California Water Environment Association
Protecting our water environment through education and training.

2009 From Your Kitchen … and Beyond

Water Treatment Competition

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Introduction

Welcome to the "From Your Kitchen… and Beyond" Regional Water Treatment Competition. This competition allows students to design and construct a water treatment system and then test it against other participating schools.

This year's theme deals with the neglected wastewater pipeline infrastructure that has not received the needed seismic upgrades and maintenance to prevent breaks and system failure during an earthquake.

Competition History

The ASCE student chapter at the University of California, Davis realized that student members interested in Environmental Engineering were left out of traditional Civil Engineering competitions, such as the Concrete Canoe and the Steel Bridge Competition. To challenge interested students, the UC Davis ASCE student chapter officers appointed an "Environmental Engineering Chair", who organized environmentally related activities. After two years of brainstorming and planning, the ASCE student chapter at the University of California, Davis hosted the First Annual Environmental Engineering Competition, titled "Water Treatment from Your Kitchen." Previously, the competition has been held annually, hosted each year by the school that won the competition during the previous year. This year though, the competition is being incorporated into the annual Midpac event and will be hosted by the college who is hosting Midpac, University of Nevada Reno. Past years winners and hosts are listed below.

Year	Competition Host	Winner
1998	U.C. Davis	University of Nevada, Reno
1999	University of Nevada, Reno	Humboldt University
2000	Humboldt University	U.C. Davis
2001	U.C. Davis	University of Pacific
2002	University of Pacific	Cal Poly State University, SLO
2003	Cal Poly State University, SLO	Oregon State University
2004	Oregon State University	University of Nevada, Reno
2005	University of Nevada, Reno	University of Pacific
2006	University of Pacific	University of Nevada, Reno
2007	University of Nevada, Reno	Sacramento State University
2008	Sacramento State University	U.C. Berkeley

Scenario

A major earthquake has just occurred in California's Bay Area, affecting San Francisco, Oakland, Berkeley, and other nearby cities. The Bay Area contains an extensive wastewater pipeline system that has failed during the earthquake due to a degrading infrastructure and a lack of flexible joints. Many pipes have broken releasing wastewater all over the cities.

Instead of each city coming up with its own solution to treat and release the spilled wastewater, an emergency government group, the Bay Area Disaster Mitigation Assessment Network, has been formed and funded to choose a solution for the whole Bay Area. You, the contractor, have been asked to design, build, and present a prototype of a treatment system that can be replicated and applied to each city at the pipe breaks. There are no limits to what may be used in the treatment system, but because of the economic situation funding is very limited and the cost of the system will be heavily weighed. Simplicity of design is very important because the system must be mass produced as quickly as possible. Also, there is available electricity, but the earthquake has caused rolling blackouts so electricity will not be always readily available. The prototype will tested by running ten gallons of contaminated water through the system in one hour.

Source: http://commons.wikimedia.org/wiki/Image:Chuetsu_earthquake-earthquake_liquefaction1.jpg

Materials

There are no restrictions on materials that can be used. Recycled materials are encouraged and will be taken into consideration in cost and sustainability. Electricity will be provided by a three-prong extension cord and will be supplied for thirty consecutive minutes starting when the team chooses. The team can supply their own electricity and will not be subject to the thirty minute limitation, but will still be penalized five points.

Cost Analysis

Each team is required to prepare a cost analysis for their design. The cost analysis will be presented to the judges as part of the presentation given during the competition. The cost analysis has two sections: material costs and operational costs. The total cost will be the sum of the material and operational costs. The team with the lowest total cost will be awarded the most points (45). Teams with successively higher total costs will be awarded successively lower points (i.e. 2nd place: 40, 3rd place: 35, etc.)

Material Costs

Summary:

The material costs should include the price of all materials used in the design. Any donated materials used need to be included in the material costs as if the materials were bought new. Any recycled materials used need to be included in the material costs at half the new cost of the material. The material costs should not include the costs of tools used during pre-fabrication.

Detailed instructions:

As a contractor, it is critical that the cost of your design be minimized. All material costs must be included in your cost analysis since your design team is presenting a prototype which must eventually be replicated. While your design team can receive donations of materials to construct the prototype, the cost of donated materials must be priced as if they are new in the cost analysis since during mass-production donations could not be expected. Note: The "new" cost of new or donated materials needs to be estimated as if someone went to a brick and mortar store and purchased the material when the material was not on sale. The use of recycled materials is strongly encouraged to increase the sustainability of the design and reduce cost. "Recycled" materials are any materials bought from salvage, recycling centers, scrap yards, junkyards, etc. The recycled materials used should not be rare or unique pieces which could not normally be found as recycled material. The reported cost of recycled materials will be half the "new" cost, regardless of the price paid by the competition team. If during the competition any material(s)

appear to be priced well below a brick and mortar store price or its corresponding recycled price, the judges may discuss it amongst themselves and increase the price of the material(s) to what they deem a normal brick and mortar store price or its corresponding recycled price. The tools used for construction before the competition (pre-fabrication) do not need to be included in the material costs.

Example:

Material	Status	Cost (US dollars)
Sprocket	New	$10
Sprocket	Donated	$10
Sprocket	Recycled	$5
Drill	Tool for pre-fabrication	$0

Operational Costs

Summary:

The operational costs should include the price of all tools required for assembly during the one hour setup time and any materials which are "consumed" during the competition. Chemicals, batteries, etc are considered "consumed" during the competition and should be included in the operational costs. Chemicals used during the competition need to be priced as cost per 10 gallons of water treated. Electricity from the provided plug (a.k.a. utility hookup) does not need to be included in the operational costs.

Detailed instructions:

In addition to considering the material costs, it is important to ensure the operational costs of the design are minimized. The operational costs should include the price of all tools required for assembly during the one hour setup time. Teams are encouraged to pre-fabricate as much of their design as possible to reduce their operational costs. Teams are encouraged to maximize sustainability and by not using consumable materials; but if the teams decide to use consumable materials, they must include in the operational costs the price of any materials which are "consumed" during the competition. Materials are considered "consumed" during the competition if they are completely or partially irreversibly used up. Chemicals and batteries are considered consumed during the competition unless the design team can prove how the chemical or battery could be restored through their design. (i.e. if a design team demonstrates that energy captured from falling water recharges the batteries sufficiently that the batteries are never completely consumed, then the cost of the batteries does not need to be included in the operational costs.) Chemicals used during the competition need to be priced as cost per 10

gallons of water treated. Electricity from the provided plug (a.k.a. utility hookup) does not need to be included in the operational costs.Example

Material	Status	Cost (US dollars)
Sprocket wrench	Tool used in setup	$5
X-cell battery	Consumable	$2
Pressurized Tibanna gas	Consumable	$20/10 gal

Influent Constituents

The following materials will be mixed with ten gallons of tap water the night before the competition to simulate the wastewater. The contaminated water will be placed in two five-gallon buckets and the team will have ten minutes to pour the water into their system. To compare the untreated and treated water, an untreated water sample will be used as a control.

Table 1: Contaminant Constituents

Contaminants	Amount per 10 gallons
Creamed Corn	8.75 oz can of corn
Kaolinite Clay	4 oz
Leaves	6 oz
Canola Oil	4 oz
Ground Beef	0.5 lbs
Pre-made Jell-O	2 packs
Lemon Juice	4 oz
Soil	0.5 lbs
Rusted Chicken Wire	<= 5 in^2

Notes: Pre-made Jell-O will be two packets of Jell-O made according to the instructions on the Jell-O packet, then once fully congealed will be added to the ten gallons of water. Rusted chicken wire will be multiple pieces of chicken wire cut so they are no greater than 5 in^2, buried in wet unsaturated soil for one week, unearthed, and added to the untreated water.

Scoring

The winner of the competition will collect the most points based on the below criteria.

Table 2: Judging Criteria

Criteria	Points
Design	50
Cost	Lowest 45
Total Volume Recovered	20
First to Recover Two Liters	Shortest Time 10
Electrical Conductivity	Lowest 15
pH	Most neutral (pH=7) 15
Turbidity	Lowest 15
Dissolved Organic Carbon	Lowest 15
Dissolved Oxygen	Highest 15
Interaction Deduction	-10 for non-electrical, -5 for electrical
Presentation	20
Total	220

Technical Design

The best design will be decided by a panel of judges experienced in the field of water quality engineering. Factors taken into consideration for the design score are simplicity, sustainability, efficiency, relevance, creativity/theme, and structural and operational durability We strongly encourage the full name of the college to appear on the design or a banner or sign to be displayed next to the design.

Questions for design teams to consider each factor:

Simplicity: Is the system easy to assemble and operate?

Sustainability: What resources are used and waste generated by the system? Are the materials used safe for humans and the environment? Could any materials used contribute contaminants in

the future? What is potential for recycling the system components at the end of its functional lifetime?

Efficiency: Are the minimum resources used to the maximum effect?

Relevance: Does each component of the design have a clearly defined function?

Creativity/theme: Does the system make novel use of engineering principles? Does it show school spirit?

Structural and operational durability: Can the system function more than just once? Is the system sturdy?

Total Volume Recovered

The team that recovers the most of the initial ten gallons will receive the most points and the other teams will receive a fraction of the points equal to the fraction Volume Recovered/Most Volume Recovered.

First to Recover Two Liters

The team that recovers an initial two liters in the provided container the fastest will receive an extra 10 points.

Water Quality Parameters

Electrical conductivity, pH, turbidity, dissolved organic carbon, and dissolved oxygen will be measured using instruments provided by University Nevada Reno. Points will be awarded as listed in Table 2 with the design with the best measurement for each water quality parameter receiving full points for that parameter. For each parameter, remaining designs will receive a fraction of the points fewer than the maximum possible.

Interaction Deduction

Your team will have ten minutes to load your system with the ten gallons and then you must let it run without any human interaction, which means keep outside the 100 square foot (10'x10') treatment area. If the system is altered by a team member then there will be a ten point deduction. If your team decides to use the provided electricity then there will automatically be a five point deduction.

Presentation

Each team will give a ten-minute presentation on the team's design process and a five-minute question and answer period afterwards. The presentation at a minimum should include the overall project description, design process, detailed description of treatment principles used, environmental impacts, and cost analysis. Professionalism is encouraged. The presentation scores will be determined by a panel of judges experienced in the field of water quality engineering. The following will be available for use: Laptop with PowerPoint, TV, DVD/VCR, and a LCD Projector.

If using PowerPoint, be sure the presentation file is in PC format copied on a CD or USB-type storage device. Bring more than one copy of the presentation disk for backup. Please inform the competition committee of any additional needs that your team may have.

General Rules

1. Each team will receive 10 gallons (~38 liters) in two 5-gallon buckets of the contaminated water at their source area.
2. A maximum of 1.0 liter of tap water will be allowed in the system to be used as a primer. This water will be added during the inspection period.
3. Teams must physically introduce all of the raw water into their system within 10 minutes from the time they start.
4. The first two liters of effluent will be collected in a 2-liter container and then poured into the collection system.
5. Any design that violates the set rules will be disqualified.
6. Any design that is deemed dangerous or hazardous to the competitors, judges, or bystanders will be automatically disqualified.
7. Teams that interact with their system after the start of the hour treatment phase will be penalized 10 points for each interaction. Please see the Interaction Deduction in the previous section.
8. The winning team will write the next year's competition's rules. If the winning team is unable to write the rules then the second place team will be awarded the honor.

Time Constraints

After the initial delivery of the systems to each team's designated area, each team will have one (1) hour to setup their treatment and conveyance systems. Judges will then start to evaluate designs for rule conformance and treatment scoring. Available conveyance and treatment time will be one (1) hour.

Site Plan

The site plan to be used for the competition can be seen below: NOTE: Site plan is not to scale; all labeled dimensions are in feet. Two 5 gallon buckets will be placed inside the 10' x 10' treatment area.

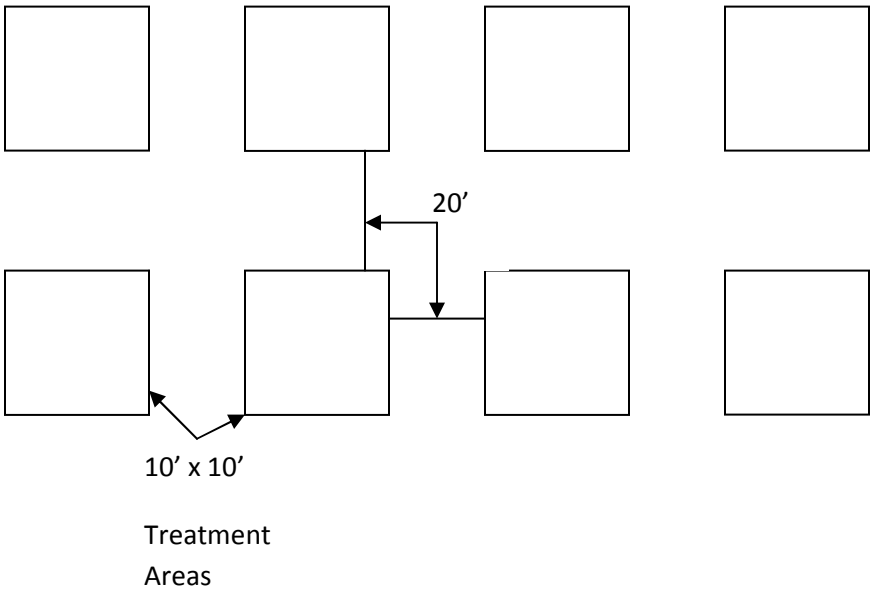

Figure 1: Site Plan

Questions and Competition Date

Questions and concerns about rules will be addressed by Nate Butler (butler@berkeley.edu) or Johnny Mendoza (johnnymendoza@berkeley.edu). Competition date and schedule can be viewed at www.midpac2009.com