McMAHON BOULEVARD
DRAINAGE REPORT

MAY 1995

Prepared by

Smith Engineering Company
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SEC No. 94-81-01

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INTRODUCTION

Smith Engineering Company is under contract with Curb Inc. to provide the design for the improvements of approximately 3,750 ft. of McMahon Boulevard (Blvd.) between Golf Course Road and Bandelier Drive. McMahon Blvd. is located on the west side of Albuquerque west of Golf Course Road and north of the Calabacillas Arroyo. The existing road extends approximately 4,800 feet and dead ends at the Caremore Nursing Home. There is an existing development on the north side of McMahon Blvd. (Paradise Heights, Unit 1); however, this area is not yet completely built out. The St. Joseph Hospital is also located on the north side of McMahon Blvd. just west of Golf Course Road. Some apartments and office buildings are located on the south side of McMahon Blvd. The reconstruction of McMahon Blvd. is part of the planned 450-500 unit Tuscany Subdivision on the south side of McMahon Blvd. The ultimate build out of McMahon Blvd. will include a six-lane arterial road with a raised center median. The project is being phased such that the south two lanes are constructed from Bandelier Drive east to approximately the St. Joseph Hospital in this phase. This design will include sidewalk and curb-and-gutter, and the road will consist of two lanes, one eastbound and one westbound. The construction of the southern two lanes will include transitions from the existing road section to the new road section at both ends. The construction will also include tie-ins to the existing drives and roads. The total distance of new road to be constructed under this contract is 2,090 feet. Approximately 1,150 feet of the existing McMahon Blvd. from St. Joseph's Hospital east to Golf Course Road will receive an overlay as part of this reconstruction.

SITE LOCATION AND DESCRIPTION

The project area is located in Bernalillo County on the northwest side of Albuquerque. A vicinity map of zone atlas A-12 is shown in Figure 1. The local climate is considered high altitude, semi-desert. Heavy afternoon showers are common from June to September. The project area is located on a ridge and is not in any Flood Insurance Rate Map (FIRM) floodplains.

A. Existing Conditions

McMahon Blvd. currently consists of a two-lane blacktop, dead-end road. The total area of the drainage basin area to the road within the project length, is about 20.2 acres and is divided equally between undeveloped and developed (residential) property. The residential property, called Paradise Heights, Unit 1, is about 20 years old and is not fully developed. Of the 28 lots that contribute flow to McMahon Blvd. from Paradise Heights, only 15 lots have houses on them. The roads in the subdivision and McMahon Blvd. have no curb-and-gutter. The off-site, overland runoff from drainage basins north of McMahon Blvd. flows to naturally occurring retention ponds located on the north side of McMahon Blvd. Runoff generated in areas south of McMahon Blvd. flows overland to the Calabacillas Arroyo. The runoff generated on the St. Joseph Hospital property flows away from McMahon Blvd. to a detention basin constructed as part of that facility.

The soils in the drainage basins are classified by the Soil Conservation Service as type "Bb", "BCC", and "BKD". These classifications have an ASSHTO classification of A-2 or A-3. These soils consist of fine sands with rapid permeability resulting in low runoff values. The native vegetation is principally Mesa Dropseed and Indian Ricegrass.

B. Developed Conditions

The hydrologic analysis considered the Paradise Heights, Unit 1 to be fully developed basins which could drain to McMahon Blvd. and the road to be fully constructed. The proposed 450-500 unit Tuscany Subdivision will be to the south of McMahon Blvd. and runoff from this development will not affect McMahon Blvd.

HYDROLOGIC/HYDRAULIC ANALYSIS

A. HYDROLOGY

The City of Albuquerque Design Process Manual (DPM), Section 22.2, was used to determine the hydrology for the project. The design storm used is the 100-Year, 6-Hour storm event. The 10-Year, 6-Hour event was also calculated to determine the flow rates in McMahon Boulevard. The drainage basins for the project are less than 40 acres, therefore, the Rational Method was used to calculate the peak runoff values. Tables A-4, A-5, and A-9 from the DPM were used to determine land treatments and the peak discharge (cfs/acre) rate for the design storm. The land treatments used for the basins are as follows:

Land Treatment Types :	A	B	C	D
McMahon Boulevard (Basin E) :	7	0	0	93
Developed Areas (Basins A-D,F):	10	25	20	45

The developed areas were considered to be residential with 4.35 DU/Acre density. Currently, the existing residential area of Paradise Heights is not fully developed, however, for the purpose of calculating runoff values, this development was considered to be fully developed. The culvert and hydraulic structures are sized for runoff from a fully developed subdivision.

Plate 1 shows the drainage basins and the proposed drainage improvements for the project. The runoff from the basins in this phase is indicated by circles with 100- and 10-Year runoff rates shown. McMahon Boulevard was considered to be one drainage basin, and there are five offsite basins which will contribute flow to the road. A description of the basins, the runoff rates from the basins, and the proposed improvements under this phase are as follows:

Basin A: This basin is not developed at this time, however, the basin was considered to be fully developed residential for runoff calculations. This basin will drain to a low area on the north side of McMahon Boulevard. The 100-Year, 6-Hour peak runoff rate will be 35.3 cfs. A 36-inch RCP culvert (outlet #1) will be constructed to convey runoff to the west side of McMahon to the historic flow path for the area runoff. A rip-rap basin will be constructed at the outlet of the culvert.

Basin B: This basin is part of the Paradise Heights Subdivision which is partly developed. This basin was considered to be fully developed for runoff calculations. This basin drains to a low point on the north side of McMahon Boulevard. The 100-Year, 6-Hour runoff from this basin will be 13.0 cfs. A 30-inch RCP culvert (outlet #2) will be constructed to convey flows to the south side of McMahon Boulevard to the historic flow path of the runoff. A rip-rap basin will be constructed at the outlet of the culvert.

Basin C: This basin is part of the Paradise Heights Subdivision which is partly developed at this time. This basin was considered to be fully developed for runoff calculations. This basin drains to a low point on the north side of McMahon Boulevard. The 100-Year, 6-Hour runoff from this basin will be 13.3 cfs. An 18-inch RCP culvert will be constructed to convey flows to a 36-inch RCP which will outlet to the west side of McMahon Boulevard (outlet #3). A rip-rap basin will be constructed at the outlet. This same outlet will serve the runoff from Basin D (see below).

Basin D: Basin D is on the east side of the Paradise Heights Subdivision and borders the St. Joseph Hospital. The runoff from this basin is 2.5 cfs. A type "D" catch basin with a 24-inch connector pipe will be constructed at the low point in the basin to drain this area. The connector pipe will flow to a 36-inch RCP drain in McMahon Boulevard which will drain to the west. These flows will move to the 36-inch RCP (outlet #3) which serves the 18-inch connector pipe from Basin C.

Basin E, This Phase:

Basin E is McMahon Boulevard as shown on Plate 1. Only the southern two lanes of McMahon Boulevard from Bandelier Drive to approximately the west property line of the St. Joseph Hospital will be reconstructed under this phase. The peak runoff value generated on McMahon Boulevard in this phase will be 10.6 cfs. These flows will move east on the road to a Type "A" catch basin to be located at the low point on the road just east of the 36-inch outlet #3.

This report assumes that additional improvements will be made to McMahon Boulevard at a later date. Therefore, increased runoff rates and the required drainage structure improvements were taken into consideration in this report. A description of the basins, runoff rates, and proposed improvements is included. The runoff from future improvements is shown on Plate 1 as a rectangle indicator with 100- and 10-Year runoff rates given in the rectangle. Runoff from drainage Basins A through D will be the same as listed for this phase of the improvements.

Basin E, Future Improvements:

The runoff from Basin E will increase with the increase in road area. When the north side of McMahon Boulevard is constructed, catch basins can be added to intercept the runoff from the road and convey it to the storm drains which are part of this phase of the construction. The drainage facilities to be constructed under this phase are sized to handle the additional flows as McMahon Boulevard is improved. An additional 30-inch storm drain is proposed for future construction (not this phase) for the north side of McMahon Boulevard and this drain will intercept overland flows on McMahon before they reach the intersection of Bandelier Drive and convey them underground to a 42-inch outfall.

Basin F: The available topography for the area indicates that runoff from this basin currently moves north to Black's Arroyo. If this area is developed, it is possible that this existing drainage pattern will be retained. If this is the case, the 27.3 cfs runoff from the 100-Year, 6-Hour storm will not move east on McMahon Boulevard and the road can handle the runoff generated on it (Basin E, future). If the existing swale is filled and runoff is allowed to move east on McMahon Boulevard, then the proposed 30-inch drain at Bandelier Drive can be extended west to intercept flows from this basin. The West Mesa Health Care Center is currently below McMahon Boulevard. If McMahon is improved in this area, the runoff from this facility would need to be conveyed to the drain system in McMahon. This would also have to be planned for in the future phases of construction for McMahon Boulevard.

B. Synopsis of Analysis Points

Analysis points are shown on Plate 1. AP's in ovals are for the improvements proposed at this time; AP's shown in rectangles are for future improvements to McMahon Boulevard.

This Phase: AP-1: 2.7 cfs overland flow on the road ~~allowed to continue east to low point in road~~ picked up by Dbl "A" Inlet @ 20+2C @ Sump; ~~35.3~~ 38.0 cfs pipe flow in the 36-inch culvert to 42-inch outlet #1.

AP-2: 10.6 cfs on the road into a catch basin; 15.8 cfs pipe flow in the 36-inch RCP in road; total of 26.4 cfs pipe flow out of 36-inch outlet #3.

AP-3: 13.0 cfs pipe flow out of 30-inch outlet #2.

Future Phases: AP-1: 32.9 cfs overland flow on south side of road allowed to continue east (this assumes that Basin F drains to McMahon Boulevard instead of north to Black's Arroyo); 5.6 cfs overland flow on north side of road allowed to continue east.

AP-2: 43.1 cfs overland flow on south side of road to be intercepted by proposed 30-inch drain; 15.7 cfs overland flow on north side of road to be intercepted by proposed 30-inch drain.

AP-3: 2.7 cfs overland flow on north side of road allowed to continue east to low point; 2.7 cfs overland flow on the south side allowed to continue east to low point; 94.1 combined cfs pipe flow to 42-inch outlet #1.
36"

AP-4: Combined 10.6 cfs overland flow on north side of road to be intercepted by catch basins at low point; combined 10.6 cfs overland flow on south side of road to be intercepted by catch basins at low point; 15.8 cfs flow in pipe; 37 cfs combined flow out of 36-inch outlet #3.

AP-5: 13.0 cfs pipe flow out of 30-inch outlet #2.

The proposed slope of the road from AP-1 to AP-2 (this phase) is 2.10%. This slope and road section can carry 5.85 cfs of flow and still provide one drive lane free from water. Therefore, the 1.7 cfs (10-year storm runoff rate) overland flow will not violate the DPM 10-Year, one lane dry criteria. The proposed slope of the road from AP-2 to AP-3 (this phase) is from 0.5% to 3.0%. This slope and road section can carry 2.86 cfs for S=0.5% and 7.0 cfs for S=3.0% of flow and still provide one drive lane free from water. The 5.1 cfs (10-year storm runoff rate) overland flow will not violate the DPM 10-Year, one lane dry criteria for the ultimate road section. Calculations were made to check the possible height of hydraulic jumps in the streets. The sections which were analyzed are Sta. 30+32 and 20+20. The possible hydraulic jump will not exceed the curb height at either of these locations. The design manual for the design of the rip-rap energy dissipators is the FHWA Circular #14. Catch basin interception capacities were checked using COA nomographs and are adequate. The hydraulic calculations for the project are provided in Appendix B.

McMAHON BLVD

HYDROLOGY SUMMARY

ST. JOSEPH TO BANDELIER, 25' ROAD + 10' S/W : LANDSCAPE

THIS PHASE	Q_{100}	Q_{10}
BASIN A	35.3	20.1
BASIN B	13.0	7.4
BASIN C	13.3	7.6
BASIN D	2.5	1.5
BASIN E	7.5	
BASIN F	(NO EFFECT THIS STAGE)	

FUTURE ST. JOSEPH TO BREAKLINE ON WEST, 106' CROSS SECTION

	Q_{100}	Q_{10}
BASIN A	35.3	20.1
BASIN B	13.0	7.4
BASIN C	13.3	7.6
BASIN D	2.5	1.5
BASIN E	53.0	34.5
BASIN F	27.3	15.6

		SOUTH SIDE		NORTH SIDE	
	STREET AP'S	Q_{100}	Q_{10}	Q_{100}	Q_{10}
	AP ①	32.9	19.3	5.6	3.7
ALL OVERLAND	AP ②	43.1	25.8	10.2	6.6
	AP ③	45.8	27.6	18.5	12.0
	AP ④	7.9	5.1	7.9	5.1

SOUTH SIDE

STREET AP'S	Q_{100}	Q_{10}
1	2.7	1.7
2	7.9	5.1

FLOWS FROM BASIN A, B, C, D THROUGH CULVERTS.

LAND TREATMENTS

WITHIN RIGHT-OF WAY

93% D

7% B

RESIDENTIAL - ASSUME FULLY DEVELOPED CONDITIONS

10,000 SF/LOT = 4.35 UNITS/ACRE

$\% D = 7\sqrt{(4.35)(4.35) + 5(4.35)} = 44.6\%$

% D = 45

% C = 20

% B = 25

% A = 10

PEAK DISCHARGE PER ACRE

ZONE 1

TABLE A-9 DPM

100-YEAR/6-HR	10-YEAR/6-HR
D = 4.37 CFS/AC	D = 2.89 CFS/AC
C = 2.87	C = 1.49
B = 2.03	B = 0.76
A = 1.29	A = 0.24

BASIN A

TOTAL SF = 484396 SF = 11.1 AC

ASSUME 100% FULLY DEVELOPED RESIDENTIAL

Q = ACRES (% LAND TREAT.) (CFS/ACRE)

100-YEAR STORM

RESIDENTIAL AREA

Q_{100} = 11.1 (0.45) 4.37 + 11.1(0.20)(2.87) + 11.1(0.25)(2.03) + 11.1(0.10)(1.29)

Q_{100} = 35.3 CFS ✓

10-YEAR STORM

DEVELOPED AREA

Q_{10} = 11.1 (0.45)2.89 + 11.1 (0.20) 1.49 + 11.1 (0.25) 0.76 + 11.1 (0.10) 0.24

= 20.12 CFS

Q_{10} = 20.1 CFS ✓

PROJECT McMAHON BLVD SHEET NO. 3 OF

SUBJECT HYDROLOGY PROJECT NO.

BY TVD DATE 3/15/95 CHECKED BY PJC DATE 5/8/95

BASIN B

TOTAL SF = 179,745 SF = 4.1 AC 100% RESIDENTIAL (FULLY DEVELOPED)

100-YEAR STORM

Q_{100} = 4.1 (0.45) 4.37 + 4.1 (0.20) 2.87 + 4.1 (0.25) 2.03 + 4.1 (0.10) 1.29

Q_{100} = 13.0 CFS ✓

10-YEAR STORM

Q_{10} = 4.1 (0.45) 2.89 + 4.1 (0.20) 1.49 + 4.1 (0.25) 0.76 + 4.1 (0.10) 0.24

Q_{10} = 7.4 CFS ✓

BASIN C

TOTAL SF = 182219 SF = 4.2 AC 100% RESIDENTIAL (FULLY DEVELOPED)

100-YEAR STORM

Q_{100} = 4.2 (0.45) 4.37 + 4.2 (0.20) 2.87 + 4.2 (0.25) 2.03 + 4.2 (0.10) 1.29

Q_{100} = 13.3 CFS ✓

10-YEAR STORM

Q_{10} = 4.2 (0.45) 2.89 + 4.2 (0.20) 1.49 + 4.2 (0.25) 0.76 + 4.2 (0.10) 0.24

Q_{10} = 7.6 CFS ✓

PROJECT McMAHON BLVD SHEET NO. 4 OF
SUBJECT HYDROLOGY PROJECT NO.
BY TVD DATE 3/15/95 CHECKED BY PJC DATE 5/8/95

BASIN D

TOTAL SF = 35,200 SF = 0.8 AC

ASSUME 100% FULLY DEVELOPED RESIDENTIAL

100-YEAR STORM

DEVELOPED AREA $Q_{100} = 0.8(0.45)4.37 + 0.8(0.20)2.87 + 0.8(0.25)2.03 + 0.8(0.10)1.29$

$Q_{100} = 2.54$ CFS

$Q_{100} = 2.5$ CFS

10-YEAR STORM

DEVELOPED AREA $Q_{10} = 0.8(0.45)2.89 + 0.8(0.20)1.49 + 0.8(0.25)0.76 + 0.8(0.10)0.24$

$Q_{10} = 1.45$ CFS

$Q_{10} = 1.5$ CFS

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PROJECT McMAHON BLVD. SHEET NO. 5 OF

SUBJECT HYDROLOGY PROJECT NO.

BY TVD DATE 3/15/95 CHECKED BY PJR DATE 5/8/95

BASIN E

AREA = 5170' × 106' = 548,020 SF = 12.6 AC.
(R/W)

ASSUME FULLY DEVELOPED (ROAD COMPLETELY BUILT)

100-YEAR STORM

$Q_{100} = 12.6(0.93)4.37 + 12.6(0.07)2.03$

$Q_{100} = 53.0$ CFS ✓

10-YEAR STORM

$Q_{10} = 12.6(0.93)2.89 + 12.6(0.07)0.76$

$Q_{10} = 34.5$ CFS ✓

BASIN F

TOTAL SF = 372,668 SF = 8.6 AC

ASSUME 100% RESIDENTIAL (FULLY DEV.)

100-YEAR STORM

$Q_{100} = 8.6(0.45)4.37 + 8.6(0.20)2.87 + 8.6(0.25)2.03 + 8.6(0.10)1.29$

$Q_{100} = 27.3$ CFS ✓

10-YEAR STORM

$Q_{10} = 8.6(0.45)2.89 + 8.6(0.20)1.49 + 8.6(0.25)0.76 + 8.6(0.10)0.24$

$Q_{10} = 15.6$ CFS ✓

PROJECT McMAHON BLVD SHEET NO. 1 OF

SUBJECT HYDROLOGY - STREET FLOW PROJECT NO. 94-81-01

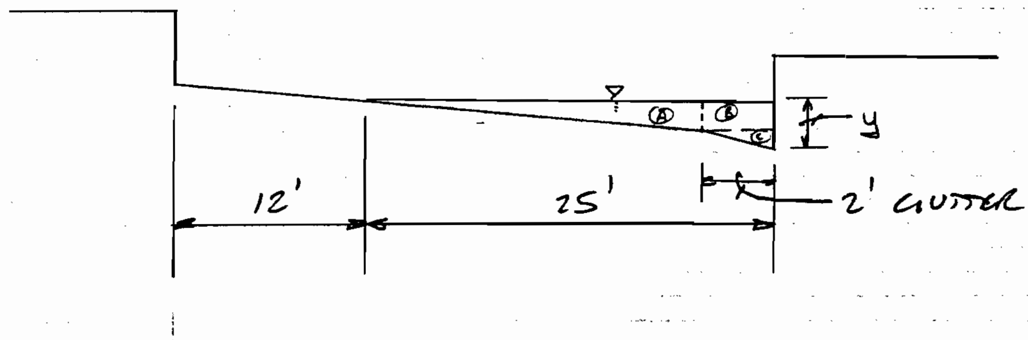
BY DR DATE 8/9/95 CHECKED BY DATE / /

(REVISION) 1/2 STREET FLOW

@ [AP-2] (FUTURE), ASSUMES S = 0.021% FOR STREET UPSTREAM

BANDELIER & McMAHON

THIS ANALYSIS IS FOR FUTURE CONSTRUCTION



AREA CALCS:

A: $[(18.75)(0.5 - 0.125)]\ 1/2 = 3.52\ ft^2$

B: $(2)(0.5 - 0.125) = 0.75\ ft^2$

C: $1/2[(2)(0.125)] = 0.125\ ft^2$

TOTAL AREA $= 3.52 + 0.75 + 0.125 = 4.40\ ft^2$

WETTED PERIMETER:

A: 18.75'

B: 0.5' - 0.125' = 0.375'

C: 0.125' + 2' = 2.125'

TOTAL W.P. = 21.25'

FIND MAX Q:

$$Q_{MAX} = \left(\frac{1.486}{0.017}\right)\left(\frac{4.40^{5/3}}{21.25^{2/3}}\right)\left(0.021^{1/2}\right) = 19.5\ cfs$$

SINCE $Q_{MAX} = 19.5$ cfs < 305 cfs PREDICTED FOR FUTURE RUNOFF, THE DESIGNER WILL HAVE TO INSTALL ADD'L CATCH BASINS WEST OF BANDELIER TO REDUCE THE STREET FLOW

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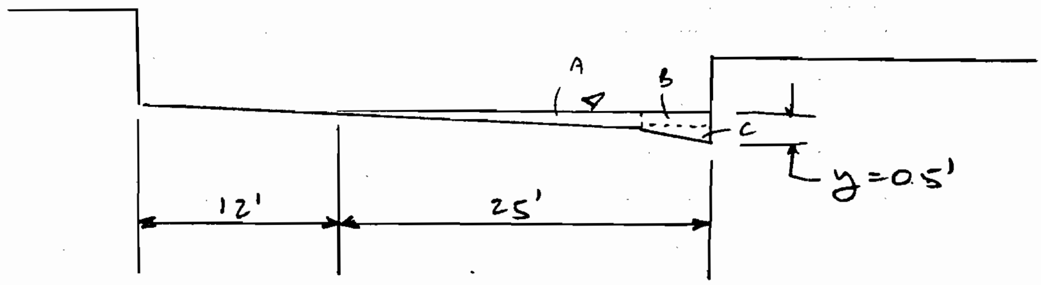
PROJECT McMAHON BLVD SHEET NO. ____ OF ____

SUBJECT HYDROLOGY - STREET FLOWS PROJECT NO. ____

BY PJC DATE 8/9/85 (REVISION) CHECKED BY ____ DATE / /

1/2 STREET FLOW @ (AP 1), STA 20+50, McMAHON

Q_{10} = 1.7 cfs, S = 0.021 ft/ft



AREA = 4.40 ft^2

WET. PER. = 21.25'

FIND MAX Q FOR ONE LANE DRY

$$Q_{max} = \left(\frac{1.486}{0.017}\right)\left(\frac{4.40^{5/3}}{21.25^{2/3}}\right)\left(0.021^{1/2}\right) = 19.5 \text{ cfs}$$

19.5 cfs > 1.7 cfs ∴ OK ✓

NOTE: FUTURE FLOWS IN THIS STREET DO NOT CHANGE.

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1/2 STREET FLOWS @ (AP2), STA 30+32, McMAHON

NOTE: THERE ARE TWO SLOPES FROM (AP1) TO (AP2)
THESE ARE 0.005 ft/ft AND 0.03 ft/ft.
CHECK BOTH CONDITIONS FOR ONE LANE
DRY CRITERIA: $Q_{10} = 5.1$ cfs

FOR S= 0.005 ft/ft:

FOR y: 0.5', A = 4.40 ft², W.P. = 21.25 ft } SEE PREVIOUS SHEETS FOR THESE CALCS.

FIND MAX Q @ y=0.5' FOR S=0.005 ft/ft

$$Q_{MAX} = \left(\frac{1.486}{0.017}\right)\left(\frac{4.40^{5/3}}{21.25^{2/3}}\right)\left(0.005^{1/2}\right) = 9.5 \text{ cfs}$$

9.5 cfs > 5.1 cfs ∴ OK ✓

FOR S=0.03 ft/ft

FOR y=0.5', A = 4.40 ft², WP = 21.25 ft }

FIND MAX. Q @ y=0.5' FOR S=0.03 ft/ft

$$Q_{MAX} = \left(\frac{1.486}{0.017}\right)\left(\frac{4.40^{5/3}}{21.25^{2/3}}\right)\left(0.03^{1/2}\right) = 23.3 \text{ cfs}$$

23.3 cfs > 5.1 cfs ∴ OK ✓

PROJECT McMAHON BLVD SHEET NO. ____ OF ____

SUBJECT HYDROLOGY – JUMP CHECKS PROJECT NO. ____

BY PJL DATE 8/9/95 (REVISION) CHECKED BY ____ DATE / /

CHECK HYDRAULIC JUMP @ (AP 1) AND (AP 2)

@ (AP 1), STA 20+50, McMAHON

$Q_{100} = 2.7$ cfs

S = 0.021 ft/ft

n = 0.017

y @ CURB = 0.29'

TW = 9.97'

V = 2.7 fps

CALC JUMP HEIGHT;

$$\text{MAX WSEL} = y + \frac{V^2}{2g}$$

$$\text{MAX WSEL} = 0.2' + \frac{2.7^2}{64.4}$$

MAX WSEL = 0.31' < 0.67' (CURB)

∴ OK ✓

@ (AP 2), STA 30+32, McMAHON

$Q_{100} = 7.9$ cfs

S = 0.03 ft/ft

n = 0.017

y @ CURB = 0.37'

TW = 12.2'

V = 4.1 fps

CALC JUMP HEIGHT;

$$\text{MAX WSEL} = y + \frac{V^2}{2g}$$

$$\text{MAX WSEL} = 0.37 + \frac{4.1^2}{64.4}$$

MAX WSEL = 0.63' < 0.67'

∴ OK ✓

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36" RCP @ (AP 1) (SEE PLATE 1)

DIA. = 36"
n = 0.013
S = 0.043 ft/ft.

100-YR 6-HOUR FLOW: FOR THIS PHASE: 38 cfs
FUTURE : 94.2 cfs

FOR 38 cfs, FLOW DEPTH = 1.07'
VEL = 16.7 fps

FOR 94.2 cfs, FLOW DEPTH = 1.81'
VEL = 21.1 fps

36" RCP @ (AP 3) (SEE PLATE 1)

DIA = 30"
n = 0.013
S = 0.025 ft/ft

100-YR, 6 HOUR FLOW: THIS PHASE: 13 cfs
FUTURE : 13 cfs

FOR 13 cfs, FLOW DEPTH: 0.76'
VEL : 10.34 fps

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PROJECT McMAHON SHEET NO. 4 OF 4
SUBJECT PIPE FLOW CALCS. PROJECT NO. 94-81-01
BY PJR DATE 7/20/95 CHECKED BY ______ DATE / /

36" @ (AP2) (SEE PLATE 1)

36" DIA

n = 0.013

S = 0.023 ft/ft.

100-YEAR, 6 HOUR FLOW: THIS PHASE : 23.7 cfs
FUTURE : 37 cfs

FOR 23.7 cfs, FLOW DEPTH = 0.99'
VEL = 11.69 fps

FOR 37 cfs, FLOW DEPTH = 1.25'
VEL = 13.21 fps

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PROJECT MCMAHON BLVD RECONS. SHEET NO. RR-1 OF RR-2

SUBJECT RIP-RAP BASIN 42" PIPE PROJECT NO. 94-81-01

BY P. CONLEY DATE 5/15/95 CHECKED BY ______ DATE / /

SIZING RIP-RAP BASINS

GIVEN: 42" RCP
$Q = 38$ cfs
$S = 0.022$ ft/ft
$n = 0.013$

FHWA CIRC # 14

ASSUME: MINIMAL TW CONDITIONS

FIND: SIZE RIP-RAP BASIN

SOLUTION:

1) FIND y_o (DEPTH OF FLOW IN PIPE)

$y_o = 1.2$ ft

$y_c = 1.91$ ft
∴ SUPERCRITICAL

2) FIND V_o (VEL. IN PIPE)

$V_o = 12.96$ fps

3) FIND y_e (BRINK CONDITION) (FLOW AREA = 2.93 ft²)

$$y_e = \left(\frac{A}{2}\right)^{1/2} = \left(\frac{2.93}{2}\right)^{1/2} = 1.21'$$

4) FIND d_{50}

$$Fr = \frac{V}{\sqrt{(32.2)y_e}} = \frac{12.96}{\sqrt{(32.2)(1.21)}} = 2.076$$

$$0.25 \le \frac{d_{50}}{y_e} \le 0.45$$

USE $\frac{d_{50}}{y_e} = 0.35$ ∴ $d_{50} = (1.21')(0.35)$

$d_{50} = 0.42'$

USE $d_{50} = 6''$

6) FIND h_s

$$\frac{d_{50}}{y_e} = \frac{0.5}{1.21} = 0.41 \qquad F = 2.076$$

FROM FIG XI-14, $\frac{h_s}{y_e} = 1.35$

$\therefore h_s = (1.35)(1.21) = 1.63'$

CHECK: $\frac{h_s}{d_{50}} = \frac{1.63}{0.5} = 3.27$

$2 < 3.27 < 4 \therefore$ OK ✓

7) SIZE DISSIPATOR POOL:

$L = 10 \cdot h_s = 10(1.63') = 16.30'$

OR

$4 \times W_o = 4(3.5') = 14'$ $\therefore$ USE <u>16.30'</u>

8) SIZE APRON:

$L = 5 \cdot h_s = 5(1.63') = 8.15'$

OR

$W_o(MIN) = 3.50'$ $\therefore$ USE <u>8.15'</u>

DIMENSIONS FOR RIP-RAP BASIN:

DISS. POOL = 16.3'
APRON = 8.15'
h_s = 1.63'

(USE SAME BASIN FOR 36" RCP)

PROJECT McMAHON BLVD RELOCS SHEET NO. ____ OF ____
SUBJECT RIP-RAP BASIN 30" RCP PROJECT NO. ____
BY P CONLEY DATE 5/15/95 CHECKED BY ____ DATE / /

FHWA CIRC # 14

GIVEN: 30" RCP
$Q = 13$ cfs
$S = 0.025$ ft/ft
$n = 0.013$

ASSUME: MINIMAL TW CONDITIONS

FIND: SIZE RIP-RAP BASIN

SOLUTION:

1) FIND y_o (DEPTH OF FLOW IN PIPE)

$y_o = 0.76'$ $y_c =$

2) FIND V_o (VEL IN PIPE)

$V_o = 10.34$ fps

3) FIND y_e (BRINK CONDITION) FLOW AREA = 1.26 ft²

$$y_e = \left(\frac{A}{2}\right)^{1/2} = \left(\frac{1.26}{2}\right)^{1/2} = 0.79$$

4) FIND d_{50}

$$Fr = \frac{V}{\sqrt{(32.2)(y_e)}} = \frac{10.34}{\sqrt{(32.2)(0.79)}} = 2.050$$

$$0.25 \le \frac{d_{50}}{y_e} \le 0.45$$

USE $\frac{d_{50}}{y_e} = 0.35$ ∴ $d_{50} = 0.79(0.35)$

$d_{50} = 0.28$

MIN SIZE $= d_{50} = 6"$

∴ USE $d_{50} = 6"$

PROJECT ____ SHEET NO. ____ OF ____

SUBJECT ____ PROJECT NO. ____

BY ____ DATE __/__/__ CHECKED BY ____ DATE __/__/__

6) FIND h_s

$$\frac{d_{50}}{y_e} = \frac{0.50}{0.79} = 0.63 \qquad F = 2.050$$

FROM FIG XI-14, $\frac{h_s}{y_e} = 0.80$

$$h_s = (0.80)(0.79) = 0.63'$$

7) SIZE DISSIPATOR POOL;

$L = 10 \cdot h_s = 10(0.63) = 6.30'$ OR $3\,W_o$ (MIN)

$3\,W_o = 3(3') = 9'$ USE 11'-0"

USE: DISS. POOL = 11'-0"

$h_s = 1.0'$

Smith Engineering Company

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