

Technical Drainage Study For Brinley Middle School Replacement

May 2023

Prepared for:

CCSD
1180 Military Tribute Place
Henderson, NV 89074

Prepared by:

LOCHSA ENGINEERING
6345 South Jones Boulevard, Suite 100
Las Vegas, Nevada 89118
(702) 365-9312

Lochsa Job # 221095

HYDROLOGIC CRITERIA AND DRAINAGE MANUAL

DRAINAGE STUDY INFORMATION FORM

Name of Development: Brinley Middle School Replacement Date: May 10, 2023

Location of Development: a) Descriptive (Cross Streets) North/South: Jones Blvd.

East/West: Smoke Ranch Rd.

b) Section: 14 Township: 20 SOUTH Range: 60 EAST

c) APN : 138-14-802-005

Name of Owner: School Board of Trustees - CCSD

Telephone No.: (702) 799-8710 Fax No.: _____ E-Mail Address: N/A

Address: 1180 Military Tribute Place Henderson, NV 89074

Contact Person-Name: CHRIS BLAKE, EI Telephone No.: 702-365-9312

* E-Mail Address: CHRIS.BLAKE@LOCHSA.COM Fax No.: 702-365-9317

Firm: LOCHSA ENGINEERING

Address: 6345 S JONES BLVD STE 100 LAS VEGAS NV 89118

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: 18.19+/- ACRES Being Developed/Disturbed: 17.09+/- 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.): School

5. Approximate upstream land area which drains to the subject site: 200+/- ACRES (along perimeter of Site)

6. Has the site drainage been evaluated in the past? ☐ YES ☒ NO If yes, please identify documentation: _____

7. If known, please briefly identify the proposed discharge point(s) of runoff from the site: NEAR SOUTHEAST CORNER OF SITE TO SMOKE RANCH RD.

8. 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: Brinley M.S. Replacement		Map ID:	
Firm Name: LOCHSA		Engineer: Edgar Leon, PE	
Address: 6345 S. JONES BLVD, STE. 100			
City: LAS VEGAS		State: NV	Zip: 89118
Phone Number: (702) 365-9312		Fax Number: (702) 365-9317	
Property Owner: CCSD			
Address: 1180 Military Tribute Place			
City: Henderson		State: NV	Zip: 89074
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 (CCRFC) 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.
☐	☒ N/A	A notarized letter from the adjacent property owner(s) allowing off-site grading or discharge.

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 CCRFC Master Plan Update Figure, (F-x), for Flood Control Facilities and Environmental areas with the site delineated.

REFERENCE:

STANDARD FORM 2

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE SUBMITTAL CHECKLIST

II. MAPS AND EXHIBITS (Continued)

- | Yes | No | |
|-------------------------------------|--------------------------|--|
| ☒ | ☐ | Off-site drainage basin maps for existing, interim and future conditions showing the existing topography, basin boundaries, concentration points, and flows in cfs. |
| ☒ | ☐ | 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. |

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. |
| ☒ | ☐ | 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. |

REFERENCE:

STANDARD FORM 2

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE SUBMITTAL CHECKLIST

III. DRAINAGE PLAN (Continued)

Yes	No	
	N/A	Streets with off-set 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 storm peak flows at basin concentration points.
✓		Concentration points and drainage flow direction 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.
	N/A	Cross-sectional detail for channels, including cutoff wall locations.
✓		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.
✓		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" x 48". 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.
✓		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.
	N/A	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	
☒	☒ 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.
☒	☐	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.
☒	☐	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	
☒	☐	Appropriate soil information and Soils Map for existing and future conditions with subbasins 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 future 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 subbasin 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.
☒	☐	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).

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.
☒	☐	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.
☒	☐	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.)
☒	☐	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. 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.
☐	☐ N/A	A complete water surface profile analysis (HEC-2, HEC-RAS, etc.) for channel flows and FEMA Zone A flood zones. • 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.
☐	☐ N/A	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.
☒	☐	Provide BMP type, size and supporting calculations for parking lots and LIDs (if required).

REFERENCE:

STANDARD FORM 2



CITY OF LAS VEGAS

MINIMUM DRAINAGE STUDY CRITERIA STANDARD FORM 2 CHECKLIST SUPPLEMENT (Revised 5/18/11)

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

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

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

I. GENERAL REQUIREMENT		
Yes	No	
	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.)
✓		Copies of all conditions of approval for development related to this property. (e.g. zoning, use permit, tentative map, etc.) Verify compliance with conditions.
✓		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. <u>EL</u> 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	
✓		(1) 24" X 36" copy of the Grading Plan, (including all Detail Sheets) sealed by the engineer.
✓		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.
✓		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	
✓		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.
✓		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.
✓		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.
✓		Back of lot elevations and lot drainage pattern for all lots including common lots.
✓		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.
✓		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.)
	N/A	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.
✓		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	
✓		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.
✓		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.

NOFA

(in the Process – should receive in 6 weeks)

Technical Drainage Study For Brinley Middle School Replacement

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- A Hydrologic Analysis
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1. GENERAL LOCATION AND DEVELOPMENT DESCRIPTION

1.1 Purpose

Lochsa Engineering has been retained by Clark County School District to provide a Technical Drainage Study for the proposed Middle School replacement located north of Smoke Ranch Rd., east of Maverick Street, south of existing residences and west of a couple commercial developments. The proposed improvements are located within the existing Brinley Middle School. Improvements are limited to proposed parking lots, five proposed school buildings, basketball courts, tennis courts, volleyball courts, soccer field and a softball field.

The purpose of this study is to provide a detailed hydrologic analysis of the site and watershed impacting it, and to substantiate the flood control design for the proposed improvements. The Clark County Regional Flood Control District (CCRFCD) Hydrologic Criteria and Drainage Design Manual (HCDDM) and the 2018 Las Vegas Valley Flood Control Master Plan Update (2018 MPU) have been compiled and utilized to prepare this study. This report presents a summary of the hydrologic and hydraulic analyses, methodology, and results of the study.

Please note that this project will be constructed in 2 phases. However, there will be no delay once phase 1 is complete. Everything will continue to be developed. Phase 1 is the east half of the Site. Once complete, Phase 2 on the west half of the property and the north portion will start right away. Therefore, we will analyze the site using existing and developed conditions since there will be no delay in construction and not be worth showing an interim Phase.

1.2 Location of Property

The property is located north of Smoke Ranch Rd., east of Maverick Street, south of existing residences and west of a couple commercial developments. Proposed parking lots, five proposed school buildings, basketball courts, tennis courts, volleyball courts, soccer field and a softball field are proposed for the Site improvements. The project site occupies the parcel identified by the Assessor's Parcel Number (APN) 138-14-802-005. The site occupies a portion of Section 14, Township 20 South, Range 60 East, M.D.M., in City of Las Vegas, Clark County, Nevada. Please refer to the copy of the Assessor's Parcel Map provided in the appendix. Figure 1 in Appendix C also provides the location of the subject site in relation to the surrounding major streets.

1.3 Description of Property

The project site occupies 18.19 acres of which only approximately 17.10 acres will be disturbed. The project area is currently an existing School. The developed site will be adding a parking lot, drive aisles and 5 school buildings over an existing grass area within the Site. The site generally slopes to the east at approximately 1.30%. A review of the 2018 MPU's Figure W-5 Soil Map indicates that the site is located within the hydrologic soil group D, defined as soils with "very low infiltration rate, high runoff potential."

2. DRAINAGE DESCRIPTION

In the CCRFCD's 2018 MPU (Reference 2), the valley was hydrologically divided into ten watersheds and each watershed was further subdivided into sub-basins. The onsite and offsite basins impacting the subject project area fall within the Central Watershed. As shown in Figure W-5 of the 2018 MPU, the project site is all located within sub-basins SR05B-C and SR05D-C.

2.1 Existing Drainage Conditions

The offsite drainage areas tributary to the site have been addressed using our topography, GISMO topography, referenced flows and a site visit.

In the existing conditions, the offsite basins are entirely developed (residential homes- 7000sq. feet) and streets (paved). The residential homes were analyzed as Industrial (CN = 93 for 'D' soil) and streets are paved (CN = 98). There are 4 offsite basins that impact the perimeter of the Site. These are discussed below as well as the referenced CLV MPU surface flow (0/432cfs) at the intersection of Smoke Ranch Rd. and Maverick Street for the 10yr and 100yr storm events.

Offsite Basin FD2 (developed – 7,000 sq. ft. homes (analyzed as Industrial), grass area and streets paved) is 15.19 acres and runoff from this basin ultimately travels east toward Maverick Street. Basin FD2 ultimately discharges 20 and 42cfs in the 10 and 100yr storm events respectively north along Maverick Street. A high point exists in Maverick Street just north of Robin Hood Circle. Therefore, all of the flow from basin FD2 travels north along Maverick Street away from the Site. FD2 is entirely developed in all conditions.

Offsite Basin FD3 (developed – 7,000 sq. ft. homes (analyzed as Industrial) and streets paved) is 4.31 acres and runoff from this basin ultimately travels east toward Maverick Street and heads south along Maverick Street. Basin FD3 ultimately discharges 8 and 15cfs in the 10 and 100yr storm events respectively south along Maverick Street toward Smoke Ranch Rd. A high point exists in Maverick Street just north of Robin Hood Circle. Therefore, all the flow from basin FD3 travels south along Maverick Street. FD3 is entirely developed in all conditions.

Offsite Basin FD1 (developed – 7,000 sq. ft. homes (analyzed as Industrial) and streets paved) is 5.99 acres and runoff from this basin ultimately travels east toward Tucumcari Drive where flows head north to Smoke Ranch Rd. Basin FD1 ultimately discharges 9 and 18cfs in the 10 and 100yr storm events respectively. These flows ultimately combine with other flows from the west within Smoke Ranch Drive. FD1 is entirely developed in all conditions.

Offsite Basin SMK (developed – 7,000 sq ft homes (analyzed as Industrial) and streets paved) is 2.74 acres and runoff from this basin ultimately travels east along Smoke Ranch Rd. Basin SMK ultimately discharges 5 and 9cfs easterly in the 10 and 100yr storm events respectively. These flows are ultimately combined with other flows from the west, south and north within Smoke Ranch Drive. SMK is entirely developed in all conditions.

There are referenced flows utilized from the City of Las Vegas MPU Northwest Neighborhood Study at the intersection of Smoke Ranch Rd. and Maverick Street. The flows referenced are 0/432cfs from Figure F-15 (Future Conditions). All upstream developments and facilities are developed already. These flows are manually added to our street flows for Smoke Ranch Drive in the 10yr and 100yr storm events.

The onsite basins have been delineated into seven (7) sub-basins and are identified as NX1, NX2, NX3, NX4, NX5, NX6 and NX7. Refer to Figure DR1, *Existing Condition Basin Map*, for basin boundaries and flow paths.

Onsite Basin NX1 (2.46ac. – 4/8cfs) is currently developed (paved parking, desert landscaping, and grass) and the runoff generated from this basin runs East to an adjacent baseball field consisting of grass. This flow just sheet flows east and continues easterly.

Onsite Basin NX2 (2.03ac. – 4/7cfs) is currently developed (paved and grass) and the runoff generated from this basin runs East to an adjacent baseball field consisting of grass. This flow just sheet flows east and continues easterly in the 10yr and 100yr storm events.

Onsite Basin NX3 (2.43ac. – 5/9cfs) is currently developed (paved and grass) and the runoff generated from this basin runs West to Maverick Street. This flow just sheet flows west and will be conveyed South along Maverick Street combining with flows from offsite basin FD3.

Onsite Basin NX4 (2.06ac. – 4/7cfs) is currently developed (paved and grass) in the SWC of the Site. The runoff generated from this basin runs southeast to Smoke Ranch Drive. This flow combines NX3, FD3, SMK and CLV MPU flows (0/432cfs) within Smoke Ranch Drive at combination point CPX1 (21/472cfs). See Existing Condition Drainage exhibit DR1 for CPX1 location.

Onsite Basin NX7 (1.28ac. – 2/3cfs) is currently developed (paved and grass) and the runoff generated from this basin runs East and South to Smoke Ranch Drive at the SEC of our Site. This flow combines with CPX1 (21/472cfs) and FD1 flow (9/18cfs) at combination point CPX2 (32/493cfs). CPX2 flows east along Smoke Ranch Rd. at the SEC of our Site.

Onsite Basin NX5 (5.34ac. – 7/14cfs) is currently developed (paved and grass) and the runoff generated from this basin runs East to adjacent private lots. The flows head east and sheet flow onto an Auto Parts and Car Wash lot where the flow continues east to Jones Blvd. **This is an existing condition.**

Onsite Basin NX6 (2.59ac. – 3/7cfs) is currently developed (paved and grass) and the runoff generated from this basin runs East to an adjacent private lot which is undeveloped. The flows head east and sheet flow onto this adjacent parcel where the flow continues east to Jones Blvd. **This is an existing condition.**

Please note there is an existing 60" RCP SD system within Smoke Ranch Rd. The flows utilized from the CLV MPU already take this into account since we are utilizing the Future F-15 exhibit from the CLV MPU. The 60" RCP will later be replaced by a 10ft x 7ft RCB to reduce flows even more in Smoke Ranch Rd as the capacity will be increased to handle additional surface flows.

The hydrologic analysis of the above-mentioned offsite basins tributary to the site are provided with the subject study. Additionally, the offsite basins are located within the McCarran Airport Rainfall Area, hence the point precipitation values for the 10-year and 100-year 6-hour storms are 1.58" and 2.77" respectively.

The HEC-1 Flood Hydrograph Package was utilized to determine the relevant onsite runoff flows. Utilizing the 1-ft topographic map for the project site, the site was delineated into onsite basins and offsite basins. The delineation of the onsite basins as well as offsite basins are depicted on Exhibit DR1, labeled as the 'Existing Drainage Plan' and Figure OFF (offsite basin map) within Appendix C.

2.2 Interim / Developed Drainage Condition

For the interim/developed condition, the analysis of the offsite basins will remain the same as in the existing condition, while the developed site will change with added buildings and sport fields in various areas within the Site. The existing condition of the offsite basins assumed full development due to improvements that have already occurred. Therefore, the estimated flow rates from the offsite basins will remain the same as analyzed in the existing condition. See Figure DR2 (Interim/Developed Drainage Plan) for the flows and drainage patterns for the site.

Utilizing the grading plan for the project, the project site is delineated into 9 onsite basins labeled as ND1 (4.47ac - 5/12cfs), NI2 (0.24ac - <1/1cfs), ND3 (0.94ac. - 2/3cfs), ND4 (1.63ac. - 3/6cfs), ND5 (4.49ac. - 8/15cfs), ND6 (2.59ac. - 5/9cfs), ND7 (2.97ac. - 6/10cfs), NI8 (0.27ac. - <1/1cfs) and NI9 (0.59ac. - 1/2cfs). Please note the basin labels with 'NI' are onsite areas that are not changing within the Site under our developed condition analysis. The delineation of onsite basins is depicted on Exhibit DR2 labeled as the 'Onsite Drainage Map, Interim/Developed Conditions'.

Onsite Basin ND1 (4.47ac - 5/12cfs) consists of paved areas, desert landscaping and grass. This area now consists of a soccer playing field. The flow ultimately discharges East to an existing baseball field near the NEC of our Site. This is a decrease in flow from existing conditions where NX1 and NX2 impact this area for a total of 15cfs.

Onsite Basin NI2 (0.24ac - <1/1cfs) consists of entirely desert landscaping. This area remains the same as existing conditions. The flow ultimately discharges West to Maverick Street. The flow from NI2 combines with FD2 flow (20/42cfs) at combination point CPD1 (20/42cfs). This flow matches the existing flows heading north along Maverick Street.

Onsite Basin ND3 (0.94ac - 2/3cfs) consists of entirely paved areas. This area now consists of basketball and pickle ball courts. The flow ultimately discharges East to onsite basin ND6 (5/9cfs).

Onsite Basin ND6 (2.59ac - 5/9cfs) consists of paved areas and desert landscaping in east portion of the Site. This area now consists of rooftops of proposed buildings, drive aisles, concrete walkways, and desert landscaping. The flow ultimately discharges to the northeast corner of the basin through curbs cuts and BMP swales before discharging off the site to the south boundary of the existing baseball field. The flows from ND3 and ND6 combine here at combination point CPD2 (7/13cfs). The flows go through the existing grass baseball field and onto a south parking lot that is only impacting the parking lot as it goes east to Jones Blvd. The existing Church is not impacted by these flows as the south parking lot of the church has curb/gutter to maintain the flows and keep them going East to Jones Blvd.

Onsite Basin NI8 (0.27ac - <1/1cfs) consists of mostly desert landscaping. The flow ultimately discharges West to Maverick Street. The flow from NI8 combines with FD3 flow (8/15cfs) and is conveyed south along Maverick Street toward Smoke Ranch Road.

Onsite Basin NI9 (0.59ac - 1/2cfs) consists of mostly paved and grassy areas. This area has not changed from existing conditions. The flow ultimately discharges South to Smoke Ranch Rd. The flow from NI8, FD3, SMK and CLV MPU Referenced Flow at combination point CPD3 (14/459cfs). These flows continue east along Smoke Ranch Rd as the surface flow.

Onsite Basin ND4 (1.63ac - 3/6cfs) consists of paved areas and desert landscaping. This area now consists of tennis courts, pickleball courts and drive aisles. The flow ultimately discharges to the Southeast through a curb cut and BMP area to an adjacent onsite basin ND5.

Onsite Basin ND5 (4.49ac - 8/15cfs) consists of paved areas and desert landscaping. This area now consists of onsite parking improvements, drive aisles, concrete areas and desert landscaping. The flow ultimately discharges East and then south through our proposed commercial driveway to Smoke Ranch Rd. The flows from ND4 and ND5 combine at combination point CPD4 (11/21cfs) as the flows discharging to Smoke Ranch Rd. through our proposed commercial driveway.

Onsite Basin ND7 (2.97ac - 6/10cfs) consists of paved areas and desert landscaping in the SEC of our Site. This area now consists of onsite drive aisles, concrete areas, proposed building rooftops and desert landscaping. The flow ultimately discharges South through our proposed commercial driveway to Smoke Ranch Rd. The flows from ND7 combine with CPD3 and CPD4 flow at combination point CPD5 (39/507cfs) at the SEC of the Site within Smoke Ranch Rd.

With this increase of 100yr flow (493cfs to 507cfs) in Smoke Ranch from existing to developed conditions, we have verified the properties just downstream of the SEC of our Site are elevated to more than twice the depth of flow ($1.26\text{ft} \times 2 = 2.52$) above the highest adjacent Flowline elevation in Smoke Ranch Rd. Existing FF elevations have been provided east of our site for verification. Please do note that even with the 14cfs increase, we only raise the 100yr depth of flow by 0.01ft, which is considered negligible. The depth went from 1.25ft to 1.26ft. But also note that a future facility will be installed in Smoke Ranch that will remove a big chunk of flow from Smoke Ranch Rd.

The HEC-1 Flood Hydrograph Package is utilized to determine the relevant onsite runoff flows. Similar to the existing conditions, the onsite developed conditions of the school addition follow their historical drainage patterns as much as possible. Utilizing the 1-ft topographic map for the project site, the site is delineated into onsite basins and offsite basins. The delineation of the onsite basins as well as offsite basins are depicted on Exhibit DR2, labeled as the 'Interim/Developed Drainage Plan'. Referenced flows (Central Neighborhood MPU) are also labeled on the Drainage plan.

There are various BMP swales that are located around the perimeter of the site to treat the parking lot areas. There are also grass field areas that impervious areas are sheet flowing through, which some of the impervious flow will infiltrate into for BMP practices. These areas are proposed to satisfy the water quality Best Management Practice (BMP) requirement in Section 1500 of the CCRFCD Drainage Design Manual. The landscaped area is designed to settle out sediment and pollutant for the water quality design flows prior to exiting the project site to the adjacent perimeter streets or adjacent parcels. **See SECTION 2.7 below for BMP discussion.**

We have provided a street and normal depth calculations for the perimeter streets in existing and developed conditions. These can be found in Appendix B. Please note that the flow increase in Smoke Ranch Rd. only increased the 100yr depth of flow by 0.01ft, which is considered negligible. But also note that a future facility will be installed in Smoke Ranch that will remove a big chunk of flow from Smoke Ranch Rd.

As shown in the attached Flow Master outputs, flows within Maverick Street are well below the maximum allowable velocity x depth ($v \times d$) values of 6.0 and 8.0 during 10- and 100-year storm events, respectively. However, Smoke Ranch Rd. maximum allowable $V \times D = 8$ or less is not met in existing nor developed conditions. A Future regional facility is planned and will remove the surface flow once it is constructed.

2.3 Future Drainage Condition

For the future condition, both the site and all the local offsite basins are assumed to be fully developed. In the future, a Clark County Regional facility within Smoke Ranch Rd. will be constructed south of the Site. A future 10ft x 7ft RCB will be constructed for 1,245cfs. This will reduce the flows significantly in Smoke Ranch Rd to negligible flows in the street.

There is no change from the interim/developed analysis for the onsite basins; therefore, no re-analysis is necessary for the future for onsite basins.

2.3 Master Planning Information

In the *2018 Las Vegas Valley Flood Control Master Plan Update – Volume I* (2018 MPU) (Reference 2), dated September 2018, as prepared by ATKINS. The valley was divided into ten watersheds and each watershed was further subdivided into sub-basins. The on-site basins fall within the Central Watershed. As shown in Figure W-5 of the 2018 MPU, the subject site is located within sub-basins SR05B-C and SR05D-C.

Refer to the annotated Figure W-5 in Appendix A.

Existing and future CCRFCD flood control facilities are shown in the *2018 Las Vegas Valley Flood Control Master Plan Update – Volume II* (2018 MPU) (Reference 3), dated September 2018, as prepared by CCRFCD. The figures and inventory tables from Volume II of the 2018 MPU were updated by CCRFCD in 2018. Per Figure F-24, the subject parcel is adjacent to a proposed MPU facility (Facility ID LVSF 0496). The existing facility is an 10ft x 7ft RCB (1,245cfs).

2.4 Floodplain Information

The project site is covered by Flood Insurance Rate Map (FIRM) for the Clark County, Nevada, and incorporated areas, Community Panel Number: 32003C2155F, Effective Date: November 16, 2011, revised to reflect LOMR Effective: October 4, 2019 (Reference 4). The project site is located within a FEMA Zone 'X' defined as: "Areas determined to be outside the 0.2% annual chance floodplain." This panel is entirely in Zone 'X'.

Refer to Figure 2 in Appendix C for the general location of the site on the FIRM panel.

2.5 Previous Drainage Studies

The overall area is covered within the CCRFCD "2018 Las Vegas Valley Flood Control Master Plan Update, Volume I and II" (Reference 2) and the W-5 Soil Map from Atkins for Soil determination (Reference 3). The site is also covered in the FIRM for the Clark County, Nevada and incorporated areas, Community Panel Number: 32003C2155F, Effective Date: November 16, 2011, revised to reflect LOMR dated October 4, 2019.

No previous Studies were used for our Study. However, we have referenced the CLV MPU Neighborhood Study for street flows at the SEC of our Site in Smoke Ranch Rd. Lochsa Engineering concurs with these referenced CLV MPU flows for surface flow.

2.7 Compliance with CCRFCD Best Management Practices (BMP)

To satisfy the water quality BMP requirement in Section 1500 of the CCRFCD Drainage Design Manual, the project site is designed to accommodate as much as possible Low Impact Development (LID) measures. As shown in the grading plan, there are various BMP swales that are located around the perimeter of the site to treat the parking lot areas. These areas are proposed to satisfy the water quality Best Management Practice (BMP) requirement in Section 1500 of the CCRFCD Drainage Design Manual. The landscaped area is designed to settle out sediment and pollutant for the water quality design flows prior to exiting the project site to the adjacent perimeter streets.

We have provided a BMP exhibit (back pocket of submittal) for the BMP areas within our site. Unfortunately, with site restrictions, we are only able to treat 1.97 acres out of a total 4.12 acres. This means we are treating approximately 49% of impervious areas which does not meet the required 75%. If we need to, we can try and flip more of the parking lot grading going further south to get to the 80ft BMP swale and/or add curb cuts within medians of the parking lot. However, the CCSD wanted to try and avoid this so we can keep slopes to a minimum. So, we are hoping with these site restrictions, that 49% of treatment will be fine for the school redesign.

3.0 PROPOSED DRAINAGE FACILITIES

3.1 General Description

The proposed improvements are limited to the proposed school buildings (4), proposed parking locations and proposed sporting areas.

3.2 Compliance with Regulations and Adopted Plans

The hydrologic analysis and drainage design of this development is in compliance with local requirements, including the CCRFCD “*Hydrologic Criteria and Drainage Design Manual*” (HCDDM) (Reference 1), and the CCRFCD “*2018 Las Vegas Valley Flood Control Master Plan Update*” (Reference 2). The site design is also in compliance with the W-5 Soil Map and Curve Number Matrix (Central Watershed; Reference 3), as well as FEMA’s FIRM with panel number 32003C2155F (Reference 4), revised to reflect LOMR dated October 4, 2019.

3.3 Hydrologic Criteria

The onsite basins of the subject project area all fall within the Central Watershed. The hydrologic and hydraulic analyses presented in this report are carried out in accordance with the CCRFCD's HCDDM (Reference 1). The rainfall values used for the hydrologic analysis of the site represent the 10-year and 100-year storm recurrence events, each with six-hour duration. The site is within the boundary for using the McCarran Airport Rainfall Data. Therefore, point precipitation values were determined using Figures 513 and Table 505 of the HCDDM.

The rainfall losses due to infiltration, interception, etc. are represented using the SCS curve number (CN) method recommended in the CCRFCD HCDDM (Reference 1). The SCS method divides the soils into four hydrologic groups as A, B, C and D. Review of the 2018 MPU's Figure W-5 Soil Map and Curve Number Matrix indicates that the site is located within the hydrologic soil group 'D', defined as soils with "very low infiltration rate, high runoff potential". The CN values for the different land uses were determined from Table 602 (page 1 and 4) of the CCRFCD HCDDM. The runoff hydrograph is determined from the design precipitation for each sub-basin using the Soil Conservation Service (SCS) unit hydrograph method. Calculations used in the hydrologic analysis for the onsite basins for existing and proposed conditions are attached in Appendix A.

3.4 Facility Design Calculations

All drainage facilities within this project have been designed in accordance with the CCRFCD “*Hydrologic Criteria and Drainage Design Manual*” (Reference 1). The onsite drainage plan has been developed to closely resemble existing drainage patterns, and to minimize any impact to the adjacent properties.

The finished floor elevation of the proposed school buildings are double the 100yr flow depth in Smoke Ranch Rd. and a minimum of twice the 100yr flow depth onsite.

4. CONCLUSIONS AND RECOMMENDATIONS

1. This project is in compliance with the applicable drainage laws as recognized by the State of Nevada.
2. This project is in compliance with the CCRFCD “2018 Las Vegas Valley Flood Control Master Plan”, as well as the CCRFCD “*Hydrologic Criteria and Drainage Design Manual*”.
3. The site and the proposed improvements are located entirely within areas designated by FEMA as Zone “X” (UnShaded), described by “*Areas of 0.2% annual chance flood*”.
4. The drainage facilities for this project have been designed to convey runoff from the 100-year storm safely through the site. In addition, they have been designed based on generally accepted engineering practices.
5. No adverse effects are expected either upstream or downstream of the subject site.

5. REFERENCES

1. Clark County Regional Flood Control District, "*Hydrologic Criteria and Drainage Design Manual*", August 1999.
2. ATKINS, "*2018 Las Vegas Valley Flood Control Master Plan Update, Volume 1 and II*", September 2018.
3. CCRFCD MPU W-5 Soil Map and Curve Number Matrix (2018)
4. Federal Emergency Management Agency, "*Flood Insurance Rate Maps; Community Panel Numbers 32003C2155F; Clark County, Nevada and Incorporated Areas*," Revised to reflect LOMR dated October 4, 2019.

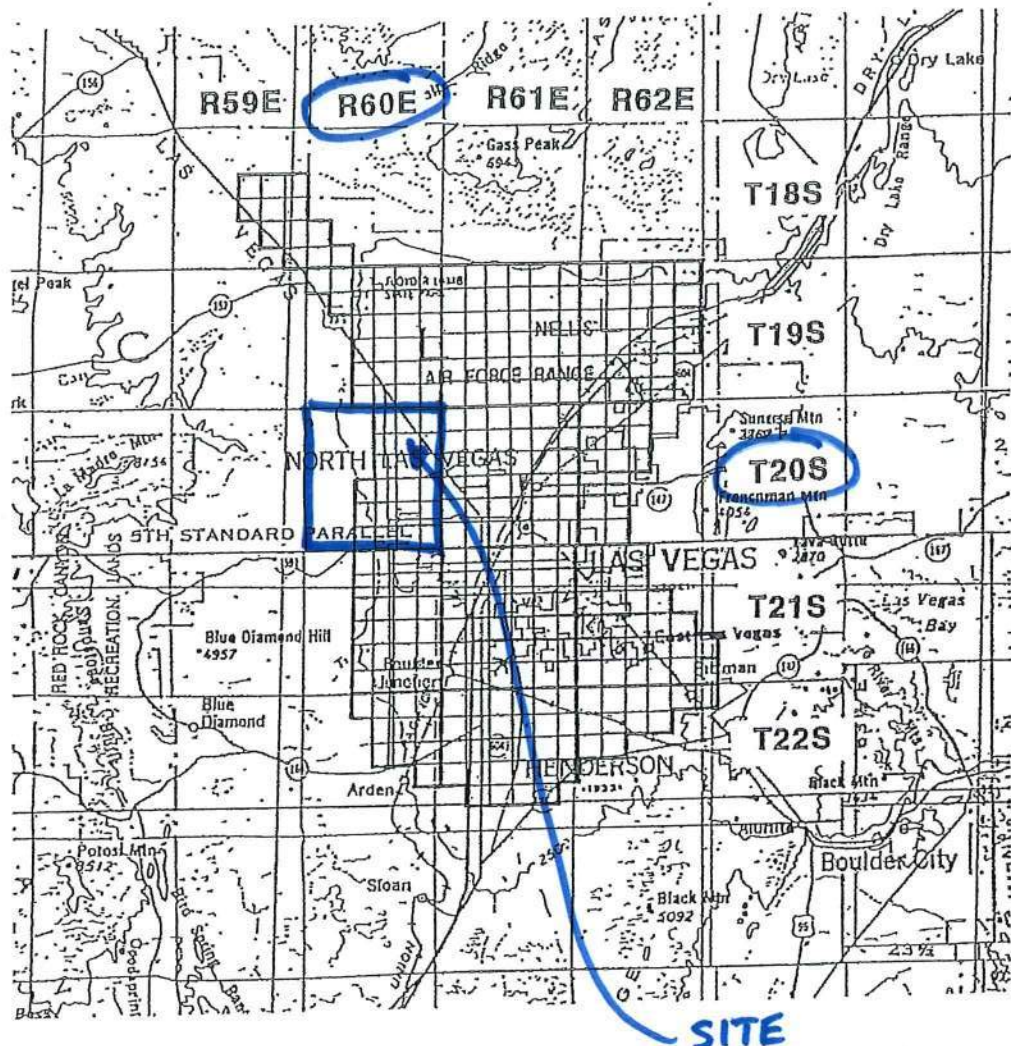
APPENDIX A

HYDROLOGIC ANALYSIS

HYDROLOGIC CHARTS

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

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.

Revision	Date

WRC
ENGINEERING

REFERENCE:

USACE, Los Angeles District, 1988

FIGURE 513

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

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

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

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

Revision	Date

WRC
ENGINEERING

REFERENCE:

USACE, Los Angeles District, 1988

TABLE 505

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

SIX-HOUR STORM DISTRIBUTIONS

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

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

Revision	Date

REFERENCE:

TABLE 503

W-5 Map & Curve Number Matrix

CCRFCD, 2018 W-5 MAP

(CENTRAL WATERSHED)

Curve Number Matrix

SOIL MAP UNIT	HYDROLOGIC SOIL GROUP					LAND USE CATEGORY INDEX NUMBER												
	A	B	C	D	ROCK OUTCROP	1	2	3	4	5	6	7	8	9	10	11	12	13
	CN --->					63	47	57	60	62	74	84	89	92	86	92	71	30
		CN --->				77	66	73	74	76	83	89	93	94	91	94	81	30
			CN --->			85	77	82	83	84	88	92	95	95	93	95	87	30
				CN --->		88	83	86	87	88	91	94	96	96	95	96	90	30
					CN --->	90	90	92	92	92	94	96	96	97	96	97	94	30
	%	%	%	%	%	SOIL TYPE COMPOSITE CN FOR LAND USE CATEGORY												
1100	6	0	0	59	35	87.0	83.0	86.0	87.0	88.0	91.0	94.0	96.0	96.0	95.0	96.0	90.0	30.0
1105	55	40	0	5	0	70.0	56.0	65.0	67.0	69.0	78.0	86.0	91.0	93.0	88.0	93.0	76.0	30.0
1107	0	100	0	0	0	77.0	66.0	73.0	74.0	76.0	83.0	89.0	93.0	94.0	91.0	94.0	81.0	30.0
1112	100	0	0	0	0	63.0	47.0	57.0	60.0	62.0	74.0	84.0	89.0	92.0	86.0	92.0	71.0	30.0
1113	100	0	0	0	0	63.0	47.0	57.0	60.0	62.0	74.0	84.0	89.0	92.0	86.0	92.0	71.0	30.0
1117	100	0	0	0	0	63.0	47.0	57.0	60.0	62.0	74.0	84.0	89.0	92.0	86.0	92.0	71.0	30.0
1120	100	0	0	0	0	63.0	47.0	57.0	60.0	62.0	74.0	84.0	89.0	92.0	86.0	92.0	71.0	30.0
1127	100	0	0	0	0	63.0	47.0	57.0	60.0	62.0	74.0	84.0	89.0	92.0	86.0	92.0	71.0	30.0
1129	100	0	0	0	0	63.0	47.0	57.0	60.0	62.0	74.0	84.0	89.0	92.0	86.0	92.0	71.0	30.0
1130	65	0	25	10	0	71.0	58.0	66.0	68.0	70.0	79.0	87.0	91.0	93.0	89.0	93.0	77.0	30.0
1132	100	0	0	0	0	63.0	47.0	57.0	60.0	62.0	74.0	84.0	89.0	92.0	86.0	92.0	71.0	30.0
1133	70	0	10	0	20	71.0	58.0	67.0	68.0	70.0	79.0	87.0	91.0	93.0	89.0	93.0	77.0	30.0
1134	100	0	0	0	0	63.0	47.0	57.0	60.0	62.0	74.0	84.0	89.0	92.0	86.0	92.0	71.0	30.0
1135	84	0	0	16	0	67.0	52.0	62.0	64.0	66.0	76.0	85.0	90.0	92.0	87.0	92.0	74.0	30.0
1140	0	0	100	0	0	85.0	77.0	82.0	83.0	84.0	88.0	92.0	95.0	95.0	93.0	95.0	87.0	30.0
1141	8	0	2	70	20	86.0	81.0	85.0	86.0	86.0	90.0	93.0	95.0	96.0	94.0	96.0	89.0	30.0
1150	0	0	0	100	0	88.0	83.0	86.0	87.0	88.0	91.0	94.0	96.0	96.0	95.0	96.0	90.0	30.0
1151	41	0	0	59	0	78.0	68.0	74.0	76.0	77.0	84.0	90.0	93.0	94.0	91.0	94.0	82.0	30.0
1152	0	0	0	100	0	88.0	83.0	86.0	87.0	88.0	91.0	94.0	96.0	96.0	95.0	96.0	90.0	30.0
1155	0	0	0	100	0	88.0	83.0	86.0	87.0	88.0	91.0	94.0	96.0	96.0	95.0	96.0	90.0	30.0
1156	1	10	0	89	0	87.0	81.0	84.0	85.0	86.0	90.0	93.0	95.0	96.0	94.0	96.0	89.0	30.0
1160	0	0	100	0	0	85.0	77.0	82.0	83.0	84.0	88.0	92.0	95.0	95.0	93.0	95.0	87.0	30.0
1160dn	46	1	0	53	0	76.0	66.0	73.0	74.0	76.0	83.0	89.0	93.0	94.0	91.0	94.0	81.0	30.0
1165	32	40	15	13	0	75.0	64.0	71.0	73.0	74.0	82.0	88.0	92.0	94.0	90.0	94.0	80.0	30.0
1181	100	0	0	0	0	63.0	47.0	57.0	60.0	62.0	74.0	84.0	89.0	92.0	86.0	92.0	71.0	30.0
1182	95	0	5	0	0	64.0	48.0	58.0	61.0	63.0	74.0	84.0	90.0	92.0	86.0	92.0	72.0	30.0
1183	100	0	0	0	0	63.0	47.0	57.0	60.0	62.0	74.0	84.0	89.0	92.0	86.0	92.0	71.0	30.0
1184	100	0	0	0	0	63.0	47.0	57.0	60.0	62.0	74.0	84.0	89.0	92.0	86.0	92.0	71.0	30.0
1187	100	0	0	0	0	63.0	47.0	57.0	60.0	62.0	74.0	84.0	89.0	92.0	86.0	92.0	71.0	30.0
1190	100	0	0	0	0	63.0	47.0	57.0	60.0	62.0	74.0	84.0	89.0	92.0	86.0	92.0	71.0	30.0
1191	100	0	0	0	0	63.0	47.0	57.0	60.0	62.0	74.0	84.0	89.0	92.0	86.0	92.0	71.0	30.0
1192	55	35	0	10	0	70.0	57.0	66.0	68.0	70.0	79.0	87.0	91.0	93.0	88.0	93.0	76.0	30.0
1200	0	0	100	0	0	85.0	77.0	82.0	83.0	84.0	88.0	92.0	95.0	95.0	93.0	95.0	87.0	30.0
1206	0	0	100	0	0	85.0	77.0	82.0	83.0	84.0	88.0	92.0	95.0	95.0	93.0	95.0	87.0	30.0
1207	3	85	5	7	0	78.0	67.0	74.0	75.0	77.0	83.0	89.0	93.0	94.0	91.0	94.0	82.0	30.0
1222	0	0	100	0	0	85.0	77.0	82.0	83.0	84.0	88.0	92.0	95.0	95.0	93.0	95.0	87.0	30.0
1225	9	20	50	21	0	82.0	73.0	79.0	80.0	81.0	86.0	91.0	94.0	95.0	92.0	95.0	85.0	30.0
1230	54	0	0	46	0	75.0	63.0	70.0	72.0	74.0	81.0	88.0	92.0	94.0	90.0	94.0	80.0	30.0
1235	66	25	0	9	0	69.0	55.0	64.0	66.0	68.0	77.0	86.0	91.0	93.0	88.0	93.0	75.0	30.0
1236	0	0	100	0	0	85.0	77.0	82.0	83.0	84.0	88.0	92.0	95.0	95.0	93.0	95.0	87.0	30.0
1237	0	0	100	0	0	85.0	77.0	82.0	83.0	84.0	88.0	92.0	95.0	95.0	93.0	95.0	87.0	30.0
1240	0	0	0	100	0	88.0	83.0	86.0	87.0	88.0	91.0	94.0	96.0	96.0	95.0	96.0	90.0	30.0
1252	0	100	0	0	0	77.0	66.0	73.0	74.0	76.0	83.0	89.0	93.0	94.0	91.0	94.0	81.0	30.0
1255	0	100	0	0	0	77.0	66.0	73.0	74.0	76.0	83.0	89.0	93.0	94.0	91.0	94.0	81.0	30.0
1260	100	0	0	0	0	63.0	47.0	57.0	60.0	62.0	74.0	84.0	89.0	92.0	86.0	92.0	71.0	30.0
1262	75	0	0	25	0	69.0	56.0	64.0	67.0	69.0	78.0	86.0	91.0	93.0	88.0	93.0	76.0	30.0
1263	95	0	0	5	0	64.0	48.0	59.0	61.0	64.0	74.0	84.0	90.0	92.0	86.0	92.0	72.0	30.0
1264	100	0	0	0	0	63.0	47.0	57.0	60.0	62.0	74.0	84.0	89.0	92.0	86.0	92.0	71.0	30.0
1270	0	0	100	0	0	85.0	77.0	82.0	83.0	84.0	88.0	92.0	95.0	95.0	93.0	95.0	87.0	30.0
1278	0	0	100	0	0	85.0	77.0	82.0	83.0	84.0	88.0	92.0	95.0	95.0	93.0	95.0	87.0	30.0
1282	0	0	100	0	0	85.0	77.0	82.0	83.0	84.0	88.0	92.0	95.0	95.0	93.0	95.0	87.0	30.0
1300	0	0	0	100	0	88.0	83.0	86.0	87.0	88.0	91.0	94.0	96.0	96.0	95.0	96.0	90.0	30.0

100% D-SOIL

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

RUNOFF CURVE NUMBERS (URBAN AREAS¹)

Cover description		Curve numbers for hydrologic soil group—			
Cover type and hydrologic condition	Average percent impervious area ²	A	B	C	D
<i>Fully developed urban areas (vegetation established)</i>					
Open space (lawns, parks, golf courses, cemeteries, etc.): ³					
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) ⁴ ...		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

Residential < 6000 ft²

Developing urban areas

Newly graded areas (pervious areas only, no vegetation) ⁵	77	86	91	94
--	----	----	----	----

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

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

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

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

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

Revision	Date

WRC
ENGINEERING

REFERENCE:
SCS TR-55; USDA, June 1986.

TABLE 602
1 of 4

HYDROLOGY

EXISTING CONDITIONS

HYDROLOGY

BRINLEY MIDDLE SCHOOL REPLACEMENT

DEVELOPMENT:
CALCULATED BY:
PROJECT NUMBER:

CB

CB

221095

DATE: May 10, 2023

[illegible]

$$t_i = 1.8 (1.1 - K) L^{0.5} / S^{1/3}$$

$K = 0.0132 \text{ CN} - 0.39$

$$\tau = L / (60 \text{ V})$$

$$t_C = t_i + t_t$$

$$t_L = t_{LAG} = 0.6 \text{ tc}$$

LOCATION: Onsite & Offsite

HYDROLOGIC CONDITION:

Onsite & Offsite

Existing

TRIAL: Final Iteration

Curve Number Calculations

BRINLEY MIDDLE SCHOOL REPLACEMENT

Sub-Basin: NX1

Total Area: 2.46 Acres

Land Use/Cover type	Area [A] (acres)	Soil Type	Percentage, P [P]	Curve Number [CN]	Product {CN x P}
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)	1.64	D	67%	98	65.3
Open Space: Poor Condition	0.72	D	29%	89	26.0
Natural desert landscaping (pervious areas only)	0.10	D	4%	88	3.6
Total:	2.46	-	100%	-	95.0

Curve Number Calculations

BRINLEY MIDDLE SCHOOL REPLACEMENT

Sub-Basin: NX2

Total Area: 2.03 Acres

Land Use/Cover type	Area [A] (acres)	Soil Type	Percentage, P [P]	Curve Number [CN]	Product {CN x P}
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)	1.32	D	65%	98	63.7
Open Space: Poor Condition	0.71	D	35%	89	31.1
Total:	2.03	-	100%	-	94.9

Curve Number Calculations

BRINLEY MIDDLE SCHOOL REPLACEMENT

Sub-Basin: NX3

Total Area: 2.43 Acres

Land Use/Cover type	Area [A] (acres)	Soil Type	Percentage, P [P]	Curve Number [CN]	Product {CN x P}
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)	2.24	D	92%	98	90.3
Open Space: Poor Condition	0.19	D	8%	89	7.0
Total:	2.43	-	100%	-	97.3

Curve Number Calculations

BRINLEY MIDDLE SCHOOL REPLACEMENT

Sub-Basin: NX4

Total Area: 2.06 Acres

Land Use/Cover type	Area [A] (acres)	Soil Type	Percentage, P [P]	Curve Number [CN]	Product {CN x P}
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)	1.78	D	86%	98	84.7
Open Space: Poor Condition	0.28	D	14%	89	12.1
Total:	2.06	-	100%	-	96.8

Curve Number Calculations

BRINLEY MIDDLE SCHOOL REPLACEMENT

Sub-Basin: NX5

Total Area: 5.34 Acres

Land Use/Cover type	Area [A] (acres)	Soil Type	Percentage, P [P]	Curve Number [CN]	Product {CN x P}
Open Space: Poor Condition	3.71	D	69%	89	61.8
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)	1.63	D	31%	98	29.9
Total:	5.34	-	100%	-	91.7

Curve Number Calculations

BRINLEY MIDDLE SCHOOL REPLACEMENT

Sub-Basin: NX6

Total Area: 2.59 Acres

Land Use/Cover type	Area [A] (acres)	Soil Type	Percentage, P [P]	Curve Number [CN]	Product {CN x P}
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)	0.30	D	12%	98	11.4
Open Space: Poor Condition	2.29	D	88%	89	78.7
Total:	2.59	-	100%	-	90.0

BRINLEY MIDDLE SCHOOL REPLACEMENT

Sub-Basin: NX7
Total Area: 1.28 Acres

Land Use/Cover type	Area [A] (acres)	Soil Type	Percentage, P [P]	Curve Number [CN]	Product {CN x P}
Open Space: Poor Condition	0.98	D	77%	89	68.1
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)	0.30	D	23%	98	23.0
Total:	1.28	-	100%	-	91.1

Curve Number Calculations

BRINLEY MIDDLE SCHOOL REPLACEMENT

Sub-Basin: SMK

Total Area: 2.74 Acres

Land Use/Cover type	Area [A] (acres)	Soil Type	Percentage, P [P]	Curve Number [CN]	Product {CN x P}
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)	1.92	D	70%	98	68.7
Industrial	0.82	D	30%	93	27.8
Total:					
	2.74	-	100%	-	96.5

Curve Number Calculations

BRINLEY MIDDLE SCHOOL REPLACEMENT

Sub-Basin: FD1

Total Area: 5.99 Acres

Land Use/Cover type	Area [A] (acres)	Soil Type	Percentage, P [P]	Curve Number [CN]	Product {CN x P}
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)	2.21	D	37%	98	36.2
Industrial	3.78	D	63%	93	58.7
Total:					
	5.99	-	100%	-	94.8

Curve Number Calculations

BRINLEY MIDDLE SCHOOL REPLACEMENT

Sub-Basin: FD2

Total Area: 15.19 Acres

Land Use/Cover type	Area [A] (acres)	Soil Type	Percentage, P [P]	Curve Number [CN]	Product {CN x P}
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)	2.91	D	19%	98	18.8
Industrial	8.83	D	58%	93	54.1
Open Space: Poor Condition	3.45	D	23%	89	20.2
Total:	15.19	-	100%	-	93.0

Curve Number Calculations

BRINLEY MIDDLE SCHOOL REPLACEMENT

Sub-Basin: FD3

Total Area: 4.31 Acres

Land Use/Cover type	Area [A] (acres)	Soil Type	Percentage, P [P]	Curve Number [CN]	Product {CN x P}
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)	1.44	D	33%	98	32.7
Industrial	2.87	D	67%	93	61.9
Total:	4.31	-	100%	-	94.7

AVERAGE VELOCITY

Input Variables	Basin NX1	Basin NX2	Basin NX3	Basin NX4	Basin NX5	Basin NX6	Basin NX7	Basin SMK	Basin FD1	Basin FD2	Basin FD3			
Bottom Width, B, (ft):	3.0	3.0	3.0	3.0	4.0	4.0	4.0	2.0	3.0	2.0	2.0			
Right Side Slope, Zr:	100	100	100	100	100	100	100	50	100	50	0			
Left Side Slope, Zl:	100	100	100	100	100	100	100	0	100	0	50			
Manning's n:	0.016	0.018	0.016	0.016	0.025	0.025	0.025	0.015	0.016	0.016	0.016			
Geometric Slope, So (ft/ft):	0.020	0.041	0.004	0.017	0.020	0.030	0.014	0.015	0.015	0.007	0.009	0.000	0.000	0.000
Flowrate, Q (cfs):	4	3.5	4.5	3.5	7	3.5	1.5	4.5	9	21	7.5			

Output Variables

Normal Depth, Yn (ft):	0.12	0.10	0.18	0.12	0.18	0.12	0.10	0.21	0.18	0.48	0.30			
Area of Flow, A, (sf):	1.83	1.38	3.66	1.76	3.90	1.99	1.41	1.52	3.75	6.72	2.83			
Velocity, V (fps):	2.18	2.53	1.23	1.99	1.80	1.76	1.06	2.96	2.40	3.12	2.65			
Wetted Perimeter, p (ft):	27.25	23.71	38.36	26.73	39.69	28.52	24.08	12.71	38.84	26.49	17.25			
Hydraulic Radius, Rh (ft):	0.07	0.06	0.10	0.07	0.10	0.07	0.06	0.12	0.10	0.25	0.16			
Free Surface Top Width, T (ft):	27.25	23.71	38.36	26.72	39.69	28.52	24.08	12.50	38.84	26.01	16.94			
Centroid, Y*, (ft):	0.04	0.04	0.06	0.04	0.06	0.05	0.04	0.08	0.06	0.17	0.11			

* NOTE : HALF OF THE 100-YEAR STORM RUNOFF FLOWS IS USED TO DETERMINE THE BASIN TRAVEL VELOCITY REQUIRED FOR THE LAG TIME CALCULATIONS

HEC-1 MODEL OUTPUT

(EXISTING CONDITIONS)

Peak Flow Summary Existing Condition

HEC-1 ID	Area (acres)	10-year Flow (cfs)	100-year Flow (cfs)
NX1	2.46	4	8
NX2	2.03	4	7
FD2	15.19	20	42
FD3	4.31	8	15
NX3	2.43	5	9
NX4	2.06	4	7
SMK	2.74	5	9
*CLV MPU	-	0	432
CPX1	-	21	472
FD1	5.99	9	18
NX7	1.28	2	3
CPX2	-	32	493
NX5	5.34	7	14
NX6	2.59	3	7

(FD3 + NX3 + NX4 + SMK + REF. FLOW)

(CPX1 + FD1 + ND7)

*CLV MPU FIGURE F-15 (APPENDIX C)

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*****
* FLOOD HYDROGRAPH PACKAGE (HEC-1)
* JUN 1998
* VERSION 4.1
* RUN DATE 08MAY23 TIME 10:53:35
*****

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X

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

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X X XXXXXX XXXX X
X X X X X
X X X X X
XXXXXX XXXX X XXXX X
X X X X X
X X X X X
X X XXXXXX XXXX XXX

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

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

1 HEC-1 INPUT PAGE 1

```

LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
1 ID
2 ID ***** TECHNICAL DRAINAGE STUDY FOR BRINLEY MIDDLE SCHOOL REPLACEMENT
3 ID EXISTING CONDITIONS - ONSITE AND OFFSITE
4 ID USING SCS METHODS AND KINEMATIC WAVE ROUTING
5 ID MASTER PLAN ADJUSTED 6-HOUR RAINFALL AND STORM DISTRIBUTION
6 ID
7 ID LOCHSA JOB # 221095
8 ID
9 ID
10 ID INPUT FILE NAME: X.DAT
11 ID
12 ID APRIL 2023
13 ID
14 ID *****
15 ID *****
16 ID MCCARRAN AIRPORT RAINFALL AREA
17 ID 10 & 100 YEAR - 6 HOUR STORM EVENT
18 ID PRECIPITATION:
19 ID 10-YEAR : 1.58 INCHES
20 ID 100-YEAR : 2.77 INCHES
21 ID 10-YEAR/100-YEAR : 1.58/2.77= 0.5704
22 ID *****
23 ID *****
24 ID *DIAGRAM
25 IT 5 200
26 IO 5 0
27 IN 5
28 JR PREC .5704 1.0
29 KK NX1
30 KM THE BASIN IS A DEVELOPED ONSITE BASIN ON NORTH PORTION OF PARCEL,
31 KM DISCHARGING EAST TO ADJACENT EXISTING BASEBALL FIELD
32 PB 2.770
33 PC 0.0 .02 .057 .07 .087 .108 .124 .13 .13 .13
34 PC .13 .13 .13 .133 .14 .142 .148 .158 .172 .181
35 PC .19 .197 .199 .2 .201 .204 .214 .229 .241 .249
36 PC .251 .256 .27 .278 .281 .283 .295 .322 .352 .409
37 PC .499 .59 .71 .744 .781 .812 .819 .835 .851 .856
38 PC .86 .868 .876 .888 .91 .926 .937 .95 .97 .976
39 PC .982 .985 .987 .989 .99 .993 .993 .994 .995 .998
40 BA .00384
41 LS 0 95.0
42 UD .083
43 KK NX2
44 KM EXISTING BASIN WITH ROOFTOP, PAVED AND GRASS, DISCHARGES EAST TO EXIST.
45 KM BASEBALL FIELD
46 BA .00317
47 LS 0 94.9
48 UD 0.050

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1 HEC-1 INPUT PAGE 2

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LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
49 KK FD2
50 KM EXISTING BASIN WEST OF SITE (RESIDENCES), DISCHARGES NORTH ALONG MAVERICK
51 BA .02373
52 LS 0 93.0
53 UD 0.099
54 KK FD3
55 KM EXISTING BASIN WEST OF SITE (RESIDENCES), DISCHARGES SOUTH ALONG MAVERICK
56 BA .00673
57 LS 0 94.7
58 UD 0.050
59 KK NX3
60 KM EXISTING SITE ON WEST CENTRAL; DRAINING WEST TO MAVERIK STREET

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X

61	BA	.00380	
62	LS	0	97.3
63	UD	0.052	
	*		
64	KK	NX4	
65	KM	SOUTHWEST EXISTING SCHOOL SITE; DISCHARGES SOUTHEAST TO EXIST. DRIVEWAY	
66	BA	.00322	
67	LS	0	96.8
68	UD	0.054	
	*		
69	KK	SMK	
70	KM	EXIST. STREET BASIN SOUTH OF SITE AND RESIDENCES; DISCHARGES EAST	
71	BA	.00428	
72	LS	0	96.5
73	UD	0.068	
	*		
74	KK	CPX1	
75	KM	COMBINE REF. CLV MPU FLOW, FD3, NX3, NX4 AND SMK FOR FLOWS DISCHARGING EAST A	
76	HC	4	
	*		
77	KK	FD1	
78	KM	OFFSITE BASIN SOUTH OF SITE; DRAINING NORTH TO SMOKE RANCH RD.	
79	BA	.00936	
80	LS	0	94.8
81	UD	0.097	
	*		
82	KK	NX7	
83	KM	SOUTH SLIVER PORTION OF SITE, DISCHARGING EAST AND SOUTH TO SMOKE RANCH	
84	BA	.00200	
85	LS	0	91.1
86	UD	0.094	
	*		

1

HEC-1 INPUT

PAGE 3

LINE	ID	1	2	3	4	5	6	7	8	9	10
87	KK	CPX2									
88	KM	COMBINE CPX1, FD1 AND NX7 FOR FLOWS DISCHARGING EAST ALONG SMOKE RANCH									
89	HC	3									
	*										
90	KK	NX5									
91	KM	CENTRAL PORTION OF SITE, DISCHARGING EAST TO PROPERTY LINE									
92	BA	.00834									
93	LS	0									
94	UD	0.095									
	*										
95	KK	NX6									
96	KM	EAST END OF SITE, DRAINING NORTHEAST TO EXIST. BASEBALL FIELD									
97	BA	.00405									
98	LS	0									
99	UD	0.086									
	*										
100	ZZ										

1

SCHEMATIC DIAGRAM OF STREAM NETWORK

INPUT LINE	(V) ROUTING	(--->) DIVERSION OR PUMP FLOW
NO.	(.) CONNECTOR	(<---) RETURN OF DIVERTED OR PUMPED FLOW
28	NX1	
43		NX2
49		FD2
54		FD3
59		NX3
64		NX4
69		SMK
74		CPX1
77		FD1
82		NX7
87		CPX2
90		NX5
95		NX6

(***) 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

*
 * RUN DATE 08MAY23 TIME 10:53:35 *
 *

X

* DAVIS, CALIFORNIA 95616 *
 * (916) 756-1104 *
 *

***** TECHNICAL DRAINAGE STUDY FOR BRINLEY MIDDLE SCHOOL REPLACEMENT
 EXISTING CONDITIONS - ONSITE AND OFFSITE
 USING SCS METHODS AND KINEMATIC WAVE ROUTING
 MASTER PLAN ADJUSTED 6-HOUR RAINFALL AND STORM DISTRIBUTION

LOCHSA JOB # 221095

INPUT FILE NAME: X.DAT

APRIL 2023

MCCARRAN AIRPORT RAINFALL AREA
 10 & 100 YEAR - 6 HOUR STORM EVENT
 PRECIPITATION:
 10-YEAR : 1.58 INCHES
 100-YEAR : 2.77 INCHES
 10-YEAR/100-YEAR : 1.58/2.77 = 0.5704

25 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 200 NUMBER OF HYDROGRAPH ORDINATES
 NDDATE 1 0 ENDING DATE
 NDTIME 1635 ENDING TIME
 ICENT 19 CENTURY MARK

 COMPUTATION INTERVAL .08 HOURS
 TOTAL TIME BASE 16.58 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
 .57 1.00

1

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

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION	
					RATIO 1 .57	RATIO 2 1.00
HYDROGRAPH AT	NX1	.00	1	FLOW	4.	8.
+				TIME	3.50	3.50
HYDROGRAPH AT	NX2	.00	1	FLOW	4.	7.
+				TIME	3.50	3.50
HYDROGRAPH AT	FD2	.02	1	FLOW	20.	42.
+				TIME	3.50	3.50
HYDROGRAPH AT	FD3	.01	1	FLOW	8.	15.
+				TIME	3.50	3.50
HYDROGRAPH AT	NX3	.00	1	FLOW	5.	9.
+				TIME	3.50	3.50
HYDROGRAPH AT	NX4	.00	1	FLOW	4.	7.
+				TIME	3.50	3.50
HYDROGRAPH AT	SMK	.00	1	FLOW	5.	9.
+				TIME	3.50	3.50
4 COMBINED AT	CPX1	.02	1	FLOW	21.	40.
+				TIME	3.50	3.50
HYDROGRAPH AT	FD1	.01	1	FLOW	9.	18.
+				TIME	3.50	3.50

From Fig. F-15 in Appendix 'C'

$$+ CLV MPu(0/432) = \frac{Q_{10}}{21} \quad \frac{Q_{100}}{472}$$

						X
HYDROGRAPH AT						
+	NX7	.00	1	FLOW	2.	3.
				TIME	3.50	3.50
3 COMBINED AT						
+	CPX2	.03	1	FLOW	32.	61.
				TIME	3.50	3.50
+ CLV MPU(0/432) =						
					<u>Q10</u>	<u>Q100</u>
					32	493
HYDROGRAPH AT						
+	NX5	.01	1	FLOW	7.	14.
				TIME	3.50	3.50
HYDROGRAPH AT						
+	NX6	.00	1	FLOW	3.	7.
				TIME	3.50	3.50

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

DEVELOPED CONDITIONS

HYDROLOGY

PROJECT NUMBER:

BRINLEY MIDDLE SCHOOL REPLACEMENT

CB

221095

DATE: May 10, 2023[illegible]

$$t_i = 1.8 (1.1 - K) L^{0.5} / S^{1/3}$$

$$K = 0.0132 \text{ CN} - 0.39$$

$$t = L / (60 \text{ V})$$

$$t_C = t_i + t_t$$

$$t_L = t_{LAG} = 0.6 \text{ tc}$$

LOCATION: Onsite & Offsite

HYDROLOGIC CONDITION:

TRIAL: Final Iteration

Curve Number Calculations

BRINLEY MIDDLE SCHOOL REPLACEMENT

Sub-Basin: ND1

Total Area: 4.47 Acres

Land Use/Cover type	Area [A] (acres)	Soil Type	Percentage, P [P]	Curve Number [CN]	Product {CN x P}
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)	0.64	D	14%	98	14.0
Open Space: Poor Condition	3.20	D	72%	89	63.7
Natural desert landscaping (pervious areas only)	0.63	D	14%	88	12.4
Total:	4.47	-	100%	-	90.1

Curve Number Calculations

BRINLEY MIDDLE SCHOOL REPLACEMENT

Sub-Basin: N12

Total Area: 0.24 Acres

Land Use/Cover type	Area [A] (acres)	Soil Type	Percentage, P [P]	Curve Number [CN]	Product {CN x P}
Natural desert landscaping (pervious areas only)	0.24	D	100%	88	88.0
Total:	0.24	-	100%	-	88.0

Curve Number Calculations

BRINLEY MIDDLE SCHOOL REPLACEMENT

Sub-Basin: ND3
Total Area: 0.94 Acres

Land Use/Cover type	Area [A] (acres)	Soil Type	Percentage, P [P]	Curve Number [CN]	Product {CN x P}
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)	0.94	D	100%	98	98.0
Total:	0.94	-	100%	-	98.0

Curve Number Calculations

BRINLEY MIDDLE SCHOOL REPLACEMENT

Sub-Basin: ND4
Total Area: 1.63 Acres

Land Use/Cover type	Area [A] (acres)	Soil Type	Percentage, P [P]	Curve Number [CN]	Product {CN x P}
Natural desert landscaping (pervious areas only)	0.22	D	13%	88	11.9
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)	1.41	D	87%	98	84.8
Total:	1.63	-	100%	-	96.7

Curve Number Calculations
BRINLEY MIDDLE SCHOOL REPLACEMENT

Sub-Basin: ND5
Total Area: 4.49 Acres

Land Use/Cover type	Area [A] (acres)	Soil Type	Percentage, P [P]	Curve Number [CN]	Product {CN x P}
Natural desert landscaping (pervious areas only)	0.96	D	21%	88	18.8
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)	3.54	D	79%	98	77.3
Total:	4.50	-	100%	-	96.1

Curve Number Calculations
BRINLEY MIDDLE SCHOOL REPLACEMENT

Sub-Basin: ND6
Total Area: 2.59 Acres

Land Use/Cover type	Area [A] (acres)	Soil Type	Percentage, P [P]	Curve Number [CN]	Product {CN x P}
Natural desert landscaping (pervious areas only)	0.23	D	9%	88	7.8
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)	2.36	D	91%	98	89.3
Total:	2.59	-	100%	-	97.1

BRINLEY MIDDLE SCHOOL REPLACEMENT

Sub-Basin: ND7
Total Area: 2.97 Acres

Land Use/Cover type	Area [A] (acres)	Soil Type	Percentage, P [P]	Curve Number [CN]	Product {CN x P}
Natural desert landscaping (pervious areas only)	0.53	D	18%	88	15.7
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)	2.44	D	82%	98	80.5
Total:	2.97	-	100%	-	96.2

BRINLEY MIDDLE SCHOOL REPLACEMENT

Sub-Basin: NI8
Total Area: 0.27 Acres

Land Use/Cover type	Area [A] (acres)	Soil Type	Percentage, P [P]	Curve Number [CN]	Product {CN x P}
Natural desert landscaping (pervious areas only)	0.27	D	100%	88	88.0
Total:	0.27	-	100%	-	88.0

Curve Number Calculations
BRINLEY MIDDLE SCHOOL REPLACEMENT

Sub-Basin: N19
Total Area: 0.59 Acres

Land Use/Cover type	Area [A] (acres)	Soil Type	Percentage, P [P]	Curve Number [CN]	Product {CN x P}
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)	0.24	D	41%	98	39.9
Open Space: Poor Condition	0.35	D	59%	89	52.8

Total: 0.59 - 100% - 92.7

AVERAGE VELOCITY

Input Variables	Basin ND1	Basin NI2	Basin ND3	Basin ND4	Basin ND5	Basin ND6	Basin ND7	Basin NI8	Basin NI9								
Bottom Width, B, (ft):	3.0	3.0	3.0	3.0	2.0	2.0	2.0	3.0	3.0								
Right Side Slope, Zr:	100	100	100	100	50	50	50	100	100								
Left Side Slope, Zl:	100	100	100	100	0	0	0	100	100								
Manning's n:	0.025	0.025	0.016	0.016	0.016	0.016	0.016	0.025	0.020								
Geometric Slope, So (ft/ft):	0.014	0.005	0.014	0.014	0.014	0.014	0.005	0.016	0.020								
Flowrate, Q (cfs) *:	6	0.5	1.5	3	7.5	4.5	5	0.5	1								

Output Variables

Normal Depth, Yn (ft):	0.18	0.08	0.09	0.12	0.27	0.22	0.29	0.06	0.07								
Area of Flow, A, (sf):	3.96	0.91	1.00	1.69	2.40	1.64	2.60	0.59	0.77								
Velocity, V (fps):	1.51	0.55	1.49	1.78	3.13	2.75	1.92	0.85	1.31								
Wetted Perimeter, p (ft):	39.93	19.29	20.26	26.15	15.89	13.18	16.55	15.61	17.76								
Hydraulic Radius, Rh (ft):	0.10	0.05	0.05	0.06	0.15	0.12	0.16	0.04	0.04								
Free Surface Top Width, T (ft):	39.93	19.29	20.26	26.15	15.62	12.96	16.26	15.61	17.76								
Centroid, Y*, (ft):	0.07	0.03	0.03	0.04	0.10	0.08	0.11	0.02	0.03								

* NOTE : HALF OF THE 100-YEAR STORM RUNOFF FLOWS IS USED TO DETERMINE THE BASIN TRAVEL VELOCITY REQUIRED FOR THE LAG TIME CALCULATIONS

HEC-1 MODEL OUTPUT

(DEVELOPED CONDITIONS)

Peak Flow Summary
Developed Condition

HEC-1 ID	Area (acres)	10-year Flow (cfs)	100-year Flow (cfs)	
ND1	4.47	5	12	
NI2	0.24	<1	1	
FD2	15.19	20	42	
CPD1	-	20	42	(NI2 + FD2)
ND3	0.94	2	3	
ND6	2.59	5	9	
CPD2	-	7	13	(ND3 + ND6)
NI8	0.27	<1	1	
FD3	4.31	8	15	
NI9	0.59	1	2	
SMK	2.74	5	9	
*CLV MPU	-	0	432	
CPD3	-	14	459	(NI8 + FD3 + NI9 + SMK + REF. FLOW)
ND4	1.63	3	6	
ND5	4.49	8	15	
CPD4	-	11	21	(ND4 + ND5)
FD1	5.99	9	18	
ND7	2.97	6	10	
CPD5	-	39	507	(CPD3 + CPD4 + FD1 + ND7 + REF. FLOW)

*CLV MPU FIGURE F-15 (APPENDIX C)

1*****
 * FLOOD HYDROGRAPH PACKAGE (HEC-1) *
 * JUN 1998 *
 * VERSION 4.1 *
 * RUN DATE 08MAY23 TIME 10:53:46 *

D

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

```

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

```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.
 THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
 THE DEFINITION OF -AMSK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
 NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
 DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
 KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1 HEC-1 INPUT PAGE 1

```

LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
1         ID
2         ID ***** TECHNICAL DRAINAGE STUDY FOR BRINLEY MIDDLE SCHOOL REPLACEME
3         ID INTERIM / DEVELOPED CONDITION - ONSITE AND OFFSITE
4         ID USING SCS METHODS AND KINEMATIC WAVE ROUTING
5         ID MASTER PLAN ADJUSTED 6-HOUR RAINFALL AND STORM DISTRIBUTION
6         ID
7         ID LOCHSA JOB # 221095
8         ID
9         ID
10        ID INPUT FILE NAME: D.DAT
11        ID
12        ID APRIL 2023
13        ID
14        ID *****
15        ID *****
16        ID MCCARRAN AIRPORT RAINFALL AREA
17        ID 10 & 100 YEAR - 6 HOUR STORM EVENT
18        ID PRECIPITATION:
19        ID 10-YEAR : 1.58 INCHES
20        ID 100-YEAR : 2.77 INCHES
21        ID 10-YEAR/100-YEAR : 1.58/2.77= 0.5704
22        ID *****
23        ID *****
24        ID *DIAGRAM
25        IT 5
26        IO 5 0
27        IN 5
28        JR PREC .5704 1.0
29
30        KK ND1
31        KM THE BASIN IS A DEVELOPED ONSITE BASIN ON NORTH PORTION OF PARCEL,
32        KM DISCHARGING EAST TO ADJACENT EXISTING BASEBALL FIELD
33        PB 2.770
34        PC 0.0 .02 .057 .07 .087 .108 .124 .13 .13
35        PC .13 .13 .13 .133 .14 .142 .148 .158 .172 .181
36        PC .19 .197 .199 .2 .201 .204 .214 .229 .241 .249
37        PC .251 .256 .27 .278 .281 .283 .295 .322 .352 .409
38        PC .499 .59 .71 .744 .781 .812 .819 .835 .851 .856
39        PC .86 .868 .876 .888 .91 .926 .937 .95 .97 .976
40        PC .982 .985 .987 .989 .99 .993 .993 .994 .995 .998
41        PC .998 .999 1.0
42        BA .00698
43        LS 0 90.1
44        UD .072
45        *
46
47        KK NI2
48        KM DEVELOPED LANDSCAPING AREA ALONG MAVERICK; DISCHARGES WEST TO MAVERICK
49        BA .00038
50        LS 0 88.0
51        UD 0.056
52        *

```

1 HEC-1 INPUT PAGE 2

```

LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
48        KK FD2
49        KM EXISTING BASIN WEST OF SITE (RESIDENCES), DISCHARGES NORTH ALONG MAVERICK
50        BA .02373
51        LS 0 93.0
52        UD 0.099
53        *
54
55        KK CPD1
56        KM COMBINE NI2 & FD2 IN MAVERICK; DISCHARGES NORTH ALONG MAVERICK
57        HC 2
58
59        KK ND3
60        KM DEVELOPED BASIN OF ATHLETIC COURTS; DRAINING EAST
61        BA .00147
62        LS 0 98.0
63        UD 0.061

```

D

```

*
61      KK      ND6
62      KM      DEVELOPED BASIN OF DRIVE ISLE AND BLDG.; DRAINING EAST
63      BA      .00405
64      LS      0      97.1
65      UD      0.050
        *

66      KK      CPD2
67      KM      COMBINE ND3 & ND6; DISCHARGES EAST
68      HC      2
        *

69      KK      NI8
70      KM      DEVELOPED LANDSCAPING AREA ALONG MAVERICK; DISCHARGES WEST TO MAVERICK
71      BA      .00042
72      LS      0      88.0
73      UD      0.050
        *

74      KK      FD3
75      KM      EXISTING BASIN WEST OF SITE (RESIDENCES), DISCHARGES SOUTH ALONG MAVERICK
76      BA      .00673
77      LS      0      94.7
78      UD      0.050
        *

79      KK      NI9
80      KM      EXISTING DEVELOPED SITE; DISCHARGES SOUTH TO SMOKE RANCH RD.
81      BA      .00092
82      LS      0      92.7
83      UD      0.050
        *

```

HEC-1 INPUT

PAGE 3

```

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

84      KK      SMK
85      KM      EXIST. STREET BASIN SOUTH OF SITE AND RESIDENCES; DISCHARGES EAST
86      BA      .00428
87      LS      0      96.5
88      UD      0.068
        *

89      KK      CPD3
90      KM      COMBINE REF. CLV MPU FLOW (0/432CFS), NI8, FD3, NI9 AND SMK; DISCHARGES EAST
91      HC      4
        *

92      KK      ND4
93      KM      CENTRAL PORTION OF SITE CONSISTS OF ATHLETIC COURTS, DISCHARGING EAST TO PARK
94      BA      .00255
95      LS      0      96.7
96      UD      0.056
        *

97      KK      ND5
98      KM      CENTRAL PORTION OF SITE, DISCHARGING SOUTH TO SMOKE RANCH
99      BA      .00702
100     LS      0      96.1
101     UD      0.067
        *

102     KK      CPD4
103     KM      COMBINE ND4 AND ND5; DISCHARGES SOUTH THROUGH CENTRAL DRIVEWAY
104     HC      2
        *

105     KK      FD1
106     KM      OFFSITE BASIN SOUTH OF SITE; DRAINING NORTH TO SMOKE RANCH RD.
107     BA      .00936
108     LS      0      94.8
109     UD      0.097
        *

110     KK      ND7
111     KM      SOUTHEAST PORTION OF SITE, DISCHARGING SOUTH TO SMOKE RANCH
112     BA      .00464
113     LS      0      96.2
114     UD      0.050
        *

115     KK      CPD5
116     KM      COMBINE CPD3, CPD4, FD1 AND ND7 IN SMOKE RANCH; DISCHARGING EAST ALONG SMOKE
117     HC      4
        *

118     ZZ

```

SCHEMATIC DIAGRAM OF STREAM NETWORK

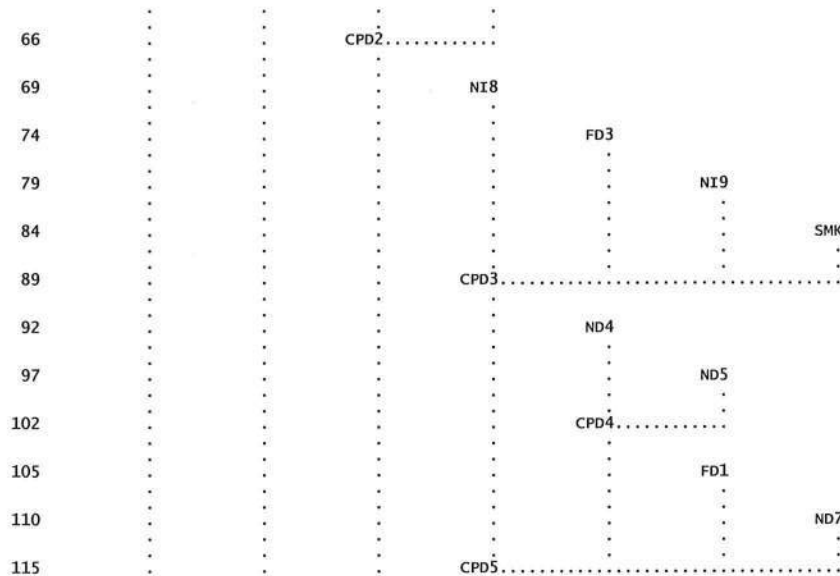
```

1
INPUT
LINE      (V) ROUTING      (--->) DIVERSION OR PUMP FLOW
NO.      (.) CONNECTOR      (<---) RETURN OF DIVERTED OR PUMPED FLOW

28      ND1
        .
43      .      NI2
        .
48      .      .      FD2
        .      .
53      .      CPD1.....
        .
56      .      .      ND3
        .      .
61      .      .      ND6

```

D



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION
 1 *****
 * FLOOD HYDROGRAPH PACKAGE (HEC-1) *
 * JUN 1998 *
 * VERSION 4.1 *
 * RUN DATE 08MAY23 TIME 10:53:46 *
 * *****

 * U.S. ARMY CORPS OF ENGINEERS *
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 * (916) 756-1104 *
 * *****

***** TECHNICAL DRAINAGE STUDY FOR BRINLEY MIDDLE SCHOOL REPLACEMENT
 INTERIM / DEVELOPED CONDITION - ONSITE AND OFFSITE
 USING SCS METHODS AND KINEMATIC WAVE ROUTING
 MASTER PLAN ADJUSTED 6-HOUR RAINFALL AND STORM DISTRIBUTION
 LOCHSA JOB # 221095

INPUT FILE NAME: D.DAT
 APRIL 2023

 MCCARRAN AIRPORT RAINFALL AREA
 10 & 100 YEAR - 6 HOUR STORM EVENT
 PRECIPITATION:
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 100-YEAR : 2.77 INCHES
 10-YEAR/100-YEAR : 1.58/2.77 = 0.5704

25 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 200 NUMBER OF HYDROGRAPH ORDINATES
 NDDATE 1 0 ENDING DATE
 NDTIME 1635 ENDING TIME
 ICENT 19 CENTURY MARK

COMPUTATION INTERVAL .08 HOURS
 TOTAL TIME BASE 16.58 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
 .57 1.00

1

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
 FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
 Page 3

D
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION	
					RATIO 1 .57	RATIO 2 1.00
HYDROGRAPH AT						
+	ND1	.01	1	FLOW TIME	5. 3.50	12. 3.50
HYDROGRAPH AT						
+	NI2	.00	1	FLOW TIME	0. 3.50	1. 3.50
HYDROGRAPH AT						
+	FD2	.02	1	FLOW TIME	20. 3.50	42. 3.50
2 COMBINED AT						
+	CPD1	.02	1	FLOW TIME	20. 3.50	42. 3.50
HYDROGRAPH AT						
+	ND3	.00	1	FLOW TIME	2. 3.50	3. 3.50
HYDROGRAPH AT						
+	ND6	.00	1	FLOW TIME	5. 3.50	9. 3.50
2 COMBINED AT						
+	CPD2	.01	1	FLOW TIME	7. 3.50	13. 3.50
HYDROGRAPH AT						
+	NI8	.00	1	FLOW TIME	0. 3.50	1. 3.50
HYDROGRAPH AT						
+	FD3	.01	1	FLOW TIME	8. 3.50	15. 3.50
HYDROGRAPH AT						
+	NI9	.00	1	FLOW TIME	1. 3.50	2. 3.50
HYDROGRAPH AT						
+	SMK	.00	1	FLOW TIME	5. 3.50	9. 3.50
4 COMBINED AT						
+	CPD3	.01	1	FLOW TIME	14. 3.50	27. 3.50
HYDROGRAPH AT						
+	ND4	.00	1	FLOW TIME	3. 3.50	6. 3.50
HYDROGRAPH AT						
+	ND5	.01	1	FLOW TIME	8. 3.50	15. 3.50
2 COMBINED AT						
+	CPD4	.01	1	FLOW TIME	11. 3.50	21. 3.50
HYDROGRAPH AT						
+	FD1	.01	1	FLOW TIME	9. 3.50	18. 3.50
HYDROGRAPH AT						
+	ND7	.00	1	FLOW TIME	6. 3.50	10. 3.50
4 COMBINED AT						
+	CPD5	.04	1	FLOW TIME	39. 3.50	75. 3.50

$$+ \text{CLV MPu (0/432)} = \frac{Q_{10}}{14} \quad \frac{Q_{100}}{459}$$

$$+ \text{CLV MPu (0/432)} = \frac{Q_{10}}{39} \quad \frac{Q_{100}}{507}$$

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

APPENDIX B

HYDRAULIC ANALYSIS

NORMAL DEPTH STREET HYDRAULIC SECTIONS

(EXISTING CONDITIONS – 10YR/100YR STORM)

Street Flow Summary
(Existing Condition)

10-year, 6-hour Storm

Street	Right of Way Width (ft)	Hydraulic Cross-Section Identifier	10-Year Flow [Q10] (cfs)	10-Year Velocity [v] (fps)	10-Year Flow Depth [d] (ft)	10-Year Velocity x Depth [v x d]	Dry Lane Width (within 1/2 ROW) (ft)
Smoke Ranch Road	100	1	21	3.79	0.63	2.39	Meets
Smoke Ranch Road	100	2	32	3.63	0.61	2.21	Meets
Maverick Street	60	3	20	2.71	0.57	1.54	N/A
Maverick Street	60	4	13	1.63	0.73	1.19	N/A

Street Flow Summary
(Existing Condition)

100-year, 6-hour Storm

Street	Right of Way Width (ft)	Hydraulic Cross-Section Identifier	100-Year Flow [Q100] (cfs)	100-Year Velocity [v] (fps)	100-Year Flow Depth [d] (ft)	100-Year Velocity x Depth [v x d]
Smoke Ranch Road	100	1	472	8.02	1.41	11.31
Smoke Ranch Road	100	2	493	7.91	1.25	9.89
Maverick Street	60	3	42	3.49	0.66	2.30
Maverick Street	60	4	24	1.87	0.85	1.59

Street Section 1 - Existing Condition - Smoke Ranch Road - 10year Worksheet for Irregular Channel

Project Description	
Worksheet	Street Section 1 - Existing Condition - Smoke Ranch Road - 10-year
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Slope	0.014000 ft/ft
Discharge	21.00 cfs ← CPX1 Flow

Options	
Current Roughness Method	oved Lotter's Method
Open Channel Weighting	oved Lotter's Method
Closed Channel Weighting	Horton's Method

Results	
Mannings Coefficient	0.015
Water Surface Elev.	72.96 ft
Elevation Range	72.33 to 73.66
Flow Area	5.5 ft²
Wetted Perimeter	30.04 ft
Top Width	29.18 ft
Actual Depth	0.63 ft ← d10
Critical Elevation	73.03 ft
Critical Slope	0.005671 ft/ft
Velocity	3.79 ft/s ← v10
Velocity Head	0.22 ft
Specific Energy	73.18 ft
Froude Number	1.53
Flow Type	Supercritical

$$d \times v$$

$$.63 \times 3.79 = 2.39 < 6 \text{ OK}$$

Calculation Messages:
Water elevation exceeds lowest end station by 0.2695254e-1 ft.
Flow is divided.

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+00.00	0+07.00	0.013
0+07.00	0+93.00	0.016
0+93.00	1+00.00	0.013

Natural Channel Points	
Station (ft)	Elevation (ft)
0+00.00	72.93
0+05.00	72.83
0+05.50	72.83
0+05.50	72.33
0+07.00	72.46
0+07.00	72.50
0+50.00	73.66

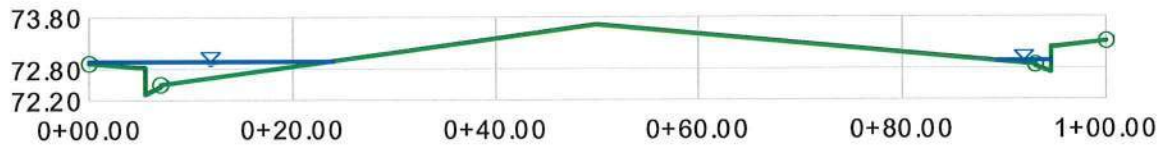
**Street Section 1 - Existing Condition - Smoke Ranch Road - 10year
Worksheet for Irregular Channel**

Natural Channel Points	
Station (ft)	Elevation (ft)
0+93.00	72.89
0+93.00	72.85
0+94.50	72.72
0+94.50	73.22
0+95.00	73.22
1+00.00	73.32

Street Section 1 - Existing Condition - Smoke Ranch Road - 10year **Cross Section for Irregular Channel**

Project Description	
Worksheet	Street Section 1 - Existing Condition - Smoke Ranch
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data	
Mannings Coefficient	0.015
Slope	0.014000 ft/ft
Water Surface Elev.	72.96 ft
Elevation Range	72.33 to 73.66
Discharge	21.00 cfs



V:5.0
H:1
NTS

Street Section 1 - Existing Condition - Smoke Ranch Road - 100year Worksheet for Irregular Channel

Project Description	
Worksheet	Street Section 1 - Existing Condition - Smoke Ranch Road - 100 year
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Slope	0.014000 ft/ft
Discharge	472.00 cfs ← CPXI flow

Options	
Current Roughness Method	oved Lotter's Method
Open Channel Weighting	oved Lotter's Method
Closed Channel Weighting	Horton's Method

Results	
Mannings Coefficient	0.015
Water Surface Elev.	73.74 ft
Elevation Range	72.33 to 73.66
Flow Area	58.8 ft²
Wetted Perimeter	102.34 ft
Top Width	100.00 ft
Actual Depth	1.41 ft ← d ₁₀₀
Critical Elevation	74.03 ft
Critical Slope	0.003623 ft/ft
Velocity	8.02 ft/s ← v ₁₀₀
Velocity Head	1.00 ft
Specific Energy	74.74 ft
Froude Number	1.84
Flow Type	Supercritical

$$dx \downarrow$$

$$1.41 \times 8.02 = 11.31$$

Calculation Messages:
Water elevation exceeds lowest end station by 0.80648859 ft.

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+00.00	0+07.00	0.013
0+07.00	0+93.00	0.016
0+93.00	1+00.00	0.013

Natural Channel Points	
Station (ft)	Elevation (ft)
0+00.00	72.93
0+05.00	72.83
0+05.50	72.83
0+05.50	72.33
0+07.00	72.46
0+07.00	72.50
0+50.00	73.66
0+93.00	72.89

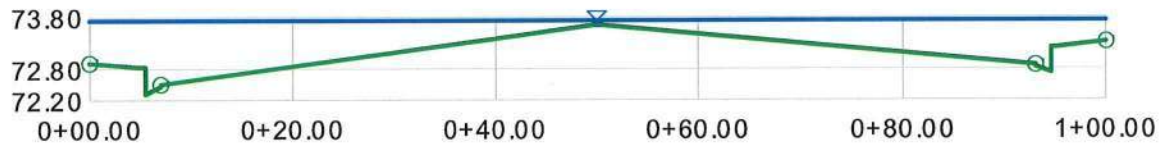
**Street Section 1 - Existing Condition - Smoke Ranch Road - 100year
Worksheet for Irregular Channel**

Natural Channel Points	
Station (ft)	Elevation (ft)
0+93.00	72.85
0+94.50	72.72
0+94.50	73.22
0+95.00	73.22
1+00.00	73.32

Street Section 1 - Existing Condition - Smoke Ranch Road - 100year Cross Section for Irregular Channel

Project Description	
Worksheet	Street Section 1 - Existing Condition - Smoke Ranch F
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data	
Mannings Coefficient	0.015
Slope	0.014000 ft/ft
Water Surface Elev.	73.74 ft
Elevation Range	72.33 to 73.66
Discharge	472.00 cfs



V:5.0
H:1
NTS

Street Section 2 - Existing Condition - Smoke Ranch Road - 10year Worksheet for Irregular Channel

Project Description	
Worksheet	Street Section 2 - Existing Condition - Smoke Ranch Road - 10 year
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Slope	0.013000 ft/ft
Discharge	32.00 cfs ← CPX2 flow

Options	
Current Roughness Method	aved Lotter's Method
Open Channel Weighting	aved Lotter's Method
Closed Channel Weighting	Horton's Method

Results	
Mannings Coefficient	0.015
Water Surface Elev.	66.42 ft
Elevation Range	66.81 to 66.86
Flow Area	8.8 ft²
Wetted Perimeter	47.79 ft
Top Width	46.72 ft
Actual Depth	0.61 ft ← d10
Critical Elevation	66.48 ft
Critical Slope	0.005691 ft/ft
Velocity	3.63 ft/s ← v10
Velocity Head	0.20 ft
Specific Energy	66.62 ft
Froude Number	1.47
Flow Type	Supercritical

$d \times v$
 $0.61 \times 3.63 = 2.21 < 6 \text{ ok}$

Calculation Messages:
Water elevation exceeds lowest end station by 0.66656786e-2 ft.
Flow is divided.

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+00.00	0+07.00	0.013
0+07.00	0+93.00	0.016
0+93.00	1+00.00	0.013

Natural Channel Points	
Station (ft)	Elevation (ft)
0+00.00	66.41
0+05.00	66.31
0+05.50	66.31
0+05.50	65.81
0+07.00	65.94
0+07.00	65.98
0+50.00	66.86

**Street Section 2 - Existing Condition - Smoke Ranch Road - 10year
Worksheet for Irregular Channel**

Natural Channel Points	
Station (ft)	Elevation (ft)
0+93.00	66.13
0+93.00	66.09
0+94.50	65.96
0+94.50	66.46
0+95.00	66.46
1+00.00	66.56

Street Section 2 - Existing Condition - Smoke Ranch Road - 10year Cross Section for Irregular Channel

Project Description	
Worksheet	Street Section 2 - Existing Condition - Smoke Ranch
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data	
Mannings Coefficient	0.015
Slope	0.013000 ft/ft
Water Surface Elev.	66.42 ft
Elevation Range	65.81 to 66.86
Discharge	32.00 cfs



V:5.0
H:1
NTS

Street Section 2 - Existing Condition - Smoke Ranch Road - 100year Worksheet for Irregular Channel

Project Description	
Worksheet	Street Section 2 - Existing Condition - Smoke Ranch Road - 100 year
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Slope	0.013000 ft/ft
Discharge	493.00 cfs ← CP x 2 flows

Options	
Current Roughness Method	oved Lotter's Method
Open Channel Weighting	oved Lotter's Method
Closed Channel Weighting	Horton's Method

Results	
Mannings Coefficient	0.015
Water Surface Elev.	67.06 ft
Elevation Range	66.81 to 66.86
Flow Area	62.3 ft²
Wetted Perimeter	102.26 ft
Top Width	100.00 ft
Actual Depth	1.25 ft ← d100
Critical Elevation	67.35 ft
Critical Slope	0.003692 ft/ft
Velocity	7.91 ft/s ← v100
Velocity Head	0.97 ft
Specific Energy	68.04 ft
Froude Number	1.77
Flow Type	Supercritical

$$d \times v$$

$$1.25 \times 7.91 = 9.89$$

Calculation Messages:
Water elevation exceeds lowest end station by 0.65217645 ft.

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+00.00	0+07.00	0.013
0+07.00	0+93.00	0.016
0+93.00	1+00.00	0.013

Natural Channel Points	
Station (ft)	Elevation (ft)
0+00.00	66.41
0+05.00	66.31
0+05.50	66.31
0+05.50	65.81
0+07.00	65.94
0+07.00	65.98
0+50.00	66.86
0+93.00	66.13

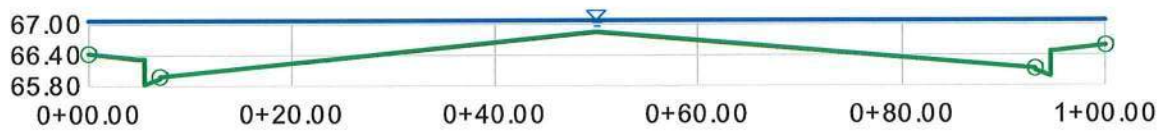
**Street Section 2 - Existing Condition - Smoke Ranch Road - 100year
Worksheet for Irregular Channel**

Natural Channel Points	
Station (ft)	Elevation (ft)
0+93.00	66.09
0+94.50	65.96
0+94.50	66.46
0+95.00	66.46
1+00.00	66.56

Street Section 2 - Existing Condition - Smoke Ranch Road - 100year Cross Section for Irregular Channel

Project Description	
Worksheet	Street Section 2 - Existing Condition - Smoke Ranch F
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data	
Mannings Coefficient	0.015
Slope	0.013000 ft/ft
Water Surface Elev.	67.06 ft
Elevation Range	65.81 to 66.86
Discharge	493.00 cfs



V:5.0
H:1
NTS

Street Section 3 - Existing Condition - Maverick Street - 10year **Worksheet for Irregular Channel**

Project Description	
Worksheet	Street Section 3 - Existing Condition - Maverick Street - 10yr
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Slope	0.010000 ft/ft
Discharge	20.00 cfs - F02 flow

Options	
Current Roughness Method	over Lotter's Method
Open Channel Weighting	over Lotter's Method
Closed Channel Weighting	Horton's Method

Results	
Mannings Coefficient	0.015
Water Surface Elev.	81.27 ft
Elevation Range	81.70 to 81.54
Flow Area	7.4 ft ²
Wetted Perimeter	50.57 ft
Top Width	49.65 ft
Actual Depth	0.57 ft - d10
Critical Elevation	81.30 ft
Critical Slope	0.006362 ft/ft
Velocity	2.71 ft/s - v10
Velocity Head	0.11 ft
Specific Energy	81.39 ft
Froude Number	1.24
Flow Type	Supercritical

$$dx \cdot v$$

$$.57 \times 2.71 = 1.54 < 6 \text{ ok}$$

Calculation Messages:
Flow is divided.

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+00.00	0+07.00	0.013
0+07.00	0+53.00	0.016
0+53.00	0+60.00	0.013

Natural Channel Points	
Station (ft)	Elevation (ft)
0+00.00	81.54
0+05.00	81.44
0+05.50	81.44
0+05.50	80.94
0+07.00	81.07
0+07.00	81.11
0+30.00	81.29
0+53.00	80.87

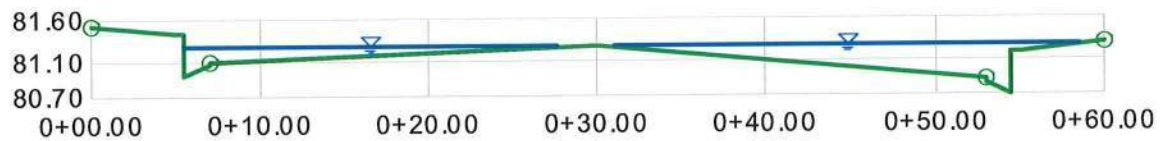
**Street Section 3 - Existing Condition - Maverick Street - 10year
Worksheet for Irregular Channel**

Natural Channel Points	
Station (ft)	Elevation (ft)
0+53.00	80.83
0+54.50	80.70
0+54.50	81.20
0+55.00	81.20
0+60.00	81.30

Street Section 3 - Existing Condition - Maverick Street - 10year Cross Section for Irregular Channel

Project Description	
Worksheet	Street Section 3 - Existing Condition - Maverick Street
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data	
Mannings Coefficient	0.015
Slope	0.010000 ft/ft
Water Surface Elev.	81.27 ft
Elevation Range	80.70 to 81.54
Discharge	20.00 cfs



V:5.0
H:1
NTS

Street Section 3 - Existing Condition - Maverick Street - 100year **Worksheet for Irregular Channel**

Project Description	
Worksheet	Street Section 3 - Existing Condition - Maverick Street +100yr
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Slope	0.010000 ft/ft
Discharge	42.00 cfs - F02 flow

Options	
Current Roughness Method	over Lotter's Method
Open Channel Weighting	over Lotter's Method
Closed Channel Weighting	Horton's Method

Results	
Mannings Coefficient	0.015
Water Surface Elev.	81.36 ft
Elevation Range	81.70 to 81.54
Flow Area	12.0 ft ²
Wetted Perimeter	55.57 ft
Top Width	54.50 ft
Actual Depth	0.66 ft ← d₁₀₀
Critical Elevation	81.40 ft
Critical Slope	0.005521 ft/ft
Velocity	3.49 ft/s ← v₁₀₀
Velocity Head	0.19 ft
Specific Energy	81.55 ft
Froude Number	1.31
Flow Type	Supercritical

d x v
.66 x 3.49 = 2.30 < 8 ok

Calculation Messages:
 Water elevation exceeds lowest end station by 0.05761100 ft.

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+00.00	0+07.00	0.013
0+07.00	0+53.00	0.016
0+53.00	0+60.00	0.013

Natural Channel Points	
Station (ft)	Elevation (ft)
0+00.00	81.54
0+05.00	81.44
0+05.50	81.44
0+05.50	80.94
0+07.00	81.07
0+07.00	81.11
0+30.00	81.29
0+53.00	80.87

**Street Section 3 - Existing Condition - Maverick Street - 100year
Worksheet for Irregular Channel**

Natural Channel Points	
Station (ft)	Elevation (ft)
0+53.00	80.83
0+54.50	80.70
0+54.50	81.20
0+55.00	81.20
0+60.00	81.30

Street Section 3 - Existing Condition - Maverick Street - 100year Cross Section for Irregular Channel

Project Description	
Worksheet	Street Section 3 - Existing Condition - Maverick Street
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data	
Mannings Coefficient	0.015
Slope	0.010000 ft/ft
Water Surface Elev.	81.36 ft
Elevation Range	80.70 to 81.54
Discharge	42.00 cfs



V:5.0
H:1
NTS

Street Section 4 - Existing Condition - Maverick Street - 10year **Worksheet for Irregular Channel**

Project Description	
Worksheet	Street Section 4 - Existing Condition - Maverick Street - 10year
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Slope	0.002000 ft/ft
Discharge	13.00 cfs ← $P03 + NX3$

Options	
Current Roughness Method	over Lotter's Method
Open Channel Weighting	over Lotter's Method
Closed Channel Weighting	Horton's Method

Results	
Mannings Coefficient	0.015
Water Surface Elev.	80.51 ft
Elevation Range	79.78 to 80.80
Flow Area	8.0 ft ²
Wetted Perimeter	36.44 ft
Top Width	35.38 ft
Actual Depth	0.73 ft ← d_{10}
Critical Elevation	80.43 ft
Critical Slope	0.005705 ft/ft
Velocity	1.63 ft/s ← V_{10}
Velocity Head	0.04 ft
Specific Energy	80.56 ft
Froude Number	0.61
Flow Type	Subcritical

$d \times V$
 $0.73 \times 1.63 = 1.19 < 6 \text{ ok}$

Calculation Messages:
 Water elevation exceeds lowest end station by 0.1347548 ft.
 Flow is divided.

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+00.00	0+07.00	0.013
0+07.00	0+53.00	0.016
0+53.00	0+60.00	0.013

Natural Channel Points	
Station (ft)	Elevation (ft)
0+00.00	80.80
0+05.00	80.70
0+05.50	80.70
0+05.50	80.20
0+07.00	80.33
0+07.00	80.37
0+30.00	80.71

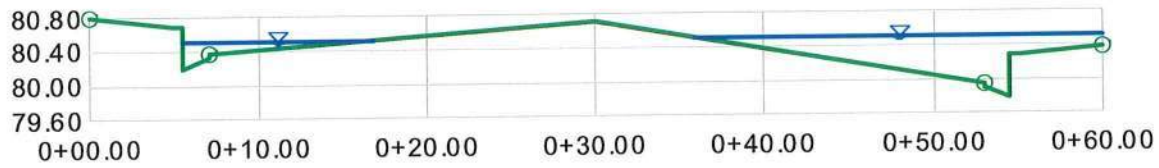
**Street Section 4 - Existing Condition - Maverick Street - 10year
Worksheet for Irregular Channel**

Natural Channel Points	
Station (ft)	Elevation (ft)
0+53.00	79.95
0+53.00	79.91
0+54.50	79.78
0+54.50	80.28
0+55.00	80.28
0+60.00	80.38

Street Section 4 - Existing Condition - Maverick Street - 10year Cross Section for Irregular Channel

Project Description	
Worksheet	Street Section 4 - Existing Condition - Maverick Street
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data	
Mannings Coefficient	0.015
Slope	0.002000 ft/ft
Water Surface Elev.	80.51 ft
Elevation Range	79.78 to 80.80
Discharge	13.00 cfs



V:5.0
H:1
NTS

Street Section 4 - Existing Condition - Maverick Street - 100year **Worksheet for Irregular Channel**

Project Description	
Worksheet	Street Section 4 - Existing Condition - Maverick Street - 100year
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Slope	.002000 ft/ft
Discharge	24.00 cfs ← F03 + NX3

Options	
Current Roughness Method	oved Lotter's Method
Open Channel Weighting	oved Lotter's Method
Closed Channel Weighting	Horton's Method

Results	
Mannings Coefficient	0.015
Water Surface Elev.	80.63 ft
Elevation Range	78.78 to 80.80
Flow Area	12.8 ft²
Wetted Perimeter	48.25 ft
Top Width	46.96 ft
Actual Depth	0.85 ft ← d100
Critical Elevation	80.54 ft
Critical Slope	0.005296 ft/ft
Velocity	1.87 ft/s ← V100
Velocity Head	0.05 ft
Specific Energy	80.69 ft
Froude Number	0.63
Flow Type	Subcritical

$d \times v$

$$0.85 \times 1.87 = 1.59 < 2 \text{ OK}$$

Calculation Messages:
 Water elevation exceeds lowest end station by 0.25294388 ft.
 Flow is divided.

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+00.00	0+07.00	0.013
0+07.00	0+53.00	0.016
0+53.00	0+60.00	0.013

Natural Channel Points	
Station (ft)	Elevation (ft)
0+00.00	80.80
0+05.00	80.70
0+05.50	80.70
0+05.50	80.20
0+07.00	80.33
0+07.00	80.37
0+30.00	80.71

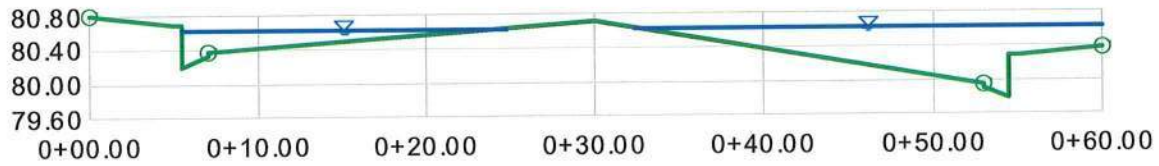
**Street Section 4 - Existing Condition - Maverick Street - 100year
Worksheet for Irregular Channel**

Natural Channel Points	
Station (ft)	Elevation (ft)
0+53.00	79.95
0+53.00	79.91
0+54.50	79.78
0+54.50	80.28
0+55.00	80.28
0+60.00	80.38

Street Section 4 - Existing Condition - Maverick Street - 100year Cross Section for Irregular Channel

Project Description	
Worksheet	Street Section 4 - Existing Condition - Maverick Stree
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data	
Mannings Coefficient	0.015
Slope	0.002000 ft/ft
Water Surface Elev.	80.63 ft
Elevation Range	79.78 to 80.80
Discharge	24.00 cfs



V:5.0
H:1
NTS

NORMAL DEPTH STREET HYDRAULIC SECTIONS

(DEVELOPED CONDITIONS – 10YR/100YR STORM)

Street Flow Summary
(Developed Condition)

10-year, 6-hour Storm

Street	Right of Way Width (ft)	Hydraulic Cross-Section Identifier	10-Year Flow [Q10] (cfs)	10-Year Velocity [v] (fps)	10-Year Flow Depth [d] (ft)	10-Year Velocity x Depth [v x d]	Dry Lane Width (within 1/2 ROW) (ft)
Smoke Ranch Road	100	5	14	3.70	0.56	2.07	Meets
Smoke Ranch Road	100	6	39	3.82	0.64	2.44	Meets
Maverick Street	60	7	20	2.71	0.57	1.54	N/A
Maverick Street	60	8	9	1.51	0.67	1.01	N/A

Street Flow Summary
(Developed Condition)

100-year, 6-hour Storm

Street	Right of Way Width (ft)	Hydraulic Cross-Section Identifier	100-Year Flow [Q100] (cfs)	100-Year Velocity [v] (fps)	100-Year Flow Depth [d] (ft)	100-Year Velocity x Depth [v x d]
Smoke Ranch Road	100	5	459	7.94	1.40	11.12
Smoke Ranch Road	100	6	507	8.00	1.26	10.08
Maverick Street	60	7	42	3.49	0.66	2.30
Maverick Street	60	8	16	1.71	0.77	1.32

Street Section 5 - Developed Condition - Smoke Ranch Road - 10year **Worksheet for Irregular Channel**

Project Description	
Worksheet	Street Section 5 - Developed Condition - Smoke Ranch Road - 10 year
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Slope	0.014000 ft/ft
Discharge	14.00 cfs ← CPD3 flow

Options

Current Roughness Method	Overlotter's Method
Open Channel Weighting Method	Overlotter's Method
Closed Channel Weighting Method	Horton's Method

Results

Mannings Coefficient	0.015
Water Surface Elev.	72.89 ft
Elevation Range	72.33 to 73.66
Flow Area	3.8 ft ²
Wetted Perimeter	21.50 ft
Top Width	20.74 ft
Actual Depth	0.56 ft ← d10
Critical Elevation	72.96 ft
Critical Slope	0.005871 ft/ft
Velocity	3.70 ft/s ← v10
Velocity Head	0.21 ft
Specific Energy	73.10 ft
Froude Number	1.53
Flow Type	Supercritical

dxv

$$0.56 \times 3.70 = 2.07 \text{ L6 OK}$$

Calculation Messages:
Flow is divided.

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+00.00	0+07.00	0.013
0+07.00	0+93.00	0.016
0+93.00	1+00.00	0.013

Natural Channel Points

Station (ft)	Elevation (ft)
0+00.00	72.93
0+05.00	72.83
0+05.50	72.83
0+05.50	72.33
0+07.00	72.46
0+07.00	72.50
0+50.00	73.66
0+93.00	72.89

**Street Section 5 - Developed Condition - Smoke Ranch Road - 10year
Worksheet for Irregular Channel**

Natural Channel Points	
Station (ft)	Elevation (ft)
0+93.00	72.85
0+94.50	72.72
0+94.50	73.22
0+95.00	73.22
1+00.00	73.32

Street Section 5 - Developed Condition - Smoke Ranch Road - 10year **Cross Section for Irregular Channel**

Project Description	
Worksheet	Street Section 5 - Developed Condition - Smoke Ranch
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data	
Mannings Coefficient	0.015
Slope	0.014000 ft/ft
Water Surface Elev.	72.89 ft
Elevation Range	72.33 to 73.66
Discharge	14.00 cfs



V:5.0
H:1
NTS

Street Section 5 - Developed Condition - Smoke Ranch Road - 100year Worksheet for Irregular Channel

Project Description	
Worksheet	Street Section 5 - Developed Condition - Smoke Ranch Road - 100 year
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Slope	0.014000 ft/ft
Discharge	459.00 cfs ← CPO3 flow

Options	
Current Roughness Method	over Lotter's Method
Open Channel Weighting	over Lotter's Method
Closed Channel Weighting	Horton's Method

Results	
Mannings Coefficient	0.015
Water Surface Elev.	73.73 ft
Elevation Range	72.33 to 73.66
Flow Area	57.8 ft²
Wetted Perimeter	102.32 ft
Top Width	100.00 ft
Actual Depth	1.40 ft ← d ₁₀₀
Critical Elevation	74.02 ft
Critical Slope	0.003638 ft/ft
Velocity	7.94 ft/s ← v ₁₀₀
Velocity Head	0.98 ft
Specific Energy	74.71 ft
Froude Number	1.84
Flow Type	Supercritical

d x v

$$1.40 \times 7.94 = 11.12$$

Calculation Messages:
Water elevation exceeds lowest end station by 0.79640285 ft.

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+00.00	0+07.00	0.013
0+07.00	0+93.00	0.016
0+93.00	1+00.00	0.013

Natural Channel Points	
Station (ft)	Elevation (ft)
0+00.00	72.93
0+05.00	72.83
0+05.50	72.83
0+05.50	72.33
0+07.00	72.46
0+07.00	72.50
0+50.00	73.66
0+93.00	72.89

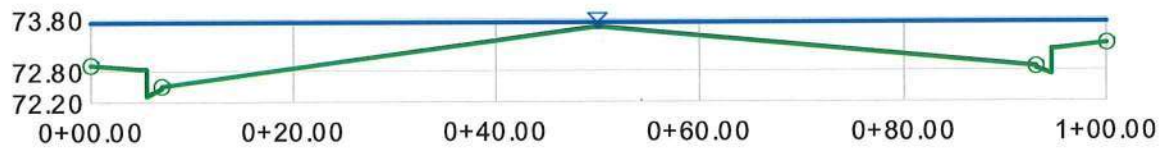
**Street Section 5 - Developed Condition - Smoke Ranch Road - 100year
Worksheet for Irregular Channel**

Natural Channel Points	
Station (ft)	Elevation (ft)
0+93.00	72.85
0+94.50	72.72
0+94.50	73.22
0+95.00	73.22
1+00.00	73.32

Street Section 5 - Developed Condition - Smoke Ranch Road - 100year Cross Section for Irregular Channel

Project Description	
Worksheet	Street Section 5 - Developed Condition - Smoke Ranch
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data	
Mannings Coefficient	0.015
Slope	0.014000 ft/ft
Water Surface Elev.	73.73 ft
Elevation Range	72.33 to 73.66
Discharge	459.00 cfs



V:5.0
H:1
NTS

Street Section 6 - Developed Condition - Smoke Ranch Road - 10year **Worksheet for Irregular Channel**

Project Description	
Worksheet	Street Section 6 - Developed Condition - Smoke Ranch Road - 10year
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Slope	0.013000 ft/ft
Discharge	39.00 cfs

Options	
Current Roughness Method	Overlotter's Method
Open Channel Weighting Method	Overlotter's Method
Closed Channel Weighting Method	Horton's Method

Results	
Mannings Coefficient	0.015
Water Surface Elev.	66.45 ft
Elevation Range	66.81 to 66.86
Flow Area	10.2 ft²
Wetted Perimeter	50.94 ft
Top Width	49.82 ft
Actual Depth	0.64 ft
Critical Elevation	66.52 ft
Critical Slope	0.005593 ft/ft
Velocity	3.82 ft/s
Velocity Head	0.23 ft
Specific Energy	66.67 ft
Froude Number	1.49
Flow Type	Supercritical

dxv
 $0.64 \times 3.82 = 2.44 < 6 \text{ OK}$

Calculation Messages:
 Water elevation exceeds lowest end station by 0.35373646e-1 ft.
 Flow is divided.

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+00.00	0+07.00	0.013
0+07.00	0+93.00	0.016
0+93.00	1+00.00	0.013

Natural Channel Points	
Station (ft)	Elevation (ft)
0+00.00	66.41
0+05.00	66.31
0+05.50	66.31
0+05.50	65.81
0+07.00	65.94
0+07.00	65.98
0+50.00	66.86

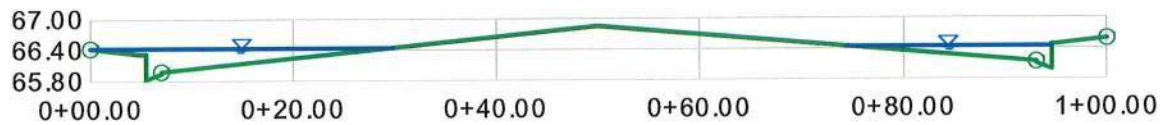
**Street Section 6 - Developed Condition - Smoke Ranch Road - 10year
Worksheet for Irregular Channel**

Natural Channel Points	
Station (ft)	Elevation (ft)
0+93.00	66.13
0+93.00	66.09
0+94.50	65.96
0+94.50	66.46
0+95.00	66.46
1+00.00	66.56

Street Section 6 - Developed Condition - Smoke Ranch Road - 10year Cross Section for Irregular Channel

Project Description	
Worksheet	Street Section 6 - Developed Condition - Smoke Ranc
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data	
Mannings Coefficient	0.015
Slope	0.013000 ft/ft
Water Surface Elev.	66.45 ft
Elevation Range	65.81 to 66.86
Discharge	39.00 cfs



V:5.0
H:1
NTS

Street Section 6 - Developed Condition - Smoke Ranch Road - 100year Worksheet for Irregular Channel

Project Description	
Worksheet	Street Section 6 - Developed Condition - Smoke Ranch Road - 100 year
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Slope	0.013000 ft/ft
Discharge	507.00 cfs ← CPD5 flow

Options	
Current Roughness Method	over Lotter's Method
Open Channel Weighting	over Lotter's Method
Closed Channel Weighting	Horton's Method

Results	
Mannings Coefficient	0.015
Water Surface Elev.	67.07 ft
Elevation Range	66.81 to 66.86
Flow Area	63.4 ft²
Wetted Perimeter	102.28 ft
Top Width	100.00 ft
Actual Depth	1.26 ft ← d100
Critical Elevation	67.37 ft
Critical Slope	0.003672 ft/ft
Velocity	8.00 ft/s ← v100
Velocity Head	1.00 ft
Specific Energy	68.07 ft
Froude Number	1.77
Flow Type	Supercritical

dx ✓

$$1.26 \times 8.00 = 10.08$$

Calculation Messages:
Water elevation exceeds lowest end station by 0.66287852 ft.

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+00.00	0+07.00	0.013
0+07.00	0+93.00	0.016
0+93.00	1+00.00	0.013

Natural Channel Points	
Station (ft)	Elevation (ft)
0+00.00	66.41
0+05.00	66.31
0+05.50	66.31
0+05.50	65.81
0+07.00	65.94
0+07.00	65.98
0+50.00	66.86
0+93.00	66.13

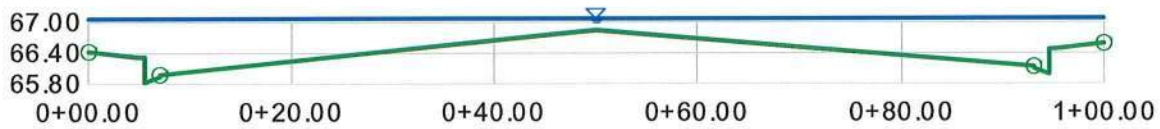
**Street Section 6 - Developed Condition - Smoke Ranch Road - 100year
Worksheet for Irregular Channel**

Natural Channel Points	
Station (ft)	Elevation (ft)
0+93.00	66.09
0+94.50	65.96
0+94.50	66.46
0+95.00	66.46
1+00.00	66.56

Street Section 6 - Developed Condition - Smoke Ranch Road - 100year Cross Section for Irregular Channel

Project Description	
Worksheet	Street Section 6 - Developed Condition - Smoke Ranch
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data	
Mannings Coefficient	0.015
Slope	0.013000 ft/ft
Water Surface Elev.	67.07 ft
Elevation Range	65.81 to 66.86
Discharge	507.00 cfs



V:5.0
H:1
NTS

Street Section 7 - Developed Condition - Maverick Street - 10year **Worksheet for Irregular Channel**

Project Description	
Worksheet	Street Section 7 - Developed Condition - Maverick Street - 10yr
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Slope	0.010000 ft/ft
Discharge	20.00 cfs - CPO1 flow

Options	
Current Roughness Method	oved Lotter's Method
Open Channel Weighting Method	oved Lotter's Method
Closed Channel Weighting Method	Horton's Method

Results	
Mannings Coefficient	0.015
Water Surface Elev.	81.27 ft
Elevation Range	81.70 to 81.54
Flow Area	7.4 ft ²
Wetted Perimeter	50.57 ft
Top Width	49.65 ft
Actual Depth	0.57 ft - d ₁₀
Critical Elevation	81.30 ft
Critical Slope	0.006362 ft/ft
Velocity	2.71 ft/s - v ₁₀
Velocity Head	0.11 ft
Specific Energy	81.39 ft
Froude Number	1.24
Flow Type	Supercritical

dxv
 $.57 \times 2.71 = 1.54 < 6 \text{ ok}$

Calculation Messages:
 Flow is divided.

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+00.00	0+07.00	0.013
0+07.00	0+53.00	0.016
0+53.00	0+60.00	0.013

Natural Channel Points	
Station (ft)	Elevation (ft)
0+00.00	81.54
0+05.00	81.44
0+05.50	81.44
0+05.50	80.94
0+07.00	81.07
0+07.00	81.11
0+30.00	81.29
0+53.00	80.87

**Street Section 7 - Developed Condition - Maverick Street - 10year
Worksheet for Irregular Channel**

Natural Channel Points	
Station (ft)	Elevation (ft)
0+53.00	80.83
0+54.50	80.70
0+54.50	81.20
0+55.00	81.20
0+60.00	81.30

Street Section 7 - Developed Condition - Maverick Street - 10year Cross Section for Irregular Channel

Project Description	
Worksheet	Street Section 7 - Developed Condition - Maverick St
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data	
Mannings Coefficient	0.015
Slope	0.010000 ft/ft
Water Surface Elev.	81.27 ft
Elevation Range	80.70 to 81.54
Discharge	20.00 cfs



V:5.0
H:1
NTS

Street Section 7 - Developed Condition - Maverick Street - 100year Worksheet for Irregular Channel

Project Description	
Worksheet	Street Section 7 - Developed Condition - Maverick Street - 100yr
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Slope	0.010000 ft/ft
Discharge	42.00 cfs - CPO1 flow

Options	
Current Roughness Method	Overlotter's Method
Open Channel Weighting Method	Overlotter's Method
Closed Channel Weighting Method	Horton's Method

Results	
Mannings Coefficient	0.015
Water Surface Elev.	81.36 ft
Elevation Range	81.70 to 81.54
Flow Area	12.0 ft²
Wetted Perimeter	55.57 ft
Top Width	54.50 ft
Actual Depth	0.66 ft - d ₁₀₀
Critical Elevation	81.40 ft
Critical Slope	0.005521 ft/ft
Velocity	3.49 ft/s - V ₁₀₀
Velocity Head	0.19 ft
Specific Energy	81.55 ft
Froude Number	1.31
Flow Type	Supercritical

$$dx \cdot v = 0.66 \times 3.49 = 2.3028 \text{ s/k}$$

Calculation Messages:
Water elevation exceeds lowest end station by 0.05761100 ft.

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+00.00	0+07.00	0.013
0+07.00	0+53.00	0.016
0+53.00	0+60.00	0.013

Natural Channel Points	
Station (ft)	Elevation (ft)
0+00.00	81.54
0+05.00	81.44
0+05.50	81.44
0+05.50	80.94
0+07.00	81.07
0+07.00	81.11
0+30.00	81.29
0+53.00	80.87

**Street Section 7 - Developed Condition - Maverick Street - 100year
Worksheet for Irregular Channel**

Natural Channel Points	
Station (ft)	Elevation (ft)
0+53.00	80.83
0+54.50	80.70
0+54.50	81.20
0+55.00	81.20
0+60.00	81.30

Street Section 7 - Developed Condition - Maverick Street - 100year Cross Section for Irregular Channel

Project Description	
Worksheet	Street Section 7 - Developed Condition - Maverick Str
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data	
Mannings Coefficient	0.015
Slope	0.010000 ft/ft
Water Surface Elev.	81.36 ft
Elevation Range	80.70 to 81.54
Discharge	42.00 cfs



V:5.0
H:1
NTS

Street Section 8 - Developed Condition - Maverick Street - 10year **Worksheet for Irregular Channel**

Project Description	
Worksheet	Street Section 8 - Developed Condition - Maverick Street - 10 year
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Slope	0.002000 ft/ft
Discharge	9.00 cfs

Options	
Current Roughness Method	Overlotter's Method
Open Channel Weighting Method	Overlotter's Method
Closed Channel Weighting Method	Horton's Method

Results	
Mannings Coefficient	0.015
Water Surface Elev.	80.45 ft
Elevation Range	79.78 to 80.80
Flow Area	5.9 ft ²
Wetted Perimeter	30.23 ft
Top Width	29.30 ft
Actual Depth	0.67 ft
Critical Elevation	80.36 ft
Critical Slope	0.005934 ft/ft
Velocity	1.51 ft/s
Velocity Head	0.04 ft
Specific Energy	80.49 ft
Froude Number	0.59
Flow Type	Subcritical

Calculation Messages:
 Water elevation exceeds lowest end station by 0.72667837e-1 ft.
 Flow is divided.

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+00.00	0+07.00	0.013
0+07.00	0+53.00	0.016
0+53.00	0+60.00	0.013

Natural Channel Points	
Station (ft)	Elevation (ft)
0+00.00	80.80
0+05.00	80.70
0+05.50	80.70
0+05.50	80.20
0+07.00	80.33
0+07.00	80.37
0+30.00	80.71

$d \times v$

$$0.67 \times 1.51 = 1.01 < 6 \text{ OK}$$

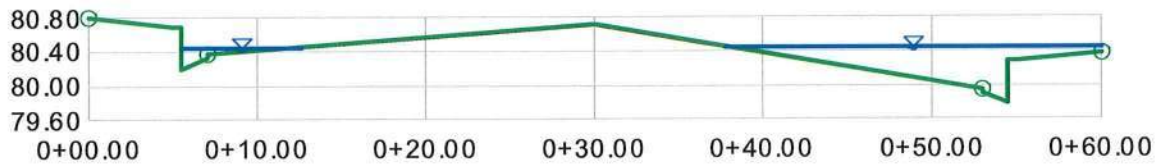
**Street Section 8 - Developed Condition - Maverick Street - 10year
Worksheet for Irregular Channel**

Natural Channel Points	
Station (ft)	Elevation (ft)
0+53.00	79.95
0+53.00	79.91
0+54.50	79.78
0+54.50	80.28
0+55.00	80.28
0+60.00	80.38

Street Section 8 - Developed Condition - Maverick Street - 10year Cross Section for Irregular Channel

Project Description	
Worksheet	Street Section 8 - Developed Condition - Maverick St
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data	
Mannings Coefficient	0.015
Slope	0.002000 ft/ft
Water Surface Elev.	80.45 ft
Elevation Range	79.78 to 80.80
Discharge	9.00 cfs



V:5.0
H:1
NTS

Street Section 8 - Developed Condition - Maverick Street - 100year **Worksheet for Irregular Channel**

Project Description	
Worksheet	Street Section 8 - Developed Condition - Maverick Street - 100 year
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Slope	0.002000 ft/ft
Discharge	16.00 cfs ← PD3 + N18

Options	
Current Roughness Method	Overlotter's Method
Open Channel Weighting	Overlotter's Method
Closed Channel Weighting	Horton's Method

Results	
Mannings Coefficient	0.015
Water Surface Elev.	80.55 ft
Elevation Range	79.78 to 80.80
Flow Area	9.4 ft ²
Wetted Perimeter	40.19 ft
Top Width	39.06 ft
Actual Depth	0.77 ft ← d100
Critical Elevation	80.46 ft
Critical Slope	0.005557 ft/ft
Velocity	1.71 ft/s ← v100
Velocity Head	0.05 ft
Specific Energy	80.60 ft
Froude Number	0.62
Flow Type	Subcritical

dxv
 $0.77 \times 1.71 = 1.32 \text{ LB OK}$

Calculation Messages:
 Water elevation exceeds lowest end station by 0.17235177 ft.
 Flow is divided.

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+00.00	0+07.00	0.013
0+07.00	0+53.00	0.016
0+53.00	0+60.00	0.013

Natural Channel Points	
Station (ft)	Elevation (ft)
0+00.00	80.80
0+05.00	80.70
0+05.50	80.70
0+05.50	80.20
0+07.00	80.33
0+07.00	80.37
0+30.00	80.71

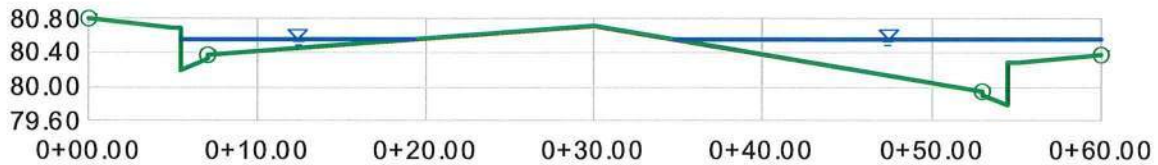
**Street Section 8 - Developed Condition - Maverick Street - 100year
Worksheet for Irregular Channel**

Natural Channel Points	
Station (ft)	Elevation (ft)
0+53.00	79.95
0+53.00	79.91
0+54.50	79.78
0+54.50	80.28
0+55.00	80.28
0+60.00	80.38

Street Section 8 - Developed Condition - Maverick Street - 100year **Cross Section for Irregular Channel**

Project Description	
Worksheet	Street Section 8 - Developed Condition - Maverick Str
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data	
Mannings Coefficient	0.015
Slope	0.002000 ft/ft
Water Surface Elev.	80.55 ft
Elevation Range	79.78 to 80.80
Discharge	16.00 cfs



V:5.0
H:1
NTS

On-Site Sections
(Developed Condition)

Hydraulic Cross-Section Identifier	100-Year Flow [Q100] (cfs)	100-Year Velocity [v] (fps)	100-Year Flow Depth [d] (ft)	100-Year [v] x [d]
A	6	2.51	0.59	1.48
B	16	2.28	0.35	0.80
C	2	2.14	0.41	0.88

Onsite Section A - Developed Condition - 100year Worksheet for Irregular Channel

Project Description	
Worksheet	Onsite Section A - Developed Condition <i>n=100 year</i>
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Slope	0.004000 ft/ft
Discharge	6.00 cfs <i>← 6 cfs (1/3 of ND6 + ND3 = 6 cfs)</i>

Options	
Current Roughness Method	Selected
Open Channel Weighting Method	Selected
Closed Channel Weighting Method	Horton's Method

Results	
Mannings Coefficient	0.014
Water Surface Elev.	72.06 ft
Elevation Range	71.47 to 73.36
Flow Area	2.4 ft²
Wetted Perimeter	10.07 ft
Top Width	9.43 ft
Actual Depth	0.59 ft <i>← d100</i>
Critical Elevation	72.03 ft
Critical Slope	0.005247 ft/ft
Velocity	2.51 ft/s <i>← v100</i>
Velocity Head	0.10 ft
Specific Energy	72.16 ft
Froude Number	0.88
Flow Type	Subcritical

d x v
 $0.59 \times 2.51 = 1.48 < 8 \text{ ok}$

Calculation Messages:
 Water elevation exceeds lowest end station by 0.88922483e-1 ft.

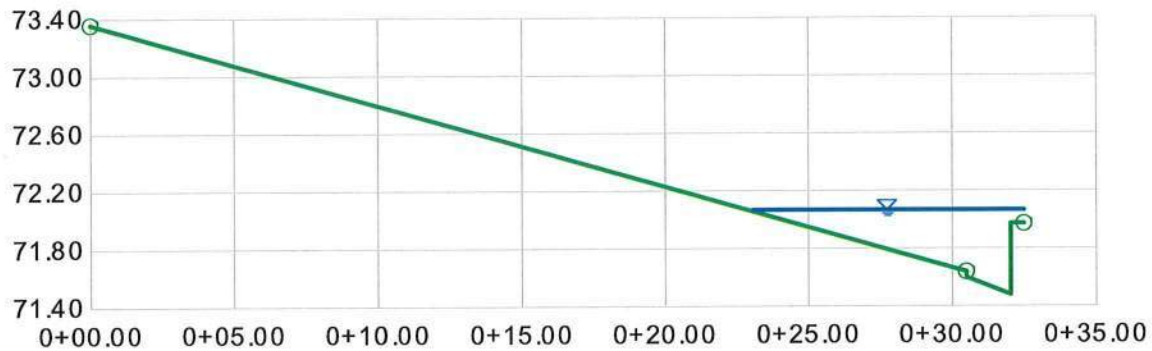
Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+00.00	0+30.50	0.016
0+30.50	0+32.50	0.013

Natural Channel Points	
Station (ft)	Elevation (ft)
0+00.00	73.36
0+30.50	71.64
0+30.50	71.60
0+32.00	71.47
0+32.00	71.97
0+32.50	71.97

Onsite Section A - Developed Condition - 100year Cross Section for Irregular Channel

Project Description	
Worksheet	Onsite Section A - Developed Condition
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data	
Mannings Coefficient	0.014
Slope	0.004000 ft/ft
Water Surface Elev.	72.06 ft
Elevation Range	.47 to 73.36
Discharge	6.00 cfs



V:5.0
H:1
NTS

Onsite Section B - Developed Condition - 100year Worksheet for Irregular Channel

Project Description	
Worksheet	Onsite Section B - Developed Condition <i>n=100 year</i>
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Slope	0.006000 ft/ft
Discharge	16.00 cfs <i>← N04 (6) + 2/3 of N05 = 16 cfs</i>

Options	
Current Roughness Method	Selected Lotter's Method
Open Channel Weighting	Selected Lotter's Method
Closed Channel Weighting	Horton's Method

Results	
Mannings Coefficient	0.016
Water Surface Elev.	72.03 ft
Elevation Range	.68 to 72.36
Flow Area	7.0 ft ²
Wetted Perimeter	40.06 ft
Top Width	39.50 ft
Actual Depth	0.35 ft <i>← d₁₀₀</i>
Critical Elevation	72.02 ft
Critical Slope	0.006706 ft/ft
Velocity	2.28 ft/s <i>← v₁₀₀</i>
Velocity Head	0.08 ft
Specific Energy	72.11 ft
Froude Number	0.95
Flow Type	Subcritical

d x v

0.35 x 2.28 = 0.80 < 8 OK

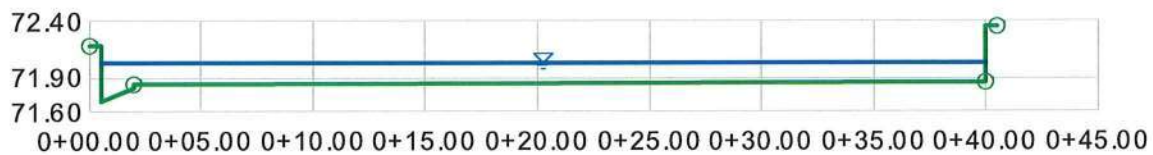
Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+00.00	0+02.00	0.013
0+02.00	0+40.00	0.016
0+40.00	0+40.50	0.013

Natural Channel Points	
Station (ft)	Elevation (ft)
0+00.00	72.18
0+00.50	72.18
0+00.50	71.68
0+02.00	71.81
0+02.00	71.85
0+40.00	71.86
0+40.00	72.36
0+40.50	72.36

Onsite Section B - Developed Condition - 100year Cross Section for Irregular Channel

Project Description	
Worksheet	Onsite Section B - Developed Condition
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data	
Mannings Coefficient	0.016
Slope	0.006000 ft/ft
Water Surface Elev.	72.03 ft
Elevation Range	.68 to 72.36
Discharge	16.00 cfs



V:5.0
H:1
NTS

Onsite Section C - Developed Condition - 100year Worksheet for Irregular Channel

Project Description	
Worksheet	Onsite Section C - Developed Condition - 100year
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Slope	0.005000 ft/ft
Discharge	2.00 cfs ← 1/5 of NO7

Options	
Current Roughness Method	over Lotter's Method
Open Channel Weighting	over Lotter's Method
Closed Channel Weighting	Horton's Method

Results	
Mannings Coefficient	0.015
Water Surface Elev.	68.63 ft
Elevation Range	68.22 to 70.63
Flow Area	0.9 ft ²
Wetted Perimeter	5.55 ft
Top Width	5.09 ft
Actual Depth	0.41 ft ← d ₁₀₀
Critical Elevation	68.61 ft
Critical Slope	0.006567 ft/ft
Velocity	2.14 ft/s ← v ₁₀₀
Velocity Head	0.07 ft
Specific Energy	68.70 ft
Froude Number	0.88
Flow Type	Subcritical

dx v

$$0.41 \times 2.14 = 0.88 < 8 \quad \underline{\text{OK}}$$

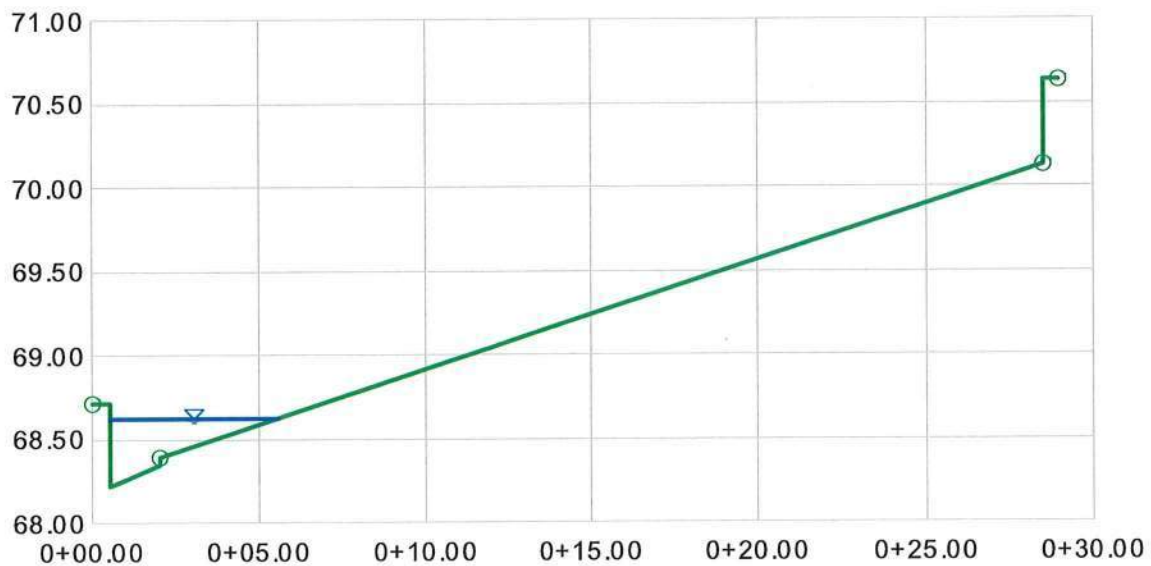
Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+00.00	0+02.00	0.013
0+02.00	0+28.50	0.016
0+28.50	0+29.00	0.013

Natural Channel Points	
Station (ft)	Elevation (ft)
0+00.00	68.72
0+00.50	68.72
0+00.50	68.22
0+02.00	68.35
0+02.00	68.39
0+28.50	70.13
0+28.50	70.63
0+29.00	70.63

Onsite Section C - Developed Condition - 100year Cross Section for Irregular Channel

Project Description	
Worksheet	Onsite Section C - Developed Condition
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data	
Mannings Coefficient	0.015
Slope	0.005000 ft/ft
Water Surface Elev.	68.63 ft
Elevation Range	68.22 to 70.63
Discharge	2.00 cfs



V:5.0
H:1
NTS

SECTION 1500 OF THE CCRFCD DRAINAGE DESIGN MANUAL
FOR THE BEST MANAGEMENT PRACTICES

Section 1500

Structural Best Management Practices

1501 INTRODUCTION

Presented in this section are design criteria for structural Best Management Practices (BMPs) for the control of surface water quality in Las Vegas Valley. These BMPs have been identified as having potential effectiveness in Las Vegas Valley based on the types of water quality conditions expected in this area, and on documented BMP performance in other areas. Criteria for the following BMPs are presented:

- Parking Lot Low Impact Development (LID)
- General Low Impact Development (LID)
 - Disconnected Impervious Areas
 - Landscape Swale
 - Depressed Medians
 - Depressed Landscaping
 - Buffer Strip
 - Pervious Overflow Parking
 - Sand / Media Filters
 - Oil / Water Separators
 - Oil / Grit Separators
 - On-Site Water Quality Basin
 - Infiltration Trench

There are currently no federal, state or local stormwater regulations which require the installation of specific water quality features in most new or existing developments in the Las Vegas Valley. The exception is new and redeveloped non-residential sites larger than 1.0 acre, for which low impact development (LID) measures are required by the Storm Water Management Plan. LID measures for sites smaller than 1 acre are encouraged for developers desiring to mitigate the impacts of urban development on surface water resources in the Las Vegas Valley.

There are three general categories of conditions for which urban stormwater quality management practices may be applied: (1) existing urban development; (2) new urban development and substantial redevelopment; and (3) construction activity. The BMPs in this section are primarily applicable to areas of new urban development, where land is available to devote to installations of this type and where design flexibility exists. In certain cases, these structural BMPs may be effective in retrofitting existing developed areas to control water quality problems. However, it is generally more cost-effective to rely on nonstructural BMPs (e.g., source controls, housekeeping practices, public education, and employee training) in these applications. BMPs related to construction activity are primarily directed toward erosion control. This issue

1502 Parking Lot LID Measures

1502.1 Description

Low impact development (LID) measures can be used for managing runoff from areas of new development and significant redevelopment (NDSR). LID measures must be applied to parking lots for all new non-residential sites of 1 acre and larger in the Las Vegas Valley. For the purpose of LID measures, a parking lot is defined as all of the impervious area outside the building footprint. Parking lot LID policies and design criteria are discussed in more detail in *Proposed Parking Lot Low Impact Development Program for Las Vegas Valley*, Las Vegas Valley Stormwater Quality Management Committee, February 2013.

1502.2 Design Criteria

Parking lot designs must be submitted to local entities with the technical drainage study required by Municipal code. A list of accepted parking lot BMPs that can be used in the Las Vegas Valley is provided in **Table 1501**.

BMP requirements shall adhere to this manual. A stepped approach to determine whether a parking lot is categorized as small, medium or large for the purpose of determining required BMPs is shown below. Any project site that is less than 1 acre in size is categorized as small; parking lot size is not a factor in determining required BMPs for small sites. For project sites that are greater than or equal to 1 acre, the parking lot size is used to determine if the category is medium or large. Sites having parking lots that are less than or equal to 1 acre are categorized as medium. Sites with parking lots greater than 1 acre are categorized as large.

Total Site Size	Parking Lot Size	Parking Lot Category
< 1 acre	Not Applicable	Small
≥ 1 acre	≤ 1 acre	Medium
≥ 1 acre	> 1 acre	Large

Once the parking lot category is determined, the BMP requirements for the parking lot design can be determined as shown in **Table 1502**. BMP requirements are more stringent as the parking lot size increases.

The designer may choose how to meet the parking lot BMP design requirements depending on specific site characteristics. In order to maximize the water quality benefit of the parking lot BMPs, the designer is encouraged to locate BMPs to capture runoff from portions of the site with the highest potential to generate pollutants.

There are no specific BMP requirements for small parking lots; however, the designer is encouraged to install any of the BMPs that are listed for parking lots in the medium or large categories.

For the Medium parking lot category, the design requirements consist of disconnecting impervious areas for at least 75 percent of the parking lot area from the onsite drainage network. This may be accomplished by directing runoff to pervious areas such as landscaping, depressed medians, parking strips, or stormwater retention basins. The design criteria are based on meeting the accepted minimum standards for the BMPs selected. The designer may choose to install a treatment BMP listed in the Large parking lot category.

For the Large parking lot category, treatment BMPs are required to treat stormwater runoff from at least 75 percent of the parking lot. Because typical site drainage layouts must account for application of flood control criteria, treatment BMPs may need to be sized to accommodate runoff from the contributing building area as well. BMPs are to be sized for the 85th percentile storm, and hydrologic and hydraulic calculations are required to be submitted for the BMP design.

The requirement to treat 75 percent of the parking lot area, either through disconnecting impervious areas or installing treatment devices, recognizes that grading and other site conditions will prevent directing all site runoff to some type of BMP. However, designers are encouraged to exceed the minimum standard when this can be done cost effectively in order to maximize the potential water quality benefits of the BMP system.

LID measures that are incorporated in the parking lot design should be planned during the site design process. Certain LID measures, including depressed medians, islands, and rock-lined swales, help to disconnect impervious areas and remove suspended particles in the stormwater runoff, prior to connection to the MS4. Parking Lot BMPs can be integrated into perimeter landscaped areas (e.g., buffers) and interior landscaped areas (e.g., medians) required by local development standards whenever possible. When incorporated into landscaping features, tributary areas to individual BMPs should be kept to less than 0.5 acres whenever possible, and should never exceed 1.0 acre.

Figure 1501 through Figure 1503, provide ideas on how parking lots can be designed to comply with the water quality regulations. The designer is required to comply with the planning code for the municipality in which the site is located. The conceptual layouts incorporate general planning requirements, however, specific planning requirements such as those for landscape buffers are determined based in part on the adjacent property. The conceptual layouts are designed to represent a commercial property that is approximately 5 acres in size, with the total parking lot area of approximately 3.3 acres.

Figure 1501, Conceptual Layout 1, represents a parking lot that can be designed so that the runoff can be directed towards the perimeter landscape buffer areas that incorporate a landscaped swale. These swales are designed as rock or xeriscaped swales to convey runoff to a low point, which discharges either directly to the MS4 or to a main drainage pipe and then into the MS4.

Figure 1502, Conceptual Layout 2, represents a parking lot that is not designed to direct all runoff towards swales installed in the perimeter landscape buffer areas. One example could be that the adjacent right-of-way at this area is higher in elevation than the onsite grade. In order to still use the landscape swale BMP, the Developer could use swales in depressed medians within the site, combined with perimeter swales where feasible.

Treatment control devices rather than BMP swales may be used, however, the amount of parking lot area required to be treated would need to be calculated. **Figure 1503**, Conceptual Layout 3, shows a conceptual level layout for this scenario, which relies on a combination of modular pavers, sand/oil separators, and underground detention to provide treatment for at least 75 percent of the parking lot area. To size the treatment control BMPs, the approaches described in section 1502.3 should be used. Note that for treatment devices, hydraulic sizing may need to account for the contribution of runoff from building areas draining through the parking lot.

1502.3 Water Quality Design Storm

This section describes the steps to be followed to determine the design hydrology for sizing parking lot BMPs in the Las Vegas Valley.

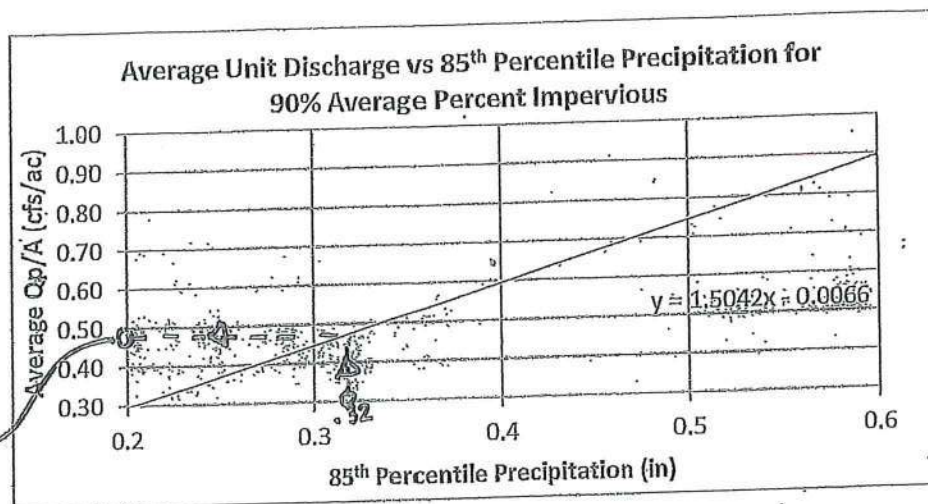
- 1. Determine BMP Design Precipitation - 85th Percentile Rainfall Depth.

D_{85}

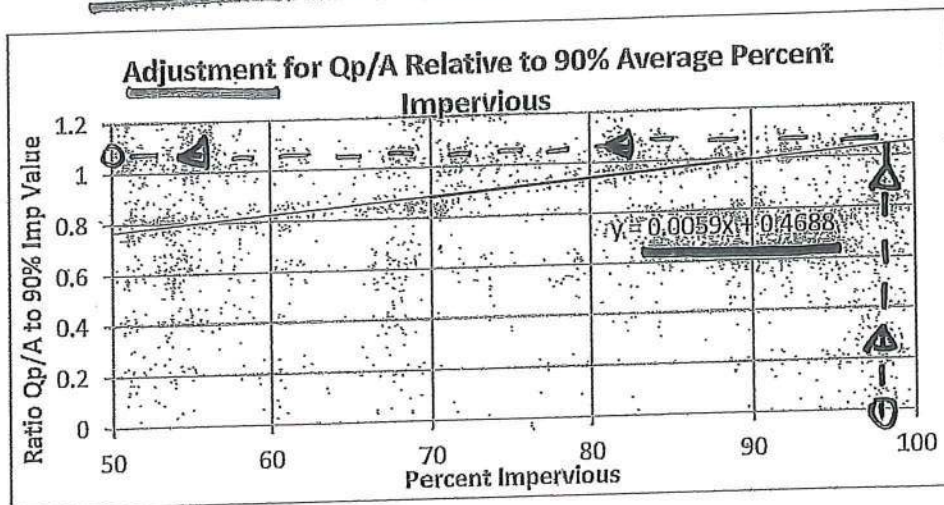
 - a. Locate site on CCRFCD Design Rainfall Map for 2-year, 6-hour storm
 - b. Determine the adjusted 2-year rainfall depth (D_2) for site, per CCRFCD methods
 - c. Compute ratio of D_2 site to D_2 for the McCarran Airport Area
 - d. Compute 85th percentile rainfall depth (D_{85}) as $0.32 \times D_2$ ratio (0.32 is D_{85} for McCarran Area)
- 2. Calculate BMP Design Peak Discharge

Q_p / area

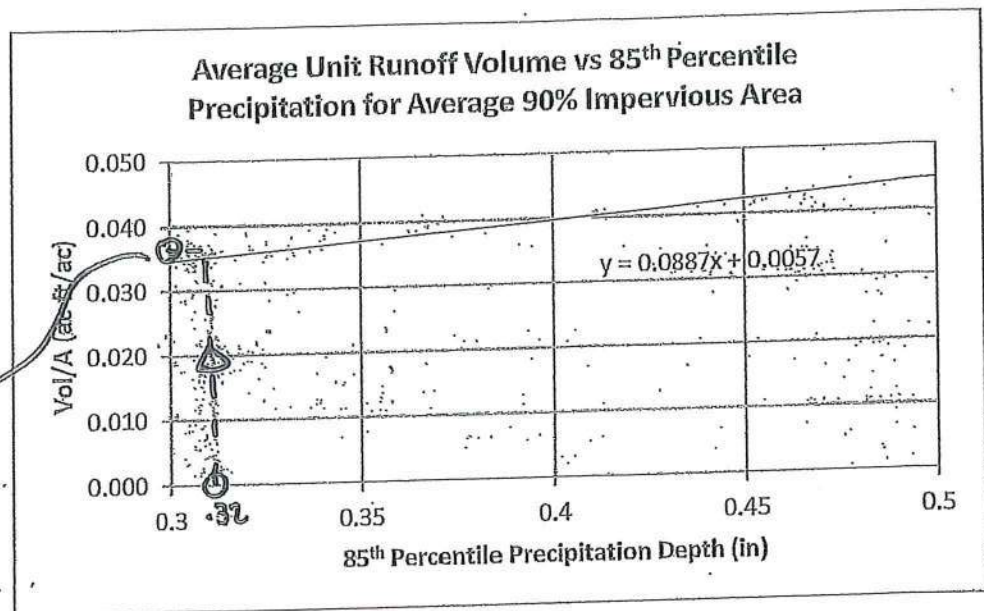
 - a. Use the following chart or regression equation to calculate the unit discharge (Q_p/A) for the 90 percent average percent impervious area condition based on the D_{85} value.



- b. Use the following chart or regression equation to calculate the unit discharge for the site based on the actual percent impervious area of the parking lot and associated landscaped areas.



- c. Calculate the peak design discharge in cfs as $Q_P = Q_P/A \times A$ where Q_P/A is from step (2b) and A is in acres.
3. Calculate BMP Design Runoff Volume
- a. Use the following chart or regression equation to calculate the unit runoff volume (Vol/A) for the 90 percent impervious condition based on the D_{85} value.



0.034

0.034
*
1.047

- Use the chart or regression equation in step (2b) to calculate the unit runoff volume for the site based on the actual average percent impervious area of the parking lot and associated landscaped areas.
- Calculate the design runoff volume in acre-feet as $Vol = Vol/A \times A$ where Vol/A is from step (3b) and A is in acres

Sample Calculation

Given: New Commercial Center in Summerlin area

Site Area = 100 acres

D₂ site / D₂ McCarran Area = 1.25

percent impervious area = 85% (parking lot and associated landscaped area)

- Determine BMP Design Precipitation - 85th Percentile Rainfall Depth (D₈₅)

$$D_{85} = 1.25 \times 0.32 = 0.40 \text{ inches}$$

- Calculate BMP Design Discharge

$$Q_P/A (90\%) = 1.5042 \times (0.40) + 0.0066 = 0.60$$

Find Adjustment factor for percent impervious

$$Q_P/A = 0.60 \times [(0.0059[85]) + 0.4688] = 0.58$$

$$Q_P = 0.58 \times 100 \text{ acres} = 58 \text{ cfs}$$

3. Calculate BMP Design Runoff Volume

$$\text{Vol/A (90\%)} = 0.0887 \times 0.40 + 0.0057 = 0.04$$

$$\text{Vol/A} = 0.04 \times (0.0059 \times [85] + 0.4688) = 0.04; \text{Vol} = 0.04 \times 100 \text{ acres} = 4.0 \text{ ac-ft.}$$

1503 LOW IMPACT DEVELOPMENT (LID)

1503.1 Description

LID measures can be used for managing runoff from areas of new development and significant redevelopment (NDSR). LIDs consist of a variety of site planning and site design measures or practices to minimize the impact of individual urban developments on stormwater quality and quantity. Developers proposing the use of measures that rely on infiltration to dispose of stormwater must perform studies to demonstrate that infiltration will be effective and will not adversely affect groundwater or downstream surface water quality. LID measures determined to be feasible for use in the Las Vegas Valley NDSR program can be found in **Table 1503**.

The BMPs presented in this section can be utilized for sites complying with the Parking Lot LID program or other site designs requiring BMPs. These BMPs are recommendations and the designer is not limited to the BMPs in this section. The designer is encouraged to contact the local entity when alternative BMPs are considered for use.

1503.2 Water Quality Benefits

Managing site runoff can significantly reduce the amount of pollutants conveyed to receiving waters. By incorporating the LID measures described below into site planning, runoff water quality can be improved by using simple technologies, employing basic practices, and educating those present on the site. Reducing pollutants in site runoff can reduce the need for downstream treatment to meet water quality goals.

1503.3 Disconnected Impervious Areas

1503.3.1 Description

This BMP consists of disconnecting impervious areas from downstream storm drainage infrastructure. Any surface in the landscape that cannot effectively absorb or infiltrate rainfall is an impervious area. This includes driveways, roads, parking lots, rooftops, and sidewalks. On natural landscapes, rainfall is absorbed into the soil and vegetation which naturally slows down, spreads out, and soaks up precipitation and runoff. A stable supply of groundwater is provided from water percolating into the soil, and the runoff is naturally filtered of impurities before it reaches creeks, streams, rivers, and bays.

The amount of impervious cover increases as areas become more developed. Natural filter systems are no longer in place to intercept the runoff which has serious implications for water quality and flood control. Typical pollutants in runoff from impervious areas include oil, litter, sediment, bacteria and in some cases, herbicides and pesticides.

1503.3.2 Water Quality Benefits

Concentrations and loads of the following pollutants are typically reduced by the LID BMP described in this section:

- Trace metals
- Hydrocarbons
- Litter

1503.3.3 Applications

This BMP applies to all urban areas. A beneficial way of mitigating stormwater runoff from impervious areas is to direct the runoff from parking lots and roads to pervious and vegetated soils.

1503.3.4 Limitations

Limitations may occur in areas with poor soils, where infiltration would not occur or could exacerbate groundwater quality problems. Limitations may also occur in ultra-urban areas where the site has no pervious area, including but not limited to high density areas.

1503.3.5 Design Criteria

Ways to mitigate the stormwater runoff by disconnecting impervious areas include:

- Breaking up flow directions from paved surfaces – Impervious surfaces are designed to allow stormwater to run off in a dispersed manner in several directions. The drainage off impervious surfaces is directed onto adjacent vegetated soil and not onto other pavements or into storm sewers.
- Minimize directly connected impervious areas - The impact of impervious surfaces is reduced by minimizing directly connected impervious areas, directing runoff from the impervious areas to pervious areas and/or small depressions, and in the process disconnecting hydrologic flow paths.
- Locating impervious surfaces to drain to natural systems - Existing zones of vegetation, from forested zones to scrub vegetation, are used

for management of stormwater runoff, often with some sort of landforming to achieve volume control. The scale of this technique can vary from microcontrol by redirecting sidewalk and driveway runoff to adjacent vegetation to conveyance of runoff from larger impervious surfaces to natural areas on the development site.

1503.3.6 Maintenance

Sweep impervious areas regularly to collect loose particles and litter. Wipe up spills with rags and other absorbent material immediately, but do not hose down the area to a storm drain. Pervious areas receiving runoff should be cleared regularly of litter and accumulated sediment.

→ 1503.4 Landscape Swale ←

1503.4.1 Description of Facility

The purpose of the swale is to settle out sediment, which has the potential to have urban pollutants bound to the particulate matter. The required length of the swale to settle out particulate pollutants is dependent on multiple factors, including velocity, characteristics of the stormwater, characteristics of the swale, and length of the swale. For the Parking Lot LID program, sizing of swales will be based on minimizing the slope of the swale to minimize the swale length and flow velocities. Xeriscaped or rock swales can be sized using the standard sizing requirements, as shown in Section 1503.4.5.

Runoff from any impervious areas on a developed site can be directed to swales, including parking lots, roof tops, parking covers, etc. The swales can be installed either within the parking lot area or at the perimeter of the site.

1503.4.2 Water Quality Benefits

Concentrations and loads of the following pollutants are typically reduced by the LID BMP described in this section:

- 
- Sediment
 - Total Phosphorus
 - Trace Metals
 - Hydrocarbons

Estimated pollutant removal efficiencies for vegetated landscape swales are given below. Pollutant removal efficiencies for rock lined or xeriscaped swales are expected to be lower.

<u>Pollutant</u>	<u>Removal Efficiency</u>
→ TSS	77%
Total Phosphorus	8%
Total Nitrogen	67%
Trace Metals	83-90%

Source: CASQA New Development and Redevelopment Handbook, 2003

1503.4.3 Applications

Landscape swales are typically located in parks, parkways, private landscaped areas, or in development buffers, and can also be used as pre-treatment devices for other structural treatment controls. They are primarily used as stormwater conveyance systems; however they are limited in their ability to mitigate large storms. Landscape swales are best utilized in low to moderate sloped areas as an alternative to ditches and curb and gutter drainage.

1503.4.4 Limitations

The effectiveness of landscape swales is decreased by compacted soils, frozen ground conditions, short grass heights, steep slopes, large storm events, high discharge rates, high velocities, and a short runoff contact time. Landscape swales also require a sufficient amount of available land area and they may not be appropriate for industrial sites or locations where spills may occur. In areas where burrowing animals are abundant, landscape swales may not perform effectively. Additionally, the infiltration rates of local soils can limit the application of landscape swales, unless underdrains are installed. Another possible issue is the formation of mosquito breeding habitat if water does not drain or infiltrate.

1503.4.5 Design Criteria

<u>Tributary Area (ac)</u>	<u>Swale Slope</u>	<u>Minimum Swale Length (ft)</u>	<u>Size of Swale</u>
≤ 0.5	≤ 1%	30	9" deep maximum, 6 ft wide at top average, 4ft wide at top minimum, 4:1 side slope
0.5 - 1.0	≤ 1%	40	9" deep maximum, 6 ft wide at top average, 4ft wide at top minimum, 4:1 side slope

Minimum criteria for sizing landscaped swales for parking lot BMPs using xeriscaped surface treatments are provided below. Sizing was based on minimizing flow velocities and maximizing flow paths to encourage settlement of sediment.

BMP swales should be as long as practically feasible to provide as much treatment as possible. The minimum length is 30 ft for tributary areas up to 0.5 acres, and 40 ft for tributary areas of up to 1.0 acre. When incorporating swales into landscaping features, tributary areas to individual BMPs should be kept to less than 0.5 acre whenever possible, and should never exceed 1.0 acre unless hydrologic and hydraulic calculations are provided. BMP swales should have a minimum average top width of 6 ft, with a minimum top width at any point of 4 ft and a maximum flow depth of 9 inches for water quality flows (approximately 2-yr storm). When combined with a larger flood control facility these dimensions should apply to the portion of the swale carrying low flows. When lined with rock, landscaped swale BMPs should have a minimum rock size of 3-inch D₅₀. When combined with a larger flood control facility, rock lining should be sized based on the anticipated flood velocities in the facility.

The Developer may propose to use an alternative size swale, if supporting calculations are submitted.

1503.4.6 Maintenance

Remove any sediment or debris build-up when the depths exceed 3 inches. Inspect for pools of standing water. At regular intervals, re-grade to restore design grade and re-vegetate.

Use of heavy equipment for mowing and removing plants/debris should be avoided to minimize soil compaction. Disturbed areas should be stabilized with seed and mulch, or rock lining, as necessary.

If a spill occurs and hazardous materials contaminate soils in the swales, the affected areas should be removed immediately and disposed of in a manner that complies with federal and state regulations. The swale soils and materials should be replaced as soon as possible.

1503.5 Depressed Median

1503.5.1 Description of Facility

Medians come in the depressed or raised form, or are made flush with the surface of the carriageways. Only the depressed medians are discussed in this section.

ACCEPTED PARKING LOT BMPs IN THE LAS VEGAS VALLEY

[illegible]

PARKING LOT BMP DESIGN REQUIREMENTS BY PARKING LOT CATEGORY

[illegible]

FEASIBLE LID MEASURES IN THE LAS VEGAS VALLEY NDSR PROGRAM

[illegible]

BMP SWALE CAPACITY

BMP Swale Capacity Worksheet for Triangular Channel

Project Description	
Worksheet	BMP Swale Capacity
Flow Element	Triangular Char
Method	Manning's Form
Solve For	Discharge

Input Data	
Mannings Coeff	0.033
Slope	.005000 ft/ft
Depth	0.75 ft
Left Side Slope	4.00 H : V
Right Side Slope	4.00 H : V

4" riprap (see Mannings calc.)

6' wide, 4:1 ss

Results	
Discharge	3.65 cfs
Flow Area	2.2 ft ²
Wetted Perim	6.18 ft
Top Width	6.00 ft
Critical Depth	0.55 ft
Critical Slope	0.025361 ft/ft
Velocity	1.62 ft/s
Velocity Head	0.04 ft
Specific Energ	0.79 ft
Froude Numb	0.47
Flow Type	Subcritical

Capacity

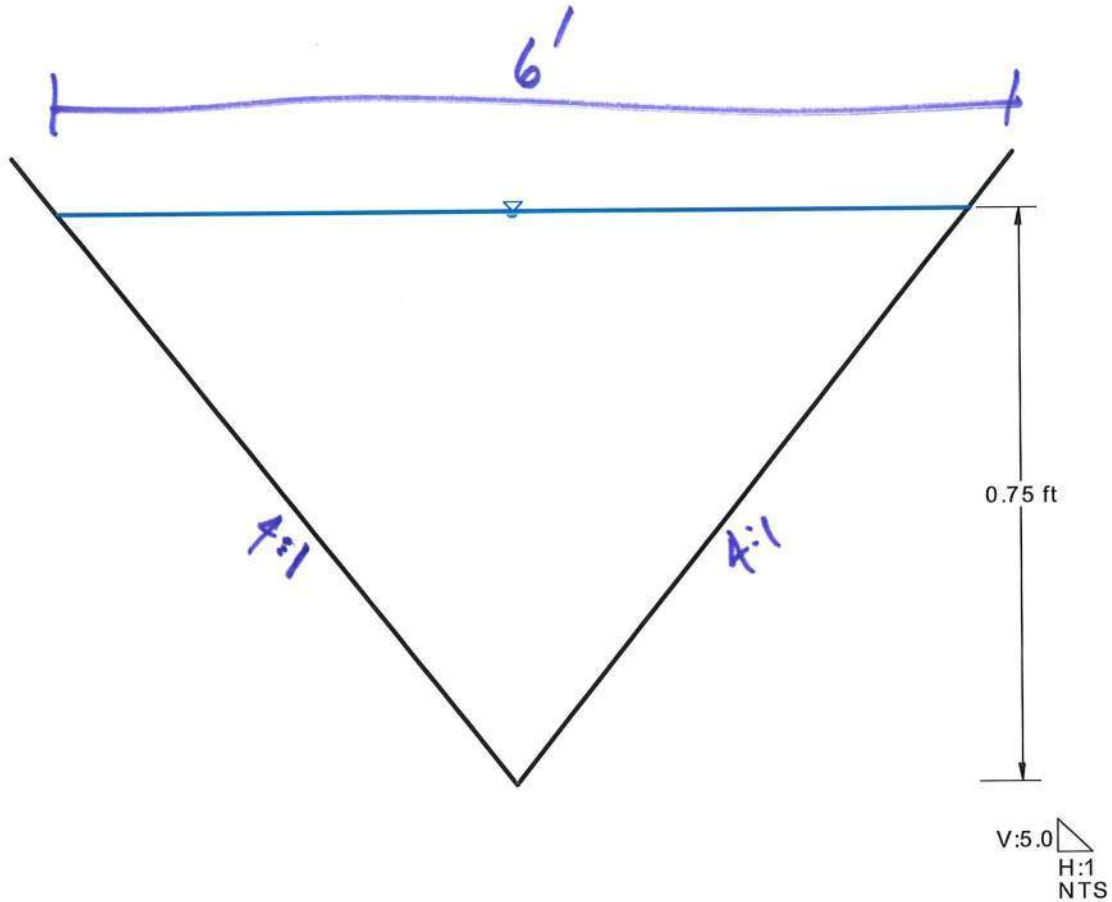
NON-EROSIVE

BMP Swale Capacity

Cross Section for Triangular Channel

Project Description	
Worksheet	BMP Swale Ca
Flow Element	Triangular Char
Method	Manning's Forr
Solve For	Discharge

Section Data	
Mannings Coeffic	0.033
Slope	005000 ft/ft
Depth	0.75 ft
Left Side Slope	4.00 H : V
Right Side Slope	4.00 H : V
Discharge	3.65 cfs



MANNING'S CALCULATION

Manning's Calculation

BRINLEY MIDDLE SCHOOL REPLACEMENT

Date: APRIL, 2023

Lochsa Job No. 221095

Calculated By: Chris Blake

From Section 705.4.4 of Hydrologic Criteria and Drainage Design Manual (HCDDM)
Equation 732:

$$n = 0.0395(D50)^{1/6}$$

n = Manning's coefficient

D50 = Mean stone size in ft, rock size for which 50% (by weight) of the riprap is smaller

Solve for n: D50= 4.0 inches

$$n = 0.0395(D50)^{1/6}$$

D50= 0.333 ft

n = **0.033**

<<<< Manning's n-value for 4-inch Loose Riprap

APPENDIX C

FIGURES

ASSESSOR'S PARCELS - CLARK COUNTY, NV.

Briana Johnson - Assessor

138-14-8

S 2 SE 4

14

T20S R60E

126 125 124 12

137 138 139 14

164 163 162 16

Scale: 1" = 200'

Rev: 8/24/2021

PARCEL BOUNDARY

CONDOMINIUM UNIT

AIR SPACE PCL

RIGHT OF WAY PCL

ROAD EASEMENT

MATCH / LEADER LINE

HISTORIC SUB BOUNDARY

HISTORIC PMAD BOUNDARY

SECTION LINE

TAX DISTRICT LINE

001 ROAD PARCEL NUMBER

001 PARCEL NUMBER

1.00 ACRES

202 PARCEL SUBSEQUENCE NUMBER

PB 24-45 PLAT RECORDING NUMBER

5 BLOCK NUMBER

5 LOT NUMBER

6.5 GOV. LOT NUMBER

MAP LEGEND

NOTES

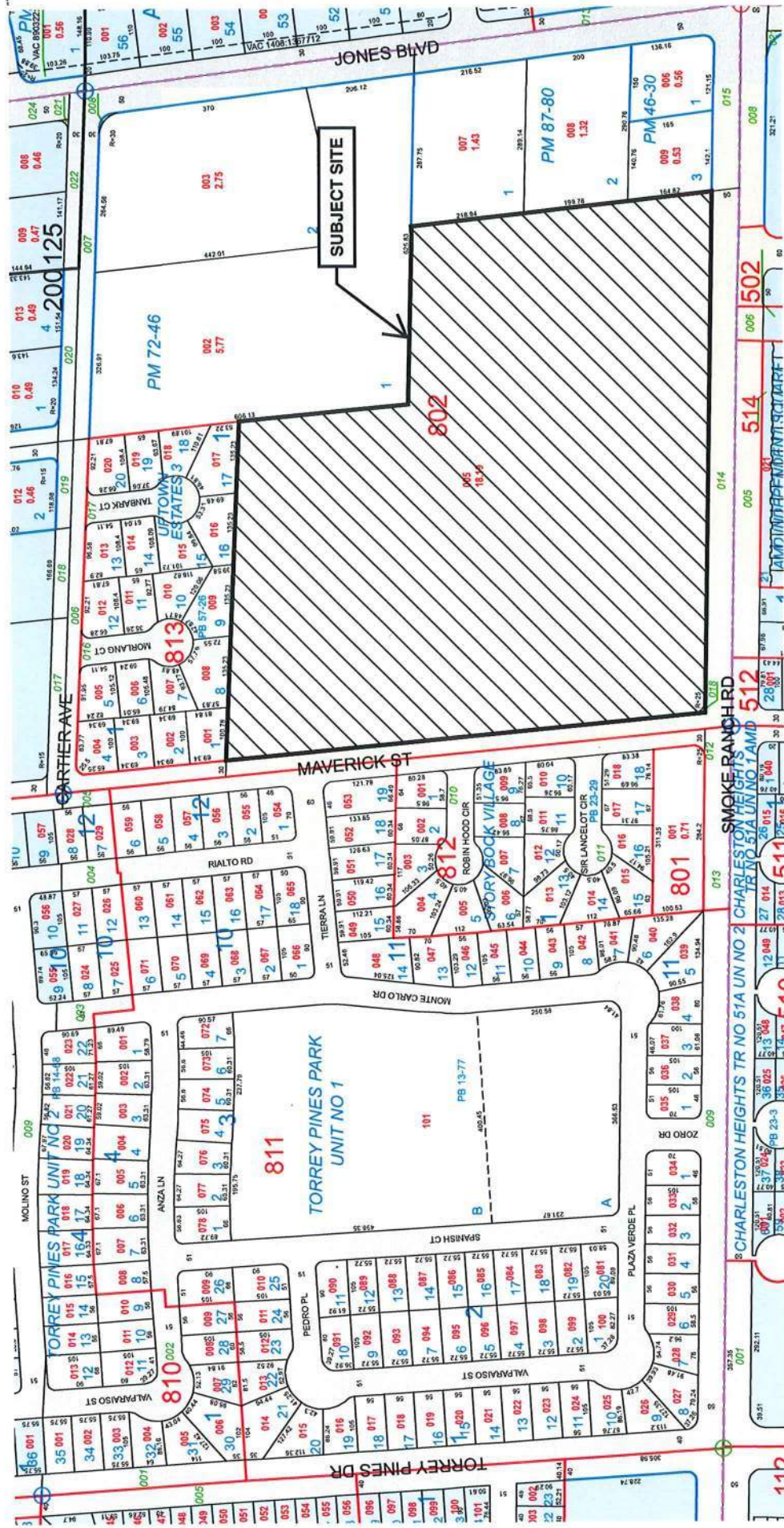
This map is for assessment use only and does NOT represent a survey.

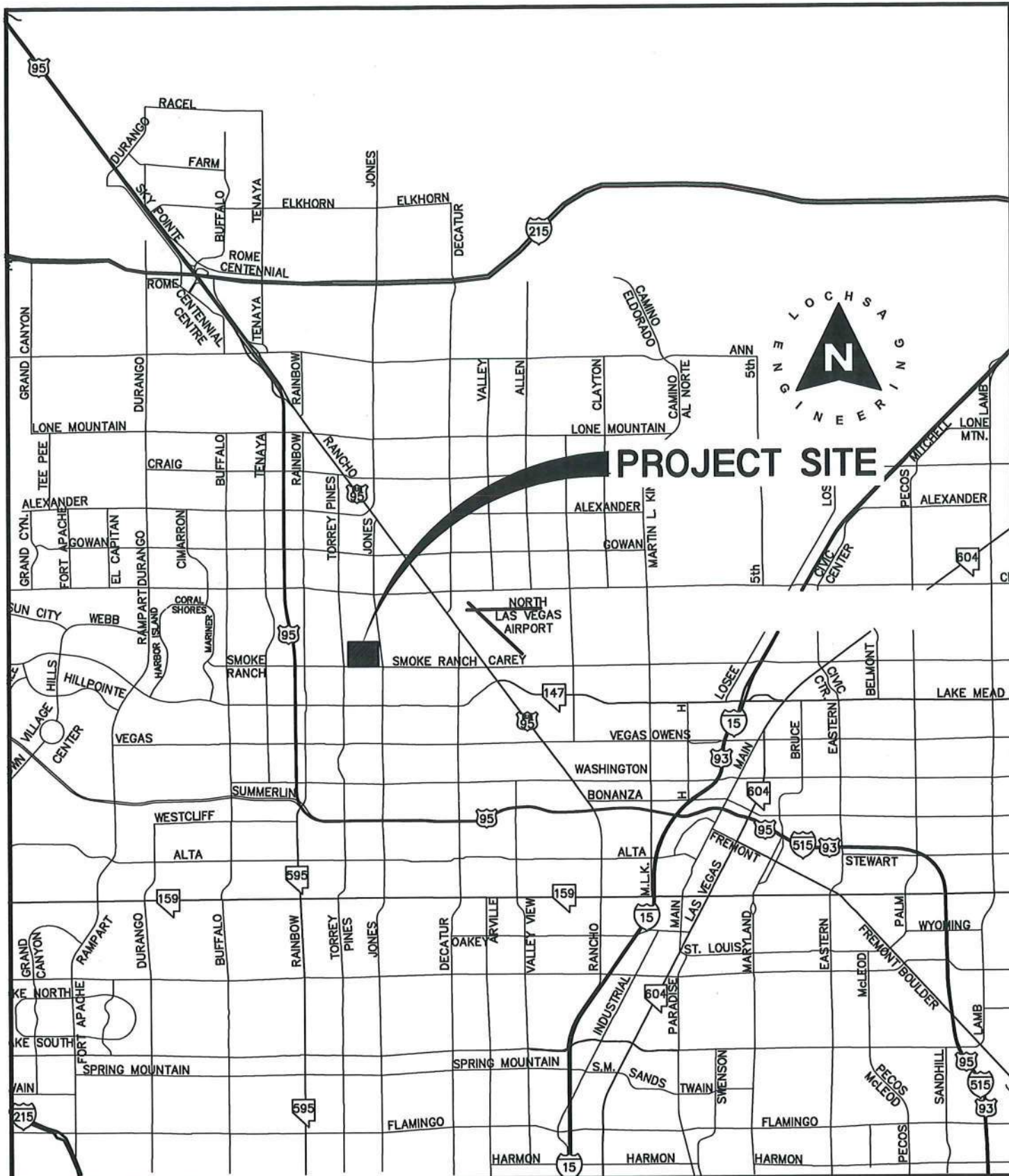
No liability is assumed for the accuracy of the data delineated herein.

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 SHEET WHEN MAP REDUCED FROM 1:10,000 ORIGINAL





DRAWN BY: JD SCALE: N.T.S.

CHECKED BY: CB DATE: 3/10/23



6345 South Jones Blvd. Suite 100
Las Vegas, NV 89118
Phone (702) 365-9312 - Fax (702) 365-9317

VICINITY MAP (FIGURE 1)

BRINLEY M.S. REPLACEMENT

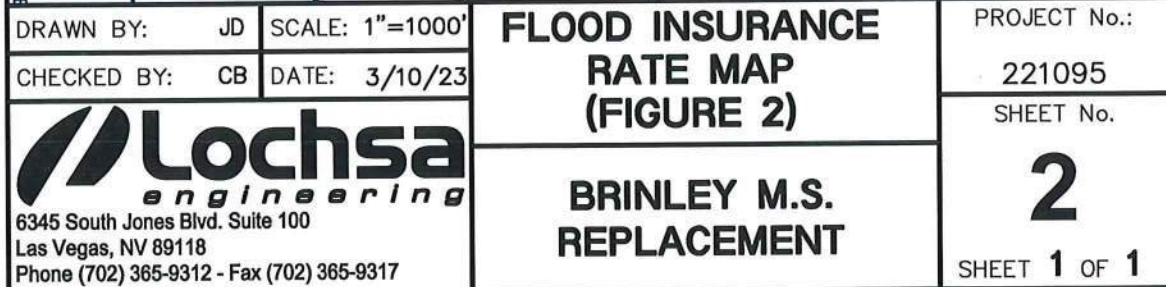
PROJECT No.:

221095

SHEET No.

1

SHEET 1 OF 1





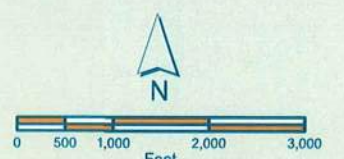
2018
LAS VEGAS VALLEY
FLOOD CONTROL
MASTER PLAN UPDATE

FIGURE F-24
FLOOD CONTROL FACILITIES

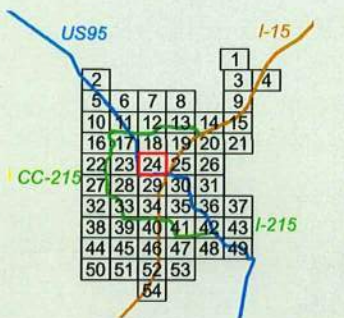
LEGEND

- 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 |

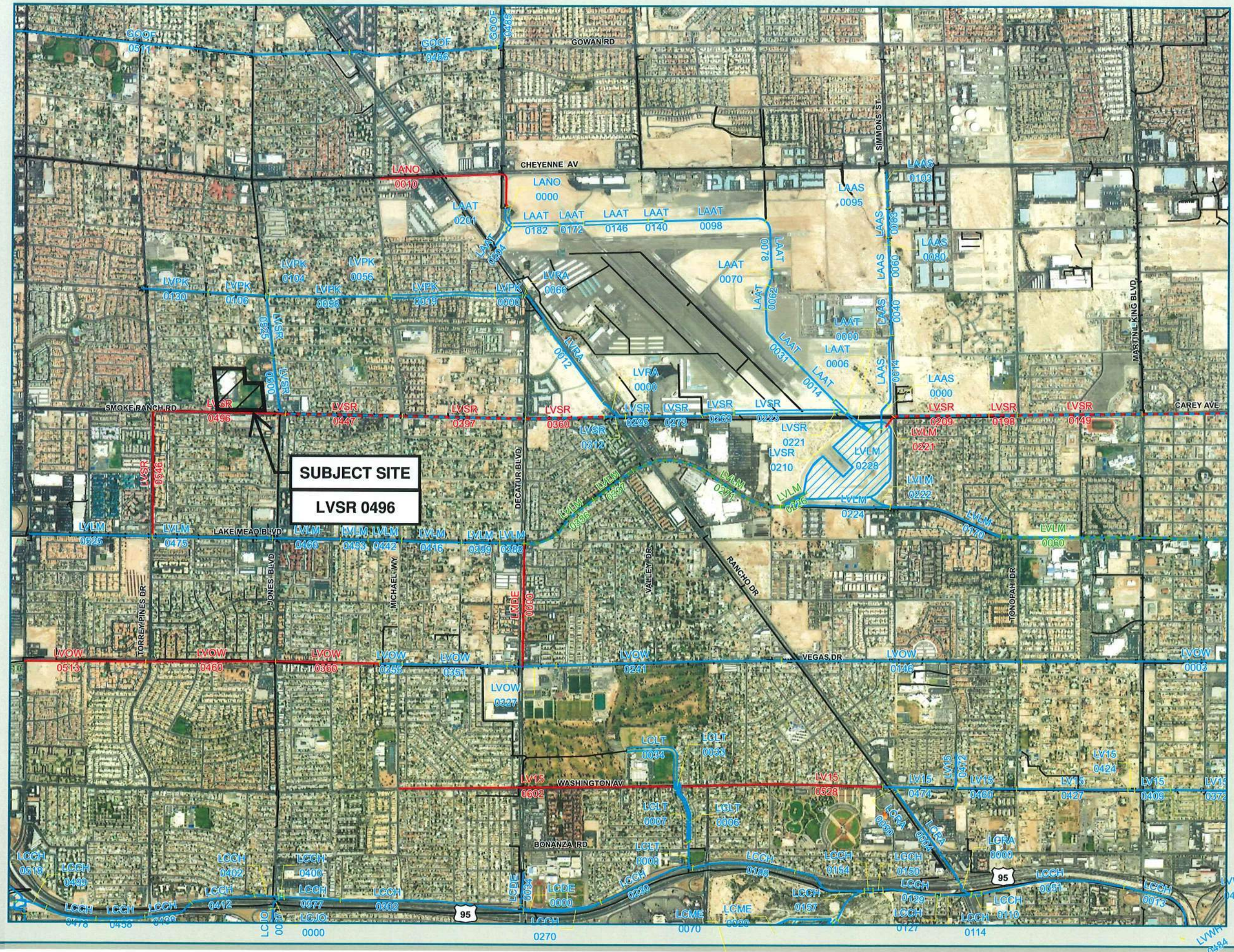


Scale: 1 inch = 2,000 feet
AerialSource: Esri World Imagery 2017



ATKINS

Member of the SNC-Lavalin Group
Louis Berger



ID / Mile	Status	Facility Description	Length (ft.)	Flow (cfs)	HEC-1 Node	HEC-1 Model	Tributary Area (sq.mi.)	Channel Slope (%)**
GOOF		GOWAN OUTFALL FACILITIES						
0485	E	90" RCP	1080	630	DGOW2A	GOW3B	1.37	0.47
0486	E	8' X 5' RCB	3200	630	DGOW2A	GOW3B	1.37	0.60
0511	E	8' X 5' RCB	8390	740	CPT6B-C	GOW3B	1.08	0.50
LAAS		NORTH LAS VEGAS AIR TERMINAL - SIMMONS						
0000	E	14' X 6' RCB	580	728	CR2-CA	NW3	2.57	0.50
0014	E	9' X 6' RCB	1489	728	CR2-CA	NW3	2.57	1.44
0040	E	8' X 6' RCB	1111	728	CR2-CA	NW3	2.57	1.74
0060	E	10' X 6' RCB	864	728	CR2-CA	NW3	2.57	0.60
0080	E	66" RCP	157	294	R-C	NW3	0.27	0.50
0083	E	60" RCP	627	294	R-C	NW3	0.27	1.42
0095	E	54" RCP	373	294	R-C	NW3	0.27	1.44
0103	E	48" RCP	400	294	R-C	NW3	0.27	1.75
LAAT		NORTH LAS VEGAS AIR TERMINAL						
0000	E	3.8' X 5' RCB	650	1364	CB3-1	NW3	4.17	0.50
0006	E	CONC CHNL 20W 8'D 1.5:1 SS	380	1364	CB3-1	NW3	4.17	0.50
0014	E	10' X 6' RCB	934	1364	CB3-1	NW3	4.17	1.84
0031	E	10' X 6' RCB	1618	1105	CB3-2	NW3	3.87	1.05
0062	E	12' X 6' RCB	511	1105	CB3-2	NW3	3.87	0.50
0070	E	12' X 6' RCB	376	1105	CB3-2	NW3	3.87	0.56
0078	E	10' X 6' RCB	1055	1105	CB3-2	NW3	3.87	0.58
0098	E	10' X 4' RCB	2207	696	CCA1-C	NW3	2.98	0.60
0140	E	CONC CHNL 6W 4'D 1.5:1 SS	338	696	CCA1-C	NW3	2.98	0.64
0146	E	CONC CHNL 6W 3'D 1.5:1 SS	1388	696	CCA1-C	NW3	2.98	0.58
0172	E	76" X 48" HERCP	536	494	CA1-C	NW3	2.77	0.75
0182	E	CONC CHNL 6W 3'D 1.5:1 SS	997	494	CA1-C	NW3	2.77	0.83
0201	E	CONC CHNL 6W 3'D 1.5:1 SS	184	494	CA1-C	NW3	2.77	0.37
0204	E	48" RCP	425	494	CA1-C	NW3	2.77	0.37
LANO		NORTH LAS VEGAS AIR TERMINAL NORTH						
0000	E	CONC CHNL 0W 3'D 1.5:1 SS	470	494	CA1-C	NW3	2.77	0.30
0010	P	8' X 4' RCB	3375	211	DA1-C	NW3	2.46	1.13
LCCH		LAS VEGAS CREEK CHANNEL						
0013	E	2: 12' X 6' RCB	2035	3050	CLC20-C	MEADOWS4	9.60	0.82
0051	E	2: 14' X 7' RCB	3113	3050	CLC20-C	MEADOWS4	9.60	0.60
0110	E	TRANSITION STRUCTURE	220	3001	CCLC16-C	MEADOWS4	9.50	
0114	E	2: 14' X 7' RCB	670	2386	CRMEDET	MEADOWS4	8.19	0.80
0127	E	TRANSITION STRUCTURE	110	2386	CRMEDET	MEADOWS4	8.19	
0129	E	2: 14' X 7' RCB	1130	2386	CRMEDET	MEADOWS4	8.19	0.50
0150	E	2: 13' X 7' RCB	200	2386	CRMEDET	MEADOWS4	8.19	0.95
0154	E	TRANSITION STRUCTURE	190	2386	CRMEDET	MEADOWS4	8.19	
0157	E	2: 12' X 6' RCB	1650	1700	CCLC14-C	SW3	2.93	1.06
0188	E	2: 12' X 6' RCB	2225	1700	CCLC14-C	SW3	2.93	1.36
0230	E	12' X 6' RCB	2140	1450	CLC14-C	SW3	2.53	1.74
0270	E	12' X 6' RCB	1705	814	CCWA02-C	SW3	1.84	0.54
0302	E	8' X 6' RCB	3940	814	CCWA02-C	SW3	1.84	2.49
0377	E	10' X 7' RCB	1226	814	CCWA02-C	SW3	1.84	0.74
0400	E	TRANSITION STRUCTURE	110	458	CWA02-C	SW3	1.47	0.49
0402	E	8' X 6' RCB @ JONES	535	458	CWA02-C	SW3	1.47	0.49
0412	E	60" RCP	1370	458	CWA02-C	SW3	1.47	1.08
0438	E	60" RCP	1090	171	CLC01-C	SW3	1.20	1.60
0458	E	60" RCP	1060	171	CLC01-C	SW3	1.20	1.60
0478	E	60" RCP	1110	171	CLC01-C	SW3	1.20	0.55
0499	E	42" RCP OUTLET	660	87	RAINBWD8	SW3	1.11	1.88
0513	E	102 AC-FT RAINBOW DETENTION BASIN		1027	RAINBWIN	SW3	1.11	
LCDE		LAS VEGAS CREEK - DECATUR						
0000	E	6' X 6' RCB	1800	430	LC11-C	SW3	0.38	1.26
0034	E	72" RCP	700	430	LC11-C	SW3	0.38	0.50
LCJO		LAS VEGAS CREEK - JONES						
0000	E	6' X 6' RCB	380	381	AL01B-C	SW3	0.37	0.50
0007	E	6' X 5' RCB	675	381	AL01B-C	SW3	0.37	0.62
LCLO		LAS VEGAS CREEK - LORENZI						
0000	E	7' X 6' RCB	445	285	DAL00A	SW3	0.41	3.37

ID / Mile	Status	Facility Description	Length (ft.)	Flow (cfs)	HEC-1 Node	HEC-1 Model	Tributary Area (sq.mi.)	Channel Slope (%)**
LCLO		LAS VEGAS CREEK - LORENZI						
0008	E	7' X 6' RCB	2983	285	DAL00A	SW3	0.41	0.40
LCLT		LAS VEGAS CREEK - LATERAL						
0000	E	6' X 6' RCB	620	250	WA10D	SW3	0.40	0.50
0006	E	CONC CHNL 10W 4'D 0.1 SS	1230	125*	WA10D*	SW3	0.40	0.62
0007	E	23' x 14' HERCP	1230	125*	WA10D*	SW3	0.40	0.62
0033	E	10' X 4' RCB @ WASHINGTON	96	372	WA10-C	SW3	0.40	0.50
0034	E	GRASS CHNL 12W 5'D 1:1 SS	1750	372	WA10-C	SW3	0.40	0.20
LCME		LAS VEGAS CREEK - MEADOWS						
0000	E	14' X 6' RCB	895	1484	MEADOWDB	SW3SC	5.67	0.72
0016	E	STILLING BASIN	140	1484	MEADOWDB	SW3SC	5.67	0.21
0017	E	3,300 CFS SPILLWAY (REPLACE W/ LCME0018)	3300		MEADOWDB	SW3SC	5.67	
0018	P	MODIFY SPILLWAY, RAISE HEIGHT BY 1' (REPLACES LCME0017)	3300		MEADOWDB	SW3SC	5.67	
0019	E	1: 11' X 5' RCB AND 1: 11.5' X 5' RCB	110	1484	MEADOWDB	SW3SC	5.67	0.81
0020	E	213 AC-FT MEADOWS DETENTION BASIN	4909		MEADOWIN	SW3SC	7.55	
LCRA		LAS VEGAS CREEK - RANCHO						
0000	E	12' X 6' RCB	380	931	CLC16-C	SW3	1.71	0.60
0004	E	12' X 6' RCB	2367	931	CLC16-C	SW3	1.71	0.77
0050	E	8' X 6' RCB	355	694	WA13D	SW3	1.39	0.50
LMDE		LAKE MEAD BOULEVARD - DECATUR BRANCH						
0000	P	10' X 5' RCB	2640	673	DCVG04-C	NW3	1.25	0.90
LV15		FREEWAY CHANNEL						
0372	E	9' X 6' RCB	1970	1152	CWA20-C	NW3	4.52	0.66
0409	E	7' X 6' RCB	815	841	CVG07	NW3	4.09	0.91
0424	E	10' X 5' RCB	130	841	CVG07	NW3	4.09	0.40
0427	E	8' X 6' RCB	2411	841	CVG07	NW3	4.09	0.60
0460	E	6' X 5' RCB	1242	253	CCWA13-C	NW3	3.31	1.50
0472	E	60" RCP	713	410	WA15A-C	NW3	0.43	0.30
0474	E	5' X 5' RCB	1625	253	CCWA13-C	NW3	3.31	1.00
0528	P	8' X 8' RCB	4420	959	CWA13-C	SW3	1.39	1.19
0602	P	2: 66" RCP	5980	551	CWA09-C	SW3	0.63	1.59
LVLN		LAS VEGAS WASH - LAKE MEAD						
0059	E	72" RCP (REPLACE W/ LVLN0060)	5952	1159	CLM20-C	NW3SC	1.36	0.66
0060	P	12' X 7' RCB (REPLACES LVLN0059)	5952	1159	CLM20-C	NW3SC	1.36	0.66
0170	E	78" RCP	2421	454	CLM16A-C	NW5	12.15	1.17
0221	P	48" RCP OUTLET	270	195	DR2	NW4	11.77	
0222	E	48" RCP OUTLET	500	368	DCAREY	NW4	11.77	
0224	E	36" RCP	2429					0.53
0225	E	90" RCP (REPLACE W/ LVLN0226)	641	2077	CLM10-C	NW3	3.01	1.35
0226	P	2: 10' X 9' RCB (REPLACES LVLN0225)	641	2077	CLM10-C	NW3	3.01	0.50
0227	E	10,000 CFS PMF SPILLWAY		10000	CARYLMOB	NW4	11.77	
0228	E	607 AC-FT CAREY LAKE MEAD DETENTION BASIN		5499	CARYLMIN	NW4	11.78	
0270	E	90" RCP (REPLACE W/ LVLN0271)	3473	2077	CLM10-C	NW3	3.01	1.35
0271	P	12' X 8' RCB (REPLACES LVLN0270)	3473	2077	CLM10-C	NW3	3.01	1.35
0336	E	84" RCP (REPLACE W/ LVLN0337)	1050	1769	CLM06-C	NW3	2.60	1.16
0337	P	12' X 8' RCB (REPLACES LVLN0336)	1050	1769	CLM06-C	NW3	2.60	1.16
0355	E	90" RCP (REPLACE W/ LVLN0356)	1840	1769	CLM06-C	NW3	2.60	0.40
0356	P	12' X 11' RCB (REPLACES LVLN0355)	1840	1769	CLM06-C	NW3	2.60	0.40
0388	E	84" RCP	520	913	CLM05-C	NW3	1.00	1.40
0399	E	78" RCP	803	913	CLM05-C	NW3	1.00	1.07
0416	E	72" RCP	1320	913	CLM05-C	NW3	1.00	1.00
0442	E	60" RCP	725	591	CLM03-C	NW3	0.63	1.28
0453	E	54" RCP	589	591	CLM03-C	NW3	0.63	2.37
0460	E	54" RCP	1464	591	CLM03-C	NW3	0.63	2.05
0475	E	48" RCP	2632	242	LM02-C	NW3	0.29	1.24
0525	E	48" RCP	2600	565	CLM01-C	NW3	0.64	1.24
LVOW		OWENS AVENUE SYSTEM						
0003	E	96" RCP	7500	1219	CLM16B-C	NW3	2.43	0.70
0146	E	84" RCP	4800	570	DCVG20-C	NW3	2.04	0.90
0241	E	72" RCP	4832	416	CVG20-C	NW3	1.56	1.65
0327	E	7' X 5' RCB	360	416	CVG20-C	NW3	1.56	1.28
0351	E	72" RCP	2250	837	CVG04-C	NW3	1.25	1.44

ID / Mile	Status	Facility Description	Length (ft.)	Flow (cfs)	HEC-1 Node	HEC-1 Model	Tributary Area (sq.mi.)	Channel Slope (%) **
LVOW		OWENS AVENUE SYSTEM						
0355	E	8' X 5' RCB	491	837	CVG04-C	NW3	1.25	0.40
0360	P	8' X 6' RCB	2300	837	CVG04-C	NW3	1.25	1.48
0460	P	7' X 6' RCB	2700	615	CVG03-C	NW3	0.95	1.48
0513	P	6' X 5' RCB	2615	463	CVG02-C	NW3	0.68	1.68
LVPK		PEAK DRIVE SYSTEM						
0000	E	CONC CHNL 15W 6'D 0:1 SS	606	1081	CPD04B-C	NW3	1.59	1.22
0019	E	CONC CHNL 20W 5.5'D 0:1 SS	2190	1081	CPD04B-C	NW3	1.59	0.57
0056	E	10' X 5' RCB	103	723	CCY04A-C	NW3	1.12	0.40
0058	E	9' X 6' RCB	2542	723	CCY04A-C	NW3	1.12	0.95
0104	E	10' X 6' RCB	76	723	CCY04A-C	NW3	1.12	1.26
0106	E	7' X 5' RCB	1235	723	CCY04A-C	NW3	1.12	0.61
0130	E	7' X 5' RCB	1435	383	CPD01-C	NW3	0.67	0.61
LVRA		LAS VEGAS WASH - RANCHO						
0000	E	12' X 8' RCB	612	1438	CCPD04BC	NW3	3.77	1.58
0012	E	12' X 8' RCB	2838	1438	CCPD04BC	NW3	3.77	0.78
0066	E	14' X 5' RCB	65	1438	CCPD04BC	NW3	3.77	1.22
LVSR		LAS VEGAS WASH - SMOKE RANCH						
0070	E	66" RCP (REPLACE W/ LVSR0071)	4118	1086	CS1-C	NW3SC	1.42	0.73
0071	P	10' X 8' RCB (REPLACES LVSR0070)	4118	1086	CS1-C	NW3SC	1.42	0.73
0148	E	54" RCP (REPLACE W/ LVSR0149)	2587	823	CS	NW3SC	0.95	0.58
0149	P	11' X 6' RCB (REPLACES LVSR0148)	2587	823	CS	NW3SC	0.95	0.58
0197	E	30" RCP (REPLACE W/ LVSR0198)	581	368	CR2-C	NW3SC	0.38	0.86
0198	P	8' X 4' RCB (REPLACES LVSR0197)	581	368	CR2-C	NW3SC	0.38	0.86
0208	E	54" RCP (REPLACE W/ LVSR0209)	2060	368	CR2-C	NW3SC	0.38	1.41
0209	P	7' X 4' RCB (REPLACES LVSR0208)	2060	368	CR2-C	NW3SC	0.38	1.41
0210	E	14' X 8' RCB	800	3092	CB1-C	NW3	6.34	1.73
0221	E	TRANSITION STRUCTURE	100	3092	CB1-C	NW3	6.34	7.08
0223	E	CONC CHNL 14W 8'D 1.5:1 SS	2150	3092	CB1-C	NW3	6.34	0.96
0263	E	14' X 8' RCB	707	3092	CB1-C	NW3	6.34	0.63
0273	E	11' X 11' RCB	1140	3092	CB1-C	NW3	6.34	0.92
0295	E	11' X 11' RCB	510	2868	CCSR05B	NW3	6.06	2.85
0312	E	8' X 8' RCB	460	1652	CSR05B	NW3	2.30	1.63
0359	E	66" RCP (REPLACE W/ LVSR0360)	1690	1652	CSR05B	NW3	2.30	0.67
0360	P	10' X 10' RCB (REPLACES LVSR0359)	1690	1652	CSR05B	NW3	2.30	0.75
0396	E	60" RCP (REPLACE W/ LVSR0397)	2640	1483	CSR05D	NW3	1.94	1.14
0397	P	10' X 9' RCB (REPLACES LVSR0396)	2640	1483	CSR05D	NW3	1.94	0.87
0446	E	54" RCP (REPLACE W/ LVSR0447)	2530	1483	CSR05D	NW3	1.94	1.14
0447	P	10' X 8' RCB (REPLACES LVSR0446)	2530	1483	CSR05D	NW3	1.94	1.25
0498	P	10' X 7' RCB	2855	1245	CSR02E	NW3	1.64	1.27
0500	E	60" RCP	1290					1.97
0525	E	54" RCP	1340					0.30
0546	P	8' X 9' RCB	2640	781	CSR00A	NW3	1.01	0.57



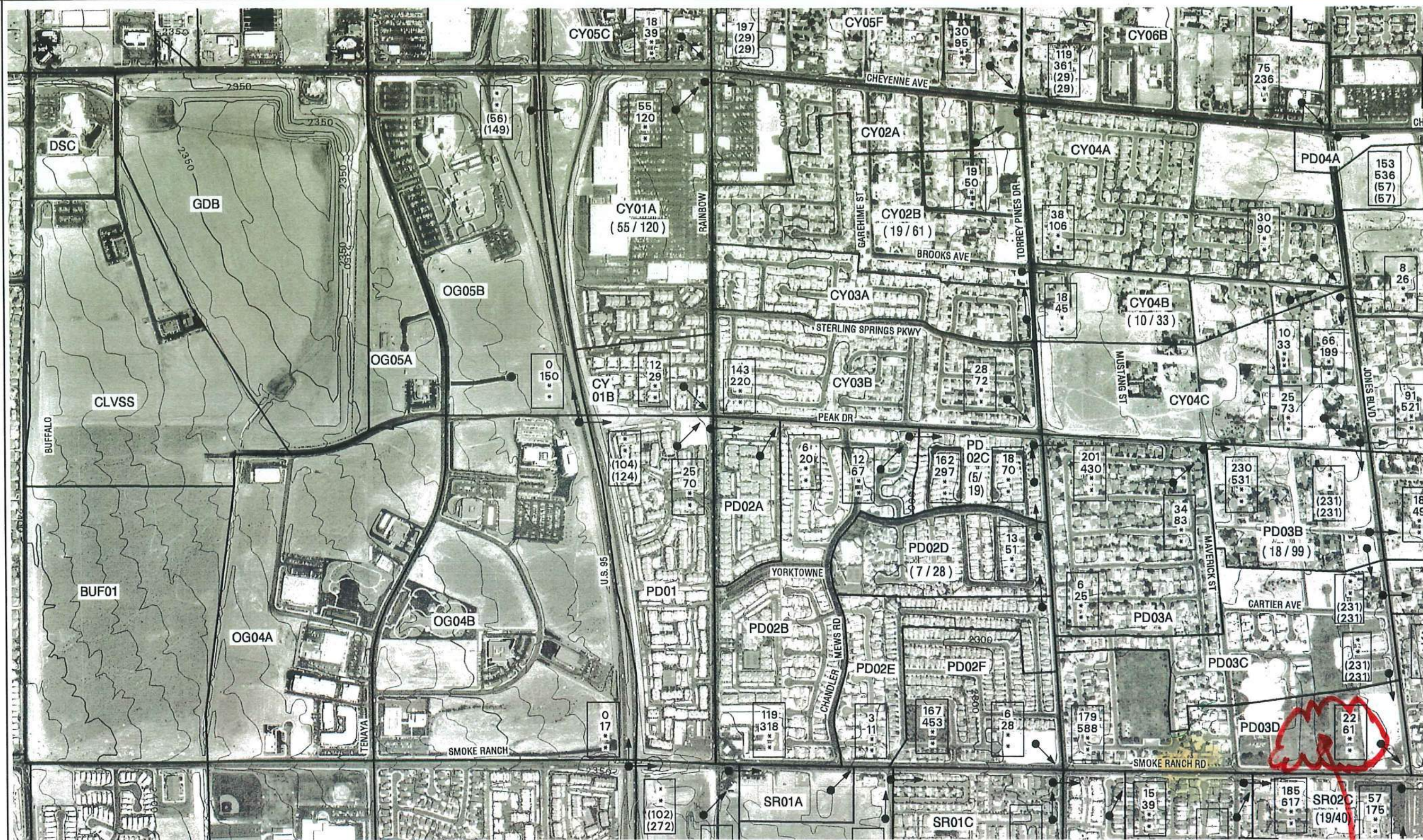
NORTHWEST NEIGHBORHOOD STUDY

LEGEND

- SUB-BASIN BOUNDARY
- FLOW ARROW
- 250 10-YEAR STREET FLOW
500 100-YEAR STREET FLOW
300 10-YEAR FACILITY FLOW
800 100-YEAR FACILITY FLOW
(FLOWS IN CFS)
- BWJS ↔ Basin-ID
(13 / 59) ↔ Contributing flow
(10-Year / 100-Year
from the basin (cfs))

PHOTO DATE: APRIL 1996

FIGURE E-15



EXISTING DRAINAGE CONDITIONS

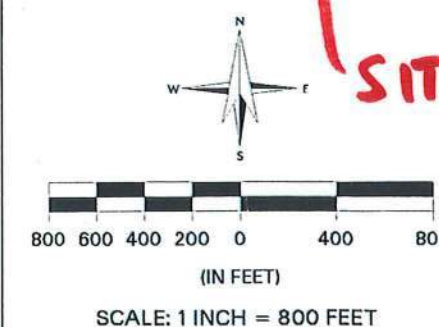
PBS POST,
BUCKLEY,
SCHUH &
JERNIGAN, INC.

ENGINEERING PLANNING SURVEYING GIS
901, N. Green Valley Pkwy, Ste 100, Henderson NV 89014
Phone: (702) 263-7275 Fax: (702) 263-7200

HUALPAI	FT. APACHE	DURANGO	BUFFALO	RAINBOW	JONES	DECATUR	ELKHORN
1	2	3					CENTENNIAL
4	5	6					ANN
7	8	9					LONE MOUNTAIN
10	11	12					ALEXANDER
	13	14					CHEYENNE
	15	16					SMOKE RANCH
	17	18					

NOTE:

Existing conditions are based on future
CN values with only existing local and
CCRFCD facilities in place



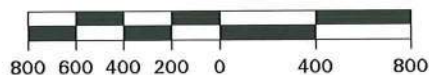
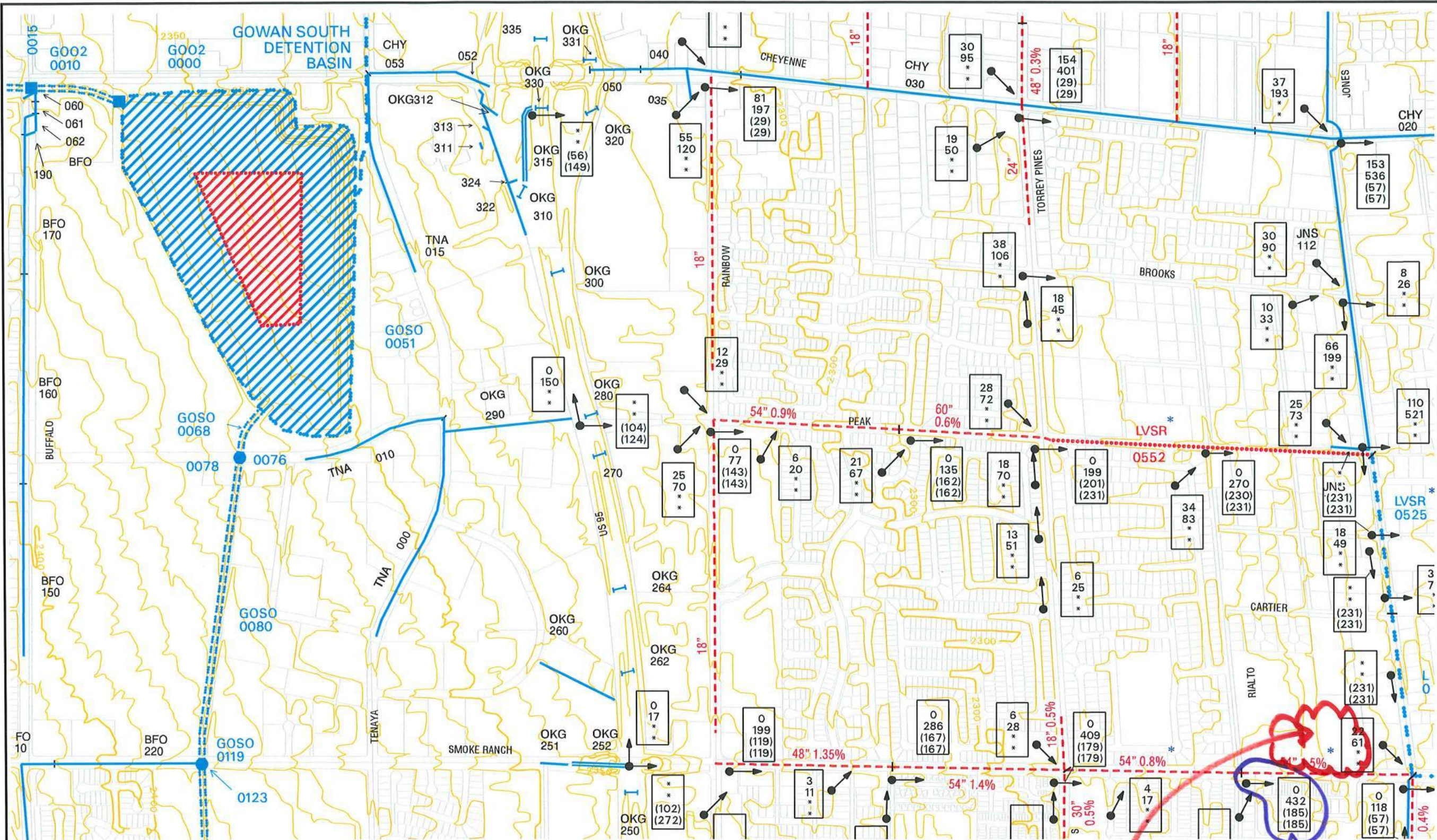


NORTHWEST NEIGHBORHOOD STUDY

LEGEND

- EXISTING REGIONAL DETENTION BASINS
- PROPOSED REGIONAL DETENTION BASINS
- EXISTING LOCAL DETENTION BASINS
- EXISTING REGIONAL BRIDGES
- PROPOSED REGIONAL BRIDGES
- EXISTING LOCAL BRIDGES
- EXISTING REGIONAL CULVERT
- PROPOSED REGIONAL CULVERT
- EXISTING LOCAL CULVERT
- EXISTING REGIONAL PIPELINE
- PROPOSED REGIONAL PIPELINE
- EXISTING LOCAL PIPELINE
- PROPOSED LOCAL PIPELINE
- EXISTING REGIONAL CHANNEL
- PROPOSED REGIONAL CHANNEL
- EXISTING LOCAL CHANNEL
- PROPOSED REGIONAL PIPELINE (Not Included in 1996 MPU)
- PROPOSED REGIONAL CHANNEL (Not Included in 1996 MPU)
- EXISTING REGIONAL DIKE/LEVEE
- PROPOSED REGIONAL DIKE/LEVEE
- EXISTING LOCAL DIKE/LEVEE
- EXISTING STORM WATER PUMPING STATION
- PROPOSED BELTWAY ALIGNMENT

FIGURE F-15



SCALE: 1 INCH = 800 FEET

FLOW ARROW

250 10-YEAR STREET FLOW
500 100-YEAR STREET FLOW
(300) 10-YEAR FACILITY FLOW
(800)

(FLOWS IN CFS)

NOTE:

Ultimate drainage conditions are based on future CN values with all flood control facilities in place

* See Chapter 7 of Volume I for additional proposed facilities in this area.

SITE

HUALPAI	FT. APACHE	DURANGO	BUFFALO	RAINBOW	JONES	DECATUR	ELKHORN
1	2	3					
4	5	6					CENTENNIAL
7	8	9					AMH
10	11	12					LOVE MOUNTAIN
							ALEXANDER
							CHEYENNE
							SMOKE RANCH

FUTURE DRAINAGE CONDITIONS

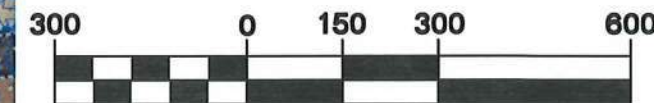


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GRAPHIC SCALE



(IN FEET)
1 Inch = 300 ft.

DRAINAGE LEGEND	
ND1	DRAINAGE BASIN LABEL
●	CONCENTRATION POINT
CMD1	COMBINATION POINT
—	ONSITE BASIN BOUNDARY
- - -	OFFSITE BASIN BOUNDARY
2 3	Q10 FLOW IN CFS (10 YR.) Q100 FLOW IN CFS (100 YR.)
→	BASIN FLOW DIRECTION

*CLV MPU FIGURE F-15 (APPENDIX C)

REFER TO DR1/DR2 FOR ONSITE DRAINAGE MAP

DRAWN BY: JD	SCALE: 1"=300'	FILE NAME: Offsite Map.dwg
CHECKED BY: CB	DATE: 5/3/23	LEGEND
LOCHSA ENGINEERING 6345 SOUTH JONES BLVD., SUITE 100 LAS VEGAS, NV 89118 P: 702 365-9312, F: 702 365-9317		FOUND MONUMENTATION
		CENTER LINE
		ROW LINE
		EASEMENT LINE
		SECTION LINE
		PROPERTY LINE
		ADJACENT PROPERTY LINE

OFFSITE BASIN MAP
(EXISTING & DEVELOPED CONDITION)

BRINLEY MS REPLACEMENT

PROJECT No.:
221095

SHEET No.

OFF

SHEET 1 OF 1