

Name: _____

CVEN 458 – Hydraulic Engineering of WDS
 Spring Semester 2012
 Dr. Kelly Brumbelow, Texas A&M University

Exam #2

Open-book, Open-notes (8 pages, 2 questions); Time allowed: 75 minutes

1. An emergency interconnect is under design so that the town of Hilltop’s WDS can receive water from the Valleytown WDS. Due to the difference in elevation between the two systems, a pump station will be needed, and the current design under consideration includes 2 pumps in parallel: Aurora model 3550 4x6-10 (10.25 in impeller) and Aurora model 3550 6x8-15 (12.25 in impeller). Technical data for these pumps is given in the attached sheets (ignore the blue triangles in the middle of the graphs). The interconnect pipeline will be 525 ft long, 12 inch diameter, cast iron ($C = 100$), and you should use the Hazen-Williams equation to compute head loss in this pipe:

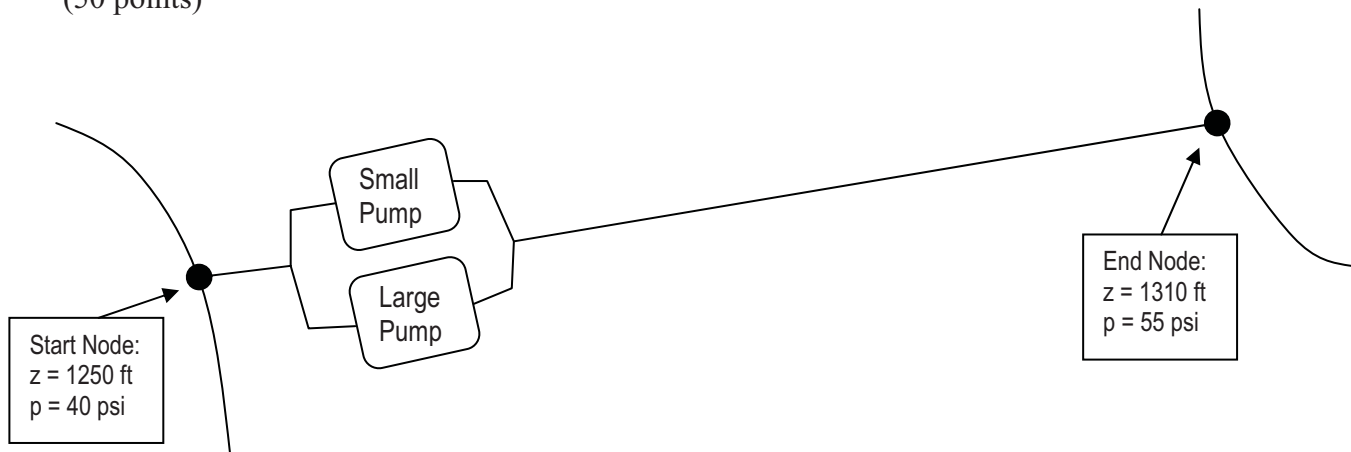
$$Q = 0.281 C D^{2.63} \left(\frac{H_f}{L} \right)^{0.54} \quad \text{or} \quad H_f = \frac{10.47 L}{C^{1.85} D^{4.87}} Q^{1.85}$$

where $[Q] = \text{gpm}$, $[D] = \text{in}$, $[L] = \text{ft}$, and $[H_f] = \text{ft}$.

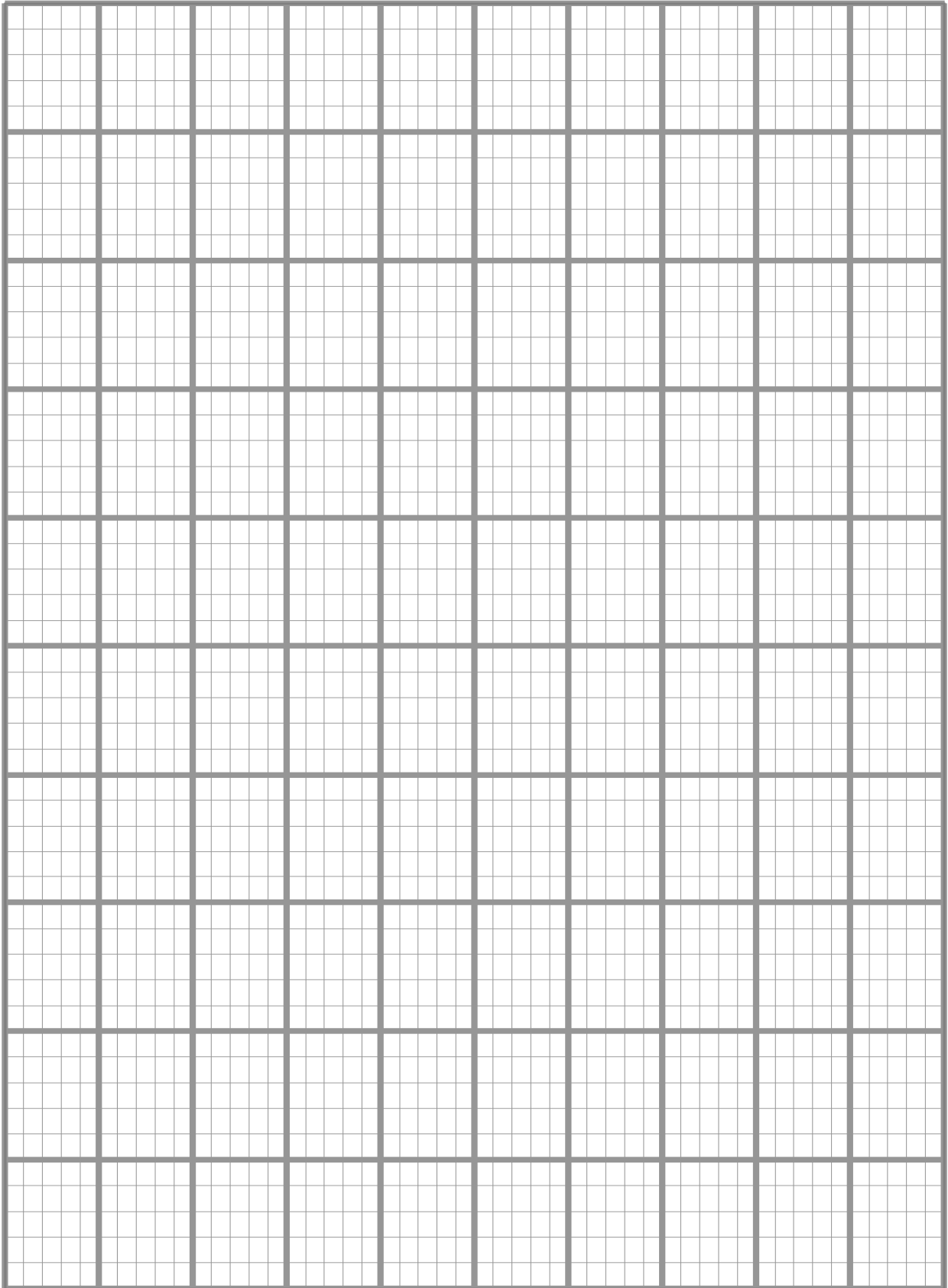
The interconnect pipeline and pump station are sketched below. A sheet of graph paper is also attached. Determine the following:

- a) What will be the flowrate (gpm) in the pipeline and shaft energy consumption (kW) of the pump when only the “small” pump (4x6-10) is operating?
- b) What will be the flowrate (gpm) in the pipeline and shaft energy consumption (kW) of the pump when only the “large” pump (6x8-15) is operating?
- c) What will be the flowrate (gpm) in the pipeline and shaft energy consumption (kW) of the pump station when both pumps are operating?

(50 points)



1 cfs = 448.83 gpm; 1 kW = 737.56 ft-lb/sec



$$1 \text{ cfs} = 448.83 \text{ gpm}; \quad 1 \text{ kW} = 737.56 \text{ ft-lb/sec}$$

{Work space for #1}

Pump Performance Datasheet

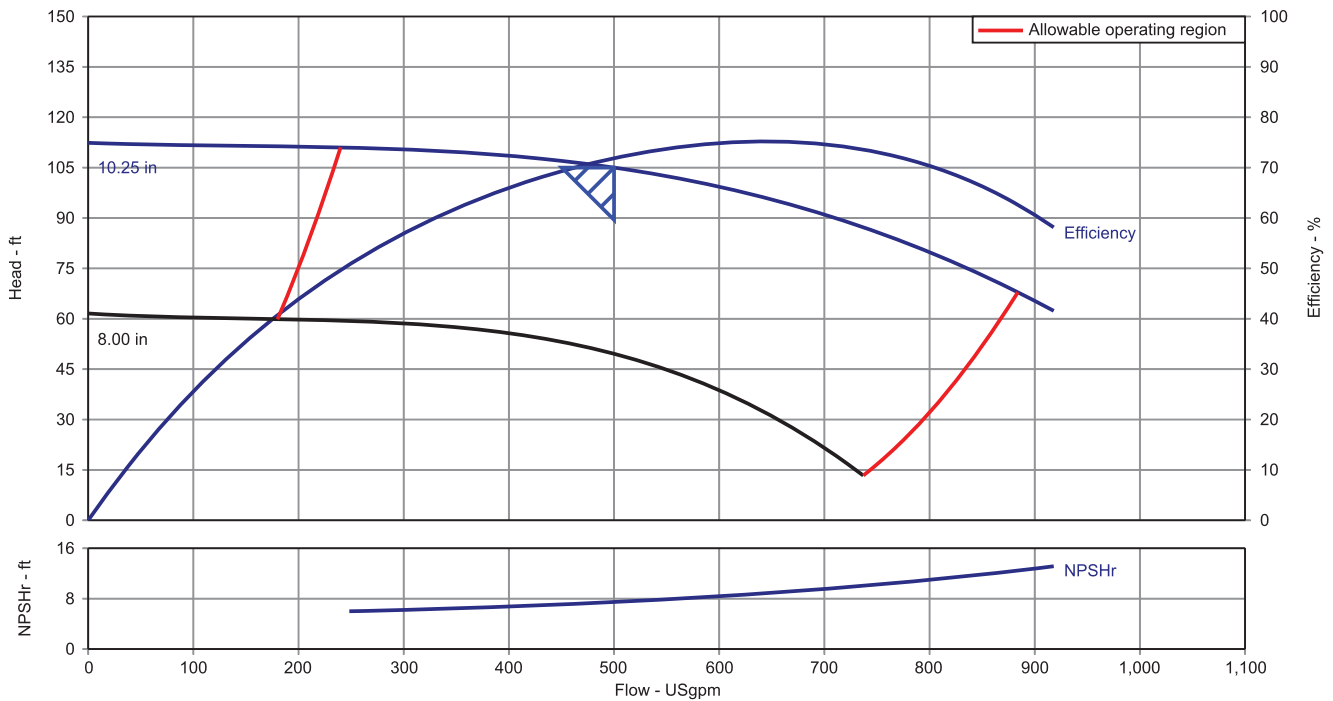
Customer :	Quote number :
Customer reference :	Size : 3550-4x6-10
Item number :	Stages : 1
Service :	Based on curve number : 553-4x6x10G-1770
Quantity : 1	Date last saved : 24 Apr 2012 4:41 PM

Operating Conditions	Liquid
Flow, rated :	Liquid type : Water
Differential head / pressure, rated (requested) :	Additional liquid description :
Differential head / pressure, rated (actual) :	Solids diameter, max : 0.00 in
Suction pressure, rated / max :	Solids concentration, by volume : 0.00 %
NPSH available, rated :	Temperature, max : 68.00 deg F
Frequency : 60 Hz	Fluid density, rated / max : 0.999 / 0.999 SG
	Viscosity, rated : 1.00 cP
	Vapor pressure, rated : 0.34 psi.a

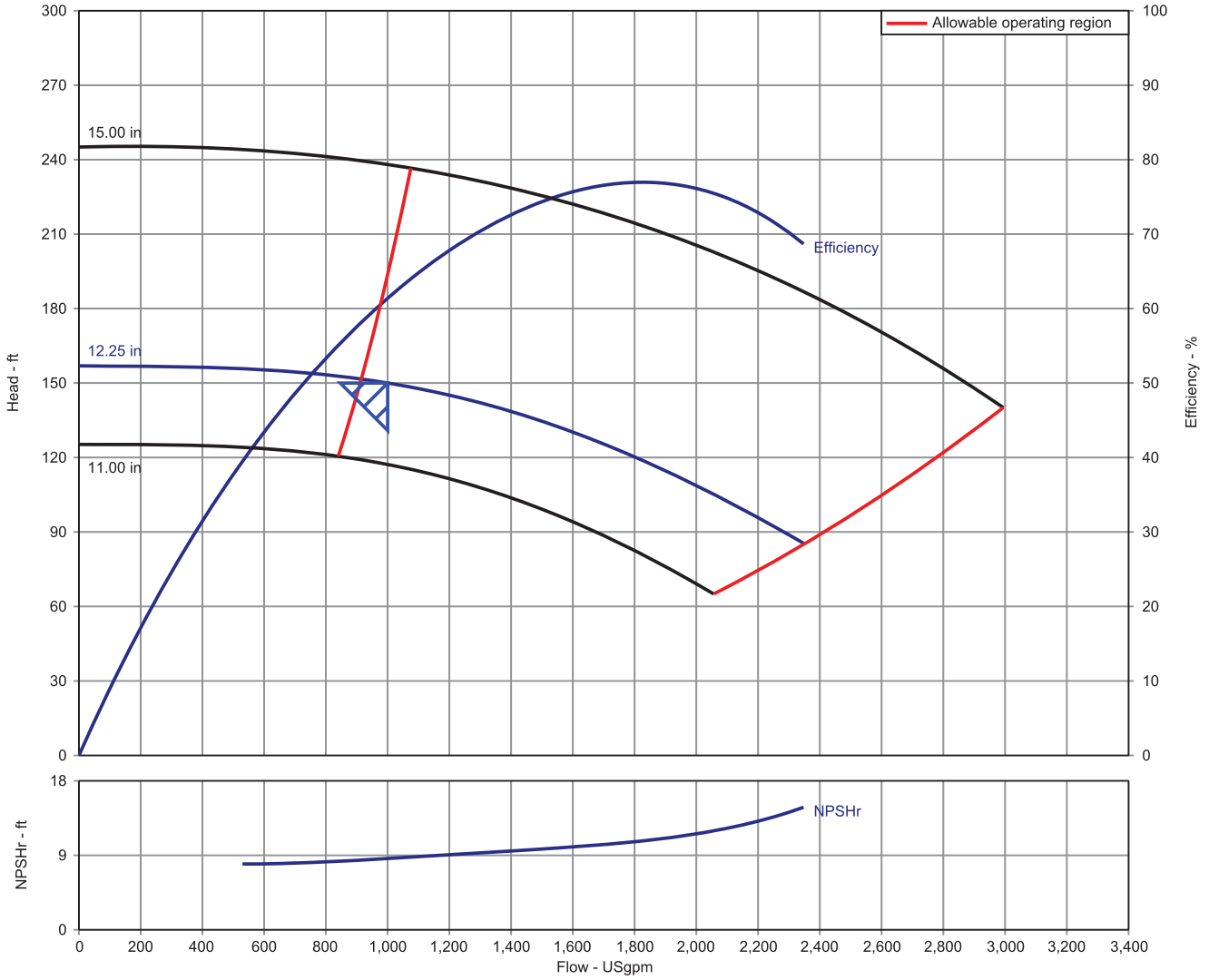
Performance	Material
Speed, rated : 1,770 rpm	Material selected : 316 Stainless Steel
Impeller diameter, rated :	
Impeller diameter, maximum :	
Impeller diameter, minimum :	
Efficiency :	
NPSH required / margin required :	
nq (imp. eye flow) / S (imp. eye flow) :	
Minimum Continuous Stable Flow :	
Head, maximum, rated diameter :	
Head rise to shutoff :	
Flow, best eff. point (BEP) :	
Flow ratio (rated / BEP) :	
Diameter ratio (rated / max) :	
Head ratio (rated dia / max dia) :	
Cq/Ch/Ce [ANSI/HI 9.6.7-2004] :	
Selection status :	

Pressure Data	
Maximum working pressure	: 48.62 psi.g
Maximum allowable working pressure	: 275.0 psi.g
Maximum allowable suction pressure	: 0.00 psi.g
Hydrostatic test pressure	: 412.5 psi.g

Driver & Power Data	
Driver sizing specification	:
Margin over specification	:
Service factor	:
Power, hydraulic	:
Power, rated	:
Power, maximum, rated diameter	:
Minimum recommended motor rating	:



Pump Performance Curve



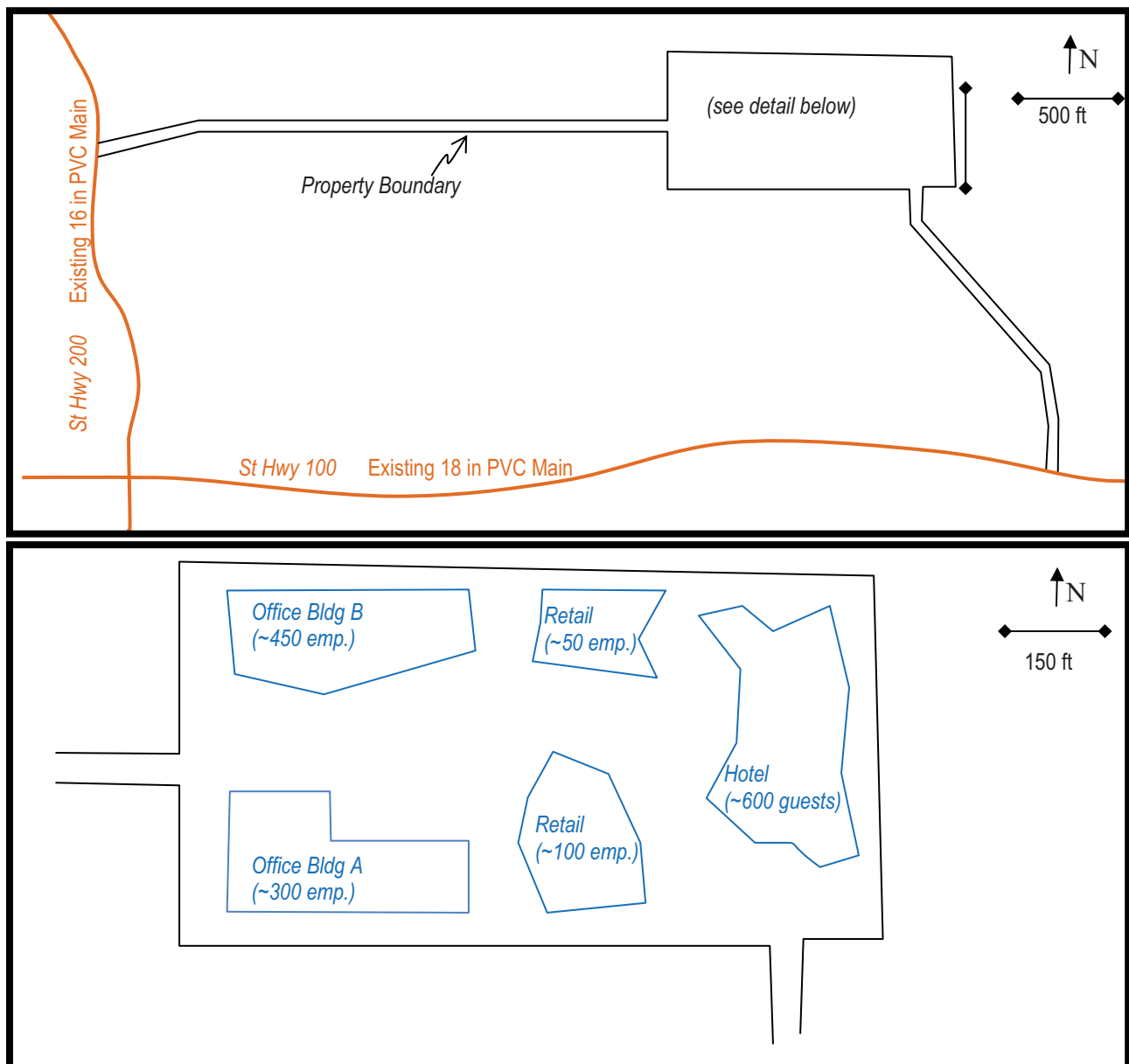
Customer :	Size :	3550-6x8-15
Customer reference :	Stages :	1
Item number :	Speed, rated :	1,780 rpm
Service :	Based on curve number :	553-6x8x15-1780
Quantity : 1	Efficiency :	
Quote number :	Power, rated :	
Date last saved : 24 Apr 2012 4:10 PM	NPSH required :	
Flow, rated :	Viscosity :	1.00 cP
Differential head / pressure, rated :	Cq/Ch/Ce [ANSI/HI 9.6.7-2004] :	1.00 / 1.00 / 1.00
Fluid density, rated / max : 0.999 / 0.999 SG		

1 cfs = 448.83 gpm; 1 kW = 737.56 ft-lb/sec

2. Drawn below is a site plan for a commercial development. Produce a valid design for the necessary water distribution mains and appliances for this development that satisfies the 2009 Bryan/College Station Unified Design Guidelines and other standards as discussed in class. You do not need to include service connections in your work. At minimum, your work should include the following:

- Diameter, material, length, and alignment for all mains.
- Type and location for all appliances and thrust blocks.
- Calculations showing system performance for average day demand, peak hour flow, and fire flow.
- Any other information of importance in determining characteristics of your design.

(50 points)



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{Work space for #2}

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{Work space for #2}