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Non-Profit Law and Consulting in Conservation of Natural Resources and the Global Environment

PRELIMINARY DRAFT OF

NHI's ENVIRONMENTALLY OPTIMAL ALTERNATIVE

FOR THE CALFED BAY-DELTA PROGRAM

July 1, 1996 Iteration

Executive Summary

NHI proposes that CALFED Program study in detail one or more alternatives that are designed specifically to maximize environmental benefits. Under the regulations and case authorities governing the federal and state environmental review processes, we believe CalFed is not at liberty to ignore a reasonable and environmentally superior alternative. This paper describes one such alternative at a level of detail comparable to the "preliminary draft alternatives" generated by the CalFed Program. The alternative proffered by NHI would fully satisfy all of the objectives specified by CalFed[1]. In fact, it will provide far greater environmental benefits than any of the CalFed alternatives to date while providing very high levels of water supply reliability. This paper describes the alternative, estimates the benefits, discusses the legal and institutional requisites, and demonstrates the technical and economic feasibility, all in a preliminary manner. Like the three "preliminary draft alternatives" developed by the CalFed staff, the scale, cost and other operational details of the NHI alternative are left to further development within the CalFed process of defining and evaluating, and selecting among alternatives.

The centerpiece of NHI's environmentally optimal alternative is the gradual, yet cumulatively dramatic, conversion of most of the delta farmlands below high tide back to the condition that existed before they were diked and filled, namely a vast, pristine, and productive mosaic of aquatic, wetland, and terrestrial habitats. This encompasses some 350,000 acres (over 500 square miles!) of new tidal wetlands. This is orders of magnitude more habitat than that proposed by the CalFed alternatives (8,000 - 12,000 acres). We envision the *largest wetland preserve in the western United States*, protected as a component of the national park system, on the doorstep of the Bay Area metropolises. In addition to the habitat benefits, it would provide enormous recreational benefits with the attendant boost to the local economy that usually accompanies the creation of a new national wildlife refuge or recreation area.

The NHI alternative would also incidentally reduce fish entrainment, and would create mechanisms for meeting environmental water needs inexpensively and voluntarily. Importantly, the NHI proposal may also provide substantially superior water supply benefits by including strategies to maximize conjunctive water management, improve efficiencies of use, foster water transfers, and indemnify water users against regulatory changes. These largely non-structural, institutional innovations could provide as much as 2 million acre feet per year of new supply to meet the needs of all sectors. Finally, the NHI alternative is likely to prove less expensive over the long-term than any of the CalFed alternatives because it avoids the costs of levee maintenance and repair and the far larger costs to water supply systems and aquatic resources associated with their eventual catastrophic failure.

This alternative would resolve the long-term unsustainability of delta agriculture

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[1] It largely solves the water quality and seismic problems in the delta without the need for targeted program elements. Therefore, water quality and seismic elements are largely absent from this alternative.

and the limitations it poses to environmental restoration through a program of gradual, compensated, and voluntary land transfers to an "Environmental Water Authority" (EWA). It proposes that the substantial public subsidies in the form of contributions to levee maintenance and repair, FEMA flood damage reimbursements, payments for the screening of delta diversions (under Articles 3 and 4 Fish and Game Code) which may be needed to protect fisheries, and foregone property taxes under the Williamson Act, be redirected and supplemented as necessary to purchase delta farmlands on a willing seller basis.

The wholesale conversion of the current delta, comprised of diked farmland and a water delivery conduit, to a vast, tidal marsh and terrestrial habitat would entail a radical modification of the delta's hydrodynamics. This will affect the suitability of the current water diversion facilities for meeting the water quality and reliability objectives, which defines CalFed "preliminary draft alternative # 1, as well as the suitability of the "through delta" alternative # 2. The nature and extent of these affects will have to be assessed to determine the viability of these conveyance options, and NHI believes that is a proper function for CalFed to perform. We withhold judgement in the meantime as to whether a small isolated transfer facility is indispensable to achieving a maximal scale habitat restoration alternative--such as posited here--in combination with the other CalFed goals. However, we believe that that degree of restoration could be accomplished with the dual delta conveyance option (draft preliminary alternative # 3). Thus, we regard the NHI proposal as a variation on alternative 3 (albeit a dramatic improvement). If the modeling results should indicate that the through delta approach is superior from both the environmental and water user perspectives, then our proposal is equally compatible with that approach.

It appears that a small isolated transfer facility with state of the art screening and real time operations, operated in tandem with substantially curtailed south delta pumps, would permit current levels of export to continue in a more reliable fashion and with substantially improved water quality. However, NHI's inclusion of this element in our proposed alternative is expressly contingent upon two conditions precedent being satisfied: (1) there must be high level of confidence that screening technology is sufficient to drastically reduce the entrainment problem if water is extracted at Hood, compared to the current situation at the delta export pumps, and (2) the institutional arrangements must be sufficient to assure that the EWA will act as an effective guarantee against increased water exports out of the system, compared to current levels.

In sum, the basic physical components of NHI's environmentally optimal alternative include:

- Large scale conversion of the delta lands below high tide back to the vast tidal marsh (and upland habitat) that existed before they were diked and filled. Existing levees would be breached (except for those islands where water is to be stored seasonally under this scenario) after shallow water and riparian habitat has been restored through filling and natural deposition as marsh vegetation re-establishes

itself.

- Seasonal storage of water in some delta islands peculiarly suited to that use.

- Enhanced environmental flow and diversion patterns through market acquisitions by a new Environmental Water Authority.

- A small east side isolated facility, appropriately screened and capacity-constrained.

- Targeted restoration in areas upstream of the delta, including screening of diversions and reduction in toxic effluents.

- Reductions in other anthropogenic sources of fish mortality, including reduction in the effects of commercial and recreational harvest, reduction in the effects of introduced aquatic species on delta native fishes, and continued research on fish biology and management requirements.

The NHI alternative links these physical components to an array of new institutional arrangements that include:

- A new Environmental Water Authority (EWA) that would be responsible for systemic restoration planning and development of comprehensive watershed preservation and management programs. This would include delta lands acquisition and restoration, determining flows and flow patterns required for restoration and preservation of the ecological system and the acquisition of such water, and pursuing other non-flow restoration activities (e.g. Category III).

- A maximal scale, state-wide conjunctive water management program to increase the yield of the developed water system to meet needs in all sectors, including improved water conveyance and groundwater management facilities.

- Demand management, predicated upon full implementation of the urban water conservation memorandum of understanding and market incentives for conservation through facilitative arrangements involving water districts, changes in criteria governing transferability, and expedited approval processes.

The NHI alternative should perform better at a lower cost than the CalFed alternatives for the following reasons:

- *Cost*:

  1) Much of the cost of the CalFed alternatives can be attributed to the high cost of levee maintenance, upgrades and setbacks, (at $ 1-3 million per mile) which create very little new habitat in return. By contrast, the NHI alternative assumes that most levees are unsustainable and proposes to

breach them in a controlled fashion, thereby substantially reducing the high cost of levee maintenance and repair while creating a vast amount of new wetland habitat. For example, the acquisition cost of new habitat under the land purchase program we envision would be only about $1500 per acre (plus the costs of filling and restoring) whereas the costs per acre under the CalFed levee setback approach would be at least 20 times that much.

2) Acquisition of additional water through market transfers will allow for the enhancement of environmental and user supplies at a fraction of the cost of new water development.

3) The conjunctive use component of the NHI alternative would also provide up to 1.4 MAF per year of additional water supply at no cost to the public fisc because it would defray its costs through sales of a portion of the increased yield.

- *Performance*:

1) The NHI alternative generates new habitat orders of magnitude greater than the CalFed alternatives.

2) The purchase of numerous delta islands will allow for the eventual elimination of most diversion points within the delta, thus resolving the problem of fish entrainment (particularly of eggs, larvae, and juveniles).

3) The NHI alternative will perform better than the closest CalFed alternative (# 3) in that we include the option of increasing the size of the isolated system above 6 kcfs (which would not increase costs significantly), provided that the extra capacity is given to the EWA. This innovation would significantly increase the chances of a high performance, stable solution.

4) The NHI alternative proposes to push conjunctive use much further than the "core actions and common programs" in the CalFed generated "preliminary draft alternatives", and the demand management programs in the NHI alternative should provide water supply reliability and efficiency for users somewhat greater than in the CalFed alternatives.

5) Because the NHI alternative explicitly relies upon water markets, coupled to conjunctive management and efficiency improvements, to carry much of the burden of future water supply and for enhanced environmental flows, little additional surface storage is required.

Section I
The NHI Environmentally Optimal Alternative

A. Introduction

The delta formed by the confluence of the two great river systems of the central valley is one of the defining environmental assets of the nation, and the entire San Francisco Bay Area community is enriched by its fish, wildlife, and native plant habitats, as well as its exceptional economic, recreation and aesthetic qualities. Once a massive wetland, the heart of the delta was covered not so long ago by some 350,000 acres of tidal freshwater marsh, surrounded by 200,000 to 300,000 acres of non-tidal marshes or seasonal wetlands, riparian woodlands on natural alluvial levees, and some upland woodlands and grasslands. But this resource has been tragically compromised over the past century and a half by progressive land transformations and hydrologic modifications, which have been greatly accelerated by the largest water development projects in the world. Altogether, over 95% of the delta's tidal wetlands have been diked, filled, and transformed into farmland to the point where not just individual species but the ecosystem as a whole is endangered.

NHI's program seeks to turn back the clock on 150 years of eradication and convert the delta back to a massive tidal marsh *while actually improving water supply reliability and quality* for the farms and cities that divert water out of the system. NHI's comprehensive plan would create mechanisms for generating as much as 2 million acre feet per year of new supply to meet the needs of all sectors. These features, which emphasize institutional innovations over new infrastructure, should make the NHI alternative very attractive to all stakeholders in the CalFed process, environmentalists and water users alike.

The centerpiece of the NHI environmentally optimal alternative is the gradual, yet cumulatively dramatic, conversion of most of the delta farmlands below high tide back to the condition that existed before they were diked and filled, namely, a vast, pristine, and productive mosaic of aquatic, wetland, and terrestrial habitats. This would encompass some 350,000 acres--over 500 square miles!--of new tidal wetlands (compared to a mere 8,000 - 12,000 acres in the CalFed "preliminary draft alternatives" that have been generated so far). At its full development, this would represent the largest tidal wetland area west of the Texas coastal marshes and the largest wetland restoration project ever achieved in the world!

In recognition of its national significance as the largest protected wetland in the west, we envision that this area would be managed as a component of the national park system, such as a national wildlife refuge or national recreation area. In addition to the habitat benefits, it would provide enormous recreational benefits with the attendant boost to the local economy, just as do all national parks and recreation areas. Creating a national reserve would also help secure the federal funding that will likely be needed to

accomplish the land acquisition and restoration work.

In sum, the objective of NHI's project is not just protection of what the delta is today, but progress toward what it could be tomorrow: a tidal wetland approximating its pre-development expanse of 350,000 acres, providing habitat for a naturally reproducing and self-sustaining fishery featuring salmon runs at least twice the recent historic rates and native fishes no longer on the brink of extinction; and a stable, defensible water allocation regime that prevents the environmental water needs of the delta from being perpetually at risk of diversion to meet the insatiable demands of the urban and agricultural sectors. This future is possible. Indeed, we have the roadmap.

B. Justification for reconversion: Agriculture in the delta is environmentally damaging, costly to the public, and ultimately unsustainable

1. *Environmental damage*

Wetlands provide vital spawning and nursery grounds for fish, and important sheltering, feeding, and nesting areas for many species of birds, some of which are endangered. Wetlands can also improve water quality by trapping sediments and by removing nutrients and some chemical contaminants. The biological damage caused by agricultural production to the delta, once a massive wetland habitat, has been severe.

Consider the following:

- *Loss of habitat*: Between 1860 and 1930, 97% of the delta's 450,000 acres of freshwater marsh were diked and planted with crops. Very little of the predisturbance wetland habitat now exists within the delta, reducing or altogether eliminating the wildlife species dependent on this resource.

- *Diversions*: The peak diversion season in the delta coincides with the months when large numbers of young chinook salmon, striped bass, American shad and other fish are present in the system. There are about 1900 unscreened diversions in the delta, pulling in large numbers of fish, eggs, and larvae. Some rough estimates indicate that the losses of young bass (generally less than 16 mm in length) is on the order of several hundred million and the loss of juvenile chinook salmon may be in the range of a few hundred thousand.[2]

- *Drainage*: The application of fertilizer and pesticides on delta farmlands can be problematic not only for local wildlife, but for inhabitants of (and visitors to) the downstream estuary. Crops rarely absorb more than half of the nutrients in fertilizers; as a result, ammonia (toxic to fish) and nitrate (which in excess can cause rapid, oxygen-depleting growth of algae) leach into agricultural drainage water. While some pesticides decompose quickly, most are more resistant to

[2] DWR report, "Screening Agricultural Diversions in the Sacramento-San Joaquin Delta."

chemical breakdown and leach into drainage water unaltered. Some studies indicate pesticides to have been a significant factor in reducing population levels of striped bass in the estuary during the period 1973-1986.

- *Flooding*: Delta agricultural land was at sea level approximately 100 years ago and sat behind minor levees. Due in large part to agricultural practices (such as tilling, burning, and soil compaction), the peat soils which mostly comprise the delta islands have been subsiding on average two to three inches per year. Parts of some islands have subsided to more than 25 feet below sea level. Constructed of unconsolidated clays, muds, or silts, the levees were never meant to withstand the increased hydrostatic loads caused by subsidence; continued subsidence makes them increasingly vulnerable to breaching. Nearly every island in the delta has been flooded once or more; several islands have been permanently abandoned and are now inundated.

  Flooding will occur through two modes: flooding during storms and flooding as a result of earthquake. The levee construction makes them potentially vulnerable to liquefaction during seismic activity, and if multiple islands were lost simultaneously by earthquake, it is likely that most delta islands would never be repaired.

  The consequences of permanent and unplanned levee failures would be severe. Land levels have subsided to such a depth that many islands, if flooded without prior modification, would be incapable of supporting a productive aquatic ecosystem. There would in fact be few offsetting environmental benefits for many decades. Furthermore, loss of the islands would lead to salt intrusion, which could degrade drinking water quality and aquatic habitat.[3] NHI's preliminary work indicates that permanent delta flooding is a significant possibility within a few decades, and that very expensive levee enhancement work would do no more than delay the inevitable and reduce the risk of failure to some degree.

2. *Public cost*

The sustainability of delta agriculture from an economic perspective depends upon the profits and costs of doing business and the level at which society is willing to subsidize agriculture. The overall costs of delta agriculture include the cost of levee maintenance, levee repair, island rehabilitation after flooding events, the environmental costs associated with unscreened diversions and certain agricultural practices (such as pesticide use), the economic costs associated with unscreened diversions (such as reduced commercial salmon catch), the economic costs associated with screening those diversions as well as other measures taken to protect endangered species, and the economic costs associated with treating delta agricultural discharges for drinking water. Some of these costs are borne by delta farmers; most of these costs are borne by society as a whole. The key question is whether the benefits of delta agriculture are worth the costs in the long run.

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[3] NHI's alternative would change the diversion point for drinking supplies to avoid this problem.

NHI's preliminary analysis indicates that the costs imposed on the environment and society by delta agriculture already far exceed any economic benefits. For example:

- *Levee subsidies*: From 1980 - 1986 (the last date for which we have information as of yet), emergency subsidies for levees cost the state and federal governments over $90 million or about $15 million per year. State subsidies for routine maintenance and repair of non-project have recently been running between $2 million and $5 million annually. In addition, the state has spent $27 million since 1989 for a special Flood Protection Program for eight delta islands and two delta communities (with a total commitment of $35 million through 1997).

- *Williamson Act subsidies*: More than 70% of California's estimated acreage of prime farmland is enrolled in the Williamson Act program, which offers preferential taxation in return for restricting land to agricultural or open space use. In partial compensation for foregone property tax revenues, the state annually pays a subvention to all participating counties and cities ($5/acre for prime agricultural land; $1/acre for open-space lands of statewide significance). State subventions paid to local governments in the delta is unknown at this time, but since the majority of delta land is dedicated to agriculture, expenditures are expected to be significant.

- *Screening*: Virtually none of the approximately 1900 diversions in the delta are screened. Current screening policies may be changing, however. The Department of Fish and Game (DFG) has recently written a "Plan of Action for Screening Diversions," and there is some indication that the US Fish and Wildlife Service is advocating a more rigorous screening policy in the delta.

  If DFG were to order diversions in the delta screened, it would wind up bearing most of the costs.[4] The potential costs for installing screening are roughly estimated at $3000 - $5000 per cfs at each siphon type intake (where average maximum flow for delta diversions is about 10-15 cfs); it is estimated that screening the multitude of delta diversions would cost more than $100 million. Operation and maintenance costs would also be significant.

- *Drinking water*: The incremental cost for drinking water treatment caused by delta island discharges may be on the order of several hundred million dollars per year.

- *Endangered species*: Delta diversions contribute significantly to the endangerment of listed and other at risk species. Resulting water use restrictions and recovery efforts by government agencies and private interests aggregate to hundreds of millions of dollars over the long-term.

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[4] Under the Fish and Game Code, DFG is responsible for installation and maintenance costs for diversions installed prior to 1972, and smaller than 250 cfs--which includes most delta diversions)

These circumstances cannot be tolerated indefinitely. Moreover, the levees are bound to fail eventually; it is only a matter of time. A catastrophic failure would jeopardize not only the farmlands but the hub of the state's water supply system, and turn the delta into an environmental wasteland. By establishing a program for gradual, compensated restoration to tidal marsh, the NHI alternative merely seeks to accelerate the inevitable breaching of the levees, and in a manner that provides a fair, voluntary and attractive option to the current landowners. Thus, while the conversion of large amounts of agricultural land to habitat is bound to be somewhat controversial (notwithstanding that major conversions of agricultural land to urban growth take place all the time without a squeak), there are indications that many delta farmers desire to sell out now, before conditions deteriorate any further.

Considering that the area of the delta in question is about 350,000 acres and that land values are in the range of $1,500 to $3,000 per acre, the state could probably save significant amounts of money in the long run by permanently retiring most of the tidal lands in the delta. This is true even is an isolated transfer facility is eventually built. Moreover, the creation of a national wetland preserve would be a great magnet for tourist revenues, thus liking providing a net economic gain for the local economy and tax base, especially over the long-run.

Most important, reconversion is absolutely essential from an environmental perspective. Without reconversion, it is doubtful that the estuarine aquatic habitat can ever be put on a firm foundation.

C. Design premises of NHI's environmentally optimal alternative

1. The NHI alternative is designed to maximize environmental benefits while fully satisfying the other objectives of the CalFed process. It largely solves the water quality and seismic problems in the delta without the need for targeted program elements. Therefore, water quality and seismic elements are generally absent from this alternative. The proposal is targeted at assuring that current levels of demand can be met with high reliability. Demands beyond the current average annual levels of diversion and export for the consumptive water users will be met through additional water efficiency improvements, additional transfers and additional groundwater storage.

2. The environmental objective assumed by this proposal is significant improvement in the ecosystem compared to a baseline level of ecosystem health. That baseline includes the 1995 WQCP, full implementation of the Category III commitments, full implementation of the CVPIA and the anadromous fish restoration program, continuation of the biological opinion and reasonable and prudent alternatives for the winter run salmon and the delta smelt, the Corps of Engineers' restrictions on south delta pumping rates, and normal operations of the water projects. We use the term "restoration" as a shorthand term for these improvements. Restoration

does not suggest a return to a perfect state of nature. Instead, given the radically altered state of the delta estuary, NHI has attempted to construct an alternative that builds on the current reality and provides highly leveraged opportunities to reestablish critical ecological functions and processes, with particular emphasis on hydrological functions. The alternative adopts an ecosystem approach, meaning that it attempts to address the restoration comprehensively throughout the entire Central Valley watershed.

3. The proposal emphasizes non-structural solutions (institutional reforms) over structural solutions (physical and facility changes) to the maximum extent feasible. However, some of the institutional improvements (e.g. conjunctive water management and reductions in fish entrainment) will necessitate structural elements.

D. Physical and functional description of the environmentally optimal alternative

The NHI Environmentally Optimal Alternative has seven basic physical components:

1. Large scale conversion of delta islands to high quality terrestrial, wetland and aquatic habitat.
2. Seasonal storage of water in some delta islands peculiarly suited to that use.
3. Enhanced environmental flow and diversion patterns.
4. A small east side isolated facility.
5. Reductions in other anthropogenic sources of fish mortality.
6. Targeted restoration in areas upstream of the delta.
7. Improved water conveyance and groundwater management facilities.
8. Demand management.

1. Conversion of delta islands to habitat

NHI proposes the purchase of some 350,000 acres of land in the delta which is currently below sea level, and conversion most of that land, over time, back to the tidal wetland conditions (and terrestrial habitat) which existed in the 19th century.[5] Some of the islands can be readily converted into a mosaic of terrestrial, riparian, and shallow habitats connected by new delta channels. Deeper islands may require measures to raise the elevation of the land before they can be converted.

The gradual transformation of land to habitat would be accomplished through voluntary acquisition and management by an Environmental Water Authority (as described below). Several small towns exist within the targeted portion of the delta; the NHI

[5] A map of the target area is attached.

proposal does not envision buying out these areas, but would enclose them in high quality levees as inholdings. In addition, the environmentally optimal alternative does *not* propose involuntary "takings" or condemnation of the delta farmlands. However, certain financial subsidies and regulatory lapses permit and encourage the current land use patterns. These are artificial and most likely ephemeral conditions. The NHI alternative would merely accelerate their inevitable demise in order to create inducements for voluntary transfers. Acquisition would start with the delta islands where agriculture is currently unsustainable without subsidies for levee maintenance or repair.

NHI's environmentally optimal alternative proposes that all subsidies and other assistance programs for maintenance and repair of the delta levees would be redirected (and supplemented as necessary) to create a fund for public acquisition of these delta farms by the Environmental Water Authority.

Islands acquired for habitat would be modified, over time, to provide high quality wetland, terrestrial and aquatic habitat. Existing levees would be breached,[6] except for those islands where water is to be stored seasonally under this scenario (see below), and shallow water and riparian habitat restored through filling and natural deposition as marsh vegetation re-establishes itself. Where desired, fee interests will be acquired subject to a life estate in the existing owners.

As a general blueprint for management of the islands acquired for environmental purposes, NHI proposes:

- Continued maintenance of levees until such time as islands have been prepared for permanent flooding.

- Interim management for optimum wetland and terrestrial habitat. Modification of diversion patterns to reduce entrainment problems.

- On the shallower islands, modification of the land surface to create a mosaic of terrestrial, riparian, and shallow habitats connected by new delta channels, then flooding of the islands.

- On the deeper islands, peat regeneration programs designed to build up the depth of the islands over a period of decades.[7] There are suggestions that the reintroduction of tule marshes into the islands could rebuild the peat at a rate of several inches per year. Once the islands were restored to depths near sea level,

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[6] However, the EWA may continue levee maintenance on lands it has acquired until appropriate conditions have been created for restoring shallow water habitat, at which time flooding would occur.

[7] Various alternatives for physical and economic feasibility will be researched, including: 1) silt deposition; 2) peat regeneration; 3) dredge spoils; and 4) the transfer of peat from one island to another through slurry lines. The Netherlands is currently implementing a similar project along their coast; we will look for any useful lessons.

the islands would be prepared, then flooded, as above.

These strategies would be implemented by the EWA in an adaptive fashion, through pilot projects and scientific study. The intensity of restoration activity would interact with the EWA's water management responsibilities. That is, through time the EWA will gain greater insight into the key leverage points for ecosystem restoration. As these leverage points become clearer, the EWA's resources will shift accordingly. Thus, the EWA could end up strongly emphasizing a rapid program of habitat restoration or the acquisition of new flows, depending upon which of the two is ultimately deemed more critical.

2. Conversion of delta islands into reservoirs

Some of the deeper islands might be converted into seasonal storage facilities for a period of years, or permanently. Storage islands would be owned and managed by the EWA and used either to increase delta outflow during critical periods, or would be connected to the export pumps via siphons and canals and used to generate environmental storage south of the delta. It may be possible to find synergies between the use of some islands for storage and other islands for habitat. For example, if two adjacent islands are 15 feet below sea level on top of 10 feet of peat, then the peat from one island could be moved using slurry lines to the other island, creating one island 5 feet below sea level (ideal for habitat) and one island 25 feet below sea level (ideal for storage with improved water quality characteristics). The feasibility of such approaches have yet to be established.

3. Improved Environmental Flow and Diversion Patterns

In the NHI alternative, improved environmental flow patterns would be the responsibility of the EWA. The EWA would be endowed with some combination of funds and or water, which, in the context of a functioning water market (also part of the NHI alternative) would be interchangeable, although funds would be more versatile. The EWA would determine on the basis of its own expertise, and in an adaptive management mode, the optimal combination of flow enhancements, diversion patterns changes, habitat improvements and physical measures to implement. Thus, the EWA might:

- Develop storage on one or more delta islands.
- Develop new supplies through conjunctive use arrangements.
- Purchase water on the open market.
- Purchase or lease diversion rights.
- Purchase storage rights in existing reservoirs.
- Exchange Sacramento River water for increased tributary outflows.

There is no need to specify exactly how the environmental flow patterns would be improved. In general, however, we may speculate that the EWA would seek to acquire water through storage, purchase, and exchange to boost tributary and delta flows during

dry years.

4. Isolated conveyance facility: Improved hydrodynamics for habitat and diversion benefits

Massive improvements in aquatic habitat within the delta may be incompatible with year round use of the state and federal south delta intakes, because of increased salinity intrusion, and because of the potential for continued large entrainment impacts. Therefore, this scenario posits an east side isolated facility. The facility would divert water through high quality screens from the vicinity of Hood to the export pumps and would be sized at approximately 6 kcfs. The facility would operate year round, except to the extent that closures might be necessary to protect down migrating salmon or pulses of eggs and larvae. Thus, the system should be able the provide in the neighborhood of 4 million acre feet per year. Additional exports would be generated through pumping from the south delta during favorable conditions (e.g., during winter storms). Urban water quality could be maximized by keeping delta water segregated from water from the isolated system to the degree possible.

Feeder lines from the isolated facility might also be built to connect to east side and San Joaquin water users. Water acquired by the EWA from the Sacramento basin could be sent through these lines to east side agriculture in exchange for increased side and San Joaquin tributary flows.

Additional capacity beyond 6 kcfs might allow for additional environmental benefits, but the benefits are less clear, and additional size would heighten concerns about the possible abuse of the facility. Therefore, if the facility is built beyond 6 kcfs, all extra capacity would be owned by the EWA. EWA could elect to lease the rights to that capacity at its own discretion to the state and federal projects, or to facilitate water transfers. If the additional diversions were deemed preferable to pumping from the south delta, then the EWA would presumably charge only nominal fees. If impacts were more substantial, then the cost would accordingly be higher.

Notably, this configuration provides substantial water quality and security benefits to water exporters, while reducing the risks of abuse of operations. In order to improve water quality, exporters will have incentives to only operate the south delta pumps during high flow conditions. Moreover, the availability of extra capacity via the EWA provides a safety valve through which additional water can be acquired, albeit at a price, during extended shortages. If the isolated system turns out to be very beneficial, it would be used at high capacity. If the benefits only appear during part of the year, then EWA control over extra capacity would allow for shifting the timing of diversions without new regulatory proceedings.[8]

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[8]Whether and when the cross delta channel gates would have to be closed will need to be investigated. With improved habitat and reduced entrainment in the delta, closure may not be necessary. On the other hand, if closure provides biological benefits, that can be accomplished without adversely affecting delta exports.

NHI wishes to make explicit that our proposal for an east side canal is expressly contingent upon two conditions precedent being satisfied: (1) there must be high level of confidence that screening technology is sufficient to drastically reduce the entrainment problem if water is extracted at Hood, compared to the current situation at the delta export pumps; and (2) the institutional arrangements must be sufficient to assure that the EWA will act as an effective guarantee against increased water exports out of the system, compared to current levels.

It is important to note that the combination of massive wetland restoration in the delta and the ICF render the seismic integrity of the delta levees irrelevant and automatically assure improvements in export water quality. These CalFed objectives become superfluous under the NHI alternative.

5. Reductions in other anthropogenic sources of mortality

Actions beyond improved habitat and flows and diversion patterns are desirable. Such actions have been discussed in detail elsewhere and include, in brief:

- Reduction in the damaging effects of commercial and recreational fish harvest.
- Reduction in the damaging effects of introduced aquatic species on delta native fishes.
- Continued research on fish biology and management requirements.
- Measures to protect spring run salmon, possibly including closure of the cross delta channel for the entire period of October-December. (Note that such closure would no longer pose a constraint on delta exports due to the new isolated facility on the Sacramento; yet closure may not in fact be necessary because of less entrainment at the south delta pumps.)

6. Upstream habitat improvements

There is little doubt that degradation of upstream habitat, as well as the altered hydrodynamics of the delta, have played a major role in the decline of delta-dependant species, and anadromous species in particular. Other non-flow factors (such as toxic loading and unscreened diversions) bear responsibility for species declines as well. The NHI alternative calls for systemic restoration, targeting areas that have substantial potential for recovered ecological processes and benefits to targeted species and habitats. Important areas for key aquatic species that are currently healthy will be candidates for management to avoid degradation and ensure that future development is compatible with maintaining high quality habitat where it now exists.

Under the NHI alternative, habitat improvements upstream of the delta will be based on a comprehensive planning structure similar to that now contemplated by

CalFed's proposal for a coordinated approach to ecosystem restoration. All federal, state and local planning efforts would be coordinated by a single entity capable of developing annual and long-term targets and concomitant action plans. Ideally, this entity would be empowered to decide how best to improve habitat on both an annual and long-term basis, employing the full range of options from restoration projects, to water acquisitions, to land purchases.

7. Groundwater storage

High level winter and spring flows, particularly during years of above average precipitation, represent the primary source of "new" supply that remains untapped in California. By new supply, we mean only water that is not subject to water right, contract delivery obligations, environmental regulation, or that does not provide significant environmental benefits. Some of these flows can be captured for beneficial uses without new surface storage reservoirs through the coordinated use of existing surface and groundwater storage capacity. Such "conjunctive water management" banks water under the ground during periods in which surface water is plentiful. That water is later retrieved for use when surface water is scarce. Thus, conjunctive use utilizes groundwater for water storage, while avoiding evaporation losses and the high economic and environmental costs associated with surface storage. While it is a well-established water management technique, California has never sought to realize the full physical potential of conjunctive use, outside of several small regulated groundwater basins in Southern California.

NHI is well along in the process of conducting a feasibility study of the physical potential for conjunctive use and the institutional changes which might be necessary to allow conjunctive management to dramatically increase the total amount of water available for beneficial use in the State. The type of conjunctive program that NHI envisions would use groundwater basins to store water in just the way water engineers have traditionally used surface reservoirs--to capture water that would otherwise be lost to the system, for subsequent delivery to uses that are not appurtenant to the area of storage. For the agricultural and urban water users, that means enhanced reliability of their water supplies and/or financial benefits. For the Bay-Delta ecosystem, it means additional delta freshwater through flows. These benefits provide the incentives that will be necessary to induce voluntary cooperation in a state-wide conjunctive use program.

NHI's preliminary estimate is that the Central Valley tributaries could yield up to 1.4 million acre feet per year on average (ignoring any conveyance or percolation constraints). This compares favorably with the estimate of the Bureau of Reclamation in their 1995 Water Augmentation Study. NHI is now in the progress of testing the feasibility of actually achieving these levels of yield. Our analysis is looking both at facilities and operational constraints as well as geohydrologic, land use and other factors. In general, the achievement of full conjunctive use potential may involve additional facilities such as canals and even offstream surface storage.

NHI is also investigating the institutional and legal framework that would be necessary to foster a maximal scale, state-wide conjunctive use program. We conclude that, notwithstanding the absence of a statutory groundwater management regime in California, there are no substantial legal or institutional constraints, and new legislation may not be necessary.

The NHI alternative does not include specific conjunctive use projects. Rather, these projects will be developed over time by water users and the EWA. However, we would propose to include conveyance facilities which provide needed infrastructure capability.

For example, improved infrastructure for conjunctive use east of the delta might be provided through feeder lines which would move east and south from the isolated system. The primary purpose for these feeder lines would be to provide exchange water to free up additional instream flows in these tributaries. However, additional capacity might be made available to provide water for groundwater storage. The storage would be used to boost local reliability, provide environmental flows, and to increase export reliability.

Southern San Joaquin infrastructure for conjunctive use might involve increased conveyance and distribution system and surface storage. The general idea is to allow for much higher summer deliveries to the southern San Joaquin Valley during wetter years so that more water can be stored via percolation and in lieu. That water can then be accessed during dry years by water users and the EWA. Additional modeling will show the degree to which water can be put into the ground with the facilities proposed in this alternative. If groundwater storage is infrastructure limited, then the CalFed Program should consider improving either conveyance capacities in the southern San Joaquin, offstream storage capability, or both.

Far more detail on the state-wide potential of conjunctive water management is provided in the current working draft of NHI's feasibility study, which will be incorporated into the final version of the NHI proposal as a technical appendix. The final report is being synchronized with the CalFed program and will be completed within the same time frame.

8. Demand management

Demand management measures are discussed in the next section.

E. Institutional Structures

The NHI alternative links these physical components to an array of new institutional arrangements. These include:

1. A new Environmental Water Authority (EWA) that would be responsible for systemic restoration planning and development of comprehensive watershed

preservation and management programs..

2. Substantially increased conjunctive management of surface and groundwater.

3. Aggressive water conservation and demand management for agricultural and urban water consumption.

4. A liberalized water transfer system.

The institutional reforms described in greater detail below are designed to both implement the physical modifications required by the NHI alternative and to go beyond them to fully achieve the CalFed objectives of improved water supply reliability and ecosystem improvements (maximal, in the case of the NHI alternative). Many of these institutional improvements are reflected in the "core actions" and "common programs" that are part of all of the CalFed alternatives. However, in this proposal, these improvements are pressed to a much fuller extent, and additional ones are added. All are quite feasible to implement, technically and economically. NHI has worked out most of the improvements in considerable detail in other papers and studies which will be incorporated into the final version of this proposal as technical appendices. Some will require new legal authorization and modest changes in existing law, as would most, perhaps all, of the CalFed alternatives. As discussed in the "Guarantees" section following, the additional authorities should be enacted at both the state and federal levels to give the institutional structures stability and predictability

1. Environmental water purchase and transfer regime: The Environmental Water Authority

This environmentally optimal alternative identifies several functions pertaining to fishery habitat and tidal wetlands restoration in the delta that would be best performed by a single agency with a high degree of technical expertise. There are also an array of pre-existing obligations of a similar type that comprise the environmental baseline for the estuary that require a similar degree of expertise and coordination. Ideally, all of these functions would be entrusted to a new, special purpose agency exercising both state and federal powers. It could be created either by special legislation at the state or federal level or through a joint powers authority with appropriate memoranda of understanding with private sector interests. If it were incorporated as a tax exempt entity, it could receive taxable deductible gifts of delta farmlands. This would expedite and lower the costs of the acquisition program. In any case, its single mission should be environmental restoration and management, with an expert staff (perhaps civil service exempt, if an official agency). Since this type of entity has been historically referred to as the "Environmental Water Authority" in policy discussions in California, we will refer to it by that title in this paper.[9]

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[9] The governance of the EWA should probably reflect the manner in which regulatory liabilities are allocated. If the EWA takes responsibility for compliance with requirements of the Clean Water Act and Endangered Species Act in the delta and indemnifies the water users with respect to those liabilities, it should quite clearly

Among the functions that need to be performed in an expert and unified manner are these:

a. Environmental Baseline Functions:

- Category III restoration program.
- CVPIA restoration program: EWA should at least coordinate with this program and, ideally, merge with it.
- Implement the delta inflow requirements of the Bay-Delta WQCP.
- Participation in the Operations group.
- Implement the Anadromous Fish Restoration Program (AFRP), or at least coordinate with this program.

b. CalFed-Environmentally Optimal Alternative:

- Tidal wetland restoration program: Land acquisition program, wetlands restoration, delta island storage program with levee maintenance.
- Hold and deploy water to implement CalFed delta throughflow recommendations that go beyond WQCP.
- Fishery habitat restoration under adaptive management paradigm: Monitoring and data gathering, development and implementation of fishery restoration plan, with emphasis on spring run recovery.
- Engage in joint water development projects with water users, e.g., conjunctive water management to provide environmental water.
- Manage a share of capacity of the isolated delta facility.

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be governed by exclusively environmental interests (from both the private and public sectors) and be assured a relatively generous level of resources. If the water users remain ultimately liable under those acts, the board should be more broadly representative.

Summary of EWA Functions:

	Environmental Baseline Functions	*CalFed-Environmentally Optimal Alternative*
Environmental water & flow augmentation	Implement the delta inflow requirements of the Bay-Delta WQCP. Implement the Anadromous Fish Restoration Program.	Implement CalFed delta throughflow recommendations that go beyond WQCP.
Physical restoration	Category III restoration program. CVPIA restoration program.	
Tidal wetlands restoration		Tidal wetland restoration program.
Fisheries habitat restoration		Adaptive management program: monitoring and data gathering, development and implementation of fishery restoration plan.
Project operations	Participation in the Operations group.	Manage share of capacity of isolated delta facility.
Joint water development projects (e.g., conjunctive use)		Engage in joint water development projects with water users--e.g., conjunctive water management to provide environmental water.

The EWA would be endowed with some combination of funds and or water, which, in the context of a functioning water market (also part of the NHI alternative) would be interchangeable, although funds would be more versatile. The EWA would determine on the basis of its own expertise, and in an adaptive management mode, the optimal combination of flow enhancements, habitat improvements and physical measures to implement. The EWA that we envision would have responsibilities commensurate with its means. Ideally, it would have the ultimate *authority* over estuarine protection and restoration, exercising "environmental water rights," acquiring delta farmland and converting it into tidal wetlands, administering restoration funds, etc., *and funding sufficient to perform these functions*. As such, it should ideally also have commensurate *responsibility* for estuarine protection and restoration.

Operational Reforms and Improved Environmental Flows: In the NHI alternative, improved environmental flow patterns would be the responsibility of the EWA. This function has been described in detail above in section D, part 3, "Physical and functional description of the environmentally optimal alternative."

Environmental indemnity feature of EWA: The EWA that we envision would have responsibilities commensurate with its means. Ideally, it would have the ultimate *authority* over estuarine protection and restoration, exercising "environmental water rights," acquiring delta farmland and converting it into tidal wetlands, administering restoration funds, etc., *and funding sufficient to perform these functions.* As such, it should ideally also have commensurate *responsibility* for estuarine protection and restoration. We describe here the 1) responsibilities, 2) governance and 3) funding for such an entity:

- ***Responsibilities:*** *On condition that it is endowed with sufficient means,* the EWA would assume the ultimate responsibility for complying with federal and state water quality, endangered species, and other environmental regulatory requirements with respect to the Bay-Delta resources. This would provide a very large "water supply reliability" premium that none of the CalFed alternatives can match. We do not propose changing the applicable state or federal environmental laws that impose regulatory burdens on the delta water users. Rather, we propose that the EWA would *indemnify* these parties against the loss of water that might be associated with these programs.

- ***Governance:*** An EWA with this degree of responsibility must have an unambiguous mission and the intellectual as well as financial resources to pursue it. Thus, we propose that the EWA be established as a joint federal-state commission, governed exclusively by environmental interests. The board might be comprised half of heads of environmental agencies and half of representatives of private sector environmental organizations.

- ***Funding:*** Funding should come from four sources: 1) Category III

commitments; 2) fees for extractions of water out of the central valley water system, with appropriate differentials reflecting relative impacts on aquatic environments and the economic value of water in the agricultural and urban sectors, and with appropriate credits for payments already assessed under the CVPIA; 3) recapture of a portion of the excess profits accruing in water transfers, and 4) public funds from the U.S. Department of Interior and the California state government appropriate to the creation of a national wildlife refuge or recreation area.

2. Institutional arrangements for conjunctive water management

The state-wide, maximal scale conjunctive use program that NHI is describing in its feasibility study can be set up without new legislation, purely on the basis of voluntary, contractual arrangements among the essential interests. These include the owners and operators of the terminal reservoirs on each of the controlled tributaries to the central valley water system (U.S. Department of Interior, California Department of Water Resources, Merced, Modesto, Turlock Irrigation Districts, and the Yuba County Water Agency), the owners of the conveyance and transfer facilities (USBR and DWR), the water districts and farmers who will provide the groundwater storage services (either direct recharge or in lieu), the municipal water agencies who will purchase portions of the yield, and the other end users of the new yield, including the fish and wildlife agencies and/or the EWA. While complex, there is nothing in the master agreement that will require additional powers or authorities or that would pose practical barriers.

3. Demand management--water conservation

For purposes of this paper, demand management refers to urban and agricultural water conservation and reclamation.

Urban conservation is currently weak in two areas: 1) not all urban agencies are implementing Best Management Practices at the levels required by the Urban Conservation MOU; and 2) conservation programs for residential landscaping have not been implemented.

Urban reclamation is improving rapidly, but many desirable reclamation programs have not been implemented because the environmental benefits of the programs have not been incorporated into the benefit side of the analysis.

Agricultural conservation is highly sensitive to the cost and alternative value of water. In many agricultural districts, the cost and alternative value of water remains too low to justify further improvements in efficient water management. In our view, further progress in agricultural water efficiency improvements is constrained not by technology and techniques--which are readily available--but by the lack of financial incentives to make economically rational from the standpoint of the farmer and the district. NHI, the Bureau

of Reclamation, the University of California, and several agricultural water districts are exploring the conservation potential of various types of incentive programs. Our preliminary conclusion is that the easiest and most efficacious device is simply to provide a market alternative, at prevailing rates, to the excessive application of irrigation water.

NHI proposes the following actions to improve water user efficiency:

- ***Improved water transfer regime.*** The creation of the institutions and the infrastructure needed to support a vigorous market in water (discussed below).

- ***Water diversion fees.*** Much of the funding needed for the NHI alternative will be generated through water diversion fees. These fees can be structured so that at least a component is roughly proportional to the environmental impacts caused by the diversions. Thus, water users that continue to draw large amounts of water from the delta during dry years may pay a large price per acre-foot, while those that only divert water during wet years will pay a much lower price per acre foot. By explicitly assessing the environmental costs of diversions, not only can money be generated for environmental restoration, but signals can be sent to water users which will encourage more efficient water use.

- ***Upgrade the urban conservation pricing BMP to mandate increasing block rate pricing.*** These measures would encourage a gradual shift in residential landscapes toward higher efficiency without the need for expensive district level programs.

4. Facilitated water transfer regime

Enhanced water transfers are essential to all of the existing CalFed alternatives. Transfers play an even larger role in the NHI environmentally superior alternative. Indeed, if current constraints and impediments to water transfers could be overcome, the market itself would provide for the incremental water needs of all sectors in California (including the environment, assuming that it has the purchasing power to enter that market, as the NHI proposal would provide).

Water used in agriculture has varying productivity depending on the crop and location of use, as well as on individual grower characteristics. Analysis by the University of California shows the least productive 20% of all water used in California agriculture generates only 4% of all state farm sales.[1] A functioning water market could readily mobilize the surface water fraction of the 20%, amounting to over 1 million acre feet per year,[2] for all unmet needs in California, including use in higher value agricultural applications. Moreover, both the theoretical and empirical evidence confirms that the most efficacious method for tapping that low-productivity water is by creating market incentives for more efficient use.

Water transfers can also be a "least-cost" method of complying with the environmental water requirements of existing laws and regulations, including the Bay-

Delta Water Quality Control Plan and the Anadromous Fish Restoration Plan of the CVPIA. Thus, a proactive program of removing the artificial constraints to water transfers is a key part of the NHI alternative.

In sum, transfers are a key mechanism for:

- providing for increased freshwater throughflows in the delta;
- increasing water supply for both environmental and consumptive uses through conjunctive water management;
- stimulating water efficiency improvements in agriculture; and
- augmenting water supplies for consumptive users.

NHI recommendations for removing the artificial constraints to water markets are presented at length in other papers which will be attached to the final version of this proposal as technical appendices.

F. Guarantees

A key attribute of a viable long-term alterative will be the ability of that option to provide some measure of assurance to all sectors that their respective benefits are safe from future corrosion. This is challenging because some sectors will receive their benefits before others, and in some cases, the costs will have to be incurred before the benefits accrue. Moreover, there is always an appreciable risk that putative benefits will fail, that laws will be broken or promises will be breached. Thus, NHI recommends that guarantees be premised to the maximum extent possible on physical limits. For example, an east side facility is desirable to permit abandonment of the delta levees and wholesale conversion of the delta to wetlands. It is also desirable to facilitate conjunctive water management. But a smaller facility is recommended to physically limit the potential for increases in north-south diversions.

The best guarantee of reliability for all sectors is a long-term solution that works; that is, one that provides increased water supply reliability for agricultural and urban water users and results in the recovery and maintenance of a diversity of natural habitats and key species. NHI is confident that we have proposed the broad outline of such a solution. Nevertheless, the NHI proposal includes several basic institutional mechanisms to insure, to the maximum degree possible, a level playing field:

- ***Adopt CalFed concept of phased linkage of environmental and water supply/quality benefits.*** This would involve, for example, creating institutional tools prior to plumbing. Thus, the EWA would be fully operational prior to the construction of the isolated transfer facility.

- ***Implement water transfer and other reforms that would allow the market to play a greater role in water allocation.*** Water will be allocated efficiently if the market is allowed to function. Thus, water transfer reforms must be linked to changes that allow the environment to be a full partner in resource allocation decisions, such as a guaranteed income stream for the EWA.

- ***Composition and governance of the EWA.*** The EWA is at the center of the NHI proposal. The physical components of the proposal will not function effectively or provide significant environmental benefits without this institutional overlay. Thus, the most significant institutional checks and balances will be required with regard to the functioning of this institution. These should include at a minimum:

  * Political insulation re: selection of governing body.

  * A guaranteed and politically isolated income stream.

  * Specific legal authority to carry out responsibilities.

  As discussed above, the authority, autonomy and means of the EWA to protect the environment should be linked to its responsibility to cover environmental liabilities. Thus, the greater the means placed at its disposal, the greater should be the degree of regulatory relief that the EWA provides the water users. Only if environmental interests are accorded autonomy in governing the institution would it provide regulatory indemnification to water users. Conversely, if the water users are represented on the governing body, then these users must remain ultimately liable for compliance with the state and federal environmental laws. Moreover, indemnification by the EWA should be made expressly conditional upon the water users compliance with all of the commitments and obligations incumbent upon them in the CalFed solution that is ultimately selected. That solution must be structured so that defaults, such as has occurred in connection with the Category III obligations out of the Delta Accord, will have tangible consequences.

- ***Build into the CalFed solution "insurance" against unusual risks.*** In addition to defaults, the gravest risk to stakeholders is that anticipated benefits or costs will be reduced or exacerbated by crisis events, such as a prolonged drought. The best coping mechanism is to set up the system with maximum resilience, such as tradable rights, groundwater banking, adequate funds for environmental water acquisitions, etc. The additional costs, if any, should be regarded as insurance premiums that will insulate the beneficiaries against future risks that, while infrequent, are inevitable.

G. Feasibility

Is it feasible to utterly transform the San Francisco Bay-Delta Estuary, the heart of the most developed water system in the world, into the largest system of restored wetlands ever created? Tidal wetland restoration in the delta is not only feasible, but inevitable, at some scale. This project is designed to push the art of the possible to the maximum extent. Here are some important factors in assessing the feasibility:

1. This proposal merely accelerates land use changes in the delta that are inevitable over the longer run because the subsidies and other special conditions on which current uses depend are simply not sustainable. It is only a matter of time before seismic events will cause a massive failure of the levee system. No amount of money can prevent this from happening. Our scenario would provide an opportunity for the delta farmers to rescue themselves before an inevitable disaster occurs. This is an alternative that is bound to be attractive at some price. We need to determine that price and factor it into the economic analysis. Buyouts would certainly be less expensive than the cost to both landowners and water exporters of a massive failure of the levees.

2. The land and water transfers necessary to make this alternative work will be wholly voluntary. While some delta landowners may resist the changes in the subsidy structure that we will promote, they are hardly in a position to justify their continuation on the basis of public benefits. We will design an acquisition program that is as accommodative as possible. Borrowing from techniques that have been developed elsewhere, we may, for instance, propose approaches that permit existing land uses to be continued during the lifetime of the current owner. We expect the dialogue with these interests to be one of the most challenging parts of this project, but the success depends on our ability to convince the agencies that provide those subsidies, not the delta landowners themselves.

3. This project will not be the first one in which wetlands were created on lands that were tens of feet below sea level. The engineering challenge has more to do with scale than with technique. By harnessing the most experienced wetland ecologists and engineers in the business, a feasible program can be described. Once again, the fundamental issue is likely to be the cost of various solutions. This can only be determined by a program of investigation of the sort outlined here.

4. The institutional innovations called for in this alternative are based upon precedents that have sufficient operating experience to allow the necessary adaptations to be described with reasonable confidence. NHI has already done a great deal of research and design work on this component.

5. The benefits of a new national wildlife refuge of these dimensions on the threshold of the San Francisco Bay Area should be politically compelling. This could be simply the most exciting environmental restoration project ever attempted adjacent

to a major metropolitan area.

6. The costs of this program would be substantial, but not excessive in comparison to 1) the obvious benefits, 2) the costs of other alternatives being considered by the CalFed process, or 3) the costs, especially, to landowners and water users in the case of a catastrophic failure of the current levees.

The comparison of the NHI alternative with the current "preliminary draft alternatives" generated by the CalFed program to date, at pages 3 - 4 of this paper further illustrates the practical advantages of the NHI approach. In sum, there are no technical or economic reasons to shrink from the bold thinking that this alternative requires.

H. Possible Variations

The NHI alternative is presented as a starting point for analysis, not as a definitive solution. Possible changes in the alternative which might be worth considering would include:

- ***A smaller isolated system.*** Urban areas south of the delta need probably less than 2 MAF per year. 2 MAF can be generated with an isolated system of less than 3 kcfs. However, the smaller the isolated system, the more essential it becomes to segregate the urban water--and the more difficult, since the export canal system cannot be dedicated to urban use at such low flows. One possible solution which would allow for a very small isolated system would be a dedicated urban reservoir near the export pumps. For example, if Los Vaqueros Reservoir were expanded to its potential capacity of 1 MAF, then urban water could be accumulated in the Reservoir over a period of months, then sent in a large slug to Southern California when agriculture is not drawing heavily upon the export system. The water then would be stored in southern California reservoirs for later use.

  Two problems would need to be faced with a very small isolated system. The first is salinity intrusion. The NHI proposal envisions opening up the delta on a large scale. This could cause salinity intrusion to such a degree that the total exports would drop to unacceptable levels. Secondly, the smaller the isolated system, the more water must continue to be pumped from the south delta. But pumping from the south delta may be incompatible with large scale delta environmental restoration--the take of fish could rise to unacceptable levels. These considerations dictated a larger size facility in the current version of the NHI alternative.

- ***South of delta offstream storage.*** Offstream storage might be used in conjunction with a very small isolated system as discussed above. It could also be used to increase the potential for conjunctive use in the Southern San Joaquin Valley. This is discussed above.

- ***Bay-Area recycling project.*** This proposal would send some 200 kaf of treated wastewater from the Bay Area into the export agricultural areas. It could be added to this proposal or could be treated as yet another reclamation alternative, to be decided upon later.

- ***The Core Elements and Essential Elements.*** The CalFed Program includes numerous "core" and "essential" elements. Time and space limitations preclude discussing all of them in detail. However, many of them are compatible with the NHI alternative. Our purpose was not to provide a fully articulated alternative, but only a general outline.

Section II
Why an Environmentally Optimal Alternative Needs to be Considered

A. Legal requisites

NHI proposes that CalFed Program study in detail one or more alternatives that are designed specifically to maximize environmental benefits. This paper has described one such alternative at a level of detail comparable to the present Program alternatives. This NHI alternative will fully satisfy all of the objectives of the CalFed program. In fact, it will provide far greater environmental benefits than any of the CalFed alternatives to date while providing very high levels of water supply reliability.

The legal standard enunciated under NEPA and CEQA for consideration of alternatives in EISs and EIRs is similar. Under both statutes, the environmental review process is legally infirm and vulnerable to being overturned by a reviewing court for failure to evaluate a reasonable range of feasible alternatives, including, particularly, alternatives that are environmentally superior or optimal, as contrasted to remote, speculative or unrealistic. This proposal addresses the physical and economic feasibility of the NHI alternative.

Thus, under the regulations and case authorities governing the federal and state environmental review processes, CalFed is not at liberty to ignore a reasonable and environmentally superior alterative. The NHI proposal would fully attain all of the CalFed objectives while providing substantially greater environmental benefits than any of the alternatives now under review. We believe that the law requires that this alternative be accorded full consideration in the EIS/EIR for the long-term Bay-Delta solution.

B. CalFed's "preliminary draft alternatives fail to include an alternative designed to maximize environmental benefits

The alternatives sketched by CalFed do not include a reasonable range of practical alternatives capable of satisfying the established objectives. Specifically, the range does not include an alternative designed to maximize environmental benefits. In fact, the environmental improvements embedded in the range of alternatives now under refinement by CalFed are quite modest compared to the potential.

Compared to the CalFed alternatives, the NHI alternative:

- Converts or restores about 350,000 acres of land--much of the delta--to high quality aquatic and wetland habitat, compared to an area on the order of 10,000 acres in the CalFed alternatives.

- Dramatically reduces the impacts of entrainment caused by water diversions into the delta islands.

- Significantly reduces, over time, the need for continuing and costly levee maintenance programs within the delta.

- Makes explicit institutional proposals which: (1) allow for the acquisition of new environmental water at low cost and with few environmental side effects; and (2) fund the environmental measures in ways that will encourage better water management by water users.

Importantly, the NHI proposal may also provide substantially superior water supply benefits by including strategies to maximize certain institutional reforms that are incipient in a more modest form in the CalFed alternatives. For instance, the NHI alternative would:

- Provide indemnities to protect water users against future regulatory changes.[3]

- Augment the yield of the developed water system by 1.4 million acre feet through a maximal scale, state-wide conjunctive water management framework.

- Reallocate as much as 20% of the water now used in agriculture for unmet needs in that and other sectors (including the environment) through voluntary, compensated market transfers.

C. Why the CalFed alternatives tend to be too narrow

The CalFed alternatives at present explore various combinations of physical modifications to the Bay-Delta system, assuming (1) all key stakeholder groups must receive benefits within each package and that (2) institutional elements can be limited to those needed to make the physical modifications work, and these can be grafted onto each package at a later date. These planning predicates necessarily produce suboptimal results for the environment and, probably, for water users.

Selecting alternatives so as to avoid disbenefits to any identifiable constituency assures that they will be limited to modest departures from the status quo. Respecting that the CalFed process is designed to engender consensus solutions and assure linked benefits to stakeholders, starting from the premise that all interest groups exercise an effective veto is unlikely to provide for the achievement of maximal potential benefits.

In NHI's view, the program goals should not be to avoid pain for every water user or every environmental asset or any participating interest. Rather the goal should be to provide maximal possible net benefits to the four principal stakeholder sectors (environmental, urban, agricultural and commercial fishing). The net benefit concept makes allowance for the fact that within each sector some parts may achieve advantages and some may suffer losses, but the sector as a whole will achieve the maximum payoff. If this cannot be accepted, then the potential for dramatic improvements in the beneficial uses of the waters of the state by all three sectors will be greatly limited. In other words,

the better approach would be to get all reasonable and practical alternatives on the table and then seek to build a critical mass of consensus among the key constituencies through a highly participatory process of investigation and consideration. That is what we seek to do in proffering this environmentally optimal alternative.

As a prime example, the CalFed Program has not squarely faced the intrinsic conflict between delta agriculture and the environment or the long-term unsustainability of delta agriculture. Instead, it has attempted to satisfy everyone by including major levee improvement projects in all alternatives to placate delta agriculture, while creating habitat along the fringes for the environmental community. This approach will necessarily lead to suboptimal solutions.

First of all, agriculture on many of the delta islands can be sustained in the short term only through major subsidies. In the long term, much of agriculture is probably unsustainable. The islands will eventually flood, the landowners and the state and federal governments will refuse to pay for restoration of the islands, and the delta will become littered with deep embayments, of low habitat and economic value. The problem worsens with every year that agriculture continues to operate in the delta. Secondly, restoration of the delta environment is simply impossible without major expansions in the amount of land dedicated to habitat. By protecting delta agriculture, the CalFed Program assures that it cannot achieve environmental restoration.

CalFed can cut this Gordian knot if it stops trying to please every stakeholder and accepts that delta agriculture on many islands is unsustainable and should be ended. Instead of subsidizing levee improvements and levee repair or creating expensive new levees on the deep islands--all so that agriculture can continue for a few more years at great expense to the taxpayer--the CalFed Program should propose to purchase all islands where permanent inundation is reasonably foreseeable without major state and federal subsidies, and manage the land for environmental purposes.

1. Conversely, the most productive 5% of water used in California agriculture produces 20% of all farm sales. David Zilberman, Richard Howitt and David Sunding, "Economic Impacts of Water Quality Regulations in the San Francisco Bay/Delta Estuary," UC Berkeley Department of Agricultural and Resource Economics, May 1993; David Sunding, David Zilberman, and Neal MacDougall, "Water Markets and the Cost of Improving Water Quality in the San Francisco Bay/Delta Estuary", Hasting's West-Northwest Journal of Environmental law and Policy 2 (Winter 1995): 159-165.

2. The least productive million acre feet of surface water used in the Central Valley produces only $30 million in farm sales. This is less than 0.2% of state farm sales, or $14 million in grower profit. David Sunding, "Economic Impacts of Market Implementation of Bay/Delta Water Quality Standards", UC Department of Agricultural and Resource Economics, May 1994.

[9] These institutional mechanisms should have utility, whichever solution is ultimately chosen by the Program.