

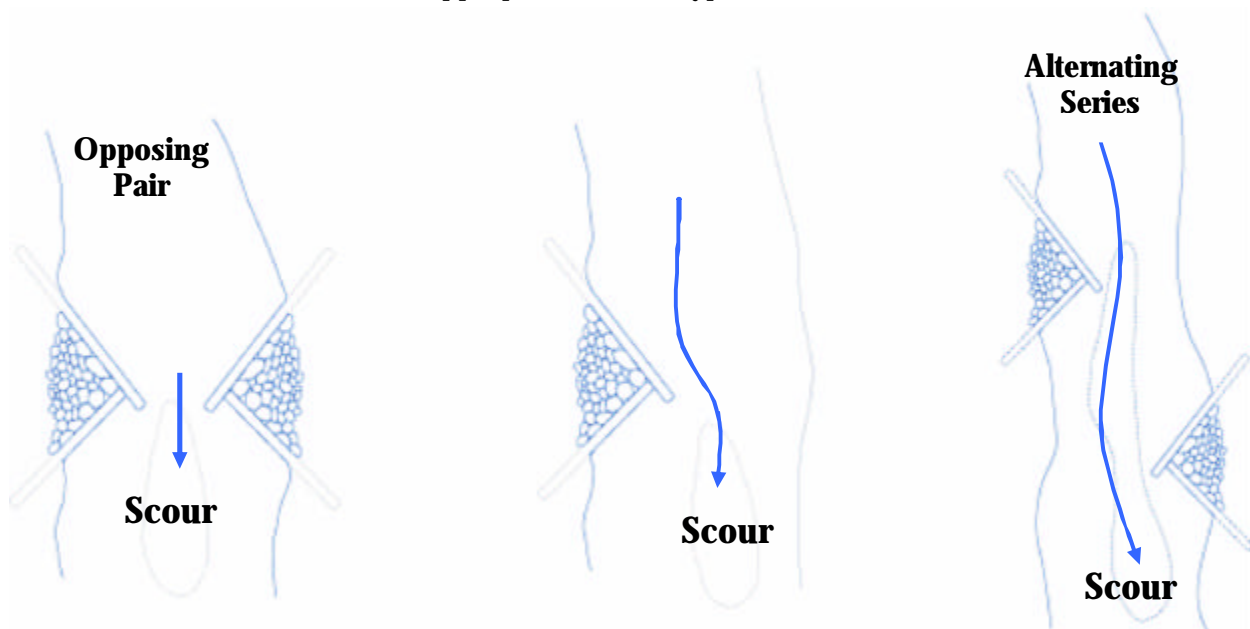
Wing Deflectors



Description

Wing deflectors are specifically designed as a solid triangular structure that reduces the width to depth ratio of the bankfull channel. Reducing channel width increases the stream velocity. The shape is important as it not only guides low flow, but also directs bankfull flows toward the thalweg. In terms of channel form, they are meant to behave as an artificial bar. Wing deflectors can be placed as single structures, in an alternating series or in opposing doubles.

In most circumstances, deflectors are simple to construct and a cost-effective means of restoring a meandering thalweg to altered channels that are wide, shallow and sluggish. Common construction materials include river stone, logs or wood debris. They have a natural appearance and are easy to maintain when constructed in the appropriate channel type.



Purpose

Placement can enhance the formation of scour pools, guide current toward cover or direct flow away from an eroding bank. Individually, they can enhance the local meandering of the thalweg and concentrate flow toward natural or created bank cover. In an alternating series, deflectors can create a deep meandering thalweg in a previously shallow and over widened channel. In opposing pairs, the deflectors further increase mid channel velocity and cause the formation of a scour pool. The scouring action maintains clean substrates which attracts aquatic insects and spawning fish. Mid channel pools provide resting and feeding habitat which invite juvenile and adult fish.

Application

Wing deflectors are placed in shallow, widened reaches of stream that lack a well defined, meandering thalweg. The host channel has a gentle slope and had some form of past influence that has increased the width to depth ratio. This could be caused by dredging or unrestricted livestock access.

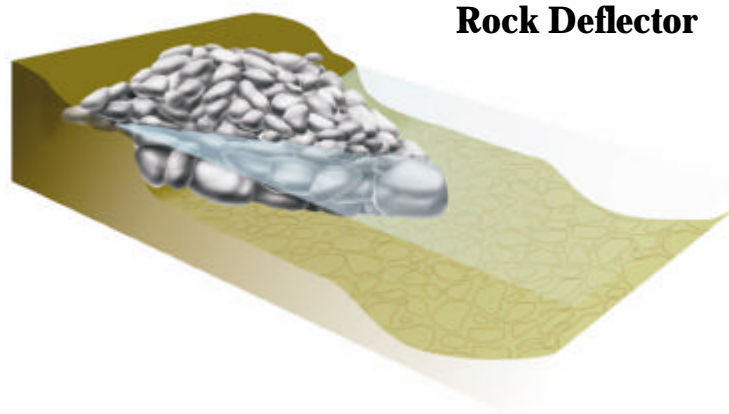
You will need a good understanding of the channel characteristics within the selected reach while having a similar awareness of a reference reach that is in a stable form. Failing this comparison, one should have sufficient baseline information to predict stable channel geometry. You will need to know what type of watercourse you are working in, the channel characteristics it should have and the dynamic nature of seasonal flow, ice formation, debris movement and sediment transport prior to selecting this rehabilitation technique. Sketches of the channel in plan view and cross section, indicating bankfull, low flow and thalweg will be essential for determining suitability and positioning. Straight runs, glides and below the crest of riffles are suitable sites for locating this type of structure. Wing deflectors are ideal in B type channels (slope between 2 to 4%) with a predominant boulder, cobble or gravel lining. They may also work well in boulder or cobble based C channels (slope less than 2%), F type channels with cobble dominate substrate or sand/silt based B channels but there may be a need for localized bank stabilization. This technique is not suited for streams with highly erodible substrates, high gradient or large volumes of ice and debris movement.

Deflectors should be designed to only alter the low flow and bankfull stages of the stream. Deflecting higher flows is generally discouraged due to the possibility of aggravated erosion and channel instability. It is highly recommended that you consult with your local MNR and Conservation Authority for advice on suitability.

Construction Guidelines

Wing deflectors are specifically designed in three dimensions as a tapered, triangular structure that points into the channel. Regardless of the materials used, there are common construction aspects that need to be addressed to maintain a functioning low profile presence in the bankfull channel.

The position within the channel is very important. It determines channel velocity, the direction of current during low flow while also directing higher flows toward the centre of the watercourse. The structure should not occupy more than one third of the width of the



bankfull channel. The upstream angle of the deflector should range between 30 to 45 degrees from the bank to guide the flow toward the centre of the channel. The angle of the downstream log should be 90 degrees to the upstream edge (see illustration). The elevation of the tip of the deflector should not exceed two times the height of the low flow channel. The tip should also be in line with the centre of stable structure on the opposite bank. The arrangement should be gradually tapered back to the bank at the elevation of the bankfull stage. The final height should allow for ice and debris to flow over top during high flows.

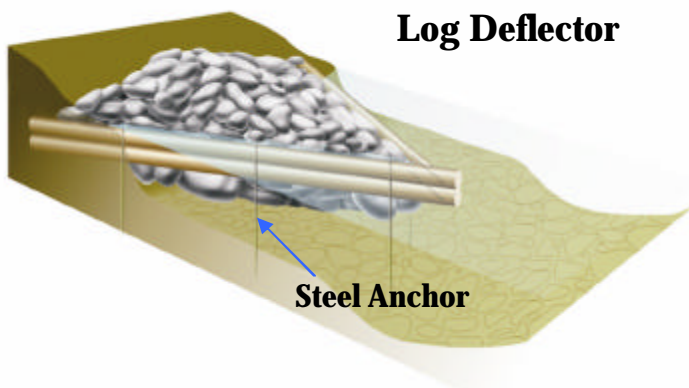
Stability under high flows is a very significant consideration that needs to be addressed through proper construction. Whether using rock or logs for the deflector, the structure should be securely anchored into the bed and bank of the channel. 25 percent of the average height of the deflector should be excavated into the bed. Logs and rock should extend 1.2 to 2.5 metres into the bank.

Wing deflectors constructed of boulders or quarried rocks are ideal in larger channels that are 5 to 10 metres in width. Excavate a trench into the bed and bank to create the outline of the triangular shape and place two layers of larger rock along the upstream edge ensuring that they are keyed together. Largest rocks should be placed at the point. Trench depth should be 25% of the average height of the deflector. Medium sized rock can be used for the trailing edge and the interior can be filled with smaller stone. The rock should be tapered from the tip up to the bankfull elevation on shore and keyed in (see illustration). Surplus bank material can be raked into the gaps between the rocks and planted with native grasses and shrub willows.

Log deflectors are built in the same fashion with a defining perimeter trench. They are more suited for streams less than 6.0 metres in width. Cedar or hemlock logs should be 30 to 50 centimeters in diameter. The upstream log is placed into position first as the leading edge. It should be level and dug into the bank 1.2 to 2.5 metres. Half of the log should be submerged into the bed of the channel. Be sure to properly align the angle at 30 to 45 degrees from the bank. The downstream log is placed to act as perpendicular brace to the upstream log. Using 1.2 metre long steel pins or "T" bars, secure into position using two to four anchoring pins per log. Nail the upstream log into the end of the downstream log. A second layer of logs can be used for additional height although frequent exposure to the air can cause decay. Use long galvanized ardox spikes to secure logs

together. The interior of the deflector can be filled with rock, brush bundles or cabled wood debris keeping in mind that the form should be sloped up to the bankfull elevation at the shore.

Single wing deflectors can be located in wide shallow runs or below the crest of riffles to the head of the pool. Multiple wing deflectors, placed in an alternating fashion 5 to 7 channel widths apart



can create a deeper, meandering thalweg in a long, straight reach.

Double wing deflectors, placed opposite to one another in the channel, further reduce the channel width and increase current velocity. This arrangement should occupy less than 80 percent of the width of the bankfull channel.

Materials Needed

There are two distinct designs used that are dependent on the widths of the channel. Wing deflectors for small streams are constructed of logs and require the following materials:

- 30 to 50 cm diameter or hemlock logs, long enough to imbed 1.2 to 2.5 m in to the bank and a maximum of $1/3^{\text{rd}}$ of the channel width
- 1.2 m steel pins or “T” bar posts, at least two per log placed 2 m apart
- 15 to 20 cm rock for fill or brush bundles and wood debris secured with aircraft cable
- long galvanized ardox spikes or steel pins to secure logs together
- shovels, rakes, sledge hammer

In larger streams and rivers, rock deflectors should be constructed with:

- 30 to 50 cm large rock for the edges and tip (amount and size will vary with size of deflector)
- 20 to 30 cm rock for the interior

In both cases, the final grading of the bank will need stabilization with a quick growing seed mixture and native shrub willows.

Cost and Maintenance Needs

Wing deflectors can be a low cost technique depending on the availability of materials, site access, channel size and need for heavy equipment. A crew of three experienced people can construct one small deflector in several hours. As channel size increases, so does the amount of materials and labour required to construct. These structures have varying degrees of longevity depending upon the materials used and the dynamic nature of the channel. Typically, they can last up to five years. Frequent monitoring and maintenance is recommended during the first year to ensure proper function, correct erosion problems or remove undesirable debris accumulation. Expected annual maintenance cost can range from \$12.00 to \$22.00 per metre depending on the availability of rock. Continue with annual monitoring after the first year to ensure deflectors work properly.

Integration

Several habitat enhancement projects can be used in conjunction with wing deflectors such as:

- L.U.N.K.E.R.S.

- instream log cover
- half log cover
- boulder placement
- sweepers

Demonstrations

This type of habitat structure has been applied in the following demonstration projects:

- Project #91, Tioga Wildlife Area - Pine River
- Project #17, Hiltz Farm
- Project #67, East Humber River Rehabilitation Project
- Project #118, Rouge River Headwaters Rehabilitation Project
- Project #109, Morningside Tributary Aquatic Habitat Rehabilitation Project
- Project #135, Halls Creek
- Project #58, Larches Creek
- Project #48, Laurel Creek
- Project #76, Lawrence Creek
- Project #32, Dedricks Creek
- Project #82, Blyth Brook Rehabilitation Program
- Project #1, Moore Drain Project

For More Information

Please refer to the following authors and their respective publications located in the bibliography:

Buchanan, R.A. et al 1989
Fitch, L. et al 1994
O.M.N.R. 1984
M.T.O. 1997
Rosgen, D. 1996