DS4156
Missing Plans
3, 4 of 12 in
1st Submittal

DS #: DS4156

APN: 139-29-301-003

PROJECT: Lorenzi Park Renovation-Phase 1

SUBMITTAL: 1st Submittal-Drainage Study

SCANNED BY/DATE:

CHECKED BY/DATE:

CITY OF LAS VEGAS INTER-OFFICE MEMORANDUM				DATE: April 26, 2007
TO: **Land Development Services** Department of Public Works				FROM: Albert Sung, P.E. Flood Control Project Engineer Department of Public Works
SUBJECT:	Drainage Study for: **Lorenzi Park Renovation – Phase 1**			**COPIES TO:** Lochsa Engineering
Cross Streets:	SEC of Washington Blvd. & Twin Lakes Dr.			City of Las Vegas Architectural Serv.
File Number:	F:\Depot\DSMemos\DS4156A.doc			Bart Anderson, P.E., DevCo
Parcel Number:	139-29-301-003			CCRFCD
Zoning Action:	SDR-19625			
FEMA Flood Zone	YES	NO	X	
Proposed Storm Drain	YES	NO	X	

HISTORY	DATE RECEIVED	DATE REVIEWED	COMMENTS	REVIEW FEES	FEES PAID Transaction #
1st Submittal	4/11/2007	4/25/2007	See Comments Below	$400.00	66764: $400
			TOTAL FEES (LDDRS):	**$400.00**	**----**

REMARKS:

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

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

1. The site is adjacent to or crosses an existing or proposed *Clark County Regional Flood Control District* (CCRFCD) master planned facility. Therefore, CCRFCD concurrence is required prior to final approval of the drainage study.

2. *Onsite Drainage Map (Existing and Proposed Conditions)*: Subbasin "NX4" consists of a man-made lake which should be retaining the runoff originated from its own basin. The notion that runoff of "NX4" discharges into "NX6" may not be correct. The west half of "NX4" may or may not drain to the north into "NX1" versus to the lake. The engineer should look into a more refined topography and verify the actual drainage pattern. Review and revise all pertinent calculations and results which impact the design of the proposed renovation.

3. Majority of the runoff from the park drains to the southeast corner and subsequently into the adjacent commercial lots to the east. No negative impact is allowed against adjacent properties, ie, the 100-year discharge can not be increased. Review and revise accordingly.

4. The engineer must verify that whether there is any public drainage easement behind the existing 16"x48" wall opening in the adjacent commercial lots. If yes, show and label the drainage easement with *City of Las Vegas* recorded document number on the grading plans. If no, either obtain an easement from the adjacent owner or secure a notarized letter of acknowledgment for drainage through their site prior to the final approval of the drainage study.

5. Current *City of Las Vegas* policy is to require a wrought iron fence if the discharge is more than 10cfs. The subject development must bring the 16"x48" opening up to current standard.

6. Provide hydraulic calculations of the ponding depth behind the opening at the southeast corner of the site for both existing and proposed conditions. The ponding depth must be improved (ie, lowered) in the proposed condition to reduce the impact to the existing walls of the adjacent residential lots to the south.

7. *Sheets DR1 & DR2*: Concentration Points "CMX2 (25/53cfs)" and "CMD2 (22/46cfs)" are to no avail on the corresponding plans. Label in the next submittal.

8. ***Sheet C4.01***: The 100-year flow depth in *Washington Boulevard* is 1.18' and the velocity is 9.20 ft/s which is very erosive. The study must address whether there is any wall or berm proposed to protect the park from potential inundation from *Washington*. Provide erosion protection measures on the grading plan and provide a typical cross section at *Washington*.

   Explain what "Additive Alternate #1" is.

9. ***Sheet C4.02***: Same comment as Sheet C4.01 along *Washington Boulevard*. In addition, the driveway entrance as in the proposed design allows substantial inundation into the site. Steepen the first portion of the driveway to reduce the inundation area. Review and revise accordingly.

10. ***Sheet C4.03***: Provide finish floor elevation for the existing houses to the south.

11. ***Sheet C4.04***: Provide finish floor elevation for the existing houses to the south. The proposal to use an existing 16"x48" wall opening at the southeast corner is not acceptable as explained in the above Comment #4. Review and revise accordingly.

12. ***Sheet C6.02***: Sections G and N provides detail at the south property line. It is recommended to construct a new wall adjacent to the property wall of the residential lots to provide positive drainage away from the adjacent neighbors.

13. All wrought iron fence must utilize *City of Las Vegas* Standard Drawing 421B. Contact Raul Cruz at 229-6171 for the AutoCAD details (421 series) to be included with the improvement plans.

14. Provide standard drainage study note on the grading plan. *"I CERTIFY THAT THIS GRADING PLAN IS IN CONFORMANCE WITH THE APPROVED DRAINAGE STUDY ON FILE AT THE CITY OF LAS VEGAS FOR THIS PROJECT (DS4156)".*

15. In *Standard Form 1*, add email address for the "*Contact Person – Name*".

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

END OF REMARKS
ays

T/R/S: T20S/R61E/29
AREA M-29

DS 4156
4/11/07
M-29
$400 —
WK 7216

Technical Drainage Study

for

Lorenzi Park Renovation Phase I

JOB# 061132

April 2007

Prepared for:

Southwick Landscape Architects
12 Commerce Center Drive, Suite D-44
Henderson, Nevada 89014
(702) 597-3108

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

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HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE STUDY INFORMATION FORM

Name of Development: Lorenzi Park Renovation Phase I Date: April 04, 2007

Location of Development: a) Descriptive (Cross Streets) Washington Avenue and Twin Lakes Drive

b) Sect. 29 Twn 20 S Rng. 61 E

Name of Owner: City of Las Vegas Assessors Parcel No: 139-29-301-003

Telephone No: (702) 229-6535 Facsimile No: (702) 384-4846

Address: 400 East Stewart Avenue

Las Vegas, Nevada 89101

Contact Person-Name: Stanley Okey Amadi Telephone No: 702-365-9312

Firm: Lochsa Engineering Email Address

Address: 6345 South Jones Boulevard, Suite 100 Las Vegas, Nevada 89118

Type of Land Development\Land Disturbance Process:

☐ Rezoning ☐ Subdivision Map ☐ Clearing and Grading Only

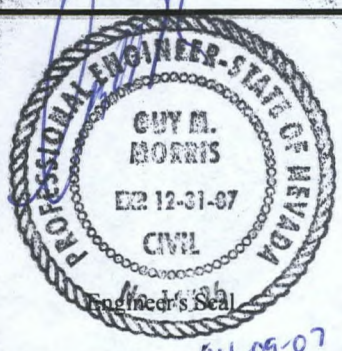
☐ Parcel Map ☐ Planned Unit Development ☐ Other (Please specify below)

☐ Large Parcel Map ■ Building Permit

1. Total Owned Land Area: At Site: 59.93 ± Acres Being Developed/ Disturbed: 35.81 ± 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.)? Public Facility (Community Park)
5. Approximate upstream land area which drains to the subject site? Basins WA11, WA14, and LC15 as analyzed in the Citywide
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: To Washington Avenue through the driveways

And to the adjacent eastern parcel through the existing block wall opening.

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



Engineer's Seal

04-09-07

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

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

Revision	Date

Local Entity File No.

REFERENCE: **STANDARD FORM 1**

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE SUBMITTAL CHECKLIST

Project Name: Lorenzi Park Renovation Phase I	Map ID:
Firm Name: Lochsa Engineering	Engineer: Guy M. Morris, P.E.
Address: 6345 South Jones Boulevard Suite 100	
City: Las Vegas State: Nevada	Zip: 89118
Phone Number: (702) 365-9312	Fax Number: (702) 365-9317
Property Owner: City of Las Vegas	
Address: C/o Southwick Landscape Architects, 12 Commerce Center Drive, Suite D-44	
City: Henderson State: NV.	Zip: 89014

Reviewed By:	Date Received:	Date Accepted for Review:

The following checklist is intended as a guide for the engineer preparing a Technical Drainage Study to submit to the local entity and Clark County Regional Flood Control District (if necessary). The listed items are the minimum information required prior to the entity performing a review. The engineer will remain responsible to ensure the Technical Drainage Study is prepared within the guidelines as set forth in the Clark County Regional Flood Control District (CCRFCD) Hydrologic Criteria and Drainage Design Manual (MANUAL).

This document is intended as an aid in preparing Technical Drainage Studies. Each study 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.

REFERENCE:	**STANDARD FORM 2**

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE SUBMITTAL CHECKLIST

II. MAPS AND EXHIBITS

Yes	No	
✓	___	A copy of a current Flood Insurance Rate Map (FIRM) with the site delineated.
✓	___	A copy of the current CCRFCD Master Plan Update Figure, (F-x), for Flood Control Facilities and Environmental areas with the site delineated.
___	N/A	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.

REFERENCE:	STANDARD FORM 2

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE SUBMITTAL CHECKLIST

III. DRAINAGE PLAN (Continued)

Yes	No	
✓		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.
	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 with 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 directions with Q_{100} and V_{100} and D_{100} in streets.
✓		Cumulative flows, velocity, and direction of flow at upstream and downstream ends of site for the 10-year and 100-year flows.
✓		Location and cross-section of street capacity calculations.
✓		Cross-sectional detail for channels, including cutoff wall locations.
✓		Existing and proposed drainage facilities, appurtenances, and connections (i.e., sidewalk, ditches, swales, storm drain systems, unimproved and improved channels, and culverts, etc.) stating size, material, shape, and slope with plan and profile and HGL calculations.
	N/A	Existing and proposed drainage easements and widths shown with sufficient detail. A cross sectional detail must be provided that shows appropriate lining and reinforcement.
✓		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.

REFERENCE:	**STANDARD FORM 2**

DRAINAGE SUBMITTAL CHECKLIST

III. DRAINAGE PLAN (Continued)

Yes	No	
✓		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 of best available information; limits of proposed floodplains based on best available information.
	N/A	For areas in Zone A, AE, AH, and AO, base flood elevations (BFEs) must be shown for each lot; BFEs may be listed on each lot, or in a table.
	N/A	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.
	N/A	Street slopes for perimeter and interior streets. The minimum slope is 0.4 percent.

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.

REFERENCE: | **STANDARD FORM 2**

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 x v $\leq$ 8. Q_{10} d x v $\leq$ 6 and 12 foot dry lane for rights-of-way $\geq$ 80 feet. Calculations must be labeled by street name as indicated on the Grading Plan.
✓	____	A summary table of interior and exterior street capacity calculations showing the street name, Q_{100} flow, slope, depth of flow, velocity and depth times velocity product and streets needing to meet 12 foot dry lane criteria.
✓	____	Appropriate hydraulic calculations for block wall openings assuming a 50 percent vertical clogging factor. (Assume the lower half of the opening is plugged).
____	N/A	Appropriate hydraulic calculations at drainage easement entrance and discharge locations to set finish floor elevations. Hydraulic calculations must include submerged weir, superelevation and tee intersection losses, where appropriate.
✓	____	Provide necessary freeboard requirements to set the finished floor elevations of all proposed buildings, 2 x depth of flow of 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 of flow depth, which ever is greater.
____	N/A	A complete water surface profile analysis (HEC-2, HEC-RAS, etc.) for channel flows and FEMA Zone A flood zones. • Field survey data • Input and output information • Plotted cross-sections based on survey with proper encroachments. • A map showing the locations 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.

REFERENCE: | **STANDARD FORM 2**

CITY OF LAS VEGAS

MINIMUM DRAINAGE STUDY CRITERIA
STANDARD FORM 2 CHECKLIST SUPPLEMENT

(Revised 06/06/01)

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 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 Clark County Regional Flood Control District (CCRFCD) Hydrologic Criteria and Drainage Design Manual (Design Manual).

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.

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.)
	N/A	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.

CITY OF LAS VEGAS MINIMUM DRAINAGE STUDY CRITERIA CHECKLIST

II. GRADING PLAN INFORMATION		
Yes	No	
	N/A	Back of lot elevations and lot drainage pattern for all lots including common lots.
	N/A	Sites with a grade difference two feet above or below existing ground are required to have approval from City of Las Vegas Current Planning. Current Planning approval is required prior to final approval of the drainage study.
✓		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.
	N/A	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.
	N/A	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.
	N/A	Lots with "B and C Type Drainage" shall be required to install an underground nuisance drainage system or a 2-foot valley gutter through the lot. 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.

Technical Drainage Study

for

Lorenzi Park Renovation Phase I

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APPENDICES

1. GENERAL LOCATION AND DEVELOPMENT DESCRIPTION

1.1 Purpose

Southwick Landscape Architects, has retained the services of Lochsa Engineering to provide a Technical Drainage Study for the Phase I of the proposed renovation to the existing Lorenzi Park located at the southeast corner of Washington Avenue and Twin Lakes Drive. The site is currently developed to a public park to be remodeled. The site does not have any technical drainage study on record for the existing park improvements. Thus, the purpose of this study is to provide an updated hydrologic analysis of the site and its tributary watersheds and establish the existing drainage pattern within and around the site. The study will also substantiate the onsite hydraulic design for the park renovation. The site and its watersheds were studied in the City of Las Vegas Flood Control Facilities Inventory and City Wide Hydrology Analysis by PBS&J. The hydrologic analyses from the City Wide will be utilized and/or adopted for reference in the subject study where necessary. The Clark County Regional Flood Control District (CCRFCD) Hydrologic Criteria and Drainage Design Manual and the CCRFCD 2002 Las Vegas Valley Flood Control Master Plan Update have been compiled and are also utilized. This report presents the hydrologic and hydraulic analyses, methodology, and results of the study.

1.2 Location of Property

The site is located at the southeast corner of the intersection of Washington Avenue and Twin Lakes Drive, extending south to the alignment of Bonanza Avenue. The site is located within a portion of the Northern Half (N 1/2) of the Southwest Quarter (SW 1/4) of Section 29, Township 20 South, Range 61 East, of the M.D.M., in the City of Las Vegas, Nevada. The site is also identified by Assessors Parcel Number APN: 139-29-301-003.

The existing Rancho Indoor Swap Meet is located adjacent to the site on the east, while

portions of the existing Twin Lakes Village and Twin Lakes Estates single family homes border the site along the southern boundary. The existing Twin Lakes Village Units and Twin Lakes Estates Units residential subdivisions are also located directly north and west across Washington Avenue and Twin Lakes Drive respectively. The southern property line of the site is in the alignment of Bonanza Avenue.

1.3 Description of Property

The entire site consists of approximately 59 acres of developed park. However, the area for the proposed renovation consists of approximately 36.0 acres. The existing site generally slopes to the east and southeast at approximately 0.90-1.00 percent. A review of the 2002 Flood Control Master Plan Update (Reference 3), Figure H-12, indicates that majority of the site and its immediate offsite watersheds are located within the hydrologic soil group D. Soil group D is defined as soils with "Low Infiltration Rate, and High Runoff Potential". The Curve Numbers (CN) for the existing and developed conditions analyses have been determined from Table 602 of the CCRFCD Hydrologic Criteria and Drainage Design Manual.

2 DRAINAGE DESCRIPTION

In the 2002 Las Vegas Valley Flood Control Master Plan Update, the valley was hydrologically divided into nine watersheds and each watershed was further subdivided into subareas. The onsite and offsite basins of the subject project area fall within the Central Watershed. The site and its immediate offsite tributary areas are located within sub-basins WA13-C and LC16-C as analyzed in the Master Plan Update. There is an existing high point in Twin Lakes Drive adjacent to the site, located approximately 500 feet south of Washington Avenue. The subject high point in the street corresponds to the sub-basin limits for WA13-C and LC16-C.

2.1 Existing Drainage Conditions

A. Offsite and Onsite Drainage

Generally, offsite flows are conveyed to the east and southeast within the surrounding streets. The offsite tributary areas to the site are fully developed and mainly consist of residential subdivisions. These areas were already studied in the City of Las Vegas Flood Control Facilities Inventory and City Wide Hydrology Analysis by PBS&J (Reference 5). The hydrologic analysis of the tributary sub-basins have been adopted from Reference 5, and will be utilized in the hydraulic design of the site. A review of Reference 5 indicates that sub-basin WA11 (29/62 cfs) is conveyed north in Twin Lakes Drive, and combines with other flows in Washington Avenue at concentration point CWA11 (174/376 cfs). Sub-basins WA13 and WA14 (21/46 cfs) are portions of the existing Twin Lakes Village Units located directly north of the site. As analyzed in Reference 5, flows from sub-basin WA13 are conveyed north towards Rancho Drive and do not impact the site. However, flows from WA14 discharge into Washington Avenue and are also conveyed east towards Rancho Drive. Surface runoff in both Twin Lakes Drive and Washington Avenue adjacent to the site have been obtained by the algebraic combination of the local flows generated onsite with the offsite flows

adopted from Reference 5. The combined existing condition flows in Washington Avenue adjacent to the site is estimated at CMX1A (212/459 cfs), and the flows increase downstream of the site as estimated at concentration point CMX2A (221/477 cfs). Furthermore, sub-basin LC15 (30/65 cfs) as analyzed in Reference 5, impacts the site in Twin Lakes Drive from the existing subdivisions to the west. Flows from LC15 are conveyed south along Twin Lakes Drive and eventually continues east on Avalon Avenue.

The existing Lorenzi Park has been analyzed as seven drainage basins identified as NX1 through NX7. The existing improvements are characteristics of a typical park and or public recreational facility with a few buildings, perimeter sidewalks, parking stalls and drive aisles. The improvements also include the tennis courts, basket ball courts and baseball courts with significant surd cover. Basin NX7 (2/3 cfs) is the existing upstream most parking lot of the site that sheet flows into Twin Lakes Drive. Runoff from NX7 is algebraically combined with offsite flows from basin WA11 to obtain surface flows in Twin Lakes Drive conveyed towards Washington Avenue. Basin NX1 (8/17 cfs) consists of the existing buildings and parking lots located at the northwest corner of the site conveyed east towards Washington Avenue. Basin NX2 (8/18 cfs) is the north central portion of the site which also consist of the entrance drive aisle and parking lots with majority of the basin covered by surd. Runoff from NX1 combines with NX2 at concentration point CMX1 (15/33 cfs), and the combined flows discharge into Washington Avenue through the driveway. Basin NX3 (9/18 cfs) is the northeastern portion of the site consisting of the existing tennis courts with perimeter sidewalks, the easternmost driveway entrance and the existing surd cover. Runoff from NX3 also discharges into Washington Avenue through the northeast corner of the site. Although flows from basins NX7, NX1 and NX2 are not conveyed through NX3, concentration point CMX2 (25/53 cfs) have been provided to estimate the total quantity of onsite flows impacting Washington Avenue in

the existing condition. Basin NX4 (4/13 cfs) is the west central portion of the site which consist of the existing manmade lake (pond) with surrounding sidewalks, parking lots and drive aisles. Runoff from NX4 is conveyed east through NX6. Basin NX5 (13/26 cfs) is the southwestern corner of the site which mainly consists of parking lots, drive aisles, a few buildings and surrounding landscape (surd cover). Runoff from NX5 is also conveyed east through basin NX6. Basin NX6 (19/45 cfs) is the southeastern majority of the site consisting of the baseball fields, paved drive aisle and basket ball courts. Majority of basin NX6 is covered by surd which is typical of baseball and public park improvements. All onsite flows from basins NX4, NX5 and NX6 combine at concentration point CMX3 (34/81 cfs), and the combined flows discharge into the adjacent parcels to the east through existing block wall openings. The onsite basins described above including the adopted concentration points from Reference 5 have been located on the Onsite Drainage Map for the Existing Condition (Sheet DR1) provided in the appendix.

2.2 Interim Drainage Condition

A. Offsite and Onsite Drainage

For the interim condition, the quantity of offsite flows adopted from Reference 5 will remain the same as in the existing condition. Additionally, the offsite areas generally consist of developed residential subdivisions. Thus, flows are not expected to increase in the future condition. The offsite flows in Washington Avenue at the intersection of Twin Lakes Drive will remain as estimated at concentration point CWA11 (174/376 cfs). Surface runoff in Washington Avenue adjacent to the site have also been obtained by the algebraic combination of the local flows generated onsite with the offsite flows adopted from Reference 5. The algebraically combined interim condition flows in Washington Avenue adjacent to the site is estimated at CMD1A (210/454 cfs), and the flows will also increase downstream of the site as estimated at concentration point CMD2A (217/467 cfs).

Similarly offsite sub-basin LC15 (30/65 cfs) as analyzed in Reference 5, impacts the site in Twin Lakes Drive from the existing subdivisions to the west. Flows from LC15 will still be conveyed south along Twin Lakes Drive and eventually continues east on Avalon Avenue. The established offsite drainage pattern will be maintained in the interim condition.

The proposed Phase I renovation improvements will only be constructed on the eastern half of the site. Therefore, the interim condition of basins NX7, NX1, NX4 and NX5 will remain as analyzed in the existing condition. However, the area for the renovations have been re-analyzed as three basins labeled ND1 through ND3. Basin ND1 (6/13 cfs) is the north central portion of the site and will mainly consist of surd cover with a network of sidewalks and picnic canopies, and also includes the new entrance driveway from Washington Avenue. Runoff from ND1 will combine with flows from the existing onsite basin NX1 at concentration point CMD1 (13/29 cfs). The combined runoff will discharge into Washington Avenue through the central driveway entrance. Basin ND2 (7/13 cfs) is the northeastern corner of the site and consists mainly of the new tennis courts. Flows from ND2 will also discharge into Washington Avenue to maintain the existing drainage patterns. The onsite basins discharging into Washington Avenue in the interim condition have been combined at concentration point CMD2 (22/46 cfs). This concentration point indicates a slight decrease and consequently an improvement over those estimated for the existing condition. Basin ND3 (17/46 cfs) is the southeastern majority of the site which comprises of significant surd cover, and also includes the new baseball fields with parking lots, drive aisles and sidewalks. Runoff from the existing upstream basins NX4 and NX5 will combine with flows from ND3 at concentration point CMD3 (32/82 cfs). The combined flows will discharge east into the adjacent parcels through a proposed wall opening. Please refer to the Onsite Drainage Map for the interim condition (Sheet DR2) provided in the appendix for the location of the basins and concentration point described

above.

2.3 Future Drainage Condition

A. Offsite and Onsite Drainage

For the future condition, both the site and the offsite basins are assumed to be fully developed. The offsite basins impacting the site in the adjacent streets will remain as estimated in the interim condition. However, a future CCRFCD facility (8'x7' RCB) to be installed in Washington Avenue will have adequate capacity to completely intercept all flows in the street adjacent to the site. Therefore, the future condition of the street will be significantly improved over the existing and interim conditions. In addition, the flows in Twin Lakes Drive will remain as already estimated in the existing and interim conditions. Thus, the future condition hydrologic and hydraulic analysis of the site and surrounding streets have not been revisited.

Furthermore, the onsite analysis presented in the existing and interim conditions represents the ultimate improvement of the site, since all the proposed improvements generally consists of renovations. Therefore, a re-analysis of the existing onsite basins will not be necessary and have not been provided.

2.4 Master Planning Information

The "*2002 Las Vegas Valley Flood Control Master Plan Update*", dated September 2002, as prepared by Post Buckley Schuh and Jernigan, Inc. (PBS&J), in association with G. C. Wallace Inc., and Louis Berger Group, for the Clark County Regional Flood Control District (CCRFCD) (Reference 3) illustrates the proposed regional master planned facilities in the area as shown on Figure F-12.

Review of the Master Plan Update (Reference 3), indicates a proposed CCRFCD facility in Washington Avenue adjacent to the site. The facility is identified in Reference 3 as LV15 0528: Las

Vegas Freeway Channel. The proposed facility will consist of an 8'x7' RCB of approximately 3,900 feet long with a flow capacity of 925 cfs. The facility is also identified in Reference 5 as LV15 0460 and was called out as a 66" RCP as adopted from the 1996 CCRFCD Master Plan Update.

2.5 Flood Plain Information

The project site is covered by Flood Insurance Rate Map (FIRM) for the Clark County, Nevada, and incorporated areas, Community Parcel Number: 32003C 2170 E, Effective Date: September 27, 2002 (Reference 4). The upstream portion of the site also encroaches into Panel Number 32003C 2165 E which is not printed.

Review of panels 3200C 2165 E and 3200C 2170 E, indicates that the site is located entirely within FEMA Flood Zone "X" (unshaded). Additionally, all the panels that not printed enclose areas located within Zone "X" (unshaded). Zone "X" (unshaded) is described by the Federal Emergency Management Agency (FEMA) as:

"*Areas determined to be outside the 0.2% annual chance floodplain*".

Figure 2 in the Appendix illustrates the location of the site on a portion of the above referenced Flood Insurance Rate Map.

2.6 Previous Drainage Studies

The overall area is covered within the CCRFCD "*2002 Las Vegas Valley Flood Control Master Plan Update, Volume I and II*" (Reference 2 and 3), and "*City of Las Vegas Flood Control Facilities Inventory and City Wide Hydrology Analysis Volume II*" (Reference 5). The offsite flows impacting the site within the perimeter streets have been adopted from Reference 5. Lochsa Engineering has reviewed the above Master Plan studies and generally concurs with the results and methodology established therein. The flows in Washington Avenue as established in Reference 5 were adopted for the hydraulic design of the site.

3. PROPOSED DRAINAGE FACILITIES

3.1 General Description

The proposed improvements have been designed to maintain the existing drainage patterns. Runoff has been designed to flow within L-curbs, valley gutters and minor swales. The runoff impacting the site in Washington Avenue was adopted from the City of Las Vegas Flood Control Facilities Inventory and City Wide Hydrology Analysis. A portion of the flows generated onsite will be conveyed to Washington Avenue while the remainder majority of the site drains eastwards to discharge into the adjacent parcels. The improvements addressed by the subject study are generally onsite but will include driveway installation onto Washington Avenue.

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 Clark County Regional Flood Control District (CCRFCD) "*Hydrologic Criteria and Drainage Design Manual*" (HCDDM) (Reference 1), and the CCRFCD "*Flood Control Master Plan Update*" (Reference 2). The design of this development is also in compliance with the Federal Emergency Management Agency (FEMA)(Reference 3) and the "*City of Las Vegas Flood Control Facilities Inventory and City Wide Hydrology Analysis*".

3.3 Hydrologic Criteria

The onsite and offsite basins of the subject property fall within the Central Watershed. The hydrologic analysis and drainage of the project site is designed in accordance with the CCRFCD Hydrologic Criteria and Drainage Design Manual (HCDDM) (Reference 3). The rainfall values used for the hydrologic analysis of the site represent the 10-year and 100-year storm recurrence events, each with a six-hour duration. The site is within the boundary for using the McCarran Airport Rainfall Data, therefore precipitation data was determined using Table 505 of the HCDDM (Reference 1). The adjusted point rainfall values for the 6-hour, 10-year and 100-year storm events

are determined from Table 505 as 1.58 and 2.77 inches, respectively. The rainfall losses due to infiltration, interception, etc. are represented using the SCS curve number (CN) method recommended in the CCRFCD Manual (Reference 1). The SCS method divides the soils into four hydrologic groups as A, B, C and D. Review of the 2002 Flood Control Master Plan Update's (Reference 3), Figure H-12, indicates that majority of the site is within the hydrologic soil group D. Soil group D is defined as soils with "Low Infiltration Rate, and High Runoff Potential". The Curve Numbers (CN) for the existing and developed condition has been determined from Table 602 of the CCRFCD Hydrologic Criteria and Drainage Design Manual. 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 offsite and onsite basins for existing and developed conditions are attached in Appendix A.

3.4 Facility Design Calculations

All drainage facilities within this project area have been designed in accordance with the HCDDM (Reference 1). Drainage facilities and street flow capacities were calculated based on Manning's equation. The proposed onsite drainage plan has been designed to closely resemble historic drainage patterns. Street capacity calculations for Washington Avenue and Twin Lakes Drive adjacent to the site have been provided in the appendix for both the existing and proposed conditions. The street capacity calculations for Twin Lakes Drive indicate that the Velocity x Depth (V*D) Products meets the street design criteria. However, the V*D criteria is not satisfied in Washington Avenue in both the existing and proposed conditions. Additionally, the minimum 12' wide dry lane for 80' or more right-of-way widths is not satisfied. These conditions are existing and has not been adversely impacted by the proposed improvements. The street conditions will be improved by the future CCRFCD facility (8'x7' RCB) to be installed in Washington Avenue, since

the facility will have the capacity to intercept all flows impacting the street adjacent to the site.

Furthermore, majority of the existing condition onsite flows estimated at concentration point CMX3 (35/81 cfs) generally impacts the adjacent eastern parcel through an existing 48"x16" block wall opening. These flows are estimated at concentration point CMD3 (32/82 cfs) in the proposed condition. An analysis of the existing block wall opening indicates that the 100-year flows will not efficiently discharge through the single opening. Orifice condition governs the discharge through the openings with a pond of approximately 3.0' behind the wall opening. The proposed improvements have been designed to closely resemble and maintain the existing drainage patterns. The block wall opening calculations have been provided in the appendix. The wall opening and ponding condition behind the wall is already existing and has not been adversely impacted by the improvements. Due to the significant quantity of runoff impacting the opening, it is recommended that the wall opening be replaced with a wrought iron gate.

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 "*Master Plan Update*", and will not conflict with any Master Planned Facilities.
3. This project is in compliance with the CCRFCD "*Hydrologic Criteria and Drainage Design Manual*" (Reference 1).
4. The site is generally located within Federal Emergency Management Agency (FEMA) Flood Zone "X" (unshaded). Zone "X" (ushaded) is described by FEMA as: "*Areas determined to be outside the 0.2% annual chance floodplain*".
5. The drainage facilities for this project have been designed to control and convey the onsite runoff from the 100-year storm safely through the site. In addition, they have been designed based on generally accepted engineering practices.
6. The subject improvements generally consist of the renovations to a portion of the existing park. No buildings and/or finished floor elevations are being proposed. The flow depths in Washington Avenue are significant with erosive velocities. However, this condition is already existing and has not been adversely impacted by the proposed improvements. It is recommended that a floodwall be constructed along Washington Avenue to keep offsite flows away from the site. However, the street condition will be improved by the future CCRFCD facility (8'x7' RCB) to be installed in Washington Avenue.

5. REFERENCES

1. Clark County Regional Flood Control District, "*Hydrologic Criteria and Drainage Design Manual,*" August 1999.
2. Post, Buckley, Schuh & Jernigan Inc., G.C. Wallace, and Louis Berger, "*2002 Las Vegas Valley Flood Control Master Plan Update, Volume I,*" September 2002.
3. Post, Buckley, Schuh & Jernigan Inc., G.C. Wallace, and Louis Berger, "*2002 Las Vegas Valley Flood Control Master Plan Update, Volume II,*" September 2002.
4. Federal Emergency Management Agency, "*Flood Insurance Rate Map; Community Panel Numbers 3200C 2165 E and 32003C 2170 E; Clark County, Nevada and Incorporated Areas,*" Dated September 27, 2002.
5. Post, Buckley, Schuh & Jernigan (PBS&J) Inc., "*City of Las Vegas Flood Control Facilities Inventory and City Wide Hydrology Analysis Volume II*". December 1997.

Peak Flow Summary
Existing Condition

HEC-1 I.D.	Area (acres)	10-year Flow (cfs)	100-year Flow (cfs)
NX7	1.13	2	3
NX1	5.68	8	17
NX2	7.90	8	18
CMX1	-	15	33
NX3	6.71	9	18
CMX2	-	25	53
NX4	8.39	4	13
RNX4	-	4	13
NX5	8.90	13	26
RNX5	-	13	25
NX6	21.22	19	45
CMX3	-	35	81

Peak Flow Summary
Proposed Condition

HEC-1 I.D.	Area (acres)	10-year Flow (cfs)	100-year Flow (cfs)
NX7	1.13	2	3
NX1	5.68	8	17
ND1	5.74	6	13
CMD1	-	13	29
ND2	4.68	7	13
CMD2	-	22	46
NX4	8.39	4	13
RNX4	-	4	13
NX5	8.90	13	26
RNX5	-	13	24
ND3	25.39	17	46
CMD3	-	32	82

Street Flow Summary
(Existing Condition)

10-year, 6-hour Storm

Street	Right of Way Width (ft)	Hydraulic Section	10-Year Flow [Q10] (cfs)	10-year Velocity [v] (fps)	10-year Flow Depth [d] (ft)	10-year Velocity x Depth Product (v x d)	Dry Lane Width (ft) (Within 1/2 ROW)
Twin Lakes Drive	50	AA	30	3.03	0.62	1.88	N/A
Twin Lakes Drive	50	BB	31	5.90	0.54	3.19	N/A
Washington Avenue	80	CC	176	6.02	0.92	5.54	No Dry Lane
Washington Avenue	80	DD	212	7.01	0.94	6.59	No Dry Lane
Washington Avenue	80	EE	221	4.74	1.07	5.07	No Dry Lane

Street Flow Summary
(Existing Condition)

100-year, 6-hour Storm

Street	Right of Way Width (ft)	Hydraulic Section	100-Year Flow [Q100] (cfs)	100-year Velocity [v] (fps)	100-year Flow Depth [d] (ft)	100-year Velocity x Depth Product (v x d)
Twin Lakes Drive	50	AA	65	4.01	0.74	2.97
Twin Lakes Drive	50	BB	65	7.33	0.70	5.13
Washington Avenue	80	CC	379	7.88	1.16	9.14
Washington Avenue	80	DD	458	9.23	1.18	10.89
Washington Avenue	80	EE	476	6.42	1.42	9.12

Street Flow Summary
(Proposed Condition)

10-year, 6-hour Storm

Street	Right of Way Width (ft)	Hydraulic Section	10-Year Flow [Q10] (cfs)	10-year Velocity [v] (fps)	10-year Flow Depth [d] (ft)	10-year Velocity x Depth Product (v x d)	Dry Lane Width (ft) (Within 1/2 ROW)
Twin Lakes Drive	50	AA	30	3.03	0.62	1.88	N/A
Twin Lakes Drive	50	BB	31	5.90	0.54	3.19	N/A
Washington Avenue	80	CC	176	6.02	0.92	5.54	No Dry Lane
Washington Avenue	80	DD	210	6.99	0.93	6.50	No Dry Lane
Washington Avenue	80	EE	217	4.71	1.07	5.04	No Dry Lane

Street Flow Summary
(Proposed Condition)

100-year, 6-hour Storm

Street	Right of Way Width (ft)	Hydraulic Section	100-Year Flow [Q100] (cfs)	100-year Velocity [v] (fps)	100-year Flow Depth [d] (ft)	100-year Velocity x Depth Product (v x d)
Twin Lakes Drive	50	AA	65	4.01	0.74	2.97
Twin Lakes Drive	50	BB	65	7.33	0.70	5.13
Washington Avenue	80	CC	379	7.88	1.16	9.14
Washington Avenue	80	DD	454	9.20	1.18	10.86
Washington Avenue	80	EE	467	6.37	1.41	8.98

APPENDIX A

HYDROLOGIC ANALYSIS

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.

MAP LEGEND

AVERAGE QA VALUE 35

ASSESSOR'S PARCELS - CLARK CO., NV.
M. W. Schofield, Assessor

BOOK T20S R61E | SEC 29 | MAP N 2 SW 4 | 139-29-3

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

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

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

001 1.00	PARCEL NUMBER ACREAGE
202	PARCEL SUB/SEQ NUMBER
PB 25-45	PLAT RECORDING NUMBER
5	BLOCK NUMBER
5	LOT NUMBER
GL5	GOV. LOT NUMBER
001	ROAD ID NUMBER

PARCEL BOUNDARY
SUBD BOUNDARY
ROAD EASEMENT
PM/LD BOUNDARY
NON-PARCEL LOT LINE
MATCH LINE

Not To Scale | Rev:11/24/97

WASHINGTON AVE
TWIN LAKES DR
BELROSE ST
AVALON AVE
TWIN LAKES ESTATES
ARTESIA AVE

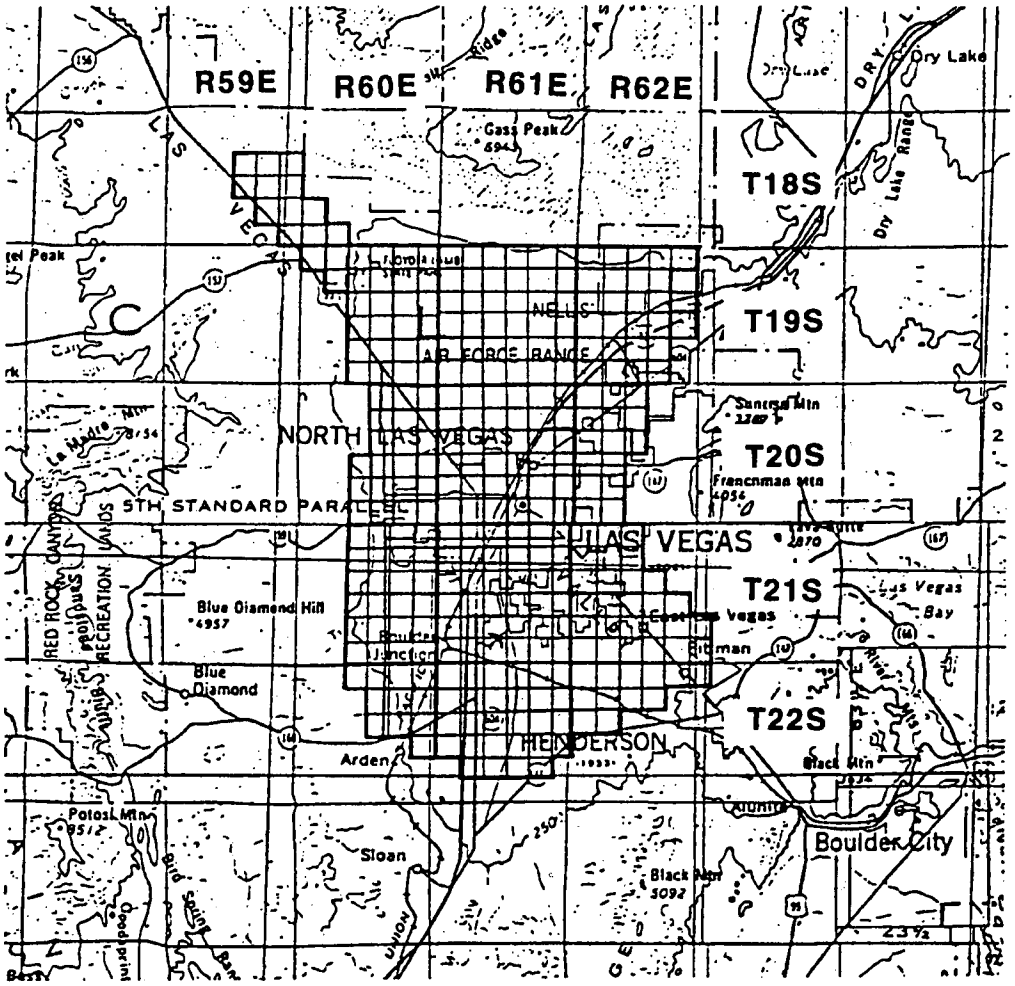
K-LAS VEGAS
(A Commercial Subdivision)
PB 61-50

001 0.48
003 0.72
002 9.95
004 1.38
004 1.99
005 2.00
006 3.69
301 003 59.37
310
200
207
70

Project Site

TAX DIST 200,207

McCARRAN AIRPORT RAINFALL AREA



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

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

Revision	Date

WRC ENGINEERING

REFERENCE:
USACE, Los Angeles District, 1988

FIGURE 513

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

SIX-HOUR STORM DISTRIBUTIONS

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

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

RUNOFF CURVE NUMBERS
(URBAN AREAS[1])

Cover description		Curve numbers for hydrologic soil group–			
Cover type and hydrologic condition	Average percent impervious area[2]	A	B	C	D
Fully developed urban areas (vegetation established)					
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					
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation)[5]		77	86	91	94

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

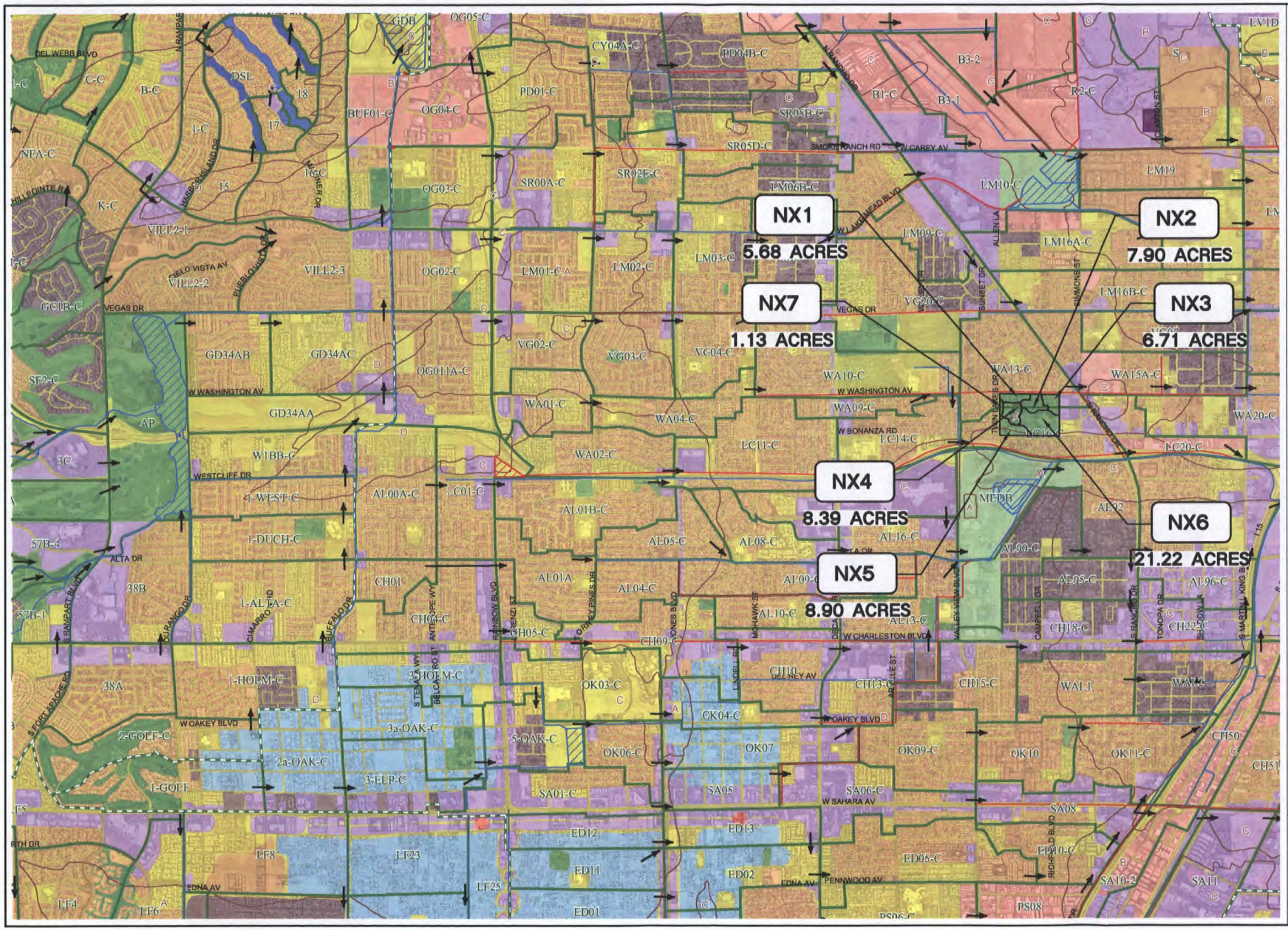
2 The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system. Impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition.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



REGIONAL FLOOD CONTROL DISTRICT

2002 LAS VEGAS VALLEY FLOOD CONTROL MASTER PLAN UPDATE

LEGEND

- Ultimate Development Boundary
- Watershed Boundary
- ID Subarea Boundary
- Flow Arrows

Flood Control Facilities

- Existing Facilities
- Proposed Facilities

Type Hydrologic Soil Groups

- A Low Runoff Potential
- B Moderately Low Runoff Potential
- C Moderately High Runoff Potential
- D High Runoff Potential

Typical Land Use

1. Undeveloped Land, Open Desert
2. Parks, Golf Courses
3. Rural
4. Low Density Residential
5. Medium Density Residential
6. High Density Residential
7. Public Facility, Multi Family
8. Commercial, Office, Retail, Casino
9. Light Industrial
10. Heavy Industrial
11. Schools
12. Lakes

N W E S

0 1,000 2,000 3,000 4,000 5,000 Feet

SCALE: 1 inch = 3000 feet

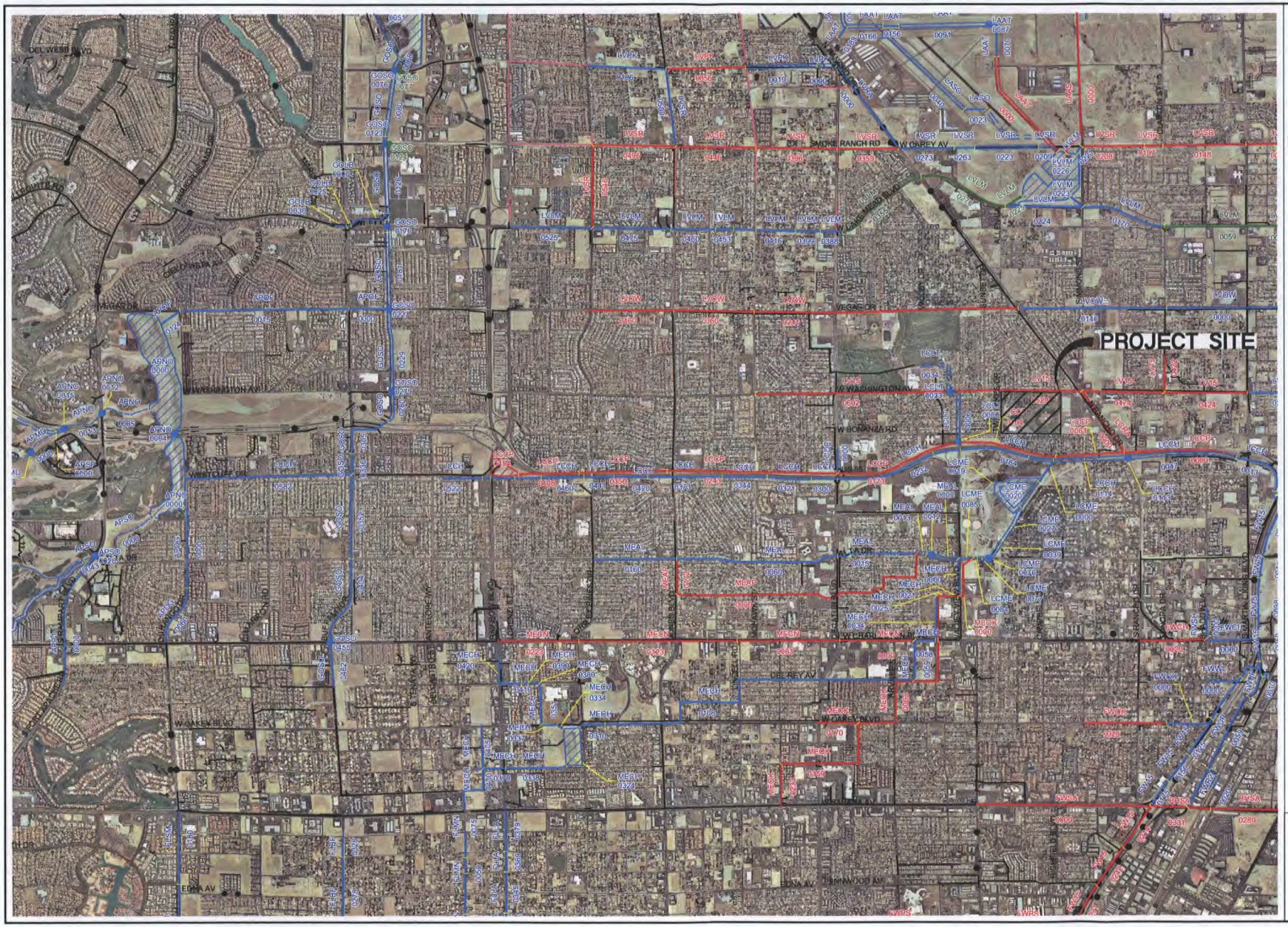
US95 I-15 I-215

HYDROLOGIC SUBAREAS, LAND USE & SOILS

FIGURE H-12

PBS&J

G.C. WALLACE, INC.



REGIONAL FLOOD CONTROL DISTRICT

2002 LAS VEGAS VALLEY FLOOD CONTROL MASTER PLAN UPDATE

LEGEND

- Ultimate Development Boundary
- Existing Facilities
- Category A Proposed Facilities
- Category B Proposed Facilities
- Local Existing Facilities
- Local Proposed Facilities
- Detention Basin
- Culvert
- Bridge
- Pipeline
- Lined Channel
- Unlined Channel
- Dike
- Natural Wash
- ID-Mile Separator

N W E S

0 1,000 2,000 3,000 4,000 5,000 Feet

SCALE: 1 inch = 3000 feet

US95 I-15 I-215

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

FLOOD CONTROL FACILITIES
FIGURE F-12

PBS&J

C.C. WILLIAMS, INC.

DEVELOPMENT: Lorenzi Park Renovation Phase I
CALCULATED BY: SOA
PROJECT NUMBER: 61132

DATE: April 2007

SUB-BASIN DATA			INITIAL/OVERLAND TIME (ti)				TRAVEL TIME (tt)				tc CHECK (URBANIZED BASINS)		FINAL tc	REMARKS			
DESIGN (1)	K (2)	AREA Ac (3)	AREA Sq. mile (4)	LENGTH Ft (5)	SLOPE % (6)	ti Min (7)	LENGTH Ft (8)	SLOPE % (9)	VELOCITY FPS (10)	tt Min (11)	TOTAL LENGTH Ft (12)	tc =(L/180)+10 Min (13)	Min (14)	CN (15)	tL Hrs (16)	Urbanized? (18)	Soil Type (19)
NX1	0.8442	5.68	0.00888	280	3.2	5.2	708	1.8	3.8	3.1	988	15.5	8.3	93.5	0.083	YES	D
NX2	0.8086	7.90	0.01234	260	3.1	5.8	820	0.7	1.1	12.0	1,080	16.0	16.0	90.8	0.160	YES	D
NX3	0.8442	6.71	0.01048	248	0.8	7.8	698	0.3	2.7	4.3	946	15.3	12.1	93.5	0.121	YES	D
NX4	0.6739	8.39	0.01311	156	0.4	13.1	477	2.8	3.0	2.7	633	13.5	13.5	80.6	0.135	YES	A/D
NX5	0.8589	8.90	0.01391	255	4.3	4.3	1,301	1.5	3.8	5.7	1,556	18.6	9.9	94.6	0.099	YES	C/D
NX6	0.7907	21.22	0.03316	360	3.3	7.1	1,092	0.7	1.4	12.6	1,452	18.1	18.1	89.5	0.181	YES	D
NX7	0.8561	1.13	0.00177	100	1.0	4.4	533	0.6	1.7	5.3	633	13.5	9.7	94.4	0.097	YES	D
ND1	0.7848	5.74	0.00897	265	2.9	6.4	758	0.5	2.2	5.8	1,023	15.7	12.2	89.0	0.122	YES	D
ND2	0.8858	4.68	0.00731	288	0.4	8.7	501	0.5	2.5	3.4	789	14.4	12.1	96.7	0.121	YES	D
ND3	0.7254	25.39	0.03967	405	2.8	9.7	1,950	0.4	5.6	5.8	2,355	23.1	15.5	84.5	0.155	YES	D

ti = 1.8 (1.1 - K) L^(0.5) / S^(1/3)

K = 0.0132 CN - 0.39

tt = L / (60 V)

tc = ti + tt

tL= tLAG = 0.6 tc

LOCATION: Onsite

HYDROLOGIC CONDITION: Existing and Proposed

TRIAL: Final Iteration

Curve Number Calculations
Lorenzi Park Renovation Phase I

Sub-Basin: **NX1**
Total Area: 5.68 Acres

Land Use/Cover type	Area [A] (acres)	Soil Type	Percentage, P [P]	Cruve Number [CN]	Product {CN x P}
Open Space: Poor Condition	2.84	D	50%	89	44.5
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)	2.84	D	50%	98	49.0
Total:	5.68	--------	100%	----------	93.5

Curve Number Calculations
Lorenzi Park Renovation Phase I

Sub-Basin: **NX2**
Total Area: 7.90 Acres

Land Use/Cover type	Area [A] (acres)	Soil Type	Percentage, P [P]	Cruve Number [CN]	Product {CN x P}
Open Space: Poor Condition	6.32	D	80%	89	71.2
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)	1.58	D	20%	98	19.6
Total:	7.90	--------	100%	----------	90.8

Curve Number Calculations
Lorenzi Park Renovation Phase I

Sub-Basin: **NX3**
Total Area: 6.71 Acres

Land Use/Cover type	Area [A] (acres)	Soil Type	Percentage, P [P]	Cruve Number [CN]	Product {CN x P}
Open Space: Poor Condition	3.36	D	50%	89	44.5
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)	3.36	D	50%	98	49.0
Total:	6.71	--------	100%	----------	93.5

Curve Number Calculations
Lorenzi Park Renovation Phase I

Sub-Basin: **NX4**
Total Area: 8.39 Acres

Land Use/Cover type	Area [A] (acres)	Soil Type	Percentage, P [P]	Cruve Number [CN]	Product {CN x P}
Open Space: Poor Condition	4.61	A	55%	68	37.4
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)	2.94	D	35%	98	34.3
Open Space: Poor Condition	0.84	D	10%	89	8.9
Total:	8.39	---	100%	---	80.6

Curve Number Calculations
Lorenzi Park Renovation Phase I

Sub-Basin: **NX5**
Total Area: 8.90 Acres

Land Use/Cover type	Area [A] (acres)	Soil Type	Percentage, P [P]	Cruve Number [CN]	Product {CN x P}
Open Space: Poor Condition	3.12	D	35%	89	31.2
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)	5.34	D	60%	98	58.8
Open Space: Poor Condition	0.18	C	2%	86	1.7
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)	0.27	C	3%	98	2.9
Total:	8.90	---	100%	---	94.6

Curve Number Calculations
Lorenzi Park Renovation Phase I

Sub-Basin: **NX6**
Total Area: 21.22 Acres

Land Use/Cover type	Area [A] (acres)	Soil Type	Percentage, P [P]	Cruve Number [CN]	Product {CN x P}
Open Space: Poor Condition	20.16	D	95%	89	84.6
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)	1.06	D	5%	98	4.9
Total:	21.22	---	100%	---	89.5

Curve Number Calculations
Lorenzi Park Renovation Phase I

Sub-Basin: **NX7**
Total Area: 1.13 Acres

Land Use/Cover type	Area [A] (acres)	Soil Type	Percentage, P [P]	Cruve Number [CN]	Product {CN x P}
Open Space: Poor Condition	0.45	D	40%	89	35.6
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)	0.68	D	60%	98	58.8
Total:	1.13	-------	100%	----------	94.4

Curve Number Calculations
Lorenzi Park Renovation Phase I

Sub-Basin: **ND1**
Total Area: 5.74 Acres

Land Use/Cover type	Area [A] (acres)	Soil Type	Percentage, P [P]	Cruve Number [CN]	Product {CN x P}
Open Space: Poor Condition	5.74	D	100%	89	89.0
Total:	5.74	-------	100%	----------	89.0

Curve Number Calculations
Lorenzi Park Renovation Phase I

Sub-Basin: **ND2**
Total Area: 4.68 Acres

Land Use/Cover type	Area [A] (acres)	Soil Type	Percentage, P [P]	Cruve Number [CN]	Product {CN x P}
Open Space: Poor Condition	0.70	D	15%	89	13.4
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)	3.98	D	85%	98	83.3
Total:	4.68	--------	100%	----------	96.7

Curve Number Calculations
Lorenzi Park Renovation Phase I

Sub-Basin: **ND3**
Total Area: 25.39 Acres

Land Use/Cover type	Area [A] (acres)	Soil Type	Percentage, P [P]	Cruve Number [CN]	Product {CN x P}
Open Space: Good Condition	19.04	D	75%	80	60.0
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)	6.35	D	25%	98	24.5
Total:	25.39	--------	100%	----------	84.5

AVERAGE VELOCITY

Input Variables	Basin NX1	Basin NX2	Basin NX3	Basin NX4	Basin NX5	Basin NX6	Basin NX7	Basin ND1	Basin ND2	Basin ND3						
Bottom Width, B, (ft):	2.0	5.0	2.0	5.0	2.0	5.0	2.0	2.0	2.0	4.0						
Right Side Slope, Zr:	0	100	50	100	50	100	0	0	3	0						
Left Side Slope, Zl:	50	100	0	100	0	100	50	50	3	0						
Manning's n:	0.015	0.030	0.015	0.015	0.015	0.030	0.015	0.015	0.025	0.013						
Geometric Slope, So (ft/ft):	0.018	0.007	0.007	0.028	0.015	0.007	0.006	0.005	0.005	0.004						
Flowrate, Q (cfs):	9	9	9	7	13	23	2	7	7	23						
Output Variables																
Normal Depth, Yn (ft):	0.27	0.26	0.33	0.13	0.33	0.37	0.18	0.32	0.70	1.03						
Area of Flow, A, (sf):	2.37	7.87	3.34	2.36	3.40	15.90	1.20	3.19	2.85	4.11						
Velocity, V (fps):	3.80	1.14	2.69	2.97	3.83	1.45	1.67	2.19	2.46	5.60						
Wetted Perimeter, p (ft):	15.79	56.34	18.73	31.10	18.87	79.90	11.32	18.30	6.41	6.05						
Hydraulic Radius, Rh (ft):	0.15	0.14	0.18	0.08	0.18	0.20	0.11	0.17	0.44	0.68						
Free SurfaceTop Width, T (ft):	15.51	56.34	18.39	31.10	18.54	79.90	11.14	17.98	6.18	4.00						
Centroid, Y*, (ft):	0.10	0.09	0.12	0.05	0.12	0.13	0.07	0.12	0.29	0.51						

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

Lorenzi Park Renovation Phase I

10-Year and 100-Year 6-Hour Storm: Existing Condition

FILE: 61132X.DAT

```
*****************************************
*                                       *
*  FLOOD HYDROGRAPH PACKAGE  (HEC-1)    *
*            JUN  1998                  *
*          VERSION 4.1                  *
*                                       *
*  RUN DATE  05APR07  TIME  10:56:00    *
*                                       *
*****************************************
```


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


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

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

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

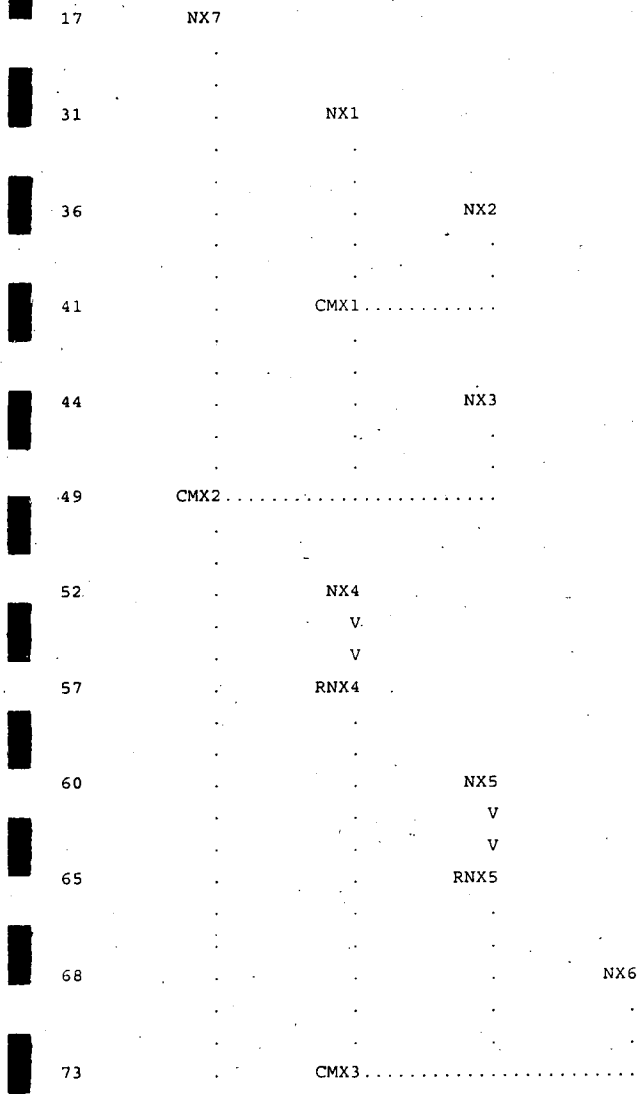
```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

    1     ID        LORENZI PARK RENOVATION PHASE I-TECHNICAL DRAINAGE STUDY
    2     ID        EXISTING CONDITION - ONSITE
    3     ID        USING SCS METHODS AND KINEMATIC WAVE ROUTING
    4     ID        MASTER PLAN ADJUSTED 6-HOUR RAINFALL AND STORM DISTRIBUTION
    5     ID
    6     ID        FILE:  61132X.DAT
    7     ID
    8     ID        ****************************************
    9     ID             McCARRAN AIRPORT RAINFALL AREA
   10     ID             10 & 100 YEAR - 6 HOUR STORM EVENT
   11     ID
   12     ID        ****************************************
          *DIAGRAM
   13     IT      5                    300
   14     IO      5       0
   15     IN      5
   16     JR    PREC   .5704     1.0

   17     KK     NX7
   18     PB    2.77
   19     PC     0.0      .02     .057      .07     .087     .108     .124      .13      .13      .13
   20     PC      .13      .13      .13     .133      .14     .142     .148     .158     .172     .181
   21     PC      .19     .197     .199       .2     .201     .204     .214     .229     .241     .249
   22     PC     .251     .256      .27     .278     .281     .283     .295     .322     .352     .409
   23     PC     .499      .59      .71     .744     .781     .812     .819     .835     .851     .856
   24     PC      .86     .868     .876     .888      .91     .926     .937      .95      .97     .976
   25     PC     .982     .985     .987     .989      .99     .993     .993     .994     .995     .998
   26     PC     .998     .999      1.0
   27     KM   ONSITE BASIN NX7
   28     BA  .00177
   29     LS       0    94.4
   30     UD    .097

   31     KK     NX1
   32     KM   ONSITE BASIN NX1
   33     BA  .00888
   34     LS       0    93.5
   35     UD    .083

   36     KK     NX2
   37     KM   ONSITE BASIN  NX2
   38     BA  .01234
   39     LS       0    90.8
   40     UD    .160

   41     KK    CMX1
   42     KM   COMBINE BASINS NX1 AND NX2
   43     HC       2

   44     KK     NX3
   45     KM   ONSITE BASIN  NX3
   46     BA  .01048
   47     LS       0    93.5
   48     UD    .121
```

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

  49          KK    CMX2
  50          KM   COMBINE BASIN NX3 WITH CMX1
  51          HC       3

  52          KK     NX4
  53          KM   ONSITE BASIN  NX4
  54          BA  .01311
  55          LS       0    80.6
  56          UD    .135

  57          KK    RNX4
  58          KM   ROUTE BASIN NX4 THROUGH NX6
  59          RK    1452   0.007   0.030           TRAP       5       100

  60          KK     NX5
  61          KM   ONSITE BASIN  NX5
  62          BA  .01391
  63          LS       0    94.6
  64          UD    .099

  65          KK    RNX5
  66          KM   ROUTE BASIN NX5 THROUGH NX6
  67          RK    1092   0.007   0.030           TRAP       5       100

  68          KK     NX6
  69          KM   ONSITE BASIN  NX6
  70          BA  .03316
  71          LS       0    89.5
  72          UD    .181

  73          KK    CMX3
  74          KM   COMBINE BASINS NX4, NX5 AND NX6
  75          HC       3
  76          ZZ
```

SCHEMATIC DIAGRAM OF STREAM NETWORK

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

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



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
**************************************
*                                    *
*  FLOOD HYDROGRAPH PACKAGE  (HEC-1) *
*            JUN  1998               *
*          VERSION 4.1               *
*                                    *
*  RUN DATE  05APR07  TIME  10:56:00 *
*                                    *
**************************************
```


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


LORENZI PARK RENOVATION PHASE I-TECHNICAL DRAINAGE STUDY
EXISTING CONDITION - ONSITE
USING SCS METHODS AND KINEMATIC WAVE ROUTING
MASTER PLAN ADJUSTED 6-HOUR RAINFALL AND STORM DISTRIBUTION

FILE: 61132X.DAT

****

McCARRAN AIRPORT RAINFALL AREA
10 & 100 YEAR - 6 HOUR STORM EVENT

****

14 IO OUTPUT CONTROL VARIABLES

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

IT HYDROGRAPH TIME DATA

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

COMPUTATION INTERVAL .08 HOURS
TOTAL TIME BASE 24.92 HOURS

ENGLISH UNITS

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

JP MULTI-PLAN OPTION

NPLAN	1	NUMBER OF PLANS

JR MULTI-RATIO OPTION
RATIOS OF PRECIPITATION
.57 1.00

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS

FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES

TIME TO PEAK IN HOURS

					RATIOS APPLIED TO PRECIPITATION	
OPERATION	STATION	AREA	PLAN		RATIO 1	RATIO 2
					.57	1.00
HYDROGRAPH AT	NX7	.00	1	FLOW	2.	3.
				TIME	3.50	3.50
HYDROGRAPH AT	NX1	.01	1	FLOW	8.	17.
				TIME	3.50	3.50
YDROGRAPH AT	NX2	.01	1	FLOW	8.	18.
				TIME	3.58	3.58
2 COMBINED AT	CMX1	.02	1	FLOW	15.	33.
				TIME	3.50	3.50
YDROGRAPH AT	NX3	.01	1	FLOW	9.	18.
				TIME	3.58	3.58
3 COMBINED AT	CMX2	.03	1	FLOW	25.	53.
				TIME	3.58	3.50
YDROGRAPH AT	NX4	.01	1	FLOW	4.	13.
				TIME	3.58	3.58
ROUTED TO	RNX4	.01	1	FLOW	4.	13.
				TIME	3.67	3.67
HYDROGRAPH AT	NX5	.01	1	FLOW	13.	26.
				TIME	3.50	3.50
ROUTED TO	RNX5	.01	1	FLOW	13.	25.
				TIME	3.58	3.58
HYDROGRAPH AT	NX6	.03	1	FLOW	19.	45.
				TIME	3.58	3.58
3 COMBINED AT	CMX3	.06	1	FLOW	34.	81.
				TIME	3.58	3.58

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING

(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	INTERPOLATED TO COMPUTATION INTERVAL DT	PEAK	TIME TO PEAK	VOLUME
		(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)
FOR PLAN = 1 RATIO= .57									
	RNX4 MANE	2.79	3.79	222.29	.35	5.00	3.72	220.00	.35

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2407E+00 EXCESS= .0000E+00 OUTFLOW= .2419E+00 BASIN STORAGE= .3876E-06 PERCENT ERROR= -.5

FOR PLAN = 1 RATIO= 1.00									
	RNX4 MANE	2.10	12.95	219.26	1.12	5.00	12.63	220.00	1.12

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7799E+00 EXCESS= .0000E+00 OUTFLOW= .7824E+00 BASIN STORAGE= .3663E-06 PERCENT ERROR= -.3

FOR PLAN = 1 RATIO= .57									
	RNX5 MANE	1.58	12.93	213.35	1.06	5.00	12.62	215.00	1.06

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7827E+00 EXCESS= .0000E+00 OUTFLOW= .7860E+00 BASIN STORAGE= .1302E-06 PERCENT ERROR= -.4

FOR PLAN = 1 RATIO= 1.00									
	RNX5 MANE	1.32	25.25	213.42	2.19	5.00	24.56	215.00	2.19

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1622E+01 EXCESS= .0000E+00 OUTFLOW= .1626E+01 BASIN STORAGE= .1889E-06 PERCENT ERROR= -.3

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

Lorenzi Park Renovation Phase I

10-Year and 100-Year 6-Hour Storm: Proposed Condition

FILE: 61132P.DAT

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

RUN DATE 05APR07 TIME 10:56:31

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

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

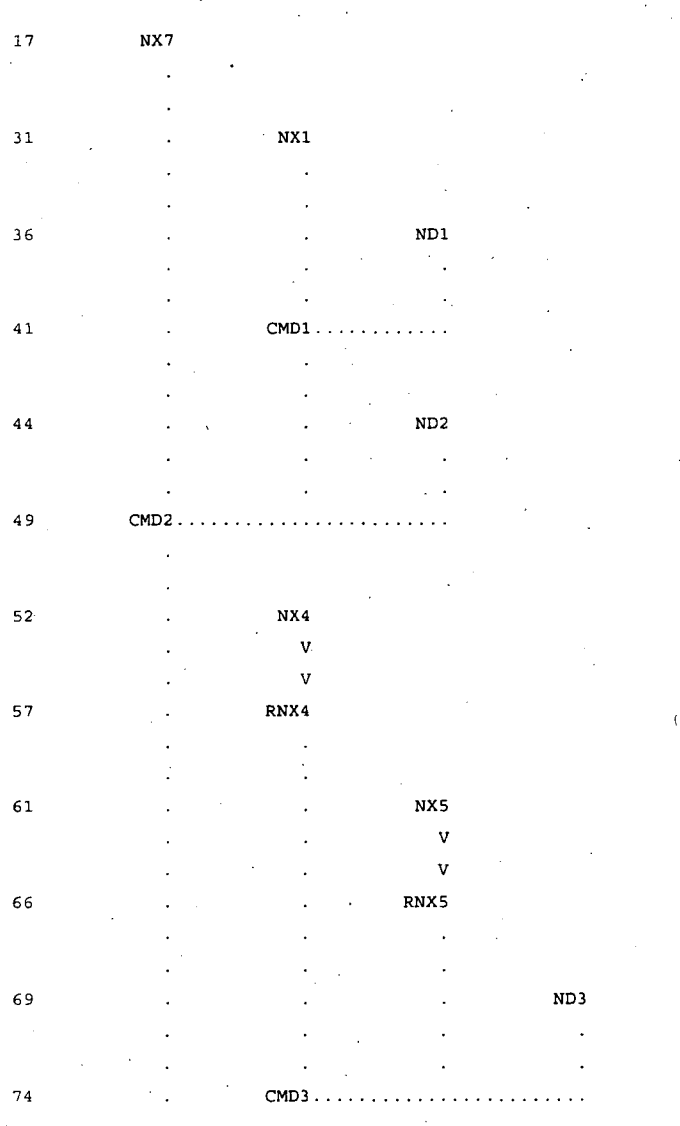
```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

    1     ID        LORENZI PARK RENOVATION PHASE I-TECHNICAL DRAINAGE STUDY
    2     ID        PROPOSED CONDITION - ONSITE
    3     ID        USING SCS METHODS AND KINEMATIC WAVE ROUTING
    4     ID        MASTER PLAN ADJUSTED 6-HOUR RAINFALL AND STORM DISTRIBUTION
    5     ID
    6     ID        FILE:  61132P.DAT
    7     ID
    8     ID        ****************************************
    9     ID             McCARRAN AIRPORT RAINFALL AREA
   10     ID             10 & 100 YEAR - 6 HOUR STORM EVENT
   11     ID
   12     ID        ****************************************
          *DIAGRAM
   13     IT       5                    300
   14     IO       5       0
   15     IN       5
   16     JR    PREC   .5704     1.0

   17     KK     NX7
   18     PB    2.77
   19     PC     0.0      .02     .057      .07     .087     .108     .124      .13      .13      .13
   20     PC     .13      .13      .13     .133      .14     .142     .148     .158     .172     .181
   21     PC     .19     .197     .199       .2     .201     .204     .214     .229     .241     .249
   22     PC    .251     .256      .27     .278     .281     .283     .295     .322     .352     .409
   23     PC    .499      .59      .71     .744     .781     .812     .819     .835     .851     .856
   24     PC     .86     .868     .876     .888      .91     .926     .937      .95      .97     .976
   25     PC    .982     .985     .987     .989      .99     .993     .993     .994     .995     .998
   26     PC    .998     .999     1.0
   27     KM   ONSITE BASIN NX7
   28     BA  .00177
   29     LS       0    94.4
   30     UD    .097

   31     KK     NX1
   32     KM   ONSITE BASIN NX1
   33     BA  .00888
   34     LS       0    93.5
   35     UD    .083

   36     KK     ND1
   37     KM   ONSITE BASIN  ND1
   38     BA  .00897
   39     LS       0    89.0
   40     UD    .122

   41     KK    CMD1
   42     KM   COMBINE BASINS NX1 AND ND1
   43     HC       2

   44     KK     ND2
   45     KM   ONSITE BASIN  ND2
   46     BA  .00731
   47     LS       0    96.7
   48     UD    .121
```

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

   49     KK    CMD2
   50     KM   COMBINE BASIN ND2 WITH CMD1
   51     HC       3

   52     KK     NX4
   53     KM   ONSITE BASIN  NX4
   54     BA  .01311
   55     LS       0    80.6
   56     UD    .135

   57     KK    RNX4
   58     KM   ROUTE BASIN NX4 THROUGH ND3
   59     RK     405   0.030   0.030          TRAP       5     100
   60     RK    1950   0.004   0.013          TRAP       4       0

   61     KK     NX5
   62     KM   ONSITE BASIN  NX5
   63     BA  .01391
   64     LS       0    94.6
   65     UD    .099

   66     KK    RNX5
   67     KM   ROUTE BASIN NX5 THROUGH ND3
   68     RK    1950   0.004   0.013          TRAP       4       0

   69     KK     ND3
   70     KM   ONSITE BASIN  ND3
   71     BA  .03967
   72     LS       0    84.5
   73     UD    .155

   74     KK    CMD3
   75     KM   COMBINE BASINS NX4, NX5 AND ND3
   76     HC       3
   77     ZZ
```

SCHEMATIC DIAGRAM OF STREAM NETWORK

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

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



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

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**************************************
*                                    *
*  FLOOD HYDROGRAPH PACKAGE  (HEC-1) *
*            JUN  1998               *
*         VERSION 4.1                *
*                                    *
*  RUN DATE  05APR07  TIME  10:56:31 *
*                                    *
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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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LORENZI PARK RENOVATION PHASE I-TECHNICAL DRAINAGE STUDY
PROPOSED CONDITION - ONSITE
USING SCS METHODS AND KINEMATIC WAVE ROUTING
MASTER PLAN ADJUSTED 6-HOUR RAINFALL AND STORM DISTRIBUTION

FILE: 61132P.DAT

****
McCARRAN AIRPORT RAINFALL AREA
10 & 100 YEAR - 6 HOUR STORM EVENT
****

14 IO OUTPUT CONTROL VARIABLES

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

IT HYDROGRAPH TIME DATA

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

COMPUTATION INTERVAL .08 HOURS
TOTAL TIME BASE 24.92 HOURS

ENGLISH UNITS

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

JP MULTI-PLAN OPTION

NPLAN	1	NUMBER OF PLANS

JR MULTI-RATIO OPTION
RATIOS OF PRECIPITATION
.57 1.00

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

					RATIOS APPLIED TO PRECIPITATION	
OPERATION	STATION	AREA	PLAN		RATIO 1	RATIO 2
					.57	1.00
HYDROGRAPH AT	NX7	.00	1	FLOW	2.	3.
				TIME	3.50	3.50
HYDROGRAPH AT	NX1	.01	1	FLOW	8.	17.
				TIME	3.50	3.50
HYDROGRAPH AT	ND1	.01	1	FLOW	6.	13.
				TIME	3.58	3.58
2 COMBINED AT	CMD1	.02	1	FLOW	13.	29.
				TIME	3.50	3.50
HYDROGRAPH AT	ND2	.01	1	FLOW	7.	13.
				TIME	3.58	3.58
3 COMBINED AT	CMD2	.03	1	FLOW	22.	46.
				TIME	3.50	3.50
HYDROGRAPH AT	NX4	.01	1	FLOW	4.	13.
				TIME	3.58	3.58
ROUTED TO	RNX4	.01	1	FLOW	4.	12.
				TIME	3.67	3.58
HYDROGRAPH AT	NX5	.01	1	FLOW	13.	26.
				TIME	3.50	3.50
ROUTED TO	RNX5	.01	1	FLOW	13.	24.
				TIME	3.58	3.58
HYDROGRAPH AT	ND3	.04	1	FLOW	16.	46.
				TIME	3.58	3.58
3 COMBINED AT	CMD3	.07	1	FLOW	32.	82.
				TIME	3.58	3.58

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING

(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	INTERPOLATED TO COMPUTATION INTERVAL DT	PEAK	TIME TO PEAK	VOLUME
		(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)
FOR PLAN = 1 RATIO= .57									
	RNX4 MANE	1.99	3.89	218.72	.35	5.00	3.82	220.00	.35

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2407E+00 EXCESS= .0000E+00 OUTFLOW= .2418E+00 BASIN STORAGE= .1398E-04 PERCENT ERROR= -.5

FOR PLAN = 1 RATIO= 1.00									
	RNX4 MANE	1.28	12.89	217.04	1.12	5.00	12.21	215.00	1.12

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7799E+00 EXCESS= .0000E+00 OUTFLOW= .7822E+00 BASIN STORAGE= .1399E-04 PERCENT ERROR= -.3

FOR PLAN = 1 RATIO= .57									
	RNX5 MANE	1.37	12.86	213.22	1.06	5.00	12.53	215.00	1.06

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7827E+00 EXCESS= .0000E+00 OUTFLOW= .7872E+00 BASIN STORAGE= .1225E-04 PERCENT ERROR= -.6

FOR PLAN = 1 RATIO= 1.00									
	RNX5 MANE	.94	25.41	212.50	2.19	5.00	24.32	215.00	2.19

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1622E+01 EXCESS= .0000E+00 OUTFLOW= .1628E+01 BASIN STORAGE= .1303E-04 PERCENT ERROR= -.4

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

APPENDIX B

HYDRAULIC ANALYSIS

STREET CAPACITY CALCULATIONS

Twin Lakes Drive and Washington Avenue-Existing and Proposed Conditions

Twin Lakes Drive @ Section AA-Existing and Proposed Conditions (10-Year)
Worksheet for Irregular Channel

Project Description	
Worksheet	Twin Lakes Drive @ Section AA-Existing and Proposed Co
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Slope	007900	ft/ft
Discharg	30.00	cfs

Options	
Current Roughness Metho	ved Lotter's Method
Open Channel Weighting	ved Lotter's Method
Closed Channel Weightin	Horton's Method

Results		
Mannings Coefficie	0.015	
Water Surface Elev	37.12	ft
Elevation Range	.50 to 37.16	
Flow Area	9.9	ft²
Wetted Perimeter	48.46	ft
Top Width	47.32	ft
Actual Depth	0.62	ft
Critical Elevation	37.14	ft
Critical Slope	0.005628	ft/ft
Velocity	3.03	ft/s
Velocity Head	0.14	ft
Specific Energy	37.26	ft
Froude Number	1.17	
Flow Type	Supercritical	

Calculation Messages:
Water elevation exceeds lowest end station by 0.36213215e-1 ft.
Flow is divided.

Roughness Segments

Start Station	End Station	Mannings Coefficient
0+00.000	0+08.000	0.013
0+08.000	0+44.800	0.016
0+44.800	0+50.800	0.013

Natural Channel Points

Station (ft)	Elevation (ft)
0+00.000	37.12
0+06.000	37.00
0+06.500	37.00
0+06.500	36.50
0+08.000	36.63
0+08.000	36.67
0+25.000	37.16

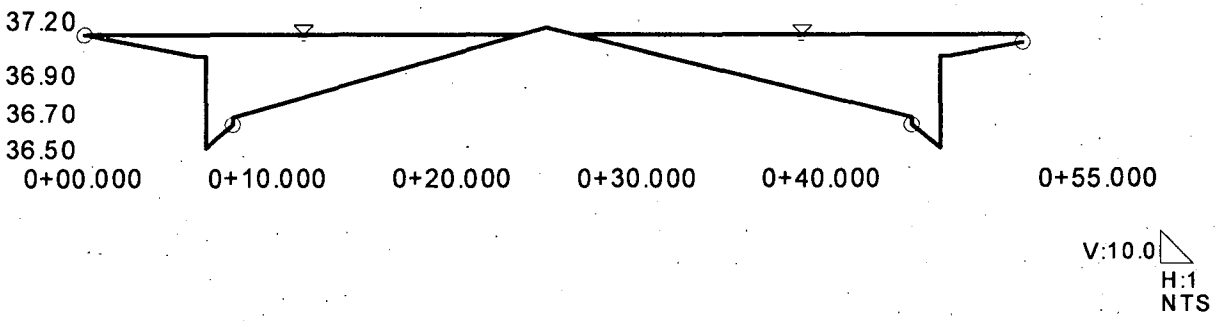
Twin Lakes Drive @ Section AA-Existing and Proposed Conditions (10-Year)
Worksheet for Irregular Channel

Natural Channel Points	
Station (ft)	Elevation (ft)
0+44.800	36.67
0+44.800	36.63
0+46.300	36.50
0+46.300	37.00
0+46.800	37.00
0+50.800	37.08

Twin Lakes Drive @ Section AA-Existing and Proposed Conditions (10-Year)
Cross Section for Irregular Channel

Project Description	
Worksheet	Twin Lakes Drive @ Section AA-Existing and Proposed Co
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficie	0.015	
Slope	0.007900	ft/ft
Water Surface Elev	37.12	ft
Elevation Range	1.50 to 37.16	
Discharge	30.00	cfs



Twin Lakes Drive @ Section AA-Existing and Proposed Conditions (100-Year)
Worksheet for Irregular Channel

Project Description	
Worksheet	Twin Lakes Drive @ Section AA-Existing and Proposed Cor
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Slope	007900 ft/ft
Discharg	65.00 cfs

Options	
Current Roughness Metho	ved Lotter's Method
Open Channel Weighting	ved Lotter's Method
Closed Channel Weightin	Horton's Method

Results		
Mannings Coefficie	0.015	
Water Surface Elev	37.24	ft
Elevation Range	.50 to 37.16	
Flow Area	16.2	ft²
Wetted Perimeter	52.19	ft
Top Width	50.80	ft
Actual Depth	0.74	ft
Critical Elevation	37.29	ft
Critical Slope	0.004818	ft/ft
Velocity	4.01	ft/s
Velocity Head	0.25	ft
Specific Energy	37.49	ft
Froude Number	1.25	
Flow Type	Supercritical	

Calculation Messages:
Water elevation exceeds lowest end station by 0.16219042 ft.

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+00.000	0+08.000	0.013
0+08.000	0+44.800	0.016
0+44.800	0+50.800	0.013

Natural Channel Points	
Station (ft)	Elevation (ft)
0+00.000	37.12
0+06.000	37.00
0+06.500	37.00
0+06.500	36.50
0+08.000	36.63
0+08.000	36.67
0+25.000	37.16
0+44.800	36.67

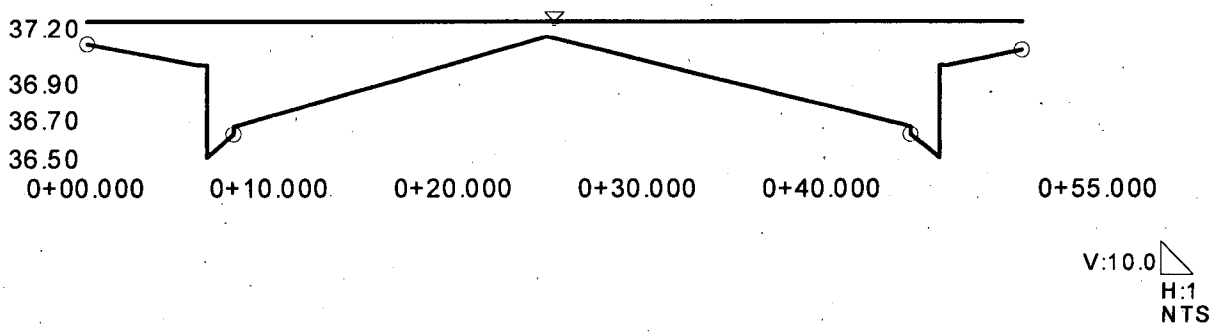
Twin Lakes Drive @ Section AA-Existing and Proposed Conditions (100-Year)
Worksheet for Irregular Channel

Natural Channel Points	
Station (ft)	Elevation (ft)
0+44.800	36.63
0+46.300	36.50
0+46.300	37.00
0+46.800	37.00
0+50.800	37.08

Twin Lakes Drive @ Section AA-Existing and Proposed Conditions (100-Year)
Cross Section for Irregular Channel

Project Description	
Worksheet	Twin Lakes Drive @ Section AA-Existing and Proposed Cor
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficier	0.015	
Slope	0.007900	ft/ft
Water Surface Elev	37.24	ft
Elevation Range	1.50 to 37.16	
Discharge	65.00	cfs



Twin Lakes Drive @ Section BB-Existing and Proposed Conditions (10-Year)
Worksheet for Irregular Channel

Project Description	
Worksheet	Twin Lakes Drive @ Section BB-Existing and Proposed Co
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Slope	032900 ft/ft
Discharge	31.00 cfs

Options	
Current Roughness Meth	ved Lotter's Method
Open Channel Weighting	ved Lotter's Method
Closed Channel Weightin	Horton's Method

Results		
Mannings Coefficie	0.015	
Water Surface Elev	36.08	ft
Elevation Range	.50 to 36.64	
Flow Area	5.3	ft²
Wetted Perimeter	28.80	ft
Top Width	27.68	ft
Actual Depth	0.58	ft
Critical Elevation	36.24	ft
Critical Slope	0.005021	ft/ft
Velocity	5.90	ft/s
Velocity Head	0.54	ft
Specific Energy	36.62	ft
Froude Number	2.39	
Flow Type	Supercritical	

Calculation Messages:
Flow is divided.
Water elevation exceeds lowest end station by 0.40441927e-2 ft.

Roughness Segments

Start Station	End Station	Mannings Coefficient
0+00.000	0+05.800	0.013
0+05.800	0+43.000	0.016
0+43.000	0+50.800	0.013

Natural Channel Points

Station (ft)	Elevation (ft)
0+00.000	36.08
0+03.800	36.00
0+04.300	36.00
0+04.300	35.50
0+05.800	35.63
0+05.800	35.67
0+25.000	36.64

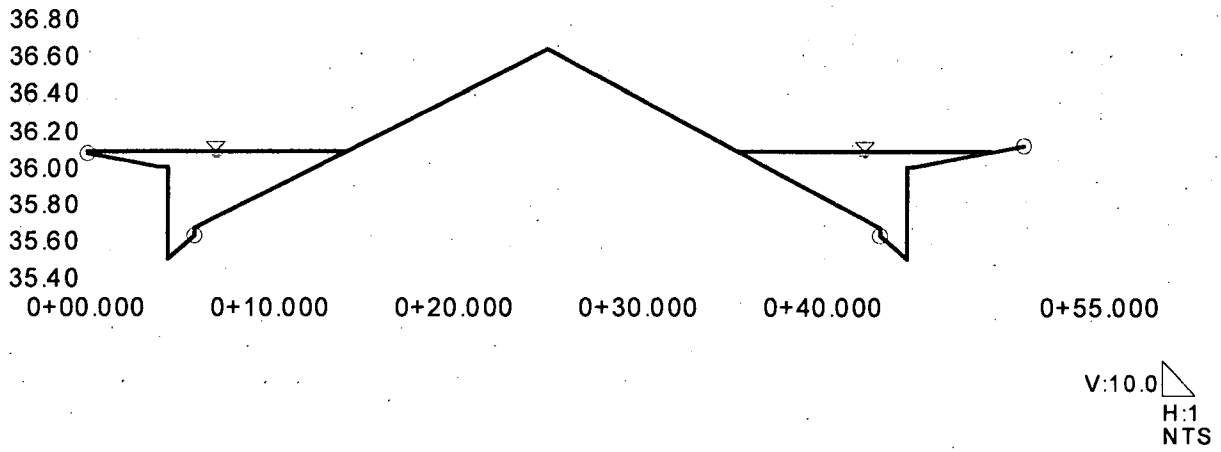
Twin Lakes Drive @ Section BB-Existing and Proposed Conditions (10-Year)
Worksheet for Irregular Channel

Natural Channel Points	
Station (ft)	Elevation (ft)
0+43.000	35.67
0+43.000	35.63
0+44.500	35.50
0+44.500	36.00
0+44.800	36.00
0+50.800	36.12

Twin Lakes Drive @ Section BB-Existing and Proposed Conditions (10-Year)
Cross Section for Irregular Channel

Project Description	
Worksheet	Twin Lakes Drive @ Section BB-Existing and Proposed Co
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficie	0.015	
Slope	0.032900	ft/ft
Water Surface Elev	36.08	ft
Elevation Range	.50 to 36.64	
Discharge	31.00	cfs



Twin Lakes Drive @ Section BB-Existing and Proposed Conditions (100-Year)
Worksheet for Irregular Channel

Project Description	
Worksheet	Twin Lakes Drive @ Section BB-Existing and Proposed Cor
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Slope	032900	ft/ft
Discharg	65.00	cfs

Options	
Current Roughness Metho	ved Lotter's Method
Open Channel Weighting	ved Lotter's Method
Closed Channel Weightin	Horton's Method

Results		
Mannings Coefficie	0.015	
Water Surface Elev	36.20	ft
Elevation Range	.50 to 36.64	
Flow Area	8.9	ft²
Wetted Perimeter	35.21	ft
Top Width	33.89	ft
Actual Depth	0.70	ft
Critical Elevation	36.43	ft
Critical Slope	0.004442	ft/ft
Velocity	7.33	ft/s
Velocity Head	0.83	ft
Specific Energy	37.03	ft
Froude Number	2.52	
Flow Type	Supercritical	

Calculation Messages:
Water elevation exceeds lowest end station by 0.11917179 ft.
Flow is divided.

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+00.000	0+05.800	0.013
0+05.800	0+43.000	0.016
0+43.000	0+50.800	0.013

Natural Channel Points	
Station (ft)	Elevation (ft)
0+00.000	36.08
0+03.800	36.00
0+04.300	36.00
0+04.300	35.50
0+05.800	35.63
0+05.800	35.67
0+25.000	36.64

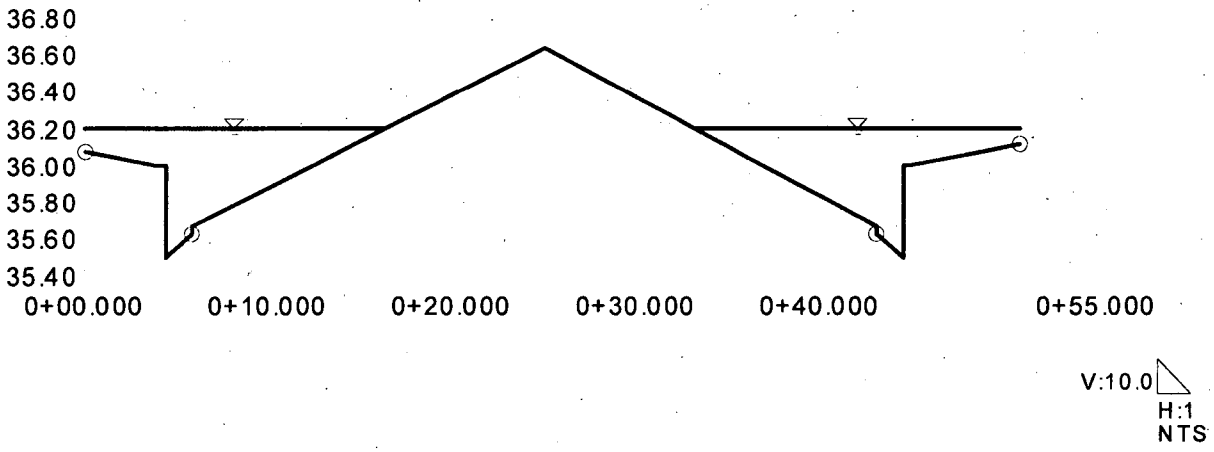
Twin Lakes Drive @ Section BB-Existing and Proposed Conditions (100-Year)
Worksheet for Irregular Channel

Natural Channel Points	
Station (ft)	Elevation (ft)
0+43.000	35.67
0+43.000	35.63
0+44.500	35.50
0+44.500	36.00
0+44.800	36.00
0+50.800	36.12

Twin Lakes Drive @ Section BB-Existing and Proposed Conditions (100-Year)
Cross Section for Irregular Channel

Project Description	
Worksheet	Twin Lakes Drive @ Section BB-Existing and Proposed Cor
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficie	0.015	
Slope	0.032900	ft/ft
Water Surface Elev	36.20	ft
Elevation Range	.50 to 36.64	
Discharge	65.00	cfs



Washington Avenue @ Section CC-Existing and Proposed Conditions (100-Year)
Worksheet for Irregular Channel

Project Description	
Worksheet	Washington Avenue @ Section CC-Existing and Proposed C
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Slope	013300	ft/ft
Discharg	379.00	cfs

Options	
Current Roughness Metho	ved Lotter's Method
Open Channel Weighting	ved Lotter's Method
Closed Channel Weightin	Horton's Method

Results		
Mannings Coefficie	0.015	
Water Surface Elev	22.66	ft
Elevation Range	.50 to 22.50	
Flow Area	48.1	ft²
Wetted Perimeter	82.24	ft
Top Width	80.00	ft
Actual Depth	1.16	ft
Critical Elevation	22.95	ft
Critical Slope	0.003681	ft/ft
Velocity	7.88	ft/s
Velocity Head	0.96	ft
Specific Energy	23.63	ft
Froude Number	1.79	
Flow Type	Supercritical	

Calculation Messages:
Water elevation exceeds lowest end station by 0.56163171 ft.

Roughness Segments

Start Station	End Station	Mannings Coefficient
0+00.000	0+07.000	0.013
0+07.000	0+73.000	0.016
0+73.000	0+80.000	0.013

Natural Channel Points

Station (ft)	Elevation (ft)
0+00.000	22.10
0+05.000	22.00
0+05.500	22.00
0+05.500	21.50
0+07.000	21.63
0+07.000	21.67
0+40.000	22.50
0+73.000	21.67

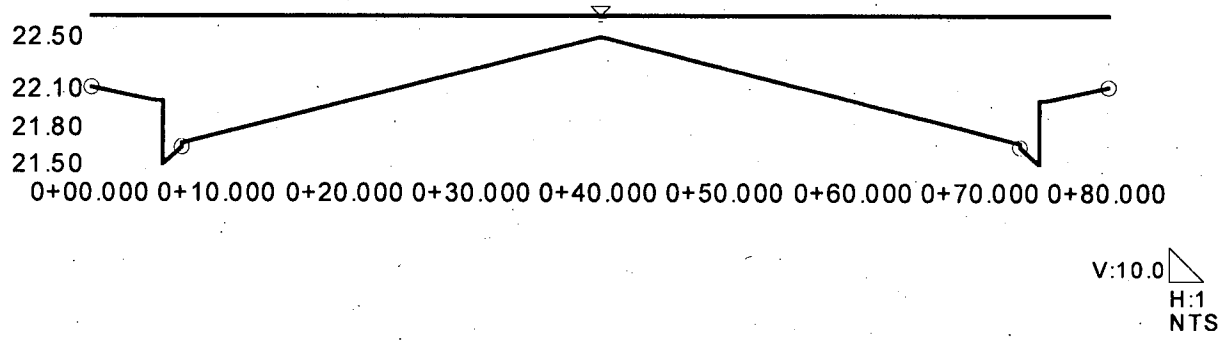
Washington Avenue @ Section CC-Existing and Proposed Conditions (100-Year)
Worksheet for Irregular Channel

Natural Channel Points	
Station (ft)	Elevation (ft)
0+73.000	21.63
0+74.500	21.50
0+74.500	22.00
0+75.000	22.00
0+80.000	22.10

Washington Avenue @ Section CC-Existing and Proposed Conditions (100-Year)
Cross Section for Irregular Channel

Project Description	
Worksheet	Washington Avenue @ Section CC-Existing and Proposed C
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficie	0.015	
Slope	0.013300	ft/ft
Water Surface Elev	22.66	ft
Elevation Range	.50 to 22.50	
Discharge	379.00	cfs



Washington Avenue @ Section CC-Existing and Proposed Conditions (100-Year)
Worksheet for Irregular Channel

Project Description	
Worksheet	Washington Avenue @ Section CC-Existing and Proposed C
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Slope	013300	ft/ft
Discharg	379.00	cfs

Options	
Current Roughness Metho	ved Lotter's Method
Open Channel Weighting	ved Lotter's Method
Closed Channel Weightin	Horton's Method

Results		
Mannings Coefficie	0.015	
Water Surface Elev	22.66	ft
Elevation Range	.50 to 22.50	
Flow Area	48.1	ft²
Wetted Perimeter	82.24	ft
Top Width	80.00	ft
Actual Depth	1.16	ft
Critical Elevation	22.95	ft
Critical Slope	0.003681	ft/ft
Velocity	7.88	ft/s
Velocity Head	0.96	ft
Specific Energy	23.63	ft
Froude Number	1.79	
Flow Type	Supercritical	

Calculation Messages:
Water elevation exceeds lowest end station by 0.56163171 ft.

Roughness Segments

Start Station	End Station	Mannings Coefficient
0+00.000	0+07.000	0.013
0+07.000	0+73.000	0.016
0+73.000	0+80.000	0.013

Natural Channel Points

Station (ft)	Elevation (ft)
0+00.000	22.10
0+05.000	22.00
0+05.500	22.00
0+05.500	21.50
0+07.000	21.63
0+07.000	21.67
0+40.000	22.50
0+73.000	21.67

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