Project Specifications

Assume that you are on the design team for building a new school in Waslala, Nicaragua. You are in charge of the design of the hydraulic system to deliver the water to the school. The closest water line supply to the school provides 0.02 m^3/s flow rate at a pressure of 15kPa(gage). The details of the school location, elevations, distances, and the desired consumption points in the building are given in Fig. 1. For this design, you may assume a steady case in which the water is being consumed continuously. For consistency and simplicity, the pipe diameters are given (NPS 4" and 2") in the schematic, however, you may choose the pipe schedule and the pipe material.

1- Show that the supply condition is not adequate to deliver water into the school and therefore a pump is required.
2- Determine the volumetric flow rate at each consumption point and the pump head.
   a) Draw a detailed sketch of your piping system (the pipe route) including all your required fittings that you are considering in minor loss calculation (also fitting for future maintenance such as valves), pipe lengths, diameters, elevations, pump location, etc. Assume that this sketch will be given to the contractors who will buy all materials and construct in for you, hence, it must include all information.
   b) Name all the problem variables and show them on your drawing, these names must match the variables in your code.
   c) List all unknowns and available equations (the variables' name must match your code and your drawing).
   d) Sketch an algorithm for your code.
   e) Each group's supplied flow rate:
      - Calculate the average of team member's birthday months, Ex. Student A and B's birthdays are in June and November, respectively. → 8.5
      - Add the average digits to the ten-thousandths decimal place of the flow rate. → this group's flow rate Q = 0.02085
   f) Use a professional programming language such as MATLAB, Python, C, C++, Java, etc. to solve your design. (Excel is not acceptable!)
      - You can only use ColeBrook formula in friction factor calculation.
3- Based on the flow rate and the pump head, pick a proper pump (impeller diameter, power input, and efficiency) from the available pump curves (online sources or the project Appendix). You do not have to check the NPSH requirement.
4- In your code, vary the main pipe line (marked in the schematic as 4") diameter over the range from NPS 2" to 8" following the available NPS tables and calculate the pump head. Plot the pump head vs the diameter of the main line.

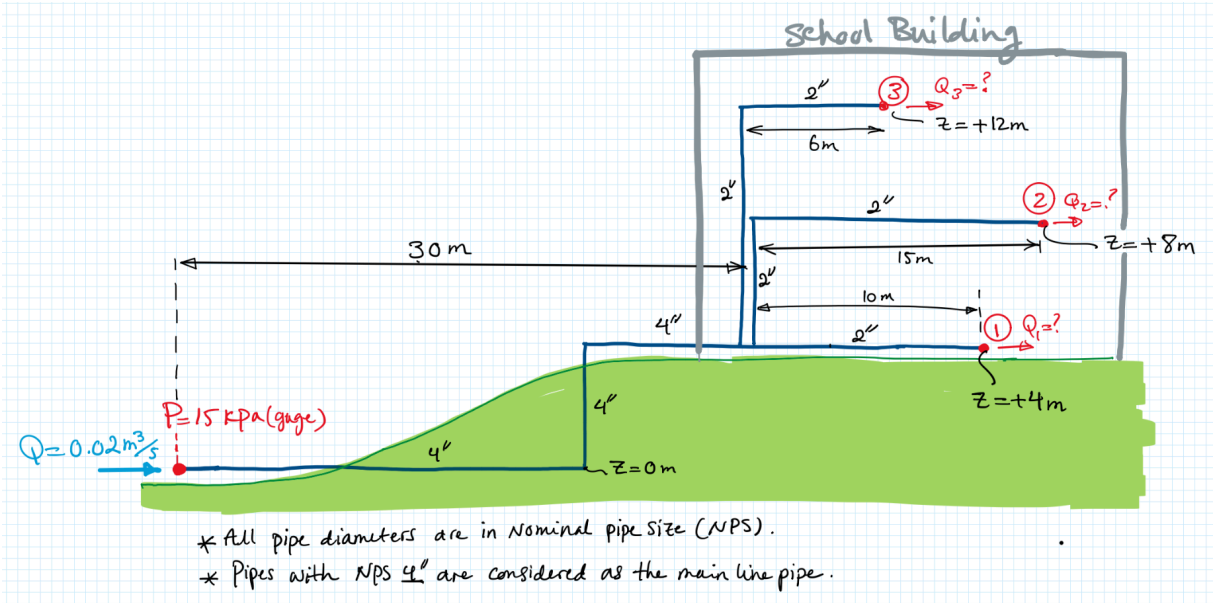

Fig. 1- schematic of the school building details, consumption points, dimensions, and water supply

5- Write a concise report including:

i. Cover page- include team names, course name and number, date of submission.

ii. Problem overview- description of the goals of your design in your own words, discussing the broader impact of the design, ethical implications, possible environmental and human impacts of the design. (half a page)

iii. Design- include parts 1 and 2 (a), (b), (c) of the above specification such as explanation and reasoning for pump requirement with calculations, piping system drawing including the pipe material and chosen schedule, all equations with descriptions.

iv. Results- include parts 2(d), (e), (f) and 3 and 4 of the above specification such as the code algorithm, results of the code, discussion and determination of the pump model, plot of pump head versus main line pipe diameter (as descried previously) with discussion.

v. Conclusions- brief summary of the project, conclusions drawn from the results, and recommendations.

vi. Appendix- code, the code should include comments and notes for every variable and their units in order for anyone to understand it and being able to run it.

vii. References- if applicable

Note 1: All figures/drawings and equations must be numbered and cross referenced in the text. Any material used from the literature or online sources must be written in your own words, cited and included in the reference section. Professional reports are usually written in passive voice.

Note2: You are required to submit your report as a single pdf document and your code file on Brightspace. Codes will be run and tested for each group!

Please name your files as: Lastname_Lastname.pdf and Lastname_Lastname.m (or other code file extensions)

Rules

- You are allowed to work with a partner on this project, and you may discuss the project with the instructor. However, you absolutely may not discuss the project with any other students – evidence of such will be considered an academic integrity violation.
- If you are having trouble finding a partner, then you can let the instructor know, and you will then be paired up with someone else. It is OK to partner up with someone in a different MECH 322 section.
- The instructor will not debug your codes.

MATLAB Tutorial:

To take the tutorial, go to https://matlabacademy.mathworks.com , launch "MATLAB Onramp", sign in and follow the instructions.

Appendix A- Pump curves:

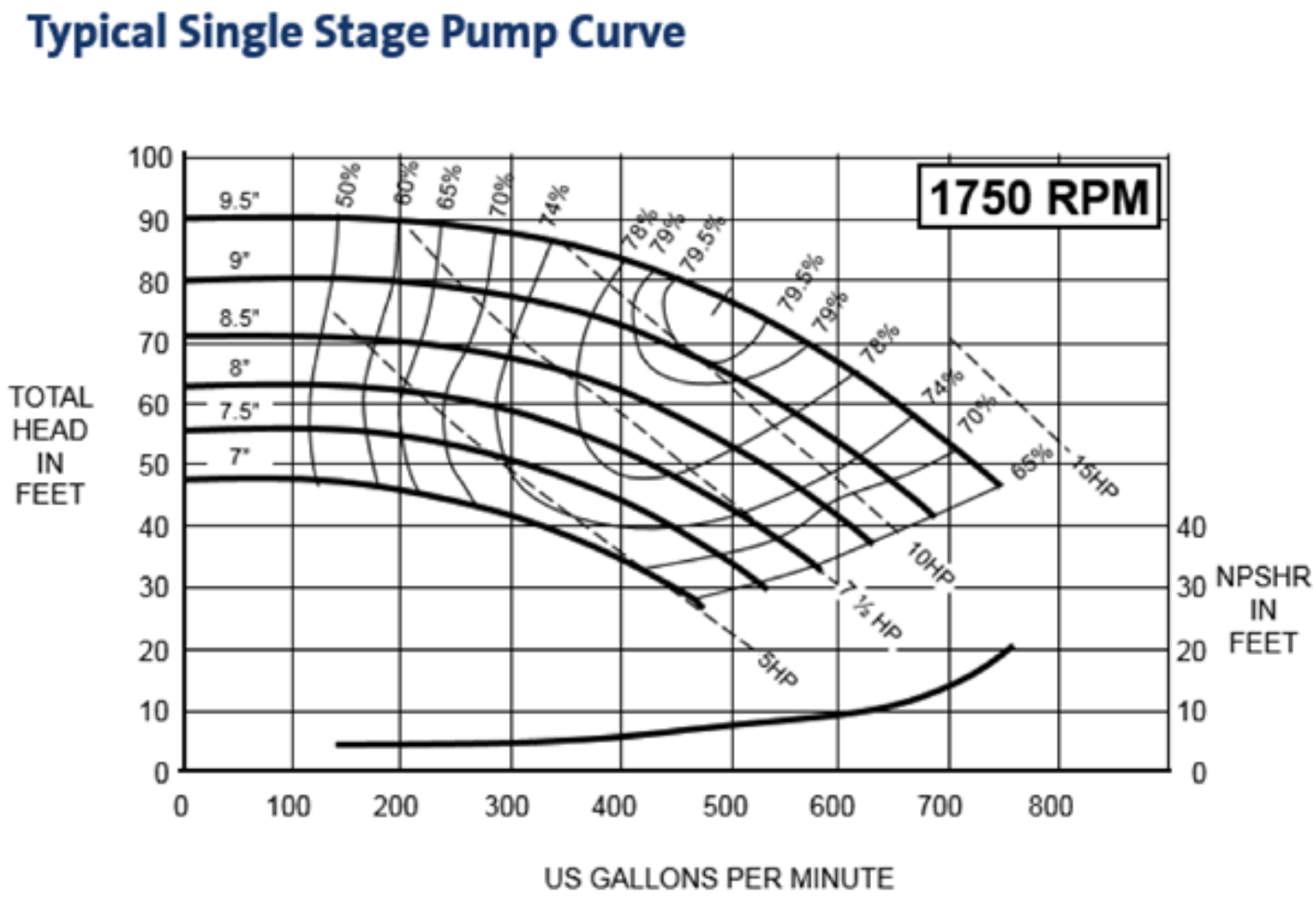

Fig. 2- pump curve for flow rates of 0-800 GPM [1]

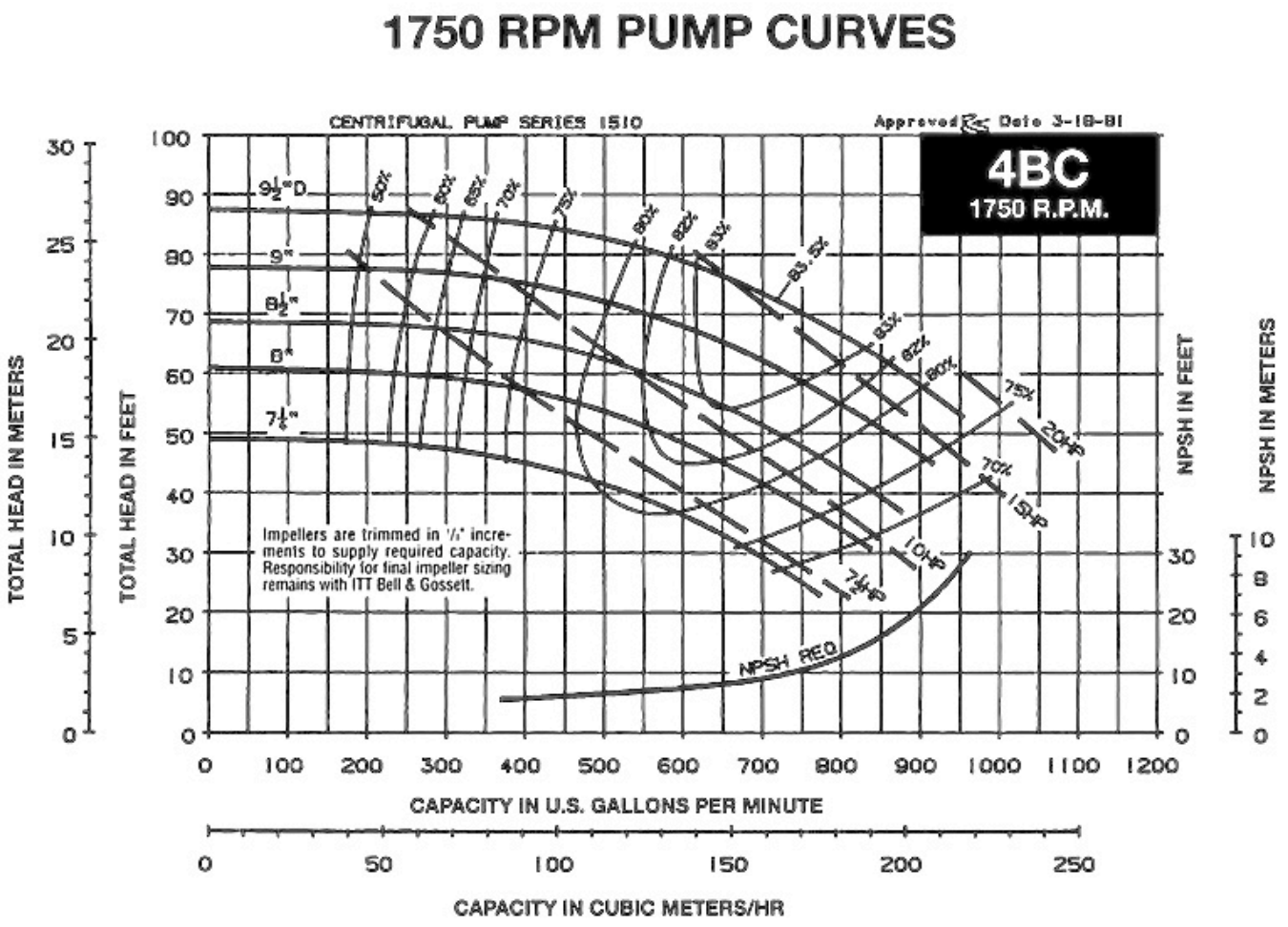

Fig. 3- pump curve for flow rates of 0-1100 GPM [2]

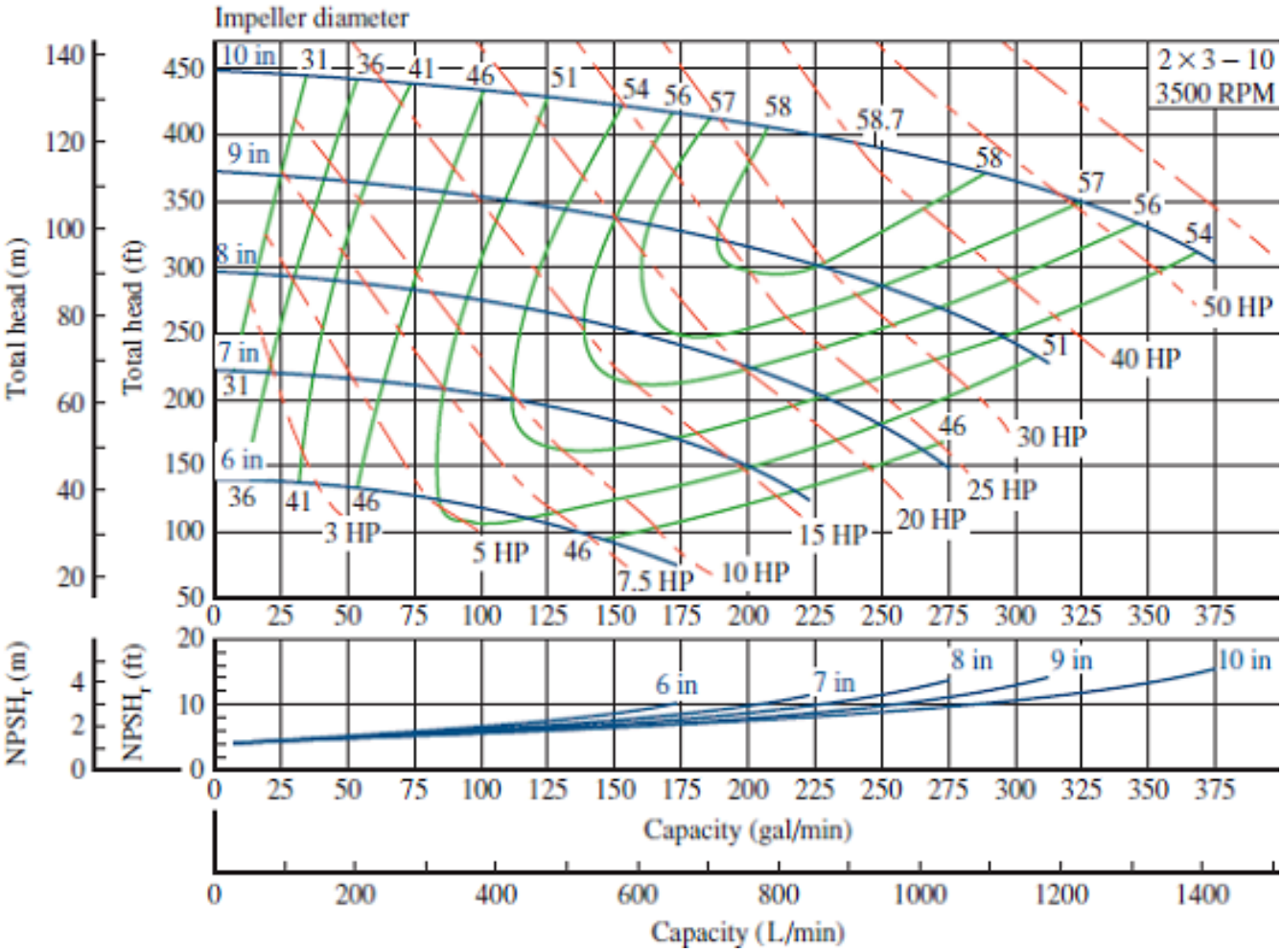

Fig. 4- pump curve for flow rates of 0-375 GPM [3]

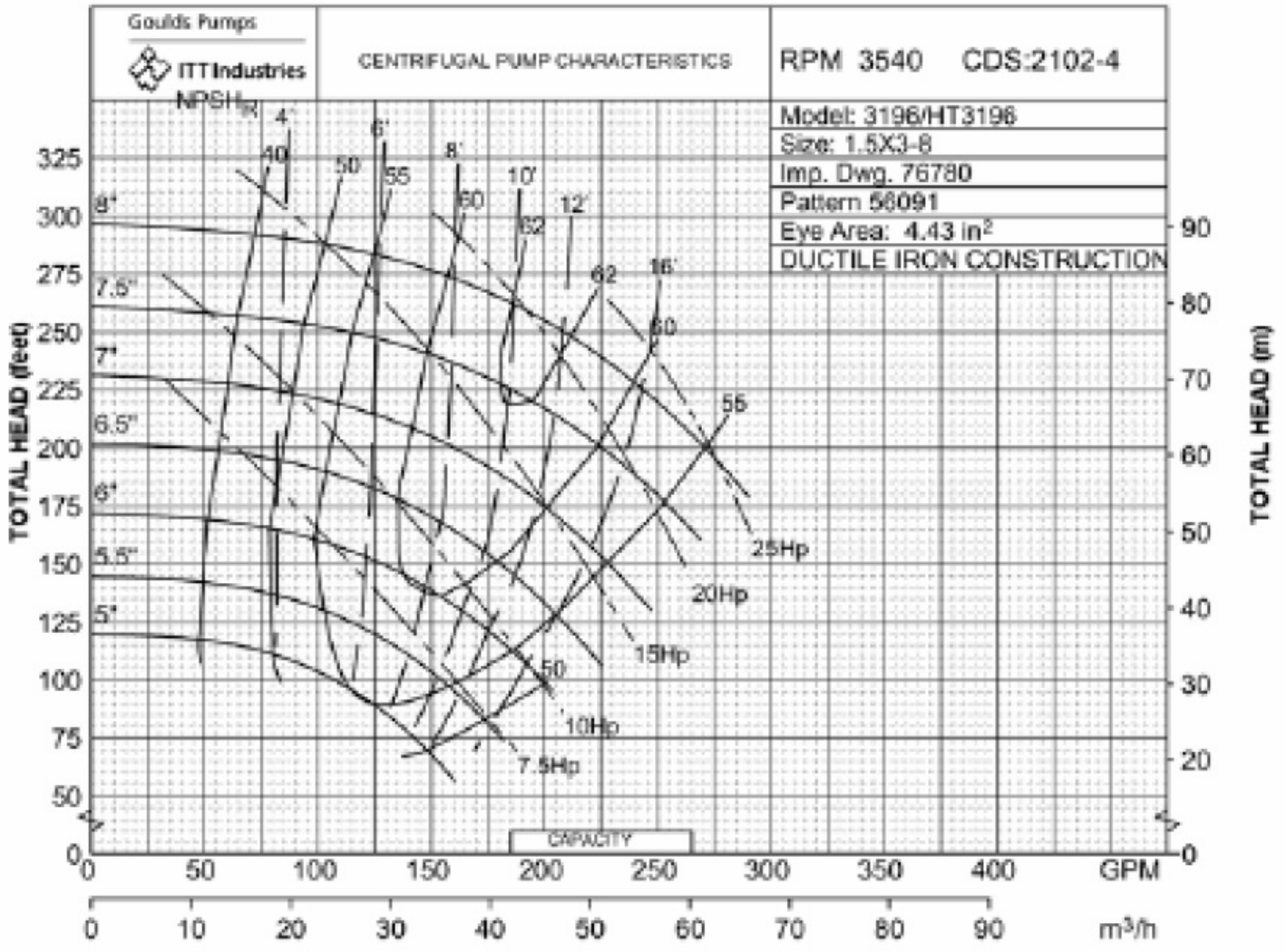

Fig. 5- pump curve for flow rates of 0-300 GPM [4]

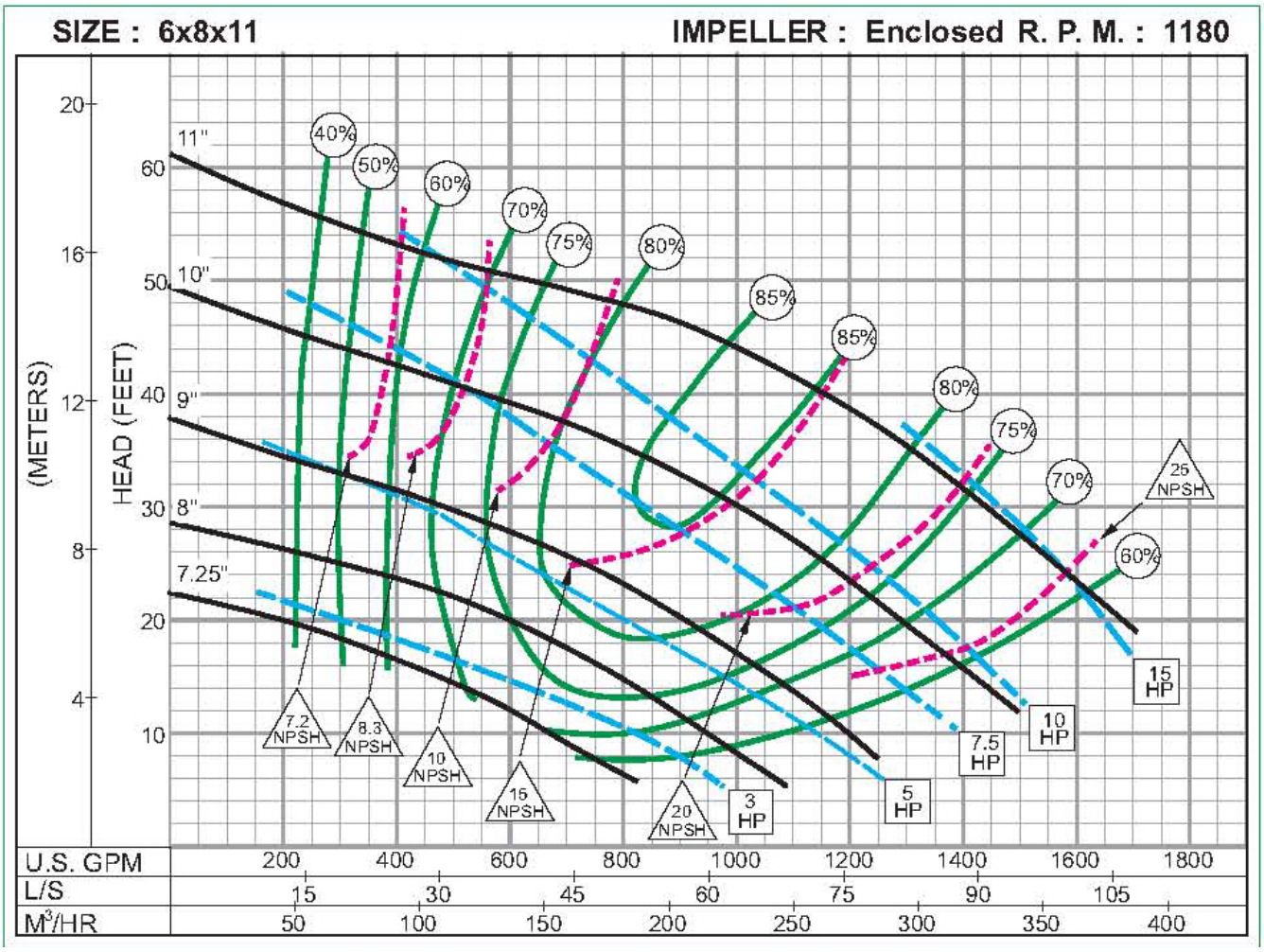

Fig. 6- pump curve for flow rates of 0-1800 GPM [5]

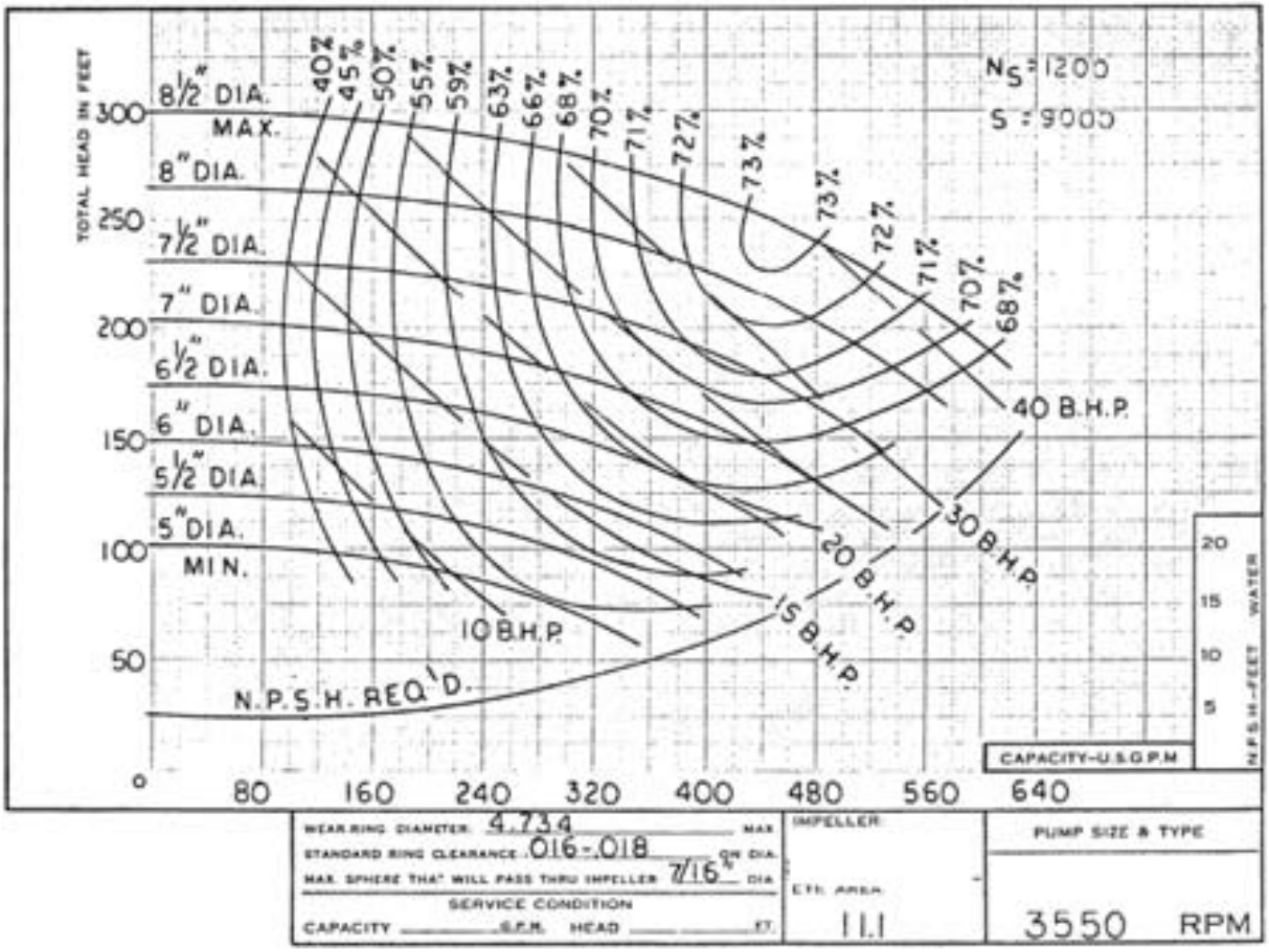

Fig. 7- pump curve for flow rates of 0-1800 GPM [6]

References:

[1]- https://www.pumpsandsystems.com/sites/default/files/article/2018-04-26%2010%3A12/pumpcurve.png
[2]- https://d2vlcm61l7u1fs.cloudfront.net/media%2F3fc%2F3fc617d0-f747-4905-b837-6ee81972a482%2Fphp9GC4Ve.png

[3]- https://mgh-images.s3.amazonaws.com/9780133414622/13860-13-28IPP1.png

[4]- https://www.researchgate.net/profile/Osama_Suleiman_Khayal/publication/318672770/figure/fig4/AS:613996059185172@1523399476833/Typical-Centrifugal-Pump-Performance-Curve.png

[5]- https://www.pumpsandsystems.com/sites/default/files/curve1_0.jpg

[6]- https://www.pumpsandsystems.com/sites/default/files/NPSH05092_0.jpg