FINAL REPORT

EVALUATION OF WATER SUPPLY ALTERNATIVES

Nipomo Community Services District

Nipomo, California

October 2001
K/J 014603.00

Kennedy/Jenks Consultants

Kennedy/Jenks Consultants

Engineers and Scientists

1000 Hill Road, Suite 200
Ventura, California 93003
805-658-0607
FAX 805-650-1522

1 October 2001

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• Called for e-copy
Monique is looking and will call back.

1/15/
$34.4K

Mr. Doug Jones
Nipomo Community Services District
148 South Wilson St.
P.O. Box 326
Nipomo, CA 93444-0326

Subject: Nipomo Community Services District
Final Evaluation of Water Supply Alternatives
K/J 014603.00 (6.01)

Dear Mr. Jones:

Enclosed please find ten copies of the Final Evaluation of Water Supply Alternatives for the Nipomo Community Services District. This version incorporates your comments dated 12 September 2001. If you have any questions about this document, please feel free to contact me at (805) 658-0607.

Also enclosed is the District's copy of the John L. Wallace & Associates Water Recycling Progress Report.

We have enjoyed working with the District on this project and look forward to opportunities to continue to serve you in the future.

Very truly yours,

KENNEDY/JENKS CONSULTANTS

Lynn M. Takaichi, P.E.
Project Manager

Enclosures

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FINAL REPORT
Evaluation of Water Supply Alternatives

1 October 2001

Prepared for

Nipomo Community Services District
148 South Wilson St.
P.O. Box 326
Nipomo CA 93444-0326

K/J Project No. 014603.00

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List of Abbreviations

Acronym/Abbreviation	**Definition**
AF	acre-feet
BMP	Best Management Practice
Caltrans	California Department of Transportation
CCWA	Central Coast Water Authority
CEQA	California Environmental Quality Act
CUWCC	California Urban Water Conservation Council
DWR	California Department of Water Resources
EDR	Electrodialysis Reversal
EIR	Environmental Impact Report
K/J	Kennedy/Jenks
HDPE	High-Density Polyethylene
MCL	Maximum Contaminant Level
NCSD	Nipomo Community Services District
NF	Nanofiltration
OCSD	Oceano Community Services District
RO	Reverse Osmosis
PVC	Polyvinyl Chloride
SBCFC&WCD	Santa Barbara County Flood Control and Water Conservation District
SLOCFC&WCD	San Luis Obispo County Flood Control and Water Conservation District
SSLOCSD	South San Luis Obispo County Sanitation District
SWP	State Water Project
TDS	Total Dissolved Solids
TOC	Total Organic Carbon
WTP	Water Treatment Plant
WWTP	Wastewater Treatment Plant

Section 1: Executive Summary

The Nipomo Community Services District (NCSD) provides water and sewer service to an unincorporated area in the southern portion of San Luis Obispo County, as shown in Figure 1-1. The NCSD service area includes approximately 4,000 acres[1] along Highway 101. Water service is provided to 10,790 people, with 40 percent of the service area provided with sewer service. Nipomo has experienced a relatively fast pace of development in recent years. Continuing growth is projected for the area, with an attendant increase in water demand.

NCSD receives its supply of water exclusively from wells that pump water from the Nipomo subunit of the Santa Maria Groundwater Basin. The California Department of Water Resources (DWR) has identified the presence of a groundwater pumping depression to the west of the NCSD service area in the area of NCSD's Sun Dale, Via Concha, Bevington, Black Lake #3 and Black Lake #4 wells. Due to the pumping depression, increasing groundwater extraction to meet the projected water demand may not be a desirable option. Additionally, ongoing litigation regarding groundwater rights in the Basin complicates additional groundwater extraction. Based on projected demand, a future supply shortfall of up to 3,550 acre-feet/year is anticipated.

A preliminary analysis was performed to consider the reliability, barriers to implementation, costs, and advantages of a variety of potential new water sources. The options considered are discussed in detail in Section 4 and summarized in Table 4-1. Based on this qualitative screening level evaluation of the potential water sources, several alternatives were recommended for more detailed evaluation and cost development.

For the selected alternatives, additional evaluation was performed to better identify and clarify the water quality issues, necessary infrastructure, reliability issues, required agreements and institutional issues, permitting/CEQA, costs, and schedule associated with each alternative. Based on this more detailed evaluation, the alternatives were ranked the following order of priority for further investigation, evaluation, and pursuit.

1. Water conservation (500-1,000 AF/yr)
2. Intertie with the City of Santa Maria (2,000-3,000 AF/yr)
3. Desalination of blowdown water, produced water, and/or recycled water and groundwater exchange with the Tosco Refinery (1,300 AF/yr)
4. Recycled water delivery to and groundwater exchange with agricultural users (500 - 1,000 AF/yr).
5. Hard rock drilling (500-1,000 AF/yr).

It is recommended that NCSD undertake specific implementation activities within the next few months in order to further refine the alternatives.

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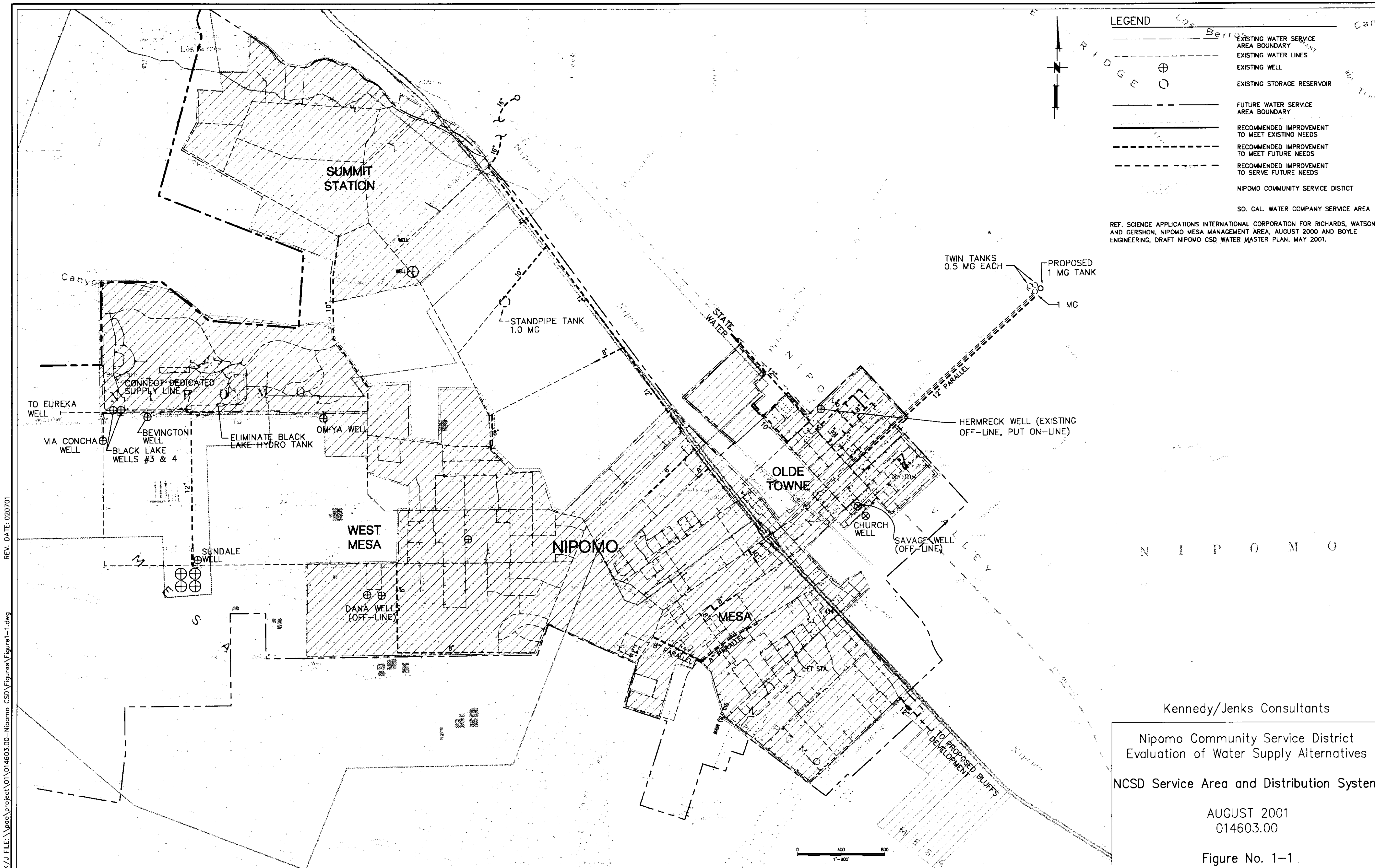
1 NCSD estimate.



Kennedy/Jenks Consultants

Nipomo Community Service District
Evaluation of Water Supply Alternatives

NCSD Service Area and Distribution System

AUGUST 2001
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Figure No. 1-1

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Section 2: Introduction

This section presents a brief background of the water supply of the NCSD and the need for an "Evaluation of Water Supply Alternatives." The organization of the report is also summarized.

2.1 Background and Objectives

The Nipomo Community Services District (NCSD) provides water and sewer service to an unincorporated area in the southern portion of San Luis Obispo County. The NCSD service area includes approximately 4,000 acres along Highway 101. Water service is provided to 10,790 people, with 40 percent of the service area provided with sewer service.

The District receives its supply of water exclusively from wells that pump water from the Nipomo subunit of the Santa Maria Groundwater Basin. The California Department of Water Resources (DWR) has identified the presence of a groundwater pumping depression to the west of the NCSD service area in the area of NCSD's Sun Dale, Via Concha, Bevington, Black Lake #3 and Black Lake #4 wells. NCSD currently does not have another source of potable water.

The Nipomo area has experienced relatively rapid development in recent years. Continuing growth is projected for the area and water demand is expected to increase accordingly. As described in Section 3, based on projected demand, a future supply shortfall is anticipated. Historical groundwater extractions have created a pumping depression and increasing groundwater extraction to meet the projected water demand may not be a desirable option. Additionally, ongoing litigation regarding groundwater rights in the Basin complicates additional groundwater extraction.

In 1994, Bookman-Edmonston prepared "Evaluation of Alternative Supplemental Water Supplies" in order to identify potential alternative water sources for NCSD. Due to changing water supply conditions, NCSD recognized the need to undertake this "Evaluation of Water Supply Alternatives." The objective of this evaluation is to provide more current information and evaluate a wider range of alternatives. This report provides an updated evaluation of some of the alternatives contained in the Bookman-Edmonston report and evaluates alternatives not previously considered.

2.2 Scope of Services

To accomplish the objectives of the "Evaluation of Water Supply Alternatives," the following scope of services was developed:

- Gather and review data to develop a list of potential specific water supply alternatives to be considered.
- Hold a workshop with NCSD to screen the alternatives to be considered, develop an evaluation matrix, prioritize the alternatives, and select six alternatives to be evaluated in greater detail.

- Prepare a detailed evaluation of the alternatives based on the approved evaluation matrix.
- Prepare a draft report and presentation for the NCSD Board in a study session.
- Prepare a final report and presentation for the NCSD Board in a regular session.

2.3 Report Organization

This report is organized as follows:

- Section 1, Executive Summary, summarizes the contents of the evaluation.
- Section 2, Introduction, provides background information, introduces the evaluation, and identifies the structure of the report.
- Section 3, Water Demand and Supply Assessment, describes NCSD's existing water supplies, as well as existing and projected water demands.
- Section 4, Potential Water Sources, provides a preliminary analysis of a wide range of potential alternatives for water supply for NCSD. The nature of the source, quantity of water available, costs, complexity of required agreements, and other basic features of the source are presented.
- Section 5, Overview of Relevant Treatment Technologies, explains the potential treatment methods that may be used for several of the alternatives.
- Section 6, Detailed Evaluation of Selected Alternatives, provides more specific evaluation of the alternatives identified in Section 4. For each alternative, the water quality, required infrastructure, reliability, required agreements/institutional agreements, permitting/CEQA, costs/funding, and schedule are discussed.
- Section 7, Recommended Plan, recommends a long-term water supply strategy. The elements of the plan, estimated costs, and recommended implementation activities are described.
- Section 8, References and Persons Contacted, presents the sources of information contained in this report.

2.4 Conduct of the Study

The "Evaluation of Water Supply Alternatives" was performed using available data from various sources, including existing NCSD and DWR reports. Additional information was gathered through personal contacts with NCSD and other relevant cities, counties, and agencies. Evaluations of potential treatment technologies and cost estimates were prepared using standard industry procedures and best professional judgment.

Section 3: Water Demand and Supply Assessment

This section assesses the current water demand and supply situation for NCSD, as well as projects future water demands, supplies, and possible deficits based on NCSD's existing planning information.

3.1 Water Supply

As described in "Evaluation of Alternative Supplemental Water Supplies,"[2] NCSD obtains its water supply through 9 wells located on the Nipomo Mesa. The Southern California Water Company also serves groundwater to an area adjacent to NCSD's service area. A recent revised final draft report by California Department of Water Resources – Southern District,[3] indicates that a pumping depression has developed over the last 15 to 20 years to the west of the NCSD service area in the area of NCSD's Sun Dale, Via Concha, Bevington, Black Lake #3 and Black Lake #4 wells. The location of NCSD's wells and the local groundwater contours are shown on Figure 3-1.

Further groundwater extractions at the rate that has occurred historically may exacerbate the situation. In addition, as the last several years have been of above-average rainfall and the groundwater depression has persisted, long-term recharge may not be sufficient for the current extraction rate. Some water continues to outflow from the groundwater basin to adjacent basins, although lowered water table elevations have reduced the amount of outflow.

NCSD and other groundwater users in the area have been sued by the Santa Maria Valley Water Conservation District. This litigation is on-going and NCSD continues to advocate its rights to the groundwater. This evaluation does not analyze the impacts of the litigation on NCSD's groundwater supply.

In 1991, the NCSD Board of Directors approved entering into an agreement with San Luis Obispo to obtain a permanent entitlement of San Luis Obispo County's portion of its contract with DWR to receive water from the State Water Project (SWP). The Board called for a general election, and a slight majority voted against contracting for SWP water. After considerable discussion, the board decided that the decision was administrative and that it would proceed with actions to obtain a SWP supply. However, in 1992, an initiative which prohibited any actions by the Board to obtain a SWP contract was approved by the voters. Since then, the Board has ceased any activities to obtain access to SWP water.

3.2 Current Demand

Based on the "Nipomo Water and Sewer Master Plan Interim Report,"[4] the existing average year water demand in the Main System is 1,890 acre-feet per year (AF/yr). An additional

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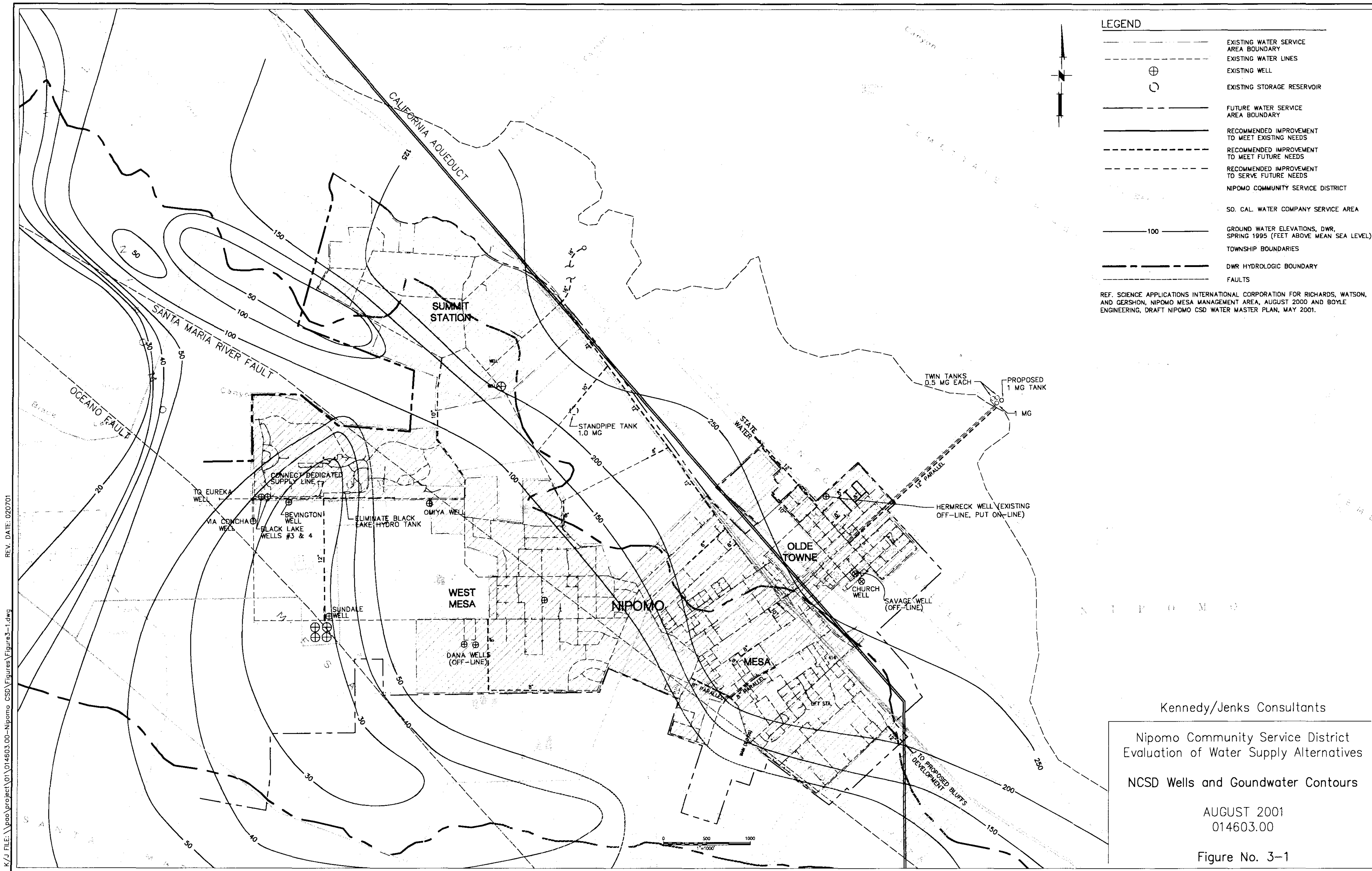
2 Bookman Edmonston, Evaluation of Alternative Supplemental Water Supplies, July 1994.

3 California Department of Water Resources, Water Resources of the Arroyo Grande- Nipomo Mesa Area (Final Draft), January 2000.

4 Boyle Engineering Corporation, Nipomo Water and Sewer Master Plan Interim Report, 23 May 2001 Revision.



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450 AF/yr is used in the Black Lake System, as shown in Table 3-1 below. This is based on a current population of the NCSD of 10,790 people[5] and includes approximately 168 acres of commercial development as well as identification of selected large water users.

TABLE 3-1
EXISTING DEMAND DISTRIBUTION

Land Use or Water User	Water Demand (AF/yr)
Residential	1,423
Non-Residential	68
Nipomo Regional Park	46
Brassica Nursery	19
Other large users and unaccounted for water	335
Main Water System Subtotal	**1,890**
Black Lake Water System Subtotal	**450**
TOTAL	**2,340**

3.3 Projected Demand at Build Out

Projected demand at build out is dependent on what development ultimately occurs within the NCSD boundaries, as well as whether NCSD annexes any additional areas. According to the "South County Area Plan,"[6] population will increase within NCSD due to major residential developments such as Cypress Ridge with 300 homes and one golf course and the Bluffs with 115 homes. In addition, the Plan projects approximately 275 acres of new commercial development and the addition of several large water users, including Nipomo High School, within the NCSD boundaries.

The Plan also includes The Woodlands, consisting of 1,300 homes, a hotel and golf course. Currently, The Woodlands development is not within the boundaries of NCSD. However, it is likely that this area would be annexed to the NCSD in the future. The estimated population of the NCSD at build-out is 20,600 excluding The Woodlands and 24,700 including The Woodlands.

In order to present a conservative analysis of future water supply alternatives, it is assumed that the total gross water demand for The Woodlands will be supplied by NCSD for a projected average year water demand at build out of 5,890 AF/yr as shown in Table 3-2.[7] Without The Woodlands, the total projected water demand would be approximately 4,300 AF/yr at build out.

In addition to the projected demand increase for NCSD, additional demand is anticipated throughout the Nipomo Mesa area. If The Woodlands is not annexed by NCSD, the water demand will still be created and another local water purveyor will need to seek additional supply to meet its needs.

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5 Boyle Engineering Corporation, 2001.
6 San Luis Obispo County Department of Planning & Building, South County Area Plan, 27 May 1999.
7 Boyle Engineering Corporation, 2001.

TABLE 3-2
PROJECTED DEMAND DISTRIBUTION AT BUILD-OUT

Land Use or Water User	Water Demand (AF/yr)
Residential incl. Black Lake	3,278
Non-Residential	132
The Woodlands[1]	1,640
Nipomo High School	81
Nipomo Regional Park	46
Brassica Nursery	19
Other large users and unaccounted for water	693
TOTAL	**5,890**

[1]This estimate is the total gross water use for The Woodlands. The Woodlands may use some recycled water for recharging the groundwater basin resulting in a net usage of 1,228 AF/yr. Under these circumstances, the total projected water demand at build out would be 5,477 AF/yr. The 5,890 AF/yr figure is used throughout this analysis in order to be conservative.

3.4 Projected Water Supply at Build-Out

With a conservative projected demand of 5,890 AF/yr and a current demand of 2,340 AF/yr, a net deficit of up to 3,550 AF/yr is anticipated. This deficit assumes that NCSD would be able to continue groundwater extraction at current levels. As indicated above, DWR has identified pumping depressions in a location west of the NCSD service area but in the area of some NCSD wells. The scope of this report did not include quantification of NCSD's contribution to the pumping depression.

Section 4: Potential Water Sources

This section provides a preliminary evaluation of a wide range of potential alternative water sources for NCSD. These alternatives were screened and the most promising alternatives are evaluated in more detail. This evaluation is presented in Section 6.

Throughout this report, references are made to the various types of costs associated with the different potential water sources. They are defined as follows:

- Commodity Cost: The amount of money that NCSD would pay to another entity for the delivered water. Typically, this cost is in $/AF.
- Capital Costs: The amount of money that would be expended to construct new facilities or modify existing ones to enable the delivery of water. This cost can be one-time or can be distributed over the lifespan of the facility and presented in units of cost as $/AF/yr.
- Operation and Maintenance (O&M) Costs: The costs associated with operating and maintaining a facility, such as electricity, labor for maintenance, and equipment replacement. The cost can be annual or $/AF.

4.1 Overview of Potential Water Sources

A number of potential water sources were identified during an initial project kick-off and brainstorming session. The water sources are:

- State Water Project
- Intertie with the City of Santa Maria
- Sea water desalination
- Purchase of real property with water rights
- Recycled water to offset potable water use
- Oil field produced water
- Hard rock drilling
- Water conservation
- Transport using water bags

In addition, the following options were considered but eliminated by NCSD staff and the K/J consulting team as likely to be impractical or infeasible:

- Obtain water from Twitchell Reservoir, which is operated by U.S. Bureau of Reclamation, to provide flood control and water to recharge groundwater basin of the Santa Maria Valley to prevent saltwater intrusion.

- Obtain excess wet weather flow from San Luis Obispo County's Lopez Lake.

- Expand Nacimiento Reservoir located in San Luis Obispo County with entitlements held by both San Luis Obispo County and Monterey County interests. There is no pipeline capacity available to distribute the water and the pipeline would most likely terminate at Avila Beach.

- Haul barges of water or icebergs from Alaska or Canada.

Groundwater management may also result in increased potable water availability and is discussed as part of this analysis.

The alternatives discussed in this Section are summarized in Table 4-1.

4.2 State Water Project

4.2.1 SWP Background

The Coastal Branch of the State Water Project's California Aqueduct is owned by DWR, with the extension owned by the Central Coast Water Authority (CCWA). CCWA was formed to finance, construct, manage and operate Santa Barbara County's 42-mile extension of the Coastal Branch from Vandenberg to Lake Cachuma. In addition, CCWA constructed and operates the Polonio Pass Water Treatment Plant (WTP) in northern San Luis Obispo County. CCWA operates all of the Coastal Branch facilities downstream of the water treatment plant in a joint powers agreement with DWR.

The San Luis Obispo County Flood Control and Water Conservation District (SLOCFC&WCD) is a contractor to the SWP for 25,000 AF/yr and the Santa Barbara County Flood Control and Water Conservation District (SBCFC&WCD) has an entitlement for 42,896 AF/yr for a total entitlement of 67,986 AF/yr. The SBCFC&WCD has transferred its financial responsibility for the entitlement to the CCWA but remains a party to any agreement that would be necessary if any entitlements were transferred. Information about the SWP entitlement holders in San Luis Obispo and Santa Barbara Counties are presented in Table 4-2.

TABLE 4-1
SUPPLY ALTERNATIVES COMPARISON TABLE

Supply Source	AF available	Costs	Complexity of Developing Contracts/ Agreements	Supply Reliability	Degree of treatment required?	New facilities required for delivery? (Distance from NCSD Boundary)	Method of Use of Supply?	CEQA Required?	Potential for legal challenge?	Additional issues	Sources
SWP- SLO- Oceano CSD	350 AF permanent supply	$1,000/AF for commodity, no up front cost, negotiable	High – OCSD, SLOCFC&WCD, SBCFC&WCD, CCWA, DWR, SWP contractors	Medium	None	Yes – turnout if approved by CCWA	Use in conjunction with groundwater	Neg. Decl. For turnout?	Medium-high	Legal issues, no turnouts, pipeline capacity issues to Nipomo	Susan Litteral, SLO County, Dan Masnada/Ray Stokes – CCWA,
SWP- SB – City of Solvang	Up to 700 AF permanent supply	Min. $1,000 - $2,400/AF for commodity, min. $1,333/AF for up-front, negotiable	High – Solvang, SYWCD, SLOCFC&WCD, SBCFC&WCD, CCWA, DWR, SWP contractors	Medium	None	Yes- turnout –if approved by CCWA	Use in conjunction with groundwater	Neg. Decl.?	Medium-high	Legal issues, Not much excess entitlement, no turnouts	City of Solvang, CCWA
Intertie with City of Santa Maria	2000 – 3000 AF permanent supply	$1,000 – 1,200/AF for commodity, $2,000/AF for up-front, negotiable + inter-tie pipeline costs	Low – 1 entity	High	None	Yes- pipeline to Santa Maria 3+- miles and pump station	Use in conjunction with groundwater		Low	Potential legal challenge	Dwayne Chisam (City of Santa Maria)
Purchase of Desal water from Santa Barbara	Max SWP entitlement is 3000 AF, interruptible	$1,100+/AF for commodity + $1,000/AF min for up-front costs	High –City of SB, SLOCFC&WCD, SBCFC&WCD, CCWA, DWR, SWP contractors	Medium-low	None	Yes- turnout if approved by CCWA	Use in conjunction with groundwater	None	Medium	Would require recommissioning of desal plant in SB	Bill Ferguson, City of SB
New groundwater well on Tosco or other property	1,200 AF permanent supply	?	Low – 1 entity	High	Low	Yes- new well, pump station, chlorination?, pipeline	Additional groundwater supply	EIR/Mit. Neg. decl.?	Medium	Proper structuring of annexation and mgmt or adjudication of basin will help secure water right	Jim Anderson -Tosco
Blowdown Desalination at Tosco	360 AF/yr	$2,000 - 3,000/AF	Low-medium, may require purchase of property from Tosco	High	High	Yes	Additional supply	EIR	Low	?	Jim Anderson -Tosco
Sea Water Desalination	2000 – 3000 AF/yr	$3,000 - 4,000/AF	Medium	High	High	Yes	Additional supply	EIR	Low	Complexity of environmental issues associated with brine outfall and slant-drilled well	
Reclaimed Water from SSLOCSD	1,625 AF – 3,625 AF	$2,200 - $8,300/AF delivered depending on end-use	Low	High	Medium-high	Yes- treatment facilities, pump station and pipeline to in-lieu users in NCSD	Use in lieu of groundwater	EIR	Low	Uncertain is sufficient demand because of high TDS	K/J, Steve Tanaka, John Wallace and Associates
Reclaimed Water from NCSD Southland WWTP	300 AF/yr	?	None	High	Medium-high	Yes- additional treatment, pump station and pipeline to in-lieu users in NCSD – E.G. Regional Park	Use in-lieu of groundwater	EIR	Low	Potential user is Regional Park and future high school, may be insufficient demand	Boyle, 2001
Oil-field Produced Water from Price Canyon (Stocker Resources)	800 AF/yr	Low or no treatment cost, delivery cost	Medium	High, may not be in perpetuity	High- but cost may be borne by oil company	Unknown- may be able to use existing pipeline following rehab	Additional supply	For WTP?	Low		K/J
Hard rock drilling	500 AF/yr	$1,000/AF	Low-medium	High	Low	Yes, well, pipeline and p.s.	Additional supply	Yes – Mitigated Neg. Decl?	Low	Samda may be willing to share up-front costs	Mel McCulloch
Conservation	100 – 200 AF/yr?		Low	Medium-high	None	None	Reduce demand	No	None	May require additional staff for long-term outreach, may reduce recharge to	CUWCC

TABLE 4-1
SUPPLY ALTERNATIVES COMPARISON TABLE

Supply Source	AF available	Costs	Complexity of Developing Contracts/ Agreements	Supply Reliability	Degree of treatment required?	New facilities required for delivery? (Distance from NCSD Boundary)	Method of Use of Supply?	CEQA Required?	Potential for legal challenge?	Additional issues	Sources
										groundwater	
Water Bags	Unknown	Unknown	Low	Medium	None	Connection to distribution system from docking ships	Additional supply	Yes - Mitigated Neg Dec	Low	Not used in the U.S.	

TABLE 4-2
SWP ENTITLEMENT HOLDERS IN SAN LUIS OBISPO AND SANTA BARBARA COUNTIES

Name	County	Amount of Entitlement (AF/yr)
City of Morro Bay	San Luis Obispo	1,313
Cuesta College	San Luis Obispo	200
California Men's Colony	San Luis Obispo	400
San Luis Obispo County Operations	San Luis Obispo	425
City of Pismo Beach	San Luis Obispo	1,240
Oceano CSD	San Luis Obispo	750
Avila Beach CSD	San Luis Obispo	100
Avila Valley Mutual Water Company	San Luis Obispo	20
San Miguelito Mutual Water Company	San Luis Obispo	275
SLO Coastal Unified School District	San Luis Obispo	7
CSA-16-1 – Shandon	San Luis Obispo	100
Drought Buffer	San Luis Obispo	2,640
Annual Turn Back Sales	San Luis Obispo	17,530
Subtotal - San Luis Obispo County		**25,000**
City of Santa Maria[1]	Santa Barbara	16,200
City of Santa Barbara[1]	Santa Barbara	3,000
City of Guadalupe[1]	Santa Barbara	550
City of Buellton	Santa Barbara	578
Goleta Water District[1]	Santa Barbara	4,500
Montecito Water District[1]	Santa Barbara	3,000
Carpinteria Valley Water District[1]	Santa Barbara	2,000
Santa Ynez River Water Conservation District, Improvement District #1- includes Solvang[1]	Santa Barbara	2,000
La Cumbre Mutual Water Company	Santa Barbara	1,000
Vandenberg Air Force Base	Santa Barbara	5,500
Santa Barbara Research Center	Santa Barbara	50
Morehart Land Company	Santa Barbara	200
Drought Buffer	Santa Barbara	3,908
	Subtotal – Santa Barbara County	**42,986**
	TOTAL	**67,986**

[1]Member agency to Central Coast Water Authority

Sources: San Luis Obispo County Flood Control and Water Conservation District, City of Santa Barbara website.

4.2.2 Issues Associated with SWP

There are a number of issues associated with the use of SWP water in the NCSD service area. The first and foremost is that in 1991 and 1992 there were a series of ordinances and referenda regarding NCSD's participation in the SWP. Therefore, there is some doubt as to NCSD's ability to participate in the SWP without returning the issue for a vote to District residents. Although it has not been determined whether NCSD could indirectly purchase SWP water, it has been assumed that for the purposes of this report, a mechanism can be developed that would allow NCSD to legally purchase SWP water.

Other issues include:

- Availability of excess entitlement
- Limitations in SWP pipeline capacity
- Reliability of SWP deliveries
- Complexity of legal agreements and approvals necessary to obtain water deliveries

4.2.3 Availability of SWP Entitlement

As discussed above, SWP entitlement is allocated to agencies of both San Luis Obispo and Santa Barbara Counties. Based on discussions with San Luis Obispo County and CCWA staff, there are only a few entities that have entitlement that is currently unused. They are as follows:

- Oceano Community Services District
- City of Santa Maria
- City of Solvang
- City of Santa Barbara

In addition, untreated water could be transferred water from other SWP contractors (e.g., Kern County Water Agency) or other sources using San Luis Obispo County as contractor. Transferred water would use the Polonio Pass WTP for treatment and the Coastal Aqueduct for conveyance. There are generally two kinds of SWP water transfers:

- A permanent sale of the entitlement
- Temporary transfer of the water on an annual or multi-year basis

Discussions with CCWA indicate that permanent transfers are not being challenged by the large SWP contractors and are therefore preferred for NCSD while temporary transfers are only being allowed on annual basis. Multi-year temporary sales are being challenged by SWP contractors because they would change current precedents. The amount of SWP entitlement that may be available on a permanent basis is limited since most entitlement holders are in areas of growth and anticipate the need for their full SWP entitlements in the future.

4.2.3.1 SWP - San Luis Obispo Option

This option requires the source of the water to be from the San Luis Obispo entitlement (e.g., Oceano CSD) with the actual water being delivered through a regional turnout at Nipomo.

Use of SWP water from San Luis Obispo would require developing agreements with or obtaining approvals by:

- Entity with entitlement for water supply and pipeline costs
- SLOCFC&WCD/San Luis Obispo County Board of Supervisors as SWP contractor
- SBCFC&WCD/Santa Barbara County Board of Supervisors for use of Santa Barbara portion of pipeline
- CCWA for water treatment and capital costs
- DWR and SWP contractors

Developing the agreements with or achieving approvals from these parties can take several years.

Although there are 17,530 AF remaining in the San Luis Obispo SWP allocation, the pipeline to San Luis Obispo has been sized for the 4,830 AF that is actually being delivered. Therefore, there is no additional pipeline capacity to deliver any more than 4,830 AF to San Luis Obispo users. The portion of the Central Coast Aqueduct that passes through the Nipomo area has been paid for only by Santa Barbara County contractors and cannot be used to convey San Luis Obispo entitlement unless agreed to by the Santa Barbara County contractors.

Discussions with the City of Pismo Beach indicate that Pismo Beach does not have excess entitlement that it is seeking to sell. Discussions with the Oceano Community Services District (OCSD) indicate that 350 AF of OCSD's 750 AF entitlement is actively being marketed for permanent transfer. OCSD has a diverse water supply including participation in San Luis Obispo's Lopez project as well as groundwater and SWP supplies. Although there has been interest in the SWP entitlement, OCSD is not currently in any negotiations for the water. OCSD has indicated that they are seeking to receive $1,100/AF in commodity cost and will consider waiving any up-front costs. Although the cost information was provided by OCSD, the cost seems low, since OCSD presumably pays more than $1,100/AF for SWP water.

OCSD's turnout is at Lopez Road and Orcutt Road near the Lopez WTP. This option has the additional complexity in that although Nipomo is in San Luis Obispo County, the portion of the Coastal Aqueduct that runs through Nipomo has been paid for by Santa Barbara County entitlement holders. Although there may be physical capacity to bring the water to Nipomo in the Coastal Aqueduct, the agreements necessary to deliver transferred entitlement may be difficult to negotiate. This issue is discussed further in Section 4.2.4.

4.2.3.2 SWP- Santa Barbara Option

Since the CCWA is no longer issuing new delivery contracts, this option requires the source of the water to be from the Santa Barbara County entitlement holder using the portion of the Coastal Aqueduct paid for by Santa Barbara County entitlement holders. The NCSD would be a sub-contractor to the Santa Barbara County entitlement holder. This approach is utilized to maintain the current financial integrity of CCWA's contracts. The entitlement holders that may have excess supply are City of Santa Maria, City of Solvang, and City of Santa Barbara.

Obtaining water from the City of Santa Maria would be less complex if the water is obtained through intertie with Santa Maria. Accordingly, this option is evaluated in greater detail in Section 4.3. Obtaining water from the City of Santa Barbara is linked to the desalination option described in Section 4.5. In this alternative, NCSD could purchase water at a desalination cost from the City of Santa Barbara, but in actuality receive SWP water.

Obtaining water from Solvang would require a similar agreement to that for the City of Santa Barbara. In addition, an agreement with City of Solvang would also require the concurrence of the Santa Ynez River Water Conservation District, Improvement District #1. Discussions with the City of Solvang, indicated that SWP water is a supplemental supply and that up to 700 AF/yr of Solvang's 1,500 AF/yr entitlement may be available for transfer. The minimum costs would be from $1,000/AF to $2,400/AF for the commodity cost and $1,333/AF for the capital costs. The City of Solvang appears willing to discuss the potential transfer of its SWP water.

The Santa Barbara option would require a similar level of effort as to the San Luis Obispo option above in that contracts and arrangements would be required with:

- Entity with entitlement for water supply and pipeline costs
- SBCFC&WCD
- SLOCFC&WCD
- CCWA for water treatment and capital costs
- DWR and SWP contractors

4.2.3.3 Other SWP Contractors

Although there are other SWP contractors such as the Kern County Water Agency whose members (e.g., Berenda-Mesa Water District, Lost Hills Water District, Belridge Water Storage District, and Wheeler Ridge-Maricopa Water Storage District) may have excess SWP entitlement, the ability to deliver treated water to NCSD is limited by the capacity of the SWP Coastal Branch Aqueduct and the Polonio Pass WTP. In addition, litigation over the SWP Monterey Amendments, which provide for water transfer mechanisms, has not been resolved. Therefore, contacts with the other SWP contractors were not made at this time.

4.2.4 Limitations in SWP Pipeline Capacity

When the SWP Coastal Branch Aqueduct was constructed, the pipeline costs were allocated to the two participating contractors. As discussed above, the San Luis Obispo portion of the pipeline was sized for the 4,830 AF of the San Luis Obispo entitlement holders and the 42,986 AF of Santa Barbara County entitlement holders. Because there were no downstream San Luis Obispo County entitlement holders The San Luis Obispo portion of the pipeline ends upstream of NCSD at the Lopez Turnout at Lopez Road and Orcutt Road. Therefore, the portion of the SWP pipeline that passes through the Nipomo area is designed for the SB County entitlement holders. Bookman-Edmonston indicated that there may be an additional 4 cubic feet per second or 2,830 AF/yr of capacity in the pipeline.[8] However, discussions with CCWA indicate that there is limited additional capacity in the pipeline for additional water above that which is already contracted.

Based on discussions with CCWA, the portion of the Coastal Aqueduct that passes through the Nipomo area has physical capacity for the additional 350 AF from OCSD. However, CCWA cautioned that any agreement to wheel an additional 350 AF/yr to NCSD would require the concurrence of CCWA, the Santa Barbara County entitlement holders and DWR. Because of the small reduction in the proportional use factors for the SB County entitlement holders, there may not be sufficient interest to allow the additional flow through the pipeline.

Like the Coastal Aqueduct, the Polonio Pass WTP is also sized for the contracted water. Therefore, neither the Polonio Pass WTP nor the Coastal Aqueduct can be used to treat or wheel water other than that for the current contractors.

4.2.5 Reliability of SWP Deliveries

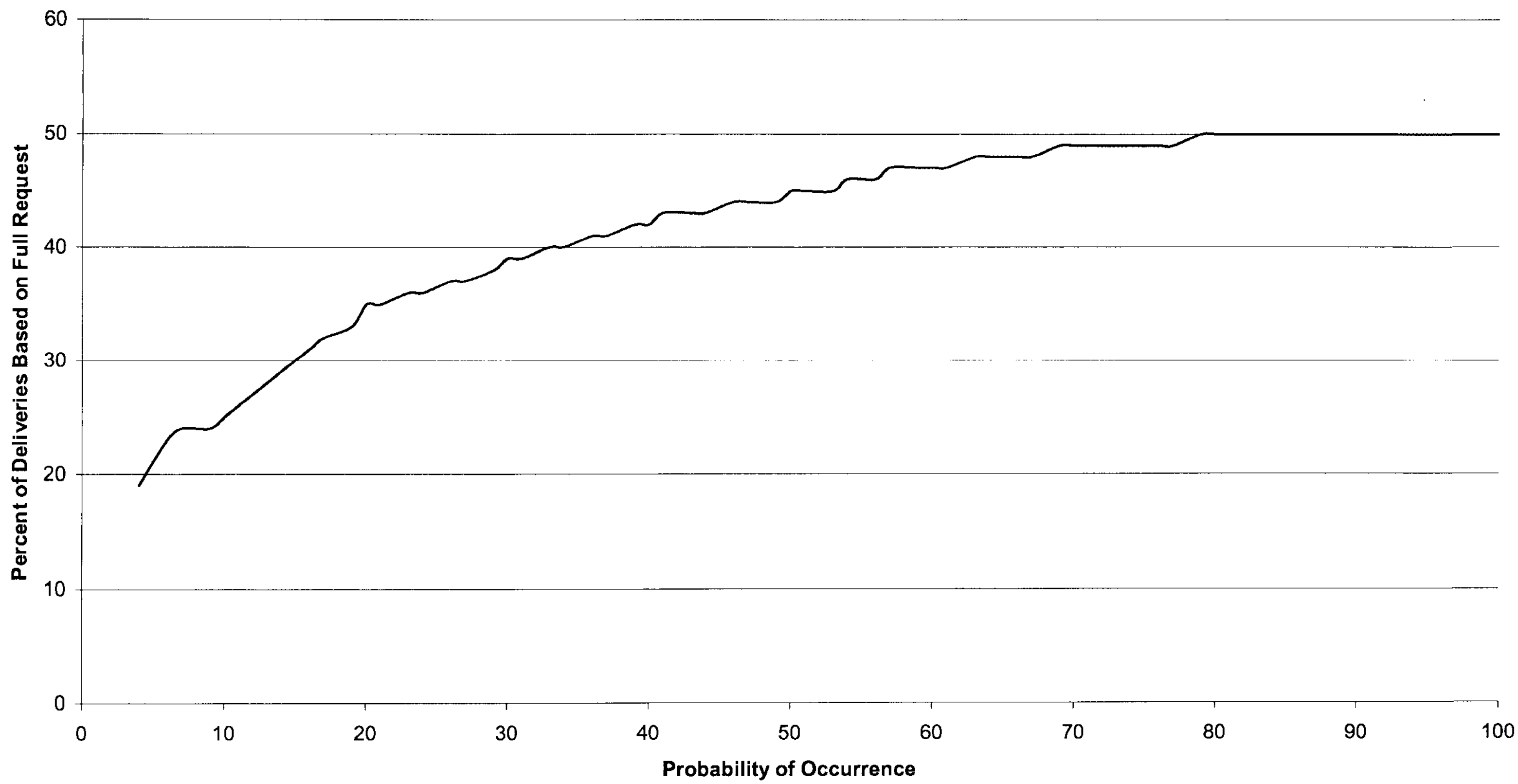
Reliability of SWP deliveries are subject to the availability of the water (i.e., precipitation, snowpack of the present and past years) and the effect of biological opinions on SWP operations. For example, although Water Year 2001 has almost average precipitation and snowfall, the DWR is estimating its deliveries at about 30 percent of the entitlement. The estimates of deliveries are based on the amount of water in SWP storage reservoirs, a conservative projection of runoff for the remainder of 2001, contractor requests and SWP operation constraints. Figures 4-1 and 4-2 summarize the current reliability of the SWP based on historical hydrologic conditions.

These estimates are updated periodically through the spring and summer. It is possible for an agency to purchase SWP "insurance water" by oversubscribing to its water allotment at a cost of $50-60/AF. By doubling DWR's commitment to the agency at 50 percent curtailment, the agency would still receive 100 percent of its original allotment.

4.2.6 Complexity of Necessary Legal Agreements and Approvals

Transfer of SWP entitlements from an existing entitlement holder is a complex and time-consuming process because there are components of water supply, pipeline, and treatment that may require the approval of:

[8] Bookman-Edmonston, 1994.



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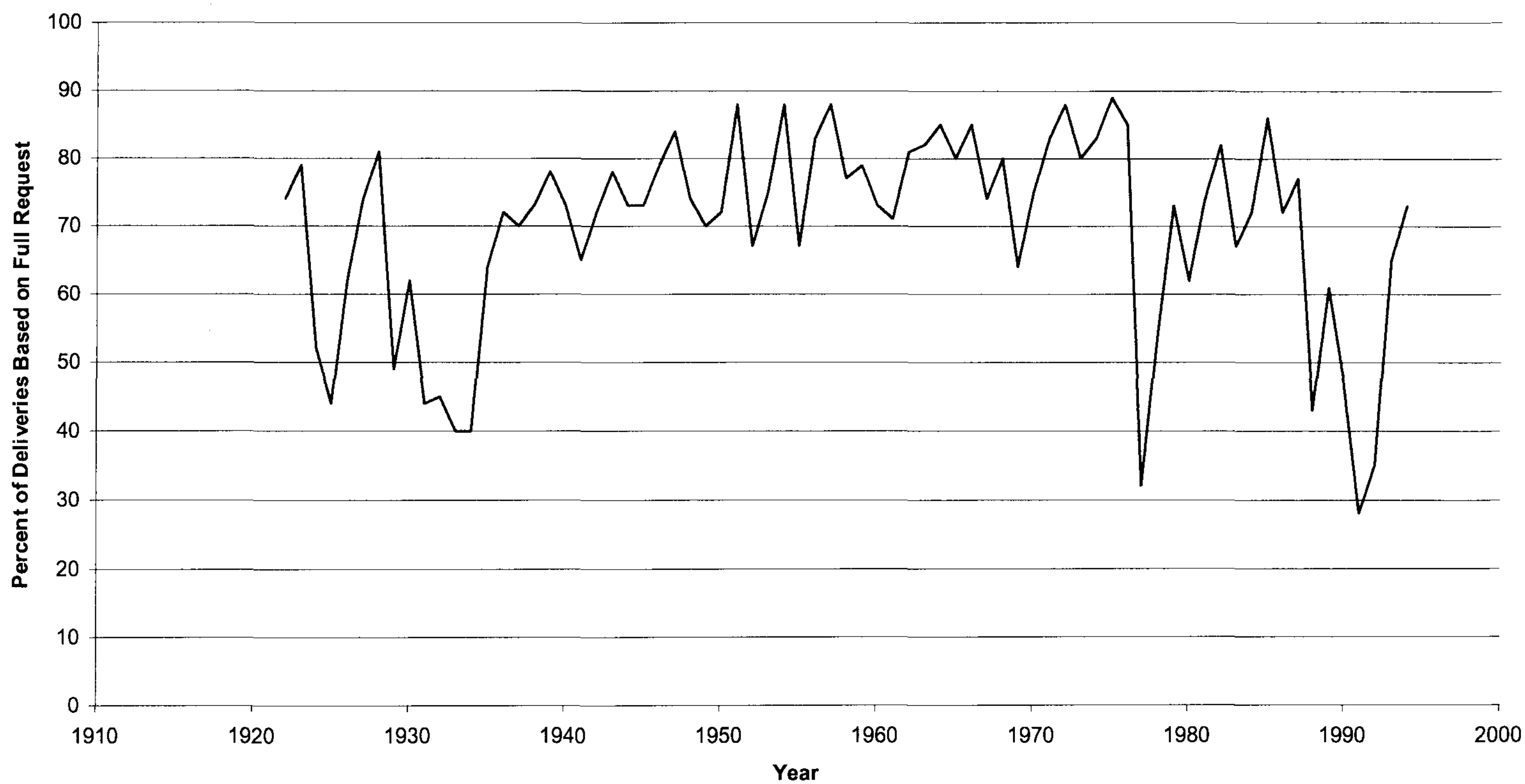
Nipomo Community Services District
Draft Evaluation of Water Supply Alternatives

Probability of Occurrence of SWP Deliveries

July 2001
K/J 014603.00

Figure 4-1



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Nipomo Community Services District
Draft Evaluation of Water Supply Alternatives

State Water Project Deliveries (1922-1994)

July 2001
K/J 014603.00

Figure 4-2

- The local entitlement holder of the SWP supply.

- The SWP contract holder (SLOCFC&WCD/Board of Supervisors or SBCFC&WCD/Board of Supervisors/CCWA) for the water supply.

- DWR for portions of the pipeline.

- CCWA for the treatment, pipeline operations, and overall project capital costs.

- DWR and the SWP contractors for the transfer, if the transfer occurs extraterritorial to a single SWP contractor.

SLOCFC&WCD staff have indicated that the SWP contractors are not approving multi-year transfer agreements. For example, in Avila Beach, 100 AF/yr of SWP entitlement remains unused because the town has been demolished as a result of contamination by petroleum products. The oil company responsible for the contamination wanted to transfer the 100 AF/yr to property in the Central Valley for agricultural irrigation. The SWP contractors did not approve a multi-year contract for this transfer and, after 2 years, the oil company ceased to continue annual renewal because of the complexity of the arrangements relative to the benefit gained from the water.

Furthermore, discussions with CCWA staff have indicated that CCWA would not automatically construct turnouts for all water users. If a turnout were constructed for NCSD, it would be a regional turnout which may have to serve additional future sub-contractors. The cost of a turnout has been estimated by CCWA at $200,000 to $400,000.

4.3 Intertie with the City of Santa Maria

Discussions with the City of Santa Maria (City) indicate that the City has sufficient water from the local groundwater (i.e., water recharged to the groundwater from Twitchell Reservoir) and a portion of its SWP entitlement is available to transfer to other entities. The water could be delivered to NCSD through an intertie, which could connect NCSD's system to the City's system near the southern edge of the Santa Maria River near Highway 101. The City is currently working with the California Department of Transportation (Caltrans) on a new Highway 101 bridge over the Santa Maria River and an intertie pipeline could be attached to the bridge as part of the bridge project. An intertie may avoid some of the issues associated with SWP water since the water that would be delivered would be a blend of waters available to Santa Maria. Initial discussions indicate that the commodity cost of delivered water would be approximately $1,000 to $1,200 per AF. An additional cost of approximately $2,000 per AF for construction of a pipeline and pump station, financing and other up-front costs would also be required.

An alternative to the construction of an intertie pipeline is for the City of Santa Maria to construction a regional SWP turnout in the Nipomo area and transport the water directly to NCSD. However, this option would allow only SWP water to be delivered to NCSD while the intertie would allow for a blend of the City's sources to be delivered to NCSD.

4.4 Purchase of Real Property With Water Rights

Another option that NCSD could consider is the purchase of property to acquire the water rights. However, any transfers of water rights must be carefully structured by a knowledgeable water rights attorney to ensure that the rights of the overlying user are retained. The structure of the water right is particularly critical since NCSD is involved in litigation regarding the groundwater basin. The properties that could be acquired or annexed are most likely to be agricultural properties.

4.5 Sea Water Desalination

The sea water desalination options available to NCSD are to construct a sea water desalination facility at the Tosco Refinery or participate in the City of Santa Barbara's sea water desalination project. These options are discussed in greater detail below.

4.5.1 Desalination at Tosco Refinery

The Tosco Refinery pumps 800-850 gpm (1,290 – 1,370 AF/yr) of groundwater for cooling water and discharges 300 gpm (484 AF/yr) of blowdown water and other wastewaters to an existing outfall. The Tosco Refinery site is an attractive location for desalination for a number of reasons:

- The Refinery is within 1.75 miles of the NCSD Eureka well and, therefore, the NCSD water distribution system at Willow Road and Highway 1.

- The Refinery has an existing ocean outfall through which to discharge brines; however, Tosco representatives have indicated that there is no additional capacity in the outfall.

The potential source waters for the Tosco location would be a new slant-drilled well under the marine mammal sanctuary to intercept sea water and/or to treat and use Tosco's 484 AF/yr of blowdown water.

Tosco currently operates a reverse osmosis (RO) treatment plant for the fresh water to minimize the mineral content of the boiler water. The existing 12-inch diameter outfall is used for discharge for the reject water from the RO treatment plant, for industrial wastewater, and for blowdown water. However, Tosco has indicated that there is no capacity in their ocean outfall for additional brines. If the blowdown water were used for desalination, then some outfall capacity would be gained since only the reject from the blowdown water treatment system would be discharged through the outfall.

A new desalination project at Tosco would require a minimum of:

1. New treatment facilities
2. New distribution/storage facilities
3. Possible land acquisition

A blowdown water treatment facility would be limited to about 484 AF/yr. Provisions would also need to be made to allow Tosco's existing groundwater to be used for NCSD potable uses. Costs for this alternative may be in the $2,000 to $3,000 AF/yr range.

A stand-alone sea water desalination plant would require a minimum of:

1. New slant-drilled well for sea water
2. New pumping facilities
3. New treatment facilities
4. New distribution/storage facilities
5. Possible land acquisition
6. New brine outfall

A sea water desalination facility would not be limited in capacity. However, Tosco's existing brine outfall does not have sufficient capacity for the brine discharge associated with sea water desalination. Construction of a new brine outfall, plus a slant-drilled well under the Marine Mammal Sanctuary would require extensive environmental analysis and expensive construction methods. The process would also be less efficient and more expensive to operate than a blowdown desalination facility, because the source water would have considerably higher TDS levels and recovery would be much lower (40% vs. 75%). Costs for a stand-alone desalination plant may be in the $3,000 to $4,000 AF/yr range.

4.5.2 City of Santa Barbara

The City of Santa Barbara has a sea water desalination plant that can produce up to 10,000 AF/yr. The plant was built in 1991 – 1992 in response to the severe drought of 1986 – 1991. Since that time, the desalination plant has been decommissioned because the City of Santa Barbara has sufficient water supply from other sources, including 3,000 AF/yr of SWP, to meet its needs. Therefore, the City of Santa Barbara has additional supply that it does not currently use.

As one of its water supply options, NCSD could purchase desalinated water from the City of Santa Barbara. Because the City of Santa Barbara is a SWP contractor and the SWP pipeline passes through the Nipomo area, NCSD could receive SWP water while paying the City of Santa Barbara to operate the desalination plant to produce the water that Santa Barbara needs. Discussions with the City of Santa Barbara have indicated that this option is feasible although Santa Barbara has never entered into such an agreement.

The current costs associated with the City of Santa Barbara desalination plant are:

- $2 – 3 million recommissioning including new membranes, new filters, new computer and controls equipment. For a production requirement of 3,000 AF, estimated unit costs are $670/AF - $1,000/AF. The capital costs are for recommissioning only. No expansion would be necessary.

- $1,100/AF operations and treatment cost. The treatment cost could increase significantly if energy prices increase. It is estimated that 30 percent of the operations and treatment cost is associated with energy and that the RO system requires 6,600 kwh/AF produced. The operations and treatment cost assumes that energy supply costs 5 cents/kwh for high voltage, interruptible energy supply. Recently, the energy cost has increased to 8 cents/kwh for the same supply raising the operations and treatment cost to $1,300/AF.

This supply would require agreements with the 6 entities necessary to deliver SWP water and may not be available at all times. City of Santa Barbara staff indicated that in a drought period, it may limit the amount of water that it would transfer. Therefore, this may not be an uninterruptible supply.

4.6 Recycled Water

Typical uses for recycled water offset potable demand by providing non-potable water to users that do not require potable quality water. There are two sources of recycled water close to the NCSD service area, the South San Luis Obispo County Sanitation District (SSLOCSD) Wastewater Treatment Plant (WWTP) in Oceano and the NCSD Southland WWTP in Nipomo. The Woodlands Development, which is currently in development, includes a wastewater treatment plant with water reclamation capabilities. The recycled water from The Woodlands Development will be used on The Woodlands golf course.

4.6.1 Recycled Water Issues

There are several issues associated with the use of recycled water including:

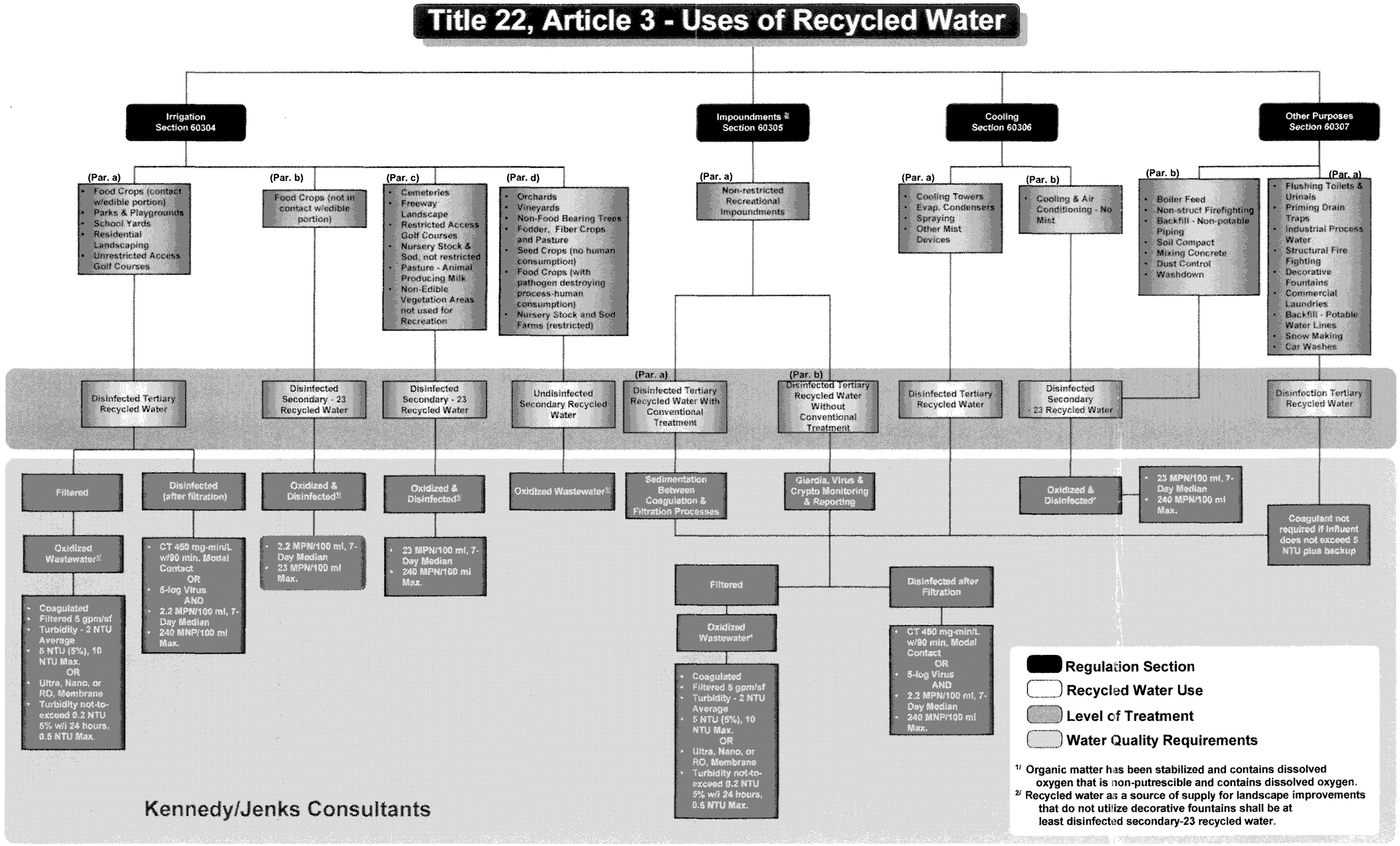
- The water quality required by the end use – agricultural or landscape irrigation, groundwater recharge, or other uses.
- The regulatory requirements associated with the end use and potential public contact with the recycled water.
- The need for additional treatment beyond what the wastewater treatment plant already provides.

The costs to treat the recycled water to achieve the appropriate water quality for the end use in accordance with the regulatory requirements depends primarily on the end use and the level of contact. Figure 4-3 presents a summary of the requirements for recycled water reuse.

4.6.2 Potential Recycled Water Sources

4.6.2.1 South San Luis Obispo County Sanitary District

John Wallace and Associates prepared an updated recycled water study in 2001. Currently, 3,136 AF/yr of wastewater is treated to the secondary level, with the SSLOCSD reclamation facility sized for 1,625 AF/yr, which would be delivered to the Bjeree and Woodland Golf Courses and for landscape irrigation along Highway 101. The 1994 Bookman-Edmonston study



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Nipomo Community Services District
Draft Evaluation of Water Supply Alternatives

Understanding Recycled Water Regulations

August 2001
K/J 014603.00

Figure 4-3

proposed to expand the SSLOCSD project from 1,625 AF/yr to 3,625 AF/yr for additional irrigation of golf courses and landscaped areas overlying the Nipomo Mesa groundwater basin or to provide the recycled water to the agricultural users in lieu of the agricultural users pumping groundwater.

One of the main issues associated with the SSLOCSD recycled water source is the high total dissolved solids (TDS) levels of the effluent. In 1992 and 1993, the effluent TDS was 1,000 – 1,200 mg/L. More recent sampling in October 2000 indicates that effluent TDS remains at 1,000 mg/L, which is most likely the result of the use of water softeners in the tributary areas.

Water with 1,000 mg/L of TDS has limited use. If the recycled water is blended with a lower TDS water, the TDS levels can be reduced. TDS levels in the groundwater are approximately 300 mg/L with some historic levels as high as 890 mg/L.[9] If groundwater is used for blending, the demand for groundwater is not reduced as much if the recycled water is used without blending. Another more expensive option for reducing effluent TDS levels is the construction of a treatment facility for additional TDS removal.

One of the reasons that the SSLOCSD recycled water project has not been constructed is the lack of demand for the recycled water. The current update that John Wallace and Associates is preparing indicates that the market for recycled water has not significantly changed since 1993 and that the costs have continued to increase.

4.6.2.2 NCSD Southland WWTP

The NCSD Southland WWTP provides treatment for wastewater from the NCSD service area. Currently, the treated wastewater is stored in evaporation/percolation ponds and about 300 AF/yr recharges the portion of the groundwater basin to the north of the Santa Maria River fault. The recharge from the treated wastewater does not immediately enter the portion of the groundwater basin where there is a pumping depression.

One of the potential uses for recycled water would be for irrigation of Nipomo Regional Park, which would offset about 46 AF/yr of potable demand. Another potential user is the future Nipomo High School, which has an estimated demand of 81 AF/yr. There may be other potential users for recycled water from Southland WWTP. However, there appear to be no significant agricultural users nearby.

Any recycled water project would require filtration and chlorination at the treatment plant, as well as storage, distribution, and pumping facilities. Capital costs for a recycled water project could be paid by connection fee for new development.

4.7 Oil Field Produced Water

Oil field produced water is a by-product of oil production generated when oil is pumped out of the reservoir. It is generally of poor water quality and unsuitable for potable, industrial, or irrigation use without treatment. One of the nearby sources of oil field produced water has TDS of 1,500 to 2,500 mg/L, hardness from 160 to 330 mg/L, total alkalinity from 500 to 600 mg/L,

9 Bookman-Edmonston, 1994.

silica from 200 to 250 mg/L, boron around 10 mg/L, total organic carbon (TOC) greater than 100 mg/L, and petroleum-related organic constituents. Oil field produced water is often of temperatures in excess of 150°F. Oil companies are finding that oil production may improve if the oil field produced water is disposed of on the surface rather than through reinjection. However, because of the water quality, reinjection has often been the most cost-effective disposal option.

4.7.1 Oil Field Produced Water Issues

Treatment processes can produce potable quality water; however, because of the poor initial water quality and the organic constituents, it is more appropriate for treated oil field produced water to be used at the Tosco Refinery for process water or for irrigation to offset groundwater demand. Pilot studies that Kennedy/Jenks has performed at the Placerita Oil Field have indicated that even with RO treatment, some organic compounds such as napthalene, 2-butanone, and ethylbenzene, can be detected in the RO effluent. As with drinking water, oil field produced water quality can vary highly from location to location; therefore, the treatment technologies described in Section 6 are specific to locations where Kennedy/Jenks has conducted studies and may not represent the conditions at the locations described near the Nipomo area.

The economics of oil production are market-driven and are different from those of drinking water supplies. As oil prices rise or drop, oil fields go into and out of production depending on the costs of production. Therefore, NCSD should be aware that the reliability of oil field produced water should be considered as a long-term, but not a permanent supply.

4.7.2 Potential Oil Field Produced Water Sources

4.7.2.1 Arroyo Grande Price Canyon Oil Field – Stocker Resources

One of the nearby potential sources of oil field produced water is the Arroyo Grande Price Canyon Oil Field owned by Stocker Resources. It is located approximately 10 miles northeast of NCSD along Highway 227 near Ormond Road. Preliminary discussions with representatives of Stocker Oil indicate that about 20,000 – 25,000 barrels per day (940 – 1200 AF/yr) of oil field produced water is generated. Because of waste streams generated during the treatment processes, it is estimated that the amount of treated water that is available is approximately 700 – 800 AF/yr. It is estimated that this oil field will be in production for 20 years or longer.

Due to the economics of oil production, Stocker Resources may be able to provide the treated water for low or no cost. An initial estimate indicates a cost of $450/AF. However, conveyance costs must also be considered. There is an existing, out-of-service 8-inch diameter pipeline from the Stocker Resources Price Canyon Oil Field to the Tosco Refinery. The pipeline was last internally inspected in 1995 and Tosco indicated that the pipeline may not be appropriate for crude oil conveyance. Tosco is exploring the feasibility of putting fiber optic cable in the portion of pipeline between Arroyo Grande and Pismo Beach.

Further consideration of this option would require additional investigation regarding the availability of an existing conveyance and an assessment of the condition of the conveyance. Stocker Resources has indicated a willingness to enter into discussions with NCSD regarding the feasibility of treating and delivering oil field produced water to NCSD or the Tosco Refinery to offset groundwater use.

4.7.2.2 Other Oil Fields

Another option for oil field produced water is from the Sisquoc Oil field to the southeast of Santa Maria. The Sisquoc Oil field is approximately 17 miles from Nipomo. Kennedy/Jenks Consultants has not had any discussion with Texaco, Graeca or Vintage oil companies that produce oil in the Sisquoc area. However, investigation of the availability of pipelines to convey water from Sisquoc to the Nipomo area has indicated that there do not appear to be any out-of-service pipelines. There are large crude oil pipelines that serve the All American Sisquoc Pump Station and the SMRC/Santa Maria Asphalt Refinery. Pipeline and oil field information would have to be confirmed with the oil companies and/or the State Fire Marshal. Because of the greater distance to Sisquoc than to Price Canyon and the lack of an obvious conveyance pipeline, this source of oil field produced water will not be explored further.

Torch Oil has initiated a project to evaluate oil field produced water at its Lompoc oil field. However, because of the distance from Lompoc to Nipomo, this option will not be explored further.

4.8 Hard Rock Drilling

NCSD was approached in 1994 by Samda, Inc. a company that specializes in finding and developing water supplies from fractured hard rock geology. There are rockier areas immediately to the east of Nipomo within about 3 miles that are candidates for this type of water development.

Samda has developed some hard rock projects in California. They have successful projects in Monterey County, at the CT Ranch in Cambria, and in San Diego County where flow rates in the range of 350 to 2,000 gpm (550 – 3,200 AF/yr) have been developed. A preliminary estimate indicates that hard rock in the Nipomo area could yield 500 - 1,000 AF/yr.

Samda develops its projects in 3 phases. Phase 1 is to review subsurface geology, evaluate yield, identify potential locations, acquire permits for test bores, and drill test bores to predict actual production capacity. Phase 2 includes test pumping and water quality of test bores to predict actual production capacity. Phase 3 includes drilling of production wells and delivery of water to NCSD's distribution system. Samda indicated that it could share in Phase 1 up-front costs up to 50 percent of the cost. The current price of delivered water is about $1,000/AF, which is based on the cost of water in the local area. Samda has indicated that this price is negotiable.

Issues associated with water rights for hard-rock drilling are similar to those for any new groundwater source. However, Samda's yield estimates are based on estimated recharge to the geologic formation that does not allow for mining of groundwater.

4.9 Water Conservation

Aggressive water conservation can reduce water use and allow existing water supplies to accommodate additional demand. The advantages of water conservation include its relatively low cost, the variety of incentive programs available, and the broad public support it enjoys. There are few barriers to implementation and the process is not complex. The disadvantages of water conservation include its dependence upon voluntary action by customers. While NCSD has a water conservation ordinance in effect, new water conservation activities would provide additional water savings. It has been estimated that water conservation can realize 10 to 20 percent savings of water at a cost that is often less than other water supply alternatives.

4.10 Transport Using Water Bags

Several companies, including World Water SA, transport potable water from areas with a surplus of fresh water to those without sufficient drinking water in "water bags" towed behind ships. World Water, SA, claims that fresh water can be transported using their bags for about $0.51/m^3$ (versus desalination at $1.19/m^3$). This cost does not include the necessary piping and pumps to get the water out of the floating bags and into the distribution system. Although this mechanism of water delivery has been used successfully in the Mediterranean and other parts of the world, it has not been implemented in the U.S.

4.11 Groundwater Storage and Management

Because NCSD relies on groundwater, any consideration of water supply alternatives should include possible groundwater storage and management. There may be an important relationship between the continued use of groundwater on the Nipomo Mesa and management of the resource. Pumping depressions have developed west of the NCSD service area boundary and expanded groundwater extractions in the area may exacerbate the declines in groundwater levels. The pumping depressions present an opportunity to store additional water either directly or in-lieu. However, in the absence of adjudication or groundwater management, the right to recover any stored water may be disputed. NCSD is currently in litigation with the Santa Maria Valley Water Conservation District regarding the groundwater basin. In addition, to the advocacy that is already occurring through the litigation, NCSD should evaluate groundwater banking and management and consider applying for available grants to perform the necessary studies.

Section 5: Overview of Relevant Treatment Technologies

Brackish water, sea water, and produced water from oil field operations contain significant amounts of dissolved solids. Removal of dissolved solids from this water is important to enable its use for potable and non-potable applications. There are a number of treatment technologies currently available for treatment, including reverse osmosis, nanofiltration, electrodialysis and electrodialysis reversal, Photonic Ionization Manipulation and Augmentation, vapor compression distillation, multistage flash distillation, and mechanical vapor compression. This section provides a brief overview of each technology and summarizes the costs and applicability of the technology.

Although these technologies can effectively remove dissolved ions, some water quality issues need to be addressed prior to choosing a technology. For example, these technologies often generate a large volume of reject water containing very high concentrations of ions. These ions, at elevated concentrations, precipitate from the process reject water. Consequently, processes such as gravity settling or belt filter press may be required to remove settled solids from the reject. In addition, some of the treatment processes use anti-scalants and anti-foaming agents to prevent silica and calcium precipitation. Anti-scalants and foaming agents, if found in the treated product water, may impact its use.

5.1 Reverse Osmosis

Reverse osmosis (RO) uses a membrane that is semi-permeable, allowing the fluid that is being purified to pass through it, while rejecting the contaminants that remain. RO removes virtually all organic compounds and 90 to 99 percent of all ions, as well as 99.9+ percent of viruses, bacteria and pyrogens. Generally, RO will remove substances with a molecular weight of greater than 150-250 daltons. The separation of ions with RO is aided by charged particles. This means that dissolved ions that carry a charge, such as salts, are more likely to be rejected by the membrane than those that are not charged, such as organics. The larger the charge and the larger the particle, the more likely it will be rejected.

RO systems include a pump, a pressure vessel, and a membrane. The feed water is pumped into the vessel where it is pressurized against the membrane. The high-pressure pump supplies the pressure needed to enable the water to pass through the membrane and have the salts rejected. This pressure ranges from 100 to 400 psi for brackish water and from 800 to 1,180 psi for sea water.

Most RO systems use a process known as crossflow to allow the membrane to continually clean itself. As some of the fluid passes through the membrane the rest continues downstream, sweeping the rejected species away from the membrane. RO is dependent on the driving force of pressure to push the fluid through the membrane. The higher the pressure, the larger the driving force. As the concentration of the fluid being rejected increases, the driving force required to continue concentrating the fluid increases.

As a portion of the water passes through the membrane, the remaining feed water increases in salt concentration. At the same time, a portion of this feed water is discharged without passing through the membrane. The amount of the feed water discharged to waste in this brine stream varies from 20 to 70 percent of the feed flow, depending on the salt content of the feed water.

Pretreatment is important in RO because the feed water must pass through very narrow passages during the process. Therefore, suspended solids must be removed and the water pre-treated so that salt precipitation or microorganism growth does not occur on the membranes. Usually the pretreatment consists of fine filtration and the addition of acid or other chemicals to inhibit precipitation. Post-treatment can include stabilizing the water, which has become quite aggressive due to the removal of all its salts and ions, and preparing it for distribution. This post-treatment might consist of the removing gases such as hydrogen sulfide and adjusting the pH.

A large selection of RO membranes are available to meet varying rejection requirements. RO can be used in residential, commercial and industrial applications to produce drinking water, industrial process water or high-purity water, as well as for desalination.

Because RO is driven by pressure, rather than by an energy-intensive phase change, it is much more energy efficient compared to distillation and more efficient than the strong chemicals required for ion exchange. However, power costs are a major component of RO operating costs.

RO facilities are becoming more common, particularly in Southern California, for desalination and other water treatment applications. For seawater desalination, RO plants are planned in Huntington Beach, Carlsbad, and Long Beach, with others planned in Texas, Florida, and elsewhere in the world. RO is in use for non-desalination purposes in Port Hueneme, El Segundo, and Carson. Plants are planned in Fountain Valley and Long Beach.

5.2 Nanofiltration

Nanofiltration (NF) is a form of filtration that uses membranes to preferentially separate different fluids or ions. It is not as fine a separation process as RO, but it also does not require the same amount of energy to perform the separation. NF is capable of concentrating divalent salts, bacteria, proteins, particles, dyes, and other constituents that have a molecular weight greater than 1,000 daltons.

NF uses a membrane that is partially permeable to perform the separation, but the membrane's pores are typically much larger than the membrane pores that are used in RO. The NF membrane will allow the water to pass through the membrane while holding back salts, and other contaminants, concentrating the reject solution. As the concentration of the fluid being rejected increases, the driving force required to continue concentrating the fluid increases. NF, like RO, is affected by the charge of the particles being rejected. Thus, particles with larger charges are more likely to be rejected than others.

NF operates at a lower pressure than RO and typically requires less energy. NF can be used for water softening and desalting.

5.3 Electrodialysis and Electrodialysis Reversal

Electrodialysis (ED) and electrodialysis reversal (EDR) employ membranes, which are semipermeable to ions based on their charge, and electrical current to reduce the ionic content of water. Two flat sheet membranes, one that preferentially permeates cations and the other anions, are stacked alternately with flow channels between them. Cathode and anode electrodes are placed on each side of the alternating stack of membranes to draw most ions through the membranes. As the source water flows between the cation and anion membranes, the voltage potential induces the cations to migrate toward the cathode through the cation membranes, and the anions to migrate toward the anode through the anion membranes. The cations and anions accumulate in the reject water side of the membranes and the product water is produced. This leaves much lower concentrations of ions in the water of the alternate channels. EDR involves reversing the polarity of the electrodes periodically to flush scale-forming ions off the membrane to minimize membrane cleaning.

The EDR system product water does not pass through the membrane as in an RO or NF system. This reduces the potential for particulate fouling on the EDR membrane surface.

Electrodialysis depends on the following general principles:

- Most salts dissolved in water are ionic, being positively (cationic) or negatively (anionic) charged.
- These ions are attracted to electrodes with an opposite electric charge.
- Membranes can be constructed to permit selective passage of either anions or cations.

The dissolved ionic constituents in a saline solution such as Na^{+}, Ca^{2+}, and CO_3^{2-} are dispersed in water, effectively neutralizing their individual charges. When electrodes connected to an outside source of direct current like a battery are placed in a container of saline water, electrical current is carried through the solution, with the ions tending to migrate to the electrode with the opposite charge.

The raw feed water must be pre-treated to exclude materials that could harm the membranes or clog the narrow channels in the cells from entering the membrane stack. The feed water is circulated through the stack with a low-pressure pump with enough power to overcome the resistance of the water as it passes through the narrow passages. A rectifier is generally used to transform alternating current to the direct current supplied to the electrodes on the outside of the membrane stacks. Post-treatment consists of stabilizing the water and preparing it for distribution. This post-treatment might consist of removing gases such as hydrogen sulfide and adjusting the pH.

Electrodialysis units are normally used to desalinate brackish water. The major energy requirement is the direct current used to separate the ionic substances in the membrane stack. Electrodialysis is currently being used in Port Hueneme.

5.4 Photonic Ionization Manipulation and Augmentation

Photonic Ionization Manipulation and Augmentation (PIMA) is a new technology that is being marketed to desalinate sea water. After standard primary screening, lasers are used to alter the water molecules to allow them to separate from most of the rest of the chemicals found in sea water, including sodium, magnesium, and chromium. After the laser treatment, these and other substances coagulate into a paste-like substance that is easily removed using stratification, sedimentation, or centrifugation, leaving behind only fresh water. Sodium, magnesium, and chromium can be recovered from the coagulated minerals and sold. The lasers also provide disinfection. Photonics claims that PIMA uses 60 percent less power than RO.

The first commercial desalination plant using PIMA technology is scheduled to begin operating in Saudi Arabia in 2001. No plants are existing or planned in the United States using PIMA technology.

5.5 Rapid Spray Distillation

Rapid Spray Distillation (RSD) is based on the principle that salt water can be ejected at high velocities in small droplets so that, as rapid evaporation occurs, solids separate out and are trapped. The resulting vapor is condensed into pure water. Aquasonics, who is patenting the RSD technology, claims that RSD generates 95 percent recovery of fresh water.

Kennedy/Jenks is not aware of an existing or planned desalination plants using RSD.

5.6 Vapor Compression Distillation

Vapor compression distillation (VCD) evaporates water using the heat from the compression of vapor rather than the direct exchange of heat from steam produced in a boiler. The boiling point temperature is reduced by reducing the pressure. Two primary methods are used to condense vapor to produce enough heat to evaporate incoming feed water: a mechanical compressor or a steam jet. The mechanical compressor is usually electrically driven, allowing the sole use of electrical power to produce water by distillation. VCD is generally used for small-and medium-scale desalination.

5.7 Multistage Flash Distillation

Multistage Flash Distillation (MSF) is an evaporative process consisting of several vessels or stages, typically anywhere from 4 to 40. Feed water is heated in a vessel called the brine heater. This is generally done by condensing steam on a bank of tubes that passes through the vessel, which in turn heats the feed water. The water then flows into another vessel, where the ambient pressure is such that the water will immediately boil. The sudden introduction of the heated water into the chamber causes it to boil rapidly, almost exploding or flashing into steam. Generally, only a small percentage of this water is converted to steam (water vapor), depending on the pressure maintained in this stage since boiling will continue only until the water cools (furnishing the heat of vaporization) to the boiling point. Steam generated by flashing in each stage is collected by condensing on tubes of heat exchangers that run through each stage. The steam generated by flashing is converted to fresh water. The tubes are cooled by the incoming feed water going to the brine heater. This, in turn, warms up the feed water so that the amount of thermal energy needed in the brine heater to raise the temperature of the feedwater is reduced.

Using multiple boiling at successive vessels, each operating at lower temperature and pressure than the previous vessel, significantly reduces the amount of energy required for vaporization in this process. MSF plants usually operate at the top feed temperatures (after the brine heater) of 194-249°F. One of the factors that affects the thermal efficiency of the plant is the difference in temperature from the brine heater to the condenser on the cold end of the plant. Operating a plant at the higher temperature limits of 248°F tends to increase the efficiency, but it also increases the potential for detrimental scale formation and accelerated corrosion of metal surfaces. MSF is primarily used for desalination.

The world's largest desalination plant in Al-Jubail, Saudi Arabia, uses MSF. Because of the high energy costs involved in this technology, it is not often used in the United States.

5.8 Mechanical Vapor Compression

Mechanical Vapor Compression (MVC) is also a distillation process. In MVC, the heat for evaporation comes from the compression of vapor rather than from direct exchange of heat from steam. The mechanical compressor is usually electrically driven, allowing the use of electric power to produce water by distillation. Unlike MSF, the temperature of MVC condensate is still at a higher temperature and may have to be cooled prior to field applications. MVC is primarily used for desalination in countries other than the U.S.

Section 6: Detailed Evaluation of Selected Alternatives

With a conservative projected water demand of 5,890 AF/yr and a current supply of 2,340 AF/yr, as described in Section 3, a net deficit of up to 3,550 AF/yr is anticipated for NCSD at build-out. In order to meet future water demands, groundwater pumping must continue at existing rates, and additional sources of 3,550 AF/yr must be identified. The potential water sources to address this estimated deficit were discussed in Section 4 and have been summarized in the matrix presented in Table 6-1. Based on this qualitative screening level evaluation of the potential water sources, the following alternatives are recommended for more detailed evaluation and cost development.

1. Intertie with the City of Santa Maria
2. Groundwater at Tosco
3. Groundwater Exchange with Agricultural Users
4. Desalination at Tosco
5. Oil field produced water from the Price Canyon Oil Field
6. Recycled Water from SSLOCSD
7. Hard rock drilling
8. Water conservation

This section provides a more detailed evaluation of the recommended alternatives. Because Alternatives 2, 3, 4, 5, and 6 are all dependent upon the ability to substitute non-potable water in applications currently using potable water, they are discussed together. Because significant lead time may be required to develop the selected alternatives, a proposed implementation schedule is also presented.

The recommended alternatives were confirmed by NCSD staff as being the most viable for further evaluation. For each of these alternatives, the following characteristics are described:

- Water Quality
- Required Infrastructure
- Reliability
- Required Agreements/Institutional Issues
- Permitting/California Environmental Quality Act (CEQA)
- Costs/Funding
- Schedule

TABLE 6-1
DETAILED EVALUATION SUMMARY

Alternative	AF Available per year	Annualized Cost per AF (over 20 yrs)[1]	Proposed Implementation Schedule	Comments
1. Intertie with Santa Maria	2,000 - 3,000	$1,700	Commence negotiations within 1 - 3 months	
1A. Turnout	2,000 - 3,000	$1,239	Commence negotiations within 1 - 3 months	Less reliable than turnout, plus has referenda implications
2. Groundwater at Tosco	1,290 - 1,370	$182[2]	Initiate conversation with Tosco within 3 - 6 months	This option would require acquisition or lease of water rights
3. Groundwater Exchange with Agricultural Users	500 - 1,000[3]	$169[2]	Initiate discussions with potential agricultural users within 3 - 6 months	This option would require acquisition or lease of water rights
4. Desalination at Tosco	360	$2,161[4]	Revisit this option annually and review technology changes	This option is always available but may require 3 - 4 years to implement fully.
5. Oil-field produced Water from Price Canyon	700 - 800	$3,970 - $4,520[4]	Conduct initial discussion within 3 - 6 months with Stocker Resources and Tosco to further test the viability of this option and to identify use of the pipeline	Cost of this project to NCSD depends highly on the value of the project to Stocker Resources
6. Recycled Water from SSLOCSD	1,200[5]	$2,080[4]	Initiate discussions with SSLOCSD within 3 - 6 months	
7. Water Conservation	500 - 1,000[6]	$11[4]	Obtain membership to CUWCC and Initiate review of water conservation program within 3 - 6 months	
8. Hard Rock Drilling	500 - 1,000	$1,024	Revisit this option annually and review	This option may be subject to litigation for water rights issues

[1] Costs do not include property or easement acquisition.
[2] Includes cost of the new potable water source only. The cost of providing an alternative water source to the owner of the groundwater rights is shown under items 4, 5, and 6.
[3] 1,000 AF/yr assumed. More may be available.
[4] Includes cost of the new alternative water source only. The cost of the potable water supply is shown under items 2 and 3.
[5] As much as 3,000 AF/yr of recycled water is available, as long as sufficient agricultural exchange can be identified to use it. 1,000 AF/yr was assumed for this evaluation.
[6] Assuming that 10% - 20% water savings can be achieved by conservation
[7] Includes one-time cost for Water Conservation Plan. Implementation of rebates and other programs is at additional cost.

Costs are summarized in the discussion of individual alternatives. Detailed cost information is provided in Appendix A. All costs are presented in 2001 dollars and are amortized over a 20-year period.

6.1 Intertie with the City of Santa Maria

The City of Santa Maria has indicated that they may be able to provide 2,000 to 3,000 AF/yr of permanent water supply to NCSD through an intertie. The City of Santa Maria receives water from groundwater and SWP water.

During discussions with NCSD staff, purchase of SWP turnback supply through Santa Maria and delivered through an intertie was identified as an option. If the water is purchased by the City, this option appears feasible and straightforward. Capacity for the City's entitlement is available in the Coastal Aqueduct. The following discussion focuses on constructing an intertie with the City of Santa Maria that would allow NCSD to receive water from the City's usual supplies of groundwater and SWP water.

Alternatively, NCSD could negotiate an agreement with the City to use 2,000 to 3,000 AF/yr of the City's water supply which could be delivered through a new turnout. This option would enable NCSD to obtain a water supply without an intertie or the complexities associated with obtaining SWP water that are discussed in Section 4. However, the issues associated with the ordinances and referenda discussed in 4.2.2 should be reviewed by the NCSD's legal counsel.

6.1.1 Water Quality

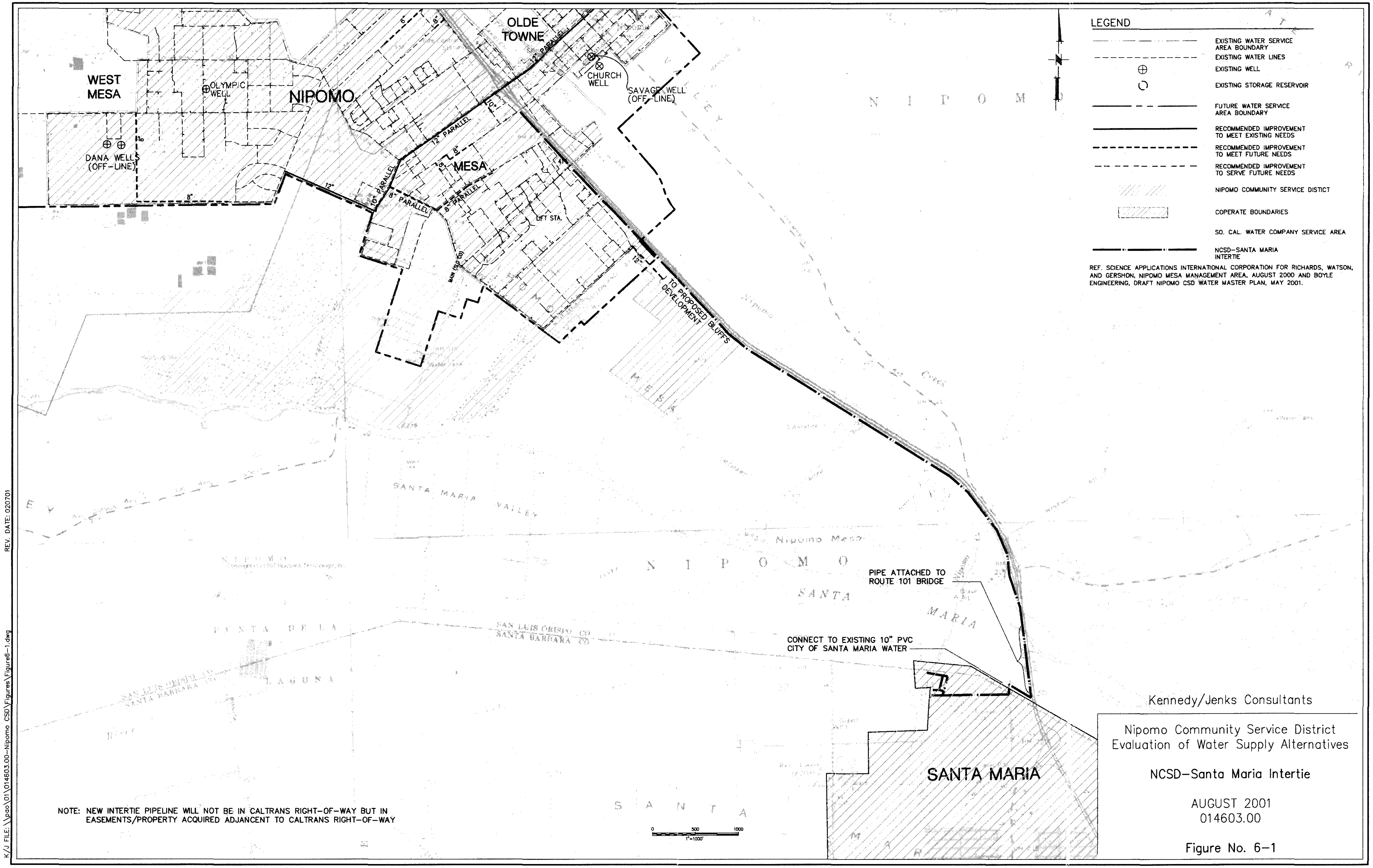
Water received through an intertie with the City could be a variable blend of its water supplies. Because the City's groundwater appears to have higher mineralization than NCSD's groundwater, a blend which meets the water quality objectives of the Water Quality Control Plan for the Central Coastal Basin (Basin Plan)[10] would be desirable so that groundwater quality is not degraded. The Basin Plan objective for TDS in the Santa Maria Basin is 1,000 mg/L, while it is 710 mg/L in the Lower Nipomo Basin. Sulfate, boron, and sodium objectives are also lower in the Lower Nipomo Basin.

If a turnout is constructed and SWP water is received, there does not appear to be any significant water quality issues.

6.1.2 Required Infrastructure

An intertie with the City of Santa Maria would require construction of a pipeline and booster pump station to transport the water into NCSD's distribution system. The 8- to 12-inch pipeline would connect to the City's distribution at its northern end on the southern side of the Santa Maria River near Highway 101, as shown in Figure 6-1. A 2,000 gpm booster station would also be required. The City is currently working with Caltrans to design a new bridge over the Santa Maria River for Highway 101. The City has indicated that they intend to incorporate a pipeline over the river into the design, regardless of whether NCSD decides to pursue this option.

10 California Regional Water Quality Control Board (Region 3), "Water Quality Control Plan for the Central Coastal Basin."


WEST MESA
NIPOMO
OLDE TOWNE
MESA
OLYMPIC WELL
DANA WELLS (OFF-LINE)
CHURCH WELL
SAVAGE WELL (OFF-LINE)
LIFT STA.
12" PARALLEL
10" PARALLEL
8" PARALLEL
TO PROPOSED BLUFFS DEVELOPMENT
PIPE ATTACHED TO ROUTE 101 BRIDGE
CONNECT TO EXISTING 10" PVC CITY OF SANTA MARIA WATER
SANTA MARIA
SANTA MARIA VALLEY
NIPOMO
LEGEND
EXISTING WATER SERVICE AREA BOUNDARY
EXISTING WATER LINES
EXISTING WELL
EXISTING STORAGE RESERVOIR
FUTURE WATER SERVICE AREA BOUNDARY
RECOMMENDED IMPROVEMENT TO MEET EXISTING NEEDS
RECOMMENDED IMPROVEMENT TO MEET FUTURE NEEDS
RECOMMENDED IMPROVEMENT TO SERVE FUTURE NEEDS
NIPOMO COMMUNITY SERVICE DISTICT
COPERATE BOUNDARIES
SO. CAL. WATER COMPANY SERVICE AREA
NCSD-SANTA MARIA INTERTIE
REF. SCIENCE APPLICATIONS INTERNATIONAL CORPORATION FOR RICHARDS, WATSON, AND GERSHON, NIPOMO MESA MANAGEMENT AREA, AUGUST 2000 AND BOYLE ENGINEERING, DRAFT NIPOMO CSD WATER MASTER PLAN, MAY 2001.
NOTE: NEW INTERTIE PIPELINE WILL NOT BE IN CALTRANS RIGHT-OF-WAY BUT IN EASEMENTS/PROPERTY ACQUIRED ADJANCENT TO CALTRANS RIGHT-OF-WAY
0 500 1000
1"=1000'
Kennedy/Jenks Consultants
Nipomo Community Service District
Evaluation of Water Supply Alternatives
NCSD-Santa Maria Intertie
AUGUST 2001
014603.00
Figure No. 6-1
K/J FILE: \\pao\01\014603.00-Nipomo CSD\Figures\Figure6-1.dwg
REV. DATE: 020701

Construction of the bridge is anticipated to start in 2002.The pipeline would connect with the City's 10-inch PVC line in Preisker Lane. The pipeline would then run along the south side of the Santa Maria River and cross the River attached to the new Highway 101 bridge. The pipeline would follow the Highway 101 alignment northward to Nipomo, where it would connect with the existing NCSD distribution system. As a result of Caltrans' policy that restricts longitudinal placement of pipelines in the Caltrans right-of-way, easements and/or property would have to be obtaining for the placement of the intertie pipeline. Highway 101 follows a relatively flat course between Santa Maria and Nipomo; however, due to the friction losses over that distance of piping, a booster station would probably be necessary.

For the turnout option, a new turnout to the SWP pipeline would be necessary, along with a pipeline to connect the turnout to the NCSD distribution system.

6.1.3 Reliability

Because the City of Santa Maria obtains water from a variety of sources, it is anticipated that the reliability of its water supply is relatively high. However, in Water Year 2001, with SWP deliveries anticipated to be 39 percent of entitlement for all contractors, the City of Santa Maria has had to obtain additional water supply from the City of Santa Barbara, Yuba County, and the Western Canal Water District in Butte County. During these conditions, the reliability of the water supply delivered to NCSD is likely to be significantly lower than the City's water supply.

If the turnout option only is used, reliability would decrease as NCSD would only have access to the SWP portion of the City's water supply. However, the overall reliability would be largely dependent on the conditions negotiated with the City. Because NCSD and the City are in the same groundwater basin, it may be possible to exchange SWP water for pumping groundwater. With the uncertainty of the outcome of the current groundwater litigation, groundwater exchange within the basin may not be a viable or desirable option.

6.1.4 Required Agreements/Institutional Issues

An intertie with the City of Santa Maria would be largely dependent upon the success of contract negotiations between NCSD and the City. Additionally, it may be necessary to obtain easements for the connecting pipeline and property for a booster pump station. Negotiations would require the involvement of NCSD staff and legal counsel, as well as Board approval.

Similarly, for the turnout option, an agreement would be necessary between NCSD and the City. Additionally, it may be necessary to obtain easements for the turnout and connecting pipeline. Negotiations would require the involvement of NCSD staff and legal counsel, as well as Board approval. CCWA approval would also be necessary.

6.1.5 Permitting/CEQA

Permits would be required for construction of the pipeline and booster station. These permits would likely include encroachment permits from Caltrans and the County for pipeline and booster station construction.

Construction of the pipeline and booster station would require preparation of environmental impact analysis documentation in accordance with CEQA. If construction is to remain largely within existing roadways, then it is likely that a Mitigated Negative Declaration would be adequate. CEQA and permitting requirements for the turnout option would be similar.

NCSD may also consider preparing a Program Environmental Impact Report (EIR) for its entire water supply program. The CEQA documents for individual components could then tier off the Program EIR. This approach would probably be the most efficient and in accordance with the requirements of CEQA.

6.1.6 Costs/Funding

The City has indicated that commodity costs would be $1,000 to $1,200 per AF, with additional capital costs for the necessary modifications to their system of approximately $2,000/AF. NCSD would be responsible for constructing a connection pipeline and booster pump station. With the costs amortized over a 20-year period, the cost comes to approximately $1,700/AF to receive water from an intertie with Santa Maria, with a turnout these costs would be approximately $1,249/AF. These costs do not include any necessary land acquisition or easements. Table 6-2 presents the costs associated with this alternative.

TABLE 6-2
COSTS FOR INTERTIE WITH SANTA MARIA

Type of Cost	Cost	Entity Responsible for Paying Cost
Commodity Cost	$1,200	NCSD
Capital Costs - Intertie		
Pipeline	$3,200,000	NCSD
Booster Station	$500,000	NCSD
Upfront Costs[1]	$4,000,000	NCSD
O&M Costs - Intertie		
Pipeline	$63,400/yr	NCSD
Booster Station	$50,000/yr	NCSD
Capital Costs - Turnout		
Pipeline	$120,000	NCSD
Turnout	$500,000	NCSD
O&M Costs - Turnout		
Pipeline	$20,000/yr	NCSD
Turnout	$20,000/yr	NCSD

Note: All costs are in 2001 dollars.
[1] Per the City of Santa Maria. Cost to be paid by NCSD. Improvements to be made by the City.

This alternative is not likely to involve any state or federal funding opportunities. The capital cost of the infrastructure would have to be borne by connection fees. O&M costs would be covered by water rate charges. However, because the turnout must be oversized, NCSD may also receive some future reimbursement if others were to use the turnout.

6.1.7 Schedule

It is recommended that negotiations with the City be given a high priority and be initiated within the next 1-3 months. Assuming there are no unforeseen complications, negotiations with the City of Santa Maria could be completed within six months. Six months would be required for the acquisition of easements and property. Permitting, design, construction, and startup of the pipeline and booster station would take approximately another 2 years.

6.2 Non-Potable Water Source Alternatives

In order for the desalination at Tosco, oil field produced water, and recycled water from SSLOCSD alternatives to accrue benefits to NCSD, the use of these non-potable water sources must allow a potable water source to be transferred to NCSD. There are two potential potable sources available: the Tosco Refinery and agricultural users. Both have the potential to use a non-potable source of water, such as desalinated blowdown water, oil field produced water, or recycled water, in exchange for the right to use their existing potable source.

The three available non-potable water sources could be phased and the two sources of water exchange implemented as demand requires. The individual potable and non-potable water sources are discussed below.

6.2.1 Groundwater at Tosco

The Tosco Refinery currently pumps 800-850 gpm (1,290 – 1,370 AF/yr) of groundwater for cooling water. If another source of cooling water is made available to the Refinery, then a commensurate quantity of groundwater could be transferred to NCSD for potable purposes.

6.2.1.1 Water Quality

The groundwater currently pumped meets all drinking water standards except for TDS, which exceeds the MCL. The most cost effective method for addressing elevated TDS levels is to blend the high-TDS groundwater with lower TDS groundwater from elsewhere in NCSD's system. Alternatively, wellhead treatment could be implemented before it could be used for potable purposes.

6.2.1.2 Required Infrastructure

In order to transfer a portion of Tosco's groundwater supply to NCSD, it would be necessary to construct a wellhead treatment facility to disinfect and potentially to reduce TDS levels and a connection to the NCSD distribution system. A new well may be necessary as well, unless arrangements can be made with Tosco to use water from its well.

Well

The Tosco Refinery currently pumps 800-850 gpm using a single well. If Tosco uses non-potable water for its steam boilers, this well may become available to NCSD for lease or purchase. Alternatively, if the well is not available for NCSD, it would be necessary to acquire land for and construct a new well.

Wellhead Treatment

The steam boilers that Tosco uses require an extremely low level of hardness, which is achieved using a combination of filtration, softening, and RO. For potable use, the water does not need to meet the same hardness requirements and this level of treatment would be unnecessary. In lieu of wellhead treatment, it is recommended that the higher TDS groundwater from this source be blended with lower TDS groundwater from elsewhere. However, wellhead treatment for disinfection would need to be provided.

Connection to NCSD Distribution System

Using groundwater from Tosco would require a connection to the existing NCSD distribution system. The refinery is within 1.75 miles of the NCSD Eureka well and therefore the NCSD water distribution system at Willow Road and Highway 1. The new well would have to be connected to the distribution system through a pipeline. With an estimated flow of 850 gpm, the pipeline would need to be approximately 12-inches in diameter.

6.2.1.3 Reliability

Groundwater from Tosco would be a reliable water source. Tosco has not observed a groundwater level decline in their well and it is suspected that the area it is pumping from an area hydrologically separate from the area where the pumping depression has been observed.

This alternative is dependent upon continued operation of the Santa Maria Refinery and Tosco's willingness to use non-potable water in lieu of the groundwater supply. For this to occur, the non-potable supply must be reliable and the water quality must consistently meet Tosco's process requirements.

6.2.1.4 Required Agreements/Institutional Issues

Using Tosco's groundwater would require an agreement with Tosco. Depending upon the exact nature of the alternative pursued, this agreement may involve:

- Purchase or lease of water rights or a water exchange.
- Purchase or lease of well.
- Non-potable water purchase or exchange by Tosco.

Property purchase or easements may also be required for the construction of a well, wellhead treatment facility, and connection to the NCSD distribution system. It would be essential for the arrangement to provide a financial benefit to Tosco.

6.2.1.5 Permitting/CEQA

Required permits include encroachment permits. A Mitigated Negative Declaration would likely be necessary to meet the requirements of CEQA.

6.2.1.6 Costs/Funding

In order to successfully implement a new groundwater source near the Tosco Refinery, it would be necessary to construct a well, wellhead treatment, and connection to the NCSD system. Costs for land acquisition are not included for any of the required infrastructure. All of these facilities would also have O&M costs. The total cost would be approximately $182 AF to pump, treat, and delivery groundwater from Tosco. Table 6-3 presents the costs associated with this alternative. However, there are additional costs associated with supplying non-potable water to Tosco, as discussed in detail below. Desalinated blowdown water would cost approximately $2,161/AF, treated oil field produced water $4,520/AF, and recycled water from SSLOCSD approximately $755/AF, resulting in a total cost between $937 and $5,639/AF. However, not all of this cost would necessarily be borne by NCSD.

TABLE 6-3
COSTS FOR GROUNDWATER AT TOSCO

Type of Cost	Cost	Entity Responsible for Paying Cost
Commodity Cost	$0	NA
Capital Costs		
Well[1]	$300,000	NCSD
Wellhead Treatment	$125,000	NCSD
Connection to NCSD System	$1,100,000	NCSD
O&M Costs		
Well	$50,000/yr	NCSD
Wellhead Treatment	$18,000/yr	NCSD
Connection to NCSD System	$22,000/yr	NCSD

Note: All costs are in 2001 dollars. Costs for replacing Tosco's groundwater with non-potable water from other sources are described in Tables 6-5, 6-6, and 6-7.
[1]It may be possible to use, purchase, or lease the existing well at Tosco.

If the Tosco Refinery were using non-potable water in lieu of groundwater, there may be the potential for the use, purchase, or lease of the existing Tosco well and water treatment facilities reducing the costs of this alternative. There may also be the possibility to modify the treatment facility to treat both the oil field produced water and the groundwater.

6.2.1.7 Schedule

Due to the complexity of the agreements required for this alternative and its dependence upon developing an acceptable supply of non-potable water, negotiations may take up to 2 years. Permitting, design, construction, and startup of the new well and wellhead treatment facility are likely to require an additional 1 to 2 years to complete.

6.2.2 Groundwater Exchange with Agricultural Users

There are currently a number of agricultural irrigators in the Nipomo area. It would be possible to provide non-potable water to the agricultural users in lieu of the agricultural users pumping groundwater. DWR has estimated that in 2000, the total agricultural applied water demand for the Nipomo Mesa area is 1,800 AF/yr, with no decline anticipated through the year 2020. All of the agricultural applied water demands in the area are met through groundwater extraction. Irrigated crops grown in the Arroyo Grande-Nipomo area include grain, corn, alfalfa, pasture, tomatoes, citrus and subtropical fruits, wine grapes, as well as other field and truck crops.[11]

Specific agricultural users have not been identified at this time. This analysis assumes that NCSD could successfully exchange between 500 and 1,000 AF/yr of agricultural groundwater.

Alternatively, NCSD could consider leasing or purchasing the water rights owned by agricultural users, essentially paying them to put the land out of production. While this option would eliminate the need to provide an alternative source of irrigation water to the farmers, it has regional economic and public relations consequences that present additional challenges.

6.2.2.1 Water Quality

Agricultural exchange would allow NCSD to extract more groundwater from the subbasin. Since NCSD could pump the additional groundwater from their existing wells, it is anticipated that the groundwater available would be similar in quality to that currently pumped by NCSD.

6.2.2.2 Required Infrastructure

No new infrastructure would be necessary in order to transfer groundwater from agricultural users to NCSD, as the groundwater does not need to actually be pumped at the agricultural user's property. Instead the agricultural users' water rights would allow NCSD to increase pumping at existing wells within the same subbasin. However, this may require modifications to existing wells and/or pipelines. New infrastructure would be required to provide the agricultural users with an alternative source of water. This is discussed in Section 6.2.5.

6.2.2.3 Reliability

Groundwater exchange with agricultural users would be a reliable water source. It would, however, be dependent on NCSD's ability to continue to provide a reliable source of non-potable water for the agricultural users.

6.2.2.4 Required Agreements/Institutional Issues

Groundwater exchange would require agreements with the agricultural users. Depending upon the exact nature of the alternative pursued, each individual agreement may require:

- Purchase or lease of water rights or a water exchange.
- Non-potable water purchase or exchange by agricultural users.

The required agreements for this alternative are more complicated than those for Tosco, because it will likely be necessary to make arrangements with several agricultural water users, rather than a single entity. The agreement would need to provide financial benefit to the agricultural users.

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11 DWR, 2000.

6.2.2.5 Permitting/CEQA

Required permits include encroachment permits. A Mitigated Negative Declaration would likely be necessary to meet the requirements of CEQA.

6.2.2.6 Costs/Funding

In order to successfully obtain a groundwater source from agricultural users, it may be necessary to increase the capacity of wells and/or pipelines within the existing NCSD system. Costs for land acquisition are not included for any of the required infrastructure. All of these facilities would also have slightly increased O&M costs. The total cost would be approximately $169/AF to pump, treat, and delivery groundwater obtained via exchange with agricultural users. Table 6-4 presents the costs associated with this alternative. However, there are additional costs associated with supplying non-potable water to the agricultural users, as discussed in detail below. Desalinated blowdown water would cost approximately $2,161/AF and recycled water from SSLOCSD approximately $755/AF, resulting in a total cost between $924 and $2,330/AF. However, not all of this cost would necessarily be borne by NCSD.

TABLE 6-4
COSTS FOR GROUNDWATER EXCHANGE WITH AGRICULTURAL USERS

Type of Cost	Cost	Entity Responsible for Paying Cost
Commodity Cost	$0	NA
Capital Costs		
Well Modifications	$500,000	NCSD
Pipeline Modifications	$500,000	NCSD
O&M Costs		
Increased Well Use	$60,000/yr	NCSD
Increased Pipeline Use	$15,000/yr	NCSD

Note: All costs are in 2001 dollars. Costs for replacing the agricultural users' groundwater with non-potable water from other sources are described in Table 6-7.

6.2.2.7 Schedule

Due to the complexity of the agreements required for this alternative, negotiations may take up to 2 years. It is recommended that agreements with Tosco be pursued first, and as more non-potable water becomes available, agricultural exchange be investigated.

6.2.3 Desalination at Tosco

The Tosco Refinery currently discharges approximately 300 gpm (484 AF/yr) of blowdown water and other wastewaters to an existing outfall. This blowdown water could be desalinated and reused by Tosco, reducing the quantity of groundwater required by the refinery. For desalination of industrial blowdown water, approximately 75 percent recovery after treatment can be achieved. Under this assumption, approximately 360 AF/yr would be available for reuse. Sea water desalination is discussed in Section 4.5.

6.2.3.1 Water Quality

Blowdown water has high levels of TDS, as well as corrosion control chemicals used in the cooling towers. Blowdown water requires treatment before reuse, often using one or more of the methods described in Section 5, before it can be used for applications such as cooling water.

6.2.3.2 Required Infrastructure

In order to desalinate blowdown water, it would be necessary to construct a treatment facility. Waste discharge facilities already exist.

<u>Treatment Facility</u>

Blowdown water requires similar treatment practices to those for brackish water and seawater. Brackish water has less of the same undesirable constituents, such as TDS, than seawater. Any of the treatment methods described in Section 5 are potential treatment methods.

The most common method currently used for desalination is RO, with pre-treatment to protect the RO membranes. In general, there has been a worldwide shift from thermal processes, such as MSF and MVC, to membrane processes such as RO for desalination. RO uses less energy than the thermal treatment processes, which makes it more cost effective to operate and is especially important when future electricity prices are uncertain.

<u>Waste Discharge Facilities</u>

Tosco has indicated that there is no capacity in their ocean outfall for additional brines. By treating and reusing approximately 484 AF/yr of blowdown water, some brine line capacity would be gained. The capacity would be adequate to accommodate the waste from the blowdown water treatment. Treatment waste requiring discharge is estimated to be approximately 120 AF/yr.

6.2.3.3 Reliability

Treatment of blowdown would provide a reliable source of non-potable water, as long as the Tosco Refinery continues to operate. The only reliability concerns would be tied to the operation of the treatment facilities.

6.2.3.4 Required Agreements/Institutional Issues

Desalination at Tosco would require an agreement with Tosco. Depending upon the exact nature of the alternative pursued, this agreement may require:

- An easement for construction of a treatment facility.
- Use of the brine discharge line.
- Use of Tosco's blowdown water.

This agreement could be relatively simple, since there are only two parties involved, NCSD and Tosco, although it would be essential for the deal to provide a financial benefit to Tosco.

6.2.3.5 Permitting/CEQA

Required permits include encroachment permits. A Mitigated Negative Declaration or EIR would likely be necessary to meet the requirements of CEQA.

6.2.3.6 Costs/Funding

In order to successfully implement a desalination alternative, it would be necessary to construct a treatment facility. Costs for land acquisition are not included for any of the required infrastructure. The treatment facility would also have O&M costs. The total cost per acre-foot to treat blowdown water would be $2,161/AF. Table 6-5 presents the costs associated with this alternative.

TABLE 6-5
COSTS FOR DESALINATION AT TOSCO

Type of Cost	Cost	Entity Responsible for Paying Cost
Commodity Cost	$0	NA
Capital Costs		
Treatment Facility[1]	$4,000,000	NCSD
O&M Costs		
Treatment Facility	$400,000/yr	NCSD

Note: All costs are in 2001 dollars.
[1]It may be possible to use, purchase, or lease the existing Tosco treatment facility.

State and federal funding may be available for desalination and reuse projects. It would also be possible to finance the project through connection fees, with O&M costs covered by water rates.

6.2.3.7 Schedule

Negotiations may take up to one year. Permitting, design, construction, and startup are likely to require an additional 3 to 4 years to complete.

6.2.4 Oil Field Produced Water from Price Canyon

Stocker Oil has indicated that they produce approximately 20,000 – 25,000 barrels per day (940 – 1,200 AF/yr) of water as a by-product of their oil extraction operations. Because of waste streams generated during the treatment processes, it is estimated that the amount of treated water that is available is approximately 700 – 800 AF/yr.

Although the treatment process can treat the water to potable quality, because of the poor initial water quality and the organic constituents, it may be more appropriate for treated oil field produced water to be used at the Tosco Refinery for process water or for irrigation to offset groundwater demand. Pilot studies that Kennedy/Jenks has been associated with have indicated that even with RO treatment, some organic compounds, such as napthalene, 2-butanone, and ethylbenzene, can be detected in the RO effluent.

Stocker Resources has indicated a willingness to enter into discussions with NCSD regarding the feasibility of treating and delivering oil field produced water to NCSD or the Tosco Refinery to offset groundwater use.

6.2.4.1 Water Quality

Oil field produced water is generally of poor water quality and unsuitable for direct use without treatment. Oil field produced water from Price Canyon has TDS of 1,500 to 2,500 mg/L, hardness from 160 to 330 mg/L, total alkalinity from 500 to 600 mg/L, silica from 200 to 250 mg/L, boron around 10 mg/L, TOC greater than 100 mg/L, and petroleum-related organic constituents. Oil field produced water is often of temperatures in excess of 150°F. Detailed water quality information and treatment goals for oil field produced water from Price Canyon are provided in Appendix B. Treatment is necessary before the water may be used for industrial or any other purpose. The proposed treatment technologies are described under Required Infrastructure below.

6.2.4.2 Required Infrastructure

The use of oil field produced water would require construction of a treatment facility and a pipeline connecting the Price Canyon Oil Field and the Tosco Refinery. Additionally, conveyance and disposal must be provided for any wastestreams associated with the treatment processes.

<u>Treatment Facilities and Waste Disposal</u>

Tosco currently pumps groundwater and treats it with filtration, softening and RO before using it in its 450-lb steam boilers. For oil field produced water to be used in Tosco's steam boilers, in lieu of groundwater, the following treatment process is recommended:

- Warm softening process using a DensaDeg clarifier to reduce hardness to below 60 mg/L and silica concentration to approximately 20 mg/L.

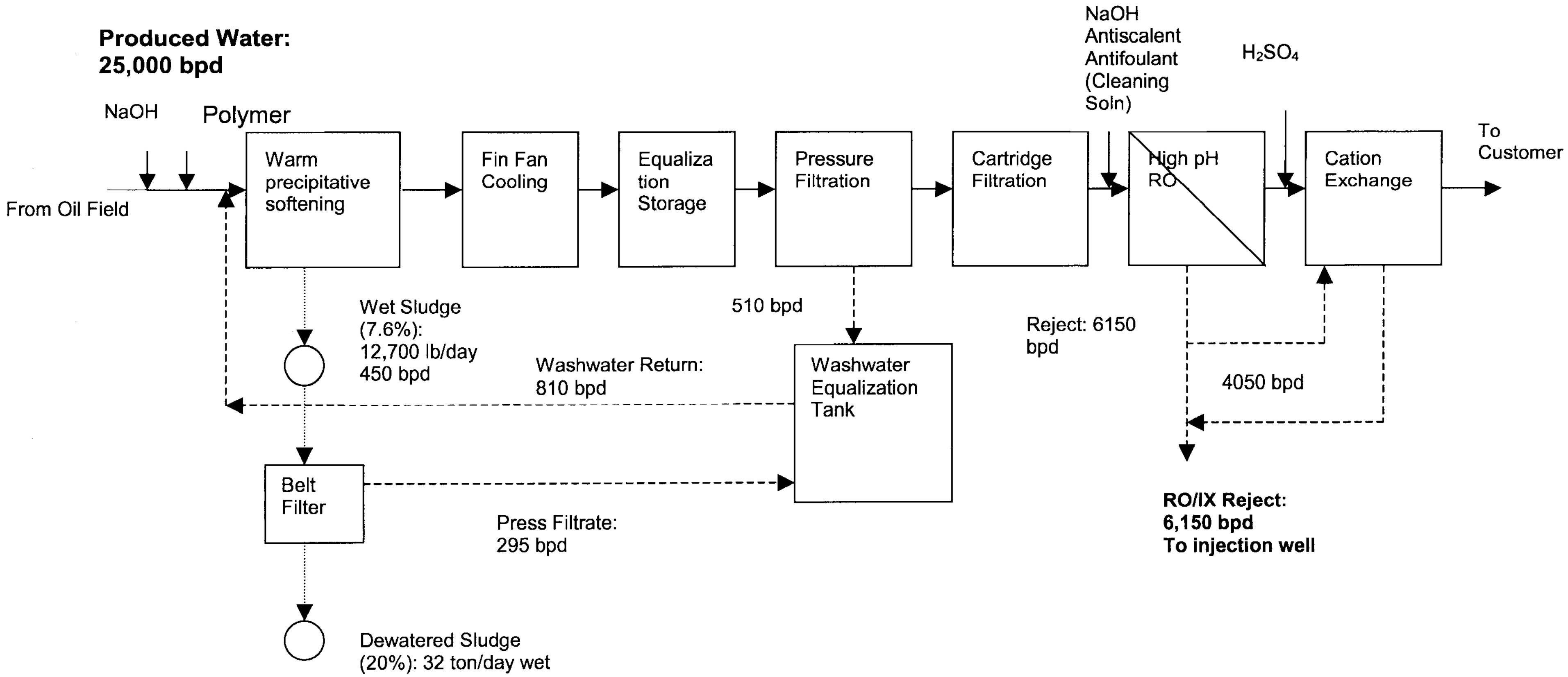
- Fin Fan system to cool the effluent from warm softening process (160°F) to approximately 110°F to facilitate RO treatment.

- Cartridge filter to pretreat RO influent.

- RO to remove hardness to below 1 mg/L, silica to below 1 mg/L, alkalinity to around 80 mg/L as $CaCO_3$ and boron to below 2 mg/L.

- Ion exchange process to remove ammonia to less than 0.5 mg/L.

This process is summarized in Figure 6-2. The process train would generate both solid and liquid wastes. Solids would be dewatered and trucked off-site. Liquid wastes would be recycled to the head of the treatment train or discharged through the outfall. Approximately 360 AF/yr of outfall capacity would be made available through the desalination alternative discussed



Kennedy/Jenks Consultants

Nipomo Community Services District
Draft Evaluation of Water Supply Alternatives

Schematic for Oil Field Produced Water Treatment Process

July 2001
K/J 014603.00

Figure 6-2

previously. Costs for construction, operation, and maintenance of waste disposal facilities are included in the costs provided below.

Pipeline Between Stocker Resources Oil Field and Tosco Refinery

There is an existing out-of-service 8-inch diameter pipeline from the Stocker Resources Price Canyon Oil Field to the Tosco/Santa Maria refinery. The pipeline was last internally inspected in 1995 and Tosco indicated that the pipeline may not be appropriate for crude oil conveyance.

As of April 2001, Stocker Resources has indicated that, due to current market factors, they are considering bringing the oil pipeline back into service. If this occurs, the pipeline will not be available for produced water conveyance. To obtain easements and construct a new pipeline would make the project economically infeasible. Stocker Resources plans to make a decision regarding the pipeline during the summer 2001. The remainder of this discussion assumes that the pipeline is indeed available for water transmission. Tosco is also exploring the feasibility of putting fiber optic cable in the portion of pipeline between Arroyo Grande and Pismo Beach, which does not necessarily preclude its use for water transfer as well.

In order to convert the existing 8-inch steel oil pipeline into a water line, the pipe would need to be rehabilitated. Several potentially viable technologies for this conversion are discussed below.

- Sliplining: A new pipe is inserted into an existing line by pulling or pushing continuous or short-length pipes. The annulus between existing pipe and liner pipe is generally grouted, to provide additional strength and support. Available materials include fiberglass, polyethylene (HDPE), Polyvinyl Chloride (PVC), Polyethylene (extruded), Polybutylene (extruded), and Polypropylene (extruded).

  Specifically, CSR Pipeline Systems offers U-liner, an HDPE pipe liner. It is continuously extruded, deformed into its patented "U" shape, and then coiled onto reels for delivery to the project site. A typical U-Liner™ crew installs an average of 500-1,000 feet of U-Liner™ per day. Installation includes cleaning the host pipe, inserting and processing U-Liner™ and restoring services.

- Cured-In-Place Pipe (CIPP): A flexible lining is inserted into a host pipe. The lining is inserted via existing manholes or other access and, depending on the system selected, is installed using water inversion, air inversion, or winched insertion. The resin is then cured.

- Fold and Form Pipe: Flexible deformed pipes are inserted into an existing line by pulling a continuous length of pipe between access points. The inserted folded or deformed pipe is heated, pressurized, and expanded or rerounded in the pipe to form a tight fit with the existing pipe. The systems can essentially be considered as variants to the conventional continuous sliplining technique. Typically, the materials used are deformed HDPE or folded PVC.

6.2.4.3 Reliability

Since oil field produced water is a by-product of oil production, its availability is largely dependent upon the production of oil. The economics of oil production are very different from those of drinking water supplies, and as oil prices rise or drop, oil fields go into and out of production depending on the costs of production. While the oil field produced water supply can most likely be considered as long-term, as it is estimated that this oil field will be in production for 20 years or longer, it is not a permanent supply.

6.2.4.4 Required Agreements/Institutional Issues

This alternative is dependent on the involvement of NCSD, Stocker Resources, and Tosco. Stocker Resources would provide and treat the oil field produced water. Tosco would use the oil field produced water in lieu of the groundwater it is currently pumping and treating for boiler water use. The groundwater would then be available for NCSD's use.

The oil field produced water alternative would require agreements between Stocker Resources and Tosco, as well as involvement from NCSD. The ability to come to the necessary agreements would be entirely dependent upon the ability to negotiate an agreement with financial benefits to Stocker Resources for treating and providing the oil field water and to Tosco for using treated oil field produced water in lieu of groundwater.

Additional lease, purchase, easements, or other agreements with Tosco would be required in order to use or acquire any of their existing facilities, such as their treatment facilities, or for use of their existing property.

6.2.4.5 Permitting/CEQA

Required permits include encroachment permits. Due to the numerous components and complexity of the project, it is likely that an EIR would be necessary to meet the requirements of CEQA.

6.2.4.6 Costs/Funding

The economics of the oil production are such that Stocker Resources may be able to provide the treated water for low or no cost. An initial estimate given at the project kick-off meeting indicated a cost of $450/AF. This cost does not include the cost of conveyance to the Tosco Refinery.

Based on the treatment process described above, the cost for treating the oil field produced water (both capital and O&M costs) would be approximately $4,320/AF. These costs are dependent upon the costs of both chemical and electricity. Detailed information on the various cost scenarios is provided in Appendix B. The capital and O&M costs for the pipeline would result in an additional $200/AF, for a total cost for delivery to the Tosco Refinery of $4,520 to $3,970 per AF. These costs include pipeline rehabilitation only and do not account for any fiber optic use.

The key issue for this alternative is how the costs are distributed among the various parties. If the benefit of having an alternative disposal method for its produced water is more than $4,520/AF to Stocker Resources, then they would be willing to sell the water for a low cost -- considerably less than it costs them to treat and deliver it. Furthermore, this alternative is only appealing to Tosco if it can purchase the water for less than its current pumping and treatment cost.

Finally, there may be the potential for the use, purchase, or lease of the existing Tosco water treatment facilities to Stocker Resources in order to treat the oil field produced water. The treatment train would need to be modified; however, the softening and RO facilities would likely be largely reusable. The availability of the facility and the costs of modifying it are unknown. O&M costs would likely be similar to those discussed above.

Unfortunately, the complexity and the large number of outstanding unknowns, including electricity costs, disposition of the pipeline between Price Canyon Oil Fields and the Tosco Refinery, and the willingness of Tosco to use oil field produced water, leave the cost of this alternative difficult to estimate. Table 6-6 presents the costs associated with this alternative.

TABLE 6-6
COSTS FOR OIL FIELD PRODUCED WATER

Type of Cost	Cost	Entity Responsible for Paying Cost
Commodity Cost	$450[1]	Tosco
Capital Costs		
Treatment Facility	$8,775,000	Stocker?
Pipeline Rehabilitation	$2,112,000	Stocker?
O&M Costs		
Treatment Facility	$2,985,000/yr	Stocker?
Pipeline Operation	$42,240/yr	Stocker?

Note: All costs are in 2001 dollars.
[1]Cost that Stocker may charge water user. Cost to Tosco must be less than current water source to be viable.

Funding may be available from state and federal sources because this project involves water reuse. It would also be possible to finance the project through connection fees, with O&M costs covered by water rates.

6.2.4.7 Schedule

Due to the complexity of the agreements required for this alternative, negotiations may take up to 2 years. Permitting, design, construction, and startup are likely to require an additional 3 to 5 years to complete. In order to test the viability of this alternative, it is suggested that discussions with Stocker Resources and Tosco be initiated within the next 3 to 6 months.

6.2.5 Recycled Water from SSLOCSD

One of the potential sources of recycled water close to the NCSD service area is the SSLOCSD Water Reclamation Facility in Oceano, which is located approximately 1.5 miles northwest of the Tosco Refinery. The SSLOCSD facility currently treats approximately 3,136 AF/yr of wastewater to the secondary level; to prevent siltation in the outfall diffusers, 886 AF/yr must be discharged, leaving approximately 2,250 AF/yr available for treatment to tertiary standards and reuse.[12] It is estimated that NCSD would need 1,200 AF/yr to offset potable water use, although

[12] John L. Wallace & Associates, 2001.

more may be available from SSLOCSD depending upon the progress of other water recycling projects in the area.

6.2.5.1 Water Quality

One of the main issues associated with the SSLOCSD recycled water source is the high TDS levels of the effluent, ranging from 1,000 – 1,200 mg/L. In order to use recycled water from SSLOCSD for agricultural irrigation, the water would have to be blended with lower TDS water, such as the treated oil field produced or blowdown water. Alternatively, effluent TDS could be reduced by constructing an additional treatment facility for TDS removal. In order to use the recycled water at the Tosco Refinery, desalination would be required.

Both the sodium absorption ratio (SAR) and electroconductivity (EC) are acceptable for irrigations purposes. The chloride levels are a bit high (300 mg/l) for some applications.

6.2.5.2 Required Infrastructure

In order to use recycled water from SSLOCSD, it would be necessary to construct a connection to the non-potable water users. If the desalination at Tosco and oil field produced water alternatives are undertaken first, then a transmission pipeline can be constructed between the SSLOCSD facility and the non-potable pipelines at the Tosco Refinery. This would allow any of the three non-potable sources to be used at the Refinery and allow blending of recycled water with the other non-potable sources to lower TDS. This blended water could be delivered to agricultural users, as discussed previously.

The SSLOCSD facility would also need to be upgraded to add tertiary treatment capacity for the quantity of recycled water to be purchased by NCSD. These upgrades would be handled by SSLOCSD, but the cost would eventually be borne by NCSD, either through an up-front cost or commodity cost.

6.2.5.3 Reliability

Recycled water is a very reliable non-potable water supply. Due to the high TDS levels in the recycled water effluent, however, this alternative would also be dependent upon the availability of a lower TDS water for blending.

6.2.5.4 Required Agreements/Institutional Issues

Using recycled water from SSLOCSD would require an agreement with SSLOCSD. This agreement could be relatively simple, since there are only two parties involved. NCSD would arrange to purchase the recycled water and deliver it to the Tosco Refinery or agricultural users.

6.2.5.5 Permitting/CEQA

Required permits include encroachment permits. A permit from the RWQCB would also be necessary for the reuse.

It is likely that a Mitigated Negative Declaration would be sufficient to meet the requirements of CEQA.

6.2.5.6 Costs/Funding

In order to use recycled water from the SSLOCSD reclamation facilityNCSD would need to construct a pipeline connecting the facility to its other non-potable water facilities. NCSD would also need to purchase the recycled water from SSLOCSD.

SSLOCSD has estimated a cost of $3,119/AF for delivering recycled water to the SSLOCSD area including Nipomo area golf courses. In developing the costs for this alternative, the costs in the SSLOCSD report were considered; however, the costs for this alternative are lower for several reasons. The SSLOCSD report assumes that 595 AF/yr of recycled water will be used; this alternative assumes the use of 1,200 AF/yr, with the accompanying economies of scale. Also, less pipeline is proposed as part of this alternative than is considered in the SSLOCSD report.

A total cost of $2,080/AF is estimated. In lieu of a commodity cost for the purchase of recycled water from SSLOCSD, the cost of the upgrades to the reclamation plant have been included in this cost. Table 6-7 presents the costs associated with this alternative.

TABLE 6-7
COSTS FOR RECYCLED WATER FROM SSLOCSD

Type of Cost	Cost	Entity Responsible for Paying Cost
Commodity Cost	$0[1]	NA
Capital Costs		
Treatment Facility	$14,000,000	NCSD
Pipeline to Agricultural Users	$1,200,000	NCSD
Pipeline to Tosco Refinery	$960,000	NCSD
O&M Costs		
Treatment Facility	$700,000/yr	NCSD
Pipeline Operation (Ag)	$150,000/yr	NCSD
Pipeline Operation (Refinery)	$120,000/yr	NCSD

Note: All costs are in 2001 dollars.
[1] SSLOCSD will likely charge either NCSD, Tosco, or the agricultural users for recycled water. This cost is not known at this time. Instead, the cost of improvements to the SSLOCSD plant were included in the capital costs.

State and federal funding may be available for desalination and reuse projects. It would also be possible to finance the project through a combination of bonds and connection fees, with O&M costs covered by water rates.

6.2.5.7 Schedule

Negotiations for this alternative should be relatively straightforward and take approximately 6 months. Permitting, design, construction, and startup are likely to require an additional 1 to 2 years to complete.

6.3 Hard Rock Drilling

As described in Section 4.8, Samda Inc believes that it can provide up to 500 - 1,000 AF/yr from hard rock drilling. Samda Inc. approaches water supply development in the same way that it has approached oil field development. Hard rock water supplies are acknowledged to be high-risk ventures where considerable capital investments must be made to develop the supply. Samda Inc. assumes the risk in the development of the project and then sells the water to the agency at a cost that is consistent with supplies in the local area. Typically, Samda Inc. enters into 20-year contracts for delivery of water. After 20 years, the facilities would be turned over to NCSD. If NCSD is willing to pay for some of the project facilities up front, then the length of the contract could be less.

Samda Inc. approaches their project developing in three phases. The upper range for the Phase 1 investigation, yield analysis, and test bore drilling is estimated to cost $250,000 depending on the number of test bores that are drilled. Samda Inc. has indicated that up to 50 percent of the cost of this Phase 1 project could be shared with NCSD.

6.3.1 Water Quality

The quality of the water coming from the hard rock to the east of Nipomo is uncertain. There has been little study done of the area. More detailed evaluation of the water quality would come as a result of completing Phase 1.

6.3.2 Required Infrastructure

6.3.2.1 Treatment

Samda would bear the cost of constructing a treatment system, if necessary. If significant treatment is required, it would likely be reflected in the cost of the delivered water. The level of treatment would be determined after completing Phase 1 and would determine the attractiveness of the hard rock water as a potable water supply.

6.3.2.2 Pipeline

Samda would deliver the water to the NCSD distribution system. If NCSD is willing to accept more up-front capital cost, NCSD could extend the distribution pipeline closer to the well site.

6.3.3 Reliability

Samda Inc. evaluates water supply for the long-term reliability of the supply. They perform a yield analysis and do not mine aquifers beyond the expected recharge rate. During the pump testing that occurs in Phase 2, Samda Inc. staff observes nearby springs and wells to evaluate impact.

6.3.4 Required Agreements/Institutional Issues

In order for NCSD to proceed, it would require NCSD to enter into an agreement with Samda Inc. to proceed with the Phase 1 evaluation of hard rock drilling in the Nipomo area. The institutional issues associated with this alternative are relatively straightforward. To begin the hard rock drilling exploration process, NCSD would have to negotiate and approve a contract with Samda Inc., and oversee the work.

One of the concerns that has been raised is the water rights issues associated with hard rock drilling. Samda Inc. indicates that they drill for new water that does not infringe on any existing rights. The goal of hard rock drilling is to intercept fractures that may be going to the ocean. As a result, Samda Inc. does not file for appropriative water rights.

6.3.5 Permitting/CEQA

Samda Inc. is responsible for all permitting associated with the Phase 1 exploration. NCSD would, however, be responsible for the preparation of any CEQA documentation required for the construction of infrastructure.

6.3.6 Costs/Funding

Samda Inc. has estimated a cost of up to $250,000 for a Phase 1 study of which Samda could pay up to 50 percent. NCSD would therefore be responsible for approximately $125,000. Commodity costs afterwards would be approximately $1,000/AF of delivered water for a total cost of $1,024/AF. Samda Inc. has indicated that these costs are negotiable and will depend on the costs of other locally available water.

This alternative is not likely to involve any state or federal funding opportunities. The capital cost of the infrastructure would have to be borne by bonds and/or connection fees. O&M costs would be covered by water rate charges.

6.3.7 Schedule

After negotiation of the contract with Samda, exploration could start immediately. Design, permitting, construction, and startup of the necessary infrastructure would take approximately 2 years. This option is always available and should be reevaluated annually.

6.4 Water Conservation

NCSD established a water conservation program several years ago and adopted a water conservation ordinance. It would be prudent for NCSD to review its conservation program and consider ways of further reducing its demand.

Since 1994, the California Urban Water Conservation Council (CUWCC) and its 160 member agencies have identified and quantified effective water conservation best management practices (BMPs). In order for NCSD to take best advantage of recent developments in water conservation, NCSD should consider becoming a member in CUWCC and participating in activities that could reduce demand. The fourteen BMPs that CUWCC has identified are:

- Residential Indoor and Outdoor Water Use Surveys: Trained staff visits homes and solicit information on current water use practices. Recommendations are made for water-saving improvements in those practices. It is intended to cover both indoor and outdoor water usage.

- Residential Plumbing Fixture Retrofits: Similar to the ultra-low-flow toilet program discussed below, incentives can be provided to replace showerheads with water-saving models. Many water districts provide a free new showerhead in exchange for the old one.

- Distribution System Water Audits, Leak Detection, and Repair: Unlike most conservation activities, which are highly dependent upon voluntary participation by customers, this BMP is one that NCSD can implement on its own. By identifying leaks and replacing and repairing piping where necessary, NCSD can minimize water loss in the system and reduce unaccounted for water.

- Metering with Commodity Rates: NCSD's current pricing structure encourages conservation by charging more for water used beyond the first 20 hundred cubic feet (HCF) per month. The rate schedule could be modified to further encourage conservation by lowering the threshold from 20 HCF or by increasing the costs of water further at 5 or 10 HCF intervals.

- Large Landscape Water Audits and Incentives: Similar to residential surveys described above, existing water use practices are examined and recommendations are made for changes that would reduce water consumption. The focus is on large landscaped areas.

- High-Efficiency Clothes Washers: Washing machines have become the single largest user of water in homes today. A high-efficiency clothes washer can save up to 20 gallons of water per load, a savings of approximately 50 percent. Numerous affordable high-efficiency machines are available on the market for residential and commercial use. High-efficiency washers tend to be more expensive than their less efficient equivalents, so some water districts offer a rebate of approximately $100 to $200 to customers who purchase them. Similar programs could be effective for dishwashers.

- Public information: NCSD could produce a brochure with water conservation tips for homes and businesses. This brochure could be included as a "bill stuffer" or made available at local public libraries, city hall, and post offices.

- School Education: Outreach in elementary, junior high, and high schools can be effective in conveying the importance of water conservation. The District could provide speakers and educational materials for local elementary, junior high, and high schools to emphasize the importance of water conservation. The Water Education Foundation, specifically Judy Wheatley at (916) 444-6420, is a good source of information on school programs. DWR's Office of Water Education also has some educational materials available for grades K-9. They focus on water conservation and understanding the hydrologic cycle. These materials are free to educators.

- Commercial, Industrial, and Institutional Audits and Incentives: Similar to residential surveys, the goal is to assess current water use practices and make recommendations for water-saving changes. For larger commercial, industrial, and institutional customers, this could include a full water efficiency study.

- Wholesale Water Agency Assistance: This BMP involves assistance from a water wholesaler, which is not applicable to NCSD's situation.

- Conservation Pricing: Conservation pricing goes beyond metering with commodity rates to make conservation more financially attractive to the customer.

- Water Conservation Coordinator: The designation of a water conservation coordinator can be very beneficial in implementing an effective water conservation program. For NCSD, it would probably be appropriate to choose an individual with current operational responsibilities to oversee and coordinate planned water conservation activities.

- Water Waste Prohibitions: Many cities and counties have laws that prohibit the wasteful use of water.

- Ultra-low flush toilets: Numerous Southern California water agencies have established programs whereby the agencies subsidize the installation of low flow toilets. These programs typically take the form of rebates from the water agency where the customers are paid between $50 and $100 for each low-flow toilet installed in their home or a free ultra-low-flow toilet giveaway.

Membership in CUWCC could provide NCSD with resources to implement those BMPs that are likely to be the most cost-effective. It has been estimated that water conservation can realize 10 to 20 percent savings of water at a cost that is often less than other water supply alternatives.

6.4.1 Water Quality

Water conservation would not have any water quality implications. It would simply allow available water to be used more efficiently.

6.4.2 Required Infrastructure

The system water audit may identify areas where pipeline replacement or repair is necessary to reduce water loss in the system. None of the other BMPs would require infrastructure modifications; however, they may require staffing changes.

6.4.3 Reliability

Water conservation is largely dependent upon voluntary actions by water customers. While NCSD can make information available and develop a favorable climate for water conservation compliance, there is no guarantee that the public will participate. In this sense, the quantity of water conserved is somewhat uncertain and unreliable. However, experience indicates that these programs can be very effective when properly implemented.

6.4.4 Required Agreements/Institutional Issues

No agreements with external entities would be necessary to implement a water conservation program. Institutional issues include modifying the duties of an existing staff member and/or hiring a new staff member to serve as water conservation coordinator.

6.4.5 Permitting/CEQA

No permits or CEQA documentation would be required for implementing a water conservation program.

6.4.6 Costs/Funding

The costs of implementing a water conservation program vary depending on the types of activities to be conducted and whether a part- or full-time staff person will be necessary to effectively implement the program. It is recommended that a separate Water Conservation Plan be prepared (at a cost of approximately $25,000) that examines NCSD water conservation needs more closely.

CUWCC's "BMP Costs and Savings Study" was prepared in order to evaluate the cost effectiveness of urban water conservation BMPs. The report compiles data from studies done all over the U.S. The data relevant to a potential NCSD water conservation program are summarized below:

- High efficiency washing machines use less electricity and water. It is estimated that approximately 98 gallons per week is saved by the use of high efficiency machines rather than standard washing machines. The cost to NCSD for such a program would include staff time to develop a rebate program, rebate costs, administration, and marketing costs. The high-efficiency models are typically $400 more than comparable conventional washers. The rebates offered by various water purveyors throughout California are presented in Table 6-8.

- Low flow showerheads use less water than conventional showerheads. It is estimated that low flow showerheads save between 5.2 and 5.8 gpd per showerhead. The cost to NCSD for such a program includes staff time to develop the program, retrofit kits ($2) or new showerheads ($10-15), administration and marketing costs.

- Ultra-low-flow toilets use less than 1.6 gallons per flush. Water savings through the program vary widely, but are typically considered to be at least 15 gallons per capita per day (gpcd). Programs could be structured using rebate incentives or direct installation. The cost to NCSD for such a program includes staff time to develop the program, rebate or toilet purchase costs, administration, and marketing costs. Rebates typically range from $35 to $75, with retail purchase of an ultra-low-flow toilet around $100-$150.

TABLE 6-8
TYPICAL WASHING MACHINE REBATE PROGRAMS

Purveyor	Rebate Amount
Los Angeles Department of Water and Power	$150
Santa Clara Valley Water District	$175
City of Davis	$150

Funding may be available from state and federal sources for implementation of water conservation programs. It would also be possible to finance the project through a combination of bonds and water rates.

6.4.7 Schedule

Membership in CUWCC to obtain the most recent information regarding water conservation and review of NCSD's current water conservation program is also a high priority and should be initiated within the next 3 to 6 months. Depending on the complexity of the program, it should take approximately 6 months to 1 year to prepare a program. Implementation would occur on an ongoing basis.

Section 7: Recommended Plan

The preceding sections of this report present NCSD's need for additional water supplies and the characteristics of the available alternatives. This section integrates the alternatives into a comprehensive implementation plan.

7.1 Development of the Recommended Plan

A conservative estimate of NCSD's long-term water requirement is a total of 5,890 AF/yr, 3,550 AF/yr more than is currently supplied with groundwater. If current groundwater supplies are reduced as a result of ongoing water rights litigation, these water requirements would increase accordingly. Because the identified water supply alternatives are limited, both in number and in capacity, the recommended plan focuses on integration of the alternatives rather than selection of one or more of the alternatives. Furthermore, because implementation of the plan and the cost of each alternative are dependent upon the results of numerous negotiations between the affected parties, development of NCSD's long-term water supply plan should be adaptive.

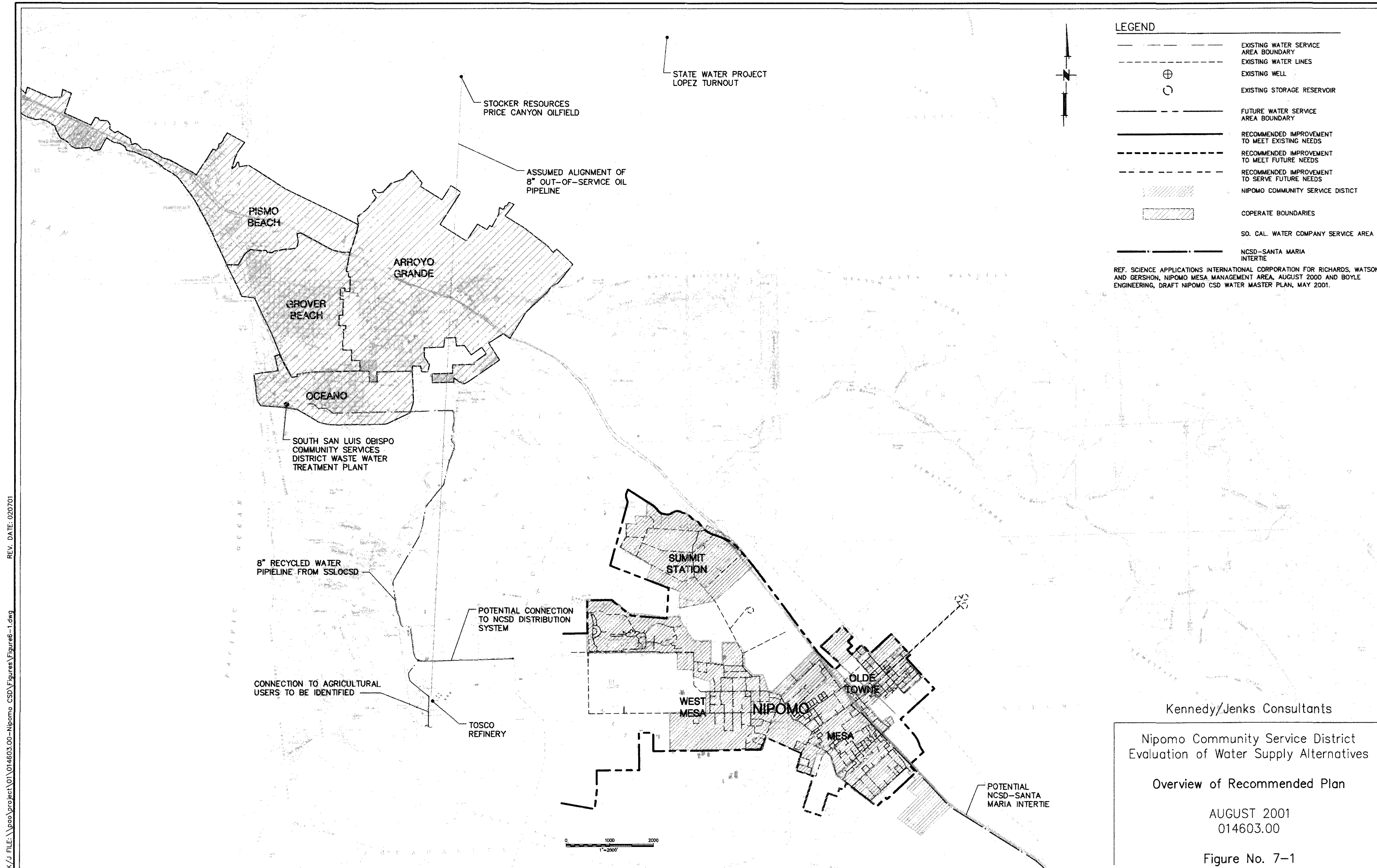
Based on these considerations, it is recommended that NCSD's long-term water supply strategy consist of the following elements in order of priority:

1. Water conservation (500-1,000 AF/yr).
2. Intertie with the City of Santa Maria (2,000-3,000 AF/yr).
3. Desalination of blowdown water, produced water, and/or recycled water and groundwater exchange with the Tosco Refinery (1,300 AF/yr).
4. Recycled water delivery to and groundwater exchange with agricultural users (500 - 1,000 AF/yr).
5. Hard rock drilling (500-1,000 AF/yr).

The recommended plan is shown on Figure 7-1. Each of these elements is discussed in the following subsections.

7.1.1 Water Conservation

Water conservation offers a 10 to 20 percent savings with a relatively low cost and without complex agreements with other entities. Additionally, more efficient use of existing water is typically supported by customers and the community. This support is essential for successfully implementing a water conservation program. The disadvantages of a water conservation program include its large dependence upon the voluntary efforts of customers. Additionally, this alternative has staffing implications for NCSD. To implement an effective program, NCSD may need to hire a full- or part-time coordinator, or redistribute existing staff responsibilities to allow an employee to dedicate his efforts largely to water conservation activities. The CUWCC, as well as numerous other water-related organizations, can provide information and support for pursuing this alternative.


LEGEND
EXISTING WATER SERVICE AREA BOUNDARY
EXISTING WATER LINES
EXISTING WELL
EXISTING STORAGE RESERVOIR
FUTURE WATER SERVICE AREA BOUNDARY
RECOMMENDED IMPROVEMENT TO MEET EXISTING NEEDS
RECOMMENDED IMPROVEMENT TO MEET FUTURE NEEDS
RECOMMENDED IMPROVEMENT TO SERVE FUTURE NEEDS
NIPOMO COMMUNITY SERVICE DISTICT
COPERATE BOUNDARIES
SO. CAL. WATER COMPANY SERVICE AREA
NCSD-SANTA MARIA INTERTIE
REF. SCIENCE APPLICATIONS INTERNATIONAL CORPORATION FOR RICHARDS, WATSON, AND GERSHON, NIPOMO MESA MANAGEMENT AREA, AUGUST 2000 AND BOYLE ENGINEERING, DRAFT NIPOMO CSD WATER MASTER PLAN, MAY 2001.
N
STATE WATER PROJECT LOPEZ TURNOUT
STOCKER RESOURCES PRICE CANYON OILFIELD
ASSUMED ALIGNMENT OF 8" OUT-OF-SERVICE OIL PIPELINE
PISMO BEACH
ARROYO GRANDE
GROVER BEACH
OCEANO
SOUTH SAN LUIS OBISPO COMMUNITY SERVICES DISTRICT WASTE WATER TREATMENT PLANT
8" RECYCLED WATER PIPIELINE FROM SSLOCSD
POTENTIAL CONNECTION TO NCSD DISTRIBUTION SYSTEM
CONNECTION TO AGRICULTURAL USERS TO BE IDENTIFIED
TOSCO REFINERY
SUMMIT STATION
WEST MESA
NIPOMO
OLDE TOWNE
MESA
POTENTIAL NCSD-SANTA MARIA INTERTIE
0 1000 2000
1"=2000'
Kennedy/Jenks Consultants
Nipomo Community Service District
Evaluation of Water Supply Alternatives
Overview of Recommended Plan
AUGUST 2001
014603.00
Figure No. 7-1
REV. DATE: 020701
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7.1.2 Intertie with the City of Santa Maria

The intertie with Santa Maria offers a relatively reliable supply from a source that is not entirely groundwater dependent. It also requires the involvement of only two entities, NCSD and the City of Santa Maria, reducing the complexity and increasing the likelihood that an agreement can be achieved. With an anticipated supply of between 2,000 to 3,000 AF/yr, this alternative can be expected to reduce the anticipated water supply deficit of 3,550 AF/yr to between 550 to 1,550 AF/yr. The disadvantages of this alternative include the potential for reliability problems when the City of Santa Maria does not receive its full entitlement of SWP water and the potential perception of NCSD customers that this is a "back door" to obtaining SWP water despite the results of the previous referenda.

If issues associated with the referenda and ordinances on SWP water can be resolved, then NCSD may consider the lower-cost option of constructing a turnout to the SWP pipeline. This option also is less reliable, as it eliminates access to Santa Maria's other sources of water.

7.1.3 Desalination of Blowdown Water, Produced Water, and/or Recycled Water at, and Groundwater Exchange with the Tosco Refinery

In order to accrue benefits to NCSD, the use of non-potable water at the Tosco Refinery must allow a potable water source to be shifted to NCSD. The Tosco Refinery has the potential to use a non-potable source of water, such as desalinated blowdown water, oil field produced water, or recycled water, in exchange for Tosco's existing groundwater rights. The three available non-potable water sources could be phased in. Sea water desalination is discussed in Section 4.5.

Desalination of blowdown water would provide a permanent non-potable water source for the Tosco Refinery. The main disadvantage of this alternative is the cost. The capital costs include construction of treatment facilities. Additionally, O&M costs for desalination facilities are high due to chemical requirements and electricity consumption. Desalination of blowdown water would require the least involved negotiations of the three non-potable water sources and should be implemented first. By desalinating the blowdown water, approximately 360 AF/yr of groundwater should become available from Tosco. As part of this phase, the blowdown water treatment facility would be constructed, as would a new well, wellhead treatment facility, and a connection to the NCSD distribution system.

Using oil field produced water from Price Canyon as a non-potable water supply requires agreements with both Stocker Resources and Tosco. There are a number of outstanding issues with the oil field produced water alternative that cannot be resolved at this time and the cost of producing water suitable for boiler feed use at the Tosco refinery could be more than $4,000/AF. Complicating the issue further is the unknown status of the pipeline connecting Stocker Resources and Tosco. If this pipeline is available, this alternative appears to be worth pursuing. Once Stocker Resources makes a definitive decision on the pipeline (expected summer 2001), NCSD should evaluate this alternative. It would provide another 700 – 800 AF/yr of non-potable water for use in the steam boilers at the Tosco Refinery. With the desalinated blowdown water, a total of 1,160 - 1,260 AF/yr of non-potable water would be available to Tosco for cooling tower use, virtually eliminating their need for groundwater at the Refinery (with the exception of their potable uses). As part of this phase, the oil field produced water treatment facility would be constructed and the pipeline connecting the oil field with the Refinery would be rehabilitated.

Recycled water offers a relatively inexpensive source of non-potable water. As potable water demand continues to increase, recycled water from SSLOCSD could be blended with oil field produced and blowdown water and desalted. The use of recycled water would be particularly important if oil field produced water were not available. The blended non-potable water could then be used for the steam boilers. To deliver recycled water, it would be necessary to construct a transmission pipeline between the SSLOCSD facility and the non-potable pipelines at the Tosco Refinery. Additionally, it would be necessary for NCSD to construct pipelines to deliver the new groundwater to the distribution system.

There are two limitations to the use of non-potable water at the Tosco Refinery. One is the water requirement of the steam boilers, which is believed to be approximately 1,300 AF/yr. The other is the capacity limitation of the ocean outfall, which is believed to be 484 AF/yr. Based on a desalination recovery of 75 percent, approximately 1,730 AF/yr of blowdown water, oil field produced water, or recycled water would be required for desalination. Based on an outfall capacity of 484 AF/yr and a desalination recovery of 75 percent, a maximum of 1,940 AF/yr could be desalted at the Tosco Refinery. The difference between the maximum capacity (1,940 AF/yr) and the capacity required by the boilers (1,730 AF/yr) is 210 AF/yr, which could be blended with recycled water in approximately equal proportions and provide 420 AF/yr of low salinity irrigation water.

7.1.4 Recycled Water Delivery and Groundwater Exchange with Agricultural Users

This element of the plan is similar to the previous one except that the desalination could occur either at the SSLOCSD plant or the Tosco Refinery and the use of the recycled water would be for agricultural irrigation rather than industrial users. However, because the use characteristics of agricultural irrigation are less predictable than those of the Refinery, this element is assigned a lower priority.

If the previous element is implemented, desalination would occur at the Tosco Refinery, desalinated water would be blended with recycled water to provide 420 AF/yr of irrigation water. If the previous element is not implemented, approximately recycled water would be desalted at the SSLOCSD plant to produce desalted recycled water (at 75 percent recovery), which would be blended in approximately equal proportions with recycled water to provide 500 to 1,000 AF/yr of irrigation water. Desalination concentrates would be disposed of through SSLOCSD's existing ocean outfall.

Pipelines to the agricultural users would be required either from the Tosco Refinery, if that element is implemented, or from the SSLOCSD, if the Tosco Refinery element is not implemented. A groundwater exchange with the agricultural users would enable NCSD to obtain potable water supplies.

7.1.5 Hard Rock Drilling

The development of hard rock water supplies can be high-risk ventures where hydrologic information is limited and groundwater rights are uncertain. Although Samda would be willing to assume up to 50 percent of the costs associated with Phase 1, NCSD would need to invest at least $125,000 in the first phase, with an estimated commodity cost of $1,000/AF once the source is developed. Because Samda bears all capital costs for wells, treatment, and connection to the NCSD distribution system, the cost of water is lower than for most of the other alternatives. However, additional study should be performed before relying upon hard rock drilling to supply new water. If hard rock drilling proves to be a viable option, then one (or more, depending upon the water obtained) of the above alternatives does not need to be implemented.

In general, while the cost of a new groundwater supply is lower than any of the other options, with the exception of water conservation, increasing reliance on groundwater involves non-monetary risks and problems. Water rights, existing and future groundwater litigation, and the potential for overpumping (even if there is currently no evidence of overdraft) could all reduce the reliability of future water supplies. Without an alternative supply from a non-groundwater dependent source, the water supply future will always hold a certain amount of risk.

7.2 Estimated Cost of the Recommended Plan

The costs of the individual elements of the recommended plan were discussed in Section 6. They are summarized in Table 7-1.

TABLE 7-1
ESTIMATED COST OF THE RECOMMENDED PLAN

Priority	Element	Commodity Cost ($)	Capital Cost ($)	O&M Cost ($/yr)	Cost ($/AF)[1]
1	***Water Conservation***	NA	NA	NA	$25,000[2]
2	***Intertie with the City of Santa Maria***	$1,200			$1,700
	Pipeline		$3,200,000	$63,400	
	Booster Station		$500,000	$50,000	
	Upfront Costs[3]		$4,000,000	NA	
	City of Santa Maria Turnout	$1,200			
	Pipeline		$120,000	$20,000	
	Turnout		$500,000	$20,000	
3	***Desalination of Blowdown Water, Produced Water, and/or Recycled Water at, and Groundwater Exchange with the Tosco Refinery[4]***				
	Groundwater from Tosco				$182
	Well		$300,000	$50,000	
	Wellhead Treatment		$125,000	$18,000	
	Connection to NCSD System		$1,100,000	$22,000	
	Desalination of Blowdown Water				$2,161
	Treatment Facility		$4,000,000	$400,000	
	Oil Field Produced Water[5]				$4,520
	Treatment Facility		$8775,000	$2,985,000	
	Pipeline Rehabilitation		$2,112,000	$42,240	
	Recycled Water[6]				$2,080
	Treatment Facility		$14,000,000	$700,000	
	Pipeline to Tosco Refinery		$960,000	$120,000	
4	***Recycled Water Delivery and Groundwater Exchange with Agricultural Users***				$2,249
	Groundwater Exchange with Agricultural Users				$169
	Well Modifications		$500,000	$60,000	
	Pipeline Modifications		$500,000	$15,000	
	Recycled Water[5]				$2,080
	Treatment Facility		$14,000,000	$130,000	
	Pipeline to Agricultural Users		$1,200,000	$150,000	
5	***Hard Rock Drilling***				$1,024

[1] All unit costs were calculated by amortizing over a 20-year period. All costs are in 2001 dollars.
[2] Cost for preparing Water Conservation Plan. Cost does not include implementation of water conservation activities.
[3] Per the City of Santa Maria. Cost to be paid by NCSD. Improvements to be made by the City.
[4] Total cost per acre-foot is dependent upon how much desalinated blowdown water, oil field produced water, and recycled water is used as the non-potable source water. The cost of the non-potable source water must be added to the cost of the groundwater.
[5] Portions of this alternative may be paid for by Stocker Resources or Tosco.
[6] Total amortized cost includes recycled water pipelines for both agricultural users and Tosco refinery. Costs for recycled water usage will vary depending upon whether it is utilized at the Tosco Refinery, by agricultural users, or for both applications. Treatment costs are under both alternatives in the table.

7.3 Recommended Implementation Activities

Based on the recommended long-term water supply plan, the following implementation activities are recommended:

1. Implement an aggressive water conservation program.
2. Initiate simultaneous negotiations with the following parties and determine the available water supply and the implementation cost of each element:
   a. City of Santa Maria
   b. Tosco
   c. Stocker Resources
   d. SSLOCSD
   e. Potential agricultural users
3. Re-evaluate the implementation costs of the plan and revise implementation priorities, and phases, if necessary.
4. Assess the potential impacts of the plan on water rates and connection charges.
5. Execute the necessary agreements and establish a financial structure to implement the plan.
6. Perform the necessary environmental, engineering and financing activities.
7. Pursue grant and low-interest funding opportunities.
8. Construct the necessary improvements in phases.

Section 8: References and Persons Contacted

8.1 References

Bookman-Edmonston Engineers, Inc., "Nipomo Community Services District, Nipomo, California, Evaluation of Alternative Supplemental Water Supplies," July 1994.

Boyle Engineering Corporation, "Nipomo Community Services District, Water and Sewer System Master Plan, Final Report," November 6, 1995.

Boyle Engineering Corporation, "Nipomo Water and Sewer Master Plan Interim Report," 23 May 2001.

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California Department of Water Resources, "Water Resources of the Arroyo Grande - Nipomo Mesa Area," January 2000.

California Regional Water Quality Control Board (Region 3), "Water Quality Control Plan for the Central Coastal Basin."

California Urban Water Conservation Council, "BMP Costs and Savings Study," July 2000.

John L. Wallace & Associates, "Water Recycling Progress Report," February 2001.

San Luis Obispo County Department of Planning and Building, "South County Area Plan," 27 May 1999.

8.2 Persons Contacted

- James Anderson - Tosco Refinery, Santa Maria
- Steve Casey, City Manager - City of Solvang
- Duane Chisam - City of Santa Maria
- Mitch Cooney, General Manager - Oceano Community Services District
- Dennis Delzeit - City of Pismo Beach
- Bill Ferguson - City of Santa Barbara
- Dan Masnada - Central Coast Water Authority
- Mel McCulloch - Samda Inc.

Appendix A

Supporting Cost Information for Detailed Alternative Evaluation

Nipomo Community Services District
Evaluation of Water Supply Alternatives
Estimated Costs
Turnout with the City of Santa Maria

WATER PRODUCED	
2,000	AF/yr

CAPITAL COSTS

	Units		Unit Cost	Total Cost	Amortized Cost
			($)	($)	($)
Turnout	1	turnout	$ 500,000	$ 500,000	$ 47,000
Pipeline	1,000	LF	$ 120	$ 120,000	$ 11,000
Total				$ 620,000	$ 58,000

Notes:
Does not include acquisition or easement costs

O&M COSTS

			Unit Cost
			($/yr)
Turnout	1	LS	20,000
Pipeline	1	LS	20,000
Total			$ 40,000

COMMODITY COSTS

			Unit Cost
			($/AF/yr)
Water			1,200
Total			$ 1,200

TOTAL ANNUAL COST	
Capital	$ 58,000
O&M	$ 40,000
Commodity	$ 1,200
Cost/AF	$ 1,249

ALL COSTS ARE IN 2001 DOLLARS.

Nipomo Community Services District
Evaluation of Water Supply Alternatives
Estimated Costs
Intertie with the City of Santa Maria

WATER PRODUCED	
2,000	AF/yr

CAPITAL COSTS

	Units		Unit Cost	Total Cost	Amortized Cost
			($)	($)	($)
Booster Pump Station	1	station	$ 500,000	$ 500,000	$ 47,000
Pipeline	26,400	LF	$ 120	$ 3,168,000	$ 299,000
Upfront Santa Maria Costs	2,000		$ 2,000	$ 4,000,000	$ 378,000
Total				$ 3,668,000	$ 724,000

Notes:
Does not include acquisition or easement costs

O&M COSTS

			Unit Cost
			($/yr)
Booster Pump Station	1	LS	50,000
Pipeline	1	LS	63,360
Total			$ 113,360

COMMODITY COSTS

			Unit Cost
			($/AF/yr)
Water			1,200
Total			$ 1,200

TOTAL ANNUAL COST	
Capital	$ 724,000
O&M	$ 113,360
Commodity	$ 1,200
Cost/AF	$ 1,619

ALL COSTS ARE IN 2001 DOLLARS.

Nipomo Community Services District
Evaluation of Water Supply Alternatives
Estimated Costs
Groundwater Supply - Tosco

WATER PRODUCED	
1,290	AF/yr

CAPITAL COSTS

	Units		Unit Cost	Total Cost	Amortized Cost
			($)	($)	($)
Well	1	LS	$ 300,000	$ 300,000	$ 28,000
Treatment Facility	1	LS	$ 125,000	$ 125,000	$ 12,000
Connection to Distribution	9,240	LF	$ 120	$ 1,108,800	$ 105,000
Total				$ 425,000	$ 145,000

Notes:
Does not include acquisition or easement costs
Assumes treatment facility is filtration unit at wellhead.

O&M COSTS

			Unit Cost
			($/yr)
Well	1	LS	50,000
Treatment Facility	1	LS	18,000
Pipeline	1	LS	22,176
Total			$ 90,176

COMMODITY COSTS

			Unit Cost
			($/AF/yr)
Water			-
Total			$ -

TOTAL ANNUAL COST	
Capital	$ 145,000
O&M	$ 90,176
Commodity	$ -
Cost/AF	$ 182

ALL COSTS ARE IN 2001 DOLLARS.

Nipomo Community Services District
Evaluation of Water Supply Alternatives
Estimated Costs
Groundwater Supply - Agricultural Exchange

WATER PRODUCED	
1,000	AF/yr

CAPITAL COSTS

	Units		Unit Cost	Total Cost	Amortized Cost
			($)	($)	($)
Well Modifications	1	LS	$ 500,000	$ 500,000	$ 47,000
Pipeline Modifications	1	LS	$ 500,000	$ 500,000	$ 47,000
Total				$ 500,000	$ 94,000

Notes:
Does not include acquisition or easement costs

O&M COSTS

			Unit Cost
			($/yr)
Increased Well Operation	1	LS	60,000
Increased Pipeline Maint.	1	LS	15,000
Total			$ 75,000

COMMODITY COSTS

			Unit Cost
			($/AF/yr)
Water			-
Total			$ -

TOTAL ANNUAL COST	
Capital	$ 94,000
O&M	$ 75,000
Commodity	$ -
Cost/AF	$ 169

ALL COSTS ARE IN 2001 DOLLARS.

Nipomo Community Services District
Evaluation of Water Supply Alternatives
Estimated Costs
Oil Field Produced Water

WATER PRODUCED	
1,200	AF/yr

CAPITAL COSTS

	Units		Unit Cost	Total Cost	Amortized Cost	
			($)	($)	($)	
Treatment Facility	1	LS	$ 8,775,000	$ 8,775,000	$ 828,000	See Appendix B for Treatment Costs.
Pipeline to Tosco	52,800	LF	$ 40	$ 2,112,000	$ 199,000	
Total				$ 8,775,000	$ 1,027,000	

Notes:
Assumes pipeline connecting Stocker and Santa Maria refinery is available.

O&M COSTS

			Unit Cost	
			($/yr)	
Treatment Facility	1	LS	2,985,000	See Appendix B for Treatment Costs.
Pipeline	1	LS	42,240	
Total	.		$ 3,027,240	

COMMODITY COSTS

			Unit Cost	
			($/AF/yr)	
Water				Stocker may charge $450 to water recipient.
Total			$ -	

Notes:
Stocker Resources could charge for the water. An initial estimate was $450/AF.

TOTAL ANNUAL COST		
Treatment (Cap/O&M)	$ 4,320	*** COST PER AF FROM APPENDIX B
Pipeline (Cap/O&M)	$ 241,240	
Commodity	$ -	
Cost/AF	$ 4,521	

ALL COSTS ARE IN 2001 DOLLARS.

Nipomo Community Services District
Evaluation of Water Supply Alternatives
Estimated Costs
Recycled Water from SSLOCSD

WATER PRODUCED	
1,200	AF/yr

CAPITAL COSTS

	Units		Unit Cost	Total Cost	Amortized Cost
			($)	($)	($)
Pipeline to Ag Users	10,000	LF	$ 120	$ 1,200,000	$ 113,000
SSLOCSD Upgrades	1	LS	14,000,000	$ 14,000,000	$ 1,322,000
Pipeline to Refinery	8,000	LF	$ 120	$ 960,000	$ 91,000
Total				$ 16,160,000	$ 1,526,000

Notes:
Does not include acquisition or easement costs

O&M COSTS

			Unit Cost
			($/yr)
Treatment Plant	$ 700,000	LS	700,000
Pipeline (ag)	$ 150,000	LS	150,000
Pipeline (refinery)	$ 120,000	LS	120,000
Total			$ 970,000

ALL COSTS ARE IN 2001 DOLLARS.

COMMODITY COSTS

			Unit Cost
			($/AF/yr)
Water			-
Total			$ -

incl. as part of plant upgrade costs

TOTAL ANNUAL COST	
Capital	$ 1,526,000
O&M	$ 970,000
Commodity	$ -
Cost/AF	$ 2,080

ALL COSTS ARE IN 2001 DOLLARS.

Nipomo Community Services District
Evaluation of Water Supply Alternatives
Estimated Costs
Desalination of Tosco Blowdown Water

WATER PRODUCED	
360	AF/yr

CAPITAL COSTS

	Units		Unit Cost	Total Cost	Amortized Cost
			($)	($)	($)
Treatment Facility	1	LS	$ 4,000,000	$ 4,000,000	$ 378,000
Total				$ 4,000,000	$ 378,000

*Scaled from Sandy Point.

Notes:
Does not include acquisition or easement costs

O&M COSTS

			Unit Cost
			($/yr)
Treatment Facility	1	LS	400,000
Total			$ 400,000

COMMODITY COSTS

			Unit Cost
			($/AF/yr)
Water			-
Total			$ -

TOTAL ANNUAL COST	
Capital	$ 378,000
O&M	$ 400,000
Commodity	$ -
Cost/AF	$ 2,161

ALL COSTS ARE IN 2001 DOLLARS.

Nipomo Community Services District
Evaluation of Water Supply Alternatives
Estimated Costs
Hard Rock Drilling

WATER PRODUCED	
500	AF/yr

CAPITAL COSTS

	Units		Unit Cost	Total Cost	Amortized Cost
			($)	($)	($)
Phase 1	1	LS	$ 125,000	$ 125,000	$ 12,000
Total				$ 125,000	$ 12,000

Notes:
Assumes $250,000 for Phase 1 investigation, yield analysis, and test bore drilling shared equally between Samda and NCSD.
Samda would bear all costs for wells, treatment, and pipeline.

O&M COSTS

			Unit Cost
			($/yr)
Borne by Samda			
Total			$ -

Notes:
Assumes that Samda bears all operating costs for first 20 years of operation.
After 20 years, facilities are turned over to NCSD.

COMMODITY COSTS

			Unit Cost
			($/AF/yr)
Water			1,000
Total			$ 1,000

TOTAL ANNUAL COST	
Capital	$ 12,000
O&M	$ -
Commodity	$ 1,000
Cost/AF	$ 1,024

ALL COSTS ARE IN 2001 DOLLARS.

Nipomo Community Services District
Evaluation of Water Supply Alternatives
Estimated Costs
Water Conservation

WATER PRODUCED	
500	AF/yr

CAPITAL COSTS

	Units		Unit Cost	Total Cost	Amortized Cost
			($)	($)	($)
Water Conservation Plan	1	LS	$ 25,000	$ 25,000	$ 2,000
Total				$ 25,000	$ 2,000

Notes:
Specific measures would be developed and costs would be estimated in the Water Conservation Plan.

O&M COSTS

			Unit Cost	Total Cost
			($)	($)
NA				
Total				$ -

TOTAL ANNUAL COST	
Capital	$ 2,000
O&M	$ -
Commodity	$ -
Cost/AF	$ 4

ALL COSTS ARE IN 2001 DOLLARS.

Appendix B

Oil Field Produced Water Treatment Assessment

Oil Field Produced Water Treatment Assessment

Objective

Price Canyon oil field produces approximately 25,000 barrels of produced water per day (bpd). The objective of this report is to evaluate the quality of produced water at the Price Canyon oil production facility, develop treatment process for using this water for boiler make up (450 psig) and provide preliminary cost estimate for produced water treatment.

Produced Water Quality Characteristics and Concerns

Table 1 shows typical produced water quality at the Price Canyon oil facility and the water quality requirements for boiler makeup water (USEPA, 1973).

TABLE 1
WATER QUALITY CRITERIA FOR BOILER MAKEUP WATER AND TYPICAL PRODUCED WATER QUALITY AT NIPOMO FACILITY

Parameter	Boiler Water Criteria*	Oil Field Produced Water Quality
Cations (mg/l)		
Sodium	as received	500 - 690
Potassium	as received	11 - 59
Aluminum	0.1	
Ammonium (NH_4)	0.1	5 - 6
Calcium	0.4	5.6 - 86
Magnesium	0.25	2 - 28
Barium	see hardness	0.18 - 0.9
Iron	0.3	0.13
Manganese	0.1	0.076
Copper	0.05	0
Zinc	0.01	0
Strontium	see hardness	0.2 - 2.1
Anions (mg/l)		
Bicarbonate	120	85 - 402.6
Sulfate	as received	16 - 220
Chloride	as received	670 - 850
Nitrate		9.5
Sulfide (S)	as received	5.9 - 24
Other inorganic		
Total Hardness	1	70 - 330
pH	8.2 - 10.0	7
Total Alkalinity (as CaCO3)	100	590
Boron (B)		6.7 - 9.4
Silica	10	74 - 230
TDS (Measured)	500	1460 - 2460
Conductivity (umhos)		2200 - 3700
Suspended solids	5	

DO	0.007	
Organics (mg/l)		
Organic Acid (as Acetic)		
Oil and Grease	ND	159.5
COD	5	590
TOC		
MBAS	1	
CCE	1	

* - USEPA, 1973

As shown in Table 1, the key water quality parameters of concern in the produced water from Nipomo facility are hardness, silica and ammonia. In addition, if the blowdown water from boiler will be used for irrigation or landscaping, the boron concentration must be below 1 mg/l.

Treatment Goals and Processes

Treatment processes were evaluated to remove hardness, alkalinity, silica, ammonium and boron from the produced water. The treatment goals for these parameters are shown in Table 2. The goal of the treatment is to provide water of quality described in Table 1. However, oxygen scavengers, pH neutralizing chemicals and anti-filming agents may need to be added to this water during make up water applications.

TABLE 2
WATER QUALITY GOALS FOR THE TREATMENT PROCESSES

Parameter	Treatment Goal (mg/l)
Hardness	< 1
Silica	< 1
Boron	< 2
Ammonium	< 0.5
Alkalinity	< 100 (as $CaCO_3$)

After preliminary evaluation of various alternatives, the following treatment process was selected for treatment:

i) Warm softening process using a DensaDeg clarifier to reduce hardness to below 60 mg/l and silica concentration to approximately 20 mg/l

ii) Reverse Osmosis to remove hardness to below 1 mg/l, silica to below 1 mg/l, alkalinity to around 80 mg/l as $CaCO_3$ and boron to below 2 mg/l

iii) Ion exchange process to remove ammonia to less than 0.5 mg/l

The initial temperature of the produced water is approximately 160 ° F. Hence, a Fin Fan system is provided to cool the effluent from warm softening process to approximately 110 ° F to facilitate RO treatment. In addition, pressure filtration to remove particulate matter from clarifier effluent, cartridge filter to pretreat RO influent and belt filter to thicken clarifier sludge are also provided. A simplified schematic of the treatment process is shown in Figure 1. The operation conditions and treated water quality from various processes are summarized in Table 3.

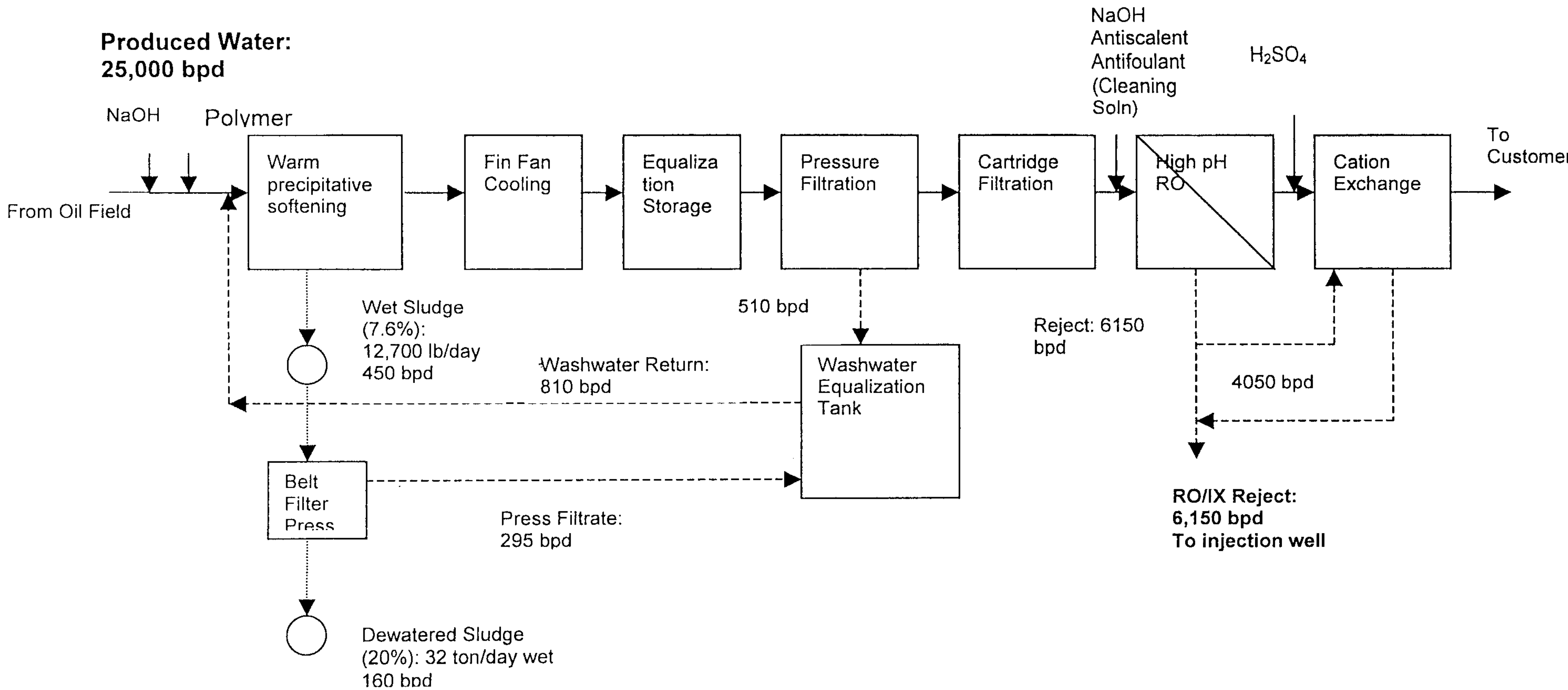

Figure 1. Simplified Schematic of the Proposed Treatment Process

TABLE 3
CONCENTRATIONS OF CONSTITUENTS OF CONCERN ANTICIPATED IN PROPOSED TREATMENT SYSTEM

	Concentration (mg/l)						
	Hardness (mg/l)	TDS (mg/l)	pH	Silica (mg/l)	Boron (B)	Ammonia (mg/l)	Alkalinity (mg/l as $CaCO_3$)
Influent	330	2460	7	230	9.4	6	590
DensaDeg Effluent	60	2500	9.5	20	9.4	5	590
RO Product	< 1	150	10.8	< 1	< 2	6	85
pH Stabilization	<1	150	7.5	<1	<2	6	60
Ion Exchange Effluent	< 1	150	7.5	< 1	< 2	< 0.5	60

Preliminary Cost Evaluations

This section summarizes show the capital and O&M costs for the treatment process. The costs are conceptual level estimates and have an accuracy of –30 to +50%. The estimates are based on experience gained with the pilot plant operations elsewhere, budgetary cost input from equipment manufacturers, cost estimation information from recent Kennedy/Jenks projects and professional judgment. The costs represent early 2001 dollars.

Capital costs were estimated for two alternatives:

1) Fin Fans are provided for cooling the water prior to RO treatment

2) Fin Fans are not provided for cooling

Table 4 summarizes the cost factors used in the conceptual treatment facility.

TABLE 4
COST FACTORS AND ASSIGNED VALUES

Parameter	Value	Unit
Dollar		
Interest rate	7	% per annum
Capital recovery period	20	Years
Capital		
Electrical and Instrumentation	15	% of process train costs
Site Work	10	% of process train costs
Contractor's overhead and profit	12	% of process train costs
Mobilization and bonding	2	% of process train costs
Contingency	10	% of process train costs
Indirect construction costs	38	% of process train costs
O&M		
Sodium Hydroxide	0.25/0.20	$ per lb
Polymer	2.40	$ per lb
RO antiscalent	2.23	$ per lb
RO chemical cleaning solution	3.22	$ per lb
Sulfuric acid	0.053	$ per lb
Electricity	0.12/0.08	$ per lb
Labor rate	30	$ per hr
Replacement RO membrane elements	990	$ per element (18 month life)
Misc. maintenance materials	1	% of process train costs
Sludge disposal	25	$ per ton waste
Brine disposal	0.11	$ per barrel
Contingencies	10	% of direct annual O&M

Construction and Total Capital Costs

Capital cost estimates include both the actual construction ("bid") and the indirect costs associated with implementing the project. Capital cost include costs related to purchase and installation of process and residuals handling equipment, site preparation, building and structural work, and other construction costs a contractor includes in a "bid cost" for a treatment facility such as mobilization and bonding, overhead and profit, and contingencies to account for uncertainties and unforeseen expenses. Indirect capital costs include such expenses as engineering design and construction management, financial, legal, and administrative services, interest during construction, utility connection fees, environmental impact reports, and permits. These costs have been estimated at 38% of the construction "bid" costs in this report. The capital cost estimates assume a level site.

Table 5 summarizes the capital cost estimate for the conceptual 25,000 produced water treatment facility with the Fin Fan cooling system. The estimated construction "bid" cost is $6.3 million, with indirect capital cost of $2.4 million, for a total project capital cost of $8.7 million. Table 6 summarizes the capital cost estimate for the process without Fin Fan cooling. The estimated construction "bid" cost is $5.8 million, with indirect capital cost of $2.2 million, for a total project capital cost of $8.0 million. The unit construction costs are $253/bpd and $234/bpd for the two systems, respectively.

Operations and Maintenance Costs

Table 7 summarizes the estimated annual O&M cost assuming an NaOH cost of $0.25/lb. The total annual O&M cost is estimated to be $3.02 million/year. This is equivalent to $0.33/bbl of the produced water treated. The O&M cost consist of $1.2 million/year for chemicals, $0.39 million/year for energy, $0.40 million/year for labor, $0.18 million/year for maintenance materials, $0.54 million/year for residuals management and $0.275 million/year for contingencies.

Sensitivity analysis for sludge disposal and sodium hydroxide costs.

A sensitivity analysis was performed using the following changes from the base case cost assumptions on the annual O&M costs:

- Changing the NaOH costs from $0.25/lb to $0.20/lb
- Changing the electricity rate from $0.12/Kw-hr to $0.08/Kw-hr
- Changing the NaOH cost to $0.20/lb and electricity cost to $0.08/Kw-hr

Tables 8, 9 and 10 compare the O&M costs for these cases. These summaries show that the cost of caustic has a significant impact on annual O&M costs, reducing the cost by approximately 2 c/bbl of produced water treated. Decreasing the electricity cost to $0.08/KW-hr reduces the O&M cost to about 1 c/bbl. Effecting both the changes simultaneously reduces the treatment cost by 3 c/bbl.

Total Cost

Table 11 shows the estimated water cost per acre-foot for all the cases. In these calculations, total water costs were estimated as the sum of amortized capital cost and O&M costs. Amortized capital cost was estimated using a 7% interest an amortization period of 20 years. The case where Fin Fans are used, under the baseline conditions, treatment cost for an acre foot of treated water is approximately $4320. If Fin Fans are not used, the cost is about $4160/acre-foot. At reduced NaOH cost ($0.20/lb), if Fin Fans are used, the cost per acre-foot of treated water is about $4070. If Fin Fans are not used, the cost is about $3900/acre-foot of treated water. With no fans provided, at reduced NaOH and electricity costs the cost of treated water per acre-foot is approximately $3770.

Reference

USEPA, 1973. Water Quality Criteria – 1972. EPA Report EPA-R3-73-033. Prepared by National Academy of Science and National Academy of Engineering.

TABLE 5
CAPITAL COST ESTIMATE FOR 25,000 BARREL PER DAY CONCEPTUAL PRODUCED WATER RECLAMATION PROJECTS

Cost Component	Cost ($1000s)*
1. Direct Process Cost	
Warm lime softening	880
Cooling	300
Equalization storage	85
Booster pumping	170
Granular media filtration	370
Reverse Osmosis	1,420
Stabilization (pH adj.)	55
Ammonium selective ion exchange	595
Subtotal	3870
2. Treatment Building	270
3. Process + Building Subtotal	4140
4. Other Direct Construction	
Electrical + Instrumentation @ 15% of Item 1 Subtotal	580
Site Work @ 10% of Item 1 Subtotal	390
5. Direct Construction Subtotal	5100
6. Contractor Markups	
Contractor's overhead & profit @ 12% of Item 5 Subtotal	610
Mobilization @ 2% of Item 5 Subtotal	100
Contingency @ 10% of Item 5 Subtotal	510
7. Total Construction Cost Estimate (Bid Cost)	6330
8. Indirect Capital Cost Estimate 38% of bid cost	2430
9. Total Capital Cost Estimate	8750
10. Unit Construction Costs	
$/bpd produced water treated	250
$/bpd water reclaimed	360
11. Unit Total Capital Costs	350
$/bpd produced water treated	

*Values rounded to two significant figures or nearest $100,000

TABLE 6
CAPITAL COST ESTIMATE FOR 25,000 BARREL PER DAY CONCEPTUAL PRODUCED WATER RECLAMATION PROJECT WITH NO FIN FAN FOR COOLING

Cost Component	Cost ($1000s)*
1. Direct Process Cost	
Warm lime softening	880
Cooling	-
Equalization storage	85
Booster pumping	170
Granular media filtration	370
Reverse Osmosis	1,420
Stabilization (pH adj.)	55
Ammonium selective ion exchange	600
Subtotal	3570
2. Treatment Building	270
3. Process + Building Subtotal	3835
4. Other Direct Construction	
Electrical + Instrumentation @ 15% of Item 1 Subtotal	535
Site Work @ 10% of Item 1 Subtotal	360
5. Direct Construction Subtotal	4730
6. Contractor Markups	
Contractor's overhead & profit @ 12% of Item 5 Subtotal	570
Mobilization @ 2% of Item 5 Subtotal	95
Contingency @ 10% of Item 5 Subtotal	470
7. Total Construction Cost Estimate (Bid Cost)	5860
8. Indirect Capital Cost Estimate 38% of bid cost	2230
9. Total Capital Cost Estimate	8100
10. Unit Construction Costs	
$/bpd produced water treated	234
$/bpd water reclaimed	335
11. Unit Total Capital Costs	323
$/bpd produced water treated	

*Values rounded to two significant figures or nearest $100,000

TABLE 7
ANNUAL OPERATIONS AND MAINTENANCE COST FOR BASE LINES CASE

Cost Component		Cost ($1000s/yr)*
1. Chemical		
Sodium Hydroxide		1040
Polymers		40
Antiscalents		7
Antifoulant		52
RO Cleaning Solution		90
Sulfuric acid		6
	Subtotal	1235
2. Electricity		
Warm softening		12
Cooling		52
Booster pump		65
Pressure Filters + pH adj.		1
Reverse osmosis		263
pH adjustment		
	Subtotal	393
3. Labor		
Operations		330
Maintenance		66
	Subtotal	396
4. Maintenance Materials		
RO Membrane		25
Other materials		158
	Subtotal	183
5. Residuals Disposal		
Sludge		290
RO concentrate		251
	Subtotal	541
6. Direct Annual O&M		2746
7. Contingency @ 10% of Item 6		275
8. Total Annual O&M		3021
9. Unit Annual O&M Cost c/bbl produced water		33

*Values rounded to two significant figures or nearest $100,000

TABLE 8
ANNUAL OPERATIONS AND MAINTENANCE COST @ NAOH COST OF $0.20/LB

Cost Component		Cost ($1000s/yr)*
1. Chemical		
Sodium Hydroxide		832
Polymers		39
Anti-scalents		7
Anti-foulant		52
RO Cleaning Solution		89
Sulfuric acid		6
	Subtotal	1025
2. Electricity		
Warm softening		12
Cooling		52
Booster pump		65
Pressure Filters + pH adj.		1
Reverse osmosis		263
pH adjustment		
	Subtotal	393
3. Labor		
Operations		330
Maintenance		66
	Subtotal	396
4. Maintenance Materials		
RO Membrane		25
Other materials		158
	Subtotal	183
5. Residuals Disposal		
Sludge		290
RO concentrate		251
	Subtotal	541
6. Direct Annual O&M		2538
7. Contingency @ 10% of Item 6		254
8. Total Annual O&M		2792
9. Unit Annual O&M Cost c/bbl produced water		31

*Values rounded to two significant figures or nearest $100,000

TABLE 9
ANNUAL OPERATIONS AND MAINTENANCE COST WITH NO FIN FAN FOR COOLING

Cost Component		Cost ($1000s/yr)*
1. Chemical		
Sodium Hydroxide		1,040
Polymers		39
Antiscalents		7
Antifoulant		52
RO Cleaning Solution		89
Sulfuric acid		6
	Subtotal	1,233
2. Electricity		
Warm softening		12
Cooling		–
Booster pump		65
Pressure Filters + pH adj.		1
Reverse osmosis		263
pH adjustment		
	Subtotal	341
3. Labor		
Operations		305
Maintenance		61
	Subtotal	366
4. Maintenance Materials		
RO Membrane		25
Other materials		155
	Subtotal	180
5. Residuals Disposal		
Sludge		290
RO concentrate		251
	Subtotal	541
6. Direct Annual O&M		2,661
7. Contingency @ 10% of Item 6		266
8. Total Annual O&M		2,927
9. Unit Annual O&M Cost c/bbl produced water		32

*Values rounded to two significant figures or nearest $100,000

TABLE 10
ANNUAL OPERATIONS AND MAINTENANCE COST WITH NO FIN FANS, @ NAOH COST $0.20/LB AND @ ELECTRICITY COST OF $0.08/KW-HR

Cost Component		Cost ($1000s/yr)*
1. Chemical		
Sodium Hydroxide		832
Polymers		39
Antiscalents		7
Antifoulant		52
RO Cleaning Solution		89
Sulfuric acid		6
	Subtotal	1,025
2. Electricity		
Warm softening		12
Cooling		–
Booster pump		65
Pressure Filters + pH adj.		1
Reverse osmosis		263
pH adjustment		
	Subtotal	341
3. Labor		
Operations		305
Maintenance		61
	Subtotal	366
4. Maintenance Materials		
RO Membrane		25
Other materials		155
	Subtotal	180
5. Residuals Disposal		
Sludge		290
RO concentrate		251
	Subtotal	541
6. Direct Annual O&M		2,453
7. Contingency @ 10% of Item 6		245
8. Total Annual O&M		2,698
9. Unit Annual O&M Cost c/bbl produced water		30

*Values rounded to two significant figures or nearest $100,000

TABLE 11
SUMMARY OF UNIT TREATMENT COSTS

	With Cooling	Without Cooling	Cooling +NaOH @ $0.2/lb	No Cooling +NaOH @ $0.20/lb	No Cooling + NaOH @ 0.20/lb + Power @ $0.08/Kw-hr
Capital Cost	8,775,000	8,133,355	8,775,055	8,133,355	8,133,355
Ammortized Capital Cost	828000	768000	828000	768000	768000
Annual O&M Cost	2,985,000	2897000	2757000	2668000	2554000
Total Annual Cost	3813000	3665000	3585000	3436000	3322000
Water Treatment Cost ($/bbl)	$0.42	$0.40	$0.39	$0.38	$0.36
Water Cost ($/Ac.ft water Produced)	$4,320	$4,160	$4,070	$3,900	$3,770