

### 203.3 Parcel Map Studies

Parcel map studies will be required according to the individual entities' processes as described in Section 1600. In general, a parcel map study for division of property for future sale or final design with no intention to proceed with any ground disturbing activities will contain Items I, II.A and C, V.B of Section 203.1 and Items 1 through 4 and 6 of Section 203.2. A Technical Drainage Study, as described in Section 204, will be required to support approval of final design.

## 204 TECHNICAL DRAINAGE STUDY

The Technical Drainage Study discusses at a detailed level the existing site hydrologic conditions and the proposed drainage plan to accommodate or modify these site drainage conditions in the final development plan for the site. The Technical Drainage Study addresses both on-site and off-site drainage analysis and improvements necessary to mitigate the impact of the proposed development on adjacent properties in accordance with current State of Nevada Drainage Law.

The Technical Drainage Study shall be in accordance with the following outline and contain the applicable information listed. **Standard Form 2** includes a drainage study criteria checklist and should be submitted along with the Technical Drainage Study. When the requested information is not applicable, signify with "N/A."

### 204.1 Study Contents

- I. TITLE PAGE
  - A. **Standard Forms 1 and 2**
  - B. Project Name, Type of Study, Study Date
  - C. Preparer's Name, Seal and Signature
  
- II. GENERAL LOCATION AND DEVELOPMENT DESCRIPTION
  - A. Location of Property
    - 1. City, County, State Highway and local streets within and adjacent to the subdivision
    - 2. Township, range, section, 1/4 section
    - 3. Drainage basin(s) encompassing the development

4. Location of development in relationship to the drainage basin's Regional Flood Control Facilities
  5. Names of surrounding developments
  6. General location map (8 ½" x 11" is suggested)
- B. Description of Property
1. Area in acres
  2. Existing site conditions (vegetation, buildings, drainage structures, etc.)
  3. General site topography
  4. Existing irrigation facilities such as ditches and canals
  5. General project description and proposed land use
- III . DRAINAGE BASIN DESCRIPTION
- A. Off-Site Drainage Description
1. Discuss off-site flows which enter property at the following discrete points:
    - a. Upstream Local Facilities runoff
    - b. Upstream Regional Facilities runoff
  2. Discuss off-site flows which enter property at non-discrete points.
  3. Discuss existing and proposed land use types and level of development in upstream basin, as defined by the local entity(ies).
  4. Hydrologic soil groups, vegetation, slope.
  5. Natural and manmade conveyances in the watershed.
- B. On-Site Drainage Description
1. Discuss historic on-site drainage patterns of the property (flow directions through site and at property line).
  2. Discuss historic drainage patterns of upstream runoff.

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 10- 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 III.D.2, Section IV.B.5, Section IV.D.1.b through e, Section IV.D.2 through 5, Section VI, Section VII.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.