Hydraway Edgedrain Experience in Ohio

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The purpose of this paper is to compare the effectiveness of the Hydraway™ edgedrain, which is manufactured by the Monsanto Company, with the Ohio Department of Transportation's standard 4-in. pipe underdrain without fabric wrap. The 650-ft-long test sections are contiguous, constructed at the same grade, and have separate outlets. The U.S. Geological Survey, Water Resources Division, installed equipment to measure the discharge from each test section. Preliminary results from the monitoring devices are not conclusive. There have been too many gaps in the data. For various reasons, such as damage from lightning, an automobile accident, and at times water backing up in the ditch, complete data for the most significant rainfall events are not available. Neither system has shown consistently superior performance over the other. The costs for the Hydraway on the two projects in 1985 were $4.10 and $5.50/ft. The costs for three projects in 1986 and 1987 were $2.42, $2.80, and $2.85/ft. This compares to an average cost of $2.50 to $3.00/ft for the standard pipe underdrain. Collection of data will be continued until matching data for the two drainage systems can be compared and definite conclusions made.

The removal of water from roadway subbase and subgrade is an important factor in extending the life of a pavement. Ohio, like many other states, has experienced numerous drainage-related pavement problems. Therefore, when the Ohio Department of Transportation was approached by the Monsanto Company with an innovative concept for draining its pavements, considerable interest was expressed. The Hydraway edgedrain, consisting of a polyethylene core wrapped with filter fabric (Figure 1), was developed through research conducted for Monsanto by Barry J. Dempsey, Professor, Department of Civil Engineering, University of Illinois.

INSTALLATION

In August, 1985, 23,500 lineal ft of prefabricated edgedrain was installed on I-70 near SR 37, in Licking County, approximately 16 mi east of Columbus. The project involved complete rehabilitation of the eastbound two-lane pavement, including milling off the existing asphalt overlay (4½ in.), cracking and seating the existing concrete pavement, and overlaying with 9 in. of asphalt concrete.

The prefabricated edgedrain was installed at a depth of 33 in. adjacent to the outside edge of pavement, for the entire length of the project, with the exception of a 650-ft control test section, on which the Ohio Department of Transportation (ODOT) standard 4-in.-diameter shallow pipe underdrain was used (Figure 2). The prefabricated drain was placed so that its top edge extended 3 in. above the bottom of the existing 9-in. portland cement concrete (PCC) pavement, as shown in Figure 2. The standard shallow pipe underdrain consisted of a 4-in. perforated polyethylene pipe, placed to a depth of 54 in. below the top of the pavement in a 12-in.-wide trench, which was backfilled with No. 8 aggregate (Table 1). Fabric wrap of the trench was not provided. Specifications of the edgedrain fabric are as follows: Specification 712.09, Filter Fabric. The fabric

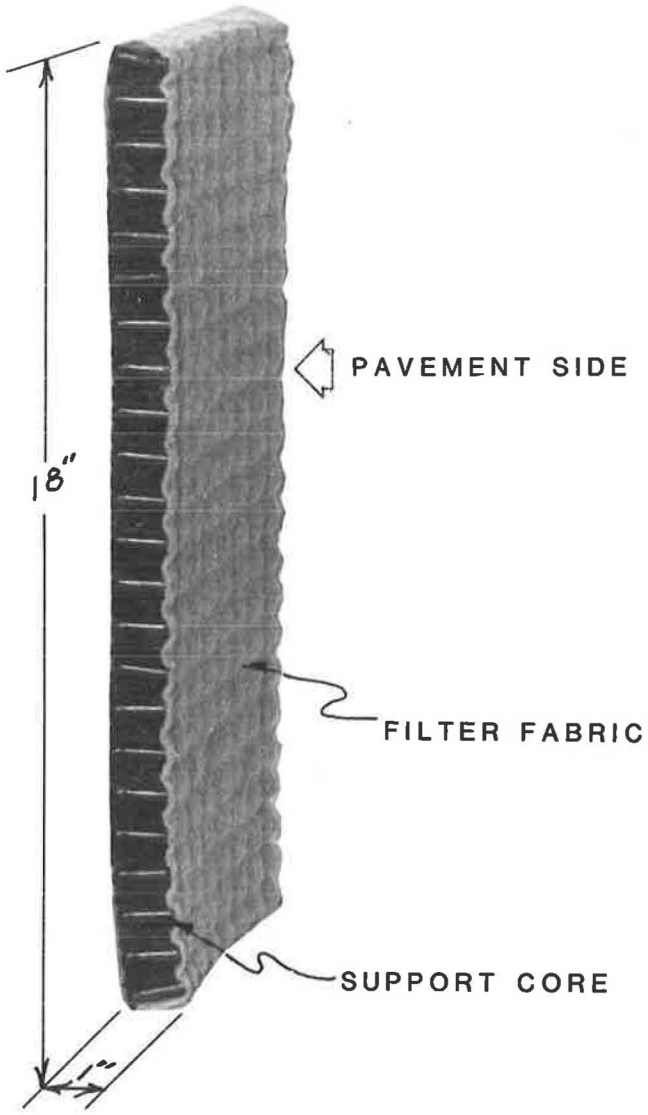
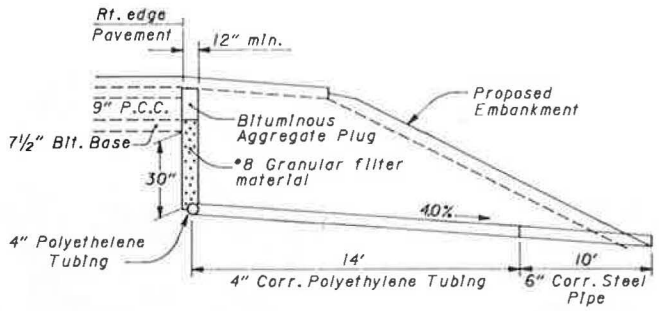
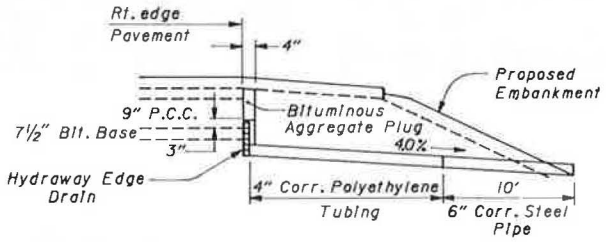


FIGURE 1 Edgedrain details.

Ohio Department of Transportation, 25 South Front Street, Columbus, Ohio 43215.



4" SHALLOW PIPE UNDERDRAIN



HYDRAWAY EDGEDRAIN

FIGURE 2 Typical sections.

TABLE 1 TRENCH BACKFILL SPECIFICATIONS—SIZES OF COARSE AGGREGATE (AASHTO M43)

Size Number	Nominal size square openings	Amounts finer than each laboratory sieve (square openings) percentage by weight								
		1	3/4	1/2	3/8	No. 4	No. 8	No. 16	No. 50	No. 100
7	1/2 to No. 4	.....	100	90 to 100	40 to 70	0 to 15	0 to 5	.....	.....	.....
78	1/2 to No. 8	.....	100	90 to 100	40 to 75	5 to 25	0 to 10	0 to 5	.....	.....
8	3/8 to No. 8	.....	.....	100	85 to 100	10 to 30	0 to 10	0 to 5	.....	.....
89	3/8 to No. 16	.....	.....	100	90 to 100	20 to 55	5 to 30	0 to 10	0 to 5	.....
9	No. 4 to No. 16	.....	.....	.....	100	85 to 100	10 to 40	0 to 10	0 to 5	.....
10	No. 4 to 0 (2)	.....	.....	.....	100	85 to 100	.....	.....	.....	10 to 30

shall be composed of strong rot-proof polymeric fibers formed into a woven or nonwoven fabric that meets the following requirements:

- Minimum tensile strength—80 lb
- Minimum puncture strength—25 psi
- Minimum tear strength—25 lb
- Minimum burst strength—130 psi
- Equivalent opening size: Soil Type 1 (soils with 50 percent or less passing U.S. No. 200 sieve)—EOS ≤ 0.6 mm; Soil Type 2 (soils with 50 percent to 85 percent passing U.S. No. 200 sieve)—EOS ≤ 0.3 mm
- Permeability—1×10^{-2} cm/sec

The installation of the prefabricated edgedrain was continuous, with a Vermeer trencher used to cut the 4-in.-wide trench in which it was placed. The edgedrain was placed immediately after the trench was cut by the use of an outrigger and a boot. The trench was then backfilled in two lifts, using the previously excavated material, which consisted mostly of granular subbase (Figures 3–5). Specifications of the subbase are given in Table 2. A small vibrating compactor, which was attached to the boot with a chain, completed the installation process.

The outlets were installed separately after all of the edgedrain was in place. The outlets consisted of a section of 4-in. corrugated polyethylene tubing which connected to the Hydraway end section. The tubing was then connected into a 6-in.-diameter, 10-ft-long corrugated steel pipe. The contractors have an option when installing animal guards. They may drill the end of the pipe and install the bars (Figure 6) or bolt on a metal collar (Figure 7). On this project, the collar was used. As a result of mowing operations, most of the collars have been knocked off and approximately 50 percent of the steel pipes have bent; however, the outlets are still functioning.

A minor problem developed the first day while cutting the trench. The existing pavement had been patched extensively,

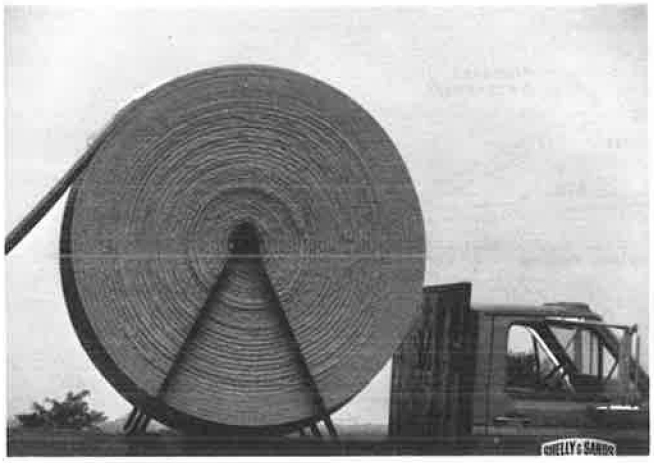


FIGURE 3 Roll of edgedrain.

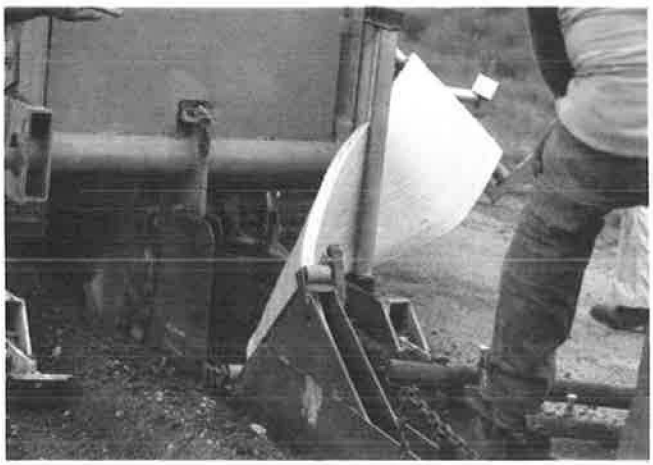


FIGURE 5 Edgedrain entering the boot.

FIGURE 4 Before installation.

FIGURE 6 Animal guard.

TABLE 2 SUBBASE SPECIFICATIONS

Total Percent Passing		
Sieve	Grading A	Grading B
2 1/2 inch	100	100
1 inch	70-100	70-100
No. 4	25-100	25-100
No. 40	5-50	10-50
No. 200	0-10	5-15

NOTE: Specification 310.02. Materials. Materials furnished under this item shall be gravel, crushed slag, crushed stone, sand, granulated slag, a mixture of crushed and granulated slags, or other types of suitable materials meeting the requirements of this item and having the approval of the director. The sodium sulfate soundness loss for aggregates shall not exceed 15 percent. However, where the major portion of the unsound material in a coarse aggregate acquires a mud-like condition when tested for soundness, the maximum loss shall be 5 percent for all uses. In addition, open-hearth and basic-oxygen furnace slag shall conform to stockpiling and aging requirements of 703.01.

and in many locations, aggregate drains had been constructed adjacent to the patches. The presence of these drains, the badly deteriorated pavement, and the 7-in.-thick asphalt shoulder, made it difficult to keep the trencher properly aligned. Because of this, there were a few times when reinforcing steel was pulled out from the edge of pavement. A second trencher, which had a wider cut of approximately 6-in., was used to cut through the asphalt shoulder. Some of the subbase in the area of

FIGURE 7 Animal guard (collar style).

FIGURE 8 Tipping bucket enclosure.

FIGURE 9 Tipping bucket.

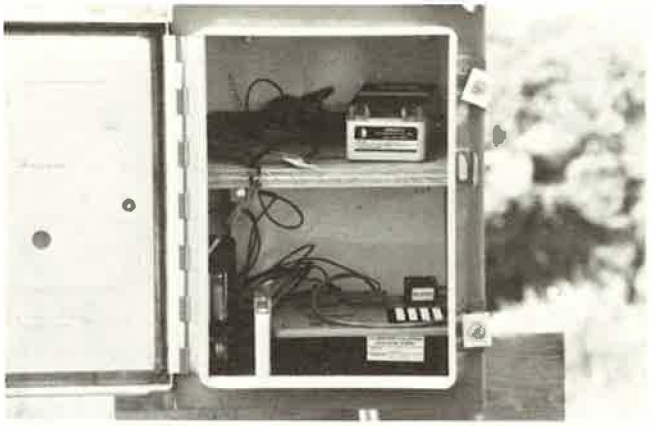


FIGURE 10 Data collection equipment.

FIGURE 11 Drilling into the edgedrain.

FIGURE 12 Viewing pipe.

FIGURE 13 Borescope.

FIGURE 14 Digging up an outlet.

the patches fell into the trench, a situation which was unavoidable. The installation rate varied from 20 to 50 ft/min. On future projects of this type, the sequence of construction will specify that planing of the asphalt overlay be done first to allow the trencher operator to locate the edge of the existing concrete pavement.

In August, 1985, 9,800 lineal ft of prefabricated edgedrain was installed on a four-lane divided pavement with a curbed median, on US-36 near Newcomerstown, Ohio. The edgedrain was placed on the outside edge of pavement for a distance of 4,900 ft, through a shale cut section. The existing pavement was in extremely poor condition. Patching and undersealing were done before resurfacing with 3 in. of asphalt.

FIGURE 15 Outlet pipe removed.

In the summer of 1986, 88,000 lineal ft of prefabricated edgedrain was installed on US-30 near VanWert, Ohio. The edgedrains were placed on both sides of this four-lane divided pavement. The original pavement was a composite design with concrete base. The joints were still in good condition; therefore, the rehabilitation was minor, consisting of asphalt undersealing and some shoulder and bridge approach repairs. The overlay was 2 in. of asphaltic concrete with sawed joints located over the existing joints. This area of Ohio has flat topography with shallow ditches, which made it difficult to outlet the edgedrains, and necessitated the cleaning of many of the ditches. The outlets were approximately 500 ft apart and the plans indicated a straight grade between them; however, in order to outlet the edgedrains, they had to be laid to a grade which followed the actual pavement grade.

MONITORING

To verify the hydraulic performance of the prefabricated drain, ODOT contracted with the U.S. Geological Survey, Water Resources Division, Columbus, Ohio, to conduct discharge testing.

In April, 1986, the Water Resources Division installed equipment to measure the discharge from two contiguous 650-ft-long underdrain sections which were constructed at the same grade, each having separate outlets. The purpose of this installation was to measure the real-time discharge response of the standard shallow pipe underdrain and the prefabricated edgedrain systems. Tipping bucket gauges were installed at the outlets of the test sections (Figures 8 and 9). These gauges operate by causing a contact closure each time a preset volume

FIGURE 16 New outlet pipe.

of water passes through them. A microprocessor-controlled logger was used to record and total the contact closures in 10-min intervals (Figure 10). Consequently, volumes and flow rates could be determined. A third tipping bucket gauge was installed in the area to measure the rates and intensities of precipitation. An event recorder was used to store the precipitation data on an erasable, reprogrammable chip.

In June, 1987, Monsanto Company representatives installed ½-in. plastic inspection pipes at three locations along the 650-ft test section of their edgedrain on I-70 (Figures 11 and 12). The pipes were placed at each end and at the center of the 650-ft test section. Viewing of the inside of the edgedrain by use of a borescope is possible (Figure 13). In the upstream location there was no flow, but in the center and downstream locations there was approximately 6 in. of standing water, which was a concern because if there was an obstruction the flow data would be affected. A decision was made to dig up the outlet pipe in an attempt to determine the cause of the problem.

On July 14, 1987, with the assistance of an ODOT maintenance crew, the flexible polyethylene outlet pipe was dug up (Figures 14–16). There was a slight rise in the flexible pipe but not enough to be a major problem. It was suggested that a rigid outlet pipe would provide a straight slope without possibilities for variations. The existing pipe was removed, bottom of the trench regraded, and a new pipe installed. Before the new pipe was installed, a water hose, which was attached to a 500-gal tank, was connected at the upstream location. With only the pressure from the tank which was mounted on a flatbed truck, it took the water 35 min to flow the 640 ft (Figure 17).

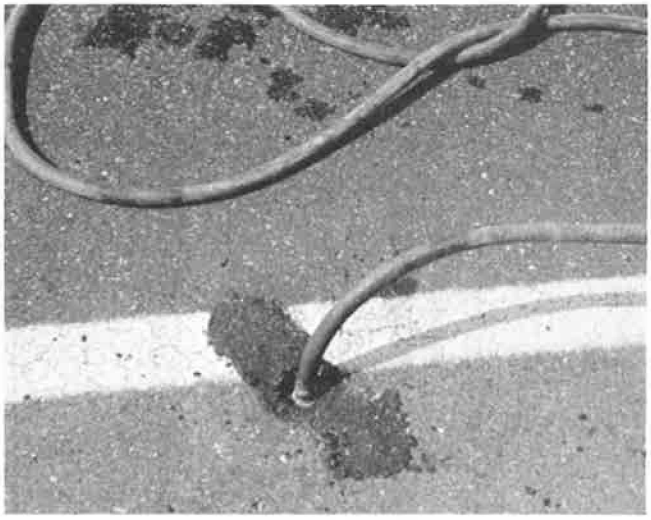


FIGURE 17 Flushing.

On July 15, 1987, the Monsanto representatives installed three borescope monitoring pipes on the eastbound lanes of the US-36 site. The location nearest the outlet pipe revealed clear water flowing to a depth of 1 in. The inside wall of the edgedrain had fines clinging to it and was functioning as predicted. The other two monitoring sites further upstream were relatively dry.

RESULTS

It cannot be determined from the average discharge charts (Appendix) which system is superior. There have been many gaps in the data due to lightning hits, an automobile accident, and at times water backing up in the ditch and rendering the tipping bucket inoperable. This has produced inconsistencies during some of the most significant rainfall events. Collection of data will continue until enough matching data for the two drainage systems can be compared and conclusions made.

Publication of this paper sponsored by Committee on Subsurface Drainage.

APPENDIX

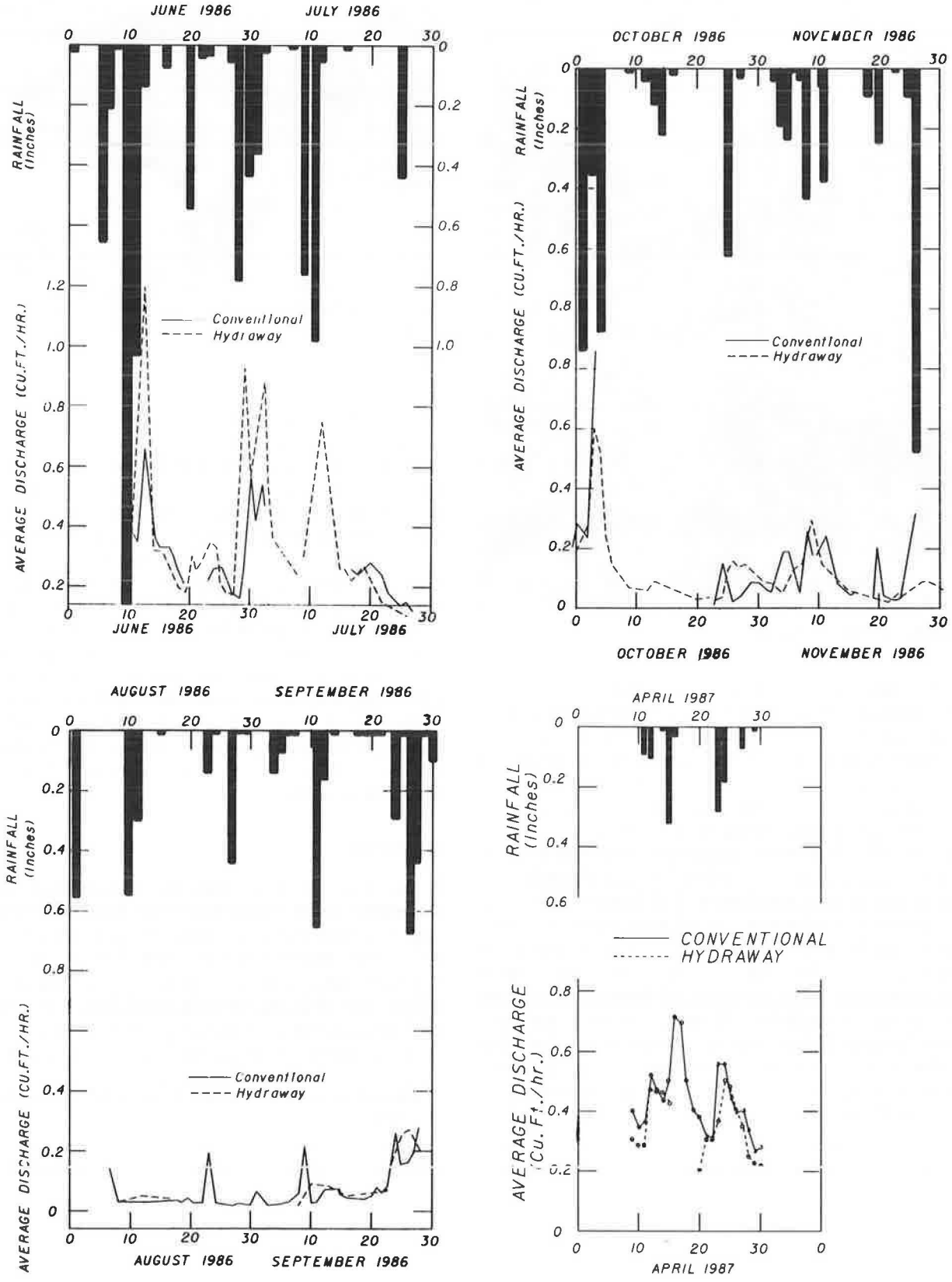


FIGURE A-1 Average discharge charts.

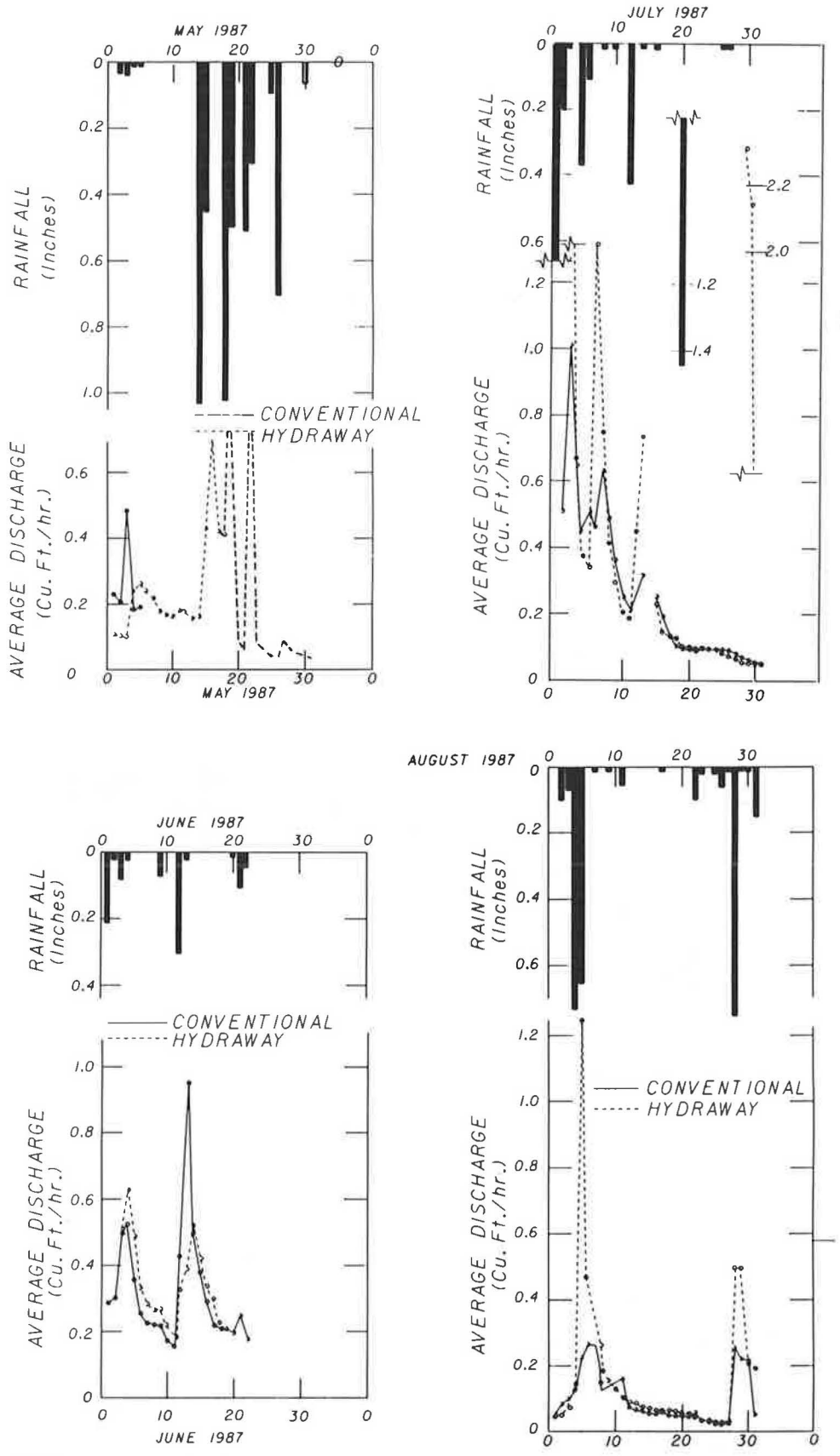


FIGURE A-1 *continued*

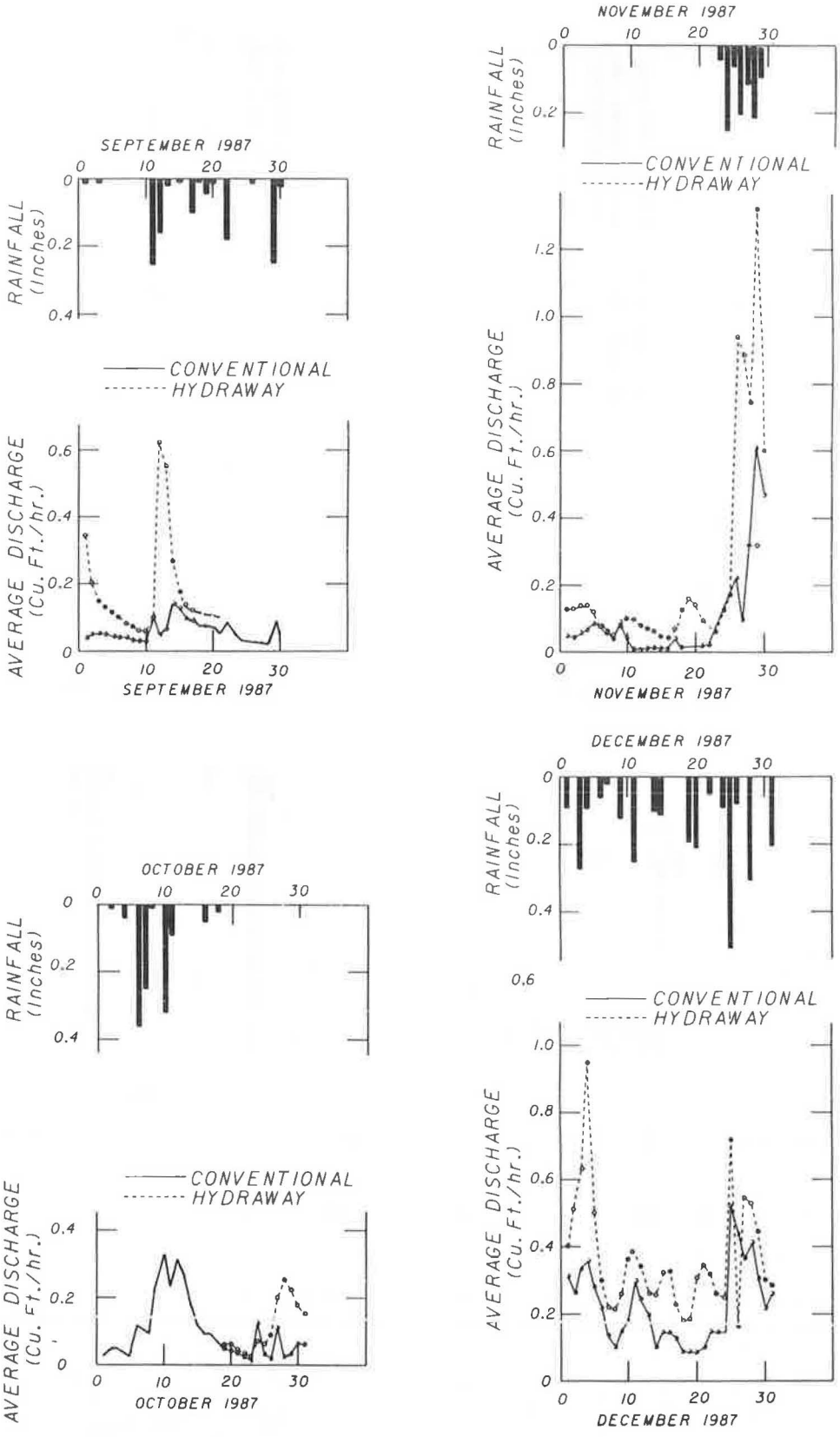


FIGURE A-1 *continued*