CHAPTER 10

STORM DRAINAGE CRITERIA

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CHAPTER 10
STORM DRAINAGE CRITERIA

10.1 POLICY SUMMARY

10.1.1 General

The statements in this section are the basis for all stormwater management within the Town of Winter Park and are to be used as guidelines in the design and evaluation of all storm drainage facilities. The *Grand County Storm Drainage Design and Criteria Manual* (Grand Co. manual) shall be used for design and evaluation of drainage facilities. The policies and criteria within the Grand Co. manual are accepted by the Town of Winter Park except where modified in these design and construction standards.

10.1.2 Major and Minor Drainage Systems

For all land uses, design of facilities within the major drainage system shall be based on the 100-year storm runoff unless the Town Engineer specifies a different level of protection. Design of facilities for the minor drainage system shall be based on the level of protection required for various land uses. The design storm associated with the minor drainage system is referred to as the minor storm.

10.1.3 Natural Drainageways

The policy of the Town shall be to direct runoff from new developments into historic and natural drainageways and to promote the recreational use and enhance the aesthetic value of such drainageways wherever possible. Runoff shall not be diverted into drainageways so as to increase erosion in the receiving drainageways. Nor shall runoff from a development be allowed to increase flooding problems in the receiving drainageway.

10.1.4 Open Channels/Drainageways

The policy of the Town shall be to maintain the stability of all open channels in order to prevent erosion and the contribution of additional sediments. All open channels which are part of the major drainage system shall have sufficient capacity to convey the 100-year storm runoff unless the Town Engineer specifies a different level of protection.

10.1.5 Detention

The policy of the Town shall be to require detention storage of stormwater runoff to limit peak discharges from newly developed areas to historic rates. Exemptions to detention requirements may be allowed in cases where the increase in historic runoff is not significant and will not aggravate flooding or erosion problems.

10.1.6 Private Property Drainage

All systems designed to pump and/or drain water from private property to the Town rights-of-way shall be approved by the Town Engineer prior to construction.

A thirty-foot (30') strip of land measured horizontally from the mean high water mark on each side of any live stream or creek located within the boundaries of the subdivision shall be protected in its natural state and shall be provided with a perpetual drainage easement, with the exception that footpaths, bridges, irrigation structures, and flood control and erosion devices may be constructed thereon. If such watercourse is along the outer boundaries of the subdivision, this requirement shall apply to that part of such watercourse and strip which is located within the subdivision. Other drainageways shall be provided with a perpetual drainage easement conforming substantially with the lines of the

drainageway and of such width necessary and adequate to carry off the predictable volume of stormwater drainage. Underground utilities may be located in such easements provided there is not a practical alternative location, that the plans are approved by the Planning and Zoning Commission through its designated representative, and that all disturbed areas are revegetated. In all cases, the thirty-foot (30') requirement described above shall be enforced as a minimum setback. A greater setback, up to one hundred fifty feet (150') may be required where:

the slope equals or exceeds thirty percent (30%)

highly erodable soils are present

the proposed use of the property presents a special hazard to water quality such as storage or handling of hazardous or toxic materials

The increased setbacks to be required in such cases shall be determined by the Planning and Zoning Commission upon the recommendation of the Town Planner. In appropriate cases, a setback of greater than one hundred fifty feet (150') may be required by the Planning and Zoning Commission in order to protect the public health, safety, and welfare.

10.1.7 **Water Quality**

It is the policy of the Town that drainage shall be controlled so as not to degrade the quality of surface water and groundwater.

10.1.8 **Preparation by Professional Engineer**

All drainage plans shall be prepared by or under the direct supervision of a Professional Engineer registered in the state of Colorado. The engineer preparing or supervising the preparation of the plan shall verify that the proposed drainage facilities will meet the standards and criteria of the ordinance and related regulations including integration with other project features such as water quality and sediment transport control measures, existing floodplain management, grading, roads, parking, and landscaping.

10.2 DRAINAGE PLAN REQUIREMENTS AND DESIGN GUIDELINES

10.2.1 **Preliminary Drainage Plan**

A preliminary drainage plan shall be submitted to the Town Engineer for review. Content requirements are detailed in Section 2, "Submittal Requirements for Construction Plans."

10.2.2 **Final Drainage Plan**

A final drainage plan shall be submitted to the Town Engineer for review with the Final Drainage Construction Plans. Content requirements are detailed in Section 2, "Submittal Requirements for Construction Plans."

10.2.3 **Final Drainage Construction Plans**

Final drainage construction plans shall be submitted to the Town Engineer for review with the final project construction plans. Content requirements are detailed in Section 2, "Submittal Requirements for Construction Plans."

10.3 GENERAL DESIGN CRITERIA

10.3.1 Introduction

These standards set forth general criteria to be followed in designing drainage facilities in the Town of Winter Park.

The planning and design of the drainage system shall not be such as to transfer the problem from one location to another or create a more hazardous condition downstream. Although improvements may not have to be made upstream or downstream from a development, provisions shall be made in all cases where significant flow is concentrated in the form of a drainage easement or drainageway for the 100-year storm to pass through the development. Natural drainageways are to be used whenever feasible. Alterations to natural drainage patterns may be approved if a thorough investigation and analysis submitted by the engineer shows no hazard or liability. The drainage plan must indicate the route the flow will take from the site to either a natural drainageway or Town storm drainage facility.

In cases when the development of property results in the alteration of drainage patterns or the concentration of flow, documentation must be provided that demonstrates existing drainage systems (either natural or man-made) have sufficient capacity to convey the altered flows without causing increased damage due to flooding. In addition, the concentration of flow or alteration of drainage patterns must not result in increased erosion to downstream properties.

All drainage improvements shall be as natural in appearance as possible to be aesthetically pleasing. Maintenance access shall be provided for all drainage and flood control facilities.

Where the Town's drainage master plan or subsequent site-specific master plans identify recommendations or criteria for drainage improvements, proposed drainage systems shall conform to that plan. In areas where master plan information is not available, major drainageways and easements shall be located to provide continuity with existing drainage conditions and facilities. These drainageways and easements shall be shown on all drainage plans and final plats.

All drainage plans, in addition to design storms, shall consider the runoff created by snow melt. Considerations shall include design features that will allow snow melt to run off from the site without causing icing problems on the surface, in inlets, in culverts or in storm drains. In addition, the design shall recognize the problems that can be created by snow melt due to the large volume of water released.

10.3.2 Hydrologic Design Criteria

10.3.2.1 General

The hydrologic analysis for a particular area shall be based on the proposed land use for that area. Contributing runoff from upstream areas shall be based on existing land use and topography. For purposes of designing detention storage facilities, calculation of historic rates of runoff shall be based on undeveloped watershed conditions unless other criteria are specified by the Town Engineer in writing.

Two separate and distinct storms shall be considered in the design of the drainage system. The first is the initial storm which occurs at fairly regular

intervals, based on the two- to ten-year storm, depending on land use. The second is the major storm which is defined as the 100-year storm. In some instances, the major storm routing will not be the same as the initial storm. In this case, a complete set of drainage plans shall be submitted for each storm system Refer to Figures 10.1, "Rainfall Intensity—Frequency Curves," and Figure 10.2, "Drainage Area vs. Discharge Frequency Curves (Snow Melt)."

10.3.2.2 Design Storms

Table 10.1 specifies design storms for both the initial and major storm runoff based on land use. In some instances a land use requiring a higher return period storm may be located above a proposed project. In such cases, in order to maintain a consistent and orderly storm drainage network, the Town Engineer may require the downstream system to be designed to the return periods applicable to the upstream area.

Table 10.1
DESIGN STORM FREQUENCIES

Land Use	Design Storm (Initial Storm)	Return Period (Major Storm)
*Residential up to four units/acre	2-year	100-year
*Residential greater than four units/acre	10-year	100-year
*Service Commercial	10-year	100-year
*Retail Commercial	10-year	100-year
*Recreational/Open Space	2-year	100-year
*Open Channels and Drainageways	- -	100-year
*Detention Facilities	10-year	100-year

10.4 STORM SEWERS

A storm sewer system shall be deemed necessary whenever street capacities to carry design storm runoff are exceeded. This includes both the initial storm and major storm runoff. When the planned storm sewer connects into existing storm sewer lines, analysis must be provided that indicates the additional flow from the proposed project does not exceed the existing storm sewer capacity.

The placement of storm inlets shall be determined by a thorough analysis of the drainage area and streets involved. Inlets shall also be located in all areas where sump (low spot) conditions exist. However, due to freezing problems at inlets and the associated hazards, sump conditions will only be allowed if no practical alternatives for grading and drainage exist. To lessen the likelihood of inlet blockage due to ice build-up in sump areas, the inlet shall be sized to have twice the capacity as would otherwise be required by this Section.

Storm sewers with pressure flows shall be designed to withstand the forces of such pressure. When pressure flow occurs, pressures that create surcharged conditions at storm inlets are not allowed.

10.4.1 **Frequency of Design Runoff**

When conditions warrant the installation of a storm sewer system and the street runoff carrying capacity does not govern the design, the storm sewer shall be designed for the storm frequencies for the specific land uses listed in Table 10.1. Creation of a storm drainage system does not relieve the developer from the requirement to provide, in the case where significant flow is concentrated, a drainage easement or drainageway for the

major (100-year) storm runoff to pass through the development.

Table 10.2
STORM DRAINAGE SYSTEM
DESIGN STORM FREQUENCIES

Land Use	Initial Design Storm Return Period Frequency
*Residential up to four units/acre	2-year
*Residential greater than four units/acre	10-year
*Commercial/Business	10-year
*Recreational/Open Space	2-year

10.4.2 **Storm Sewer Pipe**

The minimum allowable pipe diameter shall be 18 inches for main trunks and laterals. In areas where debris, sediment deposition or freezing are potential problems, the Town Engineer may require additional over-sizing of the pipe. All pipe shall be of sufficient strength to withstand AASHTO HS-20-44 loading.

If there is reason to believe that pipe corrosion may be a problem, the Town Engineer may request that a soils report be performed addressing potential corrosive properties of the soils and groundwater in the area of storm sewer installation. Additionally, an analysis of the stormwater may be required.

When located beneath areas where regular snow removal is performed, storm sewers shall consider pipe freezing problems and make efforts to divert winter flows.

10.4.3 **Inlets and Grates**

Where a clear and present danger exists such as a siphon, a drop in elevation adjacent to a sidewalk or road, a long pipe with one or more manholes, or at pipes which are near playgrounds, parks, and residential areas, a grate may be required. For most pipes through embankments and crossing streets, grates will not be required.

Storm inlets shall be installed where sump conditions exist or street runoff-carrying capacities are exceeded. When inlets are installed on "continuous grade" conditions rather than at sump locations, in most cases some gutter flow will not be intercepted by the inlet. The amount of "inlet carryover" must be included in the evaluation of the inlet and downstream facilities. All curb openings shall be installed with the opening at least two inches below the flowline elevation. Because of debris plugging, pavement overlaying, parked vehicles, and other factors which decrease inlet capacity, a reduction shall be applied to the inlet capacity.

10.4.4 **Manholes**

Table 10.3 sets forth the maximum allowable manhole spacing for storm sewers. A manhole shall be placed wherever there is a change in size, abrupt change in direction, elevation or slope, where there is a junction of two or more systems or laterals, or when the maximum distance from Table 10.3 is reached.

Table 10.3
MAXIMUM ALLOWABLE MANHOLE SPACING

Vertical Pipe Dimension (inches)	Maximum Allowable Distance Between Manholes (feet)
24 to 36	400
36 to 60	500
> 60	750

10.5 CULVERTS

The size, shape, and type of culvert crossings shall be based on the calculated flow quantities as well as existing topographic conditions. Soil tests and water analysis may be required to determine the suitability of materials in questionable areas. Allowable materials for culverts include corrugated metal and reinforced concrete.

The structural design of culverts shall conform to those methods and criteria recommended by the manufacturer for that culvert type and for the conditions found at the installation site. However, the culvert as a minimum shall be designed to withstand an HS-20-44 loading in accordance with the design procedure set forth in the current American Association of State Highway and Transportation Officials (AASHTO) *Standard Specifications for Highway Bridges*.

All culvert installations (except under major arterials or from large drainage areas) shall be designed with an overflow capacity for the major storm. Culverts under major arterials or conveying flows from drainages with areas in excess of 0.5 square miles shall have sufficient capacity to pass the 100-year storm runoff assuming that 20 percent of the inlet is plugged. Culverts under local and collector streets shall be designed to carry the 25-year storm discharge. Ponding above culvert entrances will not be allowed if such ponding will cause property or roadway damage, culvert clogging, saturation of fills, detrimental upstream deposits of debris, increase existing floodplain elevation or inundate existing or future facilities. The HW/D ratios listed in Table 10.4 are to be applied to culverts at street crossings and should not be applied in the case of an outlet from a detention facility or sedimentation facility.

Table 10.4
MAXIMUM HEADWATER/DIAMETER RATIOS (HW/D)

Storm Frequency	HW/D
25-year	1.0
100-year	1.5

All inlet structures shall be designed to minimize entrance losses. All culverts shall be fitted with flared-end sections, headwalls, wingwalls or other approved methods to minimize entrance losses. Projecting ends shall not be permitted (except beneath driveways). Ditch sections and profiles shall be transitioned at culvert inlets and outlets to allow for adequate cover over the culvert and provide inlet and outlet conditions which will not cause erosion or sediment deposition.

All outlet structures shall be protected by riprap (except beneath driveways). Outlet energy dissipators may be required where the 25-year storm flow exceeds twelve feet per second.

10.6 OPEN CHANNELS

All open channels shall be designed to carry the major storm (100-year recurrence interval). Channels shall be designed to be stable and prevent additional contributions of sediments due to erosion of the bed or banks. Channel lining with riprap or use of energy dissipation structures shall be used to provide a stable channel when necessary. A minimum of one foot or 25 percent of the design depth, whichever is greater, of freeboard shall be incorporated into channels. The design of channels on bends or curves shall take into consideration the centrifugal and gravitational forces on the flow within the channel section.

10.7 DETENTION STORAGE

10.7.1 General

The main purpose of a detention facility is to store the excess storm runoff associated with an increased proportion of impervious cover associated with development and discharge this excess at a rate similar to the rate experienced from the basin without development. Additionally, detention facilities can be designed to be multi-purpose and assist in fulfilling requirements of water quality and sediment transport control.

10.7.2 Design Criteria

All detention facilities shall be designed for the runoff resulting from the initial storm and major storm. The minor storm runoff is required in addition to the major storm runoff to prevent an increase in historic rates of runoff over a range of conditions. The facility shall be designed to release the runoff from the developed condition at or below the calculated historic peak runoff rate for the two specified storms. Facilities with dam height in excess of ten feet, surface area in excess of 20 acres or volume in excess of 100 acre-feet are referred to as "jurisdictional dams" and shall require approval of the plans by the State Engineer's office.

10.7.3 Maintenance Requirements

An important part of a detention facility is the continued maintenance of the facility to ensure that it will function as designed. Maintenance of detention facilities involves removal of debris and sediment and periodic inspection of outlets. Such tasks are necessary to preclude the facility from becoming unhealthy and to retain the effectiveness of the detention basin. Maintenance responsibility lies with the owner of the land, except as modified by specific agreement. Maintenance responsibility shall be delineated on the final plat. Maintenance access for detention ponds need not be specified as an easement but must be adequate for maintenance and shown on the Final Plat. Should the owner fail to adequately maintain the facilities, the Town shall have the right to enter the property for the purpose of operations and maintenance. All such maintenance costs and associated legal fees will be assessed to the property owner.

10.7.4 Exemptions

Specific projects may be exempted from the detention requirements based on the small size or proximity to an existing stormwater conveyance system of adequate size to convey the developed condition runoff. The Town Engineer shall require supporting analysis and certification that exclusion from the detention requirement will not cause any adverse downstream impacts.

10.8 ADDITIONAL REQUIREMENTS AND VARIANCES

The Town of Winter Park reserves the right, in the Town's best interest, to issue and enforce more stringent criteria should adverse conditions exist. Also, occasions may arise when the minimum standards are inappropriate. All applications for designs varying from the criteria shall obtain written approval of the variance from the Town Engineer prior to final approval of the plans. The engineer preparing the plans must certify that the variance does not result in a hazard or increase the likelihood of damage to adjacent and downstream properties.

10.9 FINAL APPROVAL OF DRAINAGE CONSTRUCTION

Before a release of Drainage Guarantee (Exhibit A), Certificate of Occupancy and/or final building permit will be granted, the site drainage shall be inspected for compliance with the approved drainage plan and/or site plan.

APPENDIX 1
TOWN OF WINTER PARK
DRAINAGE REPORT CHECK LIST
PRELIMINARY REPORT

	REPORT CONTENTS	REMARKS
LOCATION INFORMATION		
1.	Section, Township, Range	
2.	Adjacent Streets	
3.	Major Drainage Facilities	
4.	Adjacent Development	
DESCRIPTION OF PROPERTY		
5.	Area in Acres	
6.	Ground Cover Type/Description	
7.	Land Use	
8.	Project Description	
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MAJOR SUB-BASINS		
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2.	Anticipated Detention Facilities	
3.	Anticipated Inlets	
4.	Anticipated Channels/Swales	
5.	Compliance with Criteria	
6.	Effects on Up-stream Property	
7.	Effects on Down-stream Property	

FINAL REPORT
(SAME AS PRELIMINARY REPORT WITH THESE ADDITIONS)

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DRAINAGE CALCULATIONS FOR DESIGN AND MAJOR STORM		
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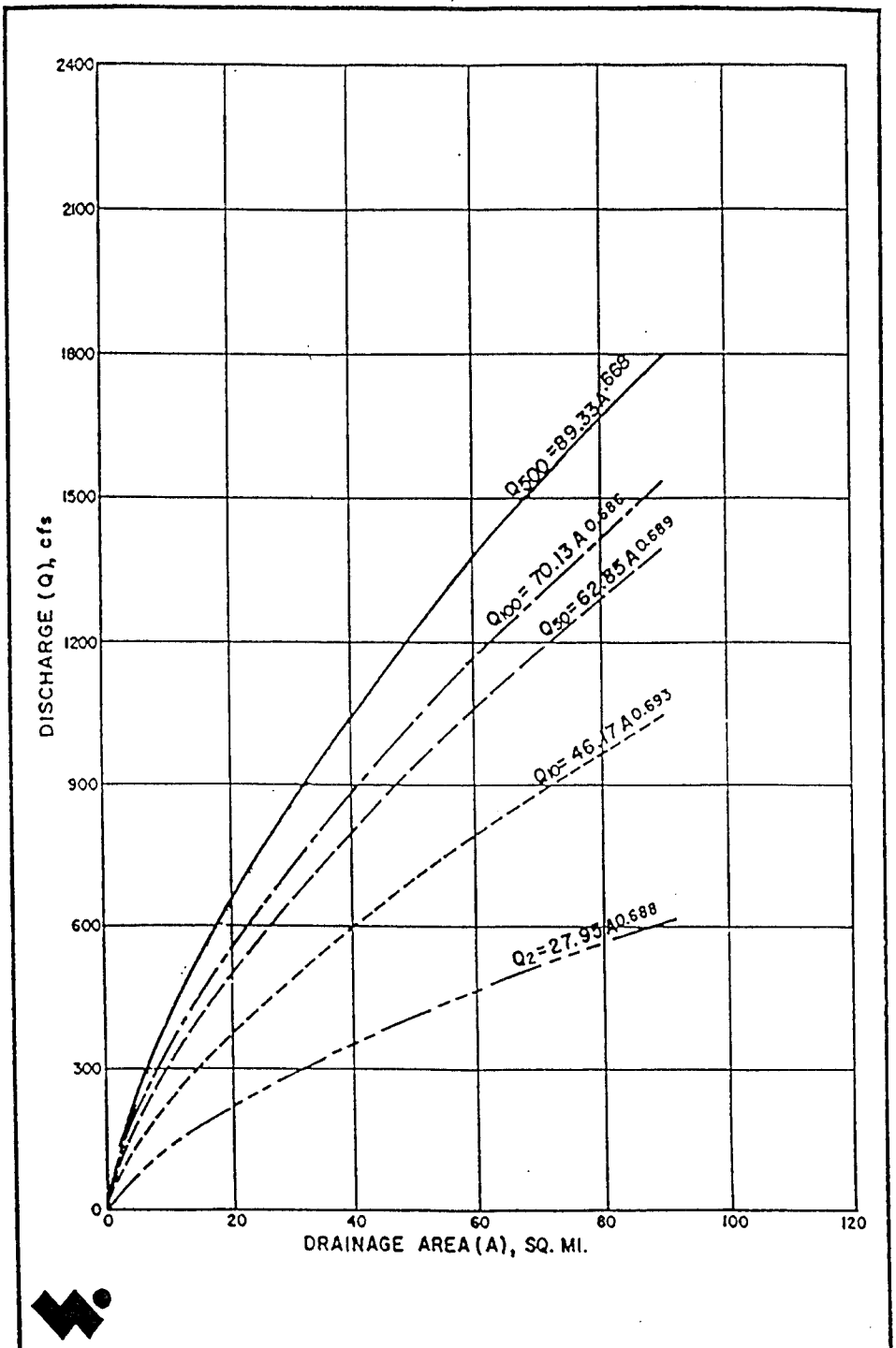
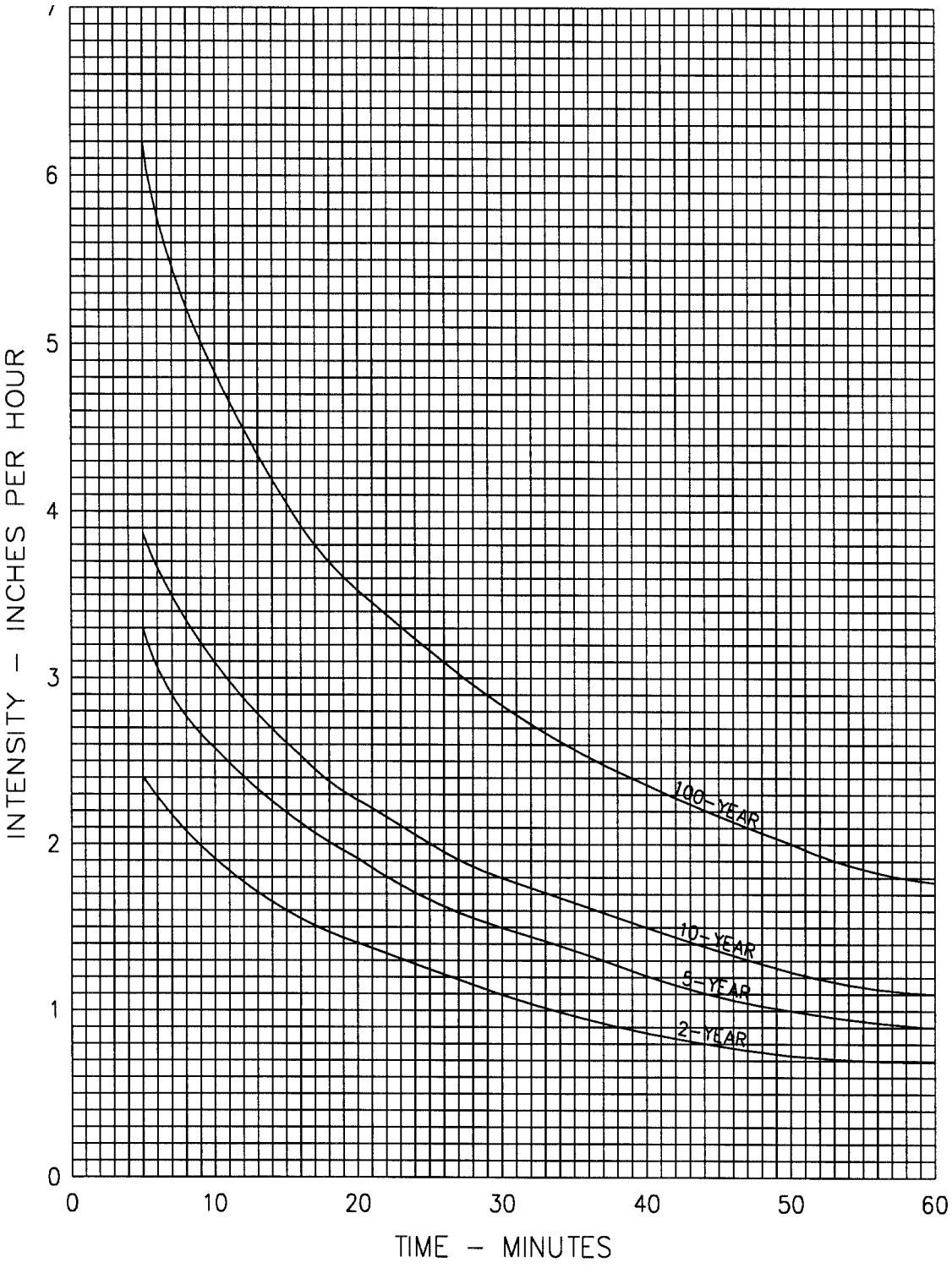
1.	Storm Sewer with Hydraulic Grade Lines	
2.	Inlets with Capacity Calculations	
3.	Detention Facilities with Hydraulic Analyses	
4.	Channels/Swales/Hydraulic Analyses	

A regional regression analysis was completed in 1983 for the Fraser River Basin (2) and the following relationships were developed where A is the drainage area in square miles:



TOWN OF WINTER PARK	DRAINAGE AREA VS. DISCHARGE FREQUENCY CURVES (SNOWMELT)	F11



DERIVED FROM THE NOAA ATLAS 2 PRECIPITATION–FREQUENCY ATLAS OF WESTERN UNITED STATES, VOLUME III–COLORADO, U.S. DEPARTMENT OF COMMERCE, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION.

AS PRESENTED IN APPENDIX A OF THE GRAND COUNTY STORM DRAINAGE MANUAL, AMENDED IN MARCH 1998.

DATE PREPARED: NOVEMBER, 1998

RAINFALL INTENSITY-FREQUENCY CURVES