When agricultural land becomes too wet, farmers have difficulty keeping it in production. Some farmers in New Mexico have this problem on land near irrigation canals and laterals and a program is now in progress to fight it with a water sealant of plastic or, more specifically, polyvinylchloride membrane linings.

High ground water on farm land is caused by excessive seepage from nearby waterways, and by poor drainage. Either the drainage or the seepage problem can cut agricultural production seriously, so a vigorous attack on the situation in the vicinity of Tucumcari has been launched by the Arch Hurley Conservancy District Board. They are working for quick results.

Back in March 1961, the district board executed a rehabilitation and betterment contract with the Bureau of Reclamation to finance a 5-year program of drainage and canal lining work. In May, they started investigations on the Bureau-built Tucumcari project.

Investigations determined that McCaskey lateral on the project, had excessive seepage of water into shallow soils underlain by a dense clay barrier which prevented deep percolation. An account was provided of the R. & B. contract method employed to line a 6,500-foot reach of McCaskey, and evaluations were made of its effect and cost.

Funds for the jobs, so work could start early, were advanced from the district until appropriated funds could become available.

Vinyl membrane, \( \frac{1}{100} \) of an inch thick, was purchased in sheets approximately 35 feet wide and 500 feet long. The sheets arrived from the manufacturer folded accordionlike, and packaged in reinforced cardboard boxes weighing 1,200 pounds each. Thirty-two thousand, two hundred and eighty-two square yards of vinyl plastic film was purchased at a price of $15,323 for lining the McCaskey and other laterals on the project.

Excavation of the lateral prism was performed by three-fourth cubic yard dragline machines.
cutting the banks back to 2 to 1 slope. The dragline operator cut the bottom 1 foot below design level attaining an exactness in excavating with a lightweight steel template, which he used as a visual guide.

Surface smoothing was then started by dragging a heavy chain along the lateral prism with vehicles pulling on each side.

The chain dragging effectively broke larger clods of earth and moved remaining clods to the lateral bottom. This was followed by handraking the slopes toward the bottom.

At this point, approximately 10 cubic feet per second of flow was released into the lateral long enough to wet the bottom, to soften the clods, and permit remaining clods to be settled into the saturated-earth bed.

Anchor trenches were excavated along each side of the lateral with motor graders. Ridges of the trenches were hand-railed so toeing in could be done without tearing or cutting the vinyl at points where stress would be expected if it settled or tightened.

Earth was also hand-excavated at concrete structure sites to expose cutoff walls where the vinyl would be cemented to the structure with an asphalt mastic cement.

Placing the vinyl membrane progressed rapidly when preparation of the lateral was complete. Flatbed trucks loaded with the boxes of vinyl were driven on the maintenance roadway to the end of the lateral and a box of plastic on top of the load was opened. Motor graders, and workmen with shovels were brought to the site. One end of the plastic in the open box was pulled out and across, to the other side of the lateral, the pulling being aided by its accordionlike folding in the box. Tearing or puncturing the material on the edges of the box was avoided because the box material was cardboard.

The vinyl was placed by men stationed along each toe-in trench, one or two men in the lateral bottom, and one on the truck assisting with unfolding. With hand shovels, workmen partially backfilled the trenches with dirt to secure the vinyl in place until the motor graders could backfill the

Cleaning out around concrete structures like the farm turnout (left) permitted cementing the lining to structures with asphalt mastic.
trenches. Securing the membrane in moderately windy weather required more precautions. Old automobile tires were rolled down the slopes to keep out the wind until the graders could blade dirt over the slopes.

Almost immediately after placement, more backfill was put over the membrane with the machines.

The end of one sheet of membrane was lapped approximately 3 feet over the end of the adjoining sheet to provide a relief lap every 500 feet, as well as where uplift seepage might be expected in the lateral bed. The relief laps were constructed by hand-excavating a transverse trench along the upstream end of each sheet of plastic, placing approximately 3 feet of plastic into the trench and backfilling over the end of the sheet before overlapping 3 feet of the next sheet of plastic. The overlap was not cemented to permit the escape of seepage water trapped under the lining.

At concrete structures in the lateral, the plastic was cut and cemented to the structures.

After partially backfilling the lateral slopes, the beaching zone along the upper part of the slopes was backfilled with 12 inches of gravelly material to resist slope erosion.

Due to dry weather, the lateral was placed into service almost immediately following placement of the membrane and prior to completion of backfilling. Irrigation deliveries were made from the lateral with checked velocity so that backfilling could be completed at the same time. This resulted in a satisfactory cover, but probably somewhat increased the cost of backfilling.

Equipment and labor costs for installing the 26,640 square yards of lining in the McCaskey lateral, excluding depreciation of equipment, are as follows:

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost per square yard of vinyl membrane</th>
<th>Total cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excavation ($0.17 per cu. yd.)</td>
<td>$0.07</td>
<td>$1,885</td>
</tr>
<tr>
<td>Installing vinyl membrane</td>
<td>$0.00</td>
<td>$2,450</td>
</tr>
<tr>
<td>Backfilling and gravel protection</td>
<td>$0.12</td>
<td>$3,123</td>
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<tr>
<td>Purchase of vinyl material</td>
<td>$0.47</td>
<td>$12,654</td>
</tr>
<tr>
<td>Total</td>
<td>$0.75</td>
<td>$20,101</td>
</tr>
</tbody>
</table>

Early evaluations of the vinyl membrane indicate a very impervious lining. On one farm, approximately 30 to 40 acres of land were previously seeped excessively making it impossible to cultivate or to support crops. This land is now being cultivated and returned to productivity.

Observation wells paralleling the lateral previously maintained high water levels during irrigation season, with maximum readings at ground level. These same wells, 7 and 8 feet deep, following 4 months' service, were dry during midsummer, indicating practically a cessation of seepage.

Although results have been encouraging and costs reasonable, some factors remain to be evaluated in the use of the buried vinyl membrane linings. A few gopher burrows have been observed in the lateral embankments near the high-water level. Careful removal of the cover materials indicates that gophers are not discouraged by the vinyl membrane. Gopher holes have been patched and eradication is now being used in the area.

The impervious lining makes a favorable environment for water grasses, cattails, and other water-loving plants. Those which have appeared in the lined area have been carefully removed and as yet disclose no punctures in the membrane.

In summary, it appears that the buried vinyl membrane lining is an effective tool in combatting seepage, with the advantages and reasonable costs far outweighing the disadvantages. The Arch Hurley Conservancy District plans to install additional reaches of lining of this type in the near future.

November 1962
Oahe Powerplant. Travelling by his silvery jet plane “Air Force No. One,” the President landed first on August 17, at Pierre, S. Dak., where he addressed 8,000 people at the Oahe Dam and powerplant. The first energy from this Corps of Engineers project started flowing into the Bureau’s Missouri River Basin power system a few months ago.

About MRB power, the President said: “The REA co-ops and power districts which have marketed this power have been a happy middle ground between private enterprise and public cooperation. They are making the most of Theodore Roosevelt’s principle that marketing agencies which represent all the people should be given a preference in the development of waters which belong to all the people.”

The final generating unit of Oahe powerplant is expected to go into production in April 1964.

Fryingpan-Arkansas Project. From S. Dakota the President flew to Pueblo, Colo., where he addressed a crowd of 15,000 at the Pueblo School stadium who heard the President marks about the huge Fryingpan-Arkansas project which he had approved by authorizing legislation the day previous.

“This marks the 60th anniversary of a reclamation program initiated under R. President Kennedy said, “and this year in which the Congress has evangelized two projects of the magnitude of Fryingpan-Arkansas and the San Juan-Chama Projects of New Mexico. Surely this is the most unusual projects in the entire Fryingpan-Arkansas is a multipurpose mountain diversion development in which will control floods, retain sediments, serve fish and wildlife, and provide re

President John F. Kennedy Reclamation and set a significant milestone visiting three major projects.