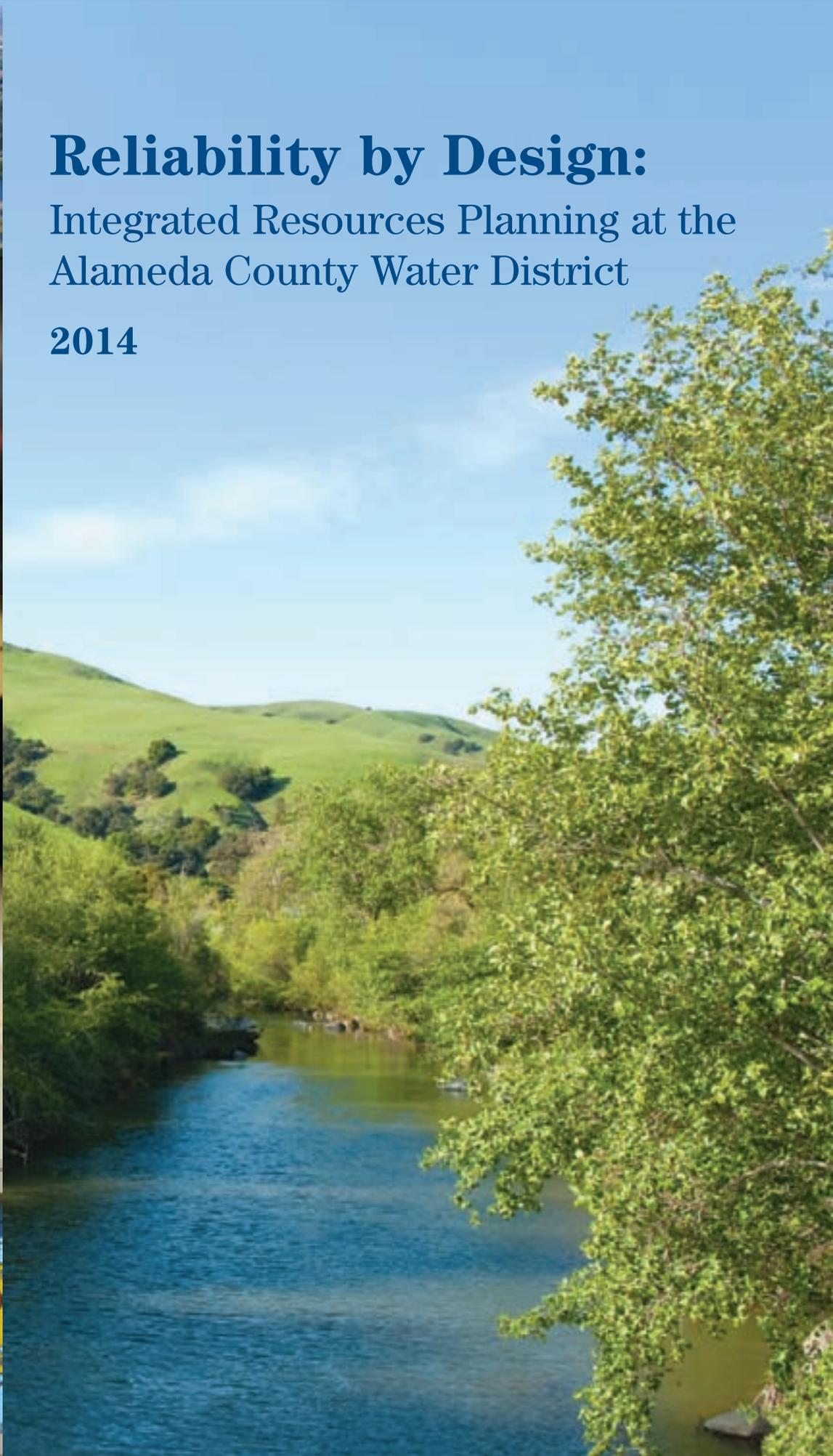




Reliability by Design:

Integrated Resources Planning at the Alameda County Water District

2014





In the early 1990s, ACWD's water supply outlook was uncertain. The District depended heavily on annual deliveries of water from the Sacramento-San Joaquin Delta — deliveries that were becoming less reliable due to the Delta's declining ecological health. At the same time, the Tri-City region was booming, and new homes and businesses needed water. Complicating matters, ACWD lacked the water storage needed to fulfill customer demand in case of drought, and the District's water delivery infrastructure was nearing capacity. The result: By 2000, the District projected, a single dry year could force water restrictions of up to 40 percent, with potential shortages only getting worse after that.



With no simple way to acquire a new source of water, it was clear that ACWD needed an alternative approach to meet customers' needs. So in 1994 and 1995, the District developed an Integrated Resources Plan, or IRP. Working with the community, ACWD comprehensively analyzed the long-term water needs of the Tri-City area and identified the most efficient ways to meet them.

What distinguished the IRP process from previous water planning efforts was that it focused on more than just providing additional water. The IRP looked carefully at the costs and benefits of dozens of approaches to match water supply to water demand, including conservation, improvements in efficiency, operational changes, and more.

The 1995 plan clearly established what ACWD needed to do: develop local water supplies, conserve water, use existing supplies as efficiently as possible, and find a way to store water for dry years. It also set other objectives, including containing costs and improving water quality.

Today, ACWD and its customers have met or exceeded nearly all of the goals set in 1995. Per-capita water demand has dropped more than 25 percent. Investments in IRP strategies have allowed ACWD to avoid building capital projects that would have cost tens of millions of dollars. And the District's overall water supply reliability has improved dramatically, even as deliveries from the Delta have grown more uncertain.

Following the principles of the IRP process, ACWD has continued to adapt to changing circumstances and plan for the future. In 2013, the District completed the second major review of the 1995 IRP. This publication tells the story of the IRP process, showing what has been achieved since 1995 and detailing the opportunities and challenges that lie ahead.

— Walt Wadlow, General Manager

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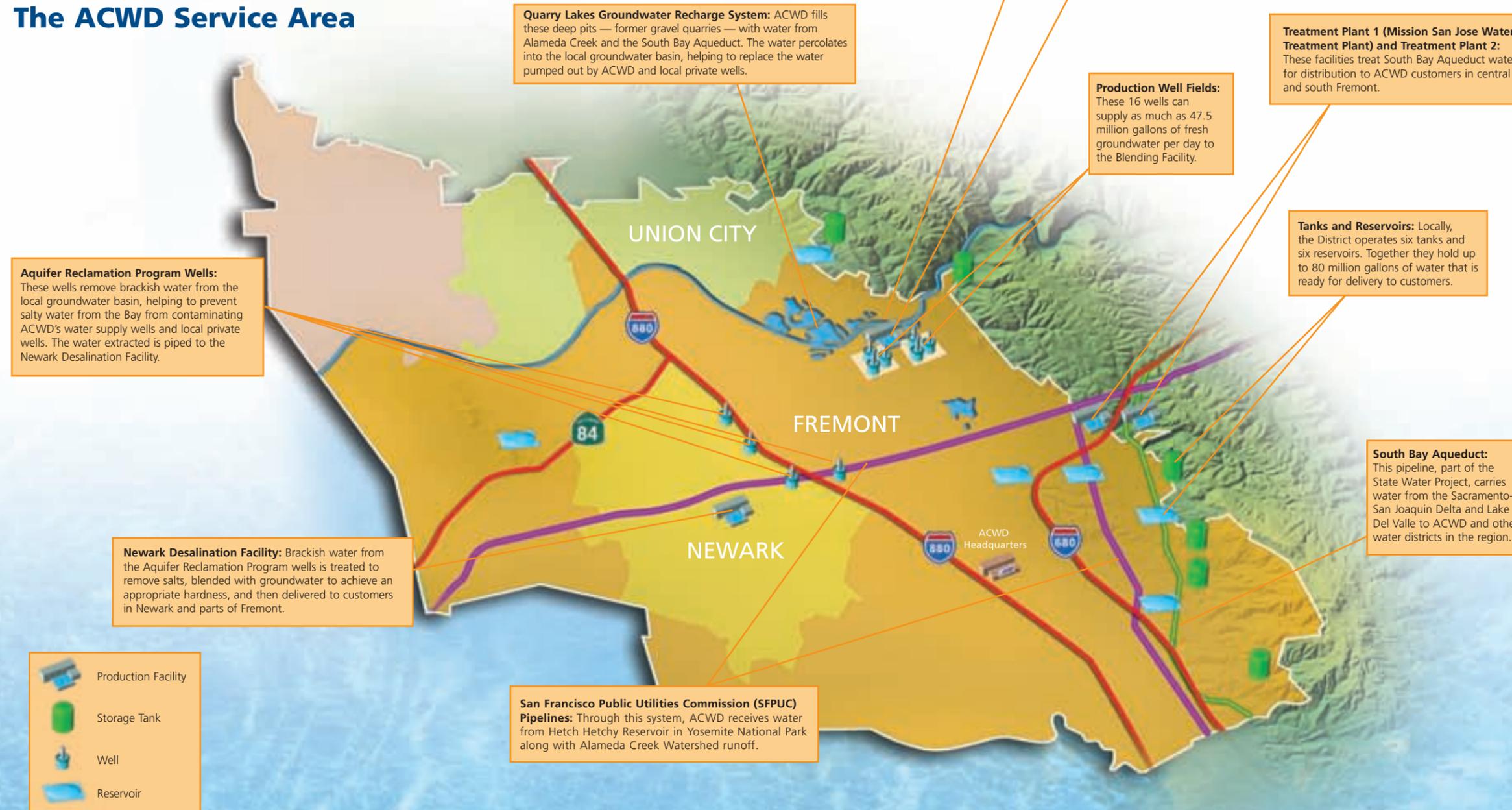
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The Alameda County Water District provides water to businesses, industrial users, and more than 330,000 residents in the cities of Fremont, Union City, and Newark. It has a full-time staff of approximately 230 and is governed by a publicly elected five-member board of directors. ACWD was founded in 1914, making it the first public water agency created under California's County Water District Law, adopted in 1913. The map below shows the District service area and the many facilities that make up the ACWD water system.

ACWD's mission is to provide reliable, high quality water at a reasonable price. In the District's early years, meeting these goals meant securing legal rights to what was then the region's only source of water, runoff from the Alameda Creek Watershed. Today, ACWD has a broad portfolio of water sources: runoff from the Alameda Creek Watershed; the local groundwater basin, which the District continually recharges; desalinated water produced from the brackish water pumped by the District's Aquifer Reclamation Program wells; the State Water Project; and the San Francisco Public Utilities Commission (SFPUC) water system. This mix of sources, along with customer conservation, provides high resilience to drought and has allowed the District to improve water reliability even as the Tri-City area has added new homes and businesses.

The ACWD Service Area

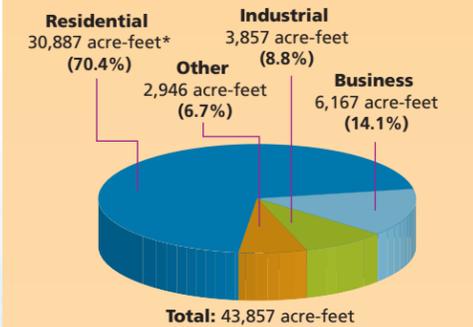


ACWD Facts and Figures

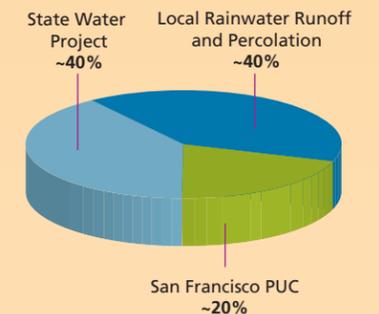
- Population served: 336,000 (cities of Fremont, Newark and Union City)
- ACWD service area: 104.8 square miles
- Average rainfall: 18.4 inches (varies from ~14" near the bay to ~20" in the eastern hills)
- Number of customers (water accounts): 82,533
- Average daily water use per person: ~133 gallons
- Average daily water deliveries: 39.2 million gallons
- Miles of water mains in ACWD service area: More than 850
- Number of water quality samples analyzed at ACWD laboratories annually: About 45,000
- ACWD annual budget: \$104.1 million
- Number of full-time employees: ~230

All figures current as of 2013

Water use by category, 2011-2012 fiscal year:



Sources of ACWD water:



* One acre-foot is enough water to serve 3.3 average homes in the ACWD service area for one year. An acre-foot is equal to 325,851.4 gallons, the amount of water required to cover one acre of land to a depth of one foot.

For a system of its size, ACWD has a remarkably complex water supply portfolio: two imported water sources, local runoff, groundwater recharge, local groundwater pumping, remote groundwater banking, and an aquifer reclamation program combined with brackish groundwater desalination.

ACWD manages these sources so that they complement one another, optimizing water reliability and quality.

For instance, the District recharges the Niles Cone Groundwater Basin with local runoff and imported State Water Project supplies and pumps water as needed for delivery to customers. By using the basin as an underground reservoir, ACWD can provide water to customers consistently even as the availability of local runoff and State Water Project imports varies from season to season and year to year. This coordination of surface and groundwater resources is known as "conjunctive use."

Another example is the blending of supplies from the San Francisco Public Utilities Commission system and ACWD's local production wells. SFPUC water is soft but costly, while local well water is hard but inexpensive (see pages 28-29 for more information on water hardness). ACWD mixes these two sources at the District Blending Facility to reduce costs and improve water quality.

The 1995 IRP process clarified three primary water supply objectives: increase reliability (the ability to meet customer demands consistently); maintain sustainable water levels in the Niles Cone Groundwater Basin; and maximize District control over water sources.

To meet these IRP goals, the District invested in the two newest components of its water system, the Semitropic Groundwater Bank and the Newark Desalination Facility. Together with water management optimization, these facilities have reduced ACWD's dependence on imported supplies and improved water supply reliability.

The following pages explain how the IRP process has guided these and other strategic investments, ensuring a reliable water supply for the region.

State Water Project: 40%

Source:

- Northern Sierra runoff

Storage:

- Lake Oroville
- San Luis Reservoir

Conveyance:

- Feather River and Sacramento River
- Sacramento-San Joaquin Delta
- California Aqueduct
- South Bay Aqueduct

ACWD Use:

- Supply Treatment Plants 1 and 2 for distribution to customers
- Recharge Niles Cone Groundwater Basin
- Storage at the Semitropic Groundwater Bank

Local Supplies: 40%

Source:

- Alameda Creek Watershed runoff
- Local rainfall

Storage:

- Quarry Lakes and the Niles Cone Groundwater Basin
- Lake Del Valle

Conveyance:

- Alameda Creek
- South Bay Aqueduct (Lake Del Valle water)

ACWD Use:

- Groundwater storage and management in the Niles Cone Groundwater Basin
- Blend with SFPUC supplies for distribution to customers
- Via Aquifer Reclamation Program wells, supply the Newark Desalination Facility
- Supply Treatment Plants 1 and 2 for distribution to customers (Lake Del Valle water)

San Francisco Public Utilities Commission: 20%

Source:

- Central Sierra runoff

Storage:

- Primary storage: Hetch Hetchy Reservoir
- Bay Area storage: Calaveras, San Antonio, and Crystal Springs reservoirs

Conveyance:

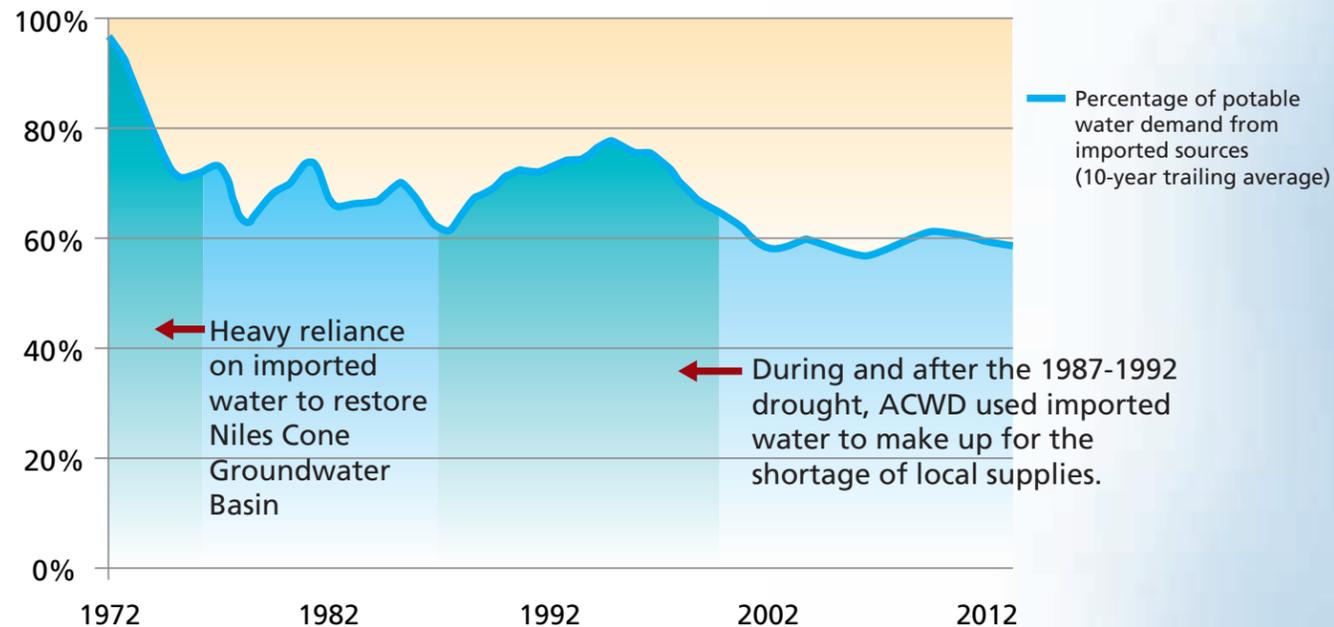
- Hetch Hetchy Aqueduct

ACWD Use:

- Blend with local groundwater for distribution to customers

- SFPUC Pipeline
- South Bay Aqueduct
- California Aqueduct

Decreasing dependence on imported water sources



By improving groundwater management and developing brackish water desalination, ACWD has decreased its dependence on imported water. Imported sources now provide an average of roughly 60 percent of the water needed to meet customer demand.

For ACWD and many other California water utilities, keeping up with growth used to mean finding more water: building a dam, digging new wells, or striking a deal to purchase a new supply. But by the 1990s, ACWD realized that it needed a broader approach to planning. New water supplies were scarce and costly, and the District's largest existing source, deliveries from the State Water Project, was growing less reliable. In 1995, the District developed its first Integrated Resources Plan, or IRP. By design, the IRP process looks broadly at the options available for matching water supplies and customer demands. Water conservation programs can reduce demand, delaying or eliminating the need for additional supply. Existing supplies can be used more effectively, for instance by using groundwater banking to store water and protect against shortfalls during droughts. At the same time,

the IRP process incorporates District goals that aren't directly related to supply and demand, such as minimizing cost, improving water quality, and mitigating environmental impacts.

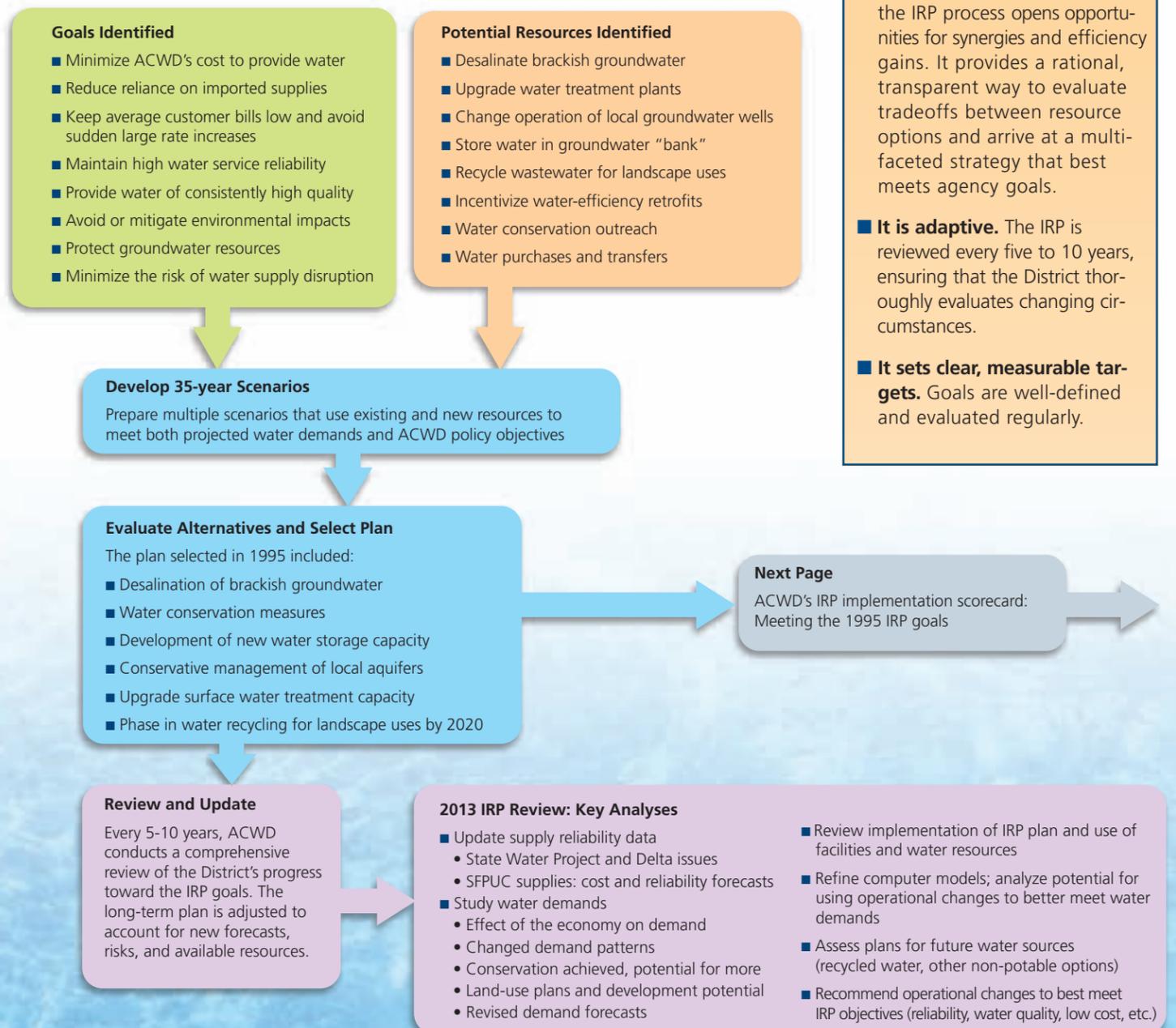
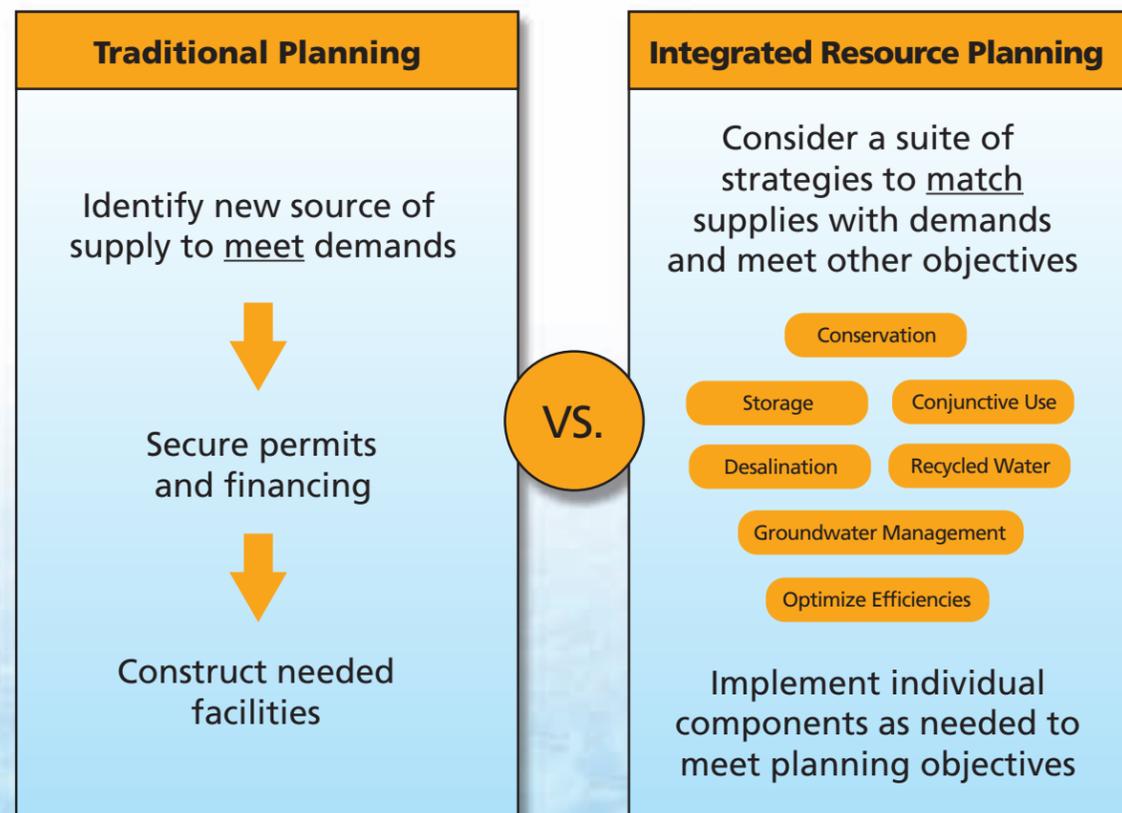
The IRP process yielded a collection of progressive strategies that continue to guide the District's investments and programs. Since 1995, ACWD has increased the reliability of the Tri-City region's water supply, improved water quality, and contained costs — all without the expense and uncertainty of developing a new water source.

The 1995 Integrated Resources Planning process clarified District goals, evaluated resource options, and guided the development of a comprehensive strategy to provide reliable, high-quality water. The plan evolves as the Tri-City region grows and changes, with major reviews in 2005 and 2013.

Advantages of Integrated Resources Planning

- **It is proactive.** Plans are developed to manage anticipated conditions 35 years or more in the future.
- **It is comprehensive and holistic.** By evaluating the costs and benefits of many alternatives simultaneously, the IRP process opens opportunities for synergies and efficiency gains. It provides a rational, transparent way to evaluate tradeoffs between resource options and arrive at a multi-faceted strategy that best meets agency goals.
- **It is adaptive.** The IRP is reviewed every five to 10 years, ensuring that the District thoroughly evaluates changing circumstances.
- **It sets clear, measurable targets.** Goals are well-defined and evaluated regularly.

Traditional water resource planning vs. Integrated Resource Planning



ACWD's IRP Strategies

The 1995 integrated resources planning process established targets to guide ACWD in ensuring a reliable water supply for the Tri-City area. Here's a summary of the targets and the steps the District has taken to meet them. In most cases, ACWD is well ahead of schedule. There's more information on each topic in the chapters that follow.

Since 1995, ACWD has implemented projects across all elements of the Integrated Resources Plan, meeting the water needs of the Tri-City area while minimizing costs.

Category	Explanation and 1995 IRP Targets	For more information	Progress to Date	What's Next
WATER RELIABILITY	Demand Management Implement cost-effective conservation measures with a focus on reducing outdoor water use Targets: 2,900 acre-feet per year savings by 2020	Demand Management Pages 18-21	Demand reduced by 3,600 acre-feet per year (3.2 million gallons per day) ✓	Aim to reduce peak summer water use through further demand management programs
	Desalination Install equipment to desalinate and use the salty groundwater that is pumped by ACWD's Aquifer Reclamation Program Targets: 3 million gallons per day (mgd) by 2000, 8 mgd by 2010	Local Water Sources 15-16	5 million gallons per day operational in 2003 10 million gallons per day operational in 2010 ✓	Continue to optimize operation of the desalination plant for maximum output, efficiency, and contribution to water quality
	Off-site Water Storage or Banking Find a new way to store water for use in dry years Targets: 65,000 acre-feet by 2000, increasing to 140,000 acre-feet by 2030	Groundwater Banking Page 17	150,000 acre-feet secured in the Semitropic Groundwater Bank ✓	Continue to optimize "deposits" and "withdrawals" to minimize costs and ensure supply reliability; explore other off-site storage options
	Groundwater Management Keep the local groundwater table at sustainable levels by recharging the aquifer and limiting the region's dependence on well water Target: Prevent water table from dropping lower than 5 feet below sea level	The Niles Cone Groundwater basin Pages 10-13	Groundwater table maintained above sea level; Quarry Lakes Groundwater Recharge System improved for more efficient operation ✓	Improve plumbing within Quarry Lakes to increase speed and efficiency of recharge operations
	Treatment Plant Upgrades Ensure that water treatment plant capacity meets needs Target: Increase capacity of Treatment Plant 2 from 17 million gallons per day to 21 million gallons per day by 2030	Water Supply Pages 4-5; 16-17	Treatment Plant 2 capacity increased to 23 million gallons per day ✓	Continue to optimize water quality and efficiency; no further capacity expansions needed for 20+ years
	Recycled Water Produce new water for landscaping and industrial use by treating and reusing wastewater produced in the District Target: 1,600 acre-feet by 2020, increasing to 2,600 acre-feet by 2030	Local Water Sources Pages 14-15	1.8 miles of non-potable water mains installed ✓	Evaluate delivering local groundwater through non-potable pipe network; major water recycling investments postponed due to lack of near-term need
Water Quality Avoid large fluctuations in water hardness Target: Monthly average hardness of 150 milligrams per liter (mg/L) for water produced at Blending Facility	Water Quality Pages 28-29	Average water hardness meeting target ✓	Optimize scheduling of water production from different sources to meet hardness targets while minimizing costs	
Environment Avoid or mitigate environmental impacts Target: Improve conditions for migrating fish	Environment Pages 22-23	Lower rubber dam removed and fish passage installed; fish screens installed at three diversion sites ✓	Implement fish passage at middle and upper rubber dams; complete installation of fish screens	
Cost Resource choices influence the District's capital and operating costs Target: Minimize resource costs; maintain low average customer bills	Demand Management; Water Supply Reliability Pages 18-19; 26-27	Tens of millions in capital expenses avoided; annual operating expenses reduced by \$4.3 million (2012) due to reduced purchases of SFPUC water ✓	Continue to optimize operations to save money	
Risk Improve water supply reliability by reducing dependence on water imported from the Sacramento-San Joaquin Delta Target: Develop water storage and desalination to increase local control	Water Supply Reliability Pages 4-5; 26-27	Water cutbacks now limited to 10 percent even during a long drought; 10 percent cutback expected only once in 30 years ✓	Continue to leverage investments in locally controlled water sources: groundwater recharge, desalinated water, and banked groundwater	
Preparing for Crisis (Added in 2005): Develop plan for major earthquake, loss of State Water Project supplies, or other serious disruption Target: Ensure that ACWD facilities and staff are prepared	Preparing for Crisis Pages 24-25	District's ability to provide safe water after a major earthquake increased by new water sources and seismic upgrades ✓	Continue to implement seismic plan; continue to evaluate and prepare for potential impacts of climate change	

Managing the Niles Cone Groundwater Basin

The Niles Cone Groundwater Basin lies beneath the ACWD service area. Sustainable management of this resource is central to the District's water planning strategy.

The Niles Cone Groundwater Basin lies beneath the ACWD service area and serves as the hub of the District's water supply system. Sustainable management of the basin is central to the District's Integrated Resources Planning process. ACWD uses the basin as an underground reservoir, pumping water out for customers and recharging it with local runoff and State Water Project supplies. If pumping exceeds recharge for an extended period, the groundwater table falls. When it falls below sea level, salt water from San Francisco Bay seeps in, contaminating the basin's fresh groundwater.

Today, the District ensures that water withdrawals are balanced by recharge. As the chart below shows, groundwater levels have been maintained continuously above sea level since the early 1990s.

Groundwater depletion was a serious problem for ACWD during the District's first 50 years. Before the development of imported supplies, local wells were the primary sources of water for both domestic and agricultural users in the region, and pumping often greatly exceeded natural recharge. The imbalance was exacerbated by upstream diversions of Alameda Creek water and the export of groundwater by water agencies and water companies serving other Bay Area communities. In 1961, the groundwater table reached an all-time low of 67.8 feet below sea level. As a result, brackish water contamination moved 8 miles inland through the aquifer system.

In 1962, ACWD began to restore the aquifer, a process that continues today. The addition of State Water Project supplies allowed the District to enhance recharge of the groundwater basin. Deliveries from the San Francisco Public Utilities Commission system gave the District a second major imported supply. In 1974, ACWD launched the Aquifer Reclamation Program to pump out brackish water trapped in the Niles Cone basin and return it to the Bay. Construction of surface water treatment plants, completed in 1975 and 1993, allowed the District to treat State Water Project supplies for delivery to customers; before these plants were built, the water could be used only to recharge the groundwater basin. In 1999, ACWD completed major improvements to the Quarry Lakes Groundwater Recharge System, significantly increasing

groundwater recharge capacity. In 2003, the Newark Desalination Facility came online and began turning the brackish water pumped by the Aquifer Reclamation Program wells into a high-quality potable supply.

Together, these measures have restored water levels in the aquifer and reversed seawater intrusion. As established in the 1995 IRP process, ACWD's long-term water planning is designed to balance recharge and withdrawals so that the groundwater table remains higher than 10 feet above sea level in normal years and never falls lower than 5 feet below sea level, even during a drought.

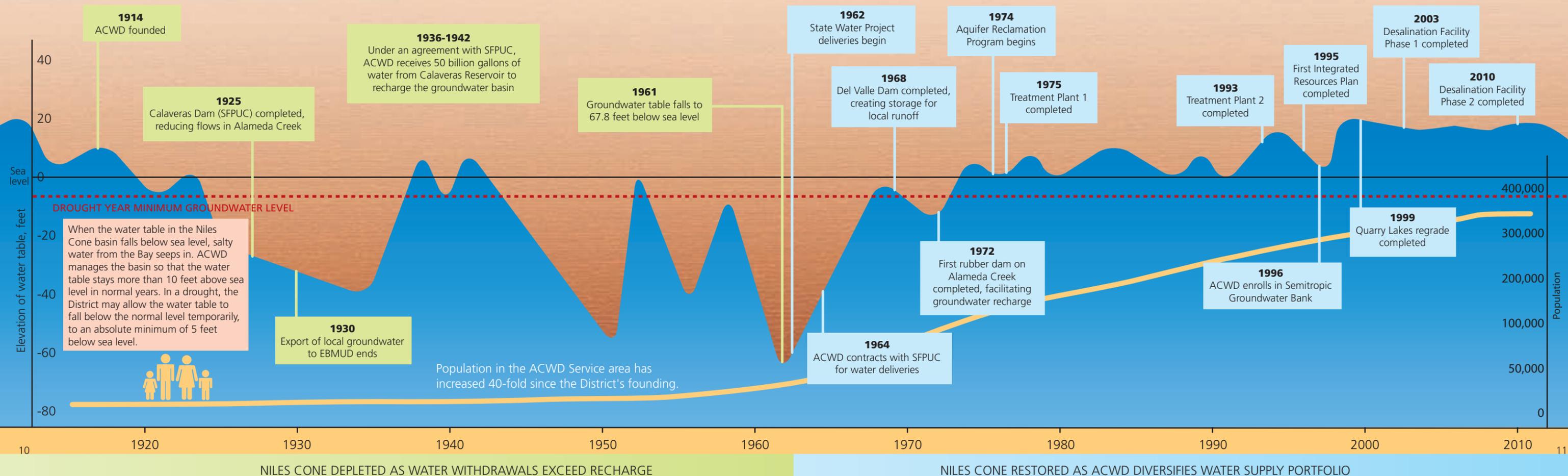


In addition to recharging the Niles Cone Groundwater Basin, the Quarry Lakes provide wildlife habitat and recreation opportunities.

Groundwater elevation in the Niles Cone Groundwater Basin, 1910 - 2013

From 1914 to 1962, ACWD depended entirely on local water: the Niles Cone Groundwater Basin, recharged by local rainfall and water in Alameda Creek. During this period, upstream diversions and groundwater exports reduced water availability, while local demands grew. As a result, the groundwater table declined drastically and brackish water contaminated much of the basin.

In 1962, ACWD began to develop new sources of water to recharge the Niles Cone Groundwater Basin and supply the fast-growing Tri-City region. Today, the District has a diverse water portfolio that reliably meets customer demands while maintaining the groundwater table at sustainable levels.



Reversing Aquifer Contamination

Decades of groundwater overdraft allowed brackish water to contaminate much of the Niles Cone Groundwater Basin. ACWD began recharging the basin with imported water in 1962. In 1974, the District launched the Aquifer Reclamation Program, which pumps brackish water out of the salt-contaminated portions of the basin. Aquifer reclamation is a slow process. ACWD estimates that pumping will need to continue for at least another 100 years to completely undo the effects of 20th-century overdraft.

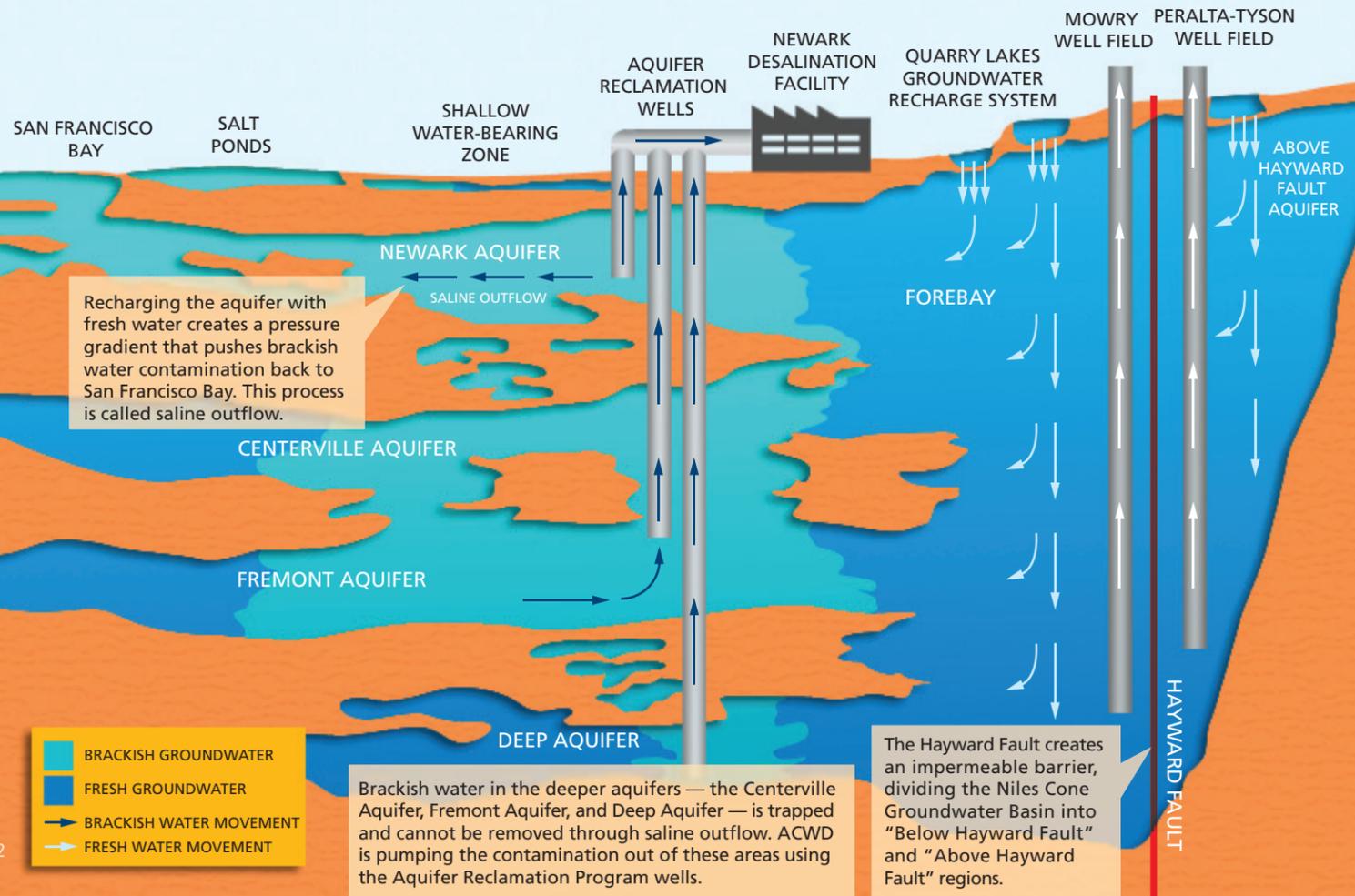
1962 By 1962, salt contamination had pushed 8 miles inland from the Bay shore, all the way to the Hayward Fault.

2013 Today, through its aquifer reclamation efforts, ACWD has pushed back that contamination more than 3 miles. Aquifer reclamation pumping alone has removed more than 360,000 metric tons of salt contamination. An even larger amount has been removed through saline outflow.

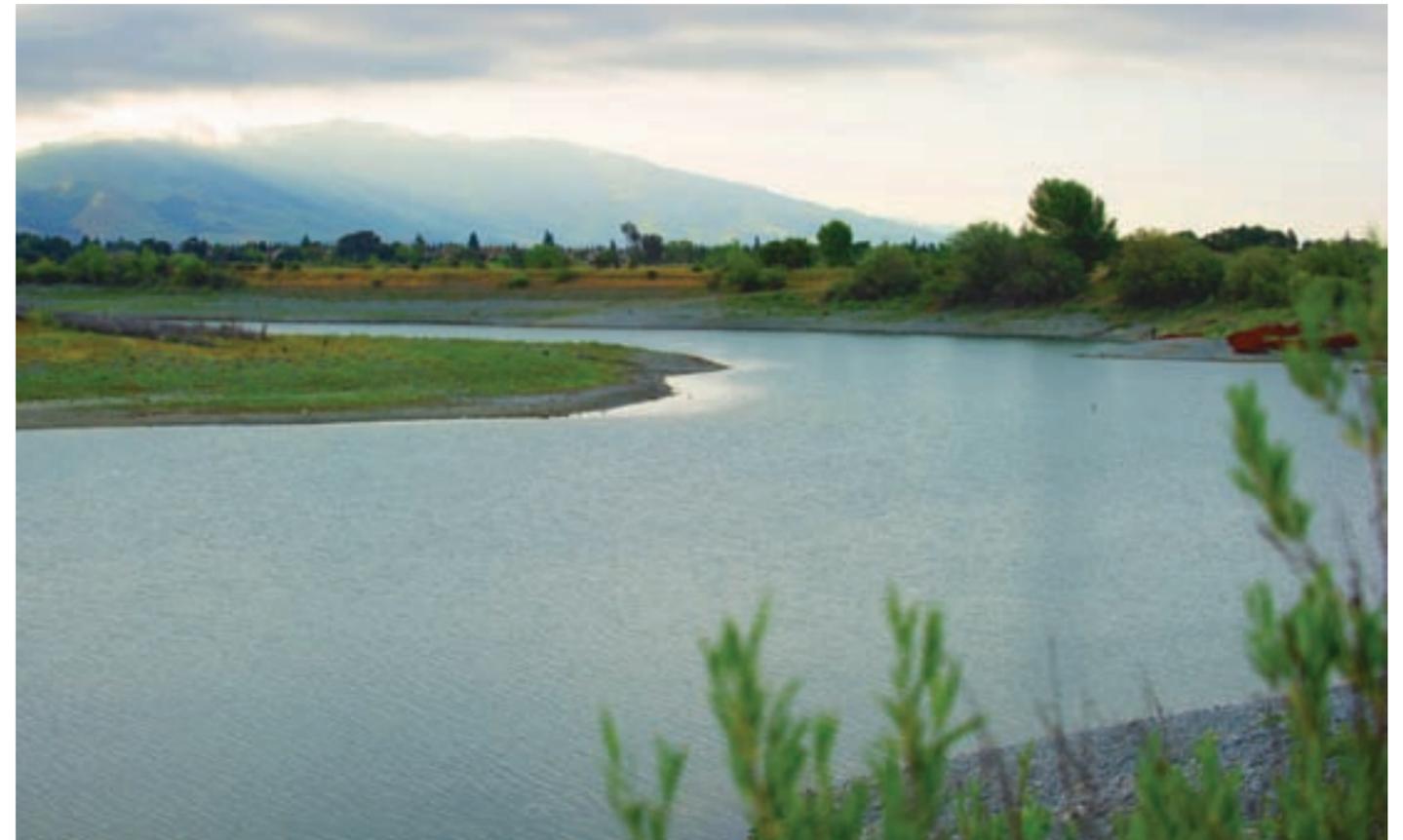


Recharge and Reclamation

ACWD adds fresh water to the aquifer through the Quarry Lakes Groundwater Recharge system. The District withdraws brackish water using the Aquifer Reclamation Program wells, which feed the Newark Desalination Facility. This cycle of fresh water recharge and brackish water extraction is steadily restoring the Niles Cone Groundwater Basin.



ACWD is steadily reversing brackish water contamination in the Niles Cone Groundwater Basin.



Quarry Lakes at sunrise

The Quarry Lakes Groundwater Recharge System

The Quarry Lakes are a series of 13 former gravel pits covering roughly 300 acres alongside Alameda Creek in northeastern Fremont. The porous earth beneath the lakes allows water to seep into the Niles Cone Groundwater Basin, where it is stored and then pumped out at ACWD's nearby well fields.

The District has been using gravel pits in this area for groundwater recharge since at least the 1930s. The current arrangement of lakes and diversion structures dates to the early 1970s. To add water to the ponds, the District uses two inflatable rubber dams to create temporary reservoirs. Water flows through intake pipes from these reservoirs into the Quarry Lakes.

The District continues to upgrade the Quarry Lakes. In the late 1990s, ACWD increased the stability and

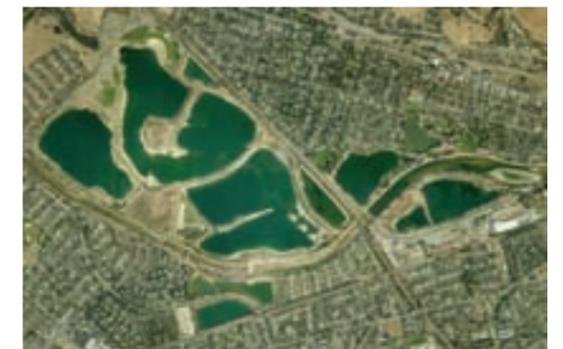


Quarry Lakes prior to 1997 improvements

As part of the improvements to the groundwater recharge facilities completed in 1999, ACWD graded much of the above-water land to allow for the development of park areas and a trail network. Today, the 471-acre park attracts nearly 200,000 visitors annually for boating, swimming, fishing, hiking, cycling, running and bird watching.

strength of the system's earthworks, adding to the water recharge capacity. Current projects are further increasing recharge efficiency.

In addition to recharging the Niles Cone Groundwater Basin with water from Alameda Creek, the Quarry Lakes are the centerpieces of a regional recreation area developed through a partnership between ACWD and the East Bay Regional Park District.



Aerial view of Quarry Lakes today

The Alameda Creek Watershed and the Niles Cone Groundwater Basin

Rainfall in the 633-square-mile Alameda Creek Watershed provides the main source of recharge for the Niles Cone Groundwater Basin. Flows in the creek fluctuate depending on the year's precipitation and releases from upstream reservoirs. In past years, annual flow has exceeded 300,000 acre-feet — more than enough to supply ACWD's customers for six years — but also has been less than 1,000 acre-feet. In a typical year, ACWD diverts 20,000 to 30,000 acre-feet of the creek's flow for groundwater recharge.

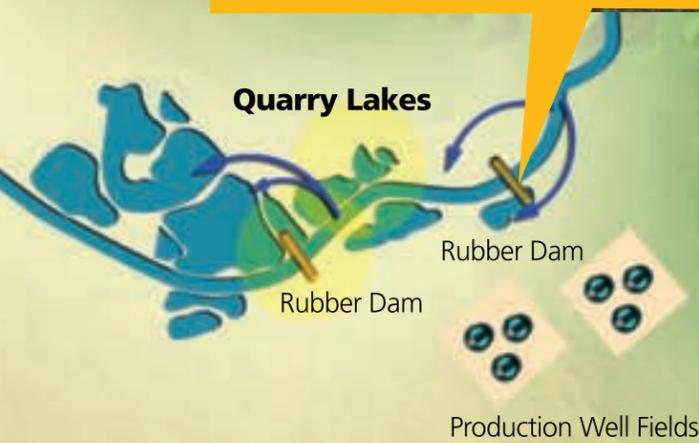
The Niles Cone Groundwater Basin is the hub of ACWD's water system. It serves as an underground reservoir. ACWD recharges the basin by diverting Alameda Creek water and State Water Project supplies into the Quarry Lakes and withdraws water as needed at the production well fields.

Aside from the Niles Cone Groundwater Basin, ACWD has relatively little water storage capacity in the Alameda Creek Watershed. The District has the right to use one-tenth of the volume of 75,000-acre-foot Lake Del Valle to store local runoff. Most of the remaining space in Lake Del Valle is allocated to State Water Project storage, while runoff captured in the watershed's other two large reservoirs, Calaveras Reservoir (100,000 acre-feet) and San Antonio Reservoir (50,000 acre-feet) belongs to the San Francisco Public Utilities Commission.

ACWD also collects roughly 1,200 acre-feet per year of direct urban runoff, which is percolated into the groundwater basin via the Quarry Lakes Groundwater Recharge System. This practice, known as "stormwater capture," benefits the environment by reducing intense peak runoff to sensitive aquatic habitats. It's also a key sustainable water supply strategy advocated by the state Department of Water Resources in the California Water Plan.



ACWD uses inflatable rubber dams to divert water from Alameda Creek into the Quarry Lakes for groundwater recharge.



Newark Desalination Facility

ACWD's desalination facility can produce up to 10 million gallons per day of fresh water. It takes brackish water from the salt-contaminated portions of the Niles Cone Groundwater Basin and pumps it at high pressure through membranes to remove salts.

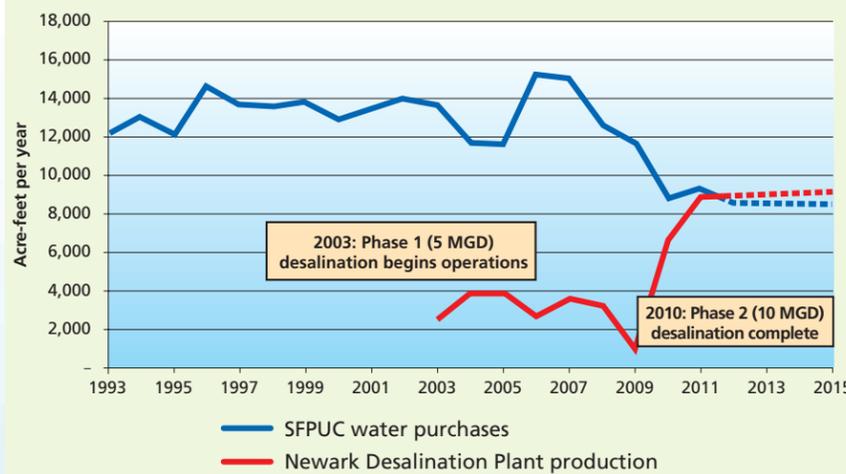
Before the facility was built, the water extracted by the Aquifer Reclamation Program wells was discharged to San Francisco Bay. The desalination facility takes this brackish water and turns it into a reliable source of potable water.

Desalination saves money by replacing SFPUC supplies (see chart). By minimizing purchases of Hetch Hetchy water, the District currently saves \$4.3 million each year — a figure that will rise as SFPUC water grows more expensive.

The desalination facility also increases the total amount of water that ACWD can produce for customers in a day — important for meeting peak summer demands. Without this facility, ACWD likely would have needed to expand one of its other production facilities, at substantial cost. In addition, desalination has helped ACWD to meet water hardness targets (see pages 28-29).

The amount of brackish water that can be pumped to feed the facility is limited by groundwater management considerations, including the needs of groundwater reclamation and replenishment, and the prevention of seawater intrusion. As a result, the operation of this facility requires careful annual planning to optimize its beneficial uses.

Replacing SFPUC supplies with local desalinated water



The Newark Desalination Facility provides high-quality water at low cost. ACWD uses this water to replace purchases of costly SFPUC water, saving an estimated \$4.3 million in 2013.



Inside the Newark Desalination Facility

Non-Potable Water Supply

ACWD's long-term planning includes the development of non-potable recycled water. Because of the large costs involved, a full-scale recycled water system would be developed only when potable water supplies can no longer meet demands.

A recycled water system would have two main components. A new treatment facility would be built to process effluent from the Union Sanitary District's wastewater treatment plant. In addition, a new network of distribution pipes would deliver the non-potable water to industrial customers and landscape irrigation sites. Some of these distribution pipes already have been laid.

Thanks to conservation and other IRP measures, ACWD will not need to develop a large recycled water system until at least 2035. In the meantime, the District is evaluating a plan to deliver raw groundwater through the already-installed non-potable distribution pipes, which would otherwise go unused. This program would take advantage of the existing non-potable pipe system, reduce operating costs, lower demand on potable water treatment facilities, and potentially help the ongoing recovery of the Niles Cone Groundwater Basin.



Pipes that distribute non-potable water are colored purple to distinguish them from potable water pipes.

The State Water Project

The State Water Project is a collection of reservoirs, aqueducts, pumping stations, and hydroelectric power facilities that provides a portion of the water supply for roughly 25 million Californians and 750,000 acres of farmland. Runoff from the northern Sierra Nevada mountains provides the main source of water for the Project. That runoff flows into the Feather River and its tributaries and is collected in Lake Oroville. Water released from Lake Oroville flows down the Feather River, into the Sacramento River, and then into the Sacramento-San Joaquin Delta. Pumps in the southern Delta then lift the water into the 444-mile California Aqueduct, which runs to Southern California. The South Bay Aqueduct branches off from the California Aqueduct to deliver water to ACWD and other water agencies in Alameda and Santa Clara counties.

The California Department of Water Resources began building the State Water Project in 1959. ACWD received its first deliveries in 1962. ACWD is one of 29 water agencies across the state that contracts with the State Water Project. The District typically receives about 1 percent of the 2.6 million acre-feet of water the Project provides in an average year.

ACWD has a contract to purchase up to 42,000 acre-feet of water annually from the Project. But that full amount is seldom available, due both to year-to-year variations in precipitation and to environmental restrictions on pumping from the Delta. Actual water availability averages roughly 25,000 acre-feet, and state projections indicate that, in the future, ACWD will receive less than 15,000 acre-feet in roughly 15 percent of all years.

The precarious nature of State Water Project supplies became clear to ACWD following the 1987-1992 drought. That event exposed major flaws in the use of the Delta as a water conveyance system, including the near-collapse of the Delta ecosystem. The severity of the problems focused state and federal government attention on the Delta and led to the creation in 1994 of the CALFED Bay-Delta Program, which ultimately involved more than two dozen state and federal agencies. ACWD correctly anticipated that the troubles in the Delta would prove intractable for many years, and in 1995 resolved (through the IRP process) to reduce the District's dependence on its annual allocation from the State Water Project. Since then, the Delta ecosystem has continued to decline, with court orders and management decisions restricting the amount of water that can be pumped into Project aqueducts.

State Water Project Supplies: Using the Semitropic Groundwater Bank to increase reliability

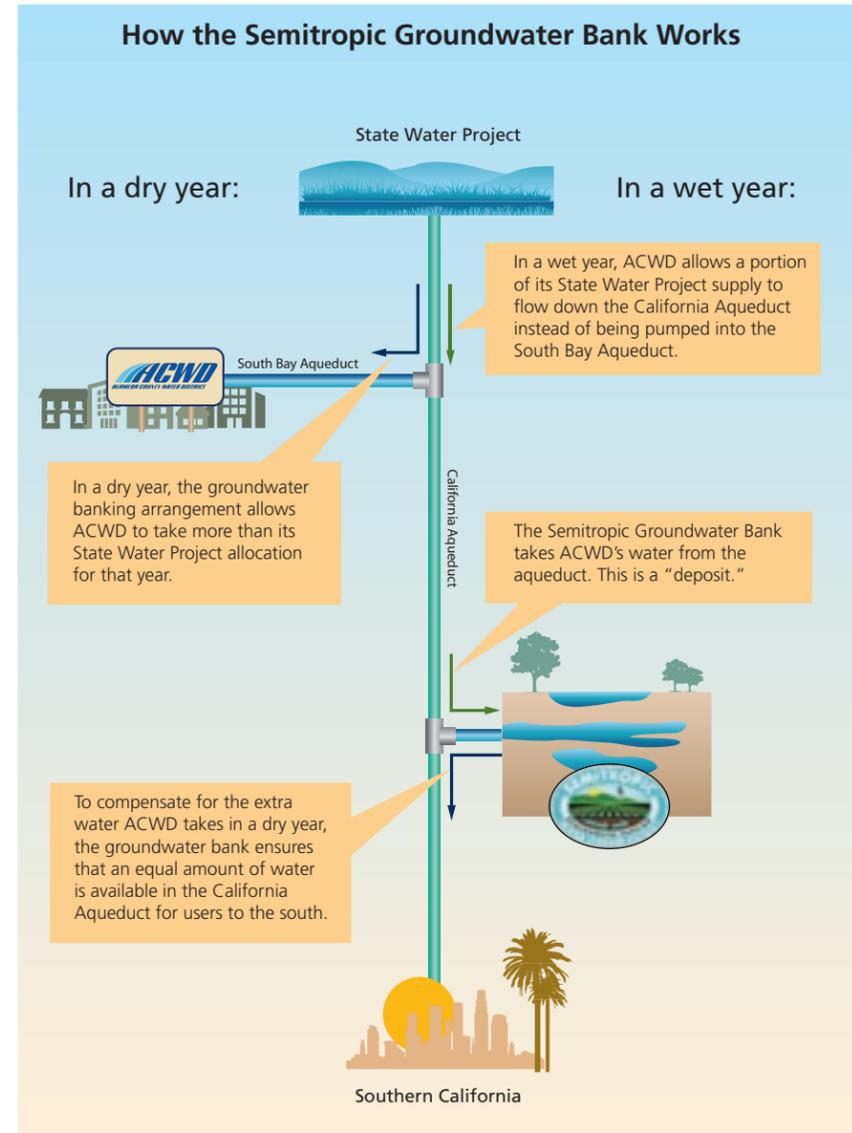


The Semitropic Groundwater Bank: Compensating for State Water Project Variability

As insurance against expected shortfalls of State Water Project supplies, ACWD in 1996 and 2001 acquired a total of 150,000 acre-feet of storage space in the Semitropic Groundwater Banking Program, located in Kern County.

In wet years, ACWD deposits a portion of its State Water Project supplies — beyond what is needed for customers — into the bank. In dry years, the District can withdraw water. Even in a prolonged drought, ACWD is eligible to withdraw at least 13,500 acre-feet annually, enough to offset reductions in deliveries of state water.

ACWD's current "balance" in the bank is close to the 150,000 acre-foot maximum. ACWD took advantage of the program by withdrawing water after the dry winters of 2007-2008 and 2008-2009. The District is also exploring the use of Semitropic withdrawals on a regular basis to reduce purchases of SFPUC water and cut costs.



The San Francisco Public Utilities Commission (SFPUC) Water System

ACWD's second source of imported water is the San Francisco Public Utilities Commission water system. Most of this water comes via the Hetch Hetchy Aqueduct, which carries water from Yosemite National Park to the Bay Area. Some water is also collected in Alameda County, in the form of rainwater runoff that flows into SFPUC's Calaveras and San Antonio reservoirs.

Because of its high-mountain source, SFPUC water is of very high quality, requiring only minimal treatment before being blended with local groundwater and delivered to customers. This water source is more reliable than the State Water Project for two main reasons. First, there is substantial reservoir storage in the SFPUC system. Second, the Hetch Hetchy Aqueduct bypasses the Delta and so is not subject to the pumping restrictions that can reduce State Water Project deliveries. Even in a severe long-term drought, SFPUC likely will be able to provide at least 67 percent of ACWD's maximum contracted amount of 15,400 acre-feet.

On the other hand, at \$1,322 per acre-foot, the SFPUC supply is ACWD's most expensive source of water. The cost is rising as ACWD pays its portion of the ongoing \$4.5-billion rehabilitation and upgrade of the SFPUC system, which will increase its ability to withstand a major earthquake. By 2023, ACWD will pay roughly \$2,200 per acre-foot for SFPUC water. ACWD is adjusting its operations to substitute less expensive supplies, but this strategy is limited by a contractual obligation to purchase at least 8,600 acre-feet of SFPUC water each year.

Integrated Resources Planning treats conservation as a water resource: Ways to reduce demand are assessed just as carefully as options to increase supply.

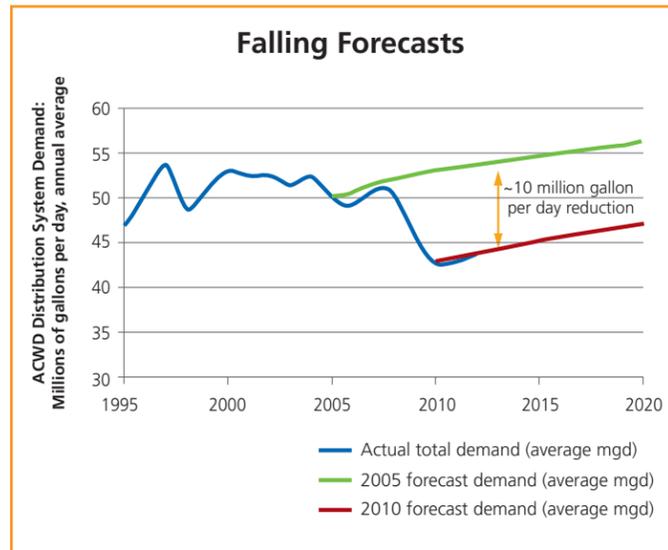
Through the 1995 IRP process, ACWD made conservation one of its central strategies in maintaining a reliable water supply while containing costs. The District set a target of reducing demand by 2.9 million gallons per day by 2025, by implementing a number of conservation programs (pages 20-21).

ACWD's customers already have exceeded that goal. Through 2012, water-saving programs and voluntary conservation have permanently reduced daily water demand by 3.2 million gallons per day ("Active Conservation").

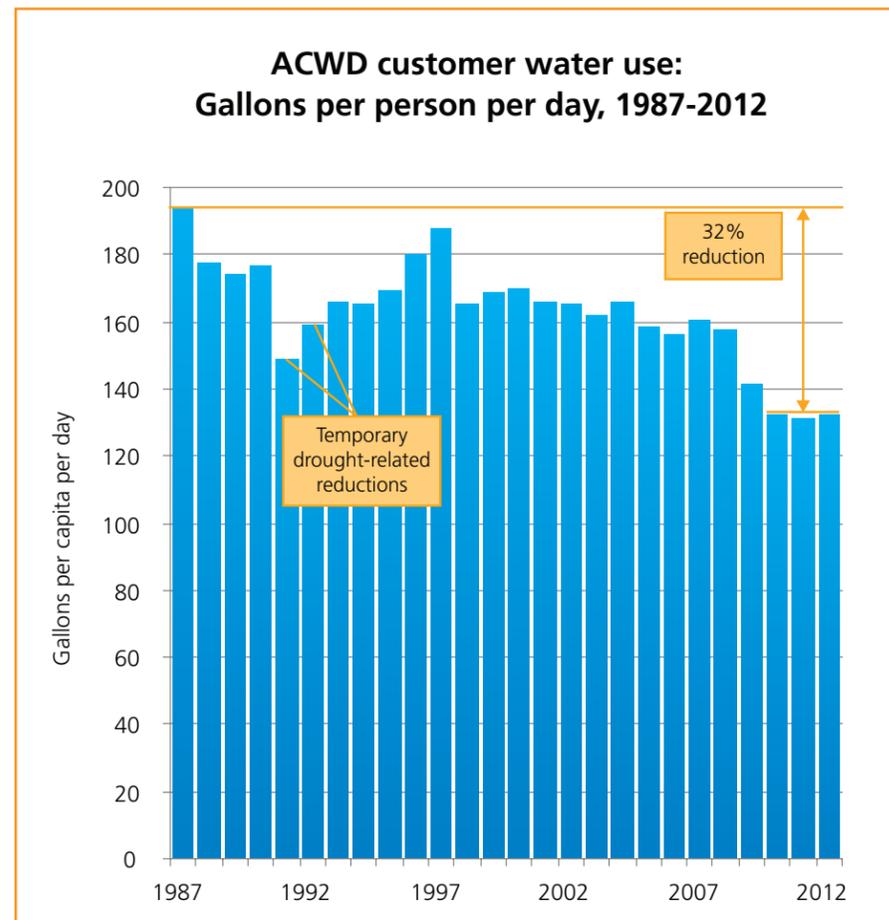
In addition, anticipated demand reduction due to "Passive Conservation" —

the gradual replacement of old toilets, faucets and showerheads with new, water-efficient models — has been realized. ACWD estimates that this category of savings totals 4.6 million gallons daily.

Together, these two types of conservation add up to 7.8 million gallons in water savings daily. Slower-than-expected housing and economic growth in the region have also reduced projected water needs. As a result, overall water demand today is roughly 10 million gallons per day lower than was anticipated in District forecasts as recently as 2005.



Due primarily to water conservation, ACWD's daily water demand today is roughly 10 million gallons less than was predicted in 2005.



Two Types of Conservation

Active Conservation (estimated 3.2 million gallons per day demand reduction through 2012):

ACWD has a comprehensive set of programs that help customers reduce their water use, from replacing turf with drought-tolerant landscaping to encouraging simple behavioral changes, such as reducing showering time (see pages 20-21). These savings are considered to be "Active Conservation" because they are a direct result of customer actions.

Passive Conservation (estimated 4.6 million gallons per day demand reduction through 2012):

Since 1992, a series of state laws has required that new toilets, faucets and showerheads be designed to use less water. Beginning in 2014, for instance, new toilets will use a maximum of 1.28 gallons per flush, compared to a maximum of 1.6 gallons today and more than 3.5 gallons 20 years ago. Water savings that result from these rules is called "Passive Conservation" because it does not require special action on the part of customers: When old toilets and fittings wear out or are upgraded in remodeling, their replacements are required to meet modern efficiency standards.

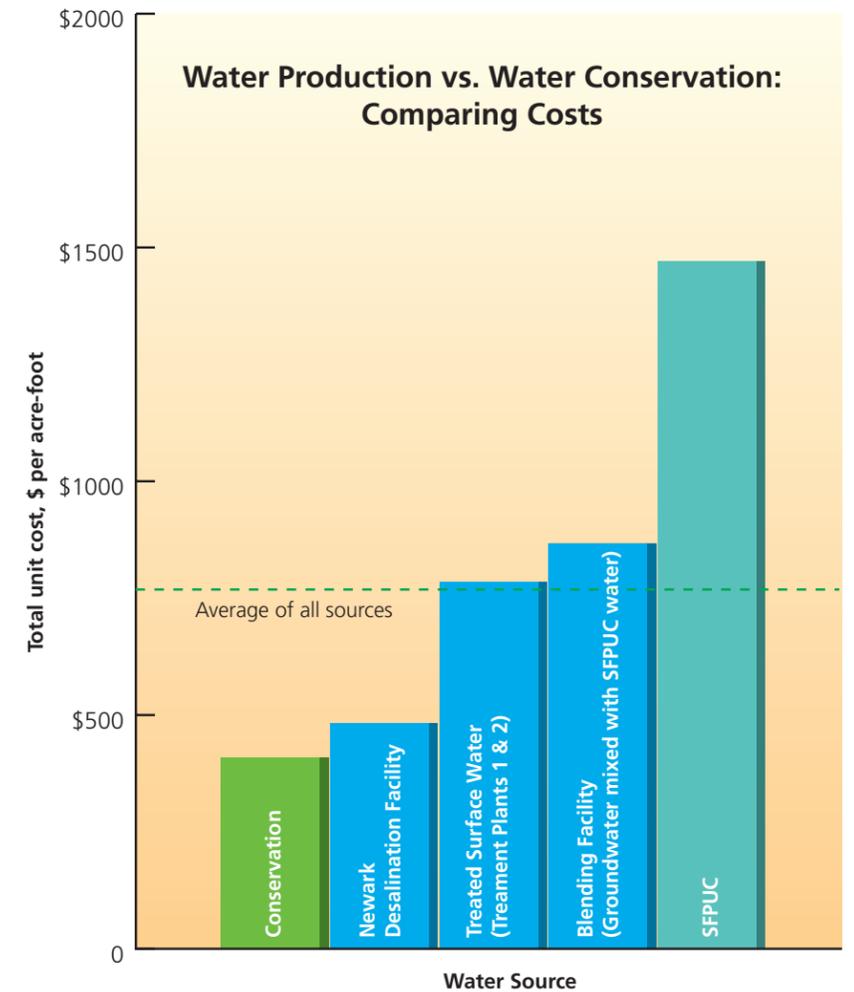
Benefits Today—and in the Future

If customers weren't conserving 7.8 million gallons per day, ACWD would face several major costs:

- \$1.2 million annually (2012 cost) in additional operating expenses to purchase, pump and treat water;
- \$25 million or more in treatment plant expansion costs;
- Either living with the costs and uncertainty of a less-reliable water supply or pursuing a \$120-million water recycling program to produce additional water; successful demand reduction has allowed ACWD to postpone most elements of the water recycling plan (and the associated costs) until at least 2035.

In addition to these budget-reducing benefits, conservation improves water quality. With lower total demand in the peak summer months, the District can reduce the amount of hard local groundwater mixed with soft SFPUC water at the Blending Facility, which in turn reduces the average hardness of water delivered to customers (see pages 28-29).

For these same reasons, ACWD needs to keep investing in conservation — even though the original IRP targets have been surpassed. In virtually all cases, conservation will be less costly, less risky, and have less environmental impact than developing a new source of water. With imported water becoming less reliable and more expensive, and given the high costs of recycled water, the importance of conservation continues to grow.



At \$410 per per acre-foot of savings produced, conservation is ACWD's least expensive source of water. For comparison, the chart shows the cost to supply an acre-foot of water from the Newark Desalination facility, the two surface water treatment plants, and the Blending Facility. These figures includes the cost to pump or purchase the source water as well as water treatment costs. The chart also shows the current cost to purchase SFPUC water, which is blended with local groundwater at the Blending Facility. Figures are based on the budgeted fiscal year 2012-2013 production summary.

How the cost of conserved water is determined:

Since 1992, ACWD has spent \$11.7 million on conservation. As a direct result, the District has avoided having to deliver an estimated total of 28,650 acre-feet of water. On average, then, ACWD has spent roughly \$410 to save each acre-foot of water.

This figure isn't exact. The total volume of water saved as a result of conservation measures can't be measured directly, so it must be estimated. In addition, ACWD's conservation budget includes spending on activities such as monitoring and evaluation that are necessary to guide future conservation programs but don't deliver water savings directly. If these costs were removed from the, the cost per acre-foot of water saved would be lower.

It is certain, however, that the cost per acre-foot saved is declining with time. That's because many conservation measures involve up-front expenses — installing a new lawn-watering controller, for instance, or re-landscaping a yard — that then provide many years of savings for little or no additional cost. As time passes, the initial costs are spread over the growing accumulation of water savings.

ACWD's water conservation programs include education and public outreach as well as specific water-saving initiatives for residences, businesses, and large landscapes. Here's a sample:



ACWD meter readers can detect sudden increases in water use and follow up immediately with customers.

leaks. Meter readers are also alerted (through their handheld devices) to a spike in water use that might indicate a leak and are equipped to follow up immediately with customers.

Residential surveys: Through a partnership with California Youth Energy Services, trained youth ages 15-22 perform free water and energy audits in residences and provide water efficient shower heads and faucet aerators.

Residential landscaping: Residential customers replacing grass with low water use plants are eligible for rebates of up to \$1,500. The District also sponsors residential landscape workshops, provides seasonal landscape irrigation reminders, and has an online tool customers can use to find information about water-efficient landscaping.

Business and Institutional Programs

Commercial clothes washer rebates: ACWD and the Union Sanitary District together offer up to \$300

toward the purchase of high-efficiency washing machines for laundromats and apartment complexes.

Commercial toilet and urinal rebates: In partnership with the Union Sanitary District, ACWD provides rebates of up to \$150 for the replacement of each high volume toilet or urinal in businesses and schools.

Surveys: Businesses, factories and institutions receive free water-efficiency consultations.

Large Landscape Programs

ACWD has several programs for customers with large landscape areas, such as office parks, home owners associations, apartment complexes, and schools.

Weather-based irrigation controllers: ACWD provides rebates for "smart" irrigation controllers that adjust watering schedules based on weather conditions. A pilot program indicated that the devices reduce average water use by nearly 20 percent.

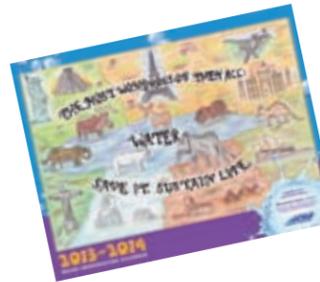
Turf replacement rebates: The District provides up to \$20,000 to support replacing non-functional grass with less water-intensive – and often more attractive – plants.

Dedicated Landscape Partnership: All customers with active irrigation meters participate in a program that determines optimum landscape water needs, alerts customers about excess usage, and provides assistance in saving water.

Trainings for landscape contractors: ACWD helps to provide regular free workshops on water use efficiency for professional landscapers.

School education and public information

For more than 20 years, ACWD has run award-winning water education programs that now reach more than 17,000 students



annually. These programs include classroom instruction, school assemblies, customized educational materials, and tours of District facilities. In addition, the District has conducted a variety of programs that help students to reduce water waste at home, such as by finding and fixing leaks in toilets, and taking shorter showers.

The District also has a long-running information and outreach program for customers, including a water-efficient demonstration garden, informative bill inserts, packets of water conservation and leak detection information sent to new customers, and billing statements that make it easy for customers to see how their water use changes from month to month and year to year.



In the Future

ACWD continues to expand its conservation programs. In 2014, the District will launch a water savings assistance program for low-income customers. Through this program, qualifying single-family homeowners will receive a free water efficiency home upgrade that includes a water use survey, leak inspection and repair, and installation of water-efficient toilets, showerheads, and faucet aerators.

The District is studying the past successes of conservation implementation and actively redefining goals and metrics for future conservation efforts and investment. These studies will help to ensure that investments continue to be cost-effective and tailored to the changing landscape of water demand in the Tri-City region.

Recent analyses indicate that conservation programs that reduce peak summer water demand provide the most benefits per dollar invested. These programs include turf replacement, smart irrigation controllers, and other initiatives that reduce outdoor watering.



Water-efficient landscaping can reduce summertime outdoor irrigation demands by 40 percent or more.



Alameda Creek and the Niles Cone Groundwater Basin are interlinked bodies of water that are central to the management of the ACWD water system. Just as the District maintains the quality and integrity of the Niles Cone basin, it is also working to improve the ecological health of Alameda Creek and preserve the District's access to the creek's water.

The 1995 IRP process identified the mitigation of resource-related impacts as the top environmental priority for the District. In recent years, ACWD's environmental restoration efforts have focused primarily on improving habitat conditions for Central California Coast steelhead, which the federal government in 1997 identified as a threatened species under the Endangered Species Act.

In the past, steelhead traveled up Alameda Creek and into tributary streams to spawn. After hatching, young fish would feed and grow in these streams until they were mature enough to make the trip downstream, through the Bay and out the Golden Gate. Alameda Creek and its tributaries provided abundant habitat for oceangoing fish — second only to the Napa River system among the rivers and creeks that drain into San Francisco and San Pablo bays.

Starting in the late 1800s, a variety of changes to the Alameda Creek Watershed altered habitat conditions for steelhead and other fish. Dams and diversions walled off many parts of the watershed to migrating fish and altered natural flow patterns. Groundwater pumping lowered the water table, causing the creek to run dry in some places by the early 20th century. Urbanization in the Livermore Valley removed wetlands that once served as natural reservoirs that helped to maintain summer flows in the creek.

Despite these changes, a small number of steelhead still return from the ocean to attempt to spawn in Alameda Creek. However, 12 miles up the creek they are blocked by the "BART weir," a flood control structure spanning the channel near the Bay Area Rapid Transit overpasses. During the steelhead migration season (winter and early spring), a community group monitors the weir — essentially a 9-foot-tall concrete step — with an Internet video camera. When a migrating fish is spotted, volunteers attempt to net the fish and release it upstream.

For more than a decade, ACWD has been working with conservation groups and resource agencies to restore fish passage up Alameda Creek. In 2009, the District removed an inflatable dam (Rubber Dam 2) and installed a fish ladder. Working with the local flood control district, ACWD plans in the coming years to install two additional fish ladders: one at the site of the BART weir and Rubber Dam 1; and the second at Rubber Dam 3. In addition, the District is installing screens on the Quarry Lakes intakes along the Flood Control Channel to protect fish. The San Francisco Public Utilities Commission has been taking steps to improve fish passage as well. SFPUC removed its Niles and Sunol dams in Alameda Creek in 2006 and is planning to adjust releases of water from Calaveras Dam to better meet the needs of steelhead.

When complete, these projects will allow migrating steelhead to swim upstream into Niles Canyon and beyond, while not impairing the District's ability to use Alameda Creek water for aquifer recharge. The fact that more than 90 percent of the land area in the Alameda Creek Watershed is undeveloped — a remarkably high percentage for a watershed in an urban region — raises hopes for steelhead recovery.

ACWD has committed over \$20 million to Alameda Creek restoration work. Grant funding and partnerships with other agencies have added \$8.65 million to support the projects.

Restoring fish passage to Alameda Creek

ACWD is working to install fish ladders at the two remaining obstacles to migrating steelhead in the District's service area. A fish ladder is a narrow, sloping water channel designed to allow fish to swim uphill past a barrier (see illustration). In combination with the removal of upstream barriers, ACWD's fish ladder projects will open many miles of Alameda Creek to spawning steelhead for the first time in more than a century.

-  Obstacles Removed
-  Remaining Obstacles
-  Fish Screens
-  Future Fish Screens

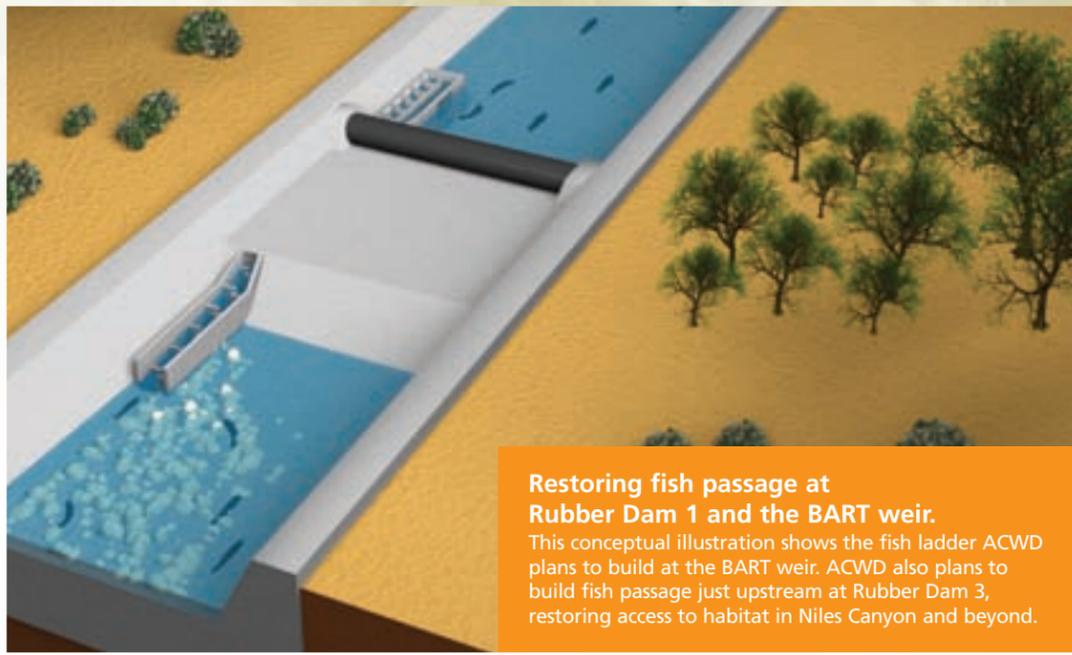
Rubber Dam 2: Inflatable dam removed and fish passage installed in 2009

Rubber Dam 3: Fish passage planned

Rubber Dam 1 and BART weir: Fish passage planned



Fish passage at the former site of Rubber Dam 2



Restoring fish passage at Rubber Dam 1 and the BART weir.

This conceptual illustration shows the fish ladder ACWD plans to build at the BART weir. ACWD also plans to build fish passage just upstream at Rubber Dam 3, restoring access to habitat in Niles Canyon and beyond.



Alameda Creek in Niles Canyon

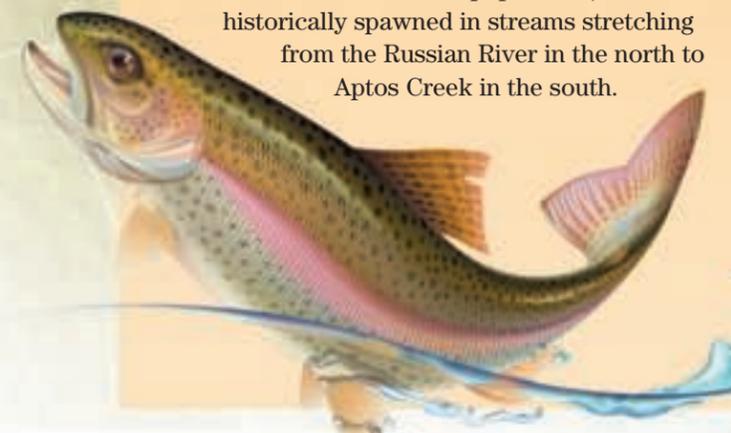


Installed Fish Screen

Steelhead

Oncorhynchus mykiss, known as steelhead or rainbow trout, is a species of salmonid, cousin to Pacific salmon such as chinook and coho. Like those fish, steelhead are anadromous, meaning that they normally spend a portion of their adult life in the ocean. However, unlike chinook and coho salmon, steelhead are capable of reaching maturity and reproducing in fresh water. Steelhead that spend their entire life in fresh water are called rainbow trout. Upstream of Calaveras Dam — and elsewhere in the upper watershed — there are robust native populations of rainbow trout. Their prevalence suggests that anadromous steelhead may be able to reproduce successfully in the upper watershed once migration barriers are removed.

Steelhead native to Alameda Creek are part of the Central California Coast population, which historically spawned in streams stretching from the Russian River in the north to Aptos Creek in the south.



In addition to working to avoid water shortages due to drought, ACWD continues to make improvements to safeguard customers' water supply against the region's most likely natural disaster, a major earthquake.

The Hayward Fault runs through the ACWD service area. Geologic records show that the fault has ruptured, on average, every 140 years. The last large earthquake on the fault occurred in 1868 and seismologists say there is a 31 percent chance of an earthquake of at least magnitude 6.7 along the fault in the next 30 years. The Calaveras and San Andreas faults are also nearby and could cause damaging quakes in the ACWD service area.

Preparing for catastrophe: Actions taken since the 1995 IRP Process:

Locally, damage from an earthquake has the potential to rupture water lines and cut off electrical power, in turn creating the possibility of water service disruption and water contamination. ACWD is taking many actions to minimize the impacts of a large quake.

Newark Desalination Facility: This plant provides an additional local source of water in case deliveries of imported supplies are disrupted. In addition, the facility provides a water source that is west of the Hayward Fault. This location is important because the District's imported water supplies are delivered and treated to the east of the fault. A major earthquake could break some of the water connections that cross the fault. If this happens, customers west of the fault can be served by the Desalination Facility as well as the Mowry Well Field.

Water main retrofits and bypasses: ACWD is strengthening water mains that cross the Hayward Fault so that they can withstand a major earthquake. In areas where earth movement is projected to be especially violent, the District is installing special valves and flexible tubing at the fault crossing that will provide ready-made bypasses around sections of pipe that may be damaged in an earthquake. This program addresses the highest-priority areas identified in the District's long-term, \$400 million plan to invest in the replacement of aging and vulnerable water mains throughout the service area.

Protect tank and reservoir connections: Flexible plumbing reduces the risk of pipe failure and/or a major leak at the District's hillside storage tanks and reservoirs. In addition, all storage tanks are being bolted to their foundations to better withstand shaking.

Automated isolation valves: In case of a water main failure or water contamination (including from a security breach), the District can quickly isolate individual storage facilities or areas of the distribution system to contain contamination and prevent damage from large leaks.

Emergency power generation: In an extended electricity outage, ACWD has mobile and stationary diesel generators that can produce enough electricity to continue to pump, treat and deliver up to 33 million gallons of water daily to customers — 75 percent of average deliveries.

Emergency reliability partnerships: ACWD and neighboring water systems in the city of Hayward and the city of Milpitas are linked by pipes. Partnerships between the agencies call for water to be delivered across service area boundaries in an emergency.

The Hayward Fault



Earthquake Protection for Hillside Tanks



Flexible pipe connections at hillside tanks protect against breaks in an earthquake.

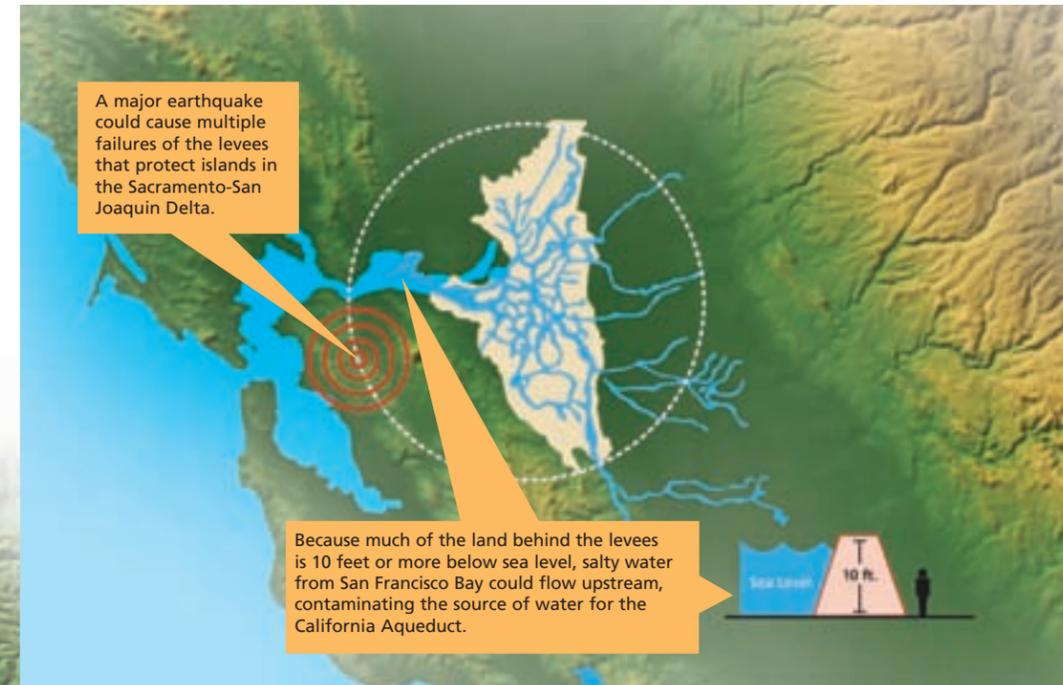


Tanks are bolted to foundations to withstand shaking.



A hillside tank

Potential Delta Disaster



A very strong quake could cause levee failures in the Sacramento-San Joaquin Delta, leading to an influx of salt water that would render State Water Project supplies undrinkable for an extended period.

Reducing ACWD's vulnerability to a long-term State Water Project outage

An ACWD analysis in 2006 indicated that losing Delta supplies for five years would result in shortages of up to 40 percent given average precipitation conditions, and up to 55 percent in drought conditions.

Since that analysis was conducted, two things have changed to significantly reduce those potential shortages.

First, and most importantly, ACWD has reduced its dependence on State Water Project supplies in the last seven years through reductions in demand and the completion of the Newark Desalination Facility. As a result, a five-year State Water Project outage likely would mean that ACWD would have to reduce deliveries by only 20 percent given average precipitation — half as much as was projected in 2006. If the levee failures coincided with an extended drought, the likely shortages would be roughly 40 percent.

Second, state and federal agencies have made preparations to facilitate faster repair of the Delta levees after a major earthquake. These measures should help to restore State Water Project deliveries more quickly.

ACWD's investments in desalination, groundwater banking, and demand management have paid off in two key ways: improved reliability and reduced annual expenses. To quantify these gains, this section compares today's ACWD water system with a hypothetical version that lacks three major improvements developed through the Integrated Resources Planning process: the Newark Desalination Facility; the Semitropic Groundwater Bank; and the benefits of more than two decades of investment in water conservation.

Reliability

The IRP investments have secured water supply sufficiency for ACWD until at least 2035. Without these investments, the District would begin to face supply shortfalls even in normal precipitation years as soon as 2020, in part because projected average deliveries from the State Water Project have fallen nearly 20 percent since 2002.

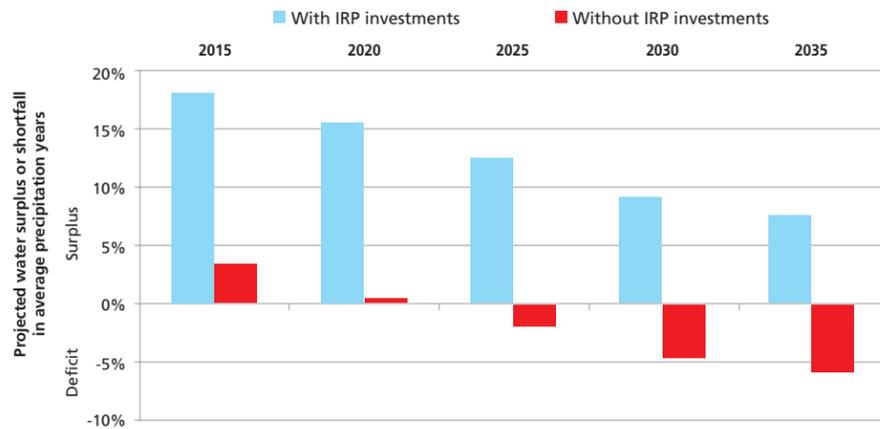
Another way to evaluate reliability is to see how ACWD's water supply strategy would fare in a drought as severe as the one California experienced in 1977, the driest single water year (precipitation measured from October 1 to September 30) since the development of the State Water Project. In such a year, ACWD's state water deliveries could be cut to 4,000 acre-feet, almost 85 percent below average.

Without the IRP-driven investments in alternative supplies and conservation, ACWD would face a large gap between supply and demand in a year as dry as 1977. Projected shortages reach 30 percent in 2015, increasing to 41 percent by 2035 due to increasing demand.

Such deep shortfalls would require customers to reduce landscape irrigation sharply and possibly cut indoor water use as well, potentially resulting in loss of property value as well as impacts to the local and regional economy. In addition, the District could be forced to purchase water from elsewhere in the state.

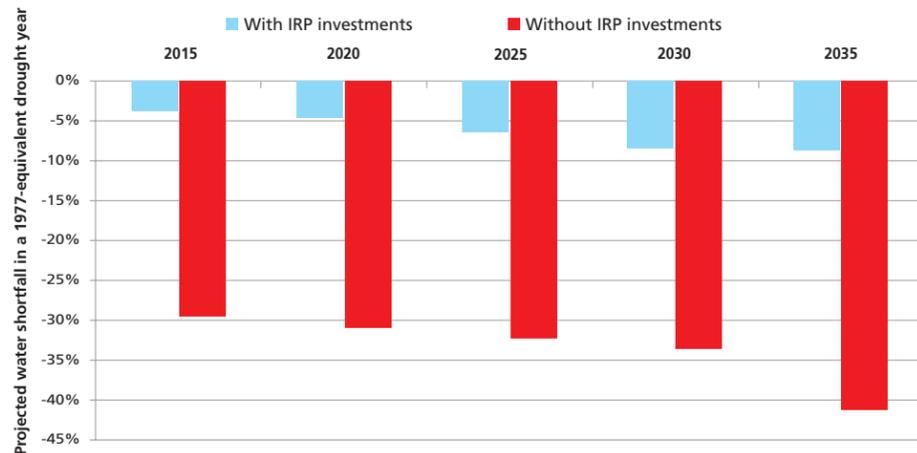
Average-Year Surplus to 2035 and Beyond

IRP investments in desalination, groundwater banking, and conservation have secured water supply sufficiency for ACWD until at least 2035. Without these investments, the District would begin to face supply shortfalls even in normal precipitation years as soon as 2020.



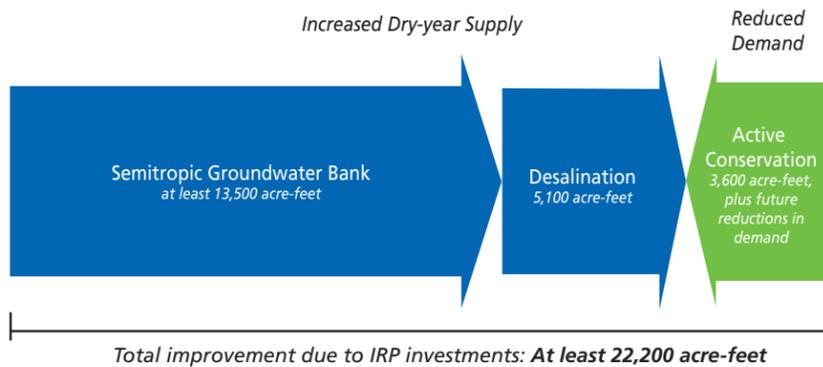
Meeting Dry-Year Demands

The same IRP investments have slashed projected drought-year shortfalls. Chart shows the one-year supply deficit in a 1977-equivalent drought.



Drought Tolerance

In a severe drought, IRP investments in groundwater banking, desalination, and demand management will narrow the gap between supply and demand by at least 22,200 acre-feet.



For comparison, projected annual demand in 2015 without active conservation is 69,670 acre-feet

With the benefit of the IRP investments, the projected supply-demand gap in a 1977-equivalent drought shrinks dramatically, to 4 percent in 2015 and 9 percent in 2035.

This improvement has three components: 5,100 acre-feet of new supply from the Newark Desalination Facility; at least 13,500 acre-feet in dry year withdrawals from the Semitropic Groundwater Bank; and reduced demand through Active Conservation (see page 18) of 3,600 acre-feet, increasing to a total of roughly 5,000 acre-feet in the future.

Cost

Operational flexibility — having multiple options to respond to change — is a guiding principle of the IRP process. In addition to enhancing water supply reliability, flexibility can deliver cost savings by providing alternatives if the cost of one of ACWD's sources of water increases.

The rising cost of San Francisco Public Utilities Commission supplies shows the direct economic benefit of operational flexibility. As SFPUC passes on the cost of its Water Supply Improvement Program — a series of repairs, seismic upgrades, and related projects — the price ACWD pays for each acre-foot of SFPUC water is projected to increase from \$1,322 in 2013 to roughly \$2,200 by 2023.

If ACWD hadn't invested in desalination and demand management, the District would need to purchase approximately 11,900 acre-feet of SFPUC water (based on conditions in the 2012-2013 fiscal year). But because those alternatives have been developed, the District can reduce deliveries to the contractual minimum of 8,600 acre-feet — a reduction of 3,300 acre-feet. This change reduced ACWD's operating costs by \$4.3 million in 2013. As the price of SFPUC water rises, the savings will grow, reaching an estimated \$8.5 million per year in 2023 (measured in 2013 dollars).

The greater reliability provided by the IRP investments also has economic



Sampling water at the Newark Desalination Facility

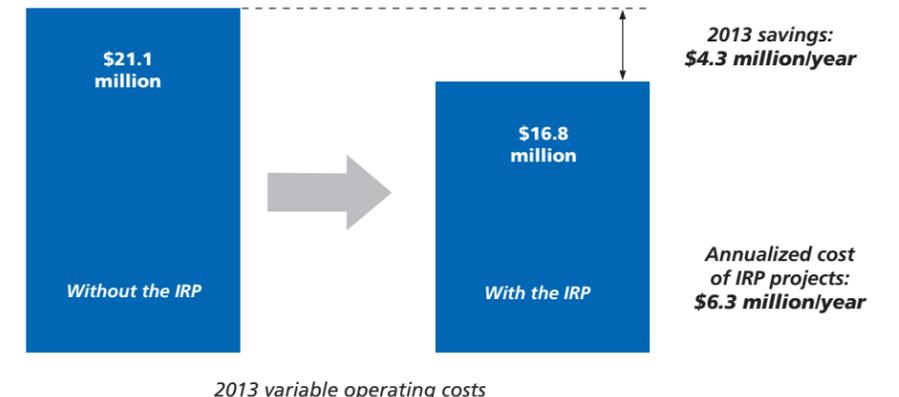
value. Without those investments, in a drought year ACWD likely would need to purchase water from elsewhere in the state. In previous exchanges these supplies cost between \$300 and \$400 per acre-foot for raw water — almost ten times the unit cost of State Water Project supply — and could be much higher in a severe drought. Avoiding the uncertainty of these potentially large costs is another benefit of the IRP investments.

How does the cost of implementing the IRP compare with these savings? Through mid-2013 the costs of

developing desalination and groundwater banking, supporting conservation, and upgrading the Quarry Lakes Groundwater Recharge System totaled \$109.8 million. Assuming an interest rate of roughly 4 percent and a 30-year repayment period, the annualized cost comes to \$6.3 million. Compared with the projected annual cost savings in 2023 of \$8.5 million per year and coupled with the water supply reliability improvements, the IRP projects are proving to be valuable investments for the Tri-City region's water future.

Cutting Costs

IRP investments in desalination and conservation have reduced the amount of water ACWD must purchase from the San Francisco Public Utilities Commission to fulfill customer demands and meet water quality targets. This shift saved roughly \$4.3 million in 2013, and will grow as the price of SFPUC water increases.



2013 variable operating costs

ACWD's top water quality priority is to provide water that is always safe to drink. To that end, District staff collect samples daily from water sources, treatment facilities, and the distribution system. In a year, the District's lab analyzes roughly 45,000 samples, an average of 123 per day. The District tests for more than 180 substances, including microbes, metals, pesticides, and organic chemicals (such as from industrial or oil/gasoline pollution). The results from these tests are summarized in an annual water quality report mailed to all customers and available on the District website. The water ACWD delivers to customers is of higher quality than state and federal health standards require on every parameter tested.

In addition, ACWD works with state regulators and businesses to monitor and respond to potential threats to the quality of water in the Niles Cone Groundwater Basin, such as underground fuel storage tanks. Because of the aquifer's central role in ACWD's water supply system, the District takes great care to prevent contamination.

A secondary but important water quality issue is hardness. The hardness of water is a function of the concentration of dissolved calcium and magnesium. These minerals occur naturally in the Niles Cone Groundwater Basin, and water from the District's production well fields is considered to be very hard.

Hardness is not a health concern, but it can be an aesthetic issue and can lead to problems in both domestic and industrial settings. In homes, hard water can, for instance, promote scaling inside hot water heaters; cause soap scum to form in showers and sinks; and make laundry detergent less effective. Hardness also can influence the taste of water delivered to customers. Such taste changes tend to be most noticeable when water hardness changes abruptly.

ACWD's diverse water supplies make managing hardness particularly challenging. While these multiple sources confer crucial reliability benefits — and are considered evidence of good

water planning practices — each source has a different hardness, meaning that providing customers with aesthetically consistent water is difficult.

Hardness is measured in milligrams per liter (mg/L). Water pumped from the Niles Cone Groundwater Basin is roughly 300 mg/L (320 mg/L from the Mowry Well Field and 280 mg/L from Peralta-Tyson). ACWD's surface water sources are substantially softer: an average of 30 mg/L for SFPUC water and roughly 100 mg/L for State Water Project supplies.

Water hardness by region in the ACWD Service Area

There are three water hardness "zones" in the ACWD service area because of differences in the hardness of water supplied by the District's four production facilities. Union City and northern Fremont (green shaded area) receive water from the Blending Facility, which mixes local groundwater with SFPUC supplies. Newark and adjacent parts of Fremont (orange) are served by the Newark Desalination Facility. Central and southern Fremont (blue) receive water from Water Treatment Plants 1 and 2; these two facilities treat surface water — from the State Water Project and runoff captured in Lake Del Valle — delivered through the South Bay Aqueduct.

Water produced at the Newark Desalination Facility is delivered to customers at a hardness between 60 and 90 mg/L.

The hardness of water delivered to customers varies with geography because different regions within the ACWD service area are supplied from different production facilities. Meeting the IRP hardness target is a challenge only at the Blending Facility, where hard local groundwater is combined with soft SFPUC supplies.

Water from other sources generally is well below the target levels.

Managing Hardness

ACWD's hardness-related water quality goal, established through the 1995 IRP process and subsequent assessments, is to provide water to all customers with an average monthly hardness of approximately 150 mg/L.

For many years, the District struggled to meet this target: In summer, the hardness of water from the Blending Facility would rise well over 150 mg/L as high overall demand (mainly due to increased outdoor irrigation) would force increased pumping of Niles Cone groundwater, driving up the ratio of hard groundwater to soft SFPUC water. Managing hardness is complicated by the fact that the simplest tool

for reducing hardness — purchasing more SFPUC water — is very costly.

Recently, however, the District has reached the target, within a tolerance of plus or minus 10 percent, by using a new operational strategy and taking advantage of desalination and reduced water demand (an example of how IRP projects can deliver multiple benefits).

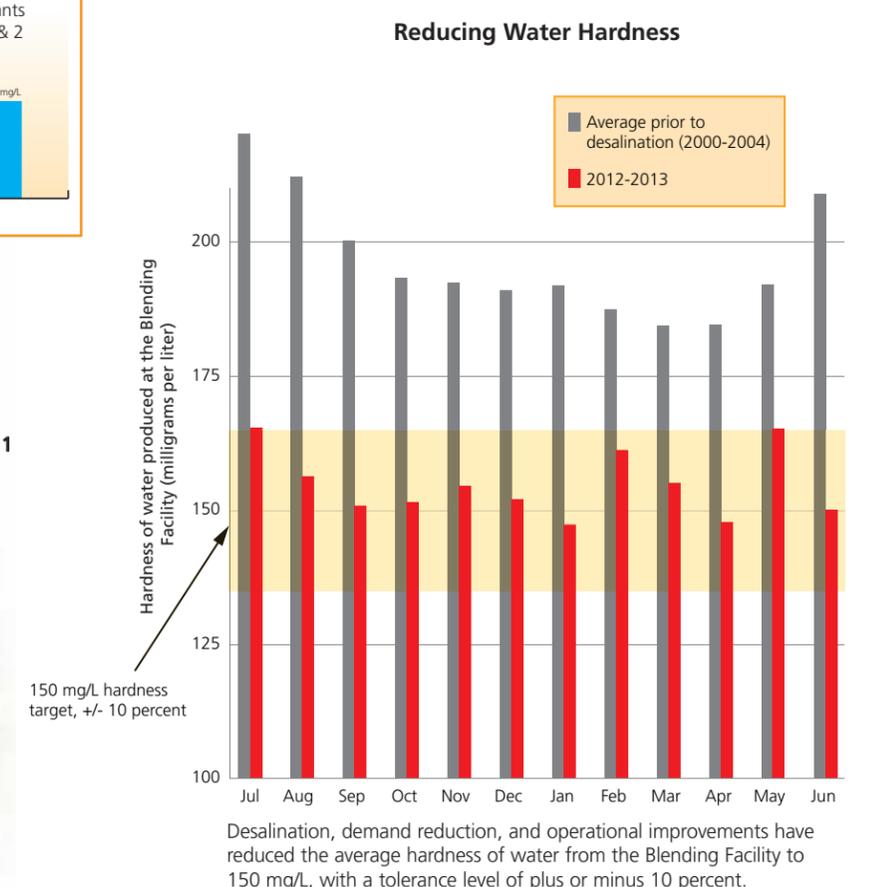
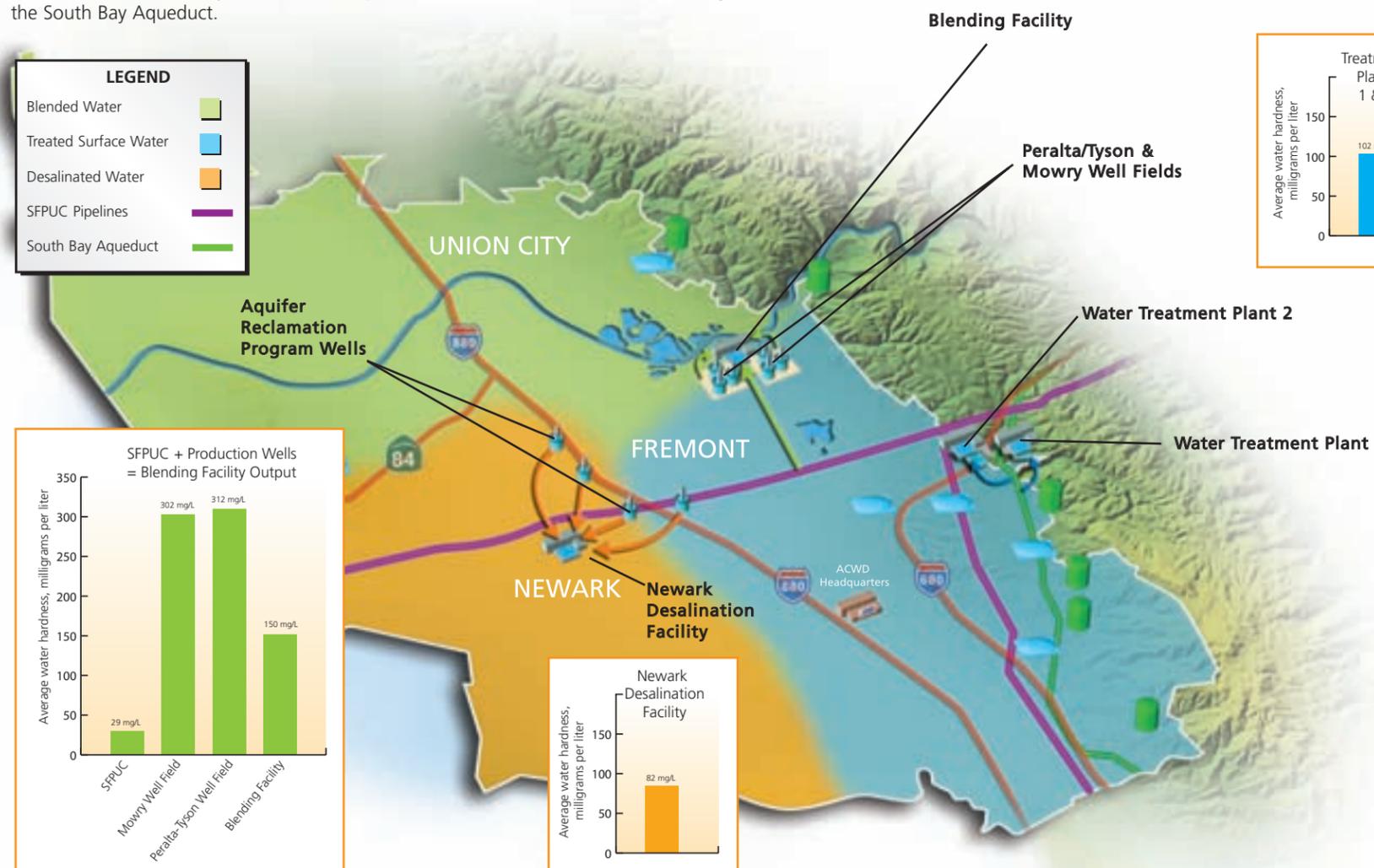
Optimizing operations: The District is continuing to work to optimize SFPUC water use throughout the year to meet hardness targets while also keeping costs in check.

Desalination: The addition of the Newark Desalination Facility provided a large new source of water,

reducing the demand on the Blending Facility; at lower production rates, it is easier to maintain the ratio of groundwater to SFPUC water needed to meet the hardness goal.

Demand reduction: Similarly, lower overall water demand helps reduce the load on the Blending Facility, which facilitates lower-hardness water.

Groundwater bank withdrawals: In the most recent IRP update, ACWD determined that in many years it will be cost-effective to withdraw water from the Semi-tropic Groundwater Bank to reduce the load on the production wells and mitigate hardness.



By implementing IRP recommendations including conservation, operational changes, and targeted investments in desalination and storage, ACWD has improved the reliability and quality of water in the Tri-City area — despite new restrictions on imports of water from the Sacramento-San Joaquin Delta.

CHALLENGES

Today, ACWD is preparing for the next generation of water supply challenges:

The Delta: While the prognosis for the hub of California’s water system is unclear, it appears likely that the future will bring either further reductions in the reliability of water exports or substantial cost increases — or possibly both.

Changing growth patterns: The Tri-City region continues to evolve. In the twentieth century, suburban houses and industrial buildings replaced agricultural operations that dated to the nineteenth century. Today’s new residential and business developments emphasize higher density and access to transportation hubs. These changes will bring new and different types of demand for water.

SFPUC water costs: By 2023, the cost of water imported via the Hetch Hetchy Aqueduct is scheduled to be roughly \$2,200, more than twice the real (inflation-adjusted) cost in 2011.

Climate change: Climate change presents potential challenges for ACWD on both sides of the water ledger. Higher temperatures may increase local landscaping water demands. On the supply side, water availability could be altered in several ways: changes in local precipitation patterns could reduce groundwater recharge; a smaller Sierra Nevada snowpack may reduce the availability of imported supplies; and sea-level rise may reduce the effective storage capacity of the Niles Cone Groundwater Basin.

OPPORTUNITIES

To manage these challenges, ACWD is building on the experience and investments of the last 20 years. The 2013 IRP Review evaluated a number of strategies that represent new applications of the water management tools developed through the original IRP process: increasing reliance on local water sources, optimizing management of existing water supplies, improving operational efficiency, and maximizing conservation.

Conservation: As the region grows, continued conservation can moderate increases in water demand. The IRP review is assessing cost-effective conservation measures, particularly those



Fixing a broken valve on a water main

that reduce summer demand. Under current water supply conditions, if total demand remains below approximately 61,000 acre-feet per year, ACWD will not need to develop another major source of water. This threshold is important, because ACWD’s next available option for new water supply — developing a full-scale, \$120-million recycled water program — is costly.

Increase use of State Water Project facilities: Changes in State Water Project operations have increased the annual availability of storage space in San Luis Reservoir. ACWD and other water agencies are entitled to use a portion of this space to store water (known as “carryover water”) that wasn’t used in the previous year. ACWD has identified ways to use this resource more effectively to help reduce water shortfalls in dry years and offset costly SFPUC purchases in normal years. This water management approach adds no new costs. As the demand for State Water Project supplies continues to grow, this resource stands to increase, because it is likely that storage space will be available in San Luis Reservoir more frequently.



Fishing the Quarry Lakes at sunrise



Maximizing efficiency: As water flows downhill from the South Bay Aqueduct into ACWD’s Water Treatment Plant 2, it passes through these hydroelectric turbines, generating more than enough power to run the facility.

Operational efficiency: ACWD continues to evaluate ways to lower expenses by streamlining the water supply process. Current analyses are exploring the benefits of shutting down certain facilities during low-demand periods rather than keeping them running at a low rate, as is the current practice.

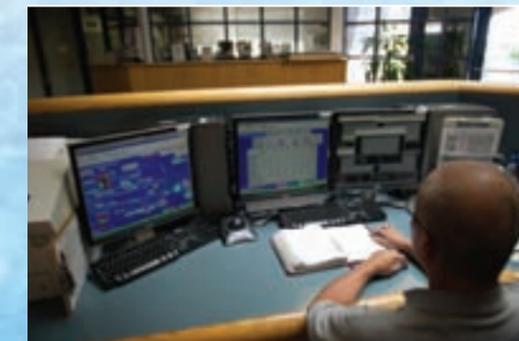
Selling surpluses: While water demand within the District remains low, ACWD will continue to look for ways to sell surplus water. Proceeds from sales would help to offset operating costs and reduce upward pressure on water rates. Transactions would be structured to have no impact on service to ACWD customers or local economic growth. Further, any water sales would be temporary and would not reduce ACWD’s long-term water availability. Current investigations are focused on selling the additional water that could be made available in winter months by running the Newark Desalination Facility at full capacity. The plant now runs at a reduced rate in winter because of low demand.

Alternative rate structures: The District is studying the effects of water rate structures that encourage efficiency while also providing stable revenue to cover the District’s fixed costs. Such rate structures could reduce year-to-year variations in rate increases while offering improved affordability for customers who use little water.

Expanding regional partnerships: ACWD is expanding regional partnerships and investigating opportunities to combine the use of water resource assets in ways that are mutually beneficial. For example, in 2013 ACWD initiated the development of a pilot program to store surplus supply in Contra Costa Water District’s (CCWD) Los Vaqueros Reservoir,

which currently has spare capacity. The stored water may improve reliability and reduce overall cost for ACWD while reducing CCWD’s overhead operating costs for the reservoir.

Water recycling: While ACWD does not plan to develop a full-scale recycled water system until at least 2035, it already has a small but growing network of non-potable water distribution pipes. These pipes are being installed as part of new developments and at sites undergoing major renovation, in anticipation of the need to use recycled water in the future. To take advantage of the non-potable distribution system in the near term, ACWD is considering using it to deliver raw (unblended) groundwater to industrial customers and landscape irrigation sites. The plan was evaluated as part of the 2013 IRP review and would include the construction of a new well field. Because unblended groundwater is very inexpensive to produce, this strategy could cut costs



Operator at Treatment Plant 2

while reducing demand on ACWD’s potable water sources.

Climate change adaptation planning: ACWD will begin the process of developing a climate change adaptation plan in the coming years. Because the magnitude of the impacts of climate change on the District is highly uncertain, ACWD will follow a “no regrets” philosophy, seeking to identify actions that will be good long-term investments regardless of the severity of future changes in temperature, local rainfall, sea level, and imported water reliability. For example:

Reducing hot-weather demand: Investments to reduce hot-weather water demands (from, for instance, evaporative cooling towers and outdoor irrigation) would improve ACWD’s ability to cope with future temperature increases. But at the same time, these investments would also improve reliability and reduce operating costs today.

Alternatives to new storage: With sea level rise projected to reduce the storage capacity of the Niles Cone Aquifer, one response would be to develop costly water storage to balance the expected loss. But the “no regrets” path suggests that the District first should seek to reduce the need for water storage by increasing summertime water conservation and using existing storage options differently — a lower-cost strategy that will benefit the District and its customers regardless of the ultimate course of climate change.

Climate-change planning can be seen as a new application of the methodologies and resource alternatives developed through the District’s Integrated Resources Planning process. In both cases, the objectives are the same: Prepare ACWD to adapt to change and provide reliable water in the future, while optimizing operations and containing costs today.

Acre-foot: A standard measurement used by water resource managers. An acre-foot equals 325,851 gallons, the amount of water required to cover an acre of land to a depth of one foot.

Aquifer: An underground pocket of porous material – such as gravel or sand — that contains water. Water in an aquifer is called groundwater.

Brackish groundwater: Groundwater that is too salty to be used as a municipal supply without desalination treatment.

Climate change adaptation planning: The process of developing strategies for responding to the potential effects of climate change, including sea level rise, changes in local precipitation, and changes in the availability of imported water.

Conjunctive use: The practice of coordinating the use of surface water and groundwater resources to increase overall water supply reliability. In ACWD's case, conjunctive use refers to the practice of recharging the Niles Cone Groundwater Basin when surface water supplies are plentiful, and withdrawing the stored water when less surface water is available.

Demand management: Taking action to reduce the amount of water customers use (see pages 18-21).

Desalination: The process of removing salt from water. ACWD uses a desalination technology called reverse osmosis, which involves forcing water through membranes with pores so small that dissolved salts cannot pass through.

Groundwater: Water underground in an aquifer.

Groundwater recharge: The process by which water percolates from the surface to fill vacant space in an aquifer. ACWD recharges the local groundwater basin by diverting water into the Quarry Lakes Groundwater Recharge System.

Groundwater bank: A water management arrangement in which an aquifer is used as a long-term storage space for water. Water can be put into the aquifer in wet years and withdrawn in dry years.

Groundwater basin: A region defined by the horizontal and vertical extent of an aquifer or a series of stacked aquifers. ACWD manages the Niles Cone Groundwater Basin, which consists of multiple aquifers at different depths (see pages 12-13). The boundaries of the basin are shown on page 5.

Hardness: A measure of the amount of certain minerals — typically calcium and magnesium — dissolved in water. "Soft water" has low concentrations of these minerals, while "hard water" has higher concentrations. High hardness can affect the taste of water and lead to mineral deposits on plumbing fittings and other problems.

Imported water: Water that is transported by aqueduct to the ACWD service area. ACWD's imported sources are the State Water Project and the San Francisco Public Utilities Commission water system.

Integrated Resources Plan (IRP): A water resources plan that outlines a comprehensive strategy for matching water supplies with customer demands. See pages 4-5 for a full explanation.

Non-potable water: In the context of ACWD, this term refers to local groundwater that has not been blended with surface water sources to reduce its hardness to District standards, but is suitable for certain landscaping and industrial uses.

Recycled water: Wastewater that has been treated so that it can be used again.

Seismic: Having to do with earthquakes. A "seismic retrofit" is a modification meant to make a structure

capable of withstanding a major earthquake.

Surface water: Water that is flowing in a stream or stored in a lake or reservoir. Water from a stream or reservoir that is delivered to ACWD through an aqueduct is considered surface water.

Watershed: An area of land defined by a common drainage point. The Alameda Creek Watershed, for instance, is an area of roughly 633 square miles within which all streams drain into Alameda Creek.

Water mains: The large pipes that distribute treated water throughout the ACWD service area. Smaller pipes, called laterals, connect mains to homes and businesses.



For more information

If you have any questions or need any more information about ACWD, please let us know. We would also appreciate any comments you have about this report. We can be reached at:

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Meetings of ACWD's Board of Directors typically begin at 6:00 p.m. on the second Thursday of each month and are open to the public. Meetings are held in the ACWD Board Room at the District's headquarters at 43885 South Grimmer Boulevard in Fremont. Further information regarding the Board meeting schedule can be found on the calendar on our website.

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