baywork bay area water/wastewater workforce reliability

GO WITH THE FLOW

WORKBOOK

East Bay Municipal Utility District

2/16/2018

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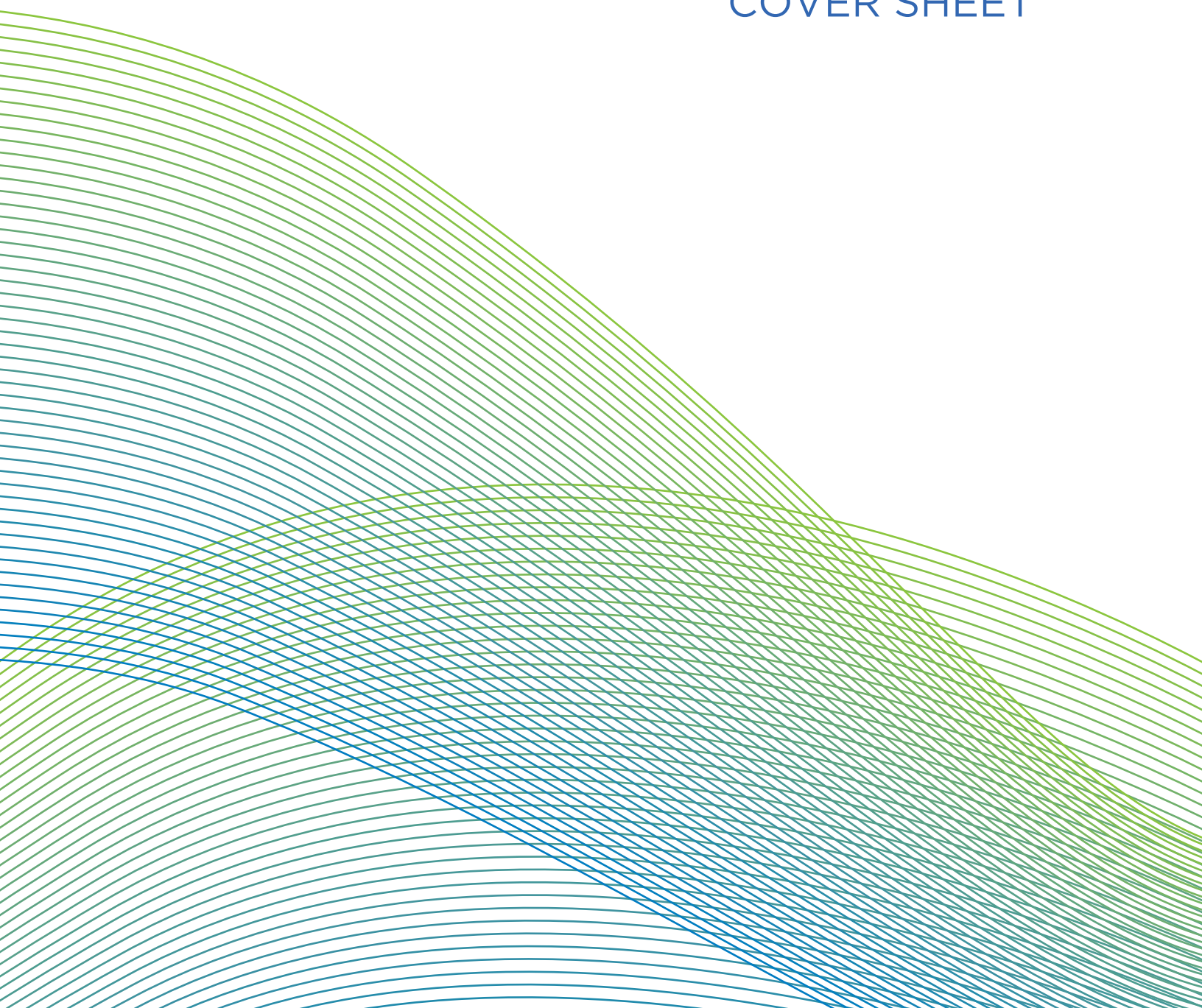
COVER SHEET



GO WITH THE FLOW

Cover Sheet for Instructors/Students

Water and wastewater treatment plants process very large quantities of water, sometimes 20-35 million gallons per day or more, depending on the size of the cities they service. Water Treatment Operators have to know ***how long*** it will take for water to get from one place to another based on "flow rate", which is measured in millions of gallons per day (MGD). The time it takes for water to flow from one end of a pipe or tank to the other is called "detention time".

Water Treatment Operators introduce chemicals into the water supply to remove particles in the water and to disinfect it so it is safe to drink. Have you had the experience of being in water that has been treated? Well, if you've ever been in a pool then you have been in water treated with chlorine.

Wastewater treatment facilities must treat enormous quantities of water with very specific quantities and combinations of chemicals at very precise moments in time as the water flows from the beginning to the end of the treatment plant. Therefore the plant operators who are responsible for treating the water must be able to calculate the volume of water and the speed at which it moves from one place to another. ("detention time")

Here are some terms and mathematical concepts that must be understood before a student can make these flow rate calculations accurately:

Volume: In this context we will be talking about square or rectangular basins. (See additional problem below to deepen learning and consider a cylindrical pipe)

The volume of water in a rectangular basin is obtained by calculating the product of the length and width of the basin and then multiplying that figure by the height of the water. Notice, the height of the water is not the same as the height of the tank.

Conversion: 7.48 gallons of water = 1 cubic ft.

Therefore 1 gallon of water occupies 0.133689 cubic feet. (Do you see how we obtained this number?)

If we calculate the volume of a basin in cubic feet, we can easily convert that volume number to gallons. In other words we can find out how many gallons would occupy a certain sized container.

If you are given flow rate in terms of gallons per ***day***, can you convert that number to gallons per ***hour***? How? What about gallons per ***minute*** or gallons per ***second?***

Now imagine a fixed quantity of water flowing through a basin…would the water flow more quickly or more slowly if the basin were smaller? Are you sure? How can you test this hypothesis?

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WARM-UP EXERCISE

GO WITH THE FLOW

WARM-UP

1) A water reservoir at EBMUD has a volume of 11,454 $\frac{5}{8}$ cubic feet.

   What are the possible dimensions of this reservoir?

   a) 11 ft wide 45 ft long 4 $\frac{5}{8}$ ft deep

   b) 22.75 ft wide 38 ft long 14.25 ft deep

   c) cannot be calculated

   d) 13 ¼ ft wide 22 ¾ ft deep 38 ft long

2) Convert 15 million gallons per day to gallons per minute.

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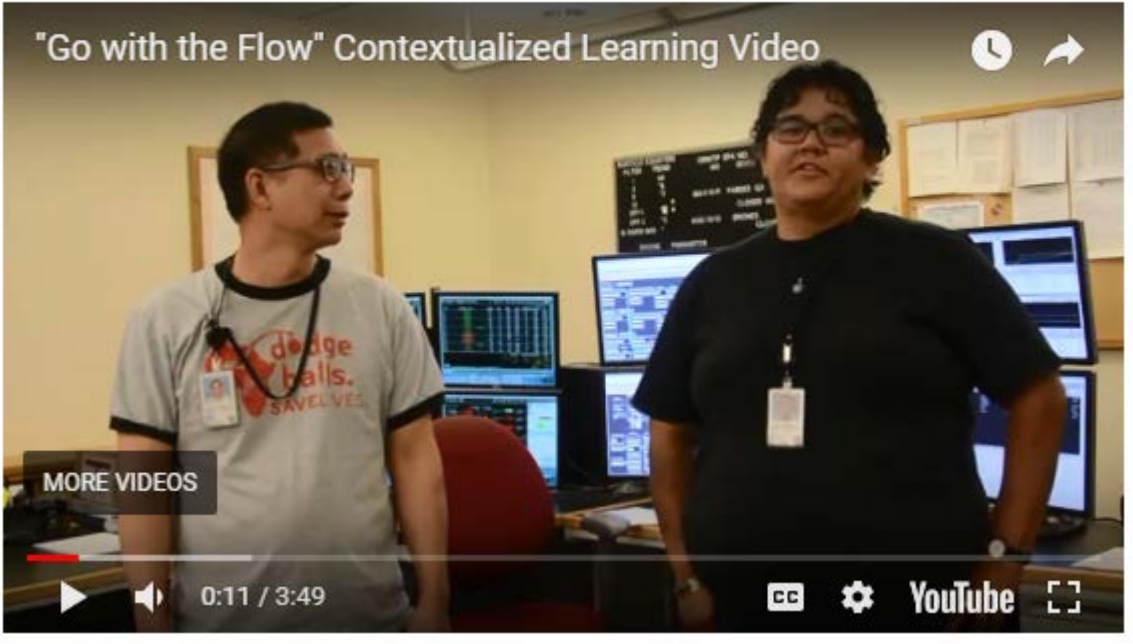
VIDEO

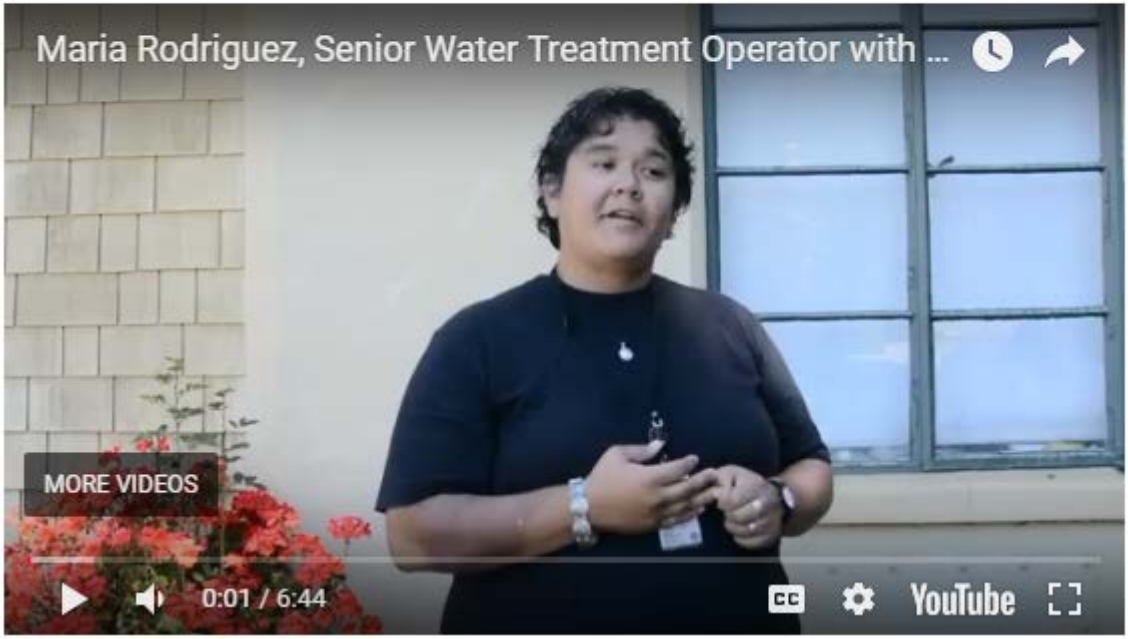
“Go with the Flow” Contextualized Learning Video

May 9, 2016



Maria Rodriguez, Senior Water Treatment Operator, East Bay Municipal Utility District

June 17, 2016



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Maria Rodriguez, Senior Water Treatment Operator, East Bay Municipal Utility District (Spanish version)

October 12, 2016

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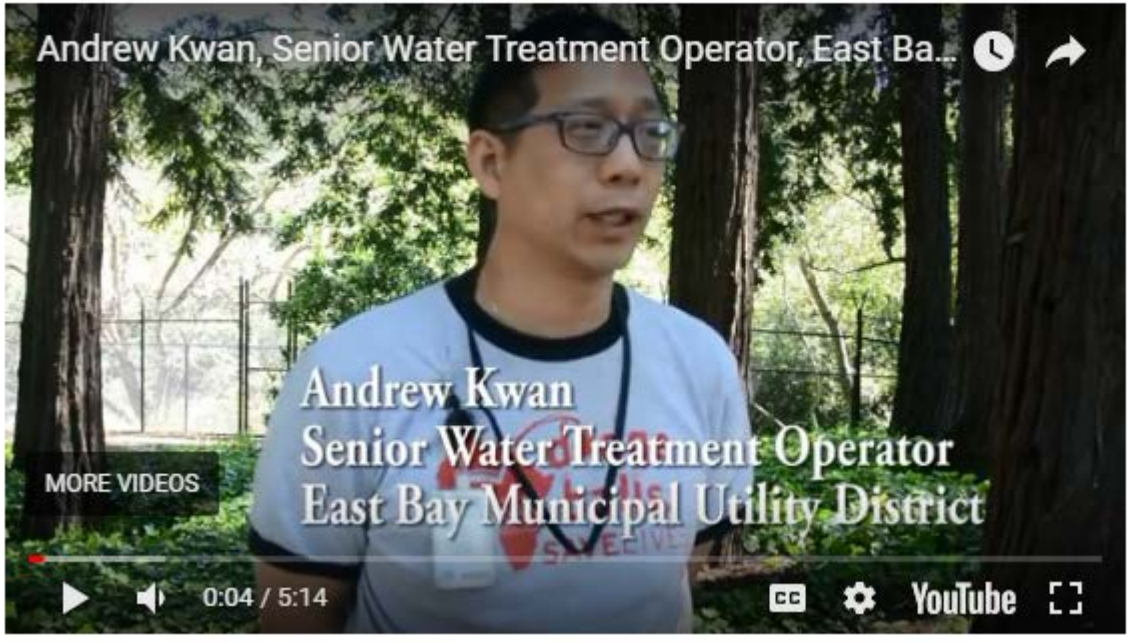
Andrew Kwan, Senior Water Treatment Operator, East Bay Municipal Utility District

June 17, 2016



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WORKSHEET

GO WITH THE FLOW

Worksheet for Students

Consider a water treatment plant that has two rectangular basins. The basins are next to each other, side by side. The raw water from a lake or river flows into the plant and is divided equally into the two basins. We will refer to these as Basin 1 and Basin 2. Basin 1 mixes the treatment chemicals to coagulate the particles in the water, and Basin 2 allows the coagulated dirt in the raw water to sink to the bottom of the basin. Basin 1 measures 62 feet-6 inches wide, 64 feet-6 inches long and 16 feet-6 inches tall. This basin contains 14 feet-9 inches of water. Basin 2 is 67 feet wide, 211 feet-6 inches long, and 18 feet-6 inches deep. This basin contains 16 feet-6 inches of water. **The flow in each basin is 9.5 million gallons per day (MGD).**

How long will it take for the water to flow from:

1) The beginning of the Basin 1 to the end of the Basin 1?

2) The beginning of the Basin 2 to the end of the Basin 2?

3) The beginning of the Basin 1 to the end of Basin 2?

If the plant had a problem and needed to take a basin out of service to clean or repair it, as discussed in the video, this would have an impact on detention time. The entire plant flow of 19 MGD would have to flow through one basin instead of two.

4) How would this change the detention time through that one remaining basin? [assume basin 1 has been taken out of service]

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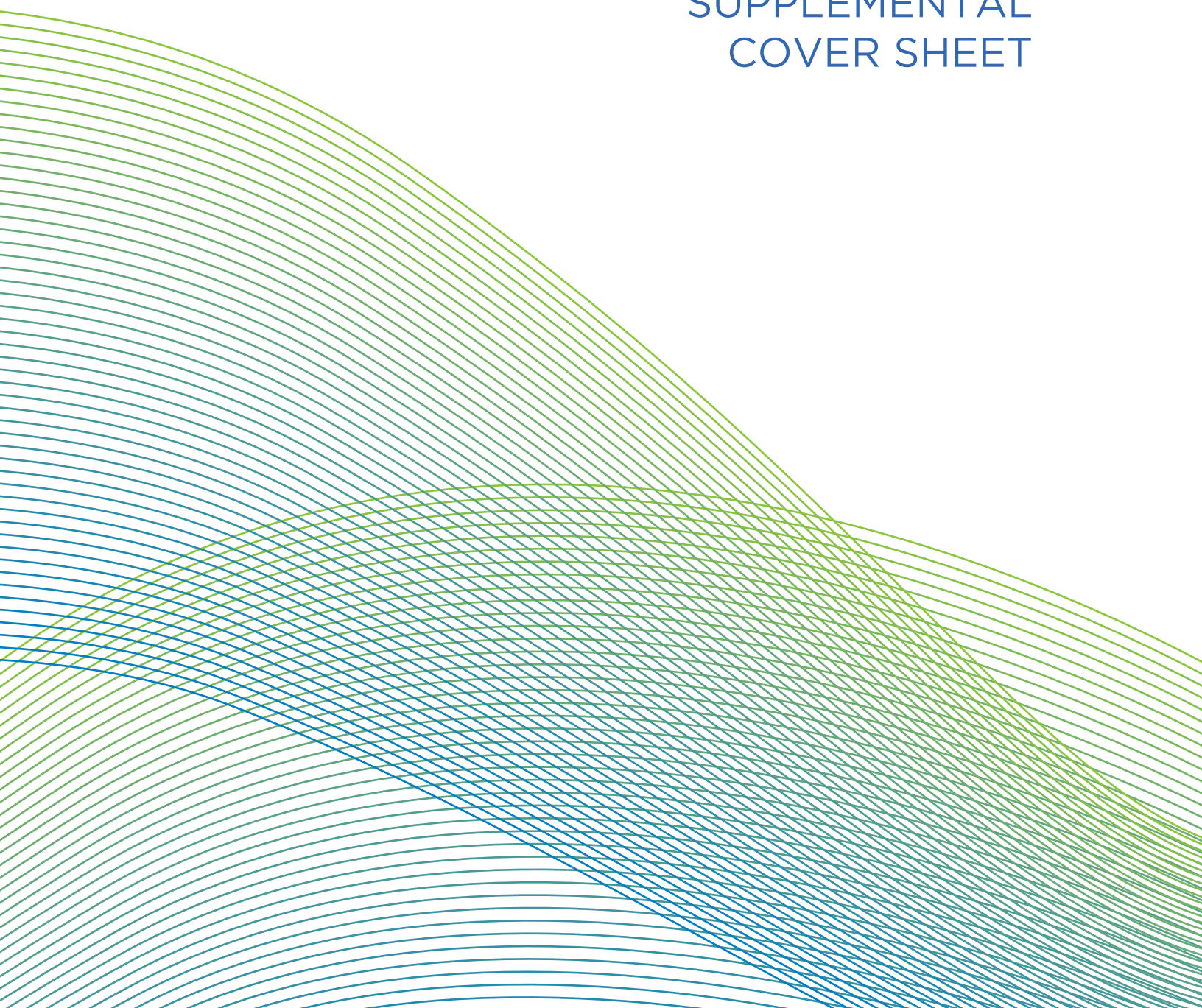
SUPPLEMENTAL COVER SHEET



GO WITH THE FLOW: Supplement, cylindrical pipe

Cover Sheet for Instructors/Students

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Here are some terms and mathematical concepts that must be understood before a student can make these flow rate calculations accurately:

Volume: In this context we will be talking about cylindrical pipes.

The volume of water in a cylinder is obtained by the following calculation:

$\pi r^2 l$ where 'r' is the radius of the pipe and 'l' is it's length (make sure units match)

Conversion: 7.48 gallons of water = 1 cubic ft.

Therefore 1 gallon of water occupies 0.133689 cubic feet.

If we calculate the volume of a pipe in cubic feet, we can easily convert that volume to gallons. In other words we can find out how many gallons would occupy a certain sized container/cylinder.

If you are given flow rate in terms of gallons per ***day***, can you convert that number to gallons per ***hour***? How? What about gallons per ***minute*** or gallons per ***second?***

Now imagine a fixed quantity of water flowing through a pipe…would the water flow more quickly or more slowly if the pipe had a smaller diameter? Are you sure? How can you test this hypothesis?

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SUPPLEMENTAL WARM-UP EXERCISE

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SUPPLEMENTAL WORKSHEET

GO WITH THE FLOW

SUPPLEMENTAL <u>WORKSHEET FOR STUDENTS</u>

Consider a water treatment plant that uses cylindrical pipes:

A treatment plant has a pipe that is 1111 ft.* long and 36 inches in diameter. The flow rate in the pipe is 20 million gallons per day.

a) How long will it take for the fluid to flow from one end of the pipe to the other?

b) What is the velocity in the pipe in feet per second?

***** For reference, a football field is 360 ft.long, so this pipe is approx the length of 3 football fields

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EXIT TICKET

GO WITH THE FLOW

Exit Ticket:

1. In your own words, describe what you learned today. Try to use as much technical terminology as possible to describe the situation you viewed in the video and the corresponding math problem.

2. How difficult did you find this problem?

3. What part of the problem was most difficult for you?

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STUDENTS FEEDBACK FORM

Feedback Form for Students (Online)

Go here for the Online Version of Feedback Form:
https://goo.gl/forms/3vSjzMuzFDuxY1y73

Feedback Form for Students

Please rate each of the following aspects of this lesson:

	Excellent	Very Good	Good	Fair	Poor	Very Poor
1. Video						
2. Lesson Presentation						
3. Worksheet						
4. Time Allotted						

5. What aspect or part of this lesson do you believe was the most effective at helping you reach the learning goal?

6. Where would you have wanted more training or help on this?

7. Did this curriculum increase your awareness of the water/wastewater industry?

8. Additional Comments/Suggestions: