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WEF Student Design Competitions

WEF STUDENTS & YOUNG PROFESSIONALS COMMITTEE
SYPC

September 23-24, 2020
WEFTEC Connect
October 5-9, 2020

Welcome to the 2020 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 following the virtual competition.

On behalf of WEF and the WEF Students and Young Professionals Committee, we would like to thank: the sponsorsof this year's competition - 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. Jamie Eichenberger, 2019-2020 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 resource recovery facility, e.g. hydraulic capacity increase, existing treatment system upgrade, biosolids management, resource recovery, etc. The water environment design competition is intended to include contemporary engineering topics, e.g. stormwater management, water reuse, wetland construction, small systems, or distributed treatment projects in developing regions, etc. Both competitions will follow the same guidelines and the same scoring system.

The competitions are designed to emphasize the value of delivering both high quality written and oral technical presentations. Scoring is determined through an evaluation of the teams' written and oral presentation skills, along with the technical content of the design solution. Teams have submitted a design report for review by the judges. At WEFTEC, the teams are required to give an oral presentation of their design project followed by a question and answer period during which only the judges may ask questions. Teams will receive scores based on their design report, presentation, and responses to judges' questions.

We are excited to welcome 28 schools representing 22 member associations and 5 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: **Bernadette Drouhard**
Phone: (770) 754-3933 Email: drouhardb@bv.com

WEF SYPC Sub-Committee Co-Chair: **E.J. Katsoulas**
Phone: (720) 326-9264 Email: ej.katsoulas@tetratech.com

WEF Manager, Association Engagement Students and Young Professionals: **Megan Livak**
Phone: (703) 684-2400 x7220 Email: mlivak@wef.org

WEF SYPC Sub-Committee Vice Chair: **Guy Yager**
Phone: (209) 769-5083 Email: yagerg@bv.com

WEF SYPC Sub-Committee Vice Chair: **Stephanie Castro**
Phone: (631) 391-5216 Email: stephanie.castro@arcadis.com

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 Megan Livak, WEF Manager, Association Engagement for Students and Young Professionals, at (703) 684-2400 x7220 or email: MLivak@wef.org.

Past WEF Student Design Competition Winners

Year	Water Environment Competition	Wastewater Competition
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

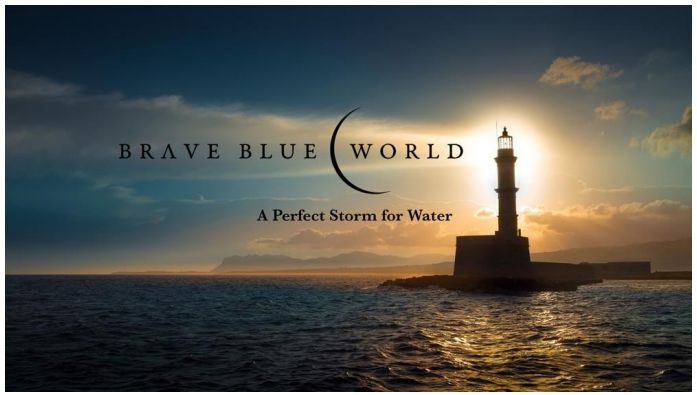
PLEASE JOIN US...

At the Live Finals!

Water Environment Finals:
September 23rd at 2:00-4:00PM EDT.
Brave Blue World viewing at 4:00PM.
Awards announced at 5:15PM.

Wastewater Finals:
September 24th at 2:00-4:00PM EDT.
Brave Blue World viewing at 4:00PM.
Awards announced at 5:15PM.

Watch the Brave Blue World trailer:
https://www.youtube.com/watch?



Acknowledgements

We would like to thank the following people for their volunteer commitment in making the 2020 Student Design Competition a success!

Bernadette Drouhard
Dominique Bertrand
Vanessa Borkowski
Christopher Chiu
Pono Hanson
Theresa Kopper
Kahao Lim
Jenny Loconsole
Daniel Luo
Nashita Naureen
Neel Shah
Brian Shoener
Guy Yager
E.J. Katsoulas
Ahmed Bitar
Stephanie Castro
Ellie Frier
Elizabeth Heise
Joe Lapastora
Megan Livak
Brad Lovett
Andrew Matsumoto
Prachi Salekar
Rucha Shah
Jenny Warren

JUDGES

We would like to thank our YP judges for volunteering their time for phase 1 of the Student Design Competitions this year in the Wastewater Design Competition and Water Environment Competition.

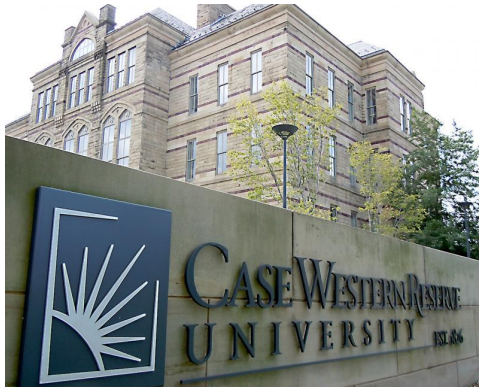
Sabrina Chang
Pooja Chari
Natalie Cook
Joseph De Paola
Adias Fostino
Logan Green
Steven Grice
Michelle Hatcher
Aleah Henry
Evan Heronemus
Tony Ibarra
Santhosh Krishna
Amy Langford
Mahmud
Liz Manning
Carol Martinson
Nick Merchant-Wells
Benjamin Pexton
Annie Sager
Graham Seggewiss
Sarah Shay
Christopher Sweetingham
Maddie Thompson
Stephanie Tran
Reva Vattukkalathil
Scott Wei
Harley Westman
Caroline Wilson
Wei Ye
Dodge Yu

THANK YOU!

Participating Teams

Wastewater Competition	Water Environment Competition
Case Western Reserve University *Ohio WEA*	Johns Hopkins University *Chesapeake WEA*
Colorado School of Mines *Rocky Mountain WEA*	Northeastern University *New England WEA*
Instituto Technológico de Costa Rica	San Diego State University *California WEA*
Manhattan College *New York WEA*	SUNY Environmental Science and Forestry *New York WEA*
Milwaukee School of Engineering *Central States WEA*	University of Guelph *WEA of Ontario*
National University of Singapore	University of Idaho *Pacific Northwest Clean Water Association*
North Carolina State University *North Caroline AWWA-WEA*	University of Illinois at Urbana-Champaign *Central States WEA*
North Dakota State University *North Dakota WEA*	University of South Florida *Florida WEA*
Northwestern University *Illinois WEA*	University of Tennessee *Kentucky-Tennessee WEA*
Tarleton State University *WEA of Texas*	University of Victoria *British Columbia Water and Waste Association*
Tecnológico de Monterrey	University of Virginia *Virginia WEA*
University of California, Irvine *California WEA*	
University of Florida *Florida WEA*	
University of Nevada, Las Vegas *Nevada WEA*	
University of Notre Dame *Indiana WEA*	
University of Vermont *New England WEA*	

Case Western Reserve University



COMPETITION:
Wastewater

No Waste, Problem Aced: Optimizing Beneficial Reuse of Biosolids Prior to BNR Upgrades

Team Members:
Aaron Mann
Kevin Pataroque
Peter Thompson

Faculty Advisor:
Kurt R. Rhoads, PE, PhD

Member Association:
Ohio Water Environment Association

The Upper Tuscarawas Wastewater Treatment Company (UTWWTP) is looking to redesign its biosolid remediation process prior to upcoming Biological Nutrient Removal (BNR) upgrades. The Summit County, OH plant treats four million gallons of water daily and produces over 500 dry tons of biosolids annually. UTWTP disposes of all biosolids by landfilling which costs the plant $120,000 annually and damages the local environment. Eight widely-used alternatives were identified and evaluated on cost, effectiveness, reliability, and environmental impact. A weighted decision matrix revealed that biogas production and composting are best suited to meet the plant's needs. A net present worth analysis of the options demonstrated that building a composting facility is more economically beneficial than building a biogas facility or maintaining the current landfill practice. A BioWin model was used to size an on-site, windrow-style compost facility. The proposed composting facility will divert biosolids from landfill, create a revenue source, and meet pay off in less than 15 years.

Colorado School of Mines

COMPETITION:
Wastewater

Nutrient Optimization for Municipal Wastewater Facilities in Colorado

Team Members:
Tori Heckart
Kayla Hubbard
Gillian Allison
Kelsey Buechler
Kate Stephens

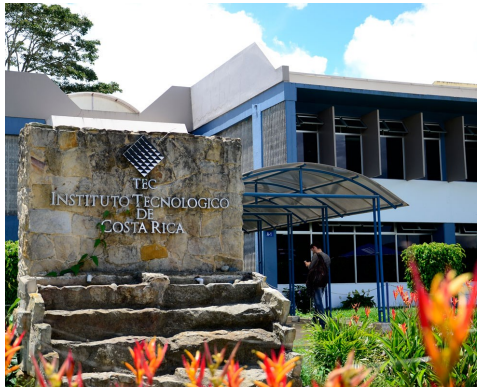
Faculty Advisor:
Chris Bellona, PhD

Member Association:
Rocky Mountain Water Environment Association

The CSM student design team was tasked with creating a conceptual design to assist the Colorado Springs Utilities' Las Vegas Street Water Resource Recovery Facility in meeting proposed regulatory limits for total nitrogen and phosphorus put forth by Regulation 31. For this project, CSM is proposing incorporating aerobic granular sludge into the current secondary treatment system to increase biological nutrient removal. At a rated capacity of 75 MGD, the design required 50 cyclones based on average daily wasting values and to provide redundancy in the system. These cyclones will process a portion of the return activated sludge stream to increase average sludge diameter and settleability. The proposed design includes a hydrocyclone storeroom in between Final Clarifiers 1 and 2 to hold the 15 skids of 10 m3/hr inDENSE cyclones (World Water Works, Oklahoma City, OK), over 2300 ft of new piping to connect the new recycle and waste streams, and three pump houses to move a portion of the final clarifier effluent to the hydrocyclone room. Additional components of this document include piping and pump calculations, an analysis of supplemental carbon sources, a cost estimation, an analysis of impacts to solids handling, anticipated results, and a triple bottom line evaluation.

Instituto Tecnológico de Costa Rica

COMPETITION:
Wastewater



Wastewater Treatment Plant Design for La Fortuna, San Carlos, Costa Rica

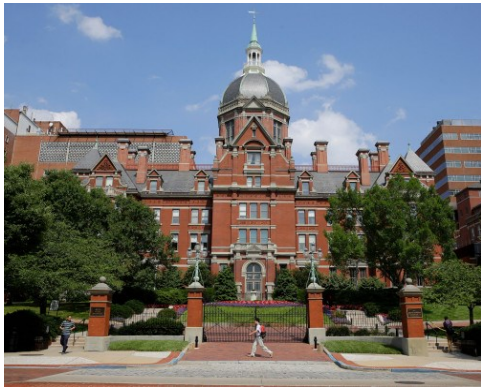
Team Members:
Lidia Rodríguez Vega
Sharon Castillo Rodríguez
Deilin Ureña Portuguez
Nicolás Morales Miranda
Antony Torres Solano
Raúl Garita Durán
Jafet Castro Sandoval
Alejandro Morales Quirós

Faculty Advisor:
MS. Eng. Diana Alexandra Zambrano Piamba

The design of a sewerage system and a WWTP are projected, which involves wastewater and sludge processing, biogas recovery, production of clean energy and administrative facilities. The design period is 25 years (flow 109 L/s). The were 5 preselected options, using 10 indicators (economic, environmental, technical, social). The selected option is composed by a high rate anaerobic pond, followed by a trickling filter. The sludge line is digested in the pond and dehydrates in drying beds. The collected biogas is used to produce energy and make the plant self-sustainable, over 87% of the energy demand is covered through clean energy production generated by wastewater treatment. The secondary treatment design variables combination caused a minimum O&M cost, that was identified through a MATLAB non-linear programming algorithm. The WWTP achieves an overall efficiency of 95% BOD removal. The administrative facilities design was inspired in national architecture and tropical essence. The total capital investment of the WWTP and sewerage proposed is US $3,283,277 and US $1,902,862, respectively. The projected user fee achieved is between USD $0.06-0.12 per month and the estimated O&M cost achieved is below US $7,230 per month.

Johns Hopkins University

COMPETITION:
Water Environment



Stormwater Management at Fort Meade

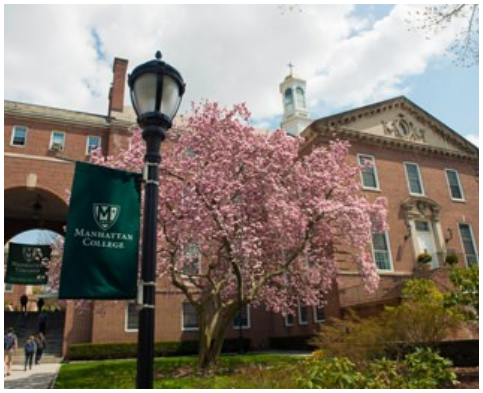
Team Members:
Bhawramaett Punruckwong Broehm
Marcos Pascual
Thomas Howard
Aryiana Moore

Faculty Advisor:
Hedy Alavi, PhD, MBA, PE, DEE

Member Association:
Chesapeake Water Environment Association

The purpose of our project was to design stormwater best management practices (BMPs) and impervious area removal strategies for an approximately 10 acre Motorpool to help the US Army at Fort Meade fulfill its impervious area requirement as an MS4 permit holder. To do so, we constructed a design matrix to select optimal BMP designs based on cost, quality and quantity control, maintenance, lifespan, and aesthetics, and determined infiltration trenches to be most suitable. Next, our team created three alternative design solutions, which provided trade-offs between high water treatment and maintaining site functionality. The selected alternative consisted of three infiltration trenches located on the property's northern and western borders that were designed to provide a total of 10.7 impervious acre treatment credits. In this project, the team developed a hydrologic model of the site using TR-55 and ArcGIS, preliminary BMP designs using AutoCAD, and a proposed project timeline and Gantt Chart. The project is estimated to cost approximately 760,000 USD.

Manhattan College



COMPETITION:
Wastewater

Characterization of Fats, Oils and Grease and Evaluation of Potential Beneficial Use

Team Members:
Adina Rivera
Dylan Curran
Nicole Kaiser
Jacqueline Delorenzo
Ryan Turadek

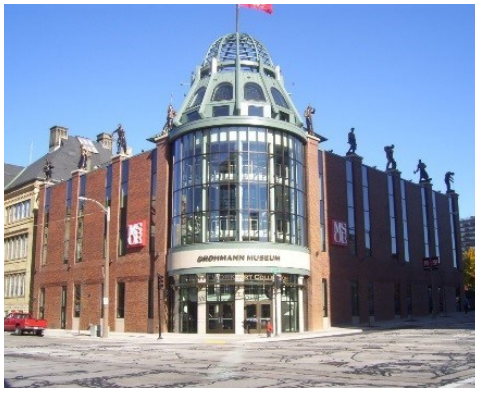
Faculty Advisor:
Jeanette A. Brown, PE, BCEE. D.WRE, Dist.M.ASCE, F.WEF
Member Association:
New York Water Environment Association

Fats Oils and Grease (FOG) is a byproduct of flood production and is made up of fatty acids and glycerol. FOG not only interferes in the biological life in surface water if left untreated, but also compromises technology in the wastewater treatment train through buildup. As this problem becomes increasingly more apparent, so do the beneficial uses of FOG.

The US EPA reports that replacing fossil fuels with biofuels has the potential to reduce the negative effects of fossil fuel production and use, including conventional and greenhouse gases (GHG) pollutant emissions, exhaustible resource depletion, and dependence on unstable suppliers (EPA 2016). Biofuels include purified or pressurized biogas, ethanol and biodiesel. The Manhattan College Team will be analyzing and comparing the potential resource recovery of FOG using a decision matrix, comparative cost analysis and return on investment (ROI). Possibilities of energy recovery include co-digestion of FOG and sludge to recover biogas or hydronic thermal separation of FOG to recover biodiesel.

Manhattan College has performed a study consisting of taking a FOG sample at two different locations at each WRRF. This data will be used to perfect taking quality samples, analyze possibilities of energy recovery and issues with material storage and conveyance.

Milwaukee School of Engineering



COMPETITION:
Wastewater

Municipal Treatment Facility - Joyabaj, Guatemala

Team Members:
Christine Boland-Prom
Blake Bostwick
Rebekah Janquart
Jamie Nguyen
Julian Sonn
Jamie Sykora

Faculty Advisor:
William Krill, MBA, PE

Member Association:
Central States Water Environment Association

The municipality of Joyabaj, Guatemala has a growing population with insufficient wastewater treatment infrastructure. Untreated wastewater is currently flowing into a river, jeopardizing the health and safety of the community and the surrounding environment. Five sites were chosen as locations of potential wastewater treatment facilities. Of the five sites, three have been designed by a Chilean engineering firm. This project focuses on the design for one of the two remaining sites. To ensure long-term feasibility with this project, five criteria were determined to address the needs of the community: reliability, land requirement, maintenance simplicity, energy consumption, and safety and security. These criteria are most impactful on the secondary treatment system, and after evaluating seven processes, a trickling filter was selected. The preliminary, primary and tertiary treatment are designed in accordance with the requirements of a trickling filter. This facility will intercept the current wastewater collection system and treat the water in accordance with Acuerdo 236 before discharging into the nearby river. The effluent concentration limit are 100 mg/L BOD5 and 100 mg/L TSS. This project will target effluent limits of 50 mg/L BOD5 and 50 mg/L TSS to ensure that standard limits are met as the community grows.

National University of Singapore

COMPETITION:
Wastewater

Development of Sustainable Wastewater Treatment Plant with Energy Recovery through the use of Biosorption and Oxidation Processes

Team Members:
David Immanual Tanaka
Chia Jia Ling
Jonathan Khoo Bing Xian
Neo Wen Yang
Wee Li Teng

Faculty Advisor:
Hu Jiangyong, Ong Say Leong

The Pulau Tekong Council (PTC) has requested a proposal to develop a domestic wastewater treatment plant to cater to the surrounding areas. The current treatment facilities are inadequate, and to meet the environmental regulations set by PTC, a new wastewater treatment facility needs to be constructed. The proposed treatment facilities were sufficiently designed to handle 50 years projected flow rate and allows for future expansion works. The team analyzed the projected flow rates from domestic sources, and the influent concentrations expected. The shortlisted treatment options' advantages and disadvantages were carefully weighed before adoption. PTC is concerned about the energy usage, impact on biodiversity, and waste production. Therefore, the team aims to maximize biogas production, minimize vibration, sound, odor, and sludge production. The team's design consists of screens, grit chambers, biosorption tank, aeration tank, clarifiers, disinfection and aeration elements. This allows the effluent to meet PTC's discharge requirements while keeping the cost and carbon footprint to a minimum through energy recovery. To reduce waste, biosolids generated would be converted into Class A biosolids and used for land applications. The impact on the biodiversity would be minimized and the system would improve the overall water quality in the island.

North Carolina State University

COMPETITION:
Wastewater

Siler City Wastewater Treatment Plant Upgrade and Expansion

Team Members:
Silvana Alfieri
Drew Casey
Ky Tanner
Kai Dunston

Faculty Advisor:
Francis L. de los Reyes III, PhD

Member Association:
North Carolina AWWA-Water Environment Association

Siler City Wastewater Treatment Plant is located in Chatham County, NC and is operated by the town of Siler City. This report focuses on the upgrade and expansion of Siler City's secondary treatment system for an increase in design flow of 4 MGD to 6 MGD with the implementation of a stricter nutrient removal permit. This report also includes recommended solutions to existing issues and operational concerns, and GPSx modeling to ensure plant effluent complies with new permit limits. Upgrades to the primary and tertiary treatment systems are currently in the design phase of a separate project.

The existing secondary treatment system consists of two oxidation ditches running in parallel. The existing system will be upgraded to a 5-Stage Bardenpho system with the addition of pre-anaerobic, pre-anoxic, post-anoxic and reaeration tanks. One new 5-Stage train will be constructed within the plant's limited footprint for a total of three identical process trains. Construction sequencing and phasing ensures maintenance of plant operations. A hydraulic analysis, tank sizing calculations, cost estimates, and a sustainability review are discussed in the report.

North Dakota State University

COMPETITION:
Wastewater

Treatment and Disposal of Biosolids from Wastewater Lagoons

Team Members:
Arianna Christian
Mara Roteliuk
Tyrel Clark
Erika Krieger
Tyler Fairchild

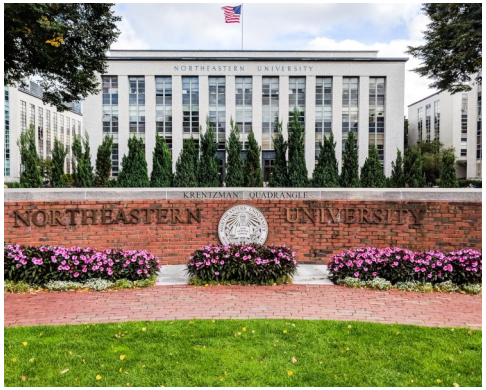
Faculty Advisor:
Wei Line, PhD

Member Association:
North Dakota Water Environment Association

The City of West Fargo is decommissioning their lagoons as all their wastewater will eventually flow to the City of Fargo's wastewater treatment plant. Decommissioning leaves biosolids, or sludge, at the bottom of each cell that must be removed before the land can be developed or reused. Our group was tasked with determining a sustainable solution to take care of the sludge. Several alternatives for the removal and disposal or reuse of the sludge were created by combining different unit treatment processes achieve stabilization, volume reduction, and a final disposal or reuse method. All the alternatives were analyzed according to weighted criteria approved by the City of West Fargo. The alternative selected after this analysis was Alternative 2: Dewatering (using sludge drying beds) and landfilling (using sludge as daily cover). Sludge will be gradually dredged from the existing lagoons to the sludge drying beds, located in an empty lagoon cell. 30 sludge drying beds will be used with a 4 o 6-week rotation to complete the process within the 10-year timeframe given by the City. From the sludge drying beds, the product will be transported to the City of Fargo landfill to be used as daily cover.

Northeastern University

COMPETITION:
Water Environment



Rock Meadow Parking Lot & Stormwater Design

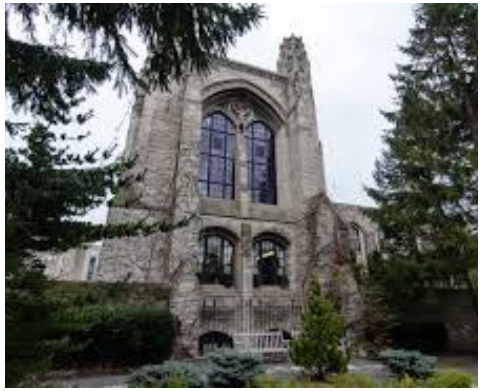
Team Members:
Samantha Kinnaly
Kate Engler
Annie Lamonte
Emma Totsubo

Faculty Advisor:
Annalisa Onnis-Hayden, PE, PhD

Member Association:
New England Water Environment Association

On behalf of the Belmont Conservation Commission (Client), Northeastern-ENV (Evergreen) has prepared a design for the main entrance and parking lot at Belmont's Rock Meadow Conservation Area. The proposed design is meant to improve the existing conditions, which include an undersized lot, an eroded and uneven surface, and no stormwater management system. Evergreen has built on a conceptual Master Plan by modifying and detailing the proposed design of the parking lot layout, stormwater management system, grading, and site improvements. The final design was selected using decision matrices, surveys of the client and community, and informed engineering recommendations. The lot design provides a 117% increase in parking capacity. A vegetated filter strip was designed to treat the stormwater runoff from the driveway and a bioswale and rain garden were designed to treat and infiltrate the stormwater runoff from the parking lot. Detailed grading plans show a 3-4% decrease in maximum driveway slope and cross slopes which direct stormwater runoff to the green infrastructure for treatment and infiltration. Additional site improvements were also selected to bolster aesthetics. The following design recommendations and construction drawing set have been issues to the client and community for construction in Summer 2020.

Northwestern University



COMPETITION:
Wastewater

Membrane Bioreactor System for a Local Brewery: Process Design and Cost Analysis with a Novel Approach to Membrane Fouling Control

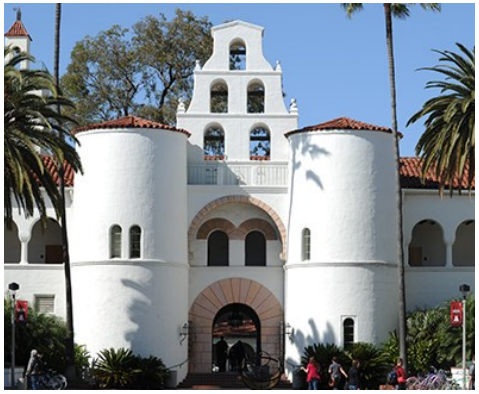
Team Members:
Yechan Won
Haley Lewis
Haotian Cai

Faculty Advisor:
Kimberly A. Gray

Member Association:
Illinois Water Environment Association

The membrane bioreactor (MBR) process combines the biological digestion with the membrane filtration to achieve very compact wastewater treatment. The small footprint of MBR systems makes them ideal for small scale applications and for retrofits and upgrades at old treatment facilities. Herein, we present the design of an immersed MBR system with an in-situ application of a polyelectrolyte complex (PEC) to create a sacrificial protective layer at the membrane surface to improve membrane performance by retarding biofouling and reduce the costs of membrane cleaning. In addition, we used a microbrewery as the model system to illustrate the advantages of the MBR system and its economics. For a system with a population equivalent of 200 and a flowrate of 100 m^3/d, the total capital expenditure (CAPEX) and annual operational expenditure (OPEX) are estimated to be $144,157.62 and $1,853.34, respectively. We calculate that the OPEX with the PEC protective layer is 12.7% cheaper than conventional chemical cleaning using the various empirical OPEX models. We found that the wastewater surcharge from a microbrewery with 20,000bbl annual production is 20.5 times higher than the annual OPEX and using this saving, the CAPEX of the proposed MBR system could be met within 4 years.

San Diego State University



COMPETITION:
Water Environment

Paradise Creek Flood Mitigation

Team Members:
Ehrick Costello
Michelle Melkonians
Marina Balcazar
Julia Moore
Sophia Jorge

Faculty Advisor:
Christy Dykstra, PhD

Member Association:
California Water Environment Association

The combination of seasonal weather phenomena such as heavy rains and king tides can lead to severe flooding problems for low lying coastal communities. National City, CA is one such community due to the presence of Paradise Creek, which is tidally influenced and passes through a heavily developed coastal community. In this project we evaluated design alternatives intended to reduce the impact of flooding on the area surrounding Paradise Creek. To achieve this, our team developed a HEC-RAS model of the creek and evaluated the performance of five alternative designs during a 2-year, 10-year, and 100-year storm. The maximum flood depth was assessed during each simulation, and compared to a baseline flood depth. This method provided a percent reduction for each alternative, which was used as the primary method of comparison.

Of the five designed evaluated, only the inflatable dam at the mouth of Paradise Creek was effective at reducing flood severity along the creek. The design reduces flooding by preventing tidal intrusion while simultaneously utilizing a large natural wetland to temporarily contain the storm runoff. This approach resulted in a 24% reduction of flood depth during a 100-year storm and is the focus of our design.

SUNY Environmental Science and Forestry

COMPETITION:
Water Environment

Nanofiltration for Microcystin Removal in Drinking Water, Auburn, NY

Team Members:
Cameron Daley
Brianna Fitzgerald
Emily Ellithorpe
Zach Patterson
Katherine Gannon
Lauren Claeys
Mallory Delanoy
Paul DeVries

Faculty Advisor:
Douglas Daley, MS, PE

Member Association:
New York Water Environment Association

The City of Auburn's Water Treatment Plant (WTP) draws its supply from Owasco Lake, which faces the seasonal problems of toxins in the water due to Harmful Algal Blooms (HABs). The WTP successfully removes one of these toxins, microcystin, on an seasonal basis with their current use of Powdered Activated Carbon (PAC); this is a temporary solution and generates waste that is discharged to the lagoon on-site. The plant needs a long-term solution to meet their water demand of 5 MGD, treat the water to meet Department of Health standards, and remove microcystin. Design and implementation of a nanofiltration system to address the problem is assessed, including potential cost benefits, maintenance requirements, and waste minimization opportunities. The final design incorporates four nanofiltration membrane skids (polyamide composite spiral wound membranes) into the current system. Each skid has a permeate production rate of 2 MGD; the design effectively eliminates the need for PAC and reduces waste entering the waste lagoon. Although the design is expensive (~$6.7M capital costs) compared to the "do-nothing" alternative, implementation of a nanofiltration design could allow the plant to become a model municipality in terms of membrane technology to address emerging issues in surface drinking water supply.

Tarleton State University

COMPETITION:
Wastewater

Expansion and Implementation of Granular Activated Sludge in a Continuous Flow WWTP

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Faculty Advisor:
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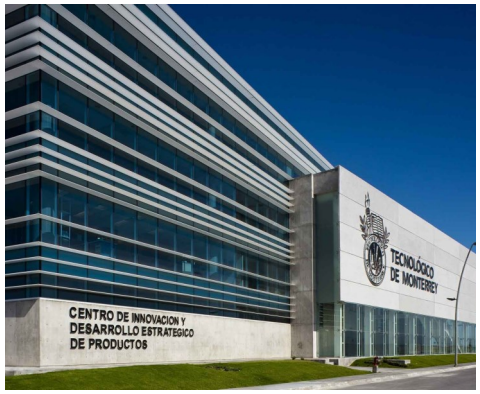
Member Association:
Water Environment Association of Texas

The City of Pflugerville, Tx has retained the WEAT competition team to design the expansion and upgrade of their Central WWTP in a 3-phase plan. The chronological phases, meant to remedy the existing plant's inadequacies and comply with TCEQ guidelines, include: a comprehensive capacity expansion from 5.3 to 10 MGD, conversion from chemical to biological phosphorus removal, and general upgrades to solids handling processes. With the goal of developing an innovative and cost-efficient solution the WEAT team has completed preliminary design on three alternatives, of which one has been selected for final design (in progress). Each alternative generally includes the same improvements with exception to the biological nutrient removal (BNR) methods. The three BNR alternatives include (1) implementation of A2O treatment zones in existing and newly constructed oxidation ditches, (2) the same features as Alternative 1 plus integrated fixed-film activated sludge (IFAS) treatment, and (3) the same features as Alternative 1 plus granular activated sludge (GAS). An evaluation of each alternative with respect to capital cost, O&M cost, ease of implementation, and footprint led to the recommendation of Alternative 3, which will be the focus of the final design report that will be prepared to contend in the WEF competition.

Tecnológico de Monterrey



COMPETITION:
Wastewater

The Gilleland Creek Wastewater Treatment Plant: Expansion Guidelines

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Member Association:
Sociedad Mexicana de Aguas, A.C.

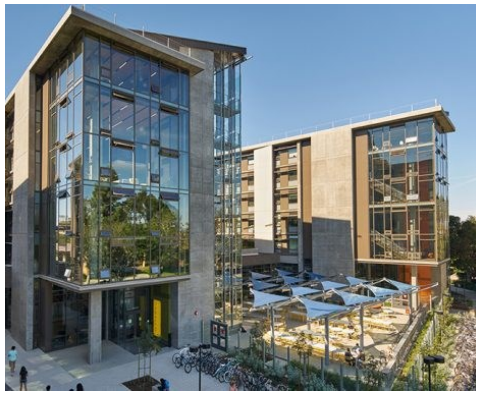
Even though the objective of a central wastewater treatment plant is to satisfy a large population in the medium and long term through a demand forecast, predicated limitations can be surpassed due to the rampant population growth, which is precisely the case of the WWTP studied.

In this report, we analyze the Central Wastewater Treatment Plant of Pflugerville, located in southeastern Texas, which has exceeded its capacity by more than 76% compared to the design flow at its opening 34 years ago.

The purpose of this plant is to treat water from domestic discharges, to achieve the quality to conform to the Texas Commission on Environmental Quality, and then deliver this high-quality water to the water-receiving bodies of the region, like The Colorado River (considered one of the main bodies located nearby), to decrease water stress and improve the environmental impact.

These guidelines aim to provide another course of action in order to expand the plant. The present design of this facility is deficient in some processes. A new design has to be implemented in order to maintain the expected quality, as the flow increases in the near future and to get the plant's capability within its parameters again.

University of California, Irvine



COMPETITION:
Wastewater

Seal Beach and Wastewater Pump Station Replacement

Team Members:
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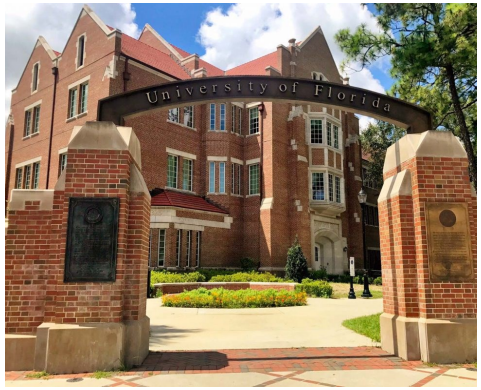
Faculty Advisor:
William Cassidy, PE

Member Association:
California Water Environment Association

The purpose of this study is to evaluate the hydraulic requirement(s) and life cycle costs to determine the best option (configuration) for a new pump station for serving the northwestern service area of the Orange County Sanitation District. The new wastewater pump station is to replace two aging pump stations, Westside and Seal Beach pump stations. The new station is to be built adjacent to the existing Seal Beach PS. The design will accommodate current as well as future (year 2040) projected flows. A dual wet well and dual pump set will be considered for the configuration of the new pump station. In addition to the new pump station and its force main(s), the study is to address the reconfiguration of the upstream sanitary sewers (gravity) feeding the existing stations. Alternatives will be considered in terms of the reconfiguration of the upstream sanitary sewers as well as the selection of pumps for the new station.

University of Florida

COMPETITION:
Wastewater



Treatment of Municipal Wastewater for Control of Glyphosate in Effluent Discharges

Team Members:
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James Snyder
Ryan Winslow
Alexandra Rubin

Faculty Advisor:
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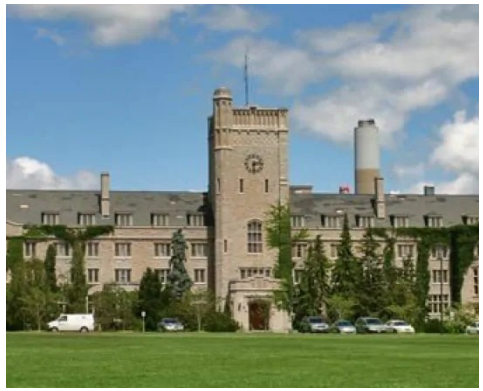
Member Association:
Florida Water Environment Association

Since the 1970s, RoundUp™ has been commercially distributed to farms as a herbicide. The main ingredient of this product is glyphosate, a bio-recalcitrant toxic phosphonate which accumulates in the human body mainly through ingestion and inhalation. Glyphosate exposure has been shown ton increase the risk of contracting non-Hodgkin's lymphoma, to incite skin and eye irritation, and has been classified by the World Health Organization as a carcinogen. Human ingestion of food and water products containing glyphosate is the primary vehicle, through urine and feces for the conveyance of glyphosate into wastewater, stormwater notwithstanding. The focus of this design is the inclusion of unit operations and processes (UOPs) for glyphosate degradation within wastewater treatment facilities. UOPs for glyphosate degradation include photo-catalysis through irradiation, degradation with a C-P lyase enzyme, reverse osmosis and oxidation through ozonation. From the scope of the alternatives examined herein, the team concludes and recommends the deployment of a TiO_2 photo-catalytic process after granular filtration and before chlorination for the control of glyphosate and the glyphosate byproduct AMPA in municipal wastewater effluent.

University of Guelph

COMPETITION:
Water Environment



Innovative Stormwater Management in the City of Richmond Hill

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Rebecca Bar
Acacia Markov
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Faculty Advisor:
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Member Association:
Water Environment Association of Ontario

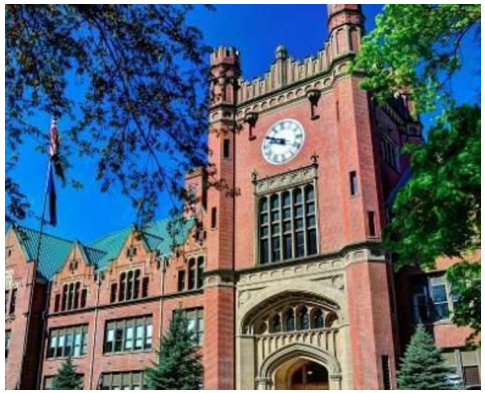
Mill Pond, an online pseudo-stormwater facility in the City of Richmond Hill, Ontario, presently faces significant sediment accumulation, obstructions to fish passage, and coldwater habitat degradation. The University of Guelph team proposes conceptual designs for the rehabilitation of Mill Pond in two phases: Phase I, transition from an online to offline pond and Phase II, LID implementation and sediment reuse.

In Phase I, upstream flows enter a primary sediment forebay for initial TSS removal. Baseflow is routed into the naturalized channel via a submerged orifice while excess flow is routed into a secondary forebay within the pond via a rock weir. The pond outlet weir discharges into a scour pool and rock ramp to allow fish passage. Sediment deposition is addressed by the forebays and the bypass channel provides fish passage. Thermal modeling identified that the design maintains pond effluent temperatures below the coldwater fish threshold.

In the Phase II sediment reuse plan, 77% of excavated material is reused with potential for increase reuse through optional value-added components. LIDs include a raingarden, green roof bike shelter, and phosphorus removal bioswale.

Environmental benefits of the final design include fish passage restoration, dead zone removal, channel naturalization, and water quality improvements.

University of Idaho



COMPETITION:
Water Environment

Potable Water Reuse in Moscow, Idaho

Team Members:
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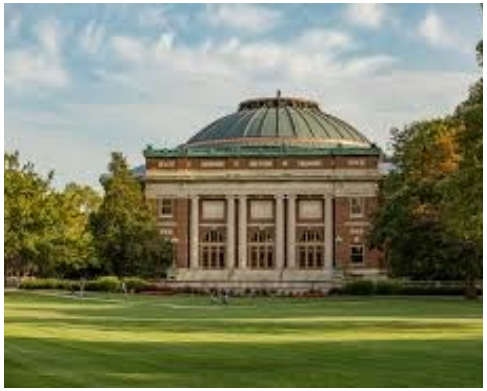
Faculty Advisor:
Erik R. Coats, PE, PhD

Member Association:
Pacific Northwest Clean Water Association

The University of Idaho student design team prepared a direct potable reuse (DPR) proposal utilizing the effluent generated at the Moscow WRRF. Motivations for this design project are drawn from the current critical need for sustainability in the water industry. Technologies used to achieve drinking water quality from wastewater effluent were researched extensively to provide the team and the City of Moscow with two options for a DPR system and one option for an IPR system. The chosen alternative is a combination of microfiltration, reverse osmosis, and UV disinfection before being applied via deep weel injection to the local aquifer.

University of Illinois at Urbana-Champaign



COMPETITION:
Water Environment

Green Infrastructure Solutions to Campus Flooding in Urbana, IL

Team Members:
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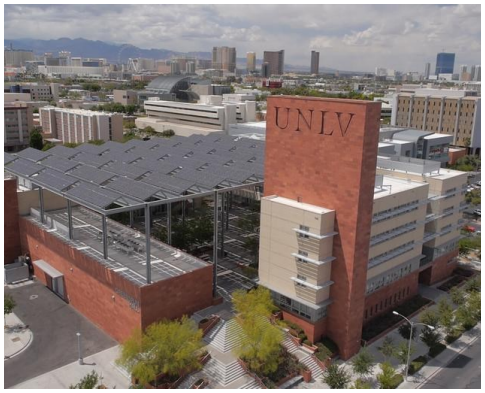
Abhijeet Saraf
Ryan Moeller

Faculty Advisor:
Jeremy Guest, PhD

Member Association:
Central States Water Environment Association

As an esteemed part of the University of Illinois at Urbana-Champaign, the College of Veterinary Medicine attracts many students from around the world. However, poor stormwater management around the facility has led to issues of flooding and even nitrate pollution from agricultural stormwater from the surrounding areas. The purpose of this project was to design green infrastructure systems in order to alleviate flooding around the Vet Med facility and improve general aesthetics. The design featured a rain garden and parking lot bioswales for collection of stormwater runoff in separate water catchments. Analysis of rainfall events, BMP design and optimization, land surveying, and cost estimates were included in the project.

University of Nevada, Las Vegas



COMPETITION:
Wastewater

Upgrading City of Henderson Kurt R. Segler Water Reclamation facility for Biological nitrogen removal

Team Members:
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Amanda Page
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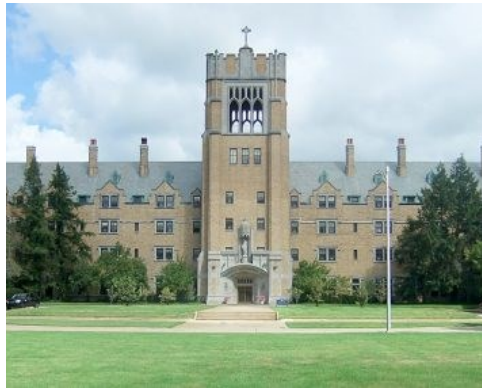
Member Association:
Nevada Water Environment

City of Henderson Kurt R. Segler Water Reclamation west complex currently uses two 12 MGD horse-shoe shaped oxidation ditches. The ditch structures are approaching the middle of their useful life and are experiencing greater operational issues, mainly due to grit and rag accumulation, and structural deficiencies due to corrosion. The wastewater effluent must be 0.5 mg/L or less for nitrogen TKN and 0.1 mg/L or less for Phosphorus (Total). The NWEA UNLV student chapter will assess, whether should be improvements to the existing structures to mitigate current concerns and improve process output, or a new treatment process should be considered to accomplish higher nutrient removal. This analysis contains future population growth and regulations as well as considering the projected future wastewater influent. A decision matrix created to evaluate the advantages and disadvantages of the selected alternatives to reduce the list of options and select the most beneficial option for the facility. For the selected option, an evaluation was made for capital, operational and maintenance costs, social and environmental elements, reliability, applicability and regulatory compliance.

University of Notre Dame & St. Mary's



COMPETITION:
Wastewater

Disinfection System Upgrade for South Bend (IN) Wastewater Treatment System

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Michael Dunn
Patrick West

Faculty Advisor:
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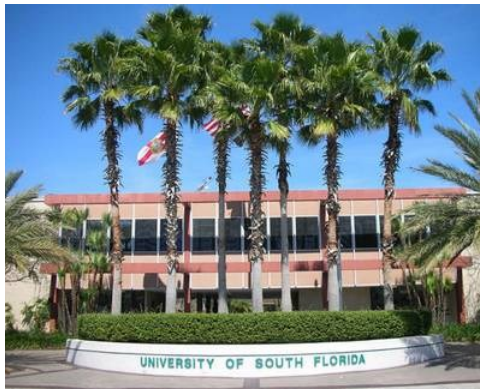
Member Association:
Indiana Water Environment Association

Our team's 'wastewater design' provides a conceptual engineering plan with which our community's POTW facility, and specifically its disinfection capacity, could be upgraded in order to comply with its current CSO-based 'Consent Decree' obligations. Our real-world design strategy was subsequently conceived to achieve the three specific goals: 1) to shift the plant's existing gas-phase 77 MGD disinfection system to a safer liquid-based chemical-delivery alternative, 2) to upgrade the plant's disinfection flow capacity by an additional 23 MGD, and 3) to conceive a new disinfection mode for this additional flow which would 'fit' within the plant's limited available land footprint. Two new chemical-delivery options were devised for implementation with the plant's existing 77 MGD process, including a sodium hypochlorite plus sodium meta-bisulfite dichlorination mode, and also using a peracetic acid (PAA) approach. The latter PAA option had several benefits (i.e., lower cost, better chemical stability, and lack of dichlorination requirement), but concerns were raised by the client regarding the concept's acceptability at a state regulatory level. As for the additional 23 MGD upgrade, ultraviolet irradiation treatment was selected on the basis of expected performance which could be achieved with the least-possible land footprint required.

University of South Florida

COMPETITION:
Water Environment



Sustainable Energy & Water Control at SE7EN Wetlands

Team Members:
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Daniel Eagan
Jasmine Wood

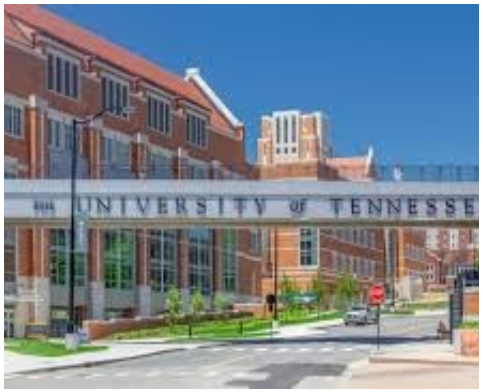
Faculty Advisor:
Sarina Ergas, PhD

Member Association:
Florida Water Environment Association

The City of Lakeland in Central Florida approached the University of South Florida Team with a project for the SE7EN Wetlands Park involving renewable energy and water control. In SE7EN Wetlands, treated wastewater from the City of Lakeland flows through 7 cells, and the flow of water between cells is controlled by 11 water control structures. With all control structures in SE7EN Wetlands at the end of their functional lives, replacement of all control structures is planned. The replaced control structures will require automated gate control as well as a network of remote sensors collecting water quality and water flow data. However, this issue is complicated by the substantial size of SE7EN Wetlands, coupled with the remoteness of the property. Thus, these conditions propose a challenge for on-site electricity generation. Furthermore, with educational facility slated to be built by 2023, SE7EN Wetlands necessitates a renewable energy source for both the educational facility and the proposed automated control structures. With the anticipated increase in visitors to SE7EN Wetlands, there is tremendous opportunity for educating the public. The educational facility and automated control structures together will inform SE7EN Wetlands patrons of renewable energy technology presently being used at SE7EN Wetlands.

University of Tennessee

COMPETITION:
Water Environment



Effluent to Beet Tap

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Kadee Klimowicz
Caroline Stephens

Faculty Advisor:
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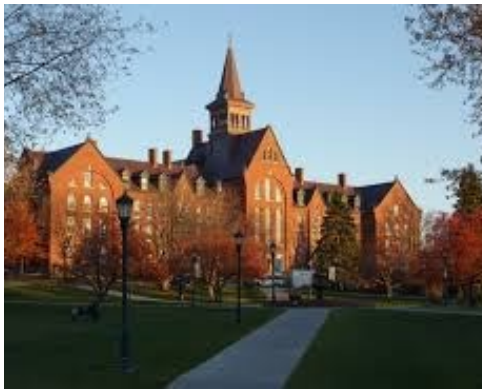
Member Association:
Kentucky-Tennessee Water Environment Association

Many engineers are capturing water at the end of the wastewater treatment process and, rather than releasing this water to nearby streams and waterways, are finding opportunities to use it. Taking opportunities to recycle water is a sustainable practice that Sustainabrew Engineering would like to bring to the forefront of the East Tennessee region. The Effluent to Beer Tap: Water Filtration System is designed to treat wastewater effluent from membrane bioreactor (MBR) wastewater plants to potable water standards to brew beer. Sustainabrew Engineering partnered with a local wastewater plant for the re-use of effluent wastewater that would typically be discharged into Beaver Creek for brewing beer with a local brewery. The compact portable treatment system not only puts water scarcity and water reuse awareness at the forefront of the Knoxville community, but could also serve as a system for regions that re in need of emergency water services, amongst other applications. The device utilizes two techniques: a Carbon Filter and Ultraviolet Irradiation to ensure the water quality meets the National Primary Safe Drinking Water Standards and brewer preferences. This technique is a cost effective way to promote water reuse through the medium of beer in the East Tennessee Region.

University of Vermont

COMPETITION:
Wastewater



South Burlington WWTF Chemical Reduction

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Faculty Advisor:
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Member Association:
New England Water Environment Association

The South Burlington Wastewater Treatment Facility located in South Burlington, Vermont, currently operates with high chemical addition of aluminum sulfate and caustic soda to remove phosphorus from wastewater. The chemical usage results in adverse effects on the symbiotic relationship between the biological and chemical treatment processes. Chemical addition also contributes a significant amount to the yearly costs of the treatment facility. Through field and laboratory testing and research, our wastewater team proposes a reworking of the current biological nutrient removal system to incorporate a return activated sludge fermentation stream. The results of BioWin modeling for this proposed alternative indicates lower chemical usage, higher BNR system performance, and a 75% and 35% cost reduction of alum and caustic soda, respectively. Therefore, the process alternative could decrease the yearly expenditure of the treatment facility while maintaining a high level of phosphorus removal.

University of Victoria

COMPETITION:
Water Environment

Cambie Corridor Rainwater Management Solutions

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Felix Motard
Robin Jory
Liam Kirchner

Faculty Advisor:
Phalguni Mukhopadhyaya

Member Association:
British Columbia Water and Waste Association

Presented in this report are the conceptual designs for a rainwater management system intended for use on an RM-8A zoned townhome, as well as a modified RM-8A layout designed in accordance with the Student Design Competition (SDC) project scope and guidelines presented by the British Columbia Water & Waste Association (BCWWA). As requested by the City of Vancouver, the modified RM-8A layout was strategically designed to optimize on-site stormwater retention and treatment, with the goal of meeting the integrated rainwater management plan (IRMP) requirements. Stormwater modelling in PCSWMM was used to analyze performance of the designs and confirm that IRMP requirements are met. A triple bottom line analysis was used to determine the social, environmental, and economic costs and benefits for the baseline and modified site layouts, ultimately indicating that the modified site is the preferred option for future implementation.

University of Virginia

COMPETITION:
Water Environment

Re-Viewing Runoff

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Ekaterina Forkin
Anna Liang

Faculty Advisor:
Brian Smith, PhD

Member Association:
Virginia Water Environment Association

At the University of Virginia's School of Engineering and Applied Sciences. Thomton Courtyard is one of the few open areas of vegetation and wildlife. Due to the current drainage design, multiple local impaired waterways such as the Rivanna River and the Chesapeake Bay bear negative repercussions of the unfiltered stormwater drainage system. The purpose of this site selection is to improve a valuable area located within the engineering school by redesigning the drainage system on a small scale. In turn, the ultimate goal of this project is to shed light on Charlottesville's regional drainage concerns by improving upon a specific drainage system while demonstrating how this single site directly contributes to larger-scale issues. This project is directly applicable to many fields of engineering, exemplifying the practical applications of infrastructure design for multiple groups of students in the context of a larger region. Looking forward, after the implementation of the project, this site will become an educational area with informative displays describing the changes made. This way, this project not only alleviates immediate drainage issues, but promotes a lasting positive environmental impact for students of all majors to come.

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Thank you!