Pump ED 101

Branch-Line Pumping and Other Options – Part 2

Joe Evans, Ph.D http://www.PumpEd101.com

Last month we reviewed several examples of open flow, branch line pumping applications. We used my Branch Line Pumping calculator to compare a branch line system with two different discharge elevations to a multi-line system that utilized two individual pumps. Based upon the input data, the multi-line system was more efficient and its breakeven point was a little over two years.

In addition to multi-line, multi-pump systems, the designer has several other alternatives to open ended, branch line systems with multiple elevations. One of the most common is the tank based system. In this type of application a storage tank is installed at or above the upper most elevation. A lower flow pump is used to keep the tank filled and gravity supplies water, under pressure to the lower elevation discharge points. One of the more common examples is a municipal water supply system. Elevated tanks or those located on hillsides utilize gravity to supply pressure to the surrounding areas. Another example is high rise buildings. Many older buildings use roof mounted tanks to supply pressurized water to the upper floors. Yet another option is to utilize a single service line with two or more pumps operating in series. Figure 1 compares this design to an open branch system.

Branch Line Pumping

Multiple Discharges / Single Pump & Pipeline
versus
Multiple Pumps / Single Pipeline

HP = (Flow X Head) / (3960 X Efficiency)

One Pump / One Pipeline

Point A to B & C

43.2 HP = (600 x 200) / (3960 X 0.7)

Two Pumps / One Pipeline

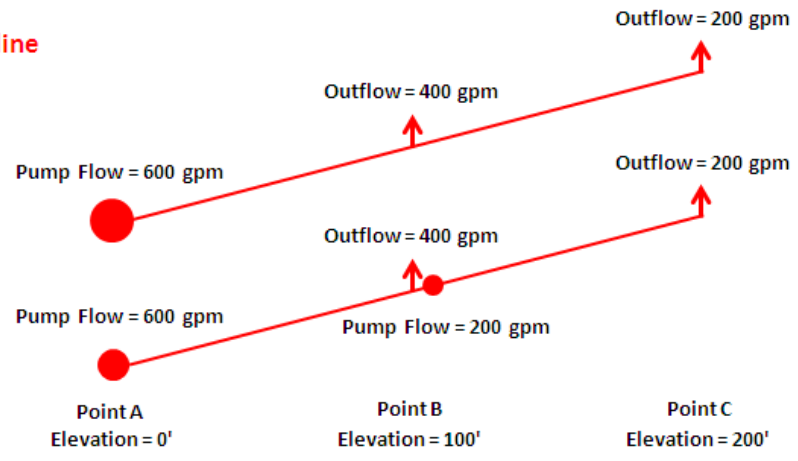
Point A to B

21.6 HP = (600 X 100) / (3960 X 0.7)

Point B to C

7.2 HP = (200 X 100) / (3960 X 0.7)

Head includes elevation & friction but the exampleassumes zero friction. Other assumptions include 70% pump efficiency and valves at points B & C.



The upper pipeline is the same open flow, branch line design we saw last month. The pump at Point A produces 600 GPM at a TDH of 200' and supplies outflows of 400 GPM and 200 GPM at branch points B and C. The power required to meet the two branch flows is 43.2 HP. The high HP requirement is due to the fact that the total head seen by the pump is directly proportional to the elevation at Point C.

The pumping system in the lower portion of Figure 1 is quite different. The pump at Point A still provides 600 GPM but, since it is pumping to Point B only its discharge head is reduced to 100'. A second pump, located at Point B and operating in series moves the remaining water to Point C. This design reduces the total power required by 33%. This results in a smaller pump at Point A that requires 21.6 HP and an even smaller one at Point B requiring just 7.2 HP. Figure 2 is the calculator portion and compares the variables offered by these two alternatives

Branch Line versus Multiple Pump Single Line Analysis

REQUIRED DATA	A to B & C	A to B		B to C		? to ?
Pump Operation - Hours / Day	8	8		8		0
Pump Operation - Days / Year	365	365		365		0
Pump Flow - GPM	600	600		200		0
Pump Head - Feet	200	100		100		0
Pump Efficiency - %	70%	70%		70%		70%
Motor Efficiency - %	94.0%	90.0%		90.0%		90.0%
Energy Cost in $/KWH	$0.11	$0.11		$0.11		$0.00
Initial & Additional System Costs	$44,000.00	-8,000.00	*	11,000.00	*	
RESULTS						
Annual Flow	105,120,000	105,120,000		35,040,000		0
BHP At Design Point	43.3	21.6		7.2		0.0
Wire to Water Efficiency - %	66%	63%		63%		63%
Annual Energy Cost	$11,035.06	$5,762.75		$1,920.92		$0.00
KW Per 1000 Gallons Pumped	0.954	0.498		0.498		#DIV/0!
Cost Per 1000 Gallons Pumped	$0.105	$0.055		$0.055		#DIV/0!
PAYBACK						
Annual Savings - $$	$3,351.39					
Annual Savings - %	30%					
Additional cost	$3,000					
Payback - Years	0.9					

Once again, the required data are entered into the yellow cells and the column to the left is the open flow, branch line system. The two columns in the middle represent the series system from Points A to B and B to C. The initial cost of the branch line system is $44000.00. When converting to a series system the cost is reduced by $8000.00 due to the smaller pump required at Point A. The additional pump and controls required at Point B adds an additional $11000.00 to the cost of the series system. Therefore, the total additional cost for the series system is

$3000.00 and based upon an annual electrical savings of about $3300.00 the payback is less than one year. For this particular example, the series system is obviously more efficient that the single pump system. It is also trumps the two pipeline design seen in Part 1 of this series. The HP required for the series system and the two pipeline design is exactly the same but, the lower piping cost of the series system makes it a more cost effective system.

As I stated in Part 1 of this series, my branch line pumping calculator is not a design tool. Instead, it is an evaluation tool that will allow you to compare traditional branch line systems with several alternatives. Once a choice is made, any number of software systems can assist you with the design phase. The Branch Line Pumping calculator can be downloaded from the "Pump Evaluation, Selection & Testing Tools" page at www.PumpEd101.com.

Joe Evans is responsible for customer and employee education at PumpTech Inc, a pump & packaged systems manufacturer & distributor with branches throughout the Pacific Northwest. He can be reached via his website www.PumpEd101.com. If there are topics that you would like to see discussed in future columns, drop him an email.