Name: _____

CVEN 458 – Hydraulic Engineering of WDS
Spring Semester 2014
Dr. Kelly Brumbelow, Texas A&M University

Exam #2 – Part A

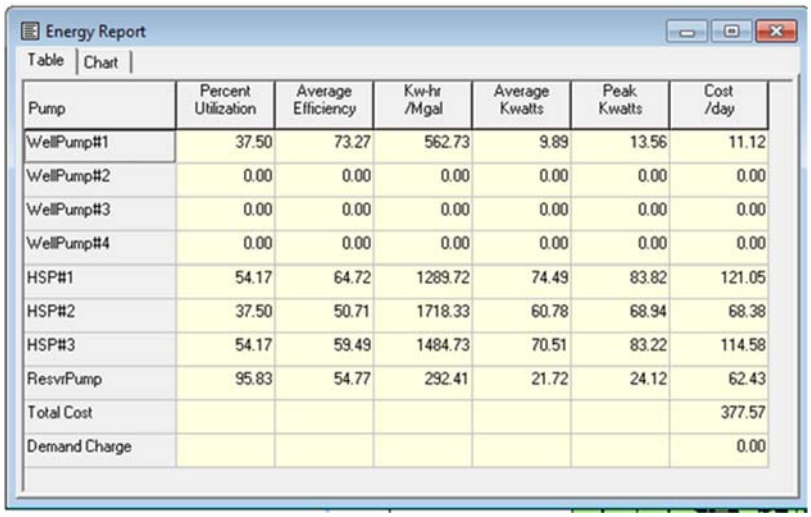
Closed-book, Closed-notes (2 pages, 2 questions in this part); Time allowed: 20 minutes
All work for Part A must be written on the Part A pages.

1. What is an "emitter" in EPANet? Explain what it is, applications for which you would use it, and the mathematical basis for it. *(15 points)*

2. Given below is the Energy Report table from EPANet for Micropolis under a specific demand scenario (ADD = 1300 gpm, Peak instantaneous demand = 1920 gpm) and pump operational plan. The BEPs for the 3 types of pumps are:

- Well pumps: BEP = 79.5% @ 370 gpm
- HSPs: BEP = 76.3% @ 1600 gpm
- Reservoir pump: BEP = 75.0% @ 820 gpm

Is it likely that daily energy cost can be reduced from its current value of $377.57? If so, what changes would you make in the pump operational plan? Explain your suggested changes.
(15 points)



Energy Report

Table | Chart

Pump	Percent Utilization	Average Efficiency	Kw-hr /Mgal	Average Kwatts	Peak Kwatts	Cost /day
WellPump#1	37.50	73.27	562.73	9.89	13.56	11.12
WellPump#2	0.00	0.00	0.00	0.00	0.00	0.00
WellPump#3	0.00	0.00	0.00	0.00	0.00	0.00
WellPump#4	0.00	0.00	0.00	0.00	0.00	0.00
HSP#1	54.17	64.72	1289.72	74.49	83.82	121.05
HSP#2	37.50	50.71	1718.33	60.78	68.94	68.38
HSP#3	54.17	59.49	1484.73	70.51	83.22	114.58
ResvrPump	95.83	54.77	292.41	21.72	24.12	62.43
Total Cost						377.57
Demand Charge						0.00

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Exam #2 – Part B

Open-book, Open-notes (1 problem); Time allowed: 55 minutes
All work for Part B must be written on separate pages with your name written on each page.

According to its 2011 regional water plan, one of the potential new sources of water supply for Region C (Dallas/Fort Worth area) is a potential reservoir site just northeast of Jacksonville, TX, tentatively named "Lake Columbia." The estimated supply available from this reservoir is 35,800 acre-feet/yr (= 22,194 gpm).

Outside the information above, I do not have any details or plans for how water would be conveyed to the DFW area. A reasonable hypothetical scheme is for water to be pumped in a pipeline from Lake Columbia to Lake Palestine just to the west. Construction on a pipeline connecting Lake Palestine to the DFW area is expected to begin this year.

Using Google Earth, I have created a hypothetical pipeline route (not shown) and elevation map (attached). Relevant details for the pipeline are:

Pipeline: 18.5 miles long, 36 in diameter, concrete (ε = 0.005 ft), no significant minor losses; minimum and maximum allowable pressures: 20 and 250 psi, respectively
Start and End Reservoir Elevations (respectively): 320 ft and 344 ft

Assume that pumps to be used at all pump stations will be Goulds Model 3409, size 14x18-28 (1185 rpm), technical data attached. To achieve the design average flowrate of ≈23,000 gpm, each pump station should have 4 pumps operating in parallel.

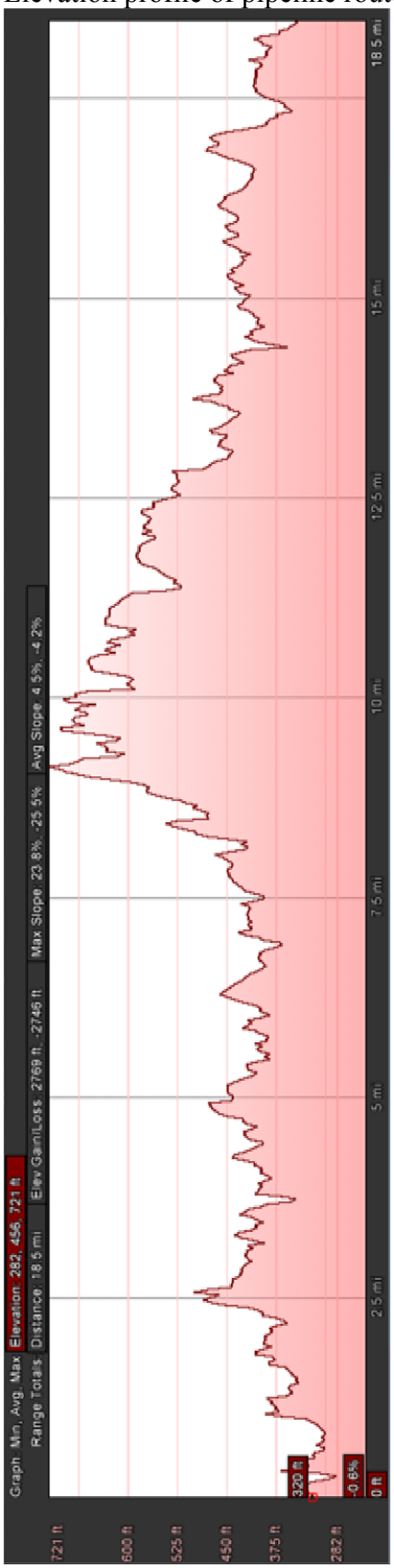
Questions you should answer:

a) What pump impeller diameter should be specified for the pumps (only one diameter for all pumps)?
b) Will more than 1 pump station be needed – i.e., will a booster station or stations be needed after the initial station at Lake Columbia? If so, where should the booster station(s) be located?
c) Given the answers to (a) and (b) above, what will be the expected flowrate (gpm) in the pipeline?
d) What will be the maximum pressure (psi) in the pipeline?
e) What will be the energy consumption (kW) of all pumps?

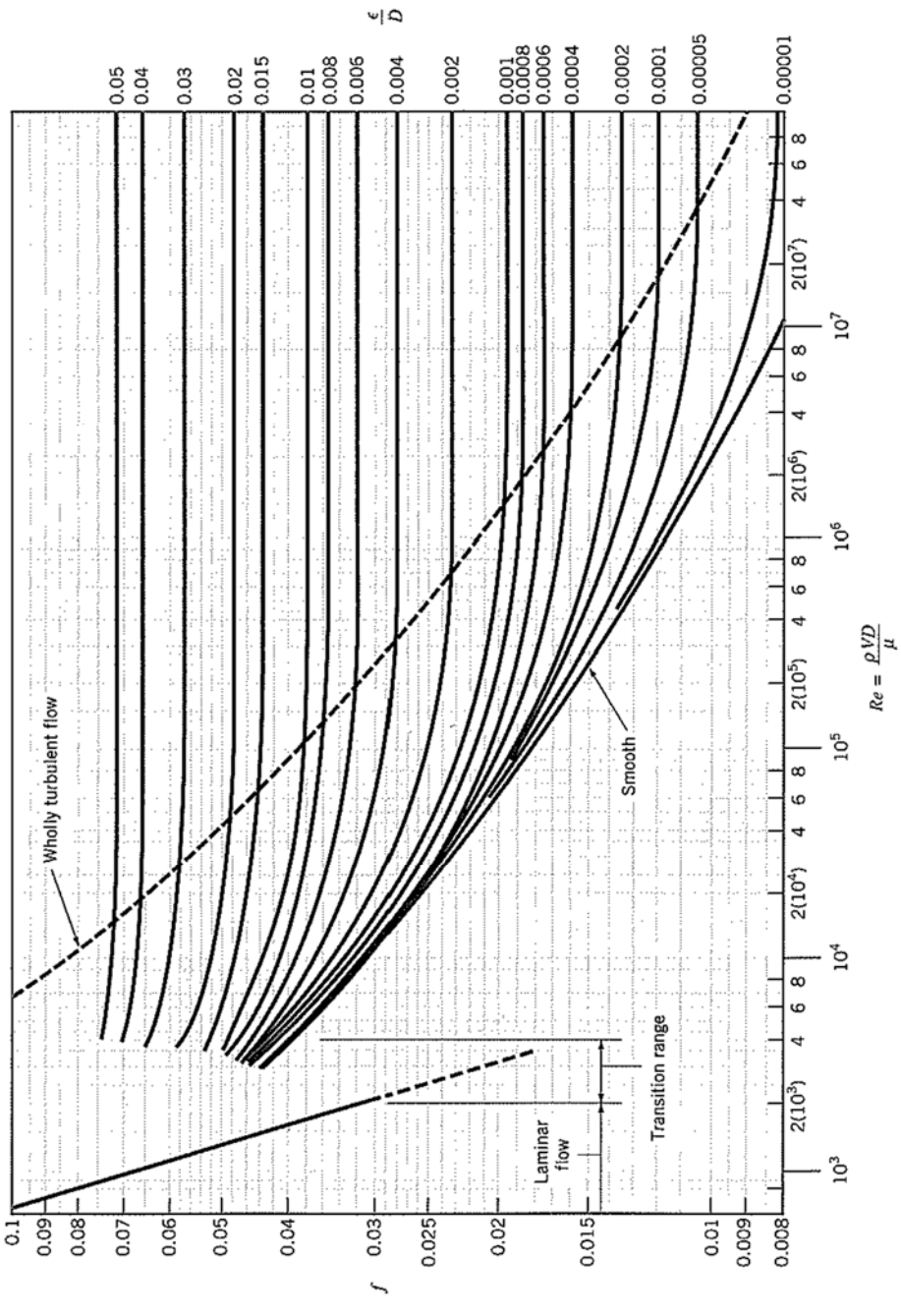
A sheet of graph paper is attached for your convenience.
(70 points)

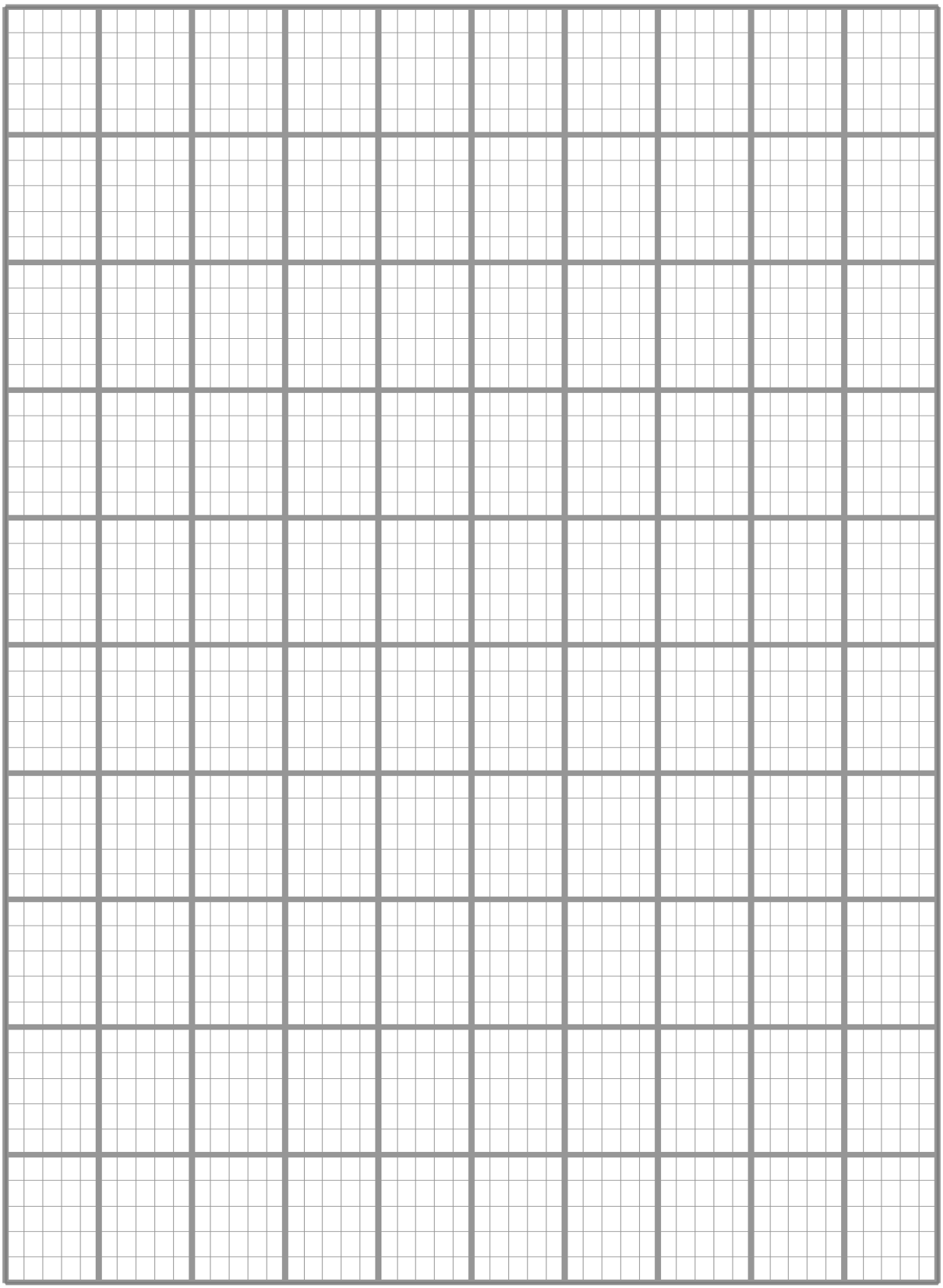
1 cfs = 448.83 gpm 1 kW = 737.56 ft-lb/sec

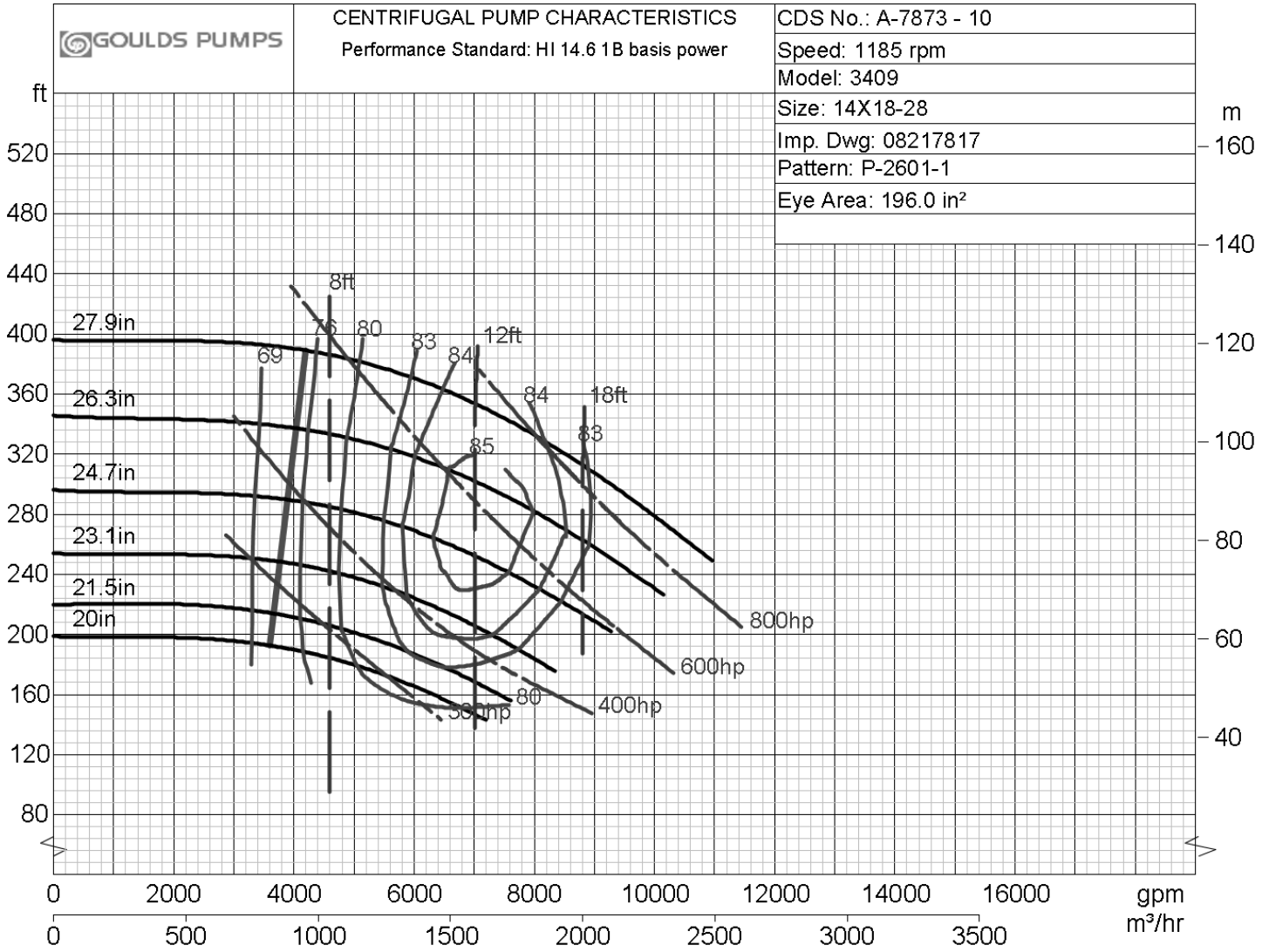
Elevation profile of pipeline route



Moody Diagram:







Item No: ITEM 001
Service:
Rated Flow: 6,000.0 gpm
Rated TDH: 200.0 ft
Imp. Dia.: 22.1000 in

Rev.: 0

ITT