During our 81-year history, Carollo has designed new or improved facilities for more than 200 wastewater treatment plants. This experience includes the design of the following treatment components:

- Headworks facilities including influent screening, grit removal, and pumping.
- Primary clarification.
- Secondary treatment utilizing both fixed film and suspended growth treatment processes.
- Biological nitrogen and phosphorus removal.
- Disinfection using chlorine gas, sodium hypochlorite, and ultraviolet light (low and medium pressure).
- Dechlorination.
- Biosolids pumping, thickening, digestion, dewatering, and reuse.
- Digester gas reuse.
- Odor control facilities.

Carollo has provided planning design services for improvements to wastewater treatment facilities ranging in size from less than 1 mgd to more than 300 mgd in capacity. We have performed projects for 12 wastewater treatment plants in the western U.S. treating flows greater than 100 mgd.
<table>
<thead>
<tr>
<th>Client/Project</th>
<th>Capacity, mgd</th>
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<tbody>
<tr>
<td>City of Portland, Oregon - Columbia Boulevard Wastewater Treatment Plant</td>
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<td>City of San Diego, California - Point Loma Wastewater Treatment Plant</td>
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<td>Magna Water Company, Utah - Magna Wastewater Treatment Plant</td>
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<td>Robson Communities, Inc., Sun Lakes, Arizona - Sun Lakes Wastewater Treatment Plant</td>
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Phases 1A and 2 Biological Nutrient Removal/ Tertiary Treatment Facility Design

Carollo provided planning, predesign, and final design of Modesto’s 2.3-mgd Phase 1A Biological Nutrient Removal (BNR)/Tertiary Treatment Project at the Jennings Road Secondary Treatment Facility. Work included predesign and final design of the $20 million project, including a primary effluent pump station, fine screen, oxidation ditch biological treatment for nitrification/denitrification, membrane bioreactors (MBR), and in-vessel UV disinfection to produce a high-quality tertiary effluent for year-round discharge to the San Joaquin River. Facilities also included a new SCADA system, new electrical power service and distribution, civil site work, and a two-mile effluent line that will discharge to the Modesto’s existing river outfall.

During predesign, Carollo conducted a week-long “concentrated, accelerated, motivated, problem-solving” (CAMP®) workshop that included Modesto staff, a multi-disciplined design team, and other project stakeholders. The CAMP® process focused and integrated the combined experience of key project stakeholders and resulted in advancing the design to 30 percent completion in just six weeks, less than half the time of a conventional approach. The project bid in 2008 and is scheduled to be completed in the summer of 2010.

Carollo recently completed preliminary design and is currently completing final design of the Phase 2 expansion which is expected to be complete in early 2010. Phase 2 consists of a 12.6-mgd BNR/tertiary treatment processes designed to allow the City to comply with new discharge requirements that are consistent with California Title 22 for unrestricted, non-potable water reuse. As a result, water recycling opportunities, including landscape irrigation, agricultural irrigation, process cooling water, and other uses will become available to the City as a means of using effluent as a key water resource.

The BNR/tertiary treatment process for Phase 2 will be designed to remove biochemical oxygen demand, as well as the nutrients ammonia and nitrates/nitrites. Filtered water that has passed through the membranes will be disinfected with UV disinfection. The final effluent will be discharged to the river or used for future recycling purposes. The project consists of primary effluent, pumps, fine screens, aeration basins, MBR tanks, and UV disinfection.

Carollo’s design of Modesto’s Phase 1A facilities included the prepurchase of stand-alone membrane tanks and equipment skids to provide tertiary treatment.
PAR 942 North Secondary Treatment Improvements and PAR 1085 South Secondary Treatment Improvements

The Metro District serves approximately 1.5 million people in a 380-square mile service area. The Metro District’s Robert W. Hite Treatment Facility (RWHTF) consists of two separate primary, secondary, and disinfection treatment process trains with combined solids treatment processes. These two process trains are known as the North Complex and the South Complex.

PAR 942 - North Complex Improvements. Carollo provided final design services and is currently providing construction management and startup services for improvements to Metro District’s 160-mgd RWHTF, North Complex. This is one of the largest WWTP expansion projects in the Rocky Mountain region. Modifications are being designed to meet effluent ammonia criteria of less than 2 mg/L and effluent nitrate daily max of less than 10 mg/L. The design includes rehabilitating 12 existing aeration basins and 22 secondary clarifiers for improved performance, capacity, and flexibility; replacing major pumping systems; and optimizing centrate treatment.

PAR 1085 - South Complex Improvements. In January 2008, the Metro District then selected Carollo to provide $17 million of design services for the South Complex. The South Complex is currently operated as a pure oxygen activated sludge process. In order to meet projected discharge limits, it is necessary to provide both nitrification and denitrification capability at the South Complex. This project includes design of a 240-mgd primary effluent pump station, activated sludge aeration basins, blower building, mixed-liquor recycle pump stations, RAS/WAS pump stations, chemical feed systems, power feed system, and modification of the existing secondary clarifiers. The construction cost for these improvements is anticipated to be $205 million. Following the expansion of the South Complex, the Metro District will have the capacity to fully nitrify and denitrify peak month flows of more than 200 mgd.
Sacramento Regional Wastewater Treatment Plant
Carbonaceous Oxidation Tank Expansion

Carollo has performed several projects for the Sacramento Regional County Sanitation District’s (SRCSD) 181-mgd Sacramento Regional Wastewater Treatment Plant (SRWTP). The $31 million Carbonaceous Oxidation (CO) Tank Expansion Project increased the plant’s activated sludge capacity by 50 percent. Oxygen dissolution is accomplished with surface aerators ranging in size from 60 hp to 200 hp. Carollo selected surface aeration equipment over the facility’s existing submerged turbine equipment based on surface aeration’s higher efficiency, less costly maintenance, and ease of operation.

The project involved the addition of four pure-oxygen-activated sludge trains, with four stages each. Key features included: five pure oxygen activated sludge tanks, a tri-level tunnel structure, two mixed liquor channels, an area control center/motor center building, 16 two-speed drive surface aerators, four 250-hp reclaimed water high pressure pumps, two 75-hp waste activated sludge pumps, and extensive process and utility piping. Because the plant had historically experienced significant difficulty with Nocardia foam, the design incorporated an innovative “classifying selector” for wasting sludge from the surface of the return activated sludge channel to more effectively control solids retention time and reduce Nocardia formation.

One of the main challenges of this project was to evaluate the construction sequencing required to build five pure oxygen activated sludge tanks around and under an existing channel and tie them to the existing tanks. Carollo used a detailed critical path schedule to analyze each construction step, including the size of the concrete pours for the slabs and the number of concrete lifts for the walls. The analysis revealed that the existing channel could be taken out of service during construction, eliminating the need for specialized construction techniques. The channel was demolished and reconstructed along with the new tanks, resulting in a cost savings of approximately $200,000 and a reduction of the construction schedule by approximately three months.

“An innovative solution to a complex problem, the remarkably high transfer efficiencies resulting from the novel design approach have made the CO tank expansion a very successful project for us.”

—Wendell Kido, Chief of Water Quality, Sacramento Regional County Sanitation District

Highlights

$31 million expansion of the existing 181-mgd pure oxygen activated sludge process by 50 percent.
One of the most complex aeration designs in recent history.
Winner of the Consulting Engineers and Land Surveyors of California 1998 Merit Award.

A detailed sequencing analysis for the SRCSD’s CO tank expansion resulted in a $200,000 construction cost savings and reduced the construction period by approximately three months.

wastewater treatment
Plant Nos. 1 and 2

Carollo has provided planning, design, and construction support services for major treatment plant expansions and pipeline projects for the Orange County Sanitation District (OCSD) since its inception in 1953. These facilities include nearly 100 projects totaling in excess of $600 million. Joint works treatment facilities provide both primary and secondary treatment at two major plants. Reclamation Plant No. 1 in Fountain Valley has a total rated primary capacity of 108 mgd and secondary treatment capacity of 80 mgd. Treatment Plant No. 2 in Huntington Beach has a rated primary capacity of 168 mgd and secondary treatment capacity of 90 mgd.

Project highlights include:

- A $65 million expansion of the secondary treatment facilities at both plants to increase the ratio of secondary effluent in the discharge to the ocean outfall. The project received the Orange County Engineering Council’s 1996 Engineering Project Achievement Award.
- A major expansion of Headworks No. 2 and Plant No. 1.
- A foul air optimization study, which included a detailed review of the nine foul air scrubber facilities at Plant Nos. 1 and 2.
- A major 30-year master plan, the largest ever undertaken by OCSD.
- A $25 million ocean outfall booster pumping station.
- A $30 million solids and gas handling facilities expansion at Plant No. 1, including one of the largest cake pumping installations in the United States.
- A $35 million digester expansion at Plant No. 1.
- An $8 million miscellaneous improvements project at Plant No. 1.
- An ocean outfall investigation and repair.
- An $18 million Interplant pipeline and utility corridor project which included a 3.5-mile, 120-inch-diameter reinforced concrete pipeline between Plant No. 1 and Plant No. 2.
- A new rate structure and financial charges for OCSD’s Strategic Plan.
Carollo has been assisting the Phoenix Metropolitan Area with planning and design to meet its growing wastewater and water needs since the 1930s when we first started working with the City of Phoenix. The 91st Avenue Wastewater Treatment Plant, which is jointly owned by the cities of Phoenix, Mesa, Scottsdale, Glendale, and Tempe, has a rated capacity of 150 mgd. Carollo has planned and designed five major expansions to this facility. The 2000 Facility Planning Study, completed by Carollo in 1979, identified wastewater treatment needs to the year 2000. Carollo updated this study in 1982 to address treatment and disposal expansion concepts.

Major plant expansions include a 45-mgd activated sludge plant in 1964, a 15-mgd addition in 1968, 30-mgd additions in 1975 and 1979, and most recently another 30-mgd expansion, bringing the plant to its current design capacity. The latest 30-mgd expansion included:

- A 30-mgd liquid stream expansion that involved primary sedimentation, aeration, and secondary sedimentation facilities; a 150-mgd centralized headworks facility; and chlorination facility additions.
- Solids handling facilities that included two 1,100-foot-diameter digesters, dissolved air flotation thickeners, and polymer handling facilities.
- A maintenance facility expansion and retrofit to provide state-of-the-art facilities for all sections of plant maintenance staff.
- A digester gas scrubbing system to clean and pressurize 2 million cubic feet of digester gas per year for sale to a local gas utility.
- A retrofit of Plants IA-IB which included refurbishing the primary and secondary sedimentation basins and converting the 60-mgd aeration basins from coarse bubble aeration to more energy-efficient fine bubble aeration.
- A retrofit of Plant IIA which included converting the 24-mgd aeration basins from coarse bubble to fine bubble aeration.
- The rehabilitation of Plant I which involved demolishing the existing gravity thickeners, paving and grading, and a major transformer replacement.

Carollo prepared the preliminary design report for the project, including design criteria, hydraulics, and process layout. Construction sequencing of the individual contracts helped to avoid the potential conflicts and maximize treatment capacity during all phases of construction.
Southside Wastewater Treatment Plant

Carollo, as a major subconsultant to an instrumentation and control engineering firm, is providing a process control system expansion design for the City of Dallas’ 110-mgd Southside Wastewater Treatment Plant. The City of Dallas Water Utilities has been working for some time towards the goal of providing process automation at the Southside plant. The top-end, computer central control system replacement, along with work in progress on selected process improvements, provides the foundation for a successful automation project. The project will evaluate all plant processes to determine the feasibility of improving plant performance through the use of automation and control systems. The existing plant is essentially manually operated, with only monitoring of the processes provided from the control room.

Carollo’s role is to assist in development of the process and instrumentation diagrams (P&IDs) for each existing plant process and then to evaluate process improvements/alternatives that would allow integrated control of plant processes through automation. The goal is to make the plant more reliable and reduce operational labor costs. Reaching this goal may require extensive improvements in field instrumentation and physical process improvements.

In a separate project, Carollo is also currently in the implementation phase of the interactive operations and maintenance (O&M) manual and digital library system for the Southside plant. This project involves the conversion of four existing O&M hard text manuals (developed by others) into an HTML fully-searchable, interactive O&M digital system. In addition to the O&M manual conversion effort, Carollo is creating a digital fully-searchable library system for all the plant’s drawings, records, specifications and manuals. This library includes 40 gigabytes of fully-searchable electronic media which represents all materials collected by the utility over the past 20 years.
Biological Phosphorus Removal Retrofit and Expansion

In 1996, Carollo began work for the Clark County Water Reclamation District (CCWRD) in Las Vegas, Nevada, to optimize and convert their existing 88-mgd nitrifying activated sludge facility from chemical phosphorus removal to biological phosphorus removal (BPR). This subtle change in plant configuration and operating strategy resulted in $2.1 million per year in operations savings and led to Carollo’s design of new secondary treatment facilities. This plant is currently the largest BPR plant in the country and is producing a fully-nitrified secondary effluent with total phosphorus concentration less than 0.3 mg/L without chemical addition.

Carollo’s work included evaluating plant performance and process optimization using the BioWin model developed by Dr. Peter Dold. These mathematical modeling efforts provided the basis for identifying a treatment configuration that could be implemented within the existing process tankage with minimal modifications. Carollo also assisted operations staff in automating the activated sludge control process for optimal biological phosphorus removal (BPR). This included implementing on-line suspended solids measurements and on-line nutrient analysis. The suspended solids probes allow CCWRD to maintain a constant solids retention time (SRT) in the activated sludge basins and waste a constant mass to the sludge thickeners. This innovative automation practice has resulted in tighter process control and improved stability and performance.

Our latest design efforts provide an additional 20 mgd of biological nutrient removal (BNR)-activated sludge capacity. The new facilities feature multiple anaerobic/anoxic/aerobic compartments to allow the plant to operate in a number of BNR configurations, increasing operational flexibility for optimal performance. Unit processes include two 3.2-million-gallon aeration basins, two 150-foot-diameter secondary clarifiers, a RAS/WAS pump station, a single-stage centrifugal blower building, a sample and control building, and an electrical power building. Two additional aeration basins and secondary clarifiers will be constructed soon after completion of the initial expansion phase.

Carollo’s work for Clark County has provided 20 mgd of additional advanced secondary treatment capacity and has led to increased operational flexibility, tighter process control, and improved stability and performance.
It is indeed welcome to work with a firm that places service before bottom line profits. We must not only trust consultants to manage project design, but also trust that their advice and recommendations are well founded on facts and technology. You have done an excellent job at both.”

—Chad Phillips, Chief of Wastewater Technical Services, City of Fresno

Carollo has completed the design of a major expansion to the Fresno-Clovis Regional Wastewater Reclamation Facility. The scope of work included the preliminary design for a facility to treat up to 160 mgd and final design of a new primary and secondary treatment plant including solids handling facilities. Carollo completed the design in two phases. The first phase increased primary and secondary capacity to 68 mgd and the second phase increased primary and secondary capacity to 80 mgd.

**Phase I Expansion.** The Phase I expansion involved design of new primary treatment facilities including new circular clarifiers, a primary sludge pump station, and chemical feed system. New secondary treatment facilities include new aeration basins, new secondary sedimentation basins, and a return-activated sludge/waste-activated sludge (RAS/WAS) sludge pump station. Solids handling facilities include two new digesters, a new digester control building, belt filter presses, a sludge conveyance system, and a sludge storage silo.

**Phase II Expansion.** This phase included the final design of two additional primary clarifiers and a primary sludge pump station, two additional aeration basins, four additional secondary sedimentation basins, two additional anaerobic digesters, and ancillary equipment to support these facilities. Construction was completed in late 1998.

Carollo designed a major expansion of the Fresno-Clovis Regional Wastewater Reclamation Facility in two phases. The project had a total construction cost in excess of $100 million.
Regional Wastewater Reclamation Facilities Design

In 1997, Carollo developed a Regional Wastewater Facilities Master Plan for the cities of Reno, Sparks, and Washoe County, Nevada, to address service area needs over the next 20 years. The planning effort identified two key wastewater treatment facilities to serve the region: the Truckee Meadows Water Reclamation Facility (TMWRF) and the South Truckee Meadows Water Reclamation Facility (STMWRF).

Beginning in 1998, Carollo started the Phase I/II design for TMWRF and STMWRF. Phase I developed the tools necessary to evaluate the assimilative capacity of the Truckee River. These include evaluating watershed and water quality alternatives to accommodate growth while improving water quality. Phase II developed preliminary design concepts for improvements and expansion needs for the TMWRF and STMWRF. In 1999, Carollo began the Phase III designs of the recommended improvements developed in Phase II.

Carollo designed improvements at TMWRF to increase plant capacity from 40 mgd to 46.5 mgd. This $35 million expansion project features a new circular primary sedimentation tank, a three-pass plug flow aeration tank, a circular secondary sedimentation tank, a primary sludge screening facility, three 900-hp single-stage aeration blowers, and chemical facilities. The project also included the addition of an acid-phase anaerobic digester and conversion of an existing digestion facility to two-phase digestion. The two-phase operating mode has increased bio-gas production for cogeneration use. In addition, Carollo is modifying the four existing aeration tanks with anaerobic selectors to provide better filament control and improve phosphorus removal.

The final design of the STMWRF increased plant capacity to 3 mgd. This $19.5 million project includes a headworks expansion, odor control, an oxidation ditch, two circular secondary clarifiers, a return-activated sludge/waste-activated sludge (RAS/WAS) pump station, a chemical storage building, a chlorine contact basin, tertiary effluent filters, and an effluent pump station.

Carollo is further developing both structural and non-structural solutions to assist the owner in the design of specific facilities and programs to achieve a regional wastewater management system.
Duck Creek Wastewater Treatment Plant Expansion

Carollo, acting in conjunction with another national engineering firm, is providing preliminary design, final design, and construction management for expansion of the Duck Creek Wastewater Treatment Plant from 30 mgd to 40 mgd, City of Garland, Texas. In addition to increased plant capacity, the goals of the 10-mgd expansion are to rehabilitate the entire plant and to make sure nitrification (ammonia) discharge requirements are not exceeded. The existing plant has the following processes: flow equalization basin; coarse screening; aerated grit removal; raw sewage pumping; primary settling basins; trickling filters; solids contactor (aeration basin); secondary settling basins; tertiary filters; chlorine disinfection; and sulfur dioxide dechlorination.

Design alternatives to achieve the expansion goal that were investigated during the preliminary design portion of the project included: increasing the size of the existing solids contactor; adding a nitrifying trickling tower (NTF); and adding a new activated sludge complex.

The existing plant has exceeded the ammonia discharge requirement during the winter months. To mitigate ammonia nitrogen excursions, the Wastewater Treatment Business Plan (completed by another consultant) recommended re-rating of the existing trickling filter/solids contact process to 25 mgd and addition of a 5-mgd activated sludge train. However, subsequent studies revealed that this was a more costly alternative than expansion of the existing solids contactors. During preliminary design, it was determined that expansion to 40 mgd and rehabilitation of the existing facilities was the most appropriate path to assure permit compliance.

Carollo was responsible for design of the following facilities: 116-mgd raw wastewater pumping station; fine step screens and vortex grit facilities; equalization basin improvements; trickling filter recycle pump station rehabilitation; trickling filter rehabilitation; snail removal basins; and a 72-mgd lift station expansion.

This project is currently under construction and the team is providing contract administration, shop drawing review, and resident engineering services.
Alvarado Wastewater Treatment Plant

Carollo's recent work for the Union Sanitary District's (USD) Alvarado Wastewater Treatment Plant includes an analysis of hydraulic and process capacity, design services for interim plant improvements, and the design of a major facilities upgrade to increase the plant’s capacity to 30 mgd in dry weather and 85 mgd in wet weather.

Carollo conducted a plant capacity analysis and designed the interim improvements to the Alvarado plant while also designing a major facilities upgrade. Interim improvements included new primary sludge pumping facilities, new sodium hypochlorite chemical storage and metering equipment for disinfection and odor control, an upgraded aeration blower system, and a completely refurbished 4-mgd activated sludge plant.

The $30 million plant upgrade project included a new headworks, new fine-bubble-covered aeration basins designed for future conversion to accommodate biological nutrient removal, a new centralized aeration blower building, a new 71-mgd primary effluent screw pump lift station, a new 30-mgd return activated sludge pump station, a new 88-foot-diameter primary anaerobic digester, and a new waste activated sludge gravity belt thickener building with three two-meter, high-capacity units.

Carollo also designed two diesel engine-driven generators, improvements to the existing cogeneration engine-driven generators, modifications to the existing power distribution system, major improvements to the odor control systems, and a new state-of-the-art supervisory control and data acquisition (SCADA) system.
Provo Wastewater Treatment Plant

Carollo performed pilot studies and subsequently designed the 21-mgd secondary and tertiary treatment facilities for Provo, Utah, in 1976. Tertiary treatment was provided at Provo in order to meet the stringent treatment requirements (BOD$_3$ 10 mg/L, SS 10 mg/L) prescribed for disposal to Utah Lake, which is used for fishing, swimming, and boating.

Treatment facilities include trickling filters as roughing filters, air-activated sludge facilities designed for complete nitrification, and conventional dual-media rapid sand filters for direct filtration of activated sludge secondary effluent. Filtration is accomplished without chemical addition. The filtration process is followed by chlorine disinfection prior to discharge.

This plant, which consistently produces an extremely high-quality effluent, won an EPA Region VIII Operation and Maintenance Excellence Award for the best wastewater treatment plant in its size category in 1986 and again in 1994. The plant was also awarded the Water Environment Federation’s Best Operational Plant Award for 1979 and was recognized in 1978 with an American Society of Civil Engineer Best Civil Engineering Project Award.

In 1992, Carollo designed and managed construction of the conversion of coarse bubble diffusers to fine bubble diffusers in the activated sludge basins at the plant, significantly reducing power costs in the blower systems and increasing air transfer rates in the basins. In 1994, Carollo designed a centrifuge dewatering facility to replace the plant’s sludge drying beds.

In 1997, Carollo designed upgrades to the tertiary filter system including electrical and instrumentation upgrades, filter media replacement, and filter washwater control upgrades. We are currently providing construction management services for this project.
San Francisco/San Bruno Water Quality Control Plant Improvement Project

Carollo provided complete planning, permitting, and design services for the San Francisco/San Bruno Water Quality Control Plant Improvement Project. The project expands the existing capacity from 9 mgd to 13 mgd average dry weather flow and provides for a wet weather treatment capacity of 62 mgd.

Carollo’s initial effort was to assess current treatment capacity. Following the capacity study, Carollo prepared a facility plan which included an evaluation of future growth potential for industrial and commercial companies expected to site their facilities in the South San Francisco area. In addition, Carollo’s design team coordinated our design with other dischargers that share the South San Francisco outfall. These included the City of Burlingame, the City of Millbrae, the San Francisco International Airport, and the City of San Bruno. Carollo held several meetings with the dischargers to gain consensus on design concepts for facilities that will be shared by all dischargers.

The project is located within the existing plant site, which is limited on three sides by the San Francisco Bay. Our design overcame the challenge of constructing the new facilities in a small and awkward area. The project consists of a new headworks, primary clarifiers, aeration basins, retrofit of existing aeration basins to fine bubble diffusion, one new secondary clarifier, new chlorine contact basins, a new return-activated sludge/waste-activated sludge (RAS/WAS) pump station, two new anaerobic digesters, a sludge dewatering building with odor control facilities, a regional sodium bisulfite facility to dechlorinate the effluent, a new regional effluent pump station, and a new 10,000-square-foot maintenance building.

Carollo’s design of improvements to the existing South San Francisco/San Bruno Water Quality Control Plant overcame the challenge of locating new facilities in a small and awkward site limited on three sides by San Francisco Bay.
Northwest Wastewater Treatment Plant Expansion

Carollo provided final design services for an expansion of the City of Springfield’s Northwest Wastewater Treatment Plant to 9.5 mgd. Facilities included peak flow retention basin improvements, new submersible influent pumps, a new grit removal facility, screenings modifications, selector basin, aeration basin improvements, secondary clarification improvements, ultraviolet (UV) disinfection, odor control, and other related appurtenances.

As part of the preliminary design process, Carollo performed on-site sample collection and laboratory testing to evaluate key characteristics of the activated sludge mixed liquor and the treatability of the effluent for UV disinfection. The testing involved determining the settling characteristics of the mixed liquor suspended solids (MLSS). Through bench-scale testing conducted at the treatment plant, Carollo developed a plant-specific settling curve and used it to establish a correlation between secondary clarifier capacity and MLSS concentration. The project also involved a conductive microscopic evaluation that revealed the presence of filamentous organisms that are known to cause reduced sludge settleability. Carollo identified the main source of the high organic waste that contributed to the poor sludge settleability and recommended pumping this low-flow, high-strength industrial waste to the 35-mgd Southwest plant.

Work included examining effluent samples for UV transmittance, particle size distribution, and collimated-beam (CB) dose/response. Sample results indicated the effluent quality was amendable to disinfection by UV and provided a basis for economically sizing this new equipment. This testing provided additional information not available from historical operating data and allowed Carollo to optimize the plant design.

Planning workshops and regular meetings held with Springfield helped to facilitate clear lines of communication. The feedback from these meetings and other project communications ensured that all project participants understood the key factors in developing the planning alternatives and recommendations. A value engineering workshop also helped to validate process selection and confirm that the recommended alternative was economical.

Carollo also assisted operations staff in automating the selector/activated sludge control process for biological nitrogen and phosphorus removal. This included implementing online dissolved oxygen measurements to allow Springfield to maintain a constant solids retention time (SRT) in the activated sludge basin and waste a constant mass to the sludge thickeners.

Carollo also provided construction-phase engineering and support services for the project, including the development of a computerized operations and maintenance manual.
East Canyon Wastewater Treatment Plant

Carollo provided wastewater treatment facility planning and design services for the Snyderville Basin Sewer Water Reclamation District (SBWRD), which serves Park City, Utah and the surrounding area. Carollo evaluated biological and chemical phosphorus removal alternatives and seasonal and year-round reuse alternatives to determine the most cost-effective means of meeting new stringent phosphorus discharge limits.

Carollo subsequently designed an expansion of SBWRD’s East Canyon Wastewater Treatment Plant to 4 mgd in order to provide additional treatment capacity for the 2002 Winter Olympic Games, and to handle future growth in the area. The expansion design included:

- Raw wastewater equalization to increase the capacity of SBWRD’s existing treatment facilities, enhance the biological phosphorus removal, and reduce the cost of tertiary chemical phosphorus polishing facilities.
- A new 4-mgd headworks facility including two 6-mm step screens with completely-redundant screening conveyors and screening washers/compactors, two vortex grit removal units, and a grit washer/classifier.
- Chemical phosphorus removal facilities, consisting of chemical addition, solids contact clarification, and tertiary filtration designed to reduce phosphorus to below 0.10 mg/L.
- Odor control facilities for the headworks, equalization basin, influent pump station, and anaerobic zone of the biological phosphorus removal process consisting of foul air fans and two dual-bed granular activated carbon (GAC) adsorption columns.
- Completely enclosed screens and covered wastewater channels in the headworks. This reduced the volume of foul air requiring treatment by 10 fold and significantly reduced capital costs.

Construction of this $14 million project was complete in 2003, eight months ahead of schedule.
Wastewater Treatment Plant Improvements Project

Carollo provided planning, design, and construction management for the City of Benicia’s $24 million Wastewater Treatment Plant Improvements Project. The project increases plant capacity to 3.25 mgd average dry weather flow (ADWF) and will allow Benicia to reliably meet discharge requirements. Carollo also negotiated favorable national pollution discharge elimination system (NPDES) permit conditions for Benicia.

Improvements will be implemented in two phases. The Phase I design included new activated sludge secondary treatment facilities which will operate in parallel with the existing rotating biological contactors (RBCs). Major facilities designed under Phase I include:

- New activated sludge aeration basins.
- A blower building.
- New secondary clarifiers.
- A new RAS/WAS pump station.
- Solids thickening and digestion facilities.
- New sodium hypochlorite disinfection facilities.
- Odor control improvements.
- Miscellaneous structural, electrical/instrumentation, and landscape improvements.

Phase II will involve the replacement of the RBCs with new secondary treatment facilities when the RBCs reach the end of their useful life.

The project presented several challenges to the Carollo design team. The facility’s hydraulic capacity was limited to approximately 8 mgd, resulting in hydraulic overflows during the wet weather season when plant flows can reach 12 mgd. As part of the design, Carollo created a computerized plant hydraulic model that allowed for the easy identification of hydraulic bottlenecks and the implementation of improvements designed to increase plant hydraulic capacity to 12 mgd average wet weather flow. Due to the close proximity of the plant to residential neighborhoods, the design incorporated stringent noise and odor control criteria. Carollo also provided assistance with public involvement, financial analysis, and environmental/legal coordination for the project.
Ashland Wastewater Treatment Plant Upgrade

Carollo has provided predesign, final design, and construction management for the City of Ashland’s Wastewater Treatment Plant Upgrade Project. Ashland originally master planned the improvements as a three-phase, seven-year project with a total cost of $27.1 million. The project addresses the immediate needs of the plant, regulatory compliance to meet total maximum daily loads (TMDL) limits, and community growth.

During predesign, Carollo was able to identify changes to the original project that reduced the construction cost by approximately $8 million. Realizing these savings involved changing the treatment process to an extended air process using an oxidation ditch. In addition to its lower cost, operations staff preferred the oxidation ditch concept because of its reduced operations and maintenance (O&M) requirements. Based on the outcome of this predesign effort, Carollo amended the City’s facility plan to include a two-phased approach which incorporated more cost-effective treatment technologies and accelerated the construction schedule. The Oregon Department of Environmental Quality reviewed and accepted this amendment.

Treatment plant improvements include rehabilitation of the existing headworks to improve screening and solids handling, odor control improvements, and electrical upgrades. Work also included rehabilitating the existing secondary clarifiers with new collector mechanisms, constructing an additional 80-foot-diameter clarifier, adding a new return sludge pump station with waste sludge pumping, and installing a new ultraviolet (UV) disinfection system to eliminate the use of chlorine gas.

Additional services include:

- Design of a tertiary treatment plant for phosphorus removal. The plant will use immersed membranes for filtration of secondary effluent to remove alum-floculated phosphorus. The tertiary plant will be on-line in the summer of 2002.
- Design of a sludge stabilization and dewatering facility. Lime stabilized sludge will be treated to Class B standards and dewatered using centrifuges.
- Public involvement assistance including meetings with the City Council and neighborhood groups, and interface with special interest groups.
- Permitting assistance.
- Full-time, onsite construction management and inspection.
- Startup, testing, training, and O&M manual preparation.

The Ashland Wastewater Treatment Plant produces the highest quality effluent anywhere in the Northwest.
Sun Lakes Wastewater Treatment Plant

Carollo provided planning, design, and construction services for the 2.4-mgd Sun Lakes Wastewater Treatment Plant, which was awarded the 1997 Engineering Excellence Merit Award, by the Arizona Consulting Engineers Association. This facility replaced an existing lagoon system for a retirement community in the Phoenix area. The plant incorporates the following unit processes:

- Sequential batch reactor (SBR) system.
- Traveling bridge filtration.
- Low-pressure ultraviolet (UV) disinfection.
- Aerobic digestion.
- Centrifuge biosolids dewatering.
- Nitrogen removal and pathogen reduction.
- Standby power system providing backup to the liquid processes and the UV system.

Carollo compared using chlorine and hypochlorite with chlorine and hypochlorite with UV disinfection, and recommended UV based on cost, safety, and the elimination of disinfection by-products and hazardous chemicals like chlorine. Suitable for groundwater injection, the low-pressure UV disinfection system produces an effluent quality of 2.2 MPN/100 ml fecal coliform.

Odors, noise, aesthetics, and space constraints were major concerns during design due to the plant’s location within 150 feet of luxury retirement homes, as well as its proximity to a golf course and a baseball field. “Good neighbor” design concepts included locating the 2.4-mgd wastewater treatment plant on a four-acre site using a sequential batch reactor (SBR) system with underground covered tanks that provide noise and odor control. The benefit of a below-grade SBR system is that the wastewater is aerated, mixed, and settled in one basin. The result is a smaller footprint, less use of concrete, and reduced capital costs. The design also includes a sophisticated odor control system consisting of a packaged chemical-assisted packed tower.

The effluent pump station distributes the reclaimed water to decorative lakes. Effluent is recharged via injection wells and recycled for golf course and agricultural irrigation. This is the first recharge well with direct injection of effluent in Arizona.

Solids are dewatered using centrifuges and then sent to a landfill. Since the facility began operating in 1997, effluent quality has been less than 0.5 NTU turbidity, total nitrogen has been less than 10 mg/L, and annual average coliform concentration is non-detectable.

“This facility has exceeded our expectations for reliability and efficiency of design, ease of operation and maintenance, its incorporation into the surrounding neighborhood, and its overall budget to the Sun Lakes community.”

—Jim Poulos, General Manager, Robson Communities, Inc.