

# 2024 Mid-Pacific Student Symposium Water Treatment Rules

**Presentation Date:** Thursday, April 4<sup>th</sup>, 2024

**Competition Date:** Saturday, April 6<sup>th</sup>, 2024

**Competition Location:** Sacramento State Campus, Parking Lot 10

## **Summary:**

The ASCE Mid-Pac Student Water Treatment Competition includes the research, design, presentation, and hands-on construction of a treatment filter made of supplies found in a hardware store. The filter is loaded with a standardized simulated wastewater to test and rank teams.

The competition allows civil and environmental engineering students to apply principles of water and wastewater treatment to develop design alternatives in a collaborative and empirical manner. It provides students an opportunity to develop leadership and project management skills and to increase awareness of technologies and opportunities in the water/wastewater fields by way of engaging with other students, faculty, and industry professionals on a practical design project.

## **Important Deadlines:**

- Registration – December 1<sup>st</sup>, 2023
- Questions and materials requests – March 1, 2024
- Design report – Submitted electronically by March 15, 2024 to [ascemidpac2024@gmail.com](mailto:ascemidpac2024@gmail.com)
- Presentation – Submitted electronically by March 29, 2024 to [ascemidpac2024@gmail.com](mailto:ascemidpac2024@gmail.com)

## **Contact:**

Any questions regarding the Water Treatment Competition may be sent to

Kira Williams

[ascemidpac2024@gmail.com](mailto:ascemidpac2024@gmail.com) (include WT in the subject line)

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## Scenario

In the distant future the world finds itself amid a zombie apocalypse. As societies collapse, governments crumble, and panic ensues, one thing holds true for survival: the necessity of clean and potable water.

Widespread infection has contaminated and compromised the local water sources. As a part of the last remaining human community, you and your group of fellow clean water experts must survive the chaos, develop creative solutions, and demonstrate your unrivaled mastery in treating water in the midst of this world-shattering event. Due to the scarcity of resources, your group only has an abundance of food grade chemicals available to sustain the treatment system.

The fate of humanity rests in your hands!

## Influent Constituents

Two (2) 5-gallon buckets will be prepared for each team. All constituents will be added and stirred 24 hours prior to competition and stirred again 5 minutes before the loading phase.

Per 5-gallon bucket:

Water	4.5 gallons
Activia Yogurt, Strawberry Flavor	1 – 4.0 fl oz container
Betty Crocker Fudge Brownie Mix	9.15 oz, half of an 18.3 oz box
Kool-Aid Tropical Punch Drink Mix (Powder)	2 cups
Quaker Quick 1-minute Oats	20 oz
Miracle-Gro Potting Mix	16 oz
Leaves (approximately 2 in x 3 in)	1 oz

## Competition Scoring

The point distribution for each section of the competition is listed below.

Table 1. Point breakdown summary

Category	Sub-category	Points
Water Quality	pH	10
	Turbidity	10
	Electrical Conductivity	6
	Volume	9
	<b>Subtotal</b>	<b>/35</b>
Design Report	Filter Design & Analysis	15
	Materials/Cost Analysis	3
	Sustainability	3
	Professional Quality	4
	<b>Subtotal</b>	<b>/25</b>
Construction	Construction Time	8
	Material Cost	12
	Construction Site Organization	3
	Overall Teamwork and Safety	2
	<b>Subtotal</b>	<b>/25</b>
Oral Presentation	Technical Content	4
	Oral Presentation	3
	Visuals	1
	Q&A Session	2
	<b>Subtotal</b>	<b>/10</b>
Poster	Technical Content	3
	Professional Quality	2
	<b>Subtotal</b>	<b>/5</b>
<b>Total</b>		<b>/100</b>

## Water Quality Testing (35 pts)

Immediately after construction and loading, the final treated water will be tested using university laboratory equipment. The following five (5) water quality parameters of your final treated product will be graded based on the scoring methods described below. Water quality is worth 35 total points.

### pH (10 pts)

pH Range	Points
$6.5 \leq \text{pH} \leq 7$	10
$6 \leq \text{pH} < 6.5$ or $7 < \text{pH} \leq 7.5$	8
$5.5 \leq \text{pH} < 6$ or $7.5 < \text{pH} \leq 8$	6
$5 \leq \text{pH} < 5.5$ or $8 < \text{pH} \leq 8.5$	4
$4.5 \leq \text{pH} < 5$ or $8.5 < \text{pH} \leq 9$	2
All other values	0

### Turbidity (10 pts)

**Target:** Minimum NTU

**Grading:** (Your rank / number of teams) \* 10 points

Teams will be ranked from worst to best, with #1 being the team with the value furthest from the target.

### Electrical Conductivity (6 pts)

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

**Grading:** (Your rank / number of teams) \* 6 points

Teams will be ranked from worst to best, with #1 being the team with the value furthest from the target.

### Volume (9 pts)

**Target:** 9 gallons

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

There is a maximum of 8 points allotted for volume. It is conceivable, however unlikely, that a team could have a volume greater than 9-gallons; in that case, the team would still only receive 8 points.

## Design Report (25 pts)

Each team is required to submit a design report detailing the overall project. The report must include a description of the design process, treatment principles utilized, environmental impacts and considerations, a cost analysis, and tables of material and operational costs. The design report is worth 25 total points. Please submit a PDF of your report via email to [ascemidpac2024@gmail.com](mailto:ascemidpac2024@gmail.com) by no later than **Friday, March 15, 2024 by 11:59 PM PST**. Hard copy submittals will not be required.

### Formatting

One (1) point will be deducted from the team's design report score for each format violation.

- **Report Cover Page:** Each cover page must contain:
  - School Name
  - Team Name
  - Competition Name: "2024 ASCE Mid-Pacific Water Treatment Competition"
- **Table of Contents:** Limited to one (1) page.
- **Body of Content:**
  - Minimum of 1,000 words
  - Maximum eight (8) pages, not including the cover page, table of contents, and appendices
  - Use 12-point Times New Roman or Arial Font, single-spaced, using normal width character spacing, and 1-inch margins on all sides
  - Headings may be of any font, size, or color
  - Body pages shall be numbered beginning on the page of the table of contents
  - Captions used for all 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 material to the design process.
- **Paper:** The content shall be presented on 8 ½" x 11" with portrait-oriented pages. Appendices shall also be presented on 8 ½" x 11" pages, however, there may be landscape-oriented pages included.
- **Miscellaneous:**
  - Photographs, tables, line drawings, graphs, or other figures included in a team's body of content shall be included in the page count. At any point in the design report, a team may reference figures in the appendix.

- A list of references or works cited should be included (if necessary). This list will not be counted as part of the report page limit.
- All work, figures, or tables not generated by the authors must be cited.
- Acknowledgements: any assistance received from others not on the team shall be recognized. Acknowledgements will not be counted as part of the report page limit.

## **Report Content**

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

- **Filter Design and Analysis (15):** The body of the design report shall contain an overview of the treatment system, the design process, and a description of how the filter works. The system design will be judged based on the approach to the scenario and the treatment principles implemented in the design process. This section must include clear descriptions of engineering design processes, description of materials used, lab techniques used, and test results obtained.
- **Material and Cost Analysis (3):** The design report must include a material list with a brief explanation and justification of each material selected. See Appendix A for list of permitted materials. The design report must include a cost analysis, which must include both a material cost estimate and an operational cost estimate. The total cost will be taken as a sum of the material and labor costs. Teams will be ranked by lowest cost estimate.
- **Sustainability (3):** The design report must include an explanation of the sustainability aspects of the treatment system. This section should discuss the environmental impacts of materials used and decisions made regarding choices to minimize cost or reduce environmental impact.
- **Professional Quality (4):** Professional quality of the design report will be based on organization, presentation, quality of writing, and effectiveness of figures, tables, and other resources presented in the report.

**Plagiarism of any kind will not be tolerated. Teams caught plagiarizing any portion of their design report will be disqualified.**

## **Construction and Treatment (25 pts)**

Teams will construct their treatment system as described in their design report. This phase will include construction, loading, and filtration. The transport of the treated effluent to the testing lab will be done after this portion of the competition. Construction and treatment is worth 25 points and will be judged based on orderliness of construction site, construction time, cost of the treatment system, and overall teamwork. Please see scoring and deduction methods presented below and in Table 1 on page 5 for point distribution.

### **Time Constraints**

Teams will be timed on the construction of their filters.

- Each team will be limited to a total of thirty (30) minutes to construct their treatment systems.
- After is the loading phase which includes ten (10) minutes for teams to chemically treat the influent and load their systems.
- A twenty (20) minute treatment period will follow.
- Any disinfectants in the system must be built into the final filtration system. Operators will not be allowed to add materials to their filtration system after the construction period.
- Immediately after the treatment period is completed, the collection basin will be removed from the treatment site and taken to the lab for testing.

### **Construction Phase**

Teams will construct their systems in a 10-ft x 10-ft space. Site limits will be based on the inside of the borders made, using either tape or chalk.

- Teams will place all their unassembled raw materials and tools in the competition area along with two provided 5-gallon buckets of contaminated water and two provided stirring sticks. Prior to beginning the construction phase, judges will compare the provided materials list in the team's design report to the materials present at the competition.
- Teams shall not pre-assemble, pre-cut, pre-mark, or tamper with materials prior to beginning of the construction, although decorations are encouraged. Teams must provide their own markers, tape measure, measuring cups, and scales, as needed. Items used for measuring or marking should not be included in the cost estimate.
- All construction materials should be sorted to match the quantity lengths provided in the Competition Rules, for example, the lumber should be four linear feet before bringing the material to the competition regardless of the initial length of purchase. In an effort to be more environmentally mindful, items that are packaged in large quantities may be opened before the competition with materials used. For example, if the design requires two feet of nylon rope and the team purchases a package of pre-cut 16 feet long rope, the team is not required to purchase a new package of material for competing.



- All prewashed materials must be dried and must be placed in their original packaging with the exception of loose sand, GAC, pebbles, and lava rocks which can be placed in clear containers based on the predetermined quantity sizes in Appendix A. A burlap sack may be used instead of a clear container but should be opened for judges to inspect. Packaging for storage does not need to be added to the materials list or the cost analysis portion of the design report. All materials not prewashed should be in original sealed packaging, as if purchased from the store. For example, if hydrogen peroxide is purchased, the hydrogen peroxide bottle should be sealed in the manner bought from the store.
- Battery-powered tools are permitted, with the exception of power saws or power blades. Corded power tools are not permitted.
- Teams must provide their own tools based on the approved list given in the Competition Rules, Appendix B.
- There are no limits to the number of operators.
- Construction time will start once the head judge says "go" at which each judge will start the clock. After 30 minutes, construction time will end with the head judge saying "stop". Operators must leave the 10-ft x 10-ft space when time is up or once they are finished with construction if early.
- Treatment systems must include a collection basin capable of holding 9 gallons of water.

### **Loading and Treatment Phases**

At the designated start time of the loading phase, teams will have ten (10) minutes to pretreat and load the influent into their filtration systems. Up to two (2) operators from each team may add any treatment chemicals to the contaminated water before loading it into their systems. A stirring stick will be provided. Teams will be given twenty (20) minutes after the loading phase to allow the water to filter through their systems. Immediately after the treatment phase, the collection basin will be removed.

### **Scoring and Deductions**

The Construction category is worth 25 points out of the 100 total points in the competition. Point allocations are shown in Table 1 on page 5. Construction scoring will be based on construction time, cost of materials, construction site organization, and teamwork and safety. All points are to be determined by the judges.

Construction Time:

Points for construction time will be awarded using the following equation:

$$(\text{your rank} / \text{number of teams}) * 8$$

Note: Teams will be ranked according to the time required for construction, from worst to best, with #1 being the team with to finish construction last.

The construction score will be adjusted if any of the violations below occur during the construction, loading, or treatment phases of the competition.

<b>Violation</b>	<b>Points Deducted</b>
Operator outside construction area	1
Any pre-marked, pre-assembled, or pre-cut materials	10
Operator begins constructing prior to start of construction phase	5
Any materials not in the team's material list reported in the design report	1 per item
Any tools used in construction not permitted in the Construction Rules or Appendix B	2 per tool
Usage of powered saws or powered blades	5

Note: Clear violation of ethical practices, based on judge's discretion, will result in disqualification of the team.

#### Cost of Treatment System:

The cost of the treatment system is worth 12 points, with the lowest cost system receiving the most points. The cost of the treatment system includes materials and operational costs as listed in the Appendices. Trash or recycling receptacles do not need to be included in the cost of the treatment system. Points will be awarded based on the following equation:

$$(\text{Your rank} / \text{number of teams}) * 12$$

Teams will be ranked from worst to best, with #1 being the team with the highest cost.

#### Safety

Safety is critical to any engineering project. Operators are required to wear personal protective equipment including hard hats, safety gloves, safety glasses, closed-toed shoes, and long pants at all times during the construction and treatment phases. Any person handling chemicals must wear a long-sleeved shirt or other article of clothing to cover arms and hands must be protected using chemical hazard protection gloves (i.e. latex or nitrile). If at any point a judge deems safety as a risk, the judge may stop the team from proceeding and will review safety practices. The stopwatch will continue running during this time.

## Oral Presentation (10 pts)

Each team shall prepare an oral presentation on their treatment system. Presentations will be evaluated on technical content and delivery. Oral presentations shall be presented in English. Presentation order shall be randomly selected before the competition begins and shall be provided at the time of on-site registration.

Teams are required to submit their presentations in PowerPoint or Google Slides for presenting their projects. Please submit your team's PowerPoint presentation via email to [ascemidpac2024@gmail.com](mailto:ascemidpac2024@gmail.com) by **Friday, March 29, 2024, 11:59 PM PST**. If a team chooses to make changes to the PowerPoint presentation after the deadline, they are allowed to do so if changes are submitted no later than 24 hours before the presentation date. Two (2) points will be deducted from the overall Oral Presentation score for changes submitted after the deadline.

### Scoring

The presentation will be scored by the parameters listed below. The point distribution for the presentation is described in Table 1 on page 5. The presentation is worth 15 points out of the competition's 100 points.

#### Technical Content:

- Presentations must include, at least, the filter design, treatment process used, materials used, a cost analysis, and a discussion of sustainability.
- The content may be presented in any order and is not limited to these components.

#### Oral presentation:

- The presentations will be six (6) minutes in duration.
- A maximum of two team members may present and answer questions.

#### Visuals:

- Teams may use PowerPoint or Google Slides for their presentations with a maximum number of slides being 20.
- Teams may use visual aids including graphs or photographs to enhance the presentation. Video clips may not be included.

#### Question & Answer:

- There will be a 4-minute question-and-answer session immediately following the presentation.
- Only the panel judges will be permitted to ask questions.
- Only the 2 presenting students will be allowed to answer questions during this time.

## Deductions

Points shall be deducted if the duration of the presentation is more than 6 minutes, as follows. There will be a 5-second grace period before point deductions begin.

Presentation Time	Points Deducted
6:06 - 6:15	1
6:16 - 6:25	2
6:26 - 6:35	3
> 6:36	4

## Poster (5 pts)

Each team must display a poster board of dimensions no larger than 11" x 17" next to their construction site. The point distribution for the poster is described in Table 1 on page 5. Poster should be in English, but teams are welcome to display an additional poster in another language.

- **Technical Content:** Posters must include the purpose of the competition, the filter design, materials used, and filter cost.
- **Professional Quality:** Professional quality of the poster will be scored based on organization, appearance, and use of language.

Note: Teams must provide their own poster stands and/or any other equipment required to display the poster.

## Appendix A: Materials List

Each team is permitted to submit a request to add two (2) materials or tools to this list. For approval. Please submit the request to ([ascemidpac2024@gmail.com](mailto:ascemidpac2024@gmail.com)) by March 1, 2024. If your suggestions are accepted, these materials will become accessible to all teams.

Note: All items must be in their original packaging (see exceptions in the Construction and Treatment Section).

Table 2: List of available materials for the filter design

Item	Unit	Cost (\$/unit)
2"x4" 3M Steel Wool	/unit	0.83
ABS Pipe, 1-1/2" Diameter	/5 lin. ft.	1.50
ABS Pipe, 2" Diameter	/5 lin. ft.	20.00
2" Adjustable Spring Clamp	/unit	6.00
All-Purpose Gravel (Quikrete)	/50 lb.	10.00
Alum (McCormick)	/oz.	1.50
Aluminum Potassium Sulfate Dodecahydrate*	/oz.	1.50
Astroturf	/sq. ft.	4.00
Baking Soda	/oz.	0.10
Bolts	/unit	0.05
Brawny Paper Towels	/roll	3.00
5 Gallon Bucket Lid	/unit	2.50
5 Gallon Bucket	/unit	2.50
Burlap	/sq. ft.	0.14
Canvas Drop Cloth	/sq. ft.	0.25
5/8" Carpet Pad	/sq. ft.	0.44
Charcoal	/lb.	0.50
Coarse Compost	/gallon	3.00
18" CoCo Liner	/unit	4.00
Coffee Filter	/unit	0.03
Commercial Grade Fine Sand	/lb.	0.16
Commercial Grade Sand	/lb.	0.12
Copper Pipe, 1/2" Diameter	/5 lin. ft.	6.00
Copper Pipe, 1" Diameter	/5 lin. ft.	16.00
Corrugated Pipe, 3" Diameter	/5 lin. ft.	2.50
Corrugated Pipe, 4" Diameter	/5 lin. ft.	3.00
Cotton Ball	/20 units	0.40
Diatomaceous Earth	/1 lb. bag	5.00
2"x4" Dimensional Lumber	/4 lin. ft.	1.70

2"x6" Dimensional Lumber	/4 lin. ft.	2.44
4"x4" Dimensional Lumber	/4 lin. ft.	3.00
Duct Tape 20 yd. Roll	/unit	10.00
3/4" Black Electrical Tape	/lin. ft.	0.06
Fiber Twine	/ft.	0.01
13 Gallon Garbage Bag	/unit	0.20
36 Gallon Garbage Bag	/unit	0.60
Gelatin (Knox Unflavored)	/4 oz.	2.00
Granular Activated Charcoal (Food Grade)	/oz.	0.40
8" x 6" x 2" Grout Sponge	/unit	2.00
Gutter Insert Foam, 3'	/unit	8.00
Gypsum (Food Grade)	/lb.	0.23
1/2" Hardware Cloth	/sq. ft.	0.67
1/4" Hardware Cloth	/sq. ft.	0.53
50 Qt. Igloo Cooler	/unit	70.00
94 Qt. Igloo Cooler	/unit	90.00
2' Ladder	/unit	30.00
4' Ladder	/unit	40.00
6' Ladder	/unit	50.00
Lava Rock	/cu. ft.	6.00
Lemon Juice	5 fl. oz.	1.00
Mylar Emergency Sleeping Blanket	/unit	3.00
Nail	/unit	0.05
Nut	/unit	0.05
3/8" Nylon Rope	/lin. ft.	0.20
Paint Tray	/tray	2.00
Peat Moss	/cu. ft.	6.50
Pebbles, Large	/5 lb.	2.50
Pebbles, Pond/Landscape	/.5 cu. ft.	4.99
Pickling Lime	/oz.	0.20
Plant Protector Bags	/bag	5.00
Plaster of Paris	/lb.	0.70
Plastic Tarp	/sq. ft.	0.20
Play Sand	/lb.	0.10
Plumbing Epoxy Putty	/putty	3.49
3/4" Thick Plywood	/4 sq. ft.	1.06
3/8" Thick Plywood	/4 sq. ft.	2.00
Pool Filter Sand	/lb.	0.30
Pumice Stone (1 CF)	/cu. ft.	11.99
2" PVC Pipe Elbow	/unit	3.00

PVC Pipe, 1" Diameter	/5 lin. ft.	1.00
PVC Pipe, 1-1/2" Diameter	/5 lin. ft.	1.50
PVC Pipe, 2" Diameter	/5 lin. ft.	2.00
Salt (Morton Iodized Table Salt)	/26 oz.	1.00
Screw	/unit	0.05
Sham-Wow	/sq. ft.	5.00
Stainless Steel Safety Wire	/lin. ft.	0.25
Standard Air Conditioner Filter	/unit	10.00
Terrycloth Rags	lb.	5.00
Tote Lid, 5 Gallon	/unit	1.00
Tote Lid, 18.5 Gallon	/unit	1.00
Tote Lid, 13 Gallon	/unit	1.00
Tote Lid, 10 Gallon	/unit	1.00
Tote, 5 Gallon	/unit	8.00
Tote, 10 Gallon	/unit	10.00
Tote, 13 Gallon	/unit	18.00
Tote, 18.5 Gallon	/unit	20.00
Tote, 30 Gallon	/unit	12.00
Trash Can, 4 Gallon	/unit	2.50
Trash Can, 8.8 Gallon*	/unit	4.00
Trash Can, 13 Gallon	/unit	5.00
Trash Can, 20 Gallon	/unit	8.00
Trash Can, 32 Gallon	/unit	13.00
Vinegar	/1 cup	0.99
Weed Control Fabric	/sq. ft.	0.11
Window Screen Mesh	/3 sq. ft.	1.00
Window Squeegee	/unit	6.00
Wood Mulch	/cu. ft.	6.00

\* Added Materials from Requests



## Appendix B: Tools and Operational Costs

Note: As stated in the Construction and Treatment Section, teams must provide their own markers, tape measure, measuring cups, and scales, as needed. Items used for measuring or marking should not be included in the cost estimate.

Table 3: Labor and Tool Costs

Item	Cost (\$/unit)
Operator	30.00
Adjustable Wrench	3.00
Basic Socket Set	5.00
Caulking Gun	2.00
Channel Locks	1.50
Cordless Drill	10.00
Drill Bits (Each)	1.50
Hand Saw	10.00
Pliers	1.50
Scissors	2.00
Screwdriver	1.00
Standard Builder's Hammer	5.00
Utility Knife	2.00
Wire Cutters	2.00
Pipe Cutters	10.00
Pipe Wrench	5.00