THAT DRAINAGE JOB

FEDERAL SECURITY AGENCY

U. S. PUBLIC HEALTH SERVICE

MALARIA CONTROL IN WAR AREAS

ATLANTA, GEORGIA DECEMBER 1945

CONTENTS

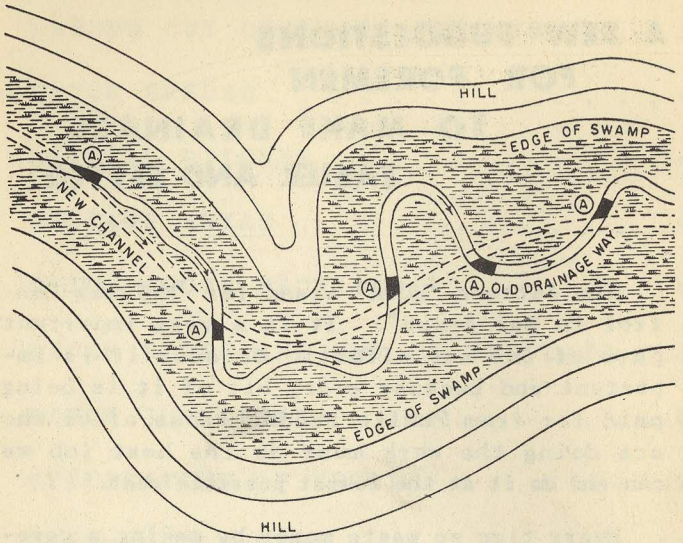
A FEW SUGGESTIONS FOR FOREMEN TO MAKE DRAINAGE EASIER AND BETTER

The letters "MCWA" stand for "Malaria Control in War Areas". It is a very important part of the war effort. Because it is important and because every bit of it is being paid for from Public Funds, those of us who are doing the work must do the best job we can and do it at the lowest possible cost.

Every time we waste money by making a careless mistake or by digging a ditch that won't do the job it was built to do, someone has to buy extra war bonds or pay extra taxes. Do a good job .... a job that will work .... and a job that will cost just as little as possible.

There are many ways to drain water from a pond or swamp. Some you may have used before — others you may not have thought of. In the next few pages a few suggestions are made, and a few common mistakes are pointed out. Look these over. They may aid YOU in doing a better job for our country at lower cost. Study the suggestions, and see if they will fit your drainage problem.

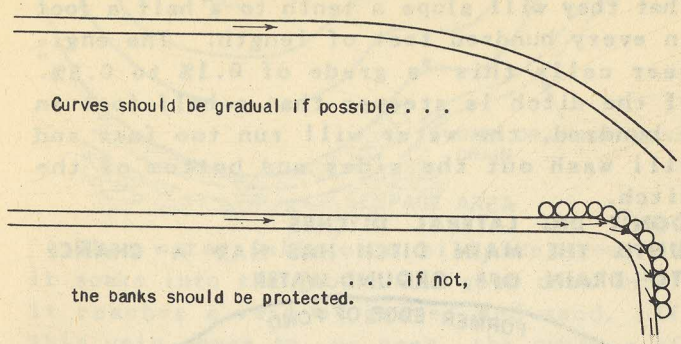
LAY OUT DITCHES AS STRAIGHT AS POSSIBLE



New ditches should be dug as straight as possible, but the ditch should follow the low land and not go through hills that would make a very deep ditch necessary. The best ditches are located in natural, small valleys through which water would naturally drain if the valley floor were low enough.

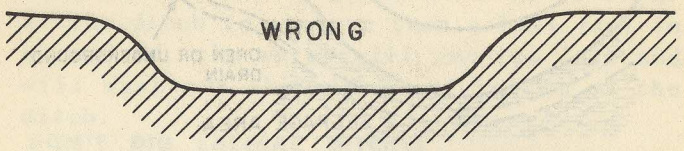
When a new channel cuts across an old winding drainage way, log and earth dams should be built (A) to keep water from flowing into the old channel. Below the dams, the holes and low spots in the old channel must be filled so that water will drain out. The lower end should be left open to permit such drainage.

CURVE DITCHES GRADUALLY OR PROTECT THE BANKS

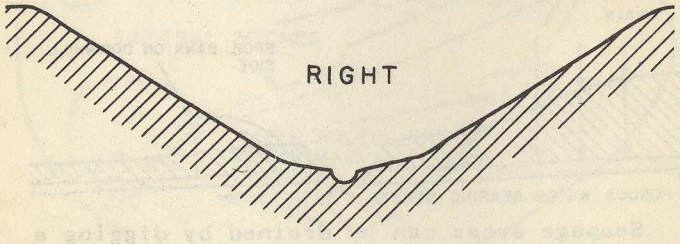


When curves are sharp, the fast-flowing water hits the outside of the curve and wears the bank away. If a sharp curve must be used, protect the bank with hand-placed stone, broken concrete, or logs set into the ground on end.

CONSTRUCT DITCHES JUST LARGE ENOUGH TO CARRY OFF SURFACE WATER RAPIDLY

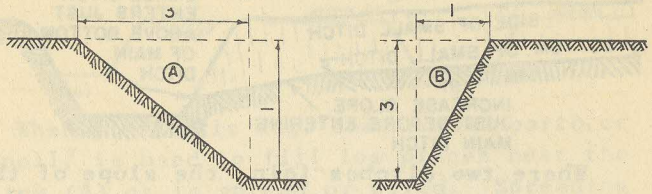


This ditch will have water spread over its bottom. Mosquitoes will breed in the ditch itself.



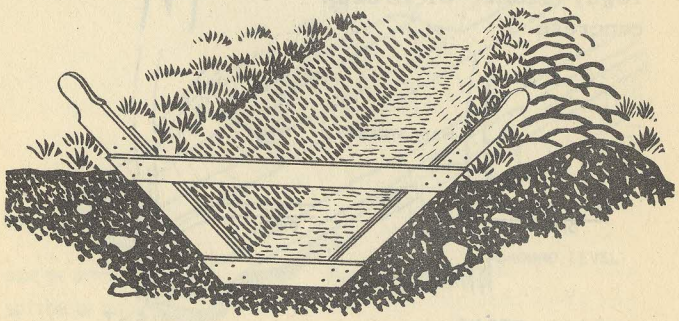
This ditch will carry as much water as the other, there will be few puddles in the bottom, and the banks will not cave. During dry periods, the water will run in the small channel in the bottom of the big ditch. There will be no water in which mosquitoes could breed.

SLOPE THE SIDES OF DITCHES PROPERLY



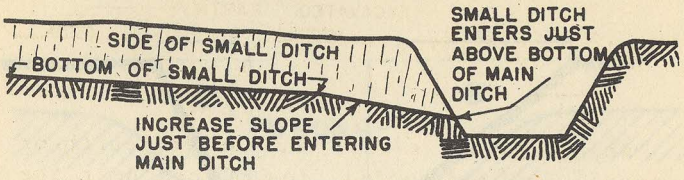
The sides of a ditch should be sloped enough so that they will not cave off into the stream. (A) shows how a ditch should be sloped in soft, loose soil. (B) shows how it may be sloped in hard, rocky soil. The commonest slope is 1:1 (1 foot vertical to 1 foot horizontal). This is suitable for firm loam and sand-clay.

USE A TEMPLATE TO SHAPE DITCHES UNIFORMLY



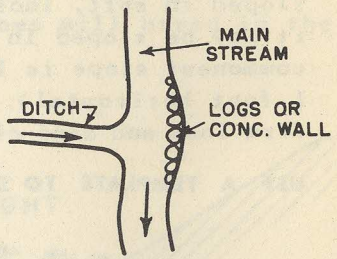
In digging ditches by hand, the use of a template constructed of wood saves labor and improves the quality of the finished ditch. A template makes it easier to obtain a uniformly shaped ditch.

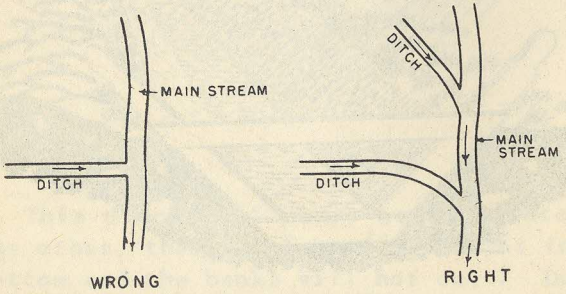
WHERE DITCHES JOIN, RUN THE SMALLER DITCH INTO THE MAIN CHANNEL IN THE DIRECTION OF FLOW



Where two ditches join, the slope of the smaller ditch should be increased just before it enters the main ditch, and it should enter a little above the bottom of the main ditch.

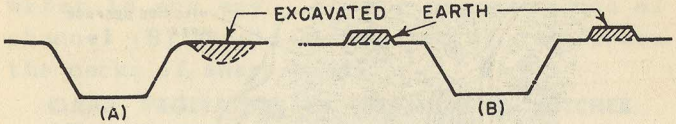
When a ditch must go straight into another, as shown, the main stream bank across from the small ditch entrance should be protected with logs, stone, or broken concrete.





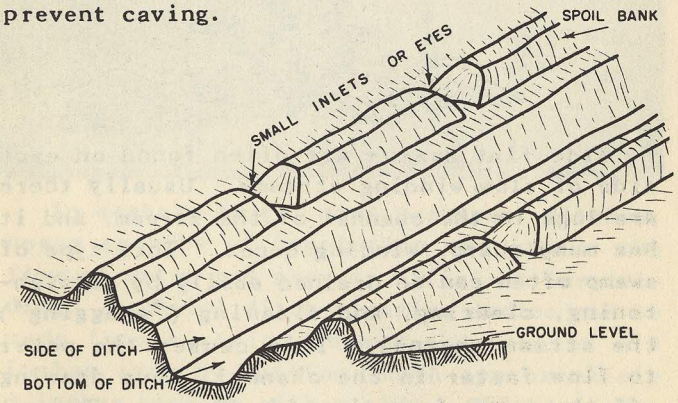
Where two ditches or a ditch and stream join, the smaller ditch should enter the main stream at about a 30° angle in the direction of flow.

USE SPOIL FOR FILLING WHERE POSSIBLE -- BUT DON'T BLOCK DRAINAGE



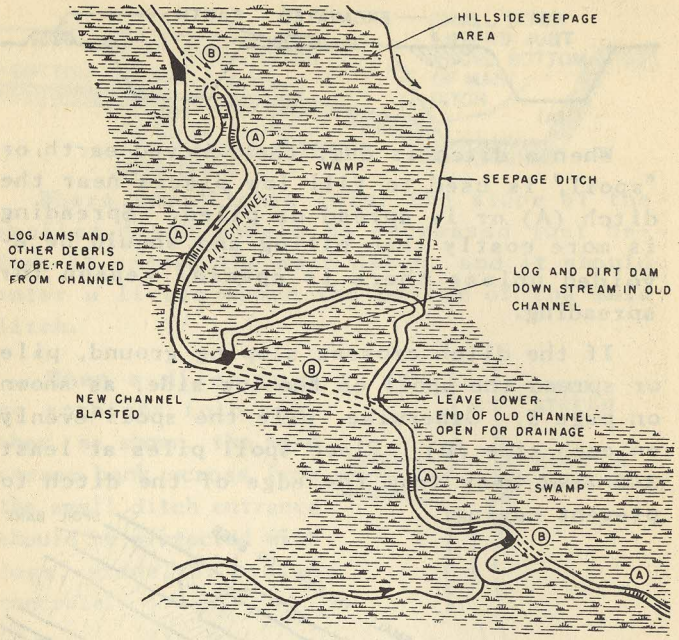
When a ditch is dug, the removed earth, or "spoil," is used to fill low places near the ditch (A) or is spread or piled. Spreading is more costly than piling and should be avoided unless there is special reason for spreading.

If the ditch crosses sloping ground, pile or spread the spoil on the low side, as shown on page 5. Otherwise, pile the spoil evenly on each side (B). Place spoil piles at least 3-6 feet back from the edge of the ditch to prevent caving.



When the earth removed from a ditch is spread on each side, small inlets, or "eyes," are cut through the bank to let the water run into the ditch from the sides.

IMPROVE DRAINAGE BY CHANNEL CLEARING



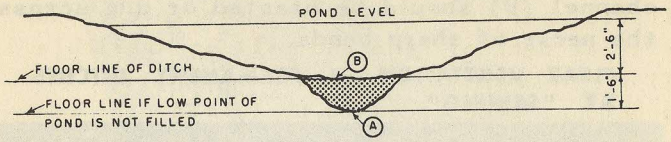
Wide flat swamps are often found on each side of slow, winding streams. Usually there are logs in the channel of the stream, and it has many sharp, winding bends. This type of swamp often can be drained easily by straightening, clearing, and cleaning ("snagging") the stream channel. This causes the water to flow faster in the channel, thus drawing off the water from the side swamps. Channel clearance is low in cost and will often be satisfactory. However, before the work is attempted, an engineer should run levels to be sure that enough slope is available.

To clear this kind of channel, remove logs (A) and other trash that slows the flow of water in any way. Short, new sections of channel (B) should be blasted or dug across the necks of sharp bends.

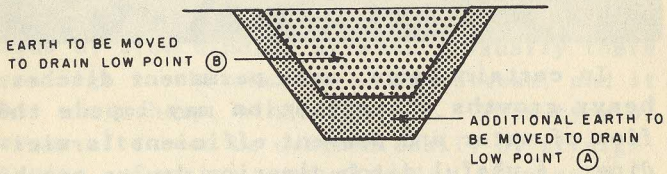
CLEAR VEGETATION IN PERMANENT DITCHES BY "SAWING"

In certain large, more permanent ditches, heavy growths of vegetation may impede the flow of water and prevent efficient larviciding. A useful ditch-clearing device can be made from a strip of heavy sheet metal 6-8 inches wide by cutting teeth approximately 3 inches wide on either side. This is bolted to a half-inch steel cable by cable clamps. By moving forward and crosswise, the saw cuts the vegetation and greatly reduces the time required for clearing ditches.

AVOID DIGGING EXCESSIVELY DEEP DITCHES BY FILLING LOW SPOTS



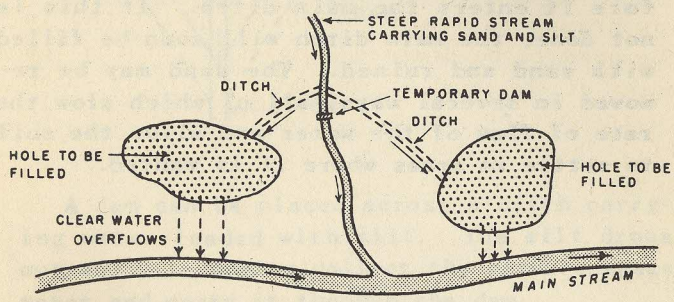
In most drainage jobs, the ditch is cut low enough to drain the lowest point (A) in the pond to be drained However, if the low point of the pond is in a small hole, as shown in the sketch above, it is often cheaper to fill the hole so that the elevation (B) becomes the low point. The elevation of (A) is 1.50 feet lower than (B). A ditch to drain the water from (A) would have to be 1.50 feet deeper than a ditch to drain the water from the elevation at (B). Notice below how much dirt has to be moved in making a deeper ditch to drain the hole.



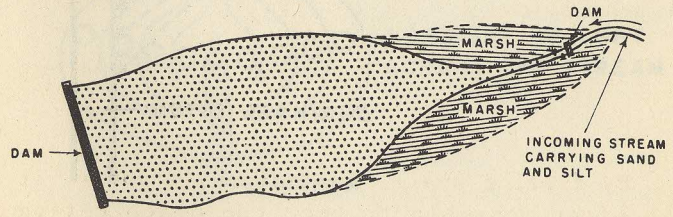
By filling small, low points in ponds, it is often possible to keep the ditch bottom higher and so make a shallower and smaller ditch which will require much less labor. An engineer should decide on the best and cheapest method to use.

USE NATURAL FILLING METHODS

Filling can sometimes be done with very little cost and effort if a stream carrying a great deal of sand and silt is available. If a stream of this kind can be diverted into a pond or other area to be filled, the sand and silt will settle to the bottom when the stream reaches the quiet water of the pond.



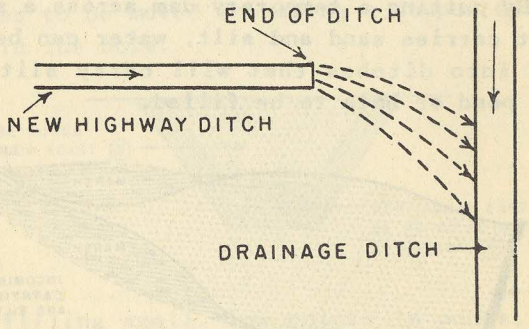
By putting a temporary dam across a stream that carries sand and silt, water can be forced into ditches that will carry silt into the pond or hole to be filled.



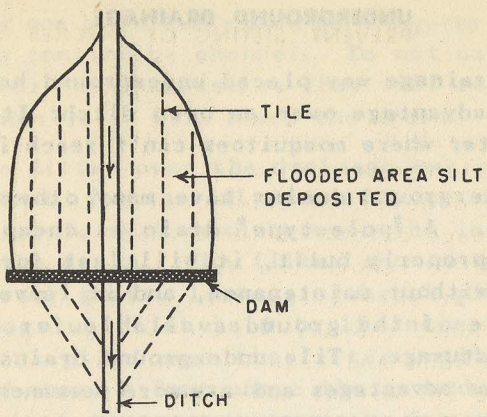
Filling of this type is often useful in filling wide, shallow areas that occur many times in ponds made by putting a dam across a stream.

PREVENT SILTING OF DITCHES

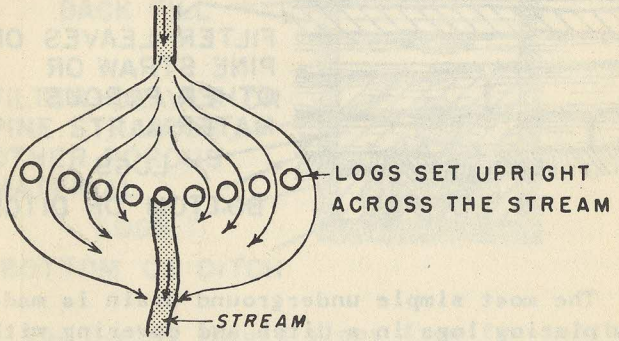
Unstable highway-side ditches and others in which water picks up a heavy load of sand should never be connected directly with a drainage ditch. Some method must always be found to remove the sand from the water before it enters the main ditch. If this is not done, the main ditch will soon be filled with sand and ruined. The sand may be removed in several ways, all of which slow the rate of flow of the water and allow the soil to settle in areas where it is wanted.



Water spreads out over a wide area and deposits silt. Only fairly clear water enters the drainage ditch.



A dam can be placed across a ditch carrying water loaded with silt. The silt drops out, and tile drains collect the clear seepage water and carry it through the dam.



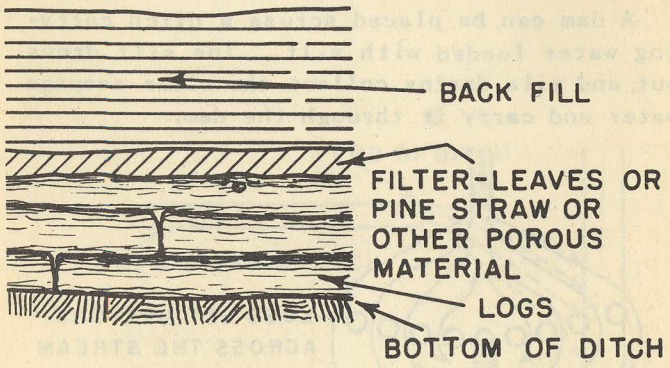
Logs set upright in the soil form a dam across the stream and force the water to slow down as it passes through or around the dam, thus depositing the silt.

UNDERGROUND DRAINAGE

A drainage way placed underground has one great advantage over an open ditch: It puts the water where mosquitoes can't reach it.

Underground drains have many other good points. A "pole type" drain is cheap. If it is properly built, it will last for many years without maintenance, and it leaves the surface of the ground available for crops and pasturage. Tile underground drains have the same advantages and are more permanent.

USE POLE DRAINS FOR UNDERGROUND DRAINAGE

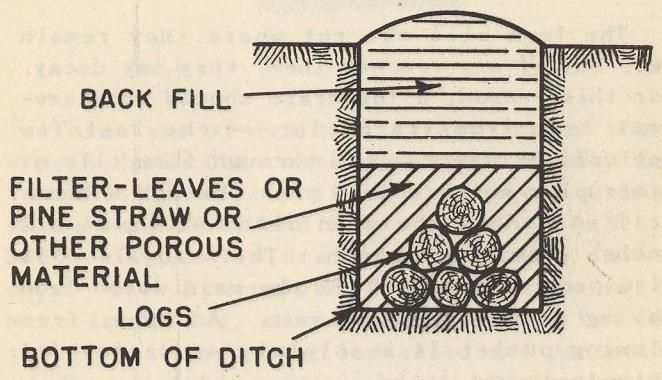


The most simple underground drain is made by placing logs in a ditch and covering with earth. This is called a "pole drain".

The logs should be 4 to 8 inches in diameter and should be piled in a pyramid in the ditch. The ends of the logs should not all

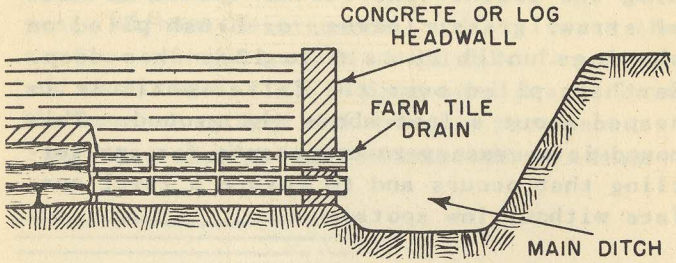
come at one point but should be staggered to insure a continuous channel. Do not use willows for this purpose, as they will resprout and their roots will block the drain.

The filter over the drainage way is very important, for the filter must keep out dirt, which would work down between the logs and clog the drain. The filter should be made of straw, grass, leaves, or brush piled on the logs until it is 6 to 12 inches deep. Earth is piled over the filter until it is heaped about a foot above the ground. This mound is necessary to compensate for any settling that occurs and to insure a level surface without low spots.



Log drains should slope from two-tenths of a foot to one foot for every hundred feet of ditch length. As in other ditches, the slope should be increased just before the drain reaches its outlet. Such drains usually should not be longer than a thousand feet.

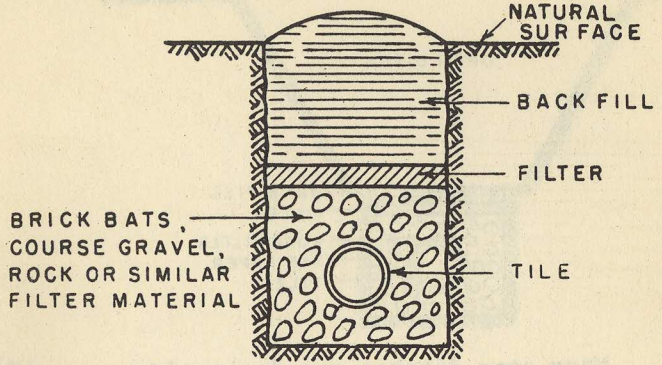
The drain should be large enough to carry the flow and deep enough to lower the water table to the desired depth. It should be placed deep enough to avoid damage by plows and to prevent blockage by plant roots. Under most conditions, this depth should be 2½ feet or more.



The logs will not rot where they remain wet, but if air reaches them, they may decay. For this reason, a log drain should stop several feet from its outlet — the last few feet of the drain being through farm tile or other pipe, which should pass through a headwall and enter the main ditch at least six inches above its bottom. The headwall will also protect the bank of the main ditch from caving or being washed out. An open, free-flowing outlet is absolutely necessary for an underground drain.

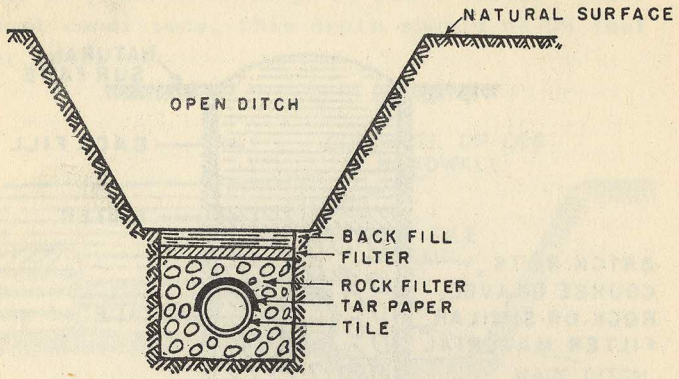
Properly constructed pole drains will last for many years without attention or repair. Some drains of this type are still in operation after 30 years of continuous successful service.

USE TILE DRAINS FOR MORE PERMANENT UNDERGROUND DRAINAGE



This type of drain will last longer than a pole drain but costs considerably more to install. However, it is well worth using where materials and labor are obtainable. Eventually, such a drain may partially "silt up". Flow is stopped, and the drain will have to be dug, cleaned, and relaid; but if the drain is properly installed and protected from crushing from above, silting will occur very slowly, if at all. Manholes and sand traps, made with large concrete pipe and placed on end, are sometimes installed at tile line intersections and about every 500 ft. along lines. These make inspection and cleaning easy.

INSTALL UNDERGROUND DRAINS BENEATH STORM DITCHES TO PREVENT POOLING OF WATER



Many open ditches are designed to carry off large amounts of storm water quickly. During dry periods, these ditches may contain only enough water to make puddles in the bottom. Mosquitoes may breed in this standing water. An underground tile drain installed underneath the ditch bottom will drain off the water from such puddles, while the big ditch normally dry, will carry large amounts of storm water when necessary.

Underground drains of one type or another should be considered in draining seepage areas, marshes, wet areas caused by springs, and areas wet by overflowing drinking fountains and artesian wells. With drainage of this type, land can be reclaimed for agriculture at very little cost, and at the same time the malaria hazard can be eliminated.

LINEAR EQUIVALENTS

12 inches	1 foot
3 feet	1 yard
5½ yards	1 rod (16½ ft.)
320 rods	1 mile (5280 ft.)

SURVEYORS' MEASURE

1 link	7.92 inches
100 links	1 chain (66 ft.)
1 chain	22 yards
10 square chains	1 square acre
1 square acre	43,650 square feet or 4,840 square yards

VOLUME EQUIVALENTS

1728 cubic inches	1 cubic yard
27 cubic feet	1 cubic yard