STANDARD FOR DIVERSIONS

Definition
A channel with a supporting ridge on the lower side constructed across the slope.

Scope
This standard covers the installation of diversions with drainage areas up to 100 acres.

Temporary
Diversions installed as an interim measure to protect or facilitate some phase of construction. They usually have a life expectancy of one year or less. The failure hazard is low.

Permanent
Divisions installed as an integral part of an overall water management and disposal system and to remain for protection of property.

Purpose
The purpose of this practice is to divert water from areas where it is in excess to sites where it can be used or disposed of safely.

Conditions Where Practice Applies
This practice applies to sites where runoff is damaging: (1) low lying areas, (2) cut or fill slopes or steeply sloping land, (3) critical sediment source areas in construction sites, (4) buildings, residences, streets and (5) active gullies or other erodible areas.

Permanent diversions are not applicable below high sediment producing areas unless land treatment practices or structural measures, designed to prevent damaging accumulations of sediment in the channels are installed with or before the diversions.

Water Quality Enhancement
The primary benefit to water quality is through the prevention of erosion of lands with large drainage areas or steep slopes. Diversions control and direct stormwater runoff to stable locations, thus preventing the development of erosive forces which result not only in soil loss, but the transportation of associated soil nutrients, fertilizers, pesticides etc. into surface and possibly ground water resources.

Design Criteria
Capacity and Freeboard
Peak discharge values shall be determined by the following:

1. Rational Method - for peak discharge of uniform drainage areas as outlined in Technical Manual for Land Use Regulation Program, Bureau of Inland and Coastal Regulations Stream Encroachment Permits, Trenton, N.J.
Standards for Soil Erosion and Sediment Control in New Jersey

May 2012

September 1997 or subsequent editions.

2. USDA-NRCS Win TR-55 or Win TR-20.

3. U.S. Army Corps of Engineers HEC HMS

4. Other methods which produce similar results to the models listed above.

The minimum size shall be that required to confine the peak runoff from the design storm plus required freeboard. The design storm and freeboard shall comply with the following table:

Table 15-1 Temporary and Permanent Diversion Sizing

<table>
<thead>
<tr>
<th>Diversion Type</th>
<th>Typical Area of protection</th>
<th>Design Storm Frequency</th>
<th>Freeboard Required (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temporary</td>
<td>Construction Areas (structures, roads, pipelines, etc.)</td>
<td>2 years</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td>Building Sites</td>
<td>5 years</td>
<td>0.0</td>
</tr>
<tr>
<td>Permanent</td>
<td>Agricultural Land</td>
<td>25 years</td>
<td>0.3 ft</td>
</tr>
<tr>
<td></td>
<td>Urban Land Areas, Play Fields, Recreation Areas, Agricultural Buildings, etc.</td>
<td>25 years</td>
<td>0.3 ft</td>
</tr>
<tr>
<td></td>
<td>Homes, schools, industrial buildings, etc.</td>
<td>50 years</td>
<td>0.5 ft</td>
</tr>
</tbody>
</table>

General Notes

1. Diverted runoff shall outlet onto an undisturbed stable area or onto an area that has been stabilized.
2. Periodic inspection and required maintenance must be provided.

Velocity

The maximum permissible velocity for design flow will be determined by the most erodible soil texture exposed and the type of vegetation expected and maintained in the channel. As a stable design, the diversion shall meet the following permissible velocity criteria and shall not be designed above 90% of critical flow (Froude number = 0.90). The following table will be used in selecting maximum permissible velocities:
Table 15-2 Maximum Permissible Velocity by Soil Type

<table>
<thead>
<tr>
<th>SOIL TEXTURE</th>
<th>Maximum Permissible Velocity (ft./sec.)</th>
<th>(velocities based on flow of clear water.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Channel Vegetation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Non-Veg.*</td>
<td>Veg.**</td>
</tr>
<tr>
<td>Sand, silt loam, sandy loam, loamy sand, loam, and muck</td>
<td>1.8</td>
<td>2.0</td>
</tr>
<tr>
<td>Silt loam, sandy loam, loamy sand, loam, and muck</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Silty clay loam, sandy clay loam</td>
<td>2.0</td>
<td>2.5</td>
</tr>
<tr>
<td>Clay, clay loam, sandy clay, silty clay</td>
<td>2.5</td>
<td>3.0</td>
</tr>
</tbody>
</table>

* Temporary Diversions

** Vegetated Channels - The minimum capacity and maximum velocity shall be determined by using the appropriate retardance factors listed below. See Appendix A6 for example and charts for use in design. Maximum allowable velocities for channels stabilized by seeding may be increased according to the type of Flexible Channel Liner used as shown in the Standard for Grassed Waterways. These velocities may be added to the allowable velocities shown above, except for sands.

Agricultural Handbook No. 667, Stability Design of Grass-Lined Open Channels, may also be used to design grass lined diversions based on tractive stress.

*** On well to excessively drained soils, the use of most cool season sod types will not survive without continued irrigation. Placement of sod in such areas must be approved by the District.

Permanent Cover and Erosion Protection

A permanent vegetative cover shall be established on all diversions in accordance with the Standard for Permanent Vegetative Cover for Soil Stabilization, or Standard for Permanent Stabilization with Sod. Where the season and other conditions may not be suitable for growing permanent erosion resistant cover, erosion protection will be provided in accordance with the Standard for Temporary Vegetative Cover for Soil Stabilization, or Standard for Stabilization with Mulch Only.

Diversions that are not designed to have a permanent vegetative cover shall be designed for bare channel velocities and with flat side slopes to prevent channel and side slope erosion. Diversions that are designed to have a permanent vegetative cover shall be seeded from the toe of the back slope to the upstream side of the designed channel width plus any required filter strip. Other areas disturbed by diversion construction shall also be seeded.

Vegetative Retardance Factors

Minimum Capacity - “D”

Maximum Allowable Velocity - “E”

Tables to select channel dimensions are available in Chapters 7 and 9, Ref. #1, appendix A-11

Bare Channels - The minimum capacity and maximum velocity shall be determined by using Manning's formula with an "n" value of 0.025.
Cross Section

The shape of the channel cross section shall be such that the diversion can be properly maintained with modern equipment. The channel may be parabolic, vee-shaped or trapezoidal.

The side slopes for permanent diversions shall not be steeper than 3:1 for maintenance purposes and preferably 4:1. Where frequent crossings are expected, slopes should be flatter. The back slope of the ridge is not to be steeper than 3:1 and preferably 4:1. The ridge shall include a settlement factor equal to 5 percent of the height. **The minimum top width of the diversion ridge after settlement is to be 4.0 feet at the design water elevation.**

In determining the cross section for temporary diversions, consideration should be given to soil type, frequency of operation and type of equipment that is anticipated to be crossing the diversion. In no case shall slopes be steeper than 1.5:1.

The top of the constructed ridge shall not be lower at any point than the design elevation plus the specified overfill for settlement.

**Profile(s) and cross-section(s) of all channel diversions shall be submitted on the Soil Erosion and Sedimentation Control Plan.**

Location

Diversion location shall be determined by outlet conditions, topography, land use, soil type and length of slope. Consideration must be given to the effects caused by changing natural water courses and putting additional flow into a water course.

Spacing on Slopes

To prevent surface runoff on slopes from exceeding the maximum sheet flow threshold distance (100 feet as defined by USDA-NRCS TR-55), spacing between multiple diversions on slopes will be **no greater than 33 vertical feet or 100 horizontal feet.** Diversions utilized on landfill slopes shall incorporate a drainage network of diversions running parallel to the slope to control runoff from very large or steep landfill caps. All diversions shall outlet into a properly designed chute which shall safely convey runoff to a stable location or other stormwater control structure. Care must be taken to prevent subsurface percolation and flow beneath the chute.

Grade

Diversion channel grade may be uniform or variable. Uniform grades are normally better. The allowable velocity for soil type and vegetative cover will determine maximum grade. Diversions with blocked ends may be used provided adequate pipe outlets are installed. If grade is to vary then each section must be individually designed.

Protection Against Sedimentation

When the movement of sediment into the diversion channel is a significant problem:

1. Land treatment or structural measures shall be installed to stabilize the source of sediment or trap the sediment.

2. If it is not possible to stabilize or trap the sediment, a filter strip of close growing grass shall be maintained above the diversion channel. The filter strip width measured from the center of the channel shall be at least
one-half the channel top width plus 15 feet.

Outlet

Each diversion must have an adequate, stable outlet. The outlet may be: a grassed, stone centered or lined waterway; a vegetated or paved area; a grade stabilization structure; a storm sewer; a stable watercourse; a tile outlet; or open channel.

The outlet in all cases, must be stable and convey water to a disposal point where damage will not result. Constructed vegetative outlets must be established prior to diversion construction.

Temporary Stone Outlet Structure

A temporary stone outlet structure (Fig. 15-1 & 2) for a diversion may be used only where the contributing watershed is less than five acres. **The minimum length, in feet, of the crest of the stone outlet structure shall be equal to six times the number of acres of the contributing drainage area.** The crest of the stone outlet structure shall be level and at least six inches lower than the lowest elevation of the top of the diversion. The stone shall be crushed stone and be 4” to 8” in diameter except for a one-foot thick blanket of 2” diameter stone on the upstream face.

The temporary stone outlet structure shall be located so as to discharge onto an already stabilized area or into a stable watercourse. The stone structure shall be embedded into the soil a minimum of four inches.

Installation Requirements

All trees, brush, stumps or other objectionable material shall be removed so they will not interfere with construction or proper functioning of the diversion. All ditches or gullies which must be crossed, will be filled and compacted prior to, or as part of the construction. Fence rows and other obstructions that will interfere with construction or the successful operation of the diversion are to be removed.

Vegetation is to be removed and the base for the ridge thoroughly disked before placement of fill.

The minimum constructed cross-section is to meet the design requirements.

The top of the constructed ridge is not to be lower than the design elevation plus the specified amount for settlement. Fertilizing, seeding and mulching shall conform to the requirements in the Standard for Permanent Vegetative Cover for Soil Stabilization.

If there is no sediment protection provided on temporary diversions it should be anticipated that periodic cleanout may be required.

Construction operations shall be carried out in such a manner that erosion and air and water pollution will be minimized. State and local laws shall be complied with.
Figures 15-1 & 15-2: Outlet Structure Cross Section and Profile
Roadbed Diversions.

Where the diversion will be temporarily used to direct water off a graded right of way onto stable areas (Figure 15-3), and the only area draining toward the diversion is the roadbed itself, the following spacing and size may be used instead of preparing individual designs for each diversion.

<table>
<thead>
<tr>
<th>Road Grade (percent)</th>
<th>Approximate Distance Between Diversions (ft)</th>
<th>Road Grade (percent)</th>
<th>Approximate Distance Between Diversions (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>400</td>
<td>15</td>
<td>60</td>
</tr>
<tr>
<td>2</td>
<td>245</td>
<td>20</td>
<td>50</td>
</tr>
<tr>
<td>5</td>
<td>125</td>
<td>25</td>
<td>40</td>
</tr>
<tr>
<td>10</td>
<td>80</td>
<td>30</td>
<td>35</td>
</tr>
</tbody>
</table>

**Design Criteria:**
- parabolic section
- 2 cfs or less flow rate
- 1% slope (grade) on diversion
- Top width: 12 feet
- Depth: 0.6 feet (0.5’ depth + 0.1’ settlement), no freeboard
Figure 15-3: General layout of roadbed diversions

Roadbed Diversions

Shallow diversions set at slight angle to roadbed. Outlet protected with rip rap and discharging to a stable area.