

**HYDROLOGY STUDY**

**for**

**Rainbow Car Wash**

**CLARK COUNTY, NEVADA**

# HYDROLOGIC CRITERIA AND DRAINAGE MANUAL

## DRAINAGE STUDY INFORMATION FORM

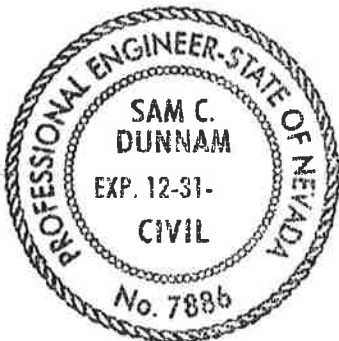
Name of Development: RAINBOW CARNASH Date: 2.2.2022  
 Location of Development: a) Descriptive (Cross Streets) North/South: NELLIS BLVD  
 East/West: SOUTH OF ONEILS AVE.  
 b) Section: 28 Township: 35 Range: 62E  
 c) APN: 140-28-110-003

Name of Owner: MARK & LORI MILLER  
 Telephone No.: 702.682.1715 Fax No.: NONE E-Mail Address: leonardlopez@hotmail.com  
 Address: 1281 TERMINAL WAY #15 BEND NEVADA 89502

Contact Person-Name: Sam C. Dunnam Telephone No.: 702.682.1715  
 \* E-Mail Address: sam.dunnam@tylin.com Fax No.: \_\_\_\_\_  
 Firm: TY Lin International  
 Address: 4050 Dean Martin Drive LV NV 89103  
 Type of Land Development/Land Disturbance Process:

|                                           |                                                     |                                                       |
|-------------------------------------------|-----------------------------------------------------|-------------------------------------------------------|
| <input type="checkbox"/> Rezoning         | <input type="checkbox"/> Subdivision Map            | <input type="checkbox"/> Clearing and Grading Only    |
| <input type="checkbox"/> Parcel Map       | <input type="checkbox"/> Planned Unit Development   | <input type="checkbox"/> Other (Please specify below) |
| <input type="checkbox"/> Large Parcel Map | <input checked="" type="checkbox"/> Building Permit |                                                       |

- Total Owned Land Area: At Site: 0.7 AC Being Developed/Disturbed: 0.7 AC
- Is a portion or all of the subject property located in a designated FEMA Flood Hazard Area? ☐ Yes\*\* ☒ No
- Is the property bordered or crossed by an existing or proposed Clark County Regional Flood Control District Master Planned Facility? ☒ Yes\*\* ☐ No
- Proposed type of development (Residential, Commercial, Etc.): COMMERCIAL
- Approximate upstream land area which drains to the subject site: 500 ft
- Has the site drainage been evaluated in the past? ☒ YES ☐ NO If yes, please identify documentation: \_\_\_\_\_
- If known, please briefly identify the proposed discharge point(s) of runoff from the site: SW CORNER OF SITE
- Briefly describe your proposed schedule for the subject project: ASAP.



Engineer's Seal

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.

\*New Required Field

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

|                             | Revision | Date |
|-----------------------------|----------|------|
|                             |          |      |
|                             |          |      |
|                             |          |      |
| Local Entity File No. _____ |          |      |

REFERENCE:

STANDARD FORM 1

# HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

## DRAINAGE SUBMITTAL CHECKLIST

|                                    |           |                          |                           |
|------------------------------------|-----------|--------------------------|---------------------------|
| Project Name:                      |           | Map ID:                  |                           |
| Firm Name: TY Lin International    |           | Engineer: Sam C. Dunnam  |                           |
| Address: 4050 Dean Martin Drive    |           |                          |                           |
| City: Las Vegas                    | State: NV | Zip: 89103               |                           |
| Phone Number: 702.682.1715         |           | Fax Number: 702.522.7105 |                           |
| Property Owner: MARK & LORE MILLER |           |                          |                           |
| Address: 1781 TERMINAL WAY         |           |                          |                           |
| City: RENO NEVADA                  |           | State: NEVADA            | Zip: 89502                |
| Reviewed By:                       |           | Date Received:           | Date Accepted for Review: |

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 (CCRFCDD) Hydrologic Criteria and Drainage Design Manual (MANUAL).

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.

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

**I. GENERAL REQUIREMENT**

| Yes                                 | No                                  |                                                                                                |
|-------------------------------------|-------------------------------------|------------------------------------------------------------------------------------------------|
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | Design Manual <b>Standard Form 1</b> with the engineer's seal and signature.                   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | Design Manual <b>Standard Form 4</b> .                                                         |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | 2 copies of the 24" x 36" Drainage Plan.                                                       |
| <input type="checkbox"/>            | <input checked="" type="checkbox"/> | A notarized letter from the adjacent property owner(s) allowing off-site grading or discharge. |

**II. MAPS AND EXHIBITS**

| Yes                                 | No                       |                                                                                                                                                |
|-------------------------------------|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | A copy of a current Flood Insurance Rate Map (FIRM) with the site delineated.                                                                  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | A copy of the current CCRFCDD Master Plan Update Figure, (F-x), for Flood Control Facilities and Environmental areas with the site delineated. |

|                   |                        |
|-------------------|------------------------|
| <b>REFERENCE:</b> | <b>STANDARD FORM 2</b> |
|-------------------|------------------------|

## HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

### DRAINAGE SUBMITTAL CHECKLIST

#### II. MAPS AND EXHIBITS (Continued)

- | Yes                                 | No                       |                                                                                                                                                                                  |
|-------------------------------------|--------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Off-site drainage basin maps for existing, interim and future conditions showing the existing topography, basin boundaries, concentration points, and flows in cfs.              |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 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. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Vicinity Map with local and major cross streets identified and a north arrow.                                                                                                    |

#### III. DRAINAGE PLAN

- | Yes                                 | No                                  |                                                                                                                                                             |
|-------------------------------------|-------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | Sheet size: 24" x 36" sealed by a registered engineer in the State of Nevada.                                                                               |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | Minimum scale: 1" = 60'.                                                                                                                                    |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | Project name.                                                                                                                                               |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | Vicinity Map with local and major cross streets.                                                                                                            |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | Revision box.                                                                                                                                               |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | North arrow and bar scale.                                                                                                                                  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | Engineer's/consultant's address and phone number.                                                                                                           |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | Elevation datum and benchmark.                                                                                                                              |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | Legend for symbols and abbreviations.                                                                                                                       |
| <input type="checkbox"/>            | <input checked="" type="checkbox"/> | Cut/fill scarps, where applicable.                                                                                                                          |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | Street names, grades, widths.                                                                                                                               |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | 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. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | Existing contours encompassing the site and 100 feet beyond with spot elevations for important locations, where appropriate.                                |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | Minimum finish floor elevations with top-of-curb elevations at upstream end of lot.                                                                         |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | Proposed typical street sections.                                                                                                                           |

REFERENCE:

STANDARD FORM 2

# HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

## DRAINAGE SUBMITTAL CHECKLIST

### III. DRAINAGE PLAN (Continued)

| Yes                                 | No                                  |                                                                                                                                                                                                                                                                             |
|-------------------------------------|-------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | Streets with off-set crowns.                                                                                                                                                                                                                                                |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | Proposed contours or spot elevations in sufficient detail to exhibit intended drainage patterns and slopes.                                                                                                                                                                 |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | Property lines.                                                                                                                                                                                                                                                             |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | Right-of-way lines and widths, existing and proposed.                                                                                                                                                                                                                       |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | Existing improvements and their elevations.                                                                                                                                                                                                                                 |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | Delineation of proposed on-site drainage basins indicating area and 10-year and 100-year storm peak flows at basin concentration points.                                                                                                                                    |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | Concentration points and drainage flow direction with $Q_{100}$ and $V_{100}$ and $D_{100}$ in streets.                                                                                                                                                                     |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | Cumulative flows, velocity, and direction of flow at upstream and downstream ends of site for the 10-year and 100-year flows.                                                                                                                                               |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | Location and cross-section of street capacity calculations.                                                                                                                                                                                                                 |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | Cross-sectional detail for channels, including cutoff wall locations.                                                                                                                                                                                                       |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | 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. |
| <input type="checkbox"/>            | <input checked="" type="checkbox"/> | Existing and proposed drainage easements and widths shown with sufficient detail. A cross sectional detail must be provided that shows appropriate lining and reinforcement.                                                                                                |
| <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 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.                                                                                                                     |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | Location and detail of flood walls illustrating depth of flow, proposed grouting height, etc.                                                                                                                                                                               |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | 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.                                                                              |
| <input type="checkbox"/>            | <input checked="" type="checkbox"/> | Building and/or lot numbers.                                                                                                                                                                                                                                                |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | Alignment of all existing, proposed, or future Regional Facilities adjacent to the site.                                                                                                                                                                                    |
| <input type="checkbox"/>            | <input checked="" type="checkbox"/> | Limits of existing floodplain based on current FIRM or best available information; limits of proposed floodplains based on best available information.                                                                                                                      |

REFERENCE:

STANDARD FORM 2

# HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

## DRAINAGE SUBMITTAL CHECKLIST

### III. DRAINAGE PLAN (Continued)

| Yes                                 | No                                  |                                                                                                                                                                                                                |
|-------------------------------------|-------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 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. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | 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 $Q_{100}$ flows.                                          |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | Street slopes for perimeter and interior streets. The minimum slope is 0.4 percent.                                                                                                                            |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | Location and detail of best management practice (BMP) for parking lots and low impact development (LID) (if required).                                                                                         |

### IV. HYDROLOGIC ANALYSIS

| Yes                                 | No                       |                                                                                                                                                                              |
|-------------------------------------|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Appropriate soil information and Soils Map for existing and future conditions with subbasins and property delineated.                                                        |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 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.                     |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 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.                       |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Use of correct precipitation values in and around the McCarran Airport rainfall area.                                                                                        |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | A discussion in the text of the hydrologic analysis justifying subbasin boundaries and cutoffs, supporting assumptions, and calculations.                                    |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | A summary table of stormwater flows showing basin area, $Q_{10}$ and $Q_{100}$ for both individual basins and combined basin flows, where applicable.                        |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Copies of supporting technical information referenced from a previously approved study and a statement accepting these results.                                              |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | On-site facilities must perpetuate flows through or around the site without significantly impacting adjacent property owners in accordance with current Nevada Drainage Law. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | Calculation for impervious area for parking lots and LIDs (if required).                                                                                                     |

REFERENCE:

STANDARD FORM 2

# HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

## DRAINAGE SUBMITTAL CHECKLIST

### V. HYDRAULIC ANALYSIS

Yes No

- |                                     |                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-------------------------------------|-------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | Flow split calculations and supporting documentation or reference for the method of flow split calculations used.                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | 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. $Q_{100} d \times v \leq 8$ . $Q_{10} d \times v \leq 6$ 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.                                                                                          |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | 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.                                                                                                                                                                                                                                                                                             |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | Appropriate hydraulic calculations for block wall openings assuming a 50 percent vertical clogging factor. (Assume the lower half of the opening is plugged.)                                                                                                                                                                                                                                                                                                                                                                     |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | 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.                                                                                                                                                                                                                                                                                       |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | 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, whichever is greater.                                                                                            |
| <input type="checkbox"/>            | <input checked="" type="checkbox"/> | A complete water surface profile analysis (HEC-2, HEC-RAS, etc.) for channel flows and FEMA Zone A flood zones. <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> |
| <input type="checkbox"/>            | <input checked="" type="checkbox"/> | Provide a 50 percent clogging factor in the capacity calculation for drop inlets.                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 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.                                                                                                                                                                                                                                                                                                                                                    |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | The mitigation of nuisance water, both during construction and in the fully developed condition, must be addressed.                                                                                                                                                                                                                                                                                                                                                                                                               |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | Provide BMP type, size and supporting calculations for parking lots and LIDs (if required).                                                                                                                                                                                                                                                                                                                                                                                                                                       |

REFERENCE:

STANDARD FORM 2

### Description

The property proposed by this project is a portion of Section 28, Township 20 South, Range 62 East, M.D.M., Clark County, Nevada. The project site is 0.71 net acres located at east side of Nellis Boulevard, south of Owens Avenue. The property is known as Assessor's Parcel Numbers 140-28-110-003 (see **Figure 1**) and Lot 2, Block 2 of Meikle Manor, Plat Book 3, Page 55 (see **Figure 8**). A convenience store and strip shopping building occupy the property adjacent to and north of the subject site. To the south is the *Car Pros Auto Center* and west of the subject site is an undeveloped, vacant lot.

Nellis Boulevard, on the west is a fully developed right-of-way which is owned and maintained by the Nevada Department of Transportation (NDOT). Other than a commercial driveway, "L" curb and sidewalk, no other above ground construction is anticipated with the public right-of-way.

The site is presently zoned General Commercial (C-2) and a site plan review and use permit have been approved under UC-21-0278. The project proposes to construct a standalone car wash with vacuums and required parking adjacent to the main structure. Access to the site will be from a single, commercial driveway onto Nellis and secondary, emergency vehicle access will occur on the easterly portion of the site and the adjacent property to the north. Planter areas will be on the eastern, southerly and westerly portions of the site which will allow for treatment site generated storm water as required by Section 1500, Best Management Practices, of the Flood Control Manual.

### Federal Emergency Management Agency- FEMA

Shown in **Figure 2**, Flood Insurance Rate Map (FIRM), Clark County, Nevada and Incorporated Areas, map number 32003 C 2185 F, dated November 16, 2011, the site is located within an un-shaded Flood Hazard Zone X. An un-shaded Flood Zone X is an area determined to be outside of the 0.2% annual chance floodplain.

### Clark County Regional Flood Control District - CCRFD

**Figures 4 and 6**, which are the 2013 and 2018 Regional Flood Control Districts Flood Control Facilities Figure F-28 and Figure F-26, show proposed regional facilities adjacent to the site, those being:

#### **2013 and 2018 CCRFCD Category "A" Proposed Facility**

|                  |                     |                 |
|------------------|---------------------|-----------------|
| <b>LVNE 0089</b> | <b>13'x 12' RCB</b> | <b>2700 cfs</b> |
| <b>LVNE 0140</b> | <b>13'x 12' RCB</b> | <b>2700 cfs</b> |



### Referenced Drainage Studies

The following approved drainage study was reviewed prior to preparing this analysis, and has specifically been referenced herein:

Used Car Lot, HTE #11-44701, by CivilWorks, Inc., Brandon Potts, P.E., dated 12/13/2011 with addendums dated 3/7/2012 and 5/21/2012.

This drainage study has been approved by Clark County and the Clark County Regional Flood Control District, and itself referenced the drainage study for Nellis/Owens Daycare, HTE #07-24151. The Daycare Study shows flows in Nellis and Owens on Figure 8 (30/31), *Developed Basin Map*, and no other display.

The text (13/34) (14/34) within the *Used Car Lot* study states that the “10-year and 100-year will increase to 60-cfs and 167-cfs”, for the proposed condition storm. These are the flow rates that will be used for depth and velocity analysis herein.

### Proposed Project

This development is proposing to construct a self-serve, drive through carwash with vacuums and required parking on the 0.7 net acre site, generally located on Nellis Boulevard, just south of Owens Avenue. Access to the site will be from a single commercial driveway onto Nellis Blvd. Additional, emergency vehicle access will be on the easterly portion of the site and through the adjacent property to the north. Planter areas along the westerly, southerly and easterly portions of the site will allow for the treatment of site generated storm water, as required, prior to leaving the property.

The site naturally drains from the east to the west, to Nellis Blvd., at a very shallow slope. The undeveloped site does not accept storm water from offsite sources along the northerly, easterly or southerly property lines. The only storm water impacting the site is that from within Nellis, on the west boundary. Nellis Blvd. is an NDOT right-of-way, and as such, an increase of storm water released from the site from the existing to developed condition is not allowed. Development of the site will ensure that there will not be an increase in storm water released from the site.

### Criteria

Runoff was determined using the U.S. Army Corps of Engineers Flood Hydrograph Package (HEC-1), version 4.1, dated June 1998. Soil Classifications were derived using the U.S. Department of Agriculture, Soils Classification Service, Soils Survey of Las Vegas Valley Areas, Nevada. (see **Figure 5**)

**Soil Type #200**

**Glencarb silt loam**

**Hydrologic Soil Group “C”**

Precipitation data is per the N.O.A.A. Precipitation Frequency Atlas of the Western United States, VOL. VII. Nevada: modified by Table 501 and a Table 502 Depth-Area reduction factor of 1.00, as allowed within the Hydrologic Criteria and Drainage Design Manual. This area is considered to be within the McCarran Standard rainfall area.

$$\text{100-Year 6-hour} = 2.0'' * 1.43 = 2.86''$$

$$\text{10-Year 6-hour} = 1.4'' * 1.24 = 1.74''$$

$$\text{2-Year 6-hour} = 1.0'' * 1.00 = 1.0''$$

Time of Concentration values were calculated using Runoff Curve Numbers as provided in Table 602 and Table 602A of the Hydrologic Criteria and Drainage Design Manual. The United States Department of Agriculture, Soil Conservation Service Engineering Division, Technical Release 55, dated June 1986; (SCS TR-55) has defined the time of concentration,  $T_c$ , as "the time for runoff to travel from the hydrologically most distant point of the watershed to a point of interest within the watershed." The open channel portion of  $T_c$  is defined as utilizing the average flow velocity for the reach analyzed.

The Soil Conservation Service (SCS) method is based upon the unit hydrograph method for determining the runoff from a given drainage basin. The discharge to unit time graph depicts that at time zero, discharge is also equal to zero. This office utilizes this method for determining time of concentration values ( $T_c$ ). **Figure 5** shows the site with the different soil types depicted.

**CN Values – Existing Condition**

**ex** 91.0 (newly graded areas)

**CN Values – Developed Condition**

**FUT** 94.0 (commercial and business)

Runoff

**Figure 9** shows that from the referenced technical drainage study for *Used Car Lot*, that at Nellis, south of Owens has 60 cfs flowing south in Nellis during the 10-year event, which increases to 167 cfs during the 100-year storm. The existing site receives no storm or nuisance flow from the parcels which are to the north, east of south of the subject site.

The undeveloped site (**ex**) releases excess storm water to Nellis Blvd. at the Southwest corner of the site. The 10-year storm expels 1 cfs, while the 100-year storm releases 2 cfs.

**Storm Flow Quantities – Existing Condition**

| Basin     | Area    | 10-Yr | 100-Yr |
|-----------|---------|-------|--------|
| <b>ex</b> | 0.71 AC | 1 cfs | 2 cfs  |

The developed condition analysis utilizes the same flows as the existing condition for what is in Nellis. The 10-year storm flow in Nellis is 60 cfs and is expected to flow at a depth of 0.75 feet and a velocity of 3.5 fps. (**calc sht #1**) The VD product of 2.6 less than the maximum allowed of 6. The 10-year storm allows for a dry lane with of 14-feet from centerline. The 100-year storm of 167 cfs is expected to flow south in Nellis at a depth of 1.0 feet and a velocity of 4.5 fps. (**calc sht #2**). The VD product of 4.5 is also less than the maximum allowed of 8.

The developed site (**FUT**) expels water to Nellis at the southwest corner of the site. During the 120-year storm the developed site is expected to release 1 cfs. The 100-year storm will increase the runoff to 2 cfs. Before leaving the site, water is routed through a swale to remove sediments and heavy metals. The 10-foot-wide swale along the east property line flows at a depth of 0.4 feet and a velocity of 1.27 fps (**calc sht #3**). This analysis assumes a Q100 of 2 cfs, which is a conservative value to use. The south property line swale flows at a depth of 0.48 feet and a velocity of 1.44 fps. (**calc sht #4**).

#### Storm Flow Quantities – Developed Condition

| Basin | Area    | 10-Yr | 100-Yr |
|-------|---------|-------|--------|
| FUT   | 0.71 AC | 1 cfs | 2 cfs  |

#### Street Flow Quantities

| Street                                           | Q100    | Slope | Depth | Velocity | VD  |
|--------------------------------------------------|---------|-------|-------|----------|-----|
| Nellis<br>Sta. 275+96 ( <b>see calc sht #1</b> ) | 167 cfs | 0.73% | 1.0'  | 3.5 fps  | 2.6 |

#### Parking Lot Low Impact Development (LID)

As of September 2013, changes to Section 1500 of the *Hydrologic Criteria and Drainage Design Manual* were made to incorporate Low Impact Development (LID) measures for managing runoff generated by parking lots. Parking lots include all impervious areas outside of the roofed areas of the project site. Section 1502.2 requires that 75% of all impervious areas be routed through a treatment BMP, such as a landscape swale, depressed median or buffer strip, which meets the requirements as set in Section 1503.4.5.

**Calc Sht #5** shows that over 75% of the onsite, impermeable areas are routed through a landscape area as required by Section 1500. **A and C** are onsite basins which are routed through a planter area prior to leaving the developed site. These two areas are routed through a landscape swale that ranges in length from 32 to 390 feet. (**calc shts 2 & 3**).

### Conclusions

- 1) The development of the project site does not conflict with the Clark County Master Plan.
- 2) The site is adjacent to any proposed CCRFCD Master Plan flood control facilities.
- 3) The site is currently located in a FEMA un-shaded Flood Zone X.
- 4) The site does not increase the predevelopment storm water release

## **LIST OF FIGURES**

- |                   |                                                                                                            |
|-------------------|------------------------------------------------------------------------------------------------------------|
| <b>Figure 1.</b>  | <b>Assessor's Parcel Map</b>                                                                               |
| <b>Figure 2.</b>  | <b>Flood Insurance Rate Map</b>                                                                            |
| <b>Figure 3.</b>  | <b>Aerial Photograph</b>                                                                                   |
| <b>Figure 4.</b>  | <b>2013 - Las Vegas Valley Flood<br/>Control Master Plan Update<br/>Flood Control Facilities</b>           |
| <b>Figure 5.</b>  | <b>2018 – Las Vegas Valley Flood<br/>Control Master Plan Update<br/>Watershed - Lower Northern LV Wash</b> |
| <b>Figure 6.</b>  | <b>2018 – Las Vegas Valley Flood<br/>Control Master Plan Update<br/>Flood Control Facilities</b>           |
| <b>Figure 7.</b>  | <b>S.C.S. Soils Map</b>                                                                                    |
| <b>Figure 8.</b>  | <b>Final Map of Paradise Acres<br/>Book 1, Page 100</b>                                                    |
| <b>Figure 9.</b>  | <b>Existing Condition<br/>Drainage Basin Map</b>                                                           |
| <b>Figure 10.</b> | <b><u>Onsite</u> Developed Condition<br/>Drainage Basin Map</b>                                            |
| <b>Figure 11.</b> | <b>Low Impact Design (LID) Basin Map</b>                                                                   |



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  
0 100 200 400 600 800

MAP LEGEND

PARCEL BOUNDARY

SUB BOUNDARY

PM/LD BOUNDARY

ROAD EASEMENT

MATCH / LEADER LINE

HISTORIC LOT LINE

HISTORIC SUB BOUNDARY

HISTORIC PM/LD BOUNDARY

SECTION LINE

CONDOMINIUM UNIT

AIR SPACE PCL

RIGHT OF WAY PCL

SUB-SURFACE PCL

ASSESSOR'S PARCELS - CLARK COUNTY, NV.

Briana Johnson - Assessor

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

BOOK T20S R62E

SEC. 28

MAP N 2 NW 4

140-28-1

124 123 122

139 140 141

162 161 160

6 5 4 3 2 1

7 8 9 10 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

8 4 8 4

5 1 5 1

6 2 6 2

7 3 7 3

8 4 8 4

5 1 5 1

CLARK COUNTY NEVADA

Scale: 1" = 200'

Rev: 1/8/2019

TAX DIST 340

FIGURE 1



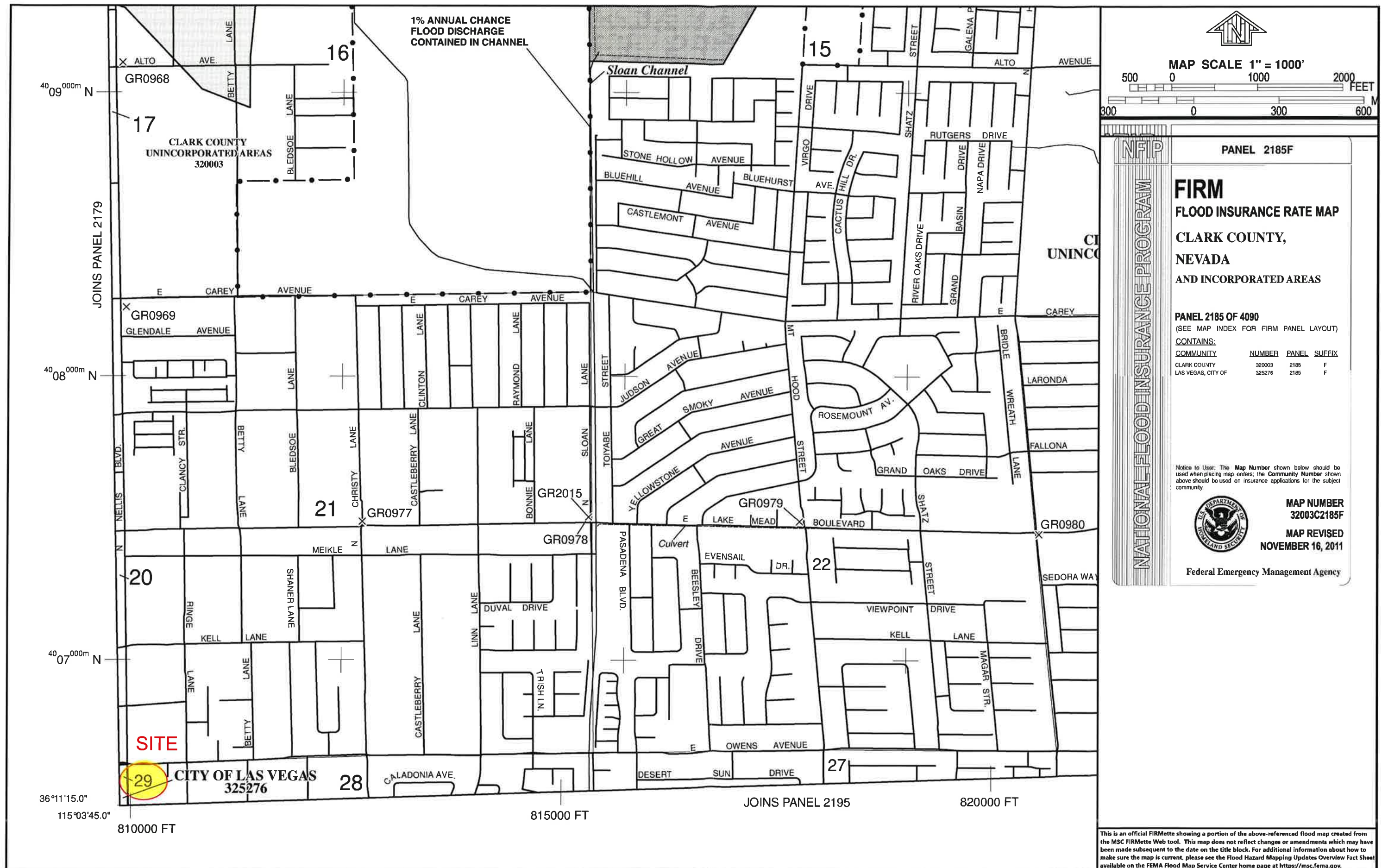


FIGURE 2







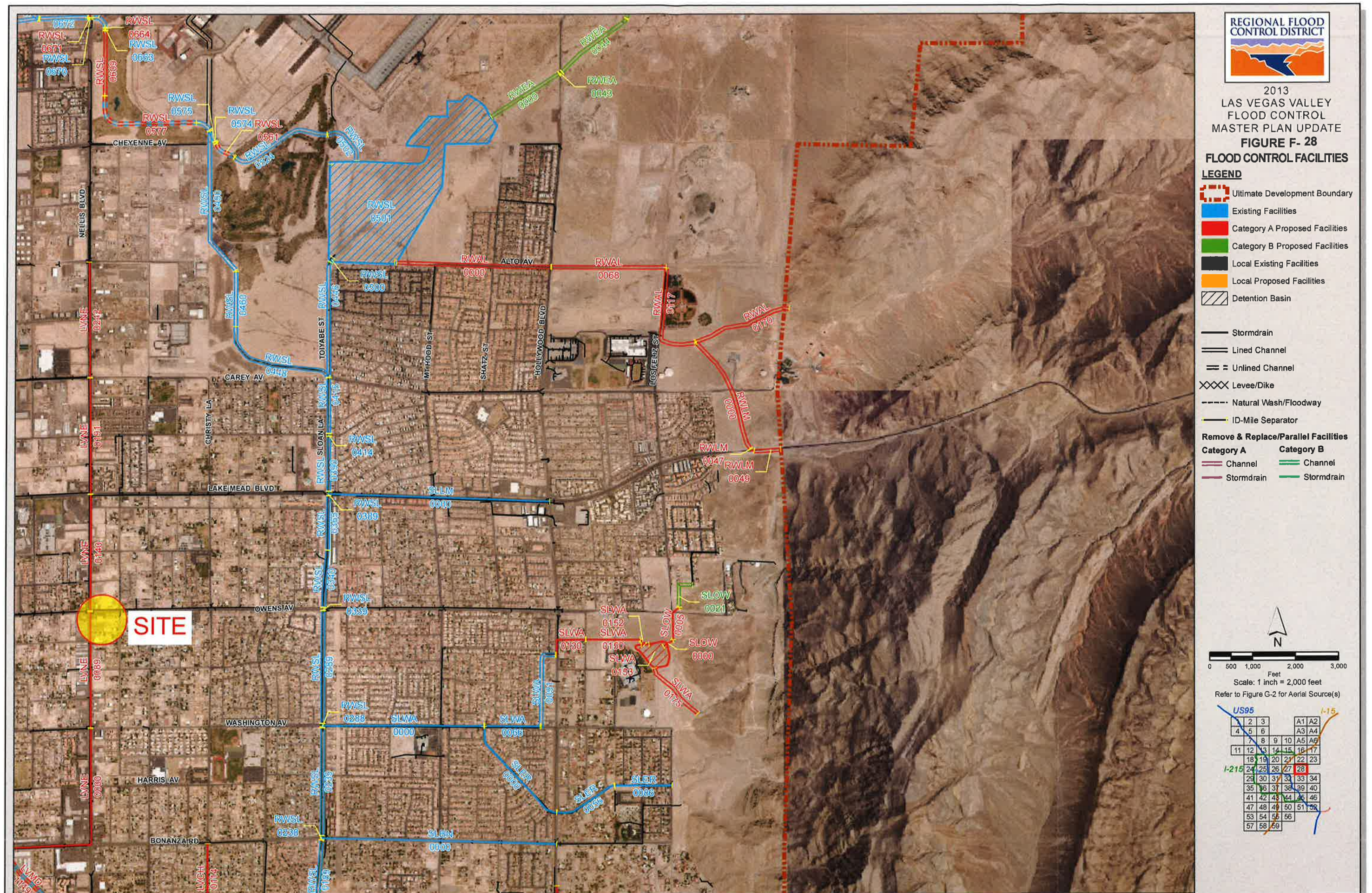


Figure 4



| ID / River Mile | Status | Facility Description                                             | Length (ft.) | Flow (cfs) | HEC-1 Node | HEC-1 Model | Tributary Area (sq.mi.) | Channel Slope (%) ** |
|-----------------|--------|------------------------------------------------------------------|--------------|------------|------------|-------------|-------------------------|----------------------|
| LVCH 0114       | P1     | RANGE WASH - CHRISTY LATERAL<br>10' X 7' RCB                     | 2600         | 649        | C324-5     | RW3         | 1.60                    | 0.58                 |
| LVNE 0000       | P1     | LAS VEGAS WASH - NELLIS<br>2: 13' X 10' RCB                      | 4675         | 2303       | CNEL02-C   | WEST3       | 3.39                    | 0.20                 |
| 0089            | P1     | 13' X 12' RCB                                                    | 2700         | 2187       | CNEL01-C   | WEST3       | 3.11                    | 0.37                 |
| 0140            | P1     | 13' X 12' RCB                                                    | 2700         | 2094       | COA03-C    | WEST3       | 2.83                    | 0.37                 |
| 0191            | P1     | 12' X 11' RCB                                                    | 2700         | 1745       | CLV53-2    | WEST3       | 2.27                    | 0.40                 |
| 0242            | P1     | 12' X 9' RCB                                                     | 2700         | 1367       | C321A-3    | WEST3       | 1.72                    | 0.56                 |
| RWAL 0000       | P1     | ALTO CONVEYANCE<br>Conc Chnl 12'W 7'D 2:1 SS                     | 3600         | 2770       | C318D2     | RW3         | 3.38                    | 1.81                 |
| 0068            | P1     | Conc Chnl 12'W 6.5'D 2:1 SS                                      | 2700         | 2770       | C318D2     | RW3         | 3.38                    | 2.78                 |
| 0117            | P1     | Conc Chnl 12'W 7.5'D 2:1 SS                                      | 2500         | 2674       | C318C      | RW3         | 3.11                    | 1.00                 |
| 0170            | P1     | Conc Chnl 12'W 5'D 2:1 SS                                        | 2340         | 1445       | 318B       | RW3         | 1.59                    | 2.92                 |
| RWEA 0000       | P0     | RANGE WASH - EAST TRIBUTARY<br>Conc Chnl 25'W 7'D 2:1 SS         | 1925         | 4033       | C318A2     | RW3SC       | 3.91                    | 0.95                 |
| 0043            | P0     | 4: 10' X 8' RCBC @ Hollywood                                     | 80           | 4033       | C318A2     | RW3SC       | 3.91                    | 0.95                 |
| 0044            | P0     | Conc Chnl 25'W 6.5'D 2:1 SS                                      | 1930         | 3230       | CC317-3    | RW3SC       | 2.66                    | 0.95                 |
| 0070            | P0     | Conc Chnl 25'W 7'D 2:1 SS                                        | 3565         | 2473       | C317-4     | RW3SC       | 2.07                    | 0.38                 |
| RWLM 0000       | P1     | LAKE MEAD CONVEYANCE TO ALTO SYSTEM<br>Conc Chnl 12'W 5'D 2:1 SS | 2900         | 1303       | 318E       | RW3         | 0.93                    | 4.67                 |
| 0047            | P1     | 12' X 6' RCBC @ Lake Mead                                        | 100          | 1303       | 318E       | RW3         | 0.93                    | 4.67                 |
| 0049            | P1     | Conc Chnl 12'W 5'D 2:1 SS                                        | 620          | 1303       | 318E       | RW3         | 0.93                    | 4.67                 |
| RWSL 0189       | E      | RANGE WASH - SLOAN<br>Conc Chnl 60'W 8'D 2:1 SS                  | 2590         | 3710       | C324-1     | SLOAN3      | 6.14                    | 0.32                 |
| 0238            | E      | 5: 10' X 5' RCBC @ Bonanza                                       | 100          | 3221       | C324-2     | SLOAN3      | 5.36                    | 0.58                 |
| 0239            | E      | Conc Chnl 60'W 8'D 2:1 SS                                        | 2600         | 3221       | C324-2     | SLOAN3      | 5.36                    | 0.19                 |
| 0288            | E      | 3 Span Bridge 54'W 7'D @ Washington Ave                          | 100          | 2687       | C324-3     | CONFDB      | 24.22                   | 0.19                 |
| 0289            | E      | Conc Chnl 60'W 8'D 2:1 SS                                        | 2700         | 2687       | C324-3     | CONFDB      | 24.22                   | 0.19                 |
| 0339            | E      | 3: 9' X 5' RCBC & 3: 7' X 5' RCBC @ Owens                        | 75           | 2555       | C324-4     | CONFDB      | 23.70                   | 0.60                 |
| 0340            | E      | Conc Chnl 48'W 6'D 2:1 SS                                        | 1350         | 2555       | C324-4     | CONFDB      | 23.70                   | 0.80                 |
| 0365            | E      | Conc Chnl 48'W 7'D 3:1 SS                                        | 1300         | 2555       | C324-4     | CONFDB      | 23.70                   | 0.80                 |
| 0389            | E      | 5: 12' X 5' RCBC @ Lake Mead                                     | 100          | 2311       | C48A1      | CONFDB      | 22.22                   | 0.36                 |
| 0390            | E      | Conc Chnl 38'W 6'D 3:1 SS                                        | 1290         | 2311       | C48A1      | CONFDB      | 22.22                   | 0.36                 |
| 0414            | E      | 4: 12' X 5.5' RCBC @ Judson Ave                                  | 60           | 2311       | C48A1      | CONFDB      | 22.22                   | 0.45                 |
| 0415            | E      | Conc Chnl 38'W 6'D 3:1 SS                                        | 1290         | 2311       | C48A1      | CONFDB      | 22.22                   | 0.36                 |
| 0446            | E      | Conc Chnl 20'W 6'D 2:1 SS                                        | 2650         | 1073       | C318D1     | CONFDB      | 20.75                   | 0.38                 |
| 0448            | E      | Conc Chnl 30'W 8'D 2:1 SS                                        | 2641         | 1831       | C321-1     | RW4SC       | 11.83                   | 0.17                 |
| 0460            | E      | Conc Chnl 14'W 8.5'D 2:1 SS                                      | 1760         | 1831       | C321-1     | RW4SC       | 11.83                   | 0.18                 |
| 0490            | E      | Conc Chnl 14'W 8.5'D 2:1 SS                                      | 3460         | 1668       | SLOAN      | RW4SC       | 10.94                   | 0.42                 |
| 0499            | E      | 72,000 cfs PMF Spillway                                          |              | 72000      | CCONDB     | RW5SC       | 20.23                   |                      |
| 0500            | E      | 2: 8' X 7' RCB Outlet                                            | 126          | 1038       | CONFDB     | RW5SC       | 20.23                   |                      |
| 0501            | E      | 1,025 ac-ft Confluence Detention Basin                           |              | 6081       | CCONDB     | RW5SC       | 20.23                   |                      |
| 0502            | E      | Grass Chnl 60'W 8'D 3:1 SS                                       | 1100         | 4377       | D2C47B3*   | RW4SC       | 10.94                   | 0.37                 |
| 0524            | E      | Grass Chnl 60'W 8'D 3:1 SS                                       | 2400         | 4377       | D2C47B3    | RW4SC       | 10.94                   | 0.37                 |
| 0560            | E      | Earth Chnl 50'W 8'D 3:1 SS (Replace w/ RWSL0561)                 | 580          | 4377       | D2C47B3    | RW4SC       | 10.94                   | 0.37                 |
| 0561            | P1     | Conc Chnl 55'W 6.5'D 2:1 SS (Replaces RWSL0560)                  | 580          | 4377       | D2C47B3    | RW4SC       | 10.94                   | 0.37                 |
| 0574            | E      | 2 Span Bridge 24'W                                               | 50           | 4377       | D2C47B3    | RW4SC       | 10.94                   | 0.38                 |
| 0575            | E      | Diversion Structure                                              | 280          | 4377       | D2C47B3    | RW4SC       | 10.94                   |                      |
| 0576            | E      | Earth Chnl 16'W 9'D 2:1 SS (Replace w/ RWSL0577)                 | 2630         | 5187       | CCSLNL     | RW4SC       | 8.62                    | 0.38                 |
| 0577            | P1     | Conc Chnl 40'W 8'D 2:1 SS (Replaces RWSL0576)                    | 2630         | 5187       | CCSLNL     | RW4SC       | 8.62                    | 0.38                 |
| 0609            | P1     | Conc Chnl 30'W 9'D 2:1 SS                                        | 1440         | 5187       | CCSLNL     | RW4SC       | 8.62                    | 0.38                 |
| 0663            | E      | 3: 10' X 8' RCBC @ Tyndall Street                                | 80           | 3080^      | CCSLNL^    | RW4SC       | 8.62                    | 0.38                 |
| 0664            | P1     | Add 4: 10' X 7' RCBC @ Tyndall Street                            | 60           | 2107^      | CCSLNL^    | RW4SC       | 8.62                    | 0.38                 |
| 0665            | E      | Conc Chnl 16'W 9'D 1.5:1 SS                                      | 435          | 5187       | CCSLNL     | RW4SC       | 8.62                    | 0.56                 |
| 0670            | E      | 3: 10' X 7' RCBC @ Nellis                                        | 100          | 3178^      | CCSLNL^    | RW4SC       | 8.62                    | 0.56                 |
| 0671            | P1     | Add 3: 12' X 7' RCBC @ Nellis                                    | 100          | 2009^      | CCSLNL^    | RW4SC       | 8.62                    | 0.56                 |
| 0672            | E      | Conc Chnl 14'W 8'D 1.5:1 SS                                      | 1130         | 2924       | CC47C-4    | RW3SC       | 3.94                    | 0.56                 |
| SLBN 0000       | E      | BONANZA ROAD CONVEYANCE<br>72" RCP                               | 5400         | 615        | C50B1      | RW3         | 0.56                    | 1.85                 |

| ID / River Mile | Status | Facility Description                                        | Length (ft.) | Flow (cfs) | HEC-1 Node | HEC-1 Model | Tributary Area (sq.mi.) | Channel Slope (%) ** |
|-----------------|--------|-------------------------------------------------------------|--------------|------------|------------|-------------|-------------------------|----------------------|
| SLER 0000       | E      | EASTRIDGE CONVEYANCE TO WASHINGTON SYSTEM<br>8' X 4.5' RCAP | 2740         | 901        | C49E5      | RW3         | 0.64                    | 1.78                 |
| 0056            | E      | 60" RCP                                                     | 1500         | 901        | C49E5      | RW3         | 0.64                    | 2.61                 |
| 0086            | E      | 78" CMP                                                     | 1350         | 623        | 49D        | RW3         | 0.35                    | 3.73                 |
| SLLM 0000       | E      | LAKE MEAD CONVEYANCE<br>48" RCP                             | 5100         | 601        | 48B        | RW3         | 0.39                    | 2.60                 |
| SLNL 0000       | P1     | NELLIS STORMDRAIN<br>2: 12' X 11' RCB                       | 3400         | 3471       | CSLNL      | RW3         | 4.68                    | 0.44                 |
| SLOW 0000       | P1     | OWENS CONVEYANCE TO WASHINGTON SYSTEM<br>6' X 6' RCB        | 270          | 317        | COW2       | RW3         | 0.23                    | 3.60                 |
| 0005            | P1     | 6' X 6' RCB                                                 | 830          | 317        | COW2       | RW3         | 0.23                    | 1.70                 |
| 0021            | P0     | Conc Chnl 12'W 3.5'D 2:1 SS                                 | 860          | 317        | COW2       | RW3         | 0.23                    | 7.50                 |
| SLST 0104       | P1     | STEWART AVENUE CONVEYANCE<br>6' X 6' RCB                    | 1700         | 408        | 20R-2      | RW3         | 0.41                    | 1.00                 |
| SLWA 0000       | E      | WASHINGTON AVENUE CONVEYANCE / DETENTION<br>11' X 8.1' RCAP | 3750         | 1195       | C49E1      | RW3         | 1.92                    | 0.60                 |
| 0066            | E      | 10' X 6' RCAP                                               | 1300         | 168        | C49E3      | RW3         | 1.03                    | 4.10                 |
| 0091            | E      | Conc Chnl 10'W 5'D 2:1 SS                                   | 1950         | 168        | C49E3      | RW3         | 1.03                    | 0.40                 |
| 0130            | P1     | 48" RCP                                                     | 1050         | 60         | OWENSOT    | RW3         | 0.87                    | 4.10                 |
| 0150            | P1     | 36" RCP                                                     | 1270         | 60         | OWENSOT    | RW3         | 0.87                    | 4.10                 |
| 0151            | P1     | 13,610 cfs PMF Spillway                                     |              | 13610      | OWENSIN    | RW3         | 0.87                    |                      |
| 0152            | P1     | 24" RCP Outlet                                              | 150          | 60         | OWENSDB    | RW3         | 0.87                    |                      |
| 0153            | P1     | 88 ac-ft Owens Detention Basin                              |              | 1288       | OWENSIN    | RW3         | 0.87                    |                      |
| 0175            | P1     | Conc Chnl 12'W 3.5' D 2:1 SS                                | 1500         | 779        | OW4        | RW3         | 0.52                    | 7.50                 |

\* The HEC-1 node shown identifies the controlling concentration point for the associated facility and is located upstream of this facility due to decreasing peak flow with increasing tributary area caused by storm distribution transitions, depth area reduction factors, or attenuation of flow from routing.

\*\* As-built or design slopes were used when available. All other slopes are based on existing topography. The user should verify the facility slope listed prior to performing any facility specific analysis.

^ For parallel facilities, the existing facility flow equals its normal depth capacity, and the proposed parallel facility flow equals the remaining flow (i.e., HEC-1 Node flow = existing facility normal depth capacity + proposed parallel facility flow).



2013 LAS VEGAS VALLEY  
FLOOD CONTROL  
MASTER PLAN UPDATE  
FACILITY INVENTORY  
FIGURE F - 28

|                            |                                                      |       |
|----------------------------|------------------------------------------------------|-------|
| L<br>E<br>G<br>E<br>N<br>D | ID (Facility Identifier)                             | AABB  |
|                            | Parent Stream Name                                   |       |
|                            | Stream Name                                          |       |
|                            | River Mile                                           | 0000  |
|                            | Distance Above Confluence with Parent Stream (Miles) |       |
|                            | Miles in Hundredths                                  |       |
|                            | Existing Facility.....                               | E     |
|                            | Proposed or Modified Facility.....                   | P     |
|                            | Contingency Level                                    |       |
|                            | Category B.....                                      | P0    |
|                            | Master Plan.....                                     | P1    |
|                            | Preliminary Design.....                              | P2    |
|                            | Design.....                                          | P3    |
|                            | Bottom Width.....                                    | W     |
|                            | Depth.....                                           | D     |
|                            | Side Slope, H:V.....                                 | SS    |
|                            | Construction Features                                |       |
|                            | Cast in Place Concrete Pipe.....                     | CIPCP |
|                            | Corrugated Metal Arch Pipe Culvert.....              | CMPAC |
|                            | Corrugated Metal Pipe Culvert.....                   | CMPC  |
|                            | High Density Polyethylene.....                       | HDPE  |
|                            | Horizontal Elliptical Reinforced Concrete Pipe.....  | HERCP |
|                            | Reinforced Concrete Arch Pipe.....                   | RCAP  |
|                            | Reinforced Concrete Arch Culvert.....                | RCAC  |
|                            | Reinforced Concrete Box.....                         | RCB   |
|                            | Reinforced Concrete Box Culvert.....                 | RCBC  |
|                            | Reinforced Concrete Pipe.....                        | RCP   |
|                            | Reinforced Concrete Pipe Culvert.....                | RPCP  |
|                            | Storm Sewer Pipe.....                                | SSP   |

Figure 4 cont'd





## 2018 Las Vegas Valley Master Plan Update

Figure W-3  
Lower Northern Las Vegas Wash Watershed

### Legend

- Flow Arrows
- Concentration Points
- Existing Facilities
- Category A Proposed Facilities
- Category B Proposed Facilities
- Ultimate Development Boundary
- Watershed
- Subbasins
- Soils
- 1: Undeveloped Land, Open desert
- 2: Parks, Golf Courses
- 3: Rural, 0.5-1 units per acre (uses 1 unit/acre)
- 4: Low-Density Residential, 1-2 units per acre (uses 2 units/acre)
- 5: Medium-Density Residential, 2-4 units per acre (uses 3 units/acre)
- 6: High-Density Residential, 4-8 units per acre (uses 6 units/acre)
- 7: Public Facility and Residential, 8-12 units/acre
- 8: Very High-Density Residential, 12 units/acre or more
- 9: Commercial, Retail, Casino, High Rise Condominiums
- 10: Light Industrial
- 11: Heavy Industrial
- 12: Schools
- 13: Lakes



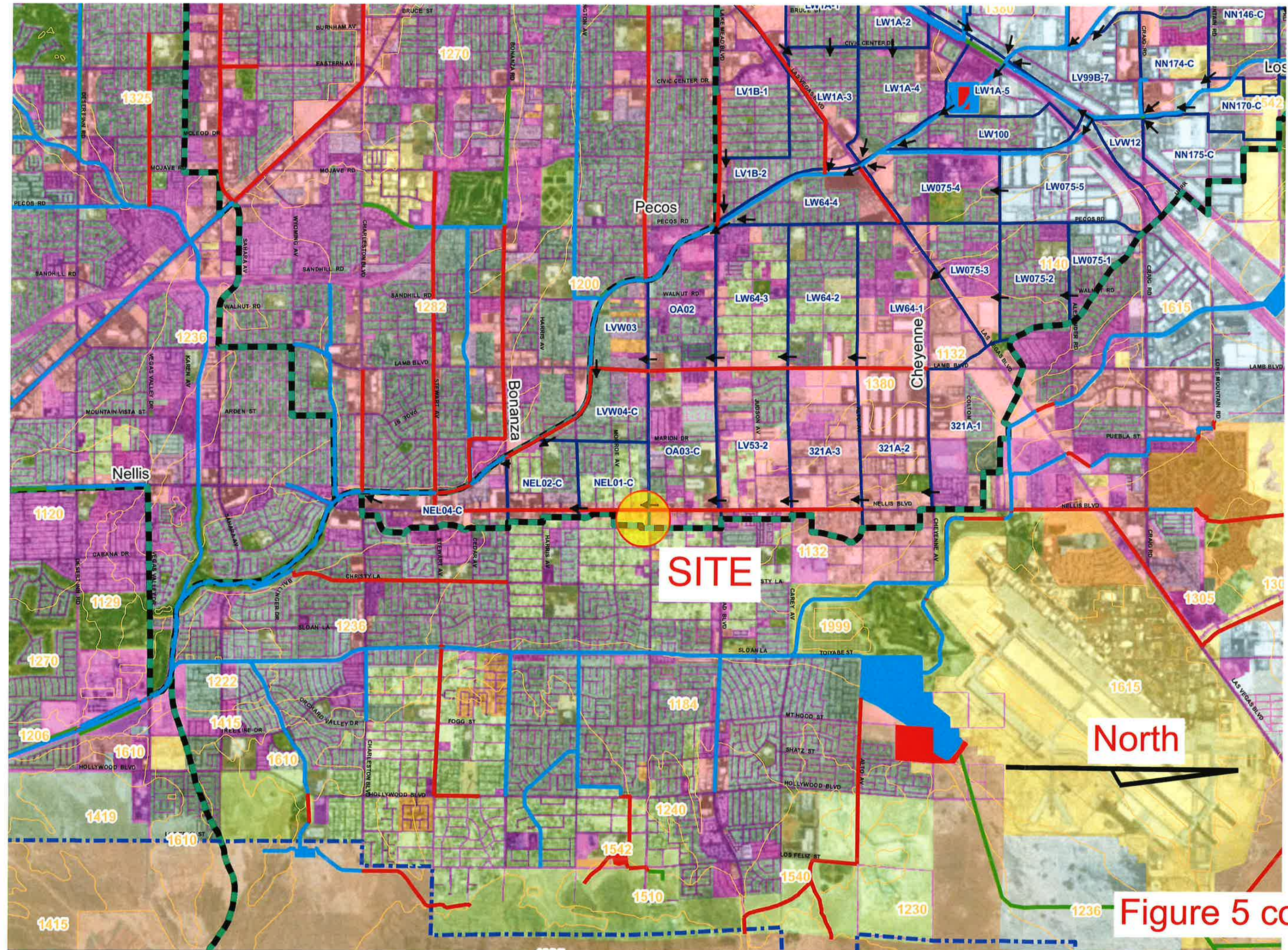
Scale: 1 inch = 1 mile  
0 0.5 1 2  
Miles

ATKINS  
Member of the SNC-Louis Berger Group



Figure 5









2018  
LAS VEGAS VALLEY  
FLOOD CONTROL  
MASTER PLAN UPDATE  
FIGURE F-26

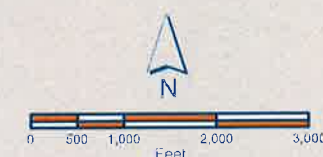
FLOOD CONTROL FACILITIES

LEGEND

- Ultimate Development Boundary
- Existing Facilities
- Category A Proposed Facilities
- Category B Proposed Facilities
- Local Existing Facilities
- Detention Basin
- Culvert or Bridge Crossing
- 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 |
| Crossing   | Crossing   |



Scale: 1 inch = 2,000 feet

AerialSource: Esri World Imagery 2017



ATKINS  
Member of the SNC-Lavalin Group

Louis Berger

Figure 6



| ID / Mile    | Status | Facility Description                                   | Length (ft.) | Flow (cfs) | HEC-1 Node | HEC-1 Model | Tributary Area (sq. mi.) | Channel Slope (%) ** |
|--------------|--------|--------------------------------------------------------|--------------|------------|------------|-------------|--------------------------|----------------------|
| LVBZ<br>0000 | P      | LAS VEGAS WASH - BONANZA                               |              |            |            |             |                          |                      |
| 0025         | P      | 2' 12" X 7' RCB                                        | 1760         | 1753       | CBN15-C    | SW3         | 2.15                     | 0.40                 |
| 0025         | P      | 2' 12" X 7' RCB                                        | 2700         | 1753       | CBN15-C    | SW3         | 2.15                     | 0.40                 |
| LVBZ<br>0114 | P      | RANGE WASH - CHRISTY LATERAL                           |              |            |            |             |                          |                      |
| 0114         | P      | 10' X 8' RCB                                           | 2800         | 1064       | C324-5     | RW3         | 1.60                     | 0.58                 |
| LVM0<br>1148 | E      | LAS VEGAS WASH - MIDDLE                                |              |            |            |             |                          |                      |
| 1148         | E      | EARTH CHNL 70'W 18'-20'D 1.5:1 SS (REPLACE W/LVM01148) | 1675         | 13812      | CCCCA10    | CLVWASH5    | 112.82                   | 0.41                 |
| 1148         | P      | CONC CHNL 70'W 10'D 1.5:1 SS (REPLACES LVM01148)       | 1675         | 13812      | CCCCA10    | CLVWASH5    | 112.82                   | 0.41                 |
| 1176         | E      | 5 SPAN BRIDGE 110'W 20'D 2:1 SS @ BONANZA              | 120          | 13206      | CLVW04-C   | CLVWASH5    | 109.77                   | 0.57                 |
| 1178         | E      | EARTH CHNL 30'W 18'-20'D 2:1 SS (REPLACE W/LVM01178)   | 1500         | 13206      | CLVW04-C   | CLVWASH5    | 109.77                   | 0.57                 |
| 1179         | P      | CONC CHNL 60'W 8.5'D 2:1 SS (REPLACES LVM01178)        | 1500         | 13206      | CLVW04-C   | CLVWASH5    | 109.77                   | 0.57                 |
| 1208         | E      | BANK-STAB CHNL 65'W 18'D 2:1 SS (REPLACE W/LVM01208)   | 1420         | 13206      | CLVW04-C   | CLVWASH5    | 109.77                   | 0.32                 |
| 1209         | P      | CONC CHNL 60'W 11'D 2:1 SS (REPLACES LVM01208)         | 1420         | 13206      | CLVW04-C   | CLVWASH5    | 109.77                   | 0.32                 |
| LVM0<br>0000 | P      | LAS VEGAS WASH - NELLIS                                |              |            |            |             |                          |                      |
| 0000         | P      | 2' 11" X 10' RCB                                       | 6100         | 2747       | CCS103-C   | WEST3       | 3.69                     | 0.30                 |
| 0089         | P      | 13' X 13' RCB                                          | 2700         | 2351       | CNEL01-C   | WEST3       | 3.11                     | 0.37                 |
| 0140         | P      | 13' X 13' RCB                                          | 2700         | 2208       | COA03-C    | WEST3       | 2.83                     | 0.37                 |
| 0191         | P      | 12' X 11' RCB                                          | 2700         | 1806       | CLV53-2    | WEST3       | 2.27                     | 0.40                 |
| 0242         | P      | 12' X 8' RCB                                           | 2700         | 1416       | C321A-3    | WEST3       | 1.72                     | 0.56                 |
| RWAL<br>0000 | P      | ALTO CONVEYANCE                                        |              |            |            |             |                          |                      |
| 0000         | P      | 14' X 7' RCB                                           | 3600         | 2256       | C318D2     | RW3         | 3.38                     | 1.81                 |
| 0068         | P      | 14' X 6' RCB                                           | 2700         | 2256       | C318D2     | RW3         | 3.38                     | 2.78                 |
| 0117         | P      | CONC CHNL 12'W 7'D 2:1 SS                              | 2500         | 2160       | C318C      | RW3         | 3.11                     | 1.00                 |
| 0170         | P      | CONC CHNL 12'W 4.5'D 2:1 SS                            | 2340         | 1139       | 318B       | RW3         | 1.56                     | 2.92                 |
| RWEA<br>0000 | P0     | RANGE WASH - EAST TRIBUTARY                            |              |            |            |             |                          |                      |
| 0000         | P0     | CONC CHNL 25'W 12'D 2:1 SS                             | 7400         | 8081       | C318A2     | RW5SC       | 27.64                    | 0.38                 |
| RWLM<br>0000 | P      | LAKE MEAD CONVEYANCE TO ALTO SYSTEM                    |              |            |            |             |                          |                      |
| 0000         | P      | CONC CHNL 12'W 4.5'D 2:1 SS                            | 2850         | 1170       | 318E       | RW3         | 0.93                     | 4.67                 |
| 0047         | P      | 12' X 5' RCB @ LAKE MEAD                               | 100          | 1170       | 318E       | RW3         | 0.93                     | 4.67                 |
| 0049         | P      | CONC CHNL 12'W 4.5'D 2:1 SS                            | 620          | 1170       | 318E       | RW3         | 0.93                     | 4.67                 |
| RWSL<br>0189 | E      | RANGE WASH - SLOAN                                     |              |            |            |             |                          |                      |
| 0238         | E      | CONC CHNL 60'W 6'D 2:1 SS                              | 2590         | 3195       | C324-1     | SLOAN3      | 6.13                     | 0.32                 |
| 0238         | E      | 5' 10" X 5' RCB @ BONANZA                              | 100          | 2884       | C324-2     | RW5SC       | 16.29                    | 0.58                 |
| 0238         | E      | CONC CHNL 60'W 6'D 2:1 SS                              | 2600         | 2884       | C324-2     | RW5SC       | 16.29                    | 0.19                 |
| 0288         | E      | 3 SPAN BRIDGE 54'W 7'D @ WASHINGTON AVE                | 100          | 2616       | C324-3     | RW5SC       | 14.91                    | 0.19                 |
| 0289         | E      | CONC CHNL 60'W 6'D 2:1 SS                              | 2700         | 2616       | C324-3     | RW5SC       | 14.91                    | 0.19                 |
| 0338         | E      | 3' 9" X 5' RCB @ OWENS                                 | 75           | 2487       | C324-4     | RW5SC       | 14.39                    | 0.60                 |
| 0340         | E      | CONC CHNL 48'W 6'D 2:1 SS                              | 1350         | 2487       | C324-4     | RW5SC       | 14.39                    | 0.60                 |
| 0365         | E      | CONC CHNL 48'W 7'D 3:1 SS                              | 1300         | 2487       | C324-4     | RW5SC       | 14.39                    | 0.60                 |
| 0389         | E      | 5' 12" X 5' RCB @ LAKE MEAD                            | 100          | 2088       | C48A1      | RW5SC       | 12.92                    | 0.36                 |
| 0380         | E      | CONC CHNL 38'W 6'D 3:1 SS                              | 1280         | 2088       | C48A1      | RW5SC       | 12.92                    | 0.36                 |
| 0414         | E      | 4' 12" X 5.5' RCB @ JUDSON AVE                         | 60           | 2088       | C48A1      | RW5SC       | 12.92                    | 0.45                 |
| 0415         | E      | CONC CHNL 38'W 6'D 3:1 SS                              | 1280         | 1947       | C321-1*    | RW4SC       | 11.82                    | 0.36                 |
| 0446         | E      | CONC CHNL 20'W 6'D 2:1 SS                              | 2650         | 929        | CONFDB     | SPDWY5      | 46.36                    | 0.38                 |
| 0448         | E      | CONC CHNL 30'W 8'D 2:1 SS                              | 2641         | 1947       | C321-1     | RW4SC       | 11.82                    | 0.17                 |
| 0460         | E      | CONC CHNL 14'W 8.5'D 2:1 SS                            | 1760         | 1847       | C321-1     | RW4SC       | 11.82                    | 0.18                 |
| 0480         | E      | CONC CHNL 14'W 8.5'D 2:1 SS                            | 3460         | 1693       | SLOAN      | RW4SC       | 10.93                    | 0.42                 |
| 0489         | E      | 72,000 CFS PMF SPILLWAY                                | 72000        | CCONDB     | SPDWY5     | 46.36       |                          |                      |
| 0500         | E      | 2' 8" X 7' RCB OUTLET                                  | 126          | 929        | CONFDB     | SPDWY5      | 46.36                    | 0.38                 |
| 0501         | E      | 1,025 AC-FT CONFLUENCE DETENTION BASIN                 |              | 10671      | CCONDB     | SPDWY5      | 46.36                    |                      |
| 0502         | E      | GRASS CHNL 60'W 6'D 3:1 SS                             | 1100         | 4553       | D2C47B3*   | RW4SC       | 10.93                    | 0.37                 |
| 0503         | P      | UPGRADE TO 1945 AC-FT CONFLUENCE DETENTION BASIN       |              | 10671      | CCONDB     | SPDWY5      | 46.36                    |                      |
| 0524         | E      | GRASS CHNL 60'W 6'D 3:1 SS                             | 2400         | 4553       | D2C47B3*   | RW4SC       | 10.93                    | 0.37                 |
| 0560         | E      | EARTH CHNL 50'W 6'D 3:1 SS (REPLACE W/RW5L0561)        | 580          | 4553       | D2C47B3    | RW4SC       | 10.93                    | 0.37                 |
| 0561         | P      | CONC CHNL 55'W 6.5'D 2:1 SS (REPLACES RW5L0560)        | 580          | 4553       | D2C47B3    | RW4SC       | 10.93                    | 0.37                 |
| 0574         | E      | 2 SPAN BRIDGE 24'W 10'D                                | 50           | 4553       | D2C47B3    | RW4SC       | 10.93                    | 0.38                 |
| 0575         | E      | DIVERSION STRUCTURE                                    | 280          | 4553       | D2C47B3    | RW4SC       | 10.93                    |                      |
| 0576         | E      | EARTH CHNL 16'W 8'D 2:1 SS (REPLACE W/RW5L0577)        | 2630         | 5218       | CCSLNL     | RW4SC       | 8.62                     | 0.38                 |
| 0577         | P      | CONC CHNL 40'W 8'D 2:1 SS (REPLACES RW5L0576)          | 2630         | 5218       | CCSLNL     | RW4SC       | 8.62                     | 0.38                 |
| 0609         | P      | CONC CHNL 30'W 8'D 2:1 SS                              | 1500         | 5218       | CCSLNL     | RW4SC       | 8.62                     | 0.38                 |
| 0663         | E      | 3' 10" X 8' RCB @ TYNDALL STREET                       | 60           | 3080*      | CCSLNL^    | RW4SC       | 8.62                     | 0.38                 |
| 0664         | P      | ADD 4' 10" X 7' RCB @ TYNDALL STREET                   | 60           | 2138*      | CCSLNL^    | RW4SC       | 8.62                     | 0.38                 |

| ID / Mile    | Status | Facility Description                      | Length (ft.) | Flow (cfs) | HEC-1 Node | HEC-1 Model | Tributary Area (sq. mi.) | Channel Slope (%) ** |
|--------------|--------|-------------------------------------------|--------------|------------|------------|-------------|--------------------------|----------------------|
| RWSL<br>0665 | E      | RANGE WASH - SLOAN                        |              |            |            |             |                          |                      |
| 0670         | E      | CONC CHNL 16'W 8'D 1.5:1 SS               | 435          | 5218       | CCSLNL     | RW4SC       | 8.62                     | 0.56                 |
| 0671         | P      | ADD 3' 12" X 7' RCB @ NELLIS              | 100          | 3178*      | CCSLNL^    | RW4SC       | 8.62                     | 0.56                 |
| 0672         | E      | CONC CHNL 14'W 8'D 1.5:1 SS               | 1130         | 2933       | CC47C-4    | RW3SC       | 3.94                     | 0.56                 |
| 0694         | E      | CONC CHNL 10'W 8'D 1.5:1 SS               | 1500         | 1686       | C47C4      | RW3SC       | 2.40                     | 0.56                 |
| 0727         | E      | 3' 10" X 8' RCB                           | 100          | 1592       | C307E3     | RW3SC       | 2.25                     | 0.56                 |
| 0728         | E      | CONC CHNL 12'W 8.5'D 1.5:1 SS             | 1345         | 1592       | C307E3     | RW3SC       | 2.25                     | 0.56                 |
| SLBN<br>0000 | E      | BONANZA ROAD CONVEYANCE                   |              |            |            |             |                          |                      |
| 0000         | E      | 72" RCP                                   | 5400         | 462        | C50B1      | RW3         | 0.54                     | 1.85                 |
| SLEB<br>0000 | E      | SLOAN CHANNEL EAST BRANCH                 |              |            |            |             |                          |                      |
| 0000         | E      | CONC CHNL 10'W 8'D 1.5:1 SS               | 840          | 1345       | C310B2     | RW3         | 1.54                     | 0.43                 |
| SLEB<br>0000 | E      | EASTRIDGE CONVEYANCE TO WASHINGTON SYSTEM |              |            |            |             |                          |                      |
| 0000         | E      | 8' X 4.5' RCAP                            | 2740         | 695        | C49E5      | RW3         | 0.64                     | 1.78                 |
| 0056         | E      | 80" RCP                                   | 1500         | 695        | C49E5      | RW3         | 0.64                     | 2.81                 |
| 0085         | E      | 78" CMP                                   | 1350         | 507        | 49D        | RW3         | 0.35                     | 3.73                 |
| SLLM<br>0000 | E      | LAKE MEAD CONVEYANCE                      |              |            |            |             |                          |                      |
| 0000         | E      | 48" RCP                                   | 5100         | 574        | C48B       | RW3         | 0.55                     | 2.60                 |
| SLNL<br>0000 | P      | NELLIS STORMDRAIN                         |              |            |            |             |                          |                      |
| 0000         | P      | 2' 12" X 11' RCB                          | 3530         | 3508       | CCSLNL     | RW3         | 4.68                     | 0.44                 |
| SLOW<br>0000 | P      | OWENS CONVEYANCE TO WASHINGTON SYSTEM     |              |            |            |             |                          |                      |
| 0000         | P      | 8' X 6' RCB                               | 270          | 304        | COW2       | RW3         | 0.23                     | 3.80                 |
| 0005         | P      | 8' X 6' RCB                               | 830          | 304        | COW2       | RW3         | 0.23                     | 1.70                 |
| 0021         | P0     | CONC CHNL 12'W 3.5'D 2:1 SS               | 860          | 304        | COW2       | RW3         | 0.23                     | 7.50                 |
| SLWA<br>0000 | E      | WASHINGTON AVENUE CONVEYANCE/DETENTION    |              |            |            |             |                          |                      |
| 0056         | E      | 11' X 8.1' RCAP                           | 3750         | 945        | C49E1      | RW3         | 1.92                     | 0.60                 |
| 0081         | E      | 10' X 6' RCAP                             | 1300         | 143        | C49E3      | RW3         | 1.03                     | 4.10                 |
| 0130         | P      | CONC CHNL 10'W 5'D 2:1 SS                 | 1950         | 143        | C49E3      | RW3         | 1.03                     | 0.40                 |
| 0150         | P      | 36" RCP                                   | 1050         | 57         | OWENSDB    | RW3         | 0.87                     | 4.10                 |
| 0151         | P      | 36" RCP                                   | 1270         | 57         | OWENSDB    | RW3         | 0.87                     | 4.10                 |
| 0151         | P      | 11,710 CFS PMF SPILLWAY                   |              | 11710      | OWENSIN    | RW3         | 0.87                     |                      |
| 0152         | P      | 24" RCP OUTLET                            | 150          | 57         | OWENSDB    | RW3         | 0.87                     | 4.10                 |
| 0153         | P      | 88 AC-FT OWENS DETENTION BASIN            |              | 1171       | OWENSIN    | RW3         | 0.87                     |                      |
| 0175         | P      | CONC CHNL 12'W 3.5'D 2:1 SS               | 1500         | 688        | OW4        | RW3         | 0.52                     | 7.50                 |

\*The HEC-1 node shown identifies the controlling concentration point for the associated facility and is located upstream of this facility due to decreasing peak flow with increasing tributary area caused by storm distribution transitions, depth area reduction factors, or attenuation of flow from routing.

\*\*As-built or design slopes were used when available. All other slopes are based on existing topography. The user should verify the facility slope listed prior to performing any facility specific analysis.

^ For parallel facilities, the existing facility flow equals its normal depth capacity, and the proposed parallel facility flow equals the remaining flow (i.e. HEC-1 Node flow = existing facility normal depth capacity + proposed parallel facility flow).



**2018 LAS VEGAS VALLEY  
FLOOD CONTROL  
MASTER PLAN UPDATE**

**FACILITY INVENTORY  
FIGURE F-26**

|   |                                                         |      |
|---|---------------------------------------------------------|------|
| L | ID (Facility Identifier)                                | AABB |
| E | Parent Stream Name                                      |      |
| G | Stream Name                                             |      |
| E | Mile                                                    | 0000 |
| N | Distance Above Confluence<br>with Parent Stream (Miles) |      |
| D | Miles in Hundredths                                     |      |

Existing Facility.....E  
Proposed or Modified Facility.....P  
Contingency Level  
Category A.....P  
Category B.....P0

Bottom Width..... W  
Depth..... D  
Side Slope, H:V..... SS

| Construction Features                               |       |
|-----------------------------------------------------|-------|
| Cast in Place Concrete Pipe.....                    | CIPCP |
| Corrugated Metal Arch Pipe Culvert.....             | CMAP  |
| Corrugated Metal Pipe Culvert.....                  | CMPC  |
| High Density Polyethylene.....                      | HDPE  |
| Horizontal Elliptical Reinforced Concrete Pipe..... | HERCP |
| Reinforced Concrete Arch Pipe.....                  | RCAP  |
| Reinforced Concrete Arch Culvert.....               | RCAC  |
| Reinforced Concrete Box.....                        | RCB   |
| Reinforced Concrete Box Culvert.....                | RCBC  |
| Reinforced Concrete Pipe.....                       | RCP   |
| Reinforced Concrete Pipe Culvert.....               | RCPC  |
| Storm Sewer Pipe.....                               | SSP   |



Figure 6 cont'd



Custom Soil Resource Report  
Soil Map

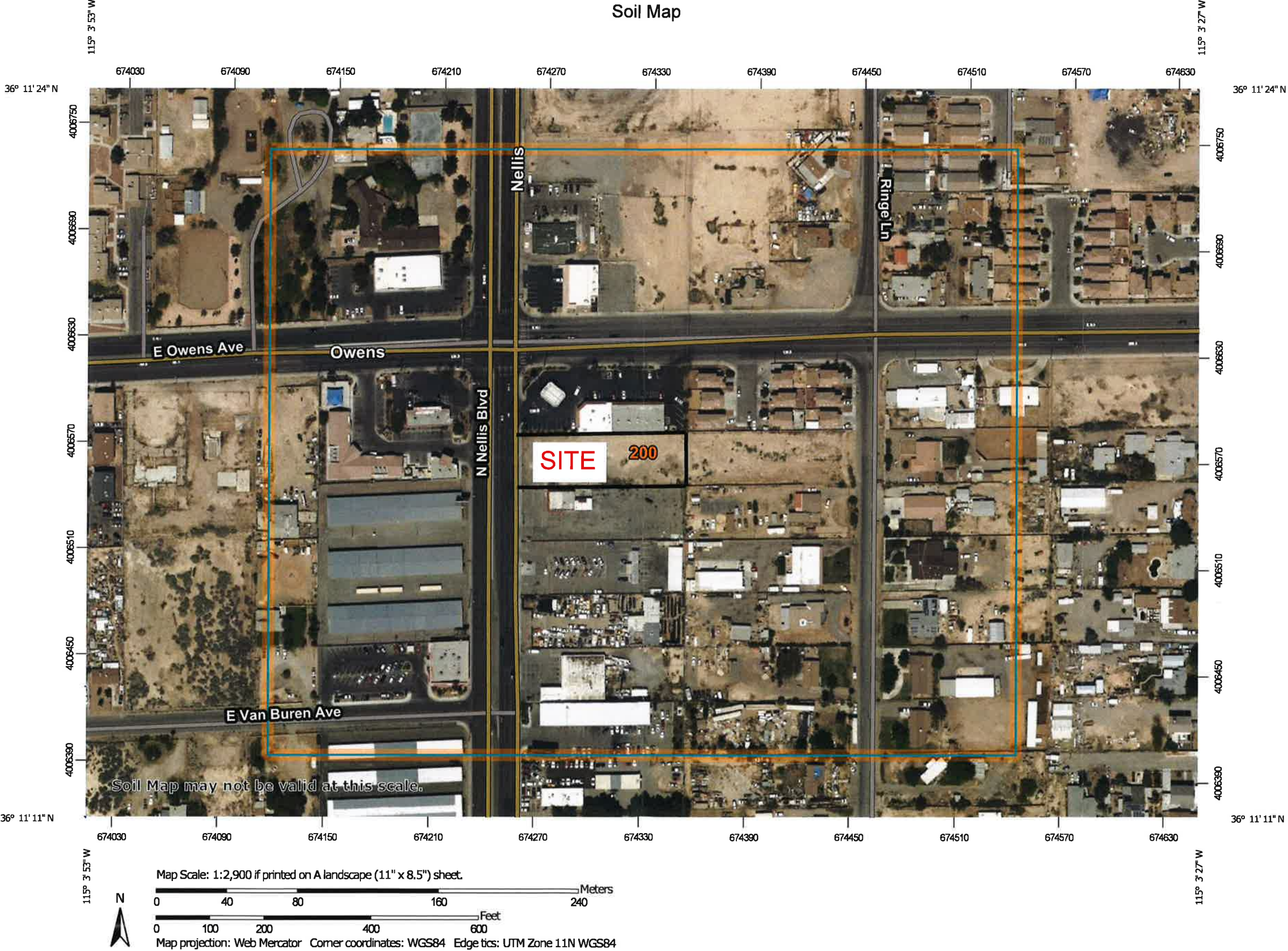


Figure 7



## Las Vegas Valley Area, Nevada, Part of Clark County

### 200—Glencarb silt loam

#### Map Unit Setting

*National map unit symbol:* hrb6  
*Elevation:* 1,500 to 2,400 feet  
*Mean annual precipitation:* 4 to 6 inches  
*Mean annual air temperature:* 64 to 70 degrees F  
*Frost-free period:* 180 to 250 days  
*Farmland classification:* Not prime farmland

#### Map Unit Composition

*Glencarb and similar soils:* 100 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

#### Description of Glencarb

##### Setting

*Landform:* Alluvial flats  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Mixed alluvium

##### Typical profile

*H1 - 0 to 6 inches:* silt loam  
*H2 - 6 to 60 inches:* stratified very fine sandy loam to silty clay loam

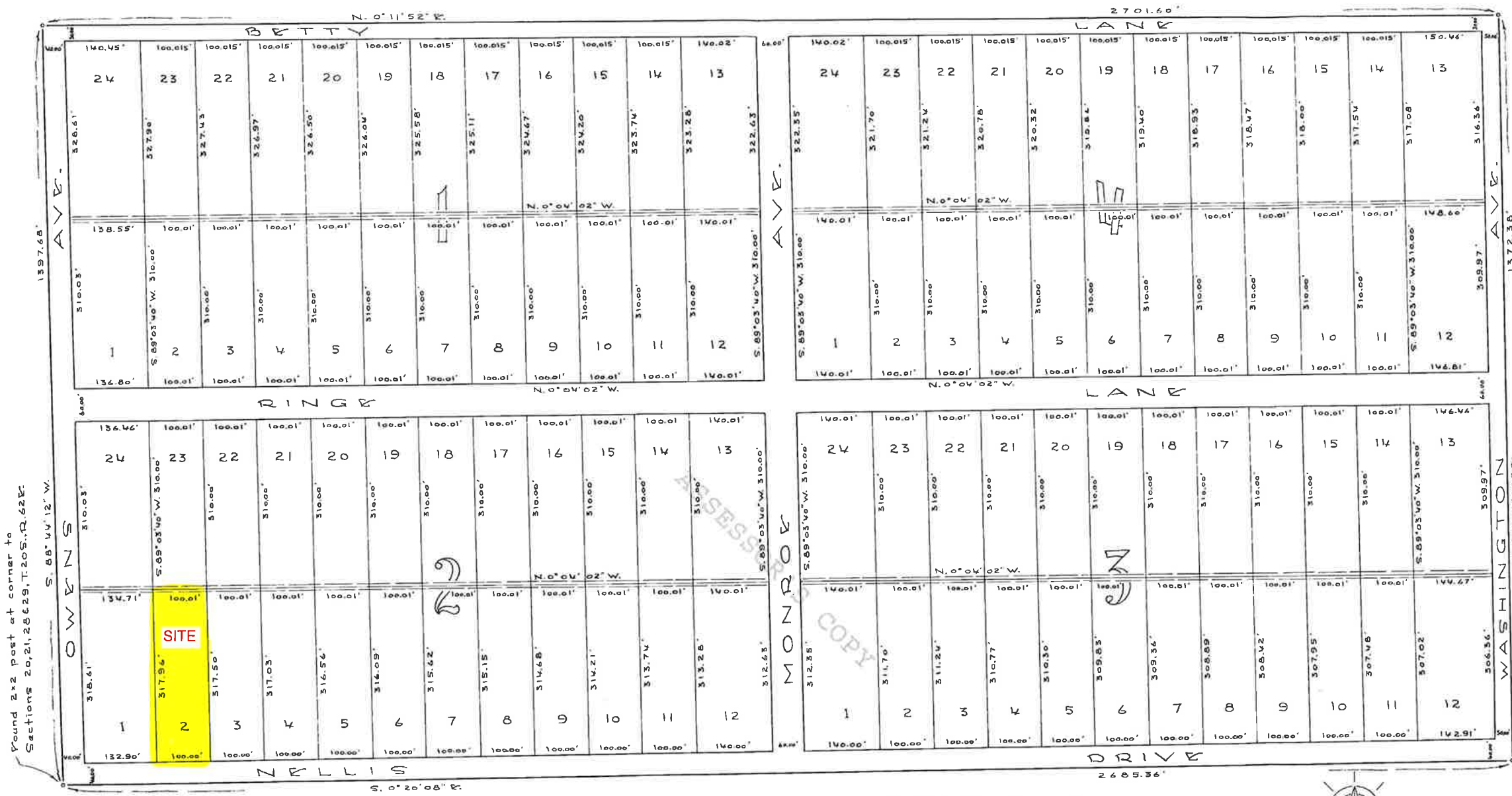
##### Properties and qualities

*Slope:* 0 to 2 percent  
*Depth to restrictive feature:* More than 80 inches  
*Drainage class:* Well drained  
*Runoff class:* Low  
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately low to moderately high (0.14 to 0.57 in/hr)  
*Depth to water table:* More than 80 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Calcium carbonate, maximum content:* 60 percent  
*Gypsum, maximum content:* 5 percent  
*Maximum salinity:* Slightly saline to moderately saline (4.0 to 8.0 mmhos/cm)  
*Sodium adsorption ratio, maximum:* 12.0  
*Available water supply, 0 to 60 inches:* High (about 10.9 inches)

##### Interpretive groups

*Land capability classification (irrigated):* 2s  
*Land capability classification (nonirrigated):* 7c  
*Hydrologic Soil Group:* C  
*Ecological site:* R030XY040NV - SODIC TERRACE  
*Other vegetative classification:* LOAMY BOTTOM (030XB020NV)  
*Hydric soil rating:* No





Found 2x2 post at corner to Sections 20, 21, 28, 29, T.20S., R.62E.

Position of quarter corner set from references in Clark Co. Eng's Office.

**ENGINEER'S CERTIFICATE**  
 I, Harlan Brown, do hereby certify that this plat is a true and accurate map of the land surveyed by me and laid out into blocks, lots and streets at the instance of BONNIE JO INC., a Nevada Corporation; that the location of said blocks, lots and streets have been definitely established and perpetuated in strict accordance with the law and as shown hereon, that the blocks, lots and streets shown hereon are situate wholly within the W 1/2 NW 1/4 Sec. 28, T.20S., R.62E., M.D.B.M.; that the survey was completed the 7th day of July, 1952.

*Harlan Brown*  
 REGISTERED CLARK COUNTY SURVEYOR NEV. #229  
**COUNTY SURVEYOR'S CERTIFICATE**  
 I, George C. Monahan, County Surveyor, Clark County, Nevada, do hereby certify that on the 21st day of July, 1952, did examine said final map; that the subdivision shown hereon is substantially the same as it appeared on the tentative map and any approved alteration thereof; that all provisions of the law and of any local ordinances applicable at the time of approval of the tentative map have been complied with, and that I am satisfied the map is technically correct.  
*George C. Monahan*  
 COUNTY SURVEYOR NEV. #231

**DEDICATION**  
 KNOW ALL MEN BY THESE PRESENTS, that BONNIE JO INC., a Nevada Corporation, owner of the property platted hereon, has caused the same to be surveyed and platted into blocks, lots and streets as shown hereon, and hereby dedicate the streets as shown, to and for the use of the public forever. Easements as shown are reserved for the construction and maintenance of public utilities. Such easements are to be free from all trees and other obstructions.  
 In witness whereof we have hereto set our hands and affixed the Corporate Seal this 19th day of JULY, 1952.  
*William L. Meikle* PRESIDENT  
*Grace Louise Meikle* SECRETARY  
**ACKNOWLEDGMENT**  
 STATE OF NEVADA } ss.  
 COUNTY OF CLARK }  
 On this 19th day of July, 1952, personally appeared before me William L. Meikle and Grace Louise Meikle to me known to be the President and Secretary respectively of BONNIE JO INC., and who executed the foregoing instrument, who acknowledged to me that they executed the same freely and voluntarily and for the purposes and uses therein mentioned.  
 MY COMMISSION EXPIRES JULY 30, 1954  
*P. D. Lane*  
 NOTARY PUBLIC IN AND FOR CLARK COUNTY, NEVADA

**LEGEND**  
 Bearings and distances are based on Plat of Survey on Page 9 Pile 1, R.R.E. Pile, Office of the Recorder, Clark County, Nevada.  
 • Indicates 6" dia. by 12" concrete monument with copper plug at exact point set 8" below surface.  
 ——— Indicates easement for utilities, five feet each side of property line.  
 Scale in Feet  
 0 50 100 200 400  
**APPROVALS**  
 Approved this 10th day of JULY, 1952, by the REGIONAL PLANNING COMMISSION OF CLARK COUNTY, NEVADA.  
*Leonard P. Taylor* CHAIRMAN  
 Approved and Accepted this 21st day of JULY, 1952, by the BOARD OF COUNTY COMMISSIONERS OF CLARK COUNTY, NEVADA.  
*Rodney Colton* CHAIRMAN  
*John Scott Reed* CLERK  
 Attest:

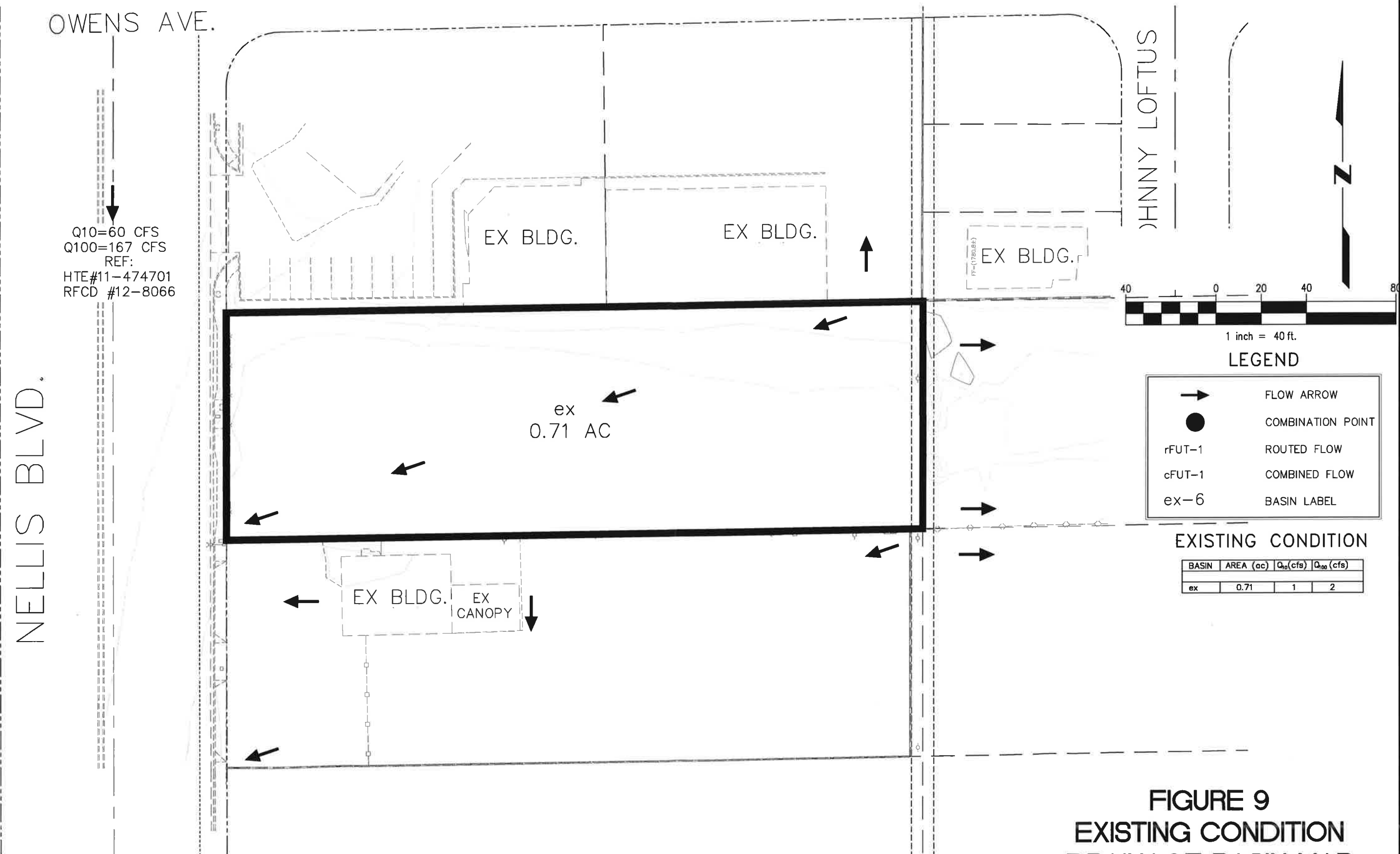
**MEIKLE MANOR TRACT 2**  
 CLARK COUNTY, NEVADA.  
 W 1/2 NW 1/4 Sec. 28, T.20S., R.62E.

Approved this 20th day of JULY, 1952, by the Las Vegas Union School District, Clark County, Nevada  
*Paul C. O'Malley, Registrar*  
 CHAIRMAN

No. 389670  
 Filed at Request of  
**HARLAN BROWN**  
 Date AUG 21-1952 At 4:30 P.M.  
 In Book 3, Page 15  
 of PLATS  
 Clark County, Nevada, Records  
 Paul C. O'Malley, Registrar  
 Fee \$ 5.00

Figure 8





**FIGURE 9**  
**EXISTING CONDITION**  
**DRAINAGE BASIN MAP**



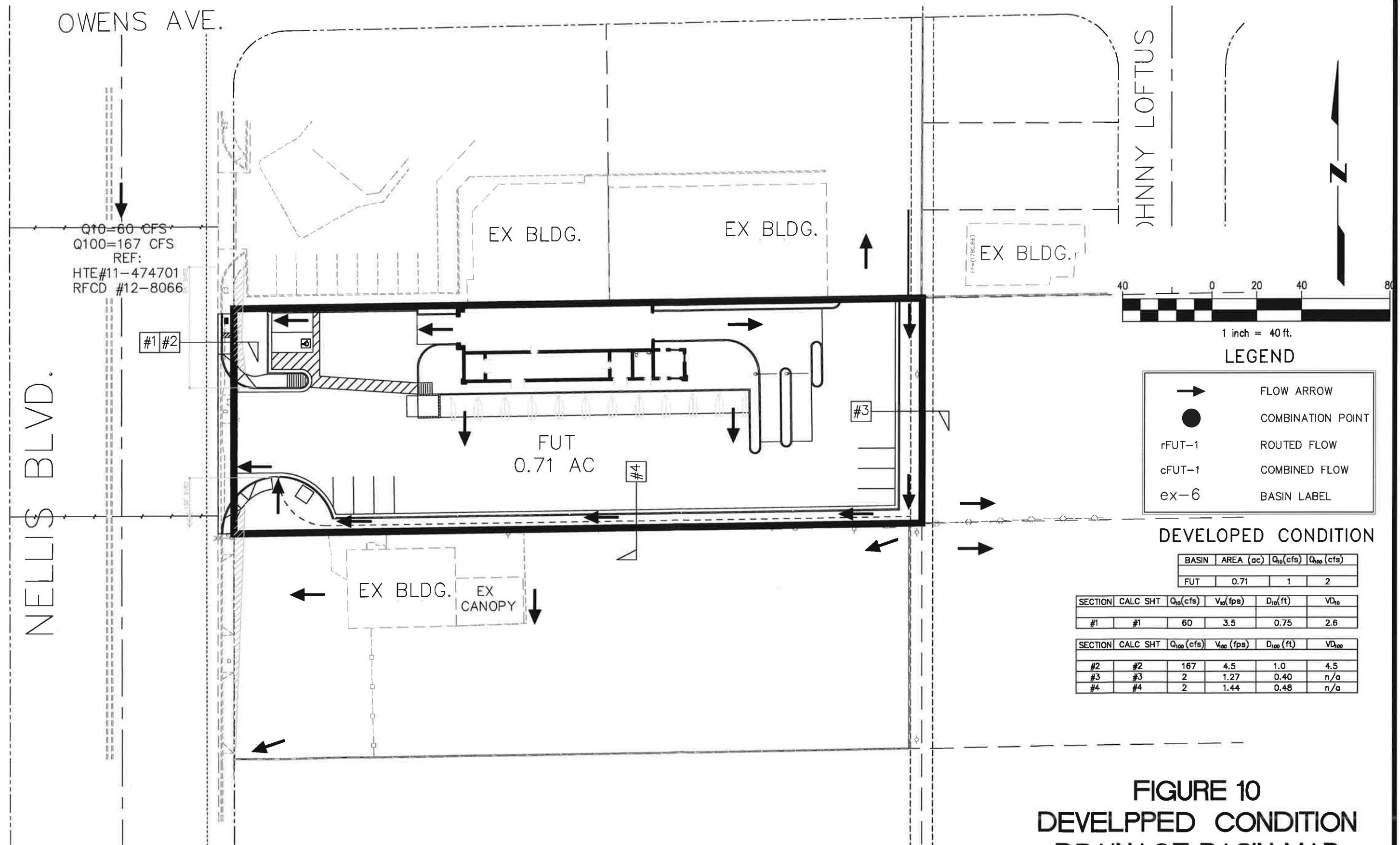


FIGURE 10  
DEVELOPPED CONDITION  
DRAINAGE BASIN MAP



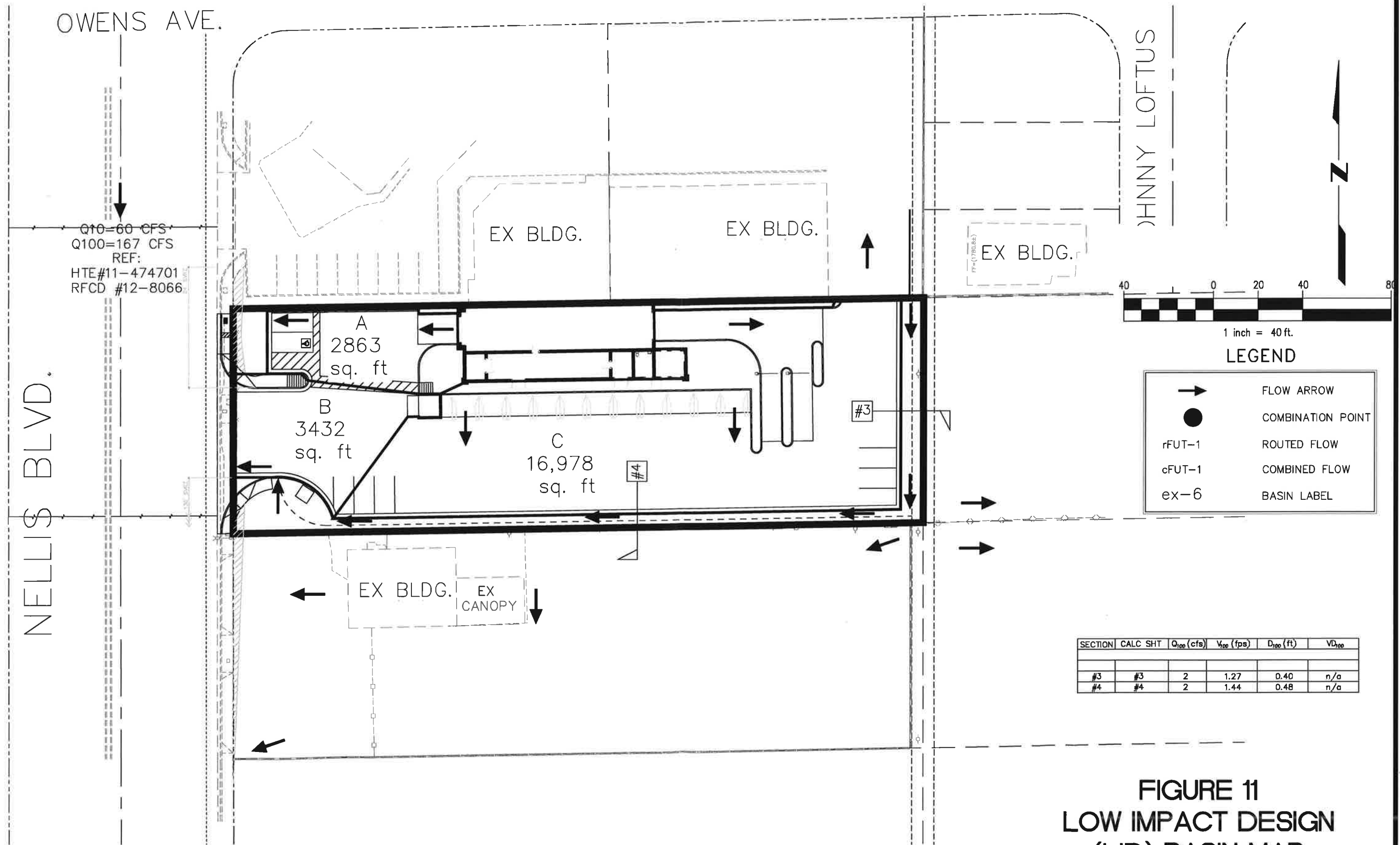
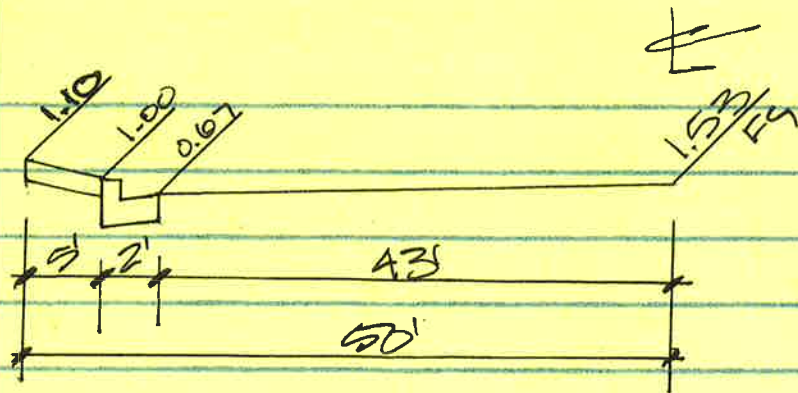


FIGURE 11  
LOW IMPACT DESIGN  
(LID) BASIN MAP



## CALCULATIONS



Given; NEILLS BLVD, SLOPE = 0.73% ,  $n = 0.016$

$Q_{10} = 60$  CFS WHOLE STREET

$Q_{10} = 30$  CFS  $\frac{1}{2}$  STREET

Find; depth and velocity

Assume; Flow @ 1.25 OE depth = 0.75'

$$A = (.15 \times 5) + (\frac{1}{2} \times 5 \times .1) + (.25 \times 2) + .6398 + (\frac{1}{2} \times .58 \times 29) = 10.5498 \text{ ft}^2$$

$$P = 36.65'$$

$$R = A/P = 0.2879$$

$$Q = 1.486 (.2879)^{2/3} (10.5498) (.0073)^{1/2} / 0.016$$

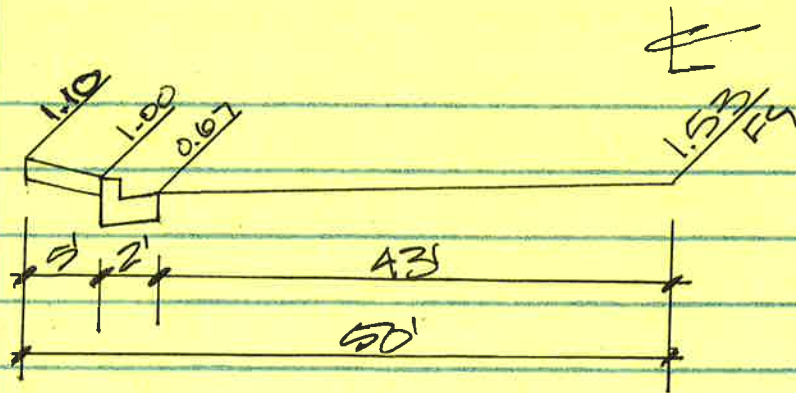
$$= 36.5 \text{ CFS} \geq 30 \quad \underline{\underline{OK}}$$

$$V = Q/A = 3.5 \text{ fps}$$

$$VD = (3.5)(.75) = 2.6 \leq 6 \quad \underline{\underline{OK}}$$

CALC SHIT #1





Given; NEWIS B.C.V.D. SLOPE = 0.73%,  $n = 0.016$

$Q_{100} = 167$  CFS WHOLE STREET

$Q_{100} = 84$  CFS  $\frac{1}{2}$  STREET

Find: depth of flow & velocity

Assume: Flow @ 1.5' OR depth = 1.0

$$A = (0.4 \times 5) + (\frac{1}{2} \times 5 \times 1) + (.5 \times 2) + .16398 + (\frac{1}{2} \times .83 \times 41.5) = 21.1123$$

$$P = 49.4$$

$$R = A/P = .4274$$

$$Q = 1.486 (.4274)^{2/3} (21.1123) (.0073)^{1/2} / .016$$

$$= 95 \text{ CFS} \geq 84 \text{ CFS} \quad \underline{\underline{OK}}$$

$$V = Q/A = 4.5 \text{ fps}$$

$$VD = (4.5 \times 1.0) = 4.5 \leq 8 \quad \underline{\underline{OK}}$$

CALC SHEET #2

## East PL swale - Q100 = 2 cfs

### Project Description

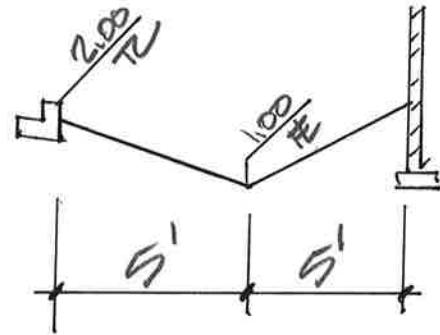
Friction Method                      Manning Formula  
Solve For                                Normal Depth

### Input Data

Roughness Coefficient                      0.025  
Channel Slope                                0.00400    ft/ft  
Left Side Slope                               10.00    ft/ft (H:V)  
Right Side Slope                              10.00    ft/ft (H:V)  
Discharge                                      2.00    ft<sup>3</sup>/s

### Results

Normal Depth                                0.40    ft  
Flow Area                                      1.57    ft<sup>2</sup>  
Wetted Perimeter                            7.97    ft  
Hydraulic Radius                            0.20    ft  
Top Width                                      7.93    ft  
Critical Depth                                0.30    ft  
Critical Slope                                0.01723    ft/ft  
Velocity                                        1.27    ft/s  
Velocity Head                                0.03    ft  
Specific Energy                               0.42    ft  
Froude Number                               0.50  
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                                0.40    ft  
Critical Depth                                0.30    ft  
Channel Slope                                0.00400    ft/ft  
Critical Slope                                0.01723    ft/ft

CALC SHEET #3



## South PL swale - Q100 = 2 cfs

### Project Description

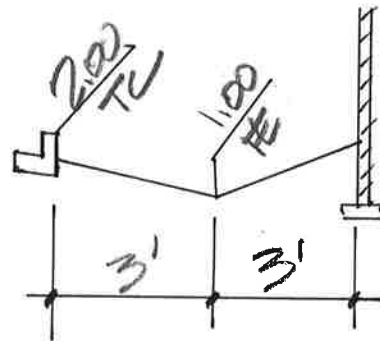
Friction Method                      Manning Formula  
Solve For                                Normal Depth

### Input Data

Roughness Coefficient                      0.025  
Channel Slope                                0.00400    ft/ft  
Left Side Slope                               6.00    ft/ft (H:V)  
Right Side Slope                              6.00    ft/ft (H:V)  
Discharge                                      2.00    ft<sup>3</sup>/s

### Results

Normal Depth                                0.48    ft  
Flow Area                                      1.39    ft<sup>2</sup>  
Wetted Perimeter                            5.85    ft  
Hydraulic Radius                            0.24    ft  
Top Width                                      5.77    ft  
Critical Depth                                0.37    ft  
Critical Slope                                0.01628    ft/ft  
Velocity                                        1.44    ft/s  
Velocity Head                                0.03    ft  
Specific Energy                               0.51    ft  
Froude Number                               0.52  
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                                0.48    ft  
Critical Depth                                0.37    ft  
Channel Slope                                0.00400    ft/ft  
Critical Slope                                0.01628    ft/ft

CALC SHT #4

## LID CALCS

Given; Figure 11

$$A = 2863^{\text{A}} - \text{TREATED IMPERMEABLE AREA}$$

$$B = 3432^{\text{A}} - \text{NOT TREATED}$$

$$C = 16,978^{\text{A}} - \text{TREATED IMPERMEABLE AREA}$$

$$\text{TOTAL} = 23,213^{\text{A}}$$

$$A+C / \text{TOTAL} = 19,841 / 23,213 = 85\%$$

$$85\% \geq 75\% \quad \underline{\underline{\text{OK}}}$$



**HEC-1 ANALYSIS  
EXISTING CONDITION**





\* FLOOD HYDROGRAPH PACKAGE (HEC-1) \*  
\* JUN 1998 \*  
\* VERSION 4.1 \*

\* RUN DATE 02FEB22 TIME 10:46:48 \*

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

X X XXXXXXX XXXX X  
X X X X X XX  
X X X X X  
XXXXXXXX XXXX X XXXXX X  
X X X X X  
X X X X X X  
X X XXXXXXX XXXX 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

```

LINE  ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
1      ID      RAINBOW CARWASH
2      ID CONDITION:  EXISTING AND DEVELOPED CONDITIONS
3      ID
4      ID
5      ID INPUT FILE:  FILE NAME 701449EX.jh1
6      ID
7      ID DESIGN STORM 6 HOUR
8      ID STORM DISTRIBUTION SDN 3
9      ID PREPARED BY:  Sam C. Dunnam, P.E.
10     ID      T.Y. LIN INTERNATIONAL
11     ID      4050 Dean Martin Drive
12     ID      Las Vegas NEVADA 89103
13     ID      702-682-1715
14     ID      sam.dunnam@tylin.com
15     ID #####
16     ID #  DEPTH-DURATION-FREQUENCY VALUES  #
17     ID #####
18     ID # NOT A STANDRAD McCARRAN AIRPORT RAIN FALL AREA #
19     ID #####
20     ID #  RATIO #1 = 2 YR 6 HOUR STORM  #
21     ID #  RATIO #2 = 10 YR 6 HOUR STORM  #
22     ID #  RATION #3 = 100 YR 6-HOUR STORM  #
23     ID #####
24     ID
25     ID
26     ID
27     ID
28     ID
29     ID
*DIAGRAM
30     IT  5  0  0  300
31     IO  5  0  0
32     IN  5  0  0
33     JR  PREC 0.6084  1
*
34     KK  ex undeveloped site
* #####
* # ex undeveloped site  #
* # Total Area = 0.00111 sq. mi.  #
* # CN = 91.0, K=8508  #
* # Tc = 9.88 min./10.00 min., minimum  #
* #####
*
35     BA 0.0011  1
36     LS  0  91  0
37     UD  0.1
*
38     PB  2.86
* NOT A STANDARD McCARRAN AIRPORT RAINFALL AREA
39     PC 0.000 0.020 0.057 0.070 0.087 0.108 0.124 0.130 0.130 0.130
40     PC 0.130 0.130 0.130 0.133 0.140 0.142 0.148 0.158 0.172 0.181
41     PC 0.190 0.197 0.199 0.200 0.201 0.204 0.214 0.229 0.241 0.249
42     PC 0.251 0.256 0.270 0.278 0.281 0.283 0.295 0.322 0.352 0.409
43     PC 0.499 0.590 0.710 0.744 0.781 0.812 0.819 0.835 0.851 0.856

```



```
LINE  ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
44    PC  0.860 0.868 0.876 0.888 0.910 0.926 0.937 0.950 0.970 0.976
45    PC  0.982 0.985 0.987 0.989 0.990 0.993 0.993 0.994 0.995 0.998
46    PC  0.998 0.999 1.000
*
47    KK  FUTdeveloped site
*
* #####
* # FUT developed site          #
* # Total Area = 0.00111 sq. mi. #
* # CN = 94.0, K=8112           #
* # Tc = 7.44 min./ 5.00 min. minimum #
* #####
*
48    BA  0.0011  1
49    LS   0   94   0
50    UD  0.0744
*
*
51    ZZ
```

SCHEMATIC DIAGRAM OF STREAM NETWORK

INPUT

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

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

34 ex

ex

47 FUT

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



```

*****
* FLOOD HYDROGRAPH PACKAGE (HEC-1) *
* JUN 1998 *
* VERSION 4.1 *
*
* RUN DATE 02FEB22 TIME 10:46:48 *
*****

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

```

RAINBOW CARWASH  
CONDITION: EXISTING AND DEVELOPED CONDITIONS

INPUT FILE: FILE NAME 701449EX.ih1

DESIGN STORM 6 HOUR  
STORM DISTRIBUTION SDN 3  
PREPARED BY: Sam C. Dunnam, P.E.  
T.Y. LIN INTERNATIONAL  
4050 Dean Martin Drive  
Las Vegas NEVADA 89103  
702-682-1715  
sam.dunnam@tylin.com

```

#####
# DEPTH-DURATION-FREQUENCY VALUES #
#####
# NOT A STANDRAD McCARRAN AIRPORT RAIN FALL AREA #
#####
# RATIO #1 = 2 YR 6 HOUR STORM #
# RATIO #2 = 10 YR 6 HOUR STORM #
# RATION #3 = 100 YR 6-HOUR STORM #
#####

```

31 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  
.61 1.00

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 | RATIOS APPLIED TO PRECIPITATION |      |         |         |
|---------------|---------|---------------------------------|------|---------|---------|
|               |         | AREA                            | PLAN | RATIO 1 | RATIO 2 |
|               |         | .61                             | 1.00 |         |         |
| HYDROGRAPH AT | ex      | .00                             | 1    | FLOW    | 1. 2.   |
|               | TIME    |                                 | 3.50 | 3.50    |         |
| HYDROGRAPH AT | FUT     | .00                             | 1    | FLOW    | 1. 2.   |
|               | TIME    |                                 | 3.50 | 3.50    |         |

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



**HEC-1 ANALYSIS  
DEVELOPED CONDITION**

## HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL - STANDARD FORM 4

**Development:** Rainbow Carwash - Existing Condition  
**Calculated by:** Sam Dunnam

Date: 2/2/2022

[illegible]



```

* FLOOD HYDROGRAPH PACKAGE (HEC-1) *
* JUN 1998
* VERSION 4.1
* RUN DATE 02FEB22 TIME 10:46:48 *

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

```

```

X X XXXXXX XXXX X
X X X X X XX
X X X X X
XXXXXXXX XXXX X XXXXX X
X X X X X
X X X X X X
X X XXXXXX XXXX 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.  
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 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

```

LINE  ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
1      ID      RAINBOW CARWASH
2      ID CONDITION:  EXISTING AND DEVELOPED CONDITIONS
3      ID
4      ID
5      ID INPUT FILE:  FILE NAME 701449EX.ih1
6      ID
7      ID DESIGN STORM 6 HOUR
8      ID STORM DISTRIBUTION SDN 3
9      ID PREPARED BY:  Sam C. Dunnam, P.E.
10     ID      T.Y. LIN INTERNATIONAL
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13     ID      702-682-1715
14     ID      sam.dunnam@tylin.com
15     ID #####
16     ID #  DEPTH-DURATION-FREQUENCY VALUES  #
17     ID #####
18     ID # NOT A STANDRAD McCARRAN AIRPORT RAIN FALL AREA #
19     ID #####
20     ID #  RATIO #1 = 2 YR 6 HOUR STORM  #
21     ID #  RATIO #2 = 10 YR 6 HOUR STORM  #
22     ID #  RATION #3 = 100 YR 6-HOUR STORM  #
23     ID #####
24     ID
25     ID
26     ID
27     ID
28     ID
29     ID
30     *DIAGRAM
31     IT  5  0  0  300
32     IO  5  0  0
33     IN  5  0  0
34     JR  PREC 0.6084  1
35     *
36     KK  ex undeveloped site
37     * #####
38     * # ex undeveloped site  #
39     * # Total Area = 0.00111 sq. mi.  #
40     * # CN = 91.0, K=.8508  #
41     * # Tc = 9.88 min./10.00 min. mininum  #
42     * #####
43     *
44     BA 0.0011  1
45     LS  0  91  0
46     UD  0.1
47     *
48     PB 2.86
49     * NOT A STANDARD McCARRAN AIRPORT RAINFALL AREA
50     PC 0.000 0.020 0.057 0.070 0.087 0.108 0.124 0.130 0.130 0.130
51     PC 0.130 0.130 0.130 0.133 0.140 0.142 0.148 0.158 0.172 0.181
52     PC 0.190 0.197 0.199 0.200 0.201 0.204 0.214 0.229 0.241 0.249
53     PC 0.251 0.256 0.270 0.278 0.281 0.283 0.295 0.322 0.352 0.409
54     PC 0.499 0.590 0.710 0.744 0.781 0.812 0.819 0.835 0.851 0.856

```



| LINE | ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10 |
|------|-----------------------------------------------------------------|
| 44   | PC 0.860 0.868 0.876 0.888 0.910 0.926 0.937 0.950 0.970 0.976  |
| 45   | PC 0.982 0.985 0.987 0.989 0.990 0.993 0.993 0.994 0.995 0.998  |
| 46   | PC 0.998 0.999 1.000                                            |
|      | *                                                               |
| 47   | KK FUTdeveloped site                                            |
|      | *                                                               |
|      | * #####                                                         |
|      | * # FUT developed site #                                        |
|      | * # Total Area = 0.00111 sq. mi. #                              |
|      | * # CN = 94.0, K=.8112 #                                        |
|      | * # Tc = 7.44 min./ 5.00 min. minimum #                         |
|      | * #####                                                         |
|      | *                                                               |
| 48   | BA 0.0011 1                                                     |
| 49   | LS 0 94 0                                                       |
| 50   | UD 0.0744                                                       |
|      | *                                                               |
|      | *                                                               |
| 51   | ZZ                                                              |

# SCHEMATIC DIAGRAM OF STREAM NETWORK

|       |               |                                          |
|-------|---------------|------------------------------------------|
| INPUT |               |                                          |
| LINE  | (V) ROUTING   | (--->) DIVERSION OR PUMP FLOW            |
| NO.   | (.) CONNECTOR | (<---) RETURN OF DIVERTED OR PUMPED FLOW |
| 34    | ex            |                                          |
|       | .             |                                          |
|       | .             |                                          |
| 47    | .             | FUT                                      |

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



```

* FLOOD HYDROGRAPH PACKAGE (HEC-1) *
* JUN 1998
* VERSION 4.1
*
* U.S. ARMY CORPS OF ENGINEERS
* HYDROLOGIC ENGINEERING CENTER
* 609 SECOND STREET
* DAVIS, CALIFORNIA 95616
* (916) 756-1104
*
* RUN DATE 02FEB22 TIME 10:46:48

```

```

RAINBOW CARWASH
CONDITION: EXISTING AND DEVELOPED CONDITIONS

```

```

INPUT FILE: FILE NAME 701449EX.ih1

```

```

DESIGN STORM 6 HOUR
STORM DISTRIBUTION SDN 3
PREPARED BY: Sam C. Dunnam, P.E.
              T.Y. LIN INTERNATIONAL
              4050 Dean Martin Drive
              Las Vegas NEVADA 89103
              702-682-1715
              sam.dunnam@tylin.com

```

```

#####
# DEPTH-DURATION-FREQUENCY VALUES #
#####
# NOT A STANDRAD McCARRAN AIRPORT RAIN FALL AREA #
#####
# RATIO #1 = 2 YR 6 HOUR STORM #
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# RATION #3 = 100 YR 6-HOUR STORM #
#####

```

```

31 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
   .61 1.00

```

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 | RATIOS APPLIED TO PRECIPITATION |      |         |         |
|---------------|---------|---------------------------------|------|---------|---------|
|               |         | AREA                            | PLAN | RATIO 1 | RATIO 2 |
|               |         | .61                             | 1.00 |         |         |
| HYDROGRAPH AT | ex      | .00                             | 1    | FLOW    | 1. 2.   |
|               | TIME    |                                 | 3.50 | 3.50    |         |
| HYDROGRAPH AT | FUT     | .00                             | 1    | FLOW    | 1. 2.   |
|               | TIME    |                                 | 3.50 | 3.50    |         |

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



## **APPENDIX**

### **REFERENCED DRAINAGE STUDIES**

*Technical Drainage Study for Used Car Lot  
By CivilWorks, Inc., Brandon Potts, P.E., dated December 13, 2011 and  
Addendums dated March 7, 2012 and May 21, 2012*

REGIONAL FLOOD  
CONTROL DISTRICT



LTR  
11-44701

Gale Wm. Fraser, II, P.E.  
General Manager/Chief  
Engineer

BOARD OF DIRECTORS

Lawrence L. Brown, III  
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Vice-Chairman  
City of North Las Vegas

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Clark County

Kraig Hafan  
City of Mesquite

Debra March  
City of Henderson

Steven D. Ross  
City of Las Vegas

Dr. Lois Tarkanian  
City of Las Vegas

Mayor Roger Tobler  
City of Boulder City

July 12, 2012

Mr. Layne Weber, P.E.  
Clark County Public Works, Development Review  
500 S. Grand Central Parkway  
Las Vegas, NV 89155

DISTRICT CONCURRENCE: USED CAR LOT  
(HTE #11-44701) (RFCD No. 12-8066)

Dear Mr. Weber:

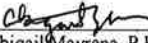
Clark County Regional Flood Control District (District) reviewed Technical Drainage Study dated December 13, 2011, Addendum No. 1 dated March 6, 2012, and Supplement No. 1 dated May 14, 2012 for above-mentioned project as submitted by CIVILWORKS, INC. In addition, District is in receipt of the Conditional Letter of Acceptance from Clark County Public Works, Development Review dated June 6, 2012.

District concurs with acceptance of this Technical Drainage Study by Clark County Public Works, Development Review.

District's review of this project was limited to issues of Regional Flood Control Significance as defined in *Uniform Regulations for the Control of Drainage*.

Please be aware that as additional information becomes available and/or restudies of Flood Insurance Studies are performed, information submitted by CIVILWORKS, INC. may be superseded. Compliance with regulatory elements and design standards specified in *Uniform Regulations for the Control of Drainage* does not imply a guarantee that properties will be free from flooding or flood damage. The District, its officials, or employees assume no liability for information, data, or conclusions presented by consulting engineers. We, therefore, make no warranties, either expressed or implied, in conducting this review.

GALE WM. FRASER, II, P.E.  
General Manager/Chief Engineer

BY:   
Abigail Mayrena, P.E., CFM  
Senior Engineer

  
Andrew R. Trelease, P.E., CFM  
Principal Civil Engineer

AM:ART:sa

c: Brandon A. Potts, P.E., CivilWorks, Inc.

P:\Letters and Memos\Local Drainage\Land Development & Drainage\2012\12-8066.doc

600 S. Grand Central Parkway, Suite 300 • Las Vegas, Nevada 89106-4511  
(702) 685-0000 • FAX: (702) 685-0001  
Website: <http://www.regionalflood.org>



## Department of Public Works

500 S Grand Central Pky • Box 554000 • Las Vegas NV 89155-4000  
(702) 455-6000 • Fax (702) 455-6040

Denis Cederburg, P.E., Director • E-Mail: dlc@ClarkCountyNV.gov

### Drainage Study Approval Letter

**Date:** June 6, 2012  
**Firm:** CivilWorks, Inc.  
**Engineer:** Brandon A. Potts, P.E.  
**Address:** 4945 W. Patrick Lane, Las Vegas, NV 89118  
**Phone:** (702) 534-7555  
**Fax:** (702) 534-1825  
**E-mail:** jkn@civilworksonline.com

**Subject:** Technical Drainage Study for Used Car Lot  
**Location:** SE of Nellis Boulevard and Owens Avenue  
**APN:** 140-28-110-003  
**Sec, Township, Range:** S28, T20S, R62E  
**Flood Zone & Panel:** Zone X, 2185F, Revised November 16, 2011  
**Application Tracking #:** 11-44701



| Submittals    | Date Received | Date Returned | Reviewer | Miscellaneous |
|---------------|---------------|---------------|----------|---------------|
| Technical     | 12/13/2011    | 12/22/2011    | WG       |               |
| Addendum #1   | 03/07/2012    | 03/19/2012    | WG       |               |
| Supplement #1 | 05/21/2012    | 06/06/2012    | WG       |               |
|               |               |               |          |               |
|               |               |               |          |               |

| Concurrence Required:<br>(Must be obtained prior to permit issuance) |                                              | Reason Concurrence is required                                                 |
|----------------------------------------------------------------------|----------------------------------------------|--------------------------------------------------------------------------------|
|                                                                      | City of Henderson                            | Adjacent to or Impacts Henderson                                               |
| X                                                                    | City of Las Vegas                            | Adjacent to or Impacts Las Vegas                                               |
|                                                                      | City of North Las Vegas                      | Adjacent to or Impacts North Las Vegas                                         |
| X                                                                    | Nevada Department of Transportation          | Adjacent to or Impacts NDOT Facility                                           |
|                                                                      | Union Pacific Rail Road                      | Adjacent to or Impacts a UPRR Facility                                         |
|                                                                      | US Army Corp of Engineers                    | Impacts a USACE Facility                                                       |
| X                                                                    | Clark County Regional Flood Control District | Regional Significance, Adjacent to or Impacts CCRFCD MPU Facility or in a SFHA |

BOARD OF COUNTY COMMISSIONERS  
SUSAN BRAGER, Chair • STEVE SISOLAK, Vice-Chair  
LARRY BROWN • TOM COLLINS • CHRIS GIUNCHIGLIANI • MARY BETH SCOW • LAWRENCE WEEKLY  
DONALD G. BURNETTE, County Manager



3/15

Used Car Lot  
June 6, 2012  
Page 2 of 3

11-44701

The referenced **Technical Drainage Study** has been reviewed and is accepted as complying with minimum improvement standards. As set forth in the subject drainage study, the following measures will be taken to mitigate flood hazards.

The site shall be graded with respect to drainage as shown on "Used Car Lot", grading plan sheets C5, C7, signed and sealed by Brandon A. Potts, P.E., on May 14, 2012.

**Check appropriate conditions**

|   |                                                                                                                                                                                                                                                                                                                                                                                    |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | Retaining/screen wall combination may be in excess of current <b>Clark County Unified Development Code, Chapter 30.64.050.</b>                                                                                                                                                                                                                                                     |
|   | A FEMA Elevation Certificate, completed by a licensed surveyor, must be submitted to and approved by CCPW Development Review Plan Check prior to the issuance of Certificates of Occupancy for those structures.                                                                                                                                                                   |
| X | MyIars of the grading plan must be submitted to the CCPW Development Review Plan Check for approval signatures prior to map recordation (residential) or permit issuance (commercial).                                                                                                                                                                                             |
|   | An administrative variance to allow the finished floor elevation(s) to be set below the current Clark County criteria must be approved. The finished floor variance must be submitted to CCPW Development Review front counter after drainage study approval and prior to offsite final review.                                                                                    |
| X | The grading plan will be reviewed by the Building Office Operations Division to ensure compliance with the ADA access requirements. Revisions to the grading plan may be required if the site accessibility design does not comply with the requirements set forth in the Accessibility Chapter of the Clark County Building Code.                                                 |
| X | The plans show work is proposed outside of the project boundary. Notarized written permission must be obtained <b>prior to grading plan approval.</b>                                                                                                                                                                                                                              |
| X | Right-of-way dedication must be verified.                                                                                                                                                                                                                                                                                                                                          |
|   | Any previously approved drainage easements that are not being used must be vacated.                                                                                                                                                                                                                                                                                                |
|   | Per <i>Regional Flood Control District policies and Procedures manual, Section VIII. D. 13. Uniform Regulations for the Control of Drainage</i> , the Engineer of Record shall provide As-Built plans or record drawings to the District after completion and final inspection of such privately installed flood control facilities that have regional flood control significance. |
|   | Structural calculations are required. The structural calculations, plans, and details must be approved prior to "Offsite" submittal and prior to CCRFCD submittal, if applicable.                                                                                                                                                                                                  |
| X | Plan revisions can be found on the red-lined plans and must be addressed.                                                                                                                                                                                                                                                                                                          |
|   | Prepare drainage easement documents as shown on the grading plans.                                                                                                                                                                                                                                                                                                                 |

Used Car Lot  
June 6, 2012  
Page 3 of 3

11-44701

The County's review is solely based on the information submitted by the Engineer of Record. The County's review is strictly limited to compliance with minimum County Codes and Standards. The Engineer of Record is responsible for researching and addressing situations that may require designs above and beyond the minimum codes for issues of public safety and impacts to upstream, downstream and adjacent properties. The County assumes no liability for information data, designs or conclusions of the Engineer of Record.

By



W. Layne Weber, P.E., CFM  
Principal Engineer  
Clark County Public Works  
Development Review

---

cc: Bartsas

113A

ADD1

11-44701  
3/1/12  
Add #1

**ADDENDUM #1 TO THE  
TECHNICAL DRAINAGE STUDY  
FOR  
USED CAR LOT  
AT  
1578 N. NELLIS BLVD.**

Project No. 104111014.01  
MARCH 6, 2012

Prepared for:

GGW ARCHITECTS  
4945 W. PATRICK LANE  
LAS VEGAS, NV 89118  
702-534-7888

Prepared by:

CIVILWORKS, INC.  
4945 W. PATRICK LANE  
LAS VEGAS, NV 89118  
702-534-7555

**Civi Works Inc**  
Engineering with "sensible" solutions tailored to your "specific" needs.

4945 W. Patrick Lane Las Vegas, NV 89118  
Office: (702) 534-7555 Fax: (702) 534-1825



# **ADDENDUM MATERIALS**

**DISCUSSION OF OFFSITE BASINS**

**REVISED TABLES 3 AND 4**

**PERMISSION TO GRADE LETTER**

## 2.0 DRAINAGE BASIN DESCRIPTION

### 2.2 Existing Off-site Drainage Description

The existing street conditions in Nellis show that the flows are conveyed south. Per the approved report 07-24151, the existing flow in Nellis is 58-cfs and 164-cfs, for the 10-year and 100-year storm events, respectively. Since the subject site is bordered by walls on the north and south sides of the property, no off-site flows enter the subject site from the north and no on-site flow enter the property to the south. In addition, there is an existing berm adjacent to the subject site along the eastern property line. There is an area between the existing berm and subject property line that generates runoff that impacts the subject site. This area does not generate enough flow to quantify.

### 2.4 Proposed Off-site Drainage Description

The off-site flow generated by the area between the existing off-site berm and the subject site will be re-directed to flow back to the east and follow the historical drainage pattern. The existing berm on the adjacent property to the east will be re-graded to begin at the proposed wall and allow the off-site flow that originally discharged (which in this case is so little that I could not be quantified) onto the subject site to follow the historical drainage pattern for the rest of the adjacent property. The flow pattern in Nellis Blvd. will remain the same. The on-site flow that will discharge into Nellis will increase the 10-year and 100-year flows to 60-cfs and 167-cfs, respectively. This increase does not show a significant change from the existing flow conditions of Nellis.

14/34

## 6.0 HYDRAULIC ANALYSIS

### 6.1 Street and Facility Hydraulics

The existing hydraulic condition of Nellis Boulevard was taken from the previously approved study for the Nellis and Owens Daycare Center (07-24151) and has been summarized in Table 3 below. Please refer to the Appendix for the Reference Material.

TABLE 3

| *EXISTING CONDITIONS HYDRAULIC SUMMARY |         |        |         |       |           |
|----------------------------------------|---------|--------|---------|-------|-----------|
| SECTION                                | Q (cfs) | D (ft) | V (fps) | (D*V) | DRY LANE? |
| NELLIS (10yr)                          | 58      | 0.70   | 2.78    | 1.95  | NO        |
| NELLIS (100yr)                         | 164     | 0.93   | 3.90    | 3.65  | N/A       |

\*Flow values were referenced from HTE 07-24151.

Table 4 below is a summarization of the proposed condition street hydraulics. Please see Appendix for the hydraulic analyses.

TABLE 4

| PROPOSED CONDITIONS HYDRAULIC SUMMARY |         |        |         |       |           |
|---------------------------------------|---------|--------|---------|-------|-----------|
| SECTION                               | Q (cfs) | D (ft) | V (fps) | (D*V) | DRY LANE? |
| NELLIS (10yr)                         | 60      | 0.83   | 3.66    | 3.03  | NO        |
| NELLIS (100yr)                        | 167     | 1.10   | 4.76    | 5.23  | N/A       |

The finished floor elevation for the main building has been set to 1779.00' which is more than 18" above the centerline of Nellis Boulevard and meets the freeboard requirement of twice the depth of flow during the 100-year storm event. Table 5 below is a summarization of the proposed condition water surface elevations within the adjacent street.

TABLE 5

| PROPOSED CONDITIONS FF CALCULATION SUMMARY |       |          |          |          |          |
|--------------------------------------------|-------|----------|----------|----------|----------|
| STREET                                     | DEPTH | FL       | WSE      | WSE + D  | MEET FF? |
| NELLIS                                     | 1.10' | 1776.80' | 1777.90' | 1779.00' | YES      |





23  
/ 34

# **REFERENCE MATERIALS**

**Approval Letter 07-24151  
Additional Reference Material**



**Department of Development Services  
Civil Engineering Division**

500 S Grand Central Pkwy 1st Fl • Box 551789 • Las Vegas NV 89155-1789  
(702) 455-4600 • Fax (702) 388-2550

Ronald L. Lynn, Building Official

June 5, 2007

WRG Inc.  
3011 W. Horizon Ridge Parkway, Suite 100  
Henderson, NV 89052

LTR  
07-24151

**CLARK COUNTY Concurrence for Nellis/Owens Daycare**

Study Updated: October 31, 2006

Update Addendum #1 Dated: December 4, 2006

Location: Southwest corner of Nellis Blvd and Owens Avenue

SEC29, T20S, R62E

H.T.E. # 07-24151 Concurrence with CLV# DS 4097B

The above-referenced project is located in the City of Las Vegas adjacent to Clark County south of Owens Avenue and west of Nellis Boulevard. The drainage study was submitted to the County for concurrence on May 17, 2007. The County has reviewed the Study and addenda. In addition, the County has received a copy of the acceptance letter from the City of Las Vegas, dated January 16, 2007. The County concurs with the acceptance of this drainage study by the City of Las Vegas. Please note that the County's review of this development is limited to drainage issues significant to Clark County unincorporated areas.

The County's review is solely based on the information submitted by the Engineer of Record. The County's review is strictly limited to compliance with minimum County Codes and Standards. The Engineer of Record is responsible for researching and addressing situations that may require designs above and beyond the minimum codes for issues of public safety and impacts to upstream, downstream and adjacent properties. The County assumes no liability for information data, designs or conclusions of the Engineer of Record.

**DEPARTMENT OF DEVELOPMENT SERVICES**

By

*Glenn S. Hale*

Glenn S. Hale, P. E.  
Senior Civil Engineer  
Civil Engineering Division

GSH/rmm

cc: Grubb & Ellis  
Albert Sung P.E., City of Las Vegas Department of Public Works  
Development File

BOARD OF COUNTY COMMISSIONERS  
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1/31

SUPP

11-44701

5/21/12

D/S

**SUPPLEMENT #1 TO THE  
TECHNICAL DRAINAGE STUDY  
FOR  
USED CAR LOT  
AT  
1578 N. NELLIS BLVD.**

Project No. 104111014.01

MAY 14, 2012

Prepared for:

GGW ARCHITECTS  
4945 W. PATRICK LANE  
LAS VEGAS, NV 89118  
702-534-7888

Prepared by:

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# **HYDRAULIC ANALYSES**

## **Revised FlowMaster Models**

11/31

NELLIS - 10YR (WRG)  
Worksheet for Irregular Channel

| Project Description |                                                                    |
|---------------------|--------------------------------------------------------------------|
| Project File        | x:\2011 projects\104111014.01 phases 4-7 @ used car lot\08 - phase |
| Worksheet           | NELLIS - 10YR (WRG)                                                |
| Flow Element        | Irregular Channel                                                  |
| Method              | Manning's Formula                                                  |
| Solve For           | Water Elevation                                                    |

| Input Data                           |                |                |             |           |
|--------------------------------------|----------------|----------------|-------------|-----------|
| Channel Slope                        |                | 0.005000 ft/ft |             |           |
| Elevation range: 0.00 ft to 1.25 ft. |                |                |             |           |
| Station (ft)                         | Elevation (ft) | Start Station  | End Station | Roughness |
| 0.00                                 | 0.60           | 0.00           | 7.00        | 0.013     |
| 5.00                                 | 0.50           | 7.00           | 93.00       | 0.016     |
| 5.50                                 | 0.50           | 93.00          | 100.00      | 0.013     |
| 5.50                                 | 0.00           |                |             |           |
| 7.00                                 | 0.13           |                |             |           |
| 7.00                                 | 0.17           |                |             |           |
| 40.00                                | 0.83           |                |             |           |
| 40.00                                | 1.25           |                |             |           |
| 45.00                                | 1.25           |                |             |           |
| 45.00                                | 0.83           |                |             |           |
| 93.00                                | 0.17           |                |             |           |
| 93.00                                | 0.13           |                |             |           |
| 94.50                                | 0.00           |                |             |           |
| 94.50                                | 0.50           |                |             |           |
| 95.00                                | 0.50           |                |             |           |
| 100.00                               | 0.60           |                |             |           |
| Discharge                            |                | 59.00          | cfs         |           |

| Results                                                |          |                 |
|--------------------------------------------------------|----------|-----------------|
| Wtd. Mannings Coefficient                              | 0.015    |                 |
| Water Surface Elevation                                | 0.70     | ft              |
| Flow Area                                              | 21.15    | ft <sup>2</sup> |
| Wetted Perimeter                                       | 80.83    | ft              |
| Top Width                                              | 79.52    | ft              |
| Height                                                 | 0.70     | ft              |
| Critical Depth                                         | 0.69     | ft              |
| Critical Slope                                         | 0.005537 | ft/ft           |
| Velocity                                               | 2.79     | ft/s            |
| Velocity Head                                          | 0.12     | ft              |
| Specific Energy                                        | 0.82     | ft              |
| Froude Number                                          | 0.95     |                 |
| Flow is subcritical.                                   |          |                 |
| Flow is divided.                                       |          |                 |
| Water elevation exceeds lowest end station by 0.10 ft. |          |                 |

14/3/

NELLIS - 100YR (WRG)  
Worksheet for Irregular Channel

| Project Description |                                                                    |
|---------------------|--------------------------------------------------------------------|
| Project File        | x:\2011 projects\104111014.01 phases 4-7 @ used car lot\08 - phase |
| Worksheet           | NELLIS - 100YR (WRG)                                               |
| Flow Element        | Irregular Channel                                                  |
| Method              | Manning's Formula                                                  |
| Solve For           | Water Elevation                                                    |

| Input Data                           |                |                |             |           |  |
|--------------------------------------|----------------|----------------|-------------|-----------|--|
| Channel Slope                        |                | 0.005000 ft/ft |             |           |  |
| Elevation range: 0.00 ft to 1.25 ft. |                |                |             |           |  |
| Station (ft)                         | Elevation (ft) | Start Station  | End Station | Roughness |  |
| 0.00                                 | 0.60           | 0.00           | 7.00        | 0.013     |  |
| 5.00                                 | 0.50           | 7.00           | 93.00       | 0.016     |  |
| 5.50                                 | 0.50           | 93.00          | 100.00      | 0.013     |  |
| 5.50                                 | 0.00           |                |             |           |  |
| 7.00                                 | 0.13           |                |             |           |  |
| 7.00                                 | 0.17           |                |             |           |  |
| 40.00                                | 0.83           |                |             |           |  |
| 40.00                                | 1.25           |                |             |           |  |
| 45.00                                | 1.25           |                |             |           |  |
| 45.00                                | 0.83           |                |             |           |  |
| 93.00                                | 0.17           |                |             |           |  |
| 93.00                                | 0.13           |                |             |           |  |
| 94.50                                | 0.00           |                |             |           |  |
| 94.50                                | 0.50           |                |             |           |  |
| 95.00                                | 0.50           |                |             |           |  |
| 100.00                               | 0.60           |                |             |           |  |
| Discharge                            |                | 166.00         | cfs         |           |  |

| Results                                                |          |                 |
|--------------------------------------------------------|----------|-----------------|
| Wtd. Mannings Coefficient                              | 0.015    |                 |
| Water Surface Elevation                                | 0.94     | ft              |
| Flow Area                                              | 42.33    | ft <sup>2</sup> |
| Wetted Perimeter                                       | 96.99    | ft              |
| Top Width                                              | 95.00    | ft              |
| Height                                                 | 0.94     | ft              |
| Critical Depth                                         | 0.95     | ft              |
| Critical Slope                                         | 0.004628 | ft/ft           |
| Velocity                                               | 3.92     | ft/s            |
| Velocity Head                                          | 0.24     | ft              |
| Specific Energy                                        | 1.18     | ft              |
| Froude Number                                          | 1.04     |                 |
| Flow is supercritical.                                 |          |                 |
| Flow is divided.                                       |          |                 |
| Water elevation exceeds lowest end station by 0.34 ft. |          |                 |



# **REFERENCE MATERIALS**

**Additional Reference Material**



07-24/51  
UPADD#1

UPDATE 1 Addendum 1  
To the Technical Drainage Study  
for the:

NELLIS CROSSING  
RENAMED TO:  
NELLIS AND OWENS  
DAYCARE CENTER

Located at the SW corner of Nellis  
Boulevard and Owens Avenue



W.R.G. Project No. 3055114.00(GRU)

City of Las Vegas, Nevada  
A portion of the North (1/4) of the NE (1/4) of Section 29,  
Township 20 South, Range 62 East, M.D.M.,  
Clark County, Nevada

Prepared for:  
Grubb & Ellis  
3800 Howard Hughes Pkwy, Suite 1220  
Las Vegas, NV 89108

1/2/18

6/1/21

## V. HYDRAULIC ANALYSES

### A. Street Flows

Normal depth calculations were performed for the drive isles and street along the project site. Although minimum velocity times depth criteria do not apply to parking lots, the depths, velocities and their products are quite low. The finished floor elevation of the project site is a minimum of twice the depth of the 100-year peak flow. The 100-year offsite flow on Nellis Boulevard is 164 cfs would overtop the existing curb along the east side of the project. Therefore, the driveway hump and landscape area will be sloped to protect the site from offsite flows. The slope will have sufficient freeboard along its length. The 10-year dry lane criterion is met in Owens Avenue. However, the 10-year dry lane criterion is not met in Nellis Boulevard. The dry lane criterion is a pre-existing condition. The project site is not adversely impacting Nellis Blvd. The calculations can be found in Appendix E.

The drive isle calculations are summarized in the following table.

| STREET SECTION           | $Q_{10}/Q_{100}$<br>(CFS) | $D_{10}/D_{100}$<br>(ft) | $V_{10}/V_{100}$<br>(ft/s) | $V_{10}D$ (ft <sup>3</sup> /s) | (0-Yr Dry Lane |
|--------------------------|---------------------------|--------------------------|----------------------------|--------------------------------|----------------|
| SECTION 1<br>Owens Ave   | 15/100                    | 0.49/0.85                | 2.31/3.43                  | 1.13/2.92                      | 17.4'          |
| SECTION 2<br>Nellis Blvd | 58/164                    | 0.70/0.93                | 2.78/3.90                  | 1.95/3.63                      | 5'             |
| SECTION 3<br>Onsite      | 1/1                       | 0.10/0.10                | 1.40/1.40                  | 0.14/0.14                      | N/A            |
| SECTION 4<br>Onsite      | 1/2                       | 0.12/0.16                | 1.42/1.69                  | 0.17/0.27                      | N/A            |





## **ADDITIONAL REFERENCE MATERIAL**

## PRECIPITATION ADJUSTMENT RATIOS

| <u>Recurrence<br/>Interval</u> | <u>Ratio to<br/>NOAA Atlas 2</u> |
|--------------------------------|----------------------------------|
| 2-year                         | 1.00                             |
| 5-year                         | 1.16                             |
| 10-year                        | 1.24                             |
| 25-year                        | 1.33                             |
| 50-year                        | 1.39                             |
| 100-year                       | 1.43                             |

- NOTE: 1. Multiply the values obtained from the NOAA Atlas 2 by the above ratios to obtain the adjusted precipitation values.
2. NOAA Atlas 2 values for use with TR-55 shall not be adjusted by the above ratios.
3. Tables 505 and 506 require no adjustments.

| <i>Revision</i> | <i>Date</i> |
|-----------------|-------------|
|                 |             |
|                 |             |
|                 |             |
|                 |             |



## 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.

| <i>Revision</i> | <i>Date</i> |
|-----------------|-------------|
|                 |             |
|                 |             |
|                 |             |
|                 |             |

# HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

## 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 | 98 | 98 |
| 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 | 94 | 95 |
| 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  $I_p = 0.25$ .
- 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.

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

# 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, bur sage, 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.

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

**WRC  
ENGINEERING**

### REFERENCE:

SCS TR-55, USDA, June 1986.

**TABLE 602  
4 of 4**



# 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.

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

REFERENCE:

TABLE 602A

# HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

## RESISTANCE FACTOR FOR OVERLAND FLOW

| Surface                                                              | N Value                    | Source     |
|----------------------------------------------------------------------|----------------------------|------------|
| Asphalt/Concrete*                                                    | 0.05 - 0.15                | a          |
| Bare Packed Soil Free of Stone                                       | 0.10                       | c          |
| Fallow - No Residue                                                  | 0.008 - 0.012              | b          |
| Conventional Tillage - No Residue                                    | 0.06 - 0.12                | b          |
| Conventional Tillage - With Residue                                  | 0.16 - 0.22                | b          |
| Chisel Plow - No Residue                                             | 0.06 - 0.12                | b          |
| Chisel Plow - With Residue                                           | 0.10 - 0.16                | b          |
| Fall Disking - With Residue                                          | 0.30 - 0.50                | b          |
| No Till - No Residue                                                 | 0.04 - 0.10                | b          |
| No Till (20 - 40 percent residue cover)                              | 0.07 - 0.17                | b          |
| No Till (60 - 100 percent residue cover)                             | 0.17 - 0.47                | b          |
| Sparse Rangeland With Debris:<br>0 Percent Cover<br>20 Percent Cover | 0.09 - 0.34<br>0.05 - 0.25 | b<br>b     |
| Sparse Vegetation                                                    | 0.053 - 0.13               | f          |
| Short Grass Prairie                                                  | 0.10 - 0.20                | f          |
| Poor Grass Cover On Moderately Rough                                 | 0.30                       | c          |
| Bare Surface                                                         |                            |            |
| Light Turf                                                           | 0.20                       | a          |
| Average Grass Cover                                                  | 0.4                        | c          |
| Dense Turf                                                           | 0.17 - 0.80                | a, c, e, f |
| Dense Grass                                                          | 0.17 - 0.30                | d          |
| Bermuda Grass                                                        | 0.30 - 0.48                | d          |
| Dense Shrubbery and Forest Litter                                    | 0.4                        | d          |

Legend: a) Harley (1975), b) Engman (1986), c) Hathaway (1945), d) Palmer (1946), e) Ragan and Duru (1972), f) Woolhiser (1975). (See Hjermfelt, 1986)

\*Asphalt/Concrete n value for open channel flow 0.01 - 0.016

**Note:** These values are factors for using the Kinematic Routing Method, and shall not be used for Manning's "n" for open channel flow.

| Revision | Date |
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### REFERENCE:

USACE, Hydrologic Engineering Center, 1990

Table 605

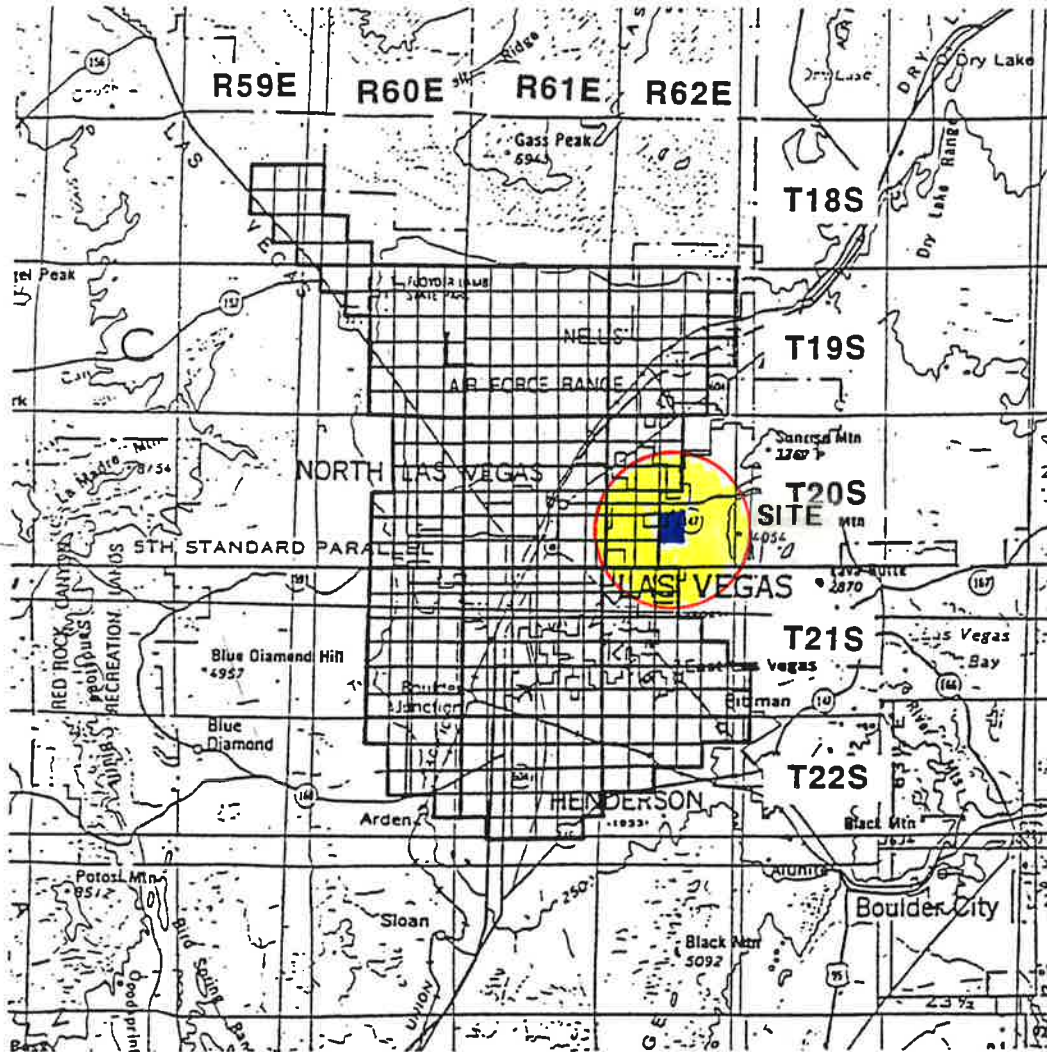
## DEPTH-DURATION-FREQUENCY VALUES FOR McCARRAN AIRPORT RAINFALL AREA (IN INCHES)

| <u>TIME</u>     | <u>RECURRENCE INTERVAL</u> |             |              |              |              |               |
|-----------------|----------------------------|-------------|--------------|--------------|--------------|---------------|
|                 | <u>2-YR</u>                | <u>5-YR</u> | <u>10-YR</u> | <u>25-YR</u> | <u>50-YR</u> | <u>100-YR</u> |
| 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.

| <i>Revision</i> | <i>Date</i> |
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# McCARRAN AIRPORT RAINFALL AREA



TOWNSHIP RANGE SECTIONS

18 South 59 East 13-15,22-26,36  
 18 South 60 East 30-32  
 19 South 60 East 1-6,8-16,21-28,33-36  
 19 South 61 East ALL SECTIONS  
 19 South 62 East 2-11,14-23,27-34  
 20 South 60 East 1-3,10-15,21-28,33-36  
 20 South 61 East ALL SECTIONS

TOWNSHIP RANGE SECTIONS

20 South 62 East 4-9,16-20,29-32  
 21 South 60 East 1-4,9-16,21-28,33-36  
 21 South 61 East ALL SECTIONS  
 21 South 62 East 4-9,15-23, 25-36  
 22 South 60 East 1-4,10-15,24  
 22 South 61 East 1-24,26-29  
 22 South 62 East 1-10,17-18

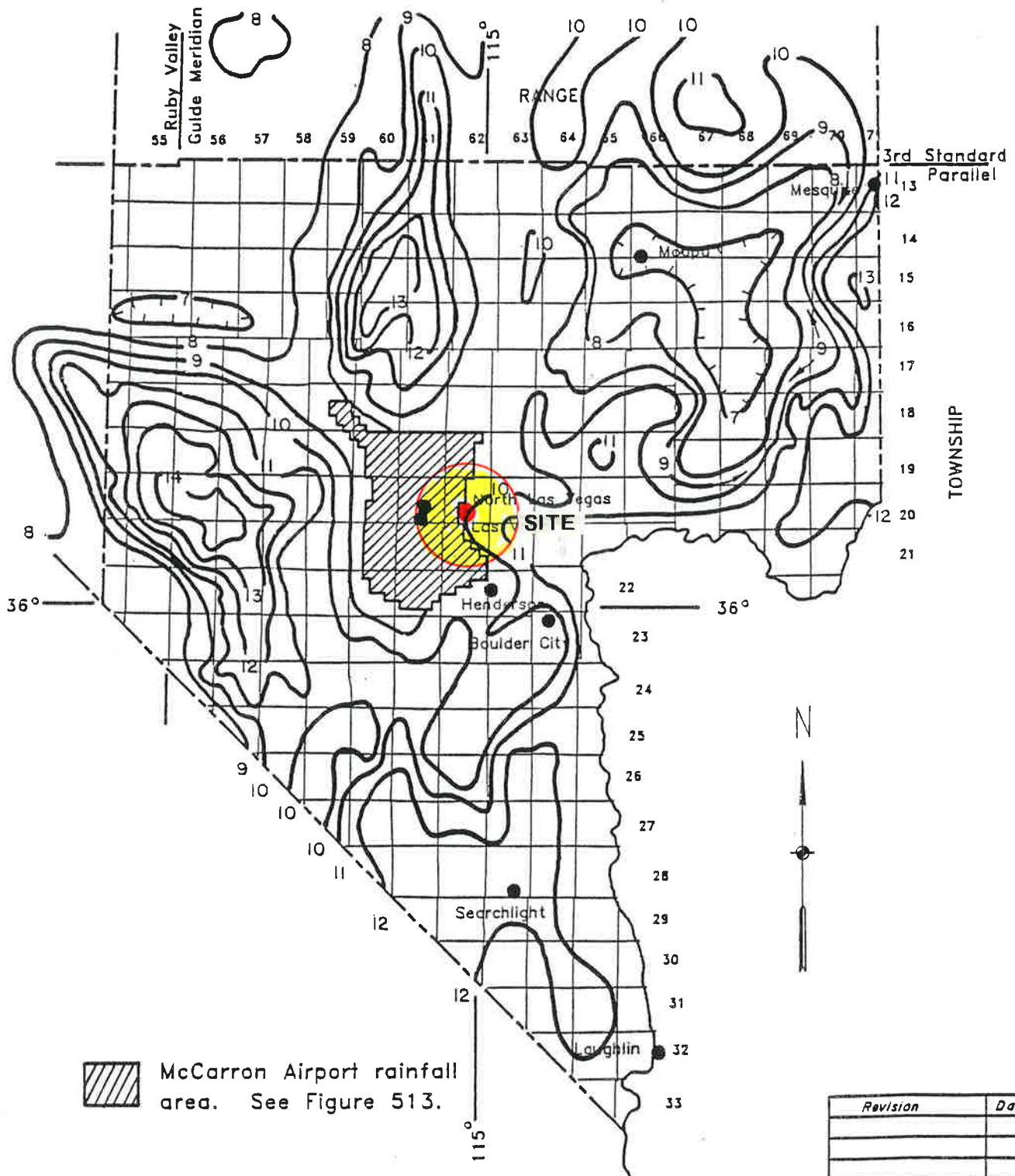
Notes:

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.

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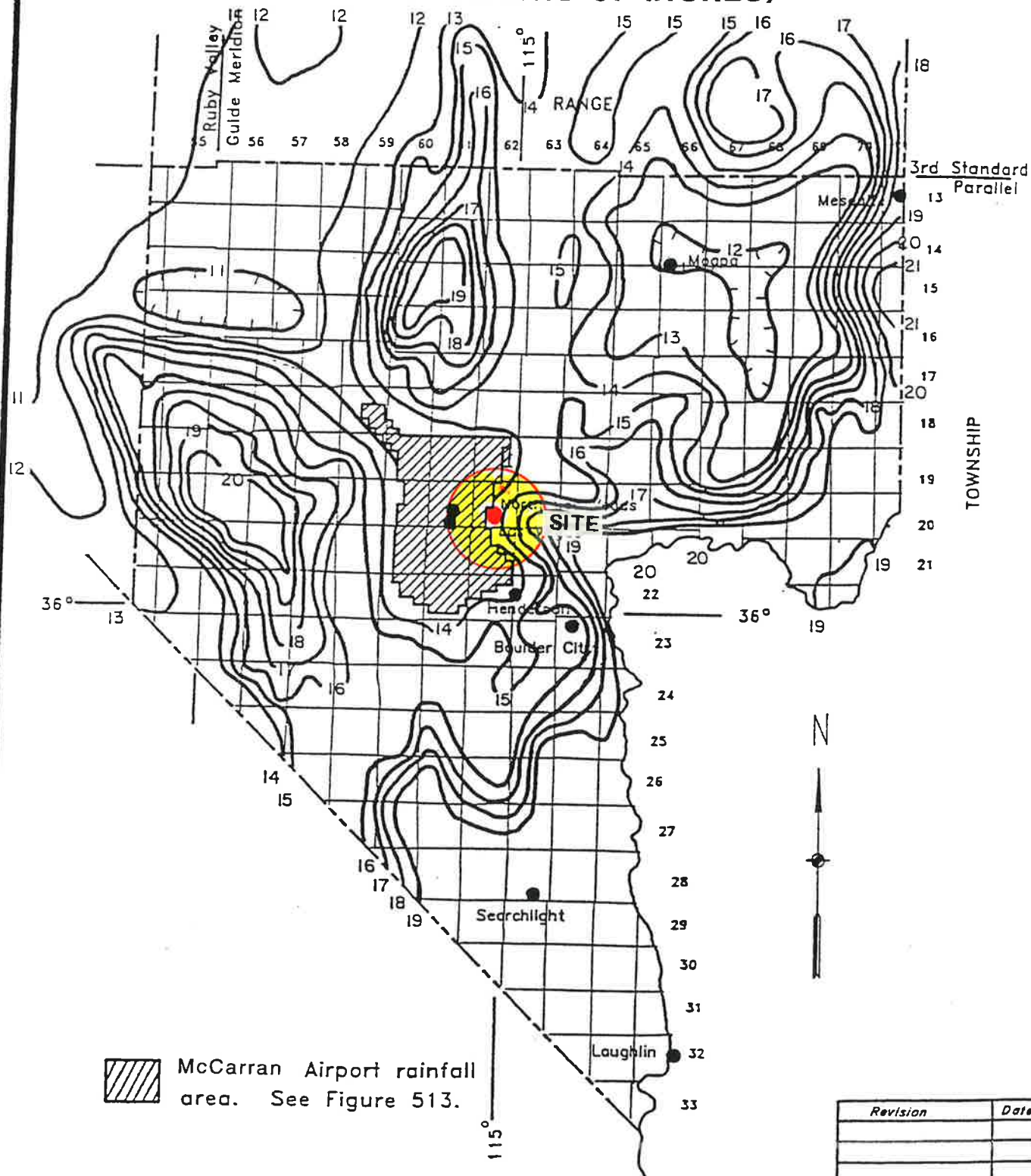


# RAINFALL DEPTH-DURATION-FREQUENCY 2-YEAR, 6-HOUR (DEPTHS IN TENTHS OF INCHES)



| Revision | Date |
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**RAINFALL DEPTH-DURATION-FREQUENCY**  
**10-YEAR, 6-HOUR**  
**(DEPTHS IN TENTHS OF INCHES)**



WRC  
ENGINEERING

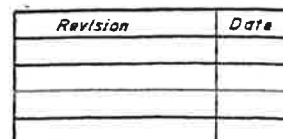
**REFERENCE:**

NOAA ATLAS 2, VOLUME VII NEVADA, 1973

**FIGURE 503**

| Revision | Date |
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|          |      |





## **ZONING APPROVAL LETTER**





# Department of Comprehensive Planning

500 S Grand Central Pkwy • Box 551741 • Las Vegas NV 89155-1741  
(702) 455-4314 • Fax (702) 455-3271

Nancy A. Amundsen, Director

RECEIVED  
JUL 30 2021

## NOTICE OF FINAL ACTION

July 29, 2021

KIM COLLINS  
5670 WYNN RD  
LAS VEGAS, NV 89118

REFERENCE: UC-21-0278

On the date indicated above, a Notice of Final Action was filed with the Clark County Clerk, Commission Division, pursuant to NRS 278.0235 and NRS 278.3195, which starts the commencement of the twenty-five (25) day limitation period specified therein.

The above referenced application was presented before the Clark County Planning Commissioners at their regular meeting of **July 20, 2021** and was **APPROVED** subject to the conditions listed below. You will be required to comply with all conditions prior to the issuance of a building permit or a business license, whichever occurs first.

Time limits to commence, complete or review this approval, apply only to this specific application. A property may have several approved applications on it with each having its own expiration date. **It is the applicant's responsibility to keep the application current.**

### CONDITIONS OF APPROVAL -

#### Current Planning

- Applicant is advised that the County is currently rewriting Title 30 and future land use applications, including applications for extensions of time, will be reviewed for conformance with the regulations in place at the time of application; a substantial change in circumstances or regulations may warrant denial or added conditions to an extension of time; the extension of time may be denied if the project has not commenced or there has been no substantial work towards completion within the time specified; and that this application must commence within 2 years of approval date or it will expire.

#### Public Works - Development Review

- Drainage study and compliance;
- Traffic study and compliance;
- Nevada Department of Transportation approval.

#### Clark County Water Reclamation District (CCWRD)

- Applicant is advised that the CCWRD is unable to verify sewer capacity based on this zoning application; that you may find instruction for submitting a Point of Connection (POC) request on the CCWRD website; and that a CCWRD approved POC must be included when submitting civil improvement plans.

#### BOARD OF COUNTY COMMISSIONERS

MARILYN KIRKPATRICK, Chair • JAMES B. GIBSON, Vice Chair  
MICHAEL NAFT • JUSTIN C. JONES • TICK SEGERBLOM • ROSS MILLER • WILLIAM MCCURDY II  
YOLANDA T. KING, County Manager