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Water Environment Federation
the water quality people

WEF Student Design Competition

WEF STUDENTS & YOUNG PROFESSIONALS COMMITTEE
YPC

WEFTEC
October 17, 2021
Chicago, IL

Welcome to the 2021 WEF Student Design Competitions

The WEF Student Design Competitions were developed to provide a forum to showcase top students who will be future water quality professionals. The competitions provide university students with an opportunity to highlight their skills and share their enthusiasm for the water environment while addressing real world design challenges. A list of this year's participating teams and each team's abstract are included in this brochure.

We encourage you to engage with these motivated students during breaks and at the Networking Reception at 5:00pm in Room S105a. The Networking Reception will be a great opportunity for further small group interaction with these bright students.

On behalf of WEF and the WEF Students and Young Professionals Committee, we would like to thank: the sponsors of this year's competition - Carollo and GHD for their support of this event; the judges for their time and personal contributions; and the WEF Board of Trustees for their support of the Students and Young Professionals Programs. Ifetayo Venner, 2020-2021 WEF Vice President, will announce this year's winners of the Student Design Competitions. Thank you to the students and their advisors for their motivation and enthusiasm.

The Student Design Competition Sub-Committee supports the design competition at the Member Association (MA) level as well as the national level. Each MA is encouraged to develop their own Student Design Competition based on a chosen design problem or allow student teams to develop their own problems and solutions. The winner of each MA competition will be invited to compete at WEFTEC in that year. If only one school is willing to participate within the MA, that team may compete at WEFTEC assuming they meet the guidelines. It is at the discretion of each MA to adopt and/or change the competition guidelines developed by the WEF Sub-Committee in order to have a successful competition. The guidelines established by WEF shall be followed during the WEFTEC competition.

The Student Design Competition Sub-Committee hosts two competitions, a wastewater design competition and water environment design competition. The wastewater design competition is intended to include design projects that traditionally address a challenge within a water

Acknowledgements

We would like to thank the following people for their volunteer commitment in making the 2021 Student Design Competition a success!

E J Katsoulas
Stephanie Castro
Sarah B Cook
Megan Heslin
Joe Lapastora
Kahao Lim
Brad Lovett
Andrew Matsumoto
Brian Shoener
Guy Yager
Bernadette Drouhard
Jenny Loconsole
Annie Sager
Jenny Warren

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resource recovery facility, e g hydraulic capacity increase, existing reatment system pgrade, biosolids management, resource recovery, etc The water environment design competition is intended o include contemporary engineering opics, e g stormwater management, water reuse, wetland construction, small systems, or distributed reatment projects in developing regions, etc Both competitions will follow he same guidelines and he same scoring system

The competitions are designed o emphasize he value of delivering both high quality written and oral echnical presentations coring is determined hrough an evaluation of he eams' written and oral presentation skills, along with he echnical content of he design solution Teams have submitted a design report for review by he judges At WEFTEC, he eams are required o give an oral presentation of heir design project followed by a question and answer period during which only he judges may ask questions Teams will receive scores based on heir design report, presentation, and responses o judges' questions

We welcome 23 schools representing 18 member associations and 4 countries who are participating in the water environment and wastewater competitions.

Please contact the SDC sub-committee if your MA is interested in participating in the future!

For more information, please contact:

WEF SYPC Sub-Committee Co-Chair: **E.J. Katsoulas**
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WEF Students & Young Professionals Committee

The mission of the WEF Students and Young Professionals Committee (SYPC) is to encourage and facilitate student and young professional involvement in WEF and the Member Associations through professional development and leadership opportunities. One of WEF's strategic initiatives is to encourage the involvement of students and young professionals in the organization. The following programs have been developed to provide opportunities for students and young professionals:

- Student chapters in colleges and universities
- Reduced student and YP membership rates
- Free registration for WEF Student Members attending WEFTEC, WEF conferences, and webcasts
- WEFTEC Student and Young Professionals Career Fair
- WEFTEC Student Lounge
- WEFTEC Students & Young Professionals Meeting
- WEF Student Design Competition
- WEF Community Service Project and Water Palooza
- YP Summit, a professional development event
- Midyear Springboard Program
- Technical workshop development opportunities
- Stockholm Junior Water Prize
- WEF Canham Graduate Studies Scholarship

The SYPC is made up of students, young professionals, academics, and water quality professionals. We welcome your participation in the WEF SYPC and/or on a student activities or young professional committee at your local member association.

The SYPC and WEF encourage you to take advantage of WEF membership benefits. For more information contact Brad Lovett, WEF Manager, Association Engagement for Students and Young Professionals, at (703) 684-2455 or email: BLovett@wef.org.

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Past WEF Student Design Competition Winners

Year	Water Environment Competition	Wastewater Competition
2020	University of Guelph	Colorado School of Mines
2019	University of British Columbia	University of Colorado - Boulder
2018	University of British Columbia	University of Colorado - Boulder
2017	University of Guelph	University of Colorado - Boulder
2016	University of Minnesota, Twin Cities	Southern Methodist University
2015	North Dakota State University	Southern Methodist University
2014	University of British Columbia and University of North British Columbia	University of South Florida
2013	University of British Columbia	University of South Florida
2012	University of South Florida	University of Colorado - Boulder
2011	University of Florida	University of Wyoming
2010	University of Florida	Southern Methodist University
2009	University of Florida	University of Colorado - Boulder

Year	Combined Competition
2008	University of Florida
2007	University of Florida & North Dakota State University (tie)
2006	University of Florida
2005	University of South Florida
2004	University of Washington
2003	University of Central Florida
2002	University of New York at Buffalo

Morning Schedule

Start Time	Wastewater Competition *Room S105a*	Wastewater Competition *Room S105bc*
7:45am	Opening Welcome	Opening Welcome
8:05am	Johns Hopkins University	Northeastern University
8:35am	Georgia Institute of Technology	Florida Gulf Coast University
9:05am	University of Windsor (Virtual)	Case Western Reserve University
9:35am	George Mason University	City College of New York
10:05am	University of Colorado Boulder	North Carolina State University
10:35am	*Break (10 Minutes)*	

Start Time	Wastewater Competition *Room S105a*	Water Environment Competition *Room S1055*
10:45am	Universidad de Monterrey	SUNY College of Environmental Science and Forestry
11:15am	Marquette University	Loyola University
11:45am	Southern Methodist University	George Mason University

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Afternoon Schedule

Start Time	Wastewater Competition *Room S105a*	Water Environment Competition *Room S105bc*
12:15pm	*Lunch Break (30 Minutes)*	California State Polytechnic University, Pomona
12:45pm	North Dakota State University	*Lunch Break (30 Minutes)*
1:15pm	University of Nevada Las Vegas	University of South Florida
1:45pm	Clemson University	Worchester Polytechnic Institute (Virtual)
2:15pm	Tecnologico de Costa Rica (Virtual)	*N/A*
3:00pm	**Process Challenge**	
5:00pm	*Networking Dessert Reception & Team Photos* Room S105a	
6:00pm	*WEF Address & Award Ceremony* Room S105a	

THANK YOU JUDGES

We would like to thank our judges for volunteering their time to the Student Design Competition. We are honored to have their attendance at the competition this year.

THANK YOU

Notes

NEXT, PLEASE JOIN US...

At the Networking Reception from 5:00 to 6:00 pm in Room S105a.

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Individually packaged food will be served for the safety of all.

Great ideas will be shared.

Your company will be enjoyed!

California State Polytechnic University, Pomona

COMPETITION:
Water Environment

A Community Approach to Puddingstone Watershed Restoration

Team Members:
Alex Berk
Eduardo Contreras
Alan De Nova
Jon Del Rosario
Flora Delgado
Albert Hong
Marifel Janice Retuta
Andrew Novak
Francisco Ponce
Ryan Porras
Christopher Rodriguez Paz
Francisco Santos Ponce
Amanda Saleeba
Anna Shao
Jose Talavera
Ernesto Torres
Alex Vasquez

Faculty Advisor:
Monica Palomo, PhD, PE, BCEE

Member Association:
California Water Environment Association

Puddingstone Reservoir is in Frank G Bonelli Regional Park, San Dimas, California. This park is managed by the Los Angeles County Department of Parks and Recreation and provides the community with recreational activities including fishing, swimming, and camping. Puddingstone Reservoir experiences excessive pollutant load, low dissolved oxygen, and high organic matter leading to algal blooms and pungent odors during the summer. These concentrations pose a health risk to the patrons of Puddingstone Reservoir and its ecosystem. As a result, the Environmental Protection Agency (EPA) designates Puddingstone Reservoir as an impaired water body. While implementing a treatment plant to reduce these concentrations is ideal, it is costly and infeasible for the highly trafficked park. Therefore, a cost-effective approach is proposed to restore the watershed's natural processes. Strategic implementation of low impact development (LID) structures is proposed to reduce heavy metal contaminant load in sheet flow runoff. Furthermore, a wetland system enhanced by low intensity chemical dosing closer to the outlet of Live Oak Wash treats nitrogen, phosphorus, and methyl mercury. Utilizing HEC-RAS to model the watershed pre and post implementation, it was determined that contaminants would be decreased significantly, reducing Nitrogen (H) by 32%, Lead by 90%, and Cadmium by 13%.

Case Western Reserve University

COMPETITION:
Water Environment

Methane Recovery for Philip Q. Maiorana WWTP

Team Members:
Andi Chakraborty
Sofie Iwamasa
Abby Slates

Faculty Advisor:
Kurt Rhoads, PhD, PE

Member Association:
Ohio Water Environment Association

The purpose of this project was to evaluate alternative methane recovery methods for the Philip Q. Maiorana (PQM) Wastewater Treatment Plant (WWTP) in Lorain, Ohio. The plant operates at about 2.6 million gallons per day (mgd) and currently uses some of their methane to heat their digestor through a heat exchange system and flares the rest. Six alternative options were evaluated, which included doing nothing, microturbines, fuel cells, reciprocating engines, natural gas generators, and furnaces. Each alternative was ranked based on initial costs, effectiveness, reliability, and environmental impact. Other WWTPs and manufacturers were contacted to learn more about the systems, and based on the experience that other plants had, the size of PQM WWTP would be best suited for a microturbine. However, the microturbine would most likely be electrically neutral due to power needed to compress the methane, so the official results of the team's research is to do nothing and keep the system that is currently in place. If PQM WWTP is still interested in implementing a new system, they should consider implementing a grease collection system to increase methane production.

Worcester Polytechnic Institute

COMPETITION:
Water Environment

Acid Leachate Active Treatment Pilot System for Cooledge Brook, MA

Team Members:
Emma Burleson
Annemarie Eastwood
Lauren Mitchell
Molly Youngs

Faculty Advisor:
John Bergendahl, PhD, PE

Member Association:
New England Water Environment Association

This project, in conjunction with MassDEP, focused on designing and testing a pilot treatment system for an acid rock drainage (ARD) contaminated site at Cooledge Brook in Northborough, MA. Cooledge Brook was impacted by runoff from sulfidic fill rock at a nearby property, resulting in a pH of 4.5 and high levels of dissolved metals in both the groundwater and surface water. We designed, built, and operated a pilot-scale batch reactor system to assess the feasibility of a large-scale treatment system at the site. The pilot system was able to successfully increase the pH of the contaminated water from 4.5 to 7.5 using a sodium hydroxide solution and a pH-metered chemical proportioning pump. Additionally, the solution was aerated to encourage coagulation, decreasing the concentration of dissolved metals in the solution. The pilot system drew water from a contaminated well using a solar-powered pump and was treated in a ten-gallon batch reactor. An electric mixer was used in conjunction with a chemical proportioning pump to add diluted NaOH. After settling, the water had a neutral pH and lower levels of dissolved metals and was discharged back to the environment. Future work will further improve the pilot system for scale up.

University of Windsor

COMPETITION:
Wastewater

Reducing Overflows and Bypasses at Port Dalhousie Wastewater Treatment Plant

Team Members:
Cay-Yen Ang
Jordan Goddard
Fabianna Palacios

Faculty Advisor:
Rajesh Seth, PhD, PE

Member Association:
Water Environment Association of Ontario

The objective of this project is to reduce the number of overflow and bypass events at the Port of Dalhousie Wastewater Treatment Plant (PDWWTP). T his will be done through a preliminary design that improves the existing plant (Phase I) and a conceptual design to achieve this goal through modifications to the plant's collection system (Phase II). T he preliminary design must reduce overflow and bypass events as low as possible, while maintaining the plant's water quality standards and a minimal capital cost. T he Phase I design proposes to increase the plant's primary capacity through the implementation of chemically enhanced primary treatment and decommissioning the flocculation tank. The secondary and tertiary treatment capacity will be increased by installing fine- bubble diffusers, increasing the influent flow through the biological treatment, and utilizing the existing combined sewer overflow tank to increase disinfection capacity. This solution ensures no overflow events will occur at the PDWWTP. The Phase II solution recommends the use of porous asphalt in parking lots throughout the collection area. In doing so, less inflow will enter the collection system, reducing the volume of influent at the PDWWTP. To eliminate future overflows at PDWWTP, 400,600 m2 of existing asphalt will need to be replaced.

City College of New York

COMPETITION:
Water Environment

Improving Wards Island WRRF Energy Recovery Through Coupled Thermal Hydrolysis and Cogeneration Systems

Team Members:
Janet Acquah
David Cham
David Ip
Julie Yaish

Faculty Advisor:
Michael Bobker, PhD

Member Association:
New York Water Environment Association

This project seeks to investigate the feasibility of implementing thermal hydrolysis process (THP) and cogeneration to improve the energy efficiency of Wards Island water resource recovery facility (WRRF). THP is an energy-intensive process that initiates the breakdown of organics to improve the digestibility of sludge and increase biogas production. Cogeneration allows the WRRF to recover and reuse biogas to produce electricity on-site, which reduced demand from the grid. The goal of this design is to determine if the increased biogas production resulting from THP is able to offset its high energy demand. Various biogas reuse applications are investigated such as cogeneration with waste heat recovery allocated to THP, direct biogas reuse to fuel THP, generating and selling fuels such as electricity or renewable natural gas (RNG) to offset costs.

Clemson University

COMPETITION:
Wastewater

F. Wayne Hill Water Resources Center Solids Processing Upgrades

Team Members:
Danny Greene
Evan Groome
Danielle Larsen
Curtis McClelland

Faculty Advisor:
Sudeep Popat, PhD

Member Association:
Water Environment Association of South Carolina

The F. Wayne Hill Water Reclamation Center (FWHWRC) treats, on average, approximately 35 million gallons per day (MGD) of wastewater and produces 32 dry tons of biosolid cake per day. Conventionally, the cake would be disposed of in landfills. However, as the Atlanta area's landfilling prices continue to rise, Gwinnett County and FWHWRC have started looking into technologies that will produce Class A biosolids. The benefit of producing Class A biosolids is that the strict regulations that must be attained for increased pathogen destruction nrender the biosolids suitable for land application. In addition to solving the issue created by increased landfill fees, the biosolids can act as a revenue source for FWHWRC, being sold to farmers or homeowners as fertilizer. For the plant to achieve Class A biosolids, they must implement an additional technology to their current solids handling system. After completing a Kepner-Tregoe (KT) Analysis, Bali Consulting has advocated for the utilization of Thermal Hydrolysis Process (THP) treatment. This treatment method is the most beneficial when a plant requires capacity expansion or is facing hauling/storage limitations because THP lowers the SRT, increases the loading rate, and allows there to be a lower volume per digester. This method addresses both of Gwinnett County's concerns: the production of Class A biosolids and the ability of FWHWRC to handle the increase in loading.

University of South Florida

COMPETITION:
Water Environment

Erosion and Water Quality Analysis of Lassing Park

Team Members:
Jordin Kahler Anna Zimmerman
Alex Orellana
Mariko Peltz
Andres Lora Santos

Faculty Advisor:
Sarina Ergas, PhD

Member Association:
Florida Water Environment Association

The City of St. Petersburg tasked Aqua Engineering with evaluating Lassing Park to improve water quality and combat erosion, while protecting the coast and providing habitats. The objective of this project is to solve these problems while preserving natural aquatic ecosystems, without compromising the needs and lifestyles of people hwo use the park for recreation and leisure. To solve water quality issues, the drainage basins of each stormwater outflow were delineated, and pipe flows were calculated. Erosion was identified to be primarily evident at the northern end of the park by examining historical images. Aqua Engineering performed a literature review to determine potential alternative solutions that may be implemented. A survey was distributed to the surrounding community to determine solutions they would support. The team explored 5 alternatives solutions: Old Pier Removal, Geotextiles & Living Shoreline, Stormwater Improvements, Bioretention Bed (Rain Garden), and Vegetated Swale. Additionally, a "do nothing" alternative is presented as a baseline option. Models of each solution and details cost analyses were prepared. After consideration Aqua Engineering has recommended: 1) Updating stormwater infrastructure that cost $21,000 2) Implementing geotextiles for a mangrove living shoreline that costs $70,500 and 3) Implementing an updated vegetated swale that cost $156,344.

University of Nevada, Las Vegas

COMPETITION:
Wastewater

Solids Separation at the Flamingo Water Resource Center by Thickeners and Odor Control

Team Members:
Meena Ejjada
Anaomi Rojas-Lujan
Jeawlyn Guerrero
Hamed Heidari
Emma Letourneau
Amanda Page

Faculty Advisor:
Eakalak Khan

Member Association:
Nevada Water Environment Association

As the largest water reclamation facility in the Las Vegas Valley, the Flamingo Water Resource Center (FWRC), located in East Las Vegas, treats 107 MGD and serves more than 245,000 residential and commercial accounts. Most of the treated wastewater discharges to the Las Vegas Wash and eventually ends up in Lake Mead. Due tothe increasing population and growing tourism in the Valley, the FWRC plans to expand its wastewater influent treatment to 150 MGD by 2025. The objectives of this design project are to provide reliable and effective biosolids thickening to enhance dewatering and to mitigate the odor of the thickened biosolids for the anticipated 150 MGD. Currently, the FWRC uses gravity thickeners followed by centrifuges for biosolids separation. Our University of Nevada, Las Vegas team considered several alternatives, including additional gravity thickeners, belt thickeners, dissolved air floatation, centrifugal thickeners, and rotary drum thickeners. A decision matrix was developed, and after the assessment of multiple factors, the team decided to proceed with the belt thickeners and to evaluate their affordability and capability. Belt thickeners help mitigate the biosolids' odor in the dewatering process, and the addition of chemicals for odor control was also considered.

Florida Gulf Coast University

COMPETITION:
Water Environment

Is Direct Potable Reuse (DPR) a Viable Option for the City of Fort Myers, FL? - Preliminary Design, Analysis, and Implication

Team Members:
Gabrielle Hastings
Yosvany Medina Pinera
Josie Wiederkehr

Faculty Advisor:
Jong-Yeop Kim, PhD, PE

Member Association:
Florida Water Environment Association

The increase in demand for potable water has led many municipalities to explore new sources of water to supplement their needs. In order to supplement potable water supply for the City of Fort Myers, the City of Myers and AECOM have tasked a group of Florida Gulf Coast University engineering students to research whether direct potable reuse (DPR) is a viable option for the City of Fort Myers, Florida. This research paper discusses the preliminary design, analysis, and implication of DPR at South Advanced Wastewater Treatment Facility (SAWWTF) and Central Advanced Wastewater Treatment Facility (CAWWTF); both located in Fort Myers, Florida. Results presented in this paper identify that post secondary water treatment systems treating reclaimed water from CAWWTF and wastewater from SAWWTF should be located adjacent to the Eddie D. Edwards water treatment facility and at the Winkler Water Storage facility respectively. The implementation of the post secondary treatment system at the Winkler Water Sotrage Facility will cost $19.7 million while the treatment system adjacent to Eddie D. Edwards will cost $21.5 million. These DPR systems will not only supplement water resources but will provide the City of Fort Myers with cost savings and environmental benefits.

George Mason University

COMPETITION:
Water Environment

Piney Run Tributary System Restoration

Team Members:
Romelia Belteton
Jenny Eid
Aivan Estacio
Camille Fulton
Nasima Sadr
Jonathan Parker
Grace Morrissey

Faculty Advisor:
Matthew Doyle, PE, CCM

Member Association:
Virginia Water Environment Association

Fairfax County has hundreds of miles of stream, many of which are in pristine condition. However, due to urban development, several streams have been suffering. Urban development plays a significant role in disturbing hydrologic balance. Impervious surfaces such as rooftops and asphalt roads replace the groundcover and increase surface runoff.

The runoff causes stream channels to erode and become deeper and wider ultimately disconnecting from their natural flood plain. One such stream suffering from urban development is a small tributary to Piney Run. The tributary is a small section of stream that has had its channel eroded away and is now starting to cause infrastructure and property damage.

To solve this problem, our team will classify the stream using the Rosgen Classification Method, make site visits to assess the geomorphic patterns, and conduct sediment assessments. We will work with Fairfax County to understand their restoration priority and other goals. Using the Natural Channel Design (NCD) method we will develop multiple design alternatives to be screened in a decision matrix. Once the alternatives are screened we will make a recommendation and further develop the alternative to include additional details, permitting, cost, and a construction schedule.

University of Colorado Boulder

COMPETITION:
Wastewater

Design for Expansion to Increase Water Reclamation at Parker Water and Sanitation District

Team Members:
Jack Costello
Spencer Lovell
Caleigh Jensen
Leah Rivera
Lucas Wagoner

Faculty Advisor:
William C. Becker, PhD, PE, BCEE

Member Association:
Rocky Mountain Water Environment Association

The Parker Water and Sanitation District (PWSD) of Parker, Colorado is comprised of the North Water Reclamation Facility (NWRF) and the South Water Reclamation Facility (SWRF). Major upgrades made to the NWRF led to naming it as the main facility, and to an uncertain future for the SWRF in terms of continued use and function. The SWRF may continue to operate as an overflow facility to support the NWRF or be shut down. Utopia Water Consulting evaluated the current operations to determine the areas of concern and upgrades needed for continued operations of the SWRF. Various alternatives within specific treatment categories were evaluated on the associated constraints of the PWSD and on criteria deemed most decisive. Evaluations were made on multi-criteria decision matrices which were specific to each treatment category including inflow, thickening, and filtration. Criteria included ease of operation, footprint and site compatibility, capital cost, operation and maintenance cost, total solids concentration, energy consumption, and odor. The final recommendations include densified activated sludge processes, gravity belt thickening, and current model filtration replacement. The estimated cost of implementation and performing operations and maintenance over 20 years comes to $3,305,284. The recommendations will accommodate the various outcomes the SWRF may face.

Universidad de Monterrey

COMPETITION:
Wastewater

Houston Intercontinental Airport Wastewater (IAH) Treatment Plant's Redesign—Troyanos

Team Members:
Bruno Julio Enrique Herrada Santos
Luis David Pedraza Caballero
Jorge Eduardo Salinas Aguirre
Arturo Zertuche Camporredondo

Faculty Advisor:
Jimmy Luis Loaiza Navia, PhD

Member Association:
Sociedad Mexicana de Aguas, A.C. (SMAAC)

Located in Houston, Texas, the IAH Wastewater Treatment Plant will need to undergo an expansion and improvement redesign to accommodate an increased flow caused by the closing of 3 nearby wastewater treatment plants. The project analyses the current conditions and capacities of the plant to recognize the areas that need to be enlarged or remodeled. After inspecting each area and stage of the treatment process, the team proposed changes to be implemented in the plant to ensure an appropriate solution that offers a long-lasting, low-cost, and low-maintenance solution for the increased flows. The main changes to be implemented are the construction of a regulation tank to alleviate the excessive peak flows, the remodeling of the aeration system and the grit removal process, the use of the activated sludges to produce energy for the plant´s operation, and the installing of a UV disinfection station to reduce the amount of chlorine needed to be added. After proposing said solutions the teams made a cost analysis with various suppliers as well as a project management analysis for the implementation of the solution, making this a more complete proposal of solution.

George Mason University

COMPETITION:
Wastewater

Biogas Manufacturing and Monetization

Team Members:
Ivan Gonzales
Caleb Hanneman
Martin Henke
Chris Mata
Katharine Simpson
Nicolas Tenorio

Faculty Advisor:
Matthew Doyle, PE, CCM

Member Association:
Virginia Water Environment Association

The Western Virginia Water Authority (Authority) owns and operates the Roanoke Regional Water Pollution Control Plant (WPCP) which process 55 MGD of wastewater, operates seven 90-foot diameter primary digesters, and provides services to all jurisdictions within the Roanoke Valley. The Authority is looking to upgrade five of the site's primary digesters by adding new mixing systems, improving the liquid process piping to them, and connecting the enhanced biogas byproduct to a Roanoke Gas pipeline. Within these primary goals, the authority wishes to equip two of the digesters to handle hauled and high strength waste and provide overflow protection for the five digesters.
The student team has assessed the existing digesters and associated components to prepare a preliminary engineering report (PER) to address the Authority's desired improvements to the WPCP in accordance with the Virginia Department of Environmental Quality, Roanoke Gas, and Authority staff. The proposed strategies include rendered final design work, documentation to facilitate modifications, and relevant manufacturers cost estimates. The final recommendation was determined by a decision matrix that focused on safety, profit, gas production efficiency and quality, sustainability, construction cost, and operator favorability.

Georgia Institute of Technology

COMPETITION:
Wastewater

Conceptual Design of a Thermal Sludge Dryer for Macon Water Authority's Biosolids Management

Team Members:
Kristina Gandara
Atiya Jangda
Olivia Wagner
Hayden Zelle

Faculty Advisor:
John Koon, PhD, PE

Member Association:
Georgia Association of Water Professionals

A proposed regulation by the Georgia Environmental Protection Department would limit the amount of high moisture sewage sludge (biosolids) able to be disposed of in a landfill. Additionally, land-use applications for the sludge as fertilizer are limited by demand and seasonal variations. The objective of this project was to analyze the feasibility of installing a thermal sludge dryer at Macon Water Authority's (MWA) Rocky Creek Water Reclamation Facility (RCWRF) capable of producing Class A biosolids at 90% solids content. The RCWRF currently produces sludge that is around 16-20% solids, while the proposed regulation considers high moisture sludge to be less than 40% solids. MWA is interested in the feasibility of a sludge dryer in order to increase their disposal options for the sludge. Furthermore, an industrial facility adjacent to the RCWRF is a potential source of waste stream that could be used to dry the sewage sludge. The dried sludge could possible act as a renewable energy source for the industrial facility's boilers. The feasibility of the use of the waste stream for the dryer is of importance to the sustainable solution to biosolids management at the RCWRF.

Tecnologico de Costa Rica

COMPETITION:
Wastewater

WWTP and Sewerage in Samara District, Costa Rica

Team Members:
Alexander Brenes Porras
Britanny Ramos Castellon
Ashley Maria Pineiro Conejo

Faculty Advisor:
Ing. Diana Zambrano Piamba

The WWTP and sewerage are designed for the Samara district, located in Guanacaste Costa Rica, as a solution for the actual wastewater problems. Most of the used septic tanks are in bad conditions caused by high groundwater levels and bad maintenance.

The design flow is 25.7 L/s; this was calculated with the per capita demand for rural population (200 L/person/day) and the projected population for 2026. The WWTP location has a surface wetland, the plant will be constructed in the high terrain with flood protection structures discharging into the land and the wetland by grooves. The objective quality is based on the Regulations for the Evaluation and Classification of the Quality of Surface Water Bodies (costarrican legislation). The selected treatment is made of pretreatment (screening and grit chamber), three UASB units, two trickling filters with their corresponding settling chamber, and a chlorine chamber. Drying beds and burning of biogas were also designed.

The sewerage distance is 37.4 made of 6" to 10" diameter pipes, distributed among the three communities Cangrejal, Samara and Torito. The total cost of WWT and sewerage is $492,288 and a monthly fee $1.83/habitant or $0.38/m3.

SUNY College of Environmental Science and Forestry

COMPETITION:
Water Environment

Green Infrastructure Retrofit Design for an Unapproved Parking Lot in Central New York

Team Members:
Zac Alderson
Lauren Claeys
Jane Clark
Cameron Daley
Emily Ellithorpe
Briana Fitzgerald
Makayla Gallegos
Katherine Gannon
Andrew Graham
Andrea Ross
Morgan VanDyke

Faculty Advisor:
Doug Daley, PE

Member Association:
New York Water Environment Association

A Central New York town is in violation of New York State Department of Environmental Conservation (NYSDEC) standards after it paved over existing soccer fields to create a parking lot without obtaining permit approval for stormwater discharge. This violation is for disturbed earth and constructed impervious surfaces, and places them in violation of the Clean Water Act. In addition to legal motivations, the resulting stormwater runoff from the newly installed impervious surface could cause issues in the area including flooding and placing too much demand on existing stormwater infrastructure. To avoid legal action and damage due to increased stormwater, this retrofit project was proposed to use green infrastructure for stormwater control. In addition to retrofit suggestions, this project will also discuss stormwater education opportunities for the nearby high school and further explore sustainability. The final design may include a combination of tree trenches, bioretention and/or porous pavement in order to meet NYSDEC stormwater requirements and qualify the client for State Pollutant Discharge Elimination System (SPDES) permit approval. The retrofit will help protect the environment and infrastructure around the lot from high intensity storm events and stormwater pollution and be an overall benefit to the public using the facility.

Johns Hopkins University

COMPETITION:
Wastewater

Filter Backwash Storage Design for Western Branch WRRF

Team Members:
Annabel Mungan
Brennan Pitts
Lindsey Pitts
JJ Tie

Faculty Advisor:
Ciaran Harman, PhD

Member Association:
Chesapeake Water Environment Association

The Western Branch Water Resources Recovery Facility (WRRF), which is designed to treat 30 million gallons of wastewater each day, faces disproportionately high flows because of precipitation and groundwater inflow and infiltration into the vast network of pipes that bring wastewater to the plant. WSSC Water, the owner and operator of Western Branch WRRF, presented concerns about potential violations of the strict nitrogen and phosphorus limits set by the State of Maryland to this design team and tasked the team with mitigation of the problem. The proposed solution targets the dirty backwash water produced by the 11 anthracite filters, which are currently bypassed during periods of high flows. The proposed design is a 3-million-gallon backwash storage tank, which can hold the dirty backwash during high flow periods to allow the filters to continue to operate. This preliminary design report includes the justification an design of the backwash storage tank, hydraulics, and solids handling, in addition not a cost estimation and preliminary project schedule.

Loyola University Chicago

COMPETITION:
Water Environment

Anaerobic Digester Senior Capstone Project

Team Members:
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Brooke McDonald
Anna Zachary

Faculty Advisor:
Gajan Sivandran, PhD

Member Association:
Illinois Water Environment Association

The team, comprised of three senior environmental engineering students from Loyola University Chicago, is working with the non-profit organization Plant Chicago to design an anaerobic digester system that focuses on circular economy and waste diversion. Anaerobic digestion is a microbial process that is used to convert agricultural and organic waste into digestate and biogas. Digestate can be a useful fertilizer, and biogas can be used in both heat and electricity applications. In order to create a system that is efficient and useful for Plant Chicago's operations, the team executed a series of experiments to study anaerobic digestion on a small scale as well as explore different design options. The experimental systems were given inoculum from a local wastewater treatment plant and studied in terms of the microbial colony health, biogas yield, and digestate yield. Controls such as temperature and continuous mixing will help inform the best environment for the system, which the team will recommend to Plant Chicago. Using design verification testing, research, and risk analyses the team will be able to determine an anaerobic digester design for Plant Chicago that will best suit their operations and uplift their waste reduction efforts.

Southern Methodist University

COMPETITION:
Wastewater

The City of Houston Intercontinental Airport Wastewater Treatment Plant Expansion

Team Members:
Michael Dudley
Julia Nolan
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Fatema Sahwi

Faculty Advisor:
Patricia Taylor, PE, PhD

Member Association:
Water Environment Association of Texas

The City of Houston Intercontinental Airport Wastewater Treatment Plant is experiencing an improvement and expansion from a flow rate of 8 MGD to 11 MGD. The basis of this design will focus on nitrogen and phosphorus removal so that the effluent discharge limits for nitrogen and phosphorus are 3 mg/l and 1 mg/l respectively. The main objective is to recommend a design that considers operator preference treatment upgrades to an anaerobic -anoxic - aerobic (A2O) biological nutrient removal system which includes new construction and retrofitting the current system. Other objectives also include primary clarifiers, a solid handling process, odor control equipment, and analyzing the Impacts to hydraulics through the plant's process units. An Opinion of Probable Construction Costs (OPCC) and an annual operation and maintenance analysis are provided as a rough estimate of the costs for improving the treatment plant. The construction sequencing associated with the proposed alternative is also evaluated. The recommended changes will allow the City of Houston IAH WWTP to comply with TCEQ requirements.

Northeastern University

COMPETITION:
Water Environment

Water Resource Recovery Facility Design for a Vermont Creamery

Team Members:
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Faculty Advisor:
Annalisa Onnis-Hayden, PhD, PE

Member Association:
New England Water Environment Association

This report outlines the preliminary design and modeling of a Water Resource Recovery Facility (WRRF) that Gaia Water Engineering Group completed for an anonymous Vermont-based creamery (referred to as ABC Dairy). The project goals were to design a sustainable process that recovers energy, nutrients, and a high-quality effluent for reuse within ABC Dairy's facility. The design team completed a comprehensive technology review and proposed three potential WRRF processes. Further analysis and comparison identified the following technologies for the final process: upflow anaerobic sludge blanket (UASB) reactors, 4-Stage Bardenpho reactors, a sludge centrifuge for biosolids dewatering, and an ultrafiltration/reverse-osmosis system (UF/RO). The proposed process recovers energy by converting organic matter in the wastewater into biogas through mesophilic UASB reactors coupled with heat and power cogeneration. A 4- stage Bardenpho reactor train combined with sludge thickening and dewatering effectively removes nutrients from the liquids stream and recovers nutrients by producing biosolids for use as a fertilizer. Final polishing is achieved through ferric chloride addition and UF/RO, producing a high-quality effluent that meets standards for reuse within the dairy production facility for equipment washing. This preliminary design includes equipment sizing and operation, chemical requirements, and cost estimates.

Marquette University

COMPETITION:
Wastewater

City of Escanaba WWTP Phosphorus Removal Upgrade to Secondary Treatment

Team Members:
Bryar Jensen
Jim Lindsay
Callen Papineau
Jakob Smith
Mathieu Stafford

Faculty Advisor:
Daniel H. Zitomer, PhD

Member Association:
Central States Water Environment Association

The goal of this project is to upgrade the secondary treatment system of the City of Escanaba wastewater treatment plant. Within these upgrades, there are specific problems that must be addressed. The upgraded secondary treatment system must improve the removal of phosphorus from the primary MLSS, improve wet weather treatment capacity, simplify treatment operations, and improve system energy efficiency. Components in the process design include clarification to remove biomass, aeration design to promote biological nutrient removal, hydraulic capacity feasibility, and overall upgrades to the activated sludge process. Our team should complete these tasks with overall simplification of design and operation. Our team will analyze the information provided by Black & Veatch and the City of Escanaba treatment facility in order to wholly understand the current and past facility operations and permit requirements. In this analysis we will be able to pinpoint problems and potential solutions to advance the facility. Beyond the design of the secondary treatment system itself, our team will also analyze the constructability of our design considering the reuse of existing mechanical components to reduce overall cost.

North Carolina State University

COMPETITION:
Water Environment

The Stowe Regional Water Resource Recovery Facility

Team Members:
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Member Association:
North Carolina AWWA-WEA

The region surrounding the City of Charlotte is one of the fastest-growing areas in North Carolina and faces increased strain on its infrastructure including its wastewater treatment capacity. The Stowe Regional Water Resource Recovery Facility (SRWRRF) is intended to supplement and replace wastewater facilities in both Mecklenburg and Gaston County and will have an initial maximum flow of 15 million gallons per day (MGD) with an expansion to 25 MGD. The SRWRRF will be a new facility, and the team explored treatment options for the facility that balance leading technology with proven reliability to produce a sustainable design. Out of several options, three technologies were investigated: a Five-Stage Bardenpho process, a membrane bioreactor (MBR) with ananaerobic/ anoxic/aerobic process (A2O), and an Adsorption/Bio-oxidation process. With feedback from the client Charlotte Water, the MBR with A2O was chosen based on nutrient removal performance, environmental footprint ,and innovation. A facility layout was prepared, and the hydraulic profile, effluent quality, capital and operation and management costs, and environmental and social impacts were assessed. The SRWRRF as designed is on track to be a flagship project for the client Charlotte Water as an integral part of the communities it will serve.

North Dakota State University

COMPETITION:
Wastewater

Moorhead Wastewater Treatment Facility Headworks Improvements

Team Members:
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Faculty Advisor:
Wei Lin, PhD

Member Association:
North Dakota Water Environment Association

The City of Moorhead, in the state of Minnesota, Wastewater Treatment Facility (WWTF) has a capacity of 18.0MGD and serves a population of 41,334 residents. The city of Moorhead has requested a design to make improvements to the headworks of the facility. The facility has started to deteriorate and needs renovations. The main concern is over elevated levels of hydrogen Sulfide (H2S) in the headworks which has caused tremendous corrosion to the grit chambers. Along with this, the bar screens have been nonoperational for months.

There were four design alternatives selected. A weighted decision matrix based on stakeholder acceptance, cost, future expansion, and treatment operations was used to select a recommended approach. We also consulted with

The purpose of this project is to provide a combination of methods to improve the large solids removal and grit removal, while also implementing an odor control system. The design includes implementation of new bar screens, grit removal system, and odor control system designed to meet 10 state standards. The system will last longer than the previous and require less maintenance.