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MARKET PRICE/ INDEXING MECHANISM FOR WATER TRANSFERS

Report to

The San Diego County Water Authority

by

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EXECUTIVE SUMMARY

The San Diego County Water Authority (San Diego) and the Imperial Irrigation District (IID) are negotiating a 75-year water transfer agreement. Because of the unusual length of this agreement, both parties wish it to include some measure price flexibility. The goal of this flexibility is to reflect the situation in California's water market as it evolves over the life of the proposed contract. This report explores options for including price flexibility in the proposed agreement.

First, the report discusses aspects of the proposed agreement that could influence the contract prices relative to those of other water transfers. The factors identified are:

- water supply reliability;
- water quality;
- type of transfer (base load or dry-year);
- the proposed use of the water (municipal and industrial); and
- the cost of developing the water for sale.

The report then identifies water conservation programs likely to be undertaken by IID to develop water for the proposed transfers. While these programs may involve some canal lining, the emphasis probably will be on the construction of tailwater return systems, reservoirs and interceptors. These facilities will allow for more-efficient operations while avoiding the spillage that these operations would entail under the current system configuration. Thus we expect that the major costs to IID will be: construction costs including the cost of land taken out of agricultural production; and electricity costs for pumping water out of these reservoirs. There will also be some increased labor costs to allow for flexible operations.

Next, the report discusses price indices in general, and some specific price indices that could usefully be considered for inclusion into the contract. These indices are:

- The consumer price index for Southern California
- Construction cost indices, including the Handy Whitman™ concrete price index and other construction and equipment price indices of specific water utility expenditures.
- Electricity price indices, including Western Area Power Administration electric rates and the Dow Jones index of electric prices at the Palo Verde switchyard.

The following section of the report reviews a series of water transfers that could be included in the development of a specific water price index. The prices of most of these transfers are either cost-based or administratively determined, and so do not adequately reflect market conditions. However, four proposals that are now under development may have the potential to provide appropriate market indications in the future. At present only one of these is operational, and it is providing unreliable data from a limited market. The proposals that may prove useful in future include:

- the Department of Water Resources' proposal for negotiated option contracts;
- Kern County Water Agency's proposals for multi-year contracts;
- the proposed Arizona groundwater bank; and,
- the Westlands electronic bulletin board for water trading.

The report next presents the results of a statistical analysis of identified water trades from 1988 through 1994. Because of the wetter hydrologic conditions in recent years, there have been few water trades for inclusion in this analysis. Our analysis was restricted to trades within California and the Lower Basin of the Colorado because this defines the market region from which San Diego is physically able to obtain water. We also restricted our analysis to those transfers for which we could identify adequate price information. While the statistical results of this analysis appeared acceptable, we do not believe that they are credible. The range of transfers analyzed is very limited: all supplies have full reliability; most are for one year only; and only one is from the Colorado River. This means that we could not test adequately for price variations that reflected possible variations in the type of transfer.

Despite these concerns, we constructed an index based on this analysis and reported the index values for 1989 through 1994. This exercise identified further problems with this approach. In most years there were few water transfers that could be used to construct the index, and in some years there were none at all. This leaves the index open to being unduly influenced in any one year by an atypical transfer. Such a transfer could be priced to reflect some facet of that contract that we would not want to include, yet cannot remove from the data. For example, the one Colorado River transfer included in our analysis was the Palo Verde/MWD agreement that involved land-fallowing. The San Diego/IID transfer does not include land fallowing, so we would prefer to exclude any resulting influence on prices. Unfortunately we do not have sufficient data to allow us to achieve this.

The report then presents a cap and floor for the price adjustment mechanism. San Diego's interest in the proposed agreement is to obtain water more cheaply than that supplied by MWD, and IID's interest is to earn more from the sale than it pays to develop the water for the sale. This suggests that the cap should be defined so that the transfer price minus the transportation cost should not exceed MWD's untreated water charge to San Diego, and the floor should be IID's conservation program costs. To make the proposed contract a little more attractive, we suggested that the cap should be 95 percent of MWD's charges, and the floor 105 percent of IID's costs. This guarantees that both parties will gain something from the contract. An alternative floor price could be based on the construction cost and electric power indices; this proposal would provide IID with an incentive to keep its costs low, and would enable it to gain additional benefits from any cost control it was able to achieve.

Finally, the report suggests that the cap and the floor could be used to develop a "split-the-savings" approach to determining a price index. Under this proposal, the price index would be developed by averaging the cap and the floor for any year. This may be the most appropriate approach to price indexing in the initial years of the proposed contract.

MARKET PRICE/INDEXING MECHANISM FOR WATER TRANSFERS

I. INTRODUCTION

The San Diego County Water Authority (San Diego) and the Imperial Irrigation District (IID) currently are negotiating a proposed water transfer agreement. This proposed agreement calls for IID to conserve a portion of Colorado River water supplied to its district and to allow San Diego to take delivery of that conserved water. The early part of the negotiating process has resulted in the development of a Summary of Draft Terms (SODT) outlining the current status of negotiations. The SODT includes a proposed schedule for the size and prices of transfers in the opening years of the agreement. As outlined in the SODT, the initial term of the proposed agreement is 75 years. This is an unusually long time-frame for water transfer agreements, and both participants are concerned that the continuing evolution of water markets might render the current proposed agreement uneconomic to one of them. In recognition of this concern, the SODT includes a section granting either party the right to adjust the contract price to reflect future market prices. The SODT also envisages the use of a price index to for such adjustments. This report analyses the type of price index that should be considered by the parties to this agreement.

The report is divided into the following sections:

- Section II summarizes the relevant features of this proposed agreement to be considered when designing the price index.
- Section III discusses price indices in general, and some specific price indices that could be useful for inclusion in this agreement.
- Section IV discusses a number of water transfer programs that could be considered as market indicators for the purposes of this agreement.
- Section V outlines statistical analyses we have conducted of past water transfers. This analysis identifies key features that influence the price of water transfers.
- Section VI presents a water price index that arises from this analysis, discusses how the index would have performed in the recent past, and problems inherent with this index.
- Section VII proposes price caps and floors, and also suggests ways that these could be incorporated into an alternative price index.

II. RELEVANT FEATURES OF THE PROPOSED AGREEMENT

There are five features of this agreement that must be considered in developing a price for water transfers. These are discussed below.

1 The reliability of the water to be provided by IID. There are extensive storage facilities on the Colorado, and IID has high priority rights to the water provided through those

facilities. The SODT suggests that San Diego will be required to share proportionally with IID any cutbacks of this Priority 3 water. Because of the high priority of this water right, the supply should be considered extremely reliable. This increases the value of the water considered for this transfer.

2. The quality of the water to be provided by IID. Water from the Colorado has high TDS levels, and so should not be considered particularly high quality.

3. The type of proposed transfer. Transfers can be considered either "core" (provided in all year types) or "dry year". Dry year transfers are considered more valuable because they provide water when supplies are scarce. This water transfer is a "core" or base load transfer, and should be considered less valuable than dry-year transfers but more valuable than low-reliability supplies.

4. The proposed use for the water. San Diego proposes to use this water to satisfy requirements for Municipal and Industrial (M&I) water users. Contracts to supply M&I water users often command higher prices than those to supply agricultural water uses.

5 The costs of obtaining the water. Most water supply contracts are in some way cost-based; that is, the supplying agency attempts to ensure that the costs of supplying the water will be reimbursed by the purchaser. Where the method for supplying the water includes land-fallowing, a higher incentive is generally felt necessary to reimburse for the loss of income that this activity will entail. The SODT specifically states that no land-fallowing is envisioned for this program.

Very little is known about IID's likely unit cost for the proposed agreement. IID is considering a range of conservation programs. From those programs under consideration by IID, we selected those for which IID had estimated the level of water savings. These are reported in Table 1, and are the programs that we believe are most likely to be implemented. All of these programs conform to the SODT requirements in that they do not include land fallowing. They are further restricted to programs that do not require cropping changes, because we believe that these will be driven more by market imperatives than by conservation programs. However, the major emphasis of this program is on increased water storage facilities that will be used to regulate water flows or to control return flows. The land on which these facilities are constructed will most likely be agricultural land, and so that land will be taken out of production. We have assumed that the cost of retiring that land will be included in the facility cost of each program, and no further allowances will need to be made to compensate for this lost production. The table includes conservation programs whose estimated annual yields total more than the 200 thousand acre-feet (TAF) called for by the contract.

The summary table suggests that the major sources of water conservation will be through construction of additional reservoirs and interceptors, and tailwater control programs. This tailwater control could be achieved through many programs:

- a continuation of the program to construct tailwater control programs as included in the current MWD/IID agreement;

- more-efficient irrigation, including a wide range of technologies from drip emitters through laser leveling of fields; and,

- water management changes including variable scheduling and on-farm regulating reservoirs.

Because each of these programs target the same water for conservation, we have included them all under the category of tailwater control to avoid double counting.

Table 1
Conservation Programs Under Consideration by IID

Program Description	Estimated Maximum Annual Yield (TAF)	Years for Installation
Canal/lateral concrete lining	4.3	One year
Mid lateral in-line reservoirs[1]	46.2	Twelve years
All-American Canal Reservoirs	21.4	Two to four years
Interceptors w/ auto checks[1]	48.7	Eight years
Tailwater control[2]	103.2	Variable
Urban Water Conservation	17.3	50 years

[1] It is not clear whether these two programs target the same conservation opportunity. Both of these target lateral discharges, which are estimated to be equal to 115 TAF. In its evaluation of both of these programs, IID discusses the Plum-Oasis lateral interceptor as a model for future construction without designating that the two programs are mutually exclusive.

[2] This category includes tailwater return systems, flexible scheduling and more-efficient irrigation technologies (such as drip or linear tracking irrigation). Each of these options target the saving/re-use of tailwater. To avoid double-counting, we have only included conservation of tailwater in one sector.

Source: Imperial Irrigation District: Memo to the General Manager dated January 9, 1996. Water Requirements and Availability Study.

III. PRICE INDICES

Price indices are routinely calculated for a wide range of goods and services, and are used for a variety of purposes. One of the most commonly-known price indices is the consumer price index (CPI) that reflects changes in the cost of living. The Commerce Department produces a range of consumer price indices. All of these indices reflect a general change in the level of some group of prices over time. There are price indexes that reflect the change in the cost of living by region. For example, for California there are three widely-used CPIs. These reflect

changes in prices in the Los Angeles basin, in the San Francisco Bay Area, and across the state as a whole. It is important to note that each of these indices reflect the change of prices over time for the specific region. The indices are not valid for price comparisons between the regions. If the price index for Los Angeles is higher than that for the Bay Area, this merely means that prices have been rising faster in Los Angeles. It does not necessarily reflect that the level of prices is higher in Los Angeles than in San Francisco.

The CPI is constructed by surveying (usually on a monthly basis) to discover the prevailing price for a fixed market basket of goods. These prices are adjusted to reflect any quality changes in the goods purchased. For example, the price individuals typically spend on computers has remained relatively constant over time, but the quality of the computer purchased for that $1500 to $2000 has changed markedly over the years. Conversely, over time the price of automobiles has risen dramatically over the last decade, but the quality of those cars, particularly in the areas of safety, reliability and fuel consumption has also increased. If the quality changes of both of these products had not been adequately reflected, the CPI would overstate the increase in the cost of living. The adjusted prices are then weighted to reflect the relative proportion of consumer spending on each of the goods surveyed.

Through time, the bundle of goods in the CPI "basket" changes to reflect the changing tastes of the nation's consumers. Sometimes these changes merely reflect a reweighting of the mix of goods in the basket. At other times new goods must be added to the basket. Once again, computers are a prime example of this; two decades ago, this category likely would not have figured in the consumer's purchasing habits, but today it is a significant contributor to the CPI. The nation is in the midst of a policy discussion over whether the adjustments to the CPI reflect adequately the changes in the consumer marketplace, or whether the current procedure should be more drastically modified than it has been in the past. One recent criticism is that the surveys canvass the same stores as they did a decade ago, whereas consumer buying patterns have changed. Consumers are much more likely to make purchases from discount stores and to the extent that prices are lower in these stores the survey's reliance on prices from the currently-sampled sources (such as department stores) will overstate consumer costs. Any price index should be adjusted to reflect such changes in consumer tastes and habits, as well as changes in the quality of goods purchased.

Indices of items other than water transfers could be considered for inclusion in the agreement. These include:

- The CPI for Southern California. This could be used to ensure that IID gains the same monetary value from payments from San Diego, and protects IID from losses due to inflation. This could be worthwhile, given that IID will pay much of the necessary money in the first years of the contract and San Diego's repayments will stretch over the full life of the contract.

- Construction materials cost indices. Many of the conservation programs will include concrete and construction labor. Indices of these are available from *The Handy-Whitman*

Index of Public Utility Construction Costs[1]. These data are reported by region, and examples of these indices for the Pacific Region are provided in Appendix A of this report.

- Construction and equipment price indices related to specific water utility expenditures, such as electric pumping equipment and reservoirs. These are also available from *The Handy-Whitman Index of Public Utility Construction Costs*, and examples of these indices for the Pacific Region are also provided in Appendix A of this report.

- Indices of electric power costs. IID supplies much of its own power needs from a variety of sources: from hydroelectric generation on the All-American Canal, and from its partial ownership in the Palo Verde nuclear generating station and the Heber geothermal generation station. In addition, it purchases power from Southern California Edison's Yucca plant, and, through the Western Area Power Administration (WAPA) it purchases electricity generated at Parker-Davis. The WAPA contract is valid through 2007, but the applicable rates are revised regularly. The rates in the WAPA Parker-Davis supply contracts could be used to construct a price index for electricity.

  A better alternative would be to use the published Dow-Jones index of electricity prices at the Palo Verde switchyard. This is the indicator price for power trading in the southwest region, and is available on a daily basis for firm and non-firm, peak and off-peak power. An example of the data available for this index is also provided in Appendix A.

Despite the ready availability of these indices, it would be preferable to develop an index that reflects the situation in California's water markets. To construct such an index, the analyst has to monitor not only the price of purchases, but also whether the mix and the quality of those purchases are changing over time. There are a series of water transfers that have taken place in the past, and will take place in the future that we will want to include in our index. We need to decide how to adjust for the lack of uniform quality and reliability of the water purchases, and decide what water purchases should be included in our water market proxy. However, we must also be aware that over time this index may need to be revised, just as the Commerce Department revises the CPI on an infrequent basis.

In constructing price indices, it is important to distinguish between spot and contract prices. Spot prices are paid for contracts for immediate delivery, while contract prices are for long-term deliveries. By their nature, spot prices are more volatile, moving low when supply is plentiful and demand is low, and high when supply is tight and demand is high. Contract prices are naturaly more stable, and unless there are unforeseen changes in the market structure contract prices should fall between the lows and the highs of the spot market. When constructing an index for a long-term contract, it is best not to reflect the inherent volatility of the spot market. Both parties have presumably entered into a contract to avoid just this uncertainty, and so the uncertainty should not be reintroduced. The index for a long-term contract should either reflect

[1]*The Handy-Whitman Index of Public Utility Construction Costs*™, compiled and published by Whitman, Requardt and Associates, 2315 Saint Paul Street, Baltimore, MD, 21218.

other long-term prices, or be a rolling average of spot prices to smooth out the more volatile fluctuations. This is particularly necessary if price adjustments are to be made infrequently. For example, if a water contract is to be adjusted once every five years, and then the adjustment is made on the basis of prices in that year alone, the price for the next five years would depend on the market situation at the time of the adjustment. This could result in the price being set unreasonably high (if the index year reflected 1991 conditions) or unreasonably low (if the index year reflected 1997 conditions).

IV. OTHER WATER TRANSFER PROGRAMS

A major difficulty with reaching an accord for water pricing under the proposed agreement is the immaturity of water markets in California. While there is a great deal of water trading underway in California, most of this is short-term (for a single season) and within a single water district. Often, the water is being used by the same individual as before the transfer, but is being applied on a different parcel of property than that to which the water right is assigned. Alternatively, two farmers within a water district may agree to exchange the timing of water deliveries to manage water application more efficiently without changing the total amount of water delivered to either farmer. Neither of these activities are water transfers in any real sense; rather, they are examples of informal flexibility in delivery schedules and diversion points. In most of these cases, no money changes hands, and no water rights are transferred either temporarily or permanently. These activities cannot be described as part of a water transfer market.

There have been more recent examples where both water and money has changed hands. These specific programs are described below.

A. The State Water Bank

During the drought year of 1991, the California Department of Water Resources (DWR) set up a water bank to manage transfers from willing sellers to willing buyers to ameliorate the worst of the expected costs of water shortages. DWR set a buying price of $125 per acre-foot (AF), and a selling price of $175. In addition, buyers had to pay transportation costs to deliver the water from the seller to the buyer. Because the prices were administratively set, they cannot be said to reflect market conditions. In fact, because the amount of water sold to the water bank exceeded the amount of water purchased from the water bank, it can be safely assumed that the administratively-set price was too high for market conditions at that time.

The State Water Bank has continued to operate since its inception, but with lower prices. In both 1992 and 1994, the Bank purchased water at $50 per AF. In other years the bank did not make purchases because of the amount of water available in the State Water Projects (SWP) storage facilities. In those wet years the market price of water appears to have been below the administratively-set price. This history emphasizes that when water is plentiful and purchasers are few, the price of water is low; when water is scarce and buyers are more numerous, the price of water will be much higher.

The prices quoted are those for the seller. The buyer may have to pay an extra 30 to 40 percent to cover losses, and $50 to $150 per AF for transportation, depending on the buyer's location. The transportation costs include the cost of electric power for pumping and the cost of facilities.

DWR is just commencing a new program to replace the State Water Bank. This program will seek to develop option contracts with willing sellers. The sellers will be paid a small amount (assumed to be approximately $3.50 per AF) for agreeing to sell an option to DWR. The contract will also have a date by which that contract must be exercised, and some idea of the frequency of that exercise. For example, a current possibility is that the options will be able to be exercised once with in a five-year period, with the option expiring at the end of that time. An additional fee will be paid at the time the option is exercised. Both the option and the exercise fee will be subject to negotiation, but the exercise fee is expected to be in the range of $36 to $42 per AF. There are no current plans for these contracts to contain an escalator, although this may arise during negotiations. DWR is planning to work with an option pricing model developed by Patricia Waters of MWD before she joined that organization.

This new program currently is undergoing environmental review and is expected to be approved during this summer, with initial negotiations occurring soon after. The environmental documentation assumes that a maximum of 400 TAF of options will be exercised in any one year. Department staff believe that this is probably much more than they will need or be able to attract. Because these prices are to be negotiated, as the parties gain more experience with the program it is likely to become a more appropriate reflection of market conditions.

B. The Monterey Agreement

This agreement was a revision of SWP contractor terms and included language to encourage water transfers, particularly among SWP contractors. A key part of the agreement changed the way that annual water supplies were allocated, and because of this change some urban water agencies were likely to be allocated more water than they wished to consume. To encourage transfers of that excess water, the Monterey Agreement set up a "turn-back pool". Contractors can return water allocations to this pool, where it can be offered for sale to other SWP contractors. To encourage early turnbacks, a higher price of 50 percent of the contract price is set for water reassigned by an initial cutoff date of February 15. Any water that remains unsold at this time is held in the pool until a second cutoff date of March 15. At that time water is sold to SWP contractors for 25 percent of the contract price. Any remaining water can be purchased by DWR, and remaining water that DWR does not wish to purchase may be sold to non-SWP contractors.

The prices for these transactions are exceptionally low, and reflect the complex trade-offs that were part of the Monterey Agreement rather than water market conditions. The pool arrangement operated in 1995, and at that time water in the pool was sold to a non-SWP contractor (the Westlands Water District) and there was no water left in the pool. This suggests that in 1995 the pool prices set a floor on market prices — that is, in 1995, the market price of water was at least as high as the pool price. This year no purchases were made from the first pool, and it remains to be seen whether purchases will be made from the second pool. Current conditions suggest that water will be left in the second pool, thus establishing that for this year's market conditions the pool price is higher than the market price. While the operation of the Monterey turn-back pools give some indication of whether market prices are below or above the pool price, it does not enable us to determine the market price in greater detail.

SWP rates are based on the capital cost of facilities and actual O&M charges. In future, these might also include any charges developed by CALFED for wildlife mitigation or other Delta maintenance costs.

C. Kern County Water Agency

The Kern County Water Agency (KCWA) has jurisdiction over SWP water imported into the county for water agencies within the county. In addition to SWP water, county water agencies obtain water from the CVP, from the Kern River, and from groundwater pumping. Like many other regions, the county has an active water exchange program in place with contractors exchanging water, times and places of delivery. In some cases these are water-for-water exchanges, where no money changes hands. In other cases, where the exchange leads to financial savings the two parties will agree to share the savings equally (known as "split-the-savings" agreements).

In the late eighties, agencies within the county entered into a lawsuit over the allocation of SWP water supplies among county agencies during shortages. In settlement of that lawsuit, KCWA made allocation changes similar to those later included in the Monterey Agreement. Once again, this resulted in some water agencies being allocated more water than they currently need. However, the price of SWP water is higher than Kern River water, so those agencies could not re-sell their water within the district and recoup their full cost. To encourage use of SWP water in place of local supplies, KCWA provides money from a settlement fund to subsidize the resale of SWP water to other local agencies. Since these transactions are at a subsidized rate, they are obviously not a reflection of the market situation. There have been no transactions under this agreement: when excess water is available, there are no agencies that need to purchase water; when agencies have needed to purchase water, there has been none available for purchase.

KCWA is currently exploring entering into multi-year sales contracts. The contracts are envisioned to provide for a range of purchases, with the extent of that range being determined by the SWP annual delivery allocation. When deliveries are curtailed, less water would be provided to the purchaser, but a guaranteed minimum supply and purchase amount will be included in the contract. This proposal is currently before the KCWA Board for approval, and a decision is expected this month. After this, the proposal will need to be reviewed and approved by the SWP Contractors and DWR. If the Contractors are in unanimous agreement, DWR approval will be obtained readily. However, this is seen as unlikely. Without these approvals, KCWA will not be able to extend this multi-year contracting approach outside of the county. If these out-of-county agreements were developed, they would be appropriate to include in a water transfer price index.

KCWA is also actively involved in water storage within their aquifer. To date this has been restricted to storage for later use by the county agencies, but the water bank process will be opened to other purchasers in future. This proposal is undergoing environmental review. KCWA is also trying to develop long-term storage agreements with agencies within the county. These must be in place before the market can be expanded to agencies outside the county borders. With environmental approval and intra-county arrangements in place, facilities will be expanded to allow sales to agencies outside the county. When these storage contracts are in place, the associated prices would be appropriate for inclusion into a water transfer index.

D. Central Valley Project

Like those of the SWP, the contractors of the Central Valley Project (CVP) have long had informal water trading within districts to increase the efficiency of water delivery schedules or diversions. One aspect of the Central Valley Improvement Act (CVPIA) was an effort to formalize and broaden the scope of transfers to include inter-district transfers and transfers outside of the CVP. In response to the Act, in 1993 the Bureau of Reclamation (Reclamation) published a set of interim guidelines for the implementation of water transfers. These guidelines set no pricing standards, with the exception that any transfers sold to institutions that are not CVP contractors must return to Reclamation a rate that reflects the full cost of that water. This requirement was made because some agricultural agencies are not covering the fixed costs associated with their share of the project. Such an agricultural agency might sell its water allocation at a rate above its own costs, but still below the allocated cost at which it was supplied by Reclamation. In effect, the contractor would be selling both its water and its subsidy. Reclamation wants to avoid this situation, but the rate limitation has yet to be implemented.

CVP rates consist of interest repayments for the funds used to construct facilities and operations and maintenance (O&M) charges. Some of these charges reflect reservoir, canal and pump maintenance, and others reflect electric power used for pumping. These rates vary widely from district to district, according to the facilities used and the age of those facilities. For example, in 1997 O&M charges for contractors north of the Delta are around $8 per AF, while those south of the Delta run as high as $26 per AF. Interest charges are even more variable, with charges ranging from one dollar to $153 per AF. The major portion of most of these charges is the interest charge. The O&M charge will increase over time, as labor, electricity and equipment prices change. Therefore only the smaller part of CVP charges will be changed to reflect changing costs of supplying water.

Two new charges have been added to the CVP's standard rates as a result of the CVPIA. These are the restoration fund charges, and an additional charge that applies to contractors that do not contribute to the 800 TAF environmental flows required by the Act. We expect that future charges could arise from the CALFED process. This is another way that CVP charges could reflect changing water market conditions.

An example of a CVP water transfer is the agreement between Arvin Edison and MWD. This is discussed below.

E. Arvin Edison Agreement

This agreement includes a complicated set of arrangements that begins with the purchase by MWD of Class Two water provided by the CVP to Arvin Edison. MWD has agreed to pay for that at Arvin Edison's costs, including: the Friant-Kern surcharge levied because Arvin Edison is not contributing water to the 800 TAF environmental flows required under the CVPIA; the cost of transporting the water to Arvin Edison; and the required federal rates. There is some debate between MWD and Reclamation as to the actual level of this cost. MWD wants to pay the agricultural rate as paid by Arvin Edison, but Reclamation wishes to levy an additional charge to reflect the eventual use of the water for M&I uses rather than agricultural uses. This issue has yet to be resolved. Additional charges may be levied as a result of the CALFED process. The current purchase price for this water is estimated to be $72 per AF.

This at-cost transfer is only the first step in the agreement. Arvin Edison will take delivery of the water that was purchased by MWD and use it to recharge the aquifer underlying its district. MWD will pay Arvin Edison $90 per AF to inject water into the basin, and a further $40 per AF to withdraw the water. MWD currently estimates the unit cost of the transfer at $224 per AF. This price will remain in place with adjustments for energy charges and other regulatory charges until the first 250 TAF has been stored. At that stage it is estimated that the revenues will have repaid the capital investment required for Arvin Edison to construct the needed facilities, and so the negotiated price is expected to drop by $30. The variable part of this fee is the energy cost of pumping the water both for recharge and withdrawal. This electricity is supplied by WAPA, and the costs paid by MWD to cover these charges will be adjusted once every five years according to the WAPA electric rates applicable at that time.

Because the water purchased is from Class Two supplies, the water supply should be deemed less reliable. However, by purchasing storage as well as water, MWD is changing this water from a wet year supply to a dry year supply. For this transaction, at least, MWD appears to be valuing dry year supplies at a minimum of $130 more per AF than it values wet year supplies.

F. Westlands Water District Electronic Bulletin Board

Over the past year, a group composed of the Westlands Water District, the Natural Heritage Institute and the University of California have developed an electronic bulletin board to be used for water trades within the Westlands Water District. The bulletin board can be used to notify other farmers of water available for sale or of purchasers wishing to obtain water. Contracts can be made over the bulletin board or outside the bulletin board with contacts identified through the bulletin board. Farmers were very hesitant to make water prices public, so the reporting of prices was made optional to encourage trades through the bulletin board. While this arrangement has proven extremely popular, very little price information has reported. In addition, the trades have all been short term (for one season or less) and a majority of trades have been between farms belonging to the same agricultural entity and so do not reflect arms-length negotiations. The bulletin board does report the average of price information reported by farmers, but this cannot be considered a reliable market indicator.

Agreement has been reached to expand the bulletin board, and it is hoped that it will soon cover water trades in all Central Valley agencies west of the San Joaquin River. Reclamation also has agreed to set up a process to grant electronic approval of inter-district trades through this bulletin board. This should encourage the trading allowed under the Central Valley Project Improvement Act. It is possible that with expanded use of the bulletin board, farmers might become more open about reporting the prices at which trades are made. If this occurs, a price index consisting of trades made on this bulletin board could prove extremely useful. However, it is possible that farmers will believe that keeping the trading prices secret will provide them with a competitive advantage, and so such an index may never have a broad-enough basis to be useful. Certainly no useful index can be constructed from the data available at present.

G. MWD/IID Agreement

Of particular interest for the San Diego/IID negotiations is the MWD/IID contract that is in many ways a precursor to the contract under current negotiation. In the earlier contract, MWD agreed to pay for conservation projects installed in IID's service territory in return for the water

saved by those projects. The conservation projects undertaken include canal lining and tailwater return systems, similar to some of the projects under consideration to provide water to San Diego. The contract calls for 106 TAF to be delivered to MWD, at an approximate 1997 cost of $126 per AF. Approximately 30 percent of this cost reflects O&M expenditures, and this portion of the charge is expected to increase at 3 percent per year. The details of this cost estimate are provided in Appendix B of this report.

H. Arizona Water Bank

The State of Arizona has proposed development of a groundwater bank to foster interstate banking and water transfers in the Lower Colorado River Basin. To the extent that prices for this water result from arms-length negotiations, this price could be a useful indicator of water market conditions. This project is still being developed, and there has been no indication of how prices are to be determined or what those prices will be.

V. STATISTICAL ANALYSIS OF PAST WATER TRANSFERS

We conducted a regression analysis of identified water transfers where we could identify the unit prices of the water transferred. We restricted our analysis to include water transfers of over 10 TAF, within California or the lower Colorado River Basin. We did not include water transfers along the Truckee River or in the Upper Colorado River Basin because these regions are not feasible sources of supply for San Diego, and reflect different water supply and demand situations.

The details of our analysis are outlined in Appendix C to this report. The results of our analysis suggested that the price of water was influenced by the following factors:

- The price of transfers increased by 3.4 cents per AF for every TAF that SWP supplies decreased;
- Transfers from north of the Delta cost $23.32 per AF more than transfers from south of the Delta; and,
- Transfers from the Colorado cost $82.70 per AF more than transfers from the Central Valley.

All of the programs included must be considered highly reliable; most of the transactions were for one year and the necessary water had been allocated before the transaction had been negotiated. This precluded any examination of price variations according to whether the sales were base load or dry-year options. Transfers through the Delta were expected to reflect a discount for lower reliability, but did not. Because of both of these factors, we were not able to reflect the value of reliability in our index. The Colorado River adjustment was expected to provide a discount because of lower water quality, but the estimate did not reflect this.

Close examination of the model suggests that these results are not robust. The model underpredicted prices of all transfers that took place in 1991, reinforcing our prior belief that the administratively-set prices for the water bank were higher than the market required. Further, all transfers in 1991 originated north of the Delta, suggesting that at least part of the price

increment related to north-of-Delta transfers was probably heavily influenced by the ability of these agencies to sell water during shortages and at times of high prices, rather than being a measure of consumer preference for north-of-Delta water. Indeed, we expected that the opposite would be the case. We had expected that the difficulties getting water through the Delta would have effectively divided the California water market in two, with higher supplies and lower demands (and therefore lower prices) in the north, and lower supplies and higher demands (with resulting higher prices) in the south.

We are also concerned because the analysis included only one transaction from the Colorado River — the MWD/Palo Verde land-fallowing experiment. The Colorado River mark-up may reflect both a premium for land-fallowing and an inducement that reflects MWD's interest in ensuring the success of the experiment rather than MWD's need for water. We had expected that the lower water quality of Colorado River water would result in a price discount for water from this source, rather than the premium that is indicated in our analysis.

VI. PROPOSED WATER TRANSFER INDEX

The results of our analysis suggest the following treatment for construction of a water transfer price index:

1 Identify all transfers of over 10 TAF in the Central Valley or the Lower Colorado River Basin.

2. Adjust all prices to reflect current year prices (using the CPI for California)

3. Adjust all prices to reflect a "normal" water year.

4 If the source of the water is north of the Delta, remove the price premium associated with transactions from this source.

5. If the source of the water is the Colorado River, remove the price premium associated with transactions from the Colorado River.

At this point, the water prices have been "cleaned" to reflect normal water years and no price premium for the source of the water. The next step is to develop a weighted average of the prices of all of the identified transactions for the year. The prices should be weighted by the amount of water transferred, so that a small transaction with an atypical price does not unduly influence the results. Finally, the Colorado River adjustment should be added back to adjust the average price to reflect the characteristics of the San Diego/IID agreement.

The prices have now been reduced to a single price for each year. These are used to develop an index by selecting a base year to be equal to 100, and dividing the price for all other years by the price for the base year. Because there was only one trade in 1988, we decided not to use this as a base year. That single trade could have been atypical, and would distort the measurement of price changes from 1988 to 1989. We decided instead to use an average of 1989 and 1990 prices as the basis for our index. An example of this calculation is presented in

Appendix D, and the resulting price index for the years 1988 through 1994 are presented in Table 2.

Table 2
Estimated Price Index

Year	Index
1989	100.0
1990	100.0
1991	105.6
1992	90.6
1993	98.2
1994	121.9

The exercise of developing this index raised another concern with this approach. In many years there are few water trades that are appropriate to include in the index, and in some years there are none. This will lead to the possibility of an atypical trade having an undesirable influence on the index in a year when there are few trades; and the impossibility of developing an index in years where there are none.

We also are not persuaded that the results of our analysis are particularly reliable. Many of the water trades reported include administratively set prices that do not reflect market valuations. The small numbers of some types of transactions, and the correlation between explanatory variables are such that we believe the explanatory variables used in our analysis are not capable of capturing the effects of interest to our project. In short, the California water market is not sufficiently developed to be used to calculate a price index. We would urge the parties to adopt at least as an interim measure the "split the savings" approach outlined in the next section. The estimation of a price index should be revisited after experience has been gained in transactions that are more market-oriented, including the contracting proposals currently being evaluated by DWR and Kern County Water Agency, and when pricing and sales information is available from the Arizona water bank.

VII. CAPS AND FLOORS TO FUTURE PRICE LEVELS

Each of the parties are entering into the proposed agreement with an overriding goal. IID must ensure that it recovers the cost of the conservation programs it proposes to undertake, and San Diego must ensure that it has not committed itself to a more expensive source of supply than that it could obtain from its current supplier, MWD. Therefore the measure of "profit" that each side is getting out of this agreement is the distance between the costs of IID's conservation programs and the contract price; and between MWD's untreated water supply charges and the contract price plus transportation charges.

Although the SODT appears specifically to address the issue of the transportation, the intent of the language is unclear:

> . . . the Market Price and the Determined Price shall be that price . . . after adjustment for all relevant factors . . . and excluding transportation and taking into account the cost of delivering water to the Authority.[2]

This passage appears to require both exclusion of transportation costs, but inclusion of costs for delivery to San Diego. We have assumed that this means that the cost of transportation to agencies other than San Diego is irrelevant to the index, and should be excluded, whereas the cost of delivery to San Diego is relevant and should be included in any transfer analysis whether or not the transfer is to be delivered to San Diego. This interpretation is appropriate, and how economic theory would require that the index be constructed.

Given the goals of the two parties, an appropriate and symmetrical cap and floor for the market price would be as follows:

Cap: The unit price of water from the San Diego/IID agreement, plus the cost of delivering that water to San Diego should not exceed 95 percent of the contemporaneous MWD charges for delivery of untreated water to San Diego.

Floor: The unit price of water from the San Diego/IID agreement, not including the cost of delivering that water to San Diego should not fall below 105 percent of the unit cost (including indirect costs such as lost electric generation) of the conservation projects undertaken by IID to provide that water to San Diego.

At MWD's current charges for untreated water of $349 per AF, the ceiling price under this proposal would be $331.55 minus the cost of transportation to San Diego. If the costs of transportation to San Diego were $100 per AF, this would result in a ceiling price of $231.55 per AF. Assuming that the programs undertaken by IID are similar to those in the MWD/IID conservation program, this would result in a current floor price of $132.56 per AF. In practice, we would expect that the projects undertaken in the San Diego/IID program would be somewhat more expensive, because we assume that the least-costly tier of programs would be exhausted before the full level of deliveries are achieved. It should be noted that given these prices, if the transportation charge exceeded $199 per AF the mutual goals of this proposed agreement would become unobtainable.

An alternative to using these indicators as a cap and a floor is to use the goals to develop a "split-the-savings" rate. This is a widely-used practice in utility trading. It is used for short-term efficiency trades between electric utilities, and as described above, it is used in water efficiency trades between agencies in Kern County. Under this proposal, the unit price for the current year would be set by averaging the cost of conservation programs and the cost of MWD supplies less the transportation cost. Using the values mentioned earlier, this would result in

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[2]San Diego County Water Authority and Imperial Irrigation District, *Cooperative Water Conservation and Transfer Program, Summary of Draft Terms*, page 3.

a unit cost of $187.50 per AF. It should be noted that this is slightly below the price quoted in the SODT for 1999.

A modification of this approach would be to include an index for the price of electricity rather than IID's actual electricity cost, and indices for construction costs rather than IID's actual construction costs to develop a cost index for IID's programs. The actual construction of this index would depend on the mix of programs being undertaken by IID, but would rely on the Palo Verde electric index and the Handy-Whitman price indices described earlier in this report. Under this proposal, if IID were able to hold its cost increases below the increases in the program index, IID would be able to gain an extra profit from the transaction. In contrast, if IID's costs exceeded the increases in the index, IID's profit would be decreased. This approach is preferable, because it provides IID with a strong incentive to control its costs. Under the usual split-the-savings approach, all costs are passed through to the buyer and the seller gains only half of the benefit of any extra cost savings they manage to achieve. However, this approach does pose the risk of lower profits to IID, and for that reason may not be acceptable.

Appendix A

Cost Indices

BULLETIN NO. 144 **To JULY 1, 1996**

THE

HANDY-WHITMAN INDEX®

of

Public Utility

Construction Costs™

Compiled and Published by

WHITMAN, REQUARDT AND ASSOCIATES

Engineers — Consultants

2315 SAINT PAUL STREET

BALTIMORE, MARYLAND 21218

TRENDS OF CONSTRUCTION COSTS

B-6

CONTINUED

COST TRENDS OF BUILDING CONSTRUCTION

PACIFIC REGION

1973=100

LINE NO.	CONSTRUCTION, MATERIAL AND LABOR	COST INDEX NUMBERS														LINE NO.
		1982		1983		1984		1985		1986		1987		1988		
		Jan. 1	July 1	Jan. 1	July 1	Jan. 1	July 1	Jan. 1	July 1	Jan. 1	July 1	Jan. 1	July 1	Jan. 1	July 1	
	Building Construction															
	Reinf. Conc. Bldg. Construction	210	215	216	217	218	228	241	236	239	243	243	248	249	260	
	Brick Building Construction	224	234	235	234	235	242	251	249	251	255	255	258	261	268	
	Structural Steel Erected	208	210	205	206	207	228	253	237	244	252	250	257	259	277	
	Reinf. Concrete (Ready-Mix)	220	226	231	231	234	236	238	241	244	244	244	247	248	253	
	Reinf. Concrete (Plant-Mix)	206	210	215	214	214	216	218	224	223	224	225	229	230	236	
	Building Material															
	Ready-Mix Concrete	233	233	234	233	229	227	228	225	226	226	227	227	227	234	
	Lumber for Reinf. Conc.	146	136	140	140	118	115	114	124	115	117	120	124	121	134	
	Steel Bars for Reinf. Conc.	211	205	190	188	196	201	206	209	215	216	209	204	218	235	
	Common Brick	266	291	284	270	264	271	279	283	285	286	287	287	295	296	
	Concrete Block	264	274	276	275	271	285	294	302	306	313	303	309	321	339	
	Labor															
	Building Trades Labor	225	237	245	248	254	256	256	258	260	262	262	265	267	269	
	Heavy Constr. Trades Labor	217	228	236	237	244	248	248	251	253	255	256	260	261	264	
	Labor for Reinf. Conc.	222	233	241	242	247	251	254	257	261	261	262	266	266	268	
	Common Labor	228	240	247	248	255	259	261	264	267	268	269	282	283	285	
	Electricians	244	265	271	277	283	283	262	266	267	264	264	266	273	277	
	Pipefitters	231	242	256	256	270	270	277	280	280	286	286	288	289	289	
	Plumbers	236	247	260	260	275	275	282	285	285	291	291	293	294	294	

B-6

CONTINUED

COST TRENDS OF BUILDING CONSTRUCTION

PACIFIC REGION

1973=100

COST INDEX NUMBERS

LINE NO.	1989		1990		1991		1992		1993		1994		1995		1996										LINE NO.
	Jan. 1	July 1	Jan. 1	July 1	Jan. 1	July 1	Jan. 1	July 1	Jan. 1	July 1	Jan. 1	July 1	Jan. 1	July 1	Jan. 1	July 1									
1																									1
2	261	268	268	270	263	261	255	265	270	280	285	301	302	303	308	314									2
3	269	276	277	280	278	279	278	285	290	294	298	308	310	315	320	326									3
4	278	285	287	285	271	254	243	251	265	271	276	302	305	306	316	320									4
5	255	263	262	267	265	274	271	279	274	287	288	299	299	304	303	313									5
6	236	244	242	247	243	253	250	262	260	277	280	292	289	290	287	295									6
7																									7
8																									8
9	235	240	240	241	238	240	243	240	241	259	260	268	270	279	281	293									9
10	128	140	136	137	124	137	135	165	179	231	240	265	240	229	216	218									10
11	243	243	231	232	220	214	172	212	204	218	232	244	245	246	234	244									11
12	299	306	310	313	322	322	329	332	338	319	319	320	321	339	348	356									12
13	339	339	339	261	268	268	272	278	279	271	270	268	282	275	275	279									13
14																									14
15																									15
16	271	277	279	283	285	294	298	301	304	312	316	318	325	328	331	336									16
17	266	273	275	281	282	292	294	297	298	304	303	313	314	317	322	326									17
18	269	280	280	286	287	299	300	306	298	306	306	316	318	323	323	334									18
19	288	294	294	299	299	308	308	314	305	314	314	325	325	334	330	343									19
20	277	280	284	287	290	300	304	304	321	322	326	324	335	339	343	347									20
21	289	291	291	291	296	315	319	309	325	334	336	334	359	360	364	363									21
22	294	296	296	296	302	306	317	317	328	339	347	347	362	362	369	370									22
23																									23
24																									24
25																									25

LINE NO.		LINE NO.
1		1
2		2
3		3
4		4
5		5
6		6
7		7
8		8
9		9
10		10
11		11
12		12
13		13
14		14
15		15
16		16
17		17
18		18
19		19
20		20
21		21
22		22
23		23
24		24
25		25

W-6

CONTINUED

COST TRENDS OF WATER UTILITY CONSTRUCTION

PACIFIC REGION

1973=100

LINE NO.	CONSTRUCTION AND EQUIPMENT	NARUC Acct.	COST INDEX NUMBERS														LINE NO.
			1982		1983		1984		1985		1986		1987		1988		
			Jan. 1	July 1	Jan. 1	July 1	Jan. 1	July 1	Jan. 1	July 1	Jan. 1	July 1	Jan. 1	July 1	Jan. 1	July 1	
1	**SOURCE OF SUPPLY PLANT**																1
2	Collecting & Impounding Res.	305	207	212	214	214	219	224	231	231	231	235	235	241	242	249	2
3																	3
4																	4
5																	5
6																	6
7	**PUMPING PLANT**																7
8	Structures & Improvements	304	222	232	234	233	234	241	249	248	250	253	254	257	260	266	8
9	Electric Pumping Equipment	311	255	257	270	271	273	276	281	282	284	283	285	290	330	303	9
10																	10
11																	11
12																	12
13																	13
14	**WATER TREATMENT PLANT**																14
15	Structures & Improvements	304	222	232	234	233	234	241	249	248	250	253	254	257	260	266	15
16	Large Treatment Plant Equip.	320	246	257	266	271	274	277	283	286	287	291	293	299	300	305	16
17	Small Treatment Plant Equip.	320	259	270	280	287	288	291	299	301	302	306	308	313	315	321	17
18																	18
19																	19
20																	20
21																	21
22	**TRANSMISSION PLANT**																22
23	Steel Reservoirs	330	217	219	186	180	180	184	186	179	179	183	190	190	215	221	23
24	Elevated Steel Tanks	330	256	256	206	194	194	202	202	193	205	208	208	208	252	261	24
25	Concrete Reservoirs	330															25
26																	26
27	Cast Iron Mains	331	223	229	234	248	240	242	258	257	247	252	255	260	262	270	27
28	Steel Mains	331	229	236	239	242	248	251	254	255	248	249	252	260	263	270	28
29	Concrete Cylinder Mains	331	216	222	230	232	236	238	240	250	256	257	253	259	270	272	29
30																	30
31																	31
32																	32
33	**DISTRIBUTION PLANT**																33
34	Mains-Average All Types	331	241	246	249	257	253	256	267	267	260	264	266	271	274	283	34
35	Cast Iron Mains	331	228	231	234	262	250	253	271	270	257	263	266	270	272	282	35
36	Cement-Asbestos Mains	331	250	260	250	253	257	259	264	264	257	258	260	271	265	272	36
37	Steel Mains	331	257	264	269	249	255	258	262	263	264	266	266	272	278	287	37
38	PVC Mains	331	143	142	144	166	150	157	155	156	157	155	151	159	188	196	38
39	Services Installed	333	216	226	231	232	239	242	247	247	249	250	252	259	262	271	39
40	Meters	334	127	128	128	153	130	163	135	135	135	135	135	135	142	142	40
41	Meter Installations	334	226	237	245	253	263	264	268	269	274	276	278	282	286	292	41
42	Hydrants Installed	335	258	270	287	291	294	292	308	308	315	320	322	332	339	342	42
43																	43
44																	44
45	**MISCELLANEOUS ITEMS**																45
46	Flocculating Equipment-Installed		453	487	521	526	528	529	552	573	576	585	601	603	603	604	46
47	Clarifier Equipment-Installed		348	379	412	412	414	415	438	457	461	462	465	467	470	470	47
48	Filter Gallery Piping-Installed		230	237	245	257	254	255	271	271	262	269	272	275	277	283	48
49																	49
50																	50
51																	51
52																	52
53																	53
54																	54
55																	55
56																	56

...UTILITY CONSTRUCTION

...TINUED ... 1975=100

COST INDEX NUMBERS

1989		1990		1991		1992		1993		1994		1995		1996											
Jan. 1	July 1	Jan. 1	July 1	Jan. 1	July 1	Jan. 1	July 1	Jan. 1	July 1	Jan. 1	July 1	Jan. 1	July 1	Jan. 1	July 1										
251	256	256	261	258	260	258	264	267	275	277	290	290	291	295	298										
268	275	276	280	278	281	279	285	293	299	304	313	315	321	323	325										
309	336	340	349	357	350	363	370	369	378	420	426	438	437	454	446										
268	275	276	280	278	281	279	285	293	299	304	313	315	321	323	325										
310	319	320	324	324	329	333	338	342	350	350	352	360	364	367	372										
326	333	335	339	336	340	343	349	352	360	360	364	369	370	374	379										
223	209	221	232	232	259	262	264	254	246	246	246	246	251	251	251										
267	267	269	281	281	286	286	284	254	249	242	242	243	250	265	269										
276	282	283	285	286	288	289	291	296	305	308	316	316	311	314	316										
278	286	288	291	293	299	297	301	307	308	323	325	330	336	332	338										
278	283	286	289	291	300	301	303	308	314	317	322	320	327	329	332										
291	295	294	296	298	301	298	300	304	311	311	316	319	318	321	322										
289	295	295	297	298	300	302	303	306	313	315	323	324	317	320	323										
293	292	291	291	289	289	273	275	280	292	289	291	299	304	309	311										
290	294	293	296	299	306	299	302	309	313	312	314	316	323	324	325										
226	219	214	211	205	203	178	179	182	194	186	183	196	202	207	207										
272	278	279	282	281	286	289	292	295	294	308	310	313	321	321	328										
135	143	178	150	156	164	164	207	207	201	171	171	188	201	210	210										
295	299	299	301	308	314	318	321	327	333	339	343	351	354	363	367										
355	372	377	378	381	384	386	388	390	396	396	398	407	410	411	414										
605	608	598	600	551	544	545	560	557	573	573	577	577	580	589	597										
471	474	474	462	435	427	427	454	451	472	474	509	518	520	548	555										
288	293	292	293	294	297	302	303	307	316	320	326	333	327	330	334										

Electricity Prices At Palo Verde Switchyard
Dow Jones Index

DATE	ACTUAL NON-FIRM ON-PEAK ($/mwh)	ACTUAL NON-FIRM OFF-PEAK ($/mwh)	ACTUAL FIRM ON-PEAK ($/mwh)	ACTUAL FIRM OFF-PEAK ($/mwh)
	N.A	N.A	N.A	N.A
	$25.55	$12.90	$22.73	$21.16
	$29.20	$14.06	$26.98	$11.73
	$21.76	$11.30	$23.40	$12.82
	$23.46	$14.66	$24.50	$15.46
	$15.34	$18.03	$22.77	$15.34
	$18.81	$16.88	$23.79	$16.44
	$21.86	$15.87	$22.16	$16.63
	$20.48	$12.96	$22.83	$13.11
	$19.36	$11.58	$23.95	$13.41
	$19.73	$11.93	$22.28	$12.97
	$15.78	$9.39	$26.74	$13.96
	$15.73	$15.39	$22.41	$14.77
	$21.60	$14.45	$24.38	$13.90
	$27.67	$14.82	$50.45	$13.31
	$30.19	$15.39	$58.24	$15.54
	$26.92	$14.00	$39.24	$14.22
	$22.66	$12.55	$38.16	$14.19
	$46.19	$12.57	$24.71	$25.33
	$25.80	$56.85	$35.37	$26.00
	$27.84	$14.49	$34.94	$32.48
	$17.17	$11.60	$19.30	$11.75
	$17.53	$11.04	$17.95	$11.44
	$14.14	$11.25	$20.00	$11.75
	$18.77	$10.94	$22.88	$12.15
	$16.09	$10.22	$25.44	$12.98
	$13.70	$10.75	$18.04	$14.62
	$15.38	$11.46	$25.32	$12.98
	$18.01	$12.16	$27.42	$13.12
	$23.88	$13.46	$28.88	$11.55

Appendix B

MWD/IID Agreement Calculations

Table B.1
Estimation of Unit Costs
MWD/IID Agreement

Year	Deliveries (AF) (1)	Per Unit O&M Cost ($/AF) (2)	Estimated O&M ($000) (3)	Actual O&M ($000) (4)	Capitalized O&M ($000) (5)	Capital Investments ($000) (6)	Indirect Costs ($000) (7)	Return to nvestment ($000) (8)	Total Annual Investment ($000) (9)	Net Total Investment ($000) (10)
1990	6110	$27.04	$165.2	$639	$473.8	$17,704		$562	$17,616	$18,673
1991	26700	$27.85	$743.5	$1,131	$387.5	$35,688	$4,600	$2,456	$38,219	$60,305
1992	33929	$28.68	$973.1	$2,258	$1,284.9	$17,817	$4,600	$3,121	$20,580	$85,739
1993	54830	$29.54	$1,619.8	$2,797	$1,177.2	$10,794	$4,600	$5,044	$11,527	$103,102
1994	72870	$30.43	$2,217.3	$1,869	($348.3)	$7,103	$4,600	$6,704	$4,651	$114,217
1995	74570	$31.34	$2,337.1	$2,651	$313.9	$7,196	$4,600	$6,860	$5,249	$126,635
1996	90880	$32.28	$2,933.7	$1,891	($1,042.7)	$6,250		$8,361	($3,154)	$130,890
1997	97740	$33.25	$3,249.9	$5,100	$529.1	$11,100		$8,992	$2,637	$141,539
1998	106110	$34.25	$3,634.0	$3,634	$0.0					
							Levelized Annual Capital Cost			$9,762.46
							Per Unit Annual Capital Cost			$92.00
							Per Unit Annual Total Cost			$126.25

Source: MWD's Financial Planning and Colorado River Resources groups

Notes to Table B.1

Actual deliveries to MWD.

Based on 1998 estimated O&M and deliveries, and assuming that prices have increased at 3 percent per year.

(3) + (2) * (1) / 1000

Amount billed by IID and paid by MWD. It is assumed that startup conditions may have led to high O&M costs that include some investments for future use.

(5) (4) - (3) This subtracts "normalized" O&M to estimate "investment" O&M.

(6) Capital investments in the program.

(7) MWD payments to IID to cover indirect costs.

(8) Deliveries (1) multiplied by the per unit annualized capital costs. This reflects the benefit MWD is gaining from the partial water deliveries.

(9) (9) = (5) + (6) + (7) + (8)

Accumulation of (9) plus 6 percent interest charges.

Levelized annual cost is estimated reflecting the 35 year life of the agreement and a six percent interest rate.

Per unit cost is levelized annual costs divided by the full level of deliveries.

Per unit annual total costs = 1998 per unit O&M costs + per unit annual capital costs.

Appendix C

Statistical Analysis of Water Transfers

Appendix C
Statistical Analysis Of Water Transfers

For this analysis, we hypothesized that water transfer prices would be influenced by the following factors:

availability of water within the state;

- whether the water was obtained from north of the Delta (and had to proceed through the Delta export pumps);

whether the water was obtained from the Central Valley or the Colorado River Basin;

- whether the purchase was for M&I or other uses;

- the duration of the contract; and,

the size of the transaction.

We assumed that identifying the source of the water from either the Colorado or the Central Valley would provide a measure of preferences for differing water quality. We had no way to test for the value of reliability, because all of the transfers (with the possible exception of water north of the Delta) were fully reliable. The duration of most transactions is for a single year and the contracts are made after water allocations are known.

We used reported SWP deliveries as a measure of water availability. This is not the best measure, and is only workable because we are working with a small number of years. Over time, deliveries will grow because of rising demands. Use of this measure will indicate that water availability is increasing over time, when in fact it is more likely to be decreasing.

The data used for this analysis are reported in the following table. Our initial analysis identified two outlying prices that did not appear consistent with the rest of the data, so we discarded these values. These are not reported in the data table.

Before conducting the analysis, we used the annual CPI to inflate all prices to 1994 dollars. We then developed a regression relating the price of water in 1994 dollars to the six variables that we expected would influence price. The resulting regression suggested that price was strongly influenced by the general availability of water in the state, whether the water came from the Colorado or the Central Valley, and whether the water needed to be transported through the Delta. The coefficients for transaction size, duration and whether the water was to be used for M&I purposes were not statistically significant, and were dropped from regression.

The regression output is also provided in this appendix. This shows that the model has relatively good statistics, but as discussed in the text of this report we believe that the results are not as robust as the statistics would suggest.

Table C.1
Water Transfer Data Used In Analysis

Year	Seller	Buyer	M&I Indicator	Price ($/AF)	SWP Deliveries	North of Delta	Size	Duration (years)	Colorado Indicator	CPI
1988	Yuba County WA	SWP	0	11.5	3701326	1	119031	1	0	121.6
1989	Kern County WA	Westlands WD	0	20	4158699	0	55000	1	0	127.7
1989	Yuba County WA	EBMUD	1	45	4158699	1	66000	1	0	127.7
1989	Yuba County WA	Dept of Fish & Game	0	11	4158699	1	39000	1	0	127.7
1989	Yuba County WA	Santa Clara Valley WD	1	45	4158699	1	17085	3	0	127.7
1990	Yuba County WA	Tulare Lake Basin WSD	0	11	3900066	1	33242	2	0	135.2
1990	Oroville-Wyandotte ID	Westlands WD	0	43	3900066	1	15000	1	0	135.2
1990	Yuba County WA	Santa Clara Valley WD	1	45	3900066	1	28962	3	0	135.2
1990	Yuba County WA	SWP	0	45	3900066	1	118909	1	0	135.2
1991	Western Canal WD	Dept of Fish & Game	0	50	1673992	1	11500	1	0	141.1
1991	Placer County WA	Santa Clara Valley WD	1	100	1673992	1	17100	1	0	141.1
1991	Conaway Conservancy	State Water Bank	0	125	1673992	1	44774	1	0	141.1
1991	Yuba County WA	State Water Bank	0	125	1673992	1	127200	1	0	141.1
1991	South Yuba WD	State Water Bank	0	125	1673992	1	17000	1	0	141.1
1991	Placer County WA	City of San Francisco	1	100	1673992	1	23900	1	0	141.1
1991	Brophy WD	State Water Bank	0	125	1673992	1	36000	1	0	141.1
1991	RD 1044	State Water Bank	0	125	1673992	1	24077	1	0	141.1
1991	Western Canal WD	State Water Bank	0	125	1673992	1	40000	1	0	141.1
1991	Yuba County WA	Santa Clara Valley WD	1	45	1673992	1	25589	3	0	141.1
1991	Joint Water District Board	State Water Bank	0	125	1673992	1	60000	1	0	141.1
1991	Ramirez WD	State Water Bank	0	125	1673992	1	13277	1	0	141.1
1991	Oroville-Wyandotte ID	State Water Bank	0	125	1673992	1	10000	1	0	141.1
1991	Yuba County WA	Dept of Fish & Game	0	50	1673992	1	28000	1	0	141.1
1992	Palo Verde ID	MWD	1	135	2233982	0	186000	2	1	146.1
1992	Oakdale/So. San Joaquin IDs	State Water Bank	0	50	2233982	0	50000	1	0	146.1
1992	Merced ID	State Water Bank	0	50	2233982	0	11705	1	0	146.1
1993	San Luis Canal	Panoche WD	0	17.52	3395287	0	10000	1	0	149.9
1993	Central AZ Water Conservation District	MWD	1	114	3395287	0	89000	4	1	149.9
1993	Central California ID	Westlands WD	0	18.07	3395287	1	12000	1	0	149.9
1993	Central California ID	Westlands WD	0	18.07	3395287	1	18000	1	0	149.9
1994	San Luis Canal Co.	Water Acq. Program	0	50	2980933	0	12000	1	0	152.2
1994	Sacramento River Water Contractors Ass	State Water Bank	0	50	2980933	1	25000	1	0	152.2
1994	Western Canal WD	Water Acq. Program	0	50	2980933	1	82403	1	0	152.2
1994	Placer County WA	State Water Bank	0	50	2980933	1	20000	1	0	152.2
1994	Richvale ID	Water Acq. Program	0	50	2980933	1	31825	1	0	152.2
1994	Los Rios Farms	State Water Bank	0	50	2980933	1	13071	1	0	152.2
1994	Ramirez WD	Water Acq. Program	0	50	2980933	1	12658	1	0	152.2

Regression Statistics

LS // Dependent Variable is REALPR
Date: 03/11/97 Time: 08:06
Sample: 1 37
Included observations: 37

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	141.3299	18.58747	7.603500	0.0000
SWP	-0.034050	0.004717	-7.219000	0.0000
DELTA	23.31879	13.11198	1.778434	0.0845
COLO	82.70130	22.55959	3.665905	0.0009

R-squared	0.674556	Mean dependent var	72.20002
Adjusted R-squared	0.644971	S.D. dependent var	45.21906
S.E. of regression	26.94348	Akaike info criterion	6.689288
Sum squared resid	23956.38	Schwarz criterion	6.863442
Log likelihood	-172.2526	F-statistic	22.80003
Durbin-Watson stat	1.867098	Prob(F-statistic)	0.000000

Appendix D

Example Calculation of Index

Appendix D
Construction of the Index

Development of the index is based on the regression analysis described in Appendix C, and the data used to produce it. The index is calculated by the following steps:

1 For each year, calculate the difference in SWP deliveries from an average year. For this exercise we used the average of the seven years included in our analysis. A longer average would be more appropriate, but in order to use a longer average it would be necessary to develop an adjustment to distinguish changes in SWP deliveries that arise from contractors' requests for water rather than the availability of water.

2. For all years, express the price in the same measure used in the regression. In this case, all of the prices are expressed in 1994 dollars.

3. Use the parameter estimates from the regression model to adjust the price. In this case, the adjusted price is calculated as follows:

   Adjusted price = Real price - (-.034 * adjusted SWP deliveries) - (23.32 * Delta) - (82.70 * Colo)

4. For each year, calculate the weighted average price using the size of each transfer as the weighting factor.

5. Because the index is being developed for Colorado transfers, add back the $82.70 premium for Colorado River Water.

Steps 1 through 5 are presented in Table D.1

The first column of Table D.2 begins with the annual weighted real price from the last column of Table D.1. Then the following three steps (shown on Table D.2) are required:

6. Deflate the real price from 1994 dollars to reflect the appropriate-year dollars.

7 Select a base year for the index. In this case, we ignored 1988 because there was only one transaction reported in that year. If that transaction was atypical, it could provide a distorting basis for the index. We chose to use an average of 1989 and 1990 values as a basis for the index.

8. Divide the historic dollar price by the basis year price to calculate the index.

Table D.1
Example Calculation of Price Index

Year	M&I Indicator	Price ($/AF)	SWP Deliveries	North of Delta	Size (AF)	Duration (Years)	Colorado Indicator	CPI	Real Price	Adjusted SWP	Adjusted Price	Size Weighting	Weighted Average	With Colo. Adjustment
1988	0	11.5	3701.3	1	119031	1	0	121.6	$14.39	552.14	$9.85	1172069		
					119031							1172069	$9.85	$92.55
1989	0	20	4158.699	0	55000		0	127.7	$23.84	1009.52	$58.16	3198835		
1989	1	45	4158.699	1	66000		0	127.7	$53.63	1009.52	$64.64	4266045		
1989	0	11	4158.699	1	39000		0	127.7	$13.11	1009.52	$24.11	940444		
1989	1	45	4158.699	1	17085		0	127.7	$53.63	1009.52	$64.64	1104324		
					177085							9509648	$53.70	$136.40
1990	0	11	3900.066	1	33242		0	135.2	$12.38	750.88	$14.59	485105		
1990	0	43	3900.066	1	15000		0	135.2	$48.41	750.88	$50.62	759252		
1990	1	45	3900.066	1	28962		0	135.2	$50.66	750.88	$52.87	1531171		
1990	0	45	3900.066	1	118909		0	135.2	$50.66	750.88	$52.87	6286515		
					196113							9062044	$46.21	$128.91
1991	0	50	1673.992	1	11500		0	141.1	$53.93	-1475.19	($19.54)	-224746		
1991	1	100	1673.992	1	17100		0	141.1	$107.87	-1475.19	$34.39	588073		
1991	0	125	1673.992	1	44774		0	141.1	$134.83	-1475.19	$61.36	2747196		
1991	0	125	1673.992	1	127200		0	141.1	$134.83	-1475.19	$61.36	7804603		
1991	0	125	1673.992	1	17000		0	141.1	$134.83	-1475.19	$61.36	1043068		
1991	1	100	1673.992	1	23900		0	141.1	$107.87	-1475.19	$34.39	821927		
1991	0	125	1673.992	1	36000		0	141.1	$134.83	-1475.19	$61.36	2208850		
1991	0	125	1673.992	1	24077		0	141.1	$134.83	-1475.19	$61.36	1477291		
1991	0	125	1673.992	1	40000		0	141.1	$134.83	-1475.19	$61.36	2454278		
1991	1	45	1673.992	1	25589		0	141.1	$48.54	-1475.19	($24.94)	-638099		
1991	0	125	1673.992	1	60000		0	141.1	$134.83	-1475.19	$61.36	3681416		
1991	0	125	1673.992	1	13277		0	141.1	$134.83	-1475.19	$61.36	814636		
1991	0	125	1673.992	1	10000		0	141.1	$134.83	-1475.19	$61.36	613569		
1991	0	50	1673.992	1	28000		0	141.1	$53.93	-1475.19	($19.54)	-547208		
					478417							22844853	$47.75	$130.45
1992	1	135	2233.982	0	186000		1	146.1	$140.64	-915.20	$26.82	4988464		
1992	0	50	2233.982	0	50000		0	146.1	$52.09	-915.20	$20.97	1048538		
1992	0	50	2233.982	0	11705		0	146.1	$52.09	-915.20	$20.97	245463		
					247705							6282464	$25.36	$108.06
1993	0	7.52	3395.287	0	10000		0	149.9	$17.79	246.10	$26.16	261563		
1993	1	114	3395.287	0	89000		1	149.9	$115.75	246.10	$41.42	3686085		
1993	0	8.07	3395.287	1	12000		0	149.9	$18.35	246.10	$3.39	40737		
1993	0	8.07	3395.287	1	18000		0	149.9	$18.35	246.10	$3.39	61106		
					129000							4049491	$31.39	$114.09
1994	0	50	2980.933		12000		0	152.2	$50.00	168.25	$44.28	531354		
1994	0	50	2980.933		25000		0	152.2	$50.00	168.25	$20.96	523987		
1994	0	50	2980.933		82403		0	152.2	$50.00	168.25	$20.96	1727124		
1994	0	50	2980.933		20000		0	152.2	$50.00	168.25	$20.96	419190		
1994	0	50	2980.933		31825		0	152.2	$50.00	168.25	$20.96	667035		
1994	0	50	2980.933		13071		0	152.2	$50.00	168.25	$20.96	273961		
1994	0	50	2980.933		12658		0	152.2	$50.00	168.25	$20.96	265305		
					77554							4407956	$56.84	$139.54

Table D.2
Index Calculation Summary

Year	Weighted Real Price	Deflated to Historic $	Index (1989-1990 = 100)
1989	$136.40	$114.44	100.0
1990	$128.91	$114.51	100.0
1991	$130.45	$120.94	105.6
1992	$108.06	$103.73	90.6
1993	$114.09	$112.37	98.2
1994	$139.54	$139.54	121.9

Declaration of Vernice Rae Hartman

I, Vernice Rae Hartman, declare that:

1. I am the Clerk of the Board for the San Diego County Water Authority, in San Diego, California. I hereby make this declaration in my official capacity on behalf of the San Diego County Water Authority.

2. I declare that the attached exhibit dated March, 1997, titled "Draft Market Price/Indexing Mechanism for Water Transfers Report to The San Diego County Water Authority by Foster Associates, Inc." is a true and accurate copy which is retained in the files of the San Diego County Water Authority, in San Diego, California.

I certify under penalty of perjury under the laws of the State of California that the above statements are true.

Dated: This 22 day of May, 2002

Vernice Rae Hartman

Vernice Rae Hartman