

CEE 371 – Fall 2009 – Design Problem 1 (work in teams of 3)
DESIGN OF AMHERST TRANSMISSION MAIN

Background

The drinking water sources for the Town of Amherst include two surface water (reservoir) supplies and several groundwater wells. To meet water demands, the Town must connect a new well to the distribution system. The well (Well #4) is located in South Amherst near Hop Brook in the Lawrence Swamp aquifer – see attached map (Figure 1).

The water must be treated – disinfection, addition of fluoride, and addition of chemicals to reduce corrosivity prior to the distribution system. This treatment is accomplished on-line (injection of chemicals to transmission main) at the Baby Carriage Brook Water Treatment Plant (BCBWTP) located approximately 4,700 ft west of Well #4. After the on-line treatment at the WTP, the transmission main proceeds 1,600 ft west to South East Street, and then travels about 5,800 ft north to Station Road where it connects to the distribution system.

The estimated safe yield of Well #4 is 1.6 MGD. The ground elevation at the well head is 172 ft and the water level while pumping at the safe yield is at an elevation of 125 ft. The BCBWTP is an on-line (transmission main) facility that causes a head loss of 12 psi at the design flow of 1.6 MGD. The overflow elevation of the distribution storage tanks in the Amherst system is approximately 470 ft. For design purposes, set the hydraulic grade line (HGL) at 480 ft for the connection of the new transmission main with the existing 12 inch pipe at the intersection of South East St. and Station Rd (ground elevation of 228 ft).

Design Task

Your team has been requested by the Town to design a transmission main from Well #4 to the distribution system. The main must be capable of supplying a design flow of 1.6 MGD, must meet hydraulic design criteria, and must be the most economical choice. Additional information for the problem follows:

- Design for a cement lined ductile iron pipe
- Construction costs have been provided in a course handout
- Assume that costs for engineering and contingencies are 20% of construction costs
- Project will be financed with municipal bonds at 7.0 % interest over 20 years
- Assume the well pump (including motor) operates at 80% efficiency
- Electric power costs 9.5 cents per kw-hr

Prepare a short design report to present hydraulic and economic analyses that lead to a recommended diameter for a cement lined ductile iron (CCDI) pipe transmission main. Be sure to state your assumptions, clearly outline and show the technical aspects of the problem, and use tables and graphs to show the results of your hydraulic and economic analyses. Include a profile sketch of the system (along the pipeline) showing the well, ground elevation, the BCBWTP, and the hydraulic grade line for the recommended pipe size.

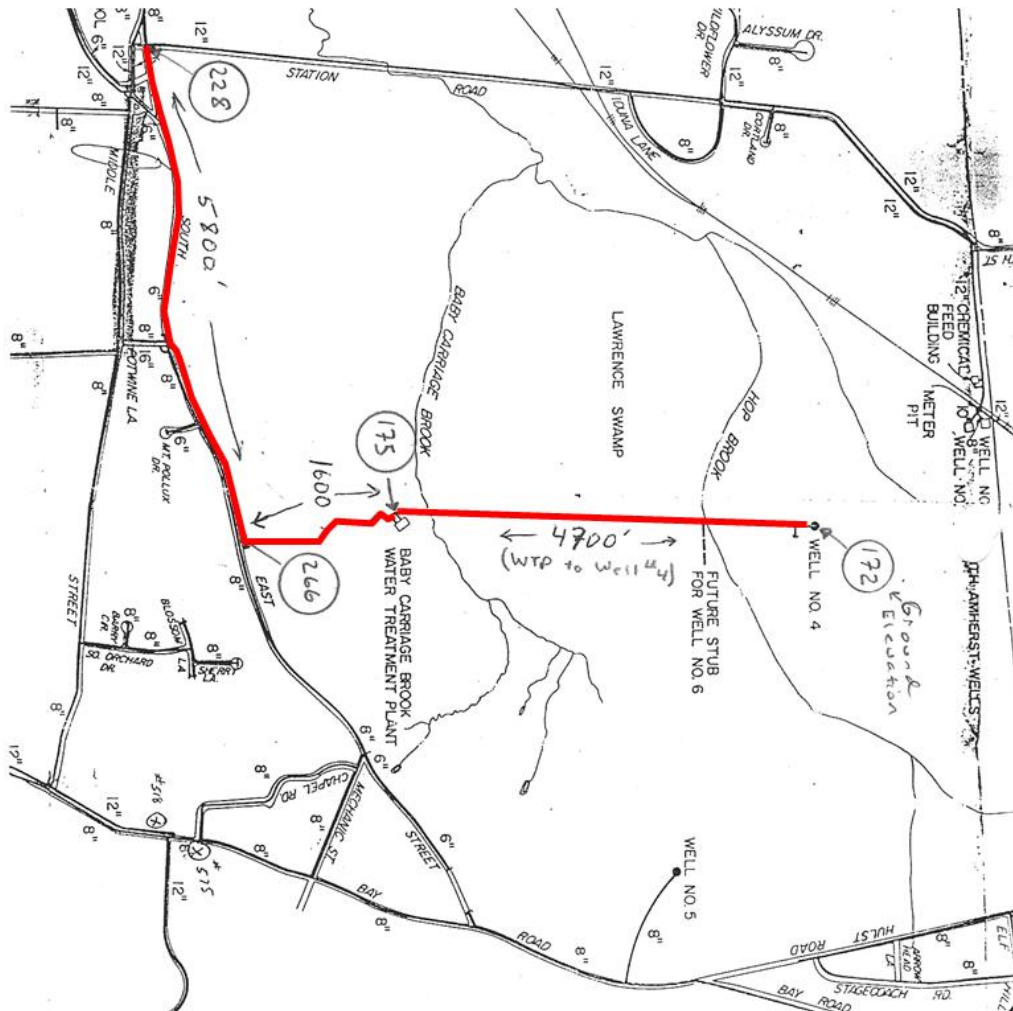
Assigned: 25 Sept 09

Due: 5 Oct 09

Supporting Information:

Cement Lined Ductile Iron Pipe Costs

Pipe Diameter (inches)	Installed cost ¹ (\$/linear ft)
6	47
8	51
10	57
12	62
14	66
16	72
18	78
20	86
24	109
27	124
30	139
36	160



¹ Installed costs include: Materials and Construction. Based on costs in December 2000; when ENR CCI = 6282.76 (using 1913 as base).