Name: _____

CVEN 458 – Hydraulic Engineering
Spring Semester 2007
Dr. Kelly Brumbelow, Texas A&M University

Exam #2

Open-book, Open-notes (7 pages, 2 questions); Time allowed: 90 minutes

1. A pump station has been designed to include 3 pumps. Two of the pumps will be Goulds model 3410, size 10X12-17-L (18 in impeller, 1785 rpm). The other pump will be a Goulds model 3408, size 6X8-17L-3A (17 in impeller, 1780 rpm). Technical data for the pumps is attached. The pipeline which the pump station serves is 500 ft long, 10 ft in diameter, and has a Darcy-Weisbach friction factor of 0.008. The pipeline begins and ends at open reservoirs and the elevation difference between the two end points is 210 ft.

Your colleague has suggested thet the pumps be operated according to the following weekly schedule. If this schedule is used, *what will be the total volume of water pumped through the pipeline each week, and what will be the weekly energy consumption of the pump station (ignoring motor efficiency)?*

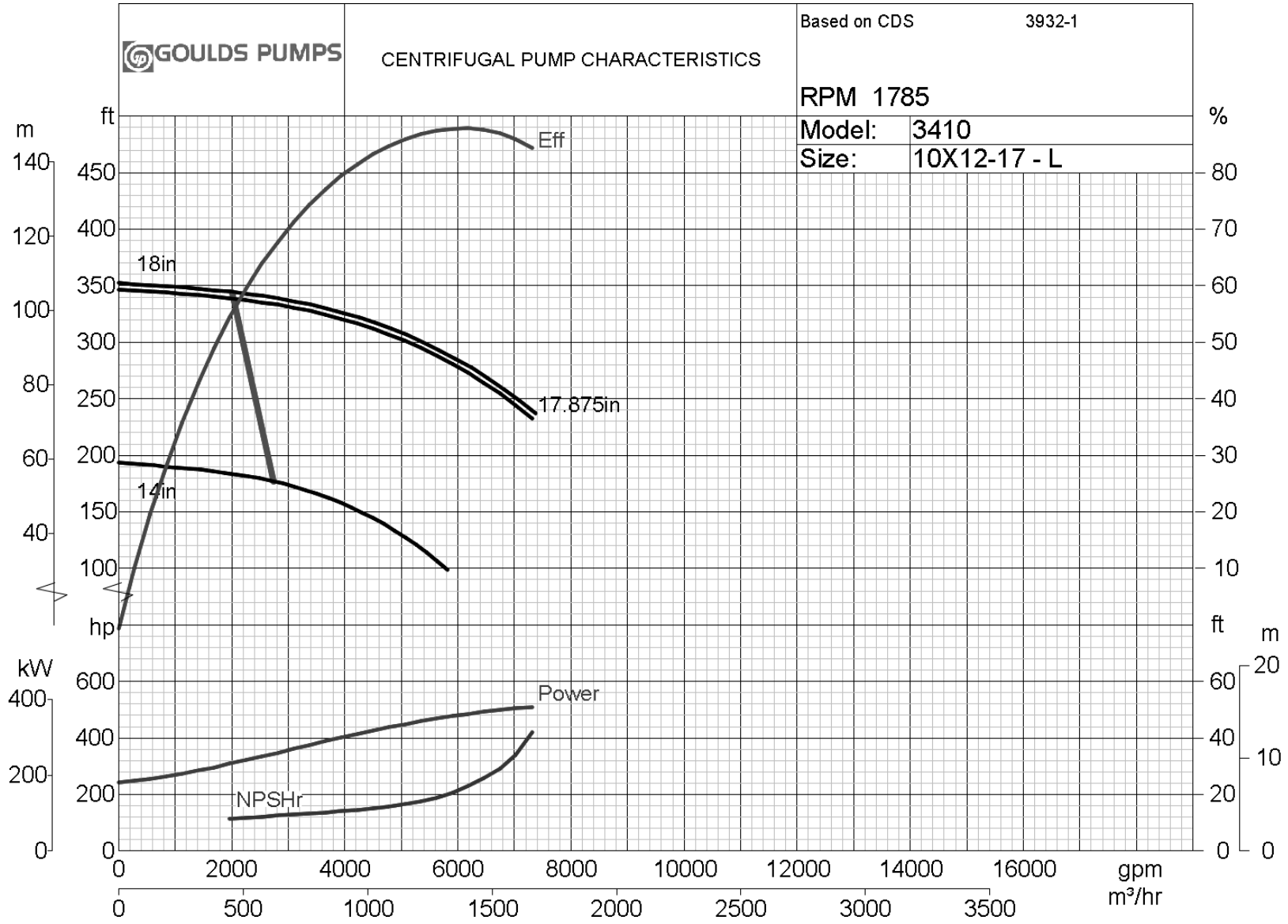
Are there any aspects of the suggested operational schedule that should be revised? (Hint: I'm not talking about fine-tuning the schedule – I'm thinking of aspects that just don't make sense.)

Operational Schedule (pumps run 24 hrs each day they are "ON"):

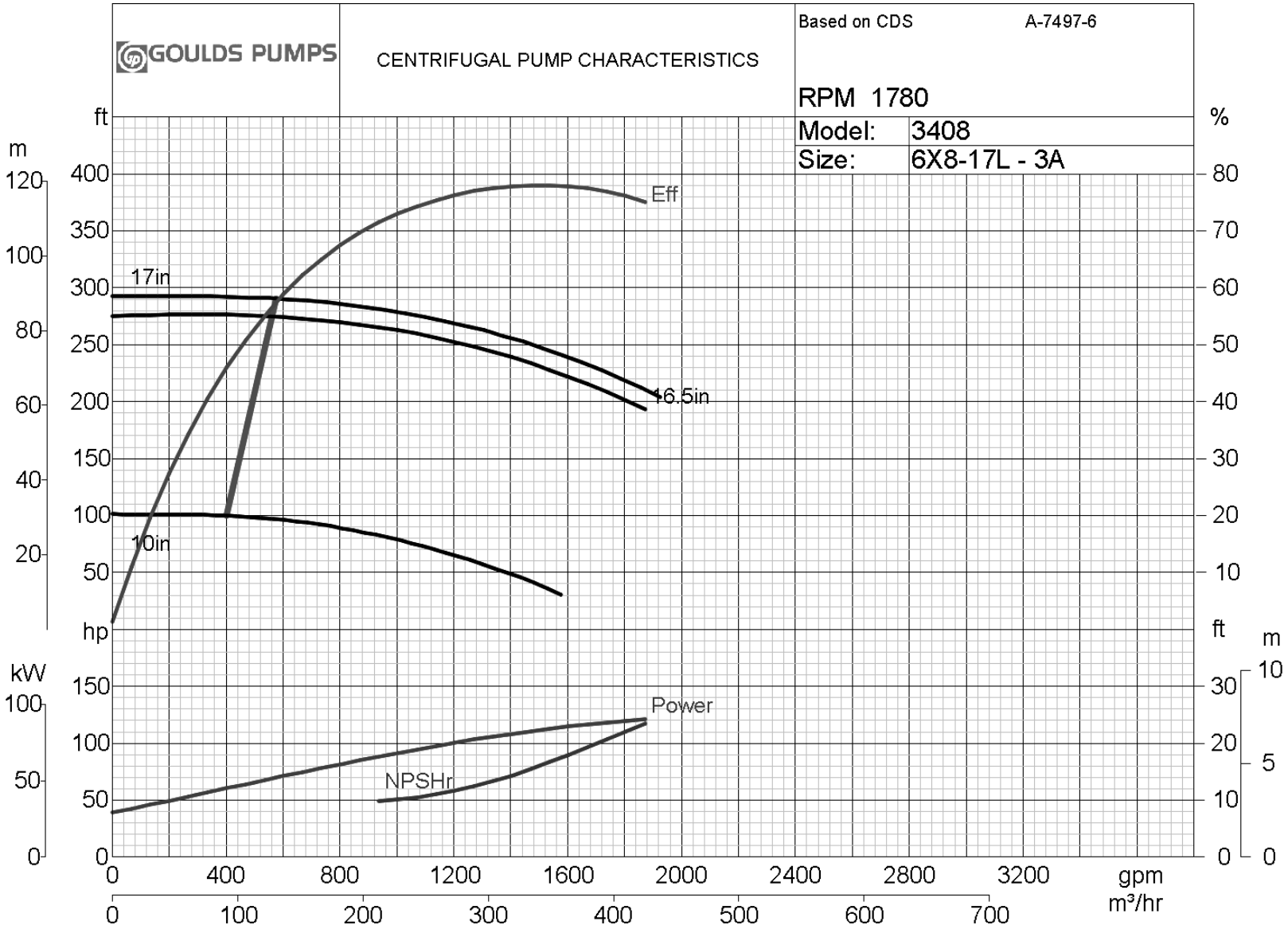
Day	Model 3410 #1	Model 3410 #2	Model 3408
Sunday	*off*	*off*	*off*
Monday	ON	*off*	ON
Tuesday	ON	ON	ON
Wednesday	ON	ON	ON
Thursday	ON	ON	*off*
Friday	ON	ON	*off*
Saturday	*off*	ON	*off*

(XX points)

(Work space for #1)



Item No: ITEM 001
Service:
Rated Flow: 5,000.0 gpm
Rated TDH: 300.0 ft
Imp. Diam.: 17.8750 in



Item No: ITEM 001
Service:
Rated Flow: 1,200.0 gpm
Rated TDH: 250.0 ft
Imp. Diam.: 16.5000 in

2. You have been asked by your boss to evaluate a preliminary distribution system design by an underperforming colleague. (For the sake of anonymity, we'll call your colleague "Tony Cahill"). "Tony" has analyzed a low-resolution design of network nodes and piping. His preliminary design includes a 72 inch transmission line from the system's pump station to its outermost node; 18 inch distribution lines branch off from the transmission line to the system nodes. You have already reviewed data on nodal elevations, demands, and spatial information, and these data are correct.

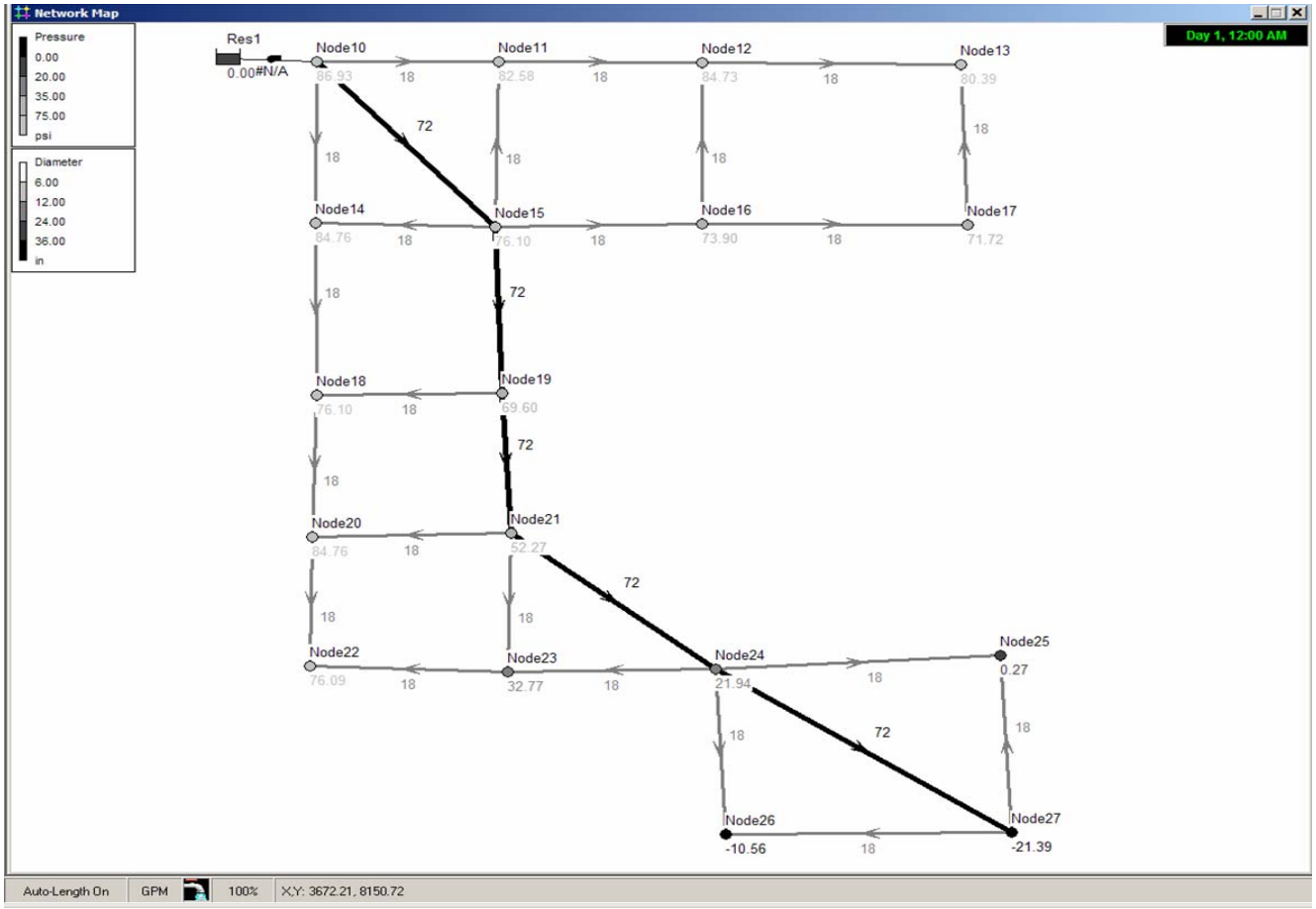
A simulation for the system has been performed for average daily demands. As can be seen in the output below and on the next page, the preliminary design has serious performance problems. Several nodes have pressures below allowable levels. "Tony" is insistent the design should work since the very large transmission line should have very low head loss. He maintains that you should simply find the error in EPANet's calculations and the design will be ready to move on to "fleshing out" at higher resolution.

Are the performance problems found by the simulation the result of calculation errors or design problems? If design problems are present, suggest specific elements for design revision to bring performance to minimum standards. Do some quick calculations to support your suggestions.

Is the simulation that has been performed sufficient to evaluate the preliminary design? If not, what other steps need to be taken before your firm may move on to higher resolution design? Have any significant aspects/requirements of the design process been omitted thus far?
(XX points)

Network Table - Nodes

Node ID	Elevation ft	Base Demand GPM	Pressure psi
Node10	100	100	86.93
Node11	110	250	82.58
Node12	105	145	84.73
Node13	115	120	80.39
Node14	105	55	84.76
Node15	125	65	76.10
Node16	130	75	73.90
Node17	135	85	71.72
Node18	125	100	76.10
Node19	140	65	69.60
Node20	105	100	84.76
Node21	180	55	52.27
Node22	125	150	76.09
Node23	225	55	32.77
Node24	250	100	21.94
Node25	300	50	0.27
Node26	325	50	-10.56
Node27	350	100	-21.39



[PIPES]			*(ft)*	*(in)*	*(Haz-Wms C)*			
;ID	Node1	Node2	Length	Diameter	Roughness	MinorLoss	Status	
Pipe1	Node10	Node15	3447.55	72	130	0	Open	;
Pipe2	Node15	Node19	2547.36	72	130	0	Open	;
Pipe3	Node19	Node21	2135.10	72	130	0	Open	;
Pipe4	Node21	Node24	3408.21	72	130	0	Open	;
Pipe5	Node24	Node27	4640.67	72	130	0	Open	;
Pipe6	Node10	Node14	2454.03	18	130	0	Open	;
Pipe7	Node14	Node18	2626.83	18	130	0	Open	;
Pipe8	Node18	Node20	2178.18	18	130	0	Open	;
Pipe9	Node20	Node22	1970.35	18	130	0	Open	;
Pipe10	Node14	Node15	2385.49	18	130	0	Open	;
Pipe11	Node18	Node19	2442.50	18	130	0	Open	;
Pipe12	Node20	Node21	2627.64	18	130	0	Open	;
Pipe13	Node21	Node23	2120.32	18	130	0	Open	;
Pipe14	Node22	Node23	2616.45	18	130	0	Open	;
Pipe15	Node10	Node11	2407.83	18	130	0	Open	;
Pipe16	Node11	Node15	2511.94	18	130	0	Open	;
Pipe17	Node11	Node12	2684.36	18	130	0	Open	;
Pipe18	Node15	Node16	2730.80	18	130	0	Open	;
Pipe19	Node12	Node13	3421.74	18	130	0	Open	;
Pipe20	Node16	Node17	3513.90	18	130	0	Open	;
Pipe21	Node13	Node17	2455.65	18	130	0	Open	;
Pipe22	Node12	Node16	2453.92	18	130	0	Open	;
Pipe23	Node23	Node24	2742.15	18	130	0	Open	;
Pipe24	Node24	Node25	3773.64	18	130	0	Open	;
Pipe25	Node24	Node26	2515.32	18	130	0	Open	;
Pipe26	Node25	Node27	2711.51	18	130	0	Open	;
Pipe27	Node26	Node27	3778.87	18	130	0	Open	;

(Work space for #2)