Pothole Drainage at the Minot Station

By G. N. Geiszler[1]

Throughout North Dakota, except to a lesser degree in the area south and west of the Missouri river, the land is dotted with potholes of various sizes. Many of these have water in them, or are too wet to plant at regular seeding time, but dry up in early summer and generally are permitted to grow up to weeds during the remainder of the growing season.

Most of these depressions are part of an imperfect drainage way. Usually as those higher up on the plain fill with run-off waters, they overflow into those lower on the plain, until all run-off is either stored in the potholes, or the surplus finds its way into an established drain.

Many of these potholes can be easily reclaimed by draining them into existing drainage ways, and others into larger potholes and sloughs. This is especially true in the more level plain lying east and north of the Missouri Plateau. Here the entire area has a gradual slope to the north and / or east. Thus the potholes, in effect, are small basins on the side of a hill. All that is necessary is to cut a ditch through the ridge between the pothole and the lower lying ground to permit the water to pass on down the slope.

On the Missouri Plateau the potholes generally are much deeper, so that drainage is not economically feasible on as extensive a scale. However, here some improvement is possible by draining the shallower potholes.

Hindrance To Tillage

The North Central Agricultural Experiment Station, consisting of 952 acres, lies on the level plain about 12 miles northeast of the plateau. A short distance to the north of the main station and bisecting the west 320 acres of the station property is a large coulee—i.e. natural drain—which empties into the Souris river. Potholes were quite numerous on the cropland, and presented a number of problems. Most of these problems also exist on farms, but were more serious on the station because of the type of crop production carried on.

In the spring potholes interfere with field operations, as power equipment cannot be operated close to the edge of the depression. Some of the shallower ones do not have a very distinct border; consequently, it is not infrequent that the tractor operator gets too close and has his equipment bog down in the mud. This consumes considerable time, at a critical season, as well as expense in getting the equipment free. There also is a tendency to delay field operations until some of the shallower holes are dry enough to cultivate. Where crops are grown which do best when seeded early, this delay has an adverse effect on the yield of the entire field. In addition to this, of course, there is the loss due to a loss of acres.

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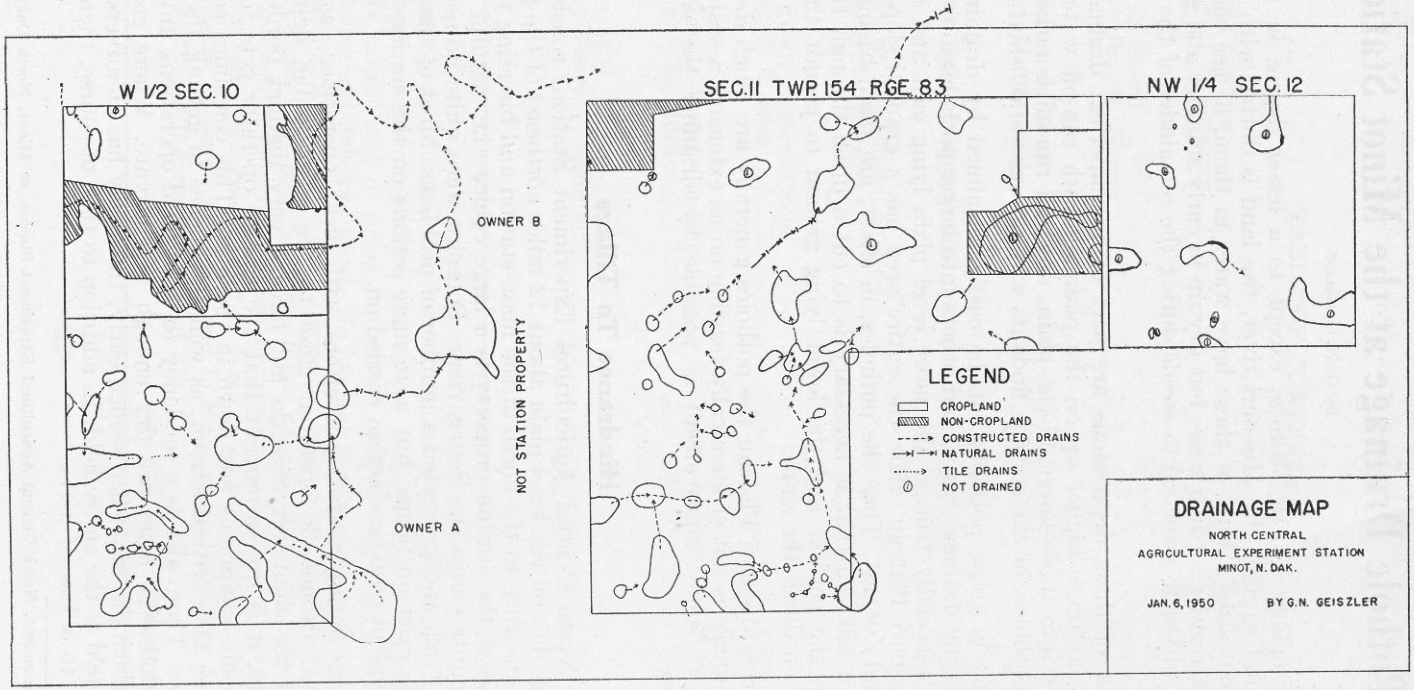
W 1/2 SEC. 10
SEC. 11 TWP. 154 RGE. 83
NW 1/4 SEC. 12
OWNER B
OWNER A
NOT STATION PROPERTY
LEGEND
CROPLAND
NON-CROPLAND
CONSTRUCTED DRAINS
NATURAL DRAINS
TILE DRAINS
NOT DRAINED
DRAINAGE MAP
NORTH CENTRAL
AGRICULTURAL EXPERIMENT STATION
MINOT, N. DAK.
JAN. 6, 1950
BY G.N. GEISZLER

Seedbeds For Weeds

These depressions also serve as areas for the growing and further infecting of the field with noxious weeds. It is not uncommon to find the first patches of quackgrass, field bindweed and Canada thistle adjacent to these areas. Here, because of the favorable moisture conditions, they thrive and produce abundant seed crops to infest the remainder of the field.

These areas are so-called breeding beds for these weeds, because the farmer in many seasons is not able to do a good enough job of cultivation to prevent weed seedlings from becoming established. Potholes also promote growth of such weeds as wild sun flower, smart weed, yellow pigeon grass, wild oats, and others. These usually appear after the potholes have dried up, and since the crop has been seeded around the area, they are permitted to grow unmolested.

As a general rule, the soils in these depressions are suitable for crop production. In fact, in seasons when they can be seeded, or after drainage, the highest yielding crops are produced on these areas. However, if left undrained the soils will undoubtedly deteriorate, because much of the water evaporates leaving the minerals in it—mostly salts—to accumulate in the depression. Most of them already have a rim of soil around the normal water edge which runs high in these salts. Evidence of this is found in the soapy character of the soil when wet, and when dry it is extremely hard. These are conditions characteristic of soil with high salt content.

On the station, the potholes also created a problem in laying out permanent fields and determining acreages. Permanent fields are necessary in the seed production program, so that crop sequences can be planned to reduce the hazards of mixing due to volunteer grain, and for keeping field records. Ability to closely determine the size of a field is important in planning seeding of the newer varieties, of which seed supplies are usually small and definitely limited.

Drainage Program Planned

To overcome some of the problems created by the potholes, a program of draining all feasible areas was undertaken. On the original 480-acre tract work was done by regularly employed help, using plows and a five foot scraper. Subsequently, a Whirlwind terracer was obtained. This was equipped with a ditcher attachment. The terracer was operated with the power take-off on a row-crop tractor. Some ditching also was done with a one-way disc plow where, by a series of successive operations, the soil was moved out of the drainage ditch.

These operations were found suitable for shallow ditches. They were suitable for building ditches which could readily be crossed with farm machinery where the cuts were 18 inches or less. Where it was not necessary to cross the ditch with farm equipment, a suitable ditch to a depth of two feet was constructed. No detailed cost records were maintained, but the speed with which a ditch could be constructed is evidence that it was much less than when soil had to be moved with a scraper.

The heavy run-off in the spring of 1949 caused all of the potholes to fill, and many which before had only covered small areas now were good-sized sloughs. This high water level made it possible to study the potholes and find the points at which they normally over-flowed. This served as a guide in making the surveys for constructing the drainage ditches.

The cooperation of the Southwest Ward Soil Conservation District was solicited and obtained. They surveyed and staked all of the ditches on the west half of section 10 and on the southwest quarter of section 11. Since the district's dirt moving equipment was committed for the remainder of the season, a separate contract was entered into with a local contractor to construct the ditches. This service is available to any farmer living in a Soil Conservation District on the same basis as to the station.

Cost Of The Program

The cost of constructing the ditches was 17 cents a cubic yard, where no ditch existed, and $12 an hour for enlarging a few existing ditches, and bulldozer work where necessary to get the waste soil into the lower portions of the pothole. In all cases the soil out of the ditch was placed in the bottom of the pothole to reduce the depth of ditch required.

In order to get the potholes dried up so that the open ditches could be constructed in the fall it was necessary to trench, with a dragline, several of the larger potholes to permit the water to escape three months before the ditching operations were begun. In two instances where relatively deep cuts were required, these trenches were later used to lay tile to provide the necessary drainage. Here, also, it was necessary to extend the trench farther into the pothole by the use of dynamite.

Tile used was 10 and 12-inch sewer tile which had been damaged so that it was not suitable for sewer construction, therefore was much cheaper than undamaged tile. It was considered quite suitable for this type of drainage.

Whether such a drainage program is economical depends, of course, on the cost per acre for the area benefited. The following tabulation gives the costs on the work done by contract, the number of acres benefited and the cost per acre. The total acreage benefited on the station by the different methods of drainage is 76.6 acres, or nearly 10 per cent of the crop acreage.

Tile	$ 281.00
Cost of trenching	660.63
Cost of dynamite	61.58
Cost of ditching	3045.95
Estimated cost of laying tile	150.00
Total cost	$4199.16
Calculated acres benefited	58.0 acres
Cost per acre	$ 72.40

In addition to the acreage on the station benefited, about seven acres on an adjoining farm were benefited. In fact, some of the cost given above was incurred by some extra work on this seven acres. This work was necessary to get authority to let the drainage waters pass over this neighbor's land to the natural drainage way.

Although a cost of $72 an acre may seem high, when land can be purchased for $40 or $50 an acre, it must be remembered that these cost figures cover only draining the more difficult areas, as the shallower potholes had already been drained by the use of the one-way plow or whirlwind terracer.

Further, since farmers generally are of the opinion that it costs just as much to farm a tract of land when you go around the potholes as when you can farm through them, all of the crops produced on the reclaimed area can be credited against the drainage cost. It is, therefore, a conservative estimate that on the basis of current prices, two crops will pay for the drainage work. There is the further advantage that the additional acres are within the existing fields.

DRAINAGE DITCHES USED ON MINOT EXPERIMENT STATION PROJECT

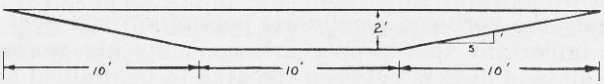

Fig 1 For crossing with machinery, use 5 to 1 side slopes on ditches less than 2' deep

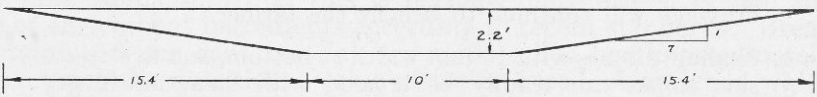

Fig. 2 For ditches greater than 2' deep, use 7 to 1 side slopes

From the map one will observe the haphazard distribution of the potholes, and the location of the ditches.

All open ditches were designed with a 10-foot width at the bottom and sides sloped to permit operating farm machinery through the ditch. Where the maximum cut was two feet, or less, a side slope of five to one gave a ditch which can readily be crossed, while cuts deeper than two feet required a seven-to-one side slope to permit farm machinery to cross safely. This is shown in the accompanying diagram, Figs. 1 and 2.

The ditch grade was kept at one-tenth of one per cent. This flat grade permits the water to flow slowly enough to avoid water erosion. In some cases the natural slope beyond the outlet end of the ditch is steeper than the ditch grade. In these locations, grassed waterways may have to be provided to prevent gullies from forming.

From the map of the station, showing pothole locations, it will be noted that the drainage from the west half of section 10 has to flow over two neighboring properties. Before the drainage work was undertaken, the problems and benefits to each were discussed with the owners. In each case, a written agreement was entered into, granting permission to let the drainage waters follow the natural slopes across their properties. These agreements were put on record with the county register of deeds to avoid misunderstandings in case of a change in ownerships.

Summary

1. Draining of potholes on cropland in the glacial plains area of North Dakota is considered an economical practice. It makes additional acres available for crop production, simplifies field operations and reduces costs, and gets rid of spots most subject to infestation by noxious weeds.

2. Because the potholes usually are part of an imperfect drain, it is important that proper arrangements are worked out with all land owners between the area to be drained and the ultimate outlet for the drainage waters. Farm neighbors can often work together in getting their drainage done. This has the advantage of permitting the ditches to follow the path of most economical construction.

3. Drainage costs will soon be repaid by the crops produced on the reclaimed areas, while the improvements resulting from drainage will continue to benefit the farmer.

4. Shallow ditches with 10-foot width at bottom, and five-to-one side slopes can readily be crossed with farm machinery. Where deeper than two-foot cuts were necessary, a seven-to-one side slope has to be used to permit convenient crossing with larger farm machinery.

DOLLARS FROM THE STRAW STACK

Farmers are now getting fairer prices for their baled straw, as a result of an instrument which determines the moisture content accurately and quickly. This small, handy electrical instrument, developed at the Northern Regional Laboratory, is now being used by the strawboard industry, and its measurements have been readily accepted by farmers. They saw at once the advantage of accurate measurement of moisture content—an important factor affecting the price of straw—over the old, less objective methods. The straw tester is also being tried out on hay.—(USDA Agricultural Research Administration.)