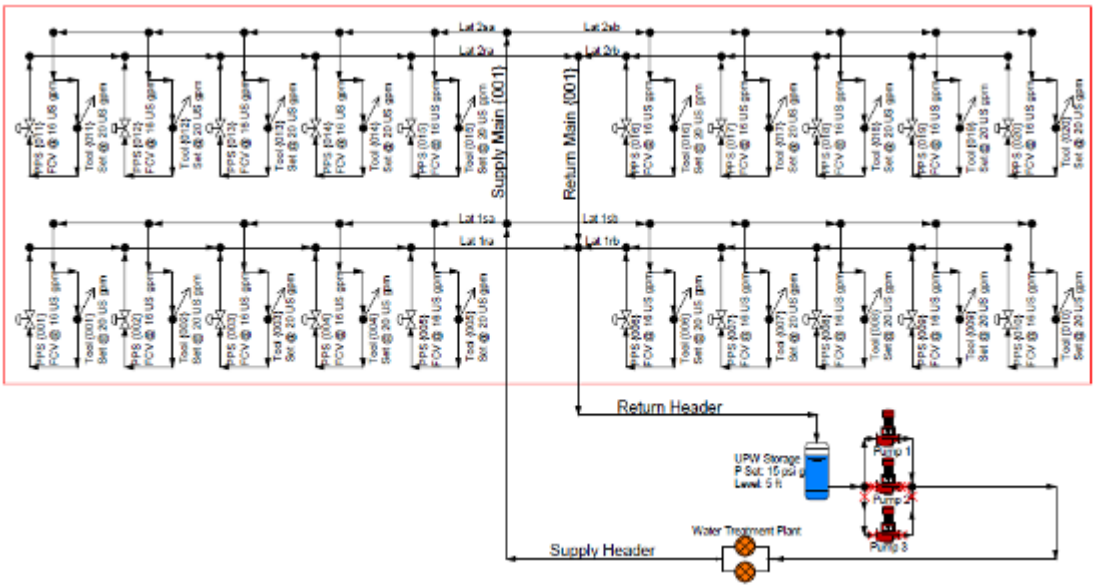
Case Study – System Expansion

Piping systems are in a continuous state of change. Over time new loads are added to cooling systems, new demands are placed on a distribution system, and plant operation systems are expanded or changed. No matter how the system is modified, any change to the system affects the pressure and flow rate in each pipeline. More importantly, any change affects how the pipelines and pumps operate together as a system.

There is a risk standard associated with major changes to a system, and the results of those changes are often realized, only after the system operates for the first time. The benefit of using piping software is that you have the capability of seeing how the system will operate during the design process, when the changes are being considered, instead of when the system is already in operation.

In this example, we will be adding to an ultra pure water system in an integrated circuit manufacturing facility. You will observe and understand how to use the various PIPE-FLO pipeline copy features to quickly build the system model. Once the changes have been made we will see their effect on the system operation.

Piping System



An ultra pure water system is a closed looped distribution system in which all the water going to the various tools in the plant is under positive pressure. In addition, the return piping is included so there is no dead-heading when a tool is not running. To prevent the introduction of any contamination into the system, there is a positive pressure maintained in the return header to the Ultra Pure Water (UPW) storage tank.

In the system above, the fluid is pumped from the UPW Storage tank, to the ultra pure water treatment plant. To simplify this example, the details of the water treatment plant have not been included. Instead it has been modeled as a single component.

The main supply and return headers run through the center of the plant, and laterals tee off of each side from the supply headers. As you can see from the figure, the tools are located off the laterals. There is a supply header to each tool. The tool has a demand of a given flow rate, and the balance of the fluid proceeds down the return header back to the UPW storage tank. Using the return header, the fluid is never dead-headed when a tool is turned off.

We will need to add four new banks of tools, two on each side of the main header.

Adding to the System

We will be adding four additional banks of tools (two on each side) to the existing system. Since there are over 100 pipelines that need to be added, it is important you have an understanding of the various copy commands.

There are three different ways to copy in PIPE-FLO

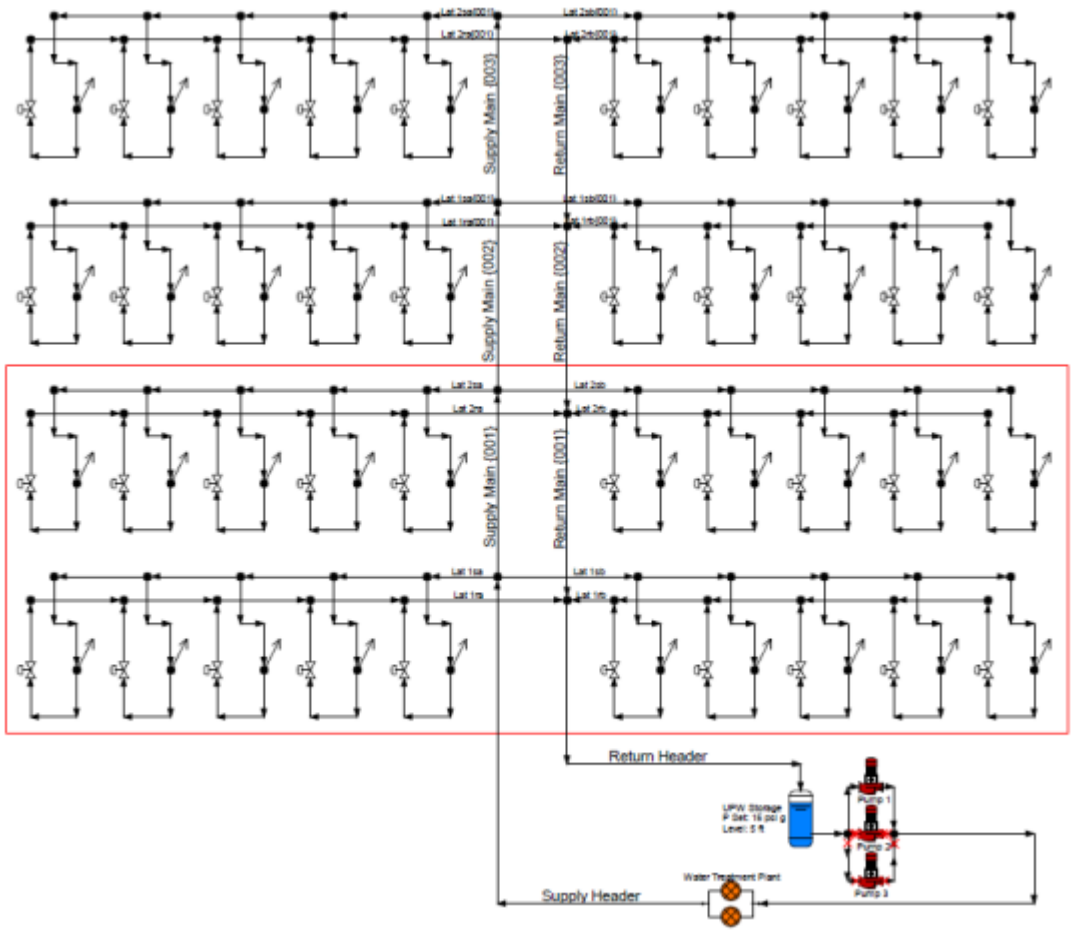
Single Copy: Copy a single device either by right clicking and selecting **Copy** or by pressing **Ctrl-C**

Group Copy: Using the selection tool, click and drag the mouse around the items you want to copy.From the context menu select the **Copy Group** menu item.

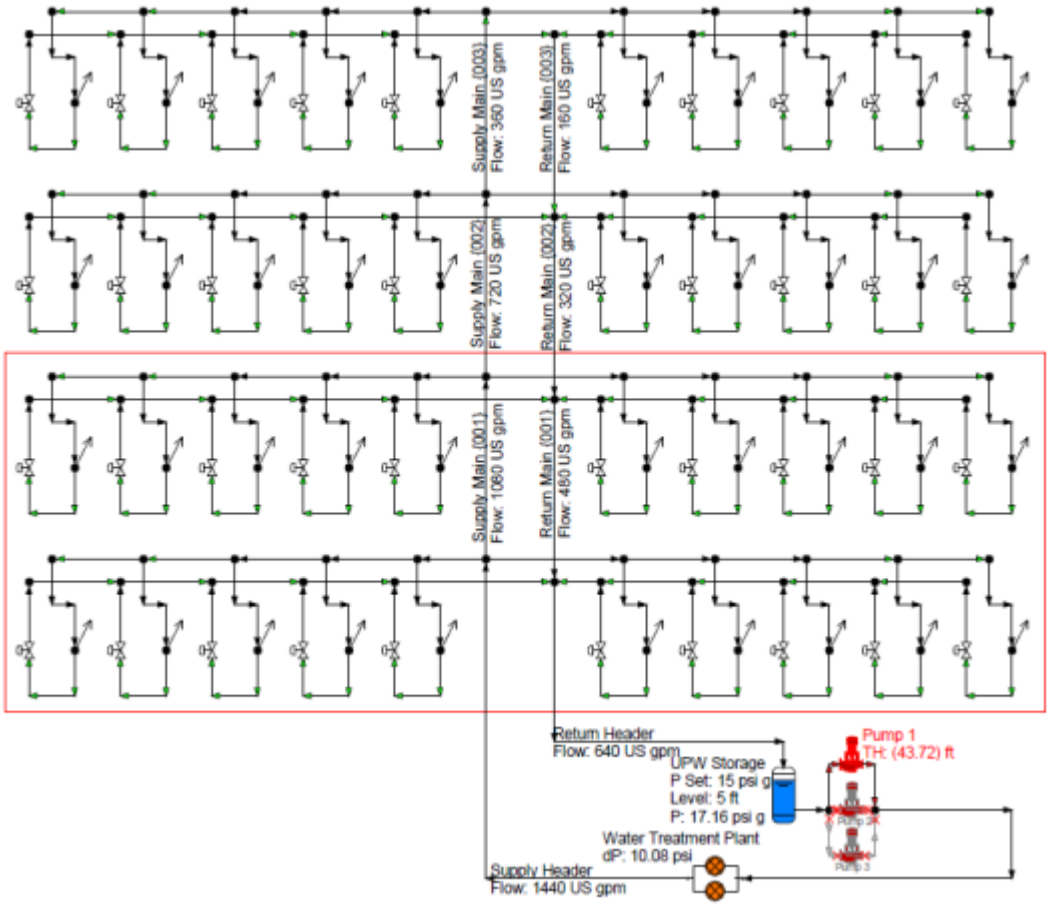
Design Copy: Within many of the dialog boxes there is a button that says Copy.By clicking on this button and selecting another of the same devices, the design information can be copied from one device to another.

Copying Designed Pipelines

By using the single and group copy functions, we can copy the system and attach it to the top to double the size.

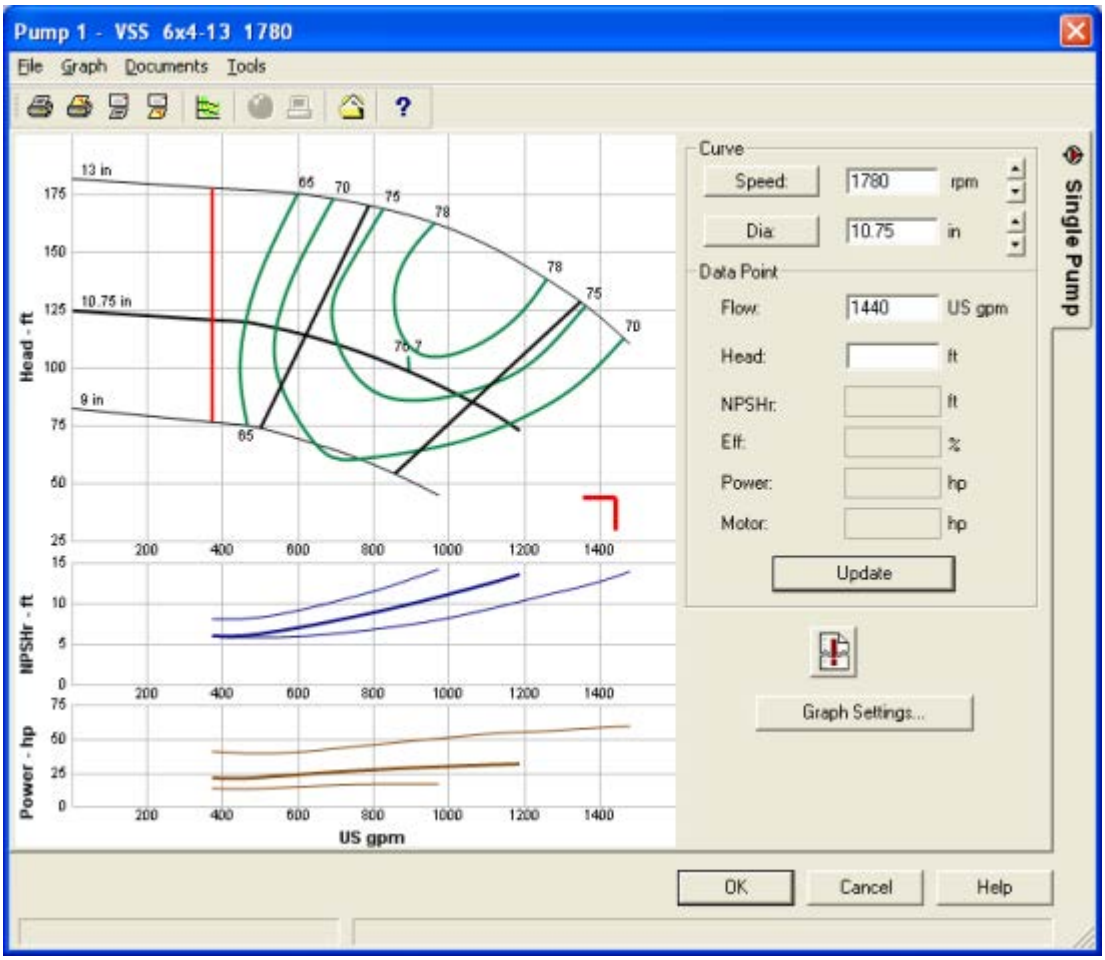


Evaluating the Expanded System



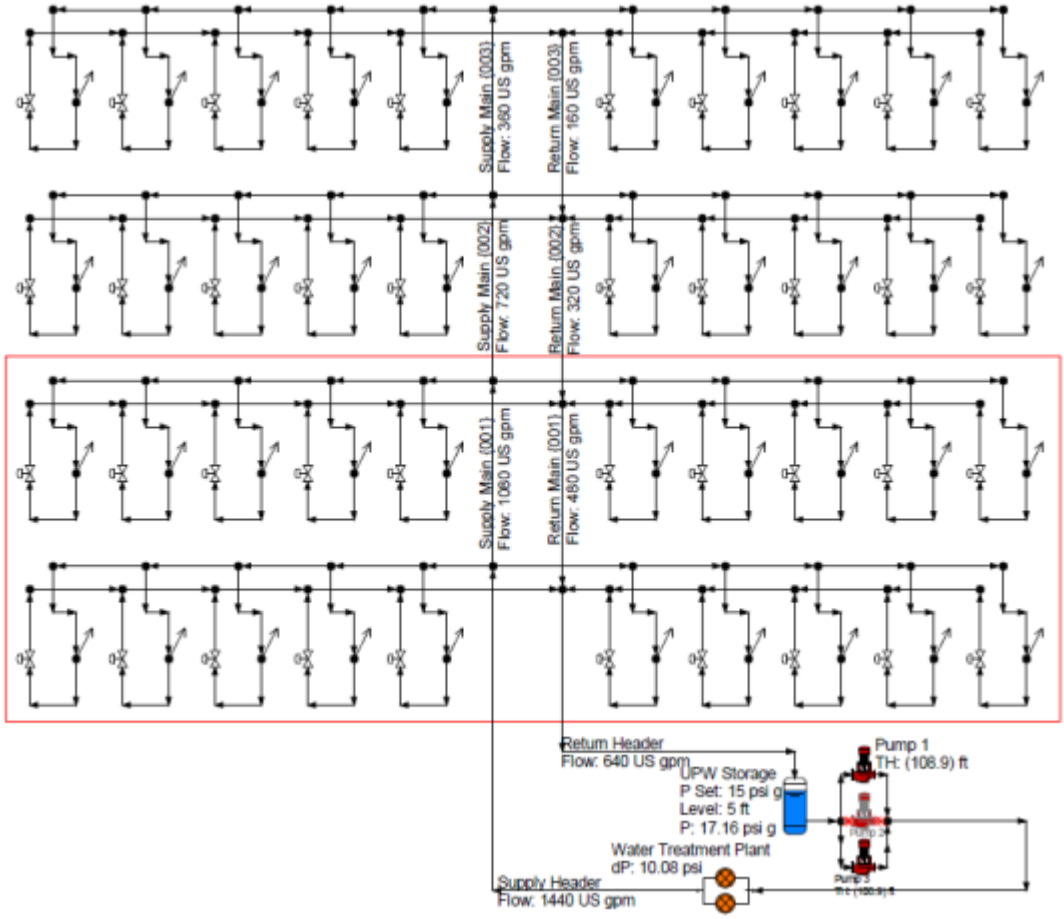
Notice the pump is red. The system was designed so that a single pump could handle four banks of tools, but not eight banks. Also notice that only one pump is currently operating.

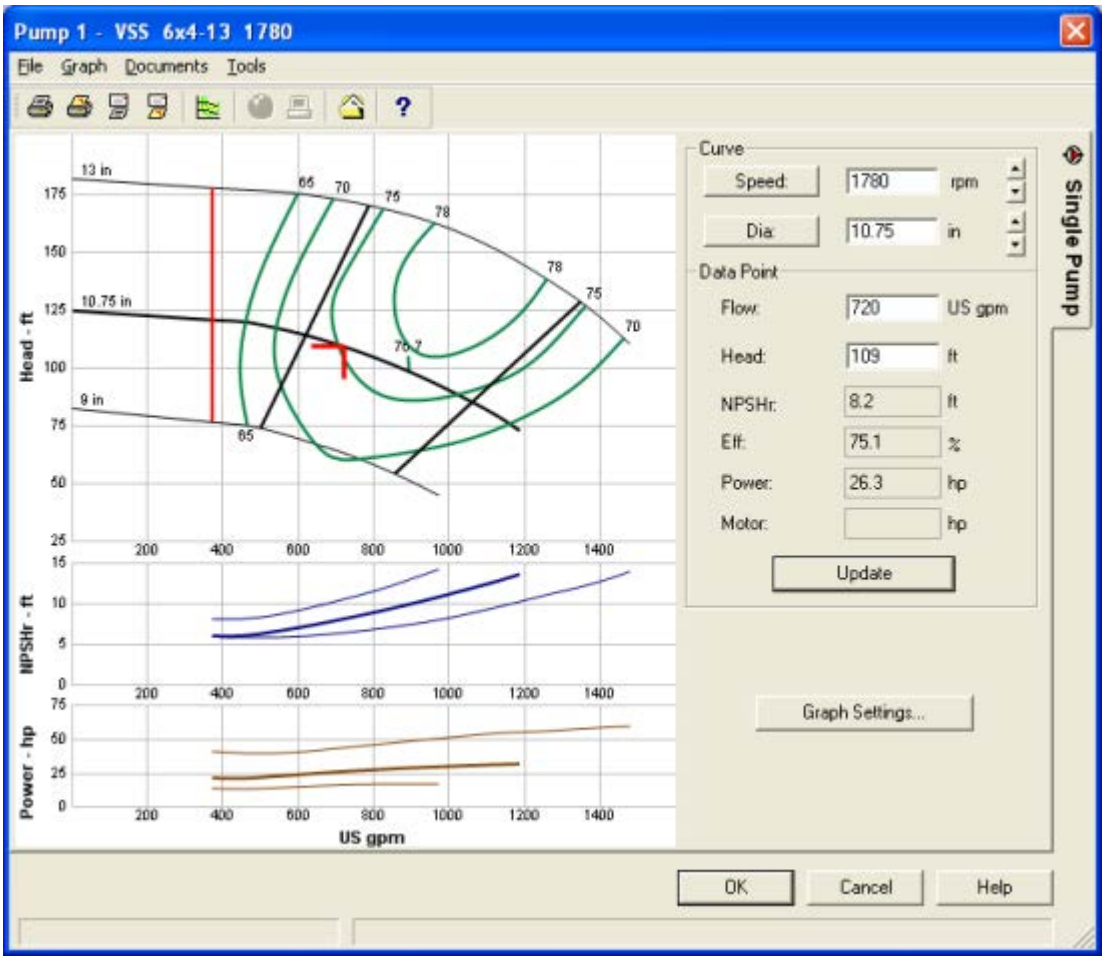
Let's look at the graph for Pump 1.

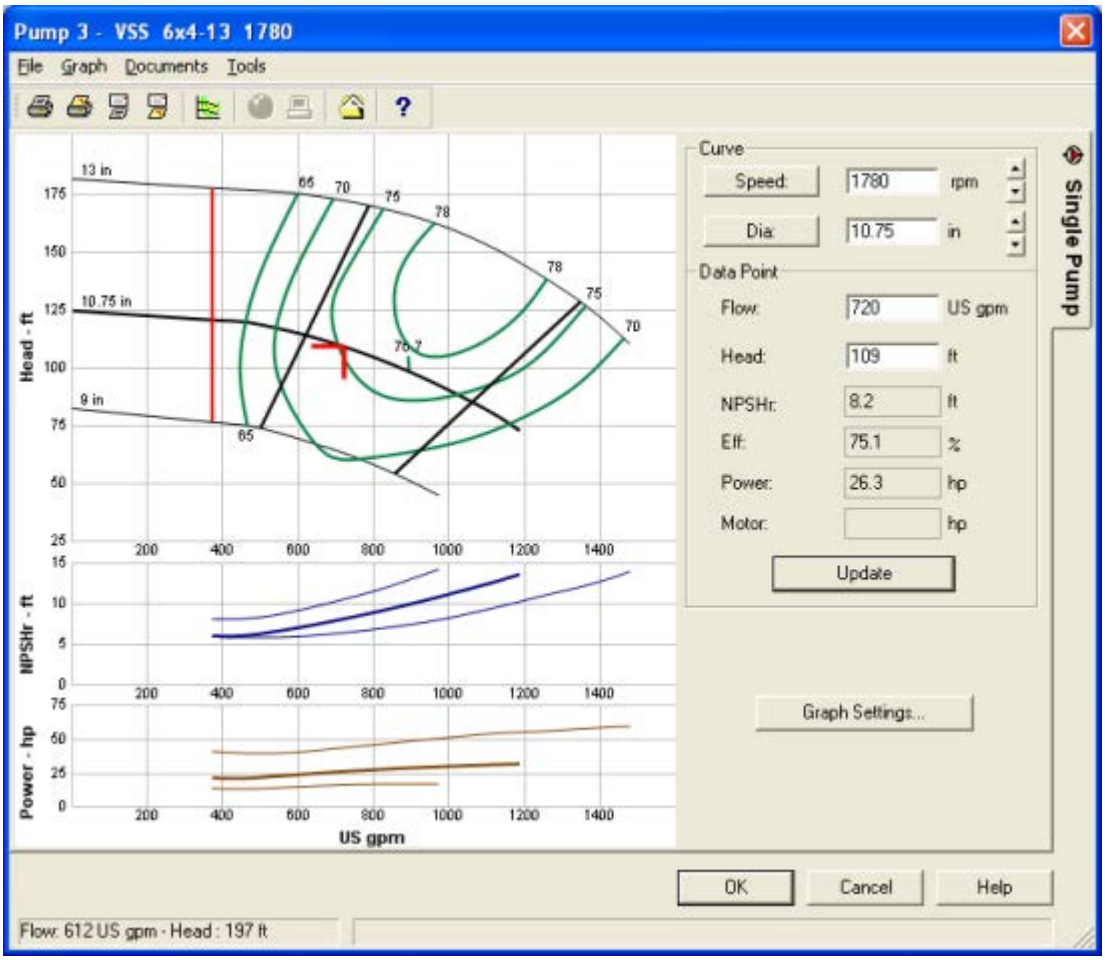


Notice the red operating point is well off the end of the graph. This pump is being stretched beyond its limits.

Now let's open Pump 3, and see how the system will operate with two pumps running.


Supply Main (003)
Flow: 360 US gpm
Return Main (003)
Flow: 160 US gpm
Supply Main (002)
Flow: 720 US gpm
Return Main (002)
Flow: 320 US gpm
Supply Main (001)
Flow: 1080 US gpm
Return Main (001)
Flow: 480 US gpm
Return Header
Flow: 640 US gpm
UPW Storage
P Set: 15 psi g
Level: 5 ft
P: 17.16 psi g
Water Treatment Plant
dP: 10.08 psi
Supply Header
Flow: 1440 US gpm
Pump 1
TH: (108.9) ft


Pump 1 - VSS 6x4-13 1780
File Graph Documents Tools
13 in
10.75 in
9 in
66
70
75
78
78
75
70
76.7
65
Head - ft
NPSHr - ft
Power - hp
US gpm
Curve
Speed: 1780 rpm
Dia: 10.75 in
Data Point
Flow: 720 US gpm
Head: 109 ft
NPSHr: 8.2 ft
Eff: 75.1 %
Power: 26.3 hp
Motor: hp
Update
Graph Settings...
Single Pump
OK
Cancel
Help



Notice Pump 1 is no longer red. Above are the graphs for Pump 1 and Pump 3.We can see that the pumps are now running in their Preferred Operating Areas.