

# Section 300

## Drainage Policy

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### 301 INTRODUCTION

NRS 543.340(4) gives the BOARD of the CCRFCD the authority to adopt written policies for administering the District and for operating and maintaining its projects and improvements. The CCRFCD has prepared and adopted POLICIES AND PROCEDURES for the operation of the District. The policies presented in this MANUAL relate specifically to the engineering aspects of drainage. The reader should become familiar with the policies of the District contained in the POLICIES AND PROCEDURES.

In urban areas it is necessary to provide an adequate drainage system in order to preserve and promote the general health, welfare, and economic well being of the region. Drainage is a regional feature that affects all governmental jurisdictions and all parcels of property. This characteristic of drainage requires coordination between different entities and cooperation from both the public and private sectors.

Master planning of Regional Flood Control Facilities as identified in the CCRFCD's Master Plan has been provided by the CCRFCD through coordination and cooperation with all impacted entities. Periodic updates, as required by NRS 543.596 or allowed by NRS 543.5965, to the CCRFCD's Master Plan must be provided by the CCRFCD and will be coordinated with the effected entities.

All Flood Control Facilities not identified in the CCRFCD's Master Plan are considered to be Local Flood Control Facilities of the entity where the facilities are located. The planning of Local Flood Control Facilities will be provided by the entity where the facility is located. If the Local Flood Control Facility impacts other entities and/or Regional Flood Control Facilities then the planning must be coordinated with the impacted entities.

When planning drainage facilities, certain underlying principles provide direction for the effort. These principles are made operational through a set of policy statements. The application of the policy is in turn facilitated by technical criteria and data. When considered in a comprehensive manner, on a regional and local level with public and private involvement, drainage facilities can be provided in developing areas in a manner that will provide the required flood protection.

**302 BASIC PRINCIPLES**

**302.1 Stormwater Drainage System**

The Stormwater Drainage System is an integral part of the total urbanization process. The planning of drainage facilities must be included in the urbanization process. The first step is to include drainage planning with all regional and local development master plans.

Drainage systems require space to accommodate their conveyance and storage functions. When the space requirements are considered, the provision for adequate drainage becomes a competing use for space along with other land uses. If adequate provision is not made in a land use plan for the drainage requirements, stormwater runoff will conflict with other land uses and may result in water damage, and may impair or even disrupt the functioning of other urban systems.

THE POLICY OF THE CCRFCD SHALL BE TO CONSIDER STORMWATER DRAINAGE AN INTEGRAL PART OF THE OVERALL URBAN SYSTEM, AND TO REQUIRE STORM DRAINAGE PLANNING FOR ALL DEVELOPMENTS TO INCLUDE THE ALLOCATION OF SPACE FOR DRAINAGE FACILITY CONSTRUCTION AND MAINTENANCE, WHICH MAY ENTAIL THE DEDICATION OF ROW AND/OR EASEMENTS.

**302.2 Multi-Purpose Resource**

Stormwater runoff is a resource that has the potential, although limited in a desert environment, of being utilized for different beneficial uses. These uses, however, must be compatible with adjacent land uses and applicable water laws.

THE POLICY OF THE CCRFCD SHALL BE TO CONSIDER STORMWATER RUNOFF AS A RESOURCE AND RECOGNIZE ITS POTENTIAL FOR OTHER USES.

**302.3 Water Rights**

A drainage design must be planned and constructed with proper recognition given to the existing water rights and applicable water laws. When the drainage system interferes with existing water rights, the value and use of the water rights are affected.

THE POLICY OF THE CCRFCD SHALL BE TO RECOGNIZE THE EXISTENCE OF VESTED WATER RIGHTS.

### **302.4 Jurisdictional Cooperation**

Since drainage considerations and problems are regional in nature, and do not respect jurisdictional boundaries, drainage planning must emphasize regional jurisdictional cooperation, unified standards, and similar drainage requirements in accomplishing the goals.

THE POLICY OF THE CCRFCD SHALL BE TO PURSUE A JURISDICTIONALLY UNIFIED DRAINAGE EFFORT TO PROMOTE AN INTEGRATED DRAINAGE PLAN.

## **303 REGIONAL AND LOCAL PLANNING**

### **303.1 Reasonable Use of Drainage**

Drainage Law (Section 400) recognizes that downstream properties should not be unreasonably burdened with increased flow rates or unreasonable changes in manner of flow from upstream properties. The law also recognizes that drainage problems should not be transferred from one location to another (basin transfers). However, drainage law also acknowledges that downstream properties cannot block natural runoff through their site and must accept runoff from upstream properties.

Drainage planners have long realized that the development process alters historic or natural drainage paths and sets the stage for violation of the above stated drainage laws. However, strict compliance with the above laws can produce drainage systems which may be a detriment to the general public. Therefore, drainage planners follow a "Reasonable Use of Drainage" philosophy to provide for economic and efficient drainage systems within the limits of drainage laws.

Briefly stated, "Reasonable Use of Drainage" is defined for planning purposes, as providing an economic and hydraulically efficient drainage system which is demonstrated not to adversely impact downstream properties within reason. This "Reasonable Use of Drainage" therefore allows development to occur while preserving the rights of adjacent property owners.

THE POLICIES OF CCRFCD REGARDING THE "REASONABLE USE OF DRAINAGE" AS RELATED TO THE STATED DRAINAGE LAWS ARE PRESENTED IN THE FOLLOWING SECTIONS.

**303.1 .I Increase in Rate of Flow**

The process of development will generally increase the rate of flow to downstream properties due to increases in impervious area from buildings, streets, and parking lots. Mitigation of these increases are generally accomplished through detention and/or retention facilities.

THE POLICY OF THE CCRFCD SHALL BE TO MINIMIZE THE INCREASE IN THE RATE OF FLOW FROM DEVELOPING PROPERTIES UNLESS DOWN STREAM FACILITIES EXIST TO ACCOMMODATE THE INCREASED FLOW RATES.

The CCRFCD's policies for detention and retention are presented in Section **303.6**.

**303.1.2 Change in Manner of Flow**

The process of development will tend to concentrate existing natural sheet flow into point flows at property lines. These point flows are generally associated with outlets from gutter flow, storm sewers, and detention facilities. Discharge of point flows on undeveloped downstream property can cause increased erosion at the discharge point and further downstream. Mitigation of these point flows can be accomplished through energy dissipators or flow spreaders.

THE POLICY OF CCRFCD SHALL BE TO REQUIRE THAT POINT FLOWS BE DISCHARGED TO DOWNSTREAM PROPERTIES AT NON-EROSIVE VELOCITIES AND DEPTHS OF FLOW.

**303.1.3 Diversion of Drainage**

The process of development can alter the historic or natural drainage paths. When these alterations result in a local on-site drainage system that discharges back into the natural drainageway or wash at or near the historic location, then the alterations (intra-basin transfer) are generally acceptable. However, when flows from the local on-site drainage system do not return to the historic drainageway or wash, then inter-basin transfer may result. These inter-basin transfers are generally not acceptable. Planning and design of drainage systems should not be based on the premise that problems can be transferred from one location or basin to another. Every reasonable attempt shall be made to mitigate non-stormwater nuisance flows.

THE POLICY OF THE CCRFCD SHALL BE TO MAINTAIN THE FLOW OF STORM RUNOFF WITHIN ITS NATURAL DRAINAGE PATH UNLESS REASONABLE USE IS DEMONSTRATED OTHERWISE.

### **303.2 Regional Master Planning**

As mandated in NRS 543.590, the CCRFCD has prepared and the BOARD has adopted a Regional Master Plan. The NRS further mandates that each entity hold a public hearing to consider adopting the Regional Master Plan as a component of its Local Master Plan pursuant to Chapter 278 of NRS.

THE POLICY OF THE CCRFCD SHALL BE TO FOLLOW THE ADOPTED REGIONAL MASTER PLAN WHICH SETS FORTH THE MOST CURRENTLY EFFECTIVE STRUCTURAL AND REGULATORY MEANS FOR CORRECTING EXISTING FLOODING WITHIN AN AREA TAKING INTO ACCOUNT THE POSSIBLE EFFECTS OF FUTURE DEVELOPMENT. THE REGIONAL MASTER PLAN HAS INCORPORATED, IN SO FAR AS POSSIBLE, PLANNING COMPLETED OR UNDERTAKEN BY THE LOCAL ENTITIES AND DEVELOPERS. THE CCRFCD RECOGNIZES THE NEED TO MODIFY AND/OR REVISE PORTIONS OF THE ADOPTED MASTER PLAN FROM TIME TO TIME TO REFLECT CHANGES DESIRED BY THE LOCAL ENTITIES AS LONG AS THE INTENT AND INTEGRITY OF THE REGIONAL MASTER PLAN ARE NOT COMPROMISED.

THE CCRFCD WILL ALSO REVIEW THE REGIONAL MASTER PLAN ANNUALLY TO ADDRESS THE REQUIREMENTS LISTED IN THE "POLICIES AND PROCEDURES."

### **303.3 Local Master Planning**

The CCRFCD's Master Plan provides a plan to handle the regional flows within an area. The CCRFCD's Master Plan depicts the main arteries of the necessary drainage system. Local Flood Control Facilities, as planned by the entities and/or developers, are an integral part of the total drainage system required to preserve and promote the general health, welfare, and economic well being of the area.

THE POLICY OF THE CCRFCD SHALL BE TO ENCOURAGE THE LOCAL ENTITIES TO DEVELOP LOCAL MASTER PLANS FOR LOCAL FLOOD CONTROL FACILITIES WHICH ARE COMPATIBLE WITH THE REGIONAL MASTER PLAN. THESE LOCAL MASTER PLANS SHALL ALSO SET FORTH SITE REQUIREMENTS FOR NEW DEVELOPMENT AND IDENTIFY THE REQUIRED PUBLIC IMPROVEMENTS.

### **303.4 Drainage Improvements**

Drainage improvements, as defined in local development drainage plans or local and regional plans, are classified as either Local Flood Control Facilities or Regional Flood Control Facilities. The Local Flood Control Facilities consist of curb and gutter, inlets and storm sewers, culverts, bridges, swales, ditches, channels, detention areas, and other drainage facilities required to convey the

minor and major storm runoff to the Regional Flood Control Facilities. These Local Flood Control Facilities are further defined as on-site (private) facilities and off-site (public) facilities. The on-site (private) facilities serve a specific development and are privately owned and maintained. The off-site (public) facilities are facilities which are dedicated to the public and connect on-site (private) facilities to the Regional Flood Control Facilities. These off-site (public) facilities may actually be constructed within the specific development to pass flow through from upstream properties. The Regional Flood Control Facilities consist of channels, storm sewers, bridges, detention areas, and other facilities which carry runoff from on-site and off-site facilities to an ultimate outfall location.

When drainage plans identify that off-site (public) facilities improvements are justified, mechanisms for funding the improvements are required. The funding for off-site (public) facilities improvements which serve only a single development should be obtained from that development. This funding is provided by having these off-site (public) facilities improvements designed and constructed by the subject development.

THE POLICY OF THE CCRFCD SHALL BE THAT ALL NEW DEVELOPMENT DESIGN AND CONSTRUCT THE REQUIRED DRAINAGE IMPROVEMENTS AS SET FORTH BELOW:

1. Local On-Site (Private) Flood Control Facilities.
2. Local Off-Site (Public) Flood Control Facilities are required to provide adequate conveyance capacity from the Local On-Site (Private) Flood Control Facilities to the Regional Flood Control Facilities or for pass through of upstream off-site runoff. Oversizing of the Local (Public) Off-Site Flood Control Facilities to accommodate future development may be required by the local entity. The local entity may also require payment to a local (Public) off-site facilities fund in lieu of construction of these facilities by the developer.
3. Regional Flood Control Facilities passing through or directly adjacent to the subject development. The CCRFCD may participate in funding of these regional improvements within the limits of the most current POLICIES AND PROCEDURES if the improvements are designed and constructed in accordance with the Regional Master Plan and this MANUAL.

### **303.5 Drainage Planning Submittal and Review**

Review and approval of drainage plans, studies, and construction drawings and specification by the local entities and CCRFCD is required to obtain a final drainage system which is consistent and integrated in analysis, design, and

level of protection. The degree of review and approval required depends on the nature of the drainage improvement under consideration.

THE POLICY OF THE CCRFCD IS TO REQUIRE THAT ALL DRAINAGE PLANS, STUDIES, AND CONSTRUCTION DRAWINGS AND SPECIFICATIONS BE REVIEWED AND APPROVED AS SET FORTH BELOW:

1. The entity shall be responsible for review and approval of all Local Flood Control Facilities, except when the proposed facilities impact the areas listed below, they shall also be approved by the CCRFCD.
  - a. Identified Flood Hazard Areas in accordance with FEMA regulations
  - b. Regional Flood Control Facilities
  - c. Facilities with Regional Significance as defined in the REGULATIONS
2. Local entities which construct flood control facilities must comply with the CCRFCD's Master Plan. Local entities may request an amendment or obtain a variance to the CCRFCD's Master Plan pursuant to NRS.
3. State Agencies shall consider and, when applicable, comply with the CCRFCD's Master Plan when planning and designing their flood control facilities.

### **303.6 Floodplain Management**

The foremost goal of many successful businesses is to obtain the greatest return for the least cost. When applied to land development, this goal translates into obtaining the largest developable land area using the most economic measures. Thus, existing floodplain land becomes more valuable if the land can be removed from the floodplain for development. The purpose of floodplain management is to provide the guidance, conditions, and restrictions for development in floodplain areas while protecting the public's health, safety, welfare, and property from danger and damage.

To provide impetus for proper floodplain management, the United States government, acting through the FEMA's National Flood Insurance Program (NFIP), has established regulations for development in floodplain areas. Compliance with these regulations allows property owners to obtain lower cost flood insurance premiums and/or eliminates the requirement for the owner to obtain, flood insurance as a condition for obtaining government supported loans., Therefore, there is a benefit to the CCRFCD population for remaining in compliance with the NFIP's regulations.

The guidance, conditions, and restrictions for development in floodplain areas as presented in the REGULATIONS are used to meet the above stated floodplain management objectives.

THE POLICY OF THE CCRFCD SHALL BE TO REGULATE FLOODPLAINS IN ACCORDANCE WITH THE DISTRICT'S ADOPTED UNIFORM REGULATIONS FOR THE CONTROL OF DRAINAGE AND THE REGULATIONS OF THE NFIP.

Since FEMA policies can change, their regulations are not specifically cited in the MANUAL. It is incumbent upon the local engineering community to keep abreast of FEMA's regulations. FEMA has adopted the 100-year flood (1 percent chance of annual occurrence) as the base flood for floodplain management purposes and delineates the 100-year floodplain on their maps. For certain stream courses studied by FEMA by detailed methods, a floodway may also be depicted. The floodway is a portion of the floodplain and is defined as the channel itself plus any adjacent land areas which must be kept free of encroachment in order to pass the base flood without increasing water surface elevations by more than a designated height. **Figure 301** depicts a typical floodplain and floodway along with some of the terminology found in FEMA's regulations. The following subsections discuss in general terms some other terms and issues having to do with FEMA's regulations.

### 303.6.1 FEMA Map Revisions and Amendments

FEMA has a number of different procedures for requesting changes to their Flood Insurance Rate Maps (FIRMs). Since the FIRMs for Clark County and the incorporated jurisdictions are effective (dated August 16, 1995), changes to them are handled either as a Letter of Map Revision (LOMR), Letter of Map Amendment (LOMA), or publication of a revised map, also known as a "physical map revision" (PMR). FEMA may issue a conditional letter of map revision (CLOMR or CLOMA) if the request is based on a proposed project. If exclusion from a Special Flood Hazard Area (SFHA) is due to elevating a structure on fill, the map revision is designated LOMR-F or CLOMR-F.

Any change to the Special Flood Hazard Information is handled as a **map revision**. These changes can include changes to floodplain boundaries, floodway boundaries, flood insurance risk zones, base flood elevations, flood depths, and other information shown on the maps. All changes must be based on existing conditions, although a conditional determination may be requested for proposed projects, such as modifications to stream channels and floodplains, and proposed elevation on fill of structures or parcels of land.

Due to the scale of FEMA's maps, individual structures or legally-described parcels of land may be inadvertently included in a SFHA. Excluding an individual structure or parcel of land from the SFHA is handled as a **map amendment**. The map amendment process is not applicable to requests

involving changes to Special Flood Hazard Information on the maps and cannot be based on new topography or hydrologic or hydraulic conditions.

The following subsections briefly discuss the various types of map revisions and amendments and how to request them. More detailed information is available from CCRFCD.

#### **303.6.1.1. Map Revisions**

Any information on FEMA's FIRMS may be changed, subject to FEMA review. However, FEMA generally only revises effective maps if changes affect 100-year flood information. Map revisions can either be a PMR or LOMR. In general, FEMA only processes PMRs only when changes involve a large area of land or increased flood risk. Otherwise, LOMRs are issued if changes involve small areas within a community.

In Clark County, the CCRFCD and the individual agencies are responsible for ensuring all obligations are met to allow the County and incorporated cities to participate in the NFIP. Although private parties may request a map revision, it is strongly suggested that such requests be submitted or coordinated with CCRFCD. If FEMA receives any map revision requests in Clark County from a private party without the concurrence of CCRFCD, the requestor will be asked for evidence that the request was first submitted to CCRFCD.

Map revisions typically fall into three categories - those based on the effects of physical changes in the floodplain, those based on the use of better data, and those based on the use of alternative methodology.

If a structure or parcel of land is elevated on fill, a map revision may be issued to remove the structure from a SFHA if both the lowest adjacent grade to the structure and the lowest floor are at or above the base flood elevation (BFE) or when the placement of fill has elevated a legally-defined parcel of land at or above the BFE. Requests for such map revisions are called LOMR-F or CLOMR-F, depending if the structure is existing or proposed.

Because each request for a map revision is unique, the required forms, supporting data, and submittal fees vary widely. Requestors should contact CCRFCD for a FEMA Application/Certification Forms and Instructions for Amendments and Revisions to National Flood insurance Program Maps.

#### **303.6.1.2 Map Amendments**

Typically, the scale of FEMA's maps do not allow the floodplain delineations to be shown in the detail required to determine whether an individual structure or legally-described parcel is within the SFHA. Similarly, existing small areas of high ground may be shown within the SFHA because they are too small to be shown to scale. FEMA has developed the map amendment process to

allow property owners or lessees to request that FEMA determine whether a specific structure or parcel is in the SFHA and, if necessary, issue a Letter of Map Amendment.

It is important to note that a LOMA should only be requested on the basis of an inadvertent inclusion in the SFHA and not due to recent alterations of topography or significant changes to the flooding information shown on the FEMA map. In either of these cases, the request should be submitted as a map revision rather than a map amendment.

Although less common than conditional map revisions, a conditional map amendment (CLOMA) can be requested if an individual intends to build a structure(s) on a single or multiple lots, but not on fill, and wants FEMA to determine whether the structure will be excluded from the SFHA shown on the effective maps.

As with map revisions, because each request for a map amendment is unique, the required forms, supporting data, and submittal fees vary widely. Requestors should contact CCRFCD for a FEMA Application/Certification Forms for Amendments and Revisions to National Flood Insurance Program Maps.

### **303.6.2 Levee Freeboard Criteria**

If a flood control levee is proposed within a FEMA SFHA and a map revision will be requested based on the levee providing protection against the 100-year flood, FEMA's levee criteria shall be used in order for FEMA to credit the levee. It is noted that FEMA's levee policy requires that the levee be maintained by a governmental agency and certified according to the Code of Federal Regulations in order to be recognized as a providing flood protection. Therefore, any levees in FEMA 100-year SFHAs shall be coordinated with the local jurisdiction and CCRFCD.

Local levees are those which are not maintained by a governmental agency. For local levees, freeboard shall be provided per Section 700 of the MANUAL. A sediment study shall be performed per Section 700 of the MANUAL. Non-erosive velocities shall be maintained, or erosion protection shall be provided to ensure the integrity of the levee during storm events.

### **303.6.3 Vertical Control (NGVD 29 vs. NAVD 88)**

The base flood elevations and elevation reference marks on the current FEMA Flood Insurance Rate Maps for Clark County and incorporated areas are based on the National Geodetic Vertical Datum of 1929 (NGVD 29). The National Geodetic Survey has determined that the national vertical control network needs to be readjusted and FEMA is in the process of converting all National Flood Insurance Program maps to the new national datum, called the

North American Vertical Datum of 1988 (NAVD 88). In addition, the Clark County Department of Public Works, Surveyor's Office, has based the official Clark County Vertical Control on NAVD 88 and requires that all new maps, plans, reports, and other documents submitted for review reflect elevations referenced to NAVD 88. Copies of the Clark County benchmark information may be obtained from the County Surveyor's Office.

However, FEMA requires that requests for map revisions and amendments use the reference datum on the applicable, effective FIRM map which, in Clark County, is NGVD 29. Therefore, as of publishing, actual work should be done in NAVD 88 and a conversion factor to NGVD 29 should accompany any submittal to FEMA.

Additional information regarding the conversion from NGVD 29 to NAVD 88 is available from CCRFCD or the County Surveyor.

### **303.7 Stormwater Runoff Detention**

The value of stormwater runoff detention as part of the urban system has been explored by many individuals, agencies, and professional societies. Detention is considered a viable method to reduce urban drainage costs. Temporarily detaining stormwater runoff can significantly reduce downstream flood hazards as well as pipe and channel requirements in urban areas. Storage also provides for sediment and debris collection which helps to keep downstream channels and streams cleaner.

THE POLICY OF THE CCRFCD SHALL BE TO REQUIRE LOCAL DETENTION STORAGE FOR NEW DEVELOPMENTS WHEN THE DEVELOPMENT INCREASES FLOWS AND DOWNSTREAM CONVEYANCE CAPACITIES OF THE LOCAL DRAINAGE SYSTEM ARE DEMONSTRATED NOT TO BE CAPABLE OF HANDLING NON-DETAINED FLOWS.

THE CAPACITY OF DOWNSTREAM CONVEYANCE SYSTEMS SHALL BE ANALYZED IN ACCORDANCE WITH THIS MANUAL AND SHALL BE BASED ON RUNOFF FROM THE DEVELOPMENT AS FULLY IMPROVED. LOCAL DETENTION IS ALSO REQUIRED WHEN DESIGNATED IN LOCAL MASTER PLANS TO REDUCE THE PEAK RUNOFF RATE IN REGIONAL FACILITIES.

EXEMPTIONS TO THE DETENTION POLICY MAY BE GRANTED BY THE LOCAL ENTITY FOR THE FOLLOWING:

1. DEVELOPMENTS OF LESS THAN 2 ACRES WITH AN IMPERVIOUS DENSITY OF 50 PERCENT OR LESS.
2. ADDITIONS TO BUILDINGS PROVIDED THE IMPERVIOUS DENSITY OF THE ENTIRE PROPERTY DOES NOT INCREASE BY MORE THAN

10 PERCENT OR THE TOTAL IMPERVIOUS AREA DOES NOT INCREASE BY MORE THAN ONE ACRE, WHICHEVER IS LESS.

3. DEVELOPMENTS WHICH DISCHARGE DIRECTLY TO A REGIONAL FLOOD CONTROL FACILITY PROVIDED THE REGIONAL FACILITY IS COMPLETED PER THE ADOPTED MASTER PLAN.
4. LOCATIONS WHERE A LOCAL DETENTION FACILITY IS PLANNED TO SERVE SEVERAL DEVELOPMENTS. FOR THIS EXEMPTION, THE LOCAL ENTITY MAY REQUIRE PAYMENT TO A LOCAL DETENTION FACILITIES FUND IN LIEU OF CONSTRUCTION OF THE DETENTION FACILITY BY THE DEVELOPER.

ALL EXEMPTIONS ARE SUBJECT TO APPROVAL OF THE LOCAL ENTITY. ADDITIONAL ANALYSIS MAY BE REQUESTED BY THE LOCAL ENTITY TO DEMONSTRATE THE BENEFITS OBTAINED BY GRANTING OF THE EXEMPTION.

### **303.8 Stormwater Runoff Retention**

Stormwater runoff retention has been used to eliminate the need for constructing outlet structures and for ease of construction. However, problems with past retention basins including soil expansion, siltation, and lack of infiltration capacity have created a nuisance to the general public.

THE POLICY OF THE CCRFCD SHALL BE TO DISCOURAGE THE USE OF RETENTION FACILITIES EXCEPT WHERE THERE ARE NO DOWNSTREAM FACILITIES TO CONVEY SITE RUNOFF. SPECIAL FACILITIES (I.E., LEACHFIELDS, ETC.) MAY BE REQUIRED BY THE LOCAL ENTITY BEFORE A RETENTION BASIN IS ALLOWED.

### **303.9 Water Quality**

In January 1984, the United States Environmental Protection Agency (USEPA) presented to Congress the results of the Nationwide Urban Runoff Program (NURP). The purpose of this study was to characterize and evaluate the quality of runoff from and due to urbanized areas. The results of the study showed that the process of urbanization decreases the quality of runoff from the natural conditions. In addition, USEPA has adopted regulations to control pollutants from entering the environment through storm drainage facilities. These regulations are administered locally through a municipal stormwater discharge permitting program by the Nevada Division of Environmental Protection (NDEP). The local National Pollutant Discharge Elimination System (NPDES) stormwater permit is issued jointly to CCRFCD, City of Las Vegas, City of North Las Vegas, City of Henderson, Clark County, and the Nevada Department of Transportation. These co-permittees have joined in a cooperative, multi-jurisdictional effort to comply with the permit requirements

and address other regional stormwater quality issues. Details of the NPDES permit are outlined in Section 207 of the MANUAL.

THE POLICY OF THE CCRFCD SHALL BE TO ENCOURAGE THE DESIGN OF DRAINAGE FACILITIES AND OTHER MEASURES WHICH ENHANCE THE QUALITY OF STORM RUNOFF.

### **303.10 Drainage Facilities Maintenance**

An important part of all storm drainage facilities is the continued maintenance of the facilities to ensure they will function as designed. Maintenance of detention facilities involves removal of debris and sediment. Such tasks are necessary to preclude the facility from becoming unhealthy and to retain the effectiveness of the detention basin. Sediment and debris must also be periodically removed from channels and storm sewers. Trash racks and street inlets must be regularly cleared of debris to maintain system capacity. Channel bank erosion, damage to drop structures, crushing of pipe inlets and outlets, and deterioration to the facilities must be repaired to avoid reduced conveyance capability, unsightliness, and ultimate failure.

THE POLICY OF THE CCRFCD SHALL BE TO REQUIRE ALL DRAINAGE FACILITIES BE DESIGNED TO MINIMIZE FACILITY MAINTENANCE AS WELL AS TO PROVIDE EASE OF MAINTENANCE AND INCLUDE MAINTENANCE ACCESS TO THE ENTIRE DRAINAGE FACILITY. A MINIMUM 20-FOOT WIDE DRAINAGE EASEMENT SHALL BE PROVIDED FOR ALL PUBLICLY MAINTAINED DRAINAGE FACILITIES. SEE SECTION 1600 FOR LOCAL ENTITY MINIMUM REQUIREMENTS.

THE POLICY OF THE CCRFCD IS TO REQUIRE THE PROPERTY OWNER OR DEVELOPER BE RESPONSIBLE FOR MAINTENANCE OF ALL PRIVATELY OWNED ON-SITE DRAINAGE FACILITIES INCLUDING, BUT NOT LIMITED TO, INLETS, PIPES, CHANNELS, AND DETENTION BASINS, UNLESS MODIFIED BY SEPARATE AGREEMENT. SHOULD THE PROPERTY OWNER OR DEVELOPER FAIL TO ADEQUATELY MAINTAIN SAID FACILITIES, THE GOVERNING ENTITY SHALL BE GIVEN THE RIGHT TO ENTER SAID PROPERTY, UPON PROPER NOTICE, FOR THE PURPOSES OF MAINTENANCE. ALL SUCH MAINTENANCE COSTS SHALL BE ASSESSED AGAINST THE OWNER.

THE POLICY OF THE CCRFCD SHALL BE TO ENSURE ALL FLOOD CONTROL FACILITIES ARE PROPERLY MAINTAINED AND TO FUND THE MAINTENANCE OF REGIONAL FLOOD CONTROL FACILITIES. THE LOCAL ENTITIES WILL BE RESPONSIBLE FOR THE MAINTENANCE OF ALL PUBLIC DRAINAGE FACILITIES NOT MAINTAINED BY CCRFCD. FOR PRIVATELY MAINTAINED FACILITIES, THE MAINTENANCE PROCEDURES SHALL BE SUBMITTED AS PART OF THE DRAINAGE STUDY REQUIREMENTS.

**304 TECHNICAL CRITERIA**

**304.1 Stormwater Management Technology**

The information presented in this MANUAL represents the current state-of-the-art in stormwater management planning and design. However, the dynamic nature of stormwater runoff technology, information, and criteria will continue to advance the state-of-the-art of stormwater management. Therefore, this MANUAL should be periodically updated to account for advances made in the stormwater management field.

THE POLICY OF THE CCRFCD SHALL BE TO KEEP ABREAST OF THE STATE-OF-THE-ART IN STORMWATER MANAGEMENT AND AMEND AND/OR MODIFY THESE CRITERIA AS NEW TECHNOLOGY IS DEVELOPED AND EXPERIENCE GAINED IN THE USE OF THESE CRITERIA.

**304.2 Design Storm Events**

The selection of design storm events is based on many factors including public perception, federal regulations, balance of economics versus public safety, physical basin characteristics, and typical storm patterns. Typically, the public perceives only two types of storm events; minor and major. The minor storm events are perceived as typical small rain storms of very short duration and low rainfall intensity which cause few problems or inconvenience to the general public. These storms appear to occur with greater frequency (every year or several years) than the larger major storms. The major storm events are perceived as occurring infrequently and appear to cause major damage to public property and possibly loss of life.

Without properly designed drainage facilities, the minor storms can also cause more damage and inconvenience than the public perception would allow. Therefore, facilities should be designed to minimize public inconvenience for minor storm events and protect public property and life for major storm events.

The federal government has recognized the need to protect the general public from catastrophic damage and destruction associated with major storm events. This recognition has resulted in the issuance of floodplain regulations for the 100-year storm event (major storm).

The CCRFCD, in reviewing the factors stated above for selection of design storm events, has determined that drainage facilities should be designed based on runoff from two storm events; a minor storm event and a major storm event. In addition, the CCRFCD has determined that the general interest of the Clark County area is better served by providing a minor storm system

design which accommodates minor storm flows of greater intensity and/or duration than the typical small annual storms.

THE POLICY OF THE CCRFCD SHALL BE TO REQUIRE ALL NEW DEVELOPMENT TO INCLUDE THE PLANNING, DESIGN, AND CONSTRUCTION OF DRAINAGE FACILITIES FOR BOTH THE MINOR AND MAJOR STORM EVENTS AND WILL INCLUDE EMERGENCY FLOW PATHS FOR FLOWS EXCEEDING THE MAJOR STORM. THE MINOR STORM EVENT SHALL HAVE A RECURRENCE INTERVAL OF 10 YEARS. THE MAJOR STORM EVENT SHALL HAVE A RECURRENCE INTERVAL OF 100 YEARS.

### 304.3 Stormwater Runoff Determination

The stormwater runoff peak, volume, and timing provide the basis for all planning, design, and construction of drainage facilities. The best method for determining stormwater runoff is to measure the runoff from a flood with a known intensity and recurrence interval. Since this approach is seldom practical, various analytical methods have been developed which predict the stormwater runoff from preselected hydrologic conditions (independent of chance). These methods are referred to as deterministic models. Other methods evaluate measured past trends to predict future trends, which are referred to as probabilistic methods (dependent on chance such as a statistical analysis). The general lack of sufficient rainfall/runoff data in the Clark County area presently precludes the use of probabilistic models for normal stormwater runoff calculations.

THE POLICY OF THE CCRFCD SHALL BE TO REQUIRE THE DETERMINATION OF STORMWATER RUNOFF (RATES AND VOLUMES) IN ACCORDANCE WITH THE FOLLOWING:

<u>CONTRIBUTING BASIN AREA</u>	<u>COMPUTATION PROCEDURE</u>
A ≤150 ACRES	MODIFIED RATIONAL FORMULA METHOD, SCS TR-55, OR HEC-1 (SCS UNIT HYDROGRAPH OR KINEMATIC WAVE)
A > 150 ACRES	HEC-1 (SCS UNIT HYDROGRAPH OR KINEMATIC WAVE)

### 304.4 Streets

The use of streets to convey stormwater runoff, although naturally occurring, interferes with the primary function of the street for transportation purposes. Streets are, however, an important component in the storm drainage system due to their large stormwater runoff carrying capacity obtained for little or no drainage related costs. In order to balance these two competing street uses, limits on the street carrying capacity are required based on the classification of the street related to emergency usage during flood events. This classification generally follows the streets' traffic classification. For example, the wider and more frequently used arterial streets are restricted further in stormwater runoff flow depths and capacity than local or collector streets.

At street intersections or sag points between intersections, two alternatives exist for positive conveyance of gutter flow past or through these locations. These two options are:

- a) Provide storm inlets and storm sewer to pass the gutter flow under the street or road.
- b) Provide a concrete valley gutter across the street and/or intersection.

The selection of which alternative to use for a given location is dependent on the street classification (i.e., arterial versus local) and on the flow direction past the intersection or sag point. The drainage planner should consult with the appropriate local entity in selection of the appropriate alternative.

Bubbler laterals have been used in the past to convey stormwater runoff under streets without constructing additional storm sewers from the downstream inlets. Although these facilities work well theoretically, problems exist in the actual field installations. These problems include the gradual siltation of the structures over time as well as stagnation of water trapped in the laterals. Therefore, bubbler facilities are prohibited unless special site conditions warrant otherwise and permission is obtained from the local entity and/or CCRFCD.

THE POLICY OF THE CCRFCD SHALL BE TO ALLOW THE USE OF STREETS FOR STORM DRAINAGE WITH SPECIFIC LIMITATIONS. THE ALLOWABLE STREET CAPACITY FOR THE MINOR STORM EVENT FOR DIFFERENT STREET ROW WIDTHS SHALL BE DETERMINED AS FOLLOWS:

ROW WIDTH	MINOR STORM STREET CAPACITY LIMITATIONS (See Note)
1) Greater than or equal to 80 feet	<ul style="list-style-type: none"> <li>A. A 12-foot wide dry lane shall be maintained in each direction (center turning lane cannot be used for a dry lane)</li> <li>B. The depth of flow at intersections with other streets with ROW widths greater than or equal to 80 feet shall be curb height (typically 6 inches) or less.</li> <li>C. The product of the flow depth (feet) in the gutter flow line times the average flow velocity (feet per second (fps)) shall be less than or equal to 6.</li> </ul>
2) Less than 80 Feet	<ul style="list-style-type: none"> <li>A. The depth of flow in the gutter flow line shall be less than or equal to 1 foot.</li> <li>B. The product of the flow depth (feet) in the gutter flow line times the average flow velocity (fps) shall be less than or equal to 6.</li> </ul>

Temporary streets will be treated as minor streets (less than 80 feet wide).

THE ALLOWABLE STREET CAPACITY FOR THE MAJOR STORM EVENT SHALL BE DETERMINED AS FOLLOWS:

MAJOR STORM STREET CAPACITY LIMITATIONS (See Note)

- A. The product of the flow depth (feet) in the gutter flowline times the average flow velocity (fps) shall be less than or equal to 8.
- B. The depth of flow in the gutter flowline shall be less than or equal to 2 feet.
- C. The transverse street flow on through traffic streets shall be at a depth less than or equal to 1 foot and a depth times velocity less than or equal to 8. This shall not be used to determine the allowable transverse flow depth for a culvert.

- D. In Special Flood Hazard Areas and Areas of Interim Delineation:
  - 1. The residential finished floor (new construction) shall be a minimum of 18 inches above the water surface elevation in the street.
  - 2. The non-residential finished floor (new construction) shall be a minimum of 18 inches above the water surface elevation in the street or be floodproofed to 18 inches above the water surface elevation in the street.
  
- E. In Non-Special Flood Hazard Areas for new construction (residential and non-residential):
  - 1. The finished floor shall be set at a vertical distance above the gutter flowline of at least twice the depth of flow in the gutter flowline up to a maximum of 18 inches above the water surface elevation in the street.

**Note: If any of the above conditions cannot be met, the maximum depth of flow in the gutter flowline shall be less than or equal to curb height (typically 6 inches). Also, other criteria such as the Federal Housing Administration (FHA) regulations may impose standards more restrictive than cited.**

**Figure 302** depicts typical lot grading and drainage.

### 304.5 Culverts and Bridges

Culverts and bridges are required where natural or manmade channels are crossed by roads and streets. The amount of channel flow which crosses over the road should be minimized to protect the road embankment and pavement from erosion damage as well as to protect vehicles and pedestrians from dangerous flow depths and velocities.

THE POLICY OF THE CCRFCD SHALL BE TO ALLOW CULVERT/BRIDGE CROSSINGS UNDER STREETS WITHIN THE FOLLOWING LIMITATIONS:

<u>ROW Width</u>	<u>Minimum Capacity (Recurrence Interval)</u>
Greater than or equal to 80 feet	100-Year (No Overflow)
Less than 80 feet	100-Year (See Note)

**Note:** An overflow section is allowed if the product of the depth in feet and the velocity in fps does not exceed 6. Also the maximum depth of flow in the overflow section shall not exceed 1 foot measured at the street gutter, or the lowest point on the street cross section.

### 304.6 Floodproofing

Floodproofing can be defined as those measures which reduce the potential for flood damages to properties within a floodplain. The floodproofing measures can range from elevating structures to intentional flooding of non-critical building spaces (i.e., basement) to minimize structural damages. Floodproofing measures are only a small part of good floodplain management which encourages wise floodplain development to minimize the adverse effects of floods.

Floodproofing can be divided into measures required for protection of existing structures or future structures. For any future construction, the floodproofing requirements are controlled by the floodplain regulations (see Section 303.6) which generally restrict the types of structures within a floodplain.

THE POLICY OF THE CCRFCD SHALL BE TO ENCOURAGE THE FLOODPROOFING OF EXISTING STRUCTURES LOCATED WITHIN A DESIGNATED FLOODPLAIN AREA WHICH ARE NOT BUILT IN CONFORMANCE TO THE ADOPTED FLOODPLAIN REGULATIONS.

### 304.7 Alluvial Fans

Alluvial fans are a common and dominant feature in the arid west. These fans, consisting of sand and fine sediment, are subject to radical changes in shape, direction, depth, and flow carrying capacity during storm events. These erratic changes increase the potential flood hazards of developing on alluvial fan areas and require additional analysis and design to provide safe and effective facilities to accommodate these hazards.

THE POLICY OF THE CCRFCD SHALL BE TO REQUIRE ADDITIONAL ANALYSIS OF RUNOFF FLOW PATTERNS AND THE EFFECT OF NATURAL RADICAL CHANGES OF THESE PATTERNS ON THE DESIGN OF DRAINAGE FACILITIES FOR PROPOSED DEVELOPMENTS ON AN ALLUVIAL FAN.

THE POLICY OF THE CCRFCD SHALL BE TO KEEP ABREAST OF THE LATEST TECHNOLOGY ON ALLUVIAL FANS AND TO DISPERSE THIS INFORMATION AS IT BECOMES AVAILABLE.

**304.8 Multiple Use Facilities**

In rapidly growing urban areas the creative use and identification of open space opportunities is important. In many cases linear and block flood control facilities can provide opportunities for trails, parks, environmental preserves and many other recreational uses.

THE POLICY OF THE CCRFCD SHALL BE TO ENCOURAGE EARLY PLANNING TO IDENTIFY AND TAKE ADVANTAGE OF MULTIPLE USE OPPORTUNITIES AFFORDED BY FLOOD CONTROL FACILITIES INCLUDED ON THE MASTER PLAN. TO THAT END MASTER PLANS, DESIGNS AND CAPITOL IMPROVEMENT PROGRAMS WILL BE MADE AVAILABLE TO ENTITY PLANNING PERSONNEL FOR THEIR USE.

It is the mission of the Clark County Regional Flood Control District to improve the protection of life and property for existing and future residents from the impacts of flooding. Inasmuch as Multiple uses do not contribute to that mission:

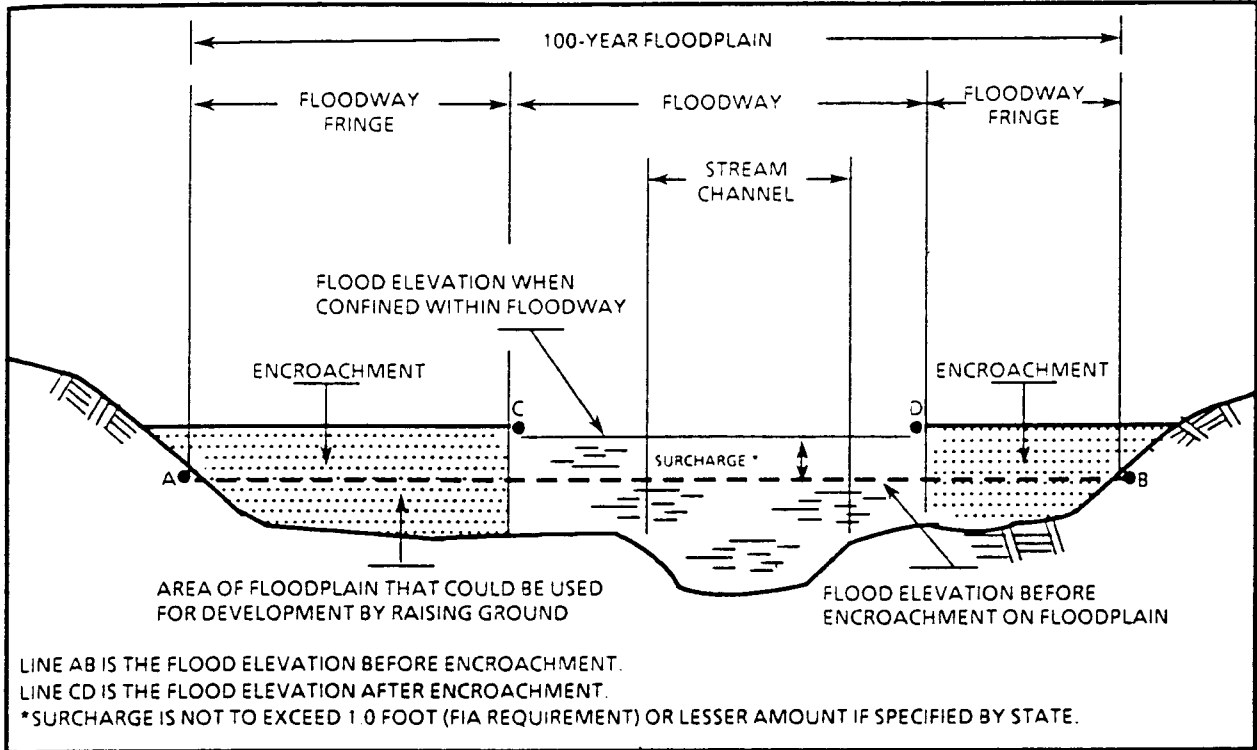
THE POLICY OF THE CCRFCD SHALL BE TO RESTRICT THE USE OF CCRFCD FUNDS TO IMPLEMENTATION OF THE FACILITIES INCLUDED ON THE FLOOD CONTROL MASTER PLAN. CCRFCD FUNDING IS NOT AVAILABLE FOR THE INSTALLATION, OPERATION, MAINTENANCE OR REHABILITATION OF RECREATION OR OTHER NON-DRAINAGE RELATED FACILITIES LOCATED IN OR WITH FLOOD CONTROL STRUCTURES.

That being said, certain considerations can be made during facility planning and design to better accommodate Multiple uses. If a Master Plan Facility is to incorporate multiple uses, then the following policy statements must be met::

1. Public safety and the proper functioning of the drainage facilities are of the highest concern and cannot be compromised by other uses.
2. Flood control facilities must be clearly signed to identify them as areas subject to flooding, and as areas that should not be used during rainfall or floods. Signs must include a 24-hour emergency telephone number. Signs should be bilingual and pictorial. Signs should be spaced at all ingress and egress points and not more than one hundred fifty feet (150) apart along or around the perimeter of a flood control facility.
3. The use of benching or tiering to create areas which would not be subject to flooding during more frequent events is encouraged. Consideration must be given to storm water flow across these benched areas to lower lying areas.
4. The use of those portions of detention basins subject to flooding during a 10-year or more frequent event, other than as wildlife habitat, should not be encouraged in any way. This includes locating recreational amenities, the creation of trails/paths, or the use of turf in those areas.

5. In general, passive recreation zones, picnic areas, soccer fields and ball fields may be suitable uses for the lower elevated tiers located above the 10-year pool.
6. Tot lots, play areas and court games should be located in the higher elevated tiers located above the 25-year pool
7. Parking areas, rest rooms, concession stands, habitable structures, and swimming pools must be located outside of the 100-year pool elevation.
8. The establishment of wetlands, passive vegetation zones, or other desirable habitat will require co-ordination with and approval by appropriate local, State and Federal agencies, as well as the development of a workable habitat management plan that allows for the periodic maintenance of the drainage facilities.
9. Detention basin embankments should have gentle slopes (3:1 or less) on the impoundment area side to allow the public to exit multiple use facilities.
10. Picnic tables, benches, trash receptacles and other amenities located in flood control facilities must be securely fastened in place.
11. Channel bottoms are often subject to unhealthy conditions due to the presence of untreated nuisance flows and the accumulation of litter, as well as to high velocity flows during storms. The use of channel bottoms for recreational uses should be avoided. Channels that have a depth \* velocity product greater than 6 ( $DV \geq 6$ ) should not be considered for recreational uses.
12. Access and maintenance roads along channels may be suitable for pedestrian and biking access. A pedestrian separation device separating the channel from the road is required. The pedestrian separation device must be designed and installed in a manner that does not impair normal operations and maintenance activities, or emergency response and rescue activities.
13. Facilities, particularly those which are intended to be used for organized recreational activities, must have use-plans developed which clearly state the conditions under which these facilities will be closed to the public, as well as an implementation plan to ensure that the facilities are not being used under those conditions. The development nor the implementation of these use-plans is the responsibility of the Regional Flood Control District. As a condition of the District's acceptance of the use-plan the entities will indemnify and hold the District harmless from damages resulting from the use of flood control facilities for recreational activities.

FEMA FLOODPLAIN/FLOODWAY SCHEMATIC

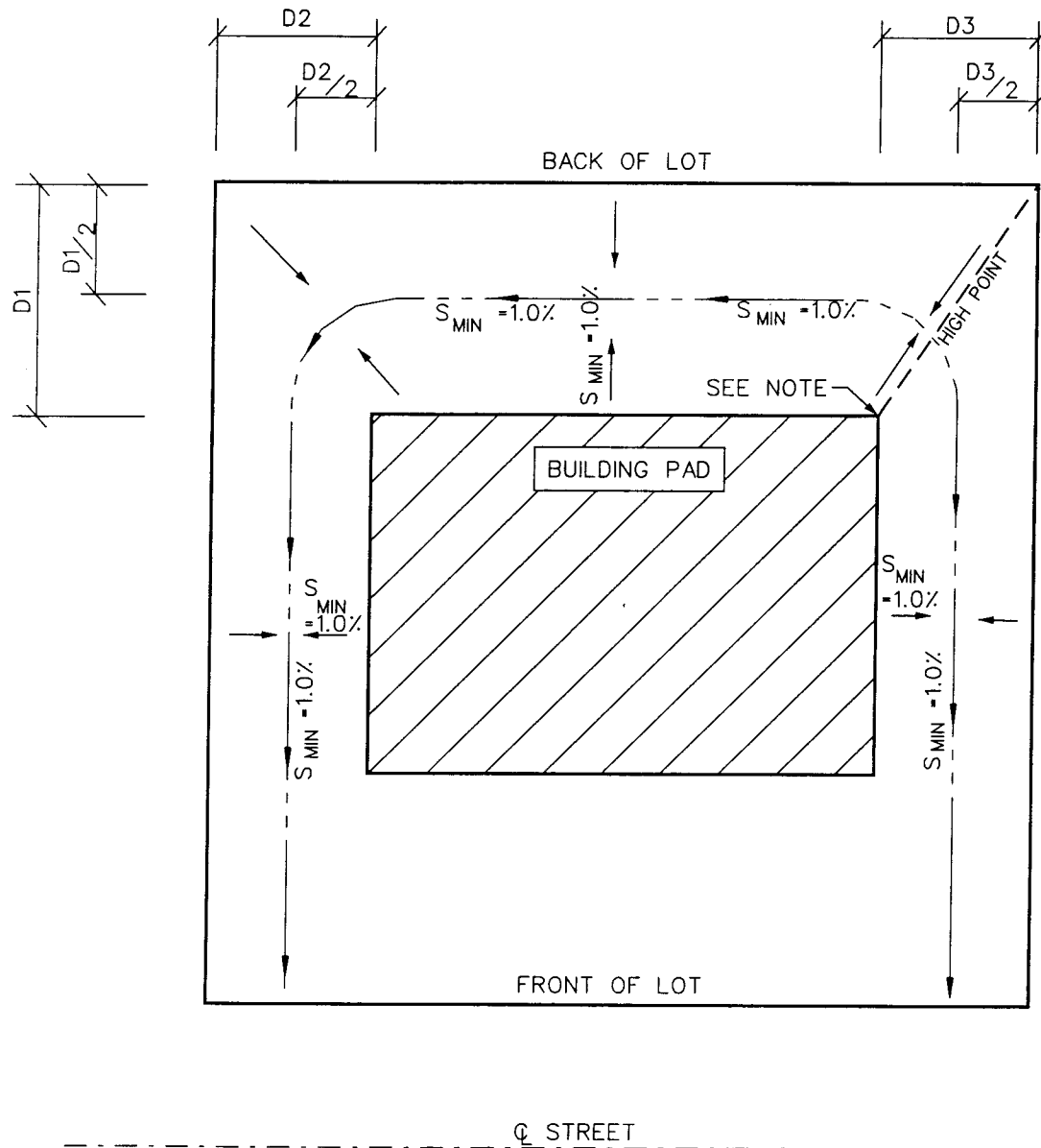


Revision	Date

REFERENCE: FEMA FIS, Clark County and Incorporated Areas, August 1995

FIGURE 301

TYPICAL LOT DRAINAGE



NOTE: MINIMUM CLEARANCE OF 8 INCHES REQUIRED BETWEEN BACKYARD HIGHPOINT AND FINISHED FLOOR ELEVATION AT BACK OF BUILDING PAD.

D - DISTANCE FROM THE PROPERTY LINE TO THE BUILDING PAD  
 $S_{MIN}$  - MINIMUM SLOPE OF LAND

Revision	Date

REFERENCE:

FIGURE 302