



**Technical Drainage Study
for**

AREA 15 DISTRICT 2

Date Prepared:
November 2022

Prepared for:
Fisher Brothers Las Vegas, LLC
299 Park Avenue, 42nd Floor
New York, NY 10171
212.940.6262

Prepared by:
Kimley-Horn and Associates, Inc.
6671 Las Vegas Boulevard South, Suite 320
Las Vegas, NV 89119
702.862.3600

Kimley»Horn

HYDROLOGIC CRITERIA AND DRAINAGE MANUAL

DRAINAGE STUDY INFORMATION FORM

Name of Development: Area 15 District 2 Date: November 2022

Location of Development: a) Descriptive (Cross Streets) North/South: Rigel Avenue & Rancho Drive
East/West: Meade Avenue & Sirius Avenue

b) Section: 8 Township: 21 South Range: 61 East

c) APN: 162-08-702-001, 162-08-702-002, 162-08-303-034, 162-08-799-003, 162-08-799-009, and 162-08-799-009

Name of Owner: New Vegas Holding Company, LLC

Telephone No.: 212.940.6262 Fax No.: n/a E-Mail Address: pbrohn@fisherbrothers.com

Address: 299 Park Avenue New York, NY 10171

Contact Person-Name: Rachael R. Dennis, P.E. Telephone No.: 702.734.5666

* E-Mail Address: Rachael.Dennis@kimley-horn.com Fax No.: _____

Firm: Kimley-Horn

Address: 6671 Las Vegas Boulevard South, #320, Las Vegas NV 89119

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	☐	Grading Permit

1. Total Owned Land Area: At Site: +/- 11.06 ac Being Developed/Disturbed: +/- 11.06 ac

2. Is a portion or all of the subject property located in a designated FEMA Flood Hazard Area? ☐ Yes** ☒ No

3. Is the property bordered or crossed by an existing or proposed Clark County Regional Flood Control District Master Planned Facility? ☒ Yes** ☐ No

4. Proposed type of development (Residential, Commercial, Etc.): Parking Garage, Commercial

5. Approximate upstream land area which drains to the subject site: +/- 4.38 sq. mi.

6. Has the site drainage been evaluated in the past? ☒ YES ☐ NO If yes, please identify documentation: Area 15 TDS (DS-4921); Area 15 Event Pkg Lot TDS (DS-5288); Area 15 - Phase 2 TDS (DS-5313)

7. If known, please briefly identify the proposed discharge point(s) of runoff from the site: Surface runoff into Rancho Drive, Rigel Avenue, & Meade Avenue

8. Briefly describe your proposed schedule for the subject project: ASAP



Engineer's Seal

11/16/22

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



November 16, 2022

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

RE: *Technical Drainage Study for Area 15 District 2*

Dear Mr. Sung,

Attached is one (1) copy of the *Technical Drainage Study for Area 15 District 2* for your review. This letter certifies that all items provided on the electronic submittal (CD) match the paper version bound into the study.

With Kimley-Horn, you should expect more and will experience better. Please contact me at (702) 734-5666 or rachael.dennis@kimley-horn.com should you have any questions or concerns.

Sincerely,

A handwritten signature in cursive script that reads "Rachael R. Dennis".

Rachael R. Dennis, P.E.

A handwritten signature in cursive script that appears to read "Sean Schofield".

Sean Schofield, Analyst



CITY OF LAS VEGAS

MINIMUM DRAINAGE STUDY CRITERIA STANDARD FORM 2 CHECKLIST SUPPLEMENT

(Revised 5/18/11)

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

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

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

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

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

CITY OF LAS VEGAS MINIMUM DRAINAGE STUDY CRITERIA CHECKLIST

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

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

CITY OF LAS VEGAS MINIMUM DRAINAGE STUDY CRITERIA CHECKLIST

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

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

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

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL			
DRAINAGE SUBMITTAL CHECKLIST			
Project Name:	Area 15 District 2		Map ID:
Firm Name:	Kimley-Horn	Engineer:	Rachael R. Dennis, PE
Address:	6671 Las Vegas Boulevard South, Suite 320		
City:	Las Vegas	State:	Nevada
Phone No.:	(702) 862-3600	Zip:	89119
		Fax No.	
Property Owner:	Fisher Brothers Las Vegas, LLC		
Address:	299 Park Avenue, 42 nd Floor		
City:	New York	State:	NY
		Zip:	10171
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 (CCRCD) 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 N/A

- | | | | |
|-------------------------------------|--------------------------|-------------------------------------|--|
| ☒ | ☐ | ☐ | 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. |

II. MAPS AND EXHIBITS

YES NO N/A

- | | | | |
|-------------------------------------|--------------------------|--------------------------|--|
| ☒ | ☐ | ☐ | A copy of a current Flood Insurance Rate Map (FIRM) with the site delineated. |
| ☒ | ☐ | ☐ | A copy of the current CCRCD Master Plan Update Figure, (F-x), for Flood Control Facilities and Environmental areas with the site delineated. |
| ☒ | ☐ | ☐ | Off-site drainage basin maps for existing, interim, and future conditions showing the existing topography, basin boundaries, concentration points, and flows in cfs. |

II. MAPS AND EXHIBITS (CONTINUED)

- | | | | |
|-------------------------------------|--------------------------|--------------------------|---|
| ☒ | ☐ | ☐ | Vicinity Map with local and major cross streets identified and a north arrow. |
|-------------------------------------|--------------------------|--------------------------|---|

III. DRAINAGE PLAN

YES	NO	N/A	
☒	☐	☐	Sheet size: 24"x36" 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.
☒	☐	☐	Existing contours encompassing the site and 100-feet beyond with spot elevations for important locations, where appropriate.
☒	☐	☐	Minimum finish floor elevations with top-of-curb elevations at upstream end of lot.
☒	☐	☐	Proposed typical street sections.
☒	☐	☐	Streets with offset crowns.
☒	☐	☐	Proposed contours or spot elevations in sufficient detail to exhibit intended drainage patterns and slopes.
☒	☐	☐	Property lines.
☒	☐	☐	Right-of-way lines and widths, existing and proposed.
☒	☐	☐	Existing improvements and their elevations.
☒	☐	☐	Delineation of proposed on-site drainage basins indicating area and 10-year and 100-year peak flows at basin concentration points.
☒	☐	☐	Concentration points and drainage flow directions with Q_{100} and V_{100} and D_{100} in streets.
☒	☐	☐	Cumulative flows, velocity, and direction of flow at upstream and downstream ends of site for the 10-year and 100-year flows.
☒	☐	☐	Location and cross-section of street capacity calculations.
☒	☐	☐	Cross-sectional detail for channels, including cutoff wall locations.

III. DRAINAGE PLAN (CONTINUED)

YES	NO	N/A	
☒	☐	☐	Existing and proposed drainage facilities, appurtenances, and connections (i.e., sidewalk ditches, swales, storm drain systems, unimproved channels, and culverts, etc.) stating size, material shape, and slope with plan and profile and HGL calculations.
☒	☐	☐	Existing and proposed drainage easements and widths shown with sufficient detail. A cross-sectional detail must be provided that shows appropriate lining and reinforcement.
☒	☐	☐	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.
☒	☐	☐	Location and detail of flood-wall(s) illustrating depth of flow, proposed grouting height, etc.
☒	☐	☐	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.
☒	☐	☐	Building and/or lot numbers.
☒	☐	☐	Alignment of all existing, proposed, or future Regional Facilities adjacent to the site.
☐	☐	☒	Limits of existing floodplain based on current FIRM or best available information; limits of proposed floodplains based on best available information.
☐	☐	☒	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.
☒	☐	☐	Appropriately elevated "humps" 6 inches above the 100-year water surface elevation at the accesses where the intent is to protect the site from the Q ₁₀₀ flows.
☒	☐	☐	Street slopes for perimeter and interior streets. The minimum slope is 0.4 percent.
☒	☐	☐	Location and detail of best management practice (BMP) for parking lots and low impact development (LID) (if required)

IV. HYDROLOGIC ANALYSIS

YES	NO	N/A	
☒	☐	☐	Appropriate soil information and Soils Map for existing and future conditions with sub-basins and property delineated.
☒	☐	☐	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 and Output information for proposed conditions from computer models (HEC-1 or TR-55). The flow routing diagram must be provided with HEC-1 models.
☒	☐	☐	Use of correct precipitation values in and around the McCarran Airport rainfall area.
☒	☐	☐	A discussion in the text of the hydrologic analysis justifying sub-basin boundaries and cutoffs, supporting assumptions, and calculations.
☒	☐	☐	A summary table of stormwater flows showing basin area Q ₁₀ and Q ₁₀₀ for both individual basins and combined basin flows, where applicable.

IV. HYDROLOGIC ANALYSIS (CONTINUED)

- | | | | |
|-------------------------------------|--------------------------|--------------------------|--|
| ☒ | ☐ | ☐ | Copies of supporting technical information referenced from a previously approved study and a statement accepting these results. |
| ☒ | ☐ | ☐ | On-site facilities must perpetuate flows through or around the site without significantly impacting adjacent property owners in accordance with current Nevada Drainage Law. |
| ☒ | ☐ | ☐ | Calculation for impervious area for parking lots and LIDs (if required) |

V. HYDRAULIC ANALYSIS

YES NO N/A

- | | | | |
|-------------------------------------|--------------------------|-------------------------------------|--|
| ☒ | ☐ | ☐ | Flow split calculations and supporting documentation or reference for the method of flow calculation used. |
| ☒ | ☐ | ☐ | Normal depth street flow calculations and cross-section diagrams for all interior and perimeter streets. Provide "d x v" products for the Q_{100} and Q_{10} flows representing the worst case for interior and all perimeter streets. $Q_{100} \text{ d x v} \leq 8$. $Q_{10} \text{ d x v} \leq 6$ and 12 foot dry lane for rights-of-way ≥ 80 feet. Calculations must be labeled by street name as indicated on the Grading Plan . |
| ☒ | ☐ | ☐ | 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. |
| ☒ | ☐ | ☐ | Appropriate hydraulic calculations for block wall openings assuming a 50 percent vertical clogging factor. (Assume the lower half of the opening is plugged.) |
| ☐ | ☐ | ☒ | 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. |
| ☒ | ☐ | ☐ | 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. Building 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. |
| ☐ | ☐ | ☒ | <p>A complete water surface profile analysis (HEC-2, HEC-RAS, etc.) for channel flows and FEMA Zone A flood zones.</p> <ul style="list-style-type: none"> • 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. |
| ☒ | ☐ | ☐ | Provide a 50 percent clogging factor in the capacity calculation for drop inlets. |
| ☒ | ☐ | ☐ | Hydraulic calculations for culverts and storm drains. D-Load calculations must be provided for storm drainpipes 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. |
| ☒ | ☐ | ☐ | Provide BMP type, size and supporting calculations for parking lots and LIDs (if required) |

Technical Drainage Study

for

AREA 15 DISTRICT 2

Date Prepared:

November 2022

Prepared for:

Fisher Brothers Las Vegas, LLC

299 Park Avenue, 42nd Floor

New York, NY 10171

212.940.6262

Prepared by:

Kimley-Horn and Associates, Inc.

6671 Las Vegas Boulevard South, Suite 320

Las Vegas, NV 89119

702.862.3600



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INTRODUCTION

Fisher Brothers Las Vegas, LLC has contracted with Kimley-Horn (KH) to provide design services for **Area 15 District 2** located at the southwest corner of Rigel Avenue and Meade Avenue, and southwest corner of Meade Avenue and Rancho Drive. Fisher Brothers Las Vegas, LLC is proposing to develop in two locations:

- 1) The proposed **1.79±-acre Parking Garage** at the southwest corner of Rigel Avenue and Meade Avenue also includes demolition of existing buildings and reconstruction of two (2) driveways which connect to the existing Rigel Avenue public street and Meade Avenue public street.
- 2) The proposed **9.27±-acre District 2 commercial site with pedestrian plaza** at the southwest corner of Meade Avenue and Rancho Drive also includes demolition of existing buildings and parking lots for the proposed six (6) commercial buildings with associated pedestrian areas and access drive aisles at Rigel Avenue and Rancho Drive.

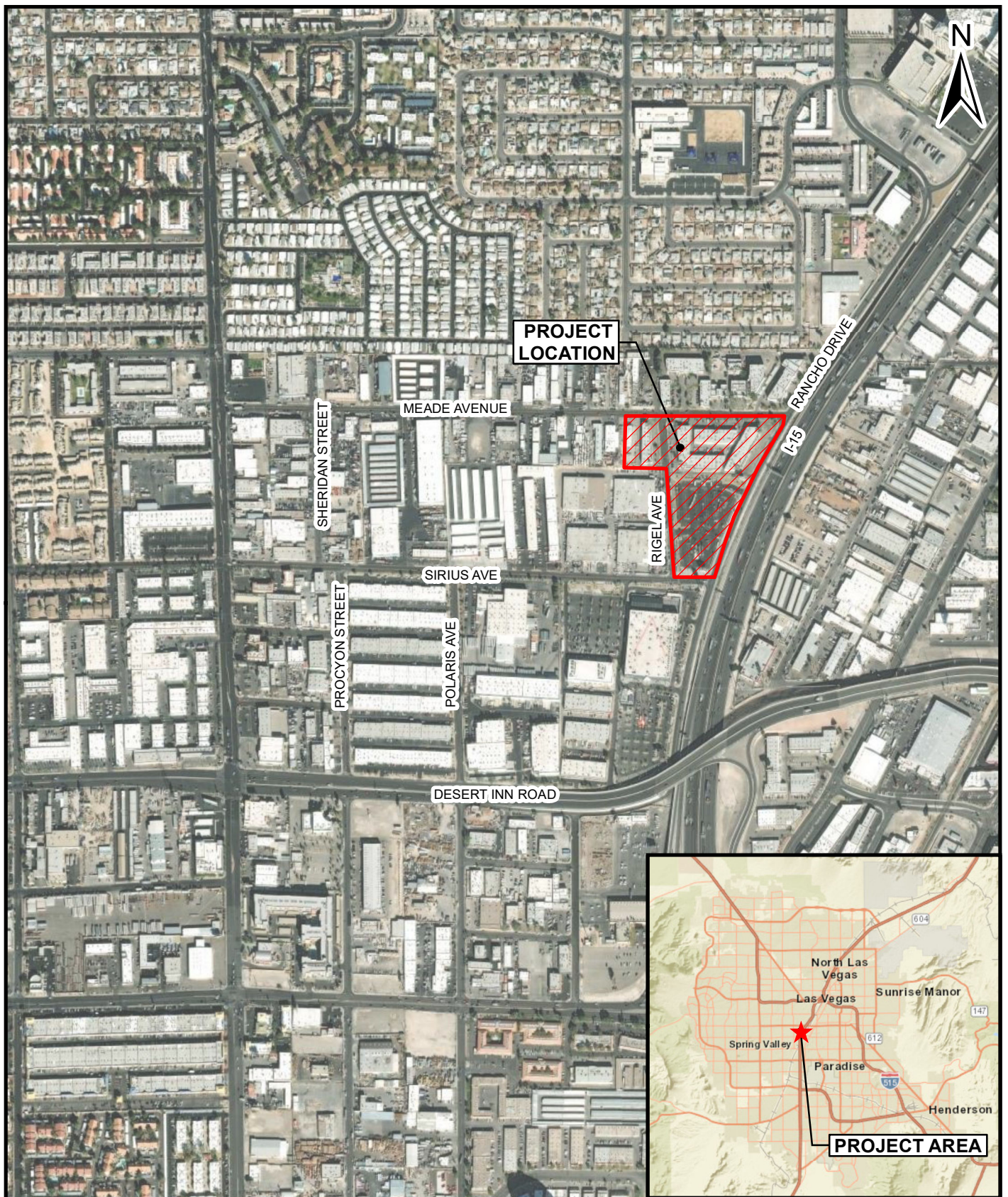
The purpose of this report is to accompany the grading plans and to provide detailed hydrologic and hydraulic analyses for the proposed project site and to determine adequate protection from offsite and onsite flows. The following tasks were performed in the preparation of this report:

1. Identify previous drainage studies for the project site and surrounding areas.
2. Identify the FEMA floodplain designation for the project site.
3. Identify existing and proposed regional drainage facilities adjacent to the site.
4. Estimate runoff generated for the peak 10-year and 100-year return period storms for existing, proposed, and ultimate conditions.
5. Recommend drainage features to protect the project from storm runoff.
6. Determine the storm water runoff generated by the 85th Percentile Rainfall for fully developed conditions and recommend on-site water quality structural Best Management Practices (BMP) to meet Parking Lot Low Impact Development (LID) requirements.

LOCATION AND DEVELOPMENT DESCRIPTION

The project site is located within Section 8, Township 21 South, Range 61 East in the City of Las Vegas, Nevada. The project site consists of Assessor's Parcel Numbers (APN) **162-08-702-001, 162-08-702-002, and 162-08-303-034**. Copies of the *Assessor's Parcel Maps* are included in **Appendix A**. Please refer to **Figure 1 – Vicinity Map** for the location of the project.

The project sites are currently existing commercial developments which have existed for more than 20 years, which was also true prior to the recently constructed A15 Event Parking Lot on APN **162-08-702-002**.



**VICINITY MAP
AREA 15 DISTRICT 2**

The **Parking Garage (APN 162-08-303-034)** site is bordered by the fully-developed Rigel Avenue and Meade Avenue to the north and east, respectively. Existing commercial development is located west and south of the **Parking Garage**. The existing **Parking Garage** site drains east and north as surface flow into Rigel Avenue and Meade Avenue, respectively. Drainage improvements will include valley gutters and/or curb and gutters to convey onsite storm runoff through the site and into Rigel Avenue. Floodwalls have been provided along the property boundary to allow offsite storm runoff to be conveyed within the adjacent streets. Offsite flows west of the site will be conveyed within a proposed concrete-lined channel and will not impact the **Parking Garage**. Flows in Rigel Avenue and Meade Avenue are conveyed within the right of way. Ultimately, flows generated offsite and onsite will discharge east into the future CCRFCD Freeway Channel from Desert Inn to Expressway (FW15) storm drain system in Rancho Drive. The proposed condition is generally consistent with both the existing and future ultimate condition drainage patterns.

The **District 2 (APNs 162-08-702-001 & 162-08-702-002)** site is bordered by the fully-developed Meade Avenue (north), Rancho Drive (east), Sirius Avenue (south), and Rigel Avenue (west). The site currently consists of existing commercial development and the A15 Event Parking Lot. The existing site drains north and east as surface flow into Meade Avenue and Rancho Drive, respectively. Drainage improvements will include valley gutters and/or curb and gutters and trench drains with onsite local storm drain to convey onsite storm runoff to the adjacent roadways and ultimately east into Rancho Drive. Floodwalls have been provided along the property boundary to allow offsite storm runoff to be conveyed within the adjacent streets. Offsite flows west of **District 2** will be conveyed within the adjacent streets and away from the proposed improvements. Flows in Rancho Drive are conveyed within the public right-of-way as well as within the existing Nevada Department of Transportation (NDOT) channel located east of Rancho Drive. Flows in the existing NDOT channel are collected and conveyed by existing culverts under I-15. Ultimately, flows generated offsite and onsite will discharge into the future CCRFCD Freeway Channel from Desert Inn to Expressway (FW15) storm drain system in Rancho Drive. The proposed condition matches both the existing and future ultimate condition drainage patterns. The proposed condition is generally consistent with both the existing and future ultimate condition drainage patterns.

PREVIOUS DRAINAGE STUDIES

Previous hydrology studies and plans that were utilized in the preparation of this report include:

1. *Technical Drainage Study for Area 15 Event Lot*; (Area 15 Event Lot Study, July 2020),

The *Area 15 Event Lot Study* establishes offsite existing condition drainage patterns adjacent to the project site in Rigel Avenue and Rancho Drive. Flows in Rigel Avenue and Rancho Drive were established in the *Area 15 Event Lot Study*. Hydrology has been referenced and/or revised (reflecting current conditions) with this study. Offsite flows that weir north of the high point in Rigel Avenue (**78 cfs**) will be conveyed north within existing right-of-way. **Cross Section RA** has been updated to show surface flows within Rigel Avenue will split at the existing driveways ultimately discharging east into Rancho Drive and north into Meade Avenue. Floodwalls have been proposed along Rigel Avenue to

contain the flows in Rigel Avenue and to direct those flows north into Meade Avenue away from the project site and ultimately into Rancho Drive.

Floodwalls have been proposed along Sirius Avenue to contain the offsite flows in Sirius Avenue and to direct those flows east away from the project site and ultimately into Rancho Drive. The referenced **Proposed Conditions HECRAS Model** has been revised to include the proposed improvements. Per the revised HECRAS Model, the flows that weir north of the high point in Rigel Avenue (**78 cfs**) will continue to be conveyed within Sirius Avenue and ultimately into Rancho Drive.

Offsite flows within Rancho Drive will be conveyed north within existing right-of-way. Per the *Area 15 Event Lot Study*, Rancho Drive will convey a total 100-year flowrate of **2,538 cfs (CRCPS06)** within the right-of-way. Referenced **Cross Sections RD and F-F** show surface flows discharging north in Rancho Drive are conveyed both within the existing roadway and adjacent riprap lined NDOT channel and have not been revised with the proposed improvements.

2. *Central Neighborhood Flood Control Master Plan Study for City of Las Vegas*; (Neighborhood Master Study, March 2005)

The *Neighborhood Master Study* establishes the historical existing and ultimate condition drainage patterns and flowrates for the upstream watershed and project site. Hydrology has been referenced and/or revised (reflecting current conditions) with this study. The *Neighborhood Master Study Subbasin PS08 (235/100 cfs)* has been prorated to quantify the offsite and onsite flowrates impacting the project site. Offsite flowrates in Rancho Drive (**CRCPS06 – 2,538 cfs**) upstream and downstream (**CPS08 – 2,582 cfs**) of the project site are also referenced. The referenced hydrologic data has been supplemented by updated hydrologic analysis from the *Area 15 Event Lot Study*.

3. *The Palms Business Centre North Grading Plans*; (Palms Plans, April 1987)

The *Palms Plans* establish the historical existing and ultimate condition drainage patterns for the project sites.

Kimley Horn has reviewed the referenced studies listed above and is in agreement with the information included therein except for where noted otherwise. The information referenced is for the purpose of determining the existing and future development drainage patterns and quantities of flow adjacent to the proposed project site. Flows referenced are indicated throughout this report and are accepted by Kimley Horn for the purposed of this study. Pertinent reference material is included in **Appendix C**.

CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT (CCRFCD) MASTER PLAN UPDATE

“The Las Vegas Valley Flood Control Master Plan Update”, **Figure F-29**, dated December 2018 (2018 MPU), as prepared by the Clark County Regional Flood Control District (CCRFCD) illustrates the existing and proposed master planned facilities in the area (**See Appendix A**). As shown on the figure, the project site is located adjacent to **future CCRFCD Regional Facility FWPS 0000** in Sirius Avenue and **future CCRFCD Regional Facility FW15 0271** in Rancho Drive. The 2018 MPU describes CCRFCD Facility FWPS 0000 as a 12' x 12' RCB that convey 3,544-cfs during the 100-year storm event. The 2018 MPU describes CCRFCD Facility FW15 0271 as dual (2) - 12' x 10' RCBs that convey 3,842-cfs during the 100-year storm event.

FLOOD HAZARD DESIGNATION

The Special Flood Hazard Areas (SFHA) for both the unincorporated and the incorporated portions of Clark County, Nevada, are outlined in the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRM). This subject site is located on FEMA FIRM Community Panel No. **32003C 2170 F**, revised November 16, 2011. As shown on the **FEMA FIRM Exhibit** (see **Appendix A**), the subject site is located within a FEMA-designated **Zone X** which is not located within a Special Flood Hazard Area (SFHA). Areas described as **Zone X** are areas determined to be outside the 0.2% annual chance flood plain (500-year).

HYDROLOGIC METHODOLOGY

The hydrologic analysis and design of this site development are in compliance with local requirements, including City of Las Vegas (CLV), the CCRFCD's “Hydrologic Criteria and Drainage Design Manual” (HCDDM), and the CCRFCD's “Flood Control Master Plan Update”.

HYDROLOGY

Existing, proposed and ultimate conditions hydrology has been referenced from the *Neighborhood Master Study* and *Area 15 Event Lot Study* as discussed earlier in the “Previous Drainage Studies” section of this report. The subbasins and flow patterns used to determine the existing and proposed condition flowrates impacting the proposed site were referenced from the *Neighborhood Master Study* and then prorated based on a unit flowrate (cfs/acre) to determine the flows generated onsite and offsite. The referenced *Neighborhood Master Study* **Figure E-19: Existing Drainage Conditions** in **Appendix C** depicts the subbasins and drainage patterns used in the existing/proposed condition hydrologic analysis for the site and quantifies developed condition flowrates. The flowrates referenced from the *Area 15 Event Lot Study* **Existing/Proposed Condition Drainage Map** in **Appendix D** depict the and drainage patterns used in the existing and proposed condition hydrologic analysis adjacent to the sites and quantify the flows in Rigel Avenue(**Cross Section RA**) and Rancho Drive (**Cross Section RD**). The existing conditions flowrate of **97 cfs** in Rigel Avenue has been revised with this study to

reflect current conditions in Rigel Avenue. The proposed conditions flowrate of **99 cfs** in Rigel Avenue has been revised with this study to reflect current conditions in Rigel Avenue Prorate calculations for the proposed sites have been included on **Figures EX-1, EX-2, PRO-1 and PRO-2** in **Appendix A**. Pertinent Reference material has been included in **Appendix D**. The proposed project site improvements are consistent with the current zoning and existing historical commercial development and maintain historical existing drainage surface flow patterns to Rancho Drive, therefore the proposed improvements will not adversely impact downstream facilities or properties.

A copy of the 2018 MPU Figure **W-4** is included in **Appendix A** to illustrate Regional's hydrologic subareas, land use and soils in the area.

EXISTING/PROPOSED CONDITIONS

The proposed condition watershed is generally consistent with the historical existing condition. The project sites discharges site runoff in an easterly direction as surface flow into Rigel Avenue and Rancho Drive. The offsite watershed will be conveyed around or through the project sites to be conveyed within the adjacent streets. Flowrates have been prorated from *Neighborhood Master Study Subbasin PS08* to quantify onsite and offsite flowrates. **Figures EX-1, EX-2, PRO-1 and PRO-2** included in **Appendix A** depicts the subbasins and drainage patterns used in the existing and proposed conditions hydrologic analysis for this project. **Table 1** summarizes the existing/proposed conditions flowrates and **Tables 2A and 2B** summarize the existing and proposed conditions prorated flowrates.

Table 1: Existing/Proposed Condition Flow Summary

Basin ID / Comb Pt	Area / Tributary Area (ac)	Q ₁₀₀ (cfs)	Q ₁₀ (cfs)
**CPS06	N/A	1,045	405
*CP05	N/A	31	18
*EX10	N/A	7	4
CP12 Q = 1,081-CFS + **PS08(OF2)	N/A	1,158	459
**CRCPS06	N/A	2,538	873
**PS08	114.56	235	100
**CPS08	N/A	2,582	917
**CCPS08	N/A	3,762	1,226

* Referenced from *Area 15 Event Lot Study*

** Referenced from *Neighborhood Master Study*

Table 2A: Existing Condition Prorated Flow Summary

BASIN ID	Q ₁₀₀ (cfs)	Q ₁₀ (cfs)	AREA (ac)	Q ₁₀₀ (cfs/ac)	Q ₁₀ (cfs/ac)
PS08**	235	100	114.6	2.05	0.87
SUBBASIN ID	Q ₁₀₀ (cfs)	Q ₁₀ (cfs)	AREA (ac)	Q ₁₀₀ (cfs/ac)	Q ₁₀ (cfs/ac)
PS08(ONA)	3.5	1.5	1.7	2.05	0.87
PS08(ONB)	4	2	1.8	2.05	0.87
PS08(ONC)	1	0.5	0.7	2.05	0.87
PS08(OND)	1	0.5	0.6	2.05	0.87
PS08(ONE)	1	0.5	0.6	2.05	0.87
PS08(ONF)	2.5	1	1.2	2.05	0.87
PS08(RA)	1	<1	0.4	2.05	0.87
PS08(OF5)	1	<1	0.3	2.05	0.87
PS08(ON1)	9	4	4.4	2.05	0.87
PS08(OF1)	19	8	9.2	2.05	0.87
PS08(OF2)	77	33	37.5	2.05	0.87
PS08(OF3)	84	36	40.9	2.05	0.87
PS08(OF4)	29	12	14.2	2.05	0.87
PS08(RD)	2	1	1.1	2.05	0.87
SUBTOTAL	235	100	114.6	-	-

** Referenced from *Neighborhood Master Study*

Table 2B: Proposed Condition Prorated Flow Summary

BASIN ID	Q₁₀₀ (cfs)	Q₁₀ (cfs)	AREA (ac)	Q₁₀₀ (cfs/ac)	Q₁₀ (cfs/ac)
PS08**	235	100	114.6	2.05	0.87
SUBBASIN ID	Q₁₀₀ (cfs)	Q₁₀ (cfs)	AREA (ac)	Q₁₀₀ (cfs/ac)	Q₁₀ (cfs/ac)
PS08(OF1)	19	8	9.2	2.05	0.87
PS08(OF2)	77	33	37.5	2.05	0.87
PS08(OF3)	84	36	40.9	2.05	0.87
PS08(OF4)	29	12	14.2	2.05	0.87
PS08(OF5)	1	<1	0.3	2.05	0.87
PS08(ONA)	2	1	0.8	2.05	0.87
PS08(ONB)	2	1	1.0	2.05	0.87
PS08(ONC)	2	1	0.8	2.05	0.87
PS08(OND1)	1	0.5	0.7	2.05	0.87
PS08(OND2)	1	0.5	0.7	2.05	0.87
PS08(ONE1)	1	<1	0.4	2.05	0.87
PS08(ONE2)	2.5	1	1.1	2.05	0.87
PS08(ONE3)	1	0.5	0.7	2.05	0.87
PS08(ONE4)	2	1	0.8	2.05	0.87
PS08(ONF1)	1	0.5	0.7	2.05	0.87
PS08(ONF2)	1	0.5	0.5	2.05	0.87
PS08(ONG)	4	2	2.1	2.05	0.87
PS08(ONH)	1	0.5	0.7	2.05	0.87
PS08(RD)	2.5	1	1.1	2.05	0.87
PS08(RA)	1	<1	0.4	2.05	0.87
SUBTOTAL	235	100	114.6	-	-

** Referenced from *Neighborhood Master Study*

ULTIMATE CONDITIONS

The ultimate conditions of the project site are defined as the offsite watershed and project site as fully developed with the adjacent and upstream CCRFCD regional facilities fully-constructed. Future CCRFCD regional facilities along Sirius Avenue and Rancho Drive collect surface flows in the respective roadways. Since the ultimate conditions reduces the flow depth in the adjacent roadways, the proposed condition has been utilized for drainage recommendations as the proposed condition generates the worst-case flowrates and depths in Rigel Avenue and Rancho Drive adjacent to the proposed sites. Refer to **Figures PRO-1 and PRO-2** included in **Appendix A** for an illustration of the future CCRFCD regional facilities in the ultimate condition.

HYDRAULIC CALCULATIONS

STREET SECTIONS

The resulting street flow data based on the flows generated during the worst-case proposed condition has been presented in **Tables 3 and 4**. **Figures PRO-1 and PRO-2** in **Appendix A** shows the locations of the cross sections corresponding to the calculations included in **Tables 5 and 6**. The offsite normal depth sections and flow rates have been calculated from their respective tributary subbasins. Hydraulic calculations have been included in **Appendix B**. Pertinent reference material has been included in **Appendix C**.

Flow depths have been analyzed for the adjacent roadways Rigel Avenue, Meade Avenue, and Rancho Drive. Referenced *Area 15 Event Lot Study* weir flows from Sirius Avenue will overtop the highpoint in Rigel Avenue (**78 cfs**) and discharge north in Rigel Avenue to combine with **prorated Basin PS08(OF1)** and for a total flowrate of **99 cfs in Rigel Avenue** upstream of the **Parking Garage** site. Referenced *Area 15 Event Lot Study Cross Section RA* has been revised accordingly. Since there is only an existing 6-inch driveway hump at this location, the flow in Rigel Avenue (**97 cfs**) approaching the intersection from the south splits with approximately **41.5 cfs** continuing north and the remaining **55.5 cfs** splitting east in the adjacent drive aisle between the *Area 15 Event Lots*. Additionally, the existing Rigel Avenue transitions to a super elevated roadway sloping to the east as it approaches Meade Avenue. The northernmost driveway at the eastern end of Rigel Avenue only has a 6-inch hump as well. The existing conditions flow in Rigel Avenue (**97 cfs**) approaching the intersection from the south will split with approximately **5 cfs** continuing north and the remaining **97 cfs** splitting east into the adjacent drive aisle and ultimately into Meade Avenue. Note that the driveway splits in Rigel Avenue are present during the existing condition and are eliminated with the proposed improvements and flows will be conveyed north to Meade Avenue and ultimately east into Rancho Drive at ****CPS08**. Flows in Rancho Drive (**2,538 cfs**) have been referenced from the *Neighborhood Master Study (CPRSP)*.

Table 3A: Existing Conditions Roadway Hydraulic Section Summary Table

STREET SECTION	TRIBUTARY BASINS	CHANNEL SLOPE	Q ₁₀₀	FLOW DEPTH	VELOCITY	D*V
		%	(cfs)	(ft)	(ft/s)	ft ² /s
*F-F(ROAD)	**CRCPS06	0.70	2,538	3.58	10.46	37.45
RD	**CRCPS06 + ON1	0.60	2,547	7.25	9.26	67.14
RD-1	**CPS08	0.25	2,582	7.41	7.48	55.43
RA (WEST)	**PS08(OF1) + 78-cfs = 97 cfs	1.00	22.0	0.63	3.34	2.10
RA (EAST)	**PS08(OF1) + 78-cfs = 97 cfs	1.00	19.5	0.50	2.92	1.46
RA-1 (CAPACITY)"	(WEST) +(EAST) + 1/2OF5 +1/2ONB2+RA = 43 cfs - (SPLIT 25 cfs)=18 cfs	0.70	18.0	0.50	2.80	1.40
RA-2 (CAPACITY)"	RA-1 (CAPACITY) + 1/2ONB2 = 19 cfs – (SPLIT 14 cfs) = 5 cfs	0.30	5.0	0.49	1.59	0.78
MA-1	OF5+1/2OF3+ONB1	3.30	86.5	0.64	6.18	3.96
MA-2	(WEST)+(EAST)+OF5+ONB1+ONB2 +RA+ONF+ONC+OF3	0.30	135.0	1.02	3.51	3.58

SECTIONS F-F(ROAD) & RD: FLOW DEPTH TAKEN FROM CHANNEL FLOWLINE
 OFFSET CROWN AT RANCHO FOR SECTION F-F
 78-CFS PER RAS ANALYSIS FLOWS NORTH IN RIGEL AVENUE

* Referenced/Revised from the *Area 15 Event Lot Study*.

Table 3B: Proposed Conditions Roadway Hydraulic Section Summary Table

STREET SECTION	TRIBUTARY BASINS	SLOPE	Q ₁₀₀	FLOW DEPTH	VELOCITY	D*V
		%	(cfs)	(ft)	(ft/s)	ft ² /s
*F-F(ROAD)	**CRCPS06	0.70	2,538	3.58	10.46	37.45
ST1.5	**CRCPS06	0.41	2,538	6.84	9.20	62.93
ST2	**CRCPS06	0.90	2,538	6.35	10.94	69.47
ST2.5	**CRCPS06	0.90	2,538	6.48	12.09	78.34
RD	**CRCPS06 + OND1 + OND2 + ONG + ***RD	0.25	2,546.5	8.56	6.05	51.79
ST3	**CRCPS06 + OND1 + OND2 + ONG + ***RD	0.67	2,546.5	6.80	10.58	71.94
RD-1	**CPS08	0.25	2,582	7.41	7.48	55.43
RA	**PS08(OF1) + 78-cfs + ONF2 + ONH	0.46	99	0.86	3.65	3.14

STREET SECTION	TRIBUTARY BASINS	SLOPE	Q ₁₀₀	FLOW DEPTH	VELOCITY	D*V
		%	(cfs)	(ft)	(ft/s)	ft ² /s
RA1	**PS08(OF1) + 78-cfs + ONF1 + ONF2 + ONC + ONB + ONH + 1/2OF5	0.68	103.5	1.30	5.50	7.15
RA2	**PS08(OF1) + 78-cfs + ONF1 + ONF2 + ONC + ONB + ONH + 1/2OF5	0.60	103.5	1.33	5.26	7.00
MA1	**PS08(OF3) + 1/2OF5	3.37	85.0	0.69	6.32	4.36
MA2A	**PS08(OF1) + **PS08(OF3) + **PS08(OF5) + 78cfs + RA + ONB + ONC + ONE1 + ONE2 + ONE3 + ONE4 + ONF1 + ONF2 + ONH	0.30	196.5	1.22	4.21	5.14
MA2B	**PS08(OF1) + **PS08(OF3) + **PS08(OF5) + 78cfs + RA + ONB + ONC + ONE2 + ONE3 + ONE4 + ONF1 + ONF2 + ONH	0.51	195.5	1.07	4.92	5.26
MA2C	**PS08(OF1) + **PS08(OF3) + **PS08(OF5) + 78cfs + RA + ONB + ONC + ONF1 + ONF2 + ONH	1.41	190	0.86	6.63	5.70

SECTIONS F-F(ROAD) & RD: FLOW DEPTH TAKEN FROM CHANNEL FLOWLINE
OFFSET CROWN AT RANCHO FOR SECTION F-F

78-CFS PER RAS ANALYSIS FLOWS NORTH IN RIGEL AVENUE

* Referenced/Revised from the *Area 15 Event Lot Study*.

Table 4: Ultimate Conditions Onsite Flow Summary Table

ONSITE SECTION	TRIBUTARY BASINS	CHANNEL SLOPE %	Q ₁₀₀ (cfs)	FLOW DEPTH (ft)
ONA	ONA	0.54	2	0.35
ONE2	ONE2	0.50	2.5	0.14
ONE4	ONE4	3.60	1	0.06
ONG1	1/2ONG	0.15	2	0.19
ONG2	1/2ONG	0.80	2	0.13
ONG3N	1/2ONG	3.02	2	0.14
ONG3S	1/2ONG	3.02	2	0.14

Based on the calculated flow characteristics, the Manual criteria for depth (D) and velocity times depth (V*D) during the 100-year storm event will not be met, however, the proposed site does not alter the historical existing condition, therefore the proposed improvements will not adversely impact downstream facilities or properties.

Note that the existing buildings north of the project site along Meade Avenue are scheduled for demolition (by others) and will not be impacted by the proposed increased flows in Meade Avenue.

PARKING LOT LOW IMPACT DEVELOPMENT (LID)

Per Section 1502.2 of the CCRFCD “Hydrologic Criteria and Drainage Design Manual”, the **Parking Garage** are classified as a Large Parking Lot since the size of the on-site Parking Garage is approximately +/-1.79 acres. LID treatment has not been provided for the District 2 site since it will not have any parking associated with the proposed improvements.

For the Large parking lot category, BMPs are required to treat storm water runoff from at least 75 percent of the parking lot. BMPs are sized for the 85th Percentile Rainfall. Please refer to **Appendix C** for all LID calculations and for **Figure LID – LID Basin Map**.

One (1) type of BMP is incorporated into the project design: landscaped swales. Due to site design and grading constraints for the Parking Garage, the project site was delineated into three (3) sub-areas; Drainage Management Areas (DMA) 1, 2, and 3.

DMA 1, 2 and 3 will be treated by **landscaped swales**. The swales are designed with a minimum length of 40 feet long and a slope of 1.00%. The proposed swales are rock-lined (d50=6-inches; thickness=12-inches) and treat more than 75 percent of the parking lot area. Based on hydraulic analysis, these swales will convey, contain and treat the peak BMP discharge (QBMP) as well as facilitate the 100-year peak flow rate; these calculations are included in **Appendix C**.

The proposed **LID Basin Map** is included in **Appendix C**. The proposed BMPs are shown on the grading plan included in **Appendix E**.

One block wall opening with a sidewalk underdrain has been added at the northeast corner of the **Parking Garage** property boundary at Rigel Avenue. The proposed opening will allow a portion of the flows generated onsite of the parking lot to discharge into Rigel Avenue.

STORM DRAIN FACILITIES AND PROTECTION

The proposed flood control facilities for the site include valley gutters and/or curb and gutters to convey onsite storm runoff east through the site and into Rigel Avenue and Rancho Drive. Due to onsite grading constraints, trench drains have been provided adjacent to the proposed **District 2** Buildings to convey onsite flows west into Rigel Avenue, north into Meade Avenue, and east into Rancho Drive. Proposed onsite local storm drain will convey flows captured by the proposed trench drains to outlet through the flood walls into the adjacent roadways and away from the proposed buildings. Floodwalls have been provided along the property boundaries to allow offsite storm runoff to be conveyed within the adjacent streets. Proposed block wall openings assume the bottom 50% is clogged. Copies of the hydraulic calculations have been included in **Appendix B**.

FUTURE CCRFCD DRAINAGE FACILITIES

The project site does not propose any storm drain improvements; however, the future CCRFCD regional facilities FWPS 0000 and FW15 0271 in Sirius Avenue and Rancho Drive will collect and convey surface flows upstream of the project site reducing the depths and flows in the adjacent roadways. The project site has been analyzed for flood protection in the worst-case scenario generated by the proposed condition where no CCRFCD facilities are in place.

EXISTING DRAINAGE CHANNEL

An existing riprap-lined channel is located along the east side of Rancho Drive within I-15 NDOT right-of-way. Existing curb cuts along Rancho Drive allow surface flow from the roadway to discharge east into the drainage facility. The existing drainage channel conveys flows in a northerly direction adjacent to Rancho Drive with flow collection by existing culverts discharging a portion of the channel flows east under I-15. This study has not analyzed any flows splitting east and conservatively uses the *Neighborhood Master Study* flowrate of **2,538-cfs (CRCPSP06)** as the flowrate in Rancho Drive. It should be noted:

- the design flowrate of the Rancho drainage channel and culverts was intended for a 50-yr storm event, and the flow interception from the 50-yr culverts would decrease the flow depth in Rancho Drive;
- the CCRFCD MPU and *Neighborhood Master Study* does not account for the 50-year facility in the conceptual drainage master plans, therefore, the existing drainage channel will likely be removed and replaced in the future to accommodate the future CCRFCD MPU drainage facilities.

Since a decrease in flow depth and flowrate along Rancho Drive will occur from either case; the study's utilization of the full flow in Rancho Drive is conservative for the flood protection analysis of the site.

DROP INLETS

Facility names for the proposed drop inlets in the calculations correspond with the tributary prorated subbasin and the facility location. Information for the drop inlets has been included on **Figures PRO-1 and PRO-2**. All drop inlet calculations which include a 50 percent clogging factor, have been included in **Appendix B**. The proposed storm drain systems are designed to intercept and convey all onsite nuisance and storm flows up to a 100-year storm event.

In the unlikely event the drop inlets at the proposed low points become completely clogged, emergency overflow paths have been provided to protect the adjacent finished floors. Emergency overflow paths have been provided at the following locations:

1. District 2 Cross Sections ON-E2 and ON-E4 – The emergency overflow path for the trench drains within the Pedestrian Plaza between proposed Buildings 1 through 6, is provided east between Buildings 1 and 6. Emergency overflows at this location will be discharged east into Meade Avenue and away from the buildings. Please note that this is an emergency overflow condition only and the proposed systems are designed to intercept and convey all onsite nuisance and storm flows up to a 100-year storm event.

2. District 2 Proposed Drop Inlets #1 and #2 – The emergency overflow path for the drop inlets located at the northeast corner of Building 1, is provided east and south of Building 1. Emergency overflows at this location will be discharged east into Rancho Drive and away from the building. Please note that this is an emergency overflow condition only and the proposed systems are designed to intercept and convey all onsite nuisance and storm flows up to a 100-year storm event.
3. District 2 Proposed Drop Inlet #3 – The emergency overflow path for the drop inlet located at the southeast corner of Building 1, is provided north in the drop off lane and east of Building 1. Emergency overflows at this location will be discharged east into Rancho Drive and away from the building. Please note that this is an emergency overflow condition only and the proposed systems are designed to intercept and convey all onsite nuisance and storm flows up to a 100-year storm event.
4. Parking Garage Block Wall Opening – The emergency overflow path for the block wall opening at the northeast corner of the Parking Garage site, is provided south and east. Emergency overflows at this location will be discharged east into Rigel Avenue and away from the garage. Please note that this is an emergency overflow condition only and the proposed systems are designed to intercept and convey all onsite nuisance and storm flows up to a 100-year storm event.

PROPOSED DRAINAGE SWALES

A proposed offsite concrete-lined u-channel and riprap lined swales have been provided to direct flows away from the proposed **Parking Garage** and ultimately into existing storm drain facilities. Facility names for the proposed swales in the calculations correspond with the tributary subbasin/Cross Section Identifier. Information for the swales has been included on **Figure PRO** and summarized in **Table 4**. Normal depth calculations have been included in **Appendix C**.

Table 5: Ultimate Conditions Drainage Swale Calculations

SECTION	TRIBUTARY BASINS	SLOPE (%)	Q ₁₀₀ (cfs)	FLOW DEPTH (ft)	VELOCITY (ft/s)	D*V	TYPE	SIDE SLOPES	BOTTOM WIDTH (ft)	Req'd d ₅₀ (in)
*F-F(CHNL)	Channel Capacity	0.70	270.1	3.00	6.43	19.29	TRAP	N/A	7	N/A
SW1	ONB	1.00	2	0.54	1.73	0.93	V - Ditch	4:1	N/A	6"
SW2	ONB	0.25	2	0.70	1.03	0.72	V - Ditch	4:1	N/A	6"
SW3	ONC+ 1/2OF5	1.00	2.5	0.54	1.73	0.93	V - Ditch	4:1	N/A	6"
SW4	ONE1	1.01	1	0.15	2.36	0.35	V-Ditch	50:1	N/A	N/A
OF5W	1/2OF5	2.74	0.5	0.06	2.81	0.17	Concrete Flume	0:1	3	N/A
OF5S	1/2OF5 + ONC	1.01	2.5	0.40	3.87	1.55	V - Ditch	4:1	N/A	N/A

* Referenced/Revised from the *Area 15 Event Lot Study*.

FINISHED FLOOR ELEVATION

The Clark County Regional Flood Control District requirement for the finish floor elevation (FF) is that it must be 18 inches above the centerline grade of the adjacent street or be elevated to twice the depth of flow up to 18 inches above the water surface elevation (WSE). Additional criteria requires the finished floor elevation to be 6 inches above adjacent onsite flowline high point. The proposed finished floor elevation has been elevated to or above at least twice the depth of flow in the adjacent pedestrian plaza and drop off aisles. Where finished floors do not meet the above-mentioned criteria based on elevations of the adjacent plaza, drop off aisles, and swales, solid grouted floodwalls will be provided for finished floor elevation protection or trench drains have been provided at the building's exterior to ensure the building is fully flood protected. The proposed driveways along Rigel Avenue and Rancho Drive are humped 6-inches above the WSE in the street. Please refer to the grading plans included in **Appendix E**.

CONCLUSIONS AND RECOMMENDATIONS

The proposed development will not adversely impact the surrounding areas in both the 10-year and 100-year storm events. The development of this project site is in compliance with the *CCRFCD Hydrologic Criteria and Design Manual* and City of Las Vegas criteria.

1. This project is in compliance with the applicable drainage laws recognized by the State of Nevada.
2. This project is in compliance with the CCRFCD's "*Master Plan Update*" and will **not** conflict with any Master Planned Facilities.
3. This project is in compliance with the CCRFCD's "*Hydrologic Criteria and Drainage Design Manual*".
4. This project lies within FEMA-designated **Flood Zone X**. Therefore, this project is not currently located in a FEMA-designated Special Flood Hazard Area.
5. The drainage facilities for this project have been designed to control and convey the onsite runoff from the 100-year storm safely around the site. In addition, they have been designed based upon generally accepted engineering practices and in accordance with local requirements.
6. Runoff generated from, or conveyed by, the project will not adversely impact any downstream properties or facilities.

REFERENCES

1. Clark County Regional Flood Control District, "*Hydrologic Criteria and Drainage Design Manual*," August 1999, Revised September 2013.
2. Clark County Regional Flood Control District, "*2018 Las Vegas Valley Flood Control Master Plan Update*," December 2018.
3. *Technical Drainage Study for Area 15 Event Lot*. Prepared by Kimley-Horn, July 2020.
4. *Central Neighborhood Flood Control Master Plan for City of Las Vegas*, Prepared by PBS&J, March 2005.
5. *The Palms Business Centre North Grading Plans*; Prepared by Baughman & Turner, April 1987,

LIST OF APPENDICES

Appendix A – Documents & Figures

- EX-1: Overall Existing Condition Drainage Map
- EX-2: Onsite Existing Condition Drainage Map
- PRO-1: Overall Proposed Condition Drainage Map
- PRO-2: Onsite Proposed Condition Drainage Map
- Assessor's Parcel Map
- FEMA FIRM Exhibit
- Figure F-29: CCRFCD 2018 MPU Flood Control Facilities & Inventory
- Figure W-Map: CCRFCD 2018 MPU Hydrologic Subareas, Land Use & Soils

Appendix B – Hydraulic Calculations

- Normal Depth Calculations - Street Sections
- Normal Depth Calculations - Onsite Sections
- Normal Depth Sections – Swales
- Normal Depth Sections – Block Wall Openings
- Emergency Overflow Calculations
- Drop Inlet Calculations
- Trench Drain Calculations
- Full Flow Capacity Calculations
- HEC-RAS Proposed Conditions Analysis (SiriusAve.prj)
 - Proposed Conditions Report
 - Summary Tables
 - Reach Profile
 - Cross Sections
 - Model (On Data CD)

Appendix C – Parking Lot LID Calculations

- LID Parking Lot LID Map & Calculations
- Table 505 2-Year 6-Hour Rainfall Depth-Duration-Frequency (McCarran)
- Normal Depth Sections – BMP Swales

Appendix D – Reference Materials

- *Technical Drainage Study for Area 15 Event Lot*; July 2020. (DS-5288).
- *Central Neighborhood Flood Control Master Plan Study for City of Las Vegas*; March 2005.
- *The Palms Business Centre North Grading Plans*; April 1987 (107V-1470).

Appendix E – Improvement Plans

Appendix F – Data CD