salmon. The sale price of the water should include a surcharge for power generation foregone at Don Pedro and La Grange Dams, since the water would be delivered from Don Pedro Reservoir and would bypass these generating facilities. Amendment of the Raker Act may be required, as would permission from the State Water Resources Control Board.

Such water sales are not unprecedented. In 2001 the San Joaquin River Group Authority proposed a 12-year transfer of 110,000 acre-feet to improve San Joaquin River water quality. The San Joaquin River Group Authority includes the Merced, Modesto, South San Joaquin, and Oakdale Irrigation Districts, the San Joaquin River Exchange Contractors, and the Friant Water Users Association.[liii]

Option 8

Desalination

San Francisco, the Marin Municipal Water District, and other Bay Area water agencies are considering the possibility of constructing ocean or bay desalination facilities. The costs of sea water desalting have declined considerably over the past 10 years, and a major new plant has been built in Tampa Bay. Impacts on marine life must be carefully considered and avoided, but obviously desalting can easily supply San Francisco and all its customers due to their proximity to the Bay and Pacific Ocean.

Option 9

Conjunctive Use of Groundwater on the Peninsula

San Francisco is considering storing water in the west side groundwater basin, which underlies the city and part of the peninsula south of the city limits. According to a 2004 report to San Francisco by Luhdorff and Scalmanini Consulting Engineers, this basin can hold up to 75,000 acre-feet, and water could be stored there for use in dry years when less water is available from the Sierra.

TUOLUMNE COUNTY: NOT FORGOTTEN

The Groveland Community Services District gets its water from the Mountain Tunnel and pays San Francisco for it, plus a surcharge. Since this proposal puts natural flow from Hetch Hetchy Valley plus water from Holm Powerhouse into the Mountain Tunnel, there will always be enough water for Groveland in the tunnel, except for infrequent tunnel maintenance, such as presently occurs. Filtration should be provided for this water supply, as well as the supplies to the communities of Early Intake and Moccasin.

CONCLUSIONS

There are more than ample ways of meeting the water needs of San Francisco and its customers on the Peninsula and in the South Bay if Hetch Hetchy Reservoir is drained. Even if it is determined that additional water is needed to serve a growing population in the South Bay service area, there is still plenty of water available.

Tuolumne River flowing from Hetch Hetchy Valley before dam construction.
California Historical Society[lxxi].

San Francisco's Proposed Water Supply Expansion Projects - Table 4

Expansion and Reliability Project

In Appendix CIP-3 & CIP-5 Dated 1/24/2002

	Control #	Year Of Completion	Escalated Cost In[1]
			Million $
SJPL No4 New[2]	202035	2011	477.3
Calaveras Dam Replacement[3]	202135	2009	170.8
Enlarge Sunol Treatment Capacity to 240 mgd[4]	202375	2009	95.3
SVWTP - New Treated Water Reservoir[5]	202397	2007	52.2
Irvington Tunnel Alternatives[6]	9970	2009	165.8
Bay Division Pipeline - Hydraulic Capacity Upgrade[7]	201441	2013	317.4
Crystal Springs Bypass Tunnel[8]	9891	2009	57.2
Crystal Springs PS and CS-SA PL Capacity[9]	201671	2011	71.8
Sunol Quarry Reservoirs[10]	99079	2014	12.2
Total escalated cost for these 9 projects			1,420.0
Total for Regional Water & Local Water projects, 77 Projects			2,555.6
Expansion and Reliability projects as % of total project escalated cost			56

Footnotes:

1. Escalated from 2003 $ to date of construction.
2. San Joaquin Pipeline No. 4 adds capacity of 130 to 160 mgd.
3. Replace by higher dam with >340,000 acre-feet additional storage and a pumping plant to move HH Aqueduct water into the larger reservoir.
4. Expansion for filtering water from enlarged Calaveras Reservoir at up to 240 mgd. Also can filter silt from Sierra water.
5. Sunol Valley Water Treatment Plant will add 40 million gal filtered water storage to match expanded filtration.
6. Second tunnel adds 115 to 150 mgd capacity.
7. Bay Division Pipeline No. 5 seventeen miles around south end of Bay, adds capacity of at least 150 mgd.
8. About one mile of new tunnel will parallel the present pipeline, both 7-foot diameter, both for raw water.
9. Pump Station plus Crystal Springs Reservoir to San Andreas Reservoir, 4-mile long 6-foot diameter Pipeline for capacity increase.
10. Convert 6 gravel quarries into reservoirs with total storage of 63,000 acre-feet. Not all will be complete by 2014.

SAN FRANCISCO'S CAPITAL IMPROVEMENT PROGRAM AND RESTORING HETCH HETCHY

The Capital Improvement Program (CIP)[xxviii] that San Francisco voters adopted in November 2002 has five goals:

- Repair deteriorated parts of the Hetch Hetchy Aqueduct and the city's distribution system.
- Strengthen aqueducts and pipelines where they cross earthquake faults and the Bay.
- Improve water treatment facilities to meet regulatory requirements.
- Make in-stream flow improvements and install water recycling systems.
- Add reliability to the system and plan for the future.

The first four goals are compatible with the removal of Hetch Hetchy Reservoir. However, to serve growth in water demand, the San Francisco plan calls for increasing diversions from the Tuolumne by another 268,000 acre-feet per year - reducing flow in the lower river by 35% from the present average annual flow of 764,000 acre-feet (data derived from Table 1).

Nine of the 77 projects included in the CIP clearly have both reliability and expansion features (Table 4). Instead of using these projects to furnish water for as yet unbuilt residential and commercial developments, the city could reconfigure them to provide replacement water after Hetch Hetchy Reservoir is removed. The water supply scenario described above (Option 2) that includes constructing a fourth San Joaquin Valley pipeline, raising Calaveras Dam, and enlarging a filtration plant is the alternative most compatible with what San Francisco proposes in its Capital Improvement Program (CIP).

Other reliability and expansion projects will allow San Francisco to move more water across the Bay to customers on the Peninsula and in the city. Table 4 lists these reliability and expansion projects. Note that a total of $1.4 billion — 56 percent of all construction money — will be spent on the nine expansion projects.

If removal of Hetch Hetchy Reservoir were considered at the same time that the environmental impacts and mitigations for the CIP are considered, many of the CIP 'reliability' features could serve this report's goal of supplying the firm yield of the present Hetch Hetchy system by moving storage of the water downstream, closer to its consumers. The new storage and conveyance system would store winter rains and spring snowmelt just as the present reservoirs do. All four San Joaquin pipelines would be used to transport what are excess high flows today to an enlarged Calaveras Reservoir.

A comprehensive environmental impact report will be prepared in conjunction with the CIP. That document should analyze the alternatives presented in this report.

MEETING THE NEEDS OF SAN FRANCISCO'S WATER CUSTOMERS

When San Francisco expanded its water system into the Sierra Nevada, it obtained a water supply far larger than its customers within the city limits could use. The city's surplus water supply was made available to the fast-growing municipalities in San Mateo, northern Santa Clara, and southern Alameda Counties. A map of the regions served by the Hetch Hetchy water supply system is on Figure 2 (inside back cover).

Alameda and Santa Clara Counties have also developed other water sources, including local reservoirs in each county, imports from the U.S. Bureau of Reclamation's Central Valley Project and the State Water Project, and imports from the Mokelumne River to Alameda County. Despite these substantial additions, however, the San Francisco supply remains an important component of the water supplies of both counties.

Since San Francisco owned their entire water supply system, the city did not have to consider the views of its customers with respect to repair, maintenance, and expansion of the system. As San Francisco continued to use power sales revenues for other city purposes, and as the system deteriorated, alarmed water customers petitioned the legislature to allow themselves to organize and deal with San Francisco in a more unified way. The customers formed the Bay Area Water Supply and Conservation Agency (BAWSCA), empowered to raise their share (approximately $2 billion) of the money needed to implement San Francisco's Capital Improvement Program.

Implementing RESTORE HETCH HETCHY's proposal would also greatly benefit the agencies that make up BAWSCA. Funds for the water efficiency, water recycling, groundwater storage, and other water supply programs envisioned in this report would be spent partially within the member agencies' service areas, based on the cost-effectiveness of the individually proposed projects. Building the fourth pipeline and expanding Calaveras Reservoir as described above would benefit both these member agencies and San Francisco.

In the development of a final proposal to remove Hetch Hetchy Reservoir, it is critical that BAWSCA's formal views be solicited, since the needs of its member agencies must be met. The "win-win" solution proposed by this report definitely takes account of the needs of all those who rely on water and power from the Tuolumne River.

WATER QUALITY

DRINKING WATER QUALITY

Drinking water quality is very important to San Francisco, Peninsula, and South Bay water users. Even water shortages in dry years are less threatening than the possibility of unhealthy water.

Water from the Tuolumne River is of very high quality. Hardness at Hetch Hetchy is about 3 milligrams per liter (mg/l), and at Don Pedro, about 14 mg/l[liv] . Both are extremely low measurements — so low that lime is added to water diverted into the Foothill Tunnel to prevent pipeline corrosion. Partly due to this addition of lime and other sources of water, hardness ends up at around 100 mg/l[xliv]. The total may also be due in part to mixing with water from Alameda Creek.

Water Filtration Plant

Of major US cities, only New York, Seattle, Boston, Portland Oregon, and San Francisco have federal exemptions from the water filtration requirement[xliv]. For years, San Francisco has resisted filtering the water from the Tuolumne River on the grounds that Tuolumne water is of such high quality that it does not require filtration. Water derived from Alameda Creek, however, is already filtered, as is water from Crystal Springs Reservoir. San Francisco has been under pressure from federal and state health officials to filter all their water, but the capital and operating costs of filtration makes city officials reluctant to do so. They do provide chloramine treatment, which kills many but not all pathogens.

Pathogenic organisms including cryptosporidium and giardia are present in San Francisco's drinking water[lvi]. The numbers of these organisms would be reduced by filtration[xliii]. Some of the funds to pay for more filtration are now available as part of the bond money provided by voters in 2002 to implement the Capital Improvement Program. Additional funds would be made available by the public and private water districts that buy water from San Francisco.

Now is the time to filter Tuolumne River water. According to the federal Centers for Disease Control, those with compromised immune systems are especially vulnerable to waterborne pathogens[lvi]. Given the many thousands of people with immune system problems who live in the Bay Area and drink Tuolumne River water, continuing to resist filtration is increasingly hard to defend from a public health perspective.

Filtering water from the Tuolumne River will also make it easier to replace the water presently derived from Hetch Hetchy Reservoir. One of the options to replace this water is to rebuild Calaveras

Reservoir, which is on a tributary of Alameda Creek. This reservoir already stores water for San Francisco, and water from the reservoir is already filtered. Tuolumne River water could be stored along with local water in an enlarged Calaveras Reservoir. All the water would be filtered, and public safety would be improved.
Other cities relying on similar sources of Sierra Nevada water — including Sacramento, Los Angeles, and cites of the East Bay Area — all filter their water. Modesto filters water from the Tuolumne[lvii].

The cost of filtration is difficult to determine. In the CIP San Francisco allocated $129 million (in 2003 dollars) for filtration plant capacity increase and for increase in filtered water storage from about 160 million gallons per day (mgd) to 240 mgd. A report by the New York City Budget office estimated that the capital cost of building a water filtration plant is somewhere between $3.39 and $6.87 for each gallon per day of water produced[lviii]. To treat a maximum of 306 mgd (full capacity of the existing system), an expanded treatment plant would cost between $224 and $453 million. Much would depend on whether it was possible to expand the plant at the existing site.

The Schlumberger Water Services study for the Environmental Defense[xliii] estimated that the cost of expanding the Sunol Treatment Plant to treat all Tuolumne River water would be between $134 and $288 million. This is above and beyond the funding San Francisco has already included in the Capital Improvement Program to expand the filtration plant.

Based on Null's estimate of $17 per acre-foot to filter Tuolumne water, the estimated additional treatment costs would be about $6 million per year, or less than $0.50 per month per customer. This would be a small price to pay for safer, purer water. This cost increase is small compared to the projected cost of water after the Capital Improvement Program is completed.

The question of where to filter and treat the water is important. By filtering and treating water at Don Pedro, some advantages can be gained. One possible location is on the tunnel spoil at Brown Adit on the left bank of the reservoir — a site that is also right under the Hetch Hetchy power lines. San Francisco already has a road leading to Brown Adit across land owned by the U.S. Bureau of Land Management (BLM). After treatment, water would be pumped into the aqueduct. San Francisco should provide funding for any additional pumping head beyond that needed after filtration.

THE DELTA

More than 20 million Californians in the San Francisco Bay Area, San Joaquin Valley, and Southern California drink water from the Sacramento–San Joaquin Delta (the vast system of channels, sloughs, and wetlands that form the junction of the Sacramento and San Joaquin Rivers). San Francisco and its customers could also replace Hetch Hetchy water from this source. Using Delta water would require filtration and other forms of treatment. There is no evidence that this source of water is in any way unsafe,

although San Francisco understandably prefers its higher-quality Tuolumne River water, partly due to lower treatment costs. If San Francisco allowed Tuolumne water to enter the Delta and to be diverted there, the quality of the Tuolumne and San Joaquin Rivers and the Delta would be improved.

CONJUNCTIVE USE WITH GROUNDWATER

If groundwater were supplied to irrigators, and if a corresponding amount of surface water were then diverted from Don Pedro Reservoir to San Francisco, filtration would be required. If groundwater were placed directly into the Hetch Hetchy system, then filtration might be required, although Modesto and Turlock do not filter most of their well water.

OTHER WATER QUALITY CONSIDERATIONS

There is some water quality degradation due to storage in Hetch Hetchy Reservoir, although it is probably not significant. That degradation is caused by warming of the water in the reservoir and minor algal growth. Not only is this loss of water quality passed on to the water users in the Bay Area, but the lower-quality water flows downstream to cause negative impacts on the Tuolumne River all the way to Don Pedro Reservoir and beyond — ultimately to the San Joaquin River and the Delta. Removal of the reservoir would eliminate this minor source of degradation.

Hetch Hetchy Reservoir - Jenny Ross

MEETING ENERGY NEEDS

Energy produced by water stored in Hetch Hetchy Reservoir is valuable to San Francisco. It is used to power the Muni system of trolley cars, San Francisco Airport, and other city departments. Remaining power is sold to the Modesto and Turlock Irrigation Districts and other agencies. Hydroelectric energy is very valuable because it can be turned on and off almost instantly. This means it can be used to meet peak loads, when electricity demand is highest and supplies are short.

But hydroelectric facilities also have a disadvantage: in dry years they cannot be counted on to produce very much power. In 1977, for example, very little water was left in Hetch Hetchy Reservoir, and the ability to generate power was greatly reduced by the end of the summer. Since San Francisco operates the Tuolumne for water supply first, the power plants on the Tuolumne have no reliable capacity (measured in kilowatts) compared to their installed capacity. (A gas turbine electricity plant has much better reliable capacity, because it is normally available to start up immediately, any time of year.) Installed nameplate capacity on all of San Francisco's hydro generators on the Tuolumne total 385 megawatts (MW). Actual operating capacity is 415 MW without overheating. Other generators on the Tuolumne are owned by the Turlock or Modesto Irrigation Districts. (Table 6).

In an average year, under the plan presented here, there would be no affect on firm capacity. This is because under the current management of the system for "water first", there is probably no reliable electrical capacity at all, since water would not be released solely to meet electrical capacity needs. (Some years ago, when San Francisco operated the system largely for power revenue, they stated that the reliable capacity of the system on the Tuolumne was 260 megawatts.)

The report by Environmental Defense[xliii] looks at the actual capacity of the powerplants, based on past performance. It concludes that the impact of removal of Hetch Hetchy Reservoir on capacity is minor: losses would exceed 100 MW only briefly during dry fall months, and are usually below 40 MW.

In an average year, according to San Francisco's annual reports and website, the Hetch Hetchy system generates 1,700 million kilowatt-hours of electrical energy. (Energy is measured in kilowatt-hours per year, abbreviated as kWh/yr, or in millions of kWh/yr, shown as M kWh/yr.) The city uses about 900 million kWh/yr for the Muni and other city services.

This power is generated at three power plants: Dion R. Holm Powerhouse on Cherry Creek, using water from Cherry and Eleanor Reservoirs; Kirkwood Powerhouse on the Tuolumne

River upstream from Early Intake Reservoir, using water from the Canyon Tunnel from O'Shaughnessy Dam in Hetch Hetchy Valley; and Moccasin Powerhouse on Moccasin Creek just upstream from Don Pedro Reservoir, using water from the Mountain Tunnel. Moccasin receives the water that previously went through Kirkwood Powerhouse. Moccasin can also generate with water diverted from Early Intake Reservoir (Figure 2, inside back cover) into the Mountain Tunnel, as would be the case if water is diverted from Cherry Creek (as was done in 1977, and would be done under the plan to divert water from below Holm Powerhouse).

Null estimates the loss of hydroelectric power, based on the wholesale price of power, to be $12 million per year, but she does not include the power that could be generated by the diversion of water from Hetch Hetchy Valley into the Canyon Tunnel after the reservoir is gone. In that scenario, the value of the power lost would be about $9 million per year (see the discussion at the end of this section).

ENERGY GENERATION AFTER THE RESERVOIR IS REMOVED

The total power reduction in median years would be 550 million kilowatt-hours. To put this loss into perspective, California uses 254 thousand million kilowatt-hours per year — 254,000,000,000 kWh/yr[lix]— so the lost power would be 0.2 percent (one-fifth of one percent) of the state's entire energy usage. But even this small power loss should be mitigated. There are several ways in which this can be done.

Table 2 shows energy production in median water year 1979 before and after removal of the dam at the various power plants. Three plans are compared to the actual daily data, but take into account the extra energy that would have been generated with a third generator at Kirkwood (which has now been installed). Median water year data were chosen. Half of the years had more runoff at Hetch Hetchy, half had less. Comparisons were made to three scenarios. The first two — stream releases for recreation; no stream releases for recreation — presumed a diversion just downstream of Hetch Hetchy. The third assumed no diversion at Hetch Hetchy. Differences in energy production as well as revenue differences are shown.

ENERGY ALTERNATIVES

Diversion of water from Holm Powerhouse to Moccasin Powerhouse

As discussed in the water section, it would be possible to divert water from below Holm Powerhouse on Cherry Creek into the Mountain Tunnel and to Moccasin Powerhouse. The amount of new energy that could be generated at Moccasin Powerhouse as a result of building the new pumping plant and pipeline is approximately 160 million kWh/yr, as derived from daily calculations underlying Table 2. The cost of this project would be $76 million. This project was proposed by San Francisco's own consultants in 1981[xxxix]. An amendment to the Raker Act might be required to build this project.

It would not be energy-efficient to use the existing canal from Lower Cherry Creek Diversion Dam to Early Intake Reservoir because this bypasses the Holm Powerhouse.

Energy Efficiency

Energy conservation would be a cost-effective way to offset the energy lost by removing Hetch Hetchy Reservoir. First priority in energy conservation programs should be given to low-income residents, who usually have the least energy-efficient appliances and home insulation.

The most cost-effective form of energy conservation would be to implement the following programs: insulation, weatherization, and replacement of old windows in under-insulated homes, apartments, office buildings, and factories. Other building energy conservation programs should also be implemented, such as giving away energy-efficient light bulbs, retrofitting showers and other hot water devices, replacing old appliances with modern, energy-efficient versions, and replacing commercial and other lighting with more energy efficient equipment. Such programs have solid track records and produce substantial energy savings at reasonable costs.

A 2002 report prepared for the Energy and Hewlett Foundations by the Xynergy Company[lx], a consulting firm, shows the types of energy conservation programs that should be implemented. The study projected that implementing conservation in California could save 30,090 million kilowatt-hours of energy by 2011 — at a cost of about $11.9 billion and a ten year savings to energy users of more than $23.2 billion. Using these calculations, the energy conservation programs needed to save the maximum of 550 million kilowatt-hours per year that would be lost in median years with the removal of O'Shaughnessy Dam would have a one time cost of about $218 million, but the programs would save consumers more than $424 million over 10 years.

Even though San Francisco uses the energy it produces at the Tuolumne River power plants only within the city, for city departments and Muni, and at the airport, it seems reasonable to implement the energy conservation program throughout the entire area served with Hetch Hetchy water, since water they use generated the energy in the first place.

Financing Energy Efficiency

The monetary savings of this program would have to be shared between San Francisco and those local communities that implement the program, if the twin goals of making the city whole financially while replacing or offsetting the lost power supply are to be achieved.

The California Public Utilities Commission would be asked to approve a program in which retrofitting of buildings would be done in the Hetch Hetchy service area. PG&E, which serves both electricity and natural gas to customers throughout the area, would undertake the retrofit program, ideally with the involvement of community groups such as the Local Efficiency Corps and others. (Some cities in the area have their own municipal electricity agencies, but PG&E supplies natural gas throughout the entire area.)

To make the program attractive to building owners, they would be allowed to keep half of the monetary savings. The other half would appear as a surcharge on their bills, with the revenue passed on to San Francisco to purchase electricity on the open market or to construct new generating facilities to replace the lost Hetch Hetchy power. PG&E would be compensated for its administrative costs and overhead.

This conservation program should require that to offset one kilowatt-hour of electricity lost due to the removal of Hetch Hetchy Reservoir, two kilowatt-hours would be saved. Even with this high standard for offsetting lost energy, the conservation program should make economic sense because energy conservation is so highly cost-effective. There would be additional savings since the electrical capacity needed to serve the retrofitted homes and businesses would be reduced, possibly avoiding the cost of constructing new generating facilities.

While even retrofitted housing eventually becomes outmoded and is torn down, most housing stock is renovated again and again. Given California's housing shortage, it is not unreasonable to assume that the energy efficiency savings would continue for at least 20 to 30 years if not longer. This makes energy conservation as long-lasting as the average power plant.

In summary, for every $100 of energy conservation retrofit, a homeowner could expect to realize a total of $200 over a period of years. The California Public Utilities Commission would allow PG&E to charge the homeowner $150 over the same period of years. $100 would go back to PG&E to pay for the energy conservation work, and $50 would go to San Francisco to replace lost revenue from their former O'Shaughnessy energy generation.

OTHER ENERGY ALTERNATIVES

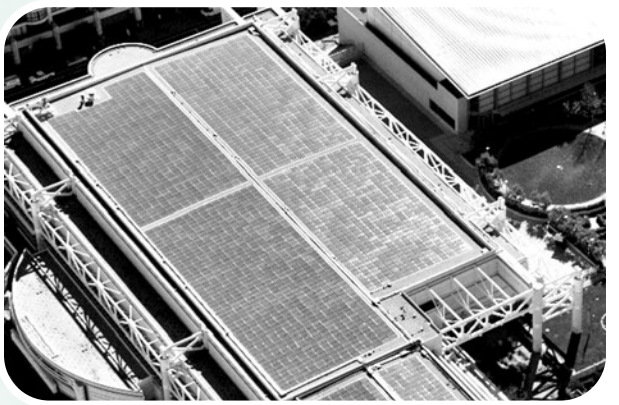
Solar Photovoltaic Energy Generation

The entire amount of energy lost by removal of the reservoir could be replaced with solar photovoltaic cells. One "peak kilowatt" system of solar cells installed in Southern California to take advantage of favorable generating conditions there will generate about 1,800 kilowatt-hours per year[lxi]. Making up the missing energy requires installing arrays of solar cells with about 306 megawatts of capacity. This is about 9 percent of the

world's installed capacity for photovoltaic, and six times California's currently installed capacity[lxii].

Present retail costs for these cells are about $4,000 per installed kilowatt of capacity[lxi]. The cells represent about two-thirds the cost of an installed system. The remaining costs are for mechanical and electrical infrastructure. It is probably safe to assume that an order of this size would result in a cost savings of at least one-third. If this is the case, installing enough photovoltaic cells to generate 550 million kilowatt-hours per year would cost about $816 million. Annual operation and maintenance costs should not be significantly higher than current costs.

Approximately 300 acres of cells would have to be installed. Ideally, the cells would be installed on rooftops to avoid using too much land.



Solar Panel System
- Moscone Center San Francisco

Thanks to San Francisco voters' approval of $100 million in revenue bonds (Measure B in 2001), the city is in the process of installing more than 50 megawatts of solar photovoltaic cells on city facilities.

Since solar energy can be generated only during daylight hours, it produces energy but not reliable capacity. However, since solar energy is mainly generated during periods of peak use, it could be sold at premium rates to California utilities. The cost per kilowatt-hour of solar-generated electricity is around $0.32. This is the price that PG&E pays for solar energy generated on peak in the summer for net metered customers[lxiii].

San Francisco presently uses Hetch Hetchy power to run its transit system and other city operations. The rest of the power is sold. If the city installed enough photovoltaic cells to generate 550 million kWh (Table 2), it could continue to use the power it needs, and then could sell the rest. City revenue would be determined by the difference between the revenue from power sales and the cost to install and use the solar cells. To insure that the city does not receive less revenue than it does now from power sales, state and federal funds would be provided to help pay for the cost of the solar cell installation.

To generate the most possible energy, the solar cells should be located in the Central Valley or the Southern California desert. Cells located near the coast generate about 15 percent less energy due to the frequency of fog in those locations[lxiv.] Desert locations have the highest generation. Despite these considerations, San Francisco and its customers may prefer locating the cells in their service area. In that case, the cells should be located as far from the coast as possible.

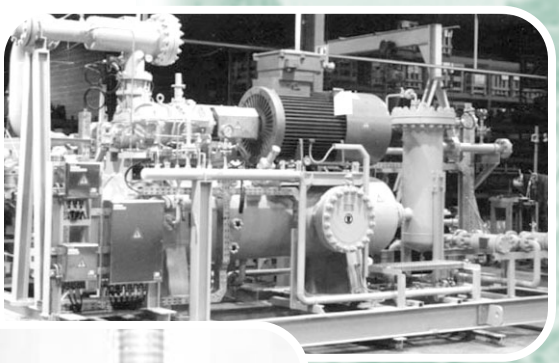
Wind and Biomass Energy

Wind energy sites are available in abundance in the southwestern part of California as well as near the Hetch Hetchy power transmission lines. Wind is a good supplement to photovoltaic generation, but it is not a reliable source since wind does not blow all the time. The U.S. Bureau of Land Management has identified wind energy sites in the Owens Valley that it hopes will not cause conflicts with raptors and their migration such as those that have occurred in the Altamont Pass area[lxv]. Bob Thomas, former director of the California wind energy program, estimates that there are a substantial amount of wind energy sites left to develop in California, easily enough to replace the 550 million kilowatt-hours needed to replace lost Hetch Hetchy energy[lxvi].

Windmill

Geothermal sources are available in California, but not near Hetch Hetchy transmission lines. However, geothermal energy sources have special environmental problems that must be taken into account and mitigated.

Biomass farms and power production provide reliable energy and capacity since fuel is grown near the power plant. Methane digesters were recently approved by the California Public Utilities Commission as generating sources that can sell energy to utility companies. Biomass is proving a practical source of alternative energy, and they can operate 24 hours a day.



Gas Turbine Power Plant

Conventional Power Replacement Projects

The lowest-cost conventional, non-conservation replacement for the energy lost due to the removal of the dam would be a gas turbine power plant. Such a plant would produce both energy and reliable electrical generation capacity, and so it would be more valuable than the lost hydroelectric energy, which, as noted above, cannot be considered reliable energy capacity.

The lost hydroelectric energy in the median year is 550 million kilowatt-hours. An optimally sized combined-cycle gas turbine plant has a capacity of 500 megawatts and costs around $714 million (according to California Energy Commission figures[lxvii]). It produces 4,012 million kilowatt-hours of electricity per year, so San Francisco would have to own only 14 percent of such a plant — at a cost of $98 million — to replace the lost energy.

This plant would generate energy costing around $0.05 per kilowatt-hour. This cost is about $0.03 to $0.04 per kilowatt-hour greater than current generating costs. San Francisco would want to be reimbursed for this cost differential, which would cost between $17 and $22 million per year. This reimbursement figure would have to be reduced substantially by taking into account the much

greater ability, and hence greater value, of the combined-cycle plant to generate reliable saleable capacity — something that is absent at Hetch Hetchy today. If there was any remaining additional reimbursement required, San Francisco's share of the powerplant could be increased.

Overall Energy Savings

These savings are in three parts:

- Energy saved by saving hot water and not having to pump water in the service area
- Energy produced at Don Pedro and La Grange Powerhouses from water not diverted by San Francisco due to water efficiency program
- Monetary savings by customers due to the energy conservation program

Since Don Pedro Reservoir very rarely spills excess water, just about every acre-foot conserved or reclaimed in San Francisco's service area can generate energy at Don Pedro Powerhouse and also at the much smaller La Grange Powerhouse.

WATER AND ENERGY REPLACEMENT ALTERNATIVES - Table 5

all costs in 2004 $million

	Cost	Yield AFA	Reliability	Capital cost $/AF	Cost Estimate	Notes
Preferred Water Alternative	$ million					
Water conservation & efficiency programs	50	123,767	high	400	PI	
Water reclamation & reuse	27	45,600	high	582	SFBARWRP	CIP includes funding
Pumping from Holm to Mountain Tunnel	76	up to 100,000+	high	760	SFPUC study updated	
Pumping from Tuolumne into Canyon Tunnel	72				Bob Hackamack estimate	
Total	225	286,000				
Preferred energy alternative	cost $mm	Million kWhr/yr	Reliability	$/KWHR		
Kirkwood+Moccasin from HH Valley**	see above	528	medium-high			
Pumping from Holm to Mountain Tunnel	see above	159	high	0.48	RHH	
Holm Powerhouse	no change	827				
Conservation & Energy Efficiency Programs	217	550	high	0.385	Xynergy	
Total	217	2064	(median year)			
Dam Removal	100					
Valley Restoration	20					
Total cost, preferred alternatives	562					
Estimatede cost of water filtration	224	(see below)				
	est. cost					
Other water alternatives	$ million		Reliability	Capital cost $/af	cost est from	
Divert from Don Pedro into Foothill Tunnel	*		high	minimal	ED	
Enlarge Calaveras Res & pumping plant	110		high		CIP: $143M for 670K AF	Reservoir
San Joaquin Pipeline No. 4	398		high		RHH	
Groundwater conjunctive use	*	unknown	high	unknown		
Delta diversion	*	267,680	medium	unknown		
Enlarge Don Pedro Reservoir	234	267,680		874	RHH	
Other Energy alternatives	cost $mm	Million kWh/y	Reliability	$/kWh		
photovoltaic	610-1220	550	diurnal/high	$0.26		
new gas turbine combined cycle	100	550	high	$0.05		
Filtration	$224-453 million to filter remaining unfiltered Sierra supply. Cost very uncertain. After implementation of the CIP, SF will be able to filter 240 mgd, or 268,000 AFA at Sunol Valley Water Treatment Plant. Filtration of all Sierra supply should be implemented regardless of the fate of O'Shaughnessy Dam, and so is not a cost associated with the removal of the dam.					
Revenue	$ million					
Value of Aggregate	9	one time		report page 16		
Value of visitation	64	annually		report page 2		
water and related energy savings to consumers not yet calculated, but substantial						
energy conservation savings to consumers	432	over ten years			Xynergy	
energy generated at DP and LG powerhouses	unknown	annually			due to lower diversion by SF	

Assumptions

Water diverted into Canyon Tunnel 1/2 mile downstream of Hetch Hetchy Valley
Need for replacement energy: 550 million kWh/y (from Table 2)
A 500 MW combined cycle gas turbine would cost $714 million, and generate 4,012 million kWh/y. Requires 14% of this plant to generate 550 MkWh/y.
O'Shaughnessy produces 1211 million killoWatt hours per year presently, and 267,680 AFA (239 mgd) of firm water supply yield.
* Diverting water from Don Pedro to the Foothill Tunnel would require lifting water up to 400 feet. The costs of this project have not been determined. ED report contains some cost estimates of Don Pedro, groundwater and Delta programs.
** Kirkwood net generation = 268. Moccasin generates = 419 - 159 = 260 using water from Kirkwood alone. Water pumped from Holm outfall produces a net generation of 159 at Moccasin. Main stem Tuolumne water generation at K + M = 260 + 268 = 528. See Table 2 and Figures1A & 1B.

Data sources

ED: Environmental Defense PI: Pacific Institute CIP: San Francisco Capital Improvement Program Null: Masters Thesis by Sarah Null, UC Davis
SFBARWRP: San Francisco Bay Area Regional Water Recycling Program Xynergy*: "California's Secret Energy Surplus: The Potential for Energy Efficiency" by the Energy and Hewlett foundations, Sept, 2002
RHH: Restore Hetch Hetchy AFA: Acre feet per year Solar photovoltaic costs from California Energy Commission. Present installed cost around $1200 million, expected to drop by half in the next ten years.
California Energy Commission estimates cost of energy from photovoltaic system in desert to be around $0.26/kWh

RESTORING HETCH HETCHY VALLEY

More than 500 dams have been removed from U.S. rivers and streams in the last 40 years, and more than 100 have been removed in the last four years, according to American Rivers[lxviii]. On the other hand, there have been relatively few studies of restoration or natural recovery of river valleys after dams were removed from them.

Perhaps the largest valley restoration took place in the Teton River canyon after the catastrophic failure of Teton Dam in 1976. The famous trout fishery above the dam is recovering, even though the nature of the river has changed somewhat due to the massive landslides that occurred as the water rapidly drained from the reservoir[lxix].

Edwards Dam in Maine was removed in 1999. Striped bass, alewives, shad, sturgeon and other species of fish and wildlife have quickly retaken their former Kennebeck River habitat upstream from the dam site[lxx]. However, this dam was only about 24 feet high. On the other hand, there are currently serious proposals to remove three major hydroelectric dams on the Snake that have devastated the salmon runs on that river; two major dams on the Elwha River, in Washington, to restore salmon populations; and one each on the Colorado and Tuolumne Rivers (Hetch Hetchy). On the Colorado, conservationists have proposed removing huge Glen Canyon Dam, one of the most controversial dams ever built. It inundated canyons comparable to those downstream at Grand Canyon.

Removing some dams can be difficult, since substantial deposits of sediment have built up behind them. This should not be a problem for Hetch Hetchy. Based on visual inspection during several droughts (1955, 1977, 1991), there is very little sediment behind O'Shaughnessy Dam, due to the granitic nature of the upstream watershed.

On the other hand, the restoration of Hetch Hetchy Valley poses several different problems.

First, construction of the dam was accomplished by using materials from the valley floor, and the old mining scars would be very visible once the reservoir is drained.

Second, the bare rock walls containing the reservoir were never home to vegetation, and they will remain non-vegetated. Either the "bathtub ring" will simply be allowed to fade over decades and centuries, or major work will have to be done to reduce its visual impact. Finally, the short growing season in this high-altitude valley may require some active restoration efforts to speed the valley's recovery.

RESTORE HETCH HETCHY sees two basic approaches to the restoration of the valley. It will finally be up to the National Park Service and Congress to determine which is better.

The first would be passive restoration: simply letting natural processes revegetate and recontour the newly exposed landscape. Monitoring would be carried out to determine the rate and nature of plant succession. In this scenario, the mining scars and other visual alterations of the landscape that occurred during the construction of the dam would initially be left untouched, to be softened gradually over the decades by rain, snow, and wind. Invasive non-native plants such as Mediterranean annual grasses would rapidly move into the valley, but after some decades they would be partially replaced by forests dominated by fir, pine, and cedar. Black oaks would likely be rare. The forest would be much thicker after a few decades than the one that preceded the dam. Existing fire suppression policies in Yosemite National Park would make natural-process meadow restoration unlikely.

The second approach would be active. It may be appropriate to resort to more intensive management of the restoration process, given the profound impacts humans have had on the valley for centuries, from the intensive fire management practiced by Native Americans, through the period of European settlement and use, to the destruction caused by mining and dam building. This scenario would call for the following types of restoration.

RECONTOURING THE LAND

During dam construction, aggregate for the concrete was mined from the valley floor near Rancheria Creek. The mined area, spoil piles from this mining, and similar disturbances in the vicinity of the dam site have significantly altered the landform of the valley floor. In order to remove the signs of human impacts from these areas, the spoil piles would need to be removed to uncover the native soil, and the mined areas would need to be backfilled and capped with native topsoil. It may be possible, if permitted, to place the spoil material in the pits for disposal. It may be necessary to remove unsuitable material and import fresh soil if reworking the existing materials proves infeasible.

In recontouring the valley, the goal will be to mimic the native terrain. It is realistic to assume that this may be accomplished through sampling soils and evaluating subsurface conditions during the removal of the dam. The dam will be removed down to the former streambed at elevation 3500 feet with the outlet made to look as much like the pre-dam photograph from the California Historical Society as possible.[lxxi] The river channel will lead to the new, mostly hidden downstream intake works of the Canyon Tunnel.

Recontouring will require the use of heavy equipment, including excavators, bulldozers, loaders, and possibly scrapers. This equipment may also be used for other aspects of the restoration work,

including stabilizing the river banks and removing the dam, so proper scheduling will be essential to reduce harmful impacts on the landscape and increase the efficiency of operations. Access to the valley for this type of equipment would require at least the building of rough roads. Some of the paths for these roads are already in place: the old railroad line, some old roads built in the valley for mining and dam construction, and the road to the boat ramp.

After the roads are no longer needed for restoration, they will be eliminated through recontouring or would be converted to trails. As described in the dam removal section of this report, it is likely that a conveyor system would be the most economical and least environmentally damaging means of removing materials from the valley during dam deconstruction. While the conveyor structure will probably be removed at the end of the work, it is possible that it could be designed to be left in place and modified to act as the principal means of transporting visitors into the valley. In this scenario the present road could be reserved for maintenance and supply trucks.

REVEGETATING THE VALLEY

This part of the management plan would provide five years for collecting native plant seeds and young plants before beginning to drain the reservoir. As the reservoir is drained according to the schedule outlined in the dam removal section of this report, aggressive replanting of native plants would take place as soon as the soil dried sufficiently.

A large-scale, detailed map of Hetch Hetchy plant communities before the reservoir was filled would be developed, based on late nineteenth-century and early twentieth-century description of Hetch Hetchy Valley by John Muir and others, and on an analysis of historic photographs and stumps remaining in Hetch Hetchy. This map would be used as a basis for restoring those communities as closely as possible to their natural state.

Restoration photos
- Mark Cederborg

Revegetation work would consist of planting and installing protective fencing for a mixture of native trees and shrubs consisting of black oaks, white alder, black cottonwood, Douglas fir, dogwood, willow, azalea, manzanita, and ceanothus. The various species of trees and shrubs would be planted in areas where those species originally occurred, along with an understory of herbaceous plants. Native bunch grasses and sedges would be collected and propagated prior to draining of the reservoir and planted in meadows and oak woodland areas as these habitats developed following drainage of the reservoir. Complete restoration would involve the planting of approximately 100,000 woody species (trees and shrubs), the dense planting of herbaceous understory species (bunch grasses and forbs), and widespread seeding of native meadow and woodland species for ground cover.

Greenhouse and nursery services would be developed in the National Park or provided by contract in order to support continuing seed collection and plant propagation for an indefinite number of years after

the reservoir was completely drained. Additional plantings would continue indefinitely and as needed to support the restoration of certain plant communities. Horticultural techniques would be used to promote the survival of plantings for their first three years or longer if necessary. Invasive non-native plants would be eliminated or suppressed throughout Hetch Hetchy Valley continuously into the future. In the first five years after the valley was drained, the widespread Mediterranean annual grasses that would be likely to invade would be suppressed in certain areas to allow native grasses and sedges a better chance to become established.

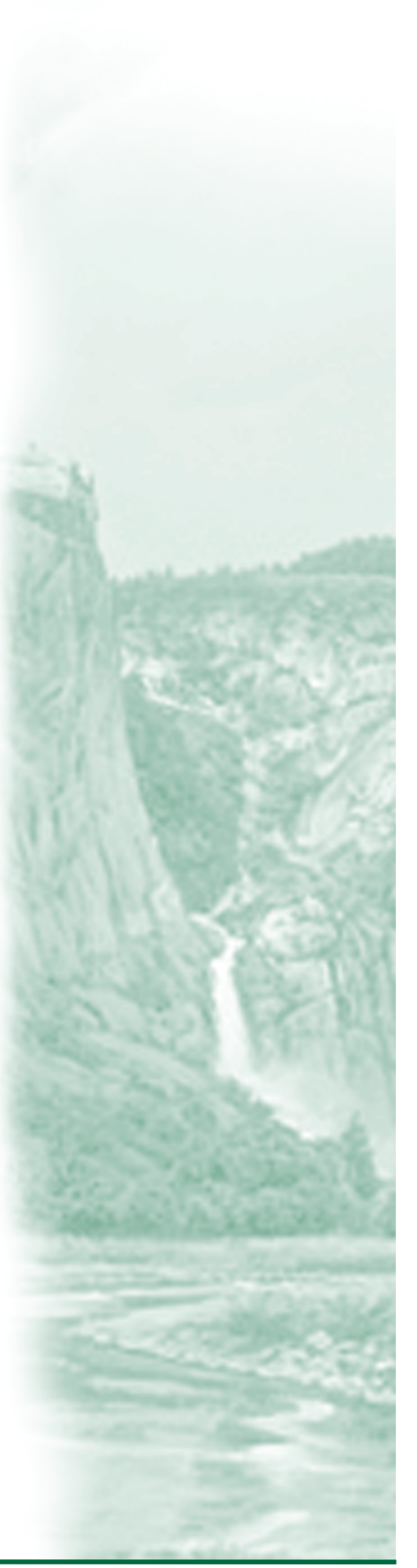
Prescribed burning would be an important management tool for encouraging and maintaining vegetative communities closely resembling those that originally occupied Hetch Hetchy Valley. These controlled fires would be used to prevent conifers from encroaching on oak woodlands and meadows and to produce and maintain open conifer forests with a natural distribution and composition of native species.

Although the use of animal breeding and propagation facilities for native species should not be necessary, this alternative would allow for that option if monitoring efforts indicated that their use would significantly enhance the rate of recovery of their populations. Capture and translocation techniques would also be used to enhance the rate of recolonization if available habitat remained unoccupied. Extensive monitoring would be used to document recovery rates, identify problems, and inform changes in management policies ("adaptive management"). Mitigation measures would be undertaken when monitoring identified recovery problems for native species.

In this active restoration scenario, there would be much less invasion of the valley by non-native plants. Vegetative cover would occur more quickly than if nature is simply allowed to take its course, and the valley would be more attractive to visitors more quickly. Prescribed burning would maintain meadows and oak woodlands, more closely mimicking the fire ecology of the valley as it was before European emigrants arrived and began to suppress natural fires.

Empirical observation of rocks near the dam that were damaged during dam construction indicate that lichen populations would make substantial progress on north-facing walls in 75 years and that black stains would return on wet, south-facing granite surfaces within five years.

Some of the cost of this active restoration work could be covered by weekend guided tours for fee-paying visitors. There is sure to be a demand from people around the world to see the dam being dismantled and the famous valley recovering. Engineers, ecologists, native plant groups, school groups, and other curious people would be likely to come.

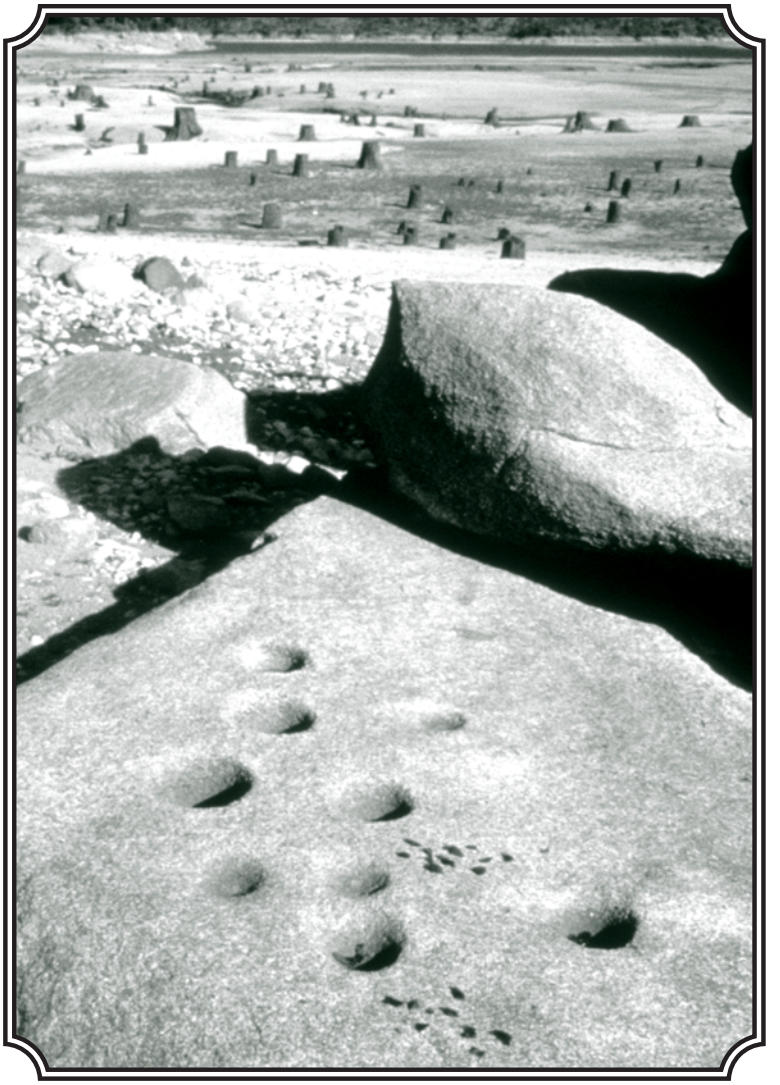


PROVIDING NEW HABITAT FOR ENDANGERED SPECIES

The endangered species most likely to repopulate the valley is the great gray owl, currently listed as endangered by the California Department of Fish and Game.

HONORING AND PROTECTING THE NATIVE AMERICAN PAST.

From the first day of restoration, Me-Wuk tribal members should join archaeologists in identifying and protecting the sites of their native villages and other cultural sites. Intensive identification and protection will continue throughout the project. Preservation of these sites will become an important part of the restoration plan.



Mortar holes on granite left by Native Americans in Hetch Hetchy Valley, photo courtesy of National Park Service

ESTIMATING THE COSTS

Passive restoration would have relatively low dollar costs, but would not reap the ecological benefits of active restoration. The costs of active restoration management would be:

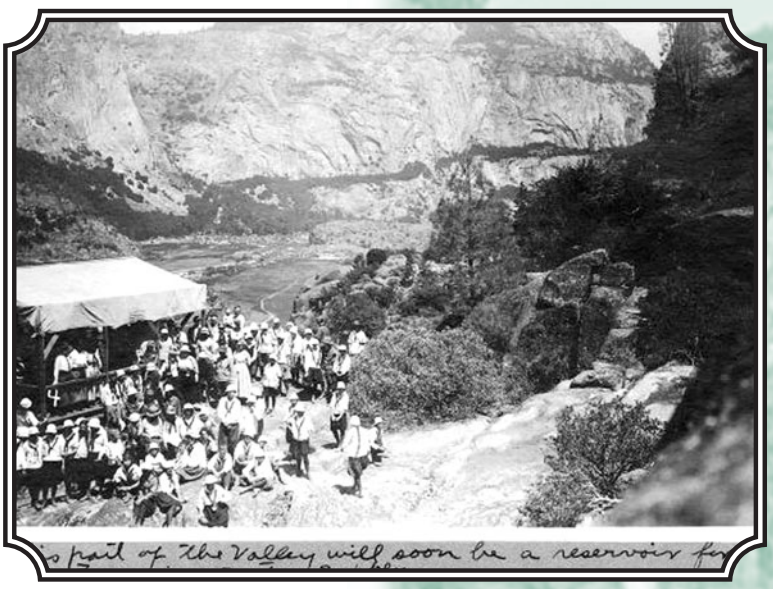
Revegetation	$6 million
Stream restoration	7 million
Landscape restoration	2 million
Design, engineering	2 million
Three years of maintenance	3 million
Total	**$20 million**

A more detailed budget for restoration is available from RESTORE HETCH HETCHY. It is possible that these costs could be substantially reduced by using labor from the California Conservation Corps or local Corps, volunteers, students, prison labor, etc.

The cost of maintaining and monitoring the revegetation and other restoration work will be about $300,000 to $600,000 per year for subsequent years, until around ten years after revegetation commences. After that time, these costs should drop substantially.

HUMAN USE OF HETCH HETCHY VALLEY

Human use of the valley after the dam is gone could take various forms. The National Park Service, with broad public input, will ultimately be responsible for determining an access and recreation plan for the valley.



Camp Fire Girls 1919 in Hetch Hetchy
- Univ of Pacific; V. Covert Martin, Stockton, CA

It is the belief of RESTORE HETCH HETCHY that the valley should be a "wilder Yosemite." In this scenario, commercial activities such as hotels, stores, restaurants, and other facilities would not be allowed. One alternative would allow only hiking trails into the valley. Others would favor more formal trails, allowing bicycles and wheelchairs on trails suitable for their use, and other forms of non-fossil-fueled access to the valley floor.

Low-impact campgrounds (such as the hike-in campground at Camp 4–Sunnyside in Yosemite Valley) could be built on the valley floor in places not subject to flooding or rockslides. San Francisco would resist such overnight use, since their water supply would still be diverted below the mouth of the valley, and maintenance of the quality of the Tuolumne River so near the point of diversion would be of great importance. If campgrounds are built, it is possible that they would contain sanitary facilities of the type that allow waste to be picked up and removed, or double-walled sewer lines could be built to remove waste from the valley. But a waste removal system would require roads or at least wide trails to allow service vehicles access to the campgrounds.

Other steps may need to be taken to preserve the water quality of the Tuolumne River, which will continue to serve as a municipal water supply for much of the Bay Area.

Another question that must be resolved is the use of San Francisco's facilities on the natural bench above the current reservoir. These buildings and residences could be a visitor center where people could stay overnight without actually staying on the valley floor. While the current accommodations provide only basic comfort, they would be very attractive to people seeking to avoid the crowds and congestion in Yosemite Valley.

The current trail system through the Grand Canyon of the Tuolumne should be connected to new trails leading into Hetch Hetchy Valley. This would allow hikers to walk from Tuolumne Meadows directly to Hetch Hetchy. It is possible that a trail could be built up to Falls Creek near one of the waterfalls to connect to the existing trails on the north side.

Rafters and kayakers should be allowed to bring their craft up into the valley. If bicycle trails are built, the boats could be brought up to the head of the valley on handcarts.

To allow greater use of Hetch Hetchy Valley, it would be possible to expand visitor facilities just outside the park. There are already several campgrounds and lodges that would become much more attractive to visitors if they could have day access to the valley.

Fishing in the Tuolumne River would be allowed under current state and federal regulations. Undoubtedly, hang gliders and rock climbers would be interested in using the valley, and the Park Service would either allow such use under regulations similar to those that apply in Yosemite Valley, or prohibit it based on the wilderness character of the valley and some protected wildlife now high on Kolana Rock.

A restored Hetch Hetchy Valley would be a marvelous resource. With proper attention to and respect for Native American cultural sites, the 1,900 acres of the valley would be available to the public, compared to the 843 acres of New York's Central Park and the 1,003 acres of San Francisco's Golden Gate Park. Imagine the opportunities to accommodate recreationists seeking a Yosemite experience in a renewed Hetch Hetchy Valley!

According to the National Parks and Recreation Association[lxxii], Yosemite National Park generates $320 million a year in spending, creating nearly 8,900 jobs. Most visits to the Park are to Yosemite Valley. Restoring Hetch Hetchy as a visitor destination could easily increase these figures by 20 percent ($60 million per year), especially because Hetch Hetchy is near Highway 120, while Yosemite Valley is on Highway 140. Hetch Hetchy would be especially likely to attract broader visitation from the Bay Area, Sacramento, and the northern Central Valley. Of course the actual increase in visitation could be lesser or greater than 20 percent.

Storage and Power Generation In the Tuolumne River Watershed - Table 6

Reservoir or Diversion (see SF system map)	Owner	Year Completed	Storage Capacity - acre ft[1]	Location	Elevation When Full - ft msl[2]	Connecting Tunnel	Associated Powerhouse	Year Powerhouse Completed	Power Drop ft	Max Flow cfs[3]	Max Capacity megaWatt MW	Elevation Turbine Nozzle - ft msl[2]	Avg. Annual Inflow or Source acre ft/y
Lake Eleanor Res.	SF	1918	27,100	Eleanor Creek	4659	Lower Cherry Aq[5]	Early Intake	1918[5]	345	200[6]	3.6[5]		172,000[2]
Lake Eleanor Res.						Eleanor-Cherry Tunnel, 1.1 mi long		tunnel 1960[5] added 10-35cfs pumps[5]		1240			
Cherry Valley Res. (Lake Lloyd)	SF	1956	268,800	Cherry Creek (Cherry River)	4702.5	Cherry Power T 6 mi long	Dion R. Holm	1960	2483.5	1010	169	2219	256,000[2]
Hetch Hetchy Res.[7]	SF	1923 & 1938[8]	360,400	main stem TR mi 117.5-125.7	3812	Canyon Power T 11.1 mi long	Robert C. Kirkwood	1967	1245	>1391	124[9]	2358	730,000[8 &2]
Lwr. Cher. Cr. Diversion	SF	1918	20	Cherry Creek	2628	Lower Cherry Aq	Early In. Ph[5] or Res.	1918[5]	345	200[6]	3.6		main T plus Kirk
Early Intake Res.	SF	1925	155	main stem mi. 105.4 to 105.6	2344	Mountain T to Priest Res.				730			Lower C Cr Aq
Priest Res (forebay)	SF	1925	2400	Mountain T 18.8 mi long	2190	Priest Power T 2.0 mi long	Moccasin	1925[10] 1969	1250	1352[11]	119	929	
Moccasin Res. (afterbay)	SF	1929	530	Moccasin PH	917.6	unnamed	Moccasin Low-head	1986			3[10]		
Don Pedro Res.	TID, MID & SF[12]	1923 & 1971[12]	2,030,000	main stem TR mi 54.9 - 78.8	830	D P R bypass T	Don Pedro	1971	450 av.	ca 6500	201[13]	ca 310	1,698,546[4]
La Grange Res.	TID, MID	1893	391	main stem TR mi 52.2 - 54.6	297	TID Main Canal	La Grange[14]	ca 1909	ca 95	ca 700	3.9		
						MID Main Canal	Stone Drop Low-head		ca 10	ca 900	0.5		
SF Domestic Diversion Aqueduct:													
Foothill Tunnel	SF	1929		Moccasin Res.		conmects to San Joaquin Pipelines		16.3 mi long	619 (400 mgd)[1]				
SJPL No. 1,2,3	SF	1-1932, 2-1952 3-1968				connects to Coast Range Tunnel		47.5 mi long	464 (300 mgd)				
Coast Range Tunnel	SF	1934				ends at Irvington Portal, invert 316 ft msl[15]		29.2 mi long	542 (350 mgd)				

Footnotes:

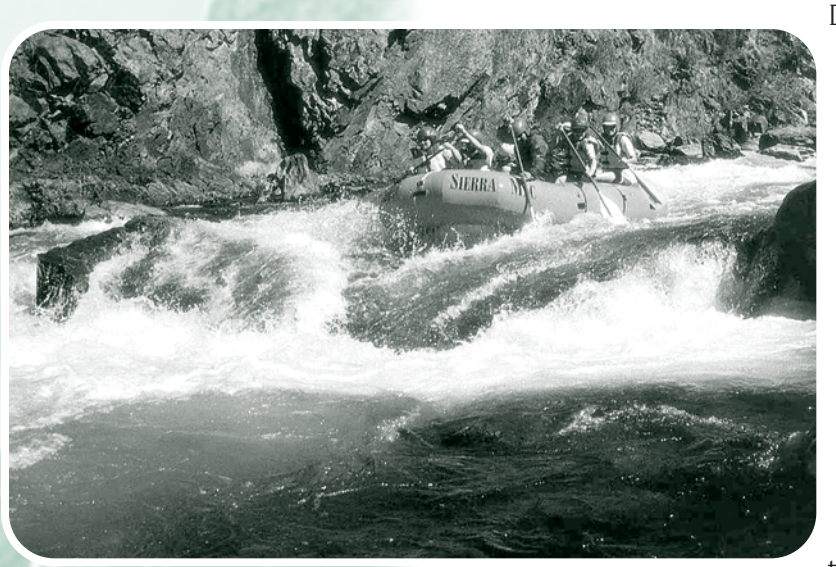
SF is City and County of San Francisco, TID is Turlock Irrigation District, MID is Modesto Irrigation District. All 3 are public entities located in central Calif. south of the 38th parallel. Ph is Powerhouse. "Nameplate" capacity of all four San Francisco's currently operating powerplants is 385 MW (mega watt). Actual full capacity generation is a little higher at 415 MW. Firm power generation is zero.

1 An acre-foot (af) is enough water to cover an acre to a depth of 1 foot, which is 325,851 gallon. "cfs" is cubic feet per second. "mgd" is million gallons per day. An average year is 365.25 days.
2 Elevation in feet above mean sea level. Much of this data is from Sverdrup & Parcel and Associates, et al, "HHW&P Watershed Firm Yield Study June, 1981", 4 vol. Also R W Beck & Assoc., 1976 Fig. 5.
3 Maximum Flow through the generators at full capacity in cubic feet per second (cfs). Not included is a PG&E powerhouse on Sullivan Creek which generates with water from South Fork Stanislaus River.
4 Don Pedro inflow for 1970-2003 average. TID and MID total diversion at La Grange Dam for 1970-2002 has averaged 907,610 af/yr (personal communication from TID, Dec 2003). Diversion of Tuolumne River flow to SF Bay area 221 mgd in 2002. See note 8 for firm yield from HH watershed. SF Capital Improvement Program (CIP) could slowly raise diversion by 0.5 %/y to more than 400 mgd by 2121.
5 Early Intake Powerhouse operated from 1918 to 1960; when a tunnel to transfer water from Lake Eleanor Res. to Cherry Valley Res. was completed. Pumps from E/C Tunnel to Cherry Res. added ca 1983.
6 Today, 3 mi long Lower Cherry Aq has a cap. of 150 cfs leading only to Early Intake Res. that can flow into M T in drought. This was done in 1977, but State Water Project water purchased at Sunol in 1991.
7 The dam at Hetch Hetchy Valley is named O'Shaughnessy Dam to memorialize Michael M. O'Shaughnessy, Manager of the Hetch Hetchy Project who died 16 days before HH water arrived at Crystal Springs Res. in Oct 1934. Only water from HH Res. has an EPA "filtration avoidance waiver" meaning that, after treatment with chloramine, this water goes directly to Bay Area customers without filtration.
8 O'Shaughnessy Dam was constructed in two phases in which 85.5 feet added height was completed in 1938. Final height is 312 ft above stream bed. Firm yield of HH watershed & Res. is 239 mgd.
9 A third generator added in 1988 increased capacity to 124 mega watt. Extra stream flow is released at HH when a 3rd generator operates. Kirkwood outfall is piped directly into Mt T, bypassing E. I. Res.
10 Moccasin Ph was replaced in 1969. Domestic water diversion to Bay Area is from Moccasin Ph outfall and/or M. afterbay; 30 mgd to M. State Fish Hatchery; surplus to M. Low-head Gen. or spill to DP.
11 Mountain Tunnel capacity is 730 cfs, but Priest Reservoir working volume and Priest Power T size allows some peaking power production at M. Ph. Some silt from HH Res. settles out in Priest Res.
12 A smaller Don Pedro completed in 1923 was covered by a Don Pedro three times as large in 1971. San Francisco contributed 50 % of the cost of the second Don Pedro to provide themselves from 570,000 up to 740,000 acre-ft of exchange storage used as a paper "water bank". All flood control space for the watershed is now at Don Pedro; 340,000 af controlled by US Corps of Engineers.
13 A fourth generator was added at DP Ph ca 1985 increasing capacity to 201 mega watt. DP Dam, reservoir water and generators plus La Grange Dam are owned (controlled) 68% by TID and 32% by MID.
14. TID alone owns La Grange Powerhouse. Lower Tuolumne stream release averaging 300,923 af/y is mostly made through this powerhouse. TID Main Canal has 2 low-head generators as well.
15. Environmental Defense, "Paradise Regained, Solutions For Restoring Yosemite's Hetch Hetchy Valley", Sept 2004, Append. A p 32 by Schlumberger Water Services. "ft msl" is elev above mean sea level.

The impact on the local economy of this additional visitation should be substantial. The effects will be felt especially along Highway 120 from Big Oak Flat to the park border. Hotels, restaurants, gas stations, and gift shops should all see substantially increased patronage. Similar though smaller effects will be seen along the Highway 140 and Highway 41 corridors, which lead directly to Yosemite Valley. Undoubtedly, overall park visitation will increase as a result of the new opportunity to visit Hetch Hetchy Valley. Some visitors would want to visit both valleys, one developed on 19th and 20th century ideas, the other on 21st century ideas.

WHITEWATER RECREATION

The removal of Hetch Hetchy Reservoir and the implementation of various water supply and energy alternatives could have either positive or negative impacts on whitewater recreation on the Tuolumne River from Holm Powerhouse on Cherry Creek down to Don Pedro Reservoir. Restoration of more natural flows on the main stem of the Tuolumne could mean more days when high water precludes boating and also more days when boating is possible due to unimpaired natural flows.



Rafting on the Tuolumne River
Sierra Mac River Trips

The final operations plan of the diversion at Hetch Hetchy and Holm Powerhouses should allow for whitewater boating between May 21 and the Sunday after Labor Day. If high water precludes boating more than it would have if the Hetch Hetchy Reservoir were still there, compensating days of boatable power releases from Holm should be provided later in the season to make up for those days. The energy plan proposed above includes 1,200 cubic feet per second on the Tuolumne for six hours every day during the rafting season.

FINANCING THE PLAN

A wide variety of financing tools is available to pay for the various elements of the plan. These tools are described below.

The overall plan will cost less than $1 billion, even including filtration, as shown in Table 5. This may seem like a lot of money. But the state and federal governments spent nearly $500 million to purchase the 7,000-acre Headwaters Forest in Northern California. Although it is an ecological treasure, Headwaters Forest receives very few visitors due to its remoteness and restricted access. A restored Hetch Hetchy Valley could attract several hundred thousand visitors a year. In addition, the water and power elements of this plan will provide more reliable water and energy to San Francisco and its customers than O'Shaughnessy Dam and Hetch Hetchy Reservoir do now.

USER FEES

San Francisco's water and power customers should be made whole financially. This means that the water and power bills of those served today by San Francisco should end up no higher than they would have been if the dam had not been removed.

It could be argued that the U.S. taxpayers who own Hetch Hetchy Valley subsidized San Franciscans and their customers for more than 70 years and that it is not unreasonable that some of that subsidy be returned by requiring San Francisco to pay all or part of the costs for removing the dam and replacing the lost energy and water. Whatever the merits of this argument, the policy it espouses would immensely complicate the political difficulty of removing the dam.

A different way to take advantage of user fees would be to impose a statewide fee on all water and power users, including those in the San Francisco service area, to pay for removing the dam and replacing any lost water and power. The argument in favor of such a fee is that the restoration of Hetch Hetchy Valley would be of such tremendous statewide benefit that all water and power users should help pay for it. Whatever the logic of such a fee, it would be politically very difficult to impose this solution. Perhaps it could be imposed as part of a fee to pay for a package including other water improvements.

OTHER REVENUE AND AVOIDED COSTS

- As described above, sale of aggregate from the dam should net around $9 million.
- The economic value of visits to the valley should be about $60 million a year.
- Consumer energy efficiency savings are estimated at $481 million a year
- Consumer water efficiency savings are large, but unknown.
- Avoided costs of repairing, maintaining, guarding, and modifying aging O'Shaughnessy Dam are unknown but are almost certainly in the millions of dollars per year.
- President Bush once proposed to increase San Francisco's rent for Hetch Hetchy Reservoir to $8 million a year[lxxiii]. This cost to San Francisco would be avoided if the reservoir were removed.

SAN FRANCISCO REVENUE BONDS

Voters in San Francisco have been generous in their support of a wide variety of general obligation bonds over the years. Such bonds require a two-thirds majority. In 2001 San Francisco voters approved a solar energy bond to be financed with the savings generated by a series of energy conservation measures.

A major part of the financing need for this program of restoring Hetch Hetchy Valley is to pay for the energy and water conservation improvements needed to replace the water and power lost when Hetch Hetchy Reservoir is removed. Energy and water conservation programs are highly cost-effective. As explained in the energy conservation section of this report, if the California Public Utilities Commission approves a plan that allows the energy savings to be shared between utility customers and the City of San Francisco, revenue bonds could be sold to provide initial financing of the energy conservation programs.

EXISTING SAN FRANCISCO CAPITAL IMPROVEMENT PROGRAM BONDS

In November 2002 San Francisco voters approved $1.6 billion in bonds to make capital improvements to the Hetch Hetchy water system. The Capital Improvement Program (CIP) includes such facilities as replacing Calaveras Dam and building the fourth pipeline across the San Joaquin Valley.

These facilities might very well make up some of the elements needed to replace the water supply lost by the removal of Hetch Hetchy Reservoir. These bonds will be paid for by increased water charges to San Franciscans, so they should be considered to be financed by user fees.

BAY AREA WATER SUPPLY AND CONSERVATION AGENCY (BAWSCA)

In 2002 the Legislature passed a bill authorizing the Alameda, Santa Clara, and San Mateo County public agencies that purchase treated water from San Francisco to form a new agency, BAWSCA, which came into existence in early 2003. It can raise funds to finance improvements to the Hetch Hetchy water system. Their share of the Capital Improvement Program costs will be about $2 billion. To the extent that these improvements are needed to replace the water from Hetch Hetchy Reservoir, they should be eligible for funding by BAWSCA.

BAWSCA has the power to add surcharges to the water bills of people and businesses served by Hetch Hetchy water, so the revenue to retire the bonds sold by the authority will come from user fees.

A similar financing authority (San Francisco Bay Area Regional Water System Financing Authority) was created earlier. Its funding authority is found in Section 81658 of the Water Code:

81658. (*a*) *The proceeds of revenue bonds issued by the authority in accordance with this division may be used only on projects designed and intended in substantial part to improve the reliability of the regional water system, including, but not limited to, strengthening the system's ability to withstand seismic events.*

It seems very likely that the following projects — called "reliability" by San Francisco, but really designed for expansion of the water supply — would be eligible for funding under this section of the Water Code. These projects would be used to replace water lost due to the removal of the Hetch Hetchy Reservoir:

- Construction of an enlarged Calaveras Reservoir
- Construction of the fourth San Joaquin Valley pipeline
- Construction of wastewater treatment and recycling facilities
- Implementation of a water conservation program

CALIFORNIA GENERAL OBLIGATION BONDS

New California general obligation bonds would be a good source for at least some of the funds needed to finance this project. Proceeds from these bonds could be used to pay for any or all components of the project, including the removal of the dam and the restoration of the valley. It is likely that funds for these purposes would be included as part of a larger water-oriented general obligation bond.

Of course, the more that could be financed through revenue bonds or other sources, the less that the state would have to pay for through a general obligation bond. The state has traditionally included water conservation in the general obligation bond acts, so there is a good argument that part of the water conservation costs could be included in a general obligation bond.

If the state considers a new general obligation bond dealing with energy, it could include the energy conservation and renewable energy generation features of this project, since these would have great benefits to the state as a whole in terms of reduced emission of air pollution and global warming gases.

Restoration of Hetch Hetchy Valley would be a tremendous boost to the tourist economies of the Central Sierra counties near the valley and of the state as a whole. People would come from around the world to see this new feature of our most famous national park. For that reason, since a great national park would be dramatically enhanced, it would be appropriate to include funding for the restoration of Hetch Hetchy Valley in a general obligation bond for state parks. Two of these bonds have been passed in recent years (Proposition 12 in 1990 and Proposition 40 in 1992). Since Yosemite Valley was once run by the state as an early state park, state park funding would be particularly appropriate.

California voters have approved three increasingly large general obligation bonds for water purposes since 1996: Proposition 204 in 1996 ($1 billion), Proposition 13 in 2000 ($2 billion), and Proposition 50 in 2002 ($3.3 billion). It would be appropriate to include Hetch Hetchy restoration funding in any such future bond.

Some will doubt that general obligation bonds are a viable funding source, given the massive amount of bonding undertaken by

the state in recent years. But even after the November, 2004 election in which voters approved $3.7 billion in new general obligation bonds, the state is projected to use less than 5 percent of the general fund to service general obligation bonds[lxxiv]. This is considered well within the upper limit for the use of the general fund to repay bonds. The gradual growth of the state's economy will also create new bonding opportunities. This is what happened after the severe recession of the early 1990's.

FEDERAL FINANCING

Since the federal government dedicated part of Yosemite National Park to San Francisco for a water supply, it is only appropriate that part of the funds to restore Hetch Hetchy Valley come from the federal government. After all, the National Park Service would be the direct beneficiary of the restoration of the valley, not only due to increased revenue from visitors to Yosemite, but from the increased visibility the park would gain with this huge restoration project. It would be appropriate for the federal government to participate financially in every aspect of this project, including water and power replacement, use of alternative energy, and valley restoration.

Federal funding could come from the following sources:

- *Land and Water Conservation Fund*. These funds are royalties from offshore oil production that go to all sorts of park and conservation programs.
- U.S. *Army Corps of Engineers*. The Corps could be the appropriate agency to remove the dam. It is increasingly involved in river restoration projects.
- *Direct Appropriation*. Congress typically appropriates funds in the budget for projects of this type. The funds could be included in the National Park Service budget.
- *Yosemite Revenue*. The Park Service now charges $20 per car to enter the park. About half of these funds remain with the park for visitor service, restoration, and so on. Some of these funds could be used to help pay to remove the dam and restore the valley.

PRIVATE FINANCING

Former Interior Secretary Donald Hodel points out that the full $500 million Statue of Liberty restoration was paid for by private donations; private funds could also be raised for this restoration project.

FINAL FINANCING PLAN

Clearly, there are ample funding sources that could be combined to finance the water and power replacement program, removing the dam and reservoir and restoring the valley. RESTORE HETCH HETCHY will work with all the agencies and levels of government listed above to develop an appropriate funding plan. Private contributions from associations, foundations, and individuals will also be considered.

LEGAL ISSUES

A number of legal issues will have to be resolved in order to clear the way for the restoration of Hetch Hetchy Valley. This discussion considers federal and state law and San Francisco ordinances.

FEDERAL LAW

By passing the Raker Act[xvi] in 1913, Congress authorized San Francisco's construction of O'Shaughnessy Dam in Yosemite National Park. It might seem logical that it would take an act of Congress to modify the Raker Act to allow the removal of the dam and the restoration of the valley. But this may not be the case. Some provisions of the Raker Act have never been implemented, such as the public power provision, despite a Supreme Court ruling on that matter [United States v City & County of San Francisco, 310 U.S. 16 (1940)]. If San Francisco decided to remove the dam, it is hard to imagine that the Department of Interior would refuse to grant a permit to restore Yosemite National Park because of the Raker Act.

Capitol Hill - Ron Good

Indeed, the Raker Act states:

Provided, however, That any changes of location of any of said rights of way or lands may be made by said grantee (San Francisco) before the final completion of any of said work permitted in section one hereof, by filing such additional map or maps as may be necessary to show such changes of location, said additional map or maps to be filed in the same manner as the original map or maps; but no change of location shall become valid until approved by the Secretary of the Interior, and the approval by the Secretary of the Interior of said map or maps showing changes of location of said rights of way or lands shall operate as an abandonment by the city and county of San Francisco to the extent of such change or changes of any of the rights of way or lands indicated on the original maps.

Since San Francisco has not completed several other requirements of the "work permitted," it is certainly conceivable that the Secretary of the Interior would have the discretion to allow the dam to be removed and allow the continued diversion of Tuolumne River water into the Canyon Tunnel, as envisioned in this report.
In any case, the Raker Act is silent on the question of the removal of facilities, and it is hard to imagine that Congress did not delegate to the Secretary the right to permit changes to the original project as required. For example, changes to the dam to improve its efficiency and safety have been approved or tolerated by the Secretary without changes to the Raker Act.

Despite the fact that no change to the Raker Act may be required, RESTORE HETCH HETCHY would endorse an amendment to the Raker Act to clarify that removal of the dam is allowed, if it were

accompanied by an authorization of funds to accomplish the removal and to replace the water and power supplies lost by San Francisco and its customers.

San Francisco owns at least some of the land under the reservoir. The city also owns visitor and other facilities near the dam. Existing federal law would allow the Secretary of Interior either to accept these as a gift from San Francisco or, if necessary, purchase them from the city. Appropriations would be required for the purchase.

San Francisco and the Modesto and Turlock Irrigation Districts would probably prefer not to amend the Raker Act because some parties would seek to remove some of the water rights and other guarantees that maintain a relative peace among the three parties.

STATE LAW

There are two important issues of state law that must be resolved.
Funding. The state should pass a law, probably a bond act to be approved by the voters, providing funding to assist in the restoration of the valley and the development of water and power alternatives.

Water Rights. San Francisco's water rights are "pre-1914" rights. This means that they were filed before 1914 and are subject only to narrow review by the State Water Resources Control Board, the state's water rights and water quality agency. This allows San Francisco more flexibility than those who hold water rights dating from after 1914.

San Francisco has the right to divert water from Hetch Hetchy Valley for water and power purposes. If diversion into the Canyon Tunnel continued after the removal of the dam, then it is possible that no change in water rights would be necessary, since there would be no substantial change in the place of diversion and the purposes of the diversion would remain the same.

Since a smaller amount of water would be diverted than when the dam was in place, there might be an argument that San Francisco's rights should be diminished. But since the water can still be controlled and recaptured downstream at both Early Intake and Don Pedro Reservoirs, such a change in water rights would probably be unnecessary.

This report concludes that no changes to San Francisco's water rights would be required if O'Shaughnessy Dam were removed, as long as the city continued to divert water into the Canyon Tunnel. Even a change in place of diversion is allowed under state law (Somach[xliii])

Since San Francisco is a California city subject to state law, the state might be able to require the transfer of the city rights and land at Hetch Hetchy to the federal government.

SAN FRANCISCO ORDINANCES

Law in San Francisco is made by ordinance, and substantial changes in city ordinances would be required to implement the restoration of Hetch Hetchy Valley.

Each of the following sections could be dealt with by a separate ordinance, or they could all be combined into one ordinance. Ordinances must be passed by the majority of the Board of Supervisors and signed by the mayor, or they may be passed as initiatives by a majority of the voters. It is our intention to work with the Board of Supervisors and the mayor to draw up, pass, and implement the necessary new ordinances.

Dam Removal. San Francisco constructed the dam, and it is logical that San Francisco remove it. This would require an ordinance authorizing removal of the dam. (Permits would also have to be obtained from appropriate state and federal agencies, especially the Department of the Interior, Tuolumne County, and CalTrans). The ordinance might require that substitute water and power facilities be in place before the dam is removed. It would also authorize funding from existing or future funds to pay for removing the dam and building replacement water and power facilities.

Replacements for Energy and Water Supplies. In order to take advantage of state and federal funding for these replacements, an ordinance applying for and accepting the funds would probably have to be passed.

Transference of Facilities at Hetch Hetchy. An ordinance would be required to sell the land and buildings owned by San Francisco at Hetch Hetchy to the federal government.

Other Constraints. The Third Agreement between San Francisco, Turlock Irrigation District and Modesto Irrigation District (June 30, 1949, Article 2) seems to limit San Francisco's aqueduct diversion to 400 mgd (619 cfs). This would constrain the ability of San Francisco to construct and operate a new 4th San Joaquin pipeline, since the proposed capacity of that facility, combined with existing diversion capacity, would exceed 400 mgd. Modesto Irrigation District has indicated an unwillingness to see the 4th San Joaquin pipeline constructed (personal communication, Sept. 2004, with Bob Hackamack)

In addition, a California Supreme Court ruling in Meridian, Ltd. v The City and County of San Francisco, (13 C. (2d) 424, May 1939, page 460), seems to limit the San Francisco diversion through its aqueduct from the Sierra to a maximum of 500 cfs (323 mgd). Meridian, Ltd. is now El Solyo Irrigation District. El Solyo ID is located south of Highway 132 and their riparian pumps are located just upstream of (and visible from) that Highway bridge on the left bank (west side) of the San Joaquin River. This case is sometimes referred to as the El Solyo Ranch decision.

POLITICAL ISSUES

The basic principle of this report is that the water and power supplies produced by Hetch Hetchy Reservoir must be replaced before Hetch Hetchy Valley is restored. Even so, the managers of the San Francisco water and power system are unlikely to voluntarily drain Hetch Hetchy Reservoir and remove O'Shaughnessy Dam. Over the last 70 years the city has become accustomed to relying on the dam for water and power, and it is now preoccupied with the need to restore a variety of water system elements. However, it is possible that there might be some support for removal from San Francisco's political leadership, who recognize the awkward position the city is in by relying on a dam in a national park for its water supply.

It would be helpful to establish a specific timeline for restoration of the valley. In this way, when funds are provided to replace water and power supplies, San Francisco will feel obliged to use the funds to make the replacements.

This raises the question of how the decision to remove the dam should be implemented. It could be done on three levels — local, state, and federal — keeping in mind the issues of San Francisco's legal authority raised earlier in this report.

LOCAL POLITICS

San Francisco voters are among the most environmentally minded in the United States, but even in the face of environmental objections, they narrowly approved the Hetch Hetchy Capital Improvement Program in 2002. The voters recognize their reliance on the Hetch Hetchy system for water. They are also aware of the financial benefits to the city of the power generated by the system.

But if the voters knew that water and power supplies could be replaced before the dam is removed, they might agree to its removal. They might even agree to help pay for the replacement water and power supplies, given the huge environmental benefits of removing the dam.

Given the real possibility that San Francisco voters might support dam removal under these conditions, one of two measures could be approved by the Board of Supervisors, placed before the voters by the Board, or approved through the initiative process.

Alternative 1. The Board of Supervisors would pass a proposition declaring it is city policy to support removal of the dam if financing becomes available to replace the water and power supplies.

The problem with such a proposition is that it relies on the Board of Supervisors to make the determination that funding is available, and the Board would always be pressed by staff not to agree that full water and power mitigation funding was in place. Still,

such a measure would establish strong city policy. A similar initiative (Proposition I) was placed on the ballot by former State Senator Quentin Kopp in June of 1994 calling for BART to go to the airport. When it passed overwhelmingly, momentum built for the extension, which is now in service.

The advantage of a measure like this is that it would lend great support to the effort to develop and fund a plan to replace the water and power supplies.

Alternative 2. Once the funding for water and power mitigation is provided by state and federal sources, a San Francisco ballot measure would provide for local funding and declare that city policy is to have the water and power replacement plan implemented immediately and then have the dam removed.

This is a much more straightforward approach, but it will be difficult to get the state and federal governments to provide replacement funding without a prior statement by the city in favor of removing the dam.

A hybrid approach might be a San Francisco initiative calling for removing the dam when replacement funding is provided, followed later by a funding and implementation measure.

It is possible that the new mayor of San Francisco will recognize that the city and its customers can be made whole by a combination of private, local, state, and federal funding, and propose such a resolution to the supervisors. This is what Mayor Tom Bradley of Los Angeles did at the end of the battle for Mono Lake.

STATE POLITICS

The main state role would be to provide funding, as discussed in the financing section of this report. But state legislators will have to be convinced that the removal of the dam is practical before they will approve funding, especially in the form of a general obligation bond act.

Generally speaking, only a few legislators care deeply about this issue. Since the Hetch Hetchy system was built, San Francisco has stood aloof from the state's major water battles, and the city has few friends in the traditional water community. Still, legislators will have to be convinced that the city will actually use state funds if they are provided.

Another possible state role would be to pass a legislative resolution that the dam should be removed while water and power users are made whole. Since such a resolution would imply some willingness on the part of the state to provide the water and power funding, there might be some hesitation about it. But Southern California legislators who remember Mono Lake might be inclined to support a resolution of this type. Passing such a resolution would bring pressure on San Francisco to remove the dam.

A legislative resolution would go a long way toward building political momentum.

In late 2004, Assembly Members Canciamilla and Wolk wrote Governor Schwarzenegger asking him to study removal of the dam. On his behalf, Resources Secretary Chrisman replied saying that a study would be carried out.

Assembly Member Lois Wolk

FEDERAL POLITICS

As discussed above in the legal section of this report, at least the Secretary of Interior would have to approve removal of the reservoir. Congress would almost certainly also have to provide some of the funds necessary to make this project feasible.

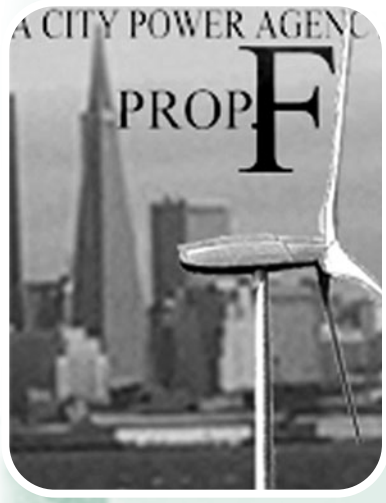
Politically, the leadership of both parties would have to be convinced that San Francisco voters would support an overall solution, that there was a good chance for an overall funding package, and that the plan to provide substitute water and power supplies was feasible.

Local Politics

It is important to remember the people who live in and near Yosemite National Park, the "place of origin" of the water flowing in the Tuolumne River. The people who live in Tuolumne, Mariposa, and Madera Counties, including the Native American community, truly are stakeholders in the debate over the restoration of Hetch Hetchy Valley. Unfortunately, their interests were virtually ignored in the early twentieth-century debates on the Raker Act.

SAN FRANCISCO MUNICIPAL POWER

Removing Hetch Hetchy Reservoir will not affect San Francisco voters' right to approve or disapprove the creation of a municipal power system. Nor will removing the reservoir reduce or increase the attractiveness of municipalization to the voters.



San Francisco currently uses power from the Hetch Hetchy system to run the Municipal Railroad (Muni) and to provide electricity for city departments and the San Francisco Airport. Most of the remaining power is sold to Modesto and Turlock Irrigation Districts under long-established contracts.

The Raker Act[xvi] contemplated that San Francisco would dedicate the electricity generated by the powerhouses on the Tuolumne to municipal use, including streetlights. The creation of a municipal utility by San Francisco was opposed by the Pacific Gas and Electric Company (PG&E), which supplies electricity to homes and businesses in San Francisco and throughout Northern California.

The U.S. Supreme Court ruled in 1940 (United States v. City and County of San Francisco, 310 U.S. 16 (1940)) that by selling electricity from the Tuolumne powerhouses to a private utility, San Francisco was in violation of the Raker Act. Despite this ruling more than six decades ago, San Francisco has still not reorganized its system to provide municipal power to residents. Over the past 70 years, the voters of San Francisco have been asked nine times whether they wished to form a municipal utility. The most recent vote was in 2001. Each time, the voters have turned down the creation of a municipal utility.

Some have raised concerns that the draining of Hetch Hetchy Reservoir and the consequent loss of power will make municipalization harder. This is certainly not the case. Although RESTORE HETCH HETCHY takes no position on the question of municipalization, the power replacement options we support are ones that rely on continued generation of power by the City and County of San Francisco, and would in no way hamper the future reorganization of the San Francisco system as a municipal utility.

As explained in the energy section of this report, it is the goal of RESTORE HETCH HETCHY to replace — by a combination of conservation and new generating facilities — all the power lost due to the draining of the reservoir and the removal of the dam. In addition, RESTORE HETCH HETCHY supports the removal of existing polluting energy sources inside the city and their replacement with cleaner and more efficient generating facilities.

Even without Hetch Hetchy Reservoir, if the measures proposed are implemented, San Francisco would still have more than ample power-generating capacity on the Tuolumne to meet all its own needs as well as its existing contracts and obligations. If the city ever decides to municipalize, it could undertake that effort even after the dam is removed.

NEXT STEPS AND RESTORATION TIMELINE

What additional information beyond this report do Congress, the California legislature, San Francisco residents, and the other customers of the city's water system need to move forward on removing the dam and replacing the water and power supplies?

Since San Francisco has so far refused to do the engineering studies necessary to determine the exact costs of dam removal and new water and energy facilities, legislators could ask agencies such as the California Department of Water Resources, University of California, National Park Service, California State Library Research Bureau, California Energy Commission, U.S. Bureau of Reclamation, U.S. Department of Energy, National Academy of Engineering, or the Army Corps of Engineers to prepare preliminary estimates of the costs of removing the dam and implementing the power and water replacement and valley restoration programs.

At the request of Assembly Members Canciamilla and Wolk, Governor Schwarzenegger has directed the California Department of Water Resources to examine existing studies, including this one, and reports produced by Environmental Defense and UC Davis graduate student Sarah Null, as well as previous analysis described in this report, as well as the broader water supply implications of dam removal.

With this information, legislators and administrative officials could develop a financing plan along with a requirement that the dam be removed. More detailed plans would be developed as the deadline for dam removal neared. This would give San Francisco motivation to cooperate in the studies, as Los Angeles did when city officials recognized that Mono Lake would have to be restored and saved.

If a major California general obligation bond act should be authorized, funds could be included in the bond measure that could be spent if dam removal is actually authorized by Congress and/or San Francisco. This state measure would not actually mandate the removal of the dam, but it would give Congress greater incentive to pass a bill authorizing the removal of the dam and the construction of replacement facilities. Similar financial incentives were offered to Los Angeles to reduce its withdrawal of water from the Mono Lake basin.

Due to litigation by RESTORE HETCH HETCHY, San Francisco has agreed not to oppose funding for further study of the idea of restoring Hetch Hetchy Valley until November 2006.

The following timeline is feasible.

2005

Congress and the California legislature call for preliminary estimates of the costs of dam removal, water and power replacement, and valley restoration.

2006

Agencies prepare estimates.

2007

San Francisco ballot measure. Congress requires removal of the dam by 2019, with water and power replacement program to be in place prior to dam removal.

2008–2009

Agencies carry out detailed studies of dam removal and water and power replacement. Funding for implementation authorized by Congress at the end of 2009.

2010–2012

Funding provided by Congress, California Legislature, Bay Area agencies, and San Francisco.

2013–2015

Environmental reviews conducted; contracts arranged; construction, purchases of facilities, and interconnection of components carried out.

2016–2021

Reservoir is drained. Dam demolition and valley restoration begin. Cost-effective water and energy programs are implemented and fully in place.

2021

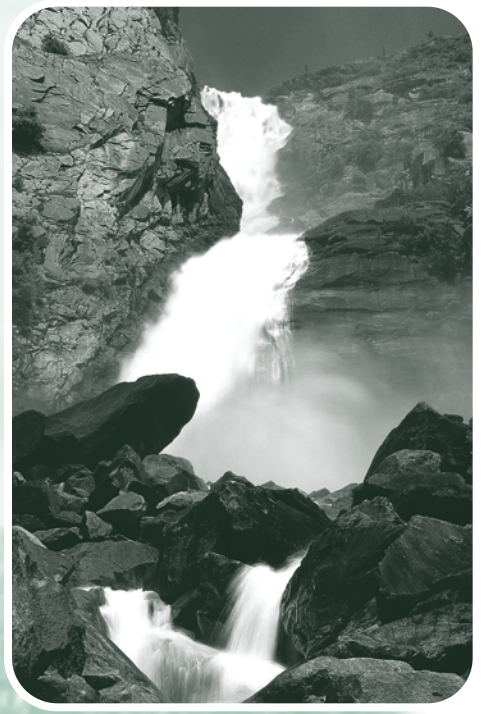
Dam is removed, debris removed, grading complete, and restoration fully under way. Visitors return to the valley for the first time since 1923.

HETCH HETCHY VALLEY AND THE BAY AREA IN 2025

Let's visit Hetch Hetchy Valley and the Bay Area in 2025 to see what changes have occurred with the implementation of this program.

By paying attention to everyone's needs, we all will have found our way back into Hetch Hetchy Valley.

At Hetch Hetchy, restoration has been taking place for eight years, and the reservoir was drained five years ago. Restoration began at the upper end of the valley, where vigorous 12-year-old pines and oaks are already more than 20 feet high. While non-native plants are present, the combination of a control program and the planting of extensive native gardens have been successful in limiting their spread.



Wapama Fall - Jenny Ross

The valley has already been repopulated by Yosemite's diverse wildlife. Bears have found new homes, bobcats and mountain lions are present, and deer roam throughout the valley. Birds not seen for a century — like John Muir's favorite, the dipper or water ouzel — are plentiful.

A remarkable renaissance in visitation has occurred in Hetch Hetchy and the surrounding mountain communities. Hikers, bicyclists, bird watchers, and other visitors are found by the many hundreds every summer day in the Hetch Hetchy Valley. Campers spend nights under the stars, with almost no distracting lights to ruin their view of the heavens. The spectacular wildflower displays in spring, coupled with the renewed giant waterfalls called Tueeulala, Wapama and Rancheria, whose cascades now extend all the way to the valley floor, are a prime attraction in the spring. During the summer months when flows in the Tuolumne are low, kayakers, canoeist and rafters float lazily through the valley, enjoying the mild weather.

White water boaters below Cherry Creek confluence are thrilled by the high flows in spring and the reliable good flows all summer.

Anglers are overjoyed by the quick restoration of native trout populations in the now highly accessible upper Tuolumne. Steelhead can be seen spawning in Alameda Creek again and are responding to cooler summer flow on the lower Tuolumne River.

Climbers are challenged by dozens of new climbing routes, most notably Kolana Rock, and the El Capitan-like rock face on the north side of the Valley. Disabled persons find paths that make their visits easier. In the winter, after cold snows, cross-country skiers enjoy one of the most breathtakingly beautiful experiences anywhere in the Sierra Nevada.

Native Americans are actively engaged in preserving and studying artifacts of their cultural history and providing interpretive and educational opportunities on the Hetch Hetchy Valley floor for park visitors.

Pieces of the dam are on sale in the various Yosemite visitor centers, including the new one on the rim above Hetch Hetchy Valley. In neighboring communities along Highway 120 and nearby side roads, motels are full, and campgrounds are in heavy demand. As is often the case throughout Yosemite, the park's overnight facilities are often full, and neighboring visitor facilities are the beneficiaries.

Overall, Yosemite visitors have increased by more than several hundred thousand, thanks to the irresistible attraction of the newly restored valley.

In the Bay Area, conservation programs have made the region more self-sufficient in energy and water supplies. This has led to greater retention of money in the region, strengthening the local economy. Bay Area low-income residents were given first preference in the energy and water conservation programs and have greatly benefited from them. They spend less money on water and electricity and are warmer in the winter.

By constructing water supply features such as reclaimed wastewater plants within the Bay Area, the region has become less vulnerable to droughts. Growth in the region is now served more by more local water sources, reducing pressure on the salmon and other resources of the Tuolumne River.

Bay Area energy supplies have been augmented by new solar and other renewable energy sources made possible by the investment of state, local, and federal funds in the project to restore Hetch Hetchy Valley and replace its water and power supplies. The lowered need for imported energy reduces California's dependence on natural gas supplies from foreign countries.

In the Central Valley, water and power supplies of the Modesto and Turlock Irrigation Districts and their customers have been maintained at historical levels. There has been no increase in costs to the districts as a result of the removal of Hetch Hetchy Reservoir.

Water supplies in the Bay Area are more reliable than when the dam was in place, due a greater diversity of water sources now available.

Flood control on the Tuolumne through Modesto has been improved by widening the floodway of the river. Higher flood flows can now pass through the city without causing damage. No reduction in flood control was caused by the removal of Hetch Hetchy Reservoir. The widened floodway has made the river more attractive to recreationists, anglers, and local residents.

Everyone involved with the removal of Hetch Hetchy Reservoir agrees that the result was a win for all concerned. The great Hetch Hetchy Valley lives again, water and power supplies have been made whole, and the economy of all affected regions has improved.

If John Muir and David Brower could visit Hetch Hetchy Valley today, they would find it once again

" . . . a grand landscape garden,
one of Nature's *rarest and*
most precious mountain temples."

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xxii USGS Minerals yearbook 2000. http://minerals.usgs.gov/minerals/pubs/state/980601.pdf

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Glossary

af:	acre foot or acre-feet. 326,000 gallons. Enough water for 10 people for one year in Southern California.
afa:	acre-feet annually.
cfs:	cubic feet per second. A cubic foot is about 8 gallons. 1cfs = 2 acre-feet per day.
kW:	kilowatt. Amount of electrical energy drawn by 10 one hundred-watt light bulbs
kWh:	kilowatt-hour. Amount of energy drawn by 10 one hundred-watt light bulbs in an hour
megawatt:	one million watts. Megawatt hour: one million watt hours
mgd:	millions of gallons per day. 1 mgd is about 3 acre-feet per day, or 1,120 acre-feet per year.
yield:	The amount of water a water facility (dam, desalter, wastewater recycling plant) can reliably produce during a relatively dry year.

Endorsers

The following organizations have endorsed removal of the reservoir, or a study of removal:

Alameda Creek Alliance
Alliance for a Clean Waterfront
The Bay Institute
California League of Conservation Voters
Clean Water Action
Environmental Defense
Friends of the River
Friends of Trinity River
Literacy for Environmental Justice
Mono Lake Committee
National Wildlife Federation
Natural Heritage Institute
Natural Resources Defense Council
Planning & Conservation League
Restore Hetch Hetchy
San Francisco League of Conservation Voters
Save The Bay
Sierra Club
Sierra Nevada Alliance
Tuolumne River Trust
Urban Watershed Project.

Sierra Club Chapters and Groups:
Loma Prieta Chapter, San Francisco Bay Chapter, Tehipite Chapter (home of Yosemite). Tehipite Chapter Groups: Mineral King and Merced. Kern Kaweah Chapter, SF Bay Chapter Groups: Northern Alameda County, San Francisco and Mt. Diablo. Mother Lode Chapter Groups: Delta-Sierra, Maidu, Placer, Yahi, Yolano. Central Ohio Group (Ohio Chapter), Washington, D.C. Chapter.

Bernal Heights Democratic Club of San Francisco
Richmond District Democratic Club of San Francisco
Eastern Madera County Chamber of Commerce
Tuolumne Me-Wuk Tribal Council (study)
Town of Fairfax Council

Editorials in New York Times, Los Angeles Times, Sacramento Bee, Fresno Bee, San Jose Mercury News, Ventura County Star, Inland Valley Daily Bulletin

Useful websites
Restore Hetch Hetchy www.hetchhethcy.org
Sierra Club Hetch Hetchy website www.sierraclub.org/ca/hetchhetchy
San Francisco PUC http://sfwater.org/home.cfm
Bay Area Water Supply and Conservation Authority (BAWSCA) http://bawua.org/about.html
Modesto Irrigation District www.mid.org
Turlock Irrigation District www.tid.org

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RESTORE HETCH HETCHY is a tax-exempt, tax-deductible, 501(c)(3) organization formed on June 6, 1999 in Merced, California.

Join the effort to restore Hetch Hetchy Valley and lead the way in the restoration of natural values throughout our nation. RESTORE HETCH HETCHY is made up of people like yourself from around the planet who are working together to bring back one of the most beautiful places on earth.

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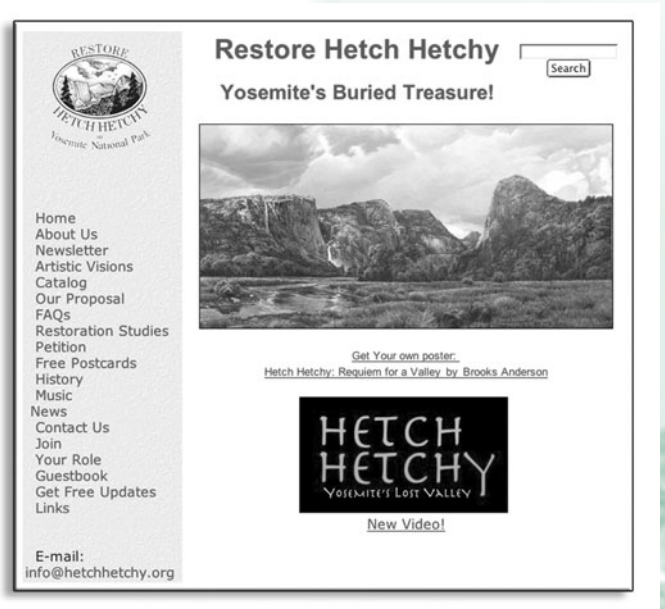

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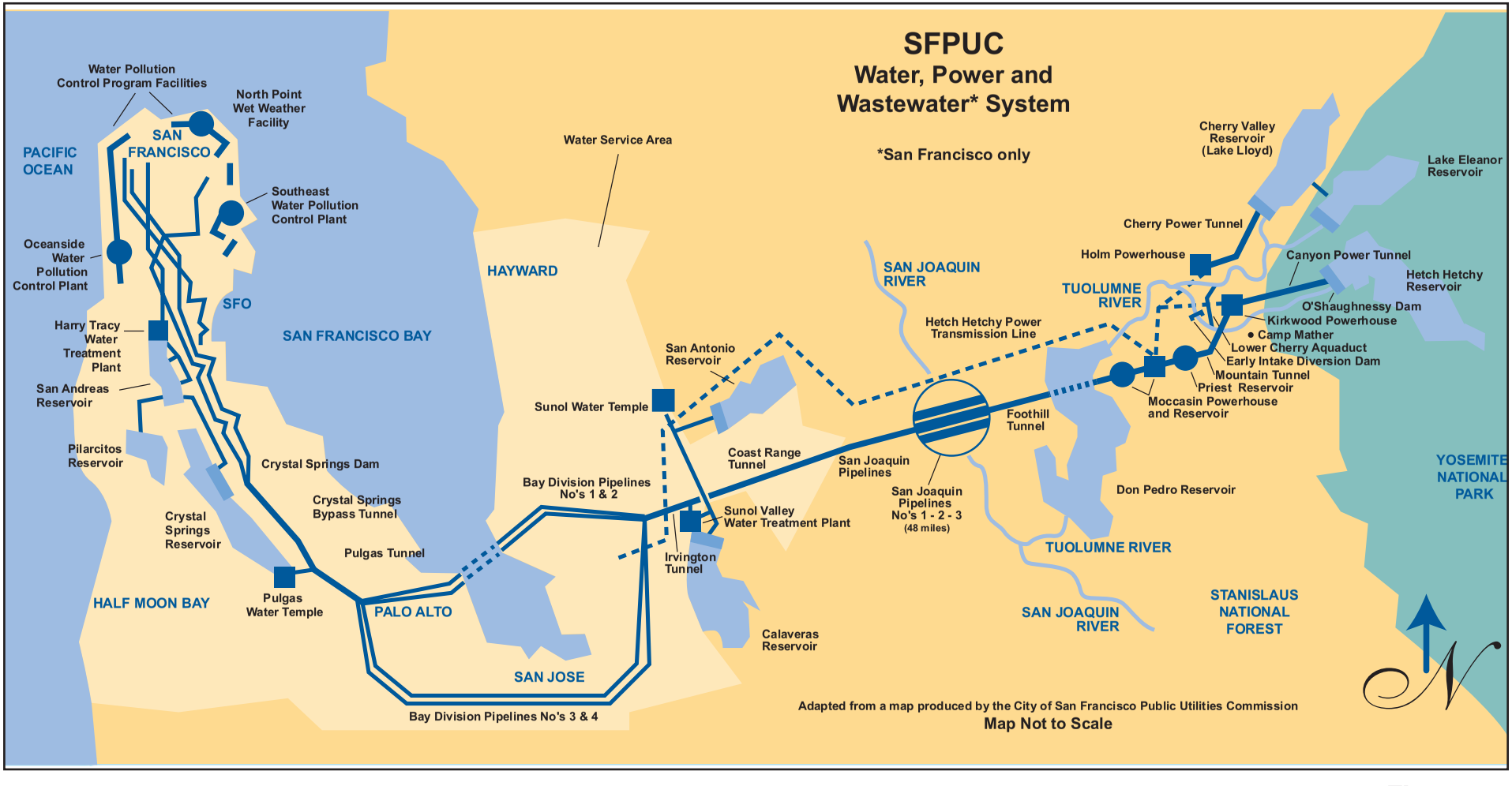

Figure 2