possible solutions for his list of problems, Mr. Johnson suggested conservation, reuse, transfer/markets, environmental restoration, negotiation/settlement and new infrastructure development.

In elaborating on these, Mr. Johnson made the following points:

Water transfers from ag to urban may be good for both the seller and the buyer. But we have to be alert to potential negative impact on third parties, such as rural communities.

Solving water problems collectively works only when coalitions are based on relationships. Long standing relationships help the parties bridge their differences when the going gets rough. You cannot short-change this trust building process and be successful.

It helps to have someone in a position of authority who is neutral and unbiased – someone who can say “if you guys don’t solve it yourselves, I will step in and decide for you.” (Example: Gale Norton, Secretary of the Interior in the Colorado River drought-sharing dispute).

We need leaders who are willing to set aside their parochial interests and see the broader perspective. Remember the far-sighted woman in the Jimmy Stewart movie who withdrew only what she had to have during the run on the bank!

Mark Smith, The Nature Conservancy

Pointing out that The Nature Conservancy is looking for enduring solutions that meet the needs of both people and the environment, Mr. Smith made a number of points, including:

Crisis can be motivating. **The best way to find common ground is to REFRAME THE ISSUES to incorporate a broader set of societal values.**



South Africa’s National Water Law of 1998 has a strong emphasis on maintaining a reserve for the environment, but it came about because of the push for equity. Under apartheid, people who depended on the rivers had no control over it. Protecting the people’s equity required protecting the rivers.

Florida has worked to avoid adverse competition for water between people and the environment by using property tax to build water systems that meet both goals.

In Michigan, there has been a court decision that you can’t ship water out of a basin (for bottled water, for instance) if you impact others on the stream. This has motivated private industry to work with former adversaries to resolve issues. Protecting the environment has come to be seen as good for the economy, such as in the case of watching out for fisheries. Categorizing the streams to determine which are the most important for preserving fish has led to practical, informed decisions.

Part of reframing the issues is thinking about water differently. For instance the concept of **water footprinting** (www.waterfootprint.org) raises awareness of how much water is required to produce the food we eat and goods we use.

Environmental stewardship is not just about keeping water in the rivers for fish, it’s about the whole ecological picture. For instance, some birds rely on the river to be high at nesting time so they guard their young from low prowling predators.

The **Alliance for Water Stewardship** is developing a global certification for water management. The Irrigation Association may want to join The Nature Conservancy, American Water Works Association and others to support this effort.

Mike Young, University of Adelaide, School of Earth and Environmental Science

Capturing the “pin drop” attention of his audience, Mike Young outlined steps Australia has taken to make water policy changes in reaction to the long running drought which has hit that continent.



Here are some points he made:

- Communities rarely plan for severe adversity.
- **Climate is changing faster than policy.**
- Irrigators thought they had security until the water was simply not there.
- All the allocations were built around averages. Finally had to face necessity for policy change.
- To keep crops alive, it would take at least a 20 percent allocation, but this year, farmers got only 2 percent.
- Some irrigators saving water from year to year. They store it up to have enough water for a crop.
- It's all about risk sharing.
- Environment doesn't come first, but it gets a share.
- The new system facilitates autonomous adjustment and change instead of slow moving courts.
- The new system creates opportunity.
- Allocation rules were put in place to deal with uncertainty.
- Seniority system had to change.
- The system lowered transaction costs.
- 2 tiers – high security pool. Low or general security pool.
- Formal volumetric allocation systems.
- Everyone has to be metered.
- **Quick trades of water are critical.**
- Can make a water trade in two days – not months or years.
- Right to trade held by individual water users, not districts (Folks sitting on district boards like to play politics.)
- Tradable Right: Unbundled into both entitlement shares into perpetuity and bank-like allocations – use licenses with limits and obligations.
- Water trading has taken off.
- Has facilitated massive technological improvements, investment in agriculture.
- Water reform has created wealth.
- An independent authority manages the system because playing politics with water is disastrous.

- His advice for the United States: Start planning for long dry periods. Bring into your sacrosanct seniority system elements of a shared system – it’s an evolutionary journey, but you must start.

John Eckhardt, Imperial Irrigation District

For 17 years, deeply involved in the largest agriculture to urban water transfer in history anywhere, John Eckhardt shared **how the Imperial Irrigation District and San Diego County Water Authority cooperated** to solve a critical shortage of water.

Points he made:

- Farmers in the Imperial Valley grow 100 different crops – all family farming, no industrial farming.
- The average field size is 70 acres. Eighty percent is tenant farming.
- Farmers didn’t want to transfer water because they are making lots of money growing vegetables.
- The efficiency/conservation program is an agricultural/municipal win-win. **Municipalities pay farmers to adopt irrigation efficiencies and the conserved water is made available for the municipalities.**
- Implementing the agreement is harder than negotiating the agreement.
- Important part is continuing return flows to keep the Salton Sea viable – because it’s important for migrating birds. The message is “Conserve, but don’t affect return flows to Salton Sea that could affect habitat.”
- Fallowing became a part of it for the first 15 years so that only consumptive use is transferred so return flow isn’t affected.
- **Water is being transferred – not water rights.**
- A handful of IID’s own water users are suing them for making the agreement. (Those suing own only

21 acre-feet out of the 150 million acre-feet in the agreement).

- One of the challenges: who gets credit for conservation – the delivery system or the individual farmer?
- Environmental mitigation – much of it picked up by state government.
- Now they have to ramp up the schedule. There are **303,000 acre-feet yet to be conserved. Can it be done? How do we develop and evaluate on-farm incentive approaches?**
- Automation and measurement are important.
- Pseudo fallowing is one conservation method being used – short cutting the yield, for instance, by irrigating for one cutting of hay instead of two. The loss of yield is made up for by revenue from leasing the saved water.



Kelly Kopp, Utah State University Cooperative Extension

Kelly Kopp gave details of a water auditing program promoted by Utah State University's Center for Water Efficient Landscaping.



More than 6,000 residents have been audited by pairs of student interns in the 10 years of the program.

What's included in a water audit?

- Meet with homeowners and explain what they will do.
- Ask for access to their irrigation controller and write down existing program.
- Manually turn on each irrigation station and walk through each zone to identify problems.
- Pick a representative of each head type and conduct a catch cup test for application rate, distribution uniformity, pressure, soil texture and rooting depth.

- Deliver a customized schedule for each station on the clock and present/explain it to homeowner.
- Leave a schedule and a list of system problems with the homeowner.

Results for three Utah cities – Sandy, West Jordan and Salt Lake City show:

- 60-75 percent of the participants had high capacity to conserve water.
- 70-80 percent of those with high capacity to conserve did so following the audit.

David Yocca, Conservation Design Forum



The Sustainable Sites Initiative being developed and promoted by the American Society of Landscape Architects, United States Botanic Garden and Lady Bird Johnson Wildflower Center was discussed by David Yocca.

It's an effort to create voluntary national guidelines and a rates system for sustainable land design, construction and maintenance practices for landscapes of all kinds, with or without buildings.

Prerequisites include conducting a pre-design site assessment, using an integrated design team, reducing potable water consumption for irrigation, and planning for sustainable landscape maintenance. Some of the credit options are:

- **Manage water on site** to replicate the hydrology of historic natural, underdeveloped ecosystems in your region.
- **Cleanse water on site** to ensure site has a positive impact on downstream water quality.
- **Maintain water features** to conserve water and other resources.
- **Use rainwater/storm water** to provide a landscape amenity, and integrate multi-functional storm water management features into the site design.

A final report will be released in the fall of 2009. Download a copy of the draft report at <http://www.sustainablesites.org>.



Sarah Stokes Alexander, The Keystone Center

Convened by The Keystone Center, **Field to Market** is a collaborative stakeholder group working together to develop a supply-chain system for agriculture sustainability.

Agricultural productivity will need to at least double in the next 40 years, while less land and water will be available for farming. The push is on to meet the need in a manner that works for farmers, our food and fiber supply, our communities and our environment.



Beginning with corn, soy, wheat and cotton, Field to Market is developing outcomes-based metrics to measure the environmental, health, and socioeconomic impacts of agriculture in the United States.

Participants range from the Kellogg Company and Monsanto to the Nature Conservancy and Environmental Defense Fund to the National Corn Growers Association and the United Soybean Board – almost 50 groups in all.

Land use, soil loss, water use, energy use, and greenhouse gas emissions are some of the variables they monitor.

They utilize a reporting system, which was already in place through the USDA – so they didn't have to set up a new system and they could go back several years in time for data.

Results show that agriculture is definitely adapting and changing. The question is whether it is enough. What's driving the improvements varies from region to region.

Growers are most interested in knowing, “what is the point of diminishing return in economic terms?” They are looking for a big bang for their buck.

Click on <http://www.fieldtomarket.org/> to try out their field print calculator.

Peter Binney, Black and Veatch Corporation



Speaking on Agricultural and Landscape Irrigation Water Management Opportunities in the Coming Years, Peter Binney cited a list of reasons why we have water stress and new demands:

- Over-allocation of reliable water supplies
- Growing urban, industrial, energy and environmental demands
- Relative value of water differences between urban and agricultural uses
- Climate variability
- Policies and politics of water management not suited to scarce resource management

- “Whiskey is for drinking; water is for fighting!”

Here are **agricultural water trends** he expects we will see:

- We will need food, but increasing globalization will influence commodity prices.
- **Limited agricultural irrigation water could be involved in a market with cities and industries, but the vast majority of ag water will remain dedicated to farming and environmental uses.**
- Urban-rural cooperative programs can be mutually beneficial.
- Water use by cities and industry will be dramatically different in the future.

His list of **options for meeting future urban water needs:**

- Water conservation and water footprint reduction
- Non-potable water reclamation for landscaping
- Acquire and transfer water from existing agriculture
 - Lease during droughts
 - Purchase and dry up farmlands
 - Increase ag efficiency and transfer the savings
 - Purchase and lease back for certain periods
- Indirect potable water reclamation, desalination, new trans-basin diversions, reservoirs, purification
- System integration and regional efficiency.

The Dialogue

The Irrigation Association conceptualized this conference to open up a wider dialogue about water issues, which greatly affect the irrigation industry. Four presenters were chosen to enter into a facilitated interactive dialogue among themselves and with the audience.

From comments provided beforehand and stemming from the keen interest in Australia's new water policy as presented by Mike Young, the facilitator chose to focus the dialogue on the issue of whether we should adopt a new framework to manage water in the United States.

Here are excerpts from the lively dialogue:



Is there a better framework for managing water in the U.S.?

Facilitator: Should we/could we change from our system of prior appropriation (“first in time, first in right”) to something else? If so, how, how would we go about making that change without upsetting the apple cart, without impacting the economics of owning a water right?

Peter Binney: The prior appropriation doctrine is a reasonable way of dealing with scarcity. It may not be the most efficient way to do it, but whether we like it or not, we have developed an economy on the presumption that owning a water right creates wealth. From a property rights standpoint, an institutional inertia standpoint, I wouldn't try to significantly modify the prior appropriation doctrine. That would

cause too much social unrest. But we do need to continually look for ways for it to evolve so that it's more adaptive.

Mike Young: Actually, what we did in Australia was very evolutionary – not revolutionary. The earlier stages did not look like a total dismantling of the old system, which it turned out to be. This was a 40-year journey. We started off with an old acreage system, then we went to metering, later we decided we would have volumes as the main management system, and we abandoned all the old acreage controls entirely. What we really created was shares, such that the unit of shares was the volume. We then changed the language we used to talk about it. We started talking about sharing risk, and after that, we realized we had to clean up all of the water rights registers because they were becoming valuable. We started trading and then we “unbundled.” So there's a whole sequence. Here in the U.S. you could build a new property rights system on

top of the existing one. Take everyone's rights as of a given year and convert that into shares in the new system. If after five years it doesn't work, you can go back to the old system. If you design the new system well, you will discover as we have in Australia that you create a lot more wealth. Once you open up the potential you get a lot of investment and a lot of innovation. That's the surprising thing we found. When we went to a proper share system folks didn't want to go back to the old system. The challenge is to build a clever system. I agree with Peter. You can't do it as a revolution. But you have to start the journey. It's a long journey.



Mark Smith: I think we are kidding ourselves if we think we can meet all our goals and not have a couple of apple carts go over. It's not just an issue of prior appropriation. Even in the east, under regulated riparian rights, the issue of changing historic water use is problematic. Trying to reallocate water that's already been allocated is tough. Try to tell New York City or Boston they should get by with less water. They may not have a property right but in every other sense they believe they have a right to that water. They've invested

in it, they've built their towns around it. The problem is broader than just prior appropriation.

John Eckhardt: I'm kind of in between. Because we have changing needs, prior appropriation is going to have to evolve, but as a senior water rights owner I still want to benefit somehow. Most agricultural users really want to farm and won't sell at any price. So it's not going to be economics that's going to change it; it will have to be something else. The legal profession has gotten so involved that what used to seem pretty simple "first in time, first in use" now has so many regulations and requirements, and is set in court so solid, we can no longer move water around on a handshake, like we used to. We also have a whole new crop of water managers—younger people who do everything by the book. As a result the prior appropriation system has lost its flexibility. It's not going to happen overnight but we're going to have to do something like what they have done in Australia.

My biggest problem with prior appropriation is maximum utilization. There's absolutely no incentive for farmers to do any efficiency conservation. It comes out of their own pockets, and unless they are increasing yield they aren't going to go for it. We need to change our measurement standard from rates of flows to volumes and then apportion according to volumes. Then you could move to a shared type of system. With volumes as measurement, efficiency makes more sense. With the advent of center pivots in Colorado, in many cases the runoff that was earlier supplying water to a second user is now not there. The second user has to divert more out of the river, legally, to make up for it. So in the long run we may actually be using more water than we did before the pivots. I do believe there's a compromise here. I just don't know what it is. But we can't hurt the guy with the senior water right because we have built a whole economy based on owning that senior water right. Getting around that is going to be the toughest issue.

Peter Binney: There's a constitutional issue here — a just compensation requirement. If somebody's built up a right to use the water, you can take it, but you have to compensate him or her for it. There's not enough money in the national treasury to do a wholesale natural resource change.

Mike Young: I'd like to challenge you on that. In Australia, we said "we will compensate you if what we do makes your resource of a lesser value." But we didn't have to write a single check, because we built something that was better and gave them a better opportunity, something that was more easily transferrable – like this \$50 bill. By having something that's consistent, it makes the cost of the adjustment much, much lower. Water starts to become valuable and people begin to invest in the new system.

What about the environment?

Mark Smith: As you have this negotiation between urban and agriculture, how do you take care of the environment? Many of these systems are over allocated for human use even before you have considered the environment. How do you bring some of that water back to the natural system when the negotiation is between two different business entities?

Mike Young: The environment has to be assigned a right. You need to differentiate between conveyance of water through the cities, and environment water – the water which is in the heart of the river itself and the water that's in the wetlands beside a river.



John Eckhardt: That's a good point for the water that's in the heart of the river, but in the Imperial Irrigation District the environmental issue is not the river – it's habitat. Agriculture IS habitat. When you shut down agriculture, you shut down habitat. We ag guys are now working with the environmental community because we need to save ag for the habitat. But it's much more than just fish in the river.

Mark Smith: Yes, it's about the fish AND all those riparian communities – wetlands and marshes. But Mike did show that the Australian government is spending billions of dollars to buy back water for the environment. We don't have similar programs in the U.S. Under prior appropriation it isn't often legally possible for the government to do that. It's an open market system. In this country it's important that there's that environmental piece in the mix, and if we are going to have these transactions, some piece is set aside for the environment.

Where does the leadership for change come from?

Facilitator: How can we get the leadership we need to tackle these difficult issues in water?

Mike Young: In Australia, our prime minister, in about 1994, said we had to become more competitive. Water use was one of the things he said we should make competitive. That started the process toward our [national water initiative](#) – which is a brilliant document about the fundamentals of water management. There was a commitment at a national level of starting that journey – things like getting water accounting right, managing risk, making it possible to adjust. Simple stuff really. Making high-level agreements on the basic flavor of where we were going to take water management over the next decade.

John Eckhardt: You say the prime minister set that in motion. My impression is that Australia started seeing their water supply dwindling and their economy changing because of that. Whether I'm right or wrong about that, my opinion is that that's what it's going to take in America. You're not going to get a proclamation from the federal government that says "this is what's going to happen." I think we are going to have the usual thing in America – an emergency – before you see any change here.

Peter Binney: We are not adapting to the scarcity projected for the future, we aren't responding to the aging infrastructure, and we don't have the right pricing in place. We're unfortunately going down the same path as General Motors. Until the bubble bursts, as it is right now in California, where we can't put the environmental piece together with the economy, we won't change. We're going to have to do something differently. You can't be a leader and say we're going to make these types of changes. It has to come out of a reaction.



Mark Smith: Whether it's going to take a crisis or not, in the meanwhile, we need to try to solve these problems. We have the tools but no one has put them together in a way that looks sustainable or workable. We need to think longer term – multigenerational. What's the solution for 50 years from now? I can think about a different future if I look further out. I think it will take a crisis to implement the changes, but right now I don't think we have a vision of success for our future – how we would allocate this water in a scarce situation in an equitable way that would achieve our multiple goals. We need to find places where that kind of problem solving can happen – where we can do trials and test things out and find out if they work, so when that moment comes and we have a tipping point,

we can apply viable answers and good solutions. We are too constrained by the realities of today. When they were building the Hoover Dam they were asking, "What's the multigenerational solution?"

Facilitator: Let's open this up to the audience.

What is the role of land use planning?

Audience Member: If there isn't enough water, why are we building more houses? In Germany, there is a very strong regulation about where you can live. You don't see cities building over farmland there.

John Eckhardt: I agree with you. Land use planning and water use planning have been disconnected. It's one of our major problems in the west. The land use planners build something beautiful and then say, "Oh, by the way, we need water there." What drives them, like everything in America, is politics. They want to bring in industry, they want to bring in a better economy, they figure we water planners can find the water. I don't have an answer for it. Maybe we need to start having joint meetings with the land use planners.

Facilitator: Western States Water Council is putting on a conference in Denver at the end of September on just that subject – how can we better integrate water supply planning with land use planning?

Peter Binney: You can't just crystallize this down by saying let's stop the cities from growing. There's another dynamic that's causing the cities to grow and why you're seeing people move from rural areas to urban areas and why we have agricultural areas 80-100 miles away from the source of water. And why we put Hoover dam where it is, and Los Angeles where it is. There's some other framework that drives people to where they recreate, where they live, where they irrigate. Unfortunately the world is not prescriptive. Our societies are not contained. That's why we have globalization. And while we don't have the political resolve – the centralized planning that you find in Germany, we will begin to see more responsible land use planning, utility planning here.



If urban landscapes are going to change, how can the irrigation industry help shape that?

Audience Member: Peter, you say urban landscapes are going to change dramatically in the future. I agree. Let me ask you, the other panelists and folks in the audience, what should the approach be for the Irrigation Association and state landscape associations, in helping shape that? What should their approach be, in the face of state and federal regulation and legislation aimed at conserving water and changing landscapes? How can we work with this in a way that will not harm our interests?

Peter Binney: When I managed water for the City of Aurora, half of the water use was outdoor landscaping. That's where we could get the greatest efficiencies and the greatest conservation. We were able to conserve 8 percent through indoor upgrades – low flow toilets and that sort of thing – but we got the most conservation outdoors. We instituted water restrictions and increased the cost of water so that water used outdoors

cost five times that of water used indoors. And we had the support of the landscape industry. Instead of standing up at city council meetings and saying “what right do you have to affect the landscape industry,” they asked, “How can we help? How can we get the demand management needed to help you – and us – survive?” They came to the table not only with irrigation improvements but better plant material choices for our semiarid environment. Their agronomic knowledge helped us educate the public about things like how Kentucky bluegrass can go dormant in the summer without harming it. So I recommend municipal folks take advantage of what the landscape industry can bring to the table – their technical knowledge of irrigation systems and plant selection, their help in taking the message to the public, and their support of the elected officials trying to make water conservation work. I think we are going to move from having unconstrained expansive lawns, but not as far as Las Vegas where they are paying folks to take out grass. I love the fact that the grass is there. That's where the elasticity is, when you do have a drought. It's easier to replace the grass than the trees. Having the voices of the landscape industry and the environmental community parallel the water manager's voice is critical.

Mike Young: We are putting more effort into diversifying our water sources through recycling and capturing storm water. And the irrigation industry can help. It doesn't have to all be the government's responsibility.

Audience Member: Smart controllers will be the law next year in California. A recent survey showed that 86 billion gallons of water per year could be saved if we required smart controllers across the whole country. That seems to be a target the Irrigation Industry could shoot for. We have the tools; it's doable; it's affordable; it's not rocket science. Let's use ET and soil moisture to let technology decide when and how to irrigate.

Audience Member: As an irrigation auditor and designer, it is surprising to me how few people, including commercial users, understand water budgets. They can't gauge whether they are applying too much water. We struggle to educate people about this, but they don't seem to be able to get their arms around it. There are some technical issues about the process yet to

be resolved. IA is trying to simplify the process. Unfortunately it is a complex topic.

Facilitator: Are some municipalities beginning to require that the irrigation designer provide distribution uniformity information?

Audience Member: That's getting to be almost the norm now. They are asking me (a landscape architect) to produce a chart telling them how long they must turn the water on to keep the plant material alive. Then, I can see them coming back to me saying "you told me we could get by with a million gallons and look how brown everything is – what did you do wrong?" I feel the litigiousness coming around. The technology is so extreme that people are not pleased with the results so they are turning it off and heading out with their hose to douse a little brown spot. So I am not convinced that technology is completely the answer, but I also don't think that for them to rely on me as an irrigation designer to tell them what to do is the answer either.



John Eckhardt: The irrigation industry needs to get involved, agriculture as well as landscape. Agriculture is just as bad as landscape when it comes to folks not knowing how much water they are using. The problem I see is we're not talking about water rights to a farmer. We have all these irrigation districts and ditch companies and conservancy districts that cause a lot of the problems we have. The irrigation industry needs to start with those folks. Don't wait for one of those irrigations companies or farmers to go looking for an engineer, because they won't. They need to know what's out there. They don't have the slightest idea where to begin. You need to get the message out about what you have to offer.

Closing

Audience member: I am not sure that we have owned up to the brutal fact that if you couple all the irrigation use together, we as an industry are the single biggest use of water on the planet. Sometimes we are bashful and ashamed about that. We don't want to measure how much water we use. I think the first step is confronting the fact that we have a tremendous responsibility. It concerns me when I hear the conversation about allowing the bubble to burst, like General Motors. I'm scared of that. I don't want to see that happen. And I think we have to figure out a way to set a floor so that doesn't happen.

Facilitator: I would like to close on a positive note – that the Irrigation Association is very concerned about these issues. The fact that the IA put on this meeting is a direct result of that concern. I think today we got a lot of good ideas, and some prodding from various people – not just from the speakers and the panel but from the audience as well. The IA will be putting much of what we covered today into a post conference report, which can provide something of a path forward that can result in some change.

The Vision

The Irrigation Association wanted to design a conference that would delve deeper into the issues than could be accomplished by staging a series of monologues by experts. Curious to hear what is at the root of what our presenters believe about the water challenges we face, we asked them to each prepare a one page “vision paper.” We asked them to share, in addition, any ideas they have for how the irrigation industry can best address those challenges, all responded to the request – in itself exemplary of the seriousness with which these presenters take these issues.

In the following pages, you can read what each of our presenters had to say. Perhaps their agreeing to record their beliefs will encourage each of you to do the same. What is your vision about water in the 21st century?

Vision—Wayne Nastri, Dutko Worldwide

Meeting our Water Challenges

As regional administrator of USEPA Region 9 from 2001-2009, I was able to participate on a broad variety of environmental issues. My experiences were shaped by the environment of Region 9 ranging from lush tropical islands in the Pacific to the snow capped peaks of the Sierra Nevada and the arid Southwest desert. Common to each locale, however, was the need for clean and safe water. Several factors impact the availability and use of water, including, but certainly not limited to, public perception and demands, economics, geography, population density, as well as legal and regulatory requirements. On the national stage, an aging and inefficient water delivery and treatment infrastructure requires investments estimated as high as \$300 billion. The West has been experiencing a severe drought and mandatory water rationing is in effect in many areas (including San Diego, Long Beach and Los Angeles). Climate change has impacted snowcaps and threatens water supplies. Given this backdrop, how should we as a society respond to these tremendous water challenges? Here are my thoughts.

- 1. Develop a true valuation of water.*
- 2. Create flexibility in our regulatory framework to allow for innovative approaches to water management (i.e., move more toward an integrated watershed approach).*
- 3. Move toward a more sustainable management of water resources that focuses on improved efficiency (i.e., treatment, delivery, use and recycling).*

Throughout our nation’s history, we have been fortunate to have an abundance of inexpensive resources. Water, especially, has been the most important resource allowing the nation to grow. As a nation, though, we are now faced with a series of water crises; shortages in the West and South. In order to spur investment in treatment technology and delivery systems, as well as general technology development that minimizes water use, we must create the economic foundation that properly values water and its uses.

While there is a certain amount of flexibility in our nations regulatory framework (usually in the form of enforcement discretion), we need to embrace opportunities and provide the time to determine their effectiveness, recognizing that we will not always be successful, but that we will continue to learn and improve upon our current practices.

By moving toward a more sustainable water management system, we improve efficiency in all sectors. Key to this is greater regional planning looking at a more holistic approach to zoning, transportation, manufacturing, industry, housing and agriculture.

Vision—Bob Johnson, Water Consult Engineering and Planning Consultants

Water is one of our most precious natural resources. It is also the lifeblood for our economy. In most of the western United States water supplies are inadequate to meet current and future demands. One of our nation's biggest challenges is finding how to close the gap between water supply and water demand while protecting our important natural ecosystem.

The western water community faces many problems. We have had extensive drought in most western rivers over the past decade. The Colorado, the Platte, the Missouri, the Rio Grande and now the Central Valley of California have all experienced below average water supplies in recent years. In addition, the preponderance of Climate models are telling us that reductions in stream flow in the western United States (with the exception of the Pacific Northwest) can be expected over next 50 years. Couple this with unprecedented population growth in many western cities and new environmental demands for water to protect endangered species and we have a recipe for disaster. Add on the need for settlement of Native American water right claims and an aging western water infrastructure and we have an even more daunting set of problems.

There are solutions. Water conservation and reuse, water transfers between willing buyers and sellers, ecosystem restoration projects, negotiation and settlement of water disputes, and new infrastructure development are tools that are available. But putting these tools to use is easier said than done. There is no cookie cutter, but there are some key ingredients for finding the right combination of tools for solving our problems. Establishing relationships among sometimes disparate groups, allowing time to find and negotiate solutions, and providing the right leadership to make parties look for common solutions are needed. It is all very hard work. But failure is not an option.

The Irrigation Association can help. By sponsoring conferences like this one, the association can help develop relationships and establish common understanding. The industry also has some influence over one of the most important tools – water conservation. Improved technology from the irrigation industry can reduce water demand for irrigation and provide new supplies to address current and future needs. Being an active player in helping to influence good solutions and supporting the broader needs of the water community is also a role the association can play.

Vision—Mark Smith, The Nature Conservancy

My vision for approaching our water challenges begins by thinking long-term. We need to think about 50- to 100-year solutions to our water challenges. When the Romans built aqueducts, when American engineers built the Hoover Dam, they were working to provide multi-generational solutions. We need to do the same. This allows us to think big thoughts and to think beyond the useful life of our current infrastructure. This long-term view frees us from the constraints of today and requires us to ponder what the next generation of infrastructure should be – and what we would like for natural resources in the future. Our goal should be to build ourselves – and in some cases 'unbuild' ourselves – into a sustainable future. This will include focusing on decentralized water and wastewater systems that work within the local water cycle while ensuring they are robust, flexible and include sufficient redundancy through interconnections to larger, regional infrastructure, where possible.

Building ourselves into sustainability must include providing clean and safe water and sanitary services to improve the standard of living for those living in poverty and otherwise economically disadvantaged. Sustainability and improving the overall standard of living on a national and global scale will require an understanding and appreciation of the ‘services’ provided by healthy natural water systems: clean water for people, abundant fish and other organisms that can be sustainably harvested for recreational, subsistence and commercial purposes, flood control and wildlife habitat from floodplains and wetlands. And we must be able to describe, and to the extent possible, quantify how these services improve our economic and social condition.

Sustainability includes working to ensure people and societies are more in tune with and accommodating of the natural rhythms of nature and the water cycle. We already do this to a degree – in winter we dress differently, we ski instead of hike, and we close some mountain roads. We need to do this more broadly. We need to understand that high waters and low waters are a natural rhythm and accommodate them. We will still need to protect cities and other key areas from large floods – but we should also be able to let our rivers breath in and out during more typical 2- to 10-year events. Part of being tuned to nature is to protect the few remaining untamed, unmanaged rivers in perpetuity so that we have the full spectrum of river and freshwater systems, from natural to highly managed.

Achieving long-range goals to provide sustainable water for people and nature will require that we invest in technology. We have access to real time data. We have SCADA systems that allow systems to be operated automatically, 24-7, based on these real-time and changing conditions. We have, or can build, the technology and tools to tune our management to the rhythms of life, the rhythm of water.

Water sustainability will require greatly improving water efficiency. We must invest in setting clear goals for efficiency, understanding the difference between essential and non-essential water uses, and use this understanding and our new technology to reduce our water foot-print and achieve these efficiency goals.

Therefore, our approach to meeting our water challenges requires thinking long-term, setting the right objectives, asking the right questions, building the right tools, making the right decisions and doing the right things. It’s that easy!

Vision—Mike Young, University of Adelaide, School of Earth and Environmental Science

Closing Observations

The real question for those responsible for water policy in the United States to ask is: “Are you ready for the challenges of the 21st century?” Specifically:

- 1) Is your entitlement and allocation regime designed to enable speedy and autonomous adjustment to massive and rapid shifts to a much drier regime?*
 - 2) Does the entitlement and allocation system allow the rapid use of markets to optimize the use of water both within and between seasons?*
 - 3) Who controls your future? Is it a regional association or does each individual have autonomy?*
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► How Can the Irrigation Industry Take a Leadership Role in Addressing our Water Challenges?

- 4) *Who is responsible for risk management and who profits from getting it right and getting it wrong? Are risks shared or individually controlled?*

In my view, the many parts of the U.S. have water entitlement and allocation systems that are poorly suited to the challenges of this century. In particular, they do not encourage investment, innovation and adjustment. What would happen if:

- 1) *Your water rights were unbundled so that you have a clear distinction between entitlements, allocations, use approvals, delivery entitlements, etc.?*
- 2) *Each water user had total control of where water was used and whom it could be sold to?*
- 3) *All water use was metered and there were strong economic incentives to improve water use efficiency?*
- 4) *If your “first in time, first in right” systems were converted to sharing systems?*
- 5) *Share systems were designed so that supply risk management was an individual responsibility?*
- 6) *The environment was given an entitlement that was no different to that given to all other users?*

Would these changes result in massive increases in investment and the profitability of the irrigation sector? Would the result be more ecologically healthy?

Vision—John Eckhardt, Imperial Irrigation District

A Water Challenge

My first hydrology class explained the “water challenge” – not enough water in the right locations at the right time with the desired quality. The concept has always been there is enough water and with cooperation, sharing and sustainability together with good engineering and economics we can solve the water challenge issues. However, a new challenge is the worldwide increase in water demand for food driven by population increase, coupled with a changing climate we have not experienced in the collective memories of the current human race. This increased demand together with what I believe are outdated water laws, political policies and regulations that don’t encourage water use efficiency and priority for food production are bringing us to a disaster of unmeasured proportions. Water laws, policies, and regulations at national and local levels have not solved problems and unfortunately have created many new challenges that don’t have simple engineering and science solutions.

My work on water delivery operations and water allocation in third world countries has given me an understanding of the value of water for food production that is much different than my growing up on a farm in Colorado. I’ve had the pleasure of working with farming families where the father gets up every morning hoping to feed his family one meal that day. If he accomplishes that one meal, he has done a good job. Here in America, we measure the water challenge as meeting the needs of municipal and industrial uses generally at the expense of reducing agriculture water use. We don’t seem to understand the importance of food production and food security. We now are third and fourth generations away from the farm and believe food comes from grocery stores and really don’t care if that food comes from America or another country. Generally we do not understand the amount of food needed today and its water production needs. As an example, Los Angeles has approximately 12 million people demanding water at the current

rate of two to three million acre-feet per year. What no one talks about is the water demand for 36 million pounds of food per day needed by those 12 million people. The article in the June 2009 issue of National Geographic had it right, “THE END OF PLENTY.” This article addressed the world food shortage, but I concluded from this article and many others in the past few years that if the world population does increase to 8 billion in the next 20 years, the competing needs of water for food between all water users, states, and nations must be resolved to prevent world war – or at least world-wide famine. I believe it is the End of Plenty for water uses that are not critical to the survival of the human race.

In my opinion, the first step to solving the water for food challenge here in the West is to understand how the western water rights system of prior appropriation and all the laws, rules, regulations, and compacts associated with the concept of “first in time, first in use” are driving water use and conjunctive ground water/ surface water use away from sharing, maximizing and efficient use of a most valuable natural resource. There is no incentive for a senior water user (usually agriculture) to become more efficient by conserving if the water can only be used by the next junior water right – especially if crop yield reduction is considered and that is not what we want to encourage.

To add to this dilemma, the agriculture water use history may decrease creating the potential of a “less valuable” water right. In addition there is no incentive to use ground water conjunctively with surface water, or basin-wide, inter-basin or inter-state maximization of water use. Many attempts have been made by municipal and industrial water users to work with agricultural water users such as dry year option contracts and various other cost sharing approaches but the bottom line is municipal and industrial users find it most economic and risk adverse to purchase the agriculture water.

I don’t know if there is enough water for eight billion people but I do know that if we want to preserve and even enhance water use for agriculture and food production the laws, regulations and policies must be changed to recognize this priority using the integration of the best science to solve the problems without impacting the economics of owning a water right.

Vision—Kelly Kopp, Utah State University Cooperative Extension

How Society Should Move Forward in the Face of Water Challenges

The recent worldwide economic crisis has forced governments, industries, businesses and individuals to do more with less financial support than ever before. This shifting approach to our professional and personal lives translates directly to the changes that will be necessary for society to meet current and future water challenges.

In some situations—for example personal use and hygiene – there is no question as to the necessity of water to meet society’s needs. In other situations – for example amenity landscape irrigation – there is serious debate as to whether or not the use of precious water resources is warranted.

In the case of personal use and hygiene, industry is rising to the challenge of water conservation with increasingly lower water use products and plumbing codes that require the use of such products. By attrition, fixtures and products that are wasteful of water will be removed from use and water savings will increase over time. Less water will be used to do more.

In the case of amenity landscape irrigation, the industry has been moving steadily toward more efficient products and techniques that do more while lessening the amount of water necessary to maintain landscapes. Industry educational programs specifically aimed toward water conservation are also increasingly available. However, the very visible nature of outdoor irrigation keeps it constantly in the public eye and makes it an obvious target for criticism by individuals and organizations focused on water conservation.

As a scientist, I believe that public policy decisions should be based upon the best scientific data available at a given point in time. If the irrigation industry is going to help society move forward in the face of existing water challenges, it must do so from a point of strength that is based upon sound, science-based information.

For example, if the energy costs of a home surrounded by a landscape are significantly reduced because of that landscape and the irrigation that maintains it, then that use of water may be justified. Similarly, if an irrigated landscape is determined to provide a significant carbon sink and to sequester carbon in this time of increasing concern regarding global climate change, then that use of water may also be justified. However, very careful analyses of the relative efficiencies of water use and energy savings or carbon sequestration must precede any such justification.

As a society, I believe that we will move forward most effectively in the face of water challenges if we make decisions that are based on scientific findings and facts rather than our personal perceptions of inefficient water use. As a scientist, I am hopeful that productive partnerships between water industries and academic institutions will help society do just that.

Vision—David Yocca, Conservation Design Forum

Water Challenges 2009 – Moving toward more sustainable living...

Today, more than ever before, in our nation's history, we are faced with a set of interrelated issues that threaten our individual and community health in a profound way. These issues include:

- *Environmental Decline – Water out of balance is behind the degradation of the ecological integrity of places in every region. Flooding from agricultural and urban runoff is coupled with drought and rivers, streams, lakes, and wetlands starved of base flow due to land that can no longer hold water where it falls.*
- *Water Shortages – Many communities, even in areas with historically plentiful water supplies, are having challenges meeting basic water supply needs. Overuse of locally available water supplies, coupled with land uses that prevent recharging essential groundwater supplies, are the unsustainable conditions created in many cities throughout the country.*
- *Unhealthy Food – The largest land use in most regions is agriculture, and an enormous, growing proportion of this is managed with industrial-scale practices that are both harmful to the land and produce food bereft of nutrition.*
- *Rising costs – Costs for daily needs are increasing, and beyond the control of most individuals. As more of these needs are produced remote from where they are used, the cost for transportation (energy and infrastructure) is a greater proportion. Costs for maintenance of infrastructure and community assets are also rising as the impacts of unsustainable practices are realized.*

These issues in part stem from the progressive separation of people from the natural world. More and more children are growing up in an environment where there is no connection to nature. "Nature deficit disorder" has impacts on health, fitness, learning, and long-term well being. Many people are largely unaware of how out of balance and fragile our collective land use and cultural practices have made our environment. People disconnected from nature in their daily life suffer physically, emotionally, and spiritually, and lose a long-term perspective regarding land use and environmental priorities.

At Conservation Design Forum, we operate under a guiding doctrine of fundamental respect for water in all of its forms. "Treat all water as a valuable resource; never squander it as a waste product" is our daily mantra. We are continuously

developing and refining ways to design and manage sites, landscapes, and watersheds in a way that mimics local, natural hydrology to take rainwater and slow, cool, cleanse, and infiltrate water where it lands.

The basis of integrated design involves the application of a range of strategies to accomplish this objective while providing other needs. Materials such as green roofs, porous pavement, and rain gardens are better, more durable, more functional, and arguably more beautiful than conventional materials. When properly designed, installed, and maintained through a collaborative, integrated process, they are also more cost effective and create more lasting value in many ways. In addition to green site, building, and community planning practices to create healthy indoor environments and walkable, mixed-use neighborhoods, communities need to be redesigned to provide more daily needs locally. Other strategies to help make places more livable and sustainable are just as critical:

- *Building soil with composted waste and producing healthy food in fields and on rooftops in each community;*
- *Re-establishing native grassland for grazing animals and other sustainable economic benefits as part of watershed stabilization;*
- *Restoring local ecology in natural areas protected for future generations; and*
- *Incorporating places for play, solace, and reflection into every neighborhood.*

The proliferation of all of these practices will continue to lead to whole new economies and employment bases. Over the next 50 years, virtually the entirety of the nation's infrastructure – roads, buildings, landscapes – will need to be refurbished or rebuilt. It can be done using old technology, and continue to degrade the environment and fall apart the way we know it does, or it can be rebuilt with sustainable practices in a way that creates long-term beauty, more vital environments, and a healthier habitat for all.

Connecting people to living, changing, landscapes and water elements improves their learning, performance, health, and spirit, and therefore imperative for all involved in shaping human habitat. The need for greater creativity to fit healthy, inspiring living to the unique attributes, opportunities and limitations, of every place throughout the country is as imperative today as ever before. The wise and conservative use of water leads to more sustainable, authentic living, a closer connection to place, and a healthier environment for future generations.

Vision—Sarah Stokes Alexander, The Keystone Center

Meeting our Water Challenges Together

“We have an unknown distance yet to run, an unknown river to explore. What falls there are, we know not; what rocks beset the channel, we know not; what walls ride over the river, we know not. Ah, well! We may conjecture many things.” – John Wesley Powell

In John Wesley Powell's time there were slightly over one billion people on the planet. There remained some vast stretches of unexplored territory in the U.S. West as well as throughout the globe. Shared resources such as water were untapped, and seemingly limitless.

One-hundred-and-fifty years later, our global population is approaching seven billion people, and we are beginning to see the dramatic effects our needs are placing on the planet, from water scarcity to food scarcity. And, just like Powell, “what falls there are, we know not.” We do know that we will likely need to double agricultural production in the next 40 years to sustain our own needs. We know that we will need to do this with less carbon, water, and land, not more.

And still, we have accomplished much in the past 150 years with respect to creating effective water delivery systems, allowing agriculture to be far more productive and meet current our needs. We have devoted much to learning more about natural systems and how they operate, where we may reach their limits, and how we can innovate our own practices to use resources more wisely.

As we look to the water challenges we face today and in the future, there are a few things we might learn from John Wesley Powell. A Civil War veteran who lost his arm in a battle, Powell, undeterred by his shortcomings, was the first to lead an expedition successfully through the Grand Canyon. First and foremost, a scientist, Powell looked to science to inform how we use and manage our water resources. Through his explorations, Powell conjectured that collaborative governance and management were important to our long-term sustainability.

There is much we still may not know about how to address our current challenges, but we do know that we must have some courage to navigate these uncharted waters using the aid of good science, leadership, and a sense of a shared purpose. We cannot assume we know the way or that others don’t. We ought to look for innovations wherever they occur. While we continue to look for ways to share and scale up the things we know that work, we can also continue the dialogue, even when it is uncomfortable, with each other to find new solutions. With these elements we can collaboratively shape a vision for resource management that will be sustainable into the future.

Vision—Peter Binney, Black and Veatch Corporation

A Vision of Water and Agriculture in the Coming Decades

Water and agriculture have been synonymous for thousands of years as the value of irrigation and economic well-being have been essential to all societies. No region or nation has flourished without a stable and effective source of food production and substantial investments in water resource development have occurred to support that industry and to contribute to the welfare and security of those populations. Indeed, the vast majority of the national water resources have been committed to securing the water supplies for agriculture with major river basins often allocating more than 75 percent of the yields for agriculture. It would appear, at face value that this natural resource policy has evolved effectively and productively and would reasonably continue to serve as an effective model for the future.

It is suggested that there are major reasons why our traditional approaches to allocating and managing the majority of our consumable water to irrigation and the business model of agriculture will change dramatically in the coming decades. The current economic crisis, globalization of the food production and agricultural cycle, increased climate variability, a changing role of federal subsidies, social and demographic changes in rural and workforce areas, the emerging middle-class consumption patterns as the world grows from six billion to nearly 10 billion people by 2050. These and other factors will have a significant impact on how we use our limited and increasingly depleted water resources and how the irrigated agriculture industry will be transformed, as it must, by necessity, continue to provide an adequate and reliable food source to society. In 2008, the world for the first time had more people living in urban areas than in rural areas. By 2050, it is forecasted that all

net population growth will occur in cities and towns and there will be an actual loss of population in rural areas. Almost all economic activity will grow in non-farm sectors. This leads to the challenge facing agriculture – the expectation will be that the farm sector will provide the food and sustenance of the urban populace while competing for water resources with urban needs as well as increased demands for energy production, environmental protection and rehabilitation and industrial production.

These changing demands will be accommodated through a number of significant changes in our water management policies and the ways in which water that has traditionally been allocated and delivered to agriculture. Water efficiencies, periodic fallowing and reallocation of water to urban or environmental uses, some permanent transfers, crop selection and farming methods will be adapted and enhanced. At the core of these changes will be the social acceptance of changed farming practices and the economics of these changes. Based on recent trends, there are expected to be a number of changes of irrigation in areas near cities or that can be interconnected to urban water systems because of expansion of the urban footprint or the 10 to one hundred times difference in value of water when priced for human consumption.

Water transfers from rural to urban uses are often characterized as being disruptive and at the expense of the rural communities – the author's experience in implementing several major transfers or fallowing programs does illustrate that mutual benefits are achieved and without the adverse consequences that are feared. Water resources will be developed and reallocated as demands and societal expectations for water management change so creating a framework that can support that change in a constructive and disciplined manner will benefit both irrigators and the other group proposing the change. That may be a city, industry, or environmental user.

There are many examples for how increased efficiency and lower water consumption in irrigation can be paid for by a city as part of an overall program to meet urban water needs without displacing the agricultural and rural benefits. There are also effective programs in urban water use where increased efficiencies in outdoor landscaping are necessary as a part of an overall program to more effectively manage regional water resources in an increasingly over-allocated water setting.



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