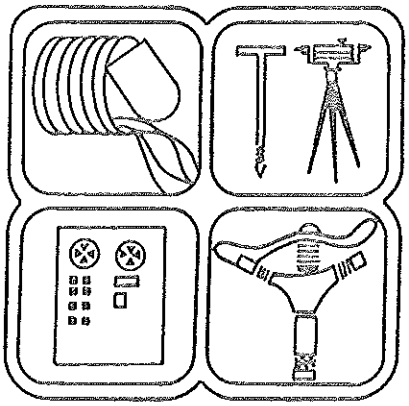

PUMP OUTLETS FOR SUBSURFACE DRAINAGE ON MINERAL SOILS

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THE CONCEPT

The water from a soil drainage system often flows by gravity into an outlet ditch, and then (by gravity) away from the drained area. However in some situations - usually in very flat areas - it may be impossible or impractical to develop an outlet that is deep enough to accept the water from subsurface drains. In such cases, you may want to consider installing a pump system. The water from the drains is collected and temporarily stored in a sump (usually a steel or concrete tank) and then is pumped into the outlet. (See Figure 1) The pump system could serve one or more farms.

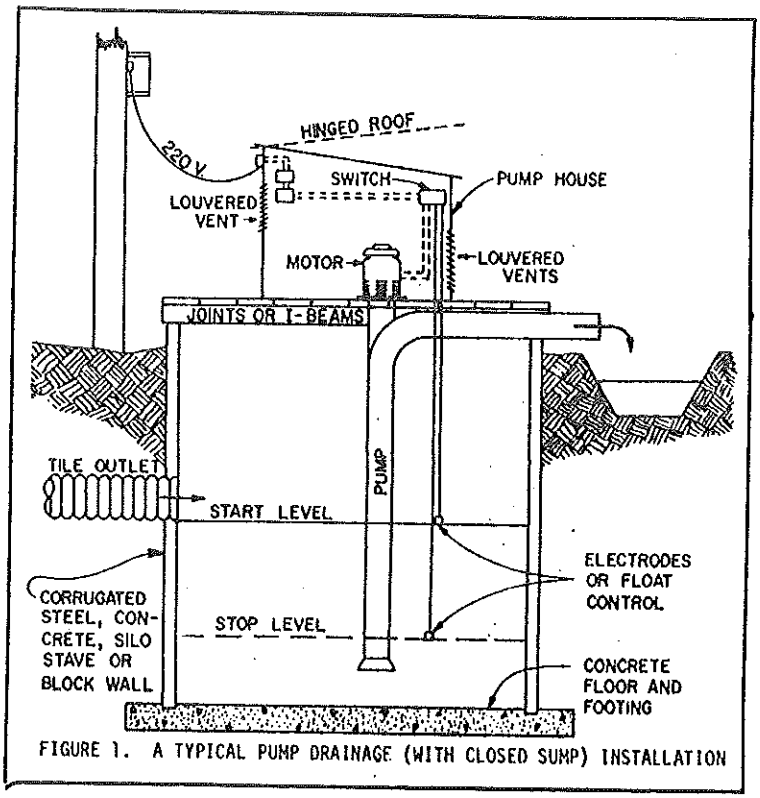

FIGURE 1. A TYPICAL PUMP DRAINAGE (WITH CLOSED SUMP) INSTALLATION

WHY PUMP?

The minimum recommended depth for a subsurface drainage system is about 30 inches. If the outlet ditch cannot be dug at least 40 inches deep, and have enough capacity to prevent water from ponding in the ditch (and submerging the drain outlets) then a sump and pump combination must be used to get the drainage water into the ditch. A pump-drainage system is similar to, but larger than the sump pump found in many rural homes.

Seasonal Cycle:

A pump drainage system is only operated when excess water must be removed from the soil. Pump drainage is seldom needed during the summer. Similarly, there is often little reason to operate the pump after the crop is harvested in the fall. Many pump drainage systems are only operated for a period of 4-6 weeks in the spring, and (if needed) for a similar period in the fall. Such seasonal pumping may limit the choice of crops, since a crop which is subject to frost heaving (like alfalfa) would not be likely to persist if subjected to winter wetness. If severe summer rains occur, the system can be used to prevent or minimize crop damage from soil wetness. Furthermore, there may be situations where the pump system could be managed to minimize droughty conditions.

POWER UNITS

Pumps can be powered by single or multi phase electric motors, tractors, p.t.o. or belt drive, diesel, or gasoline engines. Electric motors are generally preferred in pump drainage systems because of their ease of automation for cycling, efficiency, and minimal amount of maintenance. Multi (3) phase electric motors are usually required for motor sizes of 7 hp or more. Where electricity is not readily available, tractor p.t.o. or diesel engine may be the most economical choice. However, more management is generally required for operating, servicing, and maintaining these types of power units.

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TABLE 1. PUMP DISCHARGE AND SUMP STORAGE CAPACITY REQUIREMENTS FOR VARIOUS ACREAGES OF MINERAL SOILS USED FOR FIELD CROPS.

Subsurface Drains Only (Acres)	Surface & Subsurface Drains (Acres)	Pump Discharge (gpm)	Sump Storage Capacity (cubic feet)		Approximate Motor H/P
			Automatic Operation (10 cycles/hour)	Manual Operation (2 cycles/day)	
20	7.5	170	34	4,100	1
50	18.5	425	85	10,200	2
100	37.0	850	170	20,400	3
150	55.0	1,275	255	30,600	5
200	74.0	1,700	340	40,800	7

PUMP CAPACITY

The required pump capacity depends on whether you are going to pump subsurface (tile) water, surface water, or both. When pumping only water collected by subsurface drains, the discharge rate should be 8.5 gpm (gallons per minute) per acre drained where field crops are to be grown. If surface water is entering the drains through blind or open inlets or is going to be collected and pumped along with subsurface waters, the discharge rate should be about 23 gpm per acre drained for field crops.

Pumps may be either propeller or centrifugal. Generally a propeller pump is used to remove large volumes of water (400 gpm or more) when 10 feet or less lift is required. The centrifugal pump is usually used for small volumes of water (600 gpm or less) and where more lift is required.

The pump lift is the vertical distance that the pump must lift the water from the bottom of the sump to the outlet pipe. An average lift for an agricultural pump drainage installation is 8 to 10 feet.

SUMP CAPACITY

The size of the sump depends on the size of pump and whether automatic or manual operation is selected. The sump is smaller when automatic operation and frequent cycling is used. For automated operation, the sump is sized so that 5 to 15 cycles (starts and stops) per hour occur. For manual operation, the sump must be much larger because the pump is usually operated for only 2 cycles per day.

Table 1 summarizes the pump discharge and sump storage capacity requirements for various acreages of mineral soils used for field crops. The approximate electric motor horsepower is also given (based on 8 to 10 feet lift and approximate 60% efficiency). These are only to be used as guidelines for preliminary planning.

COSTS

Capital costs for pump drainage depend on the location, condition of the site, the type of drainage desired, the type of pump and power unit, the sump, and the mode of operation desired. Generally costs increase with area, but not proportionately. In other words, it may cost more per acre for a 20 acre pumping plant than for a 60 acre pumping plant. The cost range is generally within $20. to $100. per acre for subsurface drainage only (does not include field drains). A pump system (with sump) for a 100 acre field will cost approximately $50. to $60. per acre.

The size of the motor and the length of time the pump operates determines the amount of power consumed. The range of annual power consumption might be anywhere from 10 to 60 kilowatt hours of electricity per acre drained. If electricity cost 5 cents per kilowatt hour, the annual cost would range from 50 cents to $3.00 per acre.

OTHER CONSIDERATIONS

The location of the pump outlet should be at or near the point of lowest elevation for the area being drained. The pump plant should be accessible to an adjacent outlet, which must be adequate for handling the discharge and be in compliance with applicable drainage laws and local codes. Adjustments to location may be necessary to avoid unstable soil conditions (especially where concrete is used in the sump), to avoid flooding of equipment, to obtain ready access to power supply and to protect from vandalism. Environmental disturbance is generally minimal with pump outlets.

MORE INFORMATION

This fact sheet is intended to introduce the basic concept of pump outlets for subsurface drainage. The considerations for a pump drainage installation have not been discussed in any detail. More information can be obtained from your local Soil and Water Conservation District, Cooperative Extension Agent or drainage contractor. Additional copies of this fact sheet can be obtained from 334 Riley Robb Hall, Cornell University, Ithaca, NY 14853.

REFERENCES

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