Appendix A

Pretreatment Measures Design Standards

A.1 Pretreatment Forebay

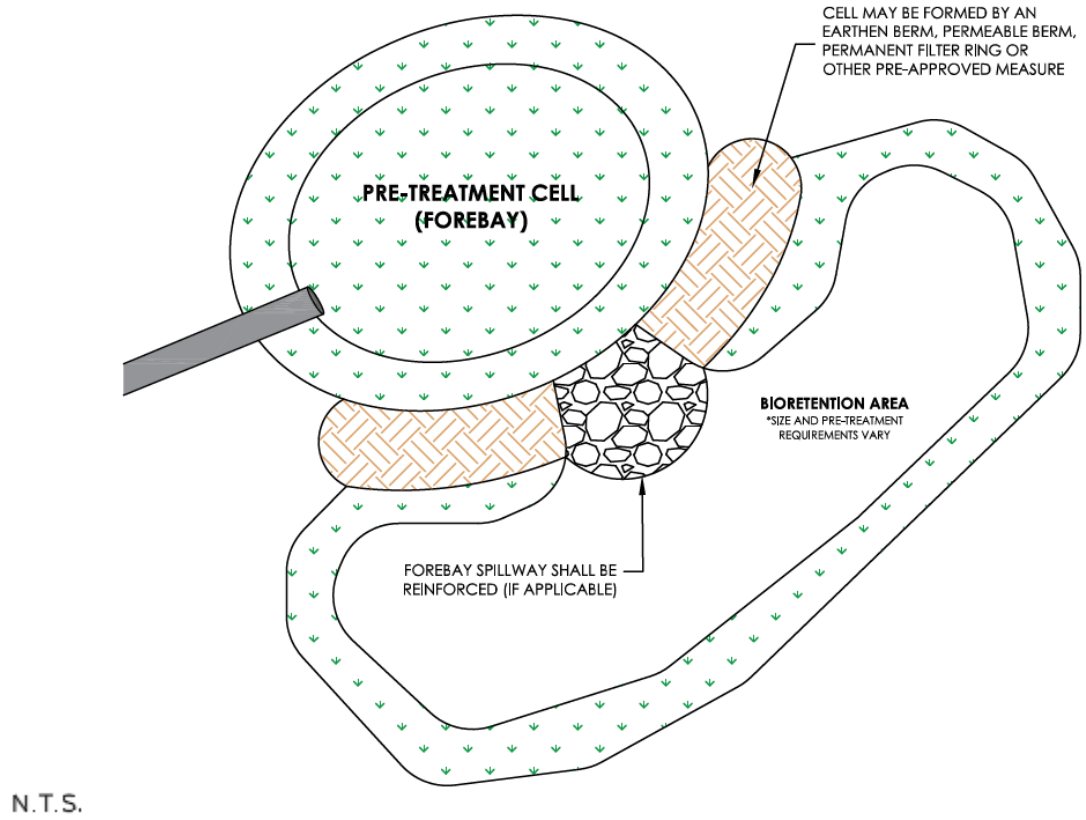


Figure A.1. Pretreatment Forebay Standard Detail

Used in concentrated flow conditions, forebays are located at piped inlets or curb cuts leading to the bioretention area and includes an energy dissipater sized for the expected rates of discharge. Forebays can be hard-lined, with concrete or grouted rip rap, to ease removal of accumulated material. Note that concrete-lined forebays may increase flow velocity without additional energy dissipation measures being incorporated. The forebay shall have a 2:1 length-to-width ratio. The forebay may be formed by a stone check dam or an earthen or rock berm. Pre-treatment forebays should not have underlying engineered soil media, in contrast to the main BMP. The ground surface of the pretreatment forebay should slope 1% towards the BMP to provide positive drainage to the surface of the BMP. Velocities entering the forebay shall be evaluated and additional measures provided as necessary to provide scour protection and energy dissipation through the forebay for the 10-year storm event. Exit velocities from the pretreatment forebay must be non-erosive for the 2-year design storm.

Table A.1. Sizing Requirements based on GIP	
GIP	**Sizing Requirement**
Level 1 Bioretention (GIP-01)	15% of Tv (exclusive)
Level 2 Bioretention (GIP-01)	15% of Tv (exclusive)
Level 1 Infiltration Trench (GIP-04)	15% of Tv (exclusive)
Level 2 Infiltration Trench (GIP-04)	15% of Tv (exclusive)
Water Quality Swale (GIP-05)	15% of Tv (exclusive)

The forebay pre-treatment volume required for concentrated flow entering a bioretention area is not included within the total treatment volume (Tv) required (see Equation A.1). Riprap used for energy dissipation within the forebay shall be sized per TDOT specifications. The treatment volume required for the forebay is computed as follows:

Equation A.1. Example Pretreatment Forebay Treatment Volume Sizing

$$Tv_{Forebay} = Total\ Tv * 0.15\ (bioretention)$$

Where:

Total Tv = Total required Treatment Volume (cu. ft.)

$Tv_{Forebay}$ = Treatment Volume required for the forebay (see table A.1) (cu. ft.)

A.2 Gravel Flow Spreaders

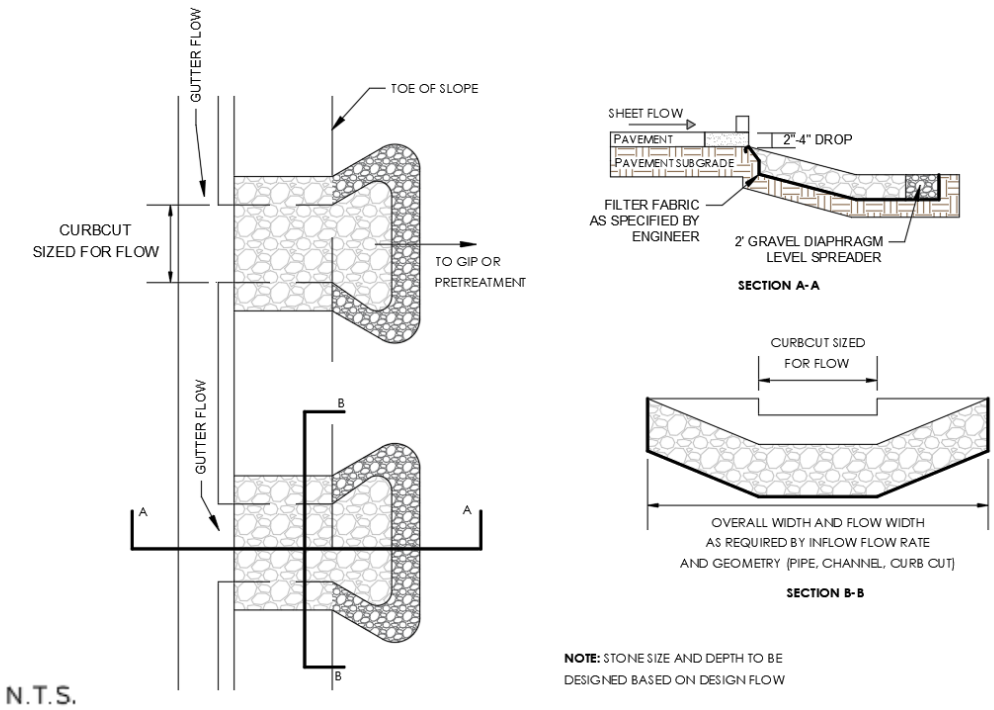


Figure A.2. Gravel Flow Spreader Standard Detail

Used in concentrated flow conditions, the gravel flow spreader is located at curb cuts, downspouts, or other small-scale concentrated inflow points, and should have a 2 to 4-inch elevation drop from a hard-edged surface into a gravel or stone diaphragm. The gravel should extend the entire width of the opening and create a level stone weir at the bottom or treatment elevation of the basin. Exit velocities from the gravel flow spreader must be non-erosive for the 2-year design storm. Gravel flow spreaders can be utilized as a pretreatment measure for the following:

- Bioretention Areas (GIP-01)
- Infiltration Trenches (GIP-04)
- Water Quality Swales (GIP-05)

A.3 Grass Filter Strips

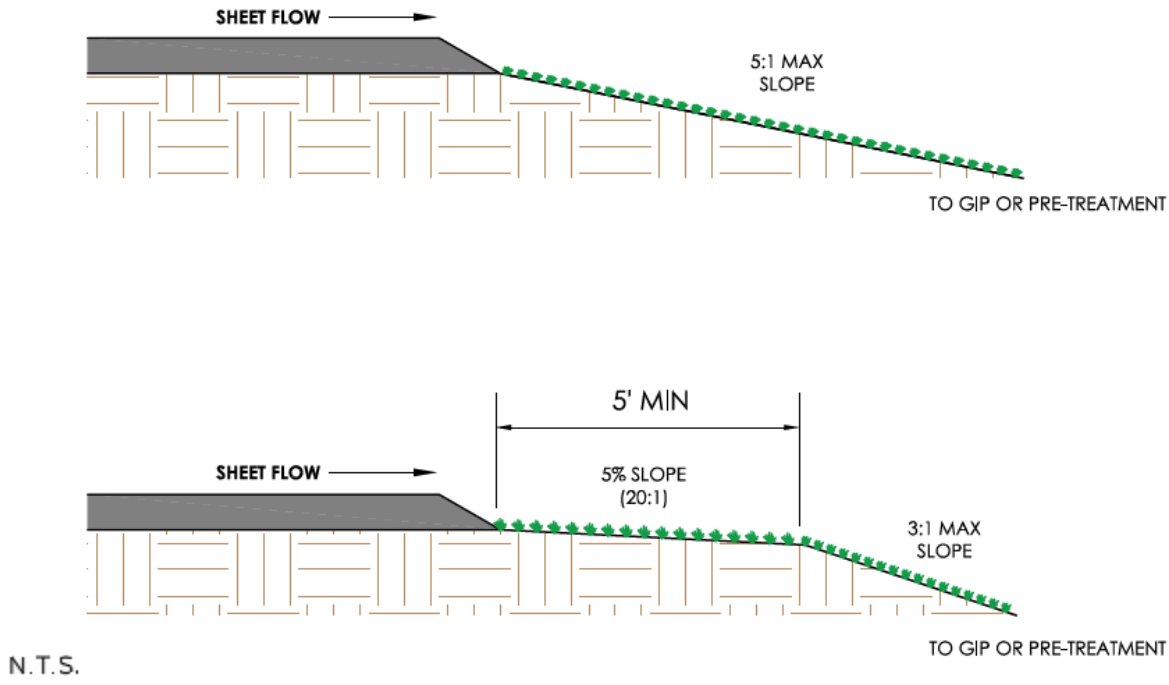


Figure A.3. Grass Filter Strip Standard Detail

Grass filter strips, or vegetated filter strips, can be utilized in sheet flow conditions only. Grass filter strips extend from the edge of pavement to the surface of the BMP at a 5:1 slope or flatter. Alternatively, provide a combined 5 feet of grass filter strip at a maximum 5% (20:1) slope and 3:1 or flatter side slopes on the bioretention basin or water quality swale.

For an infiltration trench receiving sheet flow from an adjacent drainage area, a grass filter strip with a minimum 25-foot length, as measured in the direction of flow, shall be implemented. A grass filter strip around the entire BMP is required if the facility is receiving runoff from both directions.

Grass filter strips are best suited to treat runoff from small catchment areas (less than 5,000 sq. ft. of impervious area.) Filter strips should be seeded, not sodded. If sod is to be used, sod shall be staked.

A.4 Gravel Diaphragm

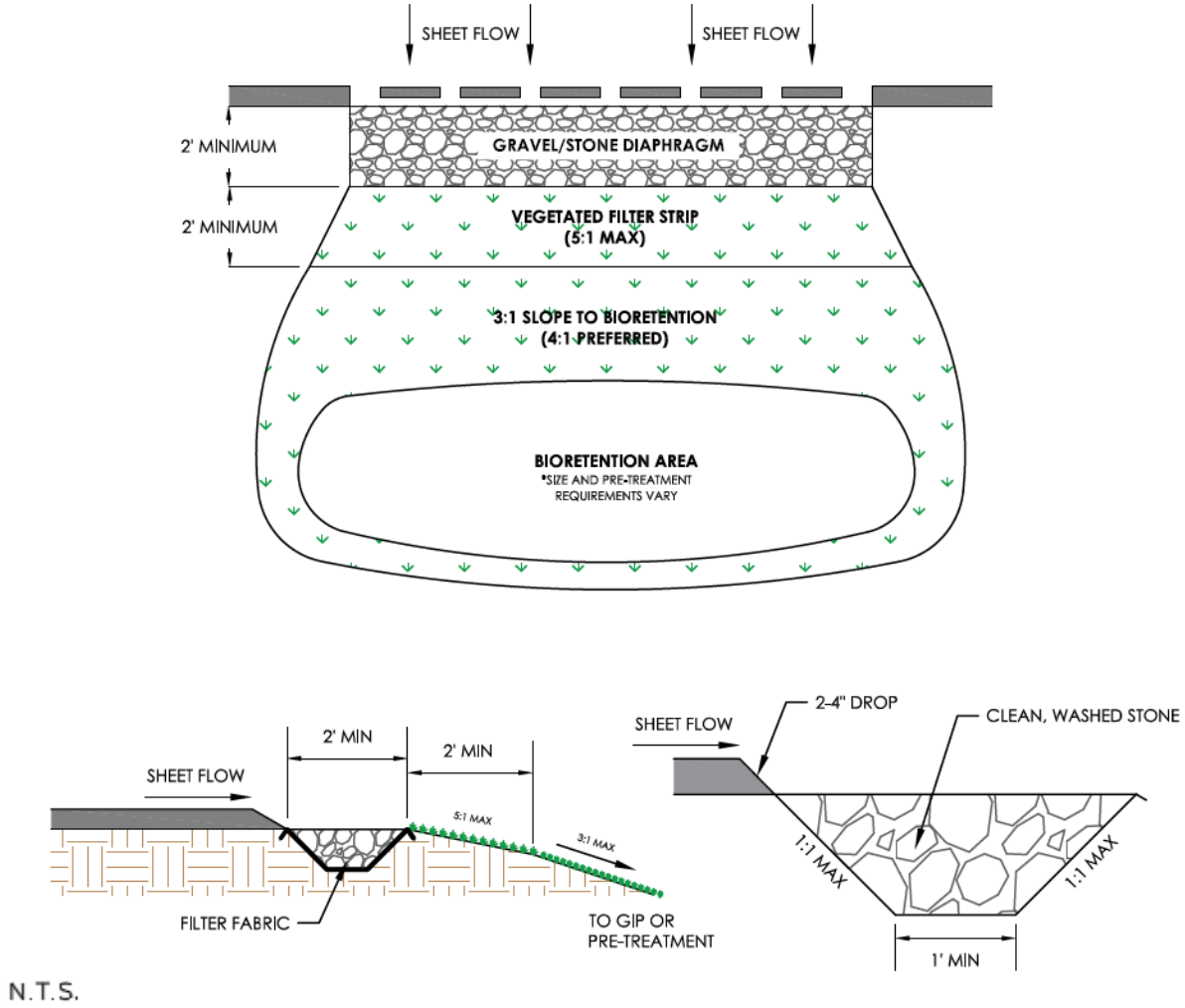
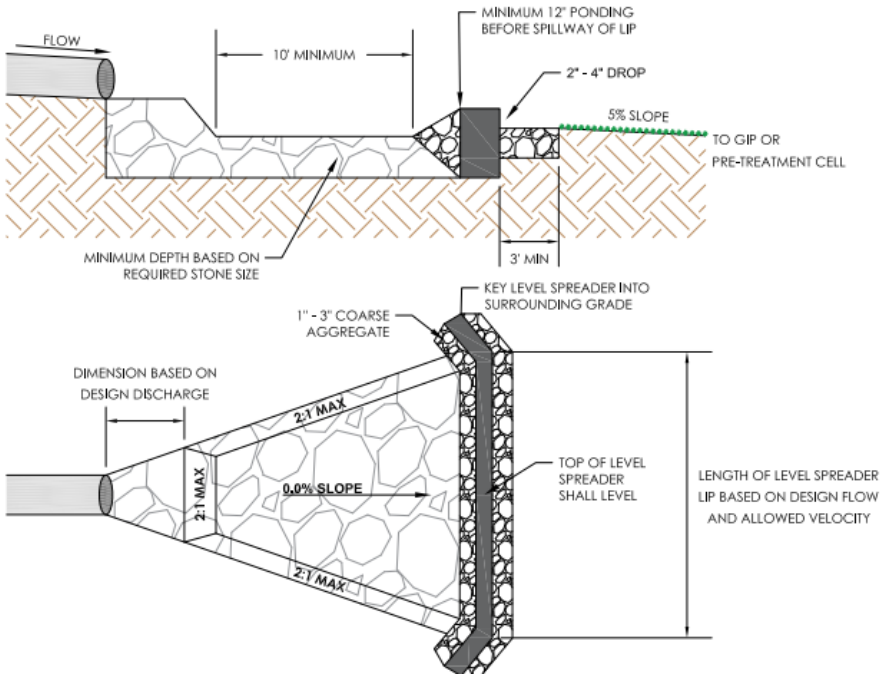


Figure A.4. Gravel Diaphragm Standard Detail

A gravel diaphragm located at the edge of the pavement should be oriented perpendicular to the flow path to pretreat lateral runoff and shall have a 2 to 4 inch drop from the edge of pavement. A layer of filter fabric shall be placed between the gravel and the underlying soils. The stone must be sized according to the calculated velocity of discharge in the 2 year storm event.

A.5 Level Spreaders



N.T.S.

Figure A.5. Engineered Level Spreader Detail

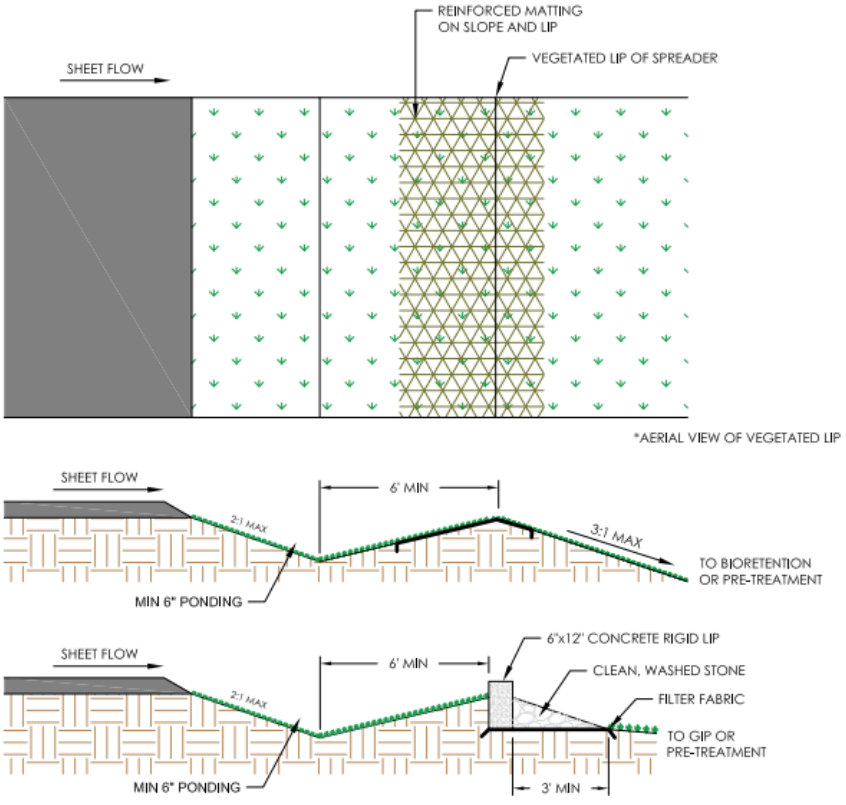


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Figure A.6. Vegetated and Rigid Lip Level Spreader Detail

The design of engineered level spreaders should conform to the following design criteria in order to ensure non-erosive sheet flow into the green infrastructure practice.

Key design elements of the engineered level spreader, as provided in **Figures A.5 and A.6**, include the following:

- A forebay should have a maximum depth of 3 feet and gradually transition to a depth of 1 foot at the level spreader lip (**Figure A.5**). The forebay is sized such that the surface area is 0.2% of the contributing impervious area. (A forebay is not necessary if the concentrated flow is from the outlet of an extended detention basin or similar practice).
- The length of the level spreader should be determined by the design flow:
  - The minimum level spreader length is 13 feet and the maximum is 130 feet.
  - For the purposes of determining the level spreader length, the peak discharge shall be determined using the rational equation with an intensity of 1-inch/hour.
- The level spreader lip shall be concrete, with a well-anchored footer, or other accepted rigid, non-erodible material.
- The ends of the level spreader section should be tied back into the slope to avoid scouring around the ends of the level spreader; otherwise, short-circuiting of the facility could create erosion.
- The level spreader should be placed 3 to 6 inches above the downstream natural grade elevation to avoid turf buildup. In order to prevent grade drops that re-concentrate the flows, a 3-foot long section of coarse aggregate, underlain by filter fabric, should be installed just below the spreader to transition from the level spreader to natural grade.

The flow is directed through a stilling basin energy dissipater and then a level spreader such that the entire design storm for the conveyance system (typically a 10-year frequency storm) is discharged as sheet flow through the floodplain.

A.6 Proprietary Structures

An approved proprietary structure, such as a water quality unit, with demonstrated capability of reducing sediment and hydrocarbons may be used as a required pretreatment measure but shall not be credited toward meeting runoff reduction requirements.