Water for the World

Choosing Between Gravity Flow and Pumps

Technical Note No. RWS. 4.P.1

Water can be delivered from one point to another in four basic ways: hauling, pumping, gravity flow or a combination of these methods. Hauling is the least efficient method. It is labor intensive, very costly, and provides only minimal quantities of water. Pumping may require a great deal of energy and usually is more expensive to operate and maintain than gravity flow. Gravity flow is efficient, requires no additional energy and is economical to operate and maintain. It may, however, be expensive to construct initially.

Gravity flow systems usually restrict the source to a specific location. Pump systems provide much more flexibility in locating a source. A source suitable for gravity flow is more likely to require treatment than one using a pump because it is likely to be a spring or a surface source. Because of its dependability and low operation and maintenance costs, if the water is of satisfactory quality gravity flow should always be considered. The final decision to use a particular means of moving water must be based on comparison of costs including operation and maintenance as well as construction costs.

Evaluating Gravity Flow Versus Pumps

To choose between gravity flow and pumps, each type of system should be evaluated. Factors which should be included in this evaluation are:

- The amount of water needed by the village,
- The amount of water the source can produce,
- The water quality,
- The difference in elevation between the source and the highest point in the system, usually the top of the storage tank,
- The distance between the source and the point of storage,
- The obstacles between the source and the village,
- The alternative water sources that are available or could be made available,
- The type of power available and its cost,
- The estimated pumping head.

Worksheet A can be used to tabulate the needed information for all sources. A map should be made of the area identifying the sources in relation to the homes to be served. Any good, clear existing map can be used. The map should show land elevations, existing homes and buildings, roads and streets. Swamps, high groundwater areas, and rock zones should be added to the map. Digging trenches for pipes in such places will be difficult and costly.

Once the necessary information is obtained, gravity flow and pumped transmission lines can be compared and cost estimates, including operation and maintenance costs, can be compared. See "Designing a System of Gravity Flow," RWS.4.D.1, and "Determining Pumping Requirements," RWS.4.D.2, for information about how to size the respective systems.

Worksheet B is a form that can be used to make cost estimates for the transmission line. Prepare an estimate

for each possible source. Worksheet C can be used to compare the costs of developing one source among two, three or more possible sources. When a satisfactory source from which water can be moved by gravity is found, every effort should be made to use it. Added pipeline length which may be required will be less costly in the long run than a pumped transmission line.

Worksheet A. Data Required for Choosing Between Gravity Flow and Pumps

1. Estimated present water needs in liters:

	Number of	Unit use		Total
Population	Persons	_____	x _____	= _____
School	Students	_____	x _____	= _____
Church	Attendees	_____	x _____	= _____
Large animals such as cows, oxen		_____	x _____	= _____
Small animals such as sheep, goats		_____	x _____	= _____
Public watering fountains		_____	x _____	= _____

Total present needs = _____

2. Estimated future water use:

Use a 20 year design life. If no better information is available, use a population growth factor of 2 times the present population and an increase in animals of 1.25 times the present number. In addition, assume an increase in the rate of water use of 2 times the present use.

Population	Present use	_____	x 4 =	_____ liters
Institutions & public fountains	Present use	_____	x 2 =	_____ liters
Animals	Present use	_____	x 1.25 =	_____ liters

Total future water use = _____ liters/day

3. For each possible water source, determine or judge:

Water quality _____

Sustained yield in liters per day _____

Difference in elevation between source and highest point in system _____

Distance between source and storage _____

Obstacles between source and village _____

Ease of construction of source protection and pipeline _____

Worksheet B. Estimated Cost of Transmission Line Pump/Gravity Flow Delivery System

Item	Quantity	Unit Cost	Total Cost
Transmission Line Materials			
8-inch PVC pipe	_____m	_____	_____
6-inch PVC pipe	_____m	_____	_____
8-inch gate valve & box	_____	_____	_____
6-inch gate valve & box	_____	_____	_____
4-inch flush valve	_____	_____	_____
Pressure reducing valves	_____	_____	_____
Power source (electricity)	_____	_____	_____
(fuel engine)	_____	_____	_____
Pump & Controls	_____		_____
Pumphouse	_____	_____	_____
Storage tank (_____m^3)	_____	_____	_____
Transmission Line Materials			_____
Labor			
Lay water lines	_____	_____	_____
Construct pumphouse	_____	_____	_____
Construct storage tank	_____	_____	_____
Construct water source	_____	_____	_____
(dug well)	_____	_____	_____
(spring)	_____	_____	_____
(surface)	_____	_____	_____
Install pump	_____	_____	_____
Install motor	_____	_____	_____
Labor			_____
Equipment			
Pickup truck	_____	_____	_____
Dump truck	_____	_____	_____
Front end loader	_____	_____	_____
Trencher	_____	_____	_____
Backhoe	_____	_____	_____
Crawler tractor	_____	_____	_____
Compressor	_____	_____	_____
Other _____	_____	_____	_____
_____	_____	_____	_____
Equipment			_____
Cost Summary			
Sub-total Materials			_____
Sub-total Labor			_____
Sub-total Equipment			_____
Sub-total project cost			_____
Add contingency 20%			_____
Total Project Cost			_____

Worksheet C. Comparison of Costs for Transmission Lines

Source	Type System Gravity/Pump/Both	Transmission Line Cost	O&M Cost
A. _____	_____	_____	_____
B. _____	_____	_____	_____
C. _____	_____	_____	_____
D. _____	_____	_____	_____
E. _____	_____	_____	_____
F. _____	_____	_____	_____
G. _____	_____	_____	_____

Source Selected _____

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