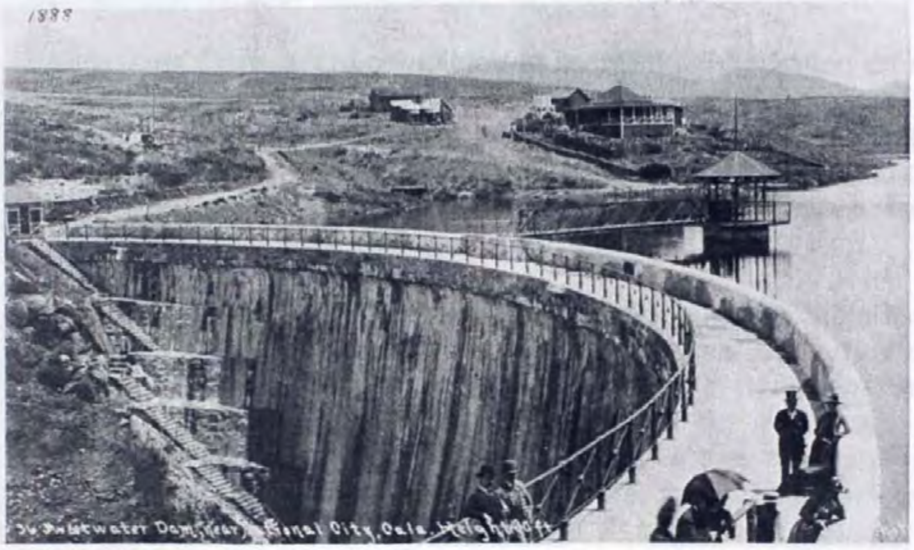
Sweetwater Dam: Then and Now

By Richard A. Reynolds
August 2, 2008



Sweetwater Dam is a very important element of the water supply to the South Bay communities. It is the key to treatment and distribution of local runoff and imported supplies. This year is the 120th in its long history in this important role. The dam, as you will see in this paper, has withstood many challenges and trials from storms that brought runoff flows from the watershed to the 100-year storm levels. A major storm in 1895, only seven years after completion of the dam, overtopped the dam by nearly two feet. This was proof of the core strength of the gravity arch configuration to withstand hydraulic forces.

Sweetwater Dam, when completed in its initial configuration on April 7, 1888 **(Figure 1)**, represented the latest design concept for masonry dams and, at its original completed height of 90 feet, was the tallest masonry, gravity arch dam in the United States. It was completed just in time to quench the thirst of South Bay residents and to ensure their hopes for land speculation, municipal growth and agricultural success.

In his Nobel Prize winning novel, "*East of Eden*", John Steinbeck was describing people in California (albeit, in the Salinas Valley) and their awareness of water conditions in general when he wrote, "*And it never failed that during the dry years the people forgot about the rich years, and during the wet years they lost all memory of the dry years. It was always that way.*" And so it was here in the South Bay. Before the dam was completed, our area was experiencing a drought. But, as it happened, the dam was completed and was filled by storms that year. For a time the dam was a marvel, a tourist site to be visited by rail, by horse and buggy, or even on foot. But, soon the dam was accepted as the structure needed to provide water for commerce to be successful in the area and to allow the subdivision and sale of lots in the Rancho de la Nación and to ensure the success of agricultural crops that were to be raised on those lots. These were the reasons why there was to be a Sweetwater Dam.

The question of "How a dam came to be needed in its particular location," cannot be answered unless we go back in time to 1830 when John Forster, a 16 year old Englishman **(Figure 2)**, left his parents' home in Liverpool, England. He took passage on a sailing ship to Valparaiso in Chile and then traveled on to Sonora, Mexico on the west coast of mainland Mexico where his uncle put him to work in his trading firm of Johnson and Aguirre. By 1833, Forster had "learned the ropes," as they said on the "square rigged ships," and was sent to Los Angeles, in Alto California, to work in the firm's trading business there. A year later, Forster started his own trading business which dealt in animal hides, horns, tallow and local wines.

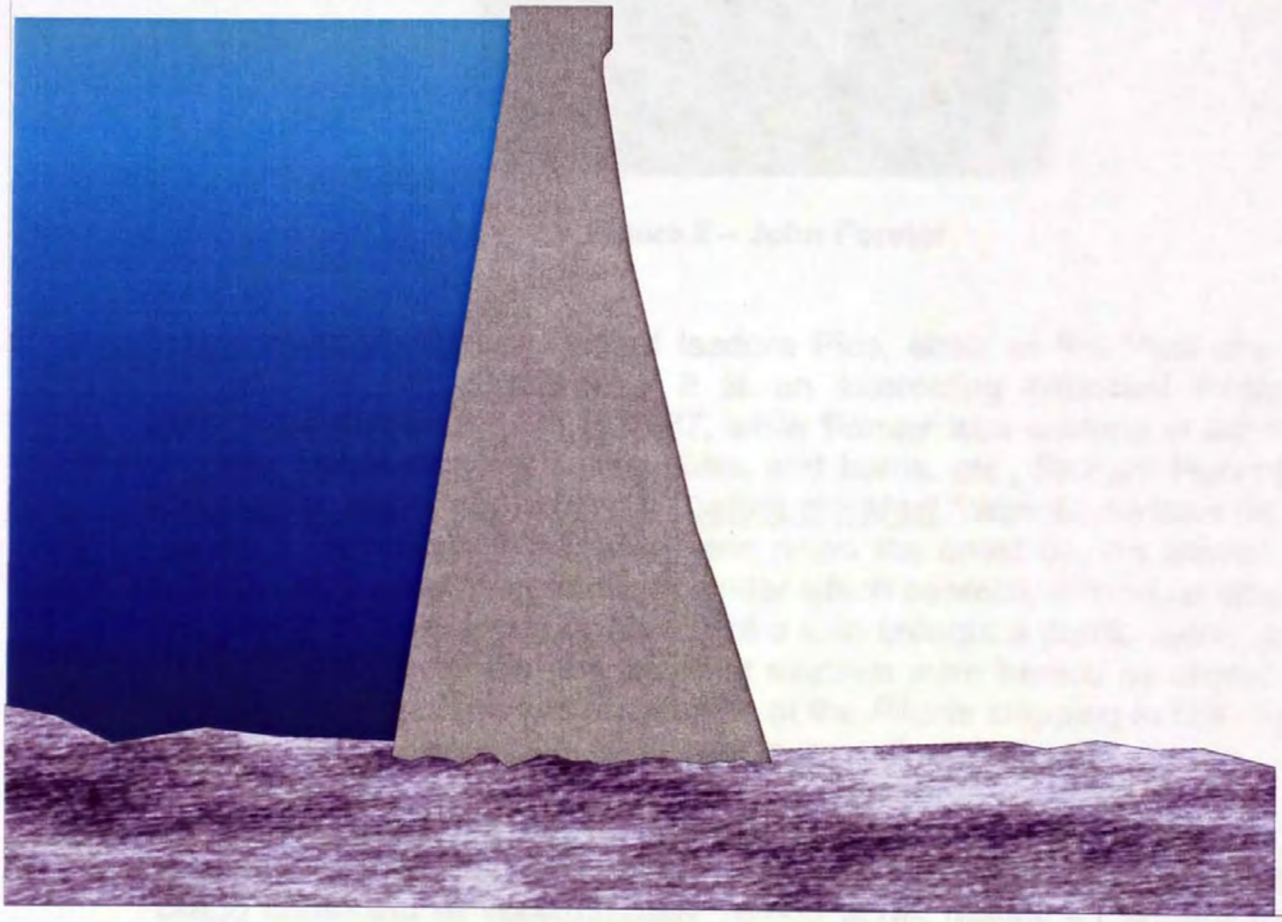


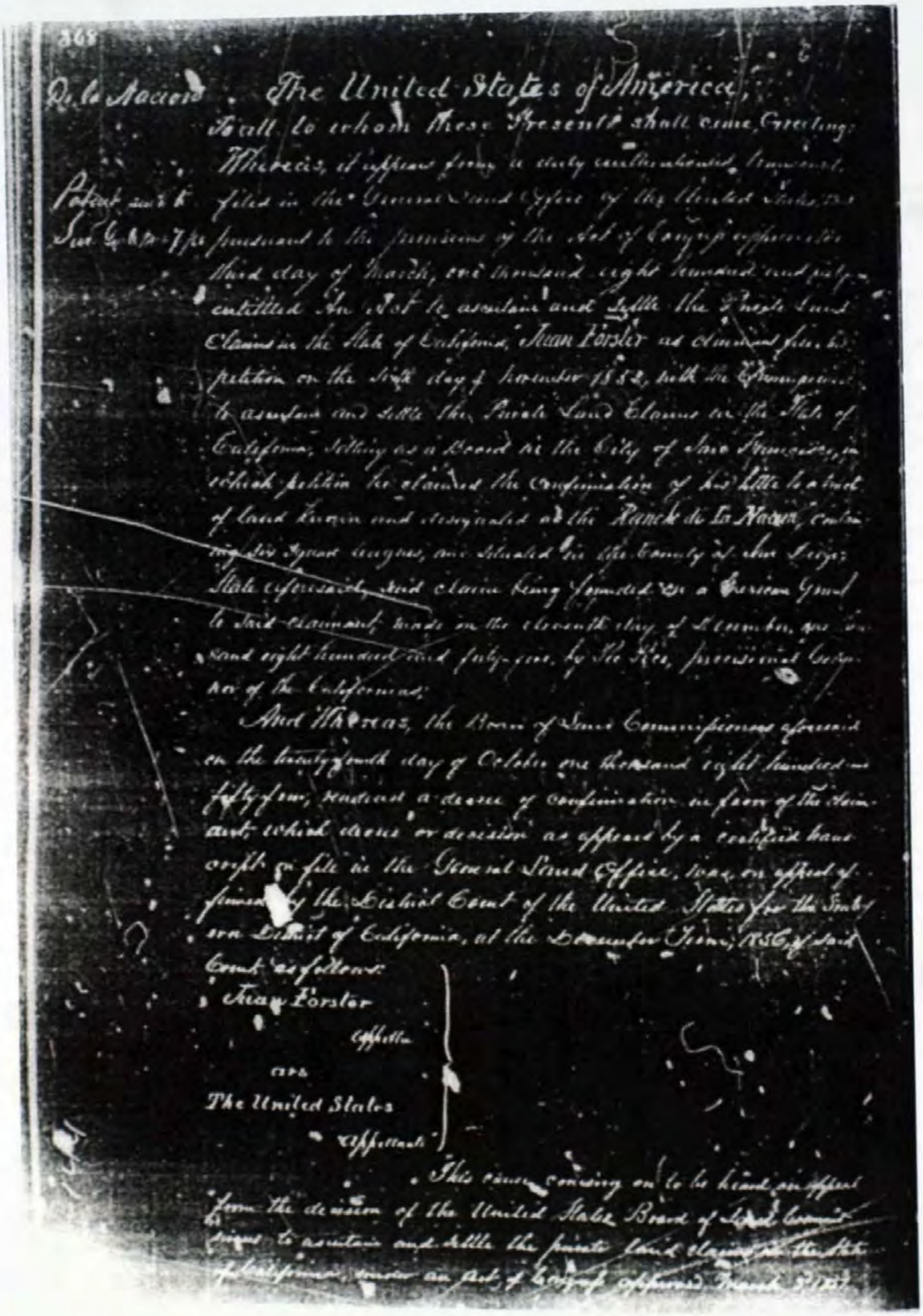
Figure 1 – Sweetwater Dam @ 90' High

Figure 2 – John Forster

In 1837, Forster married Isadora Pico, sister of Pio Pico and future Governor of Alto California. It is an interesting historical footnote to remember that from 1834 to 1837, while Forster was working in the trading industry in Los Angeles selling hides and horns, etc., Richard Henry Dana, **(Figure 3)**, author of *"Two Years before the Mast,"* was a crewman on board the brig *Pilgrim,* which sailed up and down the coast buying animal hides. Dana's book about the conditions under which seamen worked on ships and the power of the Captain or Master of a ship brought a public outcry and led to significant changes in the way that seamen were treated by captains and officers of a ship. There is no mention of the *Pilgrim* stopping in Los Angeles, so apparently no possibility for Forster to meet Dana existed.

On August 26, 1846, Forster was given a Mexican Land Grant **(Figures 4 and 5)**, to the Rancho de la Nación, a parcel of land south of San Diego consisting of approximately 26,600 acres (nearly 41 square miles in area). The grant was made through his brother-in-law, Pio Pico, then Mexican Governor of Alto California, by the Alcalde (chief administrator) of the District. During the year 1846, war between the United States and Mexico was becoming certain as Mexican troops crossed the Rio Grande River to attack the American forces under General Zachary Taylor. By 1848, the war was over and settled by the Treaty of Guadalupe Hidalgo which gave the United States the areas of Texas, New Mexico, Arizona, Nevada and California, and compensated Mexico in the amount of $15 million. As the

Figure 3 – Richard Henry Dana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De la Nacion

The United States of America,

To all to whom these Presents shall come, Greeting:

Whereas, it appears from a duly authenticated transcript filed in the General Land Office of the United States, that pursuant to the provisions of the Act of Congress approved the third day of March, one thousand eight hundred and fifty-one, entitled "An Act to ascertain and settle the Private Land Claims in the State of California," Juan Forster as claimant filed his petition on the sixth day of November 1852, with the Commissioners to ascertain and settle the Private Land Claims in the State of California, sitting as a Board in the City of San Francisco, in which petition he claimed the confirmation of his title to a tract of land known and designated as the Rancho de La Nacion, containing six square leagues, and situated in the County of San Diego, State aforesaid, said claim being founded on a Mexican Grant to said claimant made on the eleventh day of December, one thousand eight hundred and forty-five, by Pio Pico, provisional Governor of the Californias;

Patent issued Jan [illegible] 7 [illegible]

And Whereas, the Board of Land Commissioners aforesaid on the twenty-fourth day of October one thousand eight hundred and fifty-four, rendered a decree of confirmation in favor of the claimant, which decree or decision as appears by a certified transcript on file in the General Land Office, was on appeal affirmed by the District Court of the United States for the Southern District of California, at the December Term, 1856, of said Court as follows:

Juan Forster
Appellee
vs
The United States
Appellants

This cause coming on to be heard on appeal from the decision of the United States Board of Land Commissioners to ascertain and settle the private land claims in the State of California, under an Act of Congress approved March 3d 1851

Figure 4 – Rancho de la Nación Land Grant

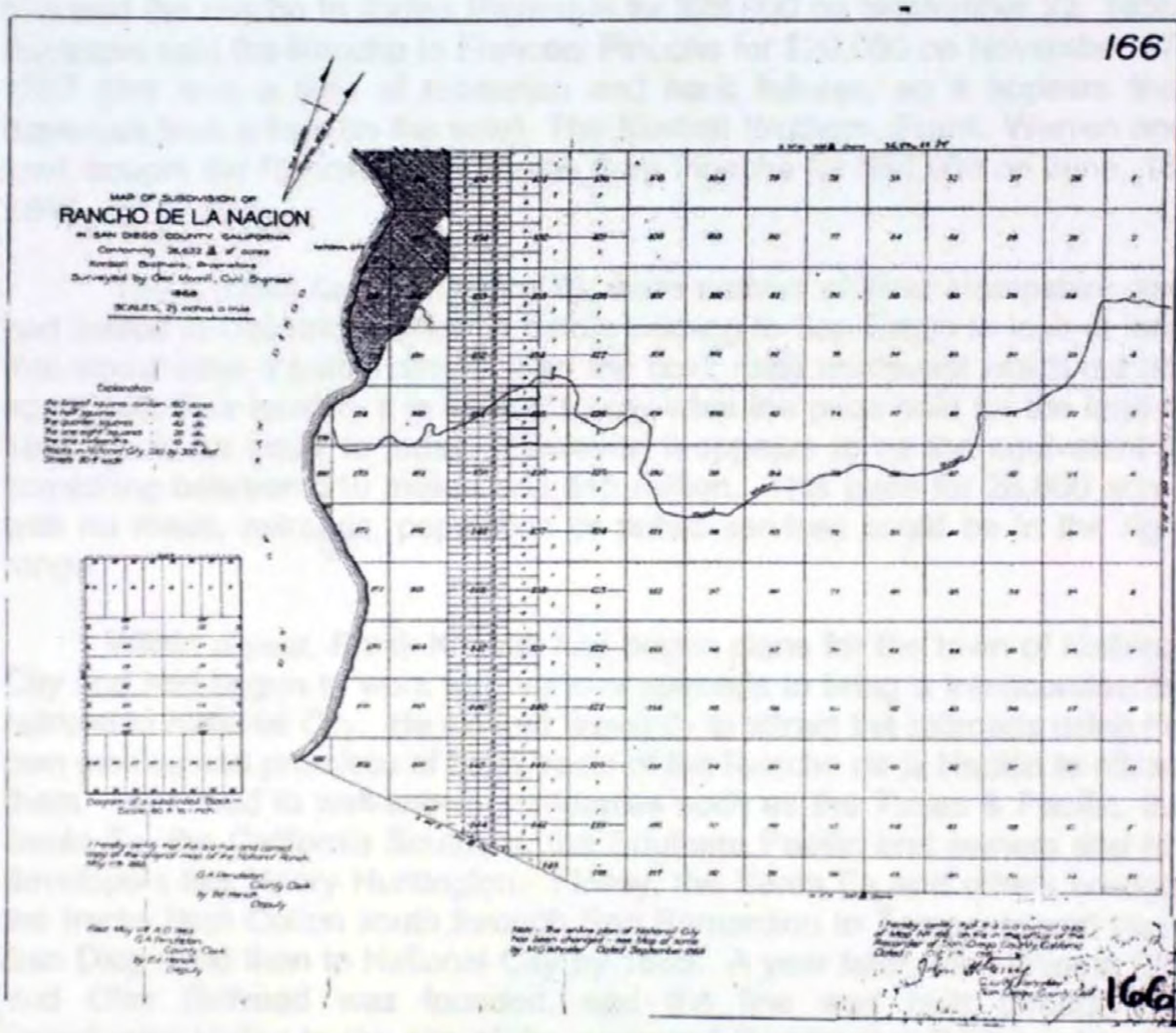

Figure 5 – Plat of Rancho de la Nación

US Government took ownership and control of the new treaty lands, Mexican Land Grants were allowed to remain as private lands. Later, proof of land ownership prior to the treaty was required to be established by filing a US land patent, in order to ensure clear title to the land. Forster filed and was granted a US land patent number MC4:4-0379 on February 27, 1866, after he had sold the rancho to Joules Bayerque for $25,000 on September 22, 1855. Bayerque sold the Rancho to Francois Pinoche for $20,000 on November 17, 1857 (this was a time of recession and bank failures, so it appears that Bayerque took a loss on the sale). The Kimball Brothers, Frank, Warren and Levi, bought the Rancho de la Nación from Pinoche for $30,000 on June, 18, 1868.

The Kimball family, **(Figure 6)**, were natives of New Hampshire and had settled in Oakland, California before coming to San Diego to look at land that would have a better climate than the cold, rainy northwest which did not agree with their health. It is difficult to say what the price paid for the land in 1868 would be equal to today. However, it appears to be the equivalent to something between $10 million and $15 million. This price for 26,600 acres with no roads, railroads, population or public services could be in the right range.

Within a year, Frank Kimball had begun plans for the town of National City and had begun to work with various railroads to bring a transcontinental railroad to National City. He worked tirelessly to attract the railroads using his own monies and promises of large tracts of the Rancho de la Nación to attract them. He talked to well-known companies such as the Texas & Pacific, the Santa Fe, the California Southern, the Southern Pacific and owners and rail developers like Henry Huntington. Finally, the Santa Fe and others brought the tracks from Colton south through San Bernardino to Temecula and on to San Diego and then to National City by 1885. A year later, the National City and Otay Railroad was founded, and the line was built through the Sweetwater Valley to the site of the proposed Sweetwater Dam by July 23, 1887 **(Figure 7)**. It had been seventeen years of travel, hard negotiations and expenditures of monies, much of which were borrowed against the land, to bring about the construction of the railroad. Now, with the means of shipping materials and people into the area by rail or by ship and the ability to move crops and manufactured goods out, the next challenge to the goal of creating a thriving city and a prosperous agricultural region was a dependable water supply.

It was John Wesley Powell, **(Figure 8)**, explorer and geologist who in 1867 explored the Rocky Mountains and the Colorado River to report back to President Andrew Johnson about the western territory. On his return, he was

Frank Kimball

Levi Kimball

Warren Kimball

Figure 6 – Kimball Family

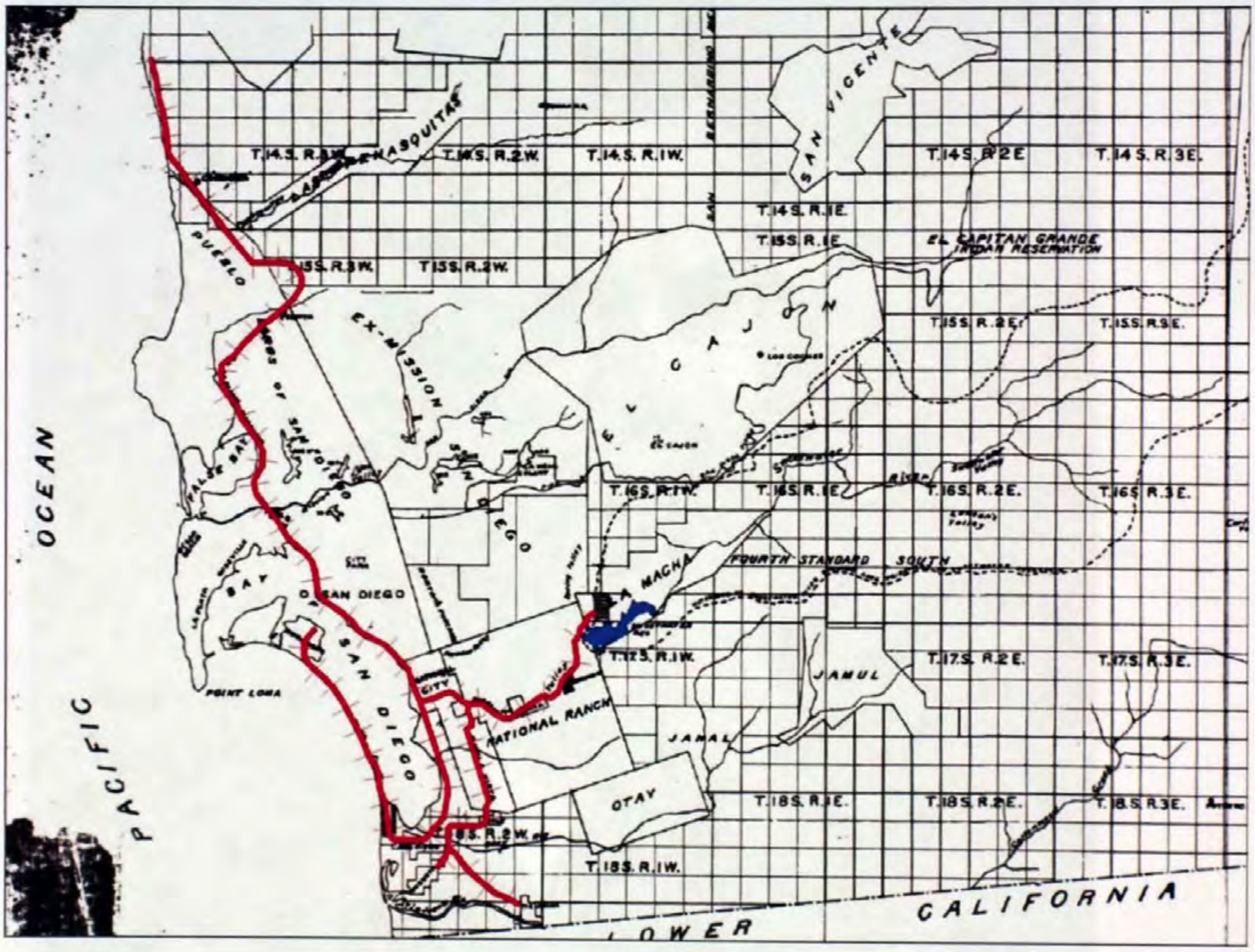

Figure 7 – Railroad to Sweetwater Dam

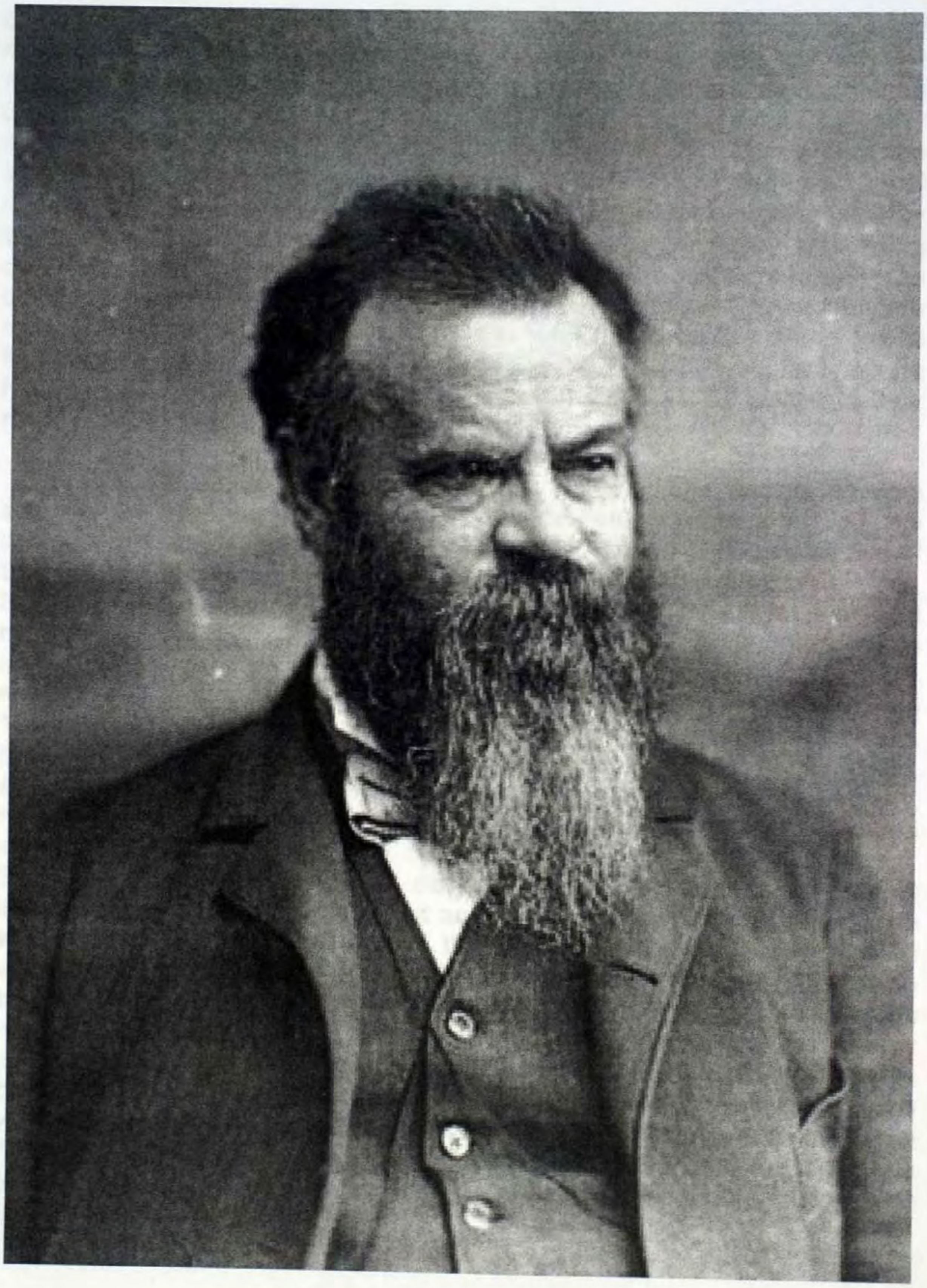

Figure 8 – John Wesley Powell

quoted as saying, *"In the whole region, land as mere land is of no value. What is really valuable is the water privilege."* So why, you may ask, did the Kimballs give $30,000 for the Rancho de la Nación? The answer is that the Sweetwater River at that time flowed almost all year long. It was only after enough people and agriculture came to the area that the river, without the ability to store water, was overtaxed. When the surface flow of the river could not provide what was needed, Kimball dug pits in the river and sold water by the bucket or the barrel. At this point, the "Water Privilege" was being overtaxed and the need for a reservoir for the long-term storage of water was obvious if the land were to be made more valuable. Kimball and his brothers rode their horses all over the Rancho de la Nación's 41 square miles. When Kimball saw the narrow gorge of the Sweetwater River Canyon, he knew he had a prime location for a reservoir and that it could be harnessed to their needs.

With the completion of the railroad to National City, and to the dam site, and the Seventeenth Street pier which had been completed in 1871, the means to get materials to the dam site now was in place. The construction of Sweetwater Dam began on November 17, 1886 under the direction of F. E. Brown. Brown's design for the dam was unusual. It was a slender, thin shell masonry arch dam which had a 10-foot bottom width and an 8-foot top width and was 50 feet high. Construction was well underway when, after two months, Frank Kimball and the management of the San Diego Land and Town Company became dissatisfied with the design and progress of the dam. Kimball did not feel comfortable with Brown or the slenderness of his design. After discussions with the board of the San Diego Land and Town Company, Kimball contacted James Dix Schuyler **(Figure 9)**, then assistant state engineer, and persuaded him to come to the dam site to inspect the dam. Schuyler suggested a different design utilizing the existing works but increasing the base width to 26 feet and using a series of three steps in the width on the down-stream face of the works to allow the future upward extension of the dam to be bonded to the original works. He also recommended raising the height to 60 feet. Schuyler's suggested changes modified the design from a slender masonry arch dam to a gravity masonry arch dam. This is very important, as we will see later, because Brown's design depended on the strength of the masonry arch alone to withstand the water forces and to then transmit them to the abutment material, while Schuyler's gravity masonry arch would withstand the water forces by nature of the weight of its cross section and also utilized the strength of the arch to increase the rigidity of the dam.

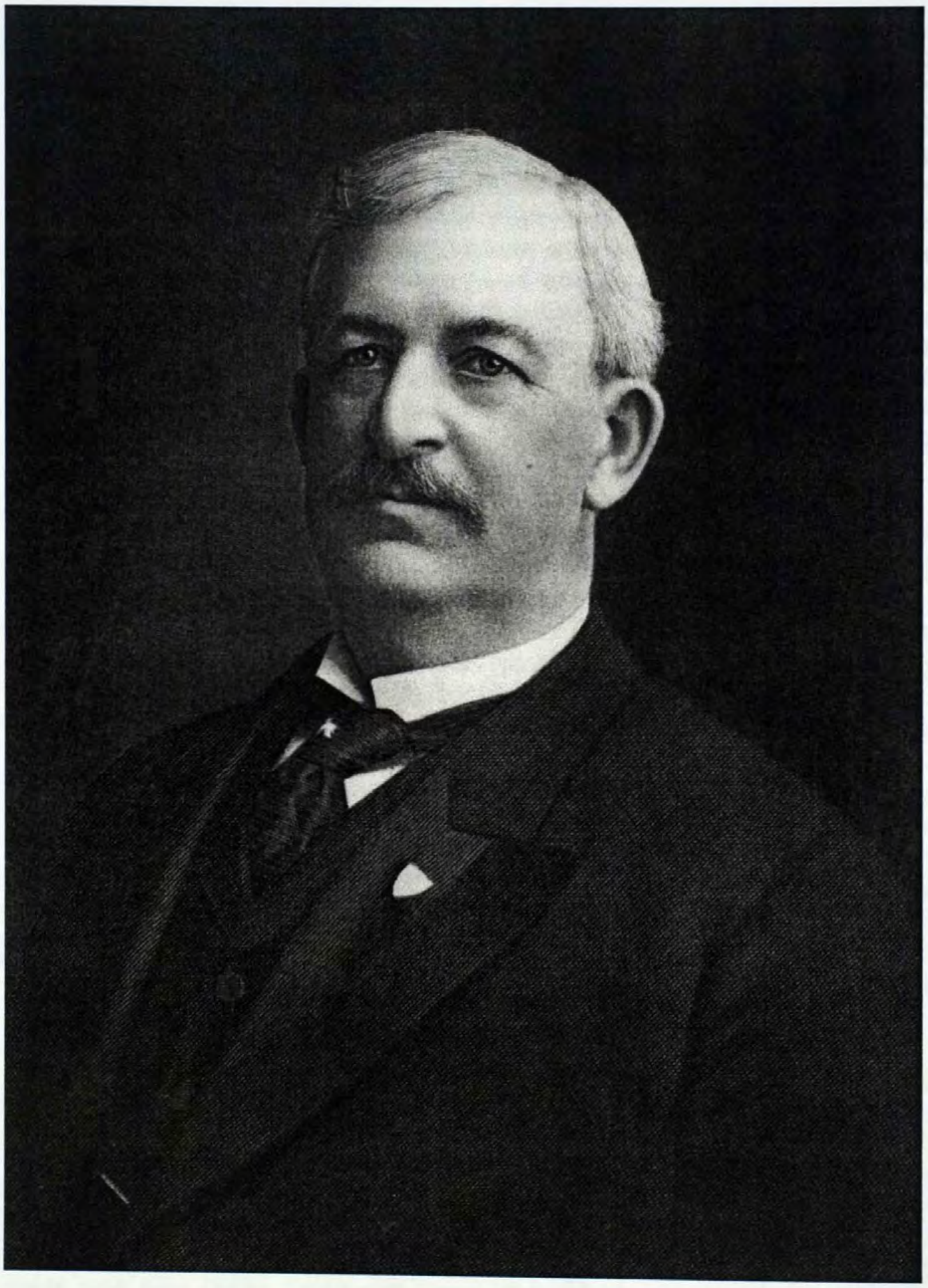

Figure 9 – James Dix Schuyler

Surveys of the watershed and the catchment area were proceeding as the construction continued. With the completion of the dam to 60 feet, the survey results showed that the storage capacity of the dam would be approximately 3,700 acre-feet of water; but that the capacity could be increased by nearly five times to slightly more than 18,000 acre-feet, if the height of the dam was increased to 90 feet. At this height the dam was expected to fill annually. The new dimensions of the 90-foot-high dam were 12 feet at the top, 46 feet at the bottom with a crest length of 360 feet. On the north side of the dam the abutment was keyed into firm material, and on the south side of the dam two spillway chutes, through the dam, were constructed into the abutment material, which was protected by a wall. The San Diego Land and Town Company board approved the plan to raise the dam and engaged James Dix Schuyler to design and supervise the construction of the dam to a height of 90 feet. The dam was completed on April 7, 1888.

It is interesting to note that the dam was constructed using mules and horses pulling wagons and providing the power for derricks to lift up to 7,000 pound rocks and for mortar mixing devices to mix all of the cement mortar to be used in the rock masonry construction of the dam, and convey it to the exact location required. The rock was quarried from a site 800 feet west of the dam on the south side of the canyon. Sand came from the local area around the dam, and the approximately 18,000 barrels of cement used in the construction of the dam were transported by sailing ships from Belgium around the Horn of South America to the Seventeenth Street Pier in National City, then by wagon or rail to the dam site. Likewise, steel came by rail from producers on the east coast of the US, by rail and wagon or, later, all the way by rail. The total cost of the dam including all labor, tools and materials totaled $234,074.11. This represents a cost that would be hard to duplicate with an expenditure of $100,000,000 in today's economy, particularly with the studies, environmental work and mitigation that would be required in today's construction climate.

In 1895, winter storms caused the lake to fill and to overtop the dam along its entire crest by as much as 22 inches of water for 40 hours **(Figure 10)**. These flows did damage to the left and right abutment and the spillway chutes. The owners were relieved that the dam held, but, concerned, they decided to increase the side channel spillway capacity to reduce future depth of flow over the crest. A drought began in 1897 and persisted until 1904. During this period, the Sweetwater Water Company bought the water rights and San Diego Land and Town Company's ownership of the water company.

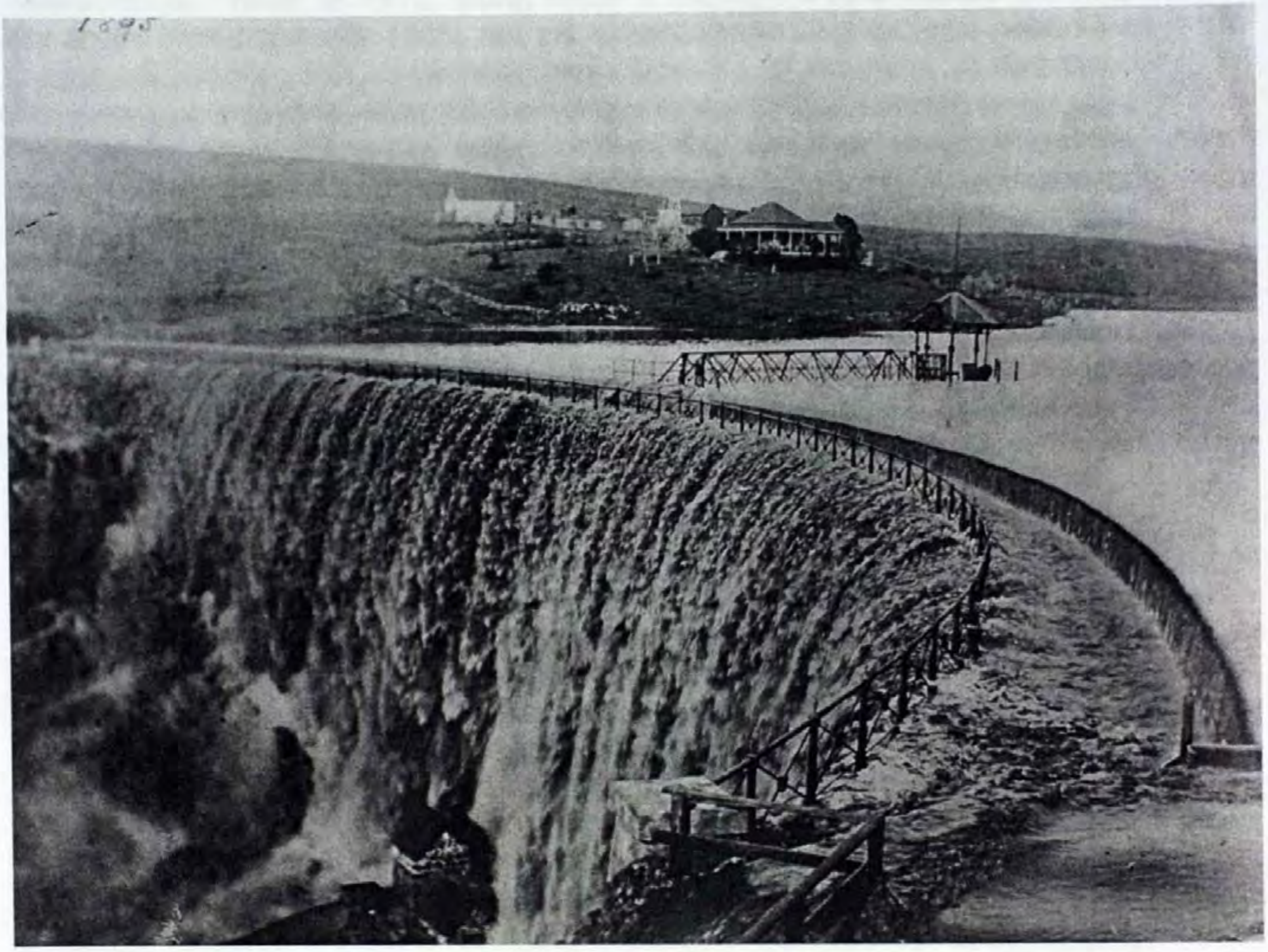

Figure 10 – Sweetwater Dam Spilling in 1895

Over the two-year period of 1910 and 1911, James Schuyler was again engaged to raise the crest of the dam with a 20-foot-high parapet wall which made the new height of the dam 110 feet. The wall increased the storage capacity of the dam to more than 26,000 acre-feet and reduced the chances that the dam would be overtopped. To offset the force of the additional depth of water stored behind the 110-foot-high dam, a massive concrete pour was placed on the downstream side of the dam. Schuyler called this concrete a "mass cyclopean concrete gravity section." The purpose of the additional concrete was to increase the weight of the gravity section of the arch to resist overturning by the weight of still water. The left abutment on the south side of the dam was fitted with an overflow weir with two chutes to discharge water flowing over the weir.

Life was good. Water was plentiful. People flocked to the South Bay communities. Then, in 1912, along came a Drought with a capital "D." The dry times lasted through 1915, not an exceptionally long drought period by current standards. But, remember there were no alternatives at that time. There was no imported water from the State Water Project to bring water from the Feather River 600 miles away, or from the Colorado River 300 miles away. There were no 800-foot-deep groundwater wells, no desalination of brackish groundwater or sea water, no regional mammoth storage lakes built to store water supplies for enduring drought conditions, and no huge aqueducts to bring imported and regional long-term stored water to San Diego. For that matter, the people were not offered low-flow shower heads or faucet-flow restrictors, nor did they get credit from the San Diego Land and Town Company's water company to purchase low-flow toilets, because they did not exist. The people knew of the water shortage and made do with less water, lest they run completely out of water.

On December 8, 1915, Charles Hatfield met with the San Diego City Council and offered to fill Morena Reservoir using his specially formulated moisture accelerators. The Council knew of his other successes in causing rain which was accredited to his methods and debated about how to include assurances. The Attorneys for the City crafted wording for payment based on success in the contract and finally agreed to pay Hatfield $10,000 if he could cause rainfall that would fill Morena Reservoir to overflowing. The San Diego City Attorney staff went to work on a final contract for Hatfield to be paid for filling Morena Reservoir. Hatfield offered a contract of his own to the City, which was not acceptable to the City Attorney, but he went to work on filling the reservoir without a contract. He built a 40-foot-tall tower with a large platform at the top on which he placed large galvanized pans containing the 23 chemicals he called his moisture accelerators. That night clouds moved in, and the next morning it was raining. The rains became heavy and continued. By January 4th the rains became heavier and consistent. On January 27, 1916, Lower Otay Dam, an earthen dam, burst and flooded the Tijuana River Valley, devastating the agricultural areas in the valley. Several bridges and river crossings were destroyed by flood water, and the railroads in the county lost trestles and bridges and tracks to the storms.

Three days later, on January 30 th, Sweetwater Dam, which had been spilling for some time, was overtopped by a peak flow of 45,500 cfs (cubic feet per second) which reached a three-and-one-half-foot height above the crest and began to impinge on the abutment supporting material on the north and south sides of the canyon. At this height the flow of water came to bear on the material that the dam was keyed into and began to erode the walls of the canyon away. Scouring increased rapidly as the entire body of water behind the dam came in contact with the steep cliffs and quickly began to empty the reservoir through new channels around the dam opened by the scouring action of the water. In the end, the dam was left standing, undamaged except that both abutments had been breached by the scour and flow of the river as it continued to flow around the dam for days. Therefore, the integrity of the dam to hold back the waters was completely lost **(Figure 11)**.

If you have ever been sailing in San Diego Bay, you know that the southern portion of the San Diego Bay, south of National City, has extensive shoals that restrict boating to the defined, marked, dredged channels for the deeper draft small boats. The shoals came into existence during the 1916 flood when both the Lower Otay Dam and the Sweetwater Dam were breeched by flood waters that scoured the two river valleys and stripped off top soil which was then deposited in the south end of the bay by the flood waters to form shoals.

James Dix Schuyler had died in 1912; his engineering genius was a loss to his profession and the art of dam construction. So now the search was on for a competent engineer to design and supervise the construction of improvements to increase the safe discharge capacity of Sweetwater Dam and reattach the north side of the dam to the proper bearing material of the canyon. Also the engineer would be required to improve the capacity of the overflow weir and of the two existing discharge chutes exiting the dam and the connection into bedrock on the south side of the dam.

Hiram Newton Savage **(Figure 12)**, an 1891 Civil Engineering graduate of Dartmouth College, was selected to perform the design and supervise the construction of the works to repair the Sweetwater Dam. Mr. Savage is notable for several of his projects as a consulting engineer prior to becoming the Hydraulic Engineer for the City of San Diego. One of his projects, a sluiceway to circulate ocean water into and out of the La Jolla Children's pool, is of current interest to San Diegans today. Savage's services were required to alleviate the odors from seal wastes due to so many seals coming into the pool. Savage's design worked well to stop the odor problem. However, in later years the sluiceway was blocked because of safety concerns for children using the pool. Recent newspaper articles discuss the problems from the return of odors to the area in the last year.

Savage addressed the problem of reconnecting the dam to the canyon walls by designing a massive siphon spillway with six rectangular siphon tubes on the north abutment. New parapets above the siphons on the north side and on the south side of the sluiceways, where flood waters had scoured

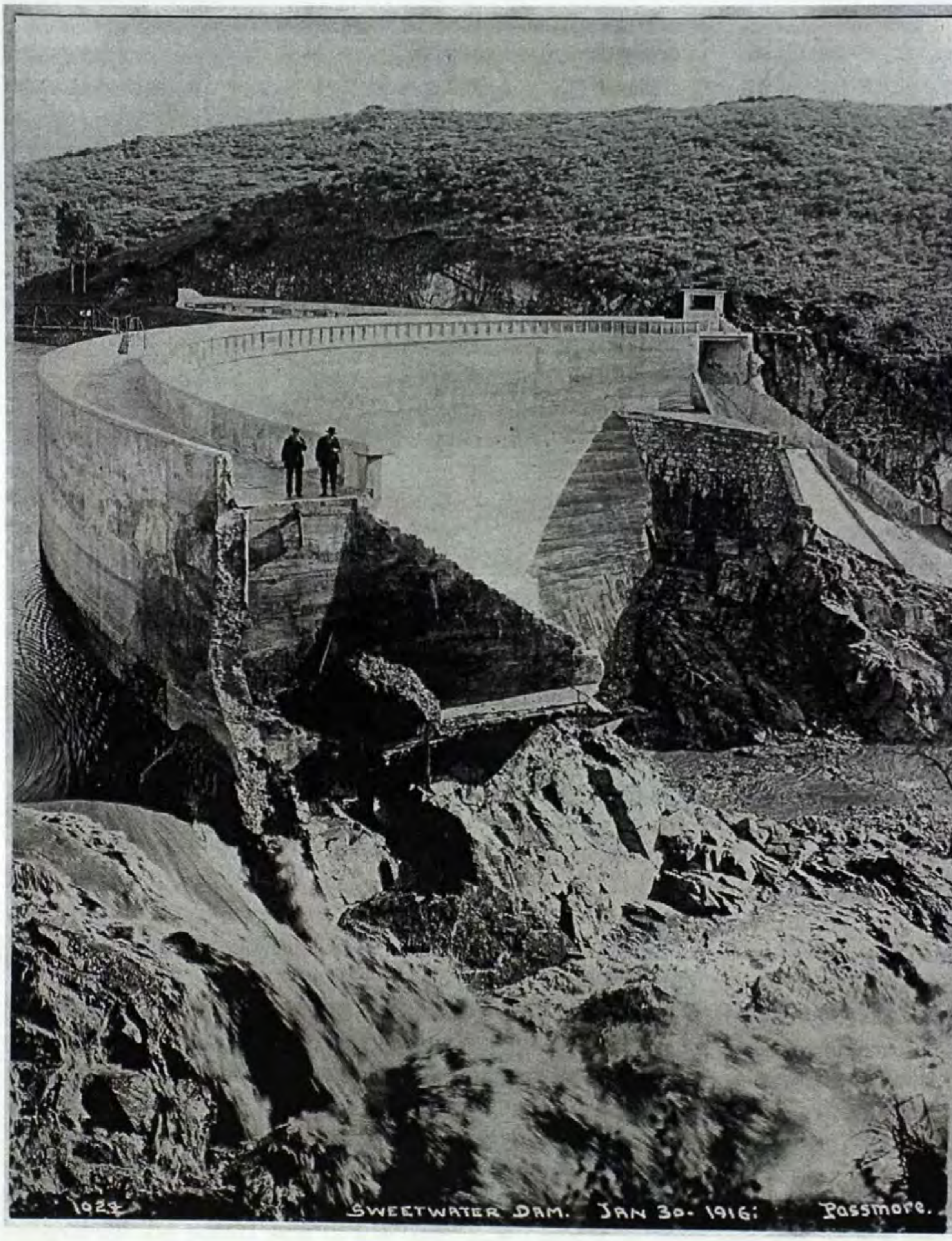

Figure 11 – Sweetwater Dam after Flood of 1916

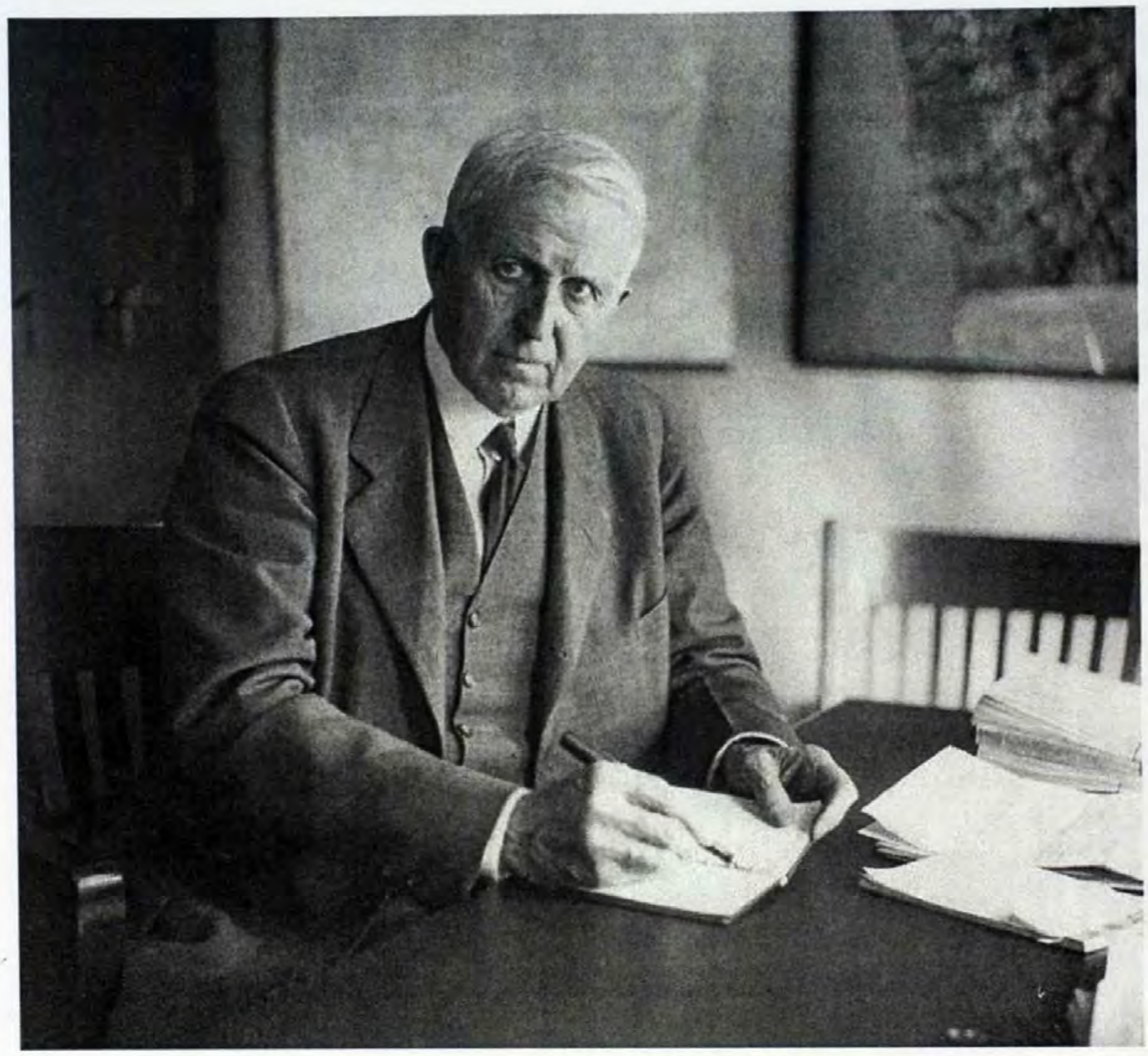

Figure 12 – Hiram Newton Savage

the canyon wall, were raised 13 feet to protect the crest from being bypassed by flood water impinging on the canyon walls. Additionally, a side channel spillway with the capacity to be raised two feet was constructed on the upstream side of the south abutment and the chutes into which the waters overflowing the side channel weir were widened and increased to five chutes instead of the previously existing two chutes. Also, the south dyke a quarter mile east of the dam was replaced by a new higher dyke 1,260 feet long and thirty seven and a half feet high to prevent the reservoir from emptying into a canyon on the south side of the reservoir. The final improvement to the dam was a low buttressed arch dam, constructed 275 feet below the toe of the dam to provide a stilling basin. The stilling weir was backfilled with large rock placed between the weir and the toe of the dam to dissipate the energy of water coming over the crest of the dam, and to protect the toe of the dam

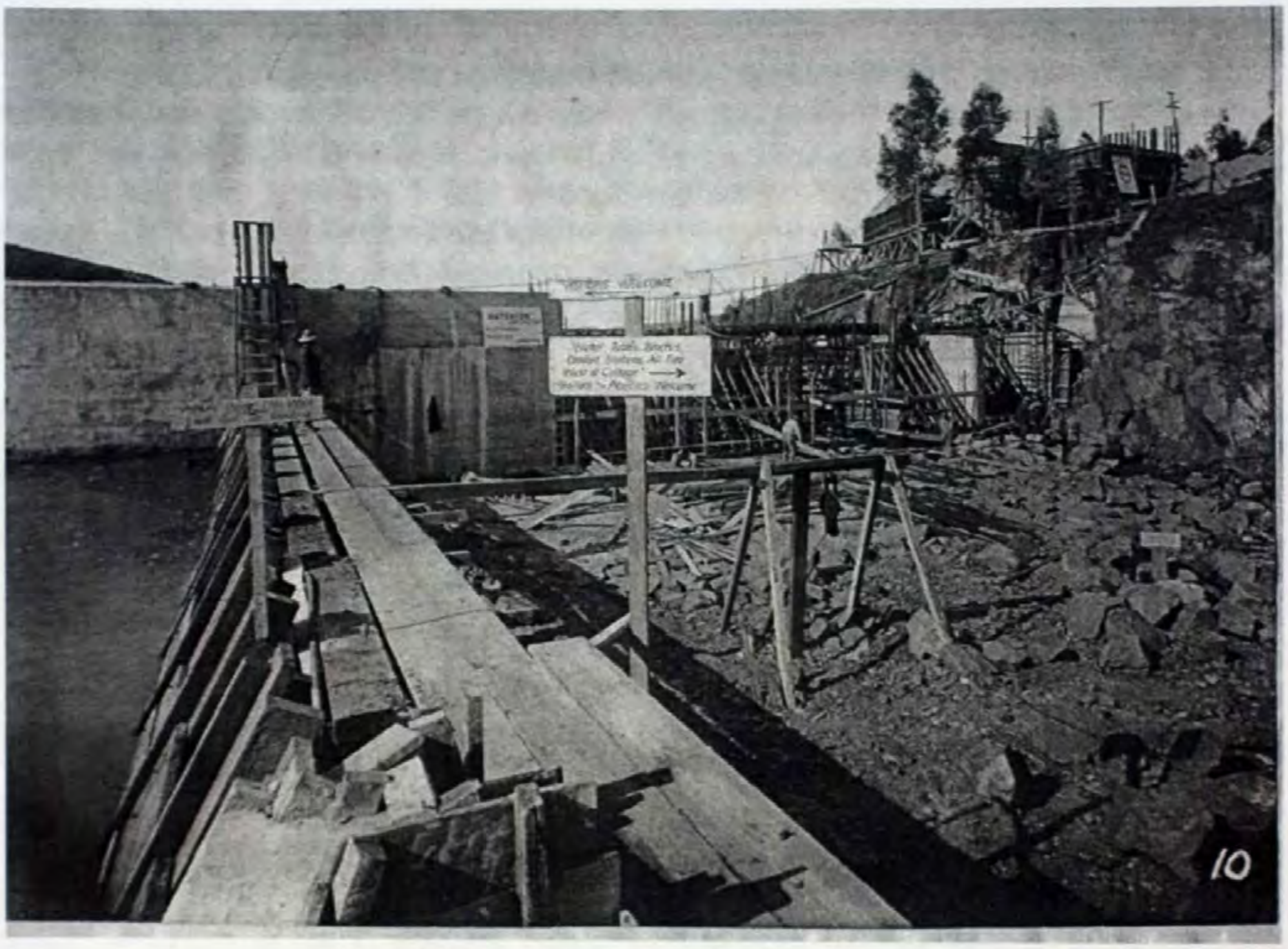

Figure 13 – Sweetwater Dam after 1917 Additions

from erosion. Savage's modifications were ingenious, and his foresight in protecting the dam from damage in future was a key factor in its 120-year longevity **(Figure 13)**.

An interesting note is that fish in the reservoir line up to leap the side channel weir during times when the reservoir is spilling. The fish then are forced to either swim down the river to the bay where there is water with high salts, or stay in the river where the pools dry up after the dam stops spilling. There have been times when people have trudged up the river to the stilling basin where they have filled and carried home gunny sacks of fish caught by hand.

In 1927, 1937, and 1938, the siphons discharged intermittently and with considerable vibrations. One observer said that when the siphons were operating it sounded like all the "Banshees of Hell" howling.

Later, in 1939-40, the upstream parapet crest wall was removed and replaced with a rounded spillway shape. Except for some grouting to stop minor leakage under the side channel spillway, no significant repairs were done to the dam until the 1990s when Sweetwater Authority vented the six siphon barrels to eliminate cavitation, repaired cavitation damage to the floors of the siphon tubes, and replaced surficially cracked concrete on the abutment walls with a reinforced concrete encasement **(Figure 14)**.

Figure 14 – Sweetwater Dam

Under ownership by the Loveland Engineers, which became California Water and Telephone Company in 1935, a decision was made to build a second dam and reservoir on the Sweetwater River 18 miles upstream of Sweetwater Reservoir, southeast of Alpine. Loveland Reservoir is impounded by the Sweetwater Falls Dam, completed in 1945. It is interesting to note that the Loveland Dam never spilled during its private ownership. It was not until 1978, the year after Sweetwater Authority began operating the water system, that Loveland spilled to the river and thus to Sweetwater Reservoir. Since that time, Loveland has spilled 19 times. Loveland, by its nature of having approximately one-half of the surface area of Sweetwater Reservoir, is an excellent long-term water storage facility. Its smaller surface area and lower temperatures, because of its elevation, mean less evaporation of water.

Imported water came to San Diego in 1947. The imported water aqueducts are owned by the San Diego County Water Authority (SDCWA), formed in 1944. The SDCWA became the wholesaler of imported water to its now 24 member water agencies of the county. The first pipeline was initially funded by the US Government through the Department of the Navy. Before the pipeline was completed, the Second World War came to an end and the San Diego County Water Authority assumed fiscal responsibility and ownership of the aqueduct. The first aqueduct terminated at San Vicente Reservoir owned by the City of San Diego. The La Mesa Sweetwater extension was completed in 1947. It brought imported water to Helix Water District at Lake Jennings, and to the South Bay Irrigation District at Sweetwater Reservoir for California Water and Telephone Company (called by many "sprinkle and tinkle"). Since by state law the privately owned water company, California Water and Telephone Company (Cal Water), could not receive imported water from The Metropolitan Water District of Southern California (MWD), the South Bay Irrigation District (SBID) was formed to receive imported water from MWD and then sell it to Cal Water. With imported water to Sweetwater Reservoir, a filtration plant to treat the local and imported water was planned and completed in 1961.

In 1950, California Water and Telephone Company took ownership of a well drilled by the City of National City. A second well was drilled in 1957. The wells are located on the south side of Division Street in National City just east of I-805 freeway. The wells are the second source of water developed for the water system. The wells have been producing two million gallons per day for over 50 years.

In 1964, General Telephone and Electronics acquired the water system from Cal Water through an exchange of shares. Their purpose was to gain the telephone service areas held by Cal Water. By 1966, General Telephone and Electronics packaged the water systems without so-called "non-operating" properties and sold them to American Water Works Service Company of Belleview, New Jersey. American changed the name of the system to California American Water Company (Cal Am). American Water Works was the largest investor-owned water company in the US at that time. They were the twelfth private owner of the Sweetwater water system in its 97-year history at the time.

Figure 15 – Sweetwater Authority Service Area

SBID began a nine-year legal battle in 1968 to acquire the water system from Cal Am. The suit for condemnation was successful in May of 1973, and over the next four years final valuations of the system and the sale of bonds to raise the funds to acquire the system took place. The final sale price of $19,036,000 was paid to Cal Am and the Sweetwater Authority, formed in 1972 to be the operating entity of the water system, began its role as the publicly-owned operator in August of 1977 **(Figure 15)**.

Ownership of the water system had been in private hands since the Kimball Brothers Water Company was formed in 1869; previous to SBID the water system had been under private ownership for 108 years. SBID, the first publicly-held owner of the water system, held ownership by virtue of the conditions of the bonds to buy the system and the fact that SBID had a financial record which the rating agencies could approve. Later in 1990, after Sweetwater Authority had been the operator of record of the water system for

13 years, the sale of new bonds for system improvements required that Sweetwater Authority, the agency with the operating record, become the owner of the water system.

In the last 20 years, Sweetwater Authority has done several studies of the San Diego Formation, which underlies the coastal plane from the border to the San Diego River, using consulting engineers and the US Geological Survey to help understand the quantity and quality of water available in this important local water resource. There are areas of the formation where the water is potable quality and needs only chlorination to be used as a public water supply. In other areas of the formation, groundwater contains 1,000 to 8,000 parts per million minerals and salts. The degraded water is usable if the minerals and salts are removed.

In the early 1990s, Sweetwater Authority began preliminary design and planning studies for the installation of a facility to remove minerals and salts from the brackish groundwater. The first phase of the Sweetwater Authority Groundwater Desalination Facility was dedicated in October of 1999 **(Figure 16)**. The facility produces four million gallons of potable water daily for the water system. Studies of the operation of the facility and of new technology have been performed and it is now possible, with the use of the latest reverse osmosis membranes and other new technology to increase the capacity of the desalination facility to 10 million gallons per day at a savings in power cost per unit. The initial plant was designed to leave ample room to double the capacity of the facility. This doubling of capacity will be accomplished with an additional 25 percent increase in production and the bonus of a power savings from the upgraded and expanded facility at the present site.

Brackish groundwater has proved to be a viable water source given the proper treatment. The Authority is looking at a similar future plant on the Otay River in partnership with the City of San Diego and Otay Water District and perhaps others. In the event that there are future needs for large quantities of ultra-pure water for industrial purposes, Sweetwater could provide ultra-pure water for industrial or other uses to a defined service area like an industrial park if it were properly sited.

Improvements in membranes for desalting of water have continued to provide new membranes that perform more efficiently and operate at reduced power requirements. The cost of desalinating sea water has been reduced by approximately 50 percent each 20-year period because of improved technologies. Therefore, the cost of desalinated water is approaching the cost of water imported from great distances, which local agencies are dependent on at this time. The problem in the future will not be our ability to

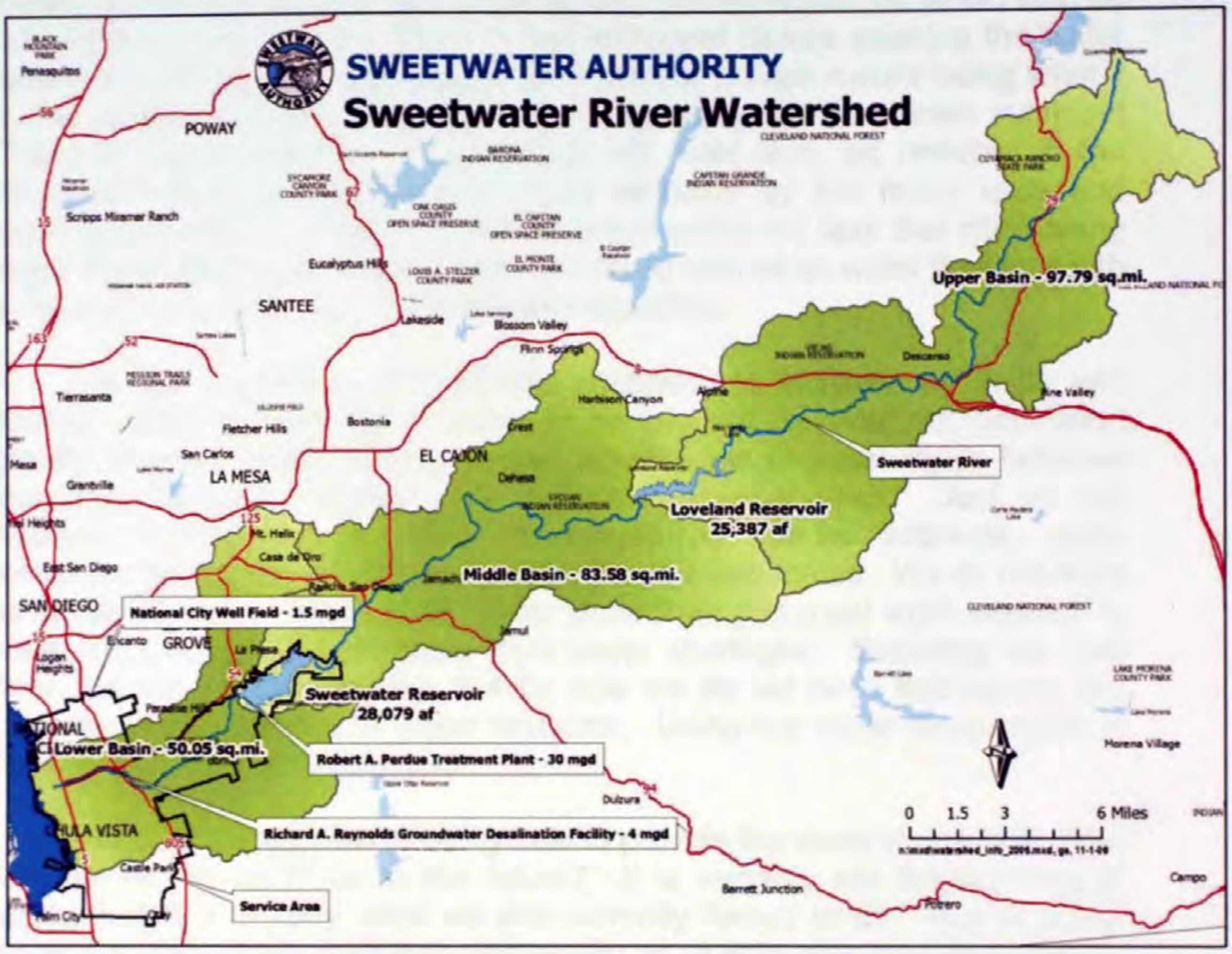

Figure 16 – Sweetwater River Watershed

produce desalinated water at low cost, but where the power to operate desalination facilities will come from. With power producers facing summer brownouts and the cost of oil rising rapidly, there will be need for dependable power from non-oil-fired plants. Nuclear power is one way this can be accomplished. Other ways would be to harness solar power, wind power, geothermal or hybrid power producing technology.

Reclaimed water is another potential water source. Reclaimed water from sewage to potable use was proposed by the City of San Diego in its ultra-pure water project. The project proposed through a demonstration project that, after primary, secondary and tertiary sewage treatment, then reverse osmosis, ultraviolet disinfections and chloramination, the reclaimed water would then become a new water supply. This new water supply, if stored at San Vicente Reservoir, could be blended with existing surface or imported water in storage at San Vicente Reservoir where it would lose any identity as treated sewage. The water at San Vicente Reservoir would then be submitted to normal water filtration and treatment before entering the water system for use by city customers. Unfortunately, human nature being what it is, the project was cancelled after being tagged by the inaccurate sobriquet "Toilet to Tap Program." The concept will most likely be revisited in the future as water supplies become more stressed by the many uses and growing populations. San Diego's idea is not unlike the task that cities along major rivers like the Mississippi River are faced with when water flowing south is reused many times by successive municipalities.

As the population of California continues to increase by leaps and bounds, water supplies will continue to be strained by droughts, population growth, environmental restrictions and adjudication of water rights between municipal, industrial, agricultural, and environmental uses. Just as our National Government is being challenged by special interests, water resources will continue to be stressed by those same forces. We do not have all of the answers. There is no "Silver Bullet," we just must work together to solve the problems which come from water shortages. Someday we may have unlimited water supplies, but for now we do not have that luxury. So, currently conservation is a water resource. Using our water more wisely is not only important, it is essential.

What is the solution to being able to provide the water where and when it is needed by all of us in the future? It is certainly not fighting over it, although that is exactly what we are currently forced to do. Nor is it one agency making those decisions unilaterally as to who gets how much water. It would seem that there needs to be a selfless effort to cooperate in reaching the solution, each making their maximum effort to see that the needs of all are met. Only then will the scripture, "*For in the wilderness shall water break out, and streams in the desert, and the parched ground shall have water. Isaiah 35:6,*" come to pass. We are heading away from the reality we want to achieve. We are not remembering the dry years when we are in the wet years and have plenty of water. We are not remembering that land without water is of no value.

Sweetwater is currently enjoying the blessing of multiple water resources and the water supply options to develop new supplies. It all started with the purchase of the Rancho de la Nación by the Kimball Brothers in 1868. At the time, it would have been very difficult to imagine all the potential water supplies that would be options in the future. The same is true now. We think we understand it all now, but who is to say that we will not, some day, be adding two hydrogen molecules to one oxygen molecule to produce pure water in large quantities on demand.

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