

Akram Botrous Ph.D., PE, BCEE

Regional Wastewater Practice Leader

I have more than 30 years of wastewater treatment research, consulting, and design experience. I have published papers and spoken in conferences on the latest development in wastewater engineering. I was the primary author of the sixth edition of the primary treatment chapter of the Manual of Practice No. 8 (MOP8).

EDUCATION

Ph.D., Environmental Engineering, University of Nebraska, Lincoln, Nebraska, 2003

MS, Sanitary Engineering, IHE, Delft, Netherlands, 1999

BS, Civil Engineering, Cairo University, Cairo, Egypt, 1992

EMPLOYMENT

2005 – Current Regional Practice Leader
Stantec Consulting, Roseville, CA

2003 – 2005 Environmental Engineer
BG Consultants, Manhattan, KS

1999 – 2003 Teaching Assistant
University of Nebraska, Lincoln, NE

1997 – 1999 Research Assistant
IHE, Delft, Netherlands

1992 – 1997 Lecturer
Cairo University, Cairo, Egypt

REGISTRATIONS

Professional Engineer #68781, State of California

MEMBERSHIPS

American Academy of Environmental Engineers & Scientists, Member

Water Environment Federation, Member

PROJECT EXPERIENCE

Wastewater Treatment

North Secondary Treatment Intensification and Upgrades at Robert W. Hite Facility (PAR 1411), Denver, Colorado (Technical Advisor, 2023-Ongoing)

Client: Metro Water Recovery

Responsible for quality review of technical memoranda, support of design criteria development, and preliminary design for upgrades to the Robert W. Hite Treatment Facility's 106-MGD North Secondary Treatment Complex using densified activated sludge technology. Key project elements include a new aeration system to provide process air to the existing secondary treatment basins; a new densified activated sludge process including a hydrocyclone facility and other ancillary processes; and extensive fixed asset replacement (FAR) work to modify and replace aging assets. The team is currently completing design and coordinating early construction work with the Construction Manager at Risk (CMAR) contractor to address critical maintenance repairs being completed as part of the FAR work.

Project No. 19007 - Flamingo WRC Secondary Treatment Aeration Basins and Clarifiers (150 MGD Expansion), Clark County, Nevada (Process Designer, 2020-2021)

Client: Clark County Water Reclamation District
Served as Process Designer on a \$233 million project to increase the secondary treatment capacity of the 130-MGD Flamingo Road Water Resource Center by 25 MGD through the addition of three secondary treatment trains using BNR, nitrification, partial denitrification, and biological phosphorous removal. Key design elements include three new 2-MG aeration basins; three 140-foot secondary clarifiers; a new 6,500-square-foot blower building housing four 800-horsepower, 12,900-cubic-foot-per-minute dual-core turbo blowers; an electrical services building; RAS/WAS/MLR/scum drain pumping facilities; and yard pumping ranging from six to 96 inches in diameter. Responsibilities included process design and modeling of the activated sludge system that is flexible to operate in one of four operating modes including A2O (anaerobic, anoxic, oxic), AO (anaerobic, oxic) with RAS denitrification, Johannesburg, and five-stage Bardenpho. I also sized the aeration system that can serve the four modes of operation.

Greeley Water Pollution Control Facility Blower Replacement, Greeley, Colorado (QA/QC Reviewer, 2018)

Client: City of Greeley
Reviewed process, mechanical, and control design for a project to replace three problematic high-speed blowers with three new magnetic bearing blowers and a new master blower control panel. I also oversaw the blower pre-selection process.

Eagle River WWTF Blower Upgrade, Eagle River, Alaska (Design Engineer, 2013-2014)

Client: AWWU

The project included the installation of one high speed single stage centrifugal blower to replace one of the existing multistage centrifugal blowers. Due to the limited ability to control air flow and to increase aeration efficiency, the City decided to replace one of the existing blowers with new high efficiency blower to demonstrate the aeration efficiency and to serve as a base line for future replacement of the remaining blowers. I was responsible for the pre-selection of the blower, design of aeration system upgrade and control. The project also included addition of ammonia sensors for monitoring.

Merced Wastewater Treatment Facility Phase V Solids Handling Upgrade, Merced, California (Design Engineer, 2011)

Client: City of Merced

Total Construction Cost: USD 27M

Designed primary treatment upgrades and decant equalization for a \$33 million expansion and upgrade project. The project featured significant modifications to an existing solids handling system to comply with updated regulations. Changes included abandoning existing earthen-lined solids drying beds and installing centrifuges and active solar driers to produce Class A biosolids.

Barstow Water Reclamation Plant Aeration System Upgrade, Barstow, California (Design Engineer, 2010-2011)

Client: Johnson Controls

Total Construction Cost: USD 2M

The Barstow original Water Reclamation Plant project was constructed in 1970s and featured three multi-stage centrifugal blowers serving two aeration basins and two aerobic digesters. Each blower was driven by a 448-horsepower natural gas fired engine and lacked automation to respond to oxygen requirements. When the City decided to replace these blowers due to the scarcity of available replacement parts and high operational costs, Stantec evaluated and designed an upgrade. I served as Design Engineer for this effort and was responsible for pre-selection of three-high speed turbo blowers and the design of the upgraded aeration system and controls.

San Andreas Wastewater Treatment Plant Upgrade, San Andreas, California (Process Engineer, 2009-2010)

Client: San Andreas Sanitary District

When new regulations required that the San Andreas Wastewater Treatment Plant be upgraded to remove ammonia, Stantec evaluated alternatives including integrated fixed film activated sludge (IFAS), sequencing batch reactor (SBR), and activated sludge in conjunction with utilizing or demolishing existing facilities. This evaluation determined that the most cost-effective alternative was to keep using the existing trickling filters and then process the low-strength biochemical oxygen demand (BOD) effluent in a new gravity thickened aerobic digester (GTAD). I led process and detailed design for this custom solution, which saved the District significant money by allowing for the use of a much smaller reactor volume downstream.

Merced Wastewater Treatment Facility Simultaneous Nitrification Denitrification and Aeration System Upgrade, Merced, California (Project Engineer, 2007)

Client: City of Merced

Provided process and detailed engineering design to upgrade a 12-MGD treatment plant to reliably meet a nitrate level of 10 mg/L without demolition of the existing diffusers or baffles. The aerobic reactors were modified to promote simultaneous nitrification and denitrification (SND) using the SymBio® process. A dissolved oxygen meter, air flow meter, and air flow control valve were provided to each aeration zone to allow independent dissolved oxygen control using the most-open-valve control strategy.

Reno-Stead Water Reclamation Facility Expansion, Reno, Nevada (Process and Design Engineer, 2018-2022)

Client: City of Reno

Process and Design Engineer for a 4-MGD expansion project, including new headworks screening and grit removal, reactor basins, secondary clarifiers, a RAS/WAS pump station, deep bed sand filters, chemical facilities, and odor control. I was responsible for biological nutrient removal (BNR) and aeration system process design. I was also involved in preparing contract drawings, specifications, and cost estimates.

City of Dinuba Wastewater Reclamation Facility Phase 1 Improvements Project, Dinuba, California (Design Engineer)

Client: City of Dinuba

Provided design services for a \$10 million project to increase the capacity of the City of Dinuba's Wastewater Reclamation Facility to 3 MGD and achieve compliance with state regulations. Improvements included improvements to headworks, influent pump station, and primary and secondary treatment upgrades as well as the addition of a new aerobic digester.

Lincoln Wastewater Treatment and Reclamation Facility Expansion, Lincoln, California, US (Lead Process Engineer)

Client: City of Lincoln

Total Construction Cost: USD 65M

Led planning, design, and construction support services for a \$90 million treatment facility expansion project. The project will consolidate wastewater treatment for the Lincoln and Placer County SMD-1 service areas as encouraged by Regional Board policy. It is comprised of a new local lift station, 15 miles of pipeline, and treatment plant upgrades including new headworks screening, oxidation ditches, secondary clarifiers, a RAS/WAS pump station, deep bed sand filters, chemical facilities, odor control, effluent disposal pumps, and reclamation piping and pumps. I prepared contract drawings, specifications, and cost estimates for secondary treatment facilities including the oxidation ditch, secondary clarifier, and RAS pump station.

City of Dixon Wastewater Treatment Facility Improvements, Dixon, California (Process and Design Engineer, 2015)

Client: City of Dixon

Total Construction Cost: CAD 25M

Provided planning, process, detailed design, and services during construction for a project to expand the secondary treatment process at a wastewater treatment plant. The \$25 million effort included converting a pond plant into an extended aeration activated sludge plant with a new self-cleaning pump station, headworks, dual train oxidation ditch and clarifiers, percolation pond improvements, screw press mechanical solids dewatering facilities, operations and laboratory building, and miscellaneous site appurtenances.

Donner Summit Public Utility District Wastewater Facilities Upgrade and Expansion, Soda Springs, California, United States (Process and Design Engineer, 2011)

Client: Donner Summit Public Utility District

Total Construction Cost: USD 19.5M

Provided process and design engineering for improvement and expansion of the membrane bioreactor system with a four-stage reactor configuration for advanced biological nitrogen removal. Nitrogen removal is a challenge for this resort community in particular because of highly variable flows and loads and cold temperatures. The project included biomass augmentation through ammonia addition during low load periods to enhance nitrification, carbon addition to enhance denitrification, and reactor heating when needed because of extreme cold temperatures.

City of Woodlake Wastewater Treatment Facility Upgrade and Expansion, Woodlake, California, US (Design Engineer, 2009)

Client: Quad Knopf

Responsible for process design and detailed design of secondary treatment facilities (ditches, clarifiers, RAS pump station, and scum pump station) for a 1.3 MGD activated sludge process. This \$15 million wastewater treatment facility replaced an existing pond plant with new facilities including headworks screening, influent pump station, two oxidation ditches with anoxic basins for nitrogen removal, two secondary clarifiers, return activated sludge and scum pump stations, solids stabilization lagoons, percolation ponds, standby generator, and operations building.

City of Williams Wastewater Treatment Plant Improvements (2009), Williams, California, US (Design Engineer, 2009)

Client: City of Williams

Responsible for process design and preparation of contract drawings, specifications, and cost estimates for the secondary treatment processes. The 0.5 MGD activated sludge process was part of the overall \$9 million project that upgraded an existing pond treatment system to an extended aeration, activated sludge treatment plant with cloth media filtration, UV disinfection, reaeration, and other supporting facilities.

Lathrop Consolidated Treatment Facility Phase I, Lathrop, California (Process and Design Engineer, 2009)

Client: City of Lathrop

Served as Process and Design Engineer for a capacity assessment of the City of Lathrop's existing membrane bioreactor (MBR) plant. The assessment concluded that the membranes were acting as a bottleneck restricting the capacity of the plant, and that the MBR plant could be expanded from 0.75 to 1.0 MGD without building more reactor basins. The resulting project included upgrades to the headworks screens and grit removal as well as biological process and membrane basins modifications compliant with Title 22 unrestricted recycled water reuse requirements.

San Andreas Wastewater Treatment Plant Upgrade, San Andreas, California (Design Engineer, 2008)

Client: San Andreas Sanitary District

Responsible for process and detailed design for secondary treatment as part of the 0.35 MGD activated sludge system, designed to reliably achieve nitrification downstream of the existing trickling filter plant.

City of Live Oak Wastewater Treatment Plant Improvements Project, Live Oak, California, US (Design Engineer, 2007)

Responsible for process design, preparation of contract drawings, specifications, and cost estimates for the secondary treatment including a selector, two oxidation ditches, two secondary clarifiers, and a RAS/WAS pump station. The \$17 million project upgraded an existing pond treatment system to a 1.4 MGD activated sludge treatment plant with cloth media filtration and UV disinfection.

City of Los Banos Wastewater Treatment Plant Expansion and Upgrade - Phase II, Los Banos, California, US (Project Engineer, 2007)

This project included the design of new headworks, an influent pump station, and miscellaneous improvements to the pond treatment system the City of Los Banos Wastewater Treatment plant. I performed hydraulic modeling and quality assurance/quality control for the design of the 20-MGD influent pump station and two mechanically cleaned bar screens.

Pilot Plant Study, Lincoln, Nebraska (Research Assistant, 2002)

Conducted pilot testing of side-stream nitrification using fluidized-bed reactor.

Wastewater Characterization, Multiple Cities, California

Provided intensive monitoring for wastewater characterization for the City of Merced in 2005, City of Dinuba in 2008, and City of Lathrop in 2009.

Aeration Studies, Multiple Projects, California (Project Engineer)

Provided process modeling services for activated sludge systems to determine biological oxygen demands and air flows required and recommend blowers for more than 20 projects. Some of these projects include Richmond, CA; Barstow, CA; Grass Valley, CA; Eagle River, AK; Live Oak, CA; and Dixon, CA.

Facility Planning

San Andreas Sanitary District Wastewater Facilities Master Plan, San Andreas, California, US

Client: San Andreas Sanitary District

San Andreas Sanitary District was required by new regulations to upgrade their wastewater treatment plant to remove ammonia. The original plant design was a trickling filter process, which proved to be unreliable to remove ammonia. Dr. Botrous was the process design engineer and evaluated several alternatives including IFAS, SBR, activated sludge in conjunction with utilizing or demolishing existing facilities. The most cost effective alternative was to keep existing trickling filters in use and then processing the low strength BOD effluent in a new activated sludge. Removing most of the BOD in the trickling filter allowed for a much smaller reactor volume downstream and lower O&M cost. Dr. Botrous carefully modeled and planned this process approach using the BioWin simulator. Thinking creatively about how to maximize the use of existing facilities saved the District a significant amount of money.

**Mid-Western Placer Regional Sewer Project,
Placer County, California (Project Engineer)**

Client: City of Lincoln

Total Construction Cost: USD 74M

This \$74 million regional project consolidates wastewater treatment for the City of Lincoln and western Placer County. The project includes a new sewage lift station with emergency storage basin, 15 miles of pipeline, and expansion of the City of Lincoln Wastewater Treatment and Reclamation Facility (WWTRF). The WWTRF expansion includes new influent pumps, headworks channel and screen, oxidation ditch, secondary clarifier, RAS/WAS pump station, deep bed sand filters, chemical feed facilities, odor control, and effluent disposal pumps. Role included alternative analysis and selection of WWTRF expansion and hydraulic analysis of force main and pump station.

**Wastewater Plant Capacity Study, Sea Ranch,
California (Project Engineer)**

Evaluated the feasibility of abandonment of the Sea Ranch North WWTP and pumping its raw sewage to the aerated ponds at Gualala Community Services District (GCSD) WWTP for treatment and subsequent reuse on the golf links.

**Valley Springs Wastewater Treatment Alternatives
Analysis, Valley Springs, California**

Evaluated wastewater treatment and disposal options. The existing wastewater facilities included near-capacity aerated ponds and the site has a flooding risk.

**Sonora Regional Wastewater Treatment Facility
Evaluation, Sonora, California (Project Engineer
and Technical Lead, 2014-2018)**

Client: Tuolumne Utilities District

Total Construction Cost: USD 500k

Served as the project engineer and technical lead for facility planning, condition assessment, and capacity evaluation of the Sonora Regional Wastewater Treatment Facility. The process evaluation included a septage receiving station, headworks, primary and secondary clarifiers, trickling filters, anaerobic digesters, and polishing ponds. The trickling filters had chronic poor performance issues due to a lack of biomass during the summer. It was stipulated that the issue was related to lack of oxygen when the rock media was replaced with the plastic media and the vent pipes were removed. A forced air system was recommended and installed.

**Newman Wastewater Treatment Alternatives
Analysis, Newman, California (Project Engineer)**

Client: City of Newman

Evaluated short- and long-term expansion alternatives to Newman's aerated pond WWTP.

**City of Brentwood Wastewater Treatment Plant
Expansion - Design Services, Brentwood,
California (Project Engineer)**

Client: City of Brentwood

Total Construction Cost: USD 44M

Prepared a study to determine the upgrades necessary to expand the plant's capacity from 5 to 7.5 MGD, and 7.5 to 10 MGD. I evaluated the headworks, influent pump station, effluent filtration, and ultraviolet disinfection.

PUBLICATIONS & WHITEPAPERS

Botrous A., Effect of Climate Change and Water Conservation on WWRF Capacity. CWEA, 2023.

Botrous A., The Importance of Wastewater Characterization and how to do it right!. Hawai'i Water Environment Association, 2021.

Botrous, A. Wastewater Aeration Systems – Principles, Practical Considerations, and Innovation. Nevada Water Environment Association (NWEA) Annual Conference, 2018.

Botrous, A. When Wastewater Data Does not Make Sense: Lessons Learned. California Water Environment Association (CWEA) Annual Conference, 2018.

Chapter 10 – Primary Treatment, Manual of Practice No. 8. Design of Municipal Wastewater Treatment Plants, 6th edition. Water Environment Federation (WEF), 2017.

Botrous, A. An Accurate Method to Estimate Energy Savings with More Efficient Blowers: Case Studies. California Water Environment Association (CWEA), 2014.

Botrous, A. Donner Summit PUD Wastewater Treatment Process Selection. Nevada Water Environment Association (NWEA), 2013.

Botrous, A., Hauser J., Beck S., Slagter C., Osmer B. Think you have a Plug Flow reactor? Think again!. Water Environment and Technology (WEF), 2010.

Botrous A., Hauser J., Knapp T., Beck S., and Molina H. Wastewater Characterization Study for Nitrogen Removal in Merced, California. Annual Conference of the Water Environment Federation, WEFTEC, 2009.

Botrous A., Dahab M., and Surampalli R. Feasibility analysis of side-stream nitrification of anaerobic sludge decant using fluidized-bed fixed-film reactors. 1st IWA-ASPIRE Conference, Singapore, 2005.

Botrous A., Dahab M., Miháلتz P. Nitrification of high-strength ammonium wastewater by a fluidized-bed reactor. Wat. Sci. Tech. 49 (5 6), 65 – 71, 2004.

Botrous A., Dahab M., Miháلتz P., and Surampalli R. Pilot-scale fluidized-bed reactor for nitrification of biosolids decant. Annual Conference of the Water Environment Federation, 2003.

Botrous A., Dahab M., Miháلتz P. Sidestream treatment of sludge dewatering decant: pilot-scale testing and feasibility analysis. IWA Conference on Design Operation and Costs of Large Wastewater Treatment Plants, Prague, Czech Republic, 2003.

Botrous A., El-Hattab I., and Dahab, M. Design of wastewater collection networks using dynamic programming optimization technique. ASCE National Conference on Environmental and Pipeline Engineering, 2000.