

DS #: 4515

APN: 139-19-812-052 & -053

PROJECT: VEGAS DRIVE CHURCH OF CHRIST (CLV CONCURRANCE)

SUBMITTAL: 1ST

SCANNED BY/DATE: _____

CHECKED BY/DATE: _____





CITY OF LAS VEGAS		DATE:
INTER-OFFICE MEMORANDUM		January 13, 2011
TO: Land Development Services Department of Public Works		FROM: Albert Sung, P.E. Flood Control Project Engineer Department of Public Works
SUBJECT: Drainage Study for: Vegas Drive Church of Christ (Project in Clark County for CLV Concurrence)		COPIES TO: Warling Engineering
Cross Streets:	NWQ of Vegas Drive & Rancho Road	Vegas Drive Church of Christ
File Number:	F:\Depot\DSMemos\DS4515A.doc	Bart Anderson, P.E., DevCo
Parcel Number:	139-19-812-052 & 139-19-812-053	CCRFGD
Zoning Action:	N/A	CCPW
FEMA Flood Zone	YES NO X	
Proposed Storm Drain	YES NO X	

HISTORY	DATE RECEIVED	DATE REVIEWED	COMMENTS	REVIEW FEES	FEES PAID Transaction #
1 st Submittal	1/7/2011	1/13/2011	See Comments Below	\$400.00	160461: \$400
			TOTAL FEES (LDDRS):	\$400.00	----

REMARKS:

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

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

City of Las Vegas Flood Control staff has reviewed the subject Technical Drainage Study including the Addendum #1. City of Las Vegas concurs with the acceptance of the drainage study by the Clark County Public Works Department. The review of this project was limited to issues of flood control significance to the City of Las Vegas.

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

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

END OF REMARKS
ays

T/R/S: T20S/R61E/19
AREA M-19

Recd: 1/7/11
DS 4515
M-19

TECHNICAL DRAINAGE STUDY

FOR

\$400

VEGAS DRIVE CHURCH OF CHRIST

**3816 & 3824 VEGAS DRIVE
LAS VEGAS, NV 89108**

COUNTY PROJECT
FOR
CLV CONCURRENCE

SEPTEMBER 30, 2010

Prepared By:

Warling Engineering

**9101 W. Sahara Ave. #105-L8
Las Vegas, NV 89117
Tel: 702-WARLING (927-5464)
Fax: 702-269-6275**

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE STUDY INFORMATION FORM

Name of Development: Vegas Drive Church of Christ Date: September 30, 2010

Location of Development: a) Descriptive (Cross Streets) North/South Vegas Drive East/West Pyramid Avenue
 b) Sect. 19 Twn. 20 S. Rng. 61 E.

Name of Owner: Vegas Drive Church of Christ Assessors Parcel No: 139-19-812-052 & 139-19-812-053

Telephone No: 702-648-4827 Facsimile No: 702-360-4480

Address: 3816 Vegas Drive, Las Vegas, NV 89108

Contact Person-Name Tony Barajas Telephone No: 702-768-7180

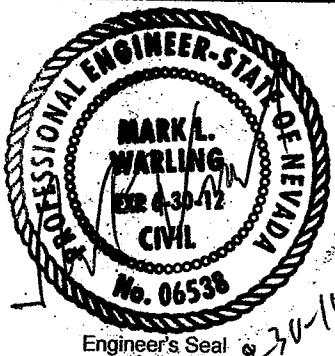
Firm: Barajas & Associates, Inc.

Address: 2965 West Lake Mead Blvd., North Las Vegas, NV 89032

Type of Land Development/Land Disturbance Process:

- | | | |
|---|---|---|
| ☐ Rezoning | ☐ Subdivision Map | ☐ Clearing and Grading Only |
| ☐ Parcel Map | ☐ Planned Unit Development | ☐ Other (Please specify below) |
| ☐ Large Parcel Map | ☒ Building Permit | |

1. Total Owned Land Area: At Site: 0.87 Acres Being Developed/Disturbed: 0.87 Acres
2. Is a portion or all of the subject property located in a designated FEMA Flood Hazard Area? ☐ Yes* ☒ No
3. Is the property bordered or crossed by an existing or proposed Clark County Regional Flood Control District Master Planned Facility? ☐ Yes* ☒ No
4. Proposed type of development (Residential, Commercial, Etc.)? Commercial
5. Approximate upstream land area which drains to the subject site? 1.52 sq. mi.
6. Has the site drainage been evaluated in the past ☒ Yes ☐ No If yes, please identify documentation:
Vegas Drive Improvements Shadow Mountain Place to Rancho Drive, by Poggemeyer Design Group, Inc. project no. 05333-C; for City of Las Vegas Dept. of Public Works
7. If known, please briefly identify the proposed discharge point(s) of runoff from the site:
Proposed commercial driveway on Vegas Drive
8. Briefly describe your proposed schedule for the subject project: commencing: 4th quarter, 2010 - estimated completion: 2nd quarter, 2011



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

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

Local Entity File No. _____

Revision

Date

REFERENCE:

Standard Form 1

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE SUBMITTAL CHECKLIST

Project Name:	Vegas Drive Church of Christ	Map ID:	
Firm Name:	Warling Engineering	Engineer:	Mark Warling, P.E.
Address:	9101 W. Sahara Ave. #105-L8		
City:	Las Vegas	State:	Nevada
		Zip:	89117
Phone Number:	702-WARLING (927-5464)	Fax Number:	702-269-6275
Property Owner:	Vegas Drive Church of Christ		
Address:	3816 Vegas Drive		
City:	Las Vegas	State:	NV
		Zip:	89108
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 (CCRFCD) 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	
☒	☐	Design Manual Standard Form 1 with the engineer's seal and signature.
☒	☐	Design Manual Standard Form 4 .
☒	☐	2 copies of the 24" x 36" Drainage Plan.
☒	☐	A notarized letter from the adjacent property owner(s) allowing off-site grading or discharge.

Reference:

STANDARD FORM 2

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE SUBMITTAL CHECKLIST

II. MAPS AND EXHIBITS

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

III. DRAINAGE PLAN

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

REFERENCE:

STANDARD FORM 2

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE SUBMITTAL CHECKLIST

III. DRAINAGE PLAN (Continued)

Yes	No	
X		Existing contours encompassing the site and 100 feet beyond with spot elevations for important locations, where appropriate.
X		Minimum finish floor elevations with top-of-curb elevations at upstream end of lot.
X		Proposed typical street sections.
N/A		Streets with off-set crowns.
X		Proposed contours or spot elevations in sufficient detail to exhibit intended drainage patterns and slopes.
X		Property lines.
X		Right-of-way lines and widths, existing and proposed.
X		Existing improvements and their elevations.
X		Delineation of proposed on-site drainage basins indicating area and 10-year and 100-year storm peak flows at basin concentration points.
X		Concentration points and drainage flow direction with Q_{100} and V_{100} and D_{100} in streets.
X		Cumulative flows, velocity, and direction of flow at upstream and downstream ends of site for the 10-year and 100-year flows.
X		Location and cross-section of street capacity calculations.
N/A		Cross-sectional detail for channels, including cutoff wall locations.
X		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.
N/A		Existing and proposed drainage easements and widths shown with sufficient detail. A cross sectional detail must be provided that shows appropriate lining and reinforcement.
N/A		Location and detail of existing, proposed, and future block wall openings. Minimum size is 16"x48". Wrought iron gate is required for flows > 10 cfs.
N/A		Location and detail of flood walls illustrating depth of flow, proposed grouting height, etc.

REFERENCE:

STANDARD FORM 2

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE SUBMITTAL CHECKLIST

III. DRAINAGE PLAN (Continued)

Yes

No

X

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.

X

Building and/or lot numbers.

N/A

Alignment of all existing, proposed, or future Regional Facilities adjacent to the site.

X

Limits of existing floodplain based on current FIRM or best available information; limits of proposed floodplains based on best available information.

N/A

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.

X

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.

X

Street slopes for perimeter and interior streets. The minimum slope is 0.4 percent.

IV. HYDROLOGIC ANALYSIS

Yes

No

X

Appropriate soil information and Soils Map for existing and future conditions with subbasins and property delineated.

X

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.

X

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.

X

Use of correct precipitation values in and around the McCarran Airport Rainfall Area.

X

A discussion in the text of the hydrologic analysis justifying subbasin boundaries and cutoffs, supporting assumptions, and calculations.

X

A summary table of storm water flows showing basin area, Q_{10} and Q_{100} for both individual basins and combined basin flows, where acceptable.

X

Copies of supporting technical information referenced from a previously approved study and a statement accepting these results.

X

On-site facilities must perpetuate flows through or around the site without significantly impacting adjacent property owners in accordance with current Nevada Drainage Law.

REFERENCE:

STANDARD FORM 2

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE SUBMITTAL CHECKLIST

V. HYDRAULIC ANALYSIS

Yes

No

N/A

Flow split calculations and supporting documentation or reference for the method of flow split calculations used.

X

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 ≥ 80 feet. Calculations must be labeled by street name as indicated on the Grading Plan.

X

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.

N/A

Appropriate hydraulic calculations for block wall openings assuming a 50 percent vertical clogging factor. (Assume the lower half of the opening is plugged.)

N/A

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.

X

Provide necessary freeboard requirements to set the finished floor elevations of all proposed buildings, 2 x depth of flow or depth of flow plus 18 inches of freeboard, whichever is less. The minimum requirement is 6 inches above adjacent upstream top of curb. Buildings adjacent to drainage easements must always be provided with 18 inches of freeboard above the Q_{100} weir height or flow depth, which ever is greater.

N/A

A complete water surface profile analysis (HEC-2, HEC-RAS, etc.) for channel flows and FEMA Zone A flood zones.

N/A

- Field survey data.
- Input and output information.
- Plotted cross-sections based on survey with proper encroachments.
- A map showing the location of the cross-sections.
- Analysis of both sub- and super-critical flow segments.
- A summary table and a discussion of the results in the text of the report.

N/A

Provide a 50 percent clogging factor in the capacity calculation for drop inlets.

X

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.

The mitigation of nuisance water, both during construction and in the fully developed condition, must be addressed.

REFERENCE:

STANDARD FORM 2

Page 1

September 30, 2010

Layne Weber, P.E.
Clark County Dept. of Development Services
500 S. Grand Central Pkwy. 1st Fl.
Las Vegas, Nevada

**Subject: Technical Drainage Study for Vegas Drive Church of Christ
 3816 & 3824 Vegas Drive, Las Vegas, NV 89108**

Dear Mr. Weber:

SITE:

The site is within the SE ¼ of the SE ¼ of Section 19, Township 20 South, Range 61 East M.D.M. in Clark County, Nevada. The site is located on the north side of Vegas Drive near the intersection of Pyramid Avenue; more specifically Lot 8 of Block 21 of Amended Plat No. 1, Eastland Heights, as shown in Book 2 of Plats, Page 38. The subject site is identified by the Clark County Assessor's Office as Assessor's Parcel Numbers 139-19-812-052 & 139-19-812-053. The subject site is presented with respect to major arterials and local collectors on the attached exhibit, Figure 1.

EXISTING CONDITIONS:

Currently, the site to be developed consists of old structures and foundations that will be demolished. The drainage of the area generally flows from west to east. The site is not adjacent to any existing or proposed Regional Flood Control District facilities. The project site resides within the FEMA zoning designation of Zone X. Please refer to Figure 2 enclosed herewith as the map depicts the site superimposed over FEMA's Flood Insurance Rate Map Number 32003C2155E, revised to reflect LOMR dated December 31, 2003. Figure 3 represents the site in relation to the CCRFCD Master Plan facilities as outlined in the 2008 Las Vegas Valley Flood Control Master Plan Update.

CITY OF LAS VEGAS STORM DRAIN:

Note that this site is adjacent to the City of Las Vegas, and the City has designed a major storm drain project in Vegas Drive entitled "Vegas Drive Improvements - Shadow Mountain Place to Rancho Drive". Poggemeyer Design Group prepared the design plans for that storm drain. (See Appendix 'A'.) The funding for the construction of that storm drain is expected from the Clark County Regional Flood Control District in the 4th quarter of 2010. The Notice To Proceed for that storm drain construction is scheduled for the 2nd quarter of 2011, and the storm drain installation near the site should be well under way by the time the proposed building is nearing completion.

HYDROLOGY:

The drainage study in support of those storm drain improvements was also prepared by Poggemeyer Design Group, PDG project No. 05333-C (hereinafter referred to as "PDG study"). That study included existing, interim, and ultimate hydrologic conditions for flooding down Vegas Drive. (Refer to Appendix 'B'.) The PDG study has been reviewed and the results deemed reasonable. The calculations within that study are included in Appendix 'B', and by reference incorporated herein.

The hydrologic analysis presented in the PDG study indicated proposed flow conditions for two different scenarios – Interim and Ultimate. The ultimate condition shows the design flow rates for the storm drain and surface flow in Vegas Drive based on the completion of a future storm drain facility that is presumed to divert away from Vegas Drive - into the Lake Mead Detention Basin - the majority of flow originating west of Decatur Boulevard. Since that particular storm drain is not due to be constructed anytime in the near future, the much higher interim flow condition value for the 100-year storm surface flow in Vegas Drive was used to design the flood protection of the site.

The site has been notated on their Sub-Basin Drainage Map (PDG Figure 3.2). The site is adjacent to cross section number 19 as shown on their Proposed Peak Flow Summary (PDG Figure 3.3). Both of those figures are included in map pockets herein, with the location for the site highlighted. The interim (higher) proposed condition shows the design flow rate for the surface flow in Vegas Drive at Section 19 as 214 cfs for each side of the street (428 cfs total). As there is no other offsite flow impacting the site, and the on-site flow is negligible, that value was accepted and used for the street flow hydraulics in Vegas Drive. No additional hydrological analysis was necessary.

HYDRAULICS:

Street flow hydraulics in Vegas Drive was calculated to determine the maximum depth of flow during a 100-year storm for sections at various key points along the frontage of the site, and included at the end of this report. The depth of flow for each of those cross sections is presented in Table 1.

OFF-SITE IMPROVEMENTS:

Off-site improvements are proposed with the site development, but they are limited to removal of existing pan driveways, and the construction of a new common commercial driveway meeting current County design standards. Curb and gutter per current County standards will be installed where those old pan driveways were removed. The existing street grade, crown, and cross fall will remain unchanged. Also, a new sidewalk will be constructed adjacent to the L-type curb and gutter along the entire frontage of Vegas Drive.

FLOOD PROTECTION:

To ensure that the proposed structures are adequately flood protected, a finished floor analysis was conducted. The proposed design finish floor elevation of the two structures is indicated in the finish floor analysis presented below in Table 1.

Table 1: Finish Floor Analysis

Cross Section	Q ₁₀₀ (cfs)	Slope (%)	Depth ₁₀₀ (ft)	Flow line Elev. (ft)	FF _{min} (ft)	FF _{Design} (ft) or TW elev.
A	428	1.80	1.05	2145.30	2147.40	2147.90
B	428	2.50	1.03	2143.08	2145.14	2146.00
C	428	2.50	1.03	2141.66	2143.72	2144.00

Note: $FF_{min} = 2(D_{100}) + \text{Flow Line Elevation}$

As shown above, the proposed building on the west lot is flood protected by an 18" high solid grouted block wall along Vegas Drive. The top of that wall has been designed to be at least

twice the depth of the 100-year flow in the street plus an additional 6 inches of freeboard. Where that wall ends, westerly of the proposed driveway, the design FF of the westerly building has been elevated in excess of twice the 100-year depth of flow in Vegas Drive at that location. Therefore, the westerly building is sufficiently elevated above the flood level.

The design FF of the easterly building has been elevated to more than twice the depth of flow at the high side of that building. Therefore, for that reason alone, the easterly building is sufficiently elevated above the flood level. Although not necessarily required for flood protection of the easterly building, the 18" high solid grouted block wall along Vegas Drive is continued easterly of the proposed driveway as well. That actually reduces any existing adverse conditions affecting the neighboring downstream properties, as it will help keep the storm flows more confined within Vegas Drive.

The driveway approach could not be "humped" sufficiently to prevent storm flows from entering the site. However, the on-site driving and parking areas of the site have been designed in such a way that any backwater inundation of the site via the driveway opening would be contained within the paved areas by the on-site curbing. The Finish Floors of the proposed buildings will not be impacted by any backwater condition. Any backwater inundation due to the driveway opening will not flow through the site, but rather recede back out the driveway into Vegas Drive. Of course, this backwater effect will be reduced and insignificant once the ultimate condition storm drain system is in place upstream of the site.

SUMMARY:

The off-site flows tributary to the site will be adequately conveyed in Vegas Drive. The proposed structures have been adequately protected by the 18" high solid grouted block wall along the street, and also elevated above the 100-year flood elevation at the driveway. Therefore, the proposed improvements do not have an adverse impact on any proposed structures, or existing downstream facilities or structures.

If you have any questions or need additional information, please do not hesitate to contact me at #927-5464 or via email at civil@cox.net. Your diligence in reviewing the items submitted herewith is greatly appreciated.

Very truly yours,

WARLING ENGINEERING



Mark Warling, PE

Id, Assessor

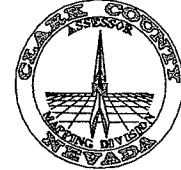
MAP S 2 SE 4

139-19-8

	R60E	R61E	R62E
T19S	125	124	123
T20S	138	139	140
T21S	163	162	161

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
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



Scale: 1" = 200'

Rev:07/02/09

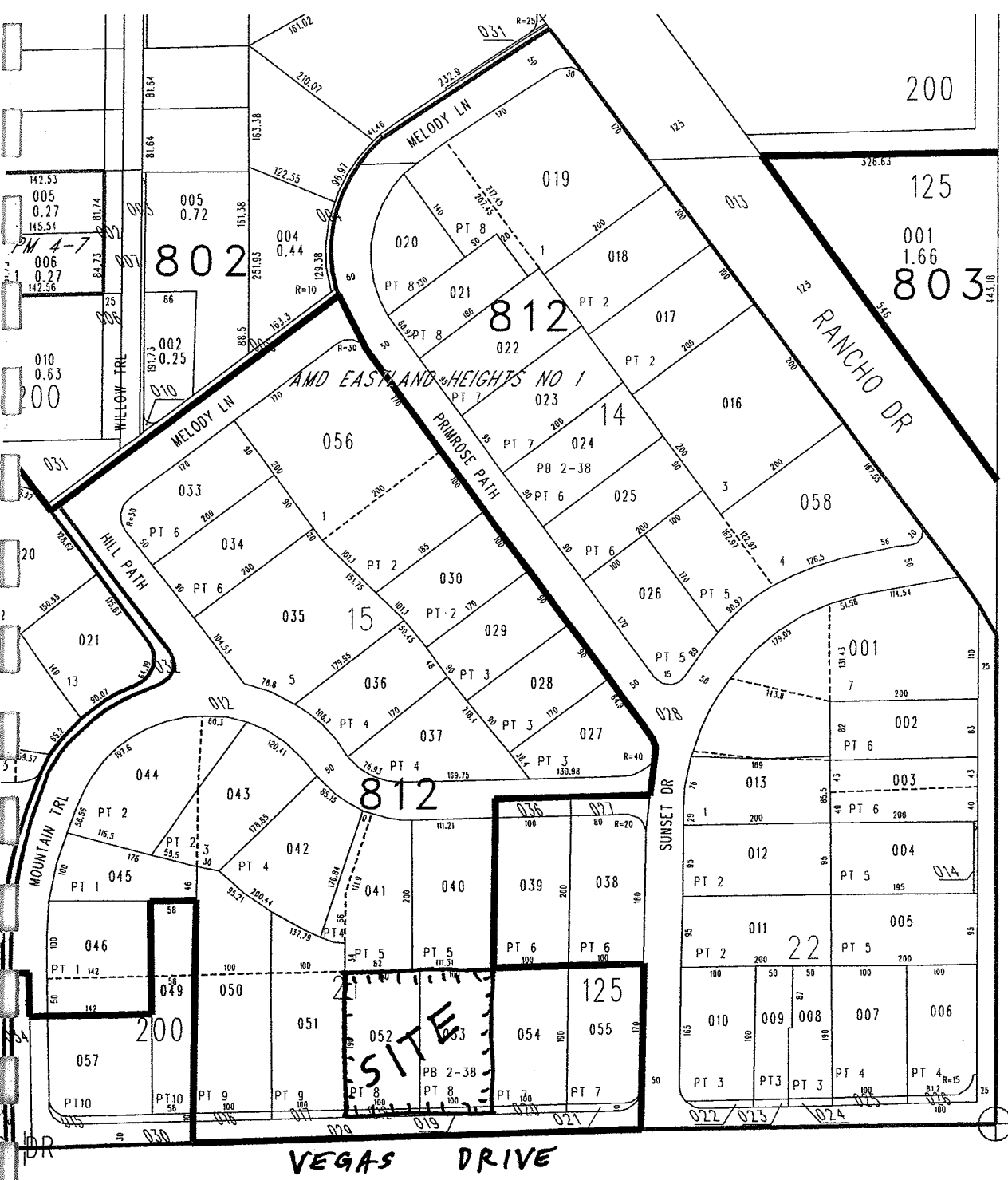


FIGURE 1.

TAX DIST 125,200

AS VEGAS

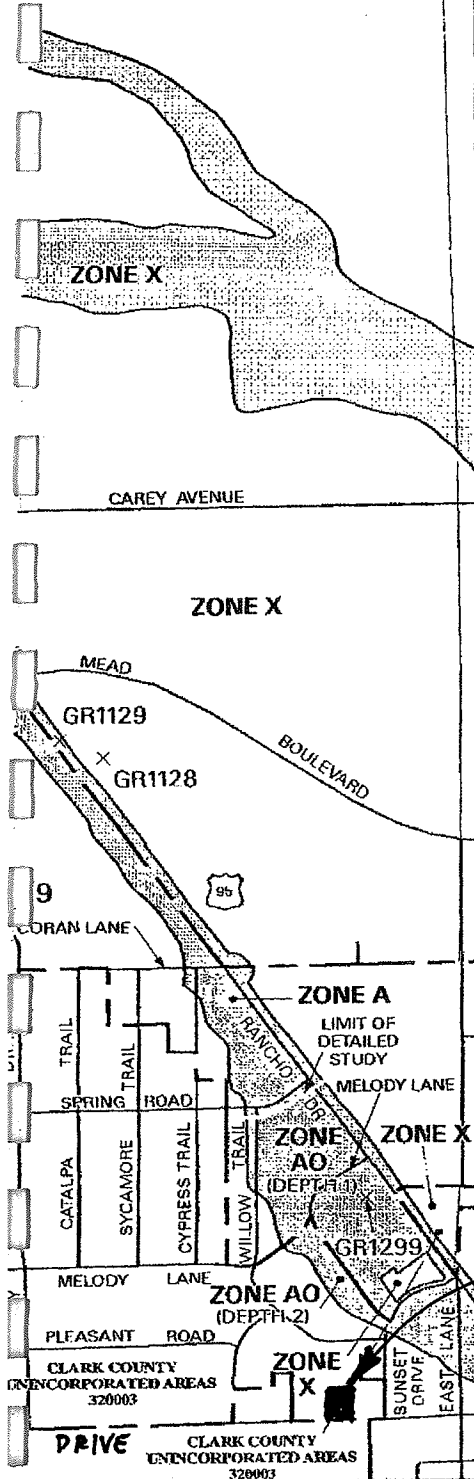
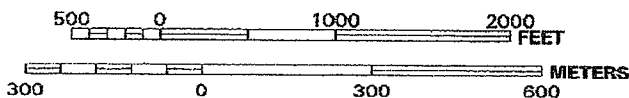
is flood hazard areas, to change zone designations, to add roads and road names, to add previously issued letters of map revision, to incorporate previously issued map amendments, and to change floodway.

For more information on map revision history prior to countywide mapping, refer to the Community Flood Insurance Study report for this jurisdiction.

If flood insurance is available in this community, contact your insurance agent for the National Flood Insurance Program at (800) 638-6620.



MAP SCALE 1" = 1000'



PANEL 2155E

FIRM FLOOD INSURANCE RATE MAP CLARK COUNTY, NEVADA AND INCORPORATED AREAS

PANEL 2155 OF 4090

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
NORTH LAS VEGAS, CITY OF	320007	2155	E
LAS VEGAS, CITY OF	325276	2155	E
CLARK COUNTY, UNINCORPORATED AREAS	320003	2155	E

**REVISED TO
REFLECT LOMR
DATED DEC 31 2003**

Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.



**MAP NUMBER
32003C2155E**

**MAP REVISED:
SEPTEMBER 27, 2002**

Federal Emergency Management Agency

FIGURE 2



FIGURE 3

VEGAS DRIVE - Q100 @ WEST PL **Worksheet for Irregular Channel**

Project Description

Worksheet	Vegas Drive -Q100 West Pl
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Slope	1.80 %
Discharge	428.00 cfs

Options

Current Roughness Method	Improved Lotter's Method
Open Channel Weighting Method	Improved Lotter's Method
Closed Channel Weighting Method	Horton's Method

Results

Mannings Coefficient	0.016
Water Surface Elevation	1.05 ft
Elevation Range	0.00 to 2.65
Flow Area	48.6 ft ²
Wetted Perimeter	81.908 ft
Top Width	80.000 ft
Actual Depth	1.05 ft
Critical Elevation	1.40 ft
Critical Slope	0.39 %
Velocity	8.80 ft/s
Velocity Head	1.20 ft
Specific Energy	2.25 ft
Froude Number	1.99
Flow Type	Supercritical

Roughness Segments

Start Station	End Station	Mannings Coefficient
1+00.0	1+80.0	0.016

Natural Channel Points

Station (ft)	Elevation (ft)
1+00.0	2.650
1+00.0	0.650
1+07.5	0.500
1+08.0	0.500
1+08.0	0.000
1+09.5	0.125
1+09.5	0.167
1+40.0	0.690
1+70.5	0.167
1+70.5	0.125
1+72.0	0.000
1+72.0	0.500
1+72.5	0.500
1+80.0	0.650
1+80.0	2.650

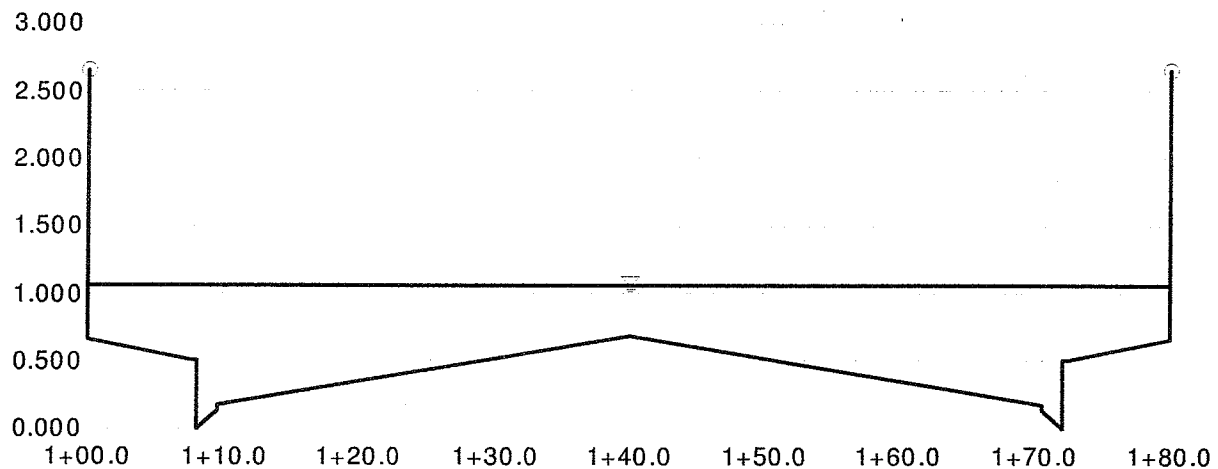
VEGAS DRIVE - Q100 @ WEST PL
Cross Section for Irregular Channel

Project Description

Worksheet	Vegas Drive -Q100 West PI
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data

Mannings Coefficient	0.016
Slope	1.80 %
Water Surface Elevation	1.05 ft
Elevation Range	0.00 to 2.65
Discharge	428.00 cfs



V:10.0
H:1
NTS

VEGAS DRIVE -Q100 @ MID-SITE **Worksheet for Irregular Channel**

Project Description

Worksheet	Vegas Drive -Q100 @ Mid-Site
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Slope	2.50 %
Discharge	428.00 cfs

Options

Current Roughness Method	Improved Lotter's Method
Open Channel Weighting Method	Improved Lotter's Method
Closed Channel Weighting Method	Horton's Method

Results

Mannings Coefficient	0.016
Water Surface Elevation	1.03 ft
Elevation Range	0.00 to 2.65
Flow Area	44.1 ft ²
Wetted Perimeter	81.866 ft
Top Width	80.000 ft
Actual Depth	1.03 ft
Critical Elevation	1.44 ft
Critical Slope	0.39 %
Velocity	9.72 ft/s
Velocity Head	1.47 ft
Specific Energy	2.49 ft
Froude Number	2.31
Flow Type	Supercritical

Roughness Segments

Start Station	End Station	Mannings Coefficient
1+00.0	1+80.0	0.016

Natural Channel Points

Station (ft)	Elevation (ft)
1+00.0	2.650
1+00.0	0.650
1+07.5	0.500
1+08.0	0.500
1+08.0	0.000
1+09.5	0.125
1+09.5	0.167
1+40.0	0.780
1+70.5	0.167
1+70.5	0.125
1+72.0	0.000
1+72.0	0.500
1+72.5	0.500
1+80.0	0.650
1+80.0	2.650

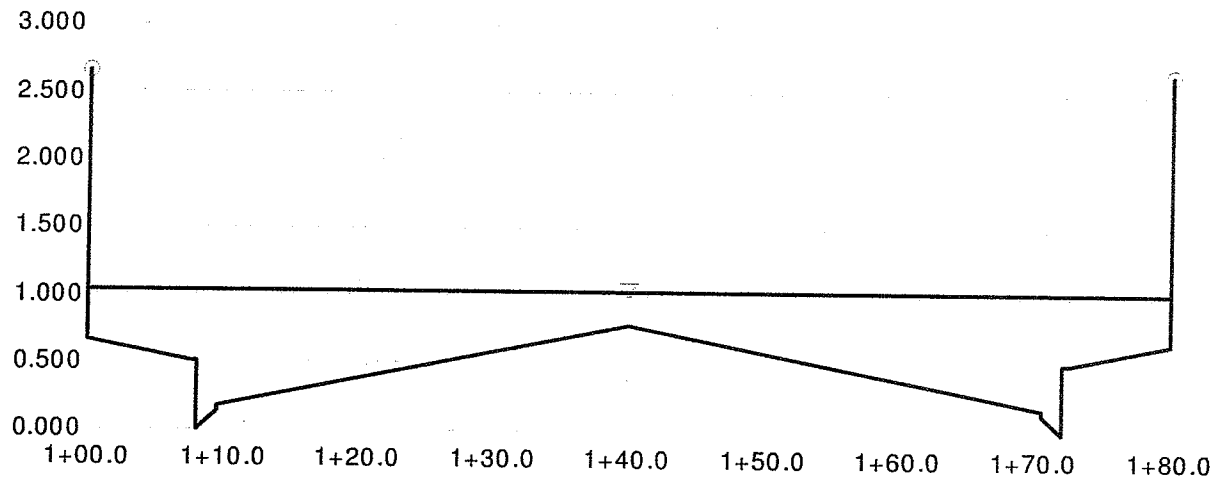
VEGAS DRIVE - Q100 @ MID-SITE
Cross Section for Irregular Channel

Project Description

Worksheet	Vegas Drive -Q100 @ Mid-Site
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data

Mannings Coefficient	0.016
Slope	2.50 %
Water Surface Elevation	1.03 ft
Elevation Range	0.00 to 2.65
Discharge	428.00 cfs



V:10.0
H:1
NTS

APPENDIX 'A'