# STATE OF MAINE

# DEPARTMENT OF TRANSPORTATION

**TRANSPORTATION RESEARCH DIVISION**
**BUREAU OF PLANNING**

**DATE** March 2001

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**EXPERIMENTAL CONSTRUCTION PROJECT ME 00-20**

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**CONSTRUCTION REPORT**

## EXPERIMENTAL UTILIZATION OF TIRE SHREDS TO ENHANCE HIGHWAY DRAINAGE
## Rome-Belgrade State Route 27 STP-3509(30)X

### INTRODUCTION

This project investigates the practical benefits of using shredded tires as a free draining material in a subsurface French drain to enhance drainage along a section of highway. French drains are below-grade structures designed to re-direct groundwater, typically around the foundation of a building or structure. French drains are used to intercept groundwater flow on the upslope side of such structures. A French drain usually feeds into a system of underdrains or to "daylight".

On this project the French drain was constructed in the shoulder and ditch area on a full highway reconstruction project in the town of Rome. (See location map). The reasons for using a French drain on this project relate to the site characteristics and design constraints for this section of highway as described later in this report. Access riser pipes and monitoring wells were installed during construction. The access riser pipes will be used to record temperatures using thermocouples that were installed during the construction process. These pipes are located at Sta. 13+929, 14+258 and 14+714. In addition, two water level monitoring wells were installed along the section which will allow observation and measurement of water levels. These monitoring wells are located within, and extend to, the bottom of the French drain. They are located at Sta. 13+930 and 14+241. The data collection will coincide with spring thaw and will continue through the critical spring runoff period.

Temperature sensitive thermocouples were placed in three vertical elevations within the drain profile. These thermocouples have leads that can be accessed through the access riser pipes which are located at an offset from the centerline of the ditch. Three monitoring locations were installed along the project; one near the top of the hill (where less subsurface water would be expected), one near the bottom of the hill (where the most water flow would be expected), and one along the middle of the sloping section (where an intermediate amount of water flow would be expected).

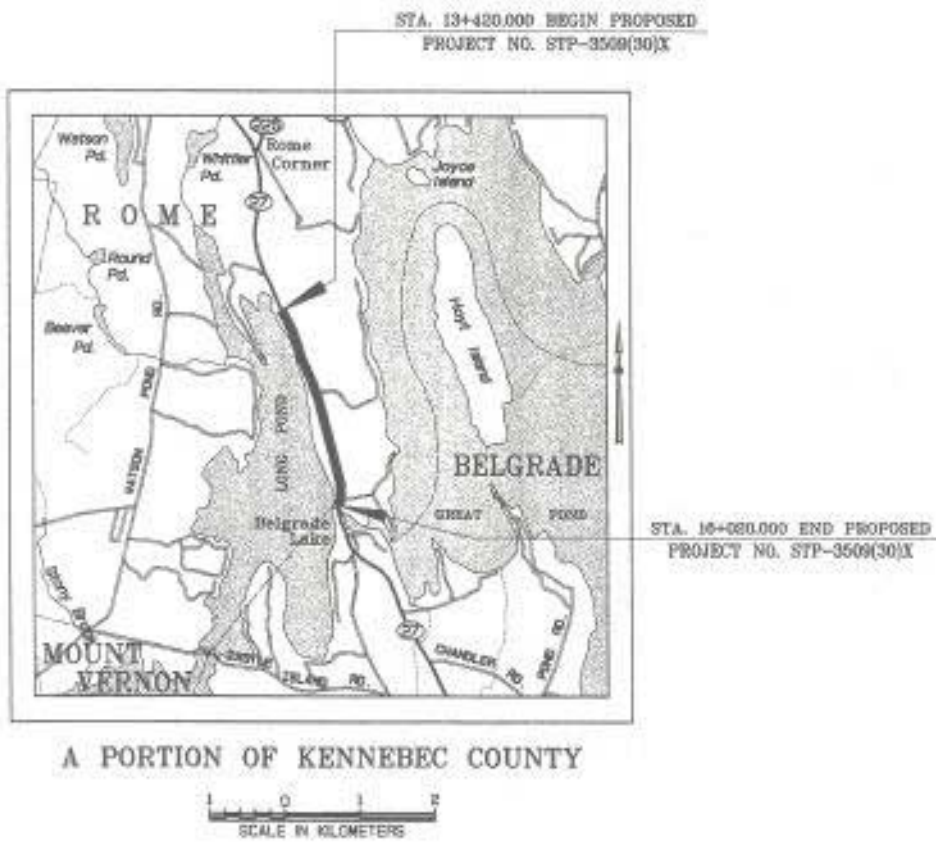


**Figure 1. Location Map**

## BACKGROUND

Past research done by others has documented the insulating value of tire shreds used in roadway construction. For example, shredded tires (tire chips) have been used experimentally as sub-grade insulation within the road profile on gravel and asphalt roads, and have also been used as lightweight fill. They have also been used experimentally to limit frost heave and pavement damage. In addition to that, the effects on groundwater have been investigated by research projects in Maine. This project seeks to build on these previous research findings and investigate using shredded tires as free draining material. In addition the project will document temperature variations in the vertical cross-section of the drain during spring thaw. If the tire shreds prevent freezing temperatures inside the drain, then the drain will continue to function through early springtime, draining excess water away from the road section, thereby lessening the damaging effects of the spring freeze/thaw cycles, and lessening the impacts of spring runoff.

The site characteristics of the highway imposed several design considerations. One consideration was the presence of significant groundwater flow. Due to the sloping topography this groundwater had to be intercepted and routed under the highway. Another consideration was that the site experiences significant amounts of surface runoff during storm events and also during spring time. The subsurface French drain was incorporated to address these site problems. The drain will help convey water longitudinally to the culverts crossing under the highway section. The shredded tires should help prevent water from freezing in the drain which would render the drain ineffective during the critical springtime runoff periods. Figure 2. below shows the location of the French drain with respect to the roadway.

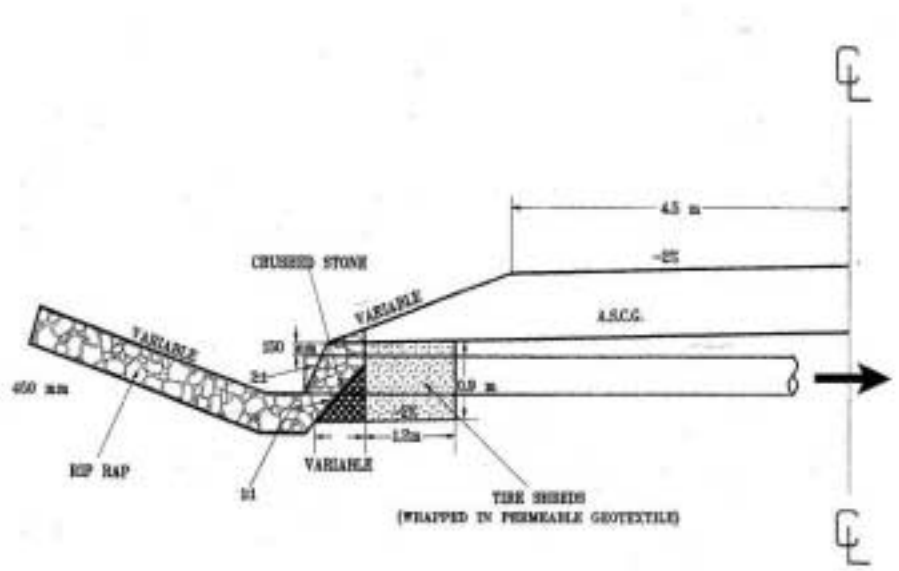


**Figure 2. Cross Section**

## CONSTRUCTION

The experimental construction is part of a full highway reconstruction completed during the summer and fall of 2000. During July and August, about 1340 meters of French drain was installed between Sta. 13+580 and Sta. 14+900 on the westerly side of the road. The French drain construction is described in Contract Special Provision Section 605. (See Appendix). Type A tire shreds were used, having a maximum dimension of 200 mm, and 100% passing the 100 mm square mesh sieve. The tire shreds were placed in lifts, compacted, then enclosed completely with a geotextile fabric meeting the requirements of Section 722.02 Drainage Geotextile Class B. The French drain is described in the Construction Requirements (See Appendix).

Construction techniques are shown in the following series of photos.



**Figure 3.**

**Figure 4.**

**Figure 5.**

**Figure 6.**

**Figure 7.**

**Figure 8.**

**Figure 9.**

**Figure 10.**

**Figure 11.**

**Figure 12.**

**Figure 13.**

**Figure 14.**

**Figure 15.**

**Figure 16.**

## DATA COLLECTION

Temperature readings will be taken weekly during the spring thaw when snowmelt runoff is occurring. In addition, water levels will be observed in the monitoring wells. The overall performance of French drain system will be observed, especially if water is flowing in the outlet culverts. These observations will continue until spring thaw is over. Observations will also be made during the second and third years after construction. Interim and final reports will be published.

## SUMMARY

Installation of the monitoring wells was completed with a minimum of disruption to the project. The success of the installation was primarily due to the flexibility of the contractor to undertake experimental construction. Monitoring the water levels and temperatures within the French drain will indicate if freezing occurs within the drain and if shredded tires contribute to maintaining subsurface flow despite freezing conditions.

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# Appendix

SPECIAL PROVISION
SECTION 605
TIRE SHRED FRENCH DRAIN

Description. This work shall consist of constructing and furnishing all material required for a 1.2 m wide x 0.9 m deep tire shred french drain in reasonably close conformity with the lines and grades shown on the plans and cross sections.

MATERIALS

Tire shreds, General. The material shall be made from scrap tires which shall be shredded into the sizes specified herein. They shall be produced by a shearing process. Tire shreds produced by a hammer mill will not be allowed. The tire shreds shall be free of any contaminates such as oil, grease, gasoline, diesel fuel, etc. that could leach into the groundwater, create a fire hazard or contaminate water flowing through the French Drain. In no case shall the tire shreds contain the remains of tires that have been subjected to a fire. The tire shreds shall be free from fragments of wood, wood chips, and other fibrous organic matter.

The tire shreds shall have less than 1% (by weight) of metal fragments which are not at least partially encased in rubber.

At least 30 days prior to beginning placement of the tire shred French Drain, the contractor shall submit a letter signed by the contractor and tire shred supplier describing the delivery schedule for the tire shreds and, if applicable, the location where tire shreds will be stockpiled prior to being placed as French drain. Tire shred storage shall be in accordance with the applicable sections of the Maine Dept. Of Environmental Protection's Maine Solid Waste Rules, Chapter 402.

Type A Tire Shreds. Type A tire shreds shall have a maximum dimension, measured in any direction, of 200 mm. In addition, Type A tire shreds shall have 100% passing the 100 mm square mesh sieve, a minimum of 95% passing (by weight) the 75 mm square mesh sieve, a minimum of 50% passing (by weight) the 50 mm square mesh sieve, and a maximum of 5% passing (by weight) the No. 4 sieve.

Tire shred sources. Known New England sources of Type A tire shreds are listed below. Other sources may also be available.

Casella Tires Inc.
Paul Chase
66 Dow Highway
Rte 236
Eliot, Maine 03903
(207) 439-5974

Routhier & Sons, Inc.
Attn: J. Paul Routhier

256 Ayer Road
Littleton, Massachusetts  01460
(978) 772-4251

## CONSTRUCTION REQUIREMENTS

Geotextiles. The tire shred French Drain shall be separated from the surrounding soil by a layer of geotextile as shown on the Special Details. The geotextile shall meet the requirements of Section 722.02, Drainage Geotextile Class B. Geotextile installation shall meet the requirements of Section 620. Any seams formed by adjacent lengths of geotextile shall be overlapped a minimum of 450 mm. Along the top of the French drain the geotextile shall have a minimum overlap of 300 mm.

Placing. The tire shred French drain shall be placed in three uniform lifts with a compacted thickness of 300 mm each. Each lift shall be brought to a uniform grade prior to compaction. Each lift shall be compacted using two passes of a walk-behind tamping foot roller with a minimum static weight of 8.9 kN. The compactor shall have a maximum width of 0.91 m. Care shall be taken to keep the compactor away from the geotextile during compaction operations. The compactor needs to be no closer than 150 mm from the edges of the trench at any time. Tears in the geotextile caused by compaction operations, shall be repaired by the Contractor so as to prevent infiltration of surrounding soil into the tire shred French drain, as directed by the Engineer. The tire shreds at the time of placement shall be free of ice and snow. If the top of any layer becomes contaminated by addition of foreign material, including but not limited to soil, organic matter, oil, grease, gasoline or diesel fuel, the contaminated material shall be removed and replaced with the specified material at no additional cost.

Contaminated Shreds. Tire shreds which become contaminated so as not to meet the material requirements of this Section, may be either be rescreened so as to meet the material specification of this Section, and placed as tire shred under drain; or may be disposed of in the construction embankment off of the paved surface in a layer no greater than 100 mm in thickness. Tire shreds disposed of in the latter manner, may be mixed with mineral soil, and shall be covered with a minimum thickness of 0.31 m of mineral soil, as directed by the Engineer.

Outlets. The Tire Shred French Drain shall outlet at each culvert, and the surrounding geotextile shall be protected from rip rap by a 150 mm thick layer of crushed stone meeting the requirements of 703.31, Crushed Stone, as shown in the Special Details.

## MEASUREMENT AND PAYMENT

Method of Measurement. Tire Shred French Drain placed as shown on the plans and Special Details and as constructed as specified in this Section, will be measured by the linear meter. In determining the density of tire shreds, the Contractor is referred to ASTM D6270-98.

Basis of Payment. Tire Shred French Drain will be paid for at the contract unit price per linear meter, which shall be full compensation for all labor, materials and equipment required to furnish an acceptable tire shred French drain. Crushed Stone geotextile protection used at outlets shall be incidental to the work.

Excavation required shall be paid for as provided in Section 206 - Structural Excavation. No allowance for payment will be made for excavating or material excavated beyond the dimensions shown on the Special Details.

Disposal of any contaminated tire shreds, which cannot be disposed of in the methods described in this Section, shall be at no additional cost.

| Payment will be under: | Pay Unit |
|---|---|
| Tire Shred French Drain | 605.38 |