INTRODUCTION TO WASTEWATER ENERGY OPTIMIZATION

SESSIONS 1& 2 WORKBOOK

AGENDA

SESSIONS 1 & 2
Opportunity Register
Plant Process Conservation
Wastewater Efficiency – Cheat Sheet
Plant Energy Basics and KPIs
Follow the BOD
Pumping Systems and Energy
W3 Systems & The DIY W3 Walkthrough
Energy Hot Spots

INTRO TO OPPORTUNITY REGISTER

	Opportunity #	Opportunity Name	Description	Location	System*	Submitted By
2						
3						
4						
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ENERGY BASICS EXERCISE

Purpose

To develop knowledge, comfort and proficiency with:

- energy units and calculations
- the relationship between energy and water

In the winter of 2019, Sickofthetide, Alabama's WRRF received the electric bill shown below. Sickofthetide's facility is an activated sludge plant that processes wintertime flows averaging 6.5 MGD.

ACME ELECTRIC — February 2019

Account ID	0004 1234-56789 8
Billing Dates	12/31/2018- 1/31/2019 32 days of service

Invoice Number	**123456789**
Current Charges	**$29,760.80**
Due By	**2/15/2019**

METER # ABC123456, Schedule 81 Secondary

Service Description	
Basic Charge	560.00
System Usage Charge	593.85
Off-Peak Usage of 195446.000 kWh x $0.0335	6,547.44
On-Peak Usage of 295347.000 kWh x $0.0504	14,885.49
Demand Charge of 932.000 kW x $1.9500	1,817.40
Transmission Charge of 932.000 kW x $0.910	848.12
Distribution Facility Capacity Charge of 1017.00 kW x $2.0600	2,095.00
	$27,347.32
Taxes and Adjustments	
City Tax (1.5%)	410.21
Public Purpose Charge (3%)	820.42
108 Regulatory Adjustments	29.47
115 Energy Efficiency Funding	1,153.38
	$2,413.48

Period Ending	Avg Daily Temp	Avg kWh per day	Avg Cost per day
1/31/2019	71.5	15338	930.03
1/31/2018	73.1	15021	889.25

Instructions:
Using information from the energy bill above, answer the questions in the activity sheet on the next page.

ACTIVITY SHEET – ENERGY BASICS EXERCISE DAY 1

a. How many kilowatt-hours of electricity did this facility use during this billing cycle? (January 2019)

b. How much cheaper is their off-peak rate than their on-peak rate?

c. The plant runs two of its four 150 hp blowers all the time in the winter. How many kW of power do the two blowers draw?

d. How many kWh do the two blowers consume on average every day?

e. From the info above, what is the average whole-plant benchmark in kilowatt-hours per million gallons treated?

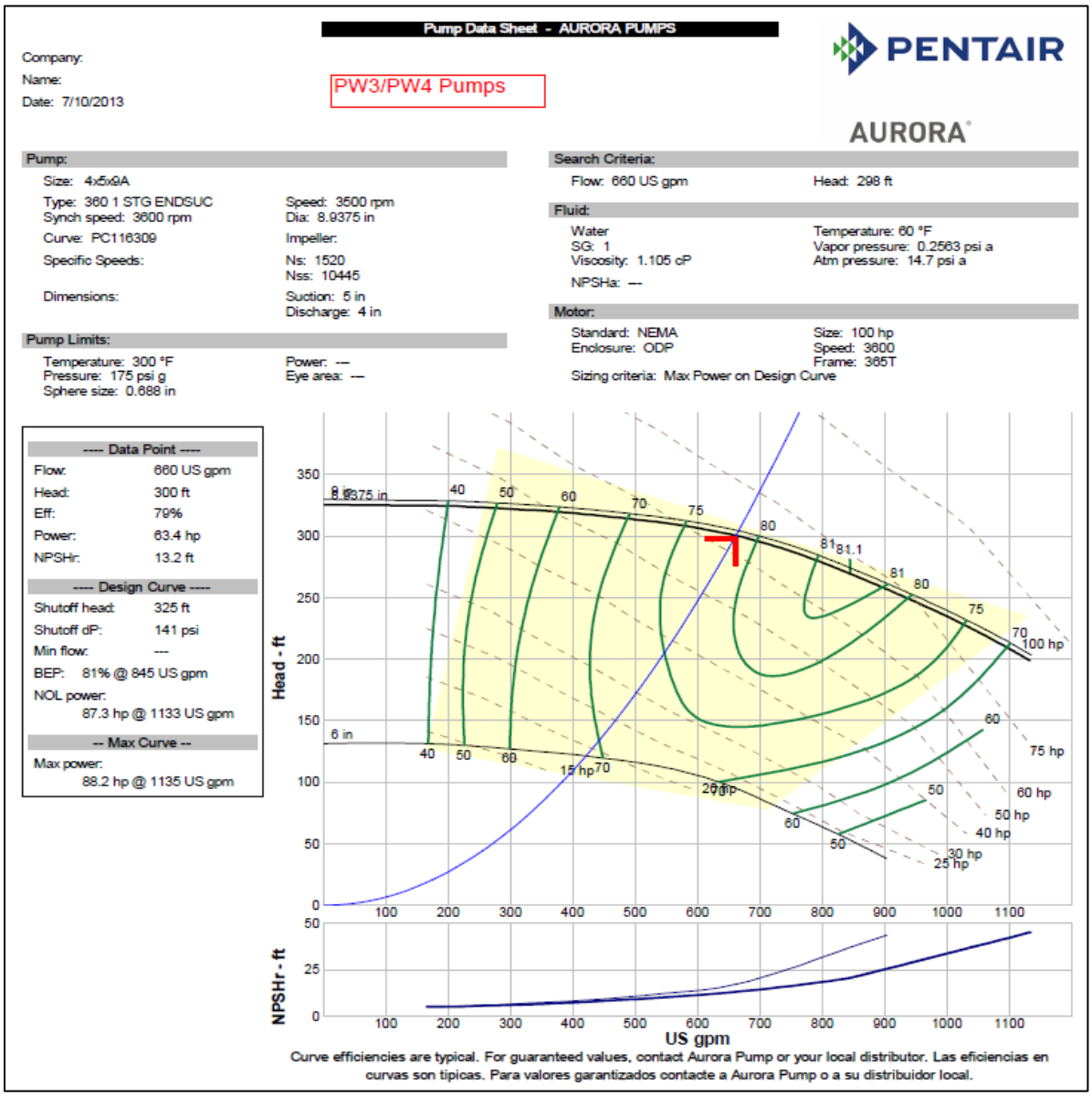
DIY W3 WALK-THROUGH

EXERCISE – PUMP CURVE

Purpose

To develop knowledge, comfort, and proficiency with reading a pump curve and understanding the energy-use implications.

This is a 100 hp pump, selected to provide 660 gpm at 298 feet of head.

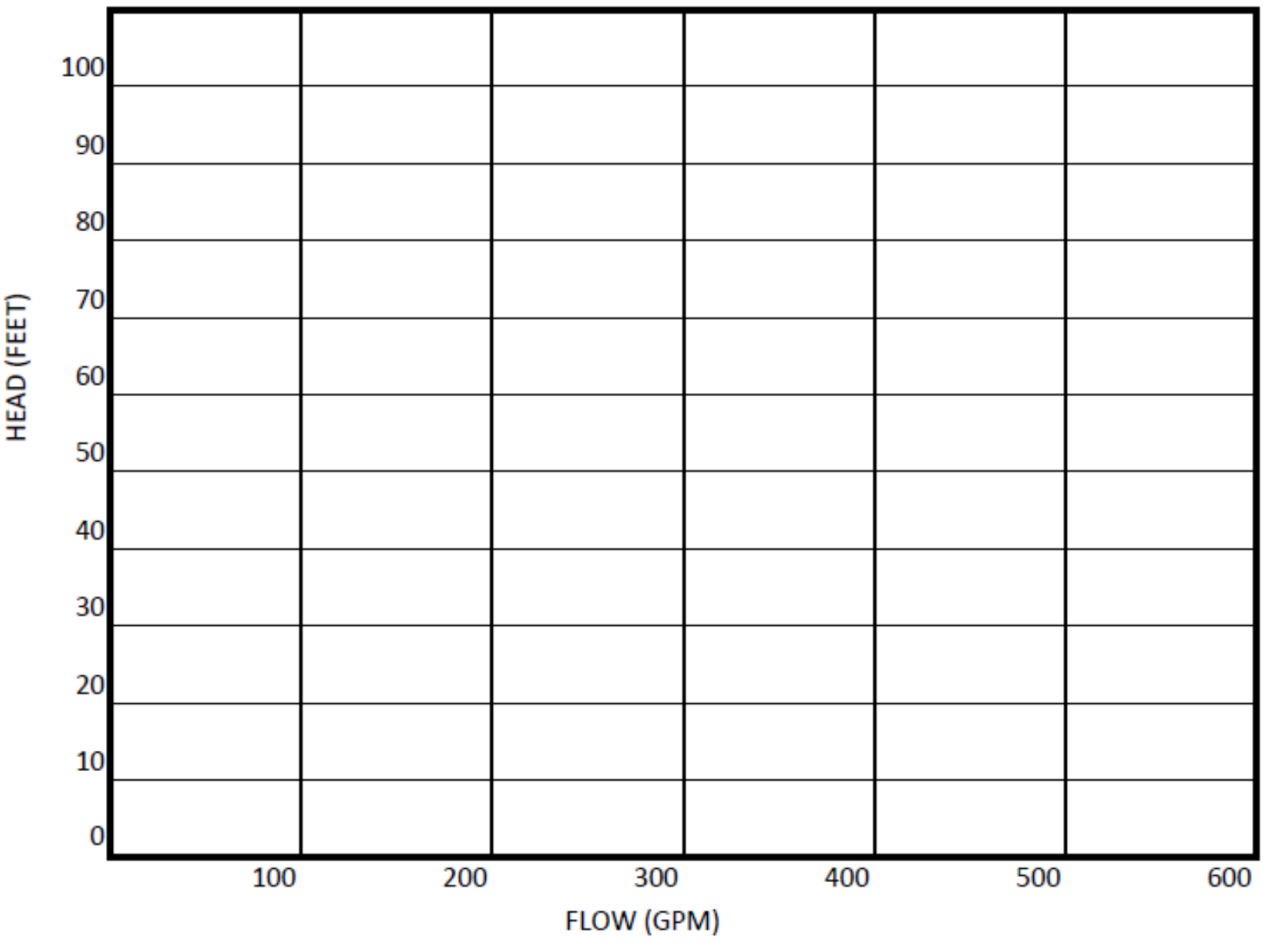


Instructions: Using information from the pump curve above, answer the questions in the activity sheet on the next page.

ACTIVITY SHEET – EXERCISE – PUMP CURVE

a. At the selection conditions of 660 gpm at 298 feet of head, what is this pump's efficiency?	%	
b. If we throttle this pump to decrease the flow to 300 gpm, what will be the resulting **head pressure**?	ft	
c. If we throttle this pump to decrease the flow to 300 gpm, what will be the resulting **pump efficiency**?	%	

ACTIVITY SHEET – EXERCISE – DESIGN ENGINEER FOR A DAY!



FIRM: _____

SYSTEM CURVE BY: _____ DATE: _____

PUMP SELECTION BY: _____ DATE: _____

Condition	Flow (gpm)	Operating kW	kWh/MG	GPM / kW
Design				
Installed				
Throttled				
VFD				

PUMPING ENERGY MATH SCRATCHPAD

Q = GPM; H = FEET; S.G. = 1 FOR WATER; η = PUMP EFFICIENCY

$$BHP = \frac{S.G. * Q * H}{3960\eta}$$

SESSION 2 OPPORTUNITY REGISTER JAM SESSION

ANSWER SHEETS

ANSWER SHEET – ENERGY BASICS EXERCISE DAY 1

a. How many kilowatt-hours of electricity did this facility use during this billing cycle? (January 2019)
   A = 490,813 kWh
b. How much cheaper is their off-peak rate than their on-peak rate?
   A = $0.0504 - $0.0335 = $0.0169, 1.7 cents per kWh
c. The plant runs two of its four 150 hp blowers all the time in the winter. How many kW of power do the two blowers draw?
   A = 2 x 150 hp x 0.75 kW/hp = 225 kW
d. How many kWh do the two blowers use on average every day?
   A = 225 kW x 24 h/d = 5,400 kWh
e. From the info above, what is the average whole-plant benchmark in kilowatt-hours per million gallons treated?
   A: 490,793 kWh / 32 days = 15,338 kWh/d; 15,338 kWh/d ÷ 6.5 MGD = 2,359 kWh/MG

ANSWER SHEET – EXERCISE – AERATION PRESSURE

a. How much energy is saved if this 50 hp blower's discharge pressure is reduced from 7 psig to 5.5 psig? _____ kWh/year

   A = 52,431 kWh/year

b. What if it's a 150 hp blower, and the pressure is lowered from 10 psig to 9.5 psig. What percentage of energy is saved? _____%

   A = 4.1%

c. If a 75 hp blower is turned down from 11 psig to 9 psig, how much money is saved (if energy costs 6¢ per kWh)? $_____/year

   A = $3,827/year

d. If a 40 hp blower is turned down from 8 psig to 7 psig, how much energy is saved, and what percentage does that represent? _____kWh/year, _____%

   A = 24,263 kWh/year, 10.6%

ANSWER SHEET – EXERCISE – PUMP CURVE

a. At the selection conditions of 660 gpm at 298 feet of head, what is this pump's efficiency? _____ %

   A = 79%

b. If we throttle this pump to decrease the flow to 300 gpm, what is the resulting head pressure? _____ feet

   A = approximately 325 feet

c. What will be the resulting pump efficiency at 300 gpm? _____%

   A = approximately 52%