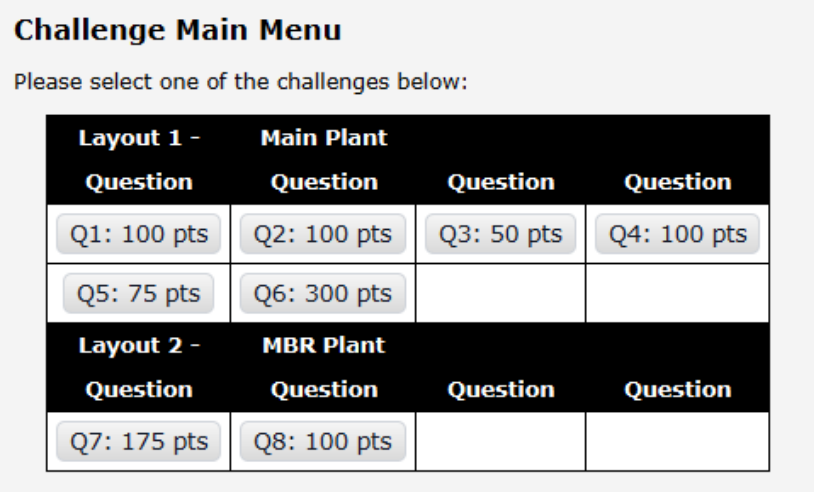
Operations Challenge Process Control Event – Simulator Question Background Information

The 2026 Operations Challenge simulator contains 2 plant layouts:

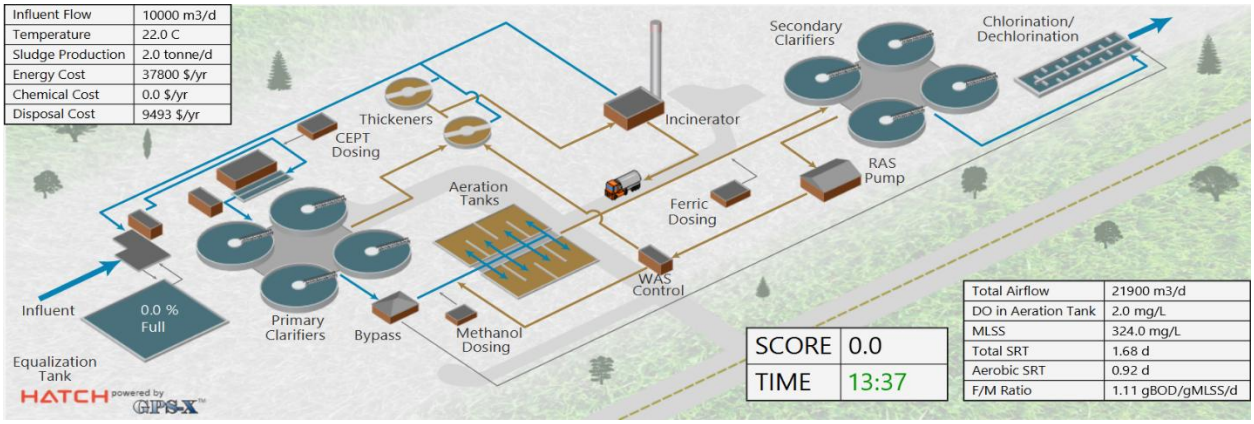
- Layout #1 – Conventional Activated Sludge Plant
- Layout #2 – Combined Activated Sludge / Membrane Bioreactor (MBR) Plant

There are 6 challenge questions from layout #1 and 2 challenge questions from layout #2. The simulator interface will switch to the appropriate layout when a challenge question is selected.



Layout #1 – Main Plant

Layout #1 contains a conventional BNR wastewater treatment plant, as shown below:



The plant consists of:

- an influent pumping station
- an Equalization (EQ) Tank
- 4 circular primary clarifiers
- 2 parallel plug-flow activated sludge aeration tanks (4 zones in series)
- 4 circular secondary clarifiers

- a CEPT dosage point (for iron and polymer addition for chemically enhanced primary treatment and chemical phosphorus precipitation)
- a secondary ferric dosage points (for iron addition for chemical phosphorus precipitation)
- a methanol dosage point (for denitrification)
- a recycled activated sludge (RAS) pumping station
- a waste activated sludge (WAS) pumping station
- 2 gravity sludge thickeners
- a sludge incinerator
- a chlorine disinfection tank, with chlorination/dichlorination options

The Challenge Questions for Layout #1

Teams will be presented with a total of 6 challenge questions for Layout #1. Teams can answer the questions in any order they like and can rerun questions as many times as needed. Make sure to click on the red SUBMIT button to register your answer each time you complete a question. Clicking on the SUBMIT button erases the previous answer for that question, so if you do a question several times, it will only remember the last answer that you submitted.

The questions cover a wide range of operational situations and require teams to make operational changes to the plant to achieve a given set of targets.

Please note that Question 6 involves running an 84-day dynamic simulation, which takes approximately 2 minutes to complete. Please make sure to leave enough time to complete the simulation before clicking on the SUBMIT button.

The following aspects of the plant can change from question to question:

- Sizes of the aeration tanks
- Surface areas of the clarifiers
- Number of primary clarifiers in service
- Number of aeration tanks in service
- Number of secondary clarifiers in service
- Influent loading (flow, COD, BOD_5, ammonia, temperature, pH)
- Starting pumped flow settings (RAS flow, WAS flow)
- Starting aeration conditions (airflow, DO controllers, etc.)
- Starting chemical addition settings (methanol, ferric, chlorine, sodium hydroxide, sulfur dioxide)

In questions 1 through 5, the teams will receive **25 points** per target achieved. In question 6, teams will receive **75 points** per target achieved. Some questions have more targets than others. The table below summarizes the point distribution per question:

#	Question	Maximum Possible Points
1	Winter Operation	100
2	Energy Cost Management	100
3	Chemically Enhanced Primary Treatment	50
4	Chemical Cost Management	100
5	Biological Phosphorus Removal	75
6	Dynamic Seasonal Dynamics	300

Notes for All Questions

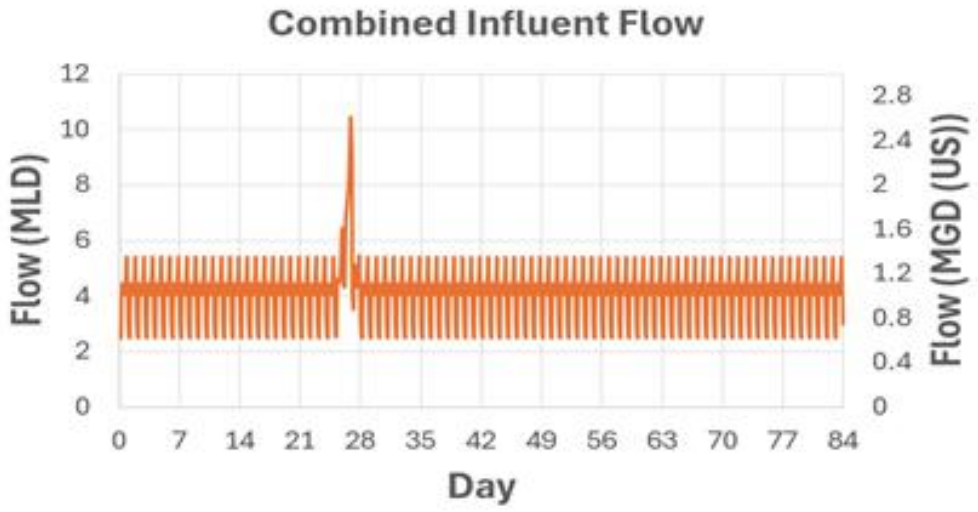
Please note that all Food-to-Microorganism (F/M) ratio calculations are calculated as $lbBOD_5/lbVSS/d$ (or in SI units, $gBOD_5/gVSS/d$).

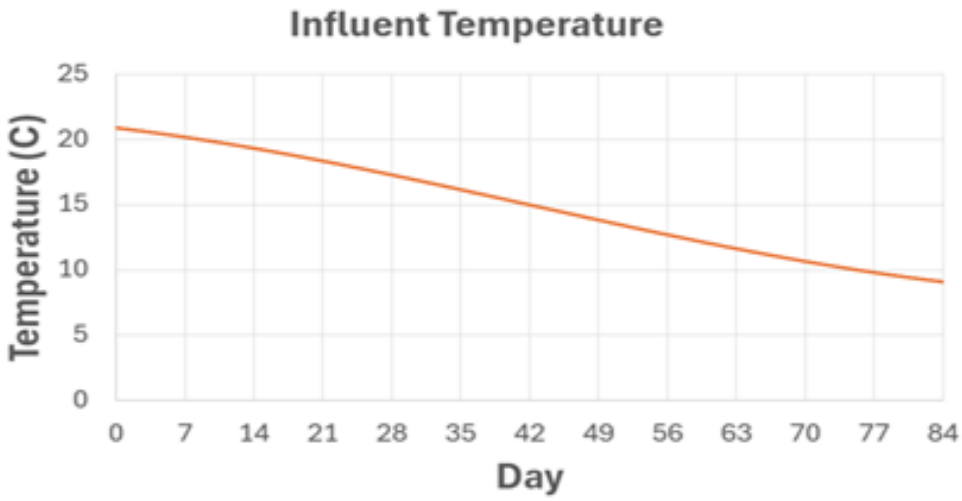
The input settings are bounded. If you set the value outside of the respective input range, the simulator will set it back to the limit.

Special Notes for Question 6: Dynamic: Seasonal Dynamics

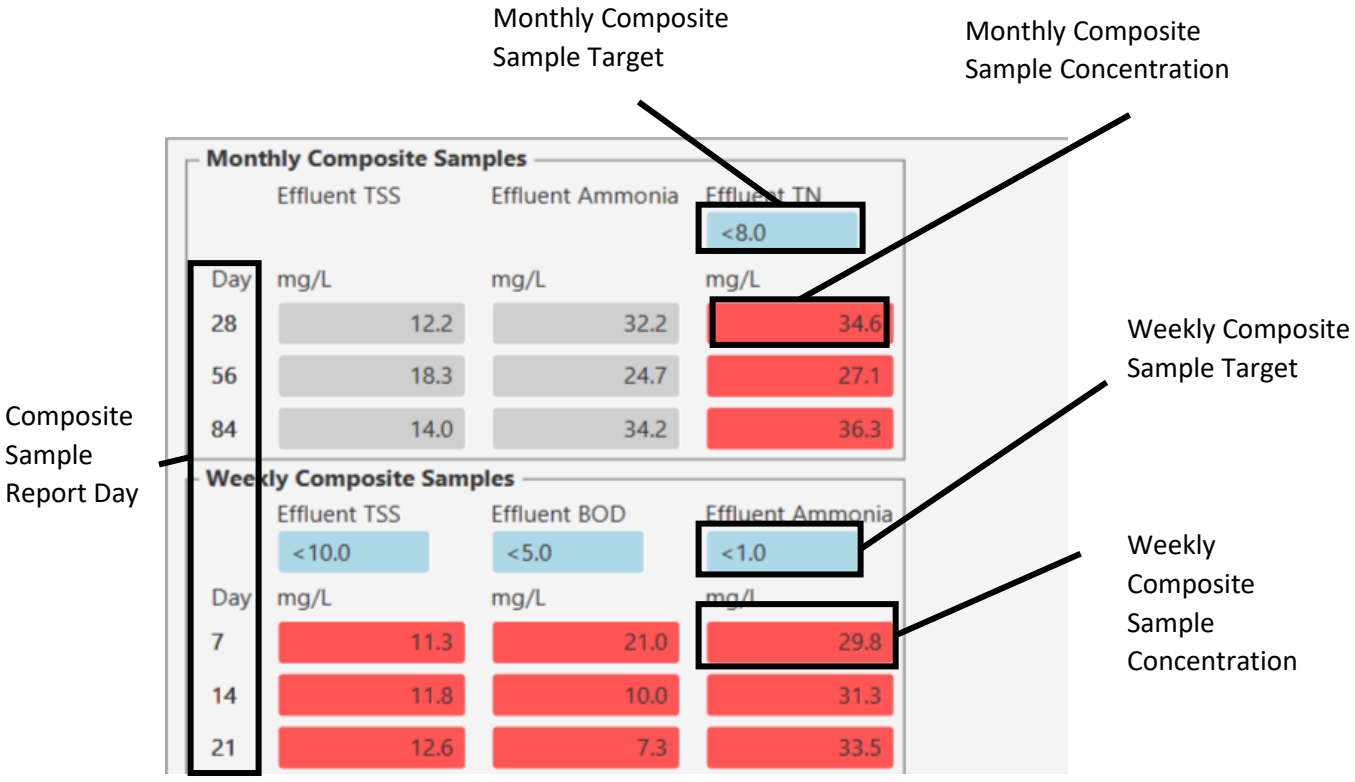
In Question 6, you will run an 84-day dynamic simulation where the influent follows a diurnal pattern. During simulation, the influent will undergo seasonal variations which causes the influent water temperature to increase over the course of the simulation as the plant transitions from winter to summer operation. On day 25, the plant begins to experience a rainfall event, resulting in increased influent flow rates. Only the flow rates and temperature changes over the course of the simulation.

The variations in influent flow rates and influent temperature over the 84-day dynamic simulation can be seen in the following images.





During the 84-day simulation, weekly (7-day) and monthly (28-day) composite samples (one sample taken each hour) will be reported at the end of each period in the tables in the lower-right corner of the screen. The red or green background will indicate whether the sample meets the specified target:



In order to score points for the weekly and monthly composite targets, **all composite samples must meet the target.** If the target is met for all samples, **75 points** are scored. For example, all 3 effluent TN monthly composite samples must be below 8.0 mg/L in the example above, and

since the samples do not meet the target, zero points would be scored for weekly effluent TN composite sample.

The four different parameters (in the above example, monthly composite effluent TN and weekly composite effluent TSS, BOD, and ammonia) are scored independently, so it is possible to get a score between 0 and 300 points on this question, depending on the operational choices made.

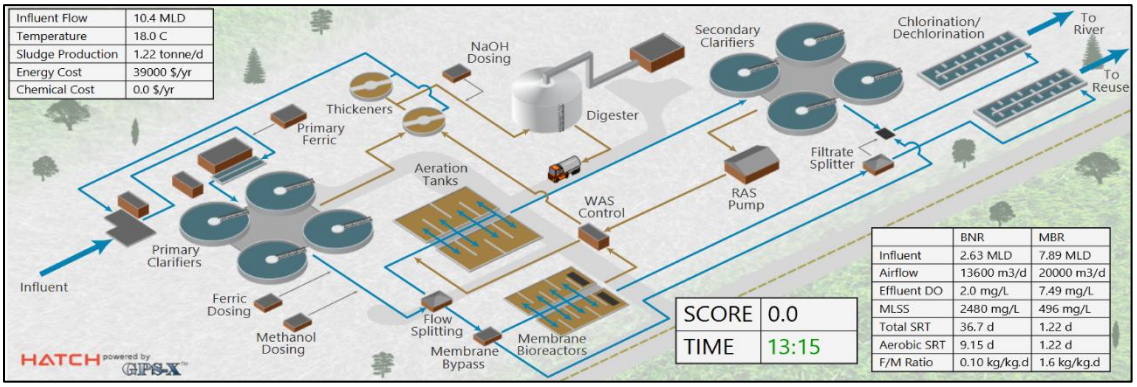
Additional Data for Question 6:

Parameter	Value
Influent Concentrations:	
COD	416 mg/L
TKN	42 mg/L
Ammonia	32 mg/L
Total Phosphorus	13 mg/L
Soluble Ortho-P	10 mg/L
pH	7 mg/L
Influent Flow	Daily diurnal pattern average = 1.06MGD (4,000 m3/d) During storm event, clean water is mixed with influent flow, peaking at ~1.6 MGD (6,000 m3/d) additional flow (see graph above).
Equalization Tank Volume	1 tank @ 1.32 MGal (5,000 m3) The simulation begins with the equalization tank empty.
Aeration Tank Volume	2 tanks @ 0.34 MGal (1,300 m3) each
Clarifier Surface Area	
Primary Clarifiers	4 clarifiers @ 3,875 ft2 (360 m2) each
Secondary Clarifiers	4 clarifiers @ 1,615 ft2 (150 m2) each

Optimal Process Parameter Ranges	
Aerobic Solids Retention Time (SRT)	3 – 15 days
Secondary Clarifier Solids Loading Rate (SLR)	<2.0 lb/ft2/hr <10.0 kg/m2/hr

Layout #2 – MBR Treatment Plant

Layout #2 contains a treatment facility that has two parallel treatment trains – one conventional activated sludge, and one that uses membrane bioreactor (MBR) technology, as shown below:



Note that there are two effluent points for this plant – one that goes to the river, and one that goes to water reuse. The activated sludge train can only discharge to the river, while the MBR train can discharge to either the river or the water reuse side. Note that there can be effluent targets for both effluent points for each challenge.

The plant consists of:

- an influent pumping station
- 4 circular primary clarifiers
- a flow-splitting station, to divide the flow between the activated sludge and MBR sides
- 2 parallel plug-flow activated sludge aeration tanks (4 zones in series)
- 4 circular secondary clarifiers
- 2 parallel membrane bioreactors (MBRs - 5 zones in series, including a small final zone containing the membranes)
- Membrane bypass
- 2 ferric dosage points (iron addition for chemical phosphorus precipitation) – **note that the 2nd dosage point is in a different location than the plant in Layout #1.**
- a methanol dosage point (for denitrification)
- a NaOH (sodium hydroxide) dosage point
- a recycled activated sludge (RAS) pumping station
- a waste activated sludge (WAS) pumping station – **both the activated sludge WAS flow and membrane bioreactor pumped flow are controlled from this building.**
- 2 gravity sludge thickeners
- an anaerobic digester
- 2 chlorine disinfection tanks (one each for the river outfall and the water reuse outlet), with chlorination/dichlorination options

The Challenge Questions for Layout #2

Teams will be presented with a total of 2 challenge questions for the plant in Layout #2. Teams can rerun questions as many times as needed. Make sure to click on the red SUBMIT button to register your answer each time you complete the question. Clicking on the SUBMIT button erases the previous answer for the question, so if you do the question several times, it will only remember the last answer that you submitted.

The question can cover a wide range of operational situations and require teams to make operational changes to the plant to achieve a given set of targets.

The following aspects of the plant can change in the question:

- Sizes of the aeration tanks
- Sizes of the MBR reactors and membrane surface area
- Surface areas of the clarifiers
- Number of primary clarifiers in service
- Number of aeration and MBR tanks in service
- Number of secondary clarifiers in service
- Influent loading (flow, COD, BOD_5, ammonia, temperature, pH)
- Starting pumped flow settings (RAS flow, WAS flow for either train)
- Starting aeration conditions (airflow, DO controllers, etc.)
- Starting chemical addition settings (methanol, ferric, chlorine, sodium hydroxide, sulfur dioxide)

Note that the MBR unit has a maximum flow rate that it can receive, and any additional flow above that limit will be bypassed around the MBR unit and sent to the river effluent. The maximum allowable flow rate can change through the question and is a function of the MBR SRT and MLSS. **Increase the SRT and/or lower the MLSS concentration to allow more flow through the MBR unit.**

Teams will receive **25 points** per target achieved in each question. The table below summarizes the point distribution per question:

#	Question	Maximum Possible Points
7	MBR Nutrient Removal	175
8	MBR Operation	100

Final Scoring

When the timer expires, the team's final score will be displayed. The final score will be the sum of all the points earned in all questions. **A perfect score is 1000 points.** There are no penalties for trying questions.