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**PPIC REPORT: ENVISIONING FUTURES FOR THE
SACRAMENTO-SAN JOAQUIN DELTA, SUMMARY**

ENVISIONING FUTURES

FOR THE SACRAMENTO–SAN JOAQUIN DELTA

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Foreword

It is telling that Hurricane Katrina would send a warning sign to California—in part because California is generally regarded as a hot bed of natural disasters. Fires, floods, and earthquakes rake the state with a frustrating regularity. Yet this is exactly what happened: Devastation in the South alerted those of us in the West to yet another potential disaster. As Californians turned outward to meet the needs of former residents of the Gulf region, especially those unfortunate enough to have lived in the lower-lying neighborhoods of New Orleans, state policymakers turned inward and realized that the Sacramento Delta held the same loss potential from a major earthquake as New Orleans had experienced from a hurricane.

Ellen Hanak, research fellow and director of the Economy Program at PPIC, and a team of experts from the University of California, Davis, decided to explain the vulnerability of the Sacramento–San Joaquin Delta and to lay out a series of options for addressing current and likely future problems. This report, *Envisioning Futures for the Sacramento–San Joaquin Delta*, describes why the Delta matters to Californians and why the region is currently in a state of crisis—from threatened freshwater supplies for the whole state to the potential extinction of numerous fish species. After reviewing years of policy studies on the Delta, as well as delving into the most updated ecological information, the authors conclude that the future requires a “vision of a variable Delta, as opposed to the commonly held vision of a static Delta.” The strategy of rigorously preserving a freshwater Delta has been risky and expensive. Instead, the authors present a case for a future approach that “yields the best outcomes overall, accompanied by strategies to reasonably compensate those who lose Delta services.”

Nine alternatives are presented across three objectives—maintaining high levels of fresh water, allowing the Delta to fluctuate between high and low levels of salinity, and moving toward a Delta that provides high levels of fresh water as needed. The authors carry out an initial summary evaluation of all nine alternatives and provide a rationale for their assessment of each one. The report does not endorse any single “best” solution among these alternatives. As the authors note, a closer look at the details will be required before the best strategy can be decided on.

However, they suggest that a hybrid solution, relying on some combination of key elements, may provide the most promising path forward.

In this spirit, the report offers a number of new ideas for managing the Delta and presents a set of central themes for ways to think about the future of the region. The most striking of these themes is that business as usual is unsustainable for current stakeholders. The combined effects of continued land subsidence (that is, sinking land elevations), sea level rise, increasing seismic risk, and worsening winter floods make continued reliance on weak Delta levees imprudent and unworkable over the long term. In very strong language, the authors conclude that significant political decisions will be needed to make major changes in the Delta. Incremental, consensus-based solutions are unlikely to prevent a major ecological and economic catastrophe of statewide significance.

The report concludes with recommendations for several actions—some related to the use of technical and scientific knowledge and others to the design of governance and finance policies. Most important, the authors identify a number of urgent items for debate and policy action. With a substantial base of empirical evidence and a considered assessment of the options, the report is not alarmist—but it does make a strong case that California’s future water supply is in serious jeopardy unless the problems of the Sacramento–San Joaquin Delta are dealt with in a thoughtful and timely fashion.

David W. Lyon
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Summary

“One gains nothing . . . by starting out with the question, ‘What is acceptable?’ And in the process of answering it, one gives away the important things, as a rule, and loses any chance to come up with an effective, let alone with the right, answer.”

Peter F. Drucker (1967), The Effective Executive

California’s Delta Crisis

The Sacramento–San Joaquin Delta is the hub of California’s water system, home to a unique ecosystem and to a diverse recreational and agricultural economy. Management strategies for the Delta that satisfy these often competing interests have been discussed and debated for almost 100 years, at times leading to acrimonious divisions between Northern and Southern California, environmental and economic interests, and agricultural and urban water users. Recently, the Delta has again taken center stage in debates on California water policy, with broad implications for statewide environmental, land use, and flood control policies. The Delta is widely perceived to be in crisis in several ways.

One dimension of the crisis is the health of the Delta’s 1,100 miles of levees, on which both Delta land use and water supply systems depend. The devastating effects of Hurricane Katrina on New Orleans’ levees galvanized public attention on the fragility of the Delta’s levee system, where close calls occur with some frequency and where a major levee break occurred in June 2004. Continued sinking of Delta islands, sea level rise, and likely increases in the severity of flooding make the Delta’s fragile levee network increasingly vulnerable to failure from earthquakes, floods, and other causes.

Long-term increases in these risk factors make the current reliance on Delta levees appear imprudent and unsustainable. Over the next 50 years, there is a two-thirds chance of a catastrophic levee failure in the Delta, leading to multiple island floodings and the intrusion of seawater. For one such scenario, the Department of Water Resources estimates that a

large earthquake near the Delta would cause major interruptions in water supplies for Southern California, the San Joaquin Valley, and the Bay Area, as well as disruptions of power, road, and shipping lines, costing the state's economy as much as \$40 billion. Such failures also would create major environmental disruptions and local flooding risks.

A second aspect of the crisis is the health of Delta fish species. In the fall of 2004, routine fish surveys registered sharp declines in the numbers of several open-water (pelagic) species, including the delta smelt, already listed as threatened under the federal and state Endangered Species Acts. Subsequent surveys have confirmed the trend, raising concerns that the smelt—sometimes seen as an indicator of ecosystem health in the Delta—risks extinction if a solution is not found quickly.

The third dimension of the crisis is institutional. The framework known as CALFED—a stakeholder-driven process established in the mid-1990s to mediate conflict and to “fix” the problems of the Delta—is facing a crisis of confidence. Although the levee and ecosystem problems noted above are partly to blame, CALFED has also been criticized for failing to elicit anticipated funding commitments. As the CALFED truce erodes, lawsuits are beginning to fill the gaps left by a lack of consensus on management strategies and options. Some of these conflicts reflect a renewal of old battle lines, pitting water exporters against environmental interests and those who use water within the Delta. But new battle lines have also emerged over the urbanization of Delta farmlands and the issue of levee stability. The pressures to develop the Delta's flat, low-lying lands are great, given their location near transportation corridors and several major metropolitan areas. Yet many concerns are being raised about the consequences for flood risk, ecosystem health, and water quality. Moreover, the prospect of levee failure raises concerns about the potentially great financial liabilities facing California's taxpayers, given the state's role in managing the Delta and its many miles of levees.

Responding to the Crisis

Recognition of the crisis in the Delta has led to appeals to pursue a number of very different management strategies. The collapse of key Delta fish populations has prompted some environmentalists to call for cutbacks in water exports. At the same time, two main proposals have surfaced

for dealing with levee instability: massive investments in the levee system (creating, in a sense, the “Fortress Delta” we discuss below) or construction of a peripheral canal at the Delta’s edge, to protect urban and agricultural interests from what many now view as the unacceptable risks of continued reliance on direct Delta exports. The resurgence of a peripheral canal proposal is significant, because it is a solution that has deeply divided Californians in the past.

As an immediate response to concerns over the health of the levee system, the state significantly increased the budget for levee repairs in 2006, and two bond measures passed in November 2006 allocate additional funds for flood control in the Delta. But there is as yet no broader plan for responding to the crisis in the Delta, including how the bond funds should be spent. Such a plan may emerge from several efforts now under way. Two technical studies are examining the causes of the pelagic organism decline and the risks to the levee system. Two policy-driven efforts are charged with looking at long-term management options. The Delta Vision effort, launched by the governor in the fall of 2006, is to develop a strategic plan for sustainable use of the Delta, in conjunction with a broad range of stakeholders and an independent Blue Ribbon Task Force. During 2007, the CALFED program must also propose alternative management strategies to meet its water and environmental goals for the Delta.

We hope that this study enriches both policy and technical discussions of the Delta’s future. Our aim is to begin a serious, scientific search for and comparison of potential long-term solutions for the coming decades. We purposely take a broader view of the options than those commonly under discussion in stakeholder circles—namely, the Fortress Delta, the peripheral canal, and the maintenance of the current levee-centric strategy with lower water export volumes.

The task at hand is urgent, and the stakes in the Delta are high. If California fails to develop a viable solution and act on it soon, we risk the loss of native species and important ecosystem services—and face significant economic disruptions. Yet there is also a risk that the political process will prematurely close off the consideration of options that could help California make the most of the Delta while protecting its unique ecosystem and species.

New Thinking About Solutions for the Delta Ecosystem

For the past 70 years, the state's policy has been to maintain the Delta as a freshwater system through a program of water flow regulation, supported by maintenance of agricultural levees. This strategy improved water quality for Delta agriculture and water exports and was assumed to protect both native and desirable alien species (particularly striped bass). But most such species have not done well under this policy. Native species have declined considerably, and some—including the delta smelt—continue to decline, even to the verge of extinction. Although recent work suggests that export pumping is having a negative effect on several key Delta species, more freshwater inflows or reduced exports alone are unlikely to save these species because the highly altered nature of the aquatic ecosystem is part of the problem.

Before the Delta was drained, diked, and settled by Europeans, it was subject to significant seasonal and interannual fluctuations in freshwater inflows, which worked in concert with large tidal ranges. Some parts of the northern, eastern, and southern Delta were largely fresh at all times. However, the western Delta was seasonally brackish and the central Delta was brackish in the dry seasons of dry years. This was the flow and water quality regime to which many native Delta species are adapted. The invasion of numerous alien species, both as deliberate introductions and as by-products of human activities, has created many problems. Many of these invasive species are better adapted than the natives to the highly altered environment that the Delta has become.

To address the problems of the Delta's native species, a fundamental change in policy is needed. A Delta that is heterogeneous and variable across space and time is more likely to support native species than is a homogeneously fresh or brackish Delta. Accepting the vision of a variable Delta, as opposed to the commonly held vision of a static Delta, will allow for more sustainable and innovative management. This is a legal and political necessity as much as it is an ecological one. Many aspects of Delta water and land management, from export operations to levee maintenance, are significantly affected by a number of federal and state environmental

laws. These laws form a significant constraint on any future management strategy of the Delta.

Facing the Tradeoffs

A comprehensive solution for the Delta also needs to take into account goals for the human use of Delta resources—including land use and water supply and quality. But a change in thinking is necessary, particularly in terms of the ability to satisfy all goals simultaneously. The approach adopted by CALFED in the mid-1990s was that “everyone would get better together,” and it was assumed that this could be achieved by managing the Delta as a single unit, simultaneously achieving improvements in habitat, levees, water quality, and water supply reliability. Going forward, Californians will need to recognize that the Delta cannot be all things to all people. Tradeoffs are inevitable. The challenge will be to pursue an approach that yields the best outcomes overall, accompanied by strategies to reasonably compensate those who lose Delta services.

Some Alternatives

With this in mind, we consider nine alternative approaches to a comprehensive solution for the Delta’s problems. This list is not exhaustive; a near-infinite number of alternatives exist for managing the Delta. However, these nine alternatives allow us to explore a variety of very different approaches in light of recent understanding of the dilemmas, vulnerabilities, and possibilities for Delta water and land management. Some of these alternatives have been under consideration at various times in the past; others are relatively new. Most seek a “soft landing” from the Delta’s current severe disequilibrium and vulnerability.

Three of these alternatives would maintain the Delta as a freshwater body, either by relying on current strategies or by building stronger systems. A second group of alternatives would manage the Delta as a more complex and fluctuating mosaic of uses, supporting water supply exports with peripheral or through-Delta aqueducts. A final group would reduce overall dependence on the Delta, or potentially abandon the Delta altogether. All nine alternatives are outlined below.

Freshwater Delta Alternatives

All three freshwater Delta alternatives would aim to maintain the Delta as a homogeneous freshwater body, continuing policies begun in the 1930s. Levees, outflows, and perhaps barrier structures would be the primary way to control Delta salinity.

1. **Levees as Usual.** The current levee-intensive system would be maintained at recent levels of effort or modestly upgraded to meet federal standards for agricultural levees. Water exports would continue to be pumped through the Delta. Levee failures would occur with increasing frequency.
2. **Fortress Delta.** “Whatever it takes” investments would be made to support or fix levees deemed strategically important for urban areas, infrastructure, and water supply exports. To contain costs, the total length of the levees in the system would be shortened, reconfiguring some islands. Lower-reliability levees (mainly in the interior of the Delta) would be allowed to fail.
3. **Seaward Saltwater Barrier.** A permanent or movable barrier would be erected at the western edge of the Delta. This is one of the oldest and most extreme proposals for keeping salt water at bay, but it has recently reemerged because Dutch engineers have suggested the construction of a large movable barrier, similar to the Maeslant storm surge barrier that protects Rotterdam in The Netherlands.

Fluctuating Delta Alternatives

In all three of these alternatives, environmental conditions, especially salinity, would be allowed to fluctuate in the western Delta to improve habitat conditions for native fish species. Urbanization would be possible along the Delta’s periphery behind strong levees.

4. **Peripheral Canal Plus.** An aqueduct would be constructed from the vicinity of Hood, on the Sacramento River, south along the Delta’s eastern edge, sending water exports to Clifton Court Forebay. This would allow water exports to circumvent the Delta and yet continue to meet the Central Valley Project and State Water Project intakes that send water to other regions of the state. This proposal augments the traditional peripheral canal proposals with special operations,

investments, and activities for environmental and other in-Delta land and water uses (hence the “plus”).

5. **South Delta Restoration Aqueduct.** This aqueduct would be similar to the peripheral canal mentioned above, but its major outlet would enter the lower San Joaquin River. These supplemental freshwater flows would resolve various water quality and flow problems of the lower San Joaquin River and the southern Delta while improving the quality of water exports and reducing entrainment of native fish at the pumps. Some flows could be channeled into a wetland and flood bypass channel through the southern Delta, contributing to improved habitat and agricultural water quality. In-Delta investments would be made for environmental and other in-Delta uses.
6. **Armored-Island Aqueduct.** By armoring select islands and cutting off or tide-gating various channels within the central-eastern Delta, a major, semi-isolated freshwater conveyance corridor for water exports would be created. Various versions of this approach have been considered since the 1950s.

Reduced-Exports Alternatives

These alternatives rely neither on new Delta export facilities nor on levees. However, they imply an ability to greatly modify the pattern and quantity of Delta exports.

7. **Opportunistic Delta.** Only opportunistic seasonal exports would be allowed, during times of high discharge of fresh water from the Delta (generally winter and spring). Export pumping capacities would be expanded to accommodate these high pumping periods, and some surface storage within and near the Delta may be built. Salinity levels would fluctuate in the western Delta, and many islands would eventually become flooded. Urbanization would be possible along the Delta’s periphery, behind strong levees.
8. **Eco-Delta.** The Delta would be managed as a single, unified entity to favor key Delta aquatic and terrestrial species. Water extraction, transportation corridors, and other functions would be maintained as long as they do not interfere with rehabilitation goals. Some

water exports would occur but less than in the Opportunistic Delta alternative.

9. **Abandoned Delta.** A planned, multidecade retreat from the Delta would occur, with the phasing out of much of the Delta’s farm economy. Water exporting agencies would transition to alternative water sources and would increase water use efficiency.

Our evaluations of these alternatives suggest some promising solutions. A summary of our evaluations appears in Table S.1, along with a summary of our rationale. The intent of our analysis is to eliminate unpromising long-term directions for the Delta and point to some promising approaches, focusing the limited available attention, talent, and resources on those more likely to be successful over time. However, detailed knowledge and analysis will be needed before the identification of a single “best” alternative can be justified.

We find that the first three alternatives, which strive to preserve the Delta as a homogeneous freshwater body, feature unpromising environmental performance at great financial expense, even though some of them would secure substantial quantities of fresh water for export and use within the Delta. In particular, the current approach to managing the Delta—with moderate reinforcement of existing levees and net Delta outflows to keep the Delta fresh—prolongs its risks and vulnerabilities, which are likely to increase over time. Temporary or permanent in-Delta improvements for agricultural and urban land users do not overcome these drawbacks.

The second set of alternatives, which allow for local specialization and variability in the Delta, seem promising and worthy of more detailed development and consideration. These alternatives are built around very different approaches for supporting water exports. In-Delta agricultural and urban users could both see benefits from levee strategies within these alternatives. Although elements of these alternatives will be familiar to many who know something about Delta water policy and politics, each one has some fundamental differences from earlier proposals.

The final set of alternatives modifies current export policies to gain the flexibility to achieve other objectives. At the extreme is the abandonment of the Delta for most purposes. The argument for this strategy is that if the Delta is unreliable and vulnerable, then it might be best to reconfigure state

Table S.1
Summary Evaluation of Alternatives

Alternatives	Summary Evaluation	Rationale
Freshwater Delta		
1. Levees as Usual—current or increased effort	Eliminate	Current and foreseeable investments at best continue a risky situation; other soft landing approaches are more promising; not sustainable in any sense
2. Fortress Delta (Dutch standards)	Eliminate	Great expense; unable to resolve important ecosystem issues
3. Seaward Saltwater Barrier	Eliminate	Great expense; profoundly undesirable ecosystem performance; water quality risks
Fluctuating Delta		
4. Peripheral Canal Plus	Consider	Environmental performance uncertain, but promising; good water export reliability; large capital investment
5. South Delta Restoration Aqueduct	Consider	Environmental performance uncertain but more adaptable than Peripheral Canal Plus; water delivery promising for exports and in-Delta uses; large capital investment
6. Armored-Island Aqueduct	Consider	Environmental performance likely poor unless carefully designed; water delivery promising; large capital investment
Reduced-Exports Delta		
7. Opportunistic Delta	Consider	Expenses and risks shift to importing areas; relatively low capital investment; environmental effectiveness unclear
8. Eco-Delta	Consider	Initial costs likely to be very high; long-term benefits potentially high if Delta becomes park/open space/endangered species refuge
9. Abandoned Delta	Eliminate	Poor overall economic performance; southern Delta water quality problems; like Alternative #1, without benefits

water, environmental, and land use policy to minimize the importance of this unreliable partner. However, we find that the environmental outcome of abandoning the Delta would be poor, because the Delta would not return to anything like its pre-European condition. Moreover, the economic costs for agricultural and other water users would be extreme, on the order of \$1.2 billion per year. However, in this group of options, the alternatives that alter export patterns to add fluctuations and improve environmental performance show some promise and merit further consideration.

Adapting to Change

No alternative will be ideal from all perspectives, and some would preclude certain current uses of the Delta entirely. Our analysis suggests that alternatives seeking to maintain the entire Delta as a freshwater system—along the lines of the current levee-centric policy—are incompatible with giving the Delta’s native species a fighting chance to survive and prosper. The levee-dependent freshwater alternatives are also the least compatible with the drivers of change currently acting on the Delta, including land subsidence (sinking land elevations), sea level rise, regional climate change, and increased seismic risk, all of which are increasing the risk of levee failure.

Changes in the Delta will have significant costs and cause some dislocations. However, most users of Delta services have considerable ability to adapt economically. As a result, costs and dislocations, if properly managed, should be modest from a statewide perspective. Mitigation should be used to ease adjustment costs. Because they have nowhere else to go, the most vulnerable users of the Delta are those native species that rely on it for survival.

New Ideas for Managing the Delta

Although our analysis draws on the long history of thinking about management options for the Delta, it includes several relatively new ideas.

- **Creating localized Delta specialization.** Traditionally, policymakers have sought to treat the entire Delta homogeneously. Allowing different parts of the Delta to specialize in particular functions or

services may make for greater overall sustained performance for all, or almost all, purposes. Spatial and temporal variability in flows, water quality, and habitat was common in the pre-European Delta.

- **Establishing a western Delta fluctuating-salinity ecosystem.** Western Delta salinity appears to have naturally fluctuated more in the past than it does now; reintroducing this fluctuation in parts of the western Delta might benefit native and desirable alien species.
- **Using peripheral areas, such as Suisun Marsh and Cache Slough, to bring back desirable natural conditions that existed in the Delta historically.** These are especially promising examples of locations that could serve valuable environmental functions.
- **Allowing the urbanization of some Delta lands.** Local land use pressures, access to major transportation and employment centers, and financial opportunities make urbanization of some Delta lands seemingly inevitable, despite high risks of flooding. Urbanization has significant potential to contribute financially and politically to solving problems in the Delta. Careful regulation should be able to provide sufficient flood protection and prevent urbanization from unreasonably interfering with environmental functions.
- **Building a Sacramento–San Joaquin Canal (Alternative #5).** Such a canal would supplement lower San Joaquin River flows with Sacramento River water to provide water near export pumps. It would simultaneously improve lower San Joaquin River and southern Delta freshwater quality and availability. This canal would provide larger supplemental flows to the San Joaquin River than earlier peripheral canal proposals.
- **Creating a San Joaquin River marsh and flood bypass.** As part of the Sacramento–San Joaquin Canal alternative, such a system would provide additional habitat for fish and wildlife, water quality improvements for southern Delta farmers, and flood bypass capacity for the lower San Joaquin River.
- **Managing expectations and providing mitigation alternatives.** It is unlikely that any Delta solution can satisfy all Delta interests in terms of water and land use. This approach differs from the underlying assumption of CALFED that all Delta interests could “get better together.” Stakeholders whose land and water interests

cannot be directly satisfied may be compensated by financial or other means. Even with such mitigations and compensations, one cannot reasonably expect universal satisfaction.

Conclusions

This report has five major conclusions:

1. The current management of the Delta is unsustainable for almost all stakeholders. The combined effects of continued land subsidence, sea level rise, increasing seismic risk, and worsening winter floods make continued reliance on weak Delta levees imprudent and unworkable over the long term.
2. Recent improvement in the understanding of the Delta environment allows for more sustainable and innovative management. Seeing the Delta as a functioning ecosystem with fluctuating flows and salinity, as it once was, allows us to think of new solutions to the Delta's problems.
3. Most users of Delta services have considerable ability to adapt economically to risk and change. Water and land users have a wide variety of adaptive responses, which, although sometimes costly, do allow them to adjust. Moreover, users of the Delta also have a history of responding to change; many are already adapting in anticipation of worsening problems in the Delta.
4. Several promising alternatives exist to current Delta management. The situation is far from hopeless. A sustainable, prosperous Delta economy and society can be built while providing water and other services statewide.
5. Significant political decisions will be needed to make major changes in the Delta. Incremental, consensus-based solutions are unlikely to prevent a major ecological and economic catastrophe of statewide significance.

Recommendations

We recommend several actions and activities.

1. **Create a technical track for developing Delta solutions.** Most recent attempts to solve the Delta's problems have been politically driven. Agencies and other stakeholders have sought to negotiate solutions based on what is politically acceptable, but this approach has not led to acceptable or workable solutions. Despite improvements in our understanding of the Delta ecosystem and the economy of California, little in the way of new solutions or approaches to the Delta has been developed or proposed. Now we are all "getting worse together." The political track of any Delta solution is necessary, but it can be better informed by a technical track, which can develop new solutions and adapt older solutions to current and future conditions. There is strong historical precedent for this: In 1911, the California Debris Commission provided such a service, suggesting effective long-term solutions for the Sacramento Valley flood control problems.
2. **Establish an institutional framework to support the development of solutions and to bring scientifically and economically promising alternatives to the attention of political authorities.** This activity needs to take a long-term view and avoid crisis-driven responses to short-term political thinking. It should have some political independence, an appropriately sized budget, the technical capability to creatively and competently explore and eliminate alternatives, and the management capability to direct multidisciplinary research and development. CALFED was supposed to have these abilities, but its direction, funds, and energy became dissipated in politics and the effort to please all stakeholders. Current technical efforts examining both the pelagic organism decline and the risks to Delta levees focus rather narrowly on specific aspects of the Delta's problems. Current policy efforts—including the Delta Vision process—lack a substantial technical component. Technical and policy endeavors need some independence within a larger framework.
3. **Launch a problem-solving research and development program.** The science effort regarding the Delta needs an overhaul. The Delta is a multidisciplinary problem, not a research topic with a single focus. Much past research on the Delta and its problems has been associated with agency data collection or basic academic and disciplinary research. A directed problem-solving research and development

program aimed primarily at developing and informing the analysis of promising solutions is needed. This program would include some basic research, but most effort would be aimed at developing and evaluating solutions. Ecosystem adaptive management experiments (supported by quantification and computer modeling), levee replacement, island land management, flood control, and integrative system design would receive greater attention in a problem-solving framework.

4. **Consider the Delta's water delivery problems in a broad context.** The foremost physical problem in the Delta is delivery of fresh water through or around the Delta. And some promising solutions exist. Potential options extend beyond the peripheral canal. However, physical solutions for water delivery must be accomplished in the broader context of developing a more sustainable Delta environment.
5. **Eliminate some solutions to the Delta's water delivery problems from further consideration.** To reduce investments of scarce time, expertise, and resources in evaluating Delta alternatives, some unpromising options should no longer be considered. These include the current levee-centric approach, the building of a downstream physical barrier to seawater, the large expansion of on-stream surface water storage, and the idea of ending all water exports. These are unreasonable solutions and they perform so poorly in economic and environmental terms as to be nonviable.
6. **Approach the Delta as a diverse and variable system rather than as a monolith.** A diversified and variable Delta by design is likely to perform better than the freshwater Delta that has been artificially maintained over the last 60 years. Better solutions are likely to emerge if the Delta is not treated homogeneously. Historically, the Delta naturally contained diverse habitats that varied across years, seasons, and tidal cycles in terms of salinity, water velocity, water clarity, elevation, and other physical habitat conditions. Reintroducing and extending this diversity, by specializing parts of the Delta for wildlife habitat, agriculture, urbanization, recreation, water supply, and other human purposes seem promising.
7. **Give direct beneficiaries primary responsibility for paying for Delta solutions.** Public funds, such as those raised through general

- obligation bonds, should be reserved for the truly public components of a Delta investment program, such as ecosystem restoration and mitigation for those who lose out. Failure to develop an effective funding mechanism will result in financial catastrophes for state and local interests in the future, especially in the wake of a natural disaster.
8. **Establish mitigation and compensation mechanisms to support the implementation of any alternative.** Not all parties will get what they want or what they have been used to getting from the Delta. In some cases, providing money or alternative land might compensate for changing or eliminating uses of water or land that would hinder broad progress.
 9. **Create stronger regional and statewide representation in Delta land use decisions.** The current institutional fragmentation of land use authorities in the Delta fosters piecemeal decisionmaking that will compound flood risks, irreversibly destroy valuable wildlife habitat, and deteriorate water quality. Regional and statewide interests should be more forcefully represented in Delta land use decisions, to protect the value of the Delta both for the region's residents and for the broader public. The Delta needs a strong regional permitting authority, along the lines of the San Francisco Bay Conservation and Development Commission or the Coastal Commission.
 10. **Make essential emergency preparedness investments.** Although it is premature to choose a long-term solution for the Delta without further technical investigation, California can take steps in the short term. All agencies relying on Delta waters should develop extended export outage plans through regional interties, water sharing arrangements, and other measures. Other infrastructure providers also need contingency plans. A program for the rapid repair of critical levees, such as the one launched in 2006, and emergency flood response plans are key.
 11. **Implement a "no regrets" strategy for the Delta.** First, given the urbanization pressures on the Delta, policy decisions are needed to establish an improved regional governance structure, institute a program to set aside or purchase key habitat, and create adequate, coherent flood control guidelines for urbanizing lands. Second, to avoid costly expenditures for islands that are of low strategic value, it

makes sense to develop a “do not resuscitate” list in the event of levee failure. Third, to improve habitat conditions for the delta smelt and other pelagic species in the short term, restoration actions should be initiated in the Suisun Marsh and Cache Slough regions.

Forging a New Path Forward

The Delta’s many problems have sparked a crisis in confidence among its many stakeholders. The CALFED process, which has been responsible for crafting solutions in the Delta since the mid-1990s, is now widely perceived as having failed to meet its objectives. That process was forged under the threat of new federal water quality standards for the Delta. CALFED’s failure lay in the course chosen for crafting solutions: favoring political consensus over making tough choices among alternatives and assuming that taxpayer largesse would foot any bill. The question going forward is whether the crisis in the Delta can spur stakeholders and the state to action with a new strategy that accepts the inevitability of both winners and losers. The future of this unique ecosystem and regional resource and of the state’s water supply system all depend on the answer. All Californians are likely to see benefits (and costs) from a comprehensive long-term solution. Otherwise, we will all see only costs.