



# SKNNRC CHALLENGE OVERVIEW



**SKNNRC**

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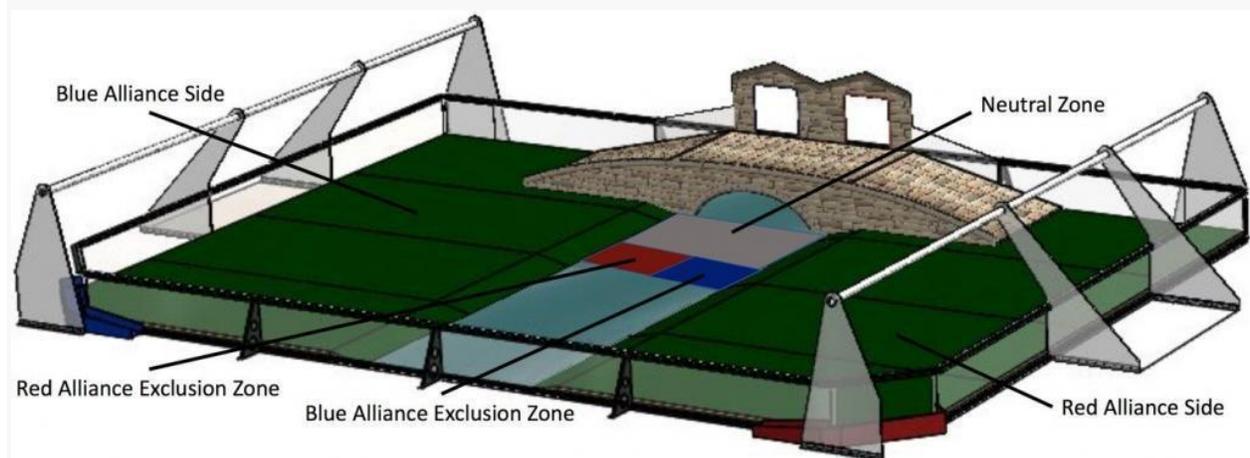
# Contents

- Game Overview ..... 2
- Challenge Overview ..... 3
- Narrative ..... 4
- Gameplay ..... 4
- Scoring..... 5
- The Arena ..... 5
- The Match ..... 7
- Pre-Match ..... 8
  - During the Match** ..... 8
- Post-Match..... 10
- The Challenge ..... 11
  - Overview** ..... 11
  - Cumulative Points**..... 11
  - Match Points**..... 11
  - The Robot**..... 11
- Scoring Summary ..... 12
- Definitions ..... 13
- Game Design Addendum #1 ..... 14

# Game Overview

This year's robotics challenge will reflect how we need to cooperate as a Federation to solve the water crisis. Teams representing over 15 schools will be organized into two (2) competing alliances, hydrogen and oxygen, each alliance composed of three (3) national teams that rearrange into different alliances each match. These alliances are tasked with transforming a polluted river into a clean water source while storing as much water as possible. As the teams prepare for the end of the game, they get out of the path of the flooding river by seeking higher ground.

Solving this global water issue will need much more than the best engineering minds of our era. It will require a whole new generation of tech savvy future STEAM leaders who will demand a global response to the issue of water security. These students are doing much more than competing in a robotics game – they are learning that these challenges will only be defeated when people realize we are all on the same team, and that with technology, we can accomplish things we can only imagine by communicating, cooperating, and working together to apply technology as a tool for positive change in the world.



# Challenge Overview

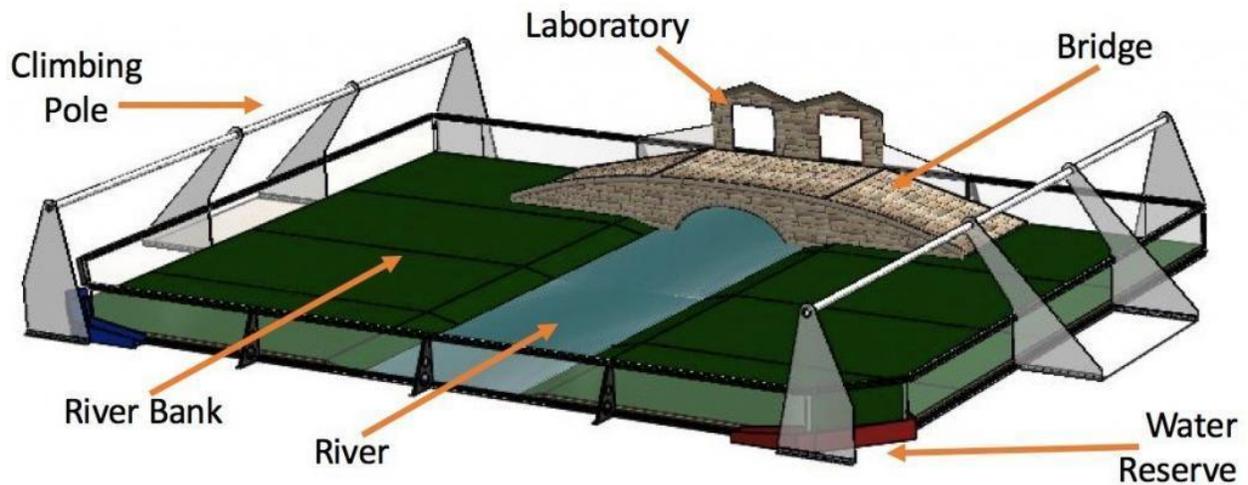
Access to clean, drinkable water has proven to be a potent source of political, economic, and social strife in nations throughout the world. At the present, more than one billion people do not have access to clean water and over half of them are children. This lack of access to drinkable water results in more deaths each year than those resulting from war. If current water consumption trends continue across the globe, two out of three people on earth will suffer from water-stressed conditions by the year 2025.

Water is not only an essential ingredient that helped lead to the development of life on Earth, but it comprises between 50 percent and 70 percent of the human body. Along with mild temperatures and breathable atmosphere, the continued ability of intelligent life on Earth to thrive depends on maintaining persistent and plentiful access to clean water.

Due to the importance of resolving this immense issue, the US National Academy of Engineering, UK Royal Academy of Engineering, and Chinese Academy of Engineering have deemed “providing access to clean water” to be one of their 14 “Grand Challenges for Engineering.” The Grand Challenges are engineering issues that must be addressed to ensure a healthy, sustainable, and increasing quality of life for billions of people across the world.

In recognition of the challenge’s importance and applicability to all nations, *FIRST Caribbean* is taking this most universal of challenges – access to clean water – as the focus for the inaugural *FIRST Caribbean* robotics game. *FIRST Caribbean* teams from around the island will come together in a yearly robotics challenge and be inspired to pursue STEM education and careers.

# Narrative



In *SKN H2O Flow*, teams learn about real-world water scarcity and contamination issues. In the game, two villages exist on either side of a contaminated river. The villagers compete to create and store purified water in their respective reserves. In a laboratory upstream, the villagers come together to research the contaminants and ultimately create a purification system so contaminants are removed before they reach the villages, thus providing clean water for all. In the end, each village prepares for the coming flood by searching for higher ground.

# Gameplay

At the beginning of the match, 40 water (represented by blue balls) and 10 contaminants (represented by orange balls) particles flow into the river. After this initial flood, balls continue to flow at a steady rate.

Two alliances of three robot teams each represent the two villages. Each alliance receives points for putting contaminants in their respective laboratory and water in their respective water reserve. Penalties are incurred if contaminants enter an alliance's respective water reserve.

Once 10 orange balls are deposited in the laboratories (regardless of the distribution among the two alliances laboratories), orange balls will stop flowing into the river. If the river is free from all contaminant particles at the end of the game, both alliances receive a "coopertition" bonus.

At the end of the match, teams must prepare for a coming flood by searching for higher ground. Points are received for robots fully on the bridge, or off the ground using the climbing bar.

## Scoring

Type	Action	Points
PARTICLE	Scored Clean Water Particle into alliance Water Reserve	1
	Scored Contaminant Particle into alliance Laboratory	4
Coopertition	Clean River	15 (both alliance)
End Game	Robot parked on Bridge	5
	Robot hanging on Climbing Bar	20
Penalty	Penalty	5 points (to opposing alliance)

## The Arena

**A1:** The game is played on a 4 meter by 5.5-meter FIELD, bounded by and including the upward- and inward-facing surfaces of the GUARDRAIL around the field.

**A2:** In the center of the FIELD is the RIVER, a 4-meter-long by 1 meter wide section comprised of a flat polycarbonate panel covered in a decorative vinyl graphic.

**A3:** Extending out from the RIVER are the RIVER BANKS, which are 4-meter-long by two-meter-wide platforms covered in green carpet, raised from the RIVER by approximately 2.25 inches (5.71 cm). There are 25cm long ramps at a 13-degree angle leading from the RIVER to the top surface of the RIVER BANKS.

**A4:** At each end of the FIELD is the CLIMBING BAR, which is a 4.2cm diameter, 75cm high (measured to the top of the bar) aluminum pipe that spans the width of the field, supported by polycarbonate uprights.

**A5:** Underneath each CLIMBING BAR in the front corners of the FIELD, there is a 20cm x 40cm opening along the top surface of the RIVER BANK called the WATER RESERVE.

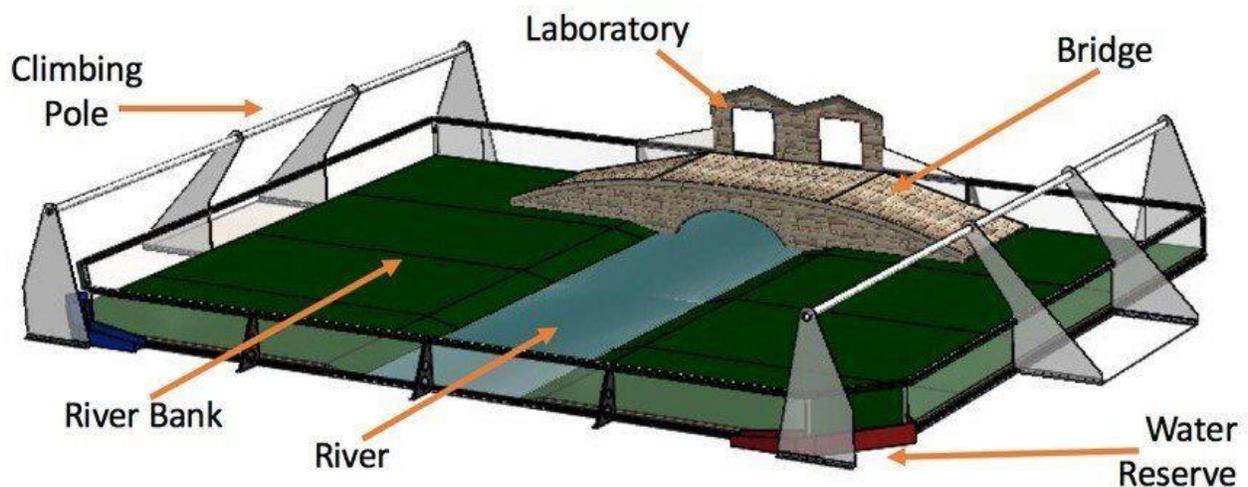
**A6:** Spanning the RIVER BANKS and RIVER, at the back of the FIELD, is the BRIDGE. The BRIDGE is comprised of a 30cm high, 125cm long, by 80cm wide panel that is approximately parallel to the floor, with two ramps 100cm long at a 14-degree angle leading from the top surfaces of the RIVER BANKS.

**A7:** At the top of the BRIDGE, against the GUARDRAIL, there are two 30cm by 30cm square openings called LABORATORIES.

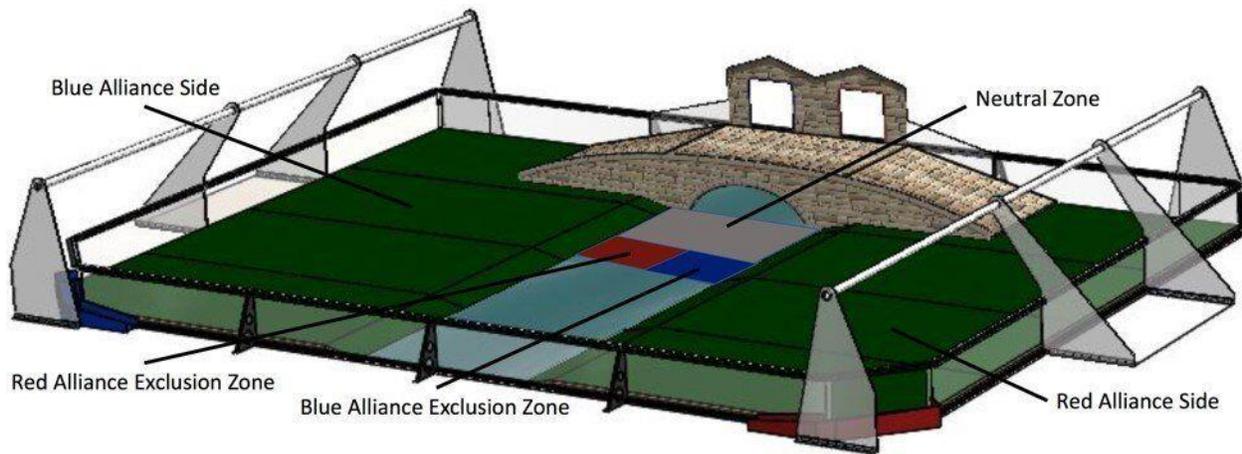
**A8:** There are two types of PARTICLES, both of which are 8cm diameter light plastic balls. CLEAN WATER PARTICLES are blue while CONTAMINANT PARTICLES are orange. PARTICLES flow out of the opening underneath the BRIDGE.

**A9:** A NEUTRAL ZONE will extend 500mm from the mouth of the bridge. The NEUTRAL ZONE will also span the width of the river.

**A10:** An EXCLUSION ZONE will extend 300mm from the end of the NEUTRAL ZONE, and will span the width of the river. The EXCLUSION ZONE will be split down the center of the river with one side being designated the Red Alliance EXCLUSION ZONE and the other side being designated the Blue Alliance EXCLUSION ZONE.



**Figure A1: General Field Layout**



**Figure A2: Neutral and Exclusion Zones**

## The Match

**M1:** The game is designed with a minimum number of rules in order to encourage teams to be creative. While teams are encouraged to be creative on the playing field, the minimal use of rigid rules should not be taken as an invitation to intentionally bend or search for ways around the rules that do exist. This is to ensure safe and fair play for all FIRST Caribbean teams. If you do not act within the spirit of the rules during gameplay, you will be penalized accordingly.

**M2:** As teams begin to strategize and wonder if certain tactics are legal, they can email

[support@iitae.tech](mailto:support@iitae.tech) or [www.iitae.tech](http://www.iitae.tech) live chat to ask their questions. *FIRST Caribbean* will review these questions, provide answers, and release game updates as needed. In certain cases, a game “update” will be sent if a question’s answer requires any change in the rules. In such cases, the game “update” will be sent to all teams.

**M3:** All members of a team in the play field area must be wearing ANSI (or equivalent) approved safety glasses and close-toed shoes (safety glasses will be provided at the game). This is to ensure the safety of all participants. Noncompliance will result in a penalty. (More information on PENALTIES can be found in the Scoring Summary and Glossary.)

# Pre-Match

**M4:** Each game is played with six teams that are assigned to one of two competing, three team alliances. The two alliances are the Hydro Alliance and the Aqua Alliance. The three team alliances are determined at random for each round so that the participating *FIRST Caribbean* teams will have the opportunity to work with different teams from around the world in each successive game. The three teams that compose an alliance must work together to accomplish their common goal of obtaining points for their alliance. Each team will attach a *FIRST Caribbean* provided alliance flag and national flag to their robot, so that robots on the field can be easily identified. The alliance flag will be either red or blue to represent the Hydro Alliance or the Aqua Alliance. For more information on the flags, please refer to **R5**.

**M5:** Three (3) students from each team are allowed within each alliance's OPERATORS BOX just outside the field area; two (2) robot drivers and one (1) robot tactician. Only robot drivers will be allowed to remotely operate their robot while the tactician may instruct the drivers.

**M6:** Prior to the start of the match, robot drivers and tacticians may place the robot anywhere fully inside the river bank on their side of the field. Hydro Alliance teams will place their robots on the field first, followed by the Aqua Alliance teams second.

**M7:** When the referees are ready, field personnel will instruct teams to select their Driver Controlled Op Mode (operational mode) and initialize their robots by triggering the teams' initialization event software with their Driver Station tablet.

**M8:** The match begins when the initial 50 game balls are released. Once the initial group of game balls passes the mouth of the bridge, a buzzer will sound signaling teams to start their robots by pressing the start button on their tablet device. After the buzzer, teams will be allowed to move at will. Teams that do not adhere to this start are subject to a PENALTY.

## During the Match

**M9:** Each match faces the Hydro Alliance against the Aqua Alliance. Both alliances are comprised of three teams each. The individual matches are two and a half (2.5) minutes long.

**M10:** As soon as the match starts, an initial flood of 40 CLEAN WATER PARTICLES and 10 CONTAMINANT PARTICLES are released. Once this occurs, PARTICLES will be released into the RIVER at a rate of approximately 1 ball per second. The PARTICLES will be a mixture of CLEAN WATER and

CONTAMINANTS with a rate of about 4 CLEAN WATER PARTICLES to 1 CONTAMINANT PARTICLE.

**M11:** As soon as the match begins, robots are free to move about the full field, including the RIVER, BRIDGE, and both RIVER BANKS to begin sorting WATER and CONTAMINANT PARTICLES into their alliance's respective WATER RESERVE and LABORATORY.

**M12:** CLEAN WATER PARTICLES are considered "scored" if they are completely inside an alliance's WATER RESERVE. Once a CLEAN WATER PARTICLE has completely stopped inside of an alliance's WATER RESERVE, it may not be purposely removed into any other area of the field or scored again. Each scored CLEAN WATER PARTICLE is worth 1 point.

**M12.A:** If a CONTAMINANT PARTICLE finds its way into a WATER RESERVE, a PENALTY is applied to the alliance that causes the PARTICLE to enter.

**M13:** CONTAMINANT PARTICLES are considered "scored" if they have been completely placed inside an alliance's LABORATORY. A scored CONTAMINANT PARTICLE may not be removed from the LABORATORY to another area of the field, nor may it be scored again. Each scored CONTAMINANT PARTICLE is worth 4 points.

**M14:** Once ten (10) CONTAMINANT PARTICLES are scored between the two alliances, the flow of CONTAMINANTS will stop. PARTICLES will continue to flow at a rate of one (1) PARTICLE per second, but only CLEAN WATER PARTICLES will flow.

**M15:** "Cooperation" Bonus: In the spirit of all robots working together within two alliances to solve the global water crisis, a bonus of 15 points will be awarded to both alliances if:

1. the flow of CONTAMINANT PARTICLES is stopped via the method described in rule **M14**, and
2. if all CONTAMINANT PARTICLES are outside the RIVER at the end of the match. Please note that until the flow of contaminants is stopped, it will be very difficult to ensure there will be no contaminants in the river area. Also note that not all CONTAMINANT PARTICLES must be scored, they must simply be outside the RIVER to qualify for the bonus. Both Conditions 1 and 2 above must be met to qualify for the "Cooperation" bonus points.

**M16:** At the conclusion of the match (as described in rule **M18**), teams must prepare for the coming river flood by parking their robots fully on the BRIDGE or pulling themselves off the ground using the CLIMBING BAR. Robots must stay off the ground after the match has concluded to receive points. Parking your robot fully on the BRIDGE is worth 5 points. Pulling your robot off the ground using the CLIMBING BAR is worth 20 points.

**M17:** Robots acting out any of the actions listed below will incur a PENALTY for their alliance. PENALTIES include:

**M17.A:** Deliberately detaching parts of their own, a teammate's, or an opponent's robot during gameplay.

**M17.B:** Intentionally destroying, damaging, tipping, or making other aggressive actions towards participating robots, particles, or the game field.

**M17.C:** Purposefully removing particles, robot parts, or any other objects located on or in the game field to a location outside of the game field.

**M17.D:** Purposefully manipulating anything on the game field in a way that is outside of the intent of fair and productive gameplay.

**M17.E:** Purposefully interfering with particle scoring in the opposite alliance's side of the field.

**M17.F:** Purposefully contacting anything outside of the game field with your robot.

**M17.G:** Pinning an opponent's robot against a wall, "t-bone", or control another robot's movement for more than 3 seconds as counted down by the referee.

**M17.H:** Forcing an alliance to break a rule.

**M17.I:** A robot may not intentionally impede access to scoring areas.

**M17.J:** A robot may not enter the Neutral Zone (more details are available in Game Design Addendum #1)

**M17.K:** A robot may not enter an opposing alliance's Exclusion Zone (more details are available in Game Design Addendum #1)

**M17.L:** A robot may not enter the Neutral Zone or either Exclusion Zone while their robot has expanded to dimensions beyond a 50cm x 50cm x 50cm cube. (more details are available in Game Design Addendum #1)

**M17.M:** A robot may not prevent an opposing alliance's robot from entering its own Exclusion Zone. (more details are available in Game Design Addendum #1)

## Post-Match

**M18:** At the end of the two and a half (2.5) minutes, the match will finish.

Upon the conclusion of the game, the robots must immediately stop moving.

**M19:** Once the match is over, the referees will immediately inspect the field to finish the scoring process.

**M20:** Once the referees and field personnel have given the all-clear, teams may remove their robots from the field.

# The Challenge

## Overview

At the 2020 *FIRST Caribbean Challenge*, a number of quantitative and qualitative awards will be presented at the conclusion of the event. Among the quantitative awards, there will be two main types.

## Cumulative Points

**C1:** At the conclusion of each game, the individual teams on each alliance will be awarded the number of points that their alliance earned at the conclusion of their match. These points are known as Cumulative Points. At the conclusion of each round, the Cumulative Points are added to each team's previous total. At the end of the six rounds, the team with the highest number of Cumulative Points will be determined to be the winner. If two or more teams have an equal number of Cumulative Points, the team with the most Match Points (as described in rule **T1** and **T2**) will be determined to be the winner. If there is still a tie, the team with the highest number of Cumulative Points earned during a single game will be determined to be the winner.

## Match Points

**T1:** Teams compete in matches to earn ranking status based on their win-lose-tie record. Teams will receive 2 ranking Match Points for wins, 1 for ties, and 0 for losses.

**T2:** Teams will first be ranked by their number of ranking Match Points. If two or more teams have an equal number of ranking Match Points, the team with the most Cumulative Points (as described in rule **C1**) will be determined to be the winner.

## The Robot

**R1:** Robots must pass safety inspection before they enter the playing field.

**R2:** To participate in a match, teams must have passed safety, hardware, and field inspection.

**R3:** Robots must be comprised solely of items from one (1) *FIRST Caribbean Kit of Parts*. Any additional parts found will prevent a team from participating until the unauthorized parts are removed.

**R4:** Teams must display a *FIRST Caribbean* provided country flag at all times. Flags will be provided and attached to robots at the event. The flags are four (4) inches (10.16cm) by six (6) inches (15.24cm) and have an approximately ten and a half (10.5) inch (26.67cm) long pole with a diameter of 3/16th of an inch (0.48cm).

**R5:** During the match, robots must also display a *FIRST Caribbean* provided Alliance flag reflecting the color of their alliance. Flags will be provided, and attached to robots prior to the match. The flags are four (4) inches (10.16cm) by six (6) inches (15.24cm) and have an approximately ten and a half (10.5) inch (26.67cm) long pole with a diameter of 3/16th of an inch (0.48cm).

**R6:** Both the alliance flag and the country flag should be attached to each robot by sliding them into the Extrusion t-slot as shown in **Figure R1** below. **The Alliance flag and country flag must be arranged exactly as shown below to ensure robots can be easily identified.**

**Fig R1: Flag slotted into Extrusion t-slot**

**R7:** The starting position of the robot must not exceed a starting volume of 50cm x 50 cm x 50cm. After the start of the match, robots may extend beyond this configuration. Any robots found in violation of this rule will not be allowed to play until they fit within the required volume.

**R8:** Robots must not pose a danger to other robots, the field, or people in the area. Any robot found in violation of this rule will prevent its team from participating until the robot is deemed safe by inspectors. Example: Any parts tensioned using the surgical tubing must properly contain this energy to ensure it cannot be accidentally released, causing harm to a robot, field element, or human bystander.

## Scoring Summary

Type	Action	Points
PARTICLE	Scored Clean Water Particle into alliance Water Reserve	1
	Scored Contaminant Particle into alliance Laboratory	4
Coopertition	Clean River	15 (both alliance)
End Game	Robot parked on Bridge	5
	Robot hanging on Climbing Bar	20

Penalty	Penalty	5 points (to opposing alliance)
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## Definitions

- **ALLIANCE:** a cooperative of up to three teams.
- **BRIDGE:** a system of PVC foam panels, polycarbonate panels, aluminum extrusions, and vinyl graphics that create the top platform, ramps and support structure for robots to drive upon.
- **CLEAN WATER PARTICLE:** A blue PARTICLE that represents clean water.
- **CLIMBING BAR:** a 4.2cm diameter, 75cm high (measured to the top of the bar), aluminum pipe that spans the width of the field.
- **CONTAMINANT PARTICLE:** An orange PARTICLE that represents contaminants in the water.
- **FIELD:** a 4 meter by 5.5-meter carpeted area, bounded by and including the upward and inward facing surfaces of the GUARDRAIL.
- **GUARDRAIL:** a system of transparent polycarbonate panels, supported on the top and bottom edges by aluminum extrusions. The GUARDRAIL prevents ROBOTS from inadvertently exiting the FIELD during a MATCH.
- **LABORATORY:** A 30cm by 30cm square opening at the top of the BRIDGE through which teams can score CONTAMINANT PARTICLES.
- **MATCH:** a two (2) minute and thirty (30) second period of time in which ALLIANCES play H2O Flow.
- **PARTICLE:** an 8cm diameter light plastic ball used to score points in H2O Flow.
- **PENALTY:** An allocation of five (5) points to the opposing alliance.
- **RIVER:** a four (4) meter long by one (1) meter wide section comprised of a flat polycarbonate panel covered in a decorative vinyl graphic.
- **RIVER BANKS:** are four (4) meter long by one meter wide sections covered in green carpet, raised from the RIVER by approximately 2.25 inches (5.71 cm). There are 25cm long ramps at a 13-degree angle leading from the RIVER to the top surface of the RIVER BANKS, on each end of the field.
- **WATER RESERVE:** A 20cm by 40cm opening on the GUARDRAIL sections in the front two corners of the field.
- **NEUTRAL ZONE:** A 500mm by 1,000mm section of the RIVER directly in front of the BRIDGE that no robots are allowed to enter.
- **EXCLUSION ZONE:** Two 300mm by 500mm sections of river that are side by side directly behind the
- **NEUTRAL Zone.** One is the Red Alliance EXCLUSION ZONE and the other is the Blue Alliance EXCLUSION ZONE. Only robots of the alliance belonging to the same colored EXCLUSION ZONE may enter the EXCLUSION ZONE.

# Game Design Addendum #1

## Rule Updates and Clarifications

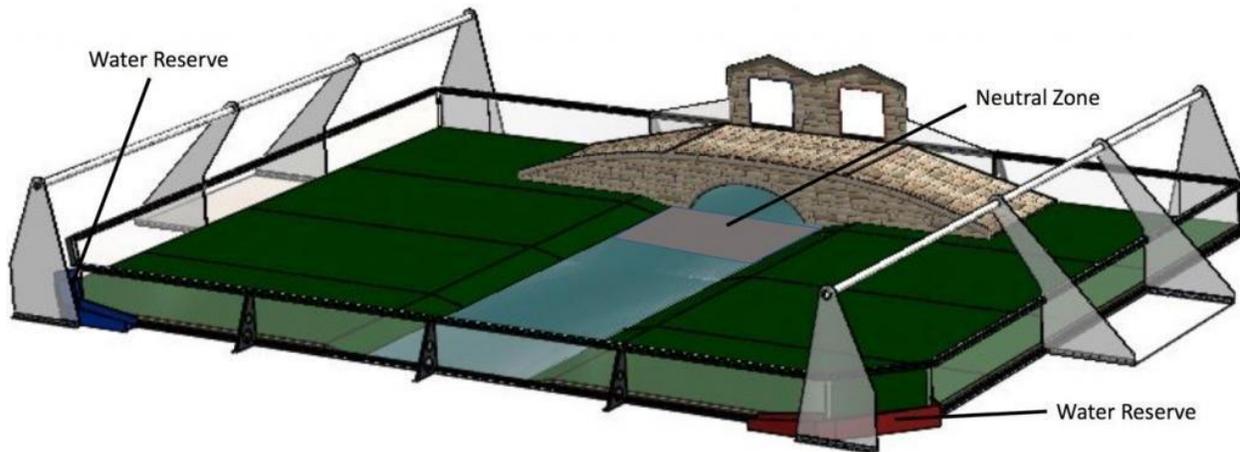
- **Clarification to Rule M5 on Page 5 of the SKN H2O Flow Manual:** Three (3) students from each team are allowed within ~~the ALLIANCE ZONE~~ each alliance's OPERATORS BOX just outside the field area; two (2) robot drivers and one (1) robot tactician. Only robot drivers will be allowed to remotely operate their robot while the tactician may instruct the drivers.
- **Clarification to Rule M17.E on Page 6 of the SKN H2O Flow Manual:** Purposefully interfering with particle scoring in the opposite alliance's ~~alliance zone~~ side of the field.
- **“Water Reserve” Goals**
  - To decrease the chance of a robot accidentally falling into and becoming trapped in their Alliance's Water Reserve (preventing their team from scoring), the width of both alliances' Water Reserves will be shortened from 500mm to 400mm.
    - This update affects Rule A5 (pg4) of the SKN H2O Flow manual.
- **Delayed Start**
  - Robots will not be allowed to move until the first 50 game balls have passed the mouth of the bridge. This action will be done in a large group at the beginning of the game.
  - A buzzer will sound when the last ball has crossed the mouth of the bridge, signaling that teams are allowed to move their robots.
    - This update affects Rule M8 (pg6) of the SKN H2O Flow manual.
- **Number of Game Balls**
  - The speed at which additional game balls will be distributed will be 1 per second. ○ This will raise the overall game ball count (blue and orange) from 80 to 200.
    - This update affects Rule M10 (pg6) and Rule M14 (pg6) of the SKN H2O Flow manual.
- **Neutral Zone**
  - To prevent one robot from disrupting gameplay for all teams:
    - A Neutral Zone will extend 500mm from the mouth of the bridge. The Neutral Zone will also span the width of the river.
    - A penalty will be incurred if a robot enters the Neutral Zone. The purpose of this rule is to prevent a single robot from blocking the opposing alliance from accessing game balls coming from the river mouth by maneuvering directly in front of it.
- This rule will be applied by the referee at the referee's discretion in a manner that upholds the spirit of this rule. This means that if part of a robot accidentally drives through a small part of the Neutral Zone without stopping or an apparent intention to disrupt game play, a penalty might not be applied. However, robots should never drive through the Neutral Zone under any circumstances, so the

only way to ensure you do not receive a penalty is to be careful and avoid the Neutral Zone completely.

- This penalty will result in +5 points for the opposing alliance.
- This penalty will be repeatedly applied at the referee's discretion if a robot continuously remains within the Neutral Zone or if a robot repeatedly enters the Neutral Zone.

! This update affects Rule M17.J (pg7) of the SKN

H2O Flow manual.

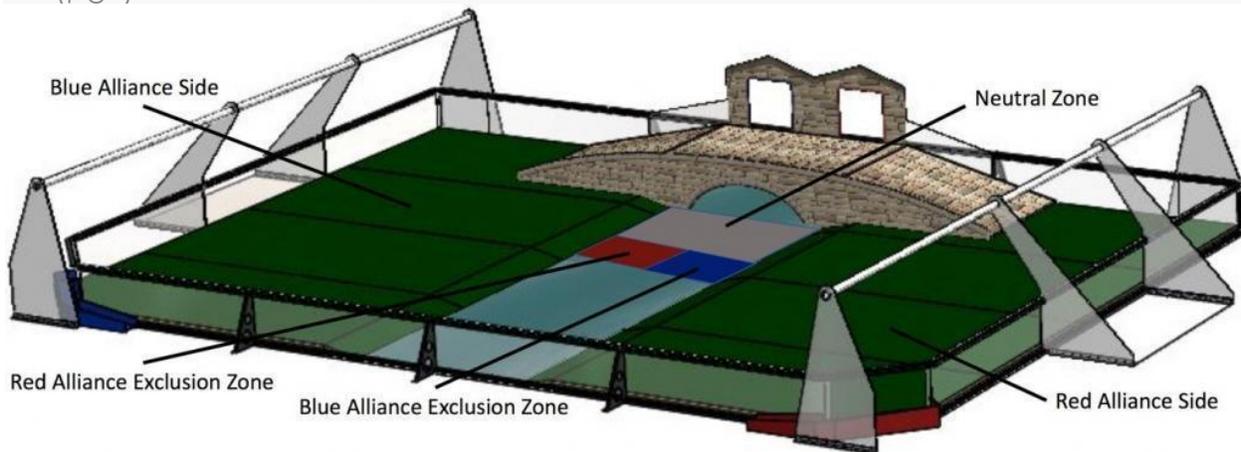


### Neutral Zone Figure

- **Exclusion Zone**
  - To prevent one robot from disrupting gameplay for all teams:
- An Exclusion Zone will extend 300mm from the end of the Neutral Zone, and will span the width of the river.
- The Exclusion Zone will be split down the center of the river.
  - One side will be the Red Alliance Exclusion Zone and the other side will be the Blue Alliance Exclusion Zone.
  - Only robots that are members of the Alliance that corresponds with the Exclusion Zone's color will be allowed to enter that Exclusion Zone (e.g., only Red Alliance robots will be allowed in the Red Alliance Exclusion Zone).
- The Exclusion Zone corresponding with a particular alliance (the alliance that will be allowed to enter it) will be located on the opposite side of the river from the alliance's starting position.
- A penalty will be incurred if a robot enters an opposing alliance's Exclusion Zone. The purpose of this rule is to prevent a single robot from blocking the opposing alliance from accessing game balls by maneuvering directly in front of the Neutral Zone.
  - This rule will be applied by the referee at the referee's discretion in a manner that upholds the spirit of this rule. This means that if part of a robot accidentally drives through a small part of an opposing alliance's Exclusion

Zone without stopping or an apparent intention to disrupt game play, a penalty might not be applied. However, robots should never enter an opposing alliance's Exclusion Zone under any circumstances, so the only way to ensure you do not receive a penalty is to be careful and avoid the opposing alliance's Exclusion Zone completely.

- This penalty will result in +5 points for the opposing alliance.
- This penalty will be repeatedly applied at the referee's discretion if a robot continuously remains within an opposing alliance's Exclusion Zone or if a robot repeatedly enters an opposing alliance's Exclusion Zone.
- When any part of a robot is within either Exclusion Zone (or the Neutral Zone), it may not be expanded beyond a 50cm X 50cm X 50cm cube.
  - The penalty for violating this rule will result in +5 points for the opposing alliance, and the penalty will be continuously applied at the referee's discretion as long as a robot continues to violate the spirit of the rule.
- Robots of each alliance must provide adequate space on the playing field to allow robots of an opposing alliance to access their Exclusion Zone.
  - The penalty for violating this rule will result in +5 points for the opposing alliance, and the penalty will be continuously applied at the referee's discretion as long as a robot continues to violate the spirit of the rule.
- This update affects Rule M17.K (pg7), Rule M17.L (pg7), and Rule M17.M (pg7) of the SKN H2O Flow manual.



**Exclusion Zone Figure**