Environmental Design

ISWS 2024 Technical Event

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USU
ASCE
STUDENT CHAPTER

ISWS 2024
Environmental Design Rules
April 11th–13th, 2024

Objective

The ISWS Environmental Competition is an undergraduate project to facilitate hands-on experience with real-world projects for students with civil and environmental engineering and related majors. This branch of the Student Symposium incorporates water treatment principles with research, design, prototyping and laboratory testing, and a technical writing and presentation component. Students will develop knowledge related to the expectations of the civil and environmental engineering practice and industry.

Teams from the Intermountain Southwest Region are given the opportunity to design, prototype, test, evaluate, and present results for a bioretention cell to treat polluted stormwater based on the scenario presented in the competition rules.

This team project will be judged on:

1. System performance
2. Report
3. Poster and Presentation
4. Aesthetics

Student teams are strongly encouraged to work closely with faculty and local engineering professionals to design a creative and practical prototype that addresses the stated challenge problem.

Participant Rules

Each school may only enter one team to compete.

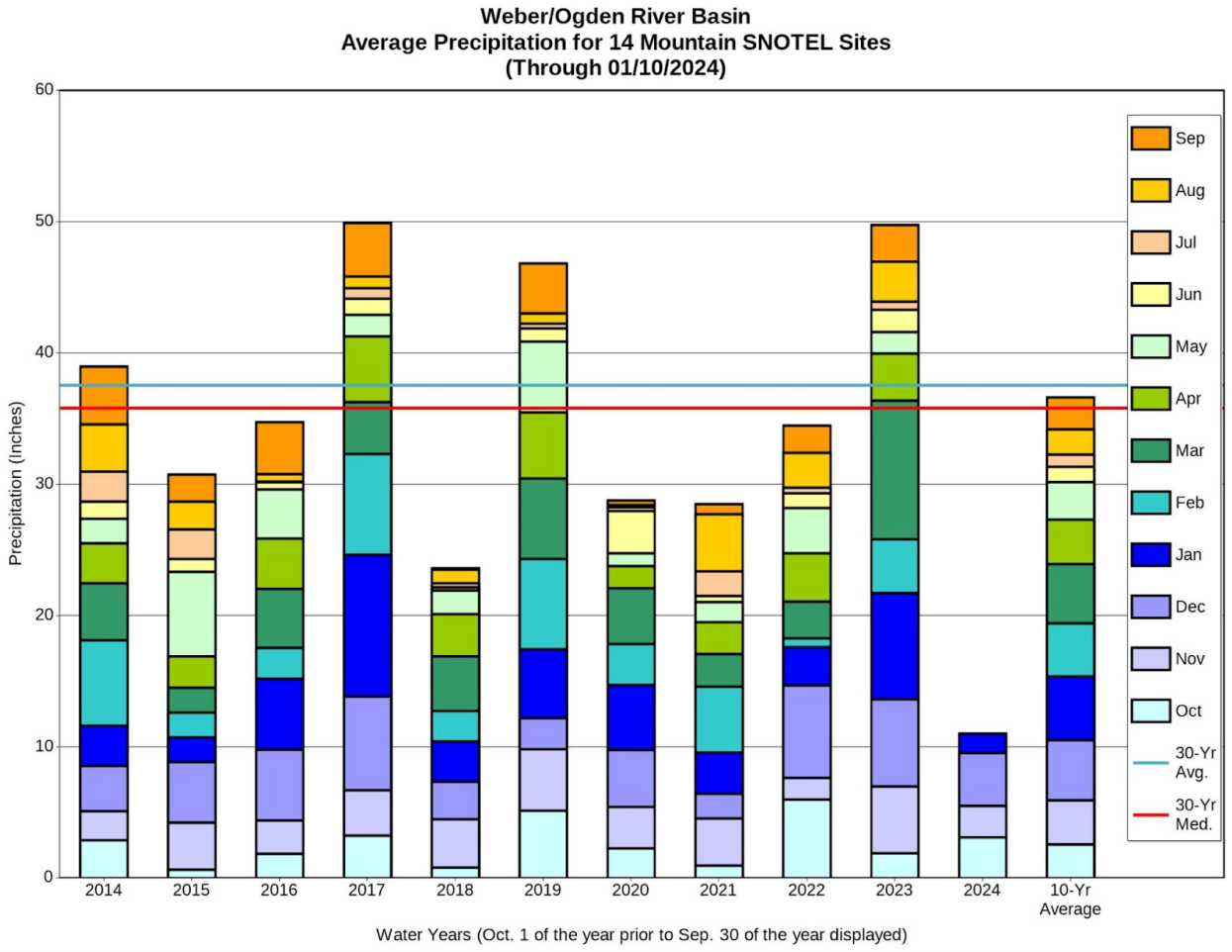
Each team may have one team Project Manager and up to four additional team members. The Project Manager may oversee and direct construction but cannot physically participate in the construction of the bioretention cell or project poster.

Each team member must be registered as a participant of ISWS 2024. The Project Manager does not have to be a registered participant of ISWS 2024.

Diversity, Equity, and Inclusion is encouraged as a consideration in the formation of all student competition teams.

Background

The Weber/Ogden River Basin experiences variable annual rainfall, with increasing unpredictability in the face of changing climate conditions. In dry years, the river basin may receive only 20-30 inches of rain. In excess years, the river basin may receive double the drought conditions, up to 50-60 inches of rain. (See UDWR Weber/Ogden River Basin graph, below).



In response to these variable rainfall conditions, the state of Utah has recommended waterwise landscaping for drought conditions and on-site stormwater retention for flood control. As development continues across the state, stormwater quality is an increasing concern. Retention strategies are encouraged that harvest or use storm water on site to protect water quality.

Scenario

The hypothetical development team Rufous United is looking to develop a single-family residential neighborhood on 11.95 acres at 41° 49 '34.4"N 111° 47' 48.6"W in Smithfield, Utah. Cache County requires all new proposed development to be evaluated for the use of Low Impact Development (LID) approach and to minimize impacts to water quality.

Your team is being considered for a bioretention cell design that will store stormwater runoff, treat pollutants, and support the local environment in accordance with Cache County objectives. You must verify the feasibility of this best management practice for your site, demonstrate your design's stormwater quality treatment capabilities, and present your design to Rufous United as a compelling design strategy for water quality improvement and sustainability.

Design Challenge

Your team will design, construct, and demonstrate the performance of a bioretention cell that will meet infiltration rates and pollutant removal requirements. Teams must design a two (2) foot by two (2) foot wide, and a minimum of five (5) inches deep bioretention cell which includes a permeable liner and a subsurface collection system for the test filtered stormwater.

Each team's competition entry will be judged on three categories with a total of 90 points:

1. On-site system performance at achieving desired effluent quantity and water quality goals (30 points)
2. Design report, consisting of:
    a. Feasibility Assessment (10 points)
    b. Calculations (5 points)
    c. Cost estimate (5 points)
    d. Plant species selection (10 points)
    e. Sustainability (people, planet, profit) (10 points)
3. On-site presentation and poster (20 points)

Points will be awarded via the Scoring Summary Table and Judging Criteria.

Minimum Onsite Performance Criteria

The system must:

1. Work on gravity alone.
2. Allow water to infiltrate at a rate between **0.25-6 in/hr**.
3. Include soil that supports plant life. Selecting the appropriate materials and plant species is critical for a successful bioretention cell. Soil characteristics should be chosen to support drainage, pollutant removal rates, and selected plant species health and viability.
4. Allow for stormwater collection post-infiltration for testing of pollutant concentrations.

Infiltration Protocol

All teams must bring two (2) 5-gallon buckets to the competition for the infiltration test. Each bucket must be empty and clean of any residue at the time of infiltration testing.

The judges will prepare the challenge water for use by all teams. No modifications to the challenge water constituent composition nor any other constituents are allowed. Addition of any treatment before or after infiltration is expressly prohibited and will result in disqualification.

The challenge water will contain undisclosed constant concentrations of nitrogen, phosphorus, and sediment to represent the pollutants commonly present in stormwater runoff. Each team will pour 5-gallons of water into the top of their mini bioretention cell. The water will be allowed to infiltrate for 15 minutes* and must be collected by the second 5-gallon bucket below the mini bioretention cell. After the judges' time call, the volume of water will be measured to calculate the infiltration rate of the mini bioretention cell, and samples will be taken from the infiltrated water for testing of pollutant concentrations.

*Note: Infiltration time may be adjusted during the competition at the discretion of the judges but will be constant for all teams.

Design Report

Each team is required to submit a technical design report. The design report will be a 2-3 page summary describing the feasibility, estimated cost, and soil/plant selections. It should also include the sizing calculations for how large your bioretention cell would need to be on the site, i.e. the required water quality volume and minimum footprint.

To determine the feasibility of this BMP, the following should be considered:

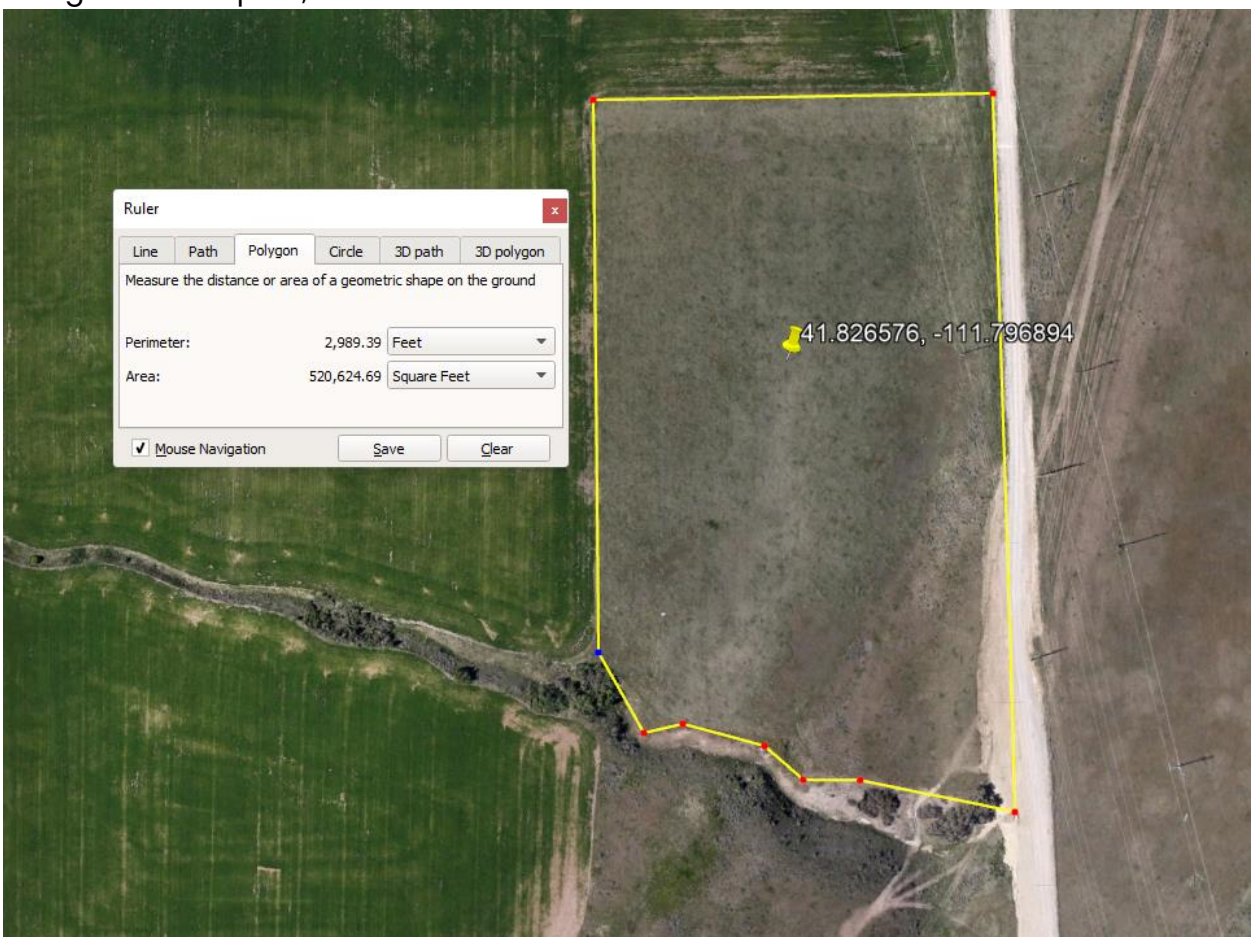
1. Will the existing soil allow for infiltration?
2. Does groundwater depth/depth to the water table meet the minimum separation requirement of the Utah DWQ LID Guide?
3. Is the design infiltration rate within the acceptable rate of **0.25-6 in/hr**?
4. Is infiltration allowed in this UPDES Infiltration Zone? (Infiltration is NOT allowed in UPDES Zones 1 & 2.)

The references in the Resources section are encouraged for determining the feasibility considerations above.

The report must be submitted by **March 28th, 2024**. Design reports are to be **directed via email** to isws.usu.2024@gmail.com, with the **subject line filled as follows: Design Report_Environmental Design - [Institution Name].**

Site Specifications

Latitude & Longitude: 41°49'34.4"N 111°47'48.6"W
Area: 520,624 square feet or 11.95 acres
Storm depth: 0.45 in
Estimated road dimensions: approximately 2100’ long, 36’ wide
40 Lots, with average building footprint of 2,000 sq ft
1 neighborhood park, 2.0 acres



Judging Criteria

Student teams will be evaluated by a panel of water quality professionals that will pose as the hypothetical development team, Rufous United. The judges will evaluate the applicability of design selections to the local environment. The poster will be evaluated based on aesthetics and visual communication of design. The presentation will be evaluated based on communication of design benefits and consideration of real-world application. The design criteria, sustainability, and design communication will be evaluated based on the parameters below.

PARAMETER	SCORE
Pollutant Removal	Lowest overall concentrations post-infiltration wins 20 points, 2 points will be subtracted per place thereafter.
Infiltration Rate	Falls within Utah LID Guide minimum and maximum values (between 0.25 in/hr and 6 in/hr), 10 points. Does not meet infiltration rate requirements, 0 points.
Feasibility Assessment	All four categories of feasibility considered,10 points. Three categories, 7 points. Two categories, 4 points. Zero categories, 0 points.
Sizing Calculations	1 point for correct volumetric runoff coefficient, 2 points for water quality volume, 2 points for minimum area
Cost Estimate	5 points for comprehensive cost estimate, 3 points for partial estimate, 0 points for no estimate.
Plant Species Selection	Plant selection best suited to the application wins 10 points. 1 point will be subtracted per place thereafter.
Sustainability	Best benefits for people, planet, and profit will win 10 points. 1 point will be subtracted per place thereafter.
Poster	Best poster wins 10 points. 1 point will be subtracted per place thereafter.
Presentation	Best presentation wins 10 points. 1 point will be subtracted per place thereafter.

Scoring Summary Table

FINAL COMPREHENSIVE SCORING	
Pollutant Removal	/20
Infiltration Rate	/10
Feasibility Assessment	/10
Sizing Calculations	/5
Cost Estimate	/5
Plant Species Selection	/10
Sustainability	/10
Poster	/10
Presentation	/10
Subtotal	**/90**

Resources

1. 1. Utah Department of Environmental Quality, A Guide to Low Impact Development Within Utah, Detail BR-2 Bioretention Cell. (https://documents.deq.utah.gov/water-quality/stormwater/updes/DWQ-2019-000161.pdf)
2. USDA Web Soil Survey. (https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx)
3. Utah Department of Environmental Quality Interactive Map Viewer, UPDES Storm Water Recharge Zones (https://enviro.deq.utah.gov/)
4. Utah State Center for Water-Efficient Landscaping (https://extension.usu.edu/cwel/plants)

Request for Information (RFI)

Requests for Information (RFI) are to be **directed via email** to isws.usu.2024@gmail.com, with the **subject line filled as follows: RFI_Environmental Design - [Institution Name].**

Official responses will be sent to the individuals requesting the information, as well as collectively uploaded onto the ISWS 2024 website for further viewing leading up to the day of the event. **The final cut-off date for submitting an RFI is March 29th, 2024.**