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THE PERFECT STORM

WORKBOOK

East Bay Municipal Utility District

2/16/2018

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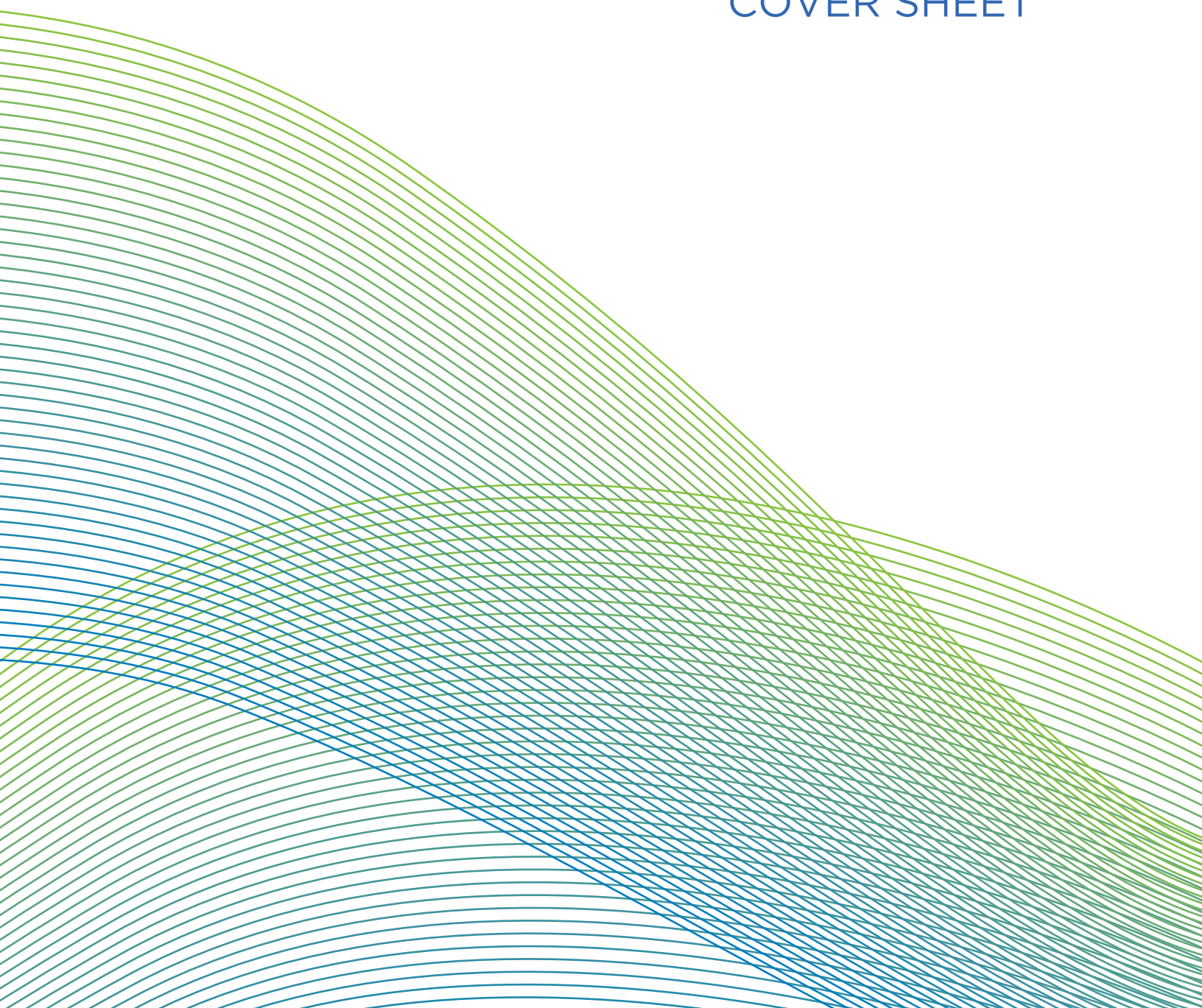
COVER SHEET



The Perfect Storm

Introduction: The following lesson introduces students to linear functions in the context of water pressure vs. water tank's height.

Materials:

- Projector connected to a computer with internet to play videos for the lesson
- Copies of each of the following:
    - Warm-Up and Exit Ticket
    - The Perfect Storm Worksheet
    - Water Treatment Conversion Sheet Entitled "State of California, Department of Public Health: Drinking Water Operator Certification Program"
    - Student Surveys

Estimated Timeframe:

- 45 minutes to an 1 hour, depending on how you spread and imbed your think time

Prior Knowledge/Skills Needed:

Before this application lesson, students must be able to:

- Find the equation of a line given 2 points
- Find percent of a number

Common Core State Standards:

CCSS.MATH.HS.A-CED.2: Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

CCSS.MATH.HS.A-REI.3: Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.

Additional Common Core State Standards:

CCSS.MATH.HS.N-Q.1: Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

CCSS.MATH.HS.N-Q.2: Define appropriate quantities for the purpose of descriptive modeling.

CCSS.MATH.HS.A-SSE.1: Interpret expressions that represent a quantity in terms of its context.

CCSS.MATH.HS.A-CED.3: Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context.

Implementation Suggestions:

- Ask students to think/write/pair/share often so students can verbalize and communicate their mathematics
- Students should do work on the board in groups or pairs

Accommodations/Modifications:

- For English Language Learners:
    - Be sure to have precise definitions of content vocabulary ready ahead of time.
    - Be sure to include think time when appropriate.
    - Ask students to Think/Write/Pair/Share between for each question
- For SPED/504:
    - Allow students to use a calculator for calculations
    - Focus on having students verbalize the process in their own words
    - While students are finding solutions you may ask students for estimated solutions first, this helps students see if they are headed in the right direction with their answers

Extensions:

- Students can use maximum and minimum values to calculate the lines that represent the upper and lower boundaries of the appropriate
- Students can graph the set of solution values (region between the line representing expected values + 2% and expected values – 2%).

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WARM-UP EXERCISE

Warm-Up:

1. Find the equation of the line between the points $(1.2, -3.5)$ and $(-8.4, 7.9)$.

2. You buy a bottle of water that says it should have 16.9 ounces in it, but it actually has 16.5 ounces in it. What is the percent error between those amounts? What does that number mean in this context?

Exit Ticket:

1. In your own words, describe what you learned today?

2. How difficult did you find this problem?

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

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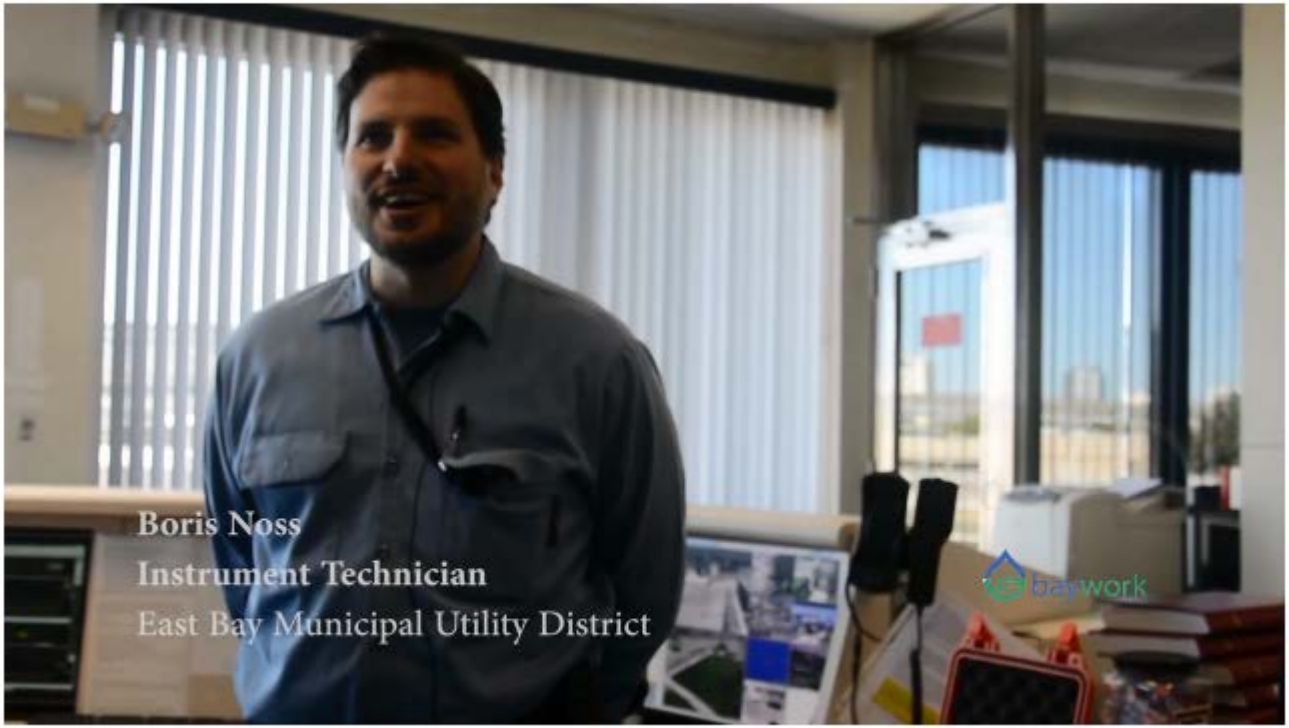
VIDEO

"The Perfect Storm" Video

January 1, 1970

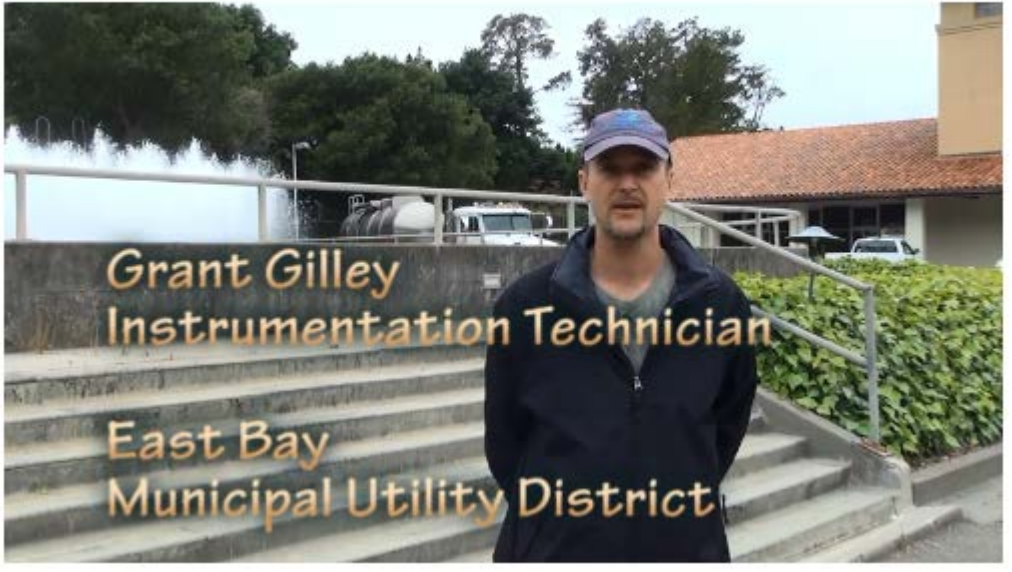
Boris Noss, Instrument Technician, East Bay Municipal Utility District

October 5, 2016



Grant Gilley, Instrument Technician, East Bay Municipal Utility District

November 30, 2016



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WORKSHEET

The Perfect Storm Worksheet

The transmitter senses the water pressure (sensor's input), which is determined by the water height in the tank; the transmitter sends a representative signal (transmitter's output) to the plant's control system. The transmitter's *LINEAR* output signal represents water height in the tank, in such a way that a signal of 4 milliamps represents a water level of 0 feet, and a signal of 20 milliamps represents a level of 19.8 feet of water. We used this pressure pump to apply a precise pressure to the sensor at 5 points along its "input range" and we wrote down the output signal values for each step. We need to see if the sensor's output is within 2% tolerance, of the original input versus output signal range it was calibrated to represent.

Below are the data we gathered from the transmitter. Is this within tolerance? Use this worksheet to help us solve this problem.

Input (ft)	0	4.9	9.8	14.7	19.6
Actual Output (mA)	3.96	7.76	11.52	15.52	19.4
Expected Output(mA)					
Precent Error					

The **actual output** values are the actual values from the transmitter. We're not sure if they are accurate so we need to find the **expected output** values from a mathematical model. By comparing the expected and actual output values, we can determine if the transmitter is functioning correctly. To create a math model we need to know a little about the tank and the transmitter. The tank can have between 0 to 19.6 feet of water in it. The transmitter ranges from 4 to 20 mA. Thus if there is 0 feet of water in the tank, the transmitter should read 4mA. If there is 19.6 feet of water in the tank the transmitter should read 20mA. This will take a few steps. Are you ready?

Create a linear equation and then fill in the expected outputs.

1. Define your variables in a complete sentence and algebraically.

2. Determine the constants of the equation. For linear equations, this is the slope and the y-intercept.

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EXIT TICKET

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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: