Air & Waste Management Association
Upper Midwest Section

Environmental Challenge
…a student team competition

2017 PROTOCOL

General Description

The Environmental Challenge is being sponsored by the Air & Waste Management Association - Upper Midwest Section (AWMA-UMS) and Central States Water Environment Association (CSWEA) - Minnesota Section, as part of their annual joint Conference on the Environment (COE). The COE will be held on November 8, 2017 at the Minneapolis Convention Center in Minneapolis, Minnesota.

The Environmental Challenge (EC) is an undergraduate student team competition to prepare and present an optimal solution to a complex "true-to-life" environmental problem. The problem presented will be of current value, representative of the location of the event, and require multidisciplinary approaches for success. The EC seeks not only technical and scientific analyses, but solutions that are presented in conjunction with the development of appropriate regulatory approaches and resolution of political and community issues.

The goals of the EC are to:

- Involve students in the annual Conference on the Environment
- Provide experience in solving complex environmental situations in a fun and supportive atmosphere
- Provide students an opportunity to display their talents
- Offer students the chance to network with environmental professionals and to find internship and job opportunities

The EC is designed to promote formation of student teams with the broadest feasible range of environmental disciplines including engineering, planning, policy, economics, and other sciences. Just as corporations and other organizations pull together teams from their staff to most effectively address any given project, so too should each student team by identifying and recruiting representatives from appropriate disciplines as needed to address the problem holistically.

Teams must research the problem background, as well as the technical, social, economic, and political aspects of the situation. Teams must stay apprised of ongoing events related to the problem so they can adjust their solutions appropriately leading up to and during the COE.

Although winning solutions to the problem must have sound engineering and technical bases, the solution does not require a full engineering design presentation. Similarly, the problem poses economic and political issues that will be addressed in a qualitative manner. Solutions are expected to provide reasonable resolutions applying basic engineering and scientific knowledge to research scenarios and critical questions.

Preparation of broad background knowledge of the challenge topic will be the key to a successful competition. At the COE, A&WMA and CSWEA conference attendees and professionals in the environmental field will be identified and available for students to approach with questions and to consult

for opinions. Students should approach conference attendees and exhibitors to identify additional individuals with expertise that is germane to the EC problem. The conference offers a great networking opportunity and the EC problem provides an excellent topic for discussion and networking. The environmental professionals provide a key interaction for the EC participants by offering direct feedback on their solutions, asking questions to prepare the students for the project presentations, and enhancing the student networking experience at the COE.

Award

Team solutions are scored and the anticipated awards for the EC are as follows:

1st Place: $1,500

2nd Place: $1,000

3rd Place: $500

Eligibility

The EC competition is open to all **undergraduate** students.

Students must register in advance for AND attend the conference to participate in the competition. The conference cost is $25 for students. This conference fee includes lunch, access to conference sessions when teams are not participating in the EC activities, and a one-year student membership in either A&WMA-UMS or CSWEA Minnesota Section.

Student teams may not contain more than five members and are generally comprised of three to five individuals.

Expectations for Proposed Problem Solutions

Solid technical analysis, logic train, process, conceptualizations, and creativity are all important to the solution and the content of your presentation. Successful teams will offer a clear and concise presentation of their solution and the rationale behind the elements of the solution. Your team will need to make reasonable assumptions as part of the solution. The assumptions must pass the "straight-face" test. This is (almost) the real world!

Challenge Elements

Team deliverables will consist of the following three elements:

1. Written solution submitted prior to the conference
2. Table-top presentation at the conference
3. Formal presentation at the conference

Any element excluded from a team's design solution will result in a score of zero for that element.

Written solutions will be submitted prior to the COE. The table-top and formal presentation will be made at the conference.

Written Solution:

Each team must submit, via email to Eric Miller at emiller@sehinc.com, a written solution by November 3, 2017. The solution should summarize the problem issues and the team's approach to the problem. The

solution must identify each team member by name and the role they will have in the presentation (e.g., "Sally" is the Wastewater Engineer and will address wastewater issues, "Jim" is the Project Manager, "Dave" is the Water Engineer, etc. Include the disciplines that you think you need). The written solution shall not exceed five pages. Supporting documentation, such as detailed analyses, should be referenced as necessary and may be a part of the Table Top presentation in the form of tables and graphs. Please limit appendices to the written solution to 10 pages.

Written solutions submitted after the due date will still be considered. A reduction of 10% will be added to the score for the written element for late submissions.

Table-top Presentation:

Each team must prepare and bring a table-top presentation of the solution to the COE. The goal of the table-top presentation is to give teams the opportunity to present their solution and receive feedback in an interactive manner with the conference participants. Conference participants will also be scoring the table-top presentations.

EC TABLE-TOP GUIDELINES

1. The entire team is asked to be present for the table-top presentation at the COE. A tabletop presentation is a required element for a design solution.
2. Each EC team will be assigned one 8-foot folding table in the Environmental Challenge room.
3. Your table-top materials should be prepared so that they may be arranged easily on the table. There is no prescribed format for the table-top materials, but they MUST include the title and the full team listing.
4. Figures, graphs, and tables should be uncluttered and simple and arranged in the sequence in which you want them to be viewed. The written report should be prepared in Microsoft Word with analyses in Microsoft Excel (or the equivalent), with a good quality printout of hardcopy materials. Materials may also be presented on a laptop provided by the student team. Text and figures should be large enough to be read from a distance of six feet. Color may be used for emphasis.
5. Team members should be prepared to brief conference participants as they visit the team table. The brief should summarize important assumptions and conclusions and clearly articulate proposed solutions to the challenge problem. A limited number of copies of the written solution should be available for distribution to interested individuals. Additionally, creativity is important in making your solution stand out. Hand-outs and other exhibits may be used to further advertise your table-top presentation.
6. A brief orientation meeting will take place prior to the Student & YP Mentor Breakfast. The orientation meeting will take place between 7:30 and 8:00 a.m. in the table top presentation room.
7. Table-top setup will judging will take place after the key note speaker address, from approximately 10:00 - 12:00 a.m. EC participants must be available to interact with the judges during the entire table-top judging period.

Formal Presentation:

Teams will provide a formal presentation of their problem solution in the afternoon to a panel of judges who are environmental professionals. The presentation should incorporate information that may have been gained during the table-top interaction. Presentation order will be chosen randomly.

A computer and projector will be provided for the presentation (with Microsoft PowerPoint). Please bring your presentation on a data stick or disk to be transferred to the computer. Plan for no more than a 15-minute presentation followed by five minutes of questions and answers.

Presentations will be judged by a panel identified prior to the COE – the panel will meet at the COE to determine top solutions.

Scoring and Awards

The winning team presentation will be strong in approach, logic, clarity, application, and creativity. Combined scores from the written solution, table-top presentation, and formal presentation will be used to determine the winning teams.

The top three teams will be announced at an Awards Ceremony at the end of the conference.

EC Timeline Summary

EC teams are required to attend an EC orientation meeting at 7:30 a.m. the day of the conference. This meeting will be held to review the EC problem and procedures, introduce judges, and answer general EC presentation questions. Check in at the Student Welcome Booth for room information.

Milestone	**Date/Time**
Teams Provide Intent to Participate	October 13, 2017
Written Proposals Due by E-mail to Eric Miller	November 3, 2017
EC Orientation Meeting at the COE	November 8, 2017 – 7:30 a.m.
EC Table-Top Presentation Setup at the COE	November 8, 2017 – 7:30 - 8:00 a.m.
EC Table-Top Presentation/Interaction at the COE	November 8, 2017 – 10:00 - 12:00 a.m.
EC Formal Presentations at the COE	November 8, 2017 – 1:00 - 3:00
EC Awards Ceremony at the COE	November 8, 2017 – 4:30

*Schedule is subject to changes to accommodate number of teams participating.

Questions should be directed to:

Eric Miller

emiller@sehinc.com

651.765.2913

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2017 PROBLEM STATEMENT

Introduction

You are the consulting engineering hired by the fictional community of Midwest, Minnesota. The community of Midwest has selected your team to assist in solving a water quality based wastewater discharge problem. You are to plan a construction project that will upgrade the city's wastewater treatment plant to meet new and changed conditions. Please Refer to the attached map of the treatment plant as the problem is described.

Midwest is a community of 5,500 residents. Midwest is a lively rural community with several meat processing facilities, small produce and dairy processors that send their untreated wastewater to the city's plant for treatment and discharge. The flows and loadings on the plant are included in the reported current flows and loads on the plant as described below.

The plant site is in close proximity to residences. Visual impacts and other concerns such as odor, noise, and traffic have been discussed in the past and will continue to be in the future.

Wastewater treatment plant upgrade projects are designed for a 20-year expected life, which means that 20-year forecasts of flows and loadings are used to determine the capacity needs of the upgrade.

Growth for the community is anticipated to add another 500 residents over the 20 year design period, with an additional 200 population equivalents added for future commercial and industrial growth.

The existing wastewater treatment facility was constructed in the last 1970's. Because of the age of equipment, the facility has exceeded its useful design life. The existing basins are in serviceable condition and may be reused as needed.

The community has been addressing inflow and infiltration in the collection system in recent years and its effect on the peak flows received at the plant during rain and runoff events. The additional 700 residents (actual +equivalent) will increase peak flows to the plant without creating additional inflow and infiltration. The peak flow increases will result from typical diurnal variations in daily flow.

The wastewater treatment facility (WWTF) at Midwest currently discharges to Raccoon Creek, which ultimately flows into Green River. Green River has been added to the State's impaired waters list, resulting in the need to impose new and more stringent discharge limits to the Midwest WWTF discharge permit.

The current discharge limits are:

CBOD5 (Carbonaceous Biochemical Oxygen Demand = 25 mg/l

TSS (Total Suspended Solids) = 45 mg/l

Total phosphorus = 5 mg/l

The new limits are proposed to be:

CBOD5 = 5 mg/l

TSS = 45 mg/l (unchanged)

Total phosphorus = 0.35 mg/l

The City wastewater staff have previous work experience operating chemical phosphorus precipitation and biological phosphorus removal treatment processes. Because of this experience, Midwest is interested in evaluating both treatment alternatives to meet the new phosphorus effluent limit.

Your first step – the object of this Student Challenge – is to conduct planning. You are to study the alternatives for meeting the new discharge limits under the new 20-year design flows and loadings and propose a recommended plant upgrade, including an estimate of the construction cost of the upgrade and annual operating costs.

For the purpose of this step, solids handling (i.e., the treatment and disposal of solids residuals from the liquid treatment processes) does not need to be sized for treatment, but may be considered for energy recovery.

Please use the following information in your assumptions.

Midwest WWTF – Facility Description

Existing flows and loads:

- Average dry weather: 0.36 mgd
- Average wet weather flow: 1.25 mgd
- Peak hourly wet weather flow: 4.00 mgd
- Average $cBOD_5$ loading: 1,900 pounds per day
- Average TSS loading: 1,250 pounds per day
- Average total phosphorus loading: 50 pounds per day
- MLSS concentration: 3,000 mg/L
- Yearly operating cost: $450,000 (excludes solids handling)

Major treatment processes:

1. Pretreatment (four influent pumps, screening, girt removal)
    a. Replacement of existing equipment and operation and maintenance should be considered. Consideration for sizing to meet future flows is not required.
2. Primary clarifier (2 basins, 35 ft dia, 16 ft deep)
3. Aeration basins (Activated sludge) (2 basins, 65 ft long, 20 ft wide, 10 ft deep)
4. Final clarifiers (3 basins, 35 ft dia, 12 ft deep)
5. Chlorine contact basin (contact channel volume 5,500 ft^3)

Other Conditions

The community of Midwest has been implementing a sustainable development plan developed for the community. A portion of the plan includes evaluating City infrastructure and services for energy efficiency and environmental impact. As part of the alternative evaluation the City has asked that the consulting firm provide an evaluation for energy consumption and potential environmental impacts for each alternative considered.

You are to prepare information about the proposed upgrade and costs that will be presented at a public information meeting. At a minimum, the following information needs to be presented:

- Description of the proposed upgrade.
- Capital and operating costs.
- Average user charge for a typical household.
- Energy considerations (i.e., what portion of the operating costs will be associated with electric demand and how might these costs be reduced).
- Air emissions, odors, and nuisance noises (i.e., the locations and processes at the plant with odor potential and how odors will be controlled).
- Ideas for gaining public acceptance of the project, particularly from plant neighbors.

Resources

Texts

- Water Supply & Pollution Control by Viessman, Hammer, Perez, and Chadik. Published by Pearson Prentice Hall, Upper Saddle River, NJ.
- Introduction to Environmental Engineering by Davis and Cornwell. Published by McGraw Hill, New York, NY.
- Wastewater Engineering Treatment and Reuse by Metcalf and Eddy. Published by McGraw Hill New York, NY.
- Tertiary Phosphorus Removal by Neethling, Smith, Moller, Lancaster, Pincince, and Zhang. Published by Water Environment Research Foundation, Alexandria, VA.
- Design Manual Phosphorus Removal by United States Environmental Protection Agency, EPA/625/1-87/001.
- Advanced Wastewater Treatment to Achieve Low Concentration of Phosphorus by United States Environmental Protection Agency, EPA 910-R-07-002.
- The Northeast Guide for Estimating Staffing at Publicly and Privately Owned Wastewater Treatment Plants by New England Interstate Water Pollution Control Commission. Published by New England Interstate Water Pollution Control Commission, Lowell, MA.

Helpful Websites for Tools and Information:

- Great Lakes – Upper Mississippi River Board, 10 States Standards (GLUMRB) Water and Wastewater Standards http://www.10statesstandards.com/
- Minnesota Pollution Control Agency, Filtration – Review Checklist https://www.pca.state.mn.us/sites/default/files/wq-wwtp5-25.pdf
- Minnesota Pollution Control Agency, Chemical Addition – Review Checklist https://www.pca.state.mn.us/sites/default/files/wq-wwtp5-14.pdf
- Minnesota Pollution Control Agency, Biological Treatment Checklist – Suspended Growth – Activated Sludge, Oxidation Ditches https://www.pca.state.mn.us/sites/default/files/wq-wwtp5-10.pdf

Your Scope of Work

The City wishes for you to prepare a presentation that illustrates your alternative evaluation with:

- Maps and drawings.
- Evaluate existing facilities and proposed facilities for flow and load conditions.
- Description of all pertinent details of the recommended alternative.
- Consider capital and operating costs using life cycle cost analysis.
- Explain cost comparisons, cost decisions (advantages or concessions)
- Summarize technical pros and cons.
- Provide final recommendations.

Where you will need to make assumptions, please clearly state your assumptions. A thoroughly considered project should address:

Thanks for participating. Good luck – we await your proposal with great anticipation!