

Design of Drainage Outlets

Introduction

The effectiveness and performance of underground drainage—a significant investment—may be compromised by poor installation or a lack of maintenance of drainage outlets. An on-site visit often helps to locate drainage outlets that are blocked, sunken or even covered over with earth and plants. These problems have several causes and some may be avoided or corrected with better planning and regular maintenance of drainage outlets.

This data sheet presents design, protection techniques against erosion and rodents, along with recommendations on the maintenance of drainage outlets.

Uses

A well planned drainage outlet not only contributes to the effectiveness and durability of a drainage system, but also will prevent degradation of the surroundings. It is not uncommon to see erosion under unprotected drainage outlets, primarily due to the speed and impact of the water flow at the drainage outlet. Moreover, designing of the outlet must counter the actions of rodents, reduce the impact of floating debris and prevent damage caused by machinery.

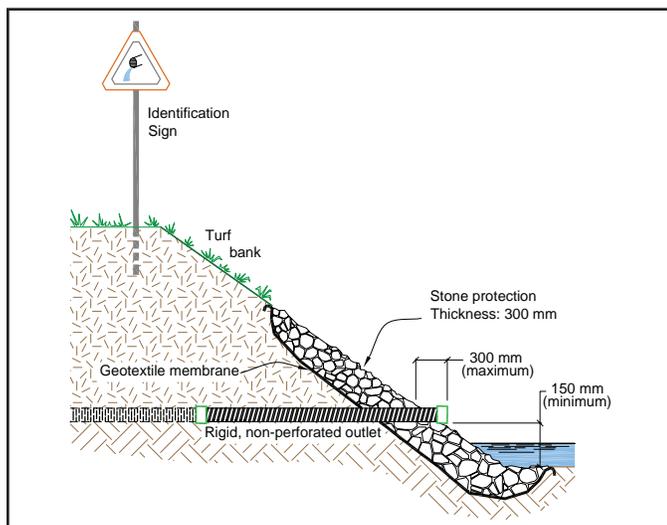


Figure 1: Designed drainage outlet
Source: Régis Potvin and Luc Lemieux (MAPAQ [Department of Agriculture, Fisheries and Food])

Location

A drainage outlet is normally located at the lowest point of the drained plot. However, installation must be avoided where the surface waters empty into the outlet channel or

the watercourse. In such case, rock chute spillway should be built to ensure stability, refer to “rock chute spillway factsheet”. Whenever possible, it is better to locate the drainage outlet in an outlet channel rather than in a watercourse in order to avoid damage because of moving ice.

Designing a drainage outlet

A well planned drainage outlet includes a rigid pipe and a protector against soil erosion at its outlet, a removable grate and appropriate signage to locate the discharge outlet.

• Rigid pipe

The drainage outlet consists of a minimum three-metre long, rigid, non-perforated pipe of galvanized steel or polyethylene. It is important to use a rigid pipe, which resists crushing or bursting better than a regular drain and is less likely to collapse. The lower end of the pipe must not exceed the bank surface by more than 300 mm (See Figure 1). It is advisable to set the drainage outlet slightly back from the watercourse to prevent damage from ice and debris. Furthermore, the drainage outlet should be installed at least 150 mm above the normal water level.

A fitted connection is recommended between the perforated drain and the rigid outlet, ensuring the joint is made tight with an appropriate adhesive tape. Normally, rigid polyethylene outlets come with a fitted connection.

The interior diameter of the rigid pipe must not exceed the diameter of the outside drain by more than 50 mm.

• Removable grate

A removable grate at the drainage outlet prevents rodents from accessing the drain. The “oscillating fork” type of grate is preferable to woven wire because it lets debris in





the drainage water pass more easily. The dimension of the openings must be a minimum of 19 mm.

- **Anti-seep collar**

This structure prevents water from flowing along the external surface of the conduit. Planning of an anti-seep collar is only recommended for a corrugated conduit when the conduit slope exceeds 10%. For more gradual slopes, a geotextile installation around the drainage outlet serves as an anti-seep collar.



Photo 1: Drainage outlet with removable grate
Source: Régis Potvin (MAPAQ)



Figure 2 a: Removable grate with oscillating fork
Source: Soleno Inc.
<http://www.soleno.com/download/Fr/1000137/Grille%20acier%20fourche%20amovible%20CDN.Fr%2008-2007.pdf>

The anti-seep collar may be constructed with the help of water repellent plywood (1,200 x 1,200 mm) with a centre hole cut that is sufficiently large to insert the rigid pipe. The joint between the pipe and the plywood must be sealed with a bituminous coating. This wall also restricts the passage of rodents, which tend to skirt the outside of the rigid pipe to work their way into the collector pipe.



Figure 2 b: Removable grate
Source: Soleno Inc.
<http://www.soleno.com/download/Fr/1000137/Grille%20acier%20fourche%20amovible%20CDN.Fr%2008-2007.pdf>

Drainage outlet protection

The placement of stones on geotextile is a simple and widespread technique to protect drainage outlets from erosion.

- **Stone protection**

A mix of fieldstone from 100-200 mm in diameter or grain-sized rubble from 50-150 mm in diameter works for this purpose. When there is significant discharge from the watercourse, the need for protection may require a calibre of 100-400 mm. The surface to protect must be excavated beforehand, based on the planned stone thickness. Plan for a stone thickness ranging from 200-300 mm at the base and reduce the thickness to 150 mm at the summit. Normally the largest stones are placed at the base, taking care to complete a toe trench.

When the bottom of the outlet channel is less than 1.5 m wide and a conduit of 200 mm or more is necessary for the collector, the bank opposite the drainage outlet should also be protected using the previously mentioned technique.

The quantity of stones necessary varies based on the need to protect. Generally, plan for 0.3 m³ of stone (\pm 0.5 ton/m²) for each square metre of protection; the minimum requirement protection for a drainage outlet is approximately 1 m³ of stones (\pm 2 tons).

Initially, an excavator is needed to place the stones but placement is completed manually to even the covered surface. Using the outside surface of the excavator bucket can help to settle the stone once it is in place.



• Geotextile

A geotextile membrane covers the entire surface area of the excavation or bank to be protected. The type of membrane for this purpose is a "Texel 7609 or 7612," a "Solenon TX-90 or TX-170" or any other equivalent membrane.

The placement is carried out by laying down the geotextile membrane at the base of the bank, i.e. at the level of the toe trench by climbing the bank. At the drain, an opening in the shape of a "+" is made to insert the membrane around the pipe. The membrane is then fixed around the drain with an appropriate adhesive tape.

If frequent maintenance of the outlet channel or watercourse is expected, it is recommended that the drainage outlet be located in an adjacent outlet channel, if possible, or slightly back from the bank to avoid redoing the work for each intervention in the watercourse.

• Other types of protection

Although rarely used in the agricultural environment, protection of a drainage outlet can be achieved with prefabricated elements, such as an apron of concrete, steel or Big "O" type polyethylene or equivalent.

Drainage outlet on an elevated bank

When the drainage outlet borders on an elevated bank, one of the following two techniques may be applied. The first consists in protecting the route of the water, either by surfacing it with a bed of stones or by extending the collector drain on the inclined surface of the bank. In the second case, the section of conduit left on the surface of the bank must be non-perforated and solidly fixed to the surface. The outlet and the protection occur at the end of the collector, at the foot of the slope (Figure 5). Another technique involves extending the drain according to the bank incline by burying it up to the foot of the slope where the outlet is planned, as described in this sheet (Figure 4).

Maintenance and protection against rodents

Inspection of drainage outlets must be done at least twice per year, i.e. in the spring and fall, to verify the stability of the work and accumulation of debris behind the grate. It should also take place following significant precipitation. To help inspect and maintain drainage outlets, it is recommended that the number of them be limited, e.g. by regrouping several drains laterally.

To limit the presence of rodents in watercourses, a riparian strip planted with shrubs and trees is recommended. Red-osier dogwood is recommended for this purpose. Its roots hold the soil well, are not invasive and disrupt the rodents from digging in the soil.

Plants with roots likely to encroach upon the drainage network (willows, poplars, maples, and horsetail) should be

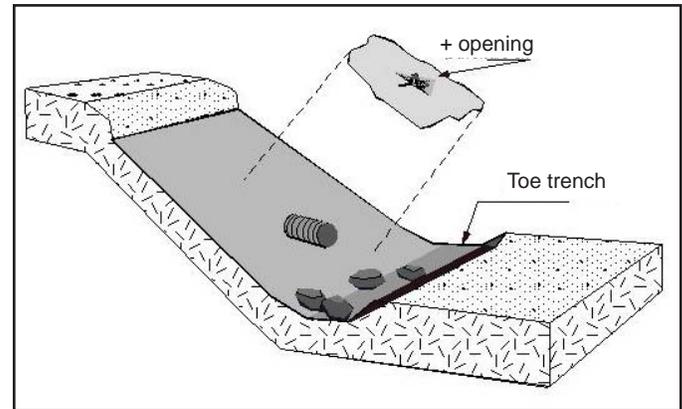


Figure 3: Geotextile membrane installation
Source: Régis Potvin and Luc Lemieux (MAPAQ)



Photo 2: Protection with fieldstones
Source: Régis Potvin (MAPAQ)

eliminated or used more than 30 metres from the drains. In all cases, plants must be maintained to ensure the drainage outlets remain clear.

The installation of a metal grate around the drain is also a good technique to control the access of rodents.

Identification

Over time, vegetation encroaches upon the banks and it becomes difficult to see the drainage outlets. To help locate them quickly for inspection or maintenance, it is necessary to properly identify their locations with a sign or simply with a brightly painted stake. This also prevents them from being damaged during future watercourse maintenance. An identification sign costs approximately \$30.

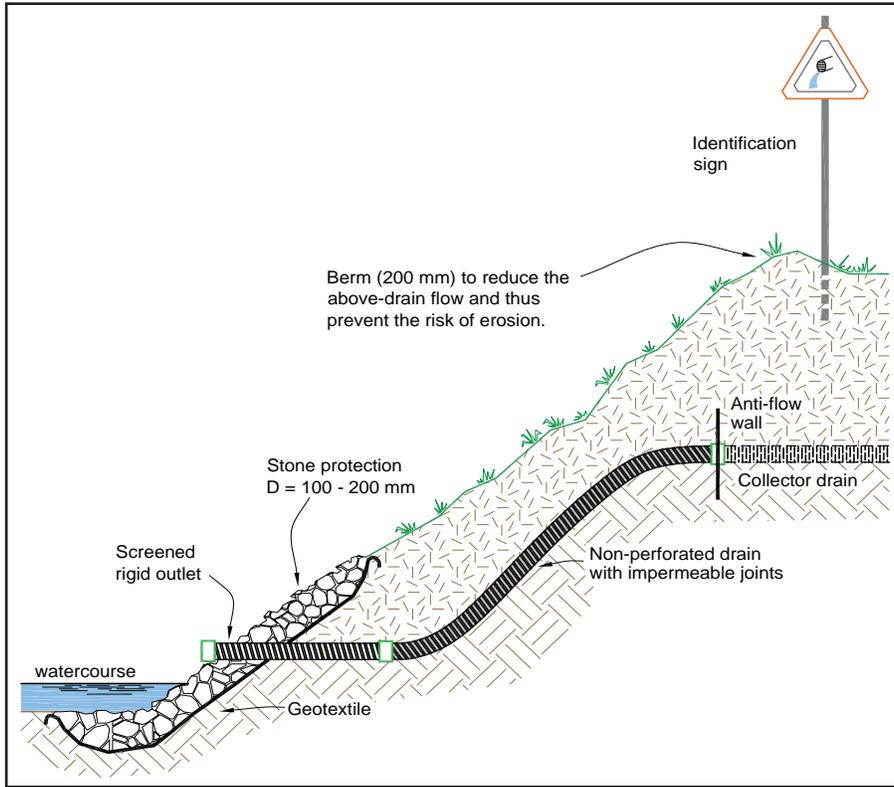


Figure 4: Drainage outlet with steep embankment and accessible by machinery
Source: Bernard Arpin, Luc Lemieux and Régis Potvin (MAPAQ)

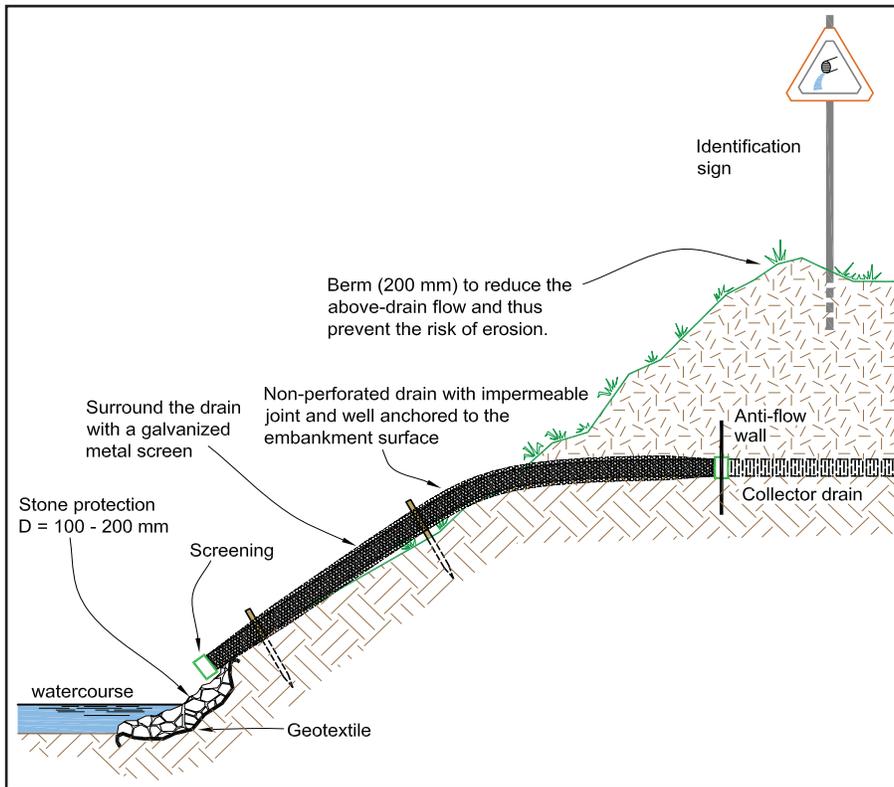


Figure 5: Drainage outlet with steep embankment and inaccessible by machinery
Source: Bernard Arpin, Luc Lemieux and Régis Potvin (MAPAQ)





Photo 3: Partially obstructed grate
Source: Mikael Guillou (MAPAQ)



Photo 4: Identification sign
Source: Luc Lemieux (MAPAQ)

WARNING

The owner is responsible for obtaining the authorization or licenses, where applicable, prior to undertaking the work. The development or stabilization of a drainage outlet may require authorization or a wildlife notice from the Ministère des Ressources naturelles et de la Faune [Quebec Department of Wildlife and Natural Resources] when work is carried out in fish habitats. In addition, a municipal permit is required if the watercourse is governed by municipal regulations.





References

Conseil des Productions végétales du Québec. 1992. Stabilisation des sorties de drain [stabilization of drainage outlets]. Agdex 700 Ministère de l'Agriculture, des Pêcheries et de l'Alimentation du Québec, p. 4.

Alain Gagnon. May 23, 2007. DATA SHEET: Sortie de drain, détails d'installation [drainage outlets: installation details]. Ministère de l'Agriculture, des pêcheries et de l'Alimentation du Québec.

This data sheet was completed in partnership with Agriculture and Agri-Food Canada and the Quebec Department of Agriculture, Fisheries and Food. It is part of a series aimed at promoting agricultural water developments as a way to control the problems of field erosion and surface drainage. Other sheets in the series include: Diagnosis and Solutions for Field Erosion and Surface Drainage Problems; Inlet and Drainage Wells; Infiltration wells; Permeable trenches; Evaluation of Peak Flows for Small Agricultural Drainage Basins in Quebec; Calculations for Sizing Inlet Wells; Diagnosis and solutions for bank erosion problems; Grassed waterways.

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