SITE DISTURBANCE PLAN REQUIREMENTS FOR HIGH RISK SITES

Kootenai County Planning Department
February 1997

RESOLUTION NO. 97-10

WHEREAS, the Kootenai County Board of Commissioners have adopted a Site Disturbance Ordinance; and

WHEREAS, the Ordinance establishes performance standards for grading, erosion and sedimentation control, and stormwater management, and

WHEREAS, Site Disturbance Plans must be submitted to demonstrate compliance with the performance standards, and

WHEREAS, the Site Disturbance Ordinance authorizes the Kootenai County Board of Commissioners to adopt by resolution design standards, plan requirements, best management practices, administrative procedures, and fee schedules, intended to implement the requirements and performance standards set forth in the Site Disturbance Ordinance; and

WHEREAS, Planning Staff has prepared a document outlining the permitting process and the required elements of a Site Disturbance Plan;

NOW, THEREFORE, IT IS HEREBY RESOLVED that the plan requirements, design standards, administrative procedures, and other information set forth in the "Site Disturbance Plan Requirements for High Risk Sites," prepared by Planning Staff, dated February 1997, be, and hereby is, adopted and incorporated by reference into the applicable provisions of the Site Disturbance Ordinance enacted in Kootenai County, Idaho.

Upon a motion to adopt the text of the foregoing Resolution made by Commissioner Panabaker, seconded by Commissioner Rankin, the following vote was recorded.

Commissioner Rankin:	Yes
Commissioner Panabaker:	Yes
Chairman Compton:	Yes

Upon said roll call, the text of the foregoing was duly enacted as a Resolution of the Board of County Commissioners of Kootenai County, Idaho, on the 5th day of March, 1997.

BY ORDER OF THE KOOTENAI COUNTY
BOARD OF COMMISSIONERS

Dick Compton, Chairman

ATTEST:
DANIEL J. ENGLISH, Clerk

BY: Deputy Clerk

INTRODUCTION

Kootenai County Site Disturbance Ordinance No. 251 establishes requirements for grading, erosion and sedimentation control, and stormwater management. By evaluating projects on an individual basis, the ordinance strives to protect property, surface water, and ground water against adverse effects from excavation, filling, clearing, unstable earthworks, soil erosion, and stormwater runoff and to provide maximum safety in the development and design of building sites, roads, and other service amenities. To meet this goal, plans and the implementation of Best Management Practices (BMPs) are required.

This document explains the process and required elements of plans for high risk sites and other projects where a design professional is required. Plan requirements for moderate risk sites, where the services of a design professional are not required, are outlined in a separate document.

This document is complementary to the Site Disturbance Ordinance and does not contain the performance standards and other requirements of the Ordinance. The design professional must also be aware that there are other ordinances and agency requirements that must be considered in the preparation of Site Disturbance plans. Examples include the Kootenai County Flood Damage Prevention Ordinance, minimum road standards of the County's Zoning, Subdivision, and Road Development Ordinances, stream crossing restrictions administered by the Idaho Department of Water Resources, and restrictions on work within wetlands administered by the U.S. Army Corps of Engineers, to name just a few.

Finally, this document is not intended to be a textbook of erosion and sedimentation control or hydraulic engineering. It is not presumed to cover all aspects of preparing a site disturbance plan, but it is believed to be sufficiently comprehensive that its provisions, along with good judgement, will result in complete and understandable submittals.

PROCESS

Application and Review

The Site Disturbance Ordinance has a risk assessment process for determining the type of plans required for development on individual lots. The Ordinance requires plans from a design professional for high risk projects, subdivisions, projects where greater than 5000 cubic yards of material will be moved or more than 2 acres will be disturbed, commercial and industrial projects, and major utility installations.

The County will perform a risk assessment at the owner's request prior to application for a permit for site disturbance. If it has not been done prior, a risk assessment will be performed upon application for a permit. The information required to be submitted for the risk determination includes owner's name, legal description of the property, written description of the proposed work, and a proper site plan. The County shall reevaluate the risk assessment if the owner proposes any changes to the project. The owner will be notified by the County of the outcome of the risk assessment.

Once the risk and plan requirements are determined, the owner is responsible for having appropriate plans prepared. Three sets of plans must be submitted for County review and approval. The County will review for compliance with requirements of applicable ordinances and this document. The general components of a site disturbance plan include: the project summary narrative, vicinity map, site plan(s), calculations, and operation and maintenance requirements. Each component is addressed in greater detail below. A checklist has been developed to assist the design professional in making a complete plan submittal. A completed checklist must be submitted by the design professional with each plan. The checklist will be used to convey any plan deficiencies back to the design professional. Upon approval of the plans and receipt of a suitable financial guarantee, a permit may be issued, and one set of approved plans will be returned to the applicant. This set of approved plans must be available on-site whenever work is in progress.

Inspections and Reports

The design professional is required by the Ordinance to perform a number of inspections before, during, and after construction. For each required inspection, an inspection report from the design professional must be submitted to the County. Prior to release of the financial guarantee, a completion report must be submitted indicating that the plan has been implemented as approved by the County. If changes are made at the site that are not reflected in the approved plans, post-construction drawings must be submitted and approved before the financial guarantee can be released. A flow chart has been developed outlining the process. The chart is included as Appendix A.

Failure to submit inspection reports will delay building inspections and may result in additional enforcement measures. The County strongly recommends that the design professional include the cost of anticipated inspections as a part of the service of preparing the plan. All plans, estimates, inspection reports, and other correspondence from the design professional must be stamped with the appropriate seal, signed, and dated.

Fees

The County charges fees for the services that are provided. The anticipated fees will be collected prior to issuance of the permit. If additional services are required which were not anticipated prior to permit issuance, they will be collected prior to release of the financial guarantee. All fees are set by the Board of County Commissioners.

SITE DISTURBANCE PLAN REQUIREMENTS

Project Summary Narrative

The project summary shall present, in text form, an overview of the proposed project. Pertinent details include: site acreage, a summary of the planned development (number of units, type of construction, etc.), the amount of impervious area, a description of temporary and permanent erosion control measures, a description of the stormwater system, any design problems or constraining environmental conditions, and a discussion of how the proposed BMPs were selected for the project. Any pertinent information which supports the design calculations should also be included in this section (justification for runoff coefficients, etc.).

The narrative must also include a description of site characteristics including a list of appropriate soil characteristics (soil erodibility factors, engineering properties, etc.) for all soil types found (or expected) on the site. Information from the U.S.D.A. Soil Conservation Service "Soil Survey of Kootenai County Area Idaho" may be used for design purposes if the soil characteristics described in the Soil Survey are confirmed by on-site investigation. The County may require additional soil testing for complex or large projects or when the soil characteristics are marginal for the BMP being proposed. If any site specific soil tests have been conducted, the results should be submitted with the plan.

If the project includes the placement of fill, slope preparation, benching, and compaction requirements must be included in the narrative. If cut or fill slopes are proposed to be steeper than 2:1, a discussion of how the steeper slopes can still meet the requirements of the ordinance must be included.

If, as an erosion control or stormwater BMP, a manufactured product is specified (e.g. silt fence, drywell, catch basin, etc.), the design professional must include the appropriate specific information on the product and where the product can be obtained. If substitutions of comparable products are not acceptable, it should be indicated in the plan.

The narrative must also contain a construction schedule with the anticipated completion date of the project. The schedule will be used in determining the length of time for the financial guarantee and whether winterization measures or other staging requirements are appropriate. The schedule must also indicate when inspections by the design professional are necessary.

An itemized estimate of the cost to implement the plans as proposed must be included. The estimate will be used to determine the amount of the financial guarantee required for the project prior to issuance of the permit.

Vicinity Drainage

A vicinity map, with a scale of 1:24,000 (2000 feet to the inch) or larger, shall be submitted showing the relationship of the development site to its surroundings. A copy of the pertinent section of a 7.5 minute U.S.G.S. topographic quad map is recommended. The vicinity map must show at least a one mile radius around the project and the extent of the watershed area(s) which drains to or through the project site. Such watershed areas must be clearly delineated on the vicinity map.

Site Plan(s)

The site plan or plans must contain information on existing site conditions, proposed grading, temporary and permanent erosion control features, and stormwater conveyance, detention and treatment. To reduce clutter, or otherwise improve the clarity of the plans, it may be prudent to use separate plans to depict pre-existing site conditions, construction phase conditions, and post-construction conditions. All site plans shall be construction quality drawings with a scale not greater than 100 feet to the inch.

The site conditions which must be shown are property boundaries; existing and proposed roads, driveways, walkways, structures, and other impervious areas; water sources and drainage channels; all utilities (including septic tanks and drainfields); existing and proposed easements; topography (at two foot intervals, referenced to datum); stream protection zones; vegetative buffers; and vegetative cover types.

The proposed changes from grading activity at the site must be shown on the plan. For example, the plan must show areas to be cleared of vegetation; where topsoil is to be removed and stockpiled; and where excavation, filling, and grading is planned (with anticipated post construction contours in 2-foot or shorter intervals). Grade breaks where surface drainage is to be directed to different basins should be clearly delineated. When applicable, the location, width, and configuration of benches, terraces, or other slope treatments must also be indicated on the plan. If ground water is expected to be encountered, provisions must be included for proper handling or conveyance.

Erosion control information must include the location, type, and proper installation of temporary erosion and sediment control measures which must be installed and inspected prior to any excavation at the site. The method(s) to be used for temporarily covering spoil piles and disturbed ground when it will not be worked for more than 48 hours must be specified. Dust abatement and measures to reduce wind erosion are recommended and may be required by the County. Permanent site stabilization and revegetation methods must also be included. Seed types, fertilization requirements, application rates, and timing must be specified. If site work will occur during the fall or winter or if the site will not be permanently revegetated or otherwise stabilized prior to September, special considerations will need to be made to minimize erosion and sedimentation.

For stormwater conveyance, detention, and treatment, the plan must have profile/cross sections; bottom elevations; slope and length of swales and open ditches; sizes, type, invert elevations, and lengths of all culverts and pipe systems; and location and construction details of detention/retention/treatment facilities and other stormwater controls. If stormwater is to be conveyed off-site after detention and treatment, a review for proper downstream easements and undersized culverts or other constrictions must be included.

Calculations

The Plan submittal shall present (in an organized manner with references to the Plan drawings where appropriate) all pertinent calculations performed for the determination of the required size of the stormwater controls. Included in this category is an analysis of off-site flows upstream of the site; a determination of pre- and post- development runoff from the site (both total volume and peak flow); detention/retention facility capacities and infiltration rates; swale, ditch, culvert, and pipe system capacities and velocities; and any other appropriate design detail.

Operation and Maintenance

All stormwater runoff controls and permanent erosion/sedimentation controls which are approved by Kootenai County shall be maintained and operated to function as they were designed "in perpetuity." It is acknowledged that development designers and contractors are not responsible for long term functioning of constructed stormwater controls. Further, land owners and agency personnel change over time making record keeping critically important to the achievement of this goal. For this reason, the Operation and Maintenance Plan must be prepared by the project design professional. The County may require this document be tied to each successive property owner through the establishment of stormwater easements which are recorded on the property title (deed).

Stormwater Easements

All stormwater control facilities (swales, grassed infiltration areas, detention/retention ponds, underground piping, vegetative buffer strips, etc.) and natural drainage channels shall be located in dedicated stormwater easements. Easements shall be located to provide access for routine inspection and shall be sized for access of construction equipment that would be needed for maintenance and repair work (ie., generally 8 to 10 feet wide for vehicle access).

Operation and Maintenance Plan Requirements

Due to the wide range of stormwater controls that could be built for development projects within the jurisdiction of Kootenai County, only general criteria can be stated in this section. This does not, however, relieve the design professional from providing a specifically detailed plan which can be followed to bring about the continual functioning of these controls. The general criteria are listed and briefly described below.

1. Inspection Schedule
   Constructed stormwater controls (including permanent erosion/sedimentation controls) shall be inspected at least annually. Inspections shall also be performed following significant precipitation and runoff events. While these post-storm inspections cannot be scheduled, they should be made a part of the Operation and Maintenance Plan.

2. Responsible Person or Entity

A person or entity shall be designated who shall be responsible for operation and maintenance of erosion and stormwater controls. This person could be the landowner for small developments, a Maintenance Supervisor or grounds keeper for larger developments or a public works representative for stormwater systems maintained by a municipality.

3. Routine Maintenance Activities
   Specific maintenance needs of the permanent erosion and sedimentation controls and the stormwater conveyance and treatment system must be given in detail. Examples of specific maintenance activities are:

   - For grassed infiltration areas, watering, mowing and fertilizing;
   - For grassed infiltration areas, sod renovation;
   - For detention basins, sediment and debris removal;
   - For detention ponds (permanent wet basins), vegetation harvesting, and sediment removal;
   - For oil/grit separators, cleaning and sludge disposal plan;
   - For storm drain inlets, debris removal;
   - For all stormwater controls repair of any deterioration which threatens their structural integrity. These repairs may include replacement of rock in emergency spillways, reconstruction of dikes or berms, replacement of catchbasin or drywell lids, etc.;

4. System Failure
   Specific ways to identify if the system has failed or is no longer functioning properly must be included. When possible, recommended changes, repairs, or procedures must be outlined.

ENGINEERING STANDARDS AND DESIGN SPECIFICATIONS FOR RUNOFF CONTROL AND HYDROLOGIC ANALYSES

Introduction

As the population density and land values increase, the effects of uncontrolled runoff become an economic burden and a serious threat to the health and well-being of a community and its citizens. Therefore, the focus of stormwater management is to protect the health, safety, and welfare of the general public and mitigate property damage by reducing the frequency and severity of flooding. Estimating the frequency and severity of future flooding events makes systematic planning and installation of structural and nonstructural measures to reduce these hazards to an acceptable level available to the designer. Additionally, treatment of stormwater to improve its water quality is now required at federal, state, and local levels to control contaminants and prevent degradation of public water sources.

Precipitation, whether it occurs as rain or snow, is the source of surface runoff in watersheds. The extent of the storm and the distribution of rainfall during the storm are two major factors which affect the rate of peak runoff.

The storm distribution can be thought of as a measure of how the rate of rainfall, or **intensity**, varies within a given time interval. For example, within a given 24-hour period, a measurable amount of precipitation may have been recorded. However, this precipitation may have occurred over the entire

24-hour period or just within one hour. These two scenarios represent entirely different storm distributions.

The size of the storm is described by the length of time over which the precipitation occurs, the total amount of precipitation occurring and how often this same size of storm would be expected to occur (its **frequency**). A 10-year, 24-hour storm is a storm producing a measured intensity of rain in 24 hours with a 10 percent chance of occurrence in any given year. Thus a 100 year, 24-hour storm is a storm producing a measured intensity of rain in 24 hours with a 1 percent chance of occurrence in any year.

The **time of concentration** is that time it takes for water to travel from the most distant part of the watershed to the point of interest. The time of concentration affects the peak rate of runoff and shape of the hydrograph.

A streamflow or discharge **hydrograph** is a graph or table showing the flow rate as a function of time at a given location on the stream or for a watershed. In effect, the hydrograph is an integral expression of the physiographic and climatic characteristics that govern the relations between rainfall and runoff of a particular drainage basin.

Antecedent moisture content is the existing soil moisture content resulting from the amount of precipitation occurring during the preceding five days. This content, especially when close to saturation, is a very important feature in the process of runoff generation.

The **infiltration and percolation rates** of soils indicate their potential to absorb precipitation and thereby reduce the volume of runoff. In general, the higher the rate of infiltration, the lower quantity of storm runoff. Fine textured soils such as clay produce a higher rate of runoff than do coarse-textured soils such as gravely sand.

The **type of cover** and its hydrologic condition affects the runoff volume. Vegetation, including the ground litter, forms numerous barriers along the path of the land which slows the water down and reduces the volume of runoff. Fallow land yields more runoff than forests or grassland for a given soil type. Development reduces the natural storage and infiltration increasing the amount of runoff.

Plants transpire moisture into the atmosphere creating a moisture deficiency in the soil which must be replaced by some portion of the precipitation before runoff occurs. The canopy provided by the foliage and ground litter allow the soil to retain its infiltration potential. Some moisture is retained on the surface of the foliage, evaporating back to the atmosphere. Other portions of the intercepted precipitation take so long to drain from the plants to the soil that it is withheld from the initial period of runoff.

Surface depression storage begins when the precipitation exceeds infiltration. **Overland flow** starts when surface depressions are full. The water in depression storage is not available as direct runoff.

In wetlands, or on very flat areas where ponding occurs within a watershed, a considerable amount of surface runoff may be retained in temporary storage, thus reducing the runoff.

Steep and unstable slopes present additional hydrologic problems. It should be recognized that while a certain site may be stable under natural conditions, the same site with steeper slopes may have increased erosion potential and an unstable slope when the site is developed. Slope and soils are in balance with vegetation, underlying geologic structure, and the ground and surface hydrologic environment in its natural, pre-developed state. Any development will permanently alter this natural equilibrium and may affect the stability of the slope.

Slope stability is a relative measure of the earth's resistance to physical change. Natural processes such as wind, rain, runoff, groundwater conditions, or human-influenced processes, such as the removal of surface vegetation or the soil mantle, result in erosion, downcutting, slumping, and sliding of the slope.

Development design on slopes is influenced by the potential for damage resulting from such processes. The relative risk to life or property may have no influence on the design or may be so great that development on a particular site should be abandoned. In all cases, special engineering considerations should be integrated into development of the site to provide an acceptable level of risk.

Engineering Standards

The standards established by this chapter are intended to represent the minimum design standards for the construction of storm drainage facilities and stream channel improvements. Compliance with these standards does not relieve the designer of the responsibility to apply conservative, sound professional judgement to protect the health, safety, and welfare of the general public. These are minimum design standards and should be considered the lowest acceptable limits in design. Special site conditions and environmental constraints may require a greater level of protection than would normally be required under these standards.

The design policies and standards contained herein are intended to serve as a basic guide in design work; however, they are not to be considered inflexible. They are also not intended to be a substitute for engineering knowledge, experience, or judgement. When it is deemed necessary or desirable to deviate from these design policies and standards, the developer shall submit plans, which show compliance with at least the minimum design standards, for approval from Kootenai County.

Stormwater Control

- The rate of runoff from any proposed land development shall not exceed the rate of runoff for the design storm prior to the proposed land development.

- Restriction of stormwater runoff on the proposed land development shall be controlled by structural measures and Best Management Practices (BMPs). Structural measures include collection systems, conveyance systems, and storage (retention/detention) systems with treatment processes. BMPs are low structural or non-structural alternatives designed to control the runoff volume from the source and improve the runoff water quality. Grassed infiltration areas are recognized as a nonstructural, low cost BMP, with high levels of contaminant removal.

- Runoff cannot be diverted in the proposed development and released to downstream property at locations not receiving runoff prior to the proposed development, unless an easement, consent, and on-site retention is provided by the downstream property owner and approval is granted by Kootenai County.

- For sites with tributary basins 10 acres or less, the peak runoff rate shall be computed using the Rational Method.

- For sites with tributary basins greater than 10 acres, the peak runoff rate shall be computed using the Soil Conservation Service TR-55 Method.

- The rainfall intensity shall be obtained from the Idaho Transportation Department's intensity-duration-frequency charts. These charts are based on U.S. Weather Bureau records, and the State of Idaho has been divided into different intensity-duration-frequency zones (IDF Zones). For Kootenai County, IDF Zone C, D, E, or F may be applicable depending on the geographic location of the site. A map of Idaho delineating the IDF zones and the IDF charts for zones C, D, E, and F are shown in Appendix F, Figures 2, 3, 4, 5, and 6, respectively.

- Other hydrologic methods may be appropriate for determination of runoff rate, however it is strongly recommended that the design professional consult with Kootenai County and all federal, state, or local authorities prior to beginning hydrology studies for the project if an alternate hydrologic method is selected.

- Developments shall be engineered and constructed to provide control of the quality and quantity of stormwater runoff during and after construction. The on-site drainage system, including conveyance systems, detention/retention systems, pollution control and emergency overflow elements, must be properly designed and sized to handle runoff from the site and conveyance through the site.

- Appropriate easements shall be established by the developer.

- Off-site stormwater runoff passing through the site shall be conveyed by hydraulically adequate conveyance systems.

- Off-site surface water (streams) entering the site shall be received and discharged at the existing locations with adequate energy dissipators to minimize downstream damage. There shall be no diversion at either of these points.

- For any future developments, Class V (e), shallow injection wells shall be authorized for disposal of stormwater runoff provided the effluent from the well meets the water quality standards set by the Department of Water Resources under the rules and regulations for "Construction and Use of Injection Wells."

- Any and all stream work shall be consistent with the requirements of Kootenai County and any or all other regulatory agencies including, but not limited to, the Environmental Protection Agency; Idaho Department of Water Resources; Idaho Department of Lands; Idaho Department of Fish and Wildlife; Idaho Department of Health and Welfare, Division of Environmental Quality, and Army Corps of Engineers.

Storm Sewers

A storm sewer is a system of drainage conduits that carries surface drainage or street wash, from catch basins or surface inlets, to an outfall. All storm sewer designs will be based on engineering analysis which takes into consideration total drainage areas, runoff rates, pipe capacity, foundation conditions, soil characteristics, pipe strength, potential construction problems, and any other factors pertinent to design.

Storm sewer design is based on the calculation of peak runoff from an area and design of a pipe system to carry the runoff. The peak runoff design storm for all conveyance systems shall be the 50-year storm.

Minimum Design Standards for Storm Sewers:

- Future expansion of the site. If it is anticipated that the site or storm sewer system may be expanded in the future, provisions for the expansion shall be incorporated into the current design.

- Location of the system. The location of the storm sewer system as it relates to the overall site design and delineation of boundaries for differing regulatory agencies (federal, state, or local) shall be clearly defined.

- Soil conditions. Surface and subsurface drainage shall be provided to assure stable soil conditions necessary for adequate soil bearing capacity and protection of fills or cuts.

- Profile of grade for the storm sewer. A profile of the pipe system shall be provided showing invert elevations, manholes or catch basins showing rim and invert elevations, existing and finished groundline or grade elevations, etc.

- Minimum pipe slope. Minimum pipe slope shall be used to maintain minimum velocities of flow. All storm sewers shall be designed and constructed to give mean velocities, when flowing full, of not less than 2.5 feet per second.

- Minimum pipe diameters. The minimum pipe diameter shall be 12 inches for storm sewers and irrigation systems, except that single laterals less than 50 feet long may be 8 inches in diameter. Pipe carrying drainage from irrigated lands shall be considered as culverts and the appropriate minimum size used.

- Junction spacing for catch basins and manholes. Catch basins or manholes shall be provided for breaks in grade, or alignment, or along pipe runs. For pipe runs, junctions shall not exceed 400 feet for pipes smaller than 48 inches or 500 feet for pipes greater than 48 inches.

- Siltation basins. Siltation basins shall be used to prevent clogging or silting of the storm sewer lines and shall be incorporated with the use of cast metal inlets, concrete inlets, or any other inlet which does not have a silt basin.

- Project life. Project life of materials for the purposes of selecting storm sewer materials shall be 100 years.

- Storm sewer systems shall be reviewed by the Idaho Department of Health and Welfare, Division of Environmental Quality for compliance with State regulations.

Culverts

A culvert is a conduit used as an artificial channel under a roadway or embankment to maintain flow from a natural channel or drainage ditch. A properly designed culvert will carry the flow without causing damaging backwater, excessive constriction, or excessive outlet velocities. Designing culverts involves the determination of design flow, hydraulic performance, economy, pipe materials, horizontal and vertical location, environmental considerations, and end designs.

The culvert design should include the profile of the culvert flow line (invert), culvert length, allowable headwater depths for the design flood and the 100 year flood, roadway or embankment cross-sections, and a roadway or embankment profile showing the height of the fill. The hydraulic features of the downstream controls, tailwater, or backwater must be given.

There are certain cases where hydraulic capacity is not the only consideration for determining the size of a waterway opening. Fish passage requirements may dictate a different type of crossing. Wetland preservation may require a culvert be upsized. The designer shall follow the regulations and recommendations of the appropriate authority (federal, state, or local) and document the information in the Stormwater Management Plan.

Minimum Design Standards for culverts:

- Minimum culvert size. The minimum diameter of culvert pipes under a main roadway shall be 18 inches, until a length of 70 feet is reached. All culverts over 70 feet long shall be 24 inches or more in diameter or shall conform to the requirements of the federal, state, or local authority, whichever is applicable. Culvert pipes from grated inlets or catch basins in the roadway have a minimum diameter of 8 inches. Culvert pipe under driveways, roadway approaches, and median drains shall have a minimum diameter of 8 inches. Pipes draining irrigated land shall be sized using the minimum culvert sizes.

- Allowable headwater. All culverts shall be designed to carry the design frequency flood with a headwater (HW) depth not greater than 1.25 times the culvert depth (D). The intent of this limitation is to prevent the headwater from materially increasing the size of the flooded upstream area under normal conditions. It must be determined in the field what headwater depths can be permitted for the design flood and the 100-year flood. Allowable headwater depths are determined by the field conditions and are not associated with design criteria.

This design standard shall assure a level of protection for all habitable structures and assure reasonable access is available to all habitable structures during the 100-year storm event (i.e. the culvert should pass the 100-year storm without damaging or eroding the roadway or embankment).

- Depth of tailwater. Depth of tailwater is important in determining the hydraulic capacity of culverts flowing with outlet control. When the downstream water-surface elevation is controlled by a downstream obstruction or backwater and the tailwater at the outlet of the culvert exceeds the height of the water outlet for the culvert barrel, the capacity of the culvert is reduced. Field inspection of all major culvert locations should be made during project design to evaluate the downstream controls and to assess the potential discharge capacity of the culvert or the resulting headwater when a culvert is flowing under outlet control.

- Velocity in culverts. Due to its hydraulic characteristics, a culvert will increase the velocity of flow over that in the natural channel. High velocities (abrasive velocities) are most critical just downstream from the culvert outlet where the erosion potential from the energy in the water is enormous.

  Culverts shall be placed on grades that produce a non-silting or nonabrasive velocity, 3 to 10 feet per second. Silting velocities may be overcome by raising the inlet of the culvert above the stream invert to increase the grade and provide a siltation basin at the inlet. Siltation basins upstream of the inlet may also be provided by excavating a basin or using a concrete basin. Siltation basins must be large enough to decrease velocities to 2 feet per second but shall not short circuit the flow over the top or along the sides of the embankment. Oversized culverts may be used where silting will occur to prevent blocking and to facilitate cleaning.

  Abrasive velocities may be overcome by raising the outlet to decrease the grade. Structural plate pipe may be provided with extra thickness in the bottom plates to account for possible abrasion. Concrete box culverts and concrete bases for arches may have steel inverts of rails or beams, or extra slab thickness to resist abrasion.

- Alignment and grade. Culverts shall generally be placed on the same alignment and grade as the natural streamed or channel to maintain the natural drainage system. This avoids creating unnatural ponding at the inlet or drops at the outlet.

  The embankment for the culvert shall consist of nonerodable material, and riprap or other outlet protection is essential. The embankment material should be free draining and capable of withstanding ponding.

  Concrete pipe may be used for any grade up to 10 percent. Corrugated metal pipe may be used for grades up to 20 percent. For grade in excess of 20 percent, the design and material shall be approved by Kootenai County.

- Minimum cover. Minimum culvert for a culvert within any roadway embankment shall be one foot or 1/3 of the culvert diameter, whichever is greater.

- Constant flow. Where a pipe flows at least 3/4 full over a period of a month or more during the year, gasketed corrugate metal pipe (CMP), rubber gasket concrete, or plastic pipe shall be required.

- Project life. Project life of culverts for the purposes of selecting culvert materials shall be 100 years.

- Minimum spacing of multiple culverts. Multiple culverts are acceptable in special cases, but their general use is discouraged. When multiple lines of pipe or pipe-arch greater than 48-inch diameter or span are used, they should be spaced so that the sides of the pipe or arch are no closer than one-half a diameter or 3 feet, whichever is less, so that sufficient space for compaction of the fill material is available. For culvert diameters up to 48 inches, the minimum distance between the sides of the pipe shall be no less than 2 feet.

- Camber. If a large amount of settlement is anticipated due to high fills, it may be necessary to add some camber to the culvert profile to correct for settlement. A soils engineer shall be consulted at Kootenai County's request as to the amount of camber which should be placed in a culvert.

  Culverts installed under moderate to high fills can experience differential settlement. At the pipe ends, there is no fill; at the centerline of the embankment, the depth of the fill is at maximum. The difference in surcharge pressure at the elevation of the culvert causes the differential settlement. Consult a soils engineer for design of a culvert under these conditions.

Culvert End Considerations. The type of end treatment used on a culvert depends on many interrelated and sometimes conflicting considerations. The designer must consider safety, aesthetics, debris capacity, hydraulic efficiency, scouring, and economics.

- Projecting ends. Projecting ends are the simplest and most economical of all end treatment designs, however, projecting ends provide no transition to prevent scouring at the outlet, and buoyancy may become a problem at the entrance. Projecting ends shall not be used in a highway "clear zone" as designated by Idaho Transportation Department.

- Beveled end. For culverts 30 inches or less in diameter, a beveled end section shall be the preferred end treatment. The standard bevel end section shall not be used on pipes laid on a skew of more than 30 degrees from the perpendicular to the centerline of the roadway.

- Flared end. A flared metal end section is a manufactured culvert end that provides a simple transition from the culvert to the stream bed or drainage channel. It provides a hydraulic transition which allows the flow to spread out and slow down before it is discharged into the watercourse. Flared ends shall not be used for culverts greater than 48 inches in diameter. Flared ends shall not be used in a highway "clear zone" as designated by Idaho Transportation Department.

- Headwalls. All pipes larger than 30 inches in diameter shall be beveled at the entrance to conform to the fill slope and provided with a concrete headwall. Pipe culverts larger than 72 inches in diameter shall have their inlet headwalls beveled, tapered, or rounded to improve the inlet flow characteristics. In addition to the headwall, riprap may be required by Kootenai County.

- Wingwalls. Wingwalls shall be used on reinforced concrete box culverts. However, they may be modified for use on circular culverts in areas with severe scour problems. The purpose is to retain and protect the embankment and to provide a transition from the channel to the culvert.

- Improved inlets. When head losses in the culvert become critical, the designer shall consider the use of a hydraulically improved inlet. These inlets provide side transitions as well as top and bottom transitions that have been designed to maximize the culvert capacity. However, it should be noted it is generally less expensive to increase the size of the culvert by one or two sizes to achieve the same or greater benefits.

Energy Dissipators. When the outlet velocities of a culvert or storm sewer outfall are excessive for the site conditions, the designer shall provide energy dissipators for culvert outlets to prevent severe scouring at the outlet. Debris and maintenance problems shall be addressed in the design.

- Riprap placed at the outlet of a culvert is the simplest method of handling outlet velocities when the soils are unstable.

- Special Energy Dissipating Structures, including impact basins and stilling basins, shall meet the requirements of Kootenai County and any or all federal, state, or local authorities and shall be approved on a site specific basis.

Culvert Debris. Debris problems can cause even an adequately designed culvert to experience hydraulic capacity problems. The culvert site is a natural location for these materials to settle and accumulate. Debris may consist of anything from limbs, sticks, or orchard prunings to logs and trees. Silt, sand, gravel, and boulders can also be classified as debris.

- There is no method to accurately predict debris problems. Examining maintenance history for similar sites is probably the most reliable way of determining potential problems. Requirements for debris deflectors, racks, basins, or spillways will be addressed on a site specific basis by Kootenai County.

Open Channel Flow

Open channel flow is encountered naturally in rivers and streams. Artificial channels include irrigation channels, drainage ditches, swales, or gutter flow for pavement drainage. Proper design requires open channels have sufficient hydraulic capacity to convey the magnitude of runoff from the design storm. In the case of grassy swales, bank protection is also required if the velocities are high enough to cause erosion or scouring.

Minimum Design Standards for open channel flow:

- Stream velocities. Stream velocities are useful in determining the hydraulic capacity of a channel and the need for erosion protection along the banks. As the depth of the water in an open channel increases, the velocity also increases.

- Manning's equation shall be the method of analysis for open channel flow. The trapezoid is the most often used for a channel cross section.

- Critical depth. It is necessary to determine critical depth in design of open channels. This will occur when the level of the headwater is controlled by the entrance of the pipe or channel rather than by the pipe or channel itself. Critical depth should always be calculated since it may control (when critical depth is less than normal depth) the capacity of the channel on a relatively steep slope (0.5-1.0 percent).

- River backwater analysis. Natural river channels tend to be highly irregular in shape so a simple analysis using Manning's Equation, while helpful for making an approximation, is not sufficiently accurate to determine a river water surface profile. Kootenai County shall be consulted on the availability and applicability of computer programs and data useful in calculating a backwater profile. Idaho Transportation Department maintains a list of applicable computer programs. Programs provided by Kootenai County or Idaho Transportation Department may be used for design. Responsibility for the use of these programs and their accuracy will be borne by the designer.

- Stream bank stabilization. Stream banks shall be stabilized to Kootenai County's satisfaction where degraded or impacted by the development. Bank stabilization is required when design flow velocities of new or existing channels exceed 3 feet per second or erosive velocity for the channel bed, whichever is smaller.

- Existing ditches shall be provided with riprapped bottoms and side slopes at the discharge points of storm sewers or culverts. The rock shall extend for a minimum of 10 feet downstream from the end of the storm sewer or culvert.

- All channel sides and bottoms shall be seeded, sodded, or riprapped as directed by Kootenai County.

- Check dams, pools, non-erosive drop structures, or other means shall be used as necessary to control velocity.

Detention/Retention Facilities

The peak rate of runoff from a site shall not be increased due to the proposed development for the design storm. Therefore, retention or detention facilities will be required on the developed site.

In certain situations, it is possible and even desirable to store a volume of water before allowing it to discharge to the downstream drainage courses. When this storage effect is properly considered the designer can reduce the amount of peak flow released to the downstream drainage facility or eliminate it altogether. Detention/retention facilities include grassed infiltration areas, earthen basins, shallow injection wells, and buried tanks or large diameter pipes.

Open or closed storage detention systems are desirable in the overall management plan for the following reasons:

Prevention of storm water runoff in excess of pre-development runoff to downstream properties.

Reduction of flow rates to downstream drainage structures.

Reduction of frequency and capacity of infiltration, conveyance, and drainage systems on the site as a whole.

The size of pump stations could be designed with smaller pumps if storage for the runoff was provided.

Existing culverts or storm sewers on site which would be undersized may be made adequate if upstream storage were provided.

Liabilities and potential problems associated with detention systems must also be considered:

There must be adequate space available for a storage basin.

The potential for damage from overtopping the design level of the storage basin must be considered.

There is a potential safety hazard to the public for storage basins which could become covered with several feet of water.

Basins subject to frequent flooding may lose natural vegetation from the excessive amounts of water.

Minimum Design Standards for detention/retention facilities:

- An overflow type storage detention system which regulates the rates of flow shall be the preferred storage facility. Landscaped facilities such as parks and play fields are recommended for use as a stormwater detention facility.
- All storage detention facilities shall be accessible for maintenance, and a regular maintenance schedule shall be submitted with the Operation and Maintenance Plan. Access for maintenance vehicles (generally 8- to 10-feet wide travel lane) shall be included in the design.
- Storage detention facilities with side slopes steeper than five horizontal to one vertical shall be fenced as approved by Kootenai County.
- The reservoir routing method is straightforward and shall be used for design of the storage detention facility. This method involves plotting an inflow hydrograph for the future storm event then, superimposing an outflow hydrograph over the inflow hydrograph. The area inscribed between the two graphs represents the volume to be stored in the facility. The inflow hydrograph will be developed using the rational method.
- The outflow hydrograph will be dependent upon the particular control structure selected as well as the depth of the water in the storage detention basin. The actual shape of the outflow hydrograph can be developed by an application of a technique known as reservoir routing.

Shallow Injection Wells

Shallow injection wells are any excavation or artificial opening into the ground which meets the following four criteria: a) it is a bored, drilled, or excavated hole, a driven mine shaft; b) it is deeper than its largest straight line surface dimension; c) it is used for or intended to be used for injection; and d) the well is less than or equal to eighteen vertical feet of depth below ground level. Catch basins with lateral sub-surface infiltration piping are also considered to be injection wells under definition c.

Class V (e) shallow injection wells are used for the disposal of nonhazardous, nonradioactive wastes such as stormwater runoff and irrigation waste water. Regarding class V (e) injection wells, *Idaho Code*, Title 42, Chapter 39, states "the groundwaters of this state to be a public resource which must be protected against unreasonable contamination or deterioration of quality to preserve such waters for diversion to beneficial uses." Contamination as defined by the statute means "the introduction into the natural groundwaters of any physical, chemical, biological, or radiological substance or matter in water which may:

1) Cause a violation of Drinking Water Standards; or

2) Adversely affect the health of the public; or

3) Adversely affect a designated and protected use of the State's groundwater."

Minimum Design Standards for shallow injection wells:

- The capacity of a site's subsurface soils to infiltrate stormwater from a shallow injection well shall be determined based on SCS soil permeability criteria. Soil gradation (sieve analysis) determinations of specific soils shall be required at the option of Kootenai County to confirm SCS soil class criteria prior to injection well construction.

- Class V (e) shallow injection wells are authorized by rule for the life of the facility provided that the required inventory information is furnished to the Department of Water Resources and use of the well does not contaminate a drinking water source.

- The owner or operator of a proposed Class V (e) injection well shall submit the following inventory information to the director of the Department of Water Resources as a condition of authorization:

  a) Facility name and location;
  b) County in which the injection well(s) is (are) located;
  c) Location of the well(s) by legal description to the nearest 10 acre tract, or by highway milepost where the well is owned or operated by a state or local entity;
  d) Ownership of the wells;
  e) Name, address, and phone number of legal contact;
  f) Type or function of the well(s);
  g) Number of wells of each type; and
  h) Operation status of the well(s).

- For any future developments, class V (e) shallow injection wells shall be authorized for disposal of stormwater runoff provided the effluent from the well meets the water quality standards set by the Department of Water Resources under the rules and regulations for "Construction and Use of Injection Wells."

- If the operation of a Class V (e) injection well is causing or may cause contamination of a drinking water source, Kootenai County, or the Department of Water Resources, shall require immediate cessation of the injection activity.

Constructed Wetlands

Man-made wetlands can provide significant storage capacities for runoff and provide effective pollutant removal. Other benefits include recreation and aesthetic possibilities. Studies have found that controlled stormwater retention in marshes has resulted in better vegetative conditions which in turn enhanced stormwater nutrient removal. Other reports indicate removal of storm generated pollution has been achieved by detention and natural treatment in small urban lakes.

The use of wetlands, whether they be lakes, ponds, or marshes, is straightforward from an engineering design standpoint. However, the disadvantage of these types of systems is a considerable effort may be required to maintain them in a healthy state. Wetlands can be seen to remove waterborne pollutants principally through physical and chemical processes which are substantially improved by biological processes associated with aquatic vegetation. This vegetation is generally resistant to the pollutants found in stormwater, however, the interactions of various plant and animal species are not completely understood, and changes in this community structure may affect the overall health, aesthetic character, and pollutant removal capacity of the wetland.

Minimum Design Standards for constructed wetlands:

- Constructed wetlands shall be approved on a site specific basis by Kootenai County.

- The designer shall be responsible for obtaining approval through all federal, state, and local authorities.

- Wetland design should utilize a team approach with expertise in hydrology, water quality, soils, botany, wildlife ecology, and landscape architecture, as well as design and construction engineering.

- Water retention time (approximated by volume divided by outflow rate) for particulate removal should be approximately one week. For removal of nutrients and soluble pollutants greater than two weeks retention time should be allowed.

- Surface area (wet pool area divided by watershed or drainage basin area) should be 0.01 minimum, but preferably greater than 0.025.

- Optimum water depth distribution within a wetland is:

%age of Area	Water Depth Distribution
50 percent	less than 6 inches (a bench form)
25 percent	6 inches to 1 foot
25 percent	2 to 3 feet

- A forebay should be constructed in the inlet channel prior to the wetland area proper. The depth of this forebay should be approximately three feet, and its surface area approximately 25 percent of the total wetland area.

- A liner should be considered if needed to maintain summer water and to prevent groundwater contamination.

- To prevent flow short circuiting, place the outlet remote from the inlet, minimize flow velocities, construct multi-celled configuration, and design a length to width rate of 3:1 minimum, greater than 5:1 preferably.

- For inlet design use techniques that will minimize entrance velocity and momentum such as level spreaders, enlarged inlet conveyance, reduced inlet slope, and baffle islands or peninsulas.

- Soils to be used for wetland construction should have moderate to fine texture (loams) with relatively high muck. (This can be an important source of plant "propagules.")

- Soil and water pH should be circumneutral (6 to 8) with slightly alkaline (7 to 8) best.

- Plant selection principals center not around water quality goals but 1) prospects for effective establishment and continued survival under site conditions, 2) using native species, 3) avoiding invasive or nuisance species, and 4) selection to fulfill multiple objectives (if any).

- Best pollutant removal plants are those dense, fine, herbaceous plants with good winter viability. Choices for specific pollutants (N.W. native plants) include:

  For metals removal -- *Oenanthe sarmentosa* (water parsley), *Spirea douglasii* (hardback), *Carex* species (sedges), *Elodea canadensis Lemna* species (duckweeds), *Nuphar* species (water lilies), *Scirpus* species (bulrushes), *Typha* species (cattails).

  For oils and other organics -- plants that grow from basal meristem - *Juncus* species, (rushes), or *Scirpus* species (bulrushes).

- Best results for establishing plantings are by using live plants or dormant rhizomes from nurseries; obtaining plants from natural wetlands is discouraged. Seeding offers lower prospects of success.

- The designer shall provide a monitoring program for insuring the wetland functions as is intended in the design.

HYDROLOGIC ANALYSIS METHODS

Drainage Basin

The size and shape of the drainage basin are important factors regardless of which method is used to determine the hydrologic characteristics of the basin. Determination of the basin area should only proceed after procurement of the best available topographic maps of the entire area contributing surface runoff to the site. Outline the area on the map(s) and determine the size in acres or square miles. Any areas that are known to be noncontributing to surface runoff should be subtracted from the total drainage area and justification given for this. The slope, length, and surface roughness of the drainage basin or watershed affect the travel times for runoff.

Rational Method

The rational method is used **to predict peak flows** for small drainage areas which can be either natural or developed. The greatest accuracy is obtained for smaller drainage basins or for developed conditions with large areas of impervious surfaces.

Drawbacks of the rational method are:

- It gives only the peak discharge and provides no information about the time distribution of the storm runoff.

- Selection of the variables for the formula is more an art of judgement than a precise account of the antecedent moisture content or an aerial distribution of rainfall intensity.[1]

Given these limitations, the rational method shall only be used for design of storm water management facilities for drainage basins **10 acres or less**. These two factors will provide the designer with a basis for designing grassed infiltration areas, storm sewers, culverts, outfalls, open channels, etc.
The formula for the rational method is as follows: $Q = C\ I\ A$

where:
Q = Runoff in cubic feet per second (cfs)
C = Runoff coefficient representing ratio of runoff to rainfall
I = Average rainfall intensity in inches per hour for a particular duration storm event
A = Drainage area in acres

When several sub-areas within a drainage basin have different runoff coefficients, the rational formula can be modified as follows:

$$Q = I\ (\sum C\ A)$$

where: $CA = C_1 \times A_1 + C_2 \times A_2 + C_3 \times A_3 + \ldots\ldots\ldots$

Runoff Coefficients

The runoff coefficient represents the ratio of runoff to rainfall. The rational method implies that this ratio is fixed for a given drainage basin. In reality, the coefficient may vary with respect to prior wetting and seasonal conditions.

The coefficients in Appendix G, Table 1, are applicable for peak storms of 10-year frequency. Less frequent, higher intensity storms will require the use of higher coefficients because infiltration and other losses have a proportionally smaller effect on the runoff. Conversely, long duration storms with low average intensities would require the use of lower coefficients. Until such time as coefficients are available for 25-year frequency storms, this table of coefficients shall be used for Kootenai County areas.

Rainfall Intensity

The rainfall intensity shall be obtained from the Idaho Transportation Department's intensity-duration-frequency charts. These charts are based on U.S. Weather Bureau records, and the State of Idaho has been divided into different intensity-duration-frequency zones (IDF Zones). For Kootenai County IDF Zone C, D, E, or F may be applicable depending on the geographic location of the site.

When using these graphs, it should be noted that the data from which they are derived is sporadic and much more information is needed for short-duration storms in order to obtain more accurate estimates.

A map of Idaho delineating the IDF zones and the IDF charts for zones C, D, E, and F are shown in Appendix F, Figures 2, 3, 4, 5, and 6, respectively.

Time of Concentration

The time of concentration is that time it takes for water to travel from the most distant part of the watershed to the point of interest. The time of concentration affects the peak rate of runoff and shape of the hydrograph.

Overland flow, storm sewer flow, and channel flow are three phases of runoff flow commonly used in computing travel time. In a given watershed or drainage basin, some areas would be dominated by overland (sheet flow) while other areas would be dominated by channel flow. Developed drainage basins may be further complicated by significant flows from storm sewers. The time of concentration is equal to the sum of the travel times computed for each sub-area.

Special attention should be given to the computation of concentration and travel time. Once storm drains are installed the flow patterns may be changed so significantly that flow retardence cannot be represented by factors based on runoff curve numbers or overland flow. Velocities of flow through culverts and channels should be computed using hydraulic procedures that take into consideration the characteristics of flow paths.

An exception to this procedure may occur when a complex drainage pattern exists. The designer should be cautious when two or more subbasins have different types of cover (i.e. different runoff coefficients). The most common case would be a large paved area together with a long narrow flat strip of natural area. In this case, the designer should check the paved area and a fraction of the natural area to determine if this combination would produce a greater peak than the peak produced by using the longest time of concentration.

A procedure for determining the time of concentration is based on the U.S. Department of Agriculture, Soil Conservation Service method which was originally developed from the Manning formula. It is sensitive to slope, type of ground cover, and the size of the channels. There are other methods and nomegraphs available in the literature that can be used by the designer.

Soil Conservation Service Method

For watersheds or drainage basins greater than 10 acres, the SCS, TR-55 method shall be used to calculate runoff volume and peak rates of discharge. The SCS uses three standard rainfall distributions, Types I, IA, and II. Type II distribution applies to all areas of the United States except for parts of the Pacific Coast States, California, Oregon, and Washington. The Type II distribution shall apply to the State of Idaho. The amount of runoff from a given watershed is solved using the following equations:

$$S=\frac{1000}{CN}-10 \qquad Q=\frac{(P-0.2S)^2}{(P-0.8S)}$$

where:
- S = Potential abstraction in inches
- P = Total storm rainfall in inches
- CN = Runoff curve number
- Q = Actual direct runoff in inches

Runoff Curve Numbers

CN represents and indicates the runoff potential of a watershed. The higher the CN, the higher the runoff potential. The factors affecting the CN, called the soil cover complex, are a combination of the hydrologic soil group, the land use, and the treatment class (cover).

The hydrologic soil groups describe a soil's potential to produce runoff from a precipitation event. Soils not protected by vegetation are placed in one of four groups on the basis of the intake of water after the soils have been wetted and have received precipitation from long duration storms. The four, standard hydrologic soil groups are:

Group A Soils having a high infiltration rate when thoroughly wet. These consist chiefly of deep, well drained to excessively drained sands or gravels. These soils have a high rate of water transmission.

Group B Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils that have a layer that impedes the downward movement of water or soils that have a moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clay soils that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer near the surface, and soils that are shallow over a nearly impervious material. These soils have a very slow rate of water transmission.

Several factors should be considered when computing the anticipated future CN for urban areas. The types of structural or non-structural methods used within the development for controlling the runoff will vary the quantity and flow paths of the runoff.

Consideration should be given to construction methods. Soils compacted by heavy equipment beyond natural compaction conditions, the extent of vegetative cover or sod versus barren soil within a pervious area, the impact of grading on surface and subsurface soils (to the extent that the mixed soils may create a completely different hydrologic condition) all must be factored into the CN determination.

Irrigation in farming communities or heavily watered lawns in suburban areas may significantly increase the moisture content in the soil above that which would be expected with natural rainfall conditions.

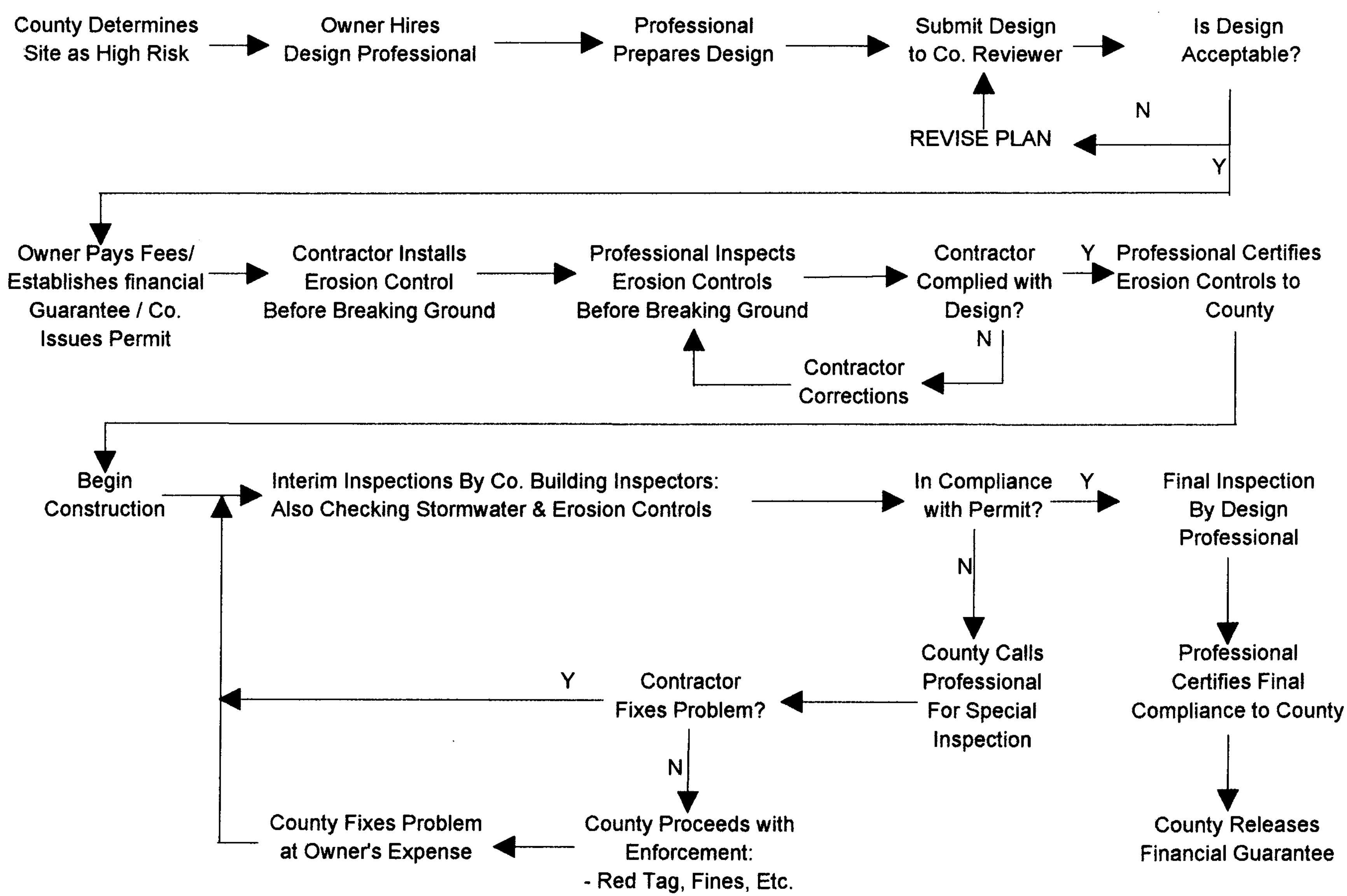
Table 2 in Appendix G gives CN's for agricultural, suburban, and urban land use classifications. The suburban and urban CN's are based on typical land use relationships that exist nationwide. The CN's should only be used when it has been determined that the area under study meets the criteria for which the CN was developed.

There will be areas to which the values in Table 2 do not apply. The percentage of impervious area for the various types of residential areas or the land use condition for the pervious areas may vary from the conditions **assumed** in Table 2. A curve for each pervious CN can be developed to determine the composite CN for any density of impervious area.

The percentage of impervious to pervious areas should be determined accurately and be representative of the site so the composite CN will assist the designer in accurately predicting the volume of runoff. The designer's assumptions and calculations shall be included in the hydraulic analysis to justify the selected Runoff Curve Numbers.

APPENDICES

APPENDIX A
PERMIT, INSPECTION & ENFORCEMENT PROCESS FOR HIGH RISK SITES



APPENDIX B - EROSION RISK ASSESSMENT

SLOPE, measured in percent, as an average across the area to be disturbed

Gradient	Point Value
0 - 10% slope	1
11 - 25% slope	5
> 25% slope	10

SOIL K FACTOR, for water erosion susceptibility, as indicated in the Soil Survey of Kootenai County Area, Idaho. The highest K factor within the proposed disturbed soil profile will be used. Soil type from the Soil Survey will be verified on-site by physical description.

K Factor	Point Value
0 - 0.2	1
0.21 - 0.4	3
> 0.4	5

PROXIMITY TO SURFACE WATER or any feature which conveys water to surface water. Surface water includes all lakes, rivers, streams, wetlands, and similar features. Conveyance features may include natural or man-made ditches. Distance is measured along the slope from the closest boundary of the proposed disturbance to the conveyance or surface water feature.

Distance	Point Value
>500	1
201' - 500'	5
0' - 200'	10

AMOUNT OF DISTURBED AREA, expressed as a percentage of the parcel area. Areas to be disturbed during installation of utilities must be included.

Disturbed Portion	Point Value
0 -33%	1
34 - 66%	5
67 - 100%	10

THE POINTS FOR EACH FACTOR SHALL BE ADDED. THE RISK CATEGORY SHALL BE DETERMINED FROM THE POINT TOTAL AS FOLLOWS:

0 - 9 = Low risk
10 - 20 = Moderate or high risk, Administrator makes determination based on experience in the area
> 20 = High risk

APPENDIX C - STORMWATER RISK ASSESSMENT

SLOPE, measured in percent, as an average across the area to be disturbed

Gradient	Point Value
0 - 5%	0
6 - 10%	3
11 - 15%	6
16 - 25%	10
> 25%	15

SOIL PERMEABILITY, measured in inches per hour as indicated in the Soil Survey of Kootenai County Area, Idaho. The lowest permeability in the soil horizon shall be used. Soil type from the Soil Survey will be verified on-site by physical description.

Permeability	Point Value
0.5 or greater	0
< 0.5	5

PROXIMITY TO SURFACE WATER or any feature which conveys water to surface water. Surface water includes all lakes, rivers, streams, wetlands, and similar features. Conveyance features may include natural or man-made ditches. Distance is measured along the slope from the closest boundary of the proposed disturbance to the conveyance or surface water feature.

Distance	Point Value
>500'	0
201' - 500'	5
0' - 200'	10

IMPERVIOUS AREA RATIO, expressed as a percentage of the parcel area covered with impervious surfaces.

Coverage	Point Value
0 - 19%	0
20 - 40%	5
> 40%	10

TOTAL IMPERVIOUS AREA, expressed in square feet.

Coverage	Point Value
5000 or greater	5
<5000 square feet	0

DRAINAGE CROSSING PROPOSED. If the project requires crossing a conveyance channel or drainage, add 5 points.

BUFFER STRIP. If the project has a useable buffer strip, which provides the appropriate level of treatment for the type of project proposed, subtract 10 points.

THE POINTS FOR EACH FACTOR SHALL BE ADDED. THE RISK CATEGORY SHALL BE DETERMINED FROM THE POINT TOTAL AS FOLLOWS:

15 Points or greater	High risk; design professional required
0 - 14 Points	Low to moderate risk; Owner or Contractor shall develop appropriate BMP's to address stormwater runoff if not naturally treated and infiltrated on site.

APPENDIX D - SITE LIMITATIONS FOR GRASSED INFILTRATION AREAS AND OTHER INFILTRATION BMPS

The use of grassed infiltration areas is the preferred stormwater management practice due to their ability to effectively treat runoff, preserve baseflow in streams, recharge groundwater, reduce peak runoff flows which can cause flooding and reduce or eliminate expensive stormwater conveyance systems.

Experience has shown that grassed infiltration areas and other infiltration BMP's can be successfully utilized if adherence to proper design, construction, and maintenance standards is followed. Where operating problems with grassed infiltration areas have occurred, the primary causes of failure have been:

- inadequate soil investigation, resulting in poorly designed systems
- improper construction practices, especially due to compaction of the soil
- siltation which clogs soils, especially due to construction-related erosion and sedimentation

It is important to realize that infiltration is not practical or possible in all cases. The feasibility of using grassed infiltration areas of other infiltration BMP's depends on a number of site characteristics.

Site Limitations

- Soil Suitability
- Depth to Bedrock, Water Table, or Impermeable Layer, or Dissimilar soil layer
- Base Flood Elevation
- Proximity to Drinking Water Wells, Septic Tanks, Drainfields, Building Foundations, Structures, and Property Lines
- Land Slopes
- Control of Siltation

Soil Suitability

Suitability of soil for infiltration is to be based on evaluating the following:

a) For a quality control treatment BMP, the soil infiltration rate shall be between 0.5 and 2.4 inches per hour;
b) For a quantity control BMP, there is no limitation on soil infiltration rate but a minimum rate of 0.5 inches per hour is recommended;
c) Runoff must infiltrate through at least 18 inches of soil which has a minimum cation exchange capacity (CEC) of 15 milliequivalent per 100 grams of dry soil.
d) Soils with 30 percent or greater clay content or 40 percent or greater silt/clay content shall not be used;
e) Infiltration systems shall not utilize fill material nor be placed over fill soils;
f) Any stone subgrade installed as part of an infiltration structure must extend below the frost line;
g) Aerobic conditions are to be maintained by designing them to drain the water quality design storm in 24 hours or less.

In addition, it is recommended that a more detailed soils investigation be conducted if potential impacts to ground water are a concern.

Depth to Bedrock, Water Table, or Impermeable Layer

The base of all facilities shall be located at least 3 feet above the seasonal high water mark, bedrock (or hardpan), and/or impermeable layer. A high water table can indicate the potential for ground water contamination. Also, infiltration may be inhibited by the water table; this could result in the BMP not functioning as designed.

Base Flood Elevation

All infiltration facilities must be located above the base flood elevation.

Proximity to Drinking Water Wells, Septic Tanks, Drainfields, Building Foundations, Structures, and Property Lines

The proximity of infiltration facilities to other structures and facilities must be taken into account. Otherwise, the potential exists to contaminate ground water, disrupt the proper functioning of septic tank systems, and damage foundations and other property. The site designer/engineer must conduct an investigation to determine the most appropriate locations of infiltration facilities; this is best done on a case-by-case basis but the following basic criteria is provided for information purposes:

- Infiltration facilities on commercial and industrial sites should be placed no closer than 100 feet from wells, septic tanks or drainfields, and springs used for drinking water supplies. In no case shall they be closer than 50 feet.

- Infiltration facilities for residential sites should be no closer than 50 feet from wells, septic tanks or drainfields, and springs used for drinking water supplies. In no case shall they be closer than 25 feet.

- Infiltration facilities should be situated at least 20 feet downslope, 100 feet upslope, or 10 feet from the side of building foundations.

Land Slopes

Application of infiltration practices on a steep grade increases the chance of water seepage from the subgrade to the lower areas of the site and reduces the amount of water which actually infiltrates.

Infiltration facilities can be located on slopes up to 15 percent as long as the slope of the base of the facility is less than 3 percent. All basins should be a minimum of 50 feet from any slope greater than 15 percent.

Control of Siltation

Surveys show that siltation is one of the major reasons for failure of infiltration facilities. This often occurs during construction. It is **vital** to prevent as much sediment as possible from entering an infiltration area. Final construction of infiltration facilities shall not be done until after the site construction has been finished and the site has been properly stabilized. Infiltration facilities shall not be used as temporary sediment traps during the construction phase, unless special consideration is given to reconstruction of the infiltration area after the site is stabilized.

APPENDIX E

Anticipated Treatment Efficiency of Stormwater Treatment BMPs

This list was prepared from several manuals of stormwater Best Management Practices and reflects anticipated treatment efficiencies of commonly used stormwater treatment BMPs. It is not intended to be absolute or all encompassing. There is considerable disagreement in the literature on the treatment efficiency of any given BMP. The design, individual site characteristics, construction methods, climate, and storm size are some of the factors which determine the actual treatment efficiency of a BMP.

Where a range is specified below, it indicates that the efficiency is dependent on some design criteria. For example, the treatment provided by extended detention ponds is dependent on the detention time provided by the pond. Other special considerations, such as including a forebay to filter some sediment out of runoff prior to discharge into a wet-pond, are necessary to obtain treatment levels in the upper end of the ranges.

If the design professional believes that a higher level of treatment is provided by the proposed BMP, or if the BMP is not listed here, it shall be the design professional's responsibility to provide information from a reliable source to substantiate the BMPs effectiveness.

Combinations of BMP's are encouraged where appropriate. These systems usually provide incrementally higher and more consistent levels of pollutant removal.

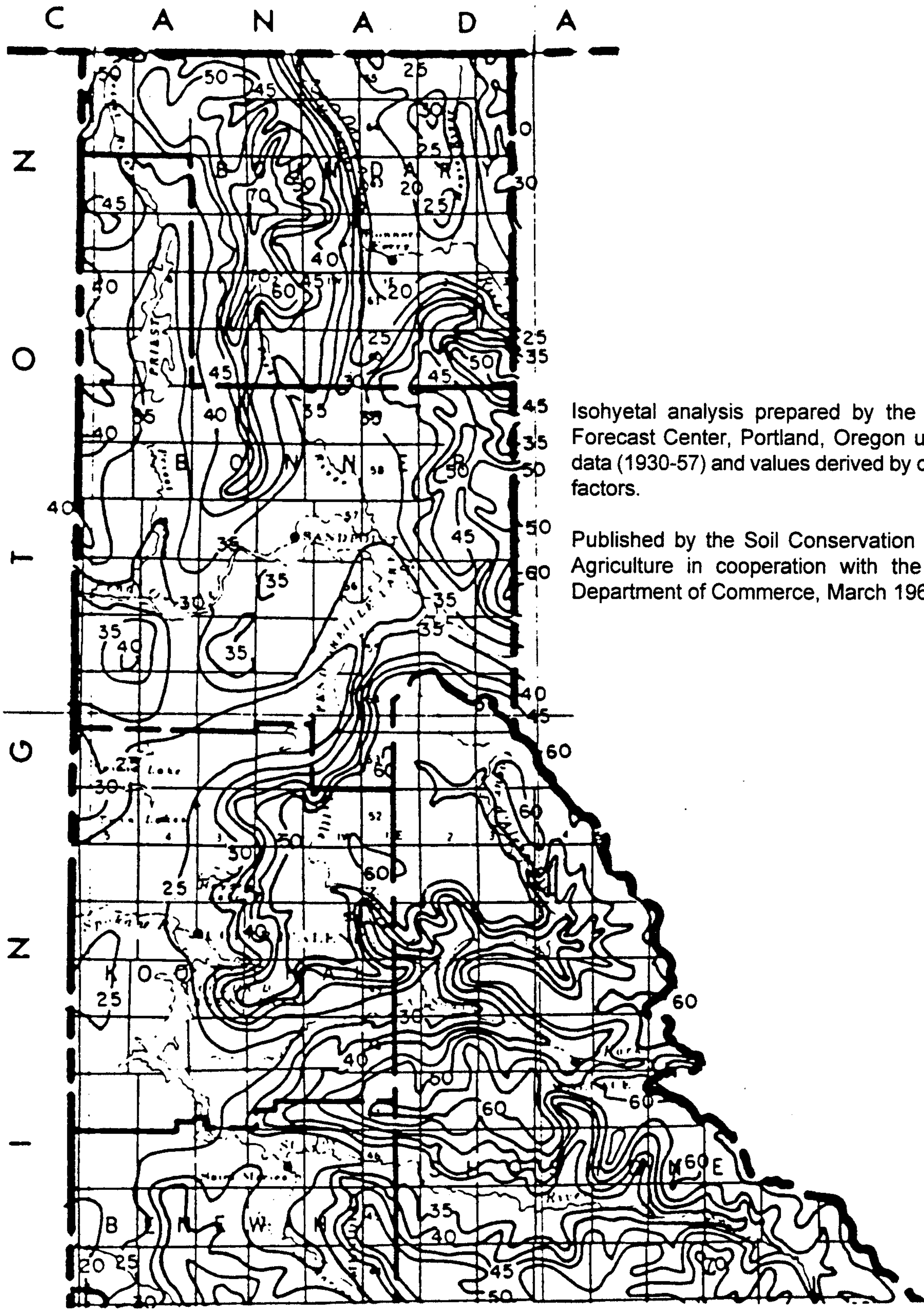
BMP	Pollutant	Treatment efficiency
Grassed Infiltration Area	Total P	85%
Aquifer soil types	Total N, Metals	80%
	Suspended Solids	95%
	Dissolved Solids	50%
	Organic Chemicals	60%
	Bacteria	99%
Infiltration Basin	Total P	70-85%
Off aquifer, sub-surface drain included,	Total N	55-80%
complete grass cover	Metals	75-80%
	Suspended Solids	90%
Constructed Wetland	Total P	30-90%
full wetland vegetation, wetland soils,	Total N	20-50%
good biological treatment, permanent	Metals	40-80%
storage pool	Suspended Solids	50-90%
Wet Ponds	Total P	40-75%
vegetated, some biological treatment	Total N	30-75%
permanent storage pool	Metals	40-80%
	Suspended Solids	60-90%

Extended Detention Ponds	Total P	20-80%
little/no vegetation, little biological	Total N	20-40%
treatment, treatment is time dependent	Metals	40-70%
relies on settling of contaminants	Suspended Solids	60-90%
Vegetated Buffer	Total P	see Table 3
	Total N	<10%
	Metals	<10%
	Suspended Solids	see Table 4
Grass lined conveyance channel	see vegetated buffer	
Infiltration Trenches	Total P	60%
not appropriate where significant	Total N	60%
sediment is involved	Metals	90%
	Suspended Solids	90%

APPENDIX F - FIGURES

MEAN ANNUAL PRECIPITATION

1930 - 1957



Isohyetal analysis prepared by the US Weather Bureau River Forecast Center, Portland, Oregon using adjusted climatological data (1930-57) and values derived by correlation with physiographic factors.

Published by the Soil Conservation Service, US Department of Agriculture in cooperation with the US Weather Bureau, US Department of Commerce, March 1965.

Figure 1

AREA CLASSIFICATION MAP FOR IDF CURVES

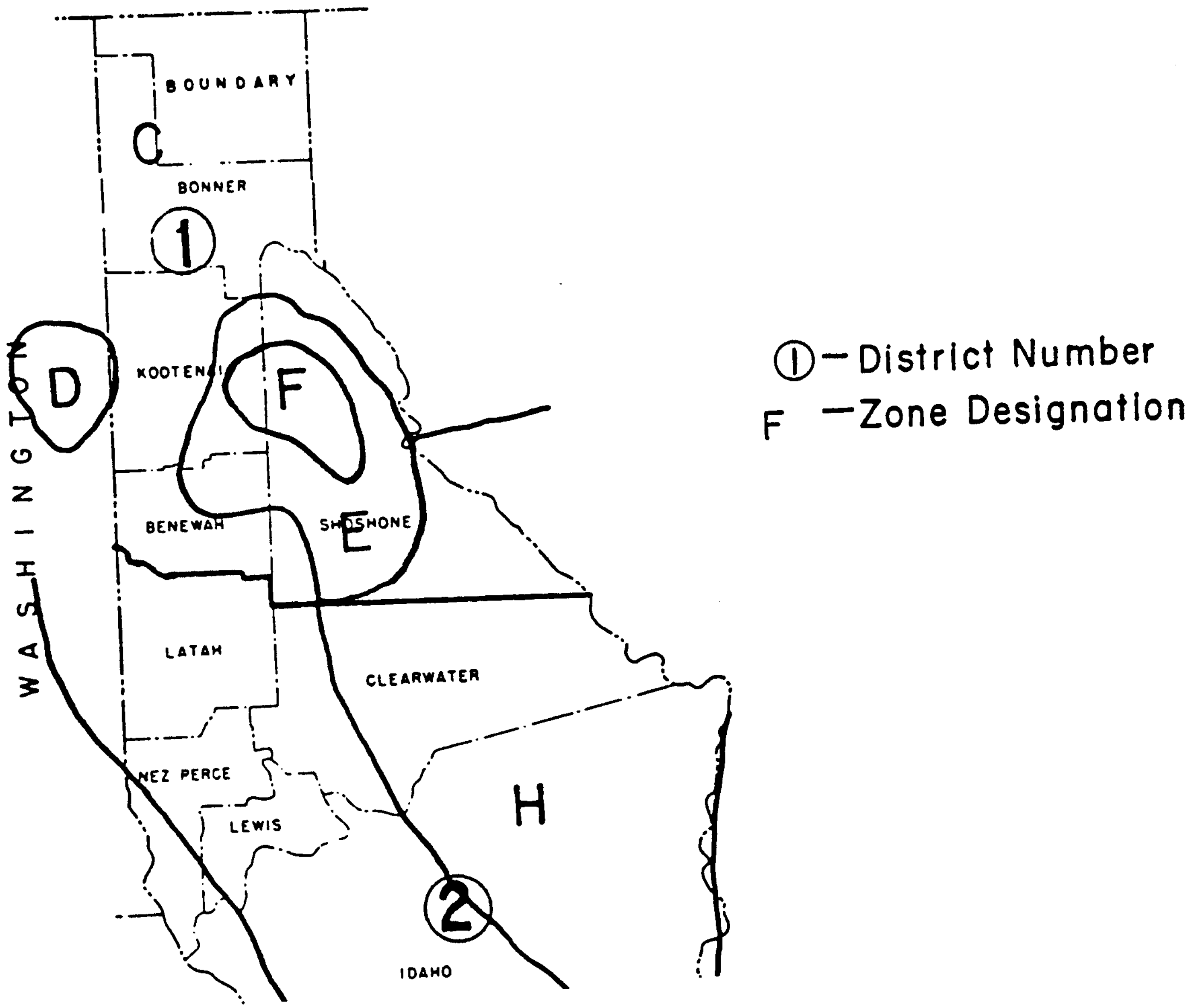


Figure 2

ZONE C, INTENSITY-DURATION-FREQUENCY CURVE
(IDAHO TRANSPORTATION DEPARTMENT)

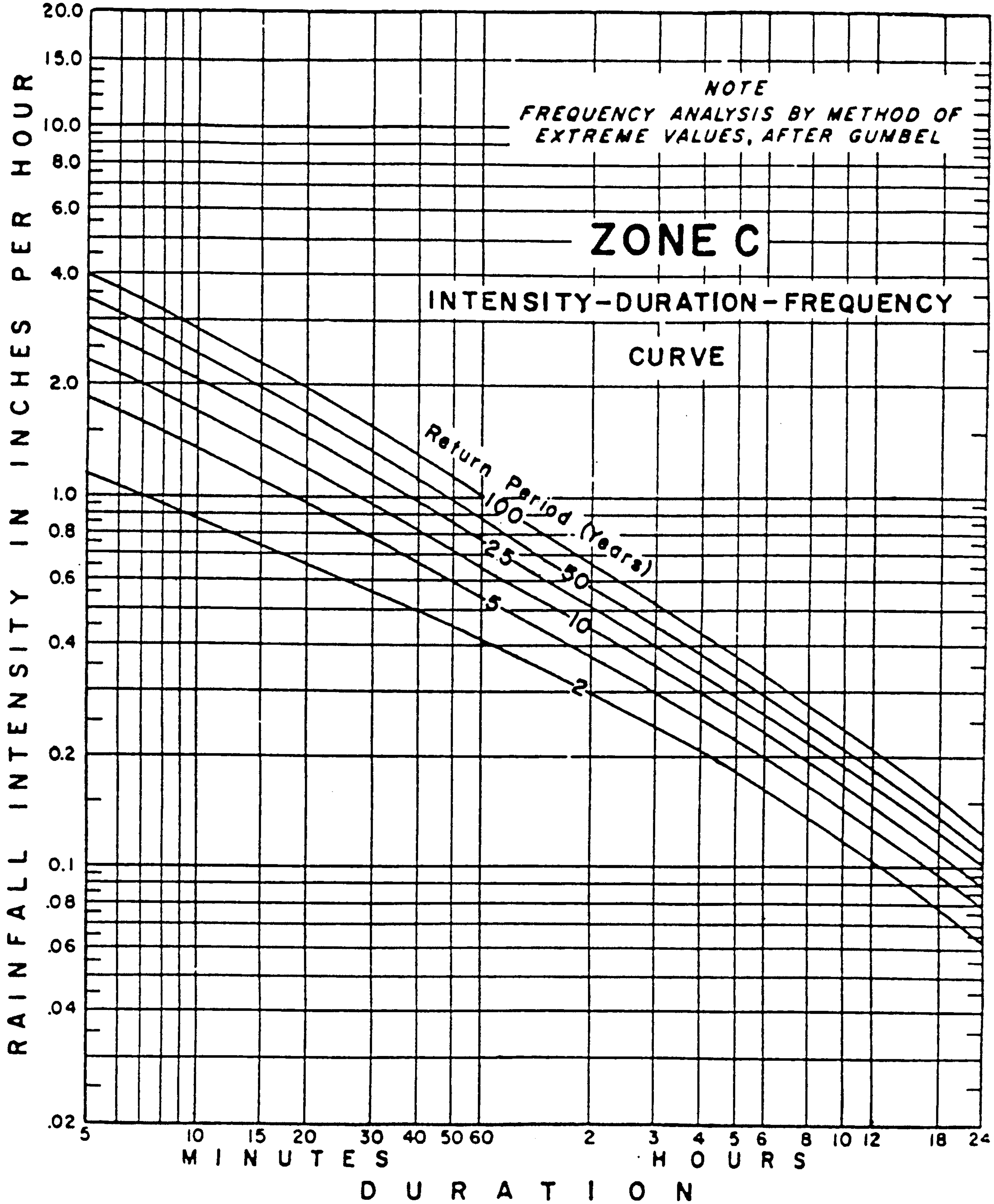


Figure 3

ZONE D, INTENSITY-DURATION-FREQUENCY CURVE
(IDAHO TRANSPORTATION DEPARTMENT)

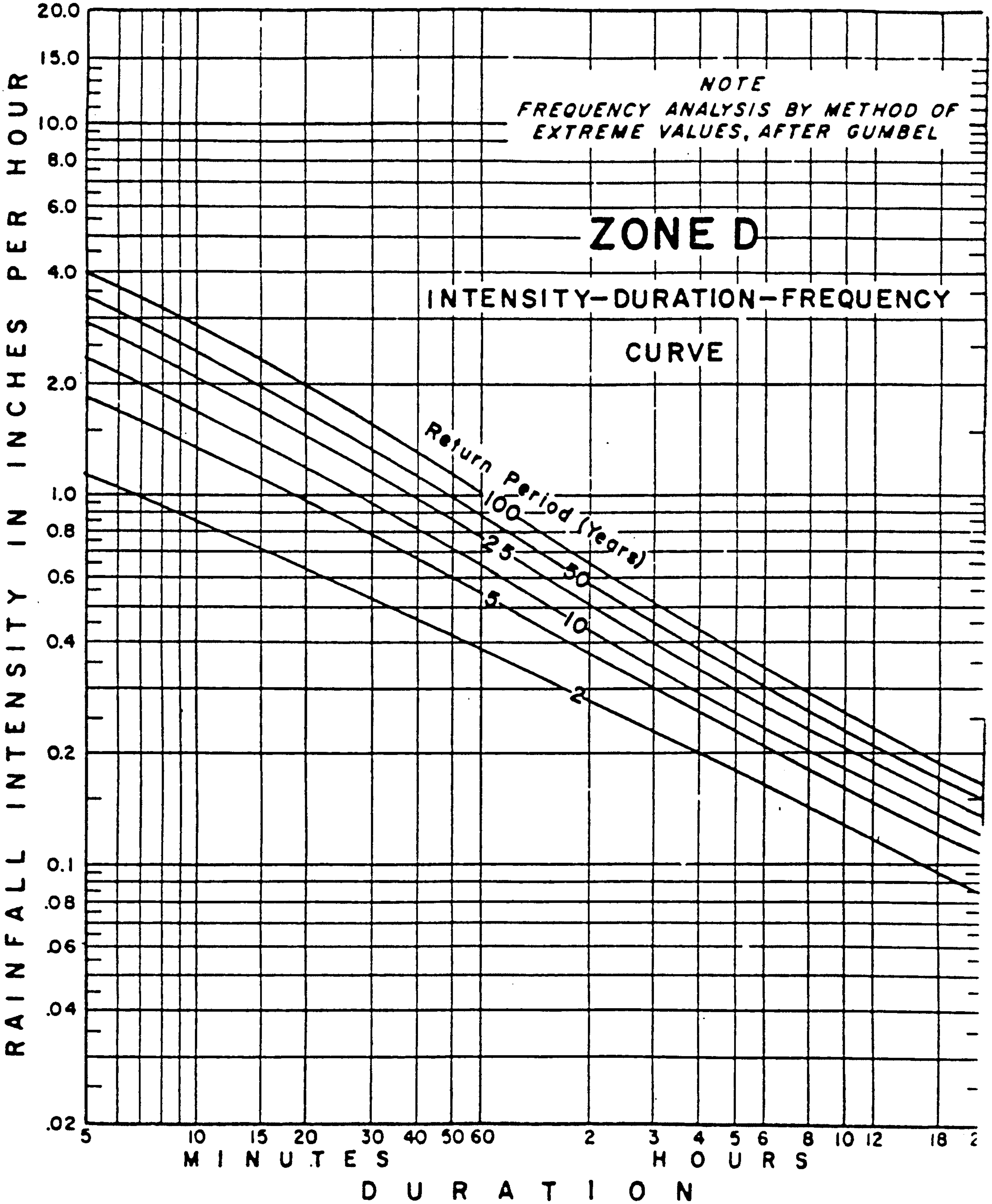


Figure 4

ZONE E, INTENSITY-DURATION-FREQUENCY CURVE
(IDAHO TRANSPORTATION DEPARTMENT)

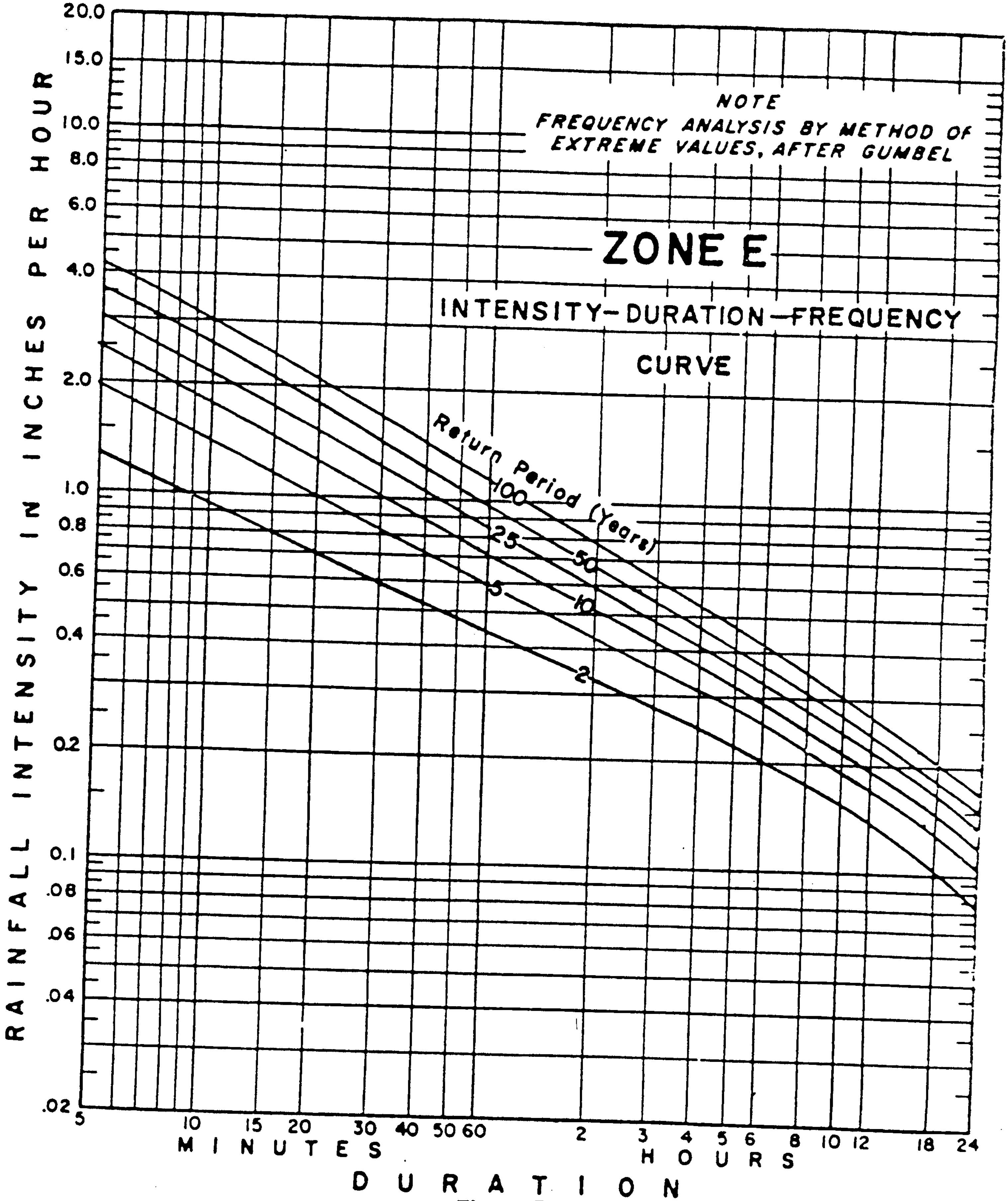


Figure 5

ZONE F, INTENSITY-DURATION-FREQUENCY CURVE
(IDAHO TRANSPORTATION DEPARTMENT)

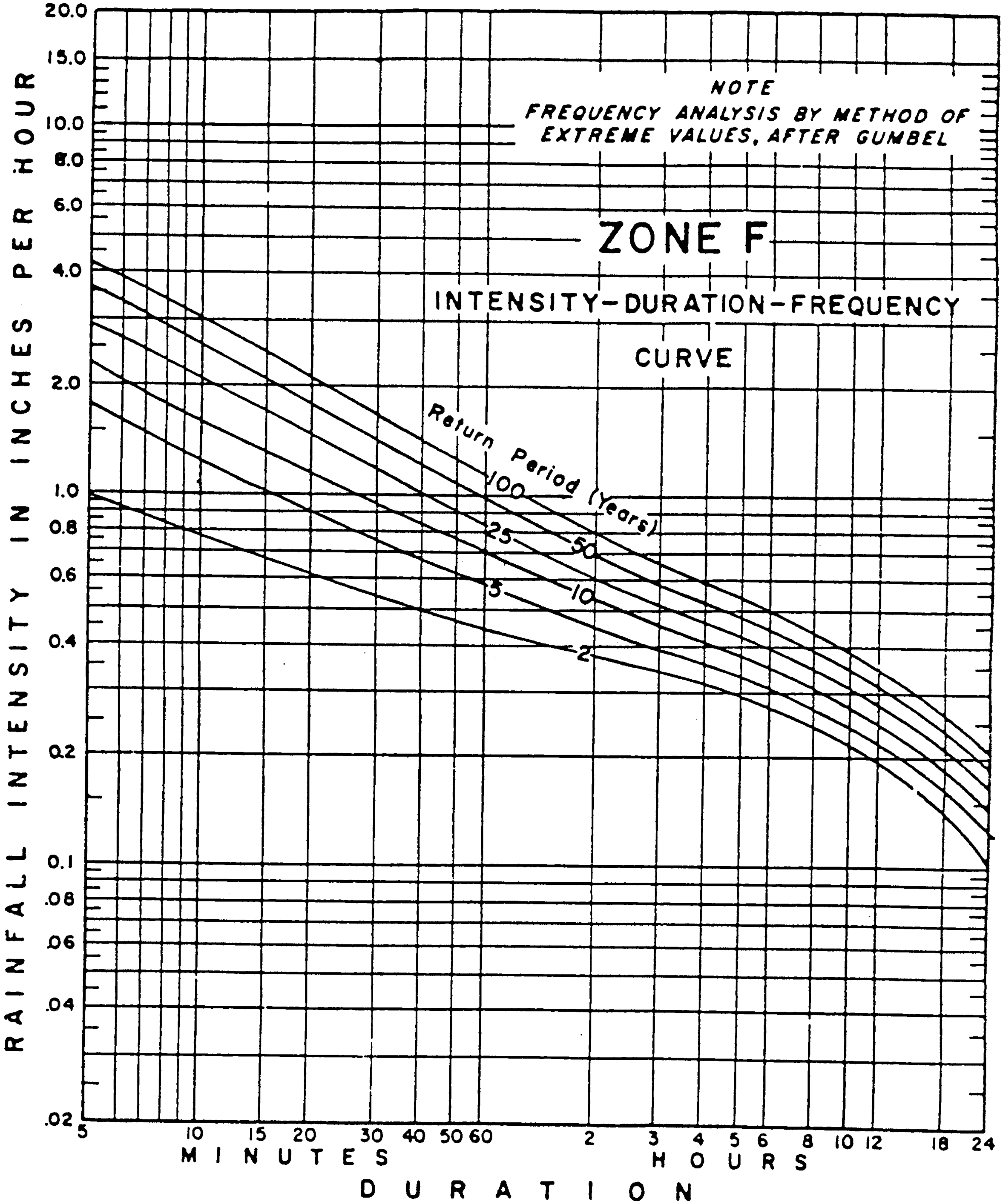


Figure 6

APPENDIX G - TABLES

RUNOFF COEFFICIENTS FOR THE RATIONAL METHOD FOR DETERMINING PEAK DISCHARGE

Description of Area	Flat	Rolling 2% - 10%	Hilly Over 10%
City Business Areas	0.80	0.85	0.85
Industrial Areas, Heavy	0.60	0.80	0.90
Industrial Areas, Light	0.50	0.70	0.80
Meadows and Pasture Land	0.25	0.30	0.35
Multi Units, Detached	0.40	0.50	0.60
Multi Units, Attached	0.60	0.65	0.70
Parks and Cemeteries	0.10	0.15	0.25
Pasture with Frozen Ground	0.40	0.45	0.50
Playgrounds	0.20	0.25	0.30
Railroad Yard	0.20	0.30	0.35
Single Family Residential	0.30	0.40	0.50
Suburban Residential	0.25	0.35	0.40
Unimproved Areas	0.10	0.20	0.30
Woodland and Forests	0.10	0.15	0.20
Character of Surface			
Cultivated Land, Clay and Loam	0.50	0.55	0.60
Cultivated Land, Sand and Gravel	0.25	0.30	0.35
Drives and Walks	0.75	0.80	0.85
Earth Shoulders	0.50	0.50	0.50
Grass Shoulders	0.25	0.25	0.25
Gravel Pavement	0.50	0.55	0.60
Lawns, Sandy Soil	0.10	0.15	0.20
Lawns, Very Sandy Soil	0.05	0.07	0.10
Lawns, Heavy Soil	0.17	0.22	0.35
Median Areas, Turf	0.25	0.30	0.30
Pavement and Roofs	0.90	0.90	0.95
Side Slopes, Turf	0.30	0.30	0.30
Side Slopes, Earth	0.60	0.60	0.60

Table 1

RUNOFF CURVE NUMBERS FOR SELECTED AGRICULTURAL, SUBURBAN, AND URBAN LAND USE ANTECEDENT MOISTURE CONDITION II, AND $I_A = 0.2S$

(SOIL CONSERVATION SERVICE, TR-55)

LAND USE DESCRIPTION	HYDROLOGIC SOIL GROUP			
	A	B	C	D
Cultivated land[1] : without conservation treatment	72	81	88	91
: with conservation treatment	62	71	78	81
Pasture or range land: poor condition	68	79	86	89
good condition	39	61	74	80
Meadow: good condition	30	58	71	78
Wood or Forest land: thin stand, poor cover, no mulch	45	66	77	83
good cover[2]	25	55	70	77
Open Spaces, lawns, parks, golf courses, cemeteries, etc.				
good condition: grass cover on 75% or more of the area	39	61	74	80
fair condition: grass cover on 50 to 75% of the area	49	69	79	84
Commercial and business areas (85% impervious)	89	92	94	95
Industrial districts (72% impervious)	81	88	91	93
Residential[3] :				
Average lot size — Average % Impervious[4]				
1/8 acre or less — 65	77	85	90	92
1/4 acre — 38	61	75	83	87
1/3 acre — 30	57	72	81	86
1/2 acre — 25	54	70	80	85
1 acre — 20	51	68	79	84
Paved parking lots, roofs, driveways, etc.[5]	98	98	98	98
Streets and roads:				
paved with curbs and storm sewers[5]	98	98	98	98
gravel	76	85	89	91
dirt	72	82	87	89

1 For a more detailed description of agricultural land use curve numbers refer to National Engineering Handbook, Section 4, Hydrology, Chapter 9, August 1972.

2 Good cover is protected from grazing and litter and brush cover soil.

3 Curve numbers are computed assuming the runoff from the house and driveway is directed towards the street with a minimum of roof water directed to lawns where additional infiltration could occur.

4 The remaining pervious areas (lawn) are considered to be in good pasture condition for these curve numbers.

5 In some warmer climates of the country, a curve number of 95 may be used.

Table 2

TOTAL PHOSPHORUS REMOVAL EFFICIENCY OF VEGETATIVE FILTER STRIPS*

Soil Type/Vegetative Cover (Manning's Roughness Coefficient)	Filter Strip Width (minimum width plus additional width for each % slope) According to Total Phosphorus Removal Efficiency				
	62% TP Removal	59% TP Removal	55% TP Removal	52% TP Removal	49% TP Removal
medium sand					
dense underbrush (.8)	10'	10'	10'	10'	10'
light underbrush (.35)	10'	10'	10'	10'	10'
grass (.2)	10'	10'	10'	10'	10'
fine sand					
dense underbrush (.8)	10'	10'	10'	10'	10'
light underbrush (.35)	10'	10'	10'	10'	10'
grass (.2)	10' + 1'	10'	10'	10'	10'
coarse silt					
dense underbrush (.8)	25' +5'	25' + 2'	15' + 2'	10' + 1'	10'
light underbrush (.35)	40' + 27'	30' +13'	25' + 8'	20' + 5'	10' + 4'
grass (.2)	85' +87'	40' + 40'	25' + 25'	20' + 18'	10' + 15'
medium silt					
dense underbrush (.8)	33' + 6'	33' + 1'	20' + 3'	13' + 1'	13'
light underbrush (.35)	52' + 35'	39' + 17'	33' + 10'	26' + 7'	13 ' + 5'
grass (.2)	111' + 113'	52' + 52'	33' + 32'	26' + 23'	13' + 20'
fine silt					
dense underbrush (.8)	123' + 24'	123' + 10'	74' + 10'	49' + 5'	49'
light underbrush (.35)	196' + 132'	147' + 64'	123' + 39'	98' + 25'	49' + 20'
grass (.2)	417' + 426'	196' + 196'	123' +122'	98' + 88'	49' + 74'

* Based on Wong and McCuen, 1982 (for sediment) with removal efficiencies adjusted to account for soluble phosphorus which will not be removed by the filter strip. Assumptions: Slope does not exceed 17%, runoff enters the strip as sheet flow, minimum filter strip width 10 feet, particulate phosphorus removal rates are the same as sediment removal rates, no soluble phosphorus will be removed by the buffer, 35% of the Total P in the incoming runoff is soluble, 65% is particulate, and no short circuiting or erosion will occur in the filter strip (a level spreader and routine inspection and maintenance will likely be needed to achieve this).

Table 3

SEDIMENT REMOVAL EFFICIENCY OF VEGETATIVE FILTER STRIPS*

Soil Type/Vegetative Cover (Manning's Roughness Coefficient)	Filter Strip Width (minimum width plus additional width for each % slope) According to Sediment Removal Efficiency				
	95% Sediment Removal	90% Sediment Removal	85% Sediment Removal	80% Sediment Removal	75% Sediment Removal
medium sand					
dense underbrush (.8)	10'	10'	10'	10'	10'
light underbrush (.35)	10'	10'	10'	10'	10'
grass (.2)	10'	10'	10'	10'	10'
fine sand					
dense underbrush (.8)	10'	10'	10'	10'	10'
light underbrush (.35)	10'	10'	10'	10'	10'
grass (.2)	10' + 1'	10'	10'	10'	10'
coarse silt					
dense underbrush (.8)	25' +5'	25' + 2'	15' + 2'	10' + 1'	10'
light underbrush (.35)	40' + 27'	30' +13'	25' + 8'	20' + 5'	10' + 4'
grass (.2)	85' +87'	40' + 40'	25' + 25'	20' + 18'	10' + 15'
medium silt					
dense underbrush (.8)	33' + 6'	33' + 1'	20' + 3'	13' + 1'	13'
light underbrush (.35)	52' + 35'	39' + 17'	33' + 10'	26' + 7'	13 ' + 5'
grass (.2)	111' + 113'	52' + 52'	33' + 32'	26' + 23'	13' + 20'
fine silt					
dense underbrush (.8)	123' + 24'	123' + 10'	74' + 10'	49' + 5'	49'
light underbrush (.35)	196' + 132'	147' + 64'	123' + 39'	98' + 25'	49' + 20'
grass (.2)	417' + 426'	196' + 196'	123' +122'	98' + 88'	49' + 74'

* Based on Wong and McCuen, 1982. Assumptions: Slope does not exceed 17%, runoff enters the strip as sheet flow, minimum filter strip width 10 feet, and no short circuiting or erosion will occur in the filter strip (a level spreader and routine inspection and maintenance will likely be needed to achieve this).

Table 4

APPENDIX H
SITE DISTURBANCE PLAN CHECKLIST

1. **Project Summary**
   - ☐ Size of site (acres or square feet)
   - ☐ Structures to be constructed
   - ☐ Size (area) of planned roads, parking areas, and sidewalks
   - ☐ Changes in drainage
   - ☐ Changes in vegetative cover
   - ☐ A description of temporary and permanent erosion control measures
   - ☐ A description of the stormwater system
   - ☐ Any design problems or constraining environmental conditions
   - ☐ How the proposed BMPs were selected for the project
   - ☐ Pertinent information which supports the design calculations
   - ☐ Soil type and suitability for proposed BMPs
   - ☐ Method(s) for handling anticipated groundwater
   - ☐ Fill placement considerations (benching, terracing, compaction, justification for steeper than ordinance standards)
   - ☐ Cut slope considerations (terracing, justification for steeper than ordinance standards)
   - ☐ Product specifications
   - ☐ Permanent stabilization requirements (seed types, fertilizers, application rates, timing)
   - ☐ Winterization requirements (when applicable)
   - ☐ Inspection schedule
   - ☐ Cost estimate
   - ☐ Construction schedule

   Comments ____

   ____

2. **Vicinity Drainage** (not greater than 2000 feet to the inch)
   - ☐ Stormwater Drainage Patterns within one mile of site
   - ☐ Existing surface water bodies (streams, rivers, lakes, wetlands) within one mile
   - ☐ Extent of the watershed area(s) which drains to or through the project site

   Comments ____

   ____

3. **Site Plan(s)** (not greater than 100 feet to the inch)

   a. Existing site conditions
      - ☐ Property boundaries
      - ☐ Existing roads, sidewalks, parking areas, and other impervious surfaces (indicating paved, gravel, dirt, etc.)
      - ☐ Structures (describe dimensions, construction)
      - ☐ Surface water features and designated buffer zones

- ☐ Water drainage channels (with flow, velocity, and volume information)
- ☐ Utilities
- ☐ Easements
- ☐ Topography (two foot contour intervals with reference datum)
- ☐ Location of soil types
- ☐ Location of vegetative cover types (grassland, scrubs, trees, wetland)

b. Proposed Features

- ☐ Areas to be cleared of vegetation
- ☐ Areas where soil is to be stockpiled
- ☐ Areas to be graded, filled, and/or excavated (with proposed final contours)
- ☐ Location/width/configuration of benches, terraces, other slope treatments
- ☐ Areas to be revegetated (indicating lawn, landscaping details, etc)
- ☐ New structures
- ☐ New roads, parking areas, sidewalks (indicating paved, gravel, dirt, etc.)
- ☐ Utilities
- ☐ Easements
- ☐ Erosion and sedimentation control features, including:
  - Location, type, and proper installation of temporary measures
  - Stabilized construction entrance, parking and staging areas
  - Method(s) for temporarily covering spoil piles and disturbed ground
  - Dust abatement and measures to reduce wind erosion
  - Permanent site stabilization and revegetation methods must also be included
- ☐ Post construction stormwater drainage patterns
- ☐ Stormwater conveyance, treatment, and detention features, including:
  - Location(s), profile/cross section(s), bottom elevations, slope(s), dimensions, invert elevation(s), other information necessary to convey the design parameters and method of functioning
- ☐ Cross section dimensions and bottom elevations of any off-site drainage channel which will either contribute runoff to the site or into which on-site runoff will pass

Comments ____

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4. **Calculations**

- ☐ Hydrologic model used (S.C.S., Rational Method)
- ☐ Assumptions made
- ☐ Data used
- ☐ Off-site runoff flowing on-site for design storm
- ☐ Existing runoff generated on-site for design storm
- ☐ Post construction runoff generated on-site for design storm
- ☐ Anticipated loss rates (evaporation, infiltration) for each treatment and detention feature
- ☐ Anticipated flow capacity and velocity in conveyance systems
- ☐ Detention/retention time and volumes

- ☐ Any other pertinent design consideration which will help describe the appropriate functioning of the system
- ☐ Post-construction runoff which will move off-site

Comments ____

____

5. **Operation and Maintenance**
   - ☐ Inspection frequency
   - ☐ Responsible person or entity
   - ☐ Routine maintenance requirements
   - ☐ System failure

   Comments ____

   ____

   ____

6. **General**
   - ☐ Submit 3 sets of plans for County review and approval
   - ☐ Plans stamped, signed, and dated by qualified design professional