



## Public Works

### (Erosion Control, Flow Control, Impervious Surface, Water, Sewer, Street, Storm)

Provide a site plan, drawn to scale (with at least one copy reduced to 8½ x 11) showing the following:

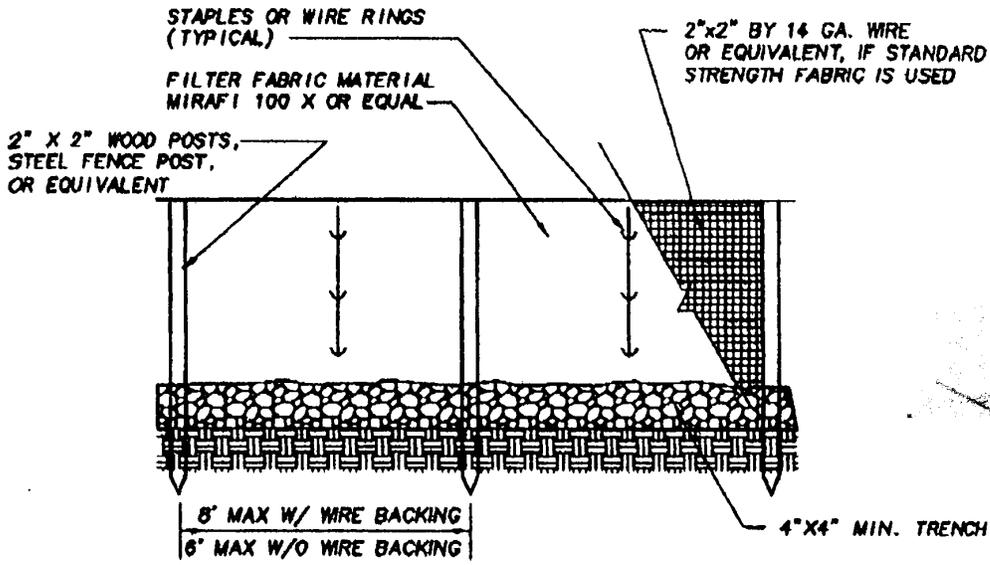
- Lot lines and dimensions
- Location of nearest street(s)
- North directional arrow
- Elevations of existing grade at lot corners
- Finished elevations of main floor
- Roof drainage system (**See Flow Control Design Handout**)
- Rock walls or other retainage systems
- Location and dimensions of driveway and other pavement
- Impervious surface calculations for entire lot coverage
- Location of building(s)
- Existing curbs, sidewalk, and adjacent streets
- Connection point of water line, including size and location of meter
- Make and model of backflow device – see separate application (if applicable)
- Connection point of sewer line - residential sewer service lines shall not be less than four inches in diameter and all sewer mains shall not be less than eight inches in diameter
- Footing drain detail
- Roof downspout connections providing all cleanouts necessary to allow for proper maintenance of the roof drain system
- Two copies of an erosion control plan showing construction entrance, silt fence and details of both. Describe other measures to be used to control erosion and sedimentation (see erosion control handout).

## Flow Control Design Criteria for Downspout Infiltration Trench

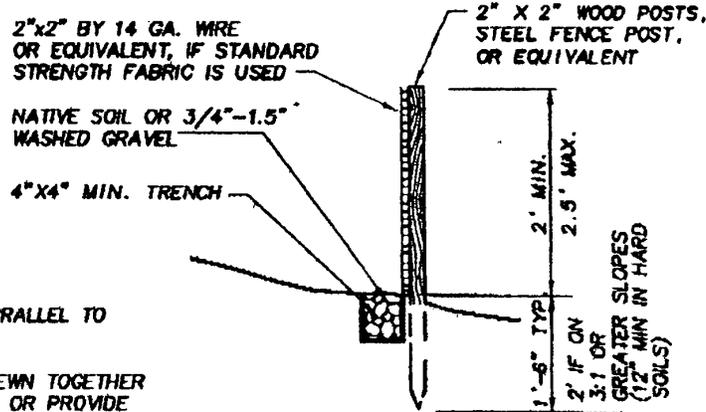
### Associated with new or remodeled construction

- 1) Contact Public Works at 564-8900 to schedule a site inspection with city engineer
- 2) On the scheduled inspection day, dig a hole three feet deep by three feet wide to be viewed by the inspector
- 3) The inspector will assist with the determination of the soil type - Fine sand, loamy sand; Sandy loam; Loam; etc.
- 4) Based on the soil type, the city engineer can provide length of trench required and other associated details for the downspout infiltration trench
- 5) Submit site plan to Public Works with the downspout infiltration trench identified for approval by Public Works
  
- 6) Contact Public Works at 564-8900 for erosion control inspection prior to commencing with construction activity on site
  
- 7) Contact Public Works at 564-8900 for inspection of infiltration trench prior to backfill/cover

# EROSION CONTROL



ELEVATION



NOTES:  
 CONSTRUCT FENCES PARRALLEL TO CONTOURS  
 SILT FENCE SHALL BE SEWN TOGETHER BY THE MANUFACTURER, OR PROVIDE 1 SECTION OF OVERLAP

TYPICAL SECTION

SILT FENCE  
 DETAIL

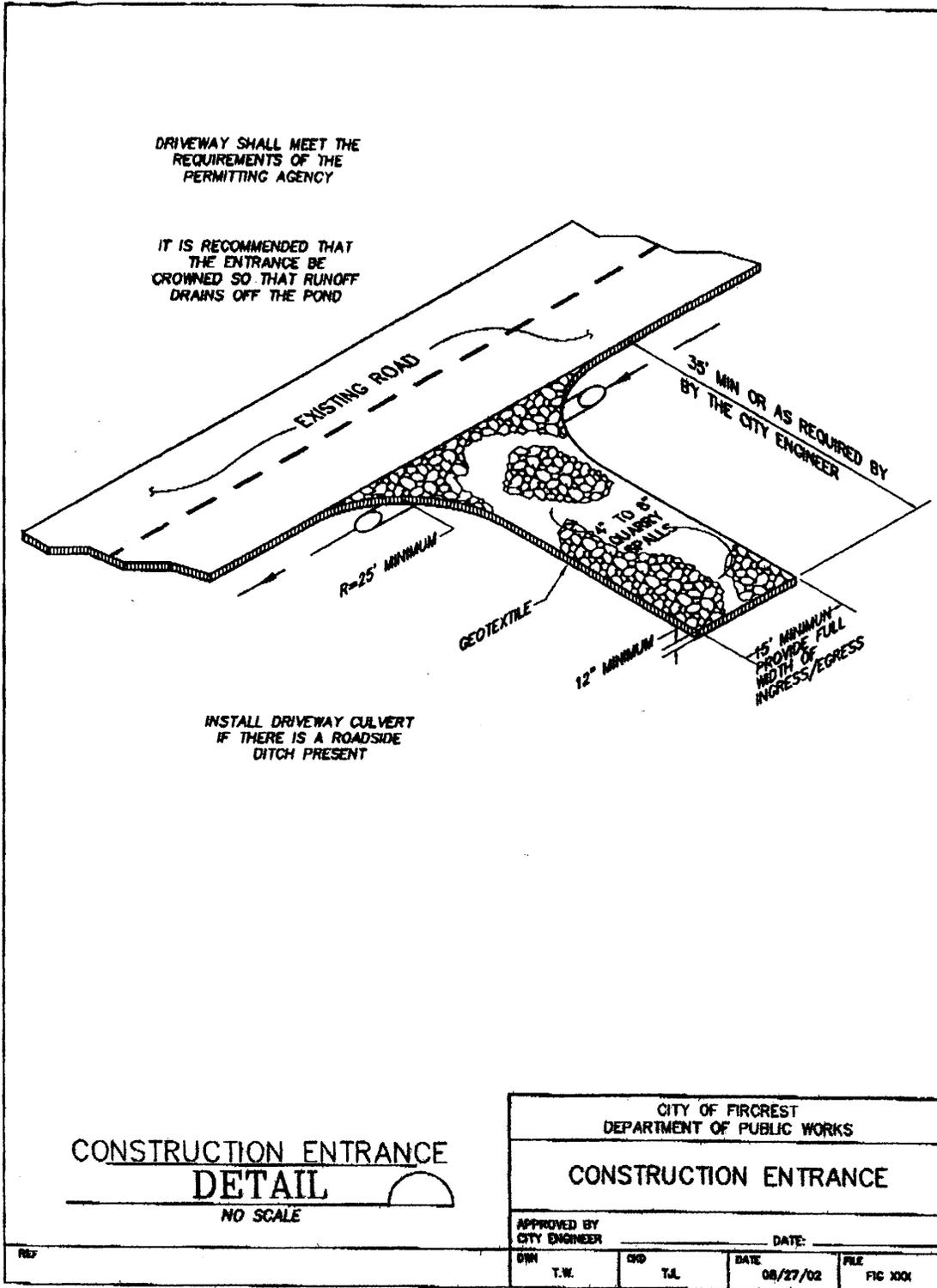
NO SCALE

CITY OF FIRCREST  
 DEPARTMENT OF PUBLIC WORKS

SILT FENCE

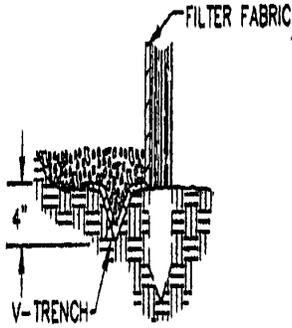
APPROVED BY CITY ENGINEER		DATE:	
DWN T.W.	CRD T.J.L.	DATE 8/27/02	FILE FIG XXX

REF

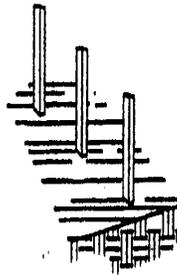


### HOW TO INSTALL FILTER FABRIC FENCE FOR RESIDENTIAL CONSTRUCTION

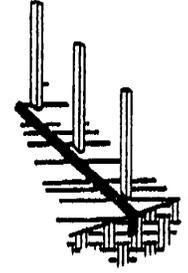
#### CROSS SECTIONS OF TRENCHES FOR FILTER FABRIC FENCES



1. SET STAKES NO MORE THAN 3 FT. APART AND DRIVE THEM INTO THE GROUND AT LEAST 8".

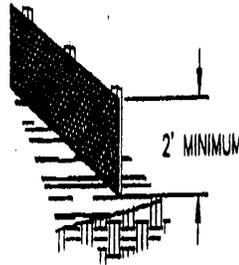
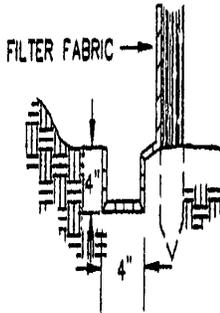


2. EXCAVATE A 4"x4" TRENCH UPSLOPE ALONG THE LINE OF STAKES.



3. STAPLE FILTER MATERIAL ON UPSLOPE SIDE OF STAKES AND EXTEND IT INTO THE TRENCH. WHEN JOINTS ARE NECESSARY, OVERLAP MATERIAL BETWEEN TWO STAKES AND FASTEN SECURELY.

4. BACKFILL AND COMPACT THE EXCAVATED SOIL.



SOURCE: NORTH CAROLINA EROSION AND SEDIMENT CONTROL PLANNING AND DESIGN MANUAL, 1988.

### FILTER FABRIC FENCES

N.T.S.

# FLOW CONTROL

## Chapter 3 - Flow Control Design

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*Note: Figures in Chapter 3 courtesy of King County, except as noted*

This chapter presents methods, criteria, and details for hydraulic analysis and design of flow control facilities and roof downspout controls. *Flow control facilities* are detention or infiltration facilities engineered to meet the flow control standards specified in Volume I. *Roof downspout controls* are infiltration or dispersion systems for use in individual lots, proposed plats, and short plats. Roof downspouts may be used in conjunction with, and in addition to, any flow control facilities that may be necessary. Implementation of roof downspout controls may reduce the total effective impervious area and result in less runoff from these surfaces. Ecology's Hydrology Model incorporates flow credits for implementing two types of roof downspout controls. These are:

- If roof runoff is *infiltrated* according to the requirements of this section, the roof area may be discounted from the total project area used for sizing the flow control facility as required in Volume I.
- If roof runoff is *dispersed* using a dispersion trench designed according to the requirements of this section on single-family lots greater than 22,000 square feet, and the *vegetative flow*\* path of the roof runoff is 50 feet or larger, the roof area may be modeled as grassed surface

This chapter also provides a description of the use of infiltration facilities for flow control. Additional design considerations and general limitations of the infiltration facilities and small site BMPs are covered in Volume V.

Roof downspout controls and small site BMPs should be applied to individual commercial lot developments when the percent impervious area and pollutant characteristics are comparable to those from residential lots.

### 3.1 Roof Downspout Controls

This section presents the criteria for design and implementation of roof downspout controls. *Roof downspout controls* are simple pre-engineered designs for infiltrating and/or dispersing runoff from roof areas for the purposes of increasing opportunities for groundwater recharge and reduction of runoff volumes from new developments.

#### ***Selection of Roof Downspout Controls***

Large lots in rural areas (5 acres or greater) typically have enough area to disperse or infiltrate roof runoff. Lots created in urban areas will typically be smaller (about 8,000 square feet) and have a limited amount of area in which to site infiltration or dispersion trenches.

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\* *Vegetative flow* path is measured from the downspout or dispersion system discharge point to the downstream property line, stream, wetland, or other impervious surface.

Downspout infiltration should be used in those soils that readily infiltrate (coarse sands and cobbles to medium sands). Dispersion BMPs should be used for urban lots located in less permeable soils, where if infiltration is not feasible. Where dispersion is not feasible because of very small lot size, or where there is a potential for creating drainage problems on adjacent lots, downspouts should be connected to the street storm drain system, which directs the runoff to a regional facility.

Where roof downspout controls are planned, the following three types must be considered in descending order of preference:

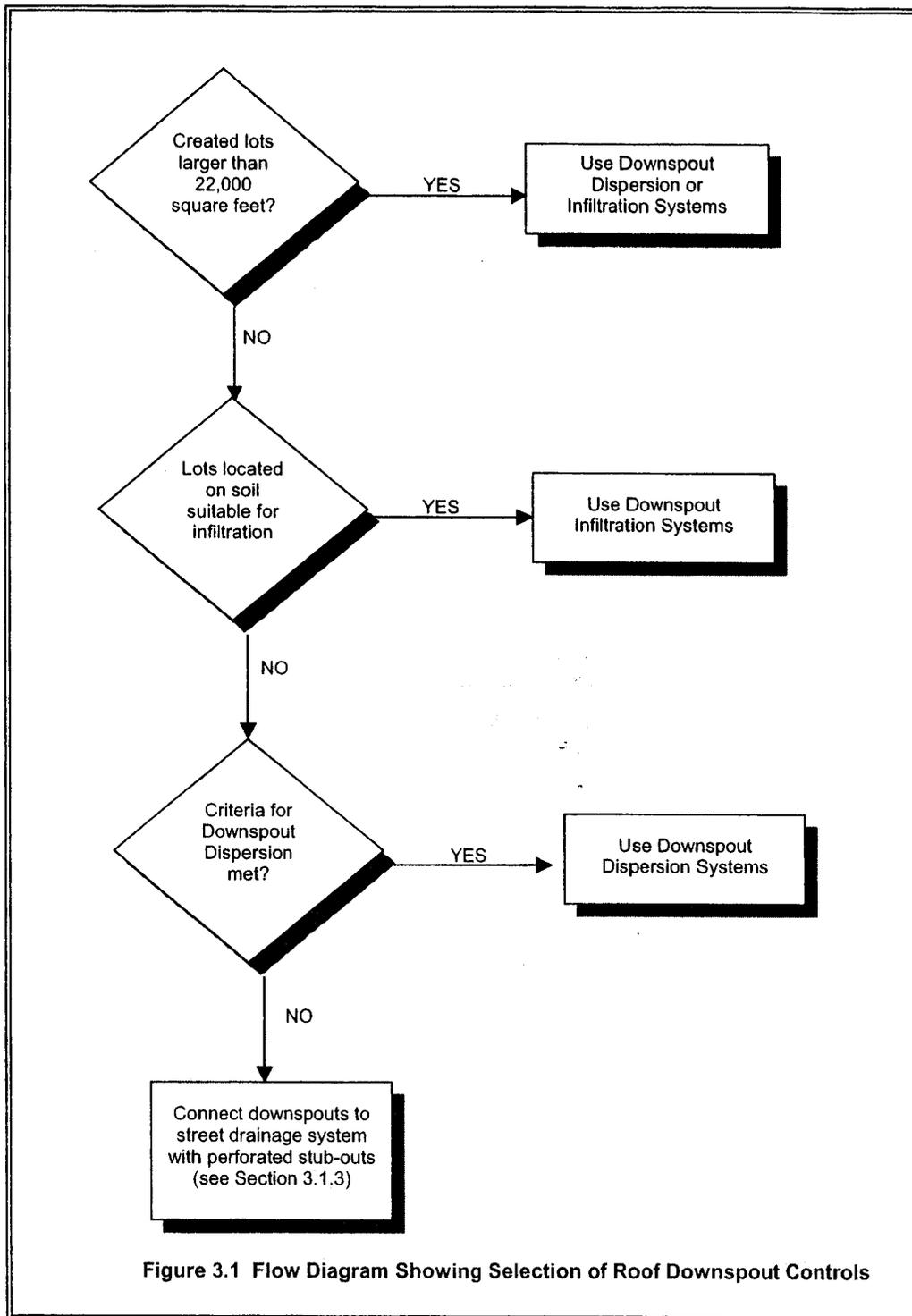
- Downspout infiltration systems (Section 3.1.1)
- Downspout dispersion systems (Section 3.1.2)
- Downspout perforated stub-out connections (Section 3.1.3)

Figure 3.1 illustrates, in general, how roof downspout controls are selected and applied in single-family subdivision projects. However, local jurisdictions may adopt approaches that are more specific to their locality. Where supported by appropriate soil infiltration tests, downspout infiltration in finer soils may be practical using a larger infiltration system.

Note: Other innovative downspout control BMPs such as rain barrels, ornamental ponds, downspout cisterns, or other downspout water storage devices may also be used if approved by the reviewing authority.

***Roof Downspout  
Controls in  
Potential Landslide  
Hazard Areas***

If or where local governments have identified “geologically hazardous areas” (WAC 365-195-410), we recommend that lots immediately adjacent to the hazard area collect roof runoff in a tightline system which conveys the runoff to the base of the slope.



### 3.1.1 Downspout Infiltration Systems

*Downspout infiltration systems* are trench or drywell designs intended only for use in infiltrating runoff from roof downspout drains. They are not designed to directly infiltrate runoff from pollutant-generating impervious surfaces.

#### ***Application***

The following apply to parcels as described in Volume I:

1. Single family subdivision projects subject to Minimum Requirement #7 for flow control (Volume I) must provide for individual downspout infiltration systems on all lots smaller than 22,000 square feet if feasible. Local governments may specify a different lot size that is more appropriate - based on local soil and slope conditions and rainfall. Concentrated flows may not be directed to adjoining lots. They must be dispersed and retained on the building lot to the maximum extent possible.
2. The feasibility or applicability of downspout infiltration must be evaluated for all subdivision single-family lots smaller than 22,000 square feet. The evaluation procedure detailed below must be used to determine if downspout infiltration is feasible or whether downspout dispersion can be used in lieu of infiltration.
3. For subdivision single-family lots greater than or equal to 22,000 square feet, downspout infiltration is optional, and the evaluation procedure detailed below may be used if downspout infiltration is being proposed voluntarily.
4. If site-specific tests indicate less than 3 feet of permeable soil from the proposed final grade to the seasonal high groundwater table, then a downspout dispersion system per Section 3.1.2 may be used in lieu of infiltration.
5. On lots or sites with more than 3 feet of permeable soil from the proposed final grade to the seasonal high groundwater table, downspout infiltration is considered feasible if the soils are outwash type soils and the infiltration trench can be designed to meet the minimum design criteria specified below.

*Note: If downspout infiltration is not provided on these lots, then a downspout dispersion system must be provided per Section 3.1.2.*

#### ***Flow Credit for Roof Downspout Infiltration***

If roof runoff is infiltrated according to the requirements of this section, the roof area may be discounted from the project area used for sizing the flow control facility as required in Volume I, Minimum Requirement #7.

**Procedure for  
Evaluating  
Feasibility**

1. A soils report must be prepared by a locally licensed onsite sewage designer or by other suitably trained persons working under the supervision of a professional engineer registered in the State of Washington to determine if soils suitable for infiltration are present on the site. The report must reference a sufficient number of soils logs to establish the type and limits of soils on the project site. The report should at a minimum identify the limits of any *outwash type soils* (i.e., those meeting USDA soil texture classes ranging from coarse sand and cobbles to medium sand) versus other soil types and include an inventory of topsoil depth.
2. On lots or sites with no outwash type soils, a downspout dispersion system per Section 3.1.2 may be used in lieu of infiltration.
3. On lots or sites containing outwash type soils (coarse sand and cobbles to medium sand), additional site-specific testing must be done. Individual lot or site tests must consist of at least one soils log at the location of the infiltration system, a minimum of 4 feet in depth (from proposed grade), identifying the SCS series of the soil and the USDA textural class of the soil horizon through the depth of the log, and noting any evidence of high groundwater level, such as mottling.

*Note: This testing must also be carried out on lots or sites where downspout infiltration is being proposed in soils other than outwash.*

4. If site-specific tests indicate less than 3 feet of permeable soil from the proposed final grade to the seasonal high groundwater table, then a downspout dispersion system per Section 3.1.2 may be used in lieu of infiltration.
5. On lots or sites with more than 3 feet of permeable soil from the proposed final grade to the seasonal high groundwater table, downspout infiltration is considered feasible if the soils are outwash type soils and the infiltration trench can be designed to meet the minimum design criteria specified below.

**Design Criteria  
for Infiltration  
Trenches**

Figure 3.2 shows a typical downspout infiltration trench system, and Figure 3.3 presents an alternative infiltration trench system for sites with coarse sand and cobble soils. These systems are designed as specified below.

**General**

1. The following minimum lengths (linear feet) per 1,000 square feet of roof area based on soil type may be used for sizing downspout infiltration trenches.

Coarse sands and cobbles	20 LF
Medium sand	30 LF
Fine sand, loamy sand	75 LF

Sandy loam	125 LF
Loam	190 LF

2. Maximum length of trench must not exceed 100 feet from the inlet sump.
3. Minimum spacing between trench centerlines must be 6 feet.
4. Filter fabric must be placed over the drain rock as shown on Figure 3.2 prior to backfilling.
5. Infiltration trenches may be placed in fill material if the fill is placed and compacted under the direct supervision of a geotechnical engineer or professional civil engineer with geotechnical expertise, and if the measured infiltration rate is at least 8 inches per hour. Trench length in fill must be 60 linear feet per 1,000 square feet of roof area. Infiltration rates can be tested using the methods described in Section 3.3.
6. Infiltration trenches should not be built on slopes steeper than 25 percent (4:1). A geotechnical analysis and report may be required on slopes over 15 percent or if located within 200 feet of the top of steep slope or landslide hazard area.
7. Trenches may be located under pavement if a small yard drain or catch basin with grate cover is placed at the end of the trench pipe such that overflow would occur out of the catch basin at an elevation at least one foot below that of the pavement, and in a location which can accommodate the overflow without creating a significant adverse impact to downhill properties or drainage systems. This is intended to prevent saturation of the pavement in the event of system failure.

**Design Criteria  
for Infiltration  
Drywells**

Figure 3.4 shows a typical downspout infiltration drywell system. These systems are designed as specified below.

**General**

1. Drywell bottoms must be a minimum of 1 foot above seasonal high groundwater level or impermeable soil layers.
2. If using drywells, each drywell may serve up to 1000 square feet of impervious surface for either medium sands or coarse sands.
3. Typically drywells are 48 inches in diameter (minimum) and have a depth of 5 feet (4 feet of gravel and 1 foot of suitable cover material).
4. Filter fabric (geotextile) must be placed on top of the drain rock and on trench or drywell sides prior to backfilling.
5. Spacing between drywells must be a minimum of 4 feet.
6. Downspout infiltration drywells must not be built on slopes greater than 25% (4:1). Drywells may not be placed on or above a landslide hazard area or slopes greater than 15% without evaluation by a

professional engineer with geotechnical expertise or qualified geologist and jurisdiction approval.

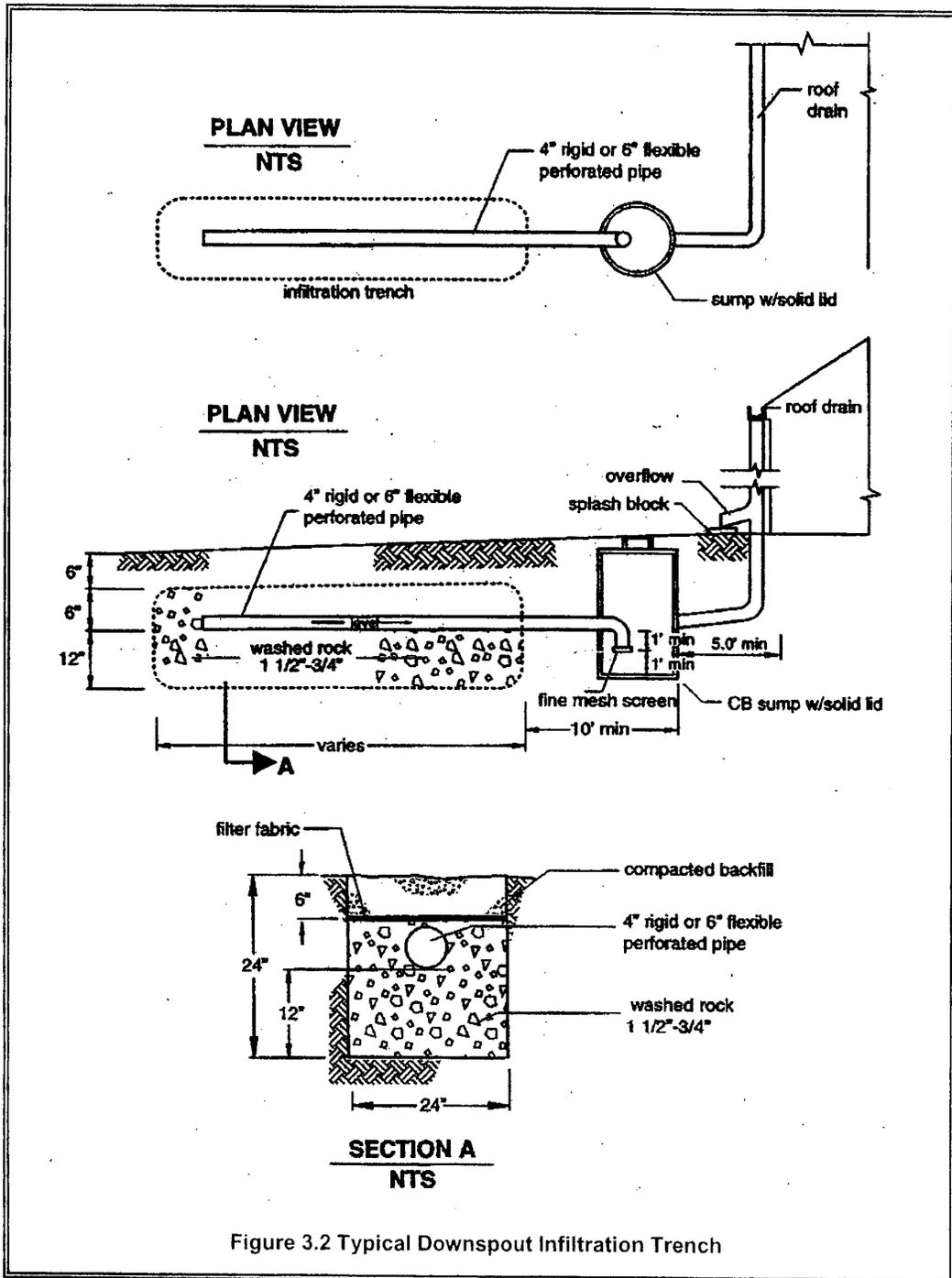
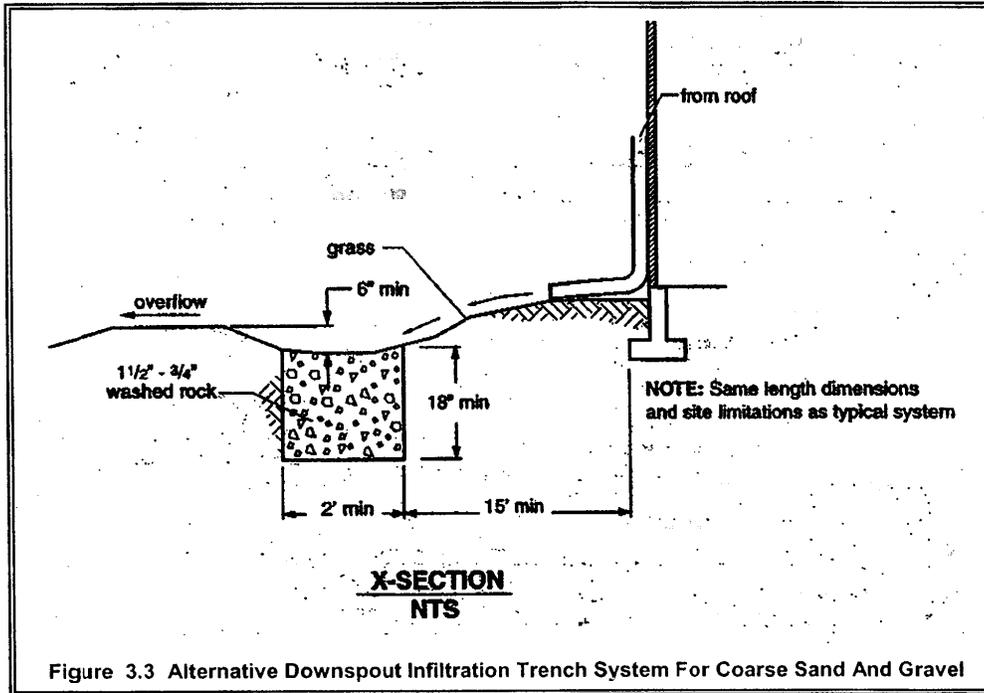
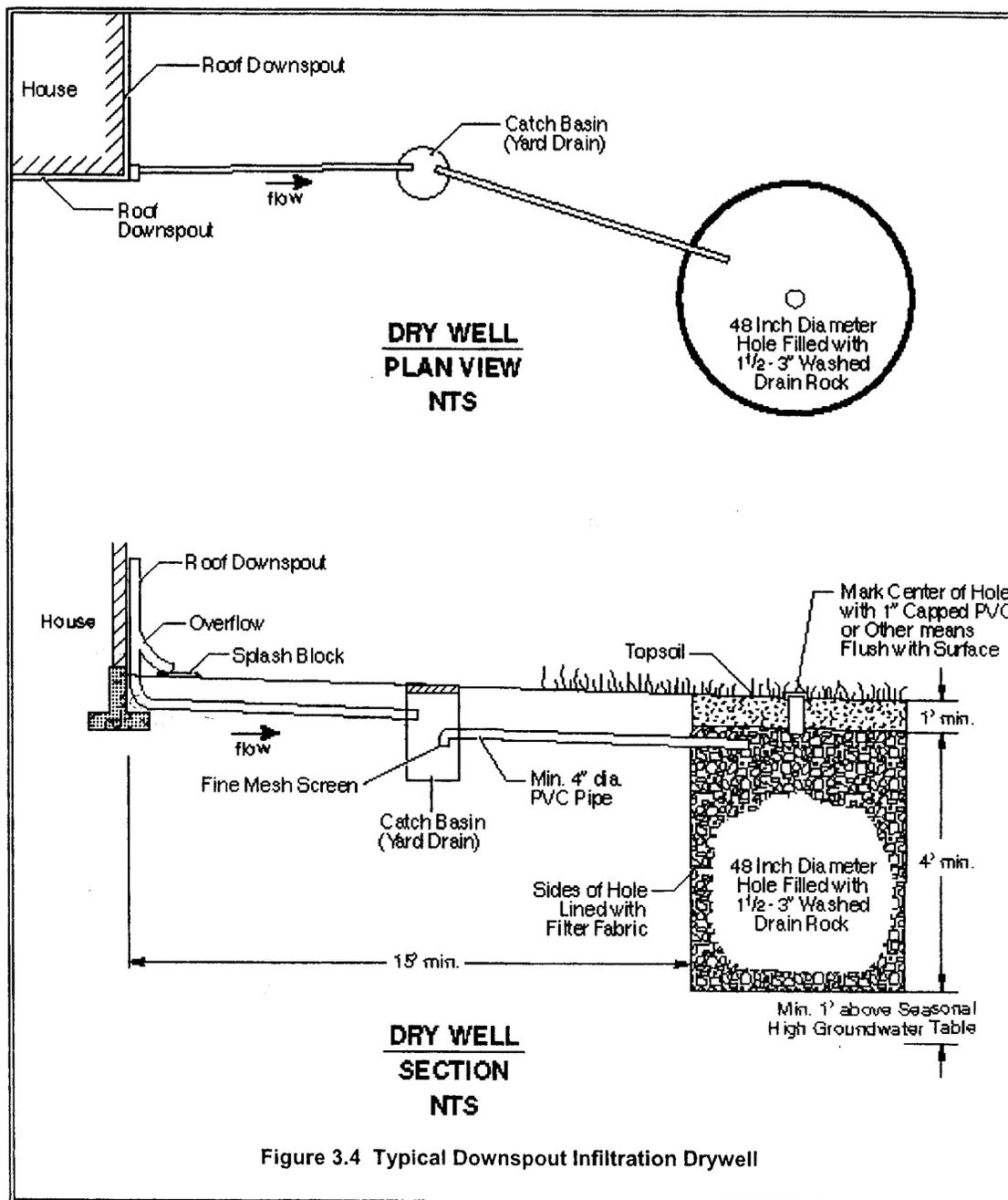


Figure 3.2 Typical Downspout Infiltration Trench

Source: King County



Source: King County



## Setbacks

Local governments may require specific setbacks in sites with steep slopes, land slide areas, open water features, springs, wells, and septic tank drain fields. Adequate room for maintenance access and equipment should also be considered. Examples of setbacks commonly used include the following:

1. All infiltration systems should be at least 10 feet from any structure, property line, or sensitive area (except steep slopes).
2. All infiltration systems must be at least 50 feet from the top of any sensitive area steep slope. This setback may be reduced to 15 feet based on a geotechnical evaluation, but in no instances may it be less than the buffer width.
3. For sites with septic systems, infiltration systems must be downgradient of the drainfield unless the site topography clearly prohibits subsurface flows from intersecting the drainfield.

### 3.1.2 Downspout Dispersion Systems

*Downspout dispersion systems* are splash blocks or gravel-filled trenches, which serve to spread roof runoff over vegetated pervious areas. Dispersion attenuates peak flows by slowing entry of the runoff into the conveyance system, allows for some infiltration, and provides some water quality benefits.

#### *Application*

Downspout dispersion must be used in all subdivision single-family lots, which meet one of the following criteria:

1. Lots greater than or equal to 22,000 square feet where downspout infiltration is not being provided according to the requirements in Section 3.1.1.
2. Lots smaller than 22,000 square feet where soils are not suitable for downspout infiltration (as determined in Section 3.1.1) and where the design criteria below can be met.

#### *Flow Credit for Roof Downspout Dispersion*

If roof runoff is dispersed using a dispersion trench designed according to the requirements of this section on single-family lots greater than 22,000 square feet, and the *vegetative flow*\* path of the roof runoff is 50 feet or larger, the roof area may be modeled as grassed surface - rather than impervious surface - when sizing the flow control facility as required in Volume I, Minimum Requirement #7.

#### *Design Criteria*

1. Downspout trenches designed as shown in Figure 3.5 should be used for all downspout dispersion applications except where splash blocks are allowed below.

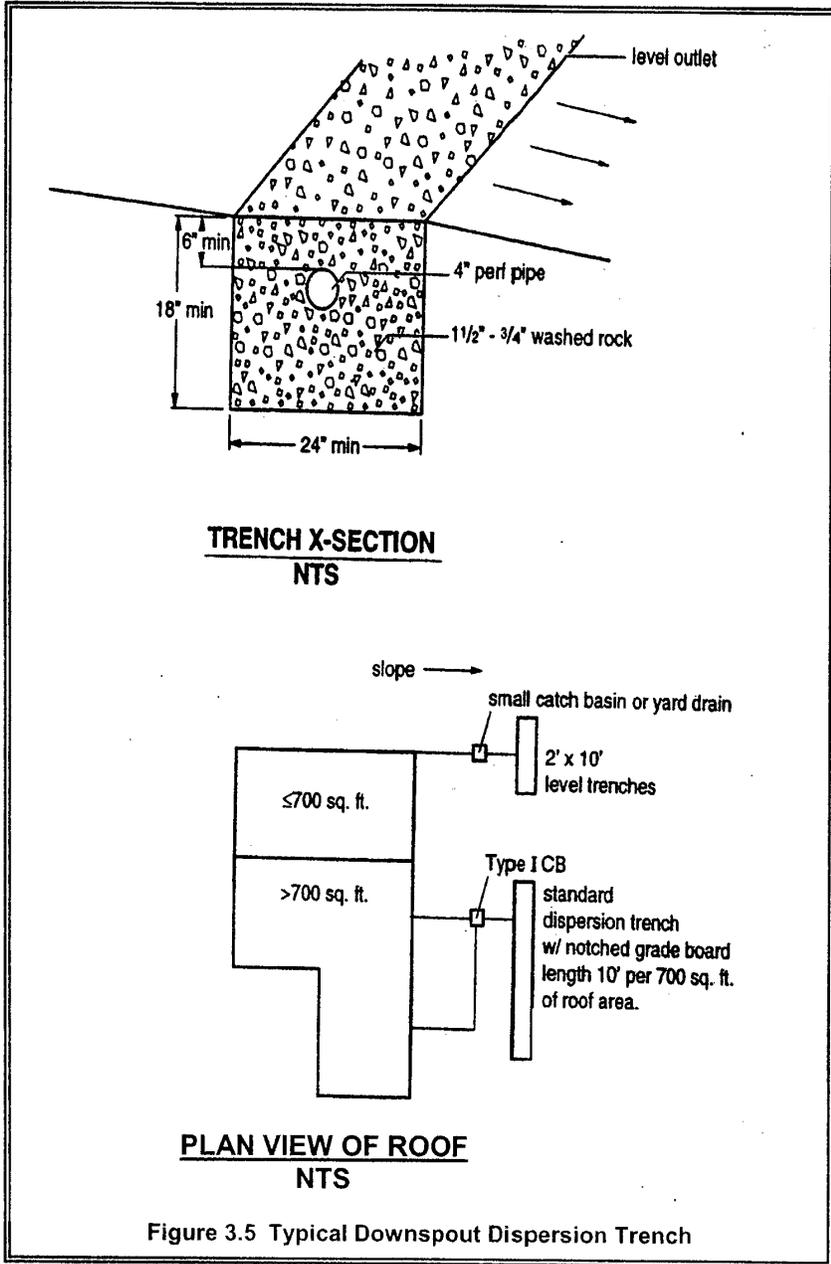
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\* *Vegetative flow* path is measured from the downspout or dispersion system discharge point to the downstream property line, stream, wetland, or other impervious surface.

2. Splash blocks shown in Figure 3.7 may be used for downspouts discharging to a *vegetated flowpath* at least 50 feet in length as measured from the downspout to the downstream property line, structure, steep slope, stream, wetland, or other impervious surface. Sensitive area buffers may count toward flowpath lengths.
3. If the vegetated flowpath (measured as defined above) is less than 25 feet on a subdivision single family lot, a perforated stub-out connection per Section 3.1.3 may be used in lieu of downspout dispersion. A perforated stub-out may also be used where implementation of downspout dispersion might cause erosion or flooding problems, either on site or on adjacent lots. This provision might be appropriate, for example, for lots constructed on steep hills where downspout discharge could be cumulative and might pose a potential hazard for lower lying lots, or where dispersed flows could create problems for adjacent offsite lots. Perforated stub-outs are not appropriate when seasonal water table is <1 foot below trench bottom.
4. For sites with septic systems, the discharge point of all dispersion systems must be downgradient of the drainfield. This requirement may be waived if site topography clearly prohibits flows from intersecting the drainfield.

#### **Design Criteria for Dispersion Trenches**

1. A vegetated flowpath of at least 25 feet in length must be maintained between the outlet of the trench and any property line, structure, stream, wetland, or impervious surface. A vegetated flowpath of at least 50 feet in length must be maintained between the outlet of the trench and any steep slope. Sensitive area buffers may count towards flowpath lengths.
2. Trenches serving up to 700 square feet of roof area may be simple 10-foot-long by 2-foot wide gravel filled trenches as shown in Figure 3.5. For roof areas larger than 700 square feet, a dispersion trench with notched grade board as shown in Figure 3.6 may be used as approved by the local jurisdiction. The total length of this design must not exceed 50 feet and must provide at least 10 feet of trench per 700 square feet of roof area.
3. A setback of at least 5 feet should be maintained between any edge of the trench and any structure or property line.
4. No erosion or flooding of downstream properties may result.
5. Runoff discharged towards landslide hazard areas must be evaluated by a geotechnical engineer or qualified geologist. The discharge point may not be placed on or above slopes greater than 20% or above erosion hazard areas without evaluation by a geotechnical engineer or qualified geologist and jurisdiction approval.



Source: King County

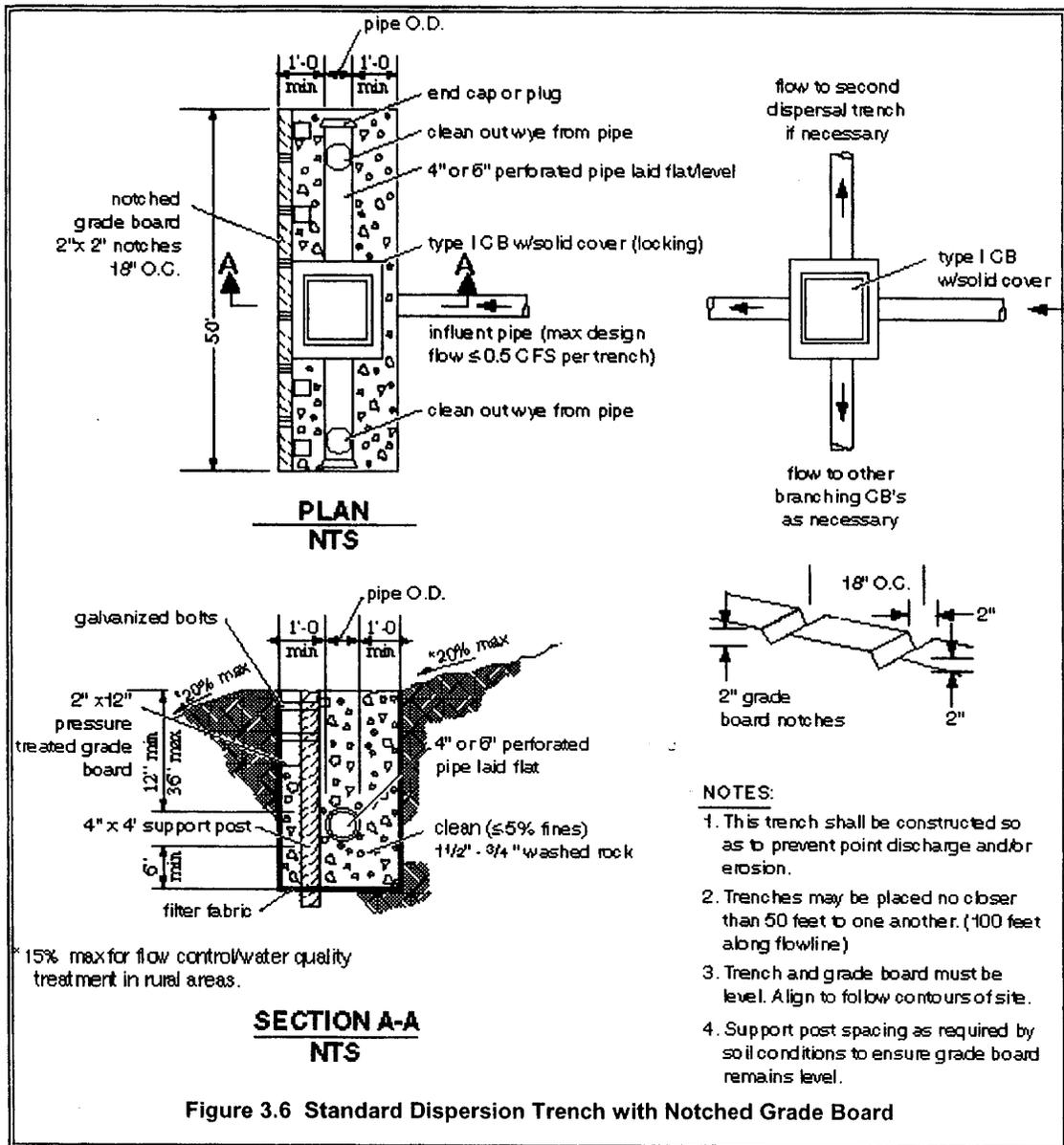


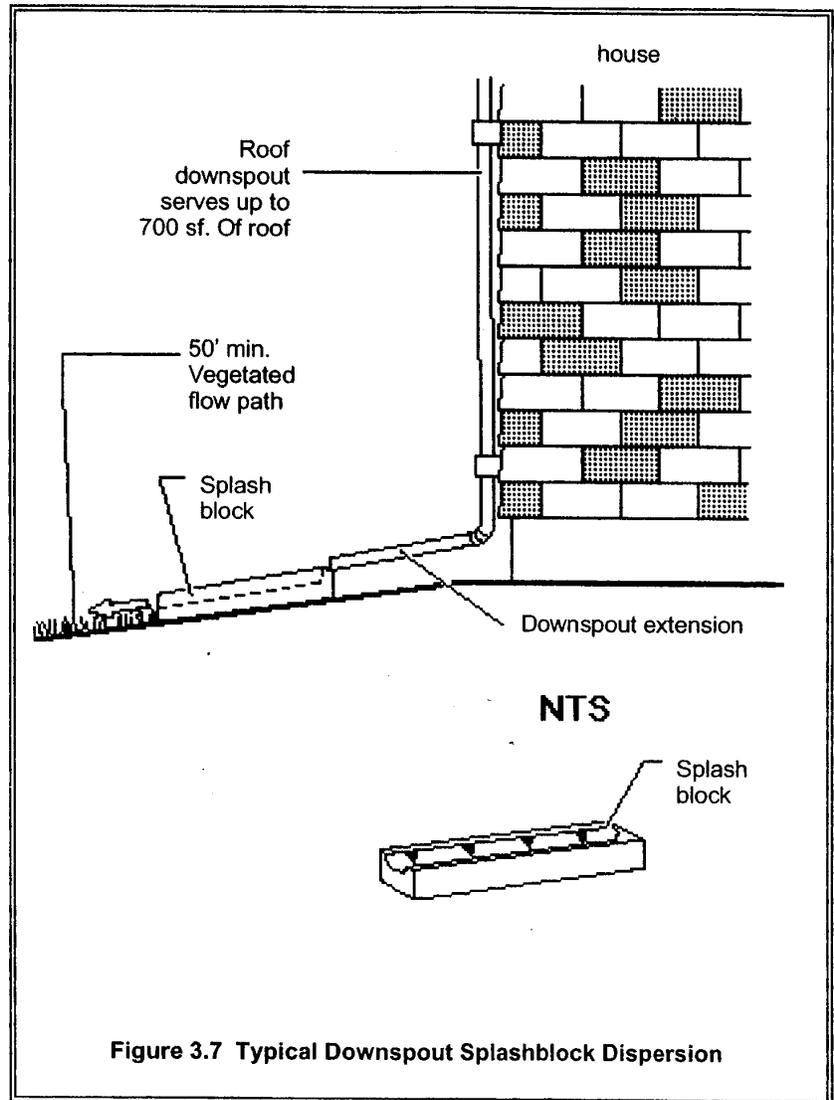
Figure 3.6 Standard Dispersion Trench with Notched Grade Board

## Design Criteria for Splashblocks

A typical downspout splashblock is shown in Figure 3.7. In general, if the ground is sloped away from the foundation and there is adequate vegetation and area for effective dispersion, splashblocks will adequately disperse storm runoff. If the ground is fairly level, if the structure includes a basement, or if foundation drains are proposed, splashblocks with downspout extensions may be a better choice because the discharge point is moved away from the foundation. Downspout extensions can include piping to a splashblock/discharge point a considerable distance from the downspout, as long as the runoff can travel through a well-vegetated area as described below.

The following apply to the use of splashblocks:

1. A vegetated flowpath of at least 50 feet should be maintained between the discharge point and any property line, structure, steep slope, stream, wetland, lake, or other impervious surface. Sensitive area buffers may count toward flowpath lengths.
2. A maximum of 700 square feet of roof area may drain to each splashblock.
3. A splashblock or a pad of crushed rock (2 feet wide by 3 feet long by 6 inches deep) should be placed at each downspout discharge point.
4. No erosion or flooding of downstream properties may result.
5. Runoff discharged towards landslide hazard areas must be evaluated by a professional engineer with geotechnical expertise or a qualified geologist. Splashblocks may not be placed on or above slopes greater than 20% or above erosion hazard areas without evaluation by a professional engineer with geotechnical expertise or qualified geologist and jurisdiction approval.
6. For sites with septic systems, the discharge point must be downslope of the primary and reserve drainfield areas. This requirement may be waived if site topography clearly prohibits flows from intersecting the drainfield or where site conditions (soil permeability, distance between systems, etc) indicate that this is unnecessary.



### 3.1.3 Perforated Stub-Out Connections

*A perforated stub-out connection* is a length of perforated pipe within a gravel-filled trench that is placed between roof downspouts and a stub-out to the local drainage system. Figure 3.8 illustrates a perforated stub-out connection. These systems are intended to provide some infiltration during drier months. During the wet winter months, they may provide little or no flow control. Perforated stub-outs are not appropriate when seasonal water table is < 1 foot below trench bottom.

In single-family subdivision projects subject to Minimum Requirement #7 for flow control (see Volume I), perforated stub-out connections may be used only when downspout infiltration or dispersion is not feasible per the criteria in Sections 3.1.1 and 3.1.2.

Location of the connection should be selected to allow a maximum amount of runoff to infiltrate into the ground (ideally a dry location on the site that is relatively well drained). To facilitate maintenance, the perforated pipe portion of the system should not be located under impervious or heavily compacted (e.g., driveways and parking areas) surfaces.

Perforated stub-out connections should consist of at least 10 feet of perforated pipe per 5,000 square feet of roof area laid in a level, 2-foot wide trench backfilled with washed drain rock. The drain rock should extend to a depth of at least 8 inches below the bottom of the pipe and should cover the pipe. The pipe should be laid level and the rock trench covered with filter fabric and 6 inches of fill (see Figure 3.8).

Setbacks are the same as for infiltration trenches.

Potential runoff discharge towards a landslide hazard area must be evaluated by a professional engineer with geotechnical expertise or a qualified geologist. The perforated portion of the pipe may not be placed on or above slopes greater than 20% or above erosion hazard areas without evaluation by a professional engineer with geotechnical expertise or qualified geologist and jurisdiction approval.

For sites with septic systems, the perforated portion of the pipe must be downgradient of the drainfield primary and reserve areas. This requirement can be waived if site topography will clearly prohibit flows from intersecting the drainfield or where site conditions (soil permeability, distance between systems, etc) indicate that this is unnecessary.

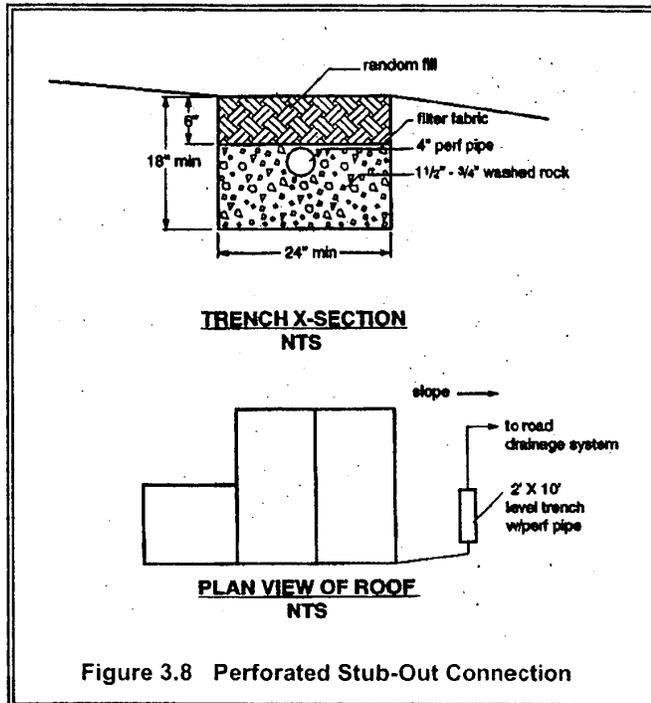


Figure 3.8 Perforated Stub-Out Connection

Source: King County

## 3.2 Detention Facilities

This section presents the methods, criteria, and details for design and analysis of detention facilities. These facilities provide for the temporary storage of increased surface water runoff resulting from development pursuant to the performance standards set forth in Minimum Requirement #7 for flow control (Volume I).

There are three primary types of detention facilities described in this section: detention ponds, tanks, and vaults.

### 3.2.1 Detention Ponds

The design criteria in this section are for detention ponds. However, many of the criteria also apply to infiltration ponds (Section 3.3 and Volume V), and water quality wetponds and combined detention/wetponds (Volume V).

## ***Dam Safety for Detention BMPs***

Stormwater detention facilities that can impound 10 acre-feet (435,600 cubic feet; 3.26 million gallons) or more with the water level at the embankment crest are subject to the state's dam safety requirements, even if water storage is intermittent and infrequent (WAC 173-175-020(1)). The principal safety concern is for the downstream population at risk if the dam should breach and allow an uncontrolled release of the pond contents. Peak flows from dam failures are typically much larger than the 100-year flows which these ponds are typically designed to accommodate.

The Dam Safety Office of the Department of Ecology uses consequence dependent design levels for critical project elements. There are eight design levels with storm recurrence intervals ranging from 1 in 500 for design step, 1 to 1 in 1,000,000 for design step 8. The specific design step for a particular project depends on the downstream population and other resources that would be at risk from a failure of the dam. Precipitation events more extreme than the 100-year event may be rare at any one location, but have historically occurred somewhere within Washington State every few years on average.

With regard to the engineering design of stormwater detention facilities, the primary effect of the state's dam safety requirements is in sizing the emergency spillway to accommodate the runoff from the dam safety design storm without overtopping the dam. The hydrologic computation procedures are the same as for the original pond design, except that the computations must use more extreme precipitation values and the appropriate dam safety design storm hyetographs. This information is described in detail within guidance documents developed by and available from the Dam Safety Office. In addition to the other design requirements for stormwater detention BMPs described elsewhere in this manual, dam safety requirements should be an integral part of planning and design for stormwater detention ponds. It is most cost-effective to consider these requirements right from the beginning of the project.

In addition to the hydrologic and hydraulic issues related to precipitation and runoff, other dam safety requirements include geotechnical issues, construction inspection and documentation, dam breach analysis, inundation mapping, emergency action planning, and periodic inspections by project owners and by Dam Safety engineers. All of these requirements, plus procedural requirements for plan review and approval and payment of construction permit fees are described in detail in guidance documents developed by and available from the Dam Safety Office.

In addition to the written guidance documents, Dam Safety engineers are available to provide technical assistance to project owners and design engineers in understanding and addressing the dam safety requirements for