

Grass Buffer (GB)



Description

Grass buffer (GB) strips are an integral part of the MDCIA land development concept. They are uniformly graded and densely vegetated areas of turf grass. They require sheet flow to promote filtration, infiltration and settling to reduce runoff pollutants. GBs differ from grass swales as they are designed to accommodate overland sheet flow rather than concentrated or channelized flow. They can be used to remove larger sediment from runoff off impervious areas.

Whenever concentrated runoff occurs, it should be evenly distributed across the width of the buffer via a flow spreader. This may be a porous pavement strip or another type of structure to achieve uniform sheet-flow conditions. GBs can also be combined with riparian zones in treating sheet flows and in stabilizing channel banks adjacent to major drainageways and receiving waters. GBs can be interspersed with shrubs and trees to improve their aesthetics and to provide shading. Irrigation in the semi-arid climate of Colorado is required to maintain a healthy and dense grass on the GB to withstand the erosive forces of runoff from impervious areas.

General Application

A GB can be used in residential and commercial/industrial areas. They are typically located adjacent to impervious areas. When used, they should be incorporated into site drainage, street drainage, and master drainage planning. Because their effectiveness depends on having an evenly distributed sheet flow over their surface, the size of the contributing area, and the associated volume of runoff have to be limited. Flow can be directly accepted from an impervious area such as from a parking lot and building roofs, provided the flow is distributed uniformly over the strip. GBs provide only marginal pollutant removal and require that follow-up structural BMPs be provided. They do, however, help to reduce some of the runoff volume from small storms.

Advantages/Disadvantages

General

The grass and other vegetation provide aesthetically pleasing green space, which can be incorporated into a development landscaping plan. In addition, their use adds little cost to a development's landscape requirements, and their maintenance should be no different than routine maintenance of the site's landscaping. Eventually, the grass strip next to the spreader or the pavement will have accumulated sufficient sediment to block runoff. At that point in time, a portion of the GB strip will need to be removed and replaced.

Grass and trees within these buffer strips can provide wildlife habitat and help reduce runoff through infiltration. If infiltration occurs, it can reduce the size of downstream drainage facilities. Gravel underdrains can be used where soils are not best suited for infiltration and to help keep the GB's surface dry.

Physical Site Suitability

The site, after final grading, should have a uniform slope and be capable of maintaining an even sheet flow throughout without concentrating runoff into shallow swales or rivulets. The allowable tributary area depends on the width, length, and the soils that lay under the GB. Hydrologic Soil Groups A and B provide the best infiltration capacity, while Soil Groups C and D provide best site stability. The swelling potential of underlying soils should also be taken into account in how the soils may affect adjacent structures and pavement when water is delivered to the grassed areas. Because of the semi-arid nature of Colorado's high plains, an irrigated grass cover is required to be effective.

Pollutant Removal

Pollutant removal depends on many factors such as soil permeability, site slope, the flow path length along the buffer, the characteristics of drainage area, runoff volumes and velocities, and the type of vegetation. The general pollutant removal of both particulate and soluble pollutants is projected to be low to moderate. GBs rely primarily upon the settling and interception of solids, and to only a minor degree, on biological uptake and runoff infiltration. See Table ND-2 for estimated range of pollutant removals.

Design Considerations

Design of GBs are based primarily on maintaining sheet-flow conditions across a uniformly graded, irrigated, dense grass cover strip. When a GB is used over unstable slopes, soils, or vegetation, formation of rills and gullies that disrupt sheet flow will occur. The resultant short-circuiting will invalidate the intended water quality benefits. GBs should be protected from excessive pedestrian or vehicular traffic that can damage the grass cover and affect even sheet-flow distribution. A mixture of grass and trees may offer benefits for slope stability and improved aesthetics.

Design Procedure and Criteria

The following steps outline the GB design procedure and criteria. Figure GB-1 is a schematic of the facility and its components.

1. Design Discharge

Determine the 2-year peak flow rate of the area draining to the GB. Also, determine the flow control type; sheet or concentrated.

2. Minimum Length

Calculate the minimum length (normal to flow) of the GB. The upstream flow needs to be uniformly distributed over this length. General guidance suggests that the hydraulic load should not exceed 0.05 cfs/linear foot of buffer in the Colorado high plains region during a 2-year storm to maintain a sheet flow of less than 1 inch throughout dense grass that is at least 2 inches high. The minimum design length (normal to flow) is therefore calculated as:

$$L_G = \frac{Q_{2\text{-year}}}{0.05}$$

In which:

L_g = Minimum design length (feet)

$Q_{2\text{-year}}$ = Peak discharge supplied to the GBs by a 2-year event (cfs)

Longer lengths may be used.

3. Minimum Width

The minimum width (W_G) (the distance along the sheet flow direction) of the GB shall be determined by the following criteria for onsite and concentrated flow control conditions:

A. Sheet Flow Control (use the larger value)

$$W_G = 0.2L_I \text{ or } 8 \text{ feet}$$

In which:

L_I = The length of flow path of the sheet flow over the upstream impervious surface (feet)

B. Concentrated Flow Control (use the larger value)

$$W_G = 0.15(A_t/L_t) \text{ or } 8 \text{ feet}$$

In which:

A_t = The tributary area (square feet)

L_t = The length of the tributary (normal to flow) upstream of the GB (feet)

The longer the buffer area is relative to the impervious area draining to it, the smaller the effective imperviousness, per Figure ND-1.

A generally rectangular shape strip is preferred and should be free of gullies or rills that concentrate the overland flow.

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|-----------------------|---|
| 4. Maximum Slope | Design slopes shall not exceed 4 percent. |
| 5. Flow Distribution | Incorporate a device on the upstream end of the buffer to evenly distribute flows along the design length. Slotted curbing, modular block porous pavement (MBP), or other spreader devices can be used to apply flows. Concentrated flow supplied to the GB must use a level spreader (or a similar concept) to evenly distribute flow onto the buffer. |
| 6. Vegetation | Vegetate the GB with irrigated dense turf in semi-arid areas of Colorado to promote sedimentation and entrapment and to protect against erosion. |
| 7. Outflow Collection | Provide a means for outflow collection. Most of the runoff during significant events will not be infiltrated and will require a collection and conveyance system. A GS can be used for this purpose and can provide another MDCIA type of a BMP. The buffer can also drain to a storm sewer or to a street gutter. |

Design Example

Design forms that provide a means of documenting the design procedure are included in the *Design Forms* section. A completed form follows as a design example.

Maintenance Recommendations

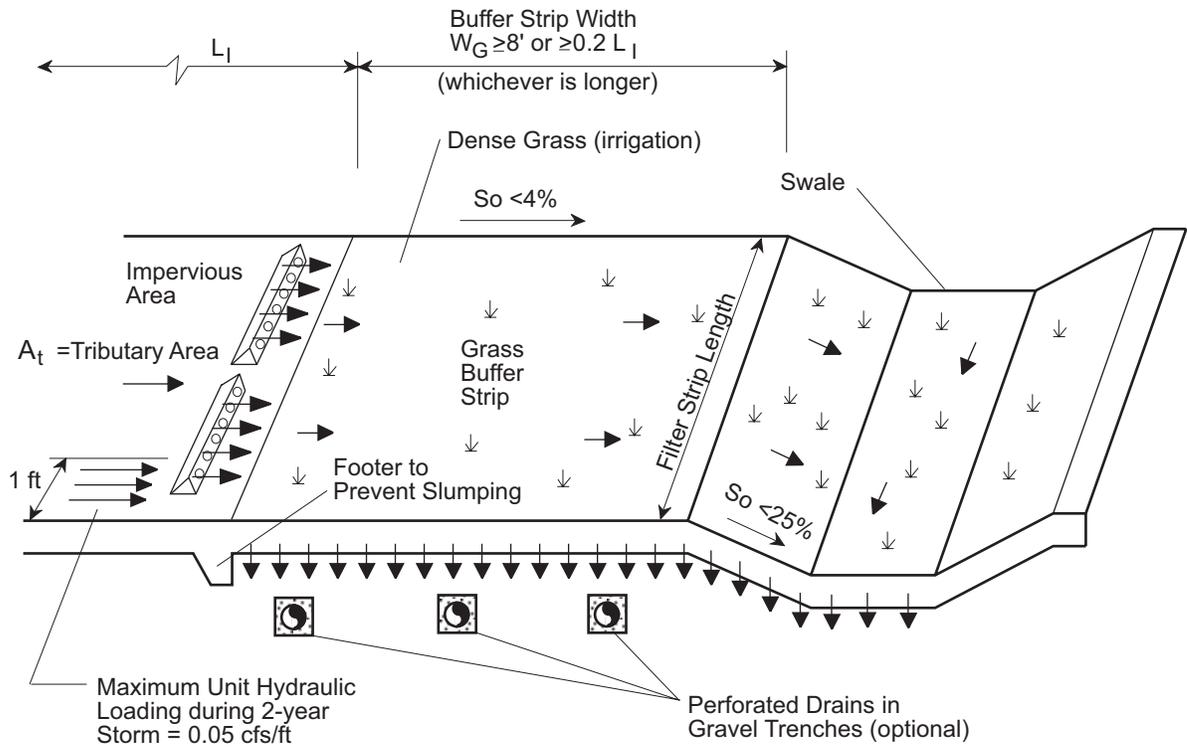
Grass buffers require general maintenance of the turf grass cover and repair of any rill or gully development. Table GB-1 presents a summary of specific maintenance requirements and a suggested frequency of action.

TABLE GB-1
Irrigated Grass Buffer Strip Maintenance Considerations

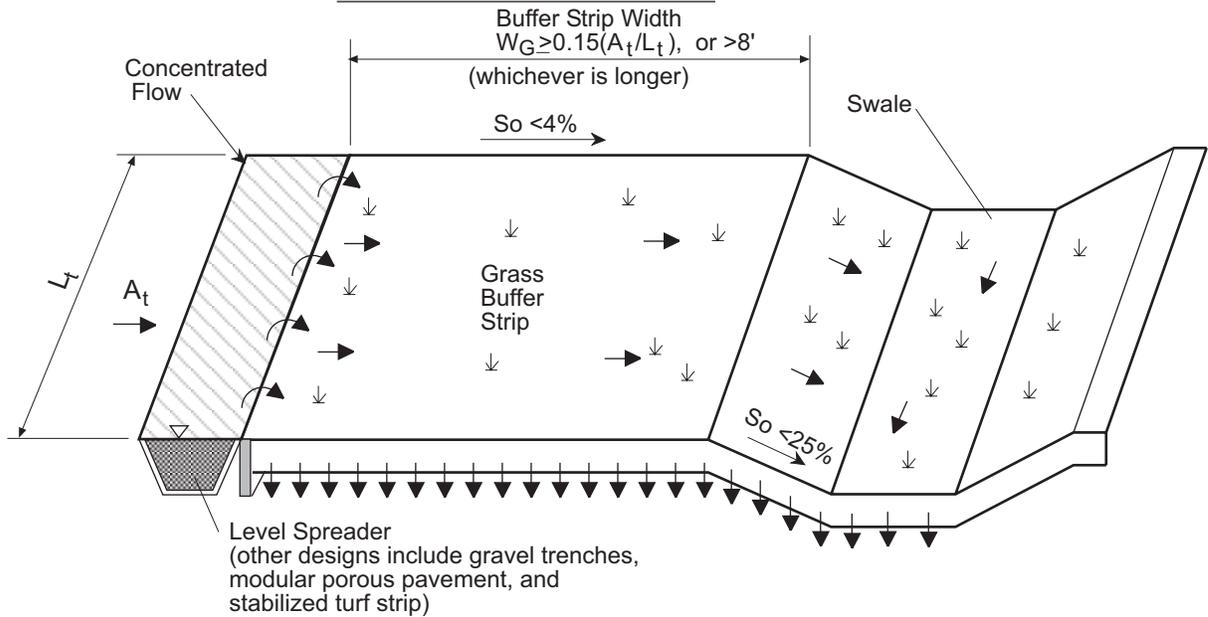
Required Action	Maintenance Objective	Frequency of Action
Lawn mowing	Maintain a dense grass cover at a recommended length of 2 to 4 inches. Collect and dispose of cuttings offsite or use a mulching mower.	Routine – As needed or recommended by inspection.
Lawn care	Use the minimum amount of biodegradable, nontoxic fertilizers and herbicides needed to maintain dense grass cover, free of weeds. Reseed and patch damaged areas.	Routine – As needed.
Irrigation	Adjust the timing sequence and water cover to maintain the required minimum soil moisture for dense grass growth. Do not overwater.	As needed.
Litter removal	Remove litter and debris to prevent gully development, enhance aesthetics, and prevent floatables from being washed offsite.	Routine – As needed by inspection.

TABLE GB-1
Irrigated Grass Buffer Strip Maintenance Considerations

Required Action	Maintenance Objective	Frequency of Action
Inspections	Inspect irrigation, turf grass density, flow distribution, gully development, and traces of pedestrian or vehicular traffic and request repairs as needed.	Annually and after each major storm (that is, larger than 0.75 inches in precipitation).
Turf replacement	To lower the turf below the surface of the adjacent pavement, use a level flow spreader, so that sheet flow is not blocked and will not cause water to back up onto the upstream pavement.	As needed when water padding becomes too high or too frequent a problem. The need for turf replacement will be higher if the pavement is sanded in winter to improve tire traction on ice. Otherwise, expect replacement once every 5 to 15 years.



SHEET FLOW CONTROL



CONCENTRATED FLOW CONTROL

Note: Not to Scale

FIGURE GB-1
Application of Grass Buffers

Design Procedure Form: Grass Buffer (GB)

Designer: _____
 Company: _____
 Date: September 21, 1999
 Project: _____
 Location: _____

1. 2-Year Design Discharge (Total)	$Q_2 =$ <u>5.0</u> cfs
2. Tributary Catchment Flow A) Design Length (Normal to runoff flow path): $L_G = Q_2 / 0.05$ B) Tributary Area in Square Feet (A_t)	$L_G =$ <u>100</u> feet $A_t =$ <u>10,000</u> square feet
3. Design Width Along Direction of Flow (Use A or B) A) Sheet Flow Control Upstream i) Length of Flow Path Over Upstream Impervious Surface ii) Design Width of Buffer: $W_G = 0.2 * L_1$ (8' minimum) B) Concentrated (Non-Sheet) Flow Control Upstream (requires a level spreader in step 5 below) i) Length of Upstream Flow Level Spreader ii) Design Width of Buffer: $W_G = 0.15 * A_t / L_1$ (8' minimum)	$L_1 =$ _____ feet $W_G =$ _____ feet $L_1 =$ <u>80</u> feet $W_G =$ <u>18.8</u> feet
4. Design Slope (not to exceed 4%)	$S =$ <u>4.00</u> %
5. Flow Distribution (Check the type used or describe "Other") Note: If Method B was Used In Step 3, Level Spreader Must Be Checked Here	<input type="checkbox"/> Slotted Curbing <input type="checkbox"/> Modular Block Porous Pavement <input checked="" type="checkbox"/> Level Spreader Other: _____ _____
6. Vegetation (Check the type used or describe "Other") Note: Irrigated Turf Grass Is Required in Semi-Arid Climates	<input checked="" type="checkbox"/> Irrigated Turf Grass <input type="checkbox"/> Non-Irrigated Turf Grass Other: _____ _____
7. Outflow Collection (Check the type used or describe "Other")	<input checked="" type="checkbox"/> Grass Lined Swale <input type="checkbox"/> Street Gutter <input type="checkbox"/> Storm Sewer Inlet <input checked="" type="checkbox"/> Underdrain Used Other: _____ _____

Notes: _____

