

**Pipe Size vs Flow [Nomograph](#)** The nomograph (link above) allows you to visually see the effect of pipe size and flow rates. You should size your pipe so that your flow velocity stays in the green or yellow range. The green range is safest, most efficient and will produce little to no noise. Flow velocities in the yellow range may be noisy and have additional back pressure. Flow velocities in the red are not recommended because of the risk of hydraulic shock and pipe/fitting/joint & pump failure.

Note: Back pressure (restriction) is exponentially dependent on flow velocity. For example in a 1" pipe going from a flow velocity of 2 ft/sect (about 5gpm) to a flow velocity of 3.86 ft/sec (about 10gpm) will increase back pressure by 300%. Going to a flow velocity of 7.71ft/sec (about 20gpm) will increase back pressure by 1300%!

These figures are for straight pipe only! The effect of putting direction changes in will compound the back pressure even more and could even result in failure of the system or burning up the pump. You will never be hurt by going to a bigger pipe and will gain by using less electricity due to a more efficient system which may offset the initial price difference for the larger pipe.

### Friction Loss Further Detailed Information

If you really want to get technical and calculate the exact friction loss through PVC and CPVC pipe you can use the Hazen-Williams equation as expressed below for water:

$f = 0.2083 (100/c)^{1.852} q^{1.852} / d_h^{4.8655}$  where  $f$  = friction head loss in feet of water per 100 feet of pipe (ft<sub>h2o</sub>/100 ft pipe)  $q$  = volume flow (gal/min)  $d_h$  = inside diameter (inches)

$c$  = a constant for internal pipe roughness. 150 is the commonly accepted value for PVC and CPVC pipe.

You can also print out and use the [Nomograph](#) courtesy of Plastics Pipe Institute, a division of The Society of The Plastics Industry. (Note: You normally want to keep your flow velocity under 12 feet per second for 4" and under and 5 feet/second for 5" and above to avoid hydraulic shock.) Compared to other materials used for water pipe, thermo-plastic pipe smoothness remains relatively constant throughout its service life.

Note -The above information is from the FlexPipePVC.com website, on January 9, 2021.

I have edited some text for brevity, and added in italics, information regarding the PSA Water system, owned by PSA, currently managed by Northwest Water Systems(NWS) from 2009 to present day.

PSA changed over from an under capacity, low pressure, failing, 50 year old system, in Summer, 2009.

A new fully pressurized, loop design, using 6 inch mains, supplies water to the PSA Park and 228 PSA parcels, including 17 new Fire Hydrants. The PSA water distribution system, included a new South Well drilled in 2007, connected to the North Well storage tanks through an 8 inch, 800 foot long connector main. 3 new distribution pumps, with new electrical controls, were connected to the 2 existing, 114,000 gallon total, water storage tanks. In 2016, a propane powered, alternate electrical power source generator, was installed at the North Well and Pump House location, to maintain legal water flow pressure, when PUD 3 power service is down.

many variables affect noise. The flow rates shown are for water, with viscosity of 1. You can use the Hazen-Williams equation below to calculate the exact flow loss through a pipe.

Find your flow in the first column (GPM) and then select the pipe size you want in the second column (pipe, ID in inches.) If it ends in the yellow or red, increase the pipe size until your line ends in the green (best) or yellow (just okay) area.

**Water Flow Chart #1** The chart below takes into consideration the potential damage from hydraulic hammer (shock) and noise considerations due to excessive fluid velocity. For more detailed information [click here for our pipe selection based on pipe size and flow requirement Nomograph](#). You can flow more than what is shown in the chart (see **Chart #2** below) however, you may run into problems if you do. **IMPORTANT:** The flow ratings in the charts below are for Rigid PVC Pipe. Reduce flow by 3% (Multiply by .97) for flow going through Flexible PVC Pipe.

READ

**GPM/GPH  
Flow based  
on PVC Pipe  
Size**

Shown are 3 charts and one formula showing water flow through a pipe. These 3 charts are general guidelines, not to be relied on as a precise source for information or as a substitute for engineering. The data between them does vary. In the chart to the left is a general guideline for how much liquid a pipe of specific size can flow in GPM (Gallons Per Minute) & GPH (Gallons Per Hour.) There are three columns. (Well there are really six, but each column is shown in Gallons per minute, and as Gallons per Hour.) The first set of columns is for water flow from gravity in a low head pressure situation to power the flow. For PSA Water system use the 2nd column The 2nd set of columns show water flow using an average pump pressure from 20 to 100 PSI

Sch 40 Pipe Size	ID (range)	OD	Assume Gravity to Low Pressure. About 6f/s flow velocity, also suction side of pump		Assume Average Pressure. (20-100PSI) About 12f/s flow velocity		Assume "High Pressure" PEAK flow. About 18f/s flow velocity*	
			GPM (with minimal pressure loss & noise)	GPH (with minimal pressure loss & noise)	GPM (with minimal pressure loss & noise)	GPH (with minimal pressure loss & noise)	GPM (with significant pressure loss & noise)	GPH (with significant pressure loss & noise)
1/2"	.50-.60"	.85"	7 gpm	420 gph	14 gpm	840 gph	21 gpm	1,260 gph
3/4"	.75-.85"	1.06"	11 gpm	660 gph	23 gpm	1,410 gph	36 gpm	2,160 gph
1"	1.00-1.03"	1.33"	16 gpm	960 gph	37 gpm	2,220 gph	58 gpm	3,510 gph
1.25" PSA	1.25-1.36"	1.67"	25 gpm	1,500 gph	62 gpm	3,750 gph	100 gpm	5,940 gph
1.5"	1.50-1.60"	1.90"	35 gpm	2100 gph	81 gpm	4,830 gph	126 gpm	7,560 gph
2" PSA	1.95-2.05"	2.38"	55 gpm	3300 gph	127 gpm	7,650 gph	200 gpm	12,000 gph
2.5"	2.35-2.45"	2.89"	80 gpm	4800 gph	190 gpm	11,400 gph	300 gpm	17,550 gph
3"	2.90-3.05"	3.50"	140 gpm	8400 gph	273 gpm	16,350 gph	425 gpm	25,650 gph
4"	3.85-3.95"	4.50"	240 gpm	14,400 gph	480 gpm	28,800 gph	700 gpm	42,000 gph
5" PSA 6" MIN	4.95-5.05"	5.563"	380 gpm	22,800 gph	750 gpm	45,000 gph	1100 gpm	66,000 gph
6" PSA	5.85-5.95"	6.61"	550 gpm	33,000 gph	1100 gpm	66,000 gph	1700 gpm	102,000 gph
8"	7.96"	8.625"	950 gpm	57,000 gph	1900 gpm	114,000 gph	2800 gpm	168,000 gph

## Water Flow Chart #2

Here is a set of data predicting the amount of flow through an **orifice** based on pressure on one side of the **orifice**. Note: This is through an **orifice**, not a pipe. Adding pipe and fittings will drop this flow significantly. In other words, this would be the theoretical maximum amount of water through a **hole** based on the pressure above it. The Water Flow Chart #1, (shown above) is more "real world" information.

Pressure	Flow in GPM through a hole diameter measured in inches							
PSI	1"	1.25"	1.5"	2"	2.5"	3"	4"	5"
20	26	47	76	161	290	468	997	2895
30	32	58	94	200	360	582	1240	3603
40	38	68	110	234	421	680	1449	4209
50	43	77	124	264	475	767	1635	4748
60	47	85	137	291	524	846	1804	5239
75	53	95	153	329	591	955	2035	5910
100	62	112	180	384	690	1115	2377	6904
125	70	126	203	433	779	1258	2681	7788
150	77	139	224	478	859	1388	2958	8593
200	90	162	262	558	1004	1621	3455	10038

## Water Flow Chart #3

This chart predicts how much flow you will get across a stainless metal ball valve of the diameter & length specified with a 1PSI pressure drop from one side of the valve assuming about 100psi on one side of the valve.

Size (ID, inches)	Length (inches)	Flow (GPM)
1/2	4.25	26
3/4	4.62	50
1	5.00	94
1-1/2	6.50	260
2	7.00	480
2-1/2	7.50	750
3	8.00	1300
4	9.00	2300
6	15.50	5400

Note: The data is for water through the valve only, and does not take into account the rest of the system. It does not give flow velocity, so there is some question as to the applicability of the data. The data comes from a book for industrial piping and probably assumes a massive pump, high flow velocities and metallic pipes. (Ie, where water hammer and noise are less of a concern than with PVC pipe.) As always, "you mileage may vary."

PSA water system pressure is 40 to 100 PSI  
 PSA water mains are 6 inch diameter.  
 Side mains are 2" diameter  
 Meter Service for laterals to double meter sets are 1.25" diameter

The 3rd set of columns is the maximum flow based on maximum recommended velocity of the liquid in the pipe. You may exceed this, but you will have to contend with excessive noise and exceedingly high inertial impacts. (I.e. Possible system failure due to hydraulic hammer effects.)

This is a very general guide and is subject to many variables. Pressure, noise allowance, bends, fittings, viscosity, etc. affect how much liquid will flow through a pipe of given size. If you can accept more noise and have higher pressure, you can pump more at the risk of system failure. If you have a lot of bends and fittings you will flow less. The flow rates shown should not produce unacceptable noise, however,