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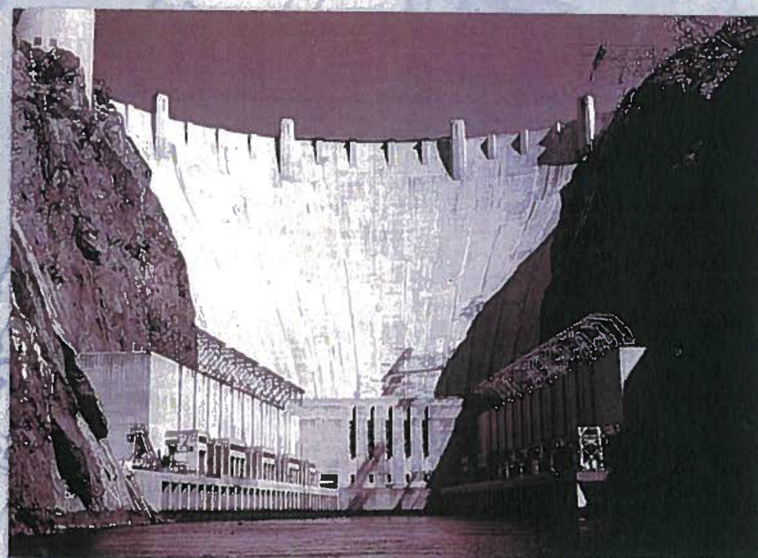
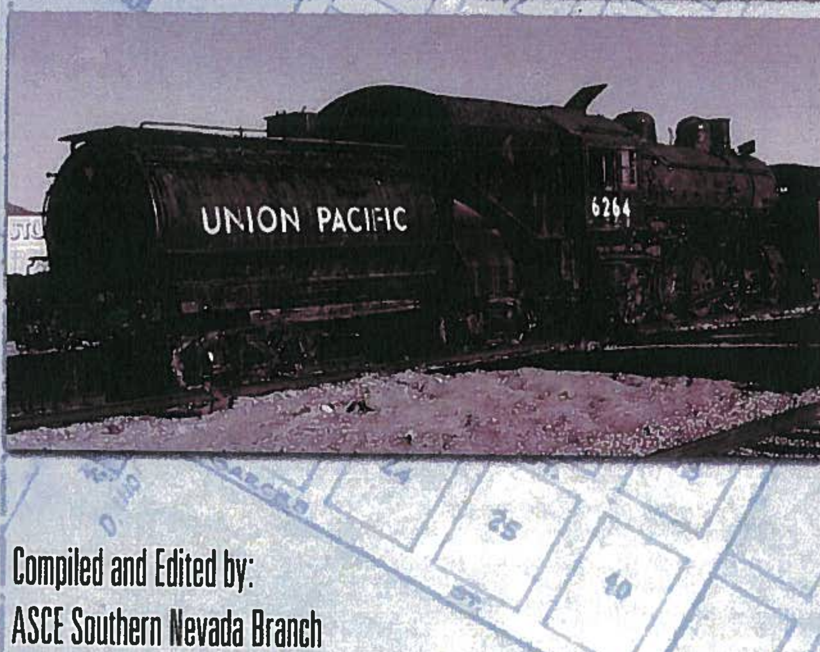
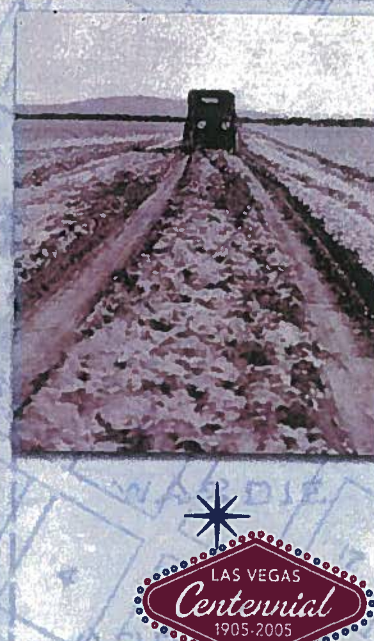
From the Spanish Trail to the Monorail

A HISTORY OF CIVIL ENGINEERING INFRASTRUCTURE IN SOUTHERN NEVADA







Compiled and Edited by:
ASCE Southern Nevada Branch
Life Member Forum

LAS VEGAS
Centennial
1905-2005
We Did It Our Way!

From the Spanish Trail to the Monorail

GeoSpatial,

A HISTORY OF CIVIL ENGINEERING INFRASTRUCTURE IN SOUTHERN NEVADA

Compiled and Edited By:

AMERICAN SOCIETY OF CIVIL ENGINEERS
SOUTHERN NEVADA BRANCH
LIFE MEMBERS FORUM

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INTRODUCTION

Charles R. Parrish

Water attracted early visitors to the Las Vegas valley. The dependable flow of three closely spaced artesian springs, joined together on the western side of the valley, meandering slowly eastward into the Colorado River sustained life in the valley. Evidence found at the spring sites suggests human occupation as early as 1,500 to 1,000 BC. These early inhabitants disappeared about 800 to 900 AD. Later, native people made their home again in the Las Vegas area and still do today.

About 1829, traders from Santa Fe, New Mexico, searching for markets to barter their animals and woolen goods, refreshed themselves and stocked up on water at the Las Vegas artesian springs before continuing to the west across the Mojave Desert. These hardy soles found trading partners in southern California and until about 1848 made yearly treks, thus establishing the Old Spanish Trail. The journals of pathfinder John C. Fremont support the stories of the New Mexico traders' trail use. One journal entry notes that Fremont traveled along the trail and stopped in Las Vegas on May 3, 1844. His entry expresses the hope that he is ahead of the traders' large herds because, if not, there would be no remaining forage near the trail for his animals.

After 1847 when the Mormons established a home in Utah, they began using a portion of the Old Spanish Trail as a trade link with people in southern California, stopping, as the traders before them, at the Las Vegas springs on their way across the desert. The Utah to California portion of the trail also came into general use by various immigrants and prospectors and over time became known as the Mormon Trail.

On June 14, 1855, Mormon missionaries arrived in Las Vegas and started a settlement downstream of the springs. They built structures, planted crops, and enlisted the help of the native people to assist with farming. About a year later, another contingent of Mormons arrived intending to mine lead in the mountains west of the valley. By that time the general feeling among farmers was that the sparse amounts of poor quality land in the area were unsuitable for their task. Their concerns with the sustainability of the farming effort coupled with their difficulty processing the ore found at the mine caused the Mormons to abandon the area and retreat to Utah in early 1857.

In 1865, Octavius Decatur Gass, a gold miner, acquired the land and for several years found success where previous farmers had failed. He and his wife, Mary, planted alfalfa, fruit trees, grapevines, and flowers and grazed cattle on native grasses along the creek. He opened a trading post that served passing immigrants and provided supplies for miners working in nearby El Dorado Canyon. Around 1879 a period of bad weather caused crop failures that, unfortunately, came at the same times as failures in Gass' other business ventures. To continue operations, Gass borrowed money from a California gold miner, Archibald Stewart, using the land as collateral. Unable to repay the loan, Stewart foreclosed and the land became his property. The Stewart family moved from southern California to Las Vegas in 1881. Two years later Archibald died from a gunshot wound. His wife, Helen, continued to operate the property until 1902 when she sold the land and water rights to Montana Senator William A. Clark.

Clark constructed the San Pedro, Los Angeles and Salt Lake City railroad, bringing it through the valley in 1905. He auctioned off parcels of land that later became the downtown portion of the City of Las Vegas and established the Las Vegas Land and Water Company to provide water for the town and for his railroad operations.

These improvements in infrastructure set in place the basic conditions necessary for settlement and permanent residency in Las Vegas. With wagon roads and railroads leading to distant places and the beginnings of a water distribution system in place, the population started to increase.

Things change. Old makes way for new. Imagine waking up one morning and finding no infrastructure–no safe drinking water, no road leading from your home to anywhere, no electricity, no telephone and no place for wastewater to go. What a frightening and inconvenient place to be.

When the infrastructure is working properly, people do not realize it exists. And, for the most part working infrastructure is the case in our country. Over the years, civil engineers have provided their expertise, using sound engineering principles, to design and construct most of the infrastructure that quietly supports our day-by-day activities as we produce history. In recent years in southern Nevada, change has occurred at a rate much faster than in other parts of the country. Old structures are demolished and new ones erected at dizzying speed. An evolving infrastructure of roads, water systems, dams, railroads, airports and other major facilities has supported this rapid change and continues as we move past the year 2005, which marked 100-years since the auction of land in downtown Las Vegas.

This book presents stories about the establishment of much of the southern Nevada infrastructure and other important related civil engineering works.

CHAPTER FIVE

WASTEWATER FACILITIES IN THE LAS VEGAS VALLEY

Walt Johnson

The wastewater systems currently used in the Las Vegas valley are state-of-the-art collection and treatment systems so technologically advanced that they are discussed at national conferences and, in some cases, are models for other wastewater treatment systems around the nation. For example, at the leading edge of technology is an automated activated sludge system first researched and implemented by the Clark County Water Reclamation District (formerly known as the Clark County Sanitation District). The largest soil biofilter in the world (at the time of its construction) is at the City of Las Vegas Water Pollution Control Facility. And the City of Henderson owns and operates one of the largest, most extensive reclaimed water systems in the western United States.

Native Americans and Mormon settlers, who arrived in the 1850s, were the first inhabitants of the area that would become Las Vegas. With the arrival of these settlers came the attendant waste disposal problems that accompany growth in any community. Outhouses and indiscriminate dumping were the first methods of disposal of wastes produced by these early settlers.

Because water use results in wastewater, the history of wastewater begins with the history of water. From the first Mormon settlement and the building of water catchment basins, small reservoirs along Las Vegas Creek, where water was drawn by buckets, human waste was deposited in primitive outhouses.

The City of Las Vegas established, as a result of the famous lot auctions held on May 15, 1905, had neither a wastewater treatment nor a sewer collection system. Even with the later development of crude water pipeline systems, such as the redwood, wire-wrapped pipes conveying drinking water from artesian springs to the first hundred or so homes, human waste disposal was still via outhouses.

Las Vegas became the county seat for Clark County in 1909, when it separated from Lincoln County. Las Vegas settlement conformed to the same pattern–the early arrival of hardy explorers and pioneers followed by the migration of people from the East–as did other towns and cities throughout the West. Later migration brought people who eventually established more refined ways of living and created more creature comforts.

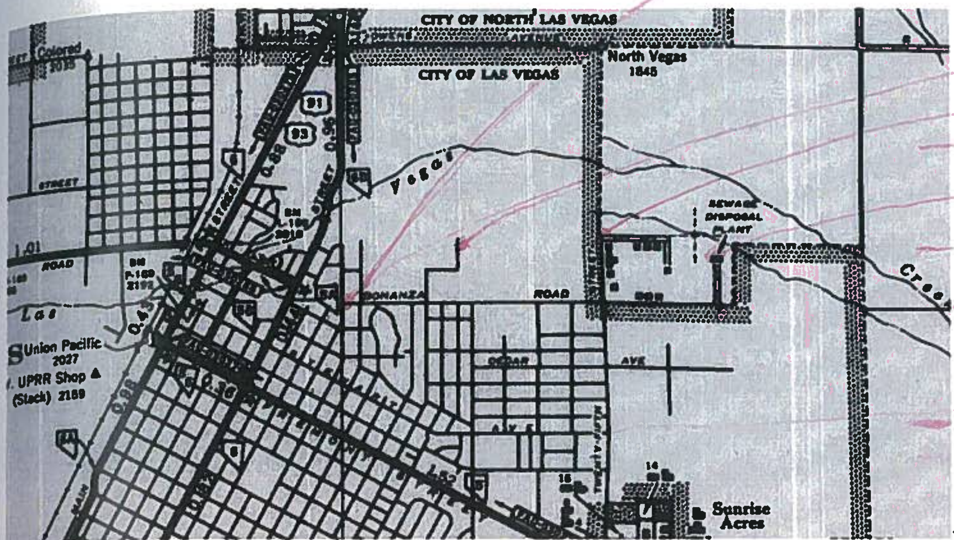
Outhouse usage continued much longer in Las Vegas than in many other western towns because of the isolation from influences of other large population centers, and because people living in Las Vegas from the 1850's to the early 1900's were less concerned about the fineries of life than they were about merely surviving in the desert.

Before the first Las Vegas incorporating charter, which passed in March 1911, an anti-gambling law became effective. Gambling continued on again and off again until finally legalized on March 19, 1931. With a population of 800, many residents were installing septic tanks and leach fields in their yards in order to have indoor plumbing. With incorporation came the ability to sell sewer bonds as a means to finance a sewer system. In 1915, when the City implemented its first 24-hour electric service it also built the first sewer system and began service. This first sewer system collected sewage from businesses and homes along Fremont, Main, and Fifth Streets, and Clark, Lewis, and Stewart Avenues. With no treatment system, the raw sewage discharged near what is now the intersection of Bonanza Road and Ninth Street. At that time, this area on the outskirts of town was 3,000 feet from the nearest occupied residence.

Raw, untreated sewage meandered east along Las Vegas Creek from this disposal point toward the Las Vegas Wash. With a 1915 population of approximately 1,000, the average daily flow of raw sewage has been estimated at 50,000 gallons per day. The Las Vegas Ranch house, nearly abandoned by this time, was only 800 feet west of this sewage disposal point. Orchards and vegetable plots were just east of the ranch, on land now occupied by Cashman Field.

In 1915, no health department or environmental protection ordinances existed. Mothers, however, knowing of the dangers, instructed their children to stay away from the area where raw sewage spilled into Las Vegas Creek. Other adults, having a general knowledge of hygiene, also knew to avoid these waters and not to use them for human consumption.

In 1931 the first wastewater treatment plant was undertaken in downtown Las Vegas. An Imhoff tank treatment plant built at 15th Street and Harris Avenue had a capacity of 1 million gallons per day.



Waste disposal plant on Bonanza Road. ca. 1952.
(Photograph courtesy of Special Collections, UNLV Libraries.)

To avoid encroaching on development, the site was located one-half mile farther east in the desert from the original discharge point. The waste (i.e., effluent) from this first treatment plant discharged to nearby Las Vegas Creek, and was used to irrigate the Las Vegas Ranch.

The Imhoff tank treatment plant consisted of two rectangular tanks set in the ground, one above the other. Wastewater entered the upper tank at one side and exited at the other side, losing 50 to 60 percent of the suspended solids in the trip across the tank. The steeply sloping sides of the upper tank guided the settling solids downward to the second tank. The bottom tank promoted a process known as anaerobic digestion of the solids turning them into a pasty substance known as sludge. Even with anaerobic digestion, every 6 to 9 months, the sludge in the lower tank would accumulate to the point that maintenance workers were required to pump the material into a truck and spread it on a designated area called a sludge bed where it was allowed to dry.

The Imhoff tank process is advantageous because of its simplicity. It has no moving parts, requires minimal operator attention, and is inexpensive to operate. Its disadvantage is low-quality effluent, similar to primary effluent from a conventional primary treatment plant. With its simplicity and low cost, however, it was an ideal choice for Las Vegas at that time. The effluent could be used to irrigate some grazing lands for cattle and horses. In the desert, conserving potable water is an added benefit. The Imhoff tank plant operated from 1931 to the 1950s.

With the continued growth of Las Vegas and the establishment of the Las Vegas Army Airfield (now Nellis Air Force Base), a new 1 million-gallon-per-day plant was built in the early 1940's. The new plant, also an Imhoff tank, was built at 25th Street and Harris Avenue, some 10 blocks east of the existing tank, and again was located away from other development. It provided greater capacity to serve the needs of the growing community. The Las Vegas Land and Water Company, for their expanding ranch, also used effluent from the second plant. Upon its formation in May 1946, the City of North Las Vegas built a wastewater collection system and connected to the City of Las Vegas collection system, adding more wastewater to the City's treatment plant.

With the population steadily increasing in the 1950s, the two Imhoff tank plants were shut down and replaced with a trickling filter plant. This plant, located at Harris Avenue and Manning Street, had a capacity of 7.5 million gallons per day. With this new source of irrigation water available, the Las Vegas Land and Water Company purchased the Winterwood Ranch, a 400-acre parcel located about 6 miles southeast of the new treatment plant near the Las Vegas Wash. They constructed a long open flow channel to bring effluent from the new trickling filter plant to their ranch.

Meanwhile, after 1931 and into the 1950s, new casinos, hotels, and motels were being built within the City boundaries and some were going up in the county south of Las Vegas for the convenience of incoming tourists. These new establishments had no City sewer service, so they installed their own wastewater systems, usually constructing large septic tanks or small treatment plants. From 1930 to 1950, the number of permanent Las Vegas residents increased from 5,200 to 30,000, and the number of daily visitors increased from 500 to 3,600.

The small community of Henderson, southeast of Las Vegas, growing as a result of the federal government's interest in magnesium production during World War II, constructed its first municipal treatment facility in 1942. The plant used trickling filters, primary and secondary clarifiers, and digesters. Effluent discharged into a series of ponds for evaporation and eventual percolation into the soils below. In the early 1950s, Imhoff tanks were installed at Henderson's Wastewater Treatment Plant No. 1.

Clark County officials soon recognized the need to provide sewer service for the growing residential development and the new casino resort hotels. In August 1954, the Clark County Sanitation District was formed, and on November 27, 1956, the first County wastewater treatment plant operations began. Called the West Plant, it was located at the east end of Flamingo Road near the Las Vegas Wash. The plant served the unincorporated area south of the City of Las Vegas–generally everything south of Sahara Avenue.

Having a capacity of 12 million gallons per day, the West plant used trickling filters, primary and secondary clarifiers, and digesters to treat wastewater. Prior to discharge to the Las Vegas Wash, through a 4,000-foot-long channel, the wastewater was disinfected with chlorine.

The City Council in 1956 moved its plant further east for the fourth time to its current location at Vegas Valley Drive and the Las Vegas Wash because of continued population growth and attendant encroachment on the existing City site. Officials considered this new location to be the ultimate easterly location for a treatment plant. In 1956 the plant had a capacity of 15 million gallons per day, and consisted of trickling filters, primary and secondary clarifiers, and digesters, similar to the County plant.

Trickling filter
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The County
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The 1956 City o
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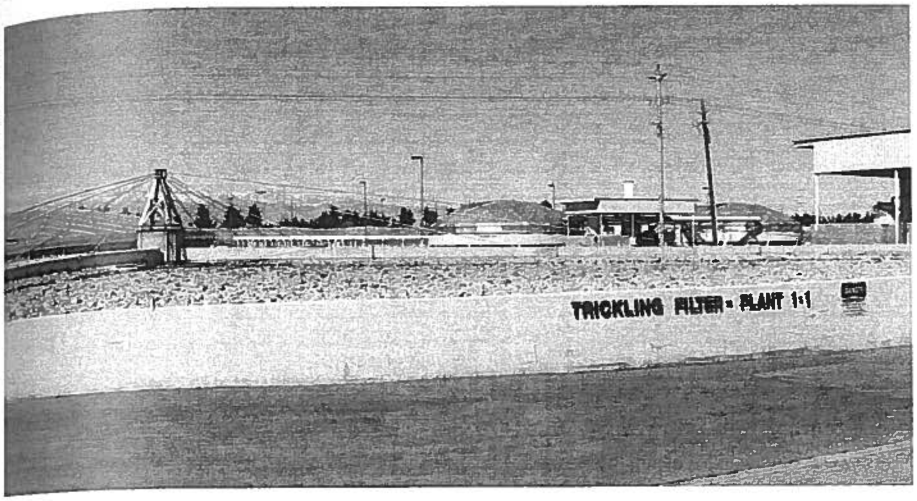
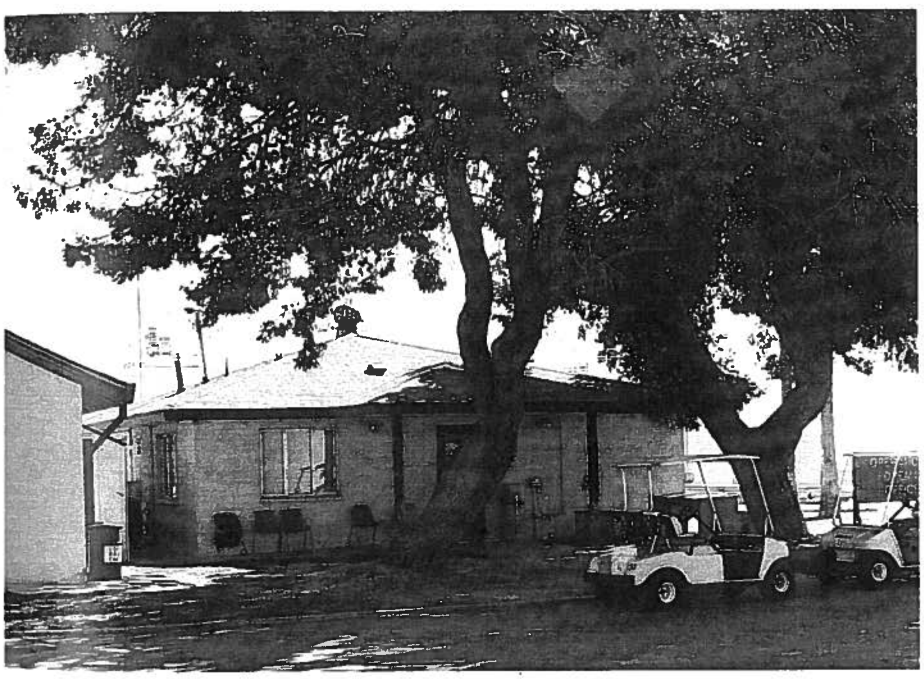
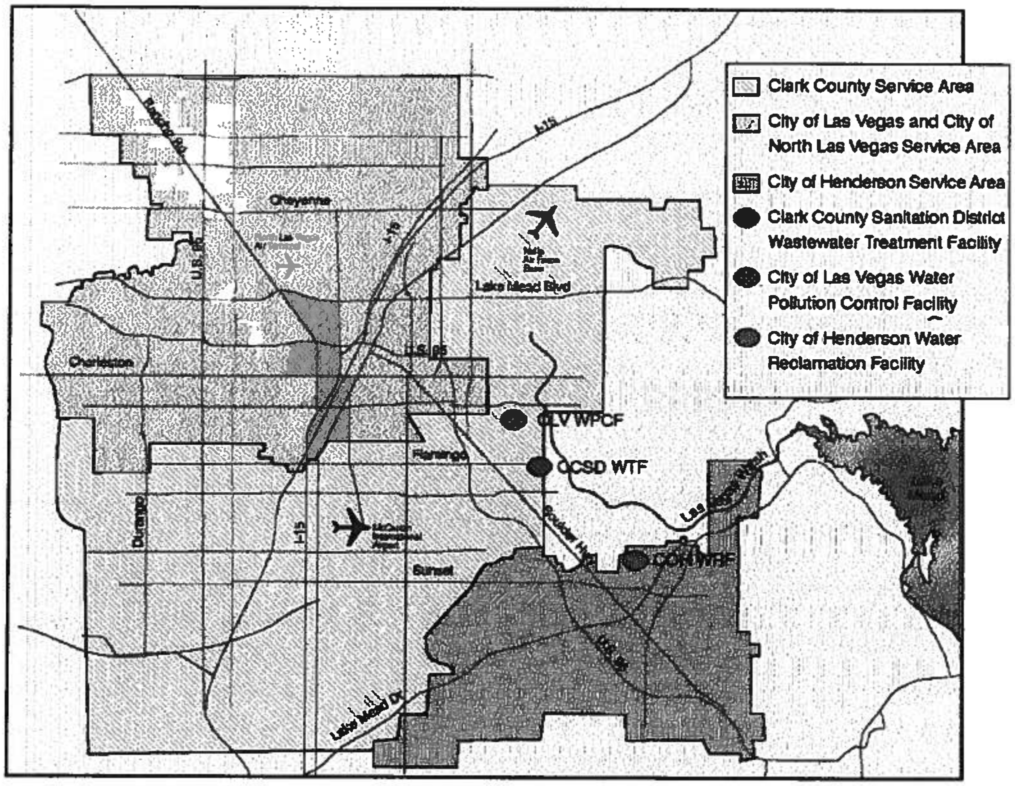


Trickling filter at City of Las Vegas Treatment Plant. ca. March 2004.
(Photograph courtesy of Charles R. Parrish.)

The County plant and the City plant were only 1 mile apart, and they are in these same locations today.



The 1956 City of Las Vegas Treatment Plant office building and original shade trees still in service. ca. March 2004.
(Photograph courtesy of Charles R. Parrish.)



Plant locations and service areas of the three valley treatment plants.
(Map courtesy of Clark County Water Reclamation District.)

From 1950 to 1960, the number of permanent Las Vegas residents increased from 30,000 to 90,000, and the number of daily visitors increased from 3,600 to 9,000.

Before 1960, when flows in the Wash were low, a wide greenbelt and wetlands area flourished. The wetlands, with their thriving vegetation, provided significant removal of nutrients as water passed through on its way to Lake Mead. However, the erosion and deep channelization of the wash, resulting from increased flows in later years, caused a narrowing of the wetlands area. Vegetation gradually dried up and the nutrient take-up capability diminished and more water and more nutrients passed through to Lake Mead.

The daily average flow of treated effluent, in 1965, from the County plant to the Wash was 5.8 million gallons per day. The average from the City plant was 6.3 million gallons per day. This total of 12.1 million gallons per day plus an additional estimated dry weather flow of 2.5 million gallons per day from the stormwater system resulting from irrigation and street runoff produced an average dry weather flow of 14.6 million gallons per day in the Wash. This flow, with a velocity of 1.9 to 2.3 feet per second in the wash began to cause erosion of the soft earthen material. Velocities above 3 feet per second will produce major erosion and "headcutting," a term used to describe the gradual bottom erosion of a channel in a manner that causes the channel to deepen backwards, or in an upstream direction.

The following excerpt from a book by Florence Lee Jones and John F. Cahlan, *Water - A History of Las Vegas*, Las Vegas, Nevada, 1975, p. 120, illustrates the growing concern about pollution of Lake Mead:

> "The drive to control pollution of the waters of Lake Mead gained momentum in the mid 1960s.
>
> "In the Clark County area a Water Pollution Control Board had been formed and was composed of representatives of local agencies involved. Director Farnsworth, representing the Water District, was elected President of the Control Board in February 1966, and was authorized by the Board to use the District's secretarial staff in performing these duties.
>
> "By 1967 there were increasing public announcements by State and Federal officials who were recognizing the growing threat to the purity of the Lake Mead waters and calling for controls.
>
> "Senator Cannon, in a statement in Las Vegas on September 16, 1967, announced that the Department of the Interior was ready to join an all-out effort to curb the menace of water pollution of Lake Mead. He termed as 'alarming' the reports, which indicated a build-up of phosphorus at Las Vegas Wash, which, if unchecked, 'would bring all recreational activity at the Wash to a halt.'
>
> "Senator Cannon stated that he had advised Governor Laxalt that if he made an official request on behalf of the State that assistance could be obtained from the Federal Water Pollution Control Administration.
>
> "It was announced immediately afterward that the State had 'two years to draft standards for water pollution control on the Colorado River,' as the Government had rejected the State's initial plan.
>
> "Governor Laxalt spoke in Las Vegas on September 28 and stated that the practice of allowing effluent water from sewers in the Valley to go down the Las Vegas Wash to Lake Mead had been neglected in the past and was a 'tragedy.'
>
> "The Governor announced on December 7, 1967, that he would appoint a committee of 13 experts to study the algae problem in Lake Mead and resulting pollution downstream at Davis Dam."

During these years, several topics were confronted by various federal, state, county and city agencies; these issues resulted in numerous meetings, studies, and conferences, and formal reports were discussed and debated, and solutions proposed.

The introduction of nutrients (such as phosphorus) leading to production of algae was the major concern regarding pollution of Lake Mead. Many other theories on the causes of the algal growth were also considered, including the effect of non-point pollution sources such as stormwater runoff from Flamingo Wash, Sloan Channel, and Duck Creek. The drying up of the wetlands in the Wash because of channel erosion was considered. Some people thought the 1964 lowering of the water level in Lake Mead during the period following the completion of Glen Canyon Dam, while Lake Powell filled, may have caused a greater concentration of pollutants in Lake Mead. Also, it became clear that the rapid growth in the Las Vegas Valley greatly increased the pollution loads in wastewater flowing to the treatment plants.

Another debate involved setting the treatment plant discharge limits and consideration of the cost effects to ratepayers for necessary upgrades to the existing treatment plants. Consideration was given to the possible design and construction of a regional treatment plant and the need for federal funding for a regional advanced wastewater treatment plant. Discussions ensued on who would operate any new plants. The possibility that a single agency such as the Las Vegas Valley Water District, the County, or the State should have authority for owning and managing water, wastewater, and stormwater facilities throughout the Las Vegas Valley was considered.

During these contentious times, the agencies and organizations shown below were assigned to study the issues, prepare reports, and make recommendations:

- Las Vegas Valley Water District
- Desert Research Institute
- Water Pollution Control Board (for Clark County)
- Inter-Agency Water Pollution Control Task Force
- Scientific Evaluation Committee
- Professional and Technical Advisory Board
- State Legislative Subcommittee on Pollution

The Nevada legislature ordered the Water District to complete a report by December 31, 1972. However, on December 27, 1971, the Environmental Protection Agency (EPA) stepped in and shortened this deadline to June 1972. The EPA sternly warned the Water District and the other 6 involved agencies that, in view of the pollution occurring in the Wash and in Lake Mead, action must be taken immediately.

Fortunately, at the time, the Water District had nearly completed its plan for the legislative committee, and the EPA reviewed and approved the plan on August 25, 1972. With this approval, the deadline for "inaugurating the system" was extended to December 31, 1975.

Of the 11 recommendations in the proposed plan, the four salient recommendations were: 1) that municipal wastewater be collected in a reservoir near the existing Clark County Sanitation District treatment plant located at the east end of Flamingo Road, 2) that a 1.5-million-gallon-per-day advanced wastewater treatment plant be constructed to reclaim a portion of the municipal wastewater effluent, 3) that a 0.25 million gallon per day desalinization pilot plant be constructed to foster research on the many uses for effluent within the valley, and finally, 4) that the utilization of treated municipal waters for in-valley irrigation purposes be maximized.

One of the more widely accepted plans, from the several engineering firms included in the group of organizations engaged in preparing studies and recommending plans, came from VTN Nevada–Jones and Stokes. This plan recommended that nine alternatives be considerated, of which the four principal alternatives were 1) groundwater recharge through injection of highly treated sewage into the aquifer, 2) complete treatment before discharge to Lake Mead through the Las Vegas Wash, 3) exporting of effluent to a dry lake for evaporation, and 4) deep well disposal by injecting the effluent thousands of feet underground.

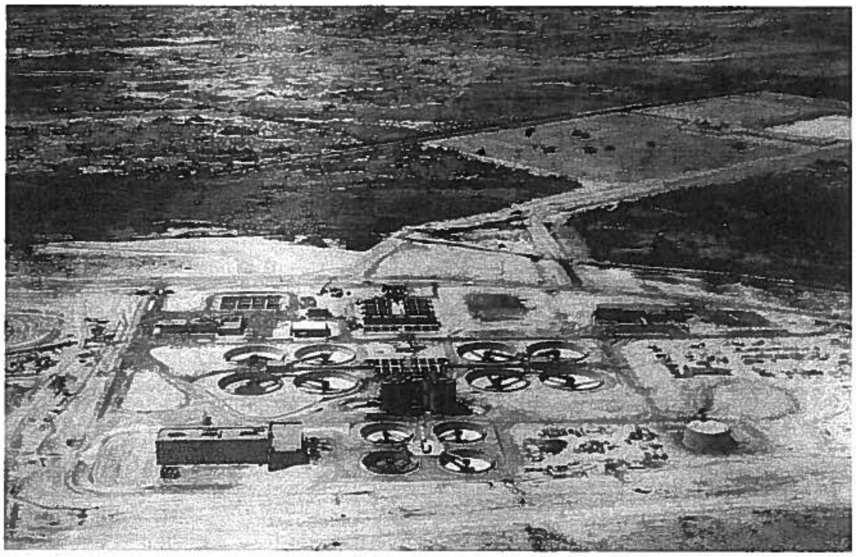
The single favored recommendation, complete treatment for discharge to Lake Mead through the Wash, called for construction of a regional secondary plant to take wastewater from the City of Las Vegas and Clark County service areas; and, an advanced wastewater treatment plant to take secondary effluent from the regional plant, from the existing City plant, from the City of Henderson plant, and from the existing Clark County plant. The combined treated effluent from the advanced wastewater treatment plant would be discharged to Lake Mead via the Las Vegas wash.

The advanced wastewater treatment plant, considered to be a high technology solution, was favored by the EPA Region IX office in San Francisco. The advanced wastewater treatment plant would use a lime addition process and filtration to remove phosphorus, which was expected to lesson the impact on Lake Mead. EPA approval meant that federal funding would be available and would defray 75 percent of the capital cost.

The 90-million-gallon-per-day advanced wastewater treatment plant, constructed on Clark County Sanitation District property east of the Wash, began operation in 1982 and treated effluent only from the Clark County secondary treatment plant. The plant used rapid mixing of lime followed by flocculation tanks, clarifiers, and dual media filtration. After final chlorination, the tertiary treated effluent was discharged to the wash. Solids generated by the treatment process were dewatered in large filter presses and hauled in trucks to the Sunrise landfill.

The reservoirs mentioned in the Water District plan were built, but not for the original purpose envisioned. Instead, they were used for secondary effluent. They were dubbed surge ponds, and used as flow equalization ponds to feed a uniform flow to the advanced wastewater treatment plant.

A 1-mile-long, 69-inch-diameter pipeline was built to bring secondary effluent from the City of Las Vegas plant to the surge ponds. The City, during a late stage of development of the advanced wastewater treatment plant, decided it would not participate in the joint operation of the plant. The City believed that phosphorus could be removed easily at their existing plant by adding alum or ferric chloride before primary sedimentation, and that they might lose control of processes, operation, and management if they were to agree to a joint operation. The connecting pipeline was never used and was eventually abandoned.



Advanced wastewater treatment plant. Surge Ponds in the upper right. ca. 1980. (Photograph courtesy of James Gans.)

In the late 1980's, the Nevada Division of Environmental Protection (NDEP) set limits for the amount of phosphorus that could be discharged to Lake Mead. The NDEP noted that the chlorophyll-A concentration would support recreational uses, no harm would come to fisheries near the lake, a diversity of species could survive in the lake, and good lake fishing would continue. The NDEP, in proposing standards, considered the amount of nutrients delivered at that time to be the maximum amount the lake could safely assimilate before an algal problem would occur. As a result, in 1991, a 434-pounds-per-day limit for phosphorus from all sources flowing into Lake Mead was set. This limit included an estimated non-point source (dry weather urban runoff and wet weather storm runoff) of 100 pounds per day, leaving 334 pounds per day as the maximum allowed from the three treatment plants.

A new county treatment plant manager hired in 1993 quickly pointed out that the lime addition process for removing phosphorus was not as cost effective as state-of-the-art processes then available. As a result of this observation, the process was changed to biological phosphorus removal. After studying modeling results, the change to the biological phosphorus removal system was accomplished by simply turning off the internal recycle pumps between the aerobic and non-aerobic tanks. With this simple action, Biological phosphorus removal became possible, and the lime addition system was turned off. This change not only eliminated the difficult maintenance work related to lime slaking and calcification scaling, but also significantly reduced the labor and equipment costs to haul lime sludge from the advanced wastewater treatment plant to a landfill. This change also eliminated the requirement for acid addition at the plant, which had been needed for pH adjustment after the addition of lime. To meet permit requirements for discharge, effluent pH must be adjusted to near neutral before discharge. The process change also allowed the trickling filters at the main plant to be turned off, since their operation removed soluble organics that were needed by the new biological phosphorus removal process. This benefit saved both electricity and labor. This process removed phosphorus to the same degree as the former chemical process, but with less labor and other costs.

New discharge requirements for ammonia came into effect in 1994. The County installed an activated sludge system in a new Central Plant which, in concert with the existing plant, removed ammonia using a nitrification process, a particular type of activated sludge process that employs a sufficiently long solids retention time to retain the nitrifying population. The Central Plant system, put into operation in December 1994, successfully removed the ammonia, thus easily meeting the new discharge requirements.

Clark County wastewater treatment plant. ca. January 2002.
(Photograph courtesy of Clark Count Water Reclamation District.)

After several months of research, the Clark County Water Reclamation District staff incorporated a further innovation by automating the activated sludge process using a constant

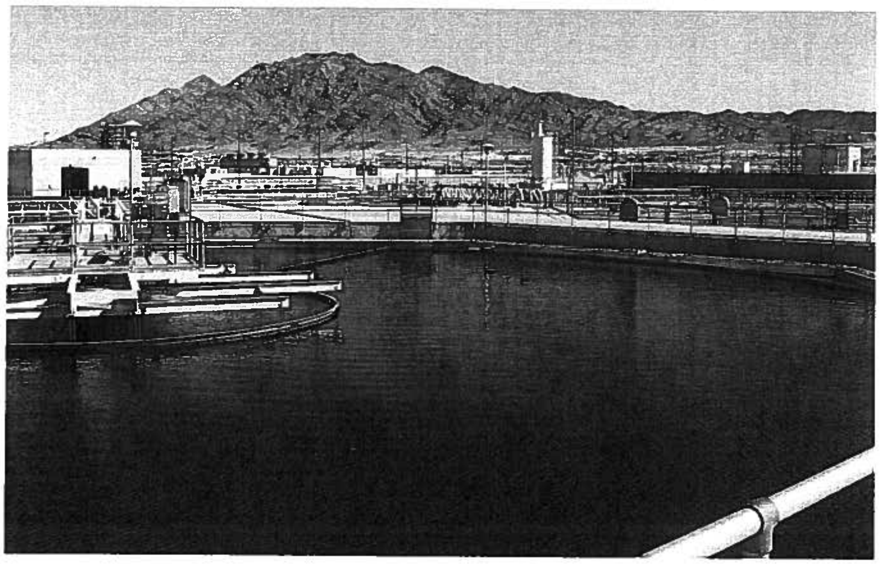
solids retention time method. Using only new suspended solids probes and the existing computer, this method reduced efforts by operator and lab personnel to control the activated sludge process. The increased uniform control also improved the efficiency of the biological process and provided a more reliable level of effluent quality.

Improvements at the Clark County Water Reclamation District lowered operating costs starting in 1997. Reductions of 30 to 40 percent were recorded, resulting in savings of $8 to $10 million annually. These innovative improvements were so noteworthy that county personnel were awarded the prestigious George Bradley Gascoigne Medal at the national conference of the Water Environment Federation in 2000.

Using benchmarking techniques comparing one operation with other like operations in other places, it can be shown that the county plant operates at a lower cost and with fewer employees per volume of wastewater treated than many other similar sized plants in the west having similar discharge permit requirements. This is in spite the fact that the pollutant loading has annually increased at a greater percentage than almost any other major plant in the United States and the plant has met ever-stricter discharge permit requirements.

The county plant, with a 2003 capacity of 110 million gallons per day has come a long way from the 12-million-gallon-per-day plant of 1956.

After choosing not to use the advanced wastewater treatment plant, the City of Las Vegas decided instead to continue operating its existing facilities to meet the more stringent discharge permit by using alum addition to remove phosphorus. Alum was added at the upstream end of the primary clarifiers.



Clarifier at City of Las Vegas wastewater treatment plant. ca. March 2004.
(Photograph courtesy of Charles R. Parrish.)

In 1993 a new dual media (sand and anthracite coal) filtration system added the ability to provide a third stage (tertiary) treatment process to remove fine particles that might contain phosphorus. Also built at this time, the third and fourth replicate trickling filter plants were placed into operation, increasing the plant capacity to 66 million gallons per day.

One of 30 dual m
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(Photo courtesy

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Nitrification bas
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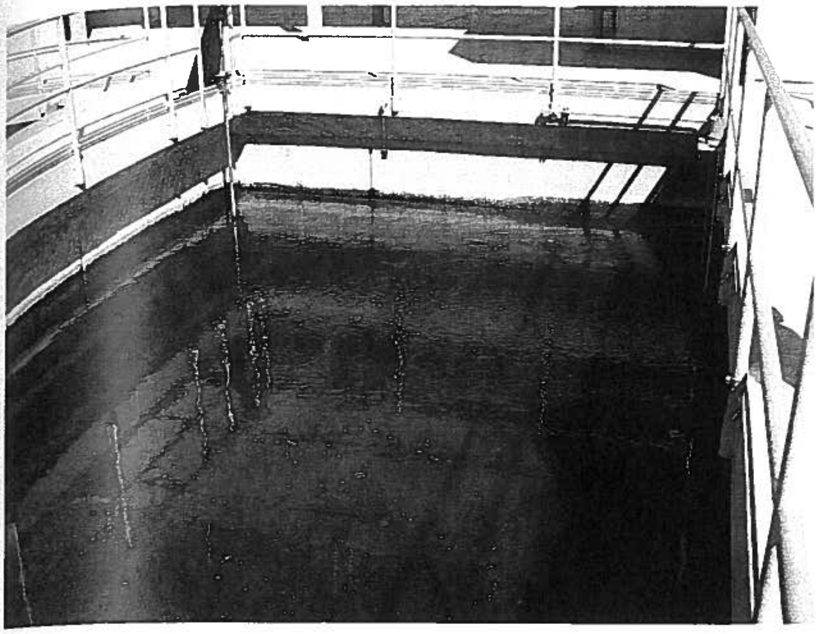
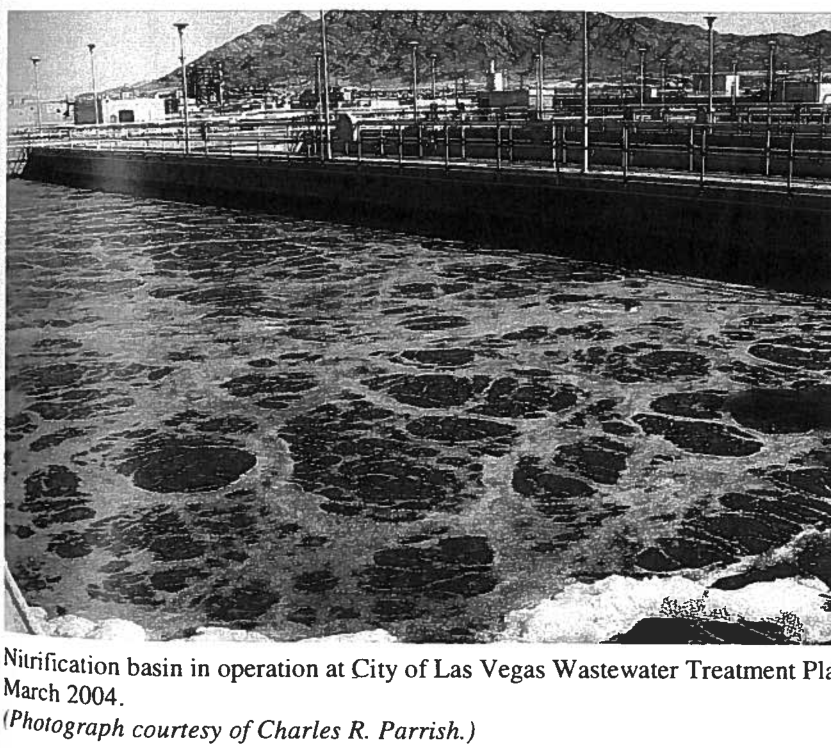


One of 30 dual media filtration basins at City of Las Vegas wastewater treatment plant. ca. March 2004.
(Photo courtesy of Charles R. Parrish.)

To meet the new ammonia limit, the City spent 3 years and $39 million building a nitrification system. The system, started in 1994, included an activated sludge (single sludge system) process facility that followed the trickling filter process.

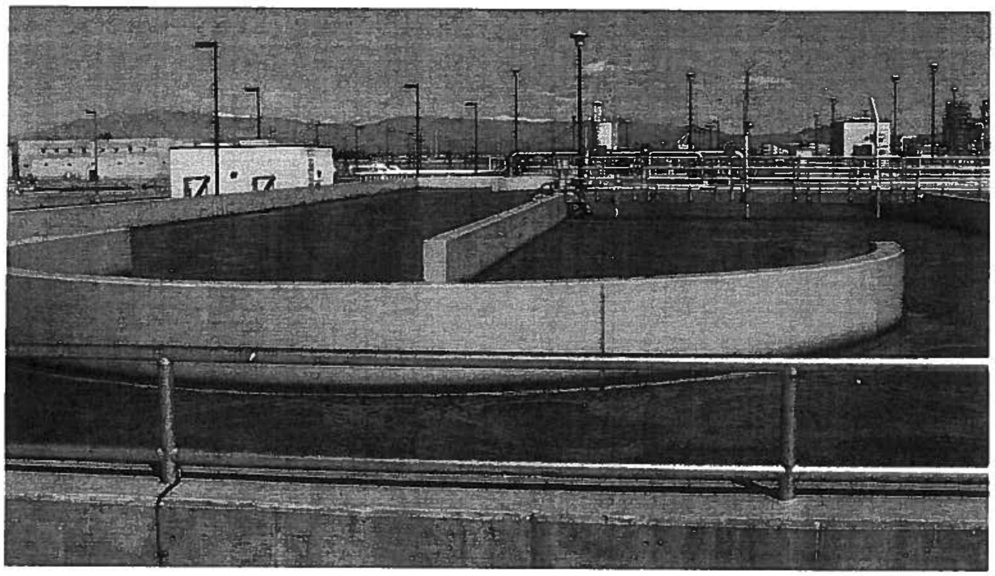


Nitrification basin in operation at City of Las Vegas Wastewater Treatment Plant. ca. March 2004.
(Photograph courtesy of Charles R. Parrish.)

These additions provided the City with a chemical addition process for phosphorus removal, a trickling filter process for removal of biological oxygen demand, and a nitrification process converting ammonia to nitrate. With these processes, the City met the requirements of pollutant removal specified by their discharge permit.

However, as incoming flows and related contaminant loadings increased with continued population growth, the City decided to split the total flow and incorporate a biological phosphorus (nutrient) removal process for a portion of their flow, rather than using the chemical phosphorus removal process. This new system starting operation in June 2003, treats 30 million gallons per day and removes ammonia and phosphorus to meet discharge permit requirements.

Because both nutrients are removed, it is called a biological nutrient removal facility. Adding this facility brought the total capacity of the City plant to 96 million gallons per day.



Biological phosphorus removal tank called "the Racetrack," at City of Las Vegas Wastewater Treatment Plant. ca. March 2004. *(Photograph courtesy of Charles R. Parrish.)*

Between 1920 and 2003, the City wastewater infrastructure improved from discharging raw sewage into Las Vegas Creek to treating wastewater with state-of-the-art technology.

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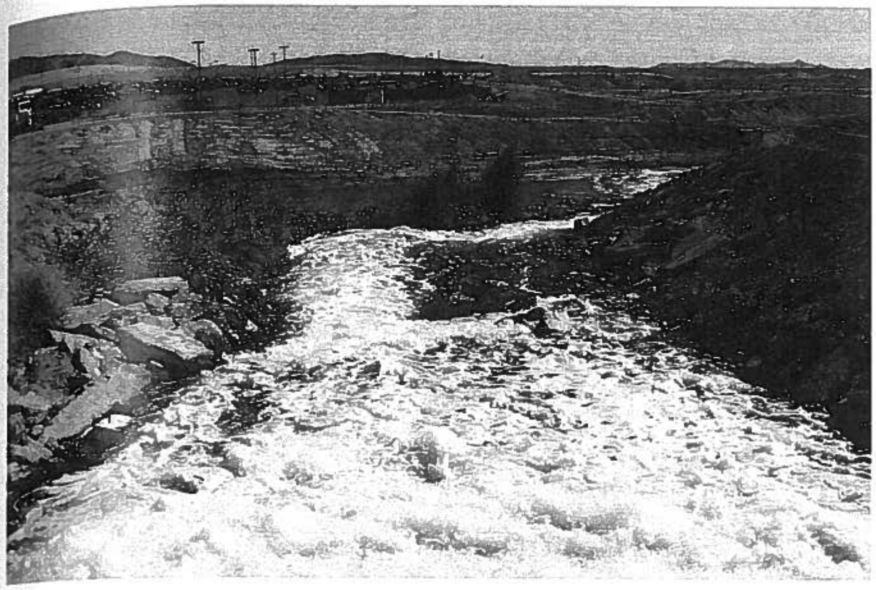

City of Las Vegas treated wastewater discharge to Las Vegas Wash. ca. March 2004.
(Photograph courtesy of Charles R. Parrish.)

In 1942 Henderson constructed its first wastewater treatment plant, known today as WWTP No. 2. Serving a population of about 5,000 people, and located near what is known today as the Basic Magnesium Incorporated upper ponds, the plant operated until 1984. Wastewater treatment in this plant used primary and secondary clarifiers, trickling filters, and anaerobic digestion to stabilize the sludge. The effluent from this plant discharged into four evaporation ponds located north of the plant. The plant later expanded to nine ponds and in 1992 the ponds were totally reconfigured and named P2-Rapid Infiltration Basins.[130]

In the 1950s, WWTP No. 1, consisting of Imhoff tanks, began operation. The new plant was positioned northwest of WWTP No. 2, 1 mile south of the Las Vegas Wash, and west of what is known today as the Basic Magnesium Incorporated lower ponds. The capacity of this facility ranged from 1 to 1.5 million gallons per day. The effluent flowed into two lagoons located close to the treatment facility, one lined and the other unlined, and into the evaporation and percolation ponds that today are part of a bird viewing preserve. The Las Vegas Building Materials Company used some of the effluent wastewater to wash their aggregate materials and some for dust abatement. WWTP No. 1 closed in 1983 after the new facility, WWTP No. 3, opened.[131]

When the three-wastewater treatment entities (City of Las Vegas, Clark County Water Reclamation District, and City of Henderson), finalized their wastewater management plans in the 1980s, the EPA for the region deemed the City of Henderson a zero-discharge entity.

Zero discharge meant that the City of Henderson could not discharge wastewater to the Wash as allowed for the City and County. This left Henderson with two alternatives for disposal of treated effluent at that time; either use evaporation and percolation ponds after pretreatment, or reuse the treated wastewater for other purposes.

An excerpt from the newsletter *Utilities Department* in 1992 best explains the history of events leading up to Henderson's situation:

> "Beginning in the late 1970s, the City of Henderson took the position of improving their own Wastewater Plant in order to avoid joining in with the Clark County Sanitation District for costs associated with the advanced waste treatment plant. Due to this decision, the County and City of Las Vegas, in their 208 Programs, did not allow for the City of Henderson to have the ability to discharge to the Las Vegas Wash. Consequently, Henderson had to take a different perspective and proceeded as a zero discharge facility. In order to achieve zero discharge, two scenarios were followed.
>
> "The first scenario was the construction of rapid infiltration basins and holding ponds. The second scenario was (the pursuit of) reclaimed wastewater for irrigation purposes. The City was successful in receiving federal grant funds for the construction of the Wastewater Plant in the early 1980s. Part of this grant was to pursue reclaimed water. The first phase of the reclaimed water (system) included a pump station, pipeline and reservoirs, which were to be constructed from the Wastewater Plant to Black Mountain Golf and Country Club. This system was financed through the use of federal funds. This was the first of two phases earmarked in the Henderson 201 Plan. The second phase was a similar system to serve the Green Valley area."

Started up in 1983, WWTP No. 3, with a capacity of 6.3 million gallons per day, consisted of two parallel trains of 8 to 12 feet deep stabilization ponds that are called facultative lagoons. A train means a series of ponds or lagoons. A facultative lagoon is one that contains both aerobic and anaerobic microorganisms (bugs). The aerobic microorganisms live in the wastewater near the surface of the lagoon where oxygen is supplied by electrically powered aerator devices. The anaerobic microorganisms live in the lower levels of the lagoon without oxygen. Facultative lagoons are common in the wastewater field and are currently the most efficient type of stabilization ponds for removing organic wastes from wastewater.

Starting in 1985, WWTP No. 3 began to provide reclaimed water for golf course irrigation. In 1989, the capacity of WWTP No. 3 was expanded to 9.5 million gallons per day by adding another train of lagoons to the treatment process.

From the startup 1983, the effluent from WWTP No. 3 flowed into the evaporation and percolation ponds, the P2 rapid infiltration basins, and to new basins called Pabco rapid infiltration basins. The Pabco rapid infiltration basins were designed with an area of 27 acres and a planned capacity of 6.3 million gallons per day. Unfortunately, in operation, they were able to handle only 1.5 million gallons per day on a continuous basis. Consequently, in 1989 the Pabco rapid infiltration basins were redesigned and increased to an area of 40 acres and a depth ranging from 3 to 5 feet.[132]

A new tertiary system treatment plant with a capacity of 10 million gallons per day, consisting of oxidation ditches, secondary clarification, and filtration for reclaimed water was started up in July 1994, providing golf course irrigation.[133] After two expansion projects, the capacity has increased to 20 million gallons per day.

City of Henderson water reclamation facility. ca. 1998. The white dots in the lagoons near the top of the photograph are aerators in operation.
(Photo courtesy of Department of Utility Services, Henderson, Nevada.)

With the zero-discharge condition removed in 1994 the City of Henderson began to discharge to the Las Vegas Wash. Current effluent disposal by Henderson includes reuse, discharge into the wash, evaporation and percolation ponds, Pabco rapid infiltration basins, and P2 rapid infiltration basins. As a result, the City of Henderson owns and operates a reclaimed water reuse system that is one of the largest and most extensive in the western United States.[134]

The City of Henderson wastewater treatment and disposal facilities are truly unique and illustrate another example of the colorful history of wastewater in Las Vegas Valley.

After reviewing the history of wastewater facilities in the Las Vegas valley, it is apparent that outstanding strides toward protecting of the water environment have been made. This is despite the fact that the rate of population growth and related generation of wastewater is among the highest of any metropolitan area in the nation. Also, this is despite the fact that regulations concerning the quality of treatment plant effluent have become significantly stricter over the years.

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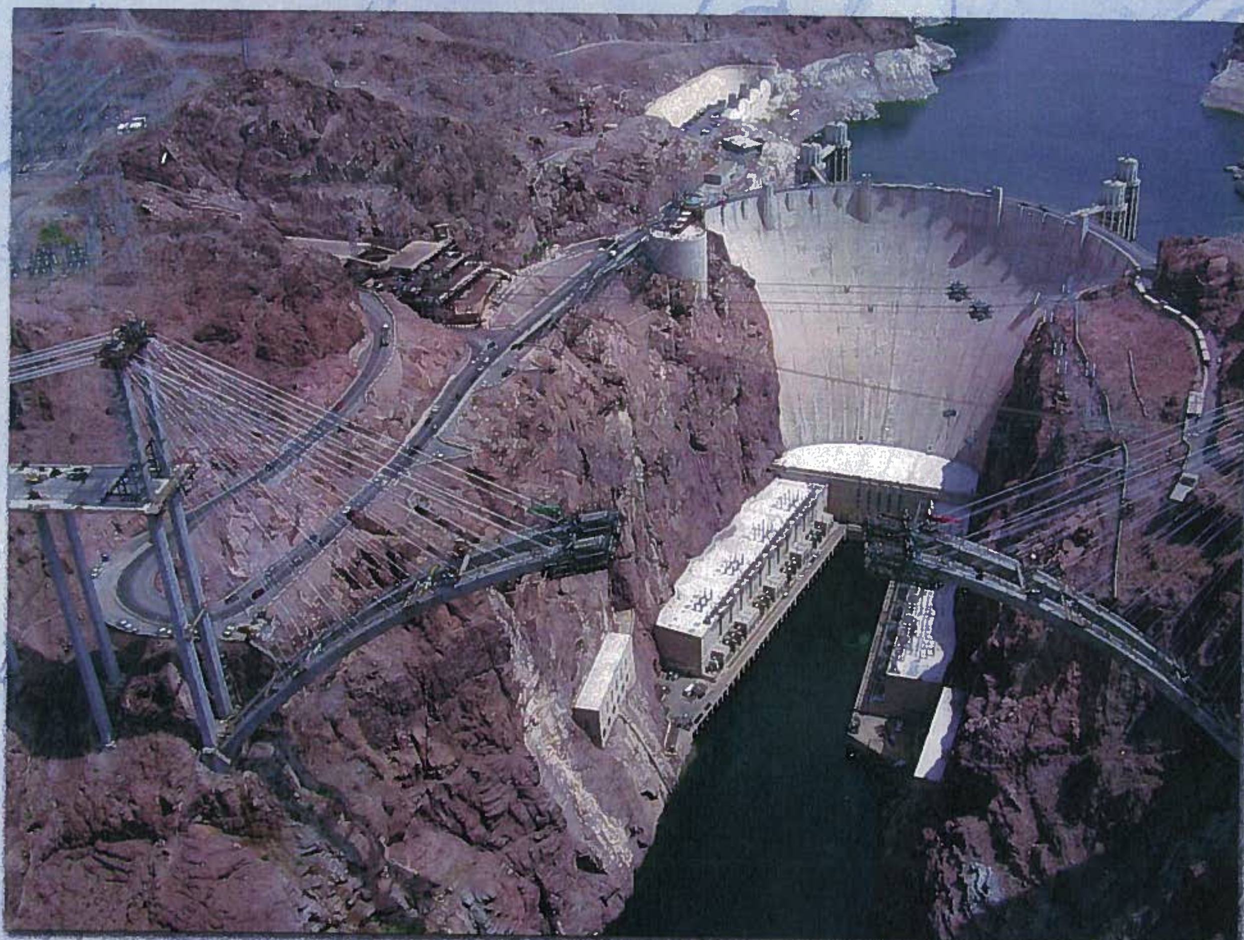

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