

DS #: 4876

APN: 125.35-101-001 5 - 002

PROJECT: Service Station & Carwash

SUBMITTAL: 1st

SCANNED BY/DATE:

CHECKED BY/DATE:



|                                                                            |                                               |                                                                                                   |
|----------------------------------------------------------------------------|-----------------------------------------------|---------------------------------------------------------------------------------------------------|
| <b>CITY OF LAS VEGAS</b>                                                   |                                               | <b>DATE:</b>                                                                                      |
| <b>INTER-OFFICE MEMORANDUM</b>                                             |                                               | April 26, 2017                                                                                    |
| <b>TO:</b><br>Land Development Services<br>Department of Building & Safety |                                               | <b>FROM:</b><br>Albert Sung, P.E.<br>Flood Control Project Engineer<br>Department of Public Works |
| <b>SUBJECT:</b>                                                            | Drainage Study for:                           | <b>COPIES TO:</b>                                                                                 |
|                                                                            | <b>Service Station &amp; Carwash</b>          | McCay Engineering                                                                                 |
| <b>Cross Streets:</b>                                                      | SEC of Ann Road & Rainbow Boulevard           | DI Vegas LLC and Diana Properties LLC                                                             |
| <b>File Number:</b>                                                        | F:\Depot\DSMemos\DS4876A.doc                  | Bart Anderson, P.E., DevCo                                                                        |
| <b>Parcel Number:</b>                                                      | 125-35-101-001 & 125-35-101-002               | CCRFGD                                                                                            |
| <b>Zoning Action:</b>                                                      | GPA-60977; SUP-60979 to SUP-60982 & SDR-60983 | CCPW                                                                                              |
| <b>FEMA Flood Zone</b>                                                     | YES                                           | NO <b>X</b>                                                                                       |
| <b>Proposed Storm Drain</b>                                                | YES                                           | NO <b>X</b>                                                                                       |

| HISTORY                    | DATE RECEIVED | DATE REVIEWED | COMMENTS           | REVIEW FEES     | FEES PAID<br>Payment Trn # |
|----------------------------|---------------|---------------|--------------------|-----------------|----------------------------|
| 1 <sup>st</sup> Submittal  | 4/13/2017     | 4/26/2017     | See Comments Below | \$400.00        | 481742: \$400              |
| <b>TOTAL FEES (LDDRS):</b> |               |               |                    | <b>\$400.00</b> | ----                       |

#### REMARKS:

The Drainage Study for the subject project has been reviewed and:

|          |                                                                                                |
|----------|------------------------------------------------------------------------------------------------|
|          | is approved subject to conformance to all City standards and the following conditions:         |
| <b>X</b> | must be resubmitted or supplemented including the following:                                   |
|          | is conditionally approved subject to Clark County Regional Flood Control District concurrence. |
|          | is conditionally approved subject to Clark County Public Works Department concurrence.         |

1. Provide a copy of the zoning/planning conditions associated with this site (**GPA-60977; SUP-60979 to SUP-60982 & SDR-60983**) with the next submittal to verify compliance with conditions. *Flood Control* will not issue conditional approval of the drainage study without the associated zoning/planning conditions (issued by the *City Council*). Any associated conditions of approval that revise the site drainage parameters will require that the drainage study be revised and resubmitted.
2. The site is adjacent to or crosses an existing or proposed *Clark County Regional Flood Control District* (CCRFGD) master planned facility (in Ann Road). Therefore, CCRFGD concurrence is required prior to final approval of the drainage study.
3. The site is also adjacent to the jurisdiction of Clark County to the northeast. The engineer must coordinate with *Clark County Department of Public Works* (CCPW) and incorporate any concerns for boundary conditions along the northern border. CCPW concurrence is required prior to final acceptance of the study.
4. The overall site consists of two parcels currently. Address whether there will be a parcel map to consolidate the parcels into one single lot.

5. Delineation for basin OFF1 should reflect the highpoints presented on the southern drainage boundary and driveway highpoint shown on the proposed driveway on Rainbow Boulevard.
6. Provide a soil map showing the delineation of onsite soils that correspond with CN calculations. Calculation presented in the "soil type calculation curve number" does not support the 100% soli composition presented in this table.
7. Per the Flowmaster inlet calculation the inlet bypass flow on Rainbow Boulevard is 0.1 cfs. If this is correct, this bypass flow should be considered in the DV cross section calculations along Rainbow Boulevard and Ann Road.
8. The study merely stated that stormwater quality features had been provided without any quantitative description or design per **Section 1500** of the **CCRFCD Hydrologic Criteria and Drainage Design Manual**. Provide calculations in the next submittal to verify that the proposed length, width and depth of the landscape swales are meeting the design guidelines.
9. Provide the Recorded Document Number for existing public drainage easement located on the southeast corner of on the grading plan.
10. Provide the City of Las Vegas Recorded Plan Number for all existing storm drain systems located on Rainbow Boulevard and Ann Road on grading plans.
11. All grading plan sheets must be signed and sealed by the registered Nevada Professional Engineer.
12. Provide construction detail for the proposed riprap lined swale on grading plans.

**NOTE:** Please be advised that all land surface area disturbances over 1 acre or any area adjacent to a water way must submit to the *Nevada Division of Environmental Protection* a "Notice of Intent" to discharge that certifies a stormwater pollution prevention plan has been developed and is maintained on site; for inclusion in the Stormwater General Permit No. NVR100000. A phased construction unit in a contiguous subdivision is considered under construction until all stripped or disturbed surface areas have been covered by paving, building construction or planting. For more information, including forms and applications see <http://ndep.nv.gov/bwpc/storm01.htm> or call (775) 687-9429.

**END OF REMARKS**

T/R/S: T19S/R60E/S35  
AREA G-35

# **McCAY ENGINEERING**

11700 W. CHARLESTON BLVD., SUITE 170-298  
LAS VEGAS, NV 89135  
702-860-3897

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## **TECHNICAL DRAINAGE STUDY FOR SERVICE STATION & CARWASH @ SEC ANN & RAINBOW**

**LAS VEGAS**  
April 13, 2017



# **McCay ENGINEERING**

### **PREPARED FOR:**

DI VEGAS LLC & DIANA PROPERTIES LLC  
10300 W. CHARLESTON BLVD., #13-F39  
LAS VEGAS NV 89135

# HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

## DRAINAGE STUDY INFORMATION FORM

Name of Development: Service Station & Carwash @ SEC Ann & Rainbow Date: April 13, 2017

Location of Development: a) Descriptive (Cross Streets) North/South: Rainbow Boulevard  
East/West: Ann Road  
b) Section: 35 Township: 19S Range: 60E  
c) APN: 125-35-101-001, -002

Name of Owner: DI Vegas LLC and Diana Properties LLC

Telephone No.: 702-501-9883 Facsimile No.: \_\_\_\_\_ Email Address: \_\_\_\_\_

Address: 10300 W. Charleston Blvd, #13-F39 Las Vegas NV 89135

Contact Person Name: Jeremy McCay Telephone No.: 702-860-3897

E-mail Address: jmccay@centurylink.net

Firm: McCay Engineering

Address: 11700 W. Charleston Blvd., Suite 170-298, Las Vegas, NV 89135

Type of Land Development/Land Disturbance Process:

☐  
☐  
☐

Rezoning  
Parcel Map  
Large Parcel Map

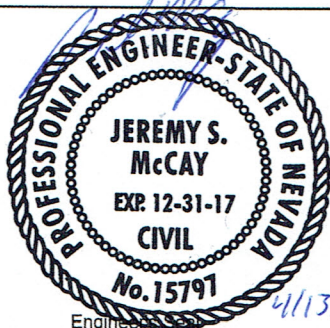
☐  
☐  
☒

Subdivision Map  
Planned Unit Development  
Building Permit

☐

Clearing and Grading Only  
Other (Please specify below)

1. Total Owned Land Area: At Site: 1.64 ac Being Developed/Disturbed: 1.64 ac
2. Is a portion or all of the subject property located in a designated FEMA Flood Hazard Area? YES\* ☐ NO ☒
3. Is the property bordered or crossed by an existing or proposed Clark County Regional Flood Control District Master Planned Facility? YES\* ☒ NO ☐
4. Proposed type of development (Residential, Commercial, Etc.)? Commercial
5. Approximate upstream land area which drains to the subject site? Approx. 0.2 acres
6. Has the site drainage been evaluated in the past? YES ☐ NO ☒ If yes, please identify documentation: \_\_\_\_\_
7. If known, please briefly identify the proposed discharge point(s) of runoff from the site:  
Ann Road and the adjacent property to the east conforming to the approved study.
8. Briefly describe your proposed schedule for the subject project: As soon as possible



Submit this form as part of the required drainage study to the local entity which has jurisdiction over the subject property. This form may provide sufficient information to serve as the Conceptual Drainage Study.

\* Review and concurrence of the Clark County Regional Flood Control District is required.

Local Entity File No. \_\_\_\_\_

| Revision | Date |
|----------|------|
|          |      |
|          |      |
|          |      |
|          |      |

Reference: **McCay Engineering Project #15164**

**STANDARD FORM 1**

| <b>HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                        |                                                                                                |     |    |  |              |               |                                                                              |              |               |                                        |              |               |                                          |                |               |                                                                                                |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|------------------------------------------------------------------------------------------------|-----|----|--|--------------|---------------|------------------------------------------------------------------------------|--------------|---------------|----------------------------------------|--------------|---------------|------------------------------------------|----------------|---------------|------------------------------------------------------------------------------------------------|
| <b>DRAINAGE SUBMITTAL CHECKLIST</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                        |                                                                                                |     |    |  |              |               |                                                                              |              |               |                                        |              |               |                                          |                |               |                                                                                                |
| Project Name: <b>Service Station &amp; Carwash @<br/>SEC Ann &amp; Rainbow</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Map ID:                                |                                                                                                |     |    |  |              |               |                                                                              |              |               |                                        |              |               |                                          |                |               |                                                                                                |
| Firm Name: <b>McCay Engineering</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Engineer: <b>Jeremy S. McCay, P.E.</b> |                                                                                                |     |    |  |              |               |                                                                              |              |               |                                        |              |               |                                          |                |               |                                                                                                |
| Address: <b>11700 W. Charleston Blvd., Suite 170-298</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                        |                                                                                                |     |    |  |              |               |                                                                              |              |               |                                        |              |               |                                          |                |               |                                                                                                |
| City: <b>Las Vegas</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | State: <b>NV</b>                       | Zip: <b>89135</b>                                                                              |     |    |  |              |               |                                                                              |              |               |                                        |              |               |                                          |                |               |                                                                                                |
| Phone Number: <b>702-860-3897</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Fax Number: <b>NA</b>                  |                                                                                                |     |    |  |              |               |                                                                              |              |               |                                        |              |               |                                          |                |               |                                                                                                |
| Property Owner: <b>DI Vegas LLC and Diana Properties LLC</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                        |                                                                                                |     |    |  |              |               |                                                                              |              |               |                                        |              |               |                                          |                |               |                                                                                                |
| Address: <b>10300 W. Charleston Blvd, #13-F39</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                        |                                                                                                |     |    |  |              |               |                                                                              |              |               |                                        |              |               |                                          |                |               |                                                                                                |
| City: <b>Las Vegas</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | State: <b>NV</b>                       | Zip: <b>89135</b>                                                                              |     |    |  |              |               |                                                                              |              |               |                                        |              |               |                                          |                |               |                                                                                                |
| Reviewed by:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Date Received:                         | Date Accepted for Review:                                                                      |     |    |  |              |               |                                                                              |              |               |                                        |              |               |                                          |                |               |                                                                                                |
| <p>The following checklist is intended as a guide for the engineer preparing a Technical Drainage Study to submit to the local entity and Clark County Regional Flood Control District (if necessary). The listed items are the minimum information required prior to the entity performing a review. The engineer will remain responsible to ensure the Technical Drainage Study is prepared within the guidelines as set forth in the Clark County Regional Flood Control District (CCRFCD) Hydrologic Criteria and Drainage Design Manual (MANUAL).</p> <p>This document is intended as an aid in preparing Technical Drainage Studies. Each study submitted is reviewed for compliance with local and regional criteria. This form is not intended to be all inclusive and does not limit the extent of the information, calculations or exhibits which may be necessary to properly evaluate the intended land use.</p> <p>If items are not applicable for the subject site, provide N/A.</p> <p><b>I. GENERAL REQUIREMENT</b></p> <table style="width: 100%; border: none;"> <tr> <td style="width: 15%; text-align: center;">Yes</td> <td style="width: 15%; text-align: center;">No</td> <td></td> </tr> <tr> <td style="text-align: center;"><u>  X  </u></td> <td style="text-align: center;"><u>      </u></td> <td>Design Manual <b>Standard Form 1</b> with the engineer's seal and signature.</td> </tr> <tr> <td style="text-align: center;"><u>  X  </u></td> <td style="text-align: center;"><u>      </u></td> <td>Design Manual <b>Standard Form 4</b>.</td> </tr> <tr> <td style="text-align: center;"><u>  X  </u></td> <td style="text-align: center;"><u>      </u></td> <td>2 copies of the 24" x 36" Drainage Plan.</td> </tr> <tr> <td style="text-align: center;"><u>  N/A  </u></td> <td style="text-align: center;"><u>      </u></td> <td>A notarized letter from the adjacent property owner(s) allowing off-site grading or discharge.</td> </tr> </table> |                                        |                                                                                                | Yes | No |  | <u>  X  </u> | <u>      </u> | Design Manual <b>Standard Form 1</b> with the engineer's seal and signature. | <u>  X  </u> | <u>      </u> | Design Manual <b>Standard Form 4</b> . | <u>  X  </u> | <u>      </u> | 2 copies of the 24" x 36" Drainage Plan. | <u>  N/A  </u> | <u>      </u> | A notarized letter from the adjacent property owner(s) allowing off-site grading or discharge. |
| Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | No                                     |                                                                                                |     |    |  |              |               |                                                                              |              |               |                                        |              |               |                                          |                |               |                                                                                                |
| <u>  X  </u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <u>      </u>                          | Design Manual <b>Standard Form 1</b> with the engineer's seal and signature.                   |     |    |  |              |               |                                                                              |              |               |                                        |              |               |                                          |                |               |                                                                                                |
| <u>  X  </u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <u>      </u>                          | Design Manual <b>Standard Form 4</b> .                                                         |     |    |  |              |               |                                                                              |              |               |                                        |              |               |                                          |                |               |                                                                                                |
| <u>  X  </u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <u>      </u>                          | 2 copies of the 24" x 36" Drainage Plan.                                                       |     |    |  |              |               |                                                                              |              |               |                                        |              |               |                                          |                |               |                                                                                                |
| <u>  N/A  </u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <u>      </u>                          | A notarized letter from the adjacent property owner(s) allowing off-site grading or discharge. |     |    |  |              |               |                                                                              |              |               |                                        |              |               |                                          |                |               |                                                                                                |
| <b>REFERENCE:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                        | <b>STANDARD FORM 2</b>                                                                         |     |    |  |              |               |                                                                              |              |               |                                        |              |               |                                          |                |               |                                                                                                |

# HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

## DRAINAGE SUBMITTAL CHECKLIST

### II. MAPS AND EXHIBITS

| Yes          | No            |                                                                                                                                                                                  |
|--------------|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <u>  X  </u> | <u>      </u> | A copy of a current Flood Insurance Rate Map (FIRM) with the site delineated.                                                                                                    |
| <u>  X  </u> | <u>      </u> | A copy of the current CCRFCD Master Plan Update Figure, (F-x), for Flood Control Facilities and Environmental areas with the site delineated.                                    |
| <u>  X  </u> | <u>      </u> | Off-site drainage basin maps for existing, interim and future conditions showing the existing topography, basin boundaries, concentration points, and flows in cfs.              |
| <u>  X  </u> | <u>      </u> | On-site drainage basin maps for existing and proposed conditions showing the existing topography, basin boundaries, concentration points, and on-site and off-site flows in cfs. |
| <u>  X  </u> | <u>      </u> | Vicinity Map with local and major cross streets identified and a north arrow.                                                                                                    |

### III. DRAINAGE PLAN

| Yes            | No            |                                                                                                                                                             |
|----------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <u>  X  </u>   | <u>      </u> | Sheet size: 24" x 36" sealed by a registered engineer in the State of Nevada.                                                                               |
| <u>  X  </u>   | <u>      </u> | Minimum scale: 1" = 60'.                                                                                                                                    |
| <u>  X  </u>   | <u>      </u> | Project Name.                                                                                                                                               |
| <u>  X  </u>   | <u>      </u> | Vicinity Map with local and major cross streets.                                                                                                            |
| <u>  X  </u>   | <u>      </u> | Revision box.                                                                                                                                               |
| <u>  X  </u>   | <u>      </u> | North arrow and bar scale.                                                                                                                                  |
| <u>  X  </u>   | <u>      </u> | Engineer's/consultant's address and phone number.                                                                                                           |
| <u>  X  </u>   | <u>      </u> | Elevation datum and benchmark.                                                                                                                              |
| <u>  X  </u>   | <u>      </u> | Legend for symbols and abbreviations.                                                                                                                       |
| <u>  N/A  </u> | <u>      </u> | Cut/fill scarps, where applicable.                                                                                                                          |
| <u>  X  </u>   | <u>      </u> | Street names, grades, widths.                                                                                                                               |
| <u>  X  </u>   | <u>      </u> | Proposed future and existing spot grades for top of curbs and street crowns at lot lines, grade breaks, and along curb returns on both sides of the street. |

**REFERENCE:**

**STANDARD FORM 2**

# HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

## DRAINAGE SUBMITTAL CHECKLIST

### III. DRAINAGE PLAN (Continued)

| Yes        | No            |                                                                                                                                                                                                                                                                             |
|------------|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <u>X</u>   | <u>      </u> | Existing contours encompassing the site and 100 feet beyond with spot elevations for important locations, where applicable.                                                                                                                                                 |
| <u>X</u>   | <u>      </u> | Minimum finish floor elevations with top-of-curb elevations at upstream end of lot.                                                                                                                                                                                         |
| <u>X</u>   | <u>      </u> | Proposed typical street sections.                                                                                                                                                                                                                                           |
| <u>N/A</u> | <u>      </u> | Streets with off-set crowns.                                                                                                                                                                                                                                                |
| <u>X</u>   | <u>      </u> | Proposed contours or spot elevations in sufficient detail to exhibit intended drainage patterns and slopes.                                                                                                                                                                 |
| <u>X</u>   | <u>      </u> | Property Lines.                                                                                                                                                                                                                                                             |
| <u>X</u>   | <u>      </u> | Right-of-way lines and widths, existing and proposed.                                                                                                                                                                                                                       |
| <u>X</u>   | <u>      </u> | Existing improvements and their elevations.                                                                                                                                                                                                                                 |
| <u>X</u>   | <u>      </u> | Delineation of proposed onsite drainage basins indicating area and 10-year and 100-year storm peak flows at basin concentration points.                                                                                                                                     |
| <u>X</u>   | <u>      </u> | Concentration points and drainage flow direction with Q100 and V100 and D100 in streets.                                                                                                                                                                                    |
| <u>X</u>   | <u>      </u> | Cumulative flows, velocity , and direction of flow at upstream and downstream ends of site for the 10-year and 100-year flows.                                                                                                                                              |
| <u>X</u>   | <u>      </u> | Location and cross-section of street capacity calculations.                                                                                                                                                                                                                 |
| <u>N/A</u> | <u>      </u> | Cross-sectional detail for channels, including cutoff wall locations.                                                                                                                                                                                                       |
| <u>X</u>   | <u>      </u> | Existing and proposed drainage facilities, appurtenances, and connections (i.e., sidewalk, ditches, swales, storm drain systems, unimproved and improved channels, and culverts, etc.) stating size, material, shape, and slope with plan and profile and HGL calculations. |
| <u>X</u>   | <u>      </u> | Existing and proposed drainage easements and widths shown with sufficient detail. A cross sectional detail must be provided that shows appropriate lining and reinforcement.                                                                                                |
| <u>X</u>   | <u>      </u> | Location and detail of existing, proposed, and future block wall openings. Minimum size is 16" x 48". Wrought iron gate is required for flows > 10 cfs.                                                                                                                     |
| <u>N/A</u> | <u>      </u> | Location and detail of flood walls illustrating depth of flow, proposed grouting height, etc.                                                                                                                                                                               |

REFERENCE:

STANDARD FORM 2

# HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

## DRAINAGE SUBMITTAL CHECKLIST

### III. DRAINAGE PLAN (Continued)

| Yes        | No            |                                                                                                                                                                                                                |
|------------|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <u>NA</u>  | <u>      </u> | Perimeter retaining wall locations. All existing and proposed walls (retaining screen and flood) must be shown with adjacent ground elevations. Flood walls with 8-inch concrete masonry unit.                 |
| <u>X</u>   | <u>      </u> | Building and/or lot numbers.                                                                                                                                                                                   |
| <u>X</u>   | <u>      </u> | Alignment of all existing, proposed, or future Regional Facilities adjacent to the site.                                                                                                                       |
| <u>N/A</u> | <u>      </u> | Limits of existing floodplain based on current FIRM or best available information; limits of proposed floodplains based on best available information.                                                         |
| <u>N/A</u> | <u>      </u> | For areas in Zone A, AE, AH, and AO, base flood elevations (BFEs) must be shown for each lot; BFEs may be listed on each lot, or in a table. Finish floor elevations must be a minimum of 18 inches above BFE. |
| <u>X</u>   | <u>      </u> | Appropriately elevated "humps" 6 inches above the 100 year water surface elevation at site accesses where the intent is to protect the site from the Q <sub>100</sub> flows.                                   |
| <u>X</u>   | <u>      </u> | Street slopes for perimeter and interior streets. The minimum slope is 0.4 percent.                                                                                                                            |

### IV. HYDROLOGIC ANALYSIS

| Yes      | No            |                                                                                                                                                                              |
|----------|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <u>X</u> | <u>      </u> | Appropriate soil information and Soils Map for existing and future conditions with subbasins and property delineated.                                                        |
| <u>X</u> | <u>      </u> | Input and output information for existing conditions from computer models (HEC-1 or TR-55). The flow routing diagram must be provided with HEC-1 models.                     |
| <u>X</u> | <u>      </u> | Input and output information for future conditions from computer models (HEC-1 or TR-55). The flow routing diagram must be provided with HEC-1 models.                       |
| <u>X</u> | <u>      </u> | Use of correct precipitation values in and around the McCarran Airport rainfall area.                                                                                        |
| <u>X</u> | <u>      </u> | A discussion in the text of the hydrologic analysis justifying subbasin boundaries and cutoffs, supporting assumptions, and calculations.                                    |
| <u>X</u> | <u>      </u> | A summary table of stormwater flows showing basin area, Q <sub>10</sub> and Q <sub>100</sub> for both individual basins and combined basin flows, where applicable.          |
| <u>X</u> | <u>      </u> | Copies of supporting technical information referenced from a previously approved study and a statement accepting these results.                                              |
| <u>X</u> | <u>      </u> | On-site facilities must perpetuate flows through or around the site without significantly impacting adjacent property owners in accordance with current Nevada Drainage Law. |

REFERENCE:

STANDARD FORM 2

# HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

## DRAINAGE SUBMITTAL CHECKLIST

### V. HYDRAULIC ANALYSIS

| Yes       | No            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-----------|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <u>NA</u> | <u>      </u> | Flow split calculations and supporting documentation or reference for the method of flow split calculations used.                                                                                                                                                                                                                                                                                                                                                                                                            |
| <u>X</u>  | <u>      </u> | Normal depth street flow calculations and cross section diagrams for all interior and perimeter streets. Provide "d x v" products for the $Q_{100}$ and $Q_{10}$ flows representing the worst case for interior and all perimeter streets. $Q_{100} \text{ d x v} \leq 8$ . $Q_{10} \text{ d x v} \leq 6$ and 12 foot dry lane for rights-of-way $\geq 80$ feet. Calculations must be labeled by street name as indicated on the Grading Plan.                                                                               |
| <u>X</u>  | <u>      </u> | A summary table of interior and exterior street capacity calculations showing the street name, $Q_{100}$ flow, slope, depth of flow, velocity and depth times velocity product and streets needing to meet 12 foot dry lane criteria.                                                                                                                                                                                                                                                                                        |
| <u>X</u>  | <u>      </u> | Appropriate hydraulic calculations for block wall openings assuming a 50 percent vertical clogging factor. (Assume the lower half of the opening is plugged.)                                                                                                                                                                                                                                                                                                                                                                |
| <u>X</u>  | <u>      </u> | Appropriate hydraulic calculations at drainage easement entrance and discharge locations to set finish floor elevations. Hydraulic calculations must include submerged weir, superelevation and tee intersection losses. where appropriate.                                                                                                                                                                                                                                                                                  |
| <u>X</u>  | <u>      </u> | Provide necessary freeboard requirements to set the finished floor elevations of all proposed buildings, 2 x depth of flow or depth of flow plus 18 inches of freeboard, whichever is less. The minimum requirement is 6 inches above adjacent upstream top of curb. Buildings adjacent to drainage easements must always be provided with 18 inches of freeboard above the $Q_{100}$ weir height or flow depth, which ever is greater.                                                                                      |
| <u>NA</u> | <u>      </u> | <p>A complete water surface profile analysis (HEC-2, HEC-RAS, etc.) for channel flows and FEMA Zone A flood zones.</p> <ul style="list-style-type: none"> <li>Field survey data.</li> <li>Input and output information.</li> <li>Plotted cross-sections based on survey with proper encroachments.</li> <li>A map showing the location of the cross-sections.</li> <li>Analysis of both sub and super-critical flow segments.</li> <li>A summary table and a discussion of the results in the text of the report.</li> </ul> |
| <u>X</u>  | <u>      </u> | Provide a 50 percent clogging factor in the capacity calculation for drop inlets.                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <u>NA</u> | <u>      </u> | Hydraulic calculations for culverts and storm drains. D-Load calculations must be provided for storm drain pipes in public rights-of-way, including headwater pool inundation.                                                                                                                                                                                                                                                                                                                                               |
| <u>X</u>  | <u>      </u> | The mitigation of nuisance water, both during construction and in the fully developed condition, must be addressed.                                                                                                                                                                                                                                                                                                                                                                                                          |

REFERENCE:

STANDARD FORM 2



# CITY OF LAS VEGAS

## MINIMUM DRAINAGE STUDY CRITERIA STANDARD FORM 2 CHECKLIST SUPPLEMENT

(Revised 5/18/11)

The following checklist is intended as a supplemental guide for the engineer preparing a Technical Drainage Study submittal to the City of Las Vegas. This supplement focuses on requirements specific to the City of Las Vegas. The requirements presented are in addition to the Clark County Regional Flood Control District (CCRFCDD) Manual Standard Form 2. The listed items are the minimum information required prior to the City performing a review. The engineer will remain responsible to ensure the Technical Drainage Study is prepared within the guidelines as set forth in the CCRFCDD Hydrologic Criteria and Drainage Design Manual (Design Manual).

An appointment must be made to preview this checklist in conjunction with CCRFCDD Standard Form 2 prior to the City accepting a new drainage study for review. The engineer must contact the Flood Control Section at (702) 229-6541 to schedule a submittal appointment.

**If items are not applicable for the subject site, provide N/A.**

| I. GENERAL REQUIREMENT |    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|------------------------|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Yes                    | No |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|                        | X  | A notarized letter from the adjacent property owner(s) allowing off-site grading. (A copy of the letter must be received prior to final acceptance of the drainage study.)                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| X                      |    | Copies of all conditions of approval for development related to this property. (e.g. zoning, use permit, tentative map, etc.) Verify compliance with conditions.                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| X                      |    | An electronic copy of the complete submittal is required to be submitted with one original hard copy of the study. Electronic documents should be on a universal computer-readable digital output device replicating your submittal. An Indexed Portable Document Format (PDF) or Print Ready CAD file formats with a minimum of 300dpi are the desired formats. If figures are in color, they must be scanned in color and saved as a separate file.<br><br>_____ by initial here, the engineer on record acknowledges that the electronic copy is an identical replicate of the original hard copy submitted to the City of Las Vegas. |

| II. GRADING PLAN INFORMATION |    |                                                                                                                                                                                                                                                                                                  |
|------------------------------|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Yes                          | No |                                                                                                                                                                                                                                                                                                  |
| X                            |    | (1) 24" X 36" copy of the Grading Plan, (including all Detail Sheets) sealed by the engineer.                                                                                                                                                                                                    |
| X                            |    | Proposed future and existing spot grades for top of curbs and street crowns at lot lines, grade breaks, and along curb returns on both sides of the street. Note: Proposed top of curb elevations must be provided for both sides of roadways even if only half street construction is required. |
| X                            |    | Label existing topography at a minimum 5 foot elevation interval including adjacent developments, finished floor elevations of existing buildings and top of existing curbs extending 100 feet around the perimeter of the site. (*Measured from the centerline of the adjacent roadway.)        |

## CITY OF LAS VEGAS MINIMUM DRAINAGE STUDY CRITERIA CHECKLIST

| II. GRADING PLAN INFORMATION |    |                                                                                                                                                                                                                                                                                                                                                                                                              |
|------------------------------|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Yes                          | No |                                                                                                                                                                                                                                                                                                                                                                                                              |
|                              | X  | Proposed on-site and off-site storm drains and other flood control facilities with plan and profile sheets for public storm drains showing the class of pipe, (Class III, IV, V, etc.), design hydraulic grade line, (HGL) and 100 year storm flow. A public drainage easement must be provided over on-site storm drains conveying off-site flows. An overflow path must be provided over all storm drains. |
| X                            |    | All existing and "to be constructed" walls with cross-sections showing wall type, (e.g. block wall, retaining wall, flood wall, etc.), with limits clearly defined, adjacent ground elevations. Wall heights must meet current ordinances and in no case exceed 14 feet above the adjacent property.                                                                                                         |
| X                            |    | Street slopes for both interior and perimeter streets. Note: The minimum slope for a roadway is 0.4 percent, a minimum 18-inch storm drain must be provided where minimum slopes cannot be met.                                                                                                                                                                                                              |
| NA                           |    | Back of lot elevations and lot drainage pattern for all lots including common lots.                                                                                                                                                                                                                                                                                                                          |
|                              | X  | Sites with a grade difference two feet above or below existing ground are required to have approval from City of Las Vegas Current Planning. Current Planning approval is required prior to final approval of the drainage study.                                                                                                                                                                            |
| X                            |    | On-site facilities must perpetuate flows through or around the site without significantly impacting adjacent property owners. (The project must pass flows through the site every 600 feet where the project is blocking flow paths.)                                                                                                                                                                        |
| NA                           |    | This project uses a solid grouted stem wall (or approved alternate) at the back of sidewalk to provide erosion protection for landscaped areas where the depth of flow in the roadway exceeds the back of walk elevation. A corresponding cross-section detail is included.                                                                                                                                  |
| X                            |    | Commercial and Common Lot Landscape areas are not allowed to drain over the sidewalk. The grading plans show flow lines with grades and sidewalk under drains for all landscape areas draining to the public ROW.                                                                                                                                                                                            |

| III. Local Entity Criteria - City of Las Vegas – Manual Section 1600 |    |                                                                                                                                                                                                          |
|----------------------------------------------------------------------|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Yes                                                                  | No |                                                                                                                                                                                                          |
| X                                                                    |    | Concrete valley gutters are required in parking lots with slopes less than 1 percent. Slopes through cul-de-sac must be at a 1 percent minimum where flow is drained through the cul-de-sac.             |
| NA                                                                   |    | Ten-foot wide public drainage easements to be privately maintained are allowed for flow less than 20 cfs. The depth of flow entering the easement must be checked using the submerged weir calculation.  |
| NA                                                                   |    | The limits of the flood zones and the base flood elevations (BFE) must be shown on all grading plans for all developments within a Special Flood Hazard Zone A, AO, AE, etc.                             |
| X                                                                    |    | Minimum finish floor elevation is 6 inches above highest adjacent top of curb. Finish floor calculations must include allowances for super elevations on curves and velocity head for tee intersections. |
| NA                                                                   |    | Finished floor elevations for buildings adjacent to public drainage easements must be a minimum of 18 inches above the Q100 weir of submerged weir elevation, whichever is greater.                      |

### CITY OF LAS VEGAS MINIMUM DRAINAGE STUDY CRITERIA CHECKLIST

| III. Local Entity Criteria - City of Las Vegas – Manual Section 1600 |    |                                                                                                                                                                                                                                                                       |
|----------------------------------------------------------------------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Yes                                                                  | No |                                                                                                                                                                                                                                                                       |
| NA                                                                   |    | Lots with “B and C Type Drainage” that drain from one lot to another through a drainage easement shall be required to install an underground nuisance drainage system or a 2-foot valley gutter. 16” x 24” minimum block wall openings are required for both options. |
| NA                                                                   |    | Bubblers are required across 80 foot and greater ROW streets. When flows exceed 10 cfs, bubblers larger than 18 inches will be required up to a maximum of 36”. Inlets must be sized to match the pipe size provided.                                                 |

- Contact the Flood Control Section regarding the drainage study review fee. These fees are payable at the time of submittal.
- The Drainage Study must be conditionally approved prior to submitting improvement plans to the Civil and Planning Development of the Department of Building and Safety for review.

This document is intended as an **aid** in preparing Technical Drainage Studies for the City of Las Vegas. Each study submitted is reviewed for compliance with local and regional criteria. This form is not intended to be all-inclusive and does not limit the extent of the information, calculations or exhibits which may be necessary to properly evaluate the intended land use.



LAS VEGAS  
CITY COUNCIL

CAROLYN G. GOODMAN  
MAYOR

STAVROS S. ANTHONY  
MAYOR PRO TEM

LOIS TARKANIAN  
STEVEN D. ROSS  
RICKI Y. BARLOW  
BOB COFFIN  
BOB BEERS

ELIZABETH N. FRETWELL  
CITY MANAGER

CITY OF LAS VEGAS  
495 S. MAIN STREET  
LAS VEGAS, NEVADA 89101

VOICE 702.229.6011  
TTY 702.386.9108  
[www.lasvegasnevada.gov](http://www.lasvegasnevada.gov)

January 21, 2016

Mr. Mike Montandon  
Rainbow Ann (I) LLC  
719 Oakbridge Court  
North Las Vegas, Nevada 89032

**RE: SDR-60983 [PRJ-60825] - SITE DEVELOPMENT PLAN REVIEW  
RELATED TO GPA-60977, ZON-60978, SUP-60980 AND SUP-60982  
CITY COUNCIL MEETING OF JANUARY 20, 2016**

Dear Mr. Montandon:

The City Council at a regular meeting held on January 20, 2016 **APPROVED** a request for a Site Development Plan Review FOR A PROPOSED 2,600 SQUARE-FOOT RESTAURANT WITH DRIVE THROUGH, A 3,675 SQUARE-FOOT GENERAL RETAIL AND A 1,905 SQUARE-FOOT CAR WASH, FULL SERVICE OR AUTO DETAILING USE DEVELOPMENT WITH A WAIVER OF THE CORNER LOT BUILDING ORIENTATION AND TO ALLOW A SERVICE OR WASH BAY TO FACE A PUBLIC RIGHT-OF-WAY on 1.64 acres on the southeast corner of Ann Road and Rainbow Boulevard (APNs 125-35-101-001 and 002), R-E (Residence Estates) [PROPOSED: C-1 (Service Commercial)] Zone, Ward 4 (Anthony) [PRJ-60825].

This approval is subject to the following conditions:

**Planning**

1. The gas fuel tanks shall be relocated as far west as possible from the eastern portion of the site.
2. The eastern perimeter wall shall be raised to eight feet in height if structurally sound and permissible; if not applicable, an eight-foot wall shall be constructed adjacent to the existing wall, or if agreed upon with the adjacent property owners, the existing wall shall be removed and a new eight-foot block wall shall be constructed.
3. The carwash tunnel shall be extended to mitigate noise pollution and the opening shall not face Ann Road.
4. All lighting shall be fixed in a downward position so as no light pollution shall impact the residents to the east.
5. A one year administrative Required Review shall be conducted from date of issuance of a C of O.

6. Approval of and conformance to the Conditions of Approval for General Plan Amendment (GPA-60977) and Rezoning (ZON-60978) shall be required, if approved.
7. This approval shall be void two years from the date of final approval, unless exercised pursuant to the provisions of LVMC Title 19.16. An Extension of Time may be filed for consideration by the City of Las Vegas.
8. All development shall be in conformance with the site plan and landscape plans and building elevations, date stamped 11/12/15, except as amended by conditions herein.
9. A Waiver is hereby approved, to allow a service or wash bay to face a public right-of-way, where such is not permitted.
10. An Exception from Title 19.08.110 is hereby approved, to allow seven uncovered parking spaces before a landscaped island are installed, where only six uncovered parking spaces is the maximum required.
11. All necessary building permits shall be obtained and final inspections shall be completed in compliance with Title 19 and all codes as required by the Department of Building and Safety.
12. These Conditions of Approval shall be affixed to the cover sheet of any plan set submitted for building permit.
13. The applicant shall coordinate with the City Surveyor and other city staff to determine the most appropriate mapping action necessary to consolidate the existing lots. The mapping action shall be completed and recorded prior to the issuance of any building permits.
14. A technical landscape plan, signed and sealed by a Registered Architect, Landscape Architect, Residential Designer or Civil Engineer, must be submitted prior to or at the same time application is made for a building permit. A permanent underground sprinkler system is required, and shall be permanently maintained in a satisfactory manner; the landscape plan shall include irrigation specifications. Installed landscaping shall not impede visibility of any traffic control device.
15. A fully operational fire protection system, including fire apparatus roads, fire hydrants and water supply, shall be installed and shall be functioning prior to construction of any combustible structures.

16. All City Code requirements and design standards of all City Departments must be satisfied, except as modified herein.

**Public Works**

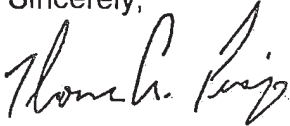
17. Grant a 5-foot Pedestrian Access Easement on Ann Road and Rainbow Boulevard adjacent to this site prior to the issuance of permits for this site.
18. Remove all substandard public street improvements and unused driveway cuts adjacent to this site, and replace with new improvements meeting current City Standards concurrent with development of this site. All existing paving damaged or removed by this development shall be restored at its original location and to its original width concurrent with development of this site.
19. Landscape and maintain all unimproved rights-of-way adjacent to this site. All landscaping and private improvements installed with this project shall be situated and maintained so as to not create sight visibility obstructions for vehicular traffic at all development access drives and abutting street intersections.
20. Unless otherwise allowed by the City Engineer, construct sidewalk on at least one side of all access drives connecting this site to the adjacent public streets concurrent with development of this site. The connecting sidewalk shall extend from the sidewalk on the public street to the first intersection of the on-site roadway network and shall be terminated on-site with a handicap ramp.
21. Meet with the Fire Protection Engineering Section of the Department of Fire Services to discuss fire requirements for the proposed use of this facility.
22. A Traffic Impact Analysis must be submitted to and approved by the Department of Public Works prior to the issuance of any building or grading permits, submittal of any construction drawings or the recordation of a Map subdividing this site, whichever may occur first. Comply with the recommendations of the approved Traffic Impact Analysis prior to occupancy of the site. The Traffic Impact Analysis shall also include a section addressing Standard Drawings #234.1 #234.2 and #234.3 to determine additional right-of-way requirements for bus turnouts adjacent to this site, if any; dedicate all areas recommended by the approved Traffic Impact Analysis. All additional rights of way required by Standard Drawing #201.1 for exclusive right turn lanes and dual left turn lanes shall be dedicated prior to or concurrent with the commencement of on site development activities unless specifically noted as not required in the approved Traffic Impact Analysis. Phased compliance will be allowed if recommended by the approved Traffic Impact Analysis. No recommendation of the approved Traffic Impact Analysis, nor compliance therewith, shall be deemed to modify or eliminate any condition of approval imposed by the Planning Commission or the City Council on the development of this site.

Mr. Mike Montandon  
Rainbow Ann (I) LLC  
SDR-60983 [PRJ-60825] - Page Four  
January 21, 2016

23. A Drainage Plan and Technical Drainage Study must be submitted to and approved by the Department of Public Works prior to the issuance of any building or grading permits or submittal of any construction drawings, whichever may occur first. Provide and improve all drainageways recommended in the approved drainage plan/study. The developer of this site shall be responsible to construct such neighborhood or local drainage facility improvements as are recommended by the City of Las Vegas Neighborhood Drainage Studies and approved Drainage Plan/Study concurrent with development of this site.

The Notice of Final Action was filed with the Las Vegas City Clerk on January 21, 2016.

Sincerely,



Thomas A. Perrigo  
Director  
Department of Planning

TAP:clb

cc: Mr. Richard Gallegos  
Pacific Design Concepts  
6725-5 South Eastern Avenue  
Las Vegas, Nevada 89118



# McCay ENGINEERING

11700 W. CHARLESTON BLVD.  
SUITE #170-298  
LAS VEGAS, NV 89135  
JMCCAY@CENTURYLINK.NET  
(702) 860-3897

April 13, 2017

Albert Sung, P.E.  
City of Las Vegas Flood Control  
333 N. Rancho Drive  
Las Vegas, Nevada 89106

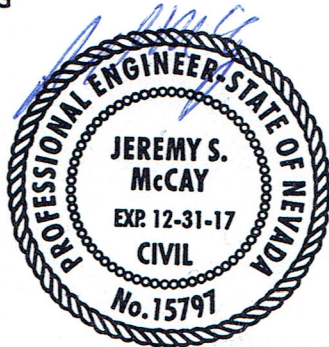
**RE: TECHNICAL DRAINAGE STUDY FOR SERVICE STATION & CARWASH @ SEC ANN & RAINBOW**  
Job No. 17232

Dear Mr. Sung:

McCay Engineering is pleased to submit two copies of the Technical Drainage Study and Grading Plan for your review and approval for the above-mentioned project. The proposed 1.64-acre commercial development is located on the southeast corner of Ann Road and Rainbow Boulevard, in a portion of the City of Las Vegas, Nevada.

If you have any questions or comments regarding this project, please do not hesitate to contact this office at (702) 860-3897.

Sincerely,  
McCay Engineering



Jeremy S. McCay, P.E.  
Principal

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## **I. INTRODUCTION**

### **A. Study Overview and Purpose**

This study is intended to serve as the technical hydrology study for the proposed development. The site comprises of approximately 1.64 acre of proposed commercial development. This study is a stand-alone document that presents the findings of a hydrologic analysis of the site and contributing watershed area.

This report will identify any natural washes as well as any existing/proposed drainage facilities that contribute stormwater runoff to the site during a 100- and 10-year, 6-hour storm event. This study has been conducted in accordance with the criteria set forth by the Clark County Regional Flood Control District's (CCRFCD) *Hydrologic Criteria and Drainage Design Manual* (Reference #1).

### **B. Location**

The project area is within the Northwest Quarter (NW 1/4) of Section 35, Township 19 South, Range 60 East, Mount Diablo Meridian, City of Las Vegas, Nevada. The site is located on the southeast corner of the intersection of Ann Road and Rainbow Boulevard (APN 125-35-101-001 and -002). See Figures 1 and 1A, *Vicinity Map* and *APN Map*.

### **C. Existing Site Description**

The Service Station & Carwash @ SEC Ann & Rainbow site is currently undeveloped. The site consists of approximately 1.64 acres in moderate to poor hydrologic condition. The general area slopes to the east at approximately 1 to 2 percent. The parcels adjacent to the project are generally a patchwork of residential, commercial, and undeveloped property. See Figure 2, *Site Description Map*.

### **D. FEMA Flood Plain Information**

A review of the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRM) Community-Panel Number 32003C1765F, effective date November 16, 2011 (Reference #5), indicates the site is located within a FEMA Zone 'X'. A Zone 'X' is described by FEMA as areas outside of the 0.2% annual chance floodplain. A map depicting the FEMA flood zones in the vicinity of the site is included in the appendix of this study. (Figure 3- FIRM Map)

### **E. CCRFCD Master Plan Information**

As shown on Figure F-19 from the *Flood Control Master Plan Update of the Las Vegas Valley* (see Figures 4 and 5 in the Appendix), prepared by PBS&J, Louis Berger Group, etc. (Reference #4), the subject site is adjacent to an existing Master Plan Flood Control Facility. The existing Ann Road Channel West facility (ANWE 0290) is a 8' x 8' RCB that has been constructed in Ann Road. Figure H-19 has also been provided (see Figure 6 in the appendix) and the site is a part of basin NW2D1-C.

### **F. Previous Drainage Studies**

There are no previous drainage studies prepared for the site. Information on flows in Ann Road were taken from the approved Technical Drainage Ann 17. Reference material has been deemed acceptable for this study and excerpts have been included in the appendix.

## II. METHODOLOGY

### A. Compliance with Regulations

This study complies with the standards set forth within Reference #1 and City of Las Vegas drainage requirements.

### B. Hydrologic Criteria

#### 1. Rainfall Criteria

The project site is located within the McCarran Airport Rainfall Area. The depth-duration-frequency values for the 6-hour, 10-year and 100-year storm events were obtained from Table 505 and Figure 513 of Reference #1. Since the site encompasses less than 8-square miles a Storm Distribution Number three (SDN #3) was used in the HEC-1 model. The precipitation values are outlined in Table 1.

#### 2. Runoff Computations

The U. S. Army Corps of Engineers HEC-1 flood hydrograph package was used to determine the peak runoff generated during the 100- and 10-year, 6-hour storm event. The HEC-1 computer model simulates the surface runoff response of a given watershed to rainfall. The HEC-1 program represents the watershed as an interconnected system of hydraulic components. Each component represents an aspect of the rainfall runoff process within a portion of the watershed. The smaller portion is referred to as a sub-basin. The computed hydrographs from each sub-basin are then combined at appropriate locations to obtain the final discharge hydrograph. The HEC-1 parameter calculations are located in appendix of this study.

The SCS curve number method was used to determine the infiltration rates for the drainage basins. The soil groups for the project site were determined using the SCS Soil Survey of the Las Vegas Valley. Curve numbers for the undeveloped onsite were determined using Table 602 (4 of 4) for areas shown to desert shrub. Curve numbers for the developed onsite and offsite were determined using Table 602 (1 of 4) and Table 602A for areas shown to commercial, residential, and paved. Soil information has been included in the appendix (also see Figure 7).

Basin areas for the offsite and onsite drainage basins were determined using a scaled plan.

Lag Time  $T_L$  is defined as the time measured from the centroid of effective rainfall to the peak of the outflow hydrograph. It is a measure of the watershed's response time, and is a coherent property to basin length, slope, roughness characteristics, and land use. The lag-times for this study were estimated by calculating the drainage basins' time of concentration,  $T_C$ . The time of concentration consists of two components; the initial overland flow time,  $t_i$ , and the gutter or channel flow time,  $t_t$ . The equation for the time of concentration is  $T_C = t_i + t_t$ . The equation for lag time is  $T_L = 0.6T_C$ .

Precipitation in the Las Vegas Valley is characterized typically by long-duration, low-intensity winter storms and by short-duration, high-intensity summer storms. The winter storms, in general, do not produce major flooding events. The summer storms however can and do produce major flash flooding hazards in the Las Vegas Valley Area.

**TABLE 1  
DRAINAGE BASIN PARAMETERS**

| <b>BASIN</b> | <b>AREA<br/>(acres)</b> | <b>CN</b> | <b>POINT PRECIP.<br/>(10 yr/100 yr)</b> | <b>DARF<br/>(10 yr/100 yr)</b> | <b>LAG<br/>(hr)</b> |
|--------------|-------------------------|-----------|-----------------------------------------|--------------------------------|---------------------|
| OFF1         | 0.19                    | 98.0      | 1.58/2.77                               | 0.57/1.00                      | 0.0500              |
| OFF2         | 0.63                    | 98.0      | 1.58/2.77                               | 0.57/1.00                      | 0.0500              |
| OFF3         | 0.09                    | 80.5      | 1.58/2.77                               | 0.57/1.00                      | 0.0760              |
| OFF4         | 0.11                    | 80.5      | 1.58/2.77                               | 0.57/1.00                      | 0.0500              |
| EXON1        | 0.40                    | 87.1      | 1.58/2.77                               | 0.57/1.00                      | 0.1000              |
| EXON2        | 1.24                    | 87.1      | 1.58/2.77                               | 0.57/1.00                      | 0.1130              |
| DEV1         | 0.25                    | 94.7      | 1.58/2.77                               | 0.57/1.00                      | 0.0500              |
| DEV2         | 1.39                    | 94.7      | 1.58/2.77                               | 0.57/1.00                      | 0.0560              |

### **III. DRAINAGE BASIN DESCRIPTIONS**

#### **A. Existing Offsite Drainage Description**

The existing offsite basins impacting the site come from the west. As shown in the approved Technical Drainage Study for Ann 17, there are no flows in Ann Road shown along the frontage of the Ann 17 development and flows have been captured by the Regional facility in the street. Existing drop inlets and stormdrain laterals have been installed in Ann Road and Rainbow Boulevard. There is a highpoint in Rainbow Boulevard near the southern boundary of the Service Station & Carwash @ SEC Ann & Rainbow project. Basin OFF1 was delineated based on the highpoint in Rainbow Boulevard and the point where it is captured by an existing drop inlet. Basin OFF2 was delineated as the remaining street along the frontage of the project. Two lowpoints have been identified on the property to the south that enter the project. These basins have been delineated as OFF3 and OFF4. Offsite flows and basins impacting the site are shown on the basin map included in the appendix (Figure 7).

#### **B. Existing Onsite Drainage Description**

The existing site was analyzed to quantify the amount of runoff generated in the existing conditions. The onsite basins have been delineated based on the sites existing topography. Onsite basin EXON1 is a portion of the existing project and is discharged to Ann Road. Onsite basin EXON2 is the remaining portion of the existing project and is discharged to the drainage easement located in the southeast corner. The delineation of the existing onsite basins are shown on Figure 7 included in the appendix. Table 2 shows a summary of the runoff amounts determined in the existing condition.

**TABLE 2**  
**10-YEAR / 100-YEAR, 6-HOUR STORM EVENT**  
**EXISTING RUNOFF AMOUNTS**

| <b>BASIN NAME/<br/>CONCENTRATION POINT</b> | <b>AREA<br/>(acres)</b> | <b>10-YEAR FLOW<br/>(cfs)</b> | <b>100-YEAR FLOW<br/>(cfs)</b> |
|--------------------------------------------|-------------------------|-------------------------------|--------------------------------|
| OFF1                                       | 0.19                    | 0                             | 1                              |
| OFF2                                       | 0.63                    | 1                             | 2                              |
| OFF3                                       | 0.09                    | 0                             | 0                              |
| OFF4                                       | 0.11                    | 0                             | 0                              |
| EXON1                                      | 0.40                    | 0                             | 1                              |
| EXON2                                      | 1.24                    | 1                             | 3                              |
| COM1                                       | --                      | 2                             | 3                              |
| COM2                                       | --                      | 1                             | 3                              |

**C. Future Offsite Drainage Description**

The future offsite basins are same as what was described in the existing condition. Offsite flows and basins impacting the site are shown on the basin map included in the appendix (Figure 8).

**D. Future Onsite Drainage Description**

The future onsite basin analyzes the proposed development. The onsite basins were delineated using the proposed onsite grading. Onsite basin DEV1 is a portion of the proposed project and is discharged to Ann Road. Onsite basin DEV2 is the remaining portion of the proposed project and is discharged to the drainage easement located in the southeast corner. The delineation of the proposed onsite basins are shown on Figure 8 included in the appendix. Table 3 shows a summary of the runoff amounts determined in the future condition.

**TABLE 3**  
**10-YEAR / 100-YEAR, 6-HOUR STORM EVENT**  
**FUTURE RUNOFF AMOUNTS**

| <b>BASIN NAME/<br/>CONCENTRATION POINT</b> | <b>AREA<br/>(acres)</b> | <b>10-YEAR FLOW<br/>(cfs)</b> | <b>100-YEAR FLOW<br/>(cfs)</b> |
|--------------------------------------------|-------------------------|-------------------------------|--------------------------------|
| OFF1                                       | 0.19                    | 0                             | 1                              |
| OFF2                                       | 0.63                    | 1                             | 2                              |
| OFF3                                       | 0.09                    | 0                             | 0                              |
| OFF4                                       | 0.11                    | 0                             | 0                              |
| DEV1                                       | 0.25                    | 0                             | 1                              |
| DEV2                                       | 1.39                    | 2                             | 5                              |
| COM1                                       | --                      | 2                             | 3                              |
| COM2                                       | --                      | 3                             | 5                              |

**E. Facility Design Calculations**

Offsite street flow calculations for the 10-year and 100-year, 6-hour storm events are summarized in the following tables:

**TABLE 4  
OFFSITE STREET FLOW CALCULATIONS**

| <b>STREET</b>                    | <b>Q<sub>10</sub>/Q<sub>100</sub><br/>(cfs)</b> | <b>D<sub>10</sub>/D<sub>100</sub><br/>(ft)</b> | <b>V<sub>10</sub>/V<sub>100</sub><br/>(ft/s)</b> | <b>V x D</b> |
|----------------------------------|-------------------------------------------------|------------------------------------------------|--------------------------------------------------|--------------|
| Rainbow Blvd (Section 1)<br>OFF1 | 0/1                                             | 0.00/0.27                                      | 0.00/1.69                                        | 0.00/0.46    |
| Rainbow Blvd (Section 2)<br>OFF2 | 1/2                                             | 0.27/0.32                                      | 1.76/2.02                                        | 0.48/0.65    |
| Ann Road (Section 3)<br>COM1     | 2/3                                             | 0.35/0.39                                      | 1.65/1.81                                        | 0.58/0.71    |

The street calculations show that the *CCRFCD Hydrologic Criteria & Drainage Design Manual* velocity/depth products criteria are met in the future. The velocity/depth products are below 6 and 8 for the 10- and 100-year storms, respectively. Ann Road and Rainbow Boulevard are required to provide 19 feet of dry lane which includes half of a center turn lane (7 feet) and an additional 12 feet. The maximum 10-year depth cannot exceed 0.65 feet. Calculations for Ann Road and Rainbow Boulevard show that the maximum 10-year depth is 0.39 feet and provides adequate dry lane. All finished floor elevations have been raised a minimum of twice the depth of flow up to 18 inches above the water surface elevation in the street along the frontage or 18 inches of flood protection has been provided by a proposed berm. Driveway entrances have been elevated to at least 6 inches above the 100-year water surface elevation.

Onsite BMPs have been included for this proposed development. A landscape swale has been provided for the control of surface water quality and the velocities are mitigated by erosion protection for the 100-year condition for basin DEV2 (see calculations in the appendix). The 100-year flowrate was used and is conservative since it is considered to be more than what is required to be mitigated in the BMP design. The total mitigated impervious area within this project is more than 75%. The proposed design satisfies BMP requirements.

Block wall openings have been provided at the two lowspots along the southern boundary wall to convey flows from the adjacent property through the site. The site is conveyed to an existing drainage easement at the southeast corner of the site. The 100-year flows entering the drainage easement are the same as determined in the approved Technical Drainage Study for Ann 17. Calculations for the blockwall openings and drainage easement have been included in the appendix.

**IV. CONCLUSIONS**

The following recommendations are provided to facilitate safety, both public and private, for the proposed commercial development.

1. Elevate the onsite entrances to prevent offsite runoff from entering the site and to maintain conveyance of offsite flow.

2. Construct all proposed street and gutter improvements to allow proper conveyance of storm water.
3. Construct block wall openings to convey flows from the adjacent property to the south.
4. Nuisance water shall be captured onsite so adjacent properties are not affected during construction.

## **V. REFERENCES**

1. *CCRFCD Hydrologic Criteria and Drainage Design Manual*, WRC Engineering, 1999.
2. *Contours*, Clark County.
3. *Soil Survey of Las Vegas Valley Area, Nevada, Part of Clark County*, Soil Conservation Service, 1985.
4. *2013 CCRFCD Flood Control Master Plan*, Post, Buckley, Schuh, and Jernigan, Inc., et al ., 2008.
5. *Flood Insurance Rate Map, Community Panel Number 32003C1765F, Clark County, Nevada*, Federal Emergency Management Agency, effective November 16, 2011.
6. *HEC-1 Flood Hydrograph Package Version 4.0*, U.S. Army Corps of Engineers Hydrologic Engineering Center, 1990.
7. *FlowMaster User's Manual Version 8.0*, Haestad Methods, Inc., 2005.
8. *Technical Drainage Study for Ann 17*, GC Wallace, 2007.



**McCay  
ENGINEERING**

---

# **APPENDIX A**

## **FIGURES**

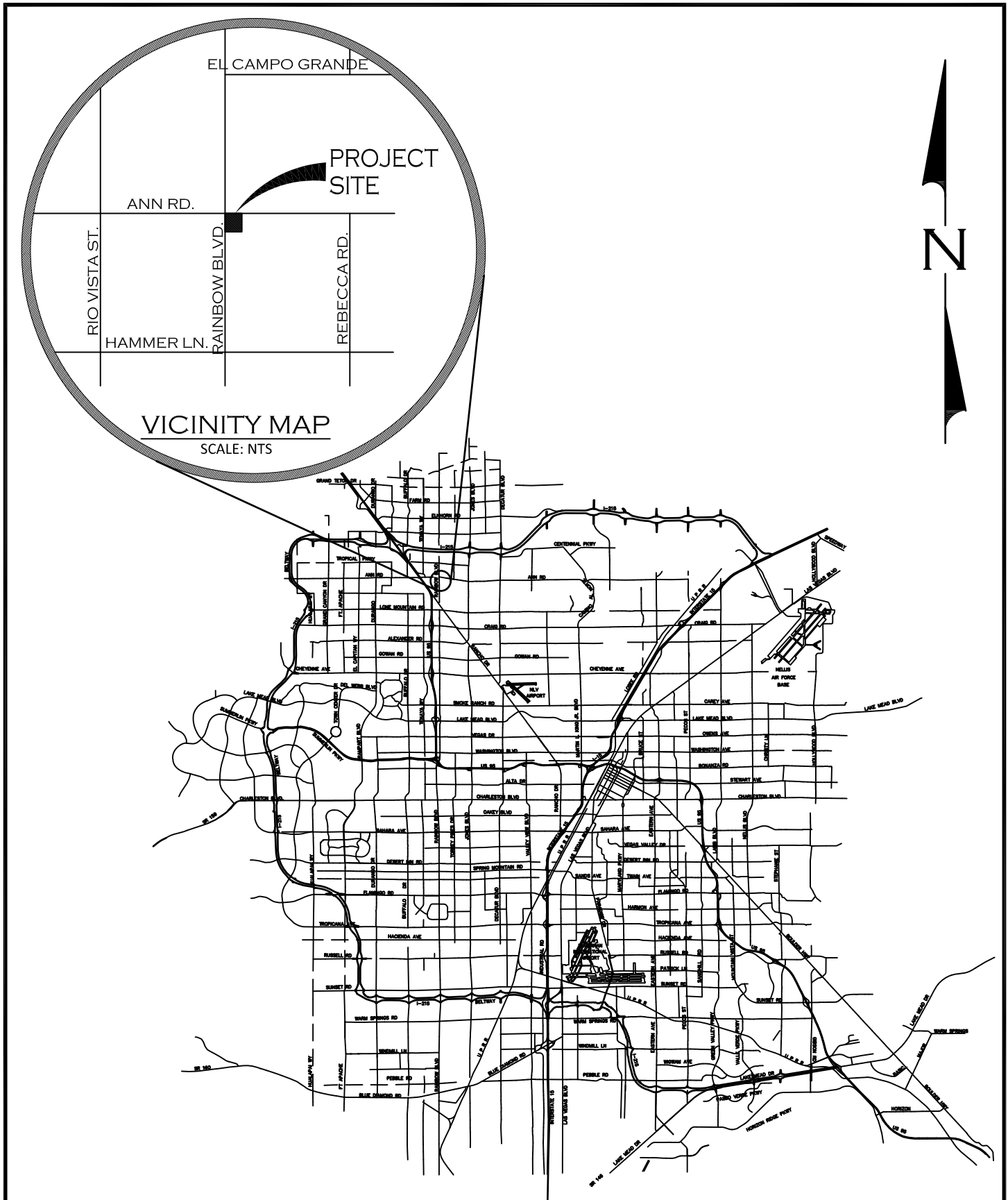


FIGURE 1  
VICINITY MAP



**McCay Engineering**

11700 W. CHARLESTON BLVD.  
SUITE #170-298  
LAS VEGAS, NEVADA 89135  
P 702-860-3897

JOB NUMBER: 17232

DRAWN BY: JSM

DATED: 4/6/2017

**NOTES**

This map is for assessment use only and does NOT represent a survey.

No liability is assumed for the accuracy of the data delineated herein. Information on roads and other non-assessed parcels may be obtained from the Road Document Listing in the Assessor's Office.

This map is compiled from official records, including surveys and deeds, but only contains the information required for assessment. See the recorded documents for more detailed legal information.

USE THIS SCALE (FEET) WHEN MAP REDUCED FROM 11X17 ORIGINAL

**ASSESSOR'S PARCELS - CLARK CO., NV.**  
**Michele W. Shafe - Assessor**

**MAP LEGEND**

|   |                         |   |                  |
|---|-------------------------|---|------------------|
| — | PARCEL BOUNDARY         | — | CONDOMINIUM UNIT |
| — | SUB BOUNDARY            | — | AIR SPACE PCL    |
| — | PM/LD BOUNDARY          | — | RIGHT OF WAY PCL |
| — | ROAD EASEMENT           | — | SUB-SURFACE PCL  |
| — | MATCH / LEADER LINE     |   |                  |
| — | HISTORIC LOT LINE       |   |                  |
| — | HISTORIC SUB BOUNDARY   |   |                  |
| — | HISTORIC PM/LD BOUNDARY |   |                  |
| — | SECTION LINE            |   |                  |

**BOOK** T19S R60E

|     |     |     |     |
|-----|-----|-----|-----|
| 099 | 100 | 101 | 102 |
| 126 | 125 | 124 | 123 |
| 137 | 138 | 139 | 140 |
| 164 | 163 | 162 | 161 |

**SEC.** 35

|    |    |    |    |    |    |
|----|----|----|----|----|----|
| 6  | 5  | 4  | 3  | 2  | 1  |
| 18 | 17 | 16 | 15 | 14 | 13 |
| 19 | 20 | 21 | 22 | 23 | 24 |
| 30 | 29 | 28 | 27 | 26 | 25 |
| 31 | 32 | 33 | 34 | 35 | 36 |

**MAP** N 2 NW 4

|   |   |   |   |
|---|---|---|---|
| 8 | 4 | 8 | 4 |
| 5 | 1 | 5 | 1 |
| 6 | 2 | 6 | 2 |
| 7 | 3 | 7 | 3 |
| 8 | 4 | 8 | 4 |
| 5 | 1 | 5 | 1 |

**125-35-1**

001 ROAD PARCEL NUMBER  
001 PARCEL NUMBER  
1.00 ACREAGE  
202 PARCEL SUB/SEQ NUMBER  
PB 24-45 PLAT RECORDING NUMBER  
5 BLOCK NUMBER  
5 LOT NUMBER  
GL5 GOV. LOT NUMBER

Scale: 1" = 200'    Rev: 02/09/2011



FIGURE 1A

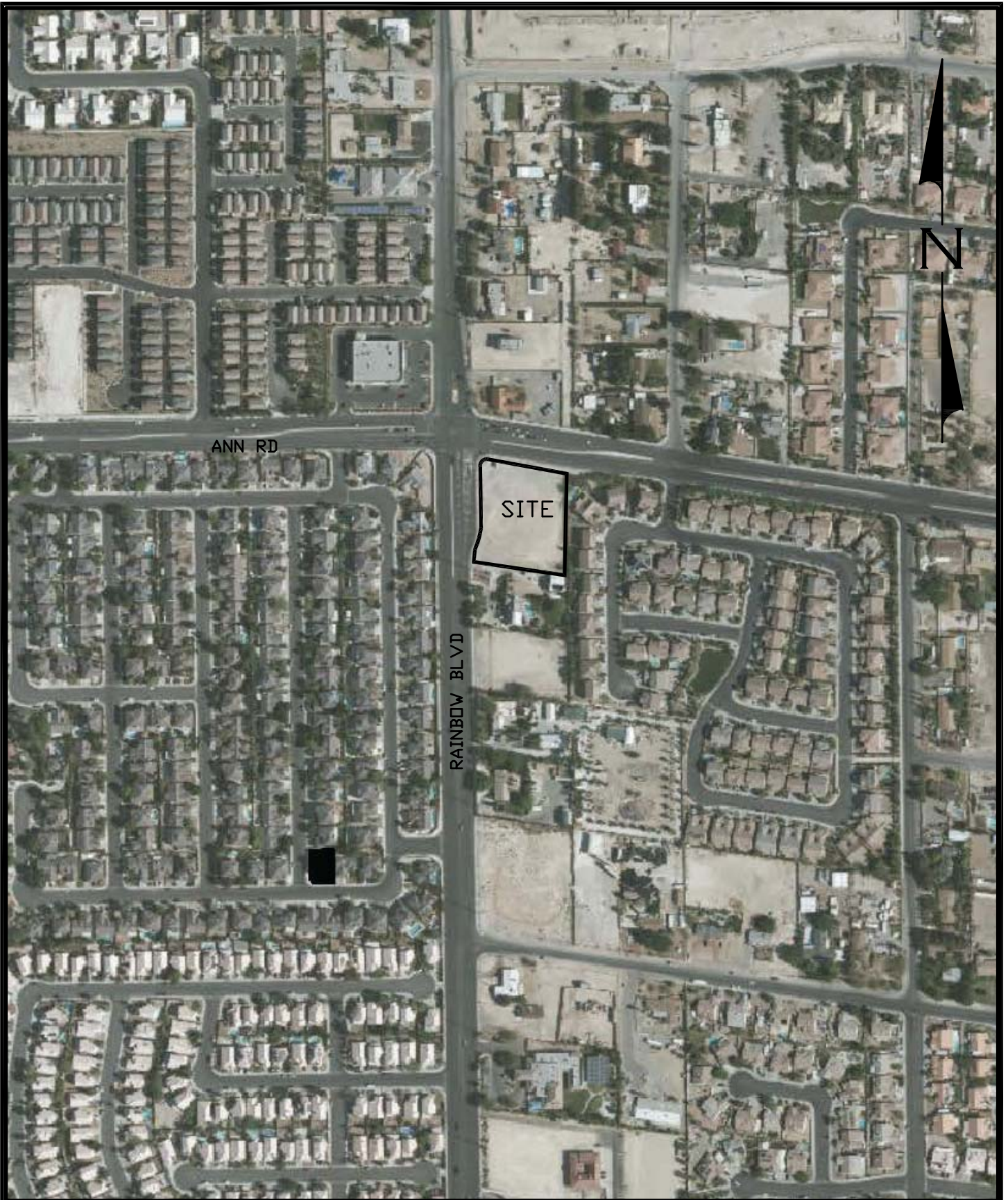
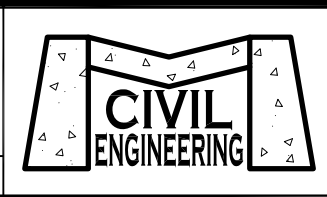
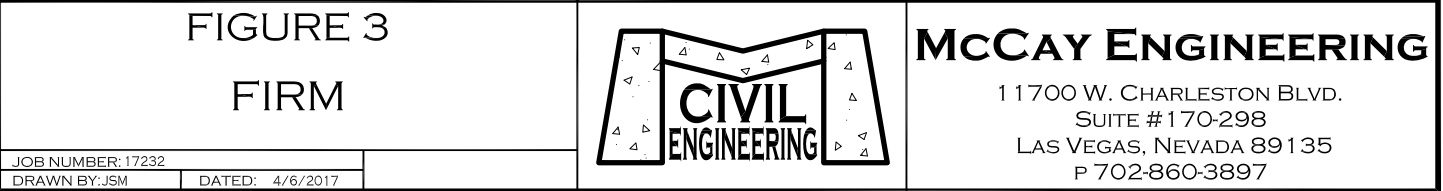


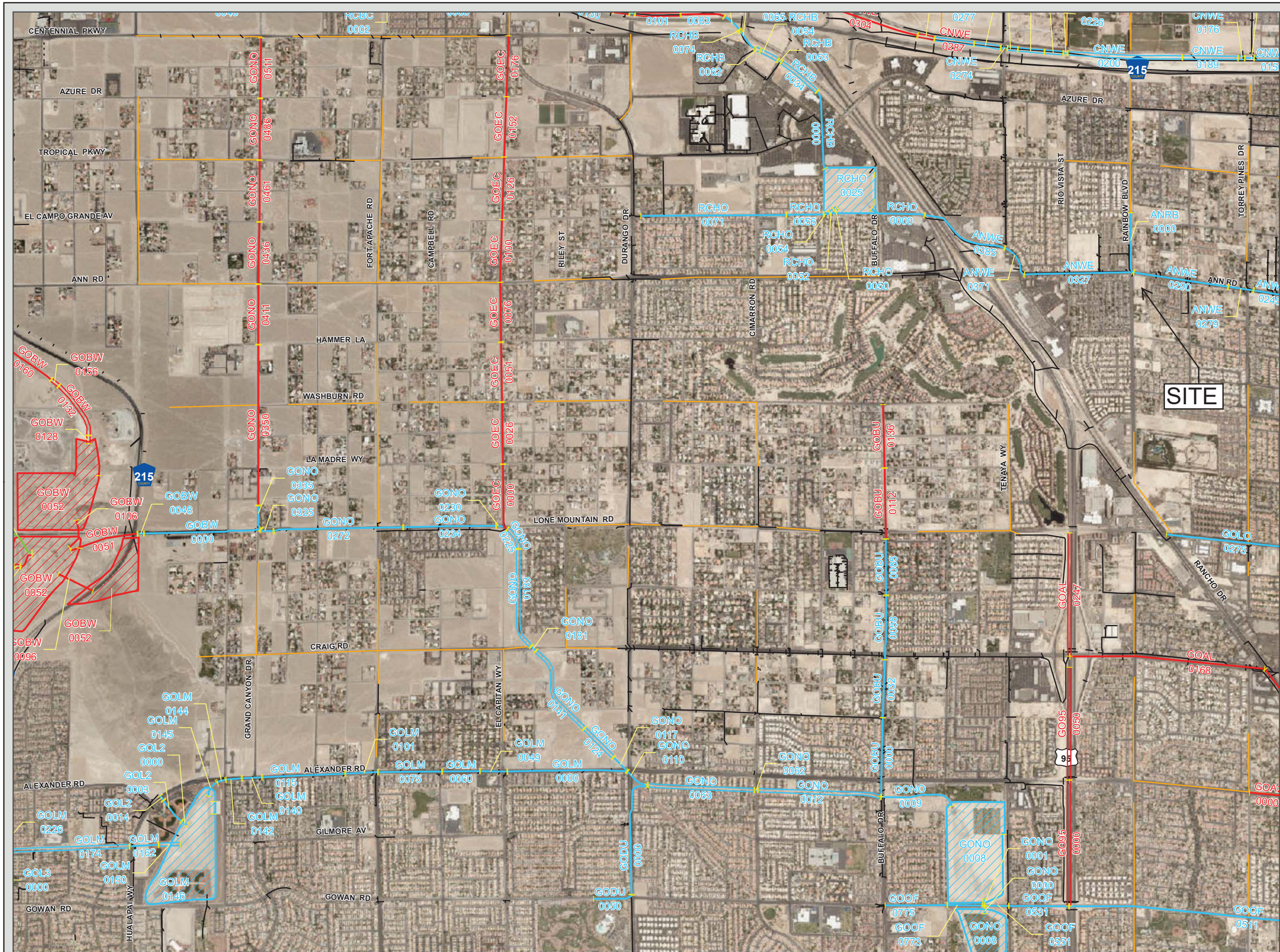
FIGURE 2  
SITE DESCRIPTION MAP

|                   |                 |
|-------------------|-----------------|
| JOB NUMBER: 17232 |                 |
| DRAWN BY: JSM     | DATED: 4/6/2017 |



**McCay Engineering**  
11700 W. CHARLESTON BLVD.  
SUITE #170-298  
LAS VEGAS, NEVADA 89135  
P 702-860-3897





2013  
LAS VEGAS VALLEY  
FLOOD CONTROL  
MASTER PLAN UPDATE

**FIGURE F- 19**  
**FLOOD CONTROL FACILITIES**

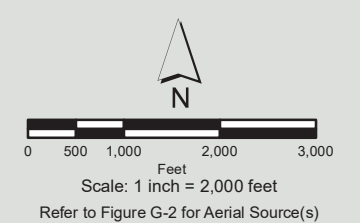
**LEGEND**

- Ultimate Development Boundary
- Existing Facilities
- Category A Proposed Facilities
- Category B Proposed Facilities
- Local Existing Facilities
- Local Proposed Facilities
- Detention Basin

- Stormdrain
- Lined Channel
- Unlined Channel
- Levee/Dike
- Natural Wash/Floodway
- ID-Mile Separator

**Remove & Replace/Parallel Facilities**

- | Category A | Category B |
|------------|------------|
| Channel    | Channel    |
| Stormdrain | Stormdrain |



US95 I-15

|    |    |    |    |    |    |
|----|----|----|----|----|----|
|    | 2  | 3  |    | A1 | A2 |
| 4  | 5  | 6  |    | A3 | A4 |
| 7  | 8  | 9  | 10 | A5 | A6 |
| 11 | 12 | 13 | 14 | 15 | 16 |
| 17 | 18 | 19 | 20 | 21 | 22 |
| 23 | 24 | 25 | 26 | 27 | 28 |
| 29 | 30 | 31 | 32 | 33 | 34 |
| 35 | 36 | 37 | 38 | 39 | 40 |
| 41 | 42 | 43 | 44 | 45 | 46 |
| 47 | 48 | 49 | 50 | 51 | 52 |
| 53 | 54 | 55 | 56 |    |    |
| 57 | 58 | 59 |    |    |    |

**FIGURE 4**



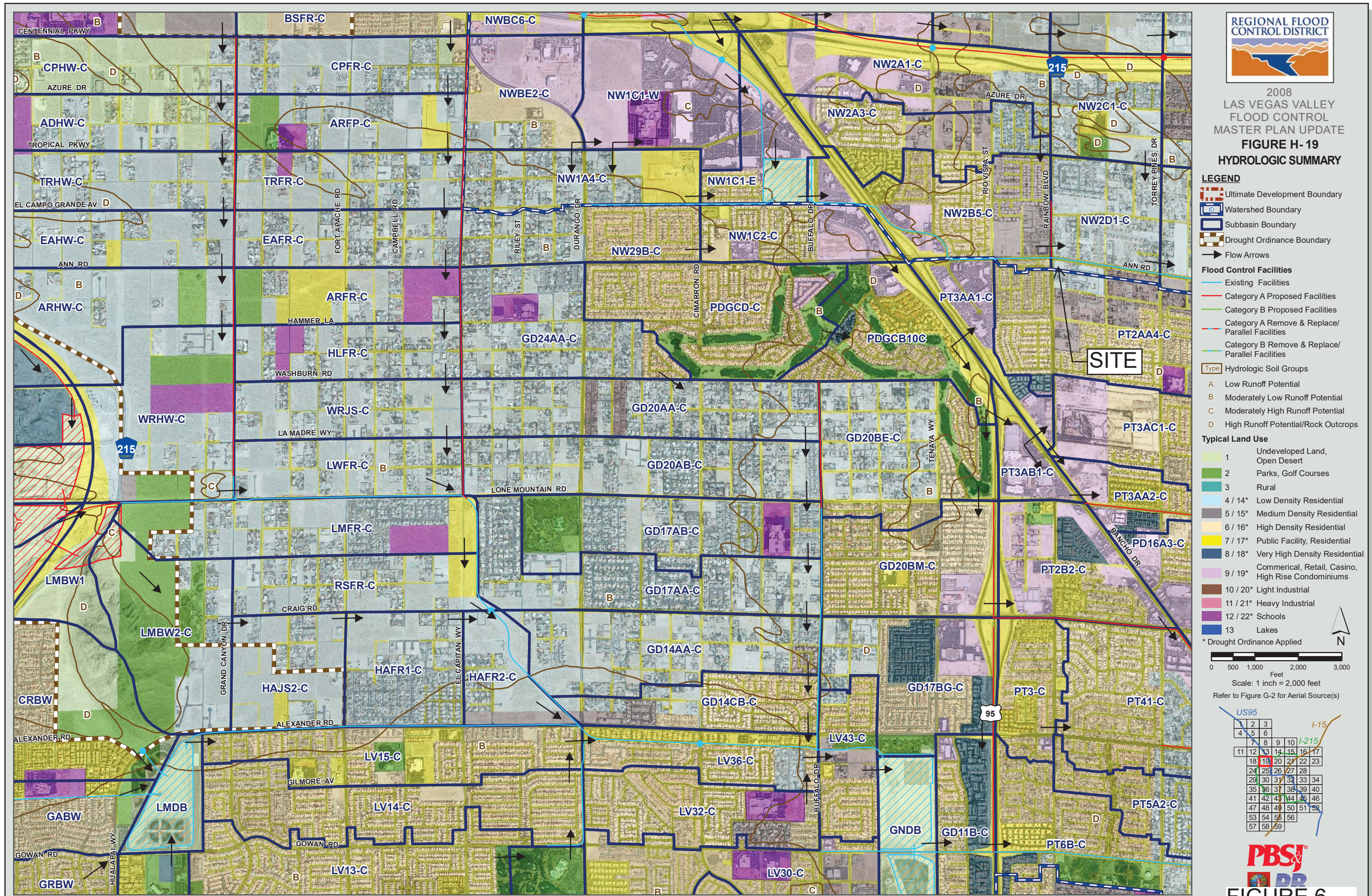
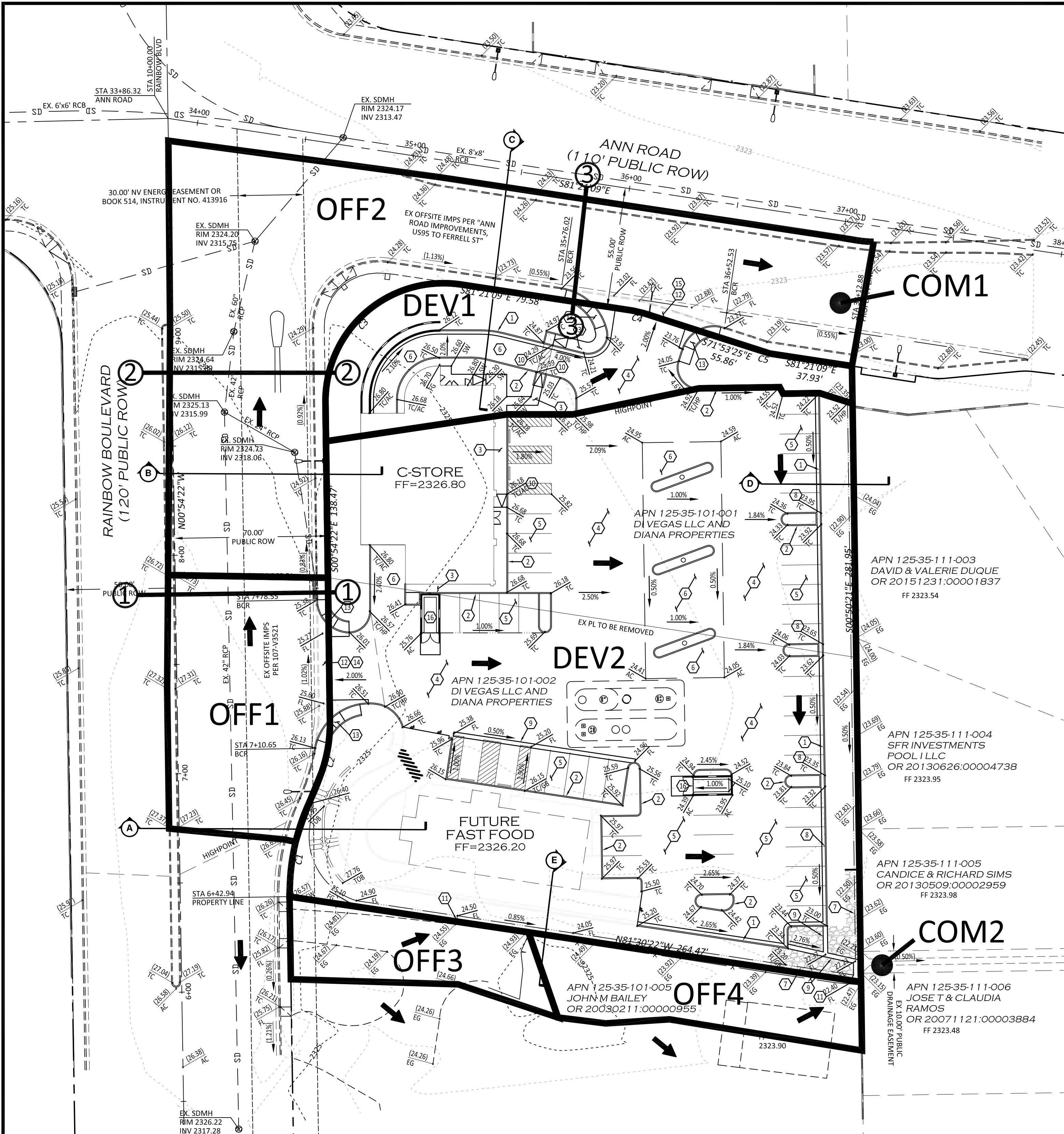


FIGURE 6





STORMWATER MANAGEMENT NOTES:

1. THE OWNER, SITE DEVELOPER, CONTRACTOR AND/OR THEIR AUTHORIZED AGENTS SHALL EACH DAY REMOVE ALL SEDIMENT, MUD, CONSTRUCTION DEBRIS, OR OTHER POTENTIAL POLLUTANTS THAT MAY HAVE BEEN DISCHARGED TO, OR ACCUMULATED IN, THE PUBLIC RIGHTS OF WAYS OF CLARK COUNTY AS A RESULT OF CONSTRUCTION ACTIVITIES ASSOCIATED WITH THIS SITE DEVELOPMENT OR CONSTRUCTION PROJECT. SUCH MATERIALS SHALL BE PREVENTED FROM ENTERING THE STORM SEWER SYSTEM.
2. ADDITIONAL CONSTRUCTION SITE DISCHARGE BEST MANAGEMENT PRACTICES MAY BE REQUIRED OF THE OWNER AND HIS OR HER AGENTS DUE TO UNFORESEEN EROSION PROBLEMS OR IF THE SUBMITTED PLAN DOES NOT MEET THE PERFORMANCE STANDARDS SPECIFIED IN CLARK COUNTY TITLE 24.40 AND THE LAS VEGAS VALLEY CONSTRUCTION SITE BMP GUIDANCE MANUAL.
3. TEMPORARY OR PERMANENT STABILIZATION PRACTICES WILL BE INSTALLED ON DISTURBED AREAS AS SOON AS PRACTICABLE AND NO LATER THAN 14 DAYS AFTER THE CONSTRUCTION ACTIVITY IN THAT PORTION OF THE SITE HAS TEMPORARILY OR PERMANENTLY CEASED. SOME EXCEPTIONS MAY APPLY; REFER TO STORMWATER GENERAL PERMIT FOR CONSTRUCTION ACTIVITY NVR100000, SECTION III.A.5.
4. AT A MINIMUM, THE CONTRACTOR OR HIS AGENT SHALL INSPECT ALL DISTURBED AREAS, AREAS USED FOR STORAGE OF MATERIALS AND EQUIPMENT THAT ARE EXPOSED TO PRECIPITATION, VEHICLE ENTRANCE AND EXIT LOCATIONS AND ALL BMPs WEEKLY, PRIOR TO A FORECASTED RAIN EVENT AND WITHIN 24 HOURS AFTER ANY ACTUAL RAIN EVENT OF 0.5 INCHES OR MORE. THE CONTRACTOR OR HIS AGENT SHALL UPDATE OR MODIFY THE STORMWATER POLLUTION PREVENTION PLAN AS NECESSARY. SOME EXCEPTIONS TO WEEKLY INSPECTIONS MAY APPLY, SUCH AS SUSPENSION OF LAND DISTURBANCE ACTIVITIES. REFER TO STORMWATER GENERAL PERMIT FOR CONSTRUCTION ACTIVITY NVR100000, SECTION III.A.12.
5. ACCUMULATED SEDIMENT IN BMPs SHALL BE REMOVED WITHIN 7 DAYS AFTER A STORMWATER RUNOFF EVENT OR PRIOR TO THE NEXT ANTICIPATED STORM EVENT, WHICHEVER IS EARLIER. SEDIMENT MUST BE REMOVED WHEN BMP DESIGN CAPACITY HAS BEEN REDUCED BY 50 PERCENT OR MORE.

Call before you Dig  
Call before you Dig  
Call before you Dig  
1-800-227-2600

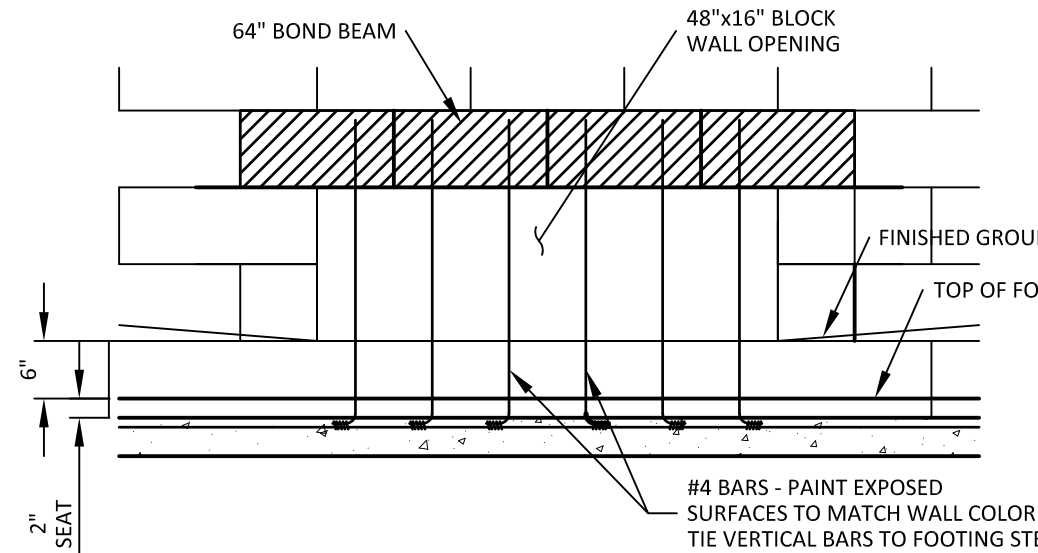
**FAST**  
Call before you Dig  
Underground  
1-702-432-5300

Call before you Dig  
Call before you Dig  
Call before you Dig  
1-702-227-2929

**DISCLAIMER NOTE**  
EXISTING UTILITY LOCATIONS SHOWN HEREIN ARE APPROXIMATE ONLY. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO DETERMINE THE EXACT VERTICAL AND HORIZONTAL LOCATION OF ALL EXISTING UNDER-GROUND UTILITIES PRIOR TO COMMENCING CONSTRUCTION. NO REPRESENTATION IS MADE THAT ALL EXISTING UTILITIES ARE SHOWN HEREON. THE ENGINEER ASSUMES NO RESPONSIBILITY FOR UTILITIES NOT SHOWN OR UTILITIES NOT SHOWN IN THEIR PROPER LOCATION. ALL DISCREPANCIES MUST BE IMMEDIATELY REPORTED TO THE ENGINEER.  
CALL BEFORE YOU DIG: 1-800-227-2600.

DEPRESSED CURB DETAIL

SCALE: NONE

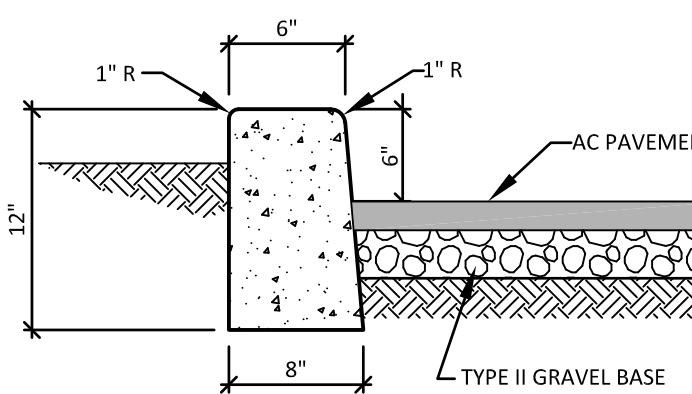


48" BLOCK WALL OPENING

SCALE: NONE

ONSITE "A" TYPE CURB DETAIL

SCALE: NONE

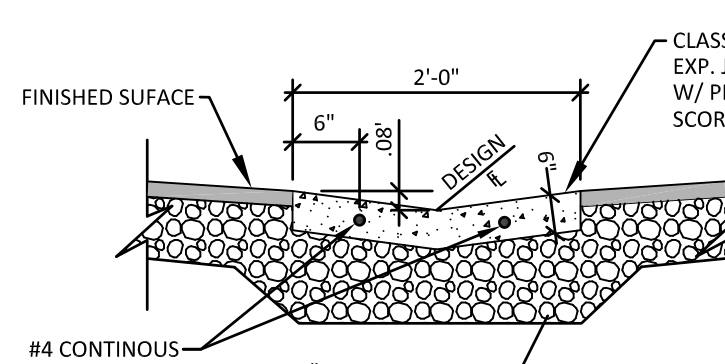


ONSITE CURB RAMP

SCALE: NONE

2" VALLEY GUTTER

SCALE: NONE



EARTHWORK QUANTITIES

NOTE: THESE QUANTITIES ARE APPROXIMATE AND AREA RAW VOLUMES ONLY. OVER EXCAVATION, SUBSIDENCE, SHRINKAGE AND BUILDING FACTORS, ARE NOT INCLUDED AS PART OF THESE EARTHWORK QUANTITIES.

|            |                      |
|------------|----------------------|
| CUT (NET)  | 25 CUBIC YARDS       |
| FILL (NET) | 33 CUBIC YARDS       |
| NET        | 8 CUBIC YARDS (FILL) |

\* REFER TO SPECIFICATIONS FOR QUANTITIES DISCLAIMER

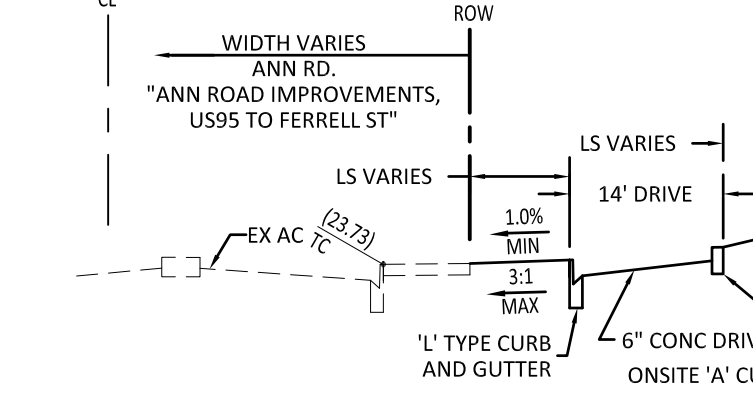
LEGAL DESCRIPTION

THAT PORTION OF THE NORTHWEST QUARTER (NW 1/4) OF THE NORTHWEST QUARTER (NW 1/4) OF SECTION 35, TOWNSHIP 19 SOUTH, RANGE 60 EAST, M.D.M., CITY OF LAS VEGAS, CLARK COUNTY, NEVADA, DESCRIBED AS FOLLOWS: LOTS ONE AND TWO AS SHOWN BY MAP THEREON ON FILE IN FILE 19 OF PARCEL MAPS, PAGE 47 IN THE OFFICE OF THE CLARK COUNTY RECORDER OF CLARK COUNTY, NEVADA. EXCEPTING THEREFROM THAT PORTION OF SAID LAND GRANTED TO THE CITY OF LAS VEGAS IN THAT CERTAIN 'FINAL ORDER OF CONDEMNATION' RECORDED FEBRUARY 10, 2006 IN BOOK 20060210 AS INSTRUMENT NO. 0000845 OF OFFICIAL RECORDS, CLARK COUNTY, NEVADA.

| Curve # | Radius  | Delta     | Length | Tangent |
|---------|---------|-----------|--------|---------|
| C1, C2  | 100.00' | 25°50'38" | 45.11' | 22.94'  |
| C3      | 54.00'  | 99°33'13" | 93.83' | 63.85'  |
| C4, C5  | 30.00'  | 9°27'44"  | 4.95'  | 2.48'   |

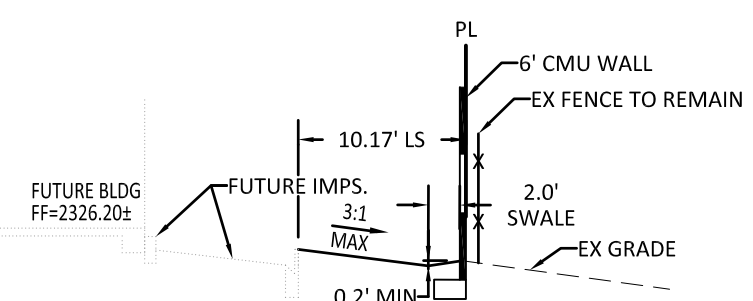
CONSTRUCTION NOTES:

1. INSTALL 'L' TYPE CURB AND GUTTER PER CCAUSD #216
2. INSTALL ONSITE 'A' TYPE CURB PER DETAIL THIS SHEET
3. INSTALL CONCRETE SIDEWALK PER CCAUSD #234
4. INSTALL 3" AC OVER 6" TYPE II AGG. BASE
5. INSTALL 2" AC OVER 6" TYPE II AGG. BASE
6. INSTALL 6" CONCRETE OVER 6" TYPE II AGG. BASE WITH STEEL REINFORCEMENT OR WEAKENED PLANE CONTROL JOINTS PER GEOTECH STUDY.
7. INSTALL 40 LF MIN RIPRAP LINED SWALE. (D50)=3", TH=6"
8. INSTALL 1 LF DEPRESSED CURB PER DETAIL THIS SHEET
9. INSTALL 2" WIDE CONCRETE VALLEY GUTTER PER DETAIL THIS SHEET
10. INSTALL ONSITE CURB RAMP PER DETAIL THIS SHEET
11. INSTALL 48" BLOCK WALL OPENING PER DETAIL THIS SHEET
12. INSTALL COMMERCIAL DRIVEWAY PER CCAUSD #222.1 & #228
13. INSTALL SIDEWALK RAMP, CASE I, PER CCAUSD #235. A & B = 8'
14. REMOVE 67.90' CURB & GUTTER, AND SIDEWALK. PROTECT EXISTING AC IN PLACE
15. REMOVE 76.51' CURB & GUTTER, AND SIDEWALK. PROTECT EXISTING AC IN PLACE
16. INSTALL TRASH ENCLOSURE PER ARCH DWGS



SECTION C

SCALE: NONE



SECTION E

SCALE: NONE

OWNER

DI VEGAS, LLC AND DIANA PROPERTIES, LLC  
10300 W. CHARLESTON BLVD., #13-F39  
LAS VEGAS, NV 89135  
P 702-501-9883

ELEVATION NOTE

ADD 2300 FEET TO ABBREVIATIONS TO GET TRUE ELEVATIONS.

BASIS OF BEARING

SOUTH 81°58'12" EAST, BEING THE BEARING OF THE CENTERLINE OF THE SOUTH LINE OF THE NORTHWEST QUARTER (NW 1/4) OF THE NORTHWEST QUARTER (NW 1/4) OF SECTION 35, TOWNSHIP 19 SOUTH, RANGE 60 EAST, M.D.M., CLARK COUNTY, NEVADA, AS SHOWN IN BOOK 134 OF PLATS, AT PAGE 62, OFFICIAL RECORDS OF CLARK COUNTY, NEVADA.

BENCHMARK

CITY OF LAS VEGAS BENCHMARK "BLV9034NES", BEING A RIVET AND PLATE IN THE TOP OF CURB, AT SW CORNER OF ANN AND RAINBOW.

ELEVATION: 2325.26 (US SURVEY FEET)  
708.74 (METERS)

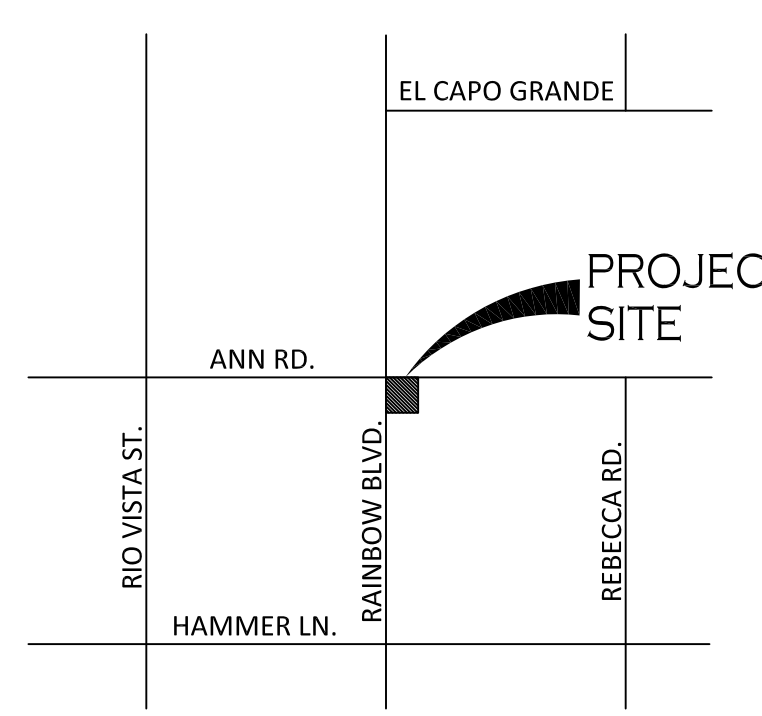
BASED ON NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).

FLOOD ZONE NOTE:

THE PROPERTY LIES WITHIN THE ZONE "X", AREAS DETERMINED TO BE OUTSIDE OF 0.2% ANNUAL CHANCE FLOOD PER FEMA FLOOD INSURANCE RATE MAP NO. 33003C1765F, DATED NOVEMBER 16, 2011.

DEVELOPER

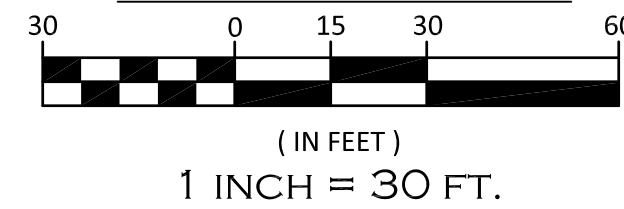
TIMOTHY P. HERBST  
5195 S. LAS VEGAS BLVD.  
LAS VEGAS, NV 89119  
P 702-798-6400



VICINITY MAP

SCALE: NTS

GRAPHIC SCALE



LEGEND

- RIGHT-OF-WAY
- PROPERTY LINE
- STREET CENTER LINE
- EXISTING BUILDING
- PROPOSED BUILDING
- EXISTING CURB & GUTTER
- PROPOSED CURB & GUTTER
- EXISTING EDGE OF AC
- PROPOSED ELEVATION
- EXISTING ELEVATION
- SLOPE & DIRECTION OF SLOPE
- GRADE BREAK
- GRADE BREAK
- PROPOSED CMU WALL
- EXISTING CMU WALL
- EXISTING 1' CONTOUR
- EXISTING 5' CONTOUR
- CROSS SECTION
- SIGHT VISIBILITY ZONE

10-YEAR / 100-YEAR, 6-HOUR STORM EVENT FUTURE RUNOFF AMOUNTS

| BASIN NAME / CONCENTRATION POINT | AREA (acres) | 10-YEAR FLOW (cfs) | 100-YEAR FLOW (cfs) |
|----------------------------------|--------------|--------------------|---------------------|
| OFF1                             | 0.19         | 0                  | 1                   |
| OFF2                             | 0.63         | 1                  | 2                   |
| OFF3                             | 0.09         | 0                  | 0                   |
| OFF4                             | 0.11         | 0                  | 0                   |
| DEV1                             | 0.25         | 0                  | 1                   |
| DEV2                             | 1.39         | 2                  | 5                   |
| COM1                             | --           | 2                  | 3                   |
| COM2                             | --           | 3                  | 5                   |

OFFSITE STREET FLOW CALCULATIONS

| STREET                        | Q <sub>10</sub> /Q <sub>100</sub> (cfs) | D <sub>10</sub> /D <sub>100</sub> (ft) | V <sub>10</sub> /V <sub>100</sub> (ft/s) | V x D     |
|-------------------------------|-----------------------------------------|----------------------------------------|------------------------------------------|-----------|
| Rainbow Blvd (Section 1) OFF1 | 0/1                                     | 0.00/0.27                              | 0.00/1.69                                | 0.00/0.46 |
| Rainbow Blvd (Section 2) OFF2 | 1/2                                     | 0.27/0.32                              | 1.76/2.02                                | 0.48/0.65 |
| Ann Road (Section 3) COM1     | 2/3                                     | 0.35/0.39                              | 1.65/1.81                                | 0.58/0.71 |

DRAINAGE STUDY COMPLIANCE

I, JEREMY S. MCCAY, HEREBY CERTIFY THAT THIS GRADING PLAN CONFORMS TO THE APPROVED DRAINAGE STUDY ON FILE WITH THE CITY OF LAS VEGAS FOR THIS PROJECT. DS

JEREMY S. MCCAY  
NEVADA P.E. NO. 15797

DATE

| REV | DATE | BY | REVISION |
|-----|------|----|----------|
|     |      |    |          |
|     |      |    |          |
|     |      |    |          |
|     |      |    |          |

**MCCAY**  
ENGINEERING  
CIVIL ENGINEERING  
11700 W. CHARLESTON BLVD.  
SUITE 100  
LAS VEGAS, NV 89135  
P 702-860-3897

GK3  
ARCHITECTURE  
2111 EDGEWOOD AVE.  
LAS VEGAS, NV 89102  
P 702-932-0455

FIGURE 8  
FUTURE BASIN MAP  
SERVICE STATION & CARWASH  
@ SEC ANN & RAINBOW

DATE: 04/11/2017  
DRAWN BY: JSM  
PROJECT MGR: JSM  
PROJECT NO: 17232  
SCALE: 1"=30'

SHEET  
OF SHEETS  
DRAWING NO.



**McCay  
ENGINEERING**

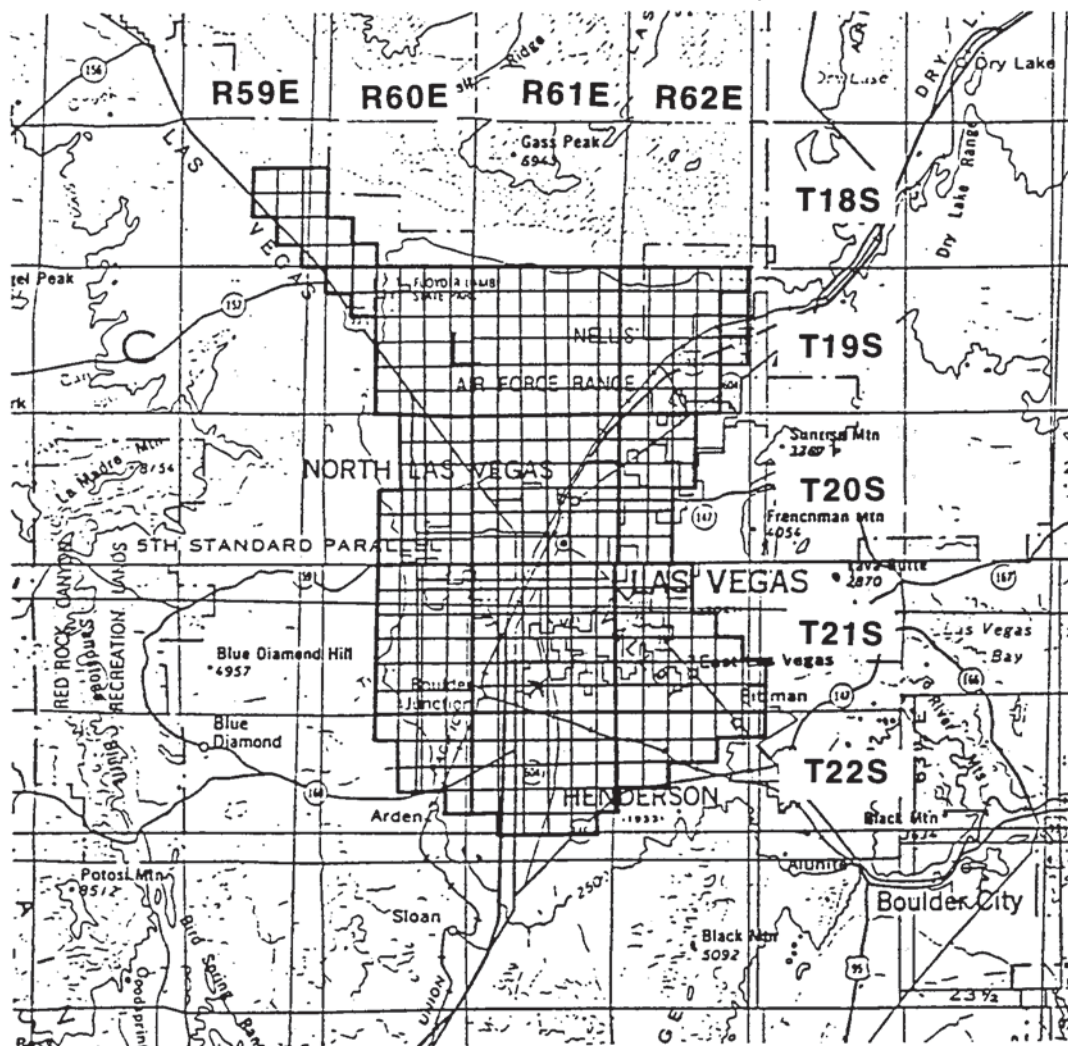
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## **APPENDIX B**

### **HYDROLOGIC PARAMETERS**

# HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

## McCARRAN AIRPORT RAINFALL AREA



| TOWNSHIP        | RANGE          | SECTIONS                    | TOWNSHIP | RANGE   | SECTIONS             |
|-----------------|----------------|-----------------------------|----------|---------|----------------------|
| 18 South        | 59 East        | 13-15,22-26,36              | 20 South | 62 East | 4-9,16-20,29-32      |
| 18 South        | 60 East        | 30-32                       | 21 South | 60 East | 1-4,9-16,21-28,33-36 |
| <b>19 South</b> | <b>60 East</b> | <b>1-6,8-16,21-28,33-36</b> | 21 South | 61 East | ALL SECTIONS         |
| 19 South        | 61 East        | ALL SECTIONS                | 21 South | 62 East | 4-9,15-23, 25-36     |
| 19 South        | 62 East        | 2-11,14-23,27-34            | 22 South | 60 East | 1-4,10-15,24         |
| 20 South        | 60 East        | 1-3,10-15,21-28,33-36       | 22 South | 61 East | 1-24,26-29           |
| 20 South        | 61 East        | ALL SECTIONS                | 22 South | 62 East | 1-10,17-18           |

Notes:

1. Refer to Table 505 and Figure 516 Depth-Duration-Frequency values in the McCarran Airport Rainfall Area.
2. Refer to Table 506 and Figure 517 for Time-Intensity-Frequency values on the McCarran Airport Rainfall Area.

| Revision | Date |
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## SIX HOUR DEPTH-AREA REDUCTION FACTORS

| <u>Drainage Area<br/>(Square Miles)</u> | <u>Six-Hour Depth-Area<br/>Reduction Factor</u> |
|-----------------------------------------|-------------------------------------------------|
|-----------------------------------------|-------------------------------------------------|

|       |      |
|-------|------|
| 0.0   | 1.00 |
| 0.5   | 0.98 |
| 1.0   | 0.97 |
| 2.0   | 0.93 |
| 4.0   | 0.91 |
| 6.0   | 0.90 |
| 8.0   | 0.88 |
| 10.0  | 0.86 |
| 20.0  | 0.79 |
| 30.0  | 0.74 |
| 50.0  | 0.68 |
| 100.0 | 0.60 |
| 150.0 | 0.55 |
| 200.0 | 0.51 |
| 300.0 | 0.46 |
| 400.0 | 0.42 |
| 500.0 | 0.39 |

NOTES: 1. A graphical representation of these factors is presented in Figure 514.

2. Consult with the local entity and/or the CCRFCD for guidance in using the Depth-Area Reduction Factors for drainage areas greater than 200 square miles.

| Revision | Date |
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# HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

## SIX-HOUR STORM DISTRIBUTIONS

| Percent of<br>Total Storm Depth |      |      |      | Percent of<br>Total Storm Depth |       |       |       |
|---------------------------------|------|------|------|---------------------------------|-------|-------|-------|
| Storm Time<br>(In Minutes)      | SDN3 | SDN4 | SDN5 | Storm Time<br>(In Minutes)      | SDN3  | SDN4  | SDN5  |
| 0                               | 0.0  | 0.0  | 0.0  | 185                             | 32.2  | 37.6  | 43.0  |
| 5                               | 2.0  | 2.0  | 2.0  | 190                             | 35.2  | 41.5  | 47.7  |
| 10                              | 5.7  | 5.8  | 5.9  | 195                             | 40.9  | 46.2  | 51.4  |
| 15                              | 7.0  | 7.5  | 8.0  | 200                             | 49.9  | 53.0  | 56.1  |
| 20                              | 8.7  | 9.9  | 11.0 | 205                             | 59.0  | 61.0  | 63.0  |
| 25                              | 10.8 | 12.6 | 14.4 | 210                             | 71.0  | 71.0  | 71.0  |
| 30                              | 12.4 | 13.7 | 15.0 | 215                             | 74.4  | 73.2  | 72.0  |
| 35                              | 13.0 | 14.5 | 16.0 | 220                             | 78.1  | 75.6  | 73.1  |
| 40                              | 13.0 | 14.9 | 16.8 | 225                             | 81.2  | 78.2  | 75.2  |
| 45                              | 13.0 | 15.1 | 17.1 | 230                             | 81.9  | 79.9  | 77.9  |
| 50                              | 13.0 | 15.5 | 18.0 | 235                             | 83.5  | 81.3  | 79.0  |
| 55                              | 13.0 | 15.6 | 18.2 | 240                             | 85.1  | 82.3  | 79.5  |
| 60                              | 13.0 | 15.9 | 18.7 | 245                             | 85.6  | 83.0  | 80.4  |
| 65                              | 13.3 | 16.2 | 19.0 | 250                             | 86.0  | 83.5  | 81.0  |
| 70                              | 14.0 | 16.9 | 19.7 | 255                             | 86.8  | 84.4  | 82.0  |
| 75                              | 14.2 | 17.2 | 20.2 | 260                             | 87.6  | 85.1  | 82.6  |
| 80                              | 14.8 | 17.9 | 21.0 | 265                             | 88.8  | 86.4  | 84.0  |
| 85                              | 15.8 | 18.9 | 22.0 | 270                             | 91.0  | 88.5  | 85.9  |
| 90                              | 17.2 | 20.1 | 23.0 | 275                             | 92.6  | 90.8  | 88.9  |
| 95                              | 18.1 | 21.1 | 24.1 | 280                             | 93.7  | 92.4  | 91.0  |
| 100                             | 19.0 | 22.0 | 25.0 | 285                             | 95.0  | 94.4  | 93.8  |
| 105                             | 19.7 | 22.8 | 25.9 | 290                             | 97.0  | 96.8  | 96.6  |
| 110                             | 19.9 | 23.2 | 26.5 | 295                             | 97.6  | 97.3  | 97.0  |
| 115                             | 20.0 | 24.0 | 28.0 | 300                             | 98.2  | 97.8  | 97.4  |
| 120                             | 20.1 | 24.6 | 29.0 | 305                             | 98.5  | 98.2  | 97.9  |
| 125                             | 20.4 | 25.2 | 30.0 | 310                             | 98.7  | 98.4  | 98.1  |
| 130                             | 21.4 | 26.0 | 30.5 | 315                             | 98.9  | 98.6  | 98.3  |
| 135                             | 22.9 | 26.9 | 30.9 | 320                             | 99.0  | 98.8  | 98.5  |
| 140                             | 24.1 | 27.6 | 31.0 | 325                             | 99.3  | 99.1  | 98.9  |
| 145                             | 24.9 | 28.3 | 31.7 | 330                             | 99.3  | 99.2  | 99.0  |
| 150                             | 25.1 | 28.6 | 32.1 | 335                             | 99.4  | 99.3  | 99.2  |
| 155                             | 25.6 | 29.2 | 32.7 | 340                             | 99.5  | 99.4  | 99.3  |
| 160                             | 27.0 | 30.2 | 33.3 | 345                             | 99.8  | 99.7  | 99.6  |
| 165                             | 27.8 | 31.2 | 34.6 | 350                             | 99.8  | 99.8  | 99.7  |
| 170                             | 28.1 | 32.1 | 36.1 | 355                             | 99.9  | 99.9  | 99.9  |
| 175                             | 28.3 | 33.2 | 38.1 | 360                             | 100.0 | 100.0 | 100.0 |
| 180                             | 29.5 | 35.2 | 40.8 |                                 |       |       |       |

- Notes: 1. For drainage areas less than 8 square miles in size, use SDN 3.  
 2. For drainage areas greater than or equal to 8 square miles and less than 12 square miles in size, use SDN 4.  
 3. For drainage areas greater than or equal to 12 square miles, use SDN 5.  
 4. A graphical representation of these values is presented on **Figure 515**.

| Revision | Date |
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REFERENCE:

TABLE 503

# HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

## DEPTH-DURATION-FREQUENCY VALUES FOR McCARRAN AIRPORT RAINFALL AREA (IN INCHES)

| TIME            | RECURRENCE INTERVAL |      |       |       |       |        |
|-----------------|---------------------|------|-------|-------|-------|--------|
|                 | 2-YR                | 5-YR | 10-YR | 25-YR | 50-YR | 100-YR |
| 5 min.          | 0.15                | 0.27 | 0.35  | 0.46  | 0.54  | 0.63   |
| 10 min.         | 0.25                | 0.44 | 0.57  | 0.74  | 0.89  | 1.02   |
| 15 min.         | 0.33                | 0.57 | 0.74  | 0.97  | 1.15  | 1.32   |
| 30 min.         | 0.44                | 0.78 | 1.01  | 1.31  | 1.55  | 1.79   |
| 1 hour          | 0.52                | 0.89 | 1.15  | 1.50  | 1.78  | 2.06   |
| 2 hour          | 0.59                | 1.01 | 1.30  | 1.70  | 2.01  | 2.30   |
| 3 hour          | 0.64                | 1.08 | 1.39  | 1.82  | 2.15  | 2.48   |
| 6 hour          | 0.72                | 1.22 | 1.58  | 2.05  | 2.41  | 2.77   |
| 24 hour (TR-55) | 1.20                | 1.60 | 1.80  | 2.40  | 2.70  | 2.96   |

- NOTE: 1. Refer to Figure 513 for a description and drawing of the area included in the McCarran Airport Rainfall Area.
2. The 24 hour values presented above are for use with TR-55 only.
3. Table 501 adjustments not required.

| Revision | Date |
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**WRC  
ENGINEERING**

**REFERENCE:**

USACE, Los Angeles District, 1988

**TABLE 505**

## RUNOFF CURVE NUMBERS (URBAN AREAS<sup>1</sup>)

| Cover description                                                                                                                    |                                              | Curve numbers for hydrologic soil group— |    |           |           |
|--------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|------------------------------------------|----|-----------|-----------|
| Cover type and hydrologic condition                                                                                                  | Average percent impervious area <sup>2</sup> | A                                        | B  | C         | D         |
| <i>Fully developed urban areas (vegetation established)</i>                                                                          |                                              |                                          |    |           |           |
| Open space (lawns, parks, golf courses, cemeteries, etc.) <sup>3</sup> :                                                             |                                              |                                          |    |           |           |
| Poor condition (grass cover < 50%) .....                                                                                             |                                              | 68                                       | 79 | 86        | 89        |
| Fair condition (grass cover 50% to 75%) .....                                                                                        |                                              | 49                                       | 69 | 79        | 84        |
| Good condition (grass cover > 75%) .....                                                                                             |                                              | 39                                       | 61 | 74        | 80        |
| Impervious areas:                                                                                                                    |                                              |                                          |    |           |           |
| Paved parking lots, roofs, driveways, etc. (excluding right-of-way) .....                                                            |                                              | 98                                       | 98 | <b>98</b> | <b>98</b> |
| Streets and roads:                                                                                                                   |                                              |                                          |    |           |           |
| Paved: curbs and storm sewers (excluding right-of-way) .....                                                                         |                                              | 98                                       | 98 | 98        | 98        |
| Paved: open ditches (including right-of-way) .....                                                                                   |                                              | 83                                       | 89 | 92        | 93        |
| Gravel (including right-of-way) .....                                                                                                |                                              | 76                                       | 85 | 89        | 91        |
| Dirt (including right-of-way) .....                                                                                                  |                                              | 72                                       | 82 | 87        | 89        |
| Western desert urban areas:                                                                                                          |                                              |                                          |    |           |           |
| Natural desert landscaping (pervious areas only) <sup>4</sup> ...                                                                    |                                              | 63                                       | 77 | 85        | 88        |
| Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders) ..... |                                              | 96                                       | 96 | 96        | 96        |
| Urban districts:                                                                                                                     |                                              |                                          |    |           |           |
| Commercial and business .....                                                                                                        | 85                                           | 89                                       | 92 | <b>94</b> | <b>95</b> |
| Industrial .....                                                                                                                     | 72                                           | 81                                       | 88 | 91        | 93        |
| Residential districts by average lot size:                                                                                           |                                              |                                          |    |           |           |

**See Table 602A**

### *Developing urban areas*

|                                                                            |    |    |    |    |
|----------------------------------------------------------------------------|----|----|----|----|
| Newly graded areas (pervious areas only, no vegetation) <sup>5</sup> ..... | 77 | 86 | 91 | 94 |
|----------------------------------------------------------------------------|----|----|----|----|

1 Average runoff condition, and  $I_a = 0.2S$ .

2 The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system. Impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using Figure 603.

3 CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.

4 Composite CN's for natural desert landscaping should be computed using Figure 603 based on the impervious area percentage (CN #98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.

5 Composite CN's to use for the design of temporary measures during grading and construction should be computed using Figure 603 based on the degree of development impervious area percentage) and the CN's for the newly graded pervious areas.

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# HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

## RUNOFF CURVE NUMBERS (SEMIARID RANGELANDS<sup>1</sup>)

| Cover description                                                                                                            |                                   | Curve numbers for hydrologic soil group— |    |    |    |
|------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|------------------------------------------|----|----|----|
| Cover type                                                                                                                   | Hydrologic condition <sup>2</sup> | A <sup>3</sup>                           | B  | C  | D  |
| Herbaceous—mixture of grass, weeds, and low-growing brush, with brush the minor element.                                     | Poor                              |                                          | 80 | 87 | 93 |
|                                                                                                                              | Fair                              |                                          | 71 | 81 | 89 |
|                                                                                                                              | Good                              |                                          | 62 | 74 | 85 |
| Oak-aspen—mountain brush mixture of oak brush, aspen, mountain mahogany, bitter brush, maple, and other brush.               | Poor                              |                                          | 66 | 74 | 79 |
|                                                                                                                              | Fair                              |                                          | 48 | 57 | 63 |
|                                                                                                                              | Good                              |                                          | 30 | 41 | 48 |
| Pinyon-juniper—pinyon, juniper, or both; grass understory.                                                                   | Poor                              |                                          | 75 | 85 | 89 |
|                                                                                                                              | Fair                              |                                          | 58 | 73 | 80 |
|                                                                                                                              | Good                              |                                          | 41 | 61 | 71 |
| Sagebrush with grass understory.                                                                                             | Poor                              |                                          | 67 | 80 | 85 |
|                                                                                                                              | Fair                              |                                          | 51 | 63 | 70 |
|                                                                                                                              | Good                              |                                          | 35 | 47 | 55 |
| Desert shrub—major plants include saltbush, greasewood, creosotebush, blackbrush, bursage, palo verde, mesquite, and cactus. | Poor                              | 63                                       | 77 | 85 | 88 |
|                                                                                                                              | Fair                              | 55                                       | 72 | 81 | 86 |
|                                                                                                                              | Good                              | 49                                       | 68 | 79 | 84 |

<sup>1</sup>Average runoff condition, and  $I_a = 0.2S$ .

<sup>2</sup>Poor: <30% ground cover (litter, grass, and brush overstory).

Fair: 30 to 70% ground cover.

Good: >70% ground cover.

<sup>3</sup>Curve numbers for group A have been developed only for desert shrub.

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# HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

## RUNOFF CURVE NUMBERS - RESIDENTIAL DISTRICTS

| Average Lot Size<br>or Usage <sup>1</sup>        | Percent<br>Impervious <sup>2</sup> | Curve Number for Hydrologic Soil Groups |    |    |    |
|--------------------------------------------------|------------------------------------|-----------------------------------------|----|----|----|
|                                                  |                                    | A                                       | B  | C  | D  |
| Apartments/Condos                                | 72                                 | 81                                      | 88 | 91 | 93 |
| Townhouses/6,000 sq ft lots or less <sup>3</sup> | 69                                 | 80                                      | 87 | 90 | 92 |
| 7,000 sq ft lots                                 | 63                                 | 76                                      | 84 | 89 | 91 |
| 8,000 sq ft lots                                 | 58                                 | 73                                      | 82 | 88 | 90 |
| 10,000 sq ft lots                                | 38                                 | 61                                      | 75 | 83 | 87 |
| 14,000 sq ft lots                                | 30                                 | 57                                      | 72 | 81 | 86 |
| 20,000 sq ft lots                                | 25                                 | 54                                      | 70 | 80 | 85 |
| 40,000 sq ft lots                                | 20                                 | 51                                      | 68 | 79 | 84 |
| 80,000 sq ft lots                                | 12                                 | 46                                      | 65 | 77 | 82 |

1 Lot size should represent the size of the average lot and not the gross acreage divided by the number of lots.

2 Actual percent impervious value should be compared to selected land use type.

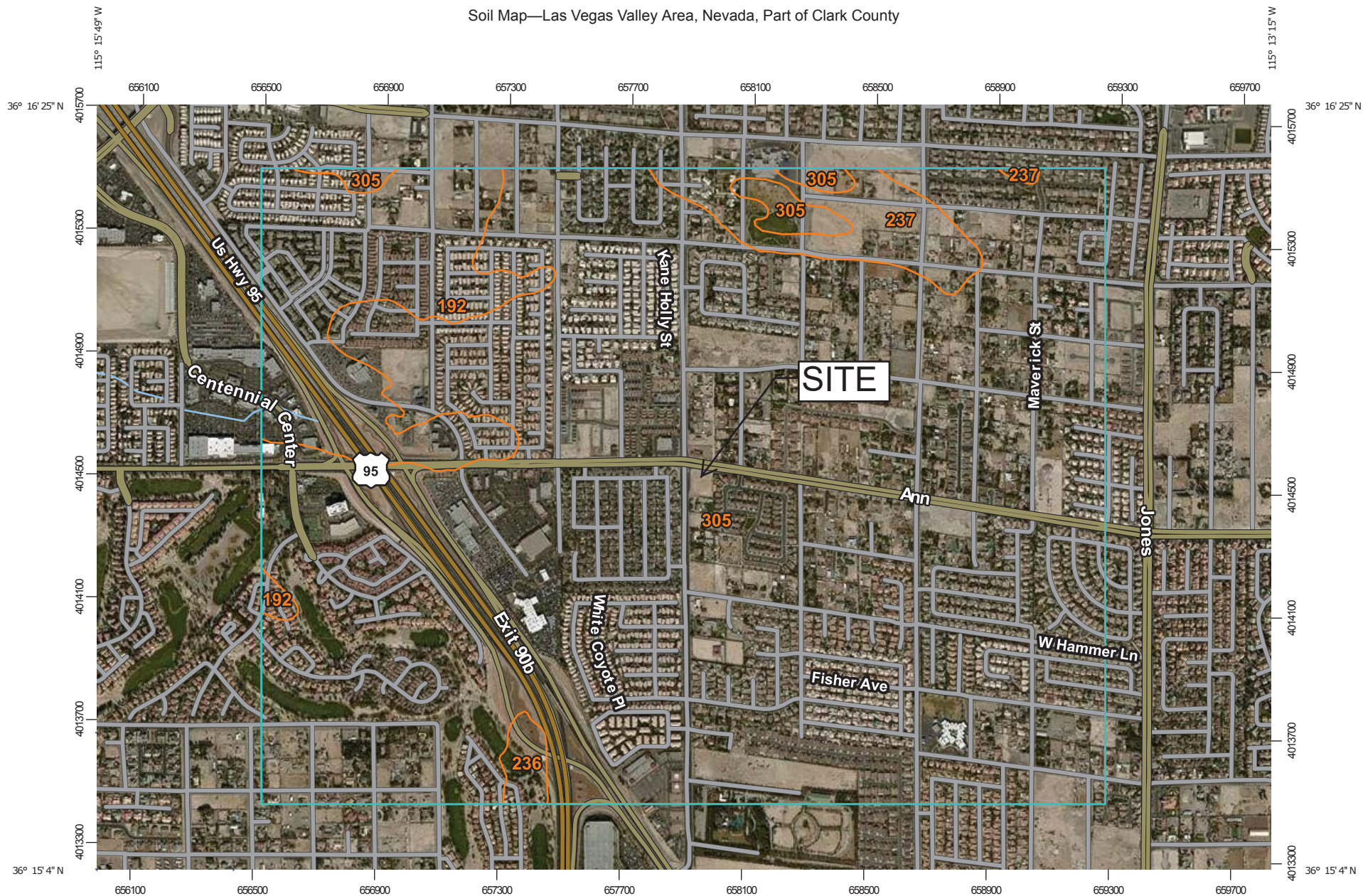
3 In cases where average residential lots are smaller than 6,000 sq ft, commercial/business/industrial land use should be used.

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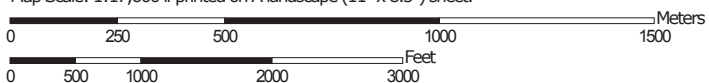
REFERENCE:

TABLE 602A

# Soil Map—Las Vegas Valley Area, Nevada, Part of Clark County



Map Scale: 1:17,600 if printed on A landscape (11" x 8.5") sheet.



Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84



**Natural Resources  
Conservation Service**

Web Soil Survey  
National Cooperative Soil Survey

4/7/2017  
Page 1 of 3

## MAP LEGEND

### Area of Interest (AOI)

 Area of Interest (AOI)

### Soils

 Soil Map Unit Polygons

 Soil Map Unit Lines

 Soil Map Unit Points

### Special Point Features



Blowout



Borrow Pit



Clay Spot



Closed Depression



Gravel Pit



Gravelly Spot



Landfill



Lava Flow



Marsh or swamp



Mine or Quarry



Miscellaneous Water



Perennial Water



Rock Outcrop



Saline Spot



Sandy Spot



Severely Eroded Spot



Sinkhole



Slide or Slip



Sodic Spot



Spoil Area



Stony Spot



Very Stony Spot



Wet Spot



Other



Special Line Features

### Water Features



Streams and Canals

### Transportation



Rails



Interstate Highways



US Routes



Major Roads



Local Roads

### Background



Aerial Photography

## MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service

Web Soil Survey URL:

Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Las Vegas Valley Area, Nevada, Part of Clark County

Survey Area Data: Version 11, Sep 16, 2016

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Sep 26, 2013—Feb 25, 2014

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

## Map Unit Legend

| Las Vegas Valley Area, Nevada, Part of Clark County (NV788) |                                                   |                |                |
|-------------------------------------------------------------|---------------------------------------------------|----------------|----------------|
| Map Unit Symbol                                             | Map Unit Name                                     | Acres in AOI   | Percent of AOI |
| 192                                                         | Dalian-McCullough complex, 0 to 4 percent slopes  | 144.9          | 10.2%          |
| 236                                                         | Glencarb very fine sandy loam, saline             | 9.2            | 0.6%           |
| 237                                                         | Glencarb very fine sandy loam, hardpan substratum | 48.4           | 3.4%           |
| 305                                                         | Las Vegas-DeStazo complex, 0 to 2 percent slopes  | 1,215.4        | 85.7%          |
| <b>Totals for Area of Interest</b>                          |                                                   | <b>1,417.9</b> | <b>100.0%</b>  |

## Report—Engineering Properties

Absence of an entry indicates that the data were not estimated. The asterisk "\*" denotes the representative texture; other possible textures follow the dash. The criteria for determining the hydrologic soil group for individual soil components is found in the National Engineering Handbook, Chapter 7 issued May 2007(<http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17757.wba>). Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

| Engineering Properties—Las Vegas Valley Area, Nevada, Part of Clark County |                  |                  |           |                                                         |                |          |               |              |                                  |              |              |              |              |                  |
|----------------------------------------------------------------------------|------------------|------------------|-----------|---------------------------------------------------------|----------------|----------|---------------|--------------|----------------------------------|--------------|--------------|--------------|--------------|------------------|
| Map unit symbol and soil name                                              | Pct. of map unit | Hydrologic group | Depth     | USDA texture                                            | Classification |          | Pct Fragments |              | Percentage passing sieve number— |              |              |              | Liquid limit | Plasticity index |
|                                                                            |                  |                  |           |                                                         | Unified        | AASHTO   | >10 inches    | 3-10 inches  | 4                                | 10           | 40           | 200          |              |                  |
|                                                                            |                  |                  | <i>In</i> |                                                         |                |          | <i>L-R-H</i>  | <i>L-R-H</i> | <i>L-R-H</i>                     | <i>L-R-H</i> | <i>L-R-H</i> | <i>L-R-H</i> | <i>L-R-H</i> | <i>L-R-H</i>     |
| 192—Dalian-McCullough complex, 0 to 4 percent slopes                       |                  |                  |           |                                                         |                |          |               |              |                                  |              |              |              |              |                  |
| Dalian                                                                     | 55               | A                | 0-5       | Very gravelly fine sandy loam                           | GM             | A-1      | 0- 0- 0       | 0- 0- 0      | 30-43-55                         | 25-38-50     | 20-30-40     | 10-18-25     | 0-7 -14      | NP               |
|                                                                            |                  |                  | 5-60      | Very gravelly sandy loam, very gravelly fine sandy loam | GM             | A-1      | 0- 0- 0       | 5- 8- 10     | 35-45-55                         | 30-40-50     | 20-30-40     | 10-18-25     | 0-7 -14      | NP               |
| Mccullough                                                                 | 35               | B                | 0-5       | Very gravelly very fine sandy loam                      | GM             | A-1      | 0- 0- 0       | 5- 8- 10     | 35-40-45                         | 30-35-40     | 25-33-40     | 15-20-25     | 20-23 -25    | NP-3 -5          |
|                                                                            |                  |                  | 5-30      | Stratified sandy loam to loam                           | SM             | A-2, A-4 | 0- 0- 0       | 0- 0- 0      | 95-98-100                        | 90-95-100    | 55-60-65     | 30-35-40     | 15-20 -25    | NP-3 -5          |
|                                                                            |                  |                  | 30-40     | Stratified coarse sand to loamy fine sand               | SM             | A-1, A-2 | 0- 0- 0       | 0- 0- 0      | 80-90-100                        | 75-85-95     | 40-50-60     | 10-20-30     | 0-7 -14      | NP               |
|                                                                            |                  |                  | 40-60     | Extremely gravelly loamy sand                           | GP-GM          | A-1      | 0- 0- 0       | 5- 8- 10     | 20-25-30                         | 15-20-25     | 10-13-15     | 5- 8- 10     | 0-7 -14      | NP               |

| Engineering Properties--Las Vegas Valley Area, Nevada, Part of Clark County |                  |                  |           |                                                    |                |          |               |              |                                  |              |              |              |              |                  |
|-----------------------------------------------------------------------------|------------------|------------------|-----------|----------------------------------------------------|----------------|----------|---------------|--------------|----------------------------------|--------------|--------------|--------------|--------------|------------------|
| Map unit symbol and soil name                                               | Pct. of map unit | Hydrologic group | Depth     | USDA texture                                       | Classification |          | Pct Fragments |              | Percentage passing sieve number— |              |              |              | Liquid limit | Plasticity index |
|                                                                             |                  |                  |           |                                                    | Unified        | AASHTO   | >10 inches    | 3-10 inches  | 4                                | 10           | 40           | 200          |              |                  |
|                                                                             |                  |                  | <i>In</i> |                                                    |                |          | <i>L-R-H</i>  | <i>L-R-H</i> | <i>L-R-H</i>                     | <i>L-R-H</i> | <i>L-R-H</i> | <i>L-R-H</i> | <i>L-R-H</i> | <i>L-R-H</i>     |
| 236—Glencarb very fine sandy loam, saline                                   |                  |                  |           |                                                    |                |          |               |              |                                  |              |              |              |              |                  |
| Glencarb                                                                    | 100              | C                | 0-6       | Very fine sandy loam                               | CL-ML, ML      | A-4      | 0- 0- 0       | 0- 0- 0      | 100-100-100                      | 100-100-100  | 85-90-95     | 55-60-65     | 20-25-30     | NP-5-10          |
|                                                                             |                  |                  | 6-60      | Stratified very fine sandy loam to silty clay loam | CL, CL-ML      | A-4, A-6 | 0- 0- 0       | 0- 0- 0      | 100-100-100                      | 100-100-100  | 95-98-100    | 75-80-85     | 20-25-30     | 5-10-15          |
| 237—Glencarb very fine sandy loam, hardpan substratum                       |                  |                  |           |                                                    |                |          |               |              |                                  |              |              |              |              |                  |
| Glencarb                                                                    | 100              | C                | 0-6       | Very fine sandy loam                               | CL-ML, ML      | A-4      | 0- 0- 0       | 0- 0- 0      | 100-100-100                      | 100-100-100  | 85-93-100    | 55-60-65     | 20-25-30     | NP-5-10          |
|                                                                             |                  |                  | 6-42      | Stratified very fine sandy loam to silty clay loam | CL, CL-ML      | A-4, A-6 | 0- 0- 0       | 0- 0- 0      | 100-100-100                      | 100-100-100  | 95-98-100    | 75-80-85     | 25-30-35     | 5-10-15          |
|                                                                             |                  |                  | 42-60     | Cemented                                           | —              | —        | —             | —            | —                                | —            | —            | —            | —            | —                |

| Engineering Properties--Las Vegas Valley Area, Nevada, Part of Clark County |                  |                  |           |                                                                                            |                |          |               |              |                                  |              |              |              |              |                  |
|-----------------------------------------------------------------------------|------------------|------------------|-----------|--------------------------------------------------------------------------------------------|----------------|----------|---------------|--------------|----------------------------------|--------------|--------------|--------------|--------------|------------------|
| Map unit symbol and soil name                                               | Pct. of map unit | Hydrologic group | Depth     | USDA texture                                                                               | Classification |          | Pct Fragments |              | Percentage passing sieve number— |              |              |              | Liquid limit | Plasticity index |
|                                                                             |                  |                  |           |                                                                                            | Unified        | AASHTO   | >10 inches    | 3-10 inches  | 4                                | 10           | 40           | 200          |              |                  |
|                                                                             |                  |                  | <i>In</i> |                                                                                            |                |          | <i>L-R-H</i>  | <i>L-R-H</i> | <i>L-R-H</i>                     | <i>L-R-H</i> | <i>L-R-H</i> | <i>L-R-H</i> | <i>L-R-H</i> | <i>L-R-H</i>     |
| 305—Las Vegas-DeStazo complex, 0 to 2 percent slopes                        |                  |                  |           |                                                                                            |                |          |               |              |                                  |              |              |              |              |                  |
| Las vegas                                                                   | 60               | D                | 0-2       | Gravelly fine sandy loam                                                                   | SM             | A-1, A-2 | 0- 0- 0       | 0- 0- 0      | 60-70-80                         | 50-63-75     | 40-53-65     | 20-25-30     | 15-20-25     | NP-3 -5          |
|                                                                             |                  |                  | 2-8       | Fine sandy loam                                                                            | SM             | A-4      | 0- 0- 0       | 0- 0- 0      | 80-90-100                        | 75-85-95     | 65-73-80     | 40-45-50     | 0-7 -14      | NP               |
|                                                                             |                  |                  | 8-12      | Gravelly sandy clay loam, gravelly loam                                                    | GC, SC         | A-2, A-6 | 0- 0- 0       | 0- 0- 0      | 60-70-80                         | 50-63-75     | 30-40-50     | 25-35-45     | 25-30-35     | 10-13-15         |
|                                                                             |                  |                  | 12-16     | Indurated                                                                                  | —              | —        | —             | —            | —                                | —            | —            | —            | —            | —                |
| Destazo                                                                     | 25               | C                | 0-11      | Fine sandy loam                                                                            | SM             | A-2, A-4 | 0- 0- 0       | 0- 0- 0      | 95-98-100                        | 90-95-100    | 70-83-95     | 30-40-50     | 20-25-30     | NP-3 -5          |
|                                                                             |                  |                  | 11-51     | Very gravelly clay loam, extremely gravelly sandy clay loam, very gravelly sandy clay loam | GC, GP-GC      | A-2      | 0- 0- 0       | 0- 0- 0      | 15-35-55                         | 10-30-50     | 10-28-45     | 5-20-35      | 25-33-40     | 10-15-20         |
|                                                                             |                  |                  | 51-62     | Sandy loam, sandy clay loam                                                                | SC, SC-SM      | A-4, A-6 | 0- 0- 0       | 0- 0- 0      | 90-95-100                        | 85-93-100    | 50-60-70     | 35-43-50     | 20-28-35     | 5-10-15          |

## Data Source Information

Soil Survey Area: Las Vegas Valley Area, Nevada, Part of Clark County

Survey Area Data: Version 11, Sep 16, 2016



## SOIL TYPE CALCULATED CURVE NUMBER

### Soil Type #305 – (Desert Shrub)

| Soil      | Percent(%) | Soil Type | CN |
|-----------|------------|-----------|----|
| Las Vegas | 60         | D         | 88 |
| Destazo   | 25         | C         | 85 |

$$CN = (0.60*88) + (0.25*85)/.85 = 87.1$$

### Soil Type #305 – (Commercial)

| Soil      | Percent(%) | Soil Type | CN |
|-----------|------------|-----------|----|
| Las Vegas | 60         | D         | 95 |
| Destazo   | 25         | C         | 94 |

$$CN = (0.60*95) + (0.25*94)/.85 = 94.7$$

### Soil Type #305 – (Residential 80k Lots)

| Soil      | Percent(%) | Soil Type | CN |
|-----------|------------|-----------|----|
| Las Vegas | 60         | D         | 82 |
| Destazo   | 25         | C         | 77 |

$$CN = (0.60*82) + (0.25*77)/.85 = 80.5$$

### Soil Type #305 – (Pavement)

| Soil      | Percent(%) | Soil Type | CN |
|-----------|------------|-----------|----|
| Las Vegas | 60         | D         | 98 |
| Destazo   | 25         | C         | 98 |

$$CN = 98.0$$

# BASIN COMPOSITE CN VALUES

## OFF1 and OFF2

### EXISTING

| Soil Type | Land Use | Percent<br>of Basin | CN Value |
|-----------|----------|---------------------|----------|
| 305       | Pavement | 100                 | 98       |

CN(Composite) = 1\*98.0  
**CN = 98.0**

## OFF3 and OFF4

### EXISTING

| Soil Type | Land Use      | Percent<br>of Basin | CN Value |
|-----------|---------------|---------------------|----------|
| 305       | SFR--80k Lots | 100                 | 80.5     |

CN(Composite) = 1\*80.5  
**CN = 80.5**

## EXON1 and EXON2

### EXISTING

| Soil Type | Land Use     | Percent<br>of Basin | CN Value |
|-----------|--------------|---------------------|----------|
| 305       | Desert Shrub | 100                 | 87.1     |

CN(Composite) = 1\*87.1  
**CN = 87.1**

## DEV1 and DEV2

### FUTURE

| Soil Type | Land Use   | Percent<br>of Basin | CN Value |
|-----------|------------|---------------------|----------|
| 305       | Commercial | 100                 | 94.7     |

CN(Composite) = 1\*94.7  
**CN = 94.7**

# HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

## TIME OF CONCENTRATION

Project No. : 17232

DEVELOPMENT : Service Station & Carwash @ SEC Ann & Rainbow  
Existing and Future Conditions  
CALCULATED BY : PDW

DATE: April 2017



| SUB-BASIN DATA  |      |        |                        |                       | INITIAL / OVERLAND TIME (Ti) |                     |                    | TRAVEL TIME (Tt)      |                     |                        |                           |                    | Tc                           | Tc CHECK URBANIZED BASINS   |                                    | FINAL Tc     | Min Tc       | Tlag                              | REMARKS         |
|-----------------|------|--------|------------------------|-----------------------|------------------------------|---------------------|--------------------|-----------------------|---------------------|------------------------|---------------------------|--------------------|------------------------------|-----------------------------|------------------------------------|--------------|--------------|-----------------------------------|-----------------|
| DESIG:          | CN   | K      | AREA<br><i>(acres)</i> | AREA<br><i>(mi^2)</i> | LENGTH<br><i>(ft)</i>        | SLOPE<br><i>(%)</i> | Ti<br><i>(min)</i> | LENGTH<br><i>(ft)</i> | SLOPE<br><i>(%)</i> | LAND COVER<br><i>k</i> | VELOCITY*<br><i>(fps)</i> | Tt<br><i>(min)</i> | Tc = Ti + Tt<br><i>(min)</i> | TOTAL LENGTH<br><i>(ft)</i> | Tc =<br>(L/180)*10<br><i>(min)</i> | <i>(min)</i> | <i>(min)</i> | Tlag=<br>0.6Tc/60<br><i>(hrs)</i> |                 |
| (1)             |      | (2)    | (3)                    | (4)                   | (5)                          | (6)                 | (7)                | (8)                   | (9)                 |                        | (10)                      | (11)               |                              | (12)                        | (13)                               | (14)         |              |                                   |                 |
| Existing Basins |      |        |                        |                       |                              |                     |                    |                       |                     |                        |                           |                    |                              |                             |                                    |              |              |                                   |                 |
| OFF1            | 98.0 | 0.9036 | 0.19                   | 0.0003                | 60                           | 2.00                | 2.17               | 90                    | 1.00                | DEV                    | 3.06                      | 0.5                | 2.7                          | 150.0                       | 10.833                             | 2.66         | 5.00         | 0.050                             | minimum Tc used |
| OFF2            | 98.0 | 0.9036 | 0.63                   | 0.0010                | 60                           | 2.00                | 2.17               | 370                   | 0.57                | DEV                    | 2.31                      | 2.7                | 4.8                          | 430.0                       | 12.389                             | 4.84         | 5.00         | 0.050                             | minimum Tc used |
| OFF3            | 80.5 | 0.6726 | 0.09                   | 0.0001                | 75                           | 0.67                | 7.61               | --                    | --                  | DEV                    | --                        | --                 | 7.6                          | 75.0                        | 10.417                             | 7.61         | 5.00         | 0.076                             |                 |
| OFF4            | 80.5 | 0.6726 | 0.11                   | 0.0002                | 50                           | 2.00                | 4.32               | 90                    | 1.67                | DEV                    | 3.95                      | 0.4                | 4.7                          | 140.0                       | 10.778                             | 4.70         | 5.00         | 0.050                             | minimum Tc used |
| EXON1           | 87.1 | 0.7597 | 0.40                   | 0.0006                | 210                          | 0.95                | 9.03               | --                    | --                  | EX                     | --                        | --                 | 9.0                          | 210.0                       | N/A                                | 9.03         | 10.00        | 0.100                             | minimum Tc used |
| EXON2           | 87.1 | 0.7597 | 1.24                   | 0.0019                | 230                          | 0.87                | 9.73               | 200                   | 0.50                | EX                     | 2.08                      | 1.6                | 11.3                         | 430.0                       | N/A                                | 11.33        | 10.00        | 0.113                             |                 |
|                 |      |        |                        |                       |                              |                     |                    |                       |                     |                        |                           |                    |                              |                             |                                    |              |              |                                   |                 |
|                 |      |        |                        |                       |                              |                     |                    |                       |                     |                        |                           |                    |                              |                             |                                    |              |              |                                   |                 |
| Future Basins   |      |        |                        |                       |                              |                     |                    |                       |                     |                        |                           |                    |                              |                             |                                    |              |              |                                   |                 |
| DEV1            | 94.7 | 0.8600 | 0.25                   | 0.0004                | 10                           | 1.00                | 1.37               | 140                   | 2.14                | DEV                    | 4.48                      | 0.5                | 1.9                          | 150.0                       | 10.833                             | 1.89         | 5.00         | 0.050                             | minimum Tc used |
| DEV2            | 94.7 | 0.8600 | 1.39                   | 0.0022                | 145                          | 1.99                | 4.14               | 195                   | 0.50                | DEV                    | 2.16                      | 1.5                | 5.6                          | 340.0                       | 11.889                             | 5.64         | 5.00         | 0.056                             |                 |
|                 |      |        |                        |                       |                              |                     |                    |                       |                     |                        |                           |                    |                              |                             |                                    |              |              |                                   |                 |
|                 |      |        |                        |                       |                              |                     |                    |                       |                     |                        |                           |                    |                              |                             |                                    |              |              |                                   |                 |
|                 |      |        |                        |                       |                              |                     |                    |                       |                     |                        |                           |                    |                              |                             |                                    |              |              |                                   |                 |
|                 |      |        |                        |                       |                              |                     |                    |                       |                     |                        |                           |                    |                              |                             |                                    |              |              |                                   |                 |
|                 |      |        |                        |                       |                              |                     |                    |                       |                     |                        |                           |                    |                              |                             |                                    |              |              |                                   |                 |
|                 |      |        |                        |                       |                              |                     |                    |                       |                     |                        |                           |                    |                              |                             |                                    |              |              |                                   |                 |
|                 |      |        |                        |                       |                              |                     |                    |                       |                     |                        |                           |                    |                              |                             |                                    |              |              |                                   |                 |

$$T_i = 1.8 (1.1 - K) L^{1/2} / S^{1/3}$$

$$T_c = T_i + T_t$$

$$K = 0.0132 (CN) - 0.39 \quad T_{lag} = 0.6T_c$$

\* The velocity in column 9 was computed using the equation  $V = CS^{0.5}$

C is a coefficient and S is the travel slope, as outlined in section 602.1 of the CCRFCD Manual.

\*As recommended in the CCRFCD Manual, C = 30.6 under developed conditions and C = 29.4 under undeveloped conditions.

REFERENCE :

STANDARD FORM 4



**McCay  
ENGINEERING**

---

## **APPENDIX C**

EXISTING HEC-1 MODEL

```

1*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1) *
*      JUN 1998                      *
*      VERSION 4.1                    *
* RUN DATE 13APR17 TIME 00:11:54    *
*
*****

```

```

*****
*
* U.S. ARMY CORPS OF ENGINEERS      *
* HYDROLOGIC ENGINEERING CENTER     *
* 609 SECOND STREET                  *
* DAVIS, CALIFORNIA 95616           *
* (916) 756-1104                    *
*
*****

```

```

X   X   XXXXXX   XXXXX   X
X   X   X       X       XX
X   X   X       X       X
XXXXXXX XXXX   X       XXXXX X
X   X   X       X       X
X   X   X       X       X
X   X   XXXXXX   XXXXX   XXX

```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE. THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY, DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1 HEC-1 INPUT PAGE 1

LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

```

1 ID
2 ID TECHNICAL DRAINAGE STUDY FOR SERVICE STATION @ CARWASH
3 ID @ SEC ANN & RAINBOW
4 ID LAS VEGAS, NEVADA
5 ID
6 ID PREPARED FOR:
7 ID
8 ID PREPARED BY:
9 ID MCCAY ENGINEERING
10 ID 11700 W. CHARLESTON BLVD, SUITE 170-298
11 ID LAS VEGAS, NV 89135
12 ID
13 ID
14 ID EXISTING 10- & 100-YEAR MODEL
15 ID FILENAME:AR-EXA.DAT
16 ID JOB#17232
17 ID
18 ID
19 ID
20 ID *DIAGRAM
21 IT 5 0 0 300
22 IO 5
23 IN 5
24 JR PREC 1.00 0.57
25 *
26 KK OFF1
27 KM EXISTING OFFSITE BASIN OFF1
28 BA 0.0003
29 PB 2.77
30 PC .000 .020 .057 .070 .087 .108 .124 .130 .130 .130
31 PC .130 .130 .130 .133 .140 .142 .148 .158 .172 .181
32 PC .190 .197 .199 .200 .201 .204 .214 .229 .241 .249
33 PC .251 .256 .270 .278 .281 .283 .295 .322 .352 .409
34 PC .499 .590 .710 .744 .781 .812 .819 .835 .851 .856
35 PC .860 .868 .876 .888 .910 .926 .937 .950 .970 .976
36 PC .982 .985 .987 .989 .990 .993 .993 .994 .995 .998
37 PC .998 .999 1.00
38 LS 0 98.0
39 UD 0.050
40 *
41 KK DIV1
42 KM DIVERSION OF FLOW INTO EXISTING STORMDRAIN
43 DT DIV1
44 DI 0 100
45 DQ 0 100
46 *
47 KK OFF2
48 KM EXISTING OFFSITE BASIN OFF2
49 BA 0.0010
50 LS 0 98.0
51 UD 0.050
52 *

```

1 HEC-1 INPUT PAGE 2

| LINE | ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10 |
|------|-----------------------------------------------------------------|
| 48   | KK EXON1                                                        |
| 49   | KM EXISTING ONSITE BASIN EXON1                                  |
| 50   | BA 0.0006                                                       |
| 51   | LS 0 87.1                                                       |
| 52   | UD 0.100                                                        |
|      | *                                                               |
| 53   | KK COM1                                                         |
| 54   | KM COMBINE OFF1, OFF2, AND EXON1                                |
| 55   | HC 3                                                            |
|      | *                                                               |
| 56   | KK EXON2                                                        |
| 57   | KM EXISTING ONSITE BASIN EXON2                                  |
| 58   | BA 0.0019                                                       |
| 59   | LS 0 87.1                                                       |
| 60   | UD 0.113                                                        |
|      | *                                                               |
| 61   | KK OFF3                                                         |
| 62   | KM EXISTING OFFSITE BASIN OFF3                                  |
| 63   | BA 0.0001                                                       |
| 64   | LS 0 80.5                                                       |
| 65   | UD 0.076                                                        |
|      | *                                                               |
| 66   | KK OFF4                                                         |
| 67   | KM EXISTING OFFSITE BASIN OFF4                                  |
| 68   | BA 0.0002                                                       |
| 69   | LS 0 80.5                                                       |
| 70   | UD 0.050                                                        |
|      | *                                                               |
| 71   | KK COM2                                                         |
| 72   | KM COMBINE EXON2, OFF3, AND OFF4                                |
| 73   | HC 3                                                            |
|      | *                                                               |
| 74   | ZZ                                                              |

1

# SCHEMATIC DIAGRAM OF STREAM NETWORK

```

INPUT
LINE      (V) ROUTING      (--->) DIVERSION OR PUMP FLOW

NO.      (.) CONNECTOR    (<---) RETURN OF DIVERTED OR PUMPED FLOW

24      OFF1
.
.
40      .----->      DIV1
38      DIV1
.
.
43      .      OFF2
.      .
.      .
48      .      .      EXON1
.      .      .
.      .      .
53      COM1.....
.
.
56      .      EXON2
.      .
.      .
61      .      .      OFF3
.      .      .
.      .      .
66      .      .      .      OFF4
.      .      .      .
.      .      .      .
71      .      COM2.....

```

(\*\*\*) RUNOFF ALSO COMPUTED AT THIS LOCATION

```

1*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1) *
* JUN 1998 *
* VERSION 4.1 *
* RUN DATE 13APR17 TIME 00:11:54 *
*
*****

```

```

*****
*
* U.S. ARMY CORPS OF ENGINEERS *
* HYDROLOGIC ENGINEERING CENTER *
* 609 SECOND STREET *
* DAVIS, CALIFORNIA 95616 *
* (916) 756-1104 *
*
*****

```

PREPARED FOR:

PREPARED BY:

MCCAY ENGINEERING  
11700 W. CHARLESTON BLVD, SUITE 170-298  
LAS VEGAS, NV 89135

EXISTING 10- & 100-YEAR MODEL  
FILENAME:AR-EXA.DAT  
JOB#17232

21 IO        OUTPUT CONTROL VARIABLES  
              IPRNT        5    PRINT CONTROL  
              IPLOT        0    PLOT CONTROL  
              QSCAL        0.   HYDROGRAPH PLOT SCALE  
  
IT            HYDROGRAPH TIME DATA  
              NMIN        5    MINUTES IN COMPUTATION INTERVAL  
              IDATE       1    0    STARTING DATE  
              ITIME       0000   STARTING TIME  
              NQ          300   NUMBER OF HYDROGRAPH ORDINATES  
              NDDATE      2    0    ENDING DATE  
              NDTIME      0055   ENDING TIME  
              ICENT       19    CENTURY MARK  
  
              COMPUTATION INTERVAL    .08 HOURS  
              TOTAL TIME BASE        24.92 HOURS  
  
              ENGLISH UNITS  
              DRAINAGE AREA        SQUARE MILES  
              PRECIPITATION DEPTH   INCHES  
              LENGTH, ELEVATION    FEET  
              FLOW                CUBIC FEET PER SECOND  
              STORAGE VOLUME       ACRE-FEET  
              SURFACE AREA        ACRES  
              TEMPERATURE        DEGREES FAHRENHEIT  
  
JP            MULTI-PLAN OPTION  
              NPLAN                1    NUMBER OF PLANS  
  
JR            MULTI-RATIO OPTION  
              RATIOS OF PRECIPITATION  
              1.00        .57

1

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS  
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES  
TIME TO PEAK IN HOURS

| OPERATION     | STATION | AREA | PLAN | RATIOS APPLIED TO PRECIPITATION |            |
|---------------|---------|------|------|---------------------------------|------------|
|               |         |      |      | RATIO 1                         | RATIO 2    |
|               |         |      |      | 1.00                            | .57        |
| HYDROGRAPH AT |         |      |      |                                 |            |
| +             | OFF1    | .00  | 1    | FLOW                            | 1.    0.   |
|               |         |      |      | TIME                            | 3.50 3.50  |
| DIVERSION TO  |         |      |      |                                 |            |
| +             | DIV1    | .00  | 1    | FLOW                            | 1.    0.   |
|               |         |      |      | TIME                            | 3.50 3.50  |
| HYDROGRAPH AT |         |      |      |                                 |            |
| +             | DIV1    | .00  | 1    | FLOW                            | 0.    0.   |
|               |         |      |      | TIME                            | .00    .00 |
| HYDROGRAPH AT |         |      |      |                                 |            |
| +             | OFF2    | .00  | 1    | FLOW                            | 2.    1.   |
|               |         |      |      | TIME                            | 3.50 3.50  |
| HYDROGRAPH AT |         |      |      |                                 |            |
| +             | EXON1   | .00  | 1    | FLOW                            | 1.    0.   |
|               |         |      |      | TIME                            | 3.50 3.50  |
| 3 COMBINED AT |         |      |      |                                 |            |
| +             | COM1    | .00  | 1    | FLOW                            | 3.    2.   |
|               |         |      |      | TIME                            | 3.50 3.50  |
| HYDROGRAPH AT |         |      |      |                                 |            |
| +             | EXON2   | .00  | 1    | FLOW                            | 3.    1.   |
|               |         |      |      | TIME                            | 3.58 3.58  |
| HYDROGRAPH AT |         |      |      |                                 |            |
| +             | OFF3    | .00  | 1    | FLOW                            | 0.    0.   |
|               |         |      |      | TIME                            | 3.50 3.50  |
| HYDROGRAPH AT |         |      |      |                                 |            |
| +             | OFF4    | .00  | 1    | FLOW                            | 0.    0.   |
|               |         |      |      | TIME                            | 3.50 3.50  |
| 3 COMBINED AT |         |      |      |                                 |            |

|   |      |     |   |      |      |      |
|---|------|-----|---|------|------|------|
| + | COM2 | .00 | 1 | FLOW | 3.   | 1.   |
|   |      |     |   | TIME | 3.50 | 3.58 |

\*\*\* NORMAL END OF HEC-1 \*\*\*



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---

## **APPENDIX D**

FUTURE HEC-1 MODEL

```

1*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1) *
*      JUN 1998                      *
*      VERSION 4.1                    *
* RUN DATE 13APR17 TIME 00:18:39    *
*
*****

```

```

*****
*
* U.S. ARMY CORPS OF ENGINEERS      *
* HYDROLOGIC ENGINEERING CENTER     *
* 609 SECOND STREET                 *
* DAVIS, CALIFORNIA 95616           *
* (916) 756-1104                    *
*
*****

```

```

X   X   XXXXXX   XXXXX   X
X   X   X       X       XX
X   X   X       X       X
XXXXXXX XXXX   X       XXXXX X
X   X   X       X       X
X   X   X       X       X
X   X   XXXXXX   XXXXX   XXX

```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE. THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY, DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1 HEC-1 INPUT PAGE 1

LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

```

1 ID
2 ID TECHNICAL DRAINAGE STUDY FOR SERVICE STATION @ CARWASH
3 ID @ SEC ANN & RAINBOW
4 ID LAS VEGAS, NEVADA
5 ID
6 ID PREPARED FOR:
7 ID
8 ID PREPARED BY:
9 ID MCCAY ENGINEERING
10 ID 11700 W. CHARLESTON BLVD, SUITE 170-298
11 ID LAS VEGAS, NV 89135
12 ID
13 ID
14 ID FUTURE 10- & 100-YEAR MODEL
15 ID FILENAME:AR-FUTA.DAT
16 ID JOB#17232
17 ID
18 ID
19 ID
20 ID *DIAGRAM
21 IT 5 0 0 300
22 IO 5
23 IN 5
24 JR PREC 1.00 0.57
25 *
26 KK OFF1
27 KM FUTURE OFFSITE BASIN OFF1
28 BA 0.0003
29 PB 2.77
30 PC .000 .020 .057 .070 .087 .108 .124 .130 .130 .130
31 PC .130 .130 .130 .133 .140 .142 .148 .158 .172 .181
32 PC .190 .197 .199 .200 .201 .204 .214 .229 .241 .249
33 PC .251 .256 .270 .278 .281 .283 .295 .322 .352 .409
34 PC .499 .590 .710 .744 .781 .812 .819 .835 .851 .856
35 PC .860 .868 .876 .888 .910 .926 .937 .950 .970 .976
36 PC .982 .985 .987 .989 .990 .993 .993 .994 .995 .998
37 PC .998 .999 1.00
38 LS 0 98.0
39 UD 0.050
40 *
41 KK DIV1
42 KM DIVERSION OF FLOW INTO EXISTING STORMDRAIN
43 DT DIV1
44 DI 0 100
45 DQ 0 100
46 *
47 KK OFF2
48 KM FUTURE OFFSITE BASIN OFF2
49 BA 0.0010
50 LS 0 98.0
51 UD 0.050
52 *

```

1 HEC-1 INPUT PAGE 2

| LINE | ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10 |
|------|-----------------------------------------------------------------|
| 48   | KK DEV1                                                         |
| 49   | KM FUTURE ONSITE BASIN EXON1                                    |
| 50   | BA 0.0004                                                       |
| 51   | LS 0 94.7                                                       |
| 52   | UD 0.050                                                        |
|      | *                                                               |
| 53   | KK COM1                                                         |
| 54   | KM COMBINE OFF1, OFF2, AND DEV1                                 |
| 55   | HC 3                                                            |
|      | *                                                               |
| 56   | KK DEV2                                                         |
| 57   | KM FUTURE ONSITE BASIN DEV2                                     |
| 58   | BA 0.0022                                                       |
| 59   | LS 0 94.7                                                       |
| 60   | UD 0.056                                                        |
|      | *                                                               |
| 61   | KK OFF3                                                         |
| 62   | KM FUTURE OFFSITE BASIN OFF3                                    |
| 63   | BA 0.0001                                                       |
| 64   | LS 0 80.5                                                       |
| 65   | UD 0.076                                                        |
|      | *                                                               |
| 66   | KK OFF4                                                         |
| 67   | KM FUTURE OFFSITE BASIN OFF4                                    |
| 68   | BA 0.0002                                                       |
| 69   | LS 0 80.5                                                       |
| 70   | UD 0.050                                                        |
|      | *                                                               |
| 71   | KK COM2                                                         |
| 72   | KM COMBINE DEV2, OFF3, AND OFF4                                 |
| 73   | HC 3                                                            |
|      | *                                                               |
| 74   | ZZ                                                              |

1

# SCHEMATIC DIAGRAM OF STREAM NETWORK

```

INPUT
LINE (V) ROUTING (--->) DIVERSION OR PUMP FLOW

NO. (.) CONNECTOR (<---) RETURN OF DIVERTED OR PUMPED FLOW

24 OFF1
.
.
40 .-----> DIV1
38 DIV1
.
.
43 . OFF2
.
.
48 . . DEV1
.
.
53 COM1.....
.
.
56 . DEV2
.
.
61 . . OFF3
.
.
66 . . . OFF4
.
.
71 . COM2.....

```

(\*\*\*) RUNOFF ALSO COMPUTED AT THIS LOCATION

```

1*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1) *
* JUN 1998 *
* VERSION 4.1 *
*
* RUN DATE 13APR17 TIME 00:18:39 *
*
*****

```

```

*****
*
* U.S. ARMY CORPS OF ENGINEERS *
* HYDROLOGIC ENGINEERING CENTER *
* 609 SECOND STREET *
* DAVIS, CALIFORNIA 95616 *
* (916) 756-1104 *
*
*****

```

PREPARED BY:

FUTURE 10- & 100-YEAR MODEL  
FILENAME:AR-FUTA.DAT  
JOB#17232

| ENGLISH UNITS       |                       |
|---------------------|-----------------------|
| DRAINAGE AREA       | SQUARE MILES          |
| PRECIPITATION DEPTH | INCHES                |
| LENGTH, ELEVATION   | FEET                  |
| FLOW                | CUBIC FEET PER SECOND |
| STORAGE VOLUME      | ACRE-Feet             |
| SURFACE AREA        | ACRES                 |
| TEMPERATURE         | DEGREES FAHRENHEIT    |

|    |                         |
|----|-------------------------|
| JR | MULTI-RATIO OPTION      |
|    | RATIOS OF PRECIPITATION |
|    | 1.00 .57                |

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS  
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES  
TIME TO PEAK IN HOURS

| OPERATION          | STATION | AREA | PLAN | RATIOS APPLIED TO PRECIPITATION |                |            |
|--------------------|---------|------|------|---------------------------------|----------------|------------|
|                    |         |      |      | RATIO 1<br>1.00                 | RATIO 2<br>.57 |            |
| HYDROGRAPH AT<br>+ | OFF1    | .00  | 1    | FLOW<br>TIME                    | 1.<br>3.50     | 0.<br>3.50 |
| DIVERSION TO<br>+  | DIV1    | .00  | 1    | FLOW<br>TIME                    | 1.<br>3.50     | 0.<br>3.50 |
| HYDROGRAPH AT<br>+ | DIV1    | .00  | 1    | FLOW<br>TIME                    | 0.<br>.00      | 0.<br>.00  |
| HYDROGRAPH AT<br>+ | OFF2    | .00  | 1    | FLOW<br>TIME                    | 2.<br>3.50     | 1.<br>3.50 |
| HYDROGRAPH AT<br>+ | DEV1    | .00  | 1    | FLOW<br>TIME                    | 1.<br>3.50     | 0.<br>3.50 |
| 3 COMBINED AT<br>+ | COM1    | .00  | 1    | FLOW<br>TIME                    | 3.<br>3.50     | 2.<br>3.50 |
| HYDROGRAPH AT<br>+ | DEV2    | .00  | 1    | FLOW<br>TIME                    | 5.<br>3.50     | 2.<br>3.50 |
| HYDROGRAPH AT<br>+ | OFF3    | .00  | 1    | FLOW<br>TIME                    | 0.<br>3.50     | 0.<br>3.50 |
| HYDROGRAPH AT<br>+ | OFF4    | .00  | 1    | FLOW<br>TIME                    | 0.<br>3.50     | 0.<br>3.50 |
| 3 COMBINED AT      |         |      |      |                                 |                |            |

|   |      |     |   |      |      |      |
|---|------|-----|---|------|------|------|
| + | COM2 | .00 | 1 | FLOW | 5.   | 3.   |
|   |      |     |   | TIME | 3.50 | 3.50 |

\*\*\* NORMAL END OF HEC-1 \*\*\*



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---

## **APPENDIX E**

### **HYDRAULIC CALCULATIONS**

## Project Description

## Input Data

Elevation (ft)

Options

## Results

Page 1 of 2

---

## Worksheet for 100 Yr Rainbow (Section 1)

---

### Results

|                 |               |       |
|-----------------|---------------|-------|
| Top Width       | 6.75          | ft    |
| Normal Depth    | 0.27          | ft    |
| Critical Depth  | 0.28          | ft    |
| Critical Slope  | 0.00817       | ft/ft |
| Velocity        | 1.69          | ft/s  |
| Velocity Head   | 0.04          | ft    |
| Specific Energy | 0.32          | ft    |
| Froude Number   | 1.01          |       |
| Flow Type       | Supercritical |       |

### GVF Input Data

|                  |      |    |
|------------------|------|----|
| Downstream Depth | 0.00 | ft |
| Length           | 0.00 | ft |
| Number Of Steps  | 0    |    |

### GVF Output Data

|                     |          |       |
|---------------------|----------|-------|
| Upstream Depth      | 0.00     | ft    |
| Profile Description |          |       |
| Profile Headloss    | 0.00     | ft    |
| Downstream Velocity | Infinity | ft/s  |
| Upstream Velocity   | Infinity | ft/s  |
| Normal Depth        | 0.27     | ft    |
| Critical Depth      | 0.28     | ft    |
| Channel Slope       | 0.00830  | ft/ft |
| Critical Slope      | 0.00817  | ft/ft |

---

## Cross Section for 100 Yr Rainbow (Section 1)

---

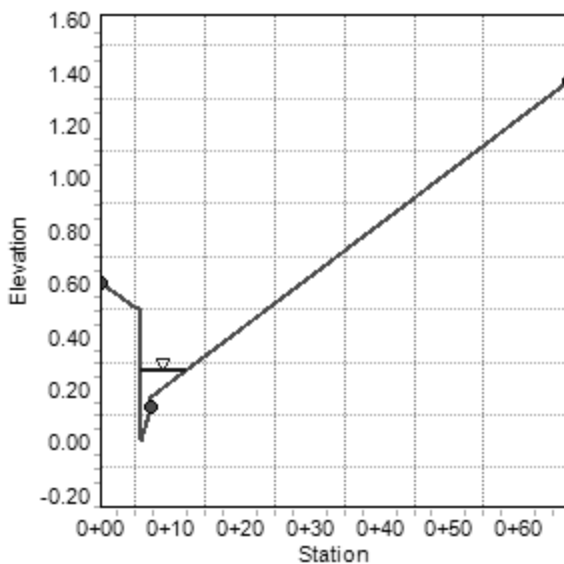
### Project Description

|                 |                 |
|-----------------|-----------------|
| Friction Method | Manning Formula |
| Solve For       | Normal Depth    |

### Input Data

|               |         |                    |
|---------------|---------|--------------------|
| Channel Slope | 0.00830 | ft/ft              |
| Normal Depth  | 0.27    | ft                 |
| Discharge     | 1.00    | ft <sup>3</sup> /s |

### Cross Section Image



## Worksheet for 10 Yr Rainbow (Section 2)

### Project Description

Friction Method                      Manning Formula  
Solve For                              Normal Depth

### Input Data

Channel Slope                                              0.00920    ft/ft  
Discharge                                                      1.00    ft<sup>3</sup>/s  
Section Definitions

| Station (ft) | Elevation (ft) |
|--------------|----------------|
| 0+00.00      | 0.60           |
| 0+05.00      | 0.50           |
| 0+05.50      | 0.50           |
| 0+05.50      | 0.00           |
| 0+07.00      | 0.13           |
| 0+07.00      | 0.17           |
| 0+67.00      | 1.37           |

### Roughness Segment Definitions

| Start Station   | Ending Station  | Roughness Coefficient |
|-----------------|-----------------|-----------------------|
| (0+00.00, 0.60) | (0+07.00, 0.13) | 0.013                 |
| (0+07.00, 0.13) | (0+67.00, 1.37) | 0.016                 |

### Options

Current Roughness Weighted Method              Pavlovskii's Method  
Open Channel Weighting Method                  Pavlovskii's Method  
Closed Channel Weighting Method                Pavlovskii's Method

### Results

Normal Depth                                              0.27    ft  
Elevation Range                                          0.00 to 1.37 ft  
Flow Area                                                      0.57    ft<sup>2</sup>  
Wetted Perimeter                                              6.89    ft  
Hydraulic Radius                                              0.08    ft

---

## Worksheet for 10 Yr Rainbow (Section 2)

---

### Results

|                 |               |       |
|-----------------|---------------|-------|
| Top Width       | 6.57          | ft    |
| Normal Depth    | 0.27          | ft    |
| Critical Depth  | 0.28          | ft    |
| Critical Slope  | 0.00815       | ft/ft |
| Velocity        | 1.76          | ft/s  |
| Velocity Head   | 0.05          | ft    |
| Specific Energy | 0.32          | ft    |
| Froude Number   | 1.06          |       |
| Flow Type       | Supercritical |       |

### GVF Input Data

|                  |      |    |
|------------------|------|----|
| Downstream Depth | 0.00 | ft |
| Length           | 0.00 | ft |
| Number Of Steps  | 0    |    |

### GVF Output Data

|                     |          |       |
|---------------------|----------|-------|
| Upstream Depth      | 0.00     | ft    |
| Profile Description |          |       |
| Profile Headloss    | 0.00     | ft    |
| Downstream Velocity | Infinity | ft/s  |
| Upstream Velocity   | Infinity | ft/s  |
| Normal Depth        | 0.27     | ft    |
| Critical Depth      | 0.28     | ft    |
| Channel Slope       | 0.00920  | ft/ft |
| Critical Slope      | 0.00815  | ft/ft |

---

## Cross Section for 10 Yr Rainbow (Section 2)

---

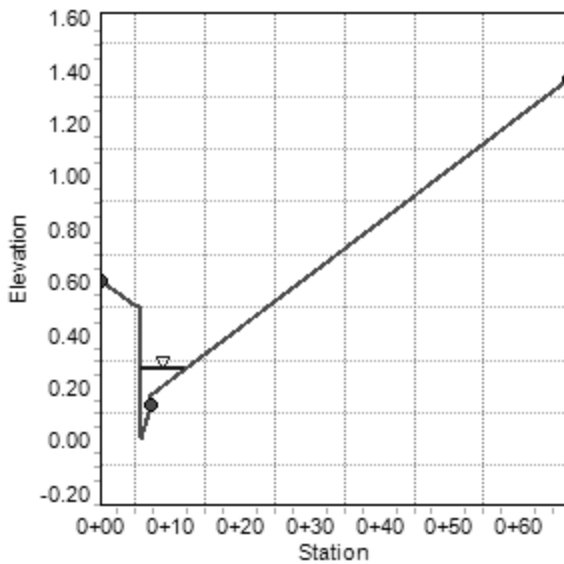
### Project Description

|                 |                 |
|-----------------|-----------------|
| Friction Method | Manning Formula |
| Solve For       | Normal Depth    |

### Input Data

|               |         |                    |
|---------------|---------|--------------------|
| Channel Slope | 0.00920 | ft/ft              |
| Normal Depth  | 0.27    | ft                 |
| Discharge     | 1.00    | ft <sup>3</sup> /s |

### Cross Section Image



## Worksheet for 100 Yr Rainbow (Section 2)

### Project Description

Friction Method                      Manning Formula  
Solve For                              Normal Depth

### Input Data

Channel Slope                                              0.00920    ft/ft  
Discharge                                                      2.00    ft<sup>3</sup>/s  
Section Definitions

| Station (ft) | Elevation (ft) |
|--------------|----------------|
| 0+00.00      | 0.60           |
| 0+05.00      | 0.50           |
| 0+05.50      | 0.50           |
| 0+05.50      | 0.00           |
| 0+07.00      | 0.13           |
| 0+07.00      | 0.17           |
| 0+67.00      | 1.37           |

### Roughness Segment Definitions

| Start Station   | Ending Station  | Roughness Coefficient |
|-----------------|-----------------|-----------------------|
| (0+00.00, 0.60) | (0+07.00, 0.13) | 0.013                 |
| (0+07.00, 0.13) | (0+67.00, 1.37) | 0.016                 |

### Options

Current Roughness Weighted Method              Pavlovskii's Method  
Open Channel Weighting Method                  Pavlovskii's Method  
Closed Channel Weighting Method                Pavlovskii's Method

### Results

Normal Depth                                              0.32    ft  
Elevation Range                                          0.00 to 1.37 ft  
Flow Area                                                      0.99    ft<sup>2</sup>  
Wetted Perimeter                                              9.61    ft  
Hydraulic Radius                                              0.10    ft

---

## Worksheet for 100 Yr Rainbow (Section 2)

---

### Results

|                 |               |       |
|-----------------|---------------|-------|
| Top Width       | 9.24          | ft    |
| Normal Depth    | 0.32          | ft    |
| Critical Depth  | 0.33          | ft    |
| Critical Slope  | 0.00766       | ft/ft |
| Velocity        | 2.02          | ft/s  |
| Velocity Head   | 0.06          | ft    |
| Specific Energy | 0.39          | ft    |
| Froude Number   | 1.09          |       |
| Flow Type       | Supercritical |       |

### GVF Input Data

|                  |      |    |
|------------------|------|----|
| Downstream Depth | 0.00 | ft |
| Length           | 0.00 | ft |
| Number Of Steps  | 0    |    |

### GVF Output Data

|                     |          |       |
|---------------------|----------|-------|
| Upstream Depth      | 0.00     | ft    |
| Profile Description |          |       |
| Profile Headloss    | 0.00     | ft    |
| Downstream Velocity | Infinity | ft/s  |
| Upstream Velocity   | Infinity | ft/s  |
| Normal Depth        | 0.32     | ft    |
| Critical Depth      | 0.33     | ft    |
| Channel Slope       | 0.00920  | ft/ft |
| Critical Slope      | 0.00766  | ft/ft |

## Cross Section for 100 Yr Rainbow (Section 2)

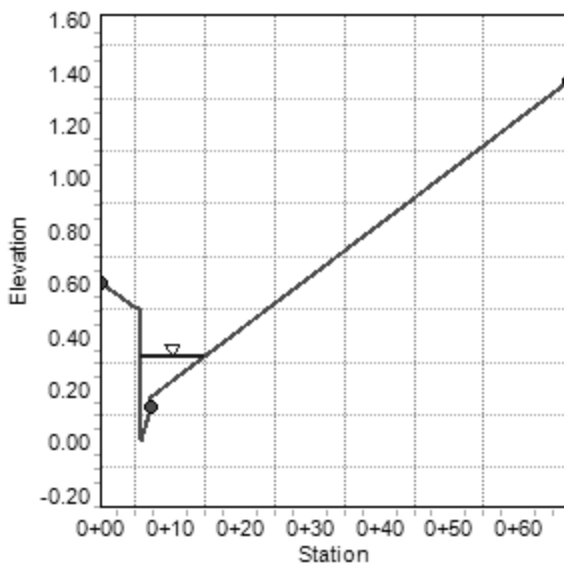
### Project Description

|                 |                 |
|-----------------|-----------------|
| Friction Method | Manning Formula |
| Solve For       | Normal Depth    |

### Input Data

|               |         |                    |
|---------------|---------|--------------------|
| Channel Slope | 0.00920 | ft/ft              |
| Normal Depth  | 0.32    | ft                 |
| Discharge     | 2.00    | ft <sup>3</sup> /s |

### Cross Section Image



## Project Description

## Input Data

Options

## Results

4/13/2017 4:08:53 AM 27 Siemens Company Drive Suite 200 W Watertown, CT 06795 USA +1-203-755-1666 Page 1 of 2

---

## Worksheet for 10 Yr Ann (Section 3)

---

### Results

|                 |             |       |
|-----------------|-------------|-------|
| Top Width       | 10.36       | ft    |
| Normal Depth    | 0.35        | ft    |
| Critical Depth  | 0.33        | ft    |
| Critical Slope  | 0.00771     | ft/ft |
| Velocity        | 1.65        | ft/s  |
| Velocity Head   | 0.04        | ft    |
| Specific Energy | 0.39        | ft    |
| Froude Number   | 0.85        |       |
| Flow Type       | Subcritical |       |

### GVF Input Data

|                  |      |    |
|------------------|------|----|
| Downstream Depth | 0.00 | ft |
| Length           | 0.00 | ft |
| Number Of Steps  | 0    |    |

### GVF Output Data

|                     |          |       |
|---------------------|----------|-------|
| Upstream Depth      | 0.00     | ft    |
| Profile Description |          |       |
| Profile Headloss    | 0.00     | ft    |
| Downstream Velocity | Infinity | ft/s  |
| Upstream Velocity   | Infinity | ft/s  |
| Normal Depth        | 0.35     | ft    |
| Critical Depth      | 0.33     | ft    |
| Channel Slope       | 0.00550  | ft/ft |
| Critical Slope      | 0.00771  | ft/ft |

## Cross Section for 10 Yr Ann (Section 3)

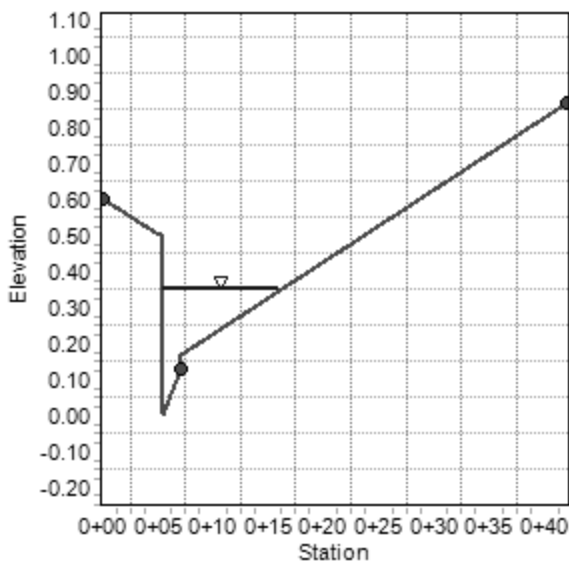
### Project Description

|                 |                 |
|-----------------|-----------------|
| Friction Method | Manning Formula |
| Solve For       | Normal Depth    |

### Input Data

|               |         |                    |
|---------------|---------|--------------------|
| Channel Slope | 0.00550 | ft/ft              |
| Normal Depth  | 0.35    | ft                 |
| Discharge     | 2.00    | ft <sup>3</sup> /s |

### Cross Section Image



## Worksheet for 100 Yr Ann (Section 3)

### Project Description

Friction Method                      Manning Formula  
Solve For                              Normal Depth

### Input Data

Channel Slope                                              0.00550    ft/ft  
Discharge                                                      3.00    ft<sup>3</sup>/s  
Section Definitions

| Station (ft) | Elevation (ft) |
|--------------|----------------|
| 0+00.00      | 0.60           |
| 0+05.00      | 0.50           |
| 0+05.50      | 0.50           |
| 0+05.50      | 0.00           |
| 0+07.00      | 0.13           |
| 0+07.00      | 0.17           |
| 0+42.00      | 0.87           |

### Roughness Segment Definitions

| Start Station   | Ending Station  | Roughness Coefficient |
|-----------------|-----------------|-----------------------|
| (0+00.00, 0.60) | (0+07.00, 0.13) | 0.013                 |
| (0+07.00, 0.13) | (0+42.00, 0.87) | 0.016                 |

### Options

Current Roughness Weighted Method              Pavlovskii's Method  
Open Channel Weighting Method                  Pavlovskii's Method  
Closed Channel Weighting Method                Pavlovskii's Method

### Results

Normal Depth                                              0.39    ft  
Elevation Range                                          0.00 to 0.87 ft  
Flow Area                                                      1.66    ft<sup>2</sup>  
Wetted Perimeter                                          12.78    ft  
Hydraulic Radius                                          0.13    ft

---

## Worksheet for 100 Yr Ann (Section 3)

---

### Results

|                 |             |       |
|-----------------|-------------|-------|
| Top Width       | 12.35       | ft    |
| Normal Depth    | 0.39        | ft    |
| Critical Depth  | 0.37        | ft    |
| Critical Slope  | 0.00738     | ft/ft |
| Velocity        | 1.81        | ft/s  |
| Velocity Head   | 0.05        | ft    |
| Specific Energy | 0.44        | ft    |
| Froude Number   | 0.87        |       |
| Flow Type       | Subcritical |       |

### GVF Input Data

|                  |      |    |
|------------------|------|----|
| Downstream Depth | 0.00 | ft |
| Length           | 0.00 | ft |
| Number Of Steps  | 0    |    |

### GVF Output Data

|                     |          |       |
|---------------------|----------|-------|
| Upstream Depth      | 0.00     | ft    |
| Profile Description |          |       |
| Profile Headloss    | 0.00     | ft    |
| Downstream Velocity | Infinity | ft/s  |
| Upstream Velocity   | Infinity | ft/s  |
| Normal Depth        | 0.39     | ft    |
| Critical Depth      | 0.37     | ft    |
| Channel Slope       | 0.00550  | ft/ft |
| Critical Slope      | 0.00738  | ft/ft |

## Cross Section for 100 Yr Ann (Section 3)

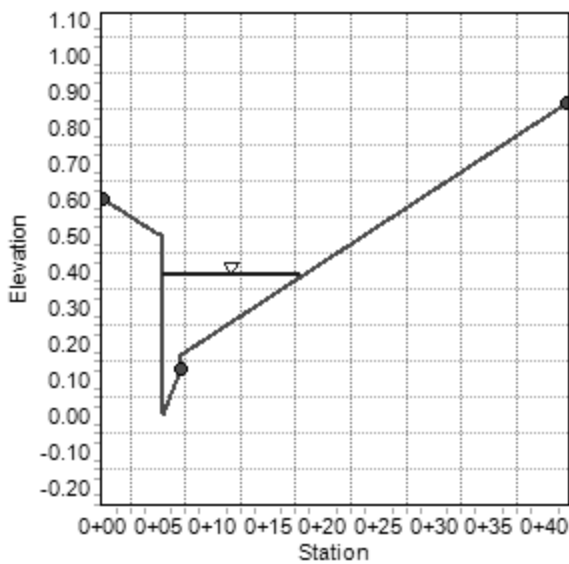
### Project Description

|                 |                 |
|-----------------|-----------------|
| Friction Method | Manning Formula |
| Solve For       | Normal Depth    |

### Input Data

|               |         |                    |
|---------------|---------|--------------------|
| Channel Slope | 0.00550 | ft/ft              |
| Normal Depth  | 0.39    | ft                 |
| Discharge     | 3.00    | ft <sup>3</sup> /s |

### Cross Section Image



## Worksheet for Existing DI in Rainbow

### Project Description

Solve For Efficiency

### Input Data

|                        |                    |                    |
|------------------------|--------------------|--------------------|
| Discharge              | 1.00               | ft <sup>3</sup> /s |
| Slope                  | 0.00830            | ft/ft              |
| Gutter Width           | 1.50               | ft                 |
| Gutter Cross Slope     | 0.02               | ft/ft              |
| Road Cross Slope       | 0.02               | ft/ft              |
| Roughness Coefficient  | 0.016              |                    |
| Local Depression       | 0.00               | in                 |
| Local Depression Width | 0.00               | ft                 |
| Grate Width            | 1.50               | ft                 |
| Grate Length           | 9.00               | ft                 |
| Grate Type             | P-50 mm (P-1-7/8") |                    |
| Clogging               | 50.00              | %                  |
| Curb Opening Length    | 9.00               | ft                 |

### Options

|                    |              |
|--------------------|--------------|
| Calculation Option | Use Both     |
| Grate Flow Option  | Exclude None |

### Results

|                           |         |                    |
|---------------------------|---------|--------------------|
| Efficiency                | 90.25   | %                  |
| Intercepted Flow          | 0.90    | ft <sup>3</sup> /s |
| Bypass Flow               | 0.10    | ft <sup>3</sup> /s |
| Spread                    | 7.46    | ft                 |
| Depth                     | 0.15    | ft                 |
| Flow Area                 | 0.56    | ft <sup>2</sup>    |
| Gutter Depression         | 0.00    | ft                 |
| Total Depression          | 0.00    | ft                 |
| Velocity                  | 1.79    | ft/s               |
| Splash Over Velocity      | 12.28   | ft/s               |
| Frontal Flow Factor       | 1.00    |                    |
| Side Flow Factor          | 0.60    |                    |
| Grate Flow Ratio          | 0.45    |                    |
| Equivalent Cross Slope    | 0.02000 | ft/ft              |
| Active Grate Length       | 4.50    | ft                 |
| Length Factor             | 0.25    |                    |
| Total Interception Length | 17.81   | ft                 |

## Cross Section for Existing DI in Rainbow

### Project Description

Solve For Efficiency

### Input Data

|                        |                    |                    |
|------------------------|--------------------|--------------------|
| Discharge              | 1.00               | ft <sup>3</sup> /s |
| Slope                  | 0.00830            | ft/ft              |
| Gutter Width           | 1.50               | ft                 |
| Gutter Cross Slope     | 0.02               | ft/ft              |
| Road Cross Slope       | 0.02               | ft/ft              |
| Roughness Coefficient  | 0.016              |                    |
| Local Depression       | 0.00               | in                 |
| Local Depression Width | 0.00               | ft                 |
| Efficiency             | 90.25              | %                  |
| Grate Width            | 1.50               | ft                 |
| Grate Length           | 9.00               | ft                 |
| Grate Type             | P-50 mm (P-1-7/8") |                    |
| Clogging               | 50.00              | %                  |
| Curb Opening Length    | 9.00               | ft                 |

### Cross Section Image



V: 1  
H: 1

## Worksheet for BMP Swale for DEV2

### Project Description

|                 |                 |
|-----------------|-----------------|
| Friction Method | Manning Formula |
| Solve For       | Normal Depth    |

### Input Data

|                       |         |                    |
|-----------------------|---------|--------------------|
| Roughness Coefficient | 0.035   |                    |
| Channel Slope         | 0.00500 | ft/ft              |
| Left Side Slope       | 4.00    | ft/ft (H:V)        |
| Right Side Slope      | 4.00    | ft/ft (H:V)        |
| Discharge             | 5.00    | ft <sup>3</sup> /s |

### Results

|                  |             |                 |
|------------------|-------------|-----------------|
| Normal Depth     | 0.86        | ft              |
| Flow Area        | 2.98        | ft <sup>2</sup> |
| Wetted Perimeter | 7.11        | ft              |
| Hydraulic Radius | 0.42        | ft              |
| Top Width        | 6.90        | ft              |
| Critical Depth   | 0.63        | ft              |
| Critical Slope   | 0.02735     | ft/ft           |
| Velocity         | 1.68        | ft/s            |
| Velocity Head    | 0.04        | ft              |
| Specific Energy  | 0.91        | ft              |
| Froude Number    | 0.45        |                 |
| Flow Type        | Subcritical |                 |

### GVF Input Data

|                  |      |    |
|------------------|------|----|
| Downstream Depth | 0.00 | ft |
| Length           | 0.00 | ft |
| Number Of Steps  | 0    |    |

### GVF Output Data

|                     |          |       |
|---------------------|----------|-------|
| Upstream Depth      | 0.00     | ft    |
| Profile Description |          |       |
| Profile Headloss    | 0.00     | ft    |
| Downstream Velocity | Infinity | ft/s  |
| Upstream Velocity   | Infinity | ft/s  |
| Normal Depth        | 0.86     | ft    |
| Critical Depth      | 0.63     | ft    |
| Channel Slope       | 0.00500  | ft/ft |
| Critical Slope      | 0.02735  | ft/ft |

# Cross Section for BMP Swale for DEV2

## Project Description

|                 |                 |
|-----------------|-----------------|
| Friction Method | Manning Formula |
| Solve For       | Normal Depth    |

## Input Data

|                       |         |             |
|-----------------------|---------|-------------|
| Roughness Coefficient | 0.035   |             |
| Channel Slope         | 0.00500 | ft/ft       |
| Normal Depth          | 0.86    | ft          |
| Left Side Slope       | 4.00    | ft/ft (H:V) |
| Right Side Slope      | 4.00    | ft/ft (H:V) |
| Discharge             | 5.00    | ft³/s       |

## Cross Section Image



V: 1  
H: 1

---

## Worksheet for Proposed Block Wall Openings

---

### Project Description

Solve For                      Headwater Elevation

### Input Data

|                  |      |                    |
|------------------|------|--------------------|
| Discharge        | 1.00 | ft <sup>3</sup> /s |
| Crest Elevation  | 0.00 | ft                 |
| Weir Coefficient | 3.00 | US                 |
| Crest Length     | 4.00 | ft                 |

### Results

|                              |      |                 |
|------------------------------|------|-----------------|
| Headwater Elevation          | 0.19 | ft              |
| Headwater Height Above Crest | 0.19 | ft              |
| Flow Area                    | 0.76 | ft <sup>2</sup> |
| Velocity                     | 1.31 | ft/s            |
| Wetted Perimeter             | 4.38 | ft              |
| Top Width                    | 4.00 | ft              |

Cross Section for Proposed Block Wall Openings

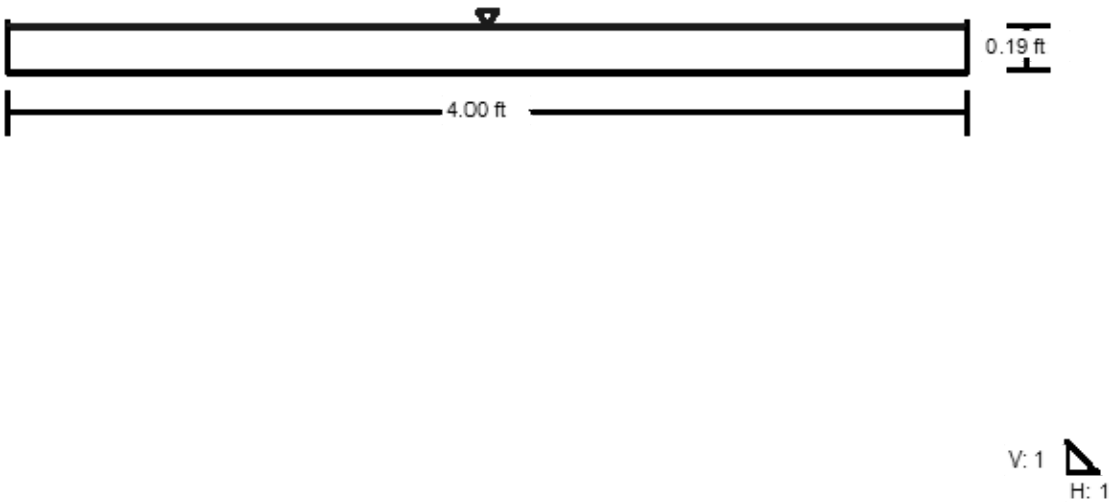
Project Description

Solve For Headwater Elevation

Input Data

|                     |      |                    |
|---------------------|------|--------------------|
| Discharge           | 1.00 | ft <sup>3</sup> /s |
| Headwater Elevation | 0.19 | ft                 |
| Crest Elevation     | 0.00 | ft                 |
| Weir Coefficient    | 3.00 | US                 |
| Crest Length        | 4.00 | ft                 |

Cross Section Image



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## Worksheet for Existing Drainage Easement

---

### Project Description

Solve For                      Headwater Elevation

### Input Data

|                  |       |                    |
|------------------|-------|--------------------|
| Discharge        | 5.00  | ft <sup>3</sup> /s |
| Crest Elevation  | 0.00  | ft                 |
| Weir Coefficient | 3.00  | US                 |
| Crest Length     | 10.00 | ft                 |

### Results

|                              |       |                 |
|------------------------------|-------|-----------------|
| Headwater Elevation          | 0.30  | ft              |
| Headwater Height Above Crest | 0.30  | ft              |
| Flow Area                    | 3.03  | ft <sup>2</sup> |
| Velocity                     | 1.65  | ft/s            |
| Wetted Perimeter             | 10.61 | ft              |
| Top Width                    | 10.00 | ft              |

Cross Section for Existing Drainage Easement

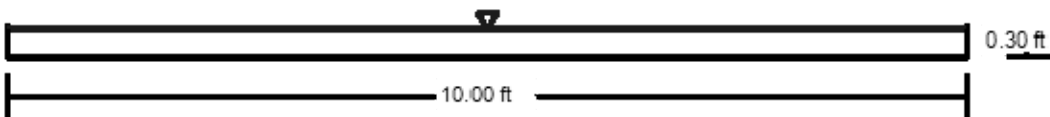
Project Description

Solve For Headwater Elevation

Input Data

|                     |       |                    |
|---------------------|-------|--------------------|
| Discharge           | 5.00  | ft <sup>3</sup> /s |
| Headwater Elevation | 0.30  | ft                 |
| Crest Elevation     | 0.00  | ft                 |
| Weir Coefficient    | 3.00  | US                 |
| Crest Length        | 10.00 | ft                 |

Cross Section Image



V: 1  
H: 1



**McCay  
ENGINEERING**

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## **APPENDIX F**

EXCERPTS FROM  
TECHNICAL DRAINAGE STUDY  
FOR ANN 17  
(PREPARED BY GC WALLACE)

|                                                                               |                                                                                |                                                                                                   |    |
|-------------------------------------------------------------------------------|--------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|----|
| <b>CITY OF LAS VEGAS</b>                                                      |                                                                                | <b>DATE:</b>                                                                                      |    |
| <b>INTER-OFFICE MEMORANDUM</b>                                                |                                                                                | February 16, 2007                                                                                 |    |
| <b>TO:</b><br>Land Development Services<br>Department of Public Works         |                                                                                | <b>FROM:</b><br>Albert Sung, P.E.<br>Flood Control Project Engineer<br>Department of Public Works |    |
| <b>SUBJECT:</b><br>Technical Drainage Study for:<br><b>Ann 17 – Update #2</b> |                                                                                | <b>COPIES TO:</b><br>G. C. Wallace                                                                |    |
| <b>Cross Streets:</b>                                                         | SEC of Ann Road & Rainbow Boulevard                                            | Pulte Homes, Inc.                                                                                 |    |
| <b>File Number:</b>                                                           | F:\Depot\DSMEMOS\DS3960F.doc                                                   | Bart Anderson, P.E., DevCo                                                                        |    |
| <b>Parcel Number:</b>                                                         | 125-35-101-003, 125-35-101-004, 125-35-101-005, 125-35-101-006, 125-35-101-008 | CCRFC                                                                                             |    |
| <b>Zoning Action:</b>                                                         | TMP-11690, VAC-9540, GPA-9144, ZON-9141, SDR-9142, VAR 9143                    | CCDDS                                                                                             |    |
| <b>FEMA Flood Zone</b>                                                        | YES                                                                            | NO                                                                                                | X  |
| <b>Proposed Storm Drain</b>                                                   | YES                                                                            | X                                                                                                 | NO |

| HISTORY                    | DATE RECEIVED | DATE REVIEWED | COMMENTS             | REVIEW FEES       | FEES PAID Trn. No. |
|----------------------------|---------------|---------------|----------------------|-------------------|--------------------|
| 1 <sup>st</sup> Submittal  | 2/24/2006     | 3/14/2006     | Not Approved         | \$400.00          | 39380: \$400       |
| 2 <sup>nd</sup> Submittal  | 4/18/2006     | 5/2/2006      | Not Approved         | \$400.00          | 43609: \$400       |
| 3 <sup>rd</sup> Submittal  | 5/18/2006     | 6/1/2006      | Conditional Approval | \$400.00          | Paid: \$400        |
| CCDDS & CCRFC              | 7/7/2006      | 7/10/2006     | Concurrence          | N/C               | N/C                |
| 4 <sup>th</sup> Submittal  | 12/13/2006    | 12/28/2006    | Approved             | \$100.00          | 59445: \$100       |
| 5 <sup>th</sup> Submittal  | 2/7/2007      | 2/16/2007     | See Comments Below   | \$100.00          | 62697: \$100       |
| <b>TOTAL FEES (LDDRS):</b> |               |               |                      | <b>\$1,400.00</b> | ----               |

**REMARKS:**

**5<sup>th</sup> Submittal: Update #2 to revise the cross section of Section 8/D-1 from full concrete to a combination of 3'-valley gutter and riprap**

The Drainage Study for the subject project has been reviewed and:

|   |                                                                                                |
|---|------------------------------------------------------------------------------------------------|
| X | is approved subject to conformance to all City standards and the following conditions:         |
|   | must be resubmitted or supplemented including the following:                                   |
|   | is conditionally approved subject to Clark County Regional Flood Control District concurrence. |
|   | must have Clark County Department of Development Services concurrence                          |

1. Provide a layer of geotextile filter fabric beneath the riprap in Section 8/D-1.

**NOTE:** Any future changes to the proposed design (or design assumptions) as outlined in the approved drainage study and attached preliminary grading plan which affect drainage must be addressed in a Drainage Study Amendment and accepted by the *City of Las Vegas Flood Control Section*. Additionally, conditional acceptance of a drainage study is valid for a period of one (1) year. If the proposed construction has not been completed in that time period, the *City of Las Vegas* reserves the right to require additional conditions and/or submission and acceptance of a complete drainage study update prior to further construction of a project.

```

1*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1)
* JUN 1998
* VERSION 4.1
*
* RUN DATE 10FEB06 TIME 11:24:51
*
*****

```

```

*****
*
* U.S. ARMY CORPS OF ENGINEERS
* HYDROLOGIC ENGINEERING CENTER
* 609 SECOND STREET
* DAVIS, CALIFORNIA 95616
* (916) 756-1104
*
*****

```

```

X X XXXXXXX XXXXX X
X X X X X XX
X X X X X X
XXXXXXX XXXX X XXXXX X
X X X X X X
X X X X X X
X X XXXXXXX XXXXX XXX

```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE. THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE, SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY, DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1

# HEC-1 INPUT

PAGE 1

LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

```

*DIAGRAM
ID HEC-1 MODEL FOR ANN 17 PROJECT
ID EXISTING CONDITIONS
ID INPUT FILE = EXIST.H1
ID INPUT FILE DATE = 2/7/06
ID DESIGN STORM = 100-YEAR 6-HOUR STORM
ID STORM DISTRIBUTION = SDN3
ID
ID
ID
IT 5 0 0 300
IO 5 0 0
IN 5 0 0
JR PREC 1.0 0.57
*
13 KK OF-1
14 KM RUNOFF FROM SUBBASIN OF-1
15 BA .00280
16 PB 2.77
17 PC 0.000 0.020 0.057 0.070 0.087 0.108 0.124 0.130 0.130 0.130
18 PC 0.130 0.130 0.130 0.133 0.140 0.142 0.148 0.158 0.172 0.181
19 PC 0.190 0.197 0.199 0.200 0.201 0.204 0.214 0.229 0.241 0.249
20 PC 0.251 0.256 0.270 0.278 0.281 0.283 0.295 0.322 0.352 0.409
21 PC 0.499 0.590 0.710 0.744 0.781 0.812 0.819 0.835 0.851 0.856
22 PC 0.860 0.868 0.876 0.888 0.910 0.926 0.937 0.950 0.970 0.976
23 PC 0.982 0.985 0.987 0.989 0.990 0.993 0.993 0.994 0.995 0.998
24 PC 0.998 0.999 1.000
25 LS 0 85
26 UD .100
*
27 KK RTOF-1
28 KM MUSKINGUM CUNGE ROUTING OF-1 TO CP1
29 KM LEN SLOPE N N/A SHAPE BW SS
30 RD 1160 .005 0.025 0 TRAP 10 3
*
31 KK ON-1
32 KM RUNOFF FROM ON1
33 BA .0112
34 LS 0 85
35 UD .176
*
36 KK CP1
37 KM COMBINE SUBBASINS OF-1 & ON-1
38 HC 2
*
39 KK ON-4
40 KM RUNOFF FROM ON-4
41 BA .0012
42 LS 0 98
43 UD .107
*

```

1

# HEC-1 INPUT

PAGE 2

LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

44 KK CP2  
45 KM COMBINE SUBBASINS CP1 & ON-4  
46 HC 2  
\*

47 KK OF-2  
48 KM RUNOFF FROM SUBBASIN OF-2  
49 BA .0032  
50 LS 0 85  
51 UD .087  
\*

52 KK RTOF-2  
53 KM MUSKINGUM CUNGE ROUTING OF-2 TO CP3  
54 KM LEN SLOPE N N/A SHAPE BW SS  
55 RD 950 .005 0.025 0 TRAP 10 3  
\*

56 KK ON-2  
57 KM RUNOFF FROM ON-2  
58 BA .0115  
59 LS 0 85  
60 UD .178  
\*

61 KK CP3  
62 KM COMBINE SUBBASINS OF-2 & ON-2  
63 HC 2  
\*

64 KK ON-3  
65 KM RUNOFF FROM ON-3  
66 BA .0055  
67 LS 0 85  
68 UD .152  
\*  
69 KM RUNOFF FROM ON-3 NOT ROUTED DUE TO SMALL DISTANCE  
\*

70 KK ON-5  
71 KM RUNOFF FROM ON-5  
72 BA .0008  
73 LS 0 98  
74 UD .072  
\*

75 KK CP4  
76 KM COMBINE SUBBASINS ON-5 & ON-3  
77 HC 2  
\*

1 HEC-1 INPUT PAGE 3

LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

78 KK CP5  
79 KM COMBINE CP2, CP3 & C4  
80 HC 3  
\*

81 KK OF-3  
82 KM RUNOFF FROM OF-3  
83 BA .0072  
84 LS 0 85  
85 UD .133  
\*

86 ZZ

1 SCHEMATIC DIAGRAM OF STREAM NETWORK

INPUT  
LINE (V) ROUTING (--->) DIVERSION OR PUMP FLOW  
NO. (.) CONNECTOR (<---) RETURN OF DIVERTED OR PUMPED FLOW

13 OF-1  
V  
V  
27 RTOF-1  
.  
31 ON-1  
.  
36 CP1.....  
.  
39 ON-4  
.  
44 CP2.....  
.  
.

```

47      .      OF-2
      .      V
      .      V
52      .      RTOF-2
      .      .
      .      .
56      .      .      ON-2
      .      .      .
      .      .      .
61      .      CP3.....
      .      .      .
      .      .      .
64      .      .      ON-3
      .      .      .
      .      .      .
70      .      .      .      ON-5
      .      .      .      .
      .      .      .      .
75      .      .      CP4.....
      .      .      .
      .      .      .
78      .      CP5.....
      .      .
      .      .
81      .      OF-3

```

(\*\*\*) RUNOFF ALSO COMPUTED AT THIS LOCATION

```

1*****
* FLOOD HYDROGRAPH PACKAGE (HEC-1) *
* JUN 1998 *
* VERSION 4.1 *
* RUN DATE 10FEB06 TIME 11:24:51 *
*****

```

```

*****
* U.S. ARMY CORPS OF ENGINEERS *
* HYDROLOGIC ENGINEERING CENTER *
* 609 SECOND STREET *
* DAVIS, CALIFORNIA 95616 *
* (916) 756-1104 *
*****

```

HEC-1 MODEL FOR ANN 17 PROJECT  
 EXISTING CONDITIONS  
 INPUT FILE = EXIST.H1  
 INPUT FILE DATE = 2/7/06  
 DESIGN STORM = 100-YEAR 6-HOUR STORM  
 STORM DISTRIBUTION = SDN3

```

10 IO      OUTPUT CONTROL VARIABLES
          IPRNT      5  PRINT CONTROL
          IPLOT      0  PLOT CONTROL
          QSCAL      0.  HYDROGRAPH PLOT SCALE

IT         HYDROGRAPH TIME DATA
          NMIN      5  MINUTES IN COMPUTATION INTERVAL
          IDATE      1  0  STARTING DATE
          ITIME      0000  STARTING TIME
          NQ        300  NUMBER OF HYDROGRAPH ORDINATES
          NDDATE     2  0  ENDING DATE
          NDTIME     0055  ENDING TIME
          ICENT      19  CENTURY MARK

          COMPUTATION INTERVAL      .08 HOURS
          TOTAL TIME BASE      24.92 HOURS

ENGLISH UNITS
DRAINAGE AREA      SQUARE MILES
PRECIPITATION DEPTH  INCHES
LENGTH, ELEVATION  FEET
FLOW               CUBIC FEET PER SECOND
STORAGE VOLUME     ACRE-FEET
SURFACE AREA       ACRES
TEMPERATURE        DEGREES FAHRENHEIT

JP         MULTI-PLAN OPTION
          NPLAN      1  NUMBER OF PLANS

JR         MULTI-RATIO OPTION
          RATIOS OF PRECIPITATION
          1.00      .57

```

1

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS  
 FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES  
 TIME TO PEAK IN HOURS

| OPERATION     | STATION | AREA | PLAN   | RATIOS APPLIED TO PRECIPITATION |         |
|---------------|---------|------|--------|---------------------------------|---------|
|               |         |      |        | RATIO 1                         | RATIO 2 |
|               |         |      |        | 1.00                            | .57     |
| HYDROGRAPH AT | OF-1    | .00  | 1 FLOW | 4.                              | 1.      |

|               |        |     |   | TIME         | 3.50        | 3.58        |
|---------------|--------|-----|---|--------------|-------------|-------------|
| ROUTED TO     |        |     |   |              |             |             |
| +             | RTOF-1 | .00 | 1 | FLOW<br>TIME | 4.<br>3.67  | 1.<br>3.75  |
| HYDROGRAPH AT |        |     |   |              |             |             |
| +             | ON-1   | .01 | 1 | FLOW<br>TIME | 13.<br>3.58 | 4.<br>3.58  |
| 2 COMBINED AT |        |     |   |              |             |             |
| +             | CP1    | .01 | 1 | FLOW<br>TIME | 15.<br>3.58 | 5.<br>3.67  |
| HYDROGRAPH AT |        |     |   |              |             |             |
| +             | ON-4   | .00 | 1 | FLOW<br>TIME | 2.<br>3.50  | 1.<br>3.50  |
| 2 COMBINED AT |        |     |   |              |             |             |
| +             | CP2    | .02 | 1 | FLOW<br>TIME | 18.<br>3.58 | 6.<br>3.67  |
| HYDROGRAPH AT |        |     |   |              |             |             |
| +             | OF-2   | .00 | 1 | FLOW<br>TIME | 4.<br>3.50  | 2.<br>3.50  |
| ROUTED TO     |        |     |   |              |             |             |
| +             | RTOF-2 | .00 | 1 | FLOW<br>TIME | 4.<br>3.67  | 2.<br>3.67  |
| HYDROGRAPH AT |        |     |   |              |             |             |
| +             | ON-2   | .01 | 1 | FLOW<br>TIME | 13.<br>3.58 | 5.<br>3.58  |
| 2 COMBINED AT |        |     |   |              |             |             |
| +             | CP3    | .01 | 1 | FLOW<br>TIME | 17.<br>3.58 | 6.<br>3.67  |
| HYDROGRAPH AT |        |     |   |              |             |             |
| +             | ON-3   | .01 | 1 | FLOW<br>TIME | 7.<br>3.58  | 2.<br>3.58  |
| HYDROGRAPH AT |        |     |   |              |             |             |
| +             | ON-5   | .00 | 1 | FLOW<br>TIME | 2.<br>3.50  | 1.<br>3.50  |
| 2 COMBINED AT |        |     |   |              |             |             |
| +             | CP4    | .01 | 1 | FLOW<br>TIME | 8.<br>3.58  | 3.<br>3.58  |
| 3 COMBINED AT |        |     |   |              |             |             |
| +             | CP5    | .04 | 1 | FLOW<br>TIME | 42.<br>3.58 | 15.<br>3.58 |
| HYDROGRAPH AT |        |     |   |              |             |             |
| +             | OF-3   | .01 | 1 | FLOW<br>TIME | 9.<br>3.58  | 3.<br>3.58  |

1

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING  
(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

| ISTAQ                                                                                                                            | ELEMENT | DT    | PEAK  | TIME TO<br>PEAK | VOLUME | DT    | INTERPOLATED TO<br>COMPUTATION INTERVAL |                 |        |
|----------------------------------------------------------------------------------------------------------------------------------|---------|-------|-------|-----------------|--------|-------|-----------------------------------------|-----------------|--------|
|                                                                                                                                  |         |       |       |                 |        |       | PEAK                                    | TIME TO<br>PEAK | VOLUME |
|                                                                                                                                  |         | (MIN) | (CFS) | (MIN)           | (IN)   | (MIN) | (CFS)                                   | (MIN)           | (IN)   |
| FOR PLAN = 1 RATIO= .00                                                                                                          |         |       |       |                 |        |       |                                         |                 |        |
| RTOF-1                                                                                                                           | MANE    | 5.00  | 3.55  | 220.00          | 1.40   | 5.00  | 3.55                                    | 220.00          | 1.40   |
| CONTINUITY SUMMARY (AC-FT) - INFLOW= .2086E+00 EXCESS= .0000E+00 OUTFLOW= .2088E+00 BASIN STORAGE= .1266E-02 PERCENT ERROR= -.7  |         |       |       |                 |        |       |                                         |                 |        |
| FOR PLAN = 1 RATIO= .00                                                                                                          |         |       |       |                 |        |       |                                         |                 |        |
| RTOF-1                                                                                                                           | MANE    | 3.25  | 1.29  | 224.25          | .50    | 5.00  | 1.28                                    | 225.00          | .50    |
| CONTINUITY SUMMARY (AC-FT) - INFLOW= .7501E-01 EXCESS= .0000E+00 OUTFLOW= .7500E-01 BASIN STORAGE= .1051E-02 PERCENT ERROR= -1.4 |         |       |       |                 |        |       |                                         |                 |        |
| FOR PLAN = 1 RATIO= .00                                                                                                          |         |       |       |                 |        |       |                                         |                 |        |
| RTOF-2                                                                                                                           | MANE    | 5.00  | 4.15  | 220.00          | 1.40   | 5.00  | 4.15                                    | 220.00          | 1.40   |
| CONTINUITY SUMMARY (AC-FT) - INFLOW= .2384E+00 EXCESS= .0000E+00 OUTFLOW= .2386E+00 BASIN STORAGE= .9388E-03 PERCENT ERROR= -.5  |         |       |       |                 |        |       |                                         |                 |        |
| FOR PLAN = 1 RATIO= .00                                                                                                          |         |       |       |                 |        |       |                                         |                 |        |
| RTOF-2                                                                                                                           | MANE    | 2.75  | 1.52  | 222.75          | .50    | 5.00  | 1.52                                    | 220.00          | .50    |
| CONTINUITY SUMMARY (AC-FT) - INFLOW= .8572E-01 EXCESS= .0000E+00 OUTFLOW= .8564E-01 BASIN STORAGE= .7720E-03 PERCENT ERROR= -.8  |         |       |       |                 |        |       |                                         |                 |        |

```

*****
* FLOOD HYDROGRAPH PACKAGE (HEC-1)
* JUN 1998
* VERSION 4.1
* RUN DATE 06APR06 TIME 16:32:54
*****

```

```

*****
* U.S. ARMY CORPS OF ENGINEERS
* HYDROLOGIC ENGINEERING CENTER
* 609 SECOND STREET
* DAVIS, CALIFORNIA 95616
* (916) 756-1104
*****

```

```

X X XXXXXXX XXXXX X
X X X X XX
X X X X X
XXXXXX XXXX X XXXXX X
X X X X X
X X X X X
X X XXXXXXX XXXXX XXX

```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE. THE DEFINITION OF -AMSK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION. NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE, SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY, DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL, LOSS RATE:GREEN AND AMPT INFILTRATION, KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1

# HEC-1 INPUT

PAGE 1

```

LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
*DIAGRAM
1 ID *****
2 ID *
3 ID *
4 ID *
5 ID *
6 ID * ANN 17 PROJECT
7 ID * DRAINAGE MODEL
8 ID * PROPOSED CONDITIONS
9 ID *
10 ID * RETURN PERIOD_ _ _ 100-YR & 10-YR
11 ID * DISTRIBUTION_ _ _ 6-HOUR SDN3
12 ID * PROJECT NO_ _ _ 764.100.100
13 ID * FILENAME_ _ _ PROP.h1
14 ID * DATE MODELED_ _ _ 4/6/06
15 ID * MODELED BY_ _ _ CR
16 ID *
17 ID *
18 ID *
19 ID *****
20 ID
21 IT 5 0 0 300
22 IO 5
23 IN 5 0 0
24 JR PREC 1 0.57
25 KK OF-1
26 KM FLOW FROM SUBBASIN OF-1
27 KM AREA 1.98 ACRES
28 BA .0031
29 PB 2.77
30 PC .000 .020 .057 .070 .087 .108 .124 .130 .130 .130
31 PC .130 .130 .130 .133 .140 .142 .148 .158 .172 .181
32 PC .190 .197 .199 .200 .201 .204 .214 .229 .241 .249
33 PC .251 .256 .270 .278 .281 .283 .295 .322 .352 .409
34 PC .499 .590 .710 .744 .781 .812 .819 .835 .851 .856
35 PC .860 .868 .876 .888 .910 .926 .937 .950 .970 .976
36 PC .982 .985 .987 .989 .990 .993 .993 .994 .995 .998
37 PC .998 .999 1.00
38 LS 0 90
39 UD .075
*
40 KK RTOF-1
41 KM MUSKINGUM CUNGE ROUTING OF-1 THRU ON-1 TO CP1
42 KM LEN SLOPE N N/A SHAPE BW SS
43 RD 800 .003 0.016 0 TRAP 0 50
*
44 KK OF-2A
45 KM RUNOFF FROM SUBBASIN OF-2A
46 KM AREA 0.73 ACRES
47 BA .0011
48 LS 0 90
49 UD .075
*

```

1

# HEC-1 INPUT

PAGE 2

```

LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
50 KK RTOF2A
51 KM MUSKINGUM CUNGE ROUTING OF-2A TO CP1
52 KM LEN SLOPE N N/A SHAPE BW SS
53 RD 540 .003 0.016 0 TRAP 0 50
*
54 KK OF-2B
55 KM RUNOFF FROM SUBBASIN OF-2B
56 KM AREA 1.02 ACRES

```

57 BA .0016  
 58 LS 0 90  
 59 UD .075  
 \*  
 60 KK RTOF2B  
 61 KM MUSKINGUM CUNGE ROUTING OF-2B TO CP1  
 62 KM LEN SLOPE N N/A SHAPE BW SS  
 63 RD 320 .004 0.025 0 TRAP 10 5 3  
 \*  
 64 KK ON-1  
 65 KM RUNOFF FROM SUBBASIN ON-1  
 66 KM AREA 4.4 ACRES  
 67 BA .0069  
 68 LS 0 90  
 69 UD .124  
 \*  
 70 KK CP1  
 71 KM COMBINE OF1, OF2A, OF2B AND ON-1  
 72 HC 4  
 \*  
 73 KK RT CP1  
 74 KM MUSKINGUM CUNGE ROUTING CP1 TO CP2  
 75 KM LEN SLOPE N N/A SHAPE BW SS  
 76 RD 425 .004 0.016 0 TRAP 0 50  
 \*  
 77 KK ON-3  
 78 KM RUNOFF FROM SUBBASIN ON-3  
 79 KM AREA 1.52 ACRES  
 80 BA .0024  
 81 LS 0 90  
 82 UD .083  
 \*  
 83 KK ON-4  
 84 KM RUNOFF FROM SUBBASIN ON-4  
 85 KM AREA 3.13 ACRES  
 86 BA .0049  
 87 LS 0 90  
 88 UD .141  
 \*

1

HEC-1 INPUT

PAGE 3

LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10  
 89 KK CP2  
 90 KM COMBINE ON-3, ON-4 & CP1  
 91 HC 3  
 \*  
 92 KK ON-2  
 93 KM RUNOFF FROM SUBBASIN ON-2  
 94 KM AREA 6.14 ACRES  
 95 BA .0095  
 96 LS 0 90  
 97 UD .143  
 \*  
 98 KK ON-5  
 99 KM RUNOFF FROM SUBBASIN ON-5  
 100 KM AREA 2.79 ACRES  
 101 BA .0044  
 102 LS 0 90  
 103 UD .093  
 \*  
 104 KK CP3  
 105 KM COMBINE ON-2, ON-5 & CP2  
 106 HC 3  
 \*  
 107 KK ON-6  
 108 KM RUNOFF FROM SUBBASIN ON-6  
 109 KM AREA 0.77 ACRES  
 110 BA .0012  
 111 LS 0 98  
 112 UD .107  
 \*  
 113 KK ON-7  
 114 KM RUNOFF FROM SUBBASIN ON-7  
 115 KM AREA 0.48 ACRES  
 116 BA .0008  
 117 LS 0 98  
 118 UD .072  
 \*  
 119 KK CP4  
 120 KM COMBINE ON-6, ON-7 AND CP3  
 121 HC 3  
 \*  
 122 KK ON-8  
 123 KM RUNOFF FROM SUBBASIN ON-8  
 124 KM AREA 0.51 ACRES  
 125 BA .0002  
 126 LS 0 98  
 127 UD .050  
 \*

1

HEC-1 INPUT

PAGE 4

LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

128 KK OF-3  
 129 KM RUNOFF FROM SUBBASIN OF-3  
 130 KM AREA 4.58 ACRES  
 131 BA .0072  
 132 LS 0 90  
 133 UD .121  
 134 ZZ

1

SCHEMATIC DIAGRAM OF STREAM NETWORK

INPUT LINE (V) ROUTING (--->) DIVERSION OR PUMP FLOW  
 NO. (.) CONNECTOR (<---) RETURN OF DIVERTED OR PUMPED FLOW

```

  25 OF-1
    V
  40 RTOF-1
    V
  44 OF-2A
    V
  50 RTOF2A
    V
  54 OF-2B
    V
  60 RTOF2B
    V
  64 ON-1
    V
  70 CP1
    V
  73 RT CP1
    V
  77 ON-3
    V
  83 ON-4
    V
  89 CP2
    V
  92 ON-2
    V
  98 ON-5
    V
  104 CP3
    V
  107 ON-6
    V
  113 ON-7
    V
  119 CP4
    V
  122 ON-8
    V
  128 OF-3
  
```

(\*\*\*) RUNOFF ALSO COMPUTED AT THIS LOCATION

\*\*\*\*\*  
 \* FLOOD HYDROGRAPH PACKAGE (HEC-1) \*  
 \* JUN 1998 \*  
 \* VERSION 4.1 \*  
 \* RUN DATE 06APR06 TIME 16:32:54 \*  
 \*\*\*\*\*

\*\*\*\*\*  
 \* U.S. ARMY CORPS OF ENGINEERS \*  
 \* HYDROLOGIC ENGINEERING CENTER \*  
 \* 609 SECOND STREET \*  
 \* DAVIS, CALIFORNIA 95616 \*  
 \* (916) 756-1104 \*  
 \*\*\*\*\*

\*\*\*\*\*  
 \* ANN 17 PROJECT \*  
 \* DRAINAGE MODEL \*  
 \* PROPOSED CONDITIONS \*  
 \* RETURN PERIOD\_ \_ \_ 100-YR & 10-YR \*  
 \* DISTRIBUTION\_ \_ \_ 6-HOUR SDN3 \*  
 \* PROJECT NO\_ \_ \_ 764.100.100 \*  
 \* FILENAME\_ \_ \_ PROP.h1 \*  
 \* DATE MODELED\_ \_ \_ 4/6/06 \*  
 \* MODELED BY\_ \_ \_ CR \*  
 \*\*\*\*\*

22 IO

## OUTPUT CONTROL VARIABLES

IPRNT 5 PRINT CONTROL  
 IPLOT 0 PLOT CONTROL  
 QSCAL 0. HYDROGRAPH PLOT SCALE

IT

## HYDROGRAPH TIME DATA

NMIN 5 MINUTES IN COMPUTATION INTERVAL  
 IDATE 1 0 STARTING DATE  
 ITIME 0000 STARTING TIME  
 NQ 300 NUMBER OF HYDROGRAPH ORDINATES  
 NDDATE 2 0 ENDING DATE  
 NDTIME 0055 ENDING TIME  
 ICENT 19 CENTURY MARK

COMPUTATION INTERVAL .08 HOURS  
 TOTAL TIME BASE 24.92 HOURS

## ENGLISH UNITS

DRAINAGE AREA SQUARE MILES  
 PRECIPITATION DEPTH INCHES  
 LENGTH, ELEVATION FEET  
 FLOW CUBIC FEET PER SECOND  
 STORAGE VOLUME ACRE-Feet  
 SURFACE AREA ACRES  
 TEMPERATURE DEGREES FAHRENHEIT

JP

## MULTI-PLAN OPTION

NPLAN 1 NUMBER OF PLANS

JR

## MULTI-RATIO OPTION

RATIOS OF PRECIPITATION  
 1.00 .57

1

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS  
 FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES  
 TIME TO PEAK IN HOURS

| OPERATION     | STATION | AREA | PLAN | RATIOS APPLIED TO PRECIPITATION |                |
|---------------|---------|------|------|---------------------------------|----------------|
|               |         |      |      | RATIO 1<br>1.00                 | RATIO 2<br>.57 |
| HYDROGRAPH AT |         |      |      |                                 |                |
| +             | OF-1    | .00  | 1    | 5.<br>3.50                      | 2.<br>3.50     |
| ROUTED TO     |         |      |      |                                 |                |
| +             | RTOF-1  | .00  | 1    | 5.<br>3.67                      | 2.<br>3.67     |
| HYDROGRAPH AT |         |      |      |                                 |                |
| +             | OF-2A   | .00  | 1    | 2.<br>3.50                      | 1.<br>3.50     |
| ROUTED TO     |         |      |      |                                 |                |
| +             | RTOF2A  | .00  | 1    | 2.<br>3.58                      | 1.<br>3.67     |
| HYDROGRAPH AT |         |      |      |                                 |                |
| +             | OF-2B   | .00  | 1    | 3.<br>3.50                      | 1.<br>3.50     |
| ROUTED TO     |         |      |      |                                 |                |
| +             | RTOF2B  | .00  | 1    | 3.<br>3.58                      | 1.<br>3.58     |
| HYDROGRAPH AT |         |      |      |                                 |                |
| +             | ON-1    | .01  | 1    | 10.<br>3.58                     | 5.<br>3.58     |
| 4 COMBINED AT |         |      |      |                                 |                |
| +             | CP1     | .01  | 1    | 19.<br>3.58                     | 8.<br>3.58     |
| ROUTED TO     |         |      |      |                                 |                |
| +             | RT CP1  | .01  | 1    | 18.<br>3.58                     | 8.<br>3.67     |
| HYDROGRAPH AT |         |      |      |                                 |                |
| +             | ON-3    | .00  | 1    | 4.<br>3.50                      | 2.<br>3.50     |
| HYDROGRAPH AT |         |      |      |                                 |                |
| +             | ON-4    | .00  | 1    | 7.<br>3.58                      | 3.<br>3.58     |
| 3 COMBINED AT |         |      |      |                                 |                |
| +             | CP2     | .02  | 1    | 29.<br>3.58                     | 12.<br>3.58    |
| HYDROGRAPH AT |         |      |      |                                 |                |
| +             | ON-2    | .01  | 1    | 14.<br>3.58                     | 6.<br>3.58     |
| HYDROGRAPH AT |         |      |      |                                 |                |
| +             | ON-5    | .00  | 1    | 7.<br>3.50                      | 3.<br>3.50     |
| 3 COMBINED AT |         |      |      |                                 |                |
| +             | CP3     | .03  | 1    | 49.<br>3.58                     | 21.<br>3.58    |
| HYDROGRAPH AT |         |      |      |                                 |                |
| +             | ON-6    | .00  | 1    | 2.<br>3.50                      | 1.<br>3.50     |

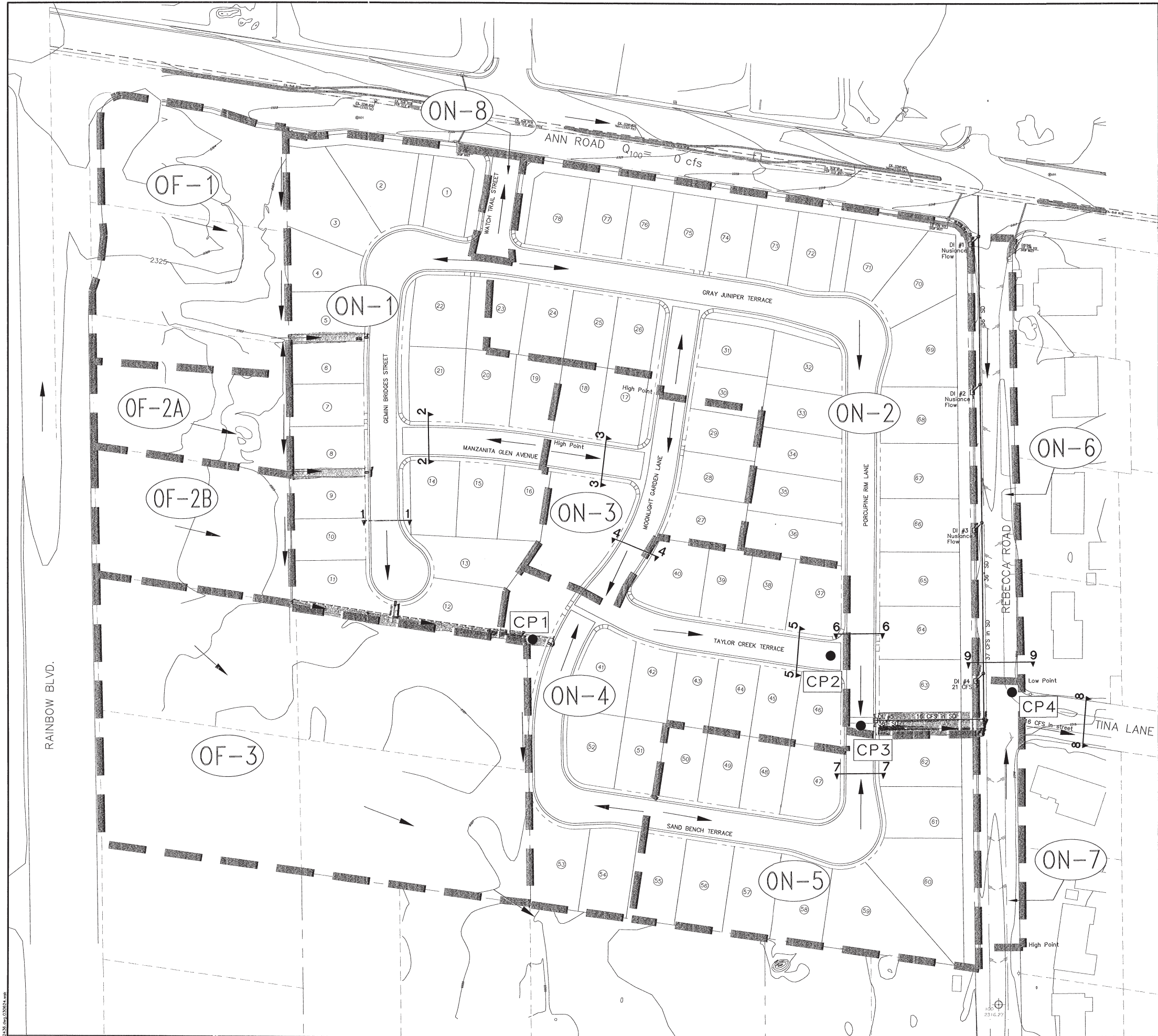
HYDROGRAPH AT  
 + ON-7 .00 1 FLOW TIME 2. 1.  
 3.50 3.50  
 3 COMBINED AT  
 + CP4 .04 1 FLOW TIME 53. 23.  
 3.58 3.58  
 HYDROGRAPH AT  
 + ON-8 .00 1 FLOW TIME 0. 0.  
 3.50 3.50  
 HYDROGRAPH AT  
 + OF-3 .01 1 FLOW TIME 11. 5.  
 3.58 3.58  
 1

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING  
 (FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

| ISTAQ                                                                                                                            | ELEMENT | DT                 | PEAK  | TIME TO<br>PEAK | VOLUME | DT    | INTERPOLATED TO<br>COMPUTATION<br>PEAK | INTERVAL<br>TIME TO<br>PEAK | VOLUME |
|----------------------------------------------------------------------------------------------------------------------------------|---------|--------------------|-------|-----------------|--------|-------|----------------------------------------|-----------------------------|--------|
|                                                                                                                                  |         | (MIN)              | (CFS) | (MIN)           | (IN)   | (MIN) | (CFS)                                  | (MIN)                       | (IN)   |
| FOR PLAN = 1<br>RTOF-1                                                                                                           | MANE    | RATIO= .00<br>3.50 | 4.96  | 217.00          | 1.78   | 5.00  | 4.89                                   | 220.00                      | 1.78   |
| CONTINUITY SUMMARY (AC-FT) - INFLOW= .2941E+00 EXCESS= .0000E+00 OUTFLOW= .2942E+00 BASIN STORAGE= .7602E-03 PERCENT ERROR= -.3  |         |                    |       |                 |        |       |                                        |                             |        |
| FOR PLAN = 1<br>RTOF-1                                                                                                           | MANE    | RATIO= .00<br>4.00 | 2.14  | 220.00          | .74    | 5.00  | 2.14                                   | 220.00                      | .75    |
| CONTINUITY SUMMARY (AC-FT) - INFLOW= .1230E+00 EXCESS= .0000E+00 OUTFLOW= .1231E+00 BASIN STORAGE= .6525E-03 PERCENT ERROR= -.6  |         |                    |       |                 |        |       |                                        |                             |        |
| FOR PLAN = 1<br>RTOF2A                                                                                                           | MANE    | RATIO= .00<br>3.50 | 1.79  | 217.00          | 1.78   | 5.00  | 1.70                                   | 215.00                      | 1.78   |
| CONTINUITY SUMMARY (AC-FT) - INFLOW= .1043E+00 EXCESS= .0000E+00 OUTFLOW= .1045E+00 BASIN STORAGE= .4563E-03 PERCENT ERROR= -.6  |         |                    |       |                 |        |       |                                        |                             |        |
| FOR PLAN = 1<br>RTOF2A                                                                                                           | MANE    | RATIO= .00<br>4.00 | .77   | 220.00          | .74    | 5.00  | .77                                    | 220.00                      | .75    |
| CONTINUITY SUMMARY (AC-FT) - INFLOW= .4365E-01 EXCESS= .0000E+00 OUTFLOW= .4365E-01 BASIN STORAGE= .4611E-03 PERCENT ERROR= -1.1 |         |                    |       |                 |        |       |                                        |                             |        |
| FOR PLAN = 1<br>RTOF2B                                                                                                           | MANE    | RATIO= .00<br>3.50 | 2.59  | 217.00          | 1.78   | 5.00  | 2.58                                   | 215.00                      | 1.78   |
| CONTINUITY SUMMARY (AC-FT) - INFLOW= .1518E+00 EXCESS= .0000E+00 OUTFLOW= .1518E+00 BASIN STORAGE= .4296E-03 PERCENT ERROR= -.3  |         |                    |       |                 |        |       |                                        |                             |        |
| FOR PLAN = 1<br>RTOF2B                                                                                                           | MANE    | RATIO= .00<br>4.00 | 1.12  | 216.00          | .74    | 5.00  | 1.08                                   | 215.00                      | .75    |
| CONTINUITY SUMMARY (AC-FT) - INFLOW= .6349E-01 EXCESS= .0000E+00 OUTFLOW= .6350E-01 BASIN STORAGE= .3393E-03 PERCENT ERROR= -.5  |         |                    |       |                 |        |       |                                        |                             |        |
| FOR PLAN = 1<br>RT CP1                                                                                                           | MANE    | RATIO= .00<br>2.99 | 18.63 | 218.61          | 1.78   | 5.00  | 18.11                                  | 215.00                      | 1.78   |
| CONTINUITY SUMMARY (AC-FT) - INFLOW= .1204E+01 EXCESS= .0000E+00 OUTFLOW= .1204E+01 BASIN STORAGE= .4132E-03 PERCENT ERROR= .0   |         |                    |       |                 |        |       |                                        |                             |        |
| FOR PLAN = 1<br>RT CP1                                                                                                           | MANE    | RATIO= .00<br>3.72 | 8.01  | 219.29          | .75    | 5.00  | 7.93                                   | 220.00                      | .75    |
| CONTINUITY SUMMARY (AC-FT) - INFLOW= .5054E+00 EXCESS= .0000E+00 OUTFLOW= .5053E+00 BASIN STORAGE= .3912E-03 PERCENT ERROR= -.1  |         |                    |       |                 |        |       |                                        |                             |        |

\*\*\* NORMAL END OF HEC-1 \*\*\*





| PROPOSED CONDITIONS<br>SUMMARY OF HEC-1 MODEL |           |                |               |
|-----------------------------------------------|-----------|----------------|---------------|
| SUBBASIN                                      | AREA (ac) | 100-YEAR (cfs) | 10-YEAR (cfs) |
| OF-1                                          | 1.98      | 5              | 2             |
| OF-2A                                         | 0.7       | 2              | 1             |
| OF-2B                                         | 1.00      | 3              | 1             |
| ON-1                                          | 4.41      | 10             | 5             |
| CP1<br>(OF1+OF2A+OF2B+ON1)                    | -         | 19             | 8             |
| ON-3                                          | 1.52      | 4              | 2             |
| ON-4                                          | 3.13      | 7              | 3             |
| CP2<br>(ON3+ON4+CP1)                          | -         | 29             | 12            |
| ON-2                                          | 6.09      | 14             | 6             |
| ON-5                                          | 2.79      | 7              | 3             |
| CP3<br>(ON2+ON5+CP2)                          | -         | 49             | 21            |
| ON-6                                          | 0.77      | 2              | 1             |
| ON-7                                          | 0.49      | 2              | 1             |
| CP4<br>(ON4+ON5+CP3)                          | -         | 53             | 23            |
| ON-8                                          | 0.15      | 0              | 0             |
| OF-3                                          | 4.58      | 11             | 5             |

| STREET FLOW CHARACTERISTICS SUMMARY |                        |            |           |            |                 |      |
|-------------------------------------|------------------------|------------|-----------|------------|-----------------|------|
| CROSS SECTION                       | CROSS SECTION LOCATION | Q100 (cfs) | SLOPE (%) | DEPTH (FT) | VELOCITY (FT/S) | V/D  |
| 9-9                                 | REBECCA                | 2.0        | 0.24      | 0.36       | 0.91            | 0.33 |
| 8-8                                 | TINA - Existing        | 42.0       | 0.30      | 0.54       | 2.25            | 1.22 |
| 8-8                                 | TINA - Proposed        | 16.0       | 0.30      | 0.39       | 1.66            | 0.65 |
| 1-1                                 | GEMINI                 | 17.0       | 0.40      | 0.50       | 1.86            | 0.93 |
| 2-2                                 | MANZANIA-2             | 4.0        | 0.71      | 0.30       | 1.76            | 0.53 |
| 3-3                                 | MANZANIA-3             | 4.0        | 1.07      | 0.28       | 2.07            | 0.58 |
| 4-4                                 | MOONLIGHT              | 4.0        | 1.08      | 0.28       | 2.07            | 0.58 |
| 5-5                                 | TAYLOR CREEK           | 29.0       | 0.40      | 0.56       | 2.30            | 1.29 |
| 6-6                                 | PORCUPINE              | 14.0       | 0.44      | 0.46       | 1.83            | 0.84 |
| 7-7                                 | SAND BENCH             | 7.0        | 1.03      | 0.33       | 2.31            | 0.76 |
| 10-10                               | WATCH TRAIL            | 0.0        | -         | -          | -               | -    |



SCALE 1" = 60'



- LEGEND
- BASIN BOUNDARY
  - BASIN DESIGNATION
  - COMBINATION POINT
  - CROSS SECTION
  - FLOW DIRECTION

This grading plan is a part of drainage study #2900, which was received on 4/19/16 and revised on 5/16/16. Page 1 of 15

G. C. WALLACE, INC.  
Engineers/Planners/Surveyors  
1555 SOUTH RAINBOW BLVD./LAS VEGAS, NEVADA 89146  
TELEPHONE: (702) 804-2000 • FAX: (702) 804-2299  
H:\0501764-100-100\DWG\Hydro\FIG-6R.dwg

PULTE HOMES, INC.  
ANN 17  
FIGURE 6R  
PROPOSED CONDITIONS DRAINAGE MAP

DRAWING  
FIG 6R  
SHT OF SHTS

