



AMERICAN SOCIETY OF CIVIL ENGINEERS

**Environmental Competition**

**April 6-8, 2017**  
**hosted at University of California Irvine**

## Summary

The ASCE Environmental Competition is an undergraduate project that gives students with civil and environmental engineering and related majors a chance to gain hands-on experiences with the research, design, and lab testing involved with water treatment principles as well as an opportunity to develop professional skills such as technical writing and presenting. Teams from 19 schools in the Pacific Southwest Region participate in this competition to design a filter to treat standardized storm water based on the scenario presented in the competition rules.

This project is judged based on (1) filter construction, (2) water quality results, (3) a design report, and (4) a poster. Students are encouraged to work closely with university faculty and local engineering professionals to create a practical and innovative method of addressing the problem stated.

## Participant Rules

- Each university may enter only one team.
- Each team must be comprised of 4 members
- Everyone on the team must be a registered participant of PSWC 2017
- The team must have at least one underclassman.
- The team must have at least one female

## Scenario

While living in southern California, your city has just become the victim of a terrible earthquake. Your city is unrecognizable with heavily damaged infrastructure and underground piping systems. Your house was destroyed as were the neighboring houses. Fortunately, the nearest high school gymnasium was built to withstand earthquakes and was therefore used as a shelter after the earthquake hit. Your family and neighbors have moved into the gymnasium. Although you have been provided with food, bottled water, and medical supplies from the school, you realize that showers and the ability to hand-wash clothes are not easily accessible because the tap water supply isn't working due to plumbing damage.

After one week living at the gym, there is still no water, and there is an estimated three more weeks before relocation due to damaged highways. You go out back to investigate the quality of the water from a storm drainage channel behind the building. The water is worse than usual because it has been polluted with the debris from fires caused by the earthquake, and it

is the only nearby water source that is easily accessible for continuous use. You have background in water resources engineering and decide to gather a group of friends to design a reusable water treatment filter so people in need will have access to some clean water for bathing and washing laundry over the next few weeks.

### Inlet Water Constituents

Two (2) 5-gallon buckets total will be prepared for each team. All constituents will be added and stirred -with a wooden stir stick 24-hours prior and then stirred again 5-minutes before the filter loading phase.

#### Per 5-gallon bucket:

- Miracle-Gro Potting Mix (500g)
- Great Value Iodized Salt (58g)
- Great Value Vegetable Oil (1 cup)
- Fleishman's Active Dry Yeast (20g)
- Kingsford's (Argo) Corn Starch (96g)
- Hawaiian Punch Fruit Juicy Red (2 cups)
- Great Value Apple Cider Vinegar (1 cup)

### Water Quality Testing

Immediately after filter construction and loading, the final treated water will be tested using university laboratory equipment. The following six (6) water quality parameters of your final treated product will be graded based on the scoring methods described below. The water quality section is worth 30 points.

#### pH Value

**Target:** Between 6.75 and 7.25

#### **Grading:**

$6.75 \leq \text{pH} \leq 7.25$			will result in 5 points
$6.25 \leq \text{pH} \leq 6.75$	or	$7.25 < \text{pH} \leq 7.75$	will result in 4 points
$5.75 \leq \text{pH} \leq 6.25$	or	$7.75 < \text{pH} \leq 8.25$	will result in 3 points
$5.25 \leq \text{pH} \leq 5.75$	or	$8.25 < \text{pH} \leq 8.75$	will result in 2 points
$4.75 \leq \text{pH} \leq 5.25$	or	$8.75 < \text{pH} \leq 9.25$	will result in 1 points

All other pH values outside of these ranges will result in 0 points

### Turbidity

**Target:** Minimum NTU (Nephelometric Turbidity Unit)

**Grading:** (Your rank /best team's rank) \* 5 points

### Electric Conductivity

**Target:** Minimal  $\mu\text{S}/\text{cm}$

**Grading:** (Your rank/best team's rank) \* 5 points

### Volume

**Target:** 9 gallons

**Grading:** (Your effluent volume (gal) / 9 gallons) \* 5 points

Please note that there is a maximum of 5 points allotted for volume. It is conceivable, however unlikely, that a team could have a volume greater than 9-gallons; in that case, they would still only receive 5 points.

### Total Free/Available Chlorine

**Target:** 4 ppm

**Grading:** (your rank/ best team's rank) \* 5 points

### Dissolved Oxygen

**Target:** 100% DO

**Grading:**

100% DO			will result in 5 points
$90\% \leq \text{DO} < 100\%$	or	$100\% < \text{DO} \leq 110\%$	will result in 4 points
$80\% \leq \text{DO} < 90\%$	or	$110\% < \text{DO} \leq 120\%$	will result in 3 points
$70\% \leq \text{DO} < 80\%$	or	$120\% < \text{DO} \leq 130\%$	will result in 2 points
$60\% \leq \text{DO} < 70\%$	or	$130\% < \text{DO} \leq 140\%$	will result in 1 point

All other DO values outside of these ranges will result in 0 points.

### **Design Report**

Each team is required to submit a design report detailing the overall project and must include a description of the design process, treatment principles utilized, environmental impacts, and a cost analysis. The design report is worth 25 points. Please submit an electronic version of

your report (in PDF format) via email to [asce.uci.conference@gmail.com](mailto:asce.uci.conference@gmail.com) with the subject line “Environmental Competition Design Report – [YOUR SCHOOL NAME]” by no later than 11:59 PM on March 6, 2017. A hard copy submission is not required.

### Formatting

One (1) point will be deducted from the team’s report score for each violation:

- **Report Cover Page:** Must contain school name, team name, and competition name: “2017 ASCE PSWC Student Water Treatment Competition
- **Table of Contents:** Limited to a total of one (1) page.
- **Body of Work:**
  - Must be a minimum of 1000 words
  - May not exceed eight (8) pages
  - Use 12- point font, single spaced, and 1 -inch margins on all sides
  - Apart from heading, Times New Roman or Arial font must be used, and the text shall have normal width character spacing
  - Headings may be of any font, size, or color
  - Body pages shall be numbered, beginning with ‘1’
  - Captions used for any photographs, tables, line drawings, graphs or other figures shall have normal width character spacing and be no less than 10- point font.
- **Appendices:** Pages shall be numbered in such a way that the appendix and page number are clearly listed (i.e. A1, A2, B1, B2, etc.) There is no limit to appendix length, but it must only contain relevant materials.
- **Paper:** The Body of Works shall be presented on 8 ½” x 11” with portrait- oriented pages. Appendices shall also be presented on 8 ½” x 11”; however they may include landscape- oriented pages.
- **Miscellaneous:**
  - Photographs, tables, line drawings, graphs, headers, and footers shall be permitted and shall be counted as part of the page limits defined above.
  - A list of references or works cited should be included (if necessary), and will not count towards the report page limit.

### Body of Work Content

The design report must include the following content. The point distribution for grading of each section is denoted in parenthesis.

- **Filter Discussion (15):** The body of the design report shall contain an overview of the filter and how it works. The filter design will be judged based on the approach each team used to solve the problem as well as the industry treatment principles implemented in the design process. This section must include clear descriptions of test results, engineering design processes, and the filters success in achieving the water quality requirements. Any advisors on the project shall be recognized.
- **Cost Analysis (3):** The design report must include a cost analysis, and teams will be ranked based on lower cost estimate.
- **Sustainability (4):** The design report must include an explanation of the sustainability aspects of your filter. This section may include the environmental impacts of materials used to design your filter and decisions made regarding choices to minimize cost or reduce environmental impact.
- **Professional Quality (3):** Professional quality of the design report will be based on organization, appearance, and use of language.

### Construction and Loading

Team will construct their filter design as shown on their technical report. This phase will include construction, filter loading, and transportation of effluent to the testing lab. This section is worth 20 total points, and will be judged based on construction time, cost of treatments system, orderliness of construction site, and overall teamwork – see scoring and deduction methods described below as well as the breakdown of competition scoring on page 7 for the point distribution.

### Site Constraints

The teams will be given a 10' x 10' area to construct their filters defined by lines on the floor. The site limits will be measured from the inside of the boundary marker. Neither materials nor participants may exceed the boundaries of the area. All sites will be located on level concrete or another hard surface. Teams will be scored on their utilization of the space, the orderliness of the site during construction, and the operators' safety and overall teamwork.

### Time Constraints

Teams will be timed on the construction of their filters. Each team will be limited to a total of thirty (30) minutes in which to construct the treatments systems. The treatment phase will follow and includes ten (10) minutes for teams to load their systems and a twenty (20) minute treatment period. The collection basin must be removed from the treatment system immediately following the treatment phase.

### Construction Details

- Teams will construct their systems in a 10' x 10' space. Site limits will be based on the inside of the placed markers, using a marking tape.
- Teams will place all their unassembled raw materials and tools in the competition area.
- Teams shall not pre-mark, pre-assemble, pre-cut or tamper with materials prior to beginning of the construction, although decoration is encouraged. In order to mark any materials, teams must provide their own markers, tape, measure, measuring cups, and scales, on an as-needed basis. Teams should include marking materials in the cost analysis.
- Powered saws or power blades are not permitted.
- Battery-powered tools are permitted, with the exception being the items listed in the above detail. Corded power tools of any kind are not permitted.
- Teams must provide their own tools
- Teams may use up to 4 operators to construct their system. Construction time will start once the chief operator says "ready" and the judge will start the clock. Construction time will end once the chief operator says "stop" and the judge will stop the clock
- Once the chief operator says "stop" teams may not re-enter the construction region, until the filter loading phase
- Teams will be given a maximum of 30 minutes for the construction of the system

- Treatment systems must include a collection basin capable of holding 9 gallons of water.

### Treatment Phase

At a designated start time, the 10-minute loading period will begin, in which only 2 operators from each team may add any treatment chemicals to their effluent. A stirring stick will be provided. Operators must be outside of their construction site before the end of the 10-minute loading period. Teams will then have 20 minutes for the treatment system to work. The collection basin must be removed from the treatment system immediately following the 30-minute treatment phase.

### Scoring and Deductions:

The Construction category is worth 20 points out of the 80 total points in the competition. Construction points will be based on the construction time remaining (13 points), the cost of the treatment system (5 points), the orderliness of their site during construction (1 point), and the operators' overall teamwork (1 point). The orderliness of their site during the construction phase, and the operators' overall teamwork will be determined based on the judge's discretion.

Points for construction time will be awarded based on the following equation:

$(\text{Your rank} / \text{best team's rank}) * 13 \text{ points}$

Deductions affect the overall "Construction" subcategory score.

- Any violation of construction limits will result in a 1 point deduction (i.e. each time an operator or a construction material goes outside the 10ft. x 10ft. boundary during the construction phase, 1 point will be deducted).
- Any pre-marked, pre-assembled. Pre-cut or tampered materials will result in a 1 point deduction
- 1 point deduction for any time an operator begins construction prior to the judge starting the stopwatch
- Usage of powered saws or powered blades will result in a 5 point deduction.
- Teams using more than 4 operators will be asked to dismiss the extra operators; ignorance of this request will result in the team's disqualification.
- A point will be deducted from the team's construction score for every time a worker or material touches or enters into the site boundary during the treatment phase.

Note: It is not possible to lose more than 15 points. **Clear violation of ethical practices, based on the judge's discretion, will result in disqualification of the team.**

### Cost of Treatment System

The cost of the treatment system is worth 5 points. The lowest cost treatment system will receive the most points.

Points will be awarded based on the following equation:

$(\text{your rank} / \text{best team's rank}) * 5 \text{ points}$

### Safety

Safety is a vital part of this competition. Operators **must** wear heard hats, safety gloves, safety glasses, close-toed shoes, and long pants at all times during the construction and treatment phases. If at any point the judge deems safety is being violated by a team, the team's construction will come to a halt and the judge will advise the team on best safety practices, while the stopwatch continues running. Any person handling chemicals must be wearing a long-sleeved shirt or other article of clothing to cover arms.

### **Poster Presentation**

Each team must display a poster board of dimensions no larger than 36" x 24" next to their work site. The posters will be judged by the parameters listed below. The point distribution for each is denoted in parenthesis. The poster section is worth a total of five (10) points.

Themes are encouraged.

- **Technical Content (2):** The poster must contain, at a minimum, the purpose of the competition, an overview of the filter design, the material list, and the filter cost.
- **Presentation / Q&A (2):** Immediately after the filter construction phase, at least one member of the team must be present to answer any questions about the poster and/or construction to a judge.
- **Professional quality (1):** Professional quality of the poster will be scored based on organization, appearance, and use of language.

Stands will not count toward the space limitation of the board. Additionally, teams will provide their own poster stands and/or any other equipment required to display the poster.

## Competition Scoring

Category	Sub- Category	Points
Water Quality	pH	5
	Turbidity	5
	Total free/ available chlorine	5
	Electrical conductivity	5
	Dissolved Oxygen	5
	Volume	5
	<b>Subtotal</b>	<b>/30</b>
Design Report	Filter design and analysis	15
	Cost analysis	3
	Sustainability	4
	Professional quality	3
	<b>Subtotal</b>	<b>/25</b>
Poster Presentation	Technical Content	2
	Presentation and Q&A	2
	Professional Quality	1
	<b>Subtotal</b>	<b>/5</b>
Construction	Construction time	13
	Cost of treatment system	5
	Orderliness of construction site	1
	Overall teamwork	1
	<b>Subtotal</b>	<b>/20</b>
<b>Total</b>		<b>/80</b>