The Challenges of Dynamic Water Management in the American West

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I.
INTRODUCTION

The premise of this climate change symposium is one whose importance the legal community in the United States has been slow to understand. There is wide agreement among climate scientists that global climate change calls for two distinct types of response. The first is a reduction in the amount and rate of greenhouse gas emissions, so as to slow increases in global temperatures and limit the impacts of associated climatic shifts. This response has attracted much attention from lawyers and economists. They have sought to force policy shifts through litigation, opined about the pros and cons of various policy designs, and

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purported to forecast the economic and social impacts of various strategies.

The second response, which has received much less attention, is adaptation. Among some climate scientists, talk of adaptation has been almost taboo for fear that it might be seen as a substitute for aggressive emission reduction measures.[1] Although lawyers may not see discussion of adaptation as taboo, until very recently they have not been much interested in it. Perhaps adaptation seems less glamorous than devising new schemes to regulate carbon dioxide emissions, perhaps it seems too difficult, or perhaps it is seen as potentially undermining the impulses toward environmental protection that provide the conceptual and political foundation for environmental law.[2]

Difficult and unappealing as it may be, however, there can be no doubt that we need to confront adaptation. No matter how quickly and how aggressively we act to rein in future emissions, the profligate consumption of fossil fuels since the industrial revolution has already irrevocably committed the globe to substantial climatic changes.[3] Dealing with those changes will pose substantial challenges, requiring that we embrace flexibility and dynamism in a way that does not come naturally to law, to our institutions, or – for that matter – to human nature. Drawing upon the history of water distribution in the arid American west, this article offers a cautionary lesson about the difficulties of meeting the challenge of climate change. While there are some

1. The reluctance to confront adaptation is described and decried in Roger Pielke, Jr., et al., *Lifting the Taboo on Adaptation*, 445 NATURE 597 (2007).

2. *See* Matthew D. Zinn, *Adapting to Climate Change: Environmental Law in a Warmer World*, 34 ECOLOGY L.Q. 61, 66 (2007) (suggesting that over-reliance on adaptation, rather than mitigation "may produce a kind of path dependence, requiring massive future environmental interventions with massive new environmental harms. These harms would occur in a natural environment increasingly less able to accommodate them and in a legal environment less able to prevent them. At the least, this means that climate policy must take into account the environmental costs of adaptation, as best they can be estimated, on the assumption that they will not be avoided. The literature and public debate about climate adaptation have yet to grapple with this problem. Moreover, if we value our own concern for the environment and wish that concern to continue into the future, we should consider binding ourselves to the mast by adopting a mitigation-preferring policy. In doing so, we may better preserve our ability, and our commitment, to protect our environment.").

3. According to the most recent report of the UN Intergovernmental Panel on Climate Change, even if emissions are frozen at 2000 levels, the world will warm at about twice the natural background rate over the next 20 years or more. Intergovernmental Panel on Climate Change, *Climate Change 2007: The Physical Science Basis, Summary for Policymakers, Contribution of Working Group I to the Fourth Assessment on Intergovernmental Panel on Climate Change* 12-13 (Feb. 2007).

hopeful signs, no one should underestimate the barriers, or the need for lawyers and legal academics to devote continued attention and energy to the task of adapting to those aspects of climate change that cannot be mitigated.

II.
WESTERN WATER PROJECTS ARE HIGHLY VULNERABLE TO GLOBAL WARMING

In California, 36 million people depend upon a Mediterranean climate characterized by three important features. First, precipitation is highly seasonal. Rain and snow are almost entirely confined to the winter months, which is great for barbecuing but not ideal for growing crops or even lawns. While 80% of the precipitation in California occurs between October and March, about 75% of the water use occurs between April and September. Second, annual precipitation is highly variable. Both floods and droughts are common. Odd as it sounds, "average" water years are rare.[4] Third, the precipitation is geographically separated from the demand for water. Average precipitation varies by an order of magnitude, from less than 12 inches to more than 120 inches per year across the state. Both population centers and key agricultural districts are concentrated in relatively dry areas. About two-thirds of all precipitation in California falls to the north of Sacramento, while about two thirds of all the water use occurs to the south. Moreover, much of the precipitation occurs in the interior mountains, while most of the population lives along the coast.[5] Because of its climate, California must rely on an elaborate plumbing system to store water in the winter and spring for use later in the year, reserve water for future years, and convey water to points of use.

The climatic details vary across the arid West, but the general picture is the same. Current patterns of human settlement throughout the region have been made possible only by more than a hundred years of intensive investment in storage and conveyance. Every major river basin in the west is dotted with large water projects that irrigate crops, produce electricity without car-

4. For a graphic depiction of this variability, see CAL. DEP'T OF WATER RESOURCES, PROGRESS ON INCORPORATING CLIMATE CHANGE INTO PLANNING AND MANAGEMENT OF CALIFORNIA'S WATER RESOURCES, TECHNICAL MEMORANDUM REPORT 2-19 (2006), *available at* http://www.climatechange.water.ca.gov/docs/DWR ClimateChangeJuly06.pdf.

5. *Id.* at 2-1 to 2-3.

bon emissions, protect against flooding, and provide drinking water for cities. The rivers those projects have channelized, tamed, and put to human work still manage to support native fish, wildlife, and vegetation – but just barely.[6]

The West is acutely aware of the impacts that global warming will have on the hydrologic cycle and, through it, on the water systems that sustain us. Those systems face a number of linked challenges. To begin with, the snowpack in western mountains provides a vital reservoir. To use California as a specific example of a more general problem, even assuming that temperature increases fall at the low end of the climate model predictions, we stand to lose half or more of the snowpack storage capacity by the end of the 21st century.[7] Warmer temperatures will mean that more of our precipitation falls as rain and runs off immediately. That has multiple consequences. First, unless additional manmade storage is developed, we will lose part of our winter precipitation that, historically, has been stored naturally for summer, ending up with a smaller effective water supply. This point has been overlooked in much of the economic analysis of the impacts of climate change on water supply, which tends to focus on the total amount of precipitation and to ignore timing. The fact is that, in a warmer climate, we could have twice as much precipitation in January and February and not one drop more of water available in July and August when it is needed. Second, the increased winter runoff and earlier snowmelt that warmer winters bring will worsen floods, which already regularly threaten to overtop or undermine our levees and drown our homes and businesses. Third, as peak flows shift earlier in the year, flows during the main irrigation season (April-September) will decline. Under a business-as-usual emissions scenario, spring and summer streamflow will decline by about 20% before mid-century and about 50% before the end of the century. Fourth, earlier snowmelt will also make it more difficult for dam operators to retain the water needed to generate hydroelectric power in the

6. Freshwater fish are, according to the US Geological Survey, the most imperiled vertebrate group in the United States. Michael A. Bogan et al., *Regional Trends of Biological Resources – Southwest*, 2 STATUS & TRENDS OF THE NATION'S BIOLOGICAL RESOURCES 543, 565 (U.S. Geological Survey 1998). A high proportion of the endangered fish are found in the West, and a remarkably high proportion of the fish in many Western basins are endangered. For some statistics and citations, see Holly Doremus, *Water, Population Growth, and Endangered Species in the West*, 72 U. COLO. L. REV. 361, 366-67 (2001).

7. CAL. DEP'T OF WATER RESOURCES, *supra* note 4, at 2-30 to -31.

summer, when the demand for electricity is highest. To complicate matters, awareness of global warming has already increased the value of hydropower. California now requires that every electric utility meet targets for renewable energy production,[8] and hydropower is, for now at least, easily the most economical renewable energy source.

California's water supply will also be impacted by sea level rise. Rising sea levels will cause increased saltwater intrusion into coastal aquifers such as those in Orange County and Monterey County. Another effect, peculiar to California and even more damaging, is the threat posed to the Sacramento-San Joaquin Delta – the hub of California's plumbing system, which supplies water to some twenty million people and three million acres of farmland.[9] The system relies on a network of Delta islands protected by levees, in combination with a controlled pattern of freshwater releases, to keep saltwater away from the water supply pumps in the South Delta. The levees are frail and becoming increasingly vulnerable. If there were an earthquake on one of the faults near the Delta, it might damage the levee system enough to allow an irreversible incursion of seawater into parts of the Delta that are currently fresh. Even without an earthquake, rising sea levels will increase the likelihood of levee destruction. The danger is greatest in the winter and early spring. In a winter storm, the crest of the waves is several feet higher than mean sea level, so that a levee can be overtopped even if it stands above mean sea level. The likelihood of a destructive wave increases exponentially with a rise in sea level. Warming temperatures will add to the stresses on the levees by making flood flows in the Sacramento and San Joaquin watersheds more likely in winter and spring, both by increasing the intensity of winter rainstorms and by accelerating melting of the snowpack.

III.

ADAPTATION WILL BE DIFFICULT, AT BEST

The scientific evidence of climate change is sufficiently certain at this point to leave no doubt that we must make changes to

8. California's Renewable Energy Portfolio Standards are set out at CAL. PUB. UTIL. CODE §§ 399.11-.20 (2007).

9. For a more detailed description of the Delta and the threats climate change poses to its economic and ecological uses, see JAY LUND ET AL., ENVISIONING FUTURES FOR THE SACRAMENTO-SAN JOAQUIN DELTA 1-60 (Public Policy Inst. of Cal. 2007).

western water systems if we hope to preserve their utility. As a species, *Homo sapiens* is nothing if not adaptable, and the United States has the additional advantage of wealth. We are confident that America will respond to the most important of human needs for water. No one will go thirsty. Based on the Western water management experience of the last one hundred years, however, we are pessimistic that the needed changes will be made in an economically rational, proactive manner; that they will introduce sufficient flexibility to allow our water systems to continue to adapt smoothly as the climate changes; or that they will take much account of the non-human world. Although there are some reasons for cautious optimism, no one should underestimate the challenges of introducing a dynamic approach to water allocation. It will require fundamental changes in the way we think about both nature and law.

A. *Infrastructure constraints*

Water facilities have both physical and operational constraints. Some things can be changed relatively easily, but others cannot. If, for example, western states want to replace the storage capacity lost with the dwindling snowpack, they will have to construct new reservoirs or increase the size of existing ones. That requires time, money, and the right political climate.

Until recently, most observers would have said that the era of big water projects ended in the 1970s, with the rise of environmental review, cost-benefit analysis, and constrained government budgets. Although the New York Times recently reported that climate change is shifting the political environment,[10] the headlines are outrunning reality. While it is true that proposals for new water projects, and new types of water projects[11] are being developed, there are few, if any, places where those projects do

10. Randal C. Archibold & Kirk Johnson, *No Longer Waiting for Rain, an Arid West Takes Action*, N.Y. TIMES, Apr. 4, 2007, at A1.

11. For the first time, desalination projects look like they might make economic sense in many parts of the West. As of March 2004, some two dozen desalination projects had been proposed along the California coast. CALIFORNIA COASTAL COMMISSION, SEAWATER DESALINATION AND THE CALIFORNIA COASTAL ACT 5 (Mar. 2004), *available at* http://www.coastal.ca.gov/energy/14a-3-2004-desalination.pdf. Two years later, the Pacific Institute found twenty proposed projects which, cumulatively, would represent a 70-fold increase in desalination capacity but still would supply only 6% of California's year 2000 water demand. HEATHER COOLEY, PETER H. GLEICK & GARY WOLFF, DESALINATION WITH A GRAIN OF SALT: A CALIFORNIA PERSPECTIVE 29 (Ian Hart ed., Pacific Inst. 2006), *available at* http://www.pacinst.org/reports/desalination/desalination_report.pdf.

not face stiff opposition. In California, Governor Schwarzenegger favors new dams, but so far the legislature does not. To the extent that new storage seems likely to feed either housing growth or subsidized agriculture, it will not find an easy political road.[12]

Even if there were political agreement, there is also the problem of financing new infrastructure. Relative to other types of public utility infrastructure, water supply and flood control infrastructure have several features which make them difficult to finance. They are extremely capital intensive, and the capital tends to be very long-lived and multipurpose – dams and aqueducts last for a very long time and serve flood control, agricultural, and urban water supply needs. Each of these features makes it hard to finance the infrastructure on a pay-as-you-go basis. Most of the cost is capital cost rather than operating cost; the capital has to be financed upfront, even though much of the benefit goes to future users; the joint-cost structure also makes it hard to figure out the marginal cost for individual users. The CALFED Bay-Delta Program offers a good illustration of the financing challenges these features bring. Several years ago, CALFED adopted the principle of "beneficiary pays." But, after much effort and many analyses, there still is no agreement on how to allocate the costs of the various CALFED activities between individual users, or between users and general taxpayers.

The problem of cost allocation and the consequent difficulty of determining financing are endemic to water supply and flood control infrastructure. These issues can go unresolved for decades. Because of inadequate funding, for example, the New Orleans Flood Defense System, authorized by Congress in 1965 with a target completion date of 1978, remained unfinished in 2005 when Hurricane Katrina hit. It was officially due for completion in 2015, fifty years after the original authorization, and there was a high likelihood of even further postponement.

B. *Institutional constraints*

Even with new water projects and without climate change, the rapid population growth of the arid West would make reallocation necessary. California alone is expected to grow from 36 mil-

12. It is worth noting that proposals for new water storage and transfer facilities, although still only talk, are far ahead of discussion of other potential solutions to the impending water crisis. No one with a national or even regional audience is openly talking about limiting population growth in Las Vegas or other water-limited cities.

lion to 51 million residents by 2040, not including undocumented migrants. Nevada and Arizona are growing even more rapidly.[13] Unfortunately, reallocating water is even more difficult than adding new infrastructure. The water status quo is among the most tenacious of what Charles Wilkinson has dubbed "the lords of yesterday."[14] It tenaciously resists change, even when it is plainly getting in the way of solving modern problems. Adapting to climate change requires breaking the hold of this ancient lord. That will not be easy. Whereas building new infrastructure requires only time and money, changing entrenched legal rules, informal entitlements, and institutions tailored to antiquated social needs and goals requires overcoming history and human nature.

IV.
THE APPEAL OF STABILITY

The root of the institutional resistance to change is that people are uncomfortable with dynamic systems. The very existence of water projects is testimony to our desire to stabilize natural systems. The same instinct makes it difficult to change the rules that govern distribution of water and other resources.

Ever since human beings decided to anchor themselves to the map by cultivating fields they have been obsessed with stabilizing dynamic nature. As human settlements have become ever more permanent and ever more elaborate, and technology has advanced, efforts to stabilize nature have accelerated. Even land, ordinarily the most stable of natural features, is dynamic in ways that pose problems. People certainly know that in California, where earthquakes are a constant threat to major population centers. Any political consultant worth her salt could mount a successful California initiative campaign to outlaw plate tectonics.

While we have not gone so far as to order the earth to stop moving, we have attempted to take the dynamics out of our rivers. The history of European settlement of North America, especially in the arid West, has been intimately tied to the ability of technology to stabilize naturally dynamic aquatic systems. The whole point of water projects is to smooth out the naturally vari-

13. Robert Glennon provides cites to support these demographic claims. *See* Robert Glennon, *Water Scarcity, Marketing, and Privatization*, 83 TEX. L. REV. 1873, 1875 (2005).

14. CHARLES F. WILKINSON, CROSSING THE NEXT MERIDIAN: LAND, WATER, AND THE FUTURE OF THE WEST 3-27 (Island Press 1993) (1992).

able hydrograph, reducing flood flows in spring run-off season and making more water available in the summer for irrigation and electric power production when demand is highest.

In the hundred years or so since large-scale plumbing of the West began, the environmental costs of river stabilization have become glaringly apparent. Yet we have done little to correct them. In part that is because we can't agree on how much to restore the environment and at whose expense. In part, it is because we are not ready to relax our grip on nature and accept rivers as truly dynamic systems. But, in significant part, it is because another urge for stability stands as a barrier to change. People are just as uncomfortable with dynamic regulatory systems and institutional regimes as they are with dynamic nature. This discomfort is at its height where economic interests, capital investments, and community identities are at stake. All of these factors are implicated with respect to any rules that divvy up entitlements to "property," including water regimes. The desire for regulatory stability springs from the same seed as the desire for stable natural environments. We want our capital investments to be secure, preferably forever. The same is true for our social and emotional investments. Change is wrenching in all kinds of ways. Although we recognize the need for it, at least intellectually, we don't want it to come too quickly, and we don't want it to go too far. It should come as no surprise, therefore, that our water institutions are not designed to be nimble. To the contrary, they are deliberately designed to emphasize stability.

V.
BARRIERS TO REDISTRIBUTING WATER

On their face, existing legal rules would seem to make it easier to reallocate water than land. Property interests in water are understood to be less secure than those in land. Water users have a property interest in the use of water, but not in the water itself. Furthermore, that interest has always been at the mercy of nature. In the West, no one expects the water supply to be constant from year to year. Water users know the constant risk of drought or shortfall.

But the forces pushing toward stability are just as strong for water as for land. Especially in arid locations, water is at least as important as land to human lives and communities. Investments of all kinds depend on the continued flow of water. The buyers of a new house expect water to continue to come out of the tap;

the house will lose virtually all of its value if it lacks a secure water supply. Farmers who have invested in production of a crop that requires irrigation also face real economic risks. Those risks extend beyond direct water users to communities dependent on farming or other water-intensive industry. They encompass not only monetary investments, but emotional ones. Neither the homeowner nor the farmer will be fully mollified by monetary compensation if the loss of water requires them to pull up stakes, move to another community, and pursue a different sort of life.

Furthermore, the private markets that allow relatively easy reallocation of land through voluntary transactions do not function well for water. Despite the efforts of a number of smart, dedicated people to promote western water markets over the past three decades or more, such markets remain sharply constrained. Water marketing poses a number of challenges. As Robert Glennon and Michael Pearce have written, "The legal constraints are formidable, the transaction costs substantial, and the emotions highly charged."[15]

To begin with, property rights in water are ill defined. Water rights often are not quantified. In the early days of appropriative systems, water rights could be obtained simply by removing water from the stream and putting it to human use. They may be lost through non-use or waste. Unfortunately, there may be no good records of either use or subsequent nonuse. California, in particular, does a poor job of measuring how much each user withdraws from a stream, and at what time of the year.[16] To make matters worse, the federal government may be entitled to high-seniority reserved rights for its lands. Until basins are quantified through state adjudication processes or otherwise, therefore, it can be very difficult for anyone to know precisely who owns what. Once water rights are quantified, there still remains uncertainty, or at least controversy, over the extent to which those rights are subject to regulatory oversight – that is, the potential for conservation mandates to limit their use.[17]

15. Robert Glennon & Michael J. Pearce, *Transferring Mainstem Colorado River Water Rights: The Arizona Experience*, 49 ARIZ. L. REV. 235, 236 (2007).

16. Dates of withdrawal are a key parameter for water rights. Since climate change will alter the pattern of seasonal streamflows in the spring and summer, withdrawal dates will have to be adjusted, causing major headaches for water rights regimes in the West.

17. *Compare Tulare Lake Basin Water Storage Dist. v. United States*, 49 Fed. Cl. 313 (2001) (holding that restrictions on irrigation water deliveries imposed for conservation purposes worked a physical taking of the property of holders of contract

Second, political boundaries pose special problems for water marketing. When land is sold, it stays where it is. The new owner can't pick it up and move it to her current location. Land transfers therefore do not typically threaten the economic well-being or social fabric of the surrounding community, and there has been no need to erect barriers to land transactions based on the location of the buyer or seller. But water transfers are different, because water can be moved from one place to another, with the potential for dramatic third-party effects. Changing points of diversion and return can cut off water claimed by junior users; loss of irrigation water to another location can threaten to tip a fragile agricultural economy. In order to control such third-party effects, most western jurisdictions have imposed both substantive and procedural limits on long-term or permanent transfers of water, such as prohibitions on removing water from its basin of origin and requirements for public interest review.

Third, the rules of water use and ownership vary far more across state boundaries, and even between irrigation project districts, than do the rules of land ownership. Although economists often promote decentralized decision-making as the most flexible way to respond to changing conditions, decentralized decision making will not work where resources cross boundaries that demarcate radically different rules governing transactions.

In light of all the barriers to water marketing, it should come as no surprise that water markets have yet to produce significant changes in long-term water allocation. Agriculture, which was established across the West before cities grew up, remains responsible for 80% of western water use.[18] Most of the water used for agricultural purposes goes to low-value crops like alfalfa, pasture forage, and cotton. This allocation is economically irrational by any measure. According to Robert Glennon, an acre-foot of water in the hands of a semi-conductor manufacturer can generate nearly a million dollars in revenue, while the same acre-foot in the hands of an alfalfa farmer would produce only about sixty dollars.[19] Yet markets have so far been unable to pry

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rights to water), *with Klamath Basin Irrigation Dist. v. United States*, 67 Fed. Cl. 504 (2005) (finding no taking by water delivery restrictions).

18. In California, for example, although the precise ration varies from year to year, agriculture generally consumes about four times as much water as urban uses. *See* 1 CAL. DEP'T. OF WATER RESOURCES, CALIFORNIA WATER PLAN UPDATE 2005: A FRAMEWORK FOR ACTION, 3-9 (2005).

19. Robert Glennon, *Water Scarcity, Marketing, and Privatization*, 83 TEX. L. REV. 1873, 1887 (2005).

much water from the farmers' hands. Voluntary reallocation, it seems, is a very slow way to change water distribution.

VI.
INSTITUTIONAL BARRIERS TO CHANGING PROJECT OPERATIONS

Beyond the difficulties in redistributing water rights, there are other institutional barriers to adjusting the operation of Western water projects in response to climate change. Water projects are often subject to rigid operational constraints that were put in place decades ago, often by judicial decree. Such constraints are remarkably hard to remove, even when their original justifications have long since evaporated. Consider, for example, the Truckee River, which flows from Lake Tahoe to Pyramid Lake, Nevada. Lake Tahoe is a federally operated reservoir. A small dam at the mouth of the Truckee River, originally constructed in 1870 and later incorporated into the Newlands Reclamation Project, raises the height of the lake a mere six feet over its natural elevation. Because the lake covers such a large area, that small dam provides more than 700,000 acre feet of storage. The reservoir is operated to provide specified flows just west of the California-Nevada state line, as required by a judicial decree entered early in the 20th century,[20] and to provide water for a defunct paper mill and two small hydroelectric projects that were once the main source of electricity for Reno, but today are insignificant power providers. If the United States needs to vary the flows to, for example, better correspond with the seasonal spawning needs of the endangered cui-ui or threatened Lahontan cutthroat trout downstream in Pyramid Lake, it has to get judicial permission to do so. That is a cumbersome process at best.

Renegotiating the flows required by that outdated decree would require that all parties agree on all allocation details. In 1990, Congress passed legislation to encourage such an agreement,[21] but the task is sufficiently complex that it has yet to be completed, despite the fact that almost all of the stakeholders see a new regime as desirable. Finally, in February 2007, the United

20. The various decrees, agreements, and statutes that govern water allocation in the Lake Tahoe-Truckee River system are described in Barbara Cosens, *Farmers, Fish, Tribal Power, and Poker: Reallocating Water in the Truckee River Basin, Nevada and California*, 10 HASTINGS W. NW. J. ENVTL. L. & POL'Y 89 (2003).

21. Pyramid Lake/Truckee-Carson Water Rights Settlement Act, Pub. L. No. 101-618, Title II, 104 Stat. 3289 (1990).

States, Nevada, California, and several other key stakeholders negotiated an agreement that would substantially revise operations of the Truckee River system, including Lake Tahoe.[22] As of January 2008, that agreement has yet to be finalized. Although that is likely to happen soon, it will not be the end of the story. The Newlands Project irrigators are not parties to the agreement, and are likely to mount a challenge once it is finalized. If the agreement unravels, everyone is likely to return to the courts to begin the battle anew. The point is that institutional evolution can be very slow, even when there is a broad consensus on the need for it and on the general direction it should take.

The law deliberately limits the pace of change in water systems in a variety of other ways. Irrigation contracts for water deliveries from federal and state water projects run for decades, typically about forty years. During that time, deliveries can be changed in response to drought, but there is intense political resistance to changes in response to environmental needs, frequently leading to litigation.[23] Hydropower licenses have the same decadal time frame. A wave of license renewals underway for dozens of projects in the Sierra Nevada alone offers an opportunity to update environmental requirements, but the new licenses must by statute run for at least thirty years.[24] During the license period, the consultation requirement of the Endangered Species Act[25] (ESA) does not apply.[26] Even the restriction on "taking" listed species, the provision which earned the ESA a reputation as the "pit bull of environmental laws,"[27] is being pushed to the same sorts of time frames. For example, a fifty year permit has been issued for activities affecting the Lower

22. Truckee River Operating Agreement, Negotiated Agreement, Feb. 21, 2007, *available at* http://www.usbr.gov/mp/troa/docs/TROA_Negotiated_Agreement_02-21-07a.pdf.

23. Irrigators are fond of calling such restrictions "regulatory droughts." There has been one successful takings claim in the Court of Claims for water delivery reductions imposed to protect endangered species. *Tulare Lake Basin Water Storage Dist. v. United States*, 49 Fed. Cl. 313 (2001). More recently, the same court reached the opposite conclusion, both distinguishing and seriously questioning the *Tulare Lake* decision along the way. *Klamath Irrigation Dist. v. United States*, 67 Fed. Cl. 504 (2005).

24. 16 U.S.C. § 1808(e).

25. 16 U.S.C. § 1536(a)(2).

26. *Cal. Sportfishing Prot. Alliance v. FERC*, 472 F.3d 593, 599 (9th Cir. 2006).

27. Donald Barry, then of World Wildlife Fund but later Assistant Secretary for Fish and Wildlife and Parks in the Clinton Administration, is usually credited with coining this description. *See, e.g.*, Timothy Egan, *Strongest U.S. Environmental Law May Become Endangered Species*, N.Y. TIMES, May 26, 1992, at A1.

Colorado River, with "no surprises" assurances that no additional mitigation measures will be required of the permittees.[28] Programs with such long timelines are clearly vulnerable to hydrologic changes associated with climate change.

Environmentalists often complain about the extent of regulatory certainty sought by resource users, but they too support some rigid constraints that make adapting to climate change difficult. Consider, for example, the water quality standards for salinity in the Sacramento-San Joaquin Delta, which have become the primary regulatory driver for operation of the interwoven State Water Project and federal Central Valley Project.[29] The salinity standards set limits on how salty the water can be at various points up the Delta at various times of the year. Because they are state water quality standards approved by the Environmental Protection Agency (EPA) under the Clean Water Act, the salinity standards cannot be loosened except in accordance with EPA's anti-degradation policy,[30] which generally prohibits the removal of existing waterway uses. Environmentalists heartily endorse the anti-degradation policy because it protects against the temptation states and localities face to chase development dollars by allowing pollution of their currently clean waters. In this case (and perhaps in others), however, it may also have unwanted negative ecological consequences. The salinity standard reduces inter-annual variability in the Delta system, ensuring that the brackish water is kept as far out to sea during dry years as during wet ones. Scientists increasingly believe that this kind of smoothing out of natural variability may be bad for the Delta ecosystem.

The fact is that there are good reasons, from different perspectives, for wanting both water distribution decisions and regulatory decisions to be stable over long time periods. Economic and emotional investments depend on the continued flow of water.

28. The regulatory documents supporting the Lower Colorado River Multi-Species Conservation Program are available at http://www.lcrmscp.gov/documents.html.

29. The water year that began in October 2006 has been dry. By May 2007, the State Water Resources Control Board sent a letter to the Department of Water Resources and Bureau of Reclamation (operators of the SWP and CVP, respectively) noting that the salinity standard had been exceeded in the southern Delta and calling for evaluation of additional measures, including releases of water that would otherwise be held in reservoirs until later in the season, to ensure compliance. Letter from Dorothy Rice, Executive Dir., State Water Resources Control Bd., to Lester Snow, Dir., Dep't of Water Resources, & Kirk Rodgers, Reg'l Dir., Bureau of Reclamation (May 11, 2007), *available at* http://www.waterrights.ca.gov/baydelta/docs/salinity/swb_051107_response.pdf.

30. 40 C.F.R. § 131.12.

Those who have already made such investments resist change, and because we do not want to discourage future investments, we do not want change to become too easy. From the opposite perspective, we also do not want to make it too easy to relax the regulatory requirements that currently restrict water operations, because the short-term economic benefits of looser standards can so easily overwhelm the long-term benefits of environmental protection. Rigorous regulatory requirements can appropriately tie us to the mast, or inappropriately tether us to yesterday's world. The reality of a changing climate challenges us to find a new balance between stability and responsiveness to change.

VII.

COURTING TRAIN WRECKS

It is widely believed that it takes a crisis to jar water institutions from one paradigm to another.[31] Of course, even before global warming became apparent, there were water crises in the West, most notably droughts and the endangered species conflicts they bring to the surface. Train wrecks do bring stakeholders to the negotiating table when, without that goad, they might simply rely on the persistence of the status quo. Endangered species train wrecks have at least sparked negotiations and new ways of thinking in river basins across the west, including the Klamath, Columbia, Platte, Colorado, and Sacramento-San Joaquin. ESA-driven crises implicating municipal water supplies, in particular, are guaranteed to get attention. Municipal water users also have the advantage of being able to bring money to the table. In California, for example, the biggest single user of water from the State Water Project is the Metropolitan Water District (MWD),[32] which provides drinking water to urban southern California. MWD's money and political power give it far more ability to shake loose public money than alfalfa growers have.

Crises can also encourage investment in or distribution of technology that makes conflicts easier to resolve. In recent years, it has become much easier to monitor water use, model systems,

31. *See, e.g.*, David H. Getches, *The Metamorphosis of Western Water Policy: Have Federal Laws and Local Decisions Eclipsed the States' Role?*, 20 STAN. ENVTL. L.J. 3, 59 (2001).

32. MWD's maximum entitlement to State Water Project water is more than 2 million acre feet, nearly half of the project's total annual delivery. Cal. Dep't of Water Resources, *State Water Project Contractors*, http://www.publicaffairs.water.ca.gov/swp/pdf/contractors.pdf.

and provide the data necessary to adjust water operations in real time. New technology makes water transactions technically easier and can sometimes identify situations in which the gains to winners so dominate the losses that compensation can eliminate political opposition. But not all systems have win-win solutions, and not all losses are compensable with money. For example, one option for the Delta is to deliberately flood some farmlands to reduce threats to other, more developed lands. That would make economic sense, but the farmers who stand to lose their land do not see the trade-off entirely in economic terms. They view themselves as the victims of societal oppression and environmental injustice.[33]

Western water crises have brought attention to stressed systems, reduced the political dominance of the status quo, and brought substantial new funding in some cases. However, it is not yet clear that such crises can catalyze sustained change. As motivators, these particular crises are both too weak and too strong. They are too weak in the sense that flood and drought ebb and flow in the west. Neither persists year after year, although drought seems to be getting more common in some locations. Water crises tend to be short-lived, which plays into our natural tendency toward policy attention deficit disorder. Where policy fixes take time, which is inevitably the case if they entail revision of established property rights institutions, crises that come and go with the seasons are not effective drivers. This is abundantly obvious to anyone who (like one of the authors) lives in the Sacramento area, where developers are racing to build homes in the historic flood plain even though it is clear that future floods will come more often and spread further than they did historically.

On the other hand, water crises are too strong as motivators in the sense that they can prompt overreaction to the point that human interests override any concern for the environment. When ESA protection of the Rio Grande silvery minnow appeared to stand in the way of Albuquerque's drinking water supply, political reaction was swift. Even though the diversions in question actually went almost entirely to low-value agriculture, Congress issued an appropriations rider ordering the Bureau of

33. Dan Tarlock has explored the new willingness of rural, resource-economy communities to present themselves as the new victims of societal overreaching. A. Dan Tarlock, *Can Cowboys Become Indians? Protecting Western Communities as Endangered Cultural Remnants*, 31 ARIZ. ST. L.J. 539 (1999).

Reclamation not to reduce deliveries to protect the fish.[34] It is politically easier, this example suggests, to allocate water away from the environment than away from any human user.

When crises do motivate change, they typically do so from one static paradigm to a new but equally static one. In other words, law and institutions typically jump from one rut to another. Transitions are not typically well planned. They happen only when it becomes impossible to ignore the misfit between law and societal goals. At that tipping point, change happens rapidly but haphazardly, along the path of least resistance. It is not encouraging that forty years of water law reform and water project reoperation have brought little progress toward a viable balance between environmental integrity and human water use. As David Getches has pointed out, we have a remarkable history of getting water decisions wrong even when we knew better.[35] By and large, as we have moved (slowly) through water regime transitions, we have failed to learn from the past, we have focused on increasing water supply to the exclusion of other potential solutions, and we have continually insisted on defying nature and common sense.

The historical record is bad enough, but our efforts to respond to global warming are likely to be even clumsier. Belatedly jumping from one rut to another is not the worst strategy if the new paradigm is likely to be a good fit for a substantial period. In the case of climate change, though, that is far from assured. Uncertainty about future, and even current, conditions complicates efforts to find the best rut. Furthermore, since a new climatic equilibrium is unlikely to develop quickly, no single rut is likely to prove a comfortable fit for very long.

VIII.
CAN CREATURES WHO CRAVE STABILITY DEAL WITH CHANGE?

The fundamental challenge for adapting to climate change is to balance our craving for stability with an adequate level of responsiveness to change. We don't mean to be unduly pessimistic. The last several years have seen some exciting changes in western water distribution, albeit not without an enormous amount of liti-

34. Pub. L. No. 108-137, § 208(a), 117 Stat. 1827, 1849-50 (2003).

35. David Getches, *Water Wrongs: Why Can't We Get It Right the First Time?*, 34 ENVTL. L. 1 (2004).

gation and conflict. Substantial flows have been restored to the Trinity River in northern California, which was once almost entirely diverted to Central Valley agricultural use. The San Joaquin River should soon have year-round water below Friant Dam for the first time in fifty years. New systems have been put in place to limit the proliferation of small diversions from the Columbia River system. State water institutions have become marginally more nimble in terms of accommodating instream flows and recognizing the connections between rivers and groundwater. In some places (notably California and Arizona) developers now must identify "wet" water available to serve the long-term needs of future homeowners before building homes.[36]

Despite these hard-won advances, it remains difficult to change water allocation or the beneficiaries of water project operations, and nearly impossible to do so on a continuing basis. Although it was recognized more than a decade ago that water institutions need to be capable of adapting to changing conditions in systems where highly stressed ecosystems serve the fundamental needs of sizable human communities, the results of attempts to develop such institutions are sobering – even without the added complication of rapid climate change. Despite a series of high-profile, well-funded efforts, we have yet to come up with a successful model for reducing conflict, satisfying the variety of water needs, or allowing waterways to behave in a dynamic way.

The latest news from the Sacramento Delta is particularly sobering. Ten years ago, there was great optimism about the ability of the CALFED experiment in state-federal cooperation to reverse the pattern of ecosystem decline and rescue human stakeholders from a seemingly endless cycle of litigation.[37] Today, both CALFED and the Delta itself are in crisis. The brief CALFED truce dissolved as win-win solutions failed to materialize and federal and state funding commitments eroded.[38] Mean-

36. The California law may have claimed its first victim in January 2008, when a large development project in Riverside County was put on hold because the local water agency could not promise to supply it with water. Deborah Schoch, Enforcing Recent Water Laws May Throttle State's Growth, L.A. Times, Jan. 14, 2008, at B1.

37. For a history of the creation of CALFED by one of the major participants, see Elizabeth Ann Rieke, *The Bay-Delta Accord: A Stride Toward Sustainability*, 67 U. COLO. L. REV. 341 (1996). For a more recent account of the novelty of CALFED's structure and functioning, see Jody Freeman & Daniel A. Farber, *Modular Environmental Regulation*, 54 DUKE L.J. 795, 837-76 (2005).

38. Lund et al., *supra* note 9, at 87-89 (describing the recent woes of CALFED).

while, the ecosystem seems more vulnerable than ever,[39] and the causes of its decline remain poorly understood. Litigation is once again the order of the day. In the highest profile lawsuit, a federal court has caused panic among water users by ruling first that the federal permit allowing incidental take of the Delta smelt was invalid,[40] and later that Delta pumping must be reduced between December and June, by an amount that is not yet clear.[41]

In one sense, climate change provides a new opportunity to tackle the existing challenge of water management. Although climate change appeared to have little political traction in the United States just a few years ago, that has turned around. Climate change is now a high-profile problem that worries people nationwide. Because of its broad geographic sweep, and because it is likely to remain observable year after year, climate change may be a more effective goad to institutional evolution than the traditional cycle of droughts and floods.

If we are to take advantage of this opportunity, we must keep two things in mind. First, we must recognize the enormity of the challenge. Creating adaptable institutions requires that we overcome both human nature and history. It will take dedicated people willing to work hard at a thankless task for a long time. It will take courageous leadership, and the ability to direct significant resources in directions that will necessarily be, at least in the

39. Surveys conducted in the spring of 2007, for example, located fewer Delta smelt, a federally threatened species, than ever recorded, only 7% as many as the average for 2000-2006. *Briefing Statement from Delta Smelt Working Group to U.S. Fish and Wildlife Service* (May 15, 2007), *available at* http://www.fws.gov/sacramento/es/documents/ds_working_group/DSWG_Briefing_Statement_15May07.pdf. Several other native fish species "are also in steep decline." Robert F. Service, *Delta Blues, California Style*, 317 SCI. 442, 443 (2007).

40. Order Granting in Part and Denying in Part Plaintiffs Motion for Summary Judgment, *NRDC v. Kempthorne*, No. 1:05-CV-01207 OWW (TAG) (May 25, 2007), *available at* http://www.earthjustice.org/library/legal_docs/decision-on-delta-smelt-biop.pdf. The court's latest order requires that federal officials produce a new biological opinion by September 2008 and in the meantime mandates enhanced monitoring for Delta smelt and reductions in pumping to ensure favorable flows at key times. Interim Remedial Order Following Summary Judgment and Evidentiary Hearing, *NRDC v. Kempthorne*, No. 1:05-cv-1207 OWW GSA (Dec. 14, 2007), *available at* http://www.earthjustice.org/library/legal_docs/delta-smelt-final-remedy-order.pdf. The Department of Water Resources estimates that compliance with the order will cut water deliveries anywhere from 7 to 30%. Department of Water Resources, Advisory (Dec. 24, 2007), *available at* http://www.water.ca.gov/news/newsreleases/122407wanger.pdf.

41. James Ricci & Eric Bailey, *Smelt Ruling May Cut Into Water Supply*, L.A. TIMES, Sept. 1, 2007.

short run, painful. It seems certain that we will eventually move out of our current institutional rut, which dedicates the lion's share of western water resources to low-value agriculture. There will be enough water in the West for municipal and industrial use once the dominance of agriculture is, as it inevitably will be, overcome. That initial change is unlikely to be easy or pleasant, and it will be only the beginning of a difficult path.

The longer term challenge will be to find suitable new ruts for short-term journeys, knowing that we will need to jump fairly quickly to others, but not knowing where those others will lead. We will need to create institutions that anticipate and accommodate change effectively. One aspect of that will have to be paying more systematic attention to detecting change, and establishing its direction, as early as possible. That means overcoming historic resistance to dedicating long-term funding to monitoring, including not only data collection but also data analysis and interpretation.

We have to acknowledge at the outset that flexible institutions inevitably carry significant costs. Insecurity will inhibit new investment, for better and for worse. Flexible regulatory systems always carry the risk of exploitation in favor of concentrated political interests; making them work for the environment will require constant vigilance. At best, a shift to more adaptive regulatory environments will commit us to an unending roller coaster ride. It is an attractive option only if there is no other viable choice, but unfortunately that seems to be the case.

Second, we must recognize that the root of the problem is not climate change or any other dynamic feature of the physical environment. The root of the problem is humans – where we choose to live and what we do to the landscape. Climate change is one more stress superimposed on a system already overtaxed by population growth, urbanization and economic development. A category five hurricane in the Gulf Coast would not be a disaster without people, homes, and vulnerable levees in its path. Our need for stability in nature is directly proportional to the size and inflexibility of our footprint on the land. Once we allow people to become dependent on the stability of land and water systems, the barriers to reintroducing flexibility quickly become almost insurmountable. We are simply not going to allow taps to go dry.

Yet our footprint continues to grow. Western communities continue to bring people to areas where water is sharply limited. If we learn only one lesson from the threat of climate change, it

should be that the natural infrastructure on which we depend is sufficiently vulnerable, and already sufficiently stressed, that we must limit new demands on it. The best way to allow for adaptability in the future is to limit our demands on the system now.

It might seem that explicitly introducing the prospect of dramatic future change into our governance systems now would protect us against developing unsustainable reliance on inevitably dynamic natural systems. History suggests otherwise, however. No matter how loudly we tell ourselves that when water resources become limited we will leave people high and dry, when push comes to shove that is not likely to happen. We continually bail people out of disasters of their own making because it is simply too hard to watch them suffer. If we allow people to become dependent on limited water systems, the end result will be that those human claims will override the needs of fish and aquatic ecosystems.

IX.
CONCLUSION

Because we have burned fossil fuels at an unsustainable pace, we are now faced with the unavoidable task of adapting to the climate changes we have set in motion. Western water distribution provides one example of how crucial, and how difficult, adaptation will be. Allowing either nature or our governance institutions to function in a dynamic manner runs counter to longstanding commitments to stabilize investments and communities. Development of more adaptive institutions will require focused attention and substantial resources. At the same time, recognizing the need for future adaptation should counsel the immediate adoption of serious limits on the continued growth of water-limited western communities. We doubt that such limits will be imposed, however. History shows how difficult it is for people to recognize limits before a crisis hits. We realize that we have painted a pessimistic picture, but we believe it is a realistic one, and that the challenge cannot be met unless its magnitude is recognized.