3. Discuss historic discharge points at downstream property lines.

C. Master Planning Information

1. Identify currently adopted master plan(s) which include the subject site.

2. Discuss proposed Master Plan Flood Control Facilities on subject site (if applicable).

3. Discuss upstream Master Plan Flood Control Facilities which would affect runoff on subject site (if applicable).

D. Floodplain Information

1. Identify all FEMA regulated floodplains which overlay on the subject site.

2.* Identify all calculated floodplains, including a proposed conditions or "with-project" floodplain.

E. Previous Drainage Studies

1. Identify any previous drainage studies for the site.

2. Identify any previous drainage studies which affect the site.

IV. PROPOSED DRAINAGE FACILITIES

A. General Description

1. Discuss proposed Local (On-Site) Drainage System plan and layout.

2. Discuss proposed Local (Off-Site) Drainage System plan from the Local (On-Site) Drainage System to the Regional Flood Control System.

3. Discuss proposed Regional Flood Control System design (only where the Regional Flood Control System passes through the subject site).

B. Compliance with Regulations and Adopted Plans

1. Discuss compliance with all Master Planned Flood Control Facilities (as applicable) and discuss all proposed deviations from the adopted Master Plans.

2. Discuss compliance with FEMA floodplain regulations and all proposed modifications to or verifications of the FEMA regulated floodplain through the subject site.

3. Discuss compliance with rules and regulations for developments on alluvial fans (if applicable).

4. Discuss compliance with previously approved drainage studies for the subject site.

5." Identify individually all requests for variances from the requirements of the drainage criteria and variances from the local entities' development code.

6. Discuss compliance with Uniform Regulations.

7. Discuss compliance with the MANUAL.

C. Hydrologic Analyses

Hydrologic analyses shall be completed for the following conditions. Calculations for all conditions shall be bound in the report:

- Existing off-site and on-site
- Existing off-site and developed on-site
- Developed off-site and on-site

1. Design rainfall computation discussion.

2. Design runoff computation discussion.

3. Discuss peak flow rates from off-site areas and facilities.

4. Discuss flow split areas and analysis.

5. Hydrologic parameters.

6. Routing schematic.

D. Facility Design Calculations

1. Discuss design calculations for the Proposed Drainage System

a. Street flow calculations
b.* Storm sewer, inlets, and ditch flow calculations
c.* Channel and culvert flow calculations
d.* Other hydraulic structure flow calculations
e.* Detention storage and outlet design calculations

2.* Discuss design calculations for the Local (Off-site) Drainage System

a. Alluvial fan analysis and calculations (when required)

3.* Discuss Floodplain/Floodway calculations as related to FEMA requirements

4.* Discuss maintenance access and potential maintenance requirements. Provide maintenance procedures for privately maintained facilities, with projected annual maintenance costs for incorporation into homeowners association.

5.* Discuss easement requirements for the proposed drainage facilities

6. Discuss phasing of all drainage facilities

V. CONCLUSIONS

1. Compliance with Drainage Laws

2. Compliance with Master Plans

3. Compliance with FEMA requirements

4. Compliance with MANUAL

5. Compliance with REGULATIONS

6. Effectiveness of proposed drainage facilities to control storm runoff

7. Impact of proposed development on off-site property and facilities

VI.* REFERENCES

1. Provide references for all drainage reports, plans, and technical information used in preparing the drainage report.

VII. APPENDICES

A. Hydrologic Computations

1. Watershed boundaries

2. Soils information

3. Land use information

4. Design rainfall calculations

5. Basin parameter calculations

6. Routing schematic

7. Runoff calculations at design points

a. Minor and major storm flows

b. Flows for historic and fully developed basin conditions

8. Hydrographs at property line discharge points, when appropriate

9. Input data listing for all computerized hydrologic calculations, maps with all parameters

B. Hydraulic Calculations

1. Street and ditch capacities

2." Inlet and storm sewer capacities (including Energy Grade Line (EGL) and Hydraulic Grade Line (HGL) calculations), with inlet and outlet condition assumptions

3.* Channel and culvert capacities

4.* Floodplain/Floodway calculations

5.* Detention area/storage/discharge rating curves and calculations

6. Input data listing for all computerized hydraulic calculations

7.* Plots of all cross sections

8.* Map with cross section locations

204.2 Drainage Plan

A detailed drainage plan(s) for the subject site shall be submitted with the Technical Drainage Study. The plan(s) shall be on a 24" x 36" drawing at an appropriate legible and microfilmable scale (a scale of 1" = 20' to 1" = 200' is recommended). A reference to all hydraulic calculations shall be a part of this plan. The following information shall be shown on this drawing, except that the off-site drainage basin boundaries may be shown at an appropriate legible scale on an exhibit.

1. Property lines and streets (roads) including right-of-way (ROW) widths within 100 feet of the property

2. Existing contours and proposed elevations sufficient to analyze drainage patterns extending 100 feet past property lines

3. Existing drainage facilities and structures, including ditches, storm sewers, channels, street flow directions, and culverts. All pertinent information such as material, size, shape, slope, and location shall also be included.

4. Limits of existing floodplains based on Flood Insurance Rate Maps (FIRMs), if available. Also, existing and proposed floodplains based on best available data (existing floodplain studies) should be shown, if available.

5. Proposed on-site drainage basin boundaries and sub-boundaries. Include off-site boundary intersections with on-site boundaries and off-site boundaries if not shown elsewhere.

6. Proposed future on-site and off-site flow concentration points, directions, and paths

7. Proposed street and ditch flow paths and slopes

8. Proposed storm sewer locations, type, size, and slope. Include inlet types, sizes and locations, and manhole locations.

9. Proposed channel alignment with typical cross section. Include major storm flow limits.

10. Proposed culvert locations, type, size, slope, and headwater pool

11. Proposed Local (On-Site) Drainage System outlet(s) to the Local (Off-Site) Drainage System

12.* Alignment of Local (Off-Site) Drainage System from Local (On-Site) Drainage System to Regional Flood Control System. If extent of Local (Off-Site) Drainage System is too large to include on the Drainage Plan, include a separate drawing showing entire drainage path of the Local (Off-Site) Drainage System.

13. Miscellaneous proposed drainage facilities (i.e., hydraulic structures, etc.)

14. Table of minor and major storm peak flows including tributary area at critical design points

15.* Maintenance easement widths and boundaries

16. Legend for all symbols used on drawing

17. Scale, North Arrow, and Title Block

204.3 Calculations Exemption

The report requirements for a Technical Drainage Study may be reduced at the request of the applicant if there is uncertainty over the final characteristics of the proposed drainage facilities or at the request of the local entity. The Technical Drainage Study shall identify all areas where the uncertainty exists. Hydrology and hydraulic calculations based upon assumptions may be provided with less detail. The areas where the assumptions and details are not provided must be identified so that they can be completed in the required detail as part of the Hydrologic/Hydraulic Calculations Addendum, if required. However, no construction permits will be issued until these details are provided in an Addendum.

Areas where assumptions are made and where the level of detail is limited shall be identified so that they can be completed in full detail as part of the Hydrologic/Hydraulic Calculations Addendum, if required.

205 HYDROLOGIC/HYDRAULIC CALCULATIONS ADDENDUM

The purpose of the Hydrologic/Hydraulic Calculations Addendum is to provide all detailed hydrologic and hydraulic calculations which were exempted from the

Technical Drainage Study requirements. This addendum shall be prepared in accordance with the following outline and contain the applicable information listed.

I. TITLE PAGE

A. **Standard Form 1**
B. Project Name, Type of Study, Study Date
C. Preparer's Name, Seal and Signature

II. HYDROLOGIC CALCULATIONS

A. Calculations exempted from the Technical Drainage Study

III. HYDRAULIC CALCULATIONS

A. Calculations exempted from the Technical Drainage Study

IV. REVISED DRAINAGE PLAN

A revised drainage plan for the subject site shall be included in this Addendum. The revised plan shall show the correct peak flows and facility capacities as computed in the enclosed calculations.

206 IMPROVEMENT PLANS

Where drainage improvements are to be constructed, the final construction plans (on 24" x 36" mylar) shall be submitted. Approval of the final construction plans (including details) by the local entity and/or CCRFCD is a condition of issuing construction permits. The plans for the drainage improvements will include:

1. Storm sewers, inlets, outlets and manholes with pertinent elevations, dimensions, type, and horizontal control indicated

2. Culverts, end sections, and inlet/outlet protection with dimensions, type, elevations, and horizontal control indicated

3. Channels, ditches, and swales (including side/rear yard swales) with lengths, widths, cross-sections, grades and erosion control (i.e., riprap, concrete, grout) indicated

4. Checks, channel drops, erosion control facilities

5. Detention pond grading, trickle channels, outlets, and landscaping

6. Other drainage related structures and facilities (including underdrains and sump pump lines)

7. HGL's for minor (storm sewer) and major (channels) storm runoff including flow rates. To avoid confusion, EGL's do not need to be shown on the original plans, but they should be plotted on a second (paper) copy of the plans and included with the Drainage Study for review.

8. Maintenance access considerations

9. Overlot grading and erosion and sedimentation control facilities

10. Drainage easements and ROW with horizontal distance to improvements

The information required for the plans shall be in accordance with sound engineering principles, this MANUAL, and the uniform STANDARD DRAWINGS and STANDARD SPECIFICATIONS. Construction documents shall include geometric, dimensional, structural, foundation, bedding, hydraulic, landscaping, and other details as needed to construct the drainage facility. The approved drainage plan shall be included as part of the construction documents for all facilities affected by the drainage plan. Construction plans shall be signed and sealed by a registered professional civil engineer in the State of Nevada as being in accordance with the approved drainage report/drawings.

207 NPDES PERMITS

The United States Environmental Protection Agency (USEPA) has adopted regulations to control pollutants from entering the environment through storm drainage facilities. Locally, the Nevada Division of Environmental Protection (NDEP) administers a municipal stormwater discharge permitting program for the Las Vegas Valley area. The local National Pollutant Discharge Elimination System (NPDES) stormwater permit is issued jointly to CCRFCD; the Cities of Las Vegas, North Las Vegas, and Henderson; Clark County; and the Nevada Department of Transportation (NDOT). These co-permittees have joined in a cooperative, multi-jurisdictional effort to comply with the permit requirements and address other regional stormwater quality issues.

In addition to mandating general municipal stormwater permits, USEPA's stormwater management program established permitting requirements for construction and industrial sites. NDEP administers construction site and industrial site permitting programs for Nevada. The emphasis of this portion of the program is on implementing best management practices (BMP) to control non-point source pollution generated from active construction sites and industrial operations. NDEP issues permits, collects fees associated with permit application and approval, and is responsible for permit monitoring and enforcement.

Non-point sources of pollution are diffuse sources which are distributed throughout the watershed and contribute to receiving waters at multiple locations. They are contrasted with point sources which contribute pollution to receiving waters at a single definable point.

NDEP is working with local jurisdictions in Las Vegas Valley to distribute information related to the construction and industrial permits as part of the permitting process of each entity.

207.1 Construction Permits

Currently, construction permits are required by NDEP for construction sites disturbing 5 acres of area or more. The construction permits require developing and implementing (1) a "Notice of Intent" to Discharge; (2) a request for inclusion in the Stormwater General Permit No. GNV0022241; and (3) a Storm Water Pollution Prevention Plan (SWPPP) for the construction area. The SWPPP commits the contractor to implement best management practices to control sediment production and other pollutants from the site. An erosion control plan is required to prevent migration of sediment from the construction site into the drainage system. An application form and fee are also required; these must be submitted to NDEP.

207.2 Industrial Permits

Industrial permits are required by NDEP for all industries engaged in activities with a high potential for contributing non-point source pollution to the drainage system. The industry categories include: mining; chemical products; paper, wood, and lumber products; metal industries; electronic equipment; etc. As with the construction permits, the industrial permits also require the development of a SWPPP to manage stormwater generated from areas directly related to manufacturing, processing, or raw material storage areas at an industrial plant. An application form and fee are also required; these must be submitted to NDEP.

208 NEVADA DEPARTMENT OF TRANSPORTATION CRITERIA

The NDOT's drainage guidelines and criteria are summarized in a publication entitled "Nevada Department of Transportation, Terms and Conditions Relating to the Drainage Aspects of Right-of-Way Occupancy Permits." In this publication, NDOT defines minimum design return frequencies for drainage facilities such as culverts and channels. The design frequencies range from the IO- to the 50-year event, based on various roadway classifications. Other design criteria such as design frequencies for roadway surface drainage facilities (curb/gutter, drop inlets, storm drains) are also presented.

In their guidelines, NDOT also lists acceptable design references, including hydrologic and hydraulic publications and computer programs.

If a project requires an NDOT ROW permit, then either an NDOT Drainage Information Form or a drainage report may need to be submitted to NDOT along with the permit application. It is possible that a single drainage report could be prepared for submittal to the entity, NDOT, and CCRFCD.

The engineer is referred to the NDOT drainage guidelines if a project involves an NDOT ROW permit.

209 MASTER DRAINAGE STUDY

Master drainage studies are utilized to establish the off-site and on-site flows for larger sized land development projects. They may be prepared when requested by the project developer or when required by the appropriate government entity during zoning actions or when specified in the entities' policy.

A Master Drainage Study will quantify the peak flows from the on-site and off-site basins. The pattern for on-site drainage routing will be established along with street hydraulic calculations. In general, the on-site basins are established based on the proposed collector/arterial street system. The need for other drainage improvements, i.e., storm sewers, open channels, etc., will be outlined as required to satisfy drainage criteria and policies.

In general, this study will be prepared in accordance with the standards of Section 204 except as noted with an asterisk (*). Detailed grading or improvement plans are not required. Latitude shall be given to the requirements of the Master Drainage Study versus a Technical Drainage Study since the detail of design may not be known at the time of preparation.

The following sub-sections of Section 204 as noted with an asterisk (*) are not required to be included in a Master Drainage Study. Other sub-sections, as determined through coordination with appropriate local Government entity, may also be omitted.

204.1 Study Contents:

Section lll.D.2, Section IV.B.5, Section IV.D.1.b through e, Section IV.D.2 through 5, Section VI, Section Vll.B.2 through 5 and 7 through 8.

204.2 Drainage Plan:

Items 12 & 15

If the requirements for the Technical Drainage Study outlined in Section 204 are met and all necessary grading and improvement plans are included in the Master Drainage Study, then the Master Drainage Study for the entire project can be utilized for overall grading of this project, construction of interim and perimeter streets, and drainage facilities.

In addition, the Master Drainage Study can be utilized for an entire project as well as a Technical Drainage Study for initial units of the project when the requirements of Section 204 are met and appropriate grading and improvement plans are provided.

Studies of roll waves and slug flow were performed primarily in connection with the mechanism of instability of uniform flow on a steep slope. Uniform flow will become unstable when the velocity of flow is very high or the channel slope is very steep. When this happens, the free surface will form a series of roll waves. In 1945, Vedernikov developed a criterion, Vedernikov number, to identify if the uniform flow is stable. Vedernikov number (N_v) is defined as:

$$Nv = x(1 - R\frac{dP}{dA})F \tag{749}$$

Where: x = 2/3 for Manning's equation

R = hydraulic radius

dP= change in wetted perimeter

dA= change in flow area

F = Froude Number

Where:

$$R\frac{dp}{dA} = \frac{by \quad d(2y + b)}{2\,y\,t\,b \quad d(by)} = \frac{2Y^*}{2Y^* + 1} \tag{750}$$

Where b = channel bottom width

y = flow depth

Y* = y/b

To be a stable uniform flow, Nv shall be less than or equal to unity.

$$Nv = \frac{2}{3}(1 - \frac{2Y^*}{2Y^*\,t\,1})F \tag{751}$$

$$and\ Nv \leq 1.0$$

The limiting Froude number for having a stable uniform flow in a rectangular channel is:

$$F \leq \frac{3}{2}(2Y^* + 1) \tag{752}$$

This conclusion agrees with the straight line on Plate B-7 of EM 111 O-2-1 601.

Similarly, limiting Froude numbers for trapezoidal channel with various side slopes, z, can be derived as:

$$F \leq \frac{3}{2}\left[\frac{(1 \text{ t } 2kY^*)(1 \text{ t } 2zY^*)}{1 + 2zY^* \text{ t } 2kzY^{*2}}\right] \text{ in which } k = \sqrt{1 + z^2} \tag{753}$$

Care has to be taken when designing a steep channel. Selections of y/b ratio, channel lining roughness and slope shall satisfy the above criteria to avoid roll waves. Otherwise mitigation shall be provided, including additional freeboard or rougher linings.

The height of roll waves can be approximated using the model of positive surges which have an advancing front with the profile similar to a moving hydraulic jump. When the height of the surge is small, the surge appears undular like an undular jump. When the height is increasing, the undulation will eventually disappear and the surge will have a sharp and steep front. Such an unsteady flow can be converted to a steady pattern by adding the wave speed to the flow field. Let the subscript 2 represents the design flow condition determined by Manning's formula for the selected channel cross section and the subscript 1 represents the section without roll waves defined by the limiting Froude number. Solving the continuity and momentum principles simultaneously yields:

$$V_2 = \frac{(V_1 - V_w)A_1 + V_w A_2}{A_2} \tag{754}$$

and the wave speed in a moving jump is:

$$V_w = V_1 + \sqrt{\frac{(A_2\bar{y}_2 - A_1\bar{y}_1)g}{A_1(1 - A_1/A_2)}} \tag{755}$$

$$h = y_2 - y_1 \tag{756}$$

in which V_w = wave velocity, V = flow velocity, A = flow area, g = gravitational acceleration, h = height of roll waves, and $\bar{y}$ = distance to centroid of flow area, approximated by 0.5y. Considering that the roll waves near the center of the channel section is similar to that in a rectangular channel, the height of roll waves can be derived as

$$h = \frac{C^2}{g}\left(\frac{2y_1}{y_1 + y_2}\right)\left(V_2 \quad V_1\right) \quad \text{c - c ' =} \quad \frac{C^2}{g}\left(\frac{2y_1}{y_1 + y_2}\right)(F_2 - F_1) \tag{757}$$

$$C = V_w - V_2 \tag{758}$$

in which F_2 = Froude number for design discharge, F, = limiting Froude number determined by Vedernikov's number, and C = celerity of wave. When the height of roll waves is small compared with the depth of flow, i.e. $y_1 \approx y_2$, Eq 757 is reduced to:

$$h = \frac{C^2}{g}(F_2 - F_1) \tag{759}$$

The above procedure predicts the height of roll waves when the design condition, F_2, deviates from the limiting condition, F,. It is suggested that design of channel freeboard must include the considerations of roll waves. Engineers must assure that the current design criteria for freeboard provides adequate height to accommodate roll waves on top of super-elevation. Otherwise, additional freeboard shall be added to the channel depth.

Design Freeboard = Maximum (Roll Waves or Empirical Freeboard)

A design example was developed to examine how this criteria will impact the selection of the channel cross-section. For instance, channel bottom widths of 10, 15, and 20 feet are considered to design a channel to pass 5,000 cubic feet per second on a slope of 3.0 percent with Manning's "n" of 0.014. The following table summarizes the recommended channel depth under the consideration of roll waves.

locations such as a change in grade of the street from positive to negative or at an intersection due to the crown slope of a cross street.

The procedure to define the capacities of standard inlets consists of defining the amount and depth of flow in the gutter and determining the theoretical flow interception by the inlet. To account for effects which decrease the capacity of the various types of inlets, such as debris plugging, pavement overlaying and variations in design assumptions, the theoretical capacity calculated in **Figures 804** through **811** for the inlet capacity should be reduced by the factors presented in **Table 802.**

Allowable inlet capacities for the standard inlets have been developed and are presented in **Figures 804** through 811 for "continuous grade" and **Figures 812** through 814 for "sump" conditions. The allowable inlet capacity is dependent on the depth of flow as determined from the street capacity calculations (for continuous grade inlets) or on the depth of ponding necessary to accept the desired flow rate (sump conditions). These depths must be kept at or below the allowable flow or ponding depths as presented in Section 304.4.

805.1 Inlets on Continuous Grade

For the "continuous grade" conditions **(Figures** 804 through 81 **I),** the capacity of an inlet is dependent upon many factors including gutter slope, depth of flow in the gutter, height and length of curb opening, street cross slope, and the amount of depression at the inlet. In addition, all of the gutter flow will not be intercepted and some flow will continue past the inlet area ("inlet carryover"). The amount of carryover must be included in the drainage facility evaluation as well as in the design of the inlet.

Flow on a street is divided into frontal flow carried by the gutter and side flow carried by the street. Street hydraulic capacity is determined by the street cross slope (S,). The interception of the frontal flow by a grated inlet is determined by the gutter flow velocity, splash velocity, and the length of the grate. Splash velocity is the flow velocity under the grate interference. Regression analyses performed on laboratory data and resulted in an empirical relationship for determining splash-over velocity based on grate length and type. Similar relationships were developed for the interception percentage of side flow. The total flow interception relationships for grated 3 foot long inlets under various water spread widths and street cross slopes are shown in **Figures** 804 through 807. The total interception is the sum of the frontal flow interception and the side flow interception, with a clogging factor.

For curb openings on a grade, the required curb opening length (Lt) for complete interception was also determined empirically. **Figures** 808 through

1603 CITY OF NORTH LAS VEGAS

Section 204

A completed **Drainage Submittal Checklist (Standard Form 2)** must be included with the initial technical drainage study submittal.

Section 303.6.1

The City of North Las Vegas does not permit the construction of permanent structures within a Federal Emergency Management Agency (FEMA) designated Special Flood Hazard Area (SFHA). Under this policy, any developer/builder proposing to place structures within a SFHA must meet the following requirements prior to the issuance of various permits and certificates-of-occupancy:

a. **Grading and off-site construction permits** may be issued by the City of North Las Vegas, Department of Public Works, once the improvement plans and drainage study have been approved and a copy of the completed Conditional Letter of Map Revision (CLOMR) application has been submitted to FEMA for processing.

b. **Building permits** can be issued once a CLOMR has been obtained from the FEMA.

c. **Certificates-of-Occupancy** can be issued once a Letter of Map Revision (LOMR) has been obtained from FEMA.

Section 304.4, Paragraph 4

Where downstream storm sewer facilities are not available, the City of North Las Vegas requires bubbler laterals for the conveyance of storm water under streets with right-of-way widths greater than or equal to 80 feet. The bubbler laterals must consist of a minimum 18-inch diameter reinforced concrete pipe. To accommodate the draining of the bubbler system prior to future downstream extension of the storm sewer system, a minimum 6-inch diameter PVC pipe must be daylighted downstream.

Section 304.4, Major Storm Street Capacity Limitations, Item A

Within the interior streets of a residential subdivision, the depth times velocity for the major storm event shall be less than or equal to 6.

Section 803.3

The City of North Las Vegas requires that stormwater drop inlet signage is obtained from the City's Resources/Environmental Division to be affixed to any installed drop inlets. Quality control inspectors will verify that the signs are properly installed.

Section 905

A minimum longitudinal street slope of 0.5 percent (0.005 ft/ft) shall be used. If the Engineer can demonstrate, to the satisfaction and approval of the City Engineer, severe topographic constraints or other mitigating factors, the design of streets with slopes less than 0.5 percent may be permitted.

General

Side Lot Drainage Easements

Side lot drainage easements are generally discouraged unless the engineer can demonstrate design constraints that render alternative site layout and drainage facility design options as impossible or impractical.

Wail openings

All wall openings must be designed to pass the 100-year storm event flows using the assumption that the bottom 50% of the openings are obstructed.

Emergency Overflow

When a storm drain system is proposed at a sump area, a non-damaging emergency surface flow path must be provided to convey the 100-year flows.

Lot Drainage Beneath Air-Conditioning Pads

For any ground-mounted air-conditioning pad that encroaches to within three (3) feet of a property line, the engineer must indicate on the plot plans how lot drainage will be accommodated beneath the pad. This can include, but is not limited to, the placement of a 4-inch diameter PVC pipe, with the inlet and outlet inverts of the pipe constructed to correspond with the flow line of the obstructed lot drainage swale.

1604 CLARK COUNTY PUBLIC WORKS - COUNTY POLICIES

1. Drainage Easements

a. Public Drainaae Easements - Public drainage easements are required for situations where a publicly maintained facility must drain through a private parcel. The easements must comply with the Clark County Public Works public drainage easement policy which follows:

- Subdivisions are to be designed to minimize the need for drainage easements;
- The drainage easement must be a minimum of 15 feet wide;
- The drainage easements must be fully concrete lined, with a low flow area constructed to a minimum grade of 1 percent in 50 feet or less or 0.5 percent for lengths greater than 50 feet;
- Block walls or combination of block wall and wrought iron to meet zoning's wall height requirements. Walls are to be located outside of the drainage easement;
- At a minimum, removable locking bollards must be placed at each end of the easement. In easements 50 feet long or less, a single galvanized gate may be installed at approximately the midpoint. In easements greater that 50 feet, two galvanized gates may be installed but they must be recessed at least 10 feet or at the front yard set backs as determined by Zoning, whichever is greater, from the public rights-of-way. Gates are to be hinged to allow 180-degree movement;
- Joint or multi-use easements are not acceptable, unless the above conditions are met;
- Where existing storm drainage facilities exist, to provide an outlet, underground storm drains will be used through an underground drainage easement with overflow section. The minimum width for a public underground drainage easement is 10 feet;

'b. Private drainage easements are to be used to convey flows from one private parcel through an adjacent private parcel. The