HYDROLOGY STUDY
ADDENEDUM #1

for

Rainbow Car Wash

CLARK COUNTY, NEVADA

HYDROLOGIC CRITERIA AND DRAINAGE MANUAL

DRAINAGE STUDY INFORMATION FORM

Name of Development: RAINBOW CARWASH Date: 2.23.22

Location of Development: a) Descriptive (Cross Streets) North/South: NELLIS BLVD.

East/West: SOUTH OF OWENS

b) Section: 28 Township: 20S Range: 62E

c) APN: 140-28-110-003

Name of Owner: MARK & LORI MILLER

Telephone No.: 775-830-6475 Fax No.: E-Mail Address: LORIMILLER@LIVE.COM

Address: 1281 TERMINAL WAY RENO NV 89502

Contact Person-Name: Sam C. Dunnam **Telephone No.:** 702.682.1715

*** E-Mail Address:** sam.dunnam@tylin.com **Fax No.:**

Firm: TY Lin International

Address: 4050 Dean Martin Drive LV NV 89103

Type of Land Development/Land Disturbance Process:

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

1. Total Owned Land Area: At Site: 0.7AC Being Developed/Disturbed: 0.7AC
2. Is a portion or all of the subject property located in a designated FEMA Flood Hazard Area? ☐ **Yes**** ☒ **No**
3. Is the property bordered or crossed by an existing or proposed Clark County Regional Flood Control District Master Planned Facility? ☒ **Yes**** ☐ **No**
4. Proposed type of development (Residential, Commercial, Etc.): COMMERCIAL
5. Approximate upstream land area which drains to the subject site: 56Ac±
6. Has the site drainage been evaluated in the past? ☒ **YES** ☐ **NO** If yes, please identify documentation: PW-22-10974
7. If known, please briefly identify the proposed discharge point(s) of runoff from the site: SW CORNER OF SITE
8. Briefly describe your proposed schedule for the subject project: ASAP.

PROFESSIONAL ENGINEER-STATE OF NEVADA
SAM C. DUNNAM
EXP. 12-31-
CIVIL
No. 7886

Engineer's Seal

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

*New Required Field

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

Local Entity File No.

Revision	Date

REFERENCE:

STANDARD FORM 1

Updated 05/01/2008

Department of Public Works

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

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

Drainage Study Comment Letter

Date: February 17, 2022
Firm: Ty Lin International
Engineer: Sam C. Dunnam
Address: 4050 Dean Martin Drive, Las Vegas, NV 89103
Phone: (702) 682-1715
Fax:
E-mail: sam.dunnam@tylin.com

Subject: Technical Drainage Study for Rainbow Carwash
Location: SEC of Owens Avenue and Nellis Boulevard
APN: 140-28-110-003
Sec, Township, Range: S28, T20S, R62E
Flood Zone & Panel: Zone X, 2185F, Dated November 16, 2011
Application Number: PW22-10974

Submittals	Date Received	Date Returned	Reviewer	Miscellaneous
Technical	02/03/2022	02/17/2022	CR	

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

Responses to the following comments must be addressed and provided with the next submittal. Incomplete responses may result in further review and time delays to the drainage study approval. CCPW Development Review will not be held responsible for project delays due to incomplete responses.

CCPW – Development Review Comments:

1. The site is adjacent to Las Vegas; therefore, City of Las Vegas concurrence is required.

2. The site is off Nellis Boulevard, an NDOT ROW; therefore, NDOT concurrence is required.

3. The site is adjacent to Facility LVNE 0089; therefore, CCRFCD concurrence is required.

4. Please note, the 2018 MPU is the most current reference for flood control facilities. The 2013 MPU Figure F-28 and 2018 MPU Figure F-26 have been provided in the study. The 2013 figures are no longer used and should not be included in the study.

5. Note, there appears to be a typo on Page 3 of the report. The text says the site is in McCarran rainfall area, but it is not, however, calculations appear to use correct adjustment ratios, tables, figures, etc., for areas outside the McCarran rainfall area.

6. It is noted that the subject study is using previously approved drainage studies. It is the engineer's responsibility when using/accepting reference material to verify that the assumptions and conclusions from the reference material are still representative of current conditions. The engineer must **provide a statement** that they have reviewed and concur that the current conditions are the same as those from the reference material.

7. The figures have been redlined and attached with these comments. Review and revise accordingly. Ensure these original redlined figures are returned with the next submittal. Some items to address:

    a. Label contours on the figures.
    b. The bar scale does not measure correctly on the printed figure. This could be a printing issue.
    c. Add the hydraulic cross-section to the legend.

8. The site is soil map unit 200 with hydrologic soil group "C" soil. Per the 2018 MPU Curve Number Matrix, it appears the existing curve number is 85 and developed curve number is 95. Review and revise accordingly.

9. Standard Form 4 does not appear to be correct. The calculated lag time for Basin FUT appears to be 0.094, not 0.074. The travel time velocity shown for Basin FUT should be calculated from the V1 equation. It appears the velocity was calculated using the V2 equation. Review and revise accordingly.

10. It is noted dry lane is not met in Nellis. When this study revises curve numbers, etc., determine whether there is any additional flow in the developed condition compared to the existing condition. Address any increase in flow onto Nellis.

11. Cross-section 1 and 2 for the flow in Nellis uses referenced flows of 167/60 for the Q100/Q10. This project site discharges 2/1 cfs onto Nellis per the HEC-1 model for the project site. Provide a hydraulic cross-section using the total flow in Nellis adjacent to the site. Flood protect the site accordingly.

12. It does not appear that the site entrances are adequate to prevent flow from entering the site. Provide calculations to show the site entrance is elevated at least 6-inches above the 100-year WSE in the adjacent street per Section 903.6 of the HCDDM.

13. There is an East Swale and a South Swale FlowMaster calculation. If these swale calculations are for a BMP swale the side slopes need to be revised to 4:1 per Section 1500 of the Manual. Review and revise accordingly.

14. Per Table 4 in the reference material for study 11-44701; D100 =1.10 ft, V100 =4.76 fps, Q100 =167 cfs, Q10 =60 cfs. The values in this table for the depth and velocity do not match the values shown on the Developed Figure 10 for this study. Also, the referenced FlowMaster calculations show 166/59 cfs for the Q100/Q10 when the flows are 167 and 60. Provide the correct referenced FlowMaster 100-yr and 10-yr cross-sections for Nellis.

15. It is unclear why 8.5" x 11" sheets were stapled to the plan set. Do not staple 8.5" x 11" sheets to the 24" x 36" plan set. These cannot be scanned with the plans. The sheets that were stapled to the plans will be scanned as reference material with the study. In the future, please include this information in the bound drainage study.

16. Provide a construction note on the plans showing the location(s) of BMPs. Label the BMP landscape swale(s) on the plans. Show the rip rap on the plans. Label the slope and rip rap size in the BMP swale(s).

17. Provide a detail of the BMP swale showing 4:1 SS.

18. Several items are missing from the plan set. Provide the notes sheet, show abbreviations and legend for line types used etc. in the next submittal.

19. Detail S does not appear to be correct. The section shows L-curb. Extend the detail past the L-curb.

20. Per UC-21-0278, incorporate cross access with the parcel to the north. See attached. Review and revise accordingly.

21. The grading plans have been red-lined. Provide highlighter marks and responses on plans to show the issues are addressed. Do not use post-it notes to reply.

The drainage/grading plans have been red-lined and require modifications prior to the next submittal. Failure to resubmit the red-lined grading plan will require an additional $400 review fee.

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

Crissy Riland, P.E.
Senior Civil Engineer
Development Review
crissy@ClarkCountyNV.gov

W. Layne Weber, P.E., CFM
Principal Engineer
Development Review
wlweber@ClarkCountyNV.gov

February 23, 2022

Clark Co. Department of Public Works
Development Review
Christine Riland, P.E.
500 S. Grand Central Parkway Box 554000
Las Vegas, NV 89155-6040

RE: Technical Drainage Study for Rainbow Carwash
PW22-10974

Comments were received from you dated 02/17/2022 and will be addressed as follows:

1. The site is adjacent to Las Vegas: therefore, City of Las Vegas concurrence is required.

Noted.

2. The site is off Nellis Boulevard, and NDOT ROW; therefore NDOT concurrence is required.

Noted.

3. The site is adjacent to facility LVNE 0089; therefore, CCRFCD concurrence is required.

Noted.

4. Please note, the 2018 MPU is the most current reference for flood control facilities. The 2013 MPU Figure F-28 and 2018 MPU Figure F-26 have been provide in the study. The 2013 figures are no longer used and should not be included in the study.

Noted.

5. Note, there appears to be a typo on Page 3 of the report. The text says the site is in the McCarran rainfall area, bit it is not, however calculations appear to us ethe correct adjustment ratios, tables, figures, etc., for areas outside of the McCarran rainfall area.

Noted. The site is <u>not</u> within a McCarran rainfall area.

6. It is noted that the subject study is using previously approved drainage studies. It is the engineer's responsibility when using/accepting reference material to verify that the assumptions and conclusions from the reference material are still representative or current conditions. The engineer must **provide a statement** that they have reviewed and concur that the current conditions are the same as those from the reference material.

The referenced drainage study has been reviewed and hereby accepts the Q100 and Q10 flows rates, listed within, as valid for the current conditions.

7. The figures have been redlined and attached with these comments. Review and revise accordingly. Ensure these original redlined figures are returned with the next submittal. Some items to discuss:
    a. Label contours on the figures
    b. The bar scale does not measure correctly on the printed figure. This could be a printing issue.
    c. Add the hydraulic cross-section to the legend.

Figures 9 and 10 have been revised accordingly

8. The site soil map unit 200 with hydraulic soil group "C" soil. Per the 2018 MPU Curve Number Matrix, it appears the existing curve number is 85 and the developed curve number is 95. Review and revise accordingly.

Curve numbers have been revised accordingly.

9. Standard Form 4 does not appear to be correct. The calculated lag time for Basin FUT appears to be 0.094, not 0.074. The travel time velocity shown for basin FUT should be calculated from the V1 equation. It appears the velocity was calculated using the V2 equation. Review and revise accordingly.

Standard Form 4 has been revised.

10. It is noted dry lane is not met in Nellis. When this study revises curve numbers, etc., determine whether there is additional flow in the developed condition compared to the existing condition. Address any increase in flow to Nellis.

NDOT does not allow an increase in storm water release from the existing condition to the developed condition. Onsite retention has been incorporated to achieve this. Calc Sht 6 shows retention volumes and release flow rates for the detention area in the southwest corner of the site.

11. Cross-section 1 and 2 for the flow in Nellis uses referenced flows 167/60 for the Q100/Q10. This project site discharges 2/1 cfs onto Nellis per HEC-1 model for the project site. Provide a hydraulic cross-section using the total flow in Nellis adjacent to the site. Flood protect the site accordingly.

Calc Shts 7 and 8 provide analysis for referenced flow in Nellis with the addition of that which is released from the site.

12. It does not appear that the site entrances are adequate to prevent flow from entering the site. Provide calculations to shoe the site entrance is elevated at least 6-inches above the 100-year WSE in the adjacent street per Section 903.6 of the HCDDM.

The NDOT Access Management Plans prohibits access to NDOT right-of-way when an alternate method can be achieved. The commercial driveway has been eliminated.

13. There is an East Swale and a South Swale FlowMaster calculation. If these swale calculations are for BMP swale the side slopes need to be revised to 4:1 per Section 1500 of the Manual. Review and revise accordingly.

Calc Shts 3 and 4 show side slopes of 10:1 and 6:1 respectively. These side slopes are less than 4:1 slope per Section 1503.4.5. This section goes on to state that:

> **<u>Minimum</u> criteria for sizing landscape swales for parking lot BMPs using xeriscaped surface treatments are provided. Sizing was based on minimizing flow velocities and maximizing flow paths to encourage settlement of sediment.**

And:

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

Calc Shts 3A and 4A show that velocities are increased and wetted perimeters reduced when using a 4:1 side slope. The proposed 10:1 and 6:1 side slopes used are numerically more efficient at meeting the requirements of Section 1503.4.5. The swales will remain as submitted to better comply with the CCRFDM.

14. Per table 4 in the reference material for the study 11-44701; D100=1.10 ft, V100=4.76 fps, Q100=167 cfs, Q10=60 cfs. The values in this table for depth and velocity do not match the values shown on the Developed Figure 10 for this study. Also, the referenced FlowMaster calculations show 166/59 cfs for

Q100/Q10 when the flows are 167 and 60. Provide the correct referenced FlowMaster 100-yr and 10-yr cross-section for Nellis.

Calc Shts 1 and 2 provide flow analysis in Nellis Blvd. for the 10 and 100-year storms. These calculations differ from the referenced study (11-44701). This study does not agree with the flow analysis in the referenced study, thereby the inclusion of Calc Shts 1 and 2, which remain valid.

15. It is unclear why 8.5" x 11" sheets were stapled to the plan set. Do not staple 8.5" x 11" to the 24" x 36" plan set. These cannot be scanned with the plans. The sheets that were stapled to the plans will be scanned as reference with the study. In the future, please include this information in the bound drainage study.

Noted.

16. Provide a construction note on the plans showing location(s) of BMPs. Label the BMP landscape swale(s) on the plans. Show the rip rap on the plans. Label the slope and rip rap size in the BMP swale(s).

Provided as requested.

17. Provide a detail of the BMP swale showing 4:1 SS.

See response to number 13.

18. Several items are missing from the plans set. Provide the notes sheet, show abbreviations and legend for line types used etc. in the next submittal.

Noted.

19. Detail S does not appear to be correct. The sections show L-curb. Extend the detail past the L-curb.

Revised as requested.

20. Per UC-21-0278, incorporate cross access wit the parcel to the north. See attached. Review and revise accordingly.

The commercial driveway onto Nellis Blvd. has been eliminated. Access is shown to be through the parcels to the north.

21. The grading plans have been red-lined. Provide highlighter marks and responses on the plan to show issues are addressed. Do not use post-it notes to reply.

Noted.

REVISED CN Values – Existing Condition

ex	85 (undeveloped land, open desert)

REVISED CN Values – Developed Condition

FUT	95 (commercial, retail, casino, high rise, condos)
off1	98 (paved areas)

REVISED Storm Flow Quantities – Existing Condition

Basin	**Area**	**10-Yr**	**100-Yr**
ex	0.71 AC	1 cfs	1 cfs

Storm Flow Quantities – Developed Condition

Basin	**Area**	**10-Yr**	**100-Yr**
FUT	0.71 AC	1 cfs	1 cfs
	(1 cfs retained onsite)		
off1	0.04 AC	0 cfs	0 cfs

REVISED Street Flow Quantities

Street	**Q100**	**Slope**	**Depth**	**Velocity**	**VD**
Nellis Sta. 275+96 (**see calc sht #1**)	167 cfs	0.73%	1.0'	3.5 fps	2.6
Nellis Sta. 275+00 (**see calc sht #8**)	168 cfs	0.73%	1.0'	3.5 fps	2.6

Respectfully,

Sam C. Dunnam, P.E., QSD, QSP
(702(682.1715

LIST OF FIGURES

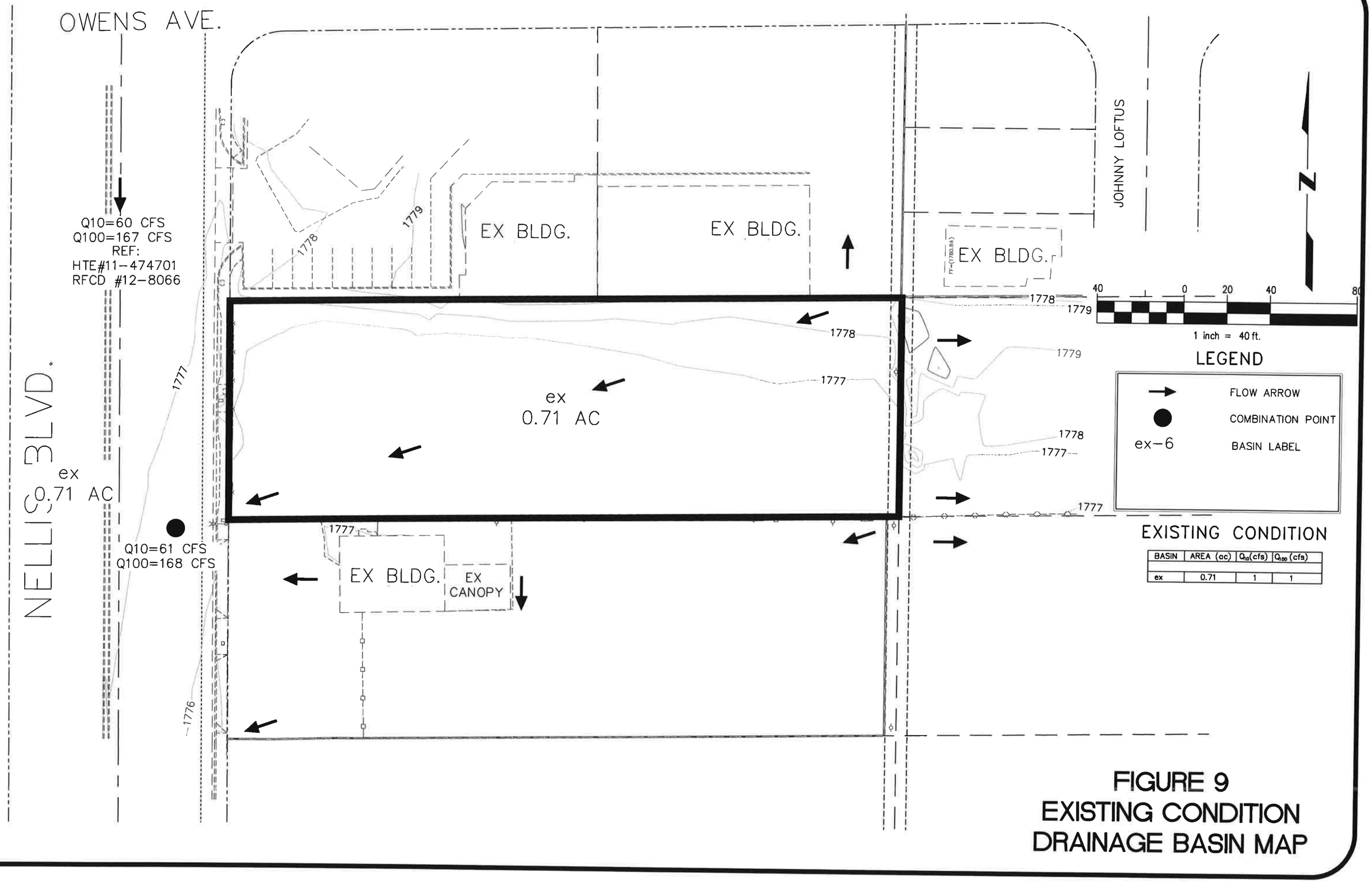
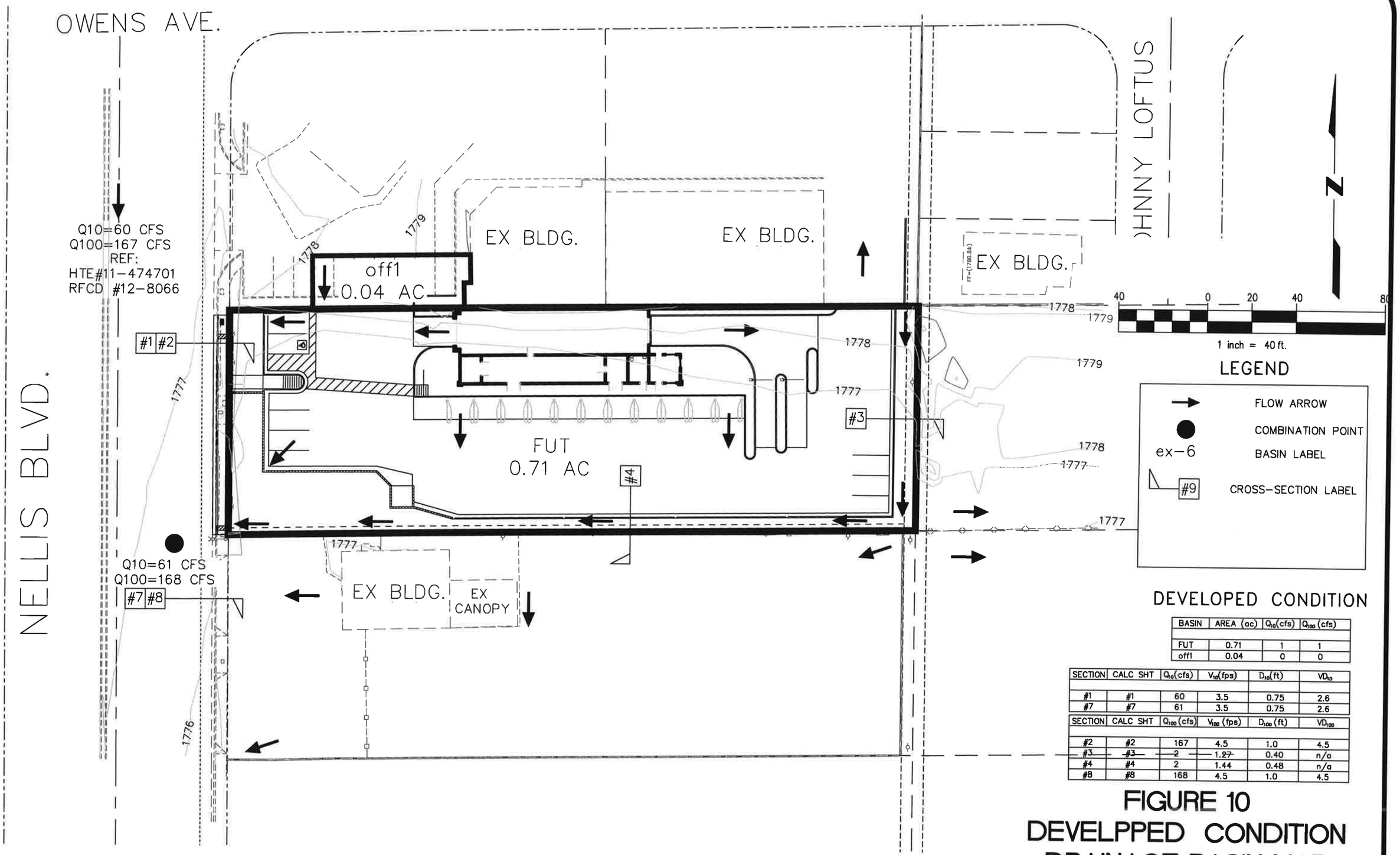


FIGURE 9
EXISTING CONDITION
DRAINAGE BASIN MAP



DEVELOPED CONDITION

BASIN	AREA (ac)	Q_{10}(cfs)	Q_{100} (cfs)
FUT	0.71	1	1
off1	0.04	0	0

SECTION	CALC SHT	Q_{10}(cfs)	V_{10}(fps)	D_{10}(ft)	VD_{10}
#1	#1	60	3.5	0.75	2.6
#7	#7	61	3.5	0.75	2.6

SECTION	CALC SHT	Q_{100}(cfs)	V_{100} (fps)	D_{100} (ft)	VD_{100}
#2	#2	167	4.5	1.0	4.5
~~#3~~	~~#3~~	~~2~~	~~1.27~~	0.40	n/a
#4	#4	2	1.44	0.48	n/a
#8	#8	168	4.5	1.0	4.5

FIGURE 10
DEVELPPED CONDITION
DRAINAGE BASIN MAP

CALCULATIONS

East PL swale-Q100 = 2 cfs w 4:1 SS

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.025	
Channel Slope	0.00400	ft/ft
Left Side Slope	4.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)
Discharge	2.00	ft^3/s

Results

Normal Depth	0.56	ft
Flow Area	1.26	ft^2
Wetted Perimeter	4.64	ft
Hydraulic Radius	0.27	ft
Top Width	4.50	ft
Critical Depth	0.43	ft
Critical Slope	0.01577	ft/ft
Velocity	1.58	ft/s
Velocity Head	0.04	ft
Specific Energy	0.60	ft
Froude Number	0.53	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.56	ft
Critical Depth	0.43	ft
Channel Slope	0.00400	ft/ft
Critical Slope	0.01577	ft/ft

CALC SHT #3A

South PL swale-Q100 = 2 cfs w 4:1 SS

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.025	
Channel Slope	0.00400	ft/ft
Left Side Slope	4.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)
Discharge	2.00	ft^3/s

Results

Normal Depth	0.56	ft
Flow Area	1.26	ft^2
Wetted Perimeter	4.64	ft
Hydraulic Radius	0.27	ft
Top Width	4.50	ft
Critical Depth	0.43	ft
Critical Slope	0.01577	ft/ft
Velocity	1.58	ft/s
Velocity Head	0.04	ft
Specific Energy	0.60	ft
Froude Number	0.53	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

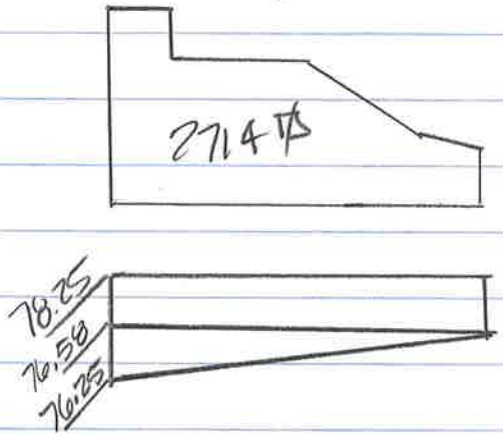
GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.56	ft
Critical Depth	0.43	ft
Channel Slope	0.00400	ft/ft
Critical Slope	0.01577	ft/ft

CALC SHT # 4A

Given; RETENTION AREA @ SW CORNER OFFSITE

BASE AREA = 2714 ft²



VOLUME:

$2714 * (76.58 - 76.25)(1/2) = 448\ ft^3$

$2714 * (78.25 - 76.58) = 4532\ ft^3$

$4980\ ft^3$

$= .11433$ Ac-FT

ASSUME 6" WIDE OPENING IN BLOCK WALL

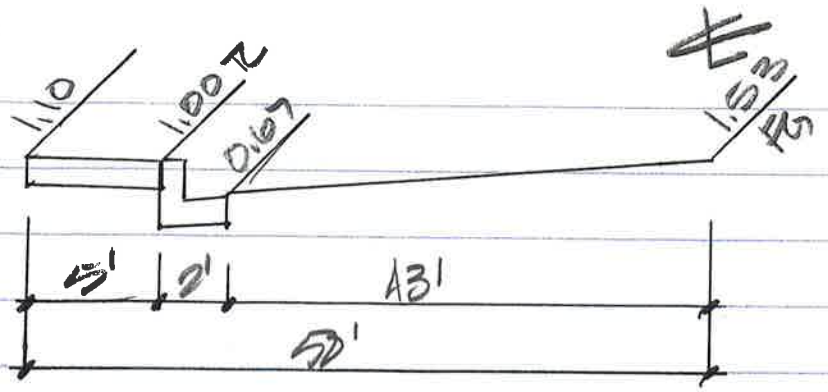
$Q = 3.33 L H^{3/2}$

@ 76.58 ⇒ $3.33(.5)(.33)^{3/2} = 0.32$ CFS

@ 78.25 ⇒ $3.33(.5)(2.0)^{3/2} = 4.71$ CFS

SV	0	.11433	Ac-FT
SE	76.25	78.25	ELEV IN FEET
SQ	0	4.71	FLOW (CFS)

CALC SHT # 6



Given; NELLS BLVD, SLOPE = 0.73%, n = .016

Q_{10} = 61 CFS WHOLE STREET

Q_{10} = 31 CFS 1/2 STREET

FIND; depth of flow and velocity

Assume; FLOW @ 1.25 OR DEPTH = 0.75'

$A = (.5*5) + (\frac{1}{2}*5*.1) + (.25*2) + .6398 + (\frac{1}{2}*.58*29) = 10.5498$ ☑

$P = 36.65'$

$R = A/P = .2879$

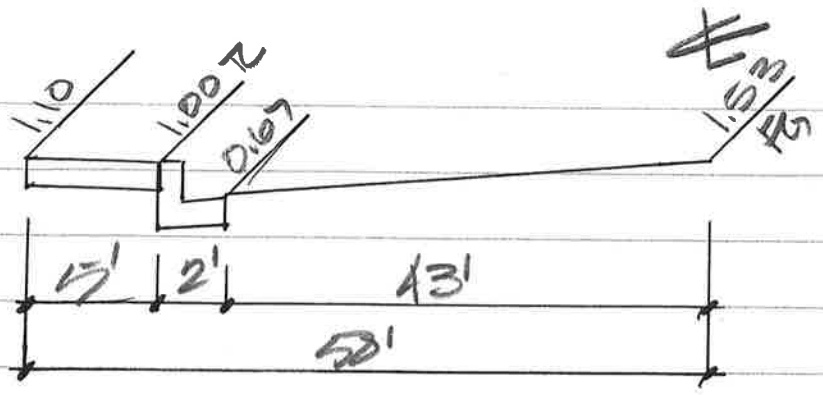
$Q = 1.486(.2879)^{2/3}(10.5498)(.0073)^{1/2}/.016$

$= 36.5$ CFS ≥ 30 OK

$V = Q/A = 3.5$ fps

$VD = (3.5)(.75) = 2.6 \leq 6$ OK

CALC SHT # 7



Given; NELLIS BLVD. SLOPE = 0.73%, n = .016

Q_{100} = 168 CFS WHOLE STREET

Q_{100} = 84 CFS ½ STREET

FIND: depth of flow & velocity

Assume; FLOW @ 1.5 OR depth = 1.0

$A = (0.4 * 5) + (\frac{1}{2} * 5 * .1) + (.5 * 2) + .6358 + (\frac{1}{2} * .83 * 41.5) = 21.1123$ ✓

$P = 49.4$

$R = A/P = .4274$

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

$= 95$ CFS $\geq$ 84 CFS OK

$V = Q/A = 4.5$ fps

$VD = (4.5)(1.0) = 4.5 \leq 8$ OK

CALC SHT # 8

HEC-1 ANALYSIS
EXISTING & PROPOSED CONDITIONS-REVISED

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL - STANDARD FORM 4

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

Date: 2/23/2022

TIME OF CONCENTRATION

SUB-BASIN DATA				INITIAL / OVERLAND TIME: t(i)				TRAVEL TIME t(t)				CONCENTRATION TIME t(c)			
DESIG:	AREA Sq. Mi.	EX/DEV EX = 1 DEV = 2	CN	K	LENGTH Ft.	SLOPE %	t(i) Min	LENGTH Ft.	SLOPE %	VEL. FPS	t(t) Min	T_L Ft.	FINAL t(c)	t(c) URBANIZED = (L/180)+10 Min	t(lag) =(0.6*T_L)/60 Hr
EXISTING & FUTURE CONDITIONS															
FUT	0.00111	2	95.00	0.8640	79	1.30	3.46	440	0.40	1.94	3.79	519	7.25	12.88	0.0725
off1	0.00006	2	98.00	0.9036	24	1.90	1.40	1	1.90	4.22	0.00	25	5.00	10.14	0.0500
	0.00000	1	0.00	######	0	0.00	#####	0	0.00	0.00	#DIV/0!	0	#DIV/0!	N/A	#DIV/0!
ex	0.00111	1	85.00	0.7320	316	0.82	12.58	1	0.82	2.66	0.01	317	12.59	N/A	0.1259
	0.00000	1	0.00	######	0	0.00	#####	0	0.00	0.00	#DIV/0!	0	#DIV/0!	N/A	#DIV/0!
	0.00000	1	0.00	######	0	0.00	#####	0	0.00	0.00	#DIV/0!	0	#DIV/0!	N/A	#DIV/0!
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				######			#####			0.00	#DIV/0!	0	#DIV/0!		#DIV/0!
				######			#####			0.00	#DIV/0!	0	#DIV/0!		#DIV/0!
				######			#####			0.00	#DIV/0!	0	#DIV/0!	10.00	#DIV/0!
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*****************************************          *****************************************
*                                       *          *                                       *
* *FLOOD HYDROGRAPH PACKAGE (HEC-1)     *          *     U.S. ARMY CORPS OF ENGINEERS      *
*           JUN  1998                   *          *   HYDROLOGIC ENGINEERING CENTER       *
*         VERSION 4.1                   *          *        609 SECOND STREET              *
*                                       *          *   DAVIS, CALIFORNIA 95616             *
* RUN DATE  22FEB22  TIME  15:17:09     *          *          (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                    RAINBOW CARWASH
    2    ID CONDITION:              EXISTING AND DEVELOPED CONDITIONS
    3    ID
    4    ID
    5    ID INPUT FILE:             FILE NAME 701449EX.ih1
    6    ID
    7    ID DESIGN STORM 6 HOUR
    8    ID STORM DISTRIBUTION SDN 3
    9    ID PREPARED BY:                Sam C. Dunnam, P.E.
   10    ID                         T.Y. LIN INTERNATIONAL
   11    ID                         4050 Dean Martin Drive
   12    ID                         Las Vegas NEVADA 89103
   13    ID                         702-682-1715
   14    ID                         sam.dunnam@tylin.com
   15    ID ###############################################
   16    ID #      DEPTH-DURATION-FREQUENCY VALUES        #
   17    ID ###############################################
   18    ID # NOT A STANDRAD McCARRAN AIRPORT RAIN FALL AREA #
   19    ID ###############################################
   20    ID #      RATIO #1 = 2 YR 6 HOUR STORM           #
   21    ID #       RATIO #2 = 10 YR 6 HOUR STORM         #
   22    ID #       RATION #3 = 100 YR 6-HOUR STORM       #
   23    ID ###############################################
   24    ID
   25    ID
   26    ID
   27    ID
   28    ID
   29    ID
        *DIAGRAM
   30    IT     5     0     0    300
   31    IO     5     0     0
   32    IN     5     0     0
   33    JR   PREC  0.6084     1
        *

   34    KK     ex undeveloped site
        * ########################################
        * # ex  undeveloped site                 #
        * # Total Area = 0.00111 sq. mi.         #
        * # CN = 85.0, K=.73207716               #
        * # Tc = 12.59 min./10.00 min. mininum   #
        * ########################################
        *
   35    BA 0.0011      1
   36    LS     0     85     0
   37    UD 0.1259
        *
   38    PB   2.86
        * NOT A STANDARD McCARRAN AIRPORT RAINFALL AREA
   39    PC  0.000  0.020  0.057  0.070  0.087  0.108  0.124  0.130  0.130  0.130
   40    PC  0.130  0.130  0.130  0.133  0.140  0.142  0.148  0.158  0.172  0.181
   41    PC  0.190  0.197  0.199  0.200  0.201  0.204  0.214  0.229  0.241  0.249
   42    PC  0.251  0.256  0.270  0.278  0.281  0.283  0.295  0.322  0.352  0.409
   43    PC  0.499  0.590  0.710  0.744  0.781  0.812  0.819  0.835  0.851  0.856
```

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

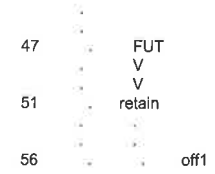
   44    PC  0.860  0.868  0.876  0.888  0.910  0.926  0.937  0.950  0.970  0.976
   45    PC  0.982  0.985  0.987  0.989  0.990  0.993  0.993  0.994  0.995  0.998
   46    PC  0.998  0.999  1.000
         *
   47    KK    FUTdeveloped site
         *
         * ########################################
         * # FUT  develoiped site                 #
         * # Total Area = 0.00111 sq. mi.         #
         * # CN = 95.0, K=.8640                   #
         * # Tc = 8.60 min./ 5.00 min. mininum    #
         * ########################################
         *
   48    BA  0.0011      1
   49    LS      0      95      0
   50    UD  0.083
         *
   51    KK  retain
   52    RS      1   ELEV      0
   53    SV      0 0.11433
   54    SE  76.25  78.25
   55    SQ      0   4.71
         *
   56    KK    off1off site area 1
         *
         * ########################################
         * # offsite area 1 - AC parking lot      #
         * # Total Area = 0.00006 sq. mi.         #
         * # CN = 98.0, K=.9036                   #
         * # Tc = 5.00 min./ 5.00 min. mininum    #
         * ########################################
         *
   57    BA   6E-5
   58    LS      0      98      0
   59    UD
         *
   60    ZZ
```

SCHEMATIC DIAGRAM OF STREAM NETWORK

INPUT LINE NO.

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

(.) CONNECTOR (<----) RETURN OF DIVERTED OR PUMPED FLOW



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
**********                                  **********
*                  *                        *                  *
* FLOOD HYDROGRAPH PACKAGE (HEC-1) *        *  U.S. ARMY CORPS OF ENGINEERS  *
*        JUN  1998         *                *  HYDROLOGIC ENGINEERING CENTER  *
*      VERSION 4.1         *                *       609 SECOND STREET        *
*                  *                        *  DAVIS, CALIFORNIA 95616       *
* RUN DATE  22FEB22  TIME  15:17:09 *        *       (916) 756-1104           *
*                  *                        *                  *
**********                                  **********
```

RAINBOW CARWASH
CONDITION: EXISTING AND DEVELOPED CONDITIONS

INPUT FILE: FILE NAME 701449EX.ih1

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

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

```
31 IO     OUTPUT CONTROL VARIABLES
            IPRNT        5  PRINT CONTROL
            IPLOT        0  PLOT CONTROL
            QSCAL        0.  HYDROGRAPH PLOT SCALE

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

         COMPUTATION INTERVAL    .08 HOURS
           TOTAL TIME BASE  24.92 HOURS

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

 JP     MULTI-PLAN OPTION
          NPLAN         1  NUMBER OF PLANS

 JR     MULTI-RATIO OPTION
          RATIOS OF PRECIPITATION
          .61     1.00
```

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

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO PRECIPITATION RATIO 1	RATIO 2
		.61	1.00		
HYDROGRAPH AT	ex	.00	1 FLOW	1.	1.
			TIME	3.58	3.58
HYDROGRAPH AT	FUT	.00	1 FLOW	1.	2.
			TIME	3.50	3.50
ROUTED TO	retain	.00	1 FLOW	1.	1.
			TIME	3.67	3.67
			** PEAK STAGES IN FEET **		
			1 STAGE	76.57	76.83
			TIME	3.67	3.67
HYDROGRAPH AT	off1	.00	1 FLOW	0.	0.
			TIME	3.50	3.50

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

ADDITIONAL REFERENCE MATERIAL

2018 Las Vegas Valley Master Plan Update Curve Numbers						
Land Use Index	Land Use Description	Curve Number for Hydrologic Soil Groups				
		A	B	C	D	Rock/Outcrop
1	Undeveloped Land, Open Desert	63	77	85	88	90
2	Parks, Golf Courses	47	66	77	83	90
3	Rural, 0.5-1 units per acre (uses 1 units/ acre)	57	73	82	86	92
4	Low- Density Residential, 1-2 units per acre (uses 2 units/ acre)	60	74	83	87	92
5	Medium Density Residential, 2-4 units per acre (uses 3 units/ acre)	62	76	84	88	92
6	High- Density Residential, 4-8 units per acre (uses 6 units/ acre)	74	83	88	91	94
7	Public Facility and Residential, 8-12 units/ acre	84	89	92	94	96
8	Very High- Density Residential, 12 units/ acre or more	89	93	95	96	96
9	Commercial, Retail, Casino, High Rise Condominiums	92	94	95	96	97
10	Light Industrial	86	91	93	95	96
11	Heavy Industrial	92	94	95	96	97
12	Schools	71	81	87	90	94
13	Lakes	30	30	30	30	30

Thus, the source of the soils information can be identified by the map unit number as follows:

Source 1: Map unit numbers 1000 to 1999
Source 2: Map unit numbers 2000 to 2999
Source 3: Map unit numbers 3000 to 3999
Source 4: Map unit numbers 4000 to 4999 and 4XXX
Source 5: Map unit numbers 5000 to 5999

NRCS methodology divides soils into four hydrologic soil groups as defined below:

Type A. High infiltration rate, low runoff potential

Type B. Moderate infiltration rate, moderately low runoff potential

Type C. Low infiltration rate, moderately high runoff potential

Type D. Very low infiltration rate, high runoff potential

Each soil type (map unit number) is made up of a certain percentage of hydrologic soil groups A, B, C, and D. In some cases, the soil type is also comprised of rock outcrop in addition to the four hydrologic soil groups. Most soil types do not include all four hydrologic soil groups or rock outcrop, and very few soil types consist entirely of a single hydrologic soil group or rock outcrop. Certain percentages of soil components did not contain an assigned hydrologic soils group in the soil survey data. For these components, hydrologic soils groups were assigned manually based on engineering judgement. Three Map Units in Source 4 (4BRB, 4CTC and 4RTF) have cumulative component percentages that do not add up to 100%. These map units were revised based on weighted percentages with a summation of 100% using existing component percentages. Information on soils data is shown in the W-Maps. The percentages of hydrologic soil groups for each map unit is located in the curve number matrix in **Appendix D.5**.

2.3.5. Curve Numbers

Rainfall losses due to soil infiltration, depression storage, and other factors were calculated using the NRCS curve number method, which is a function of soil type, land cover, and antecedent moisture condition. Based on the RFCD Design Manual, the average antecedent moisture condition (AMC II) is used for computing losses.

To develop curve numbers, the subbasin delineations, soil map unit, and land use layers were intersected in GIS to create a new GIS layer. Curve numbers were generated from a curve number matrix that calculates a soil-weighted curve number for each combination of soil map unit and land use type (see **Appendix D.5**). The weighted curve numbers were then summed for each subbasin to calculate a composite curve number for each subarea (see **Appendix D.6**).

Table 2-3 summarizes the curve numbers of each land cover type and hydrologic soil group combination based on the RFCD Hydrologic Criteria and Drainage Design Manual (Table 602). In addition, a curve number of 90 is assumed for rock outcrop and a curve number of 98 is assumed for directly connected impervious areas across all soil types.

Table 2-3 - Runoff Curve Numbers

Land Cover Type	Curve Number				
	A	B	C	D	Rock Outcrop
Desert Shrub Poor Condition	63	77	85	88	90
Desert Shrub Fair Condition	55	72	81	86	90
Landscaped Good Condition	39	61	74	80	90

Figure 2-2 shows the change in curve numbers since the 2008 MPU.