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Approved
1-22-90 RJH

# HOLLADAY STREET AND FORREST AVENUE

# WATERSHED STUDY

PREPARED BY:

McGOVERN, MacVITTIE, LODGE & DEAN, INC.
3505 N. CAMPBELL AVENUE, SUITE 501
TUCSON, AZ 85719

# HOLLADAY STREET AND FORREST AVENUE

# WATERSHED STUDY

LOCATION:

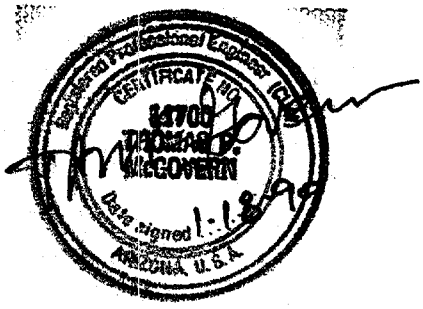
This site is located in Section 4,
Township 15 South, Range 13 East.

PREPARED FOR:

PIMA COUNTY DEPARTMENT OF TRANSPORTATION
AND FLOOD CONTROL DISTRICT
32 N. STONE AVENUE, SUITE 300
TUCSON, AZ 85701

OCTOBER 4, 1989
REVISED DECEMBER 6, 1989

MMLD 88143-03-45

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HOLLADAY/FORREST STREETS WATERSHED STUDY

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## 1.0 INTRODUCTION

### 1.1 Location.

The project is located in Township 15 South, Range 13 East, Section 4. The projected boundaries are: Mission Road to the east, Drexel Road to the south, Westover Avenue to the west and Canada Street to the north.

### 1.2 Purpose.

The purpose of the study is to identify existing flooding problems for fifteen homes adjacent and west of Holladay Street which have experienced flooding in the past three years. Some homeowners have filed drainage complaints with Pima County Flood Control District.

### 1.3 Objectives.

1. Determine critical flood hazard areas within the study area and propose a solution to mitigate these hazards.

2. Provide an accurate data base to be used for the evaluation of floodplain management alternatives.

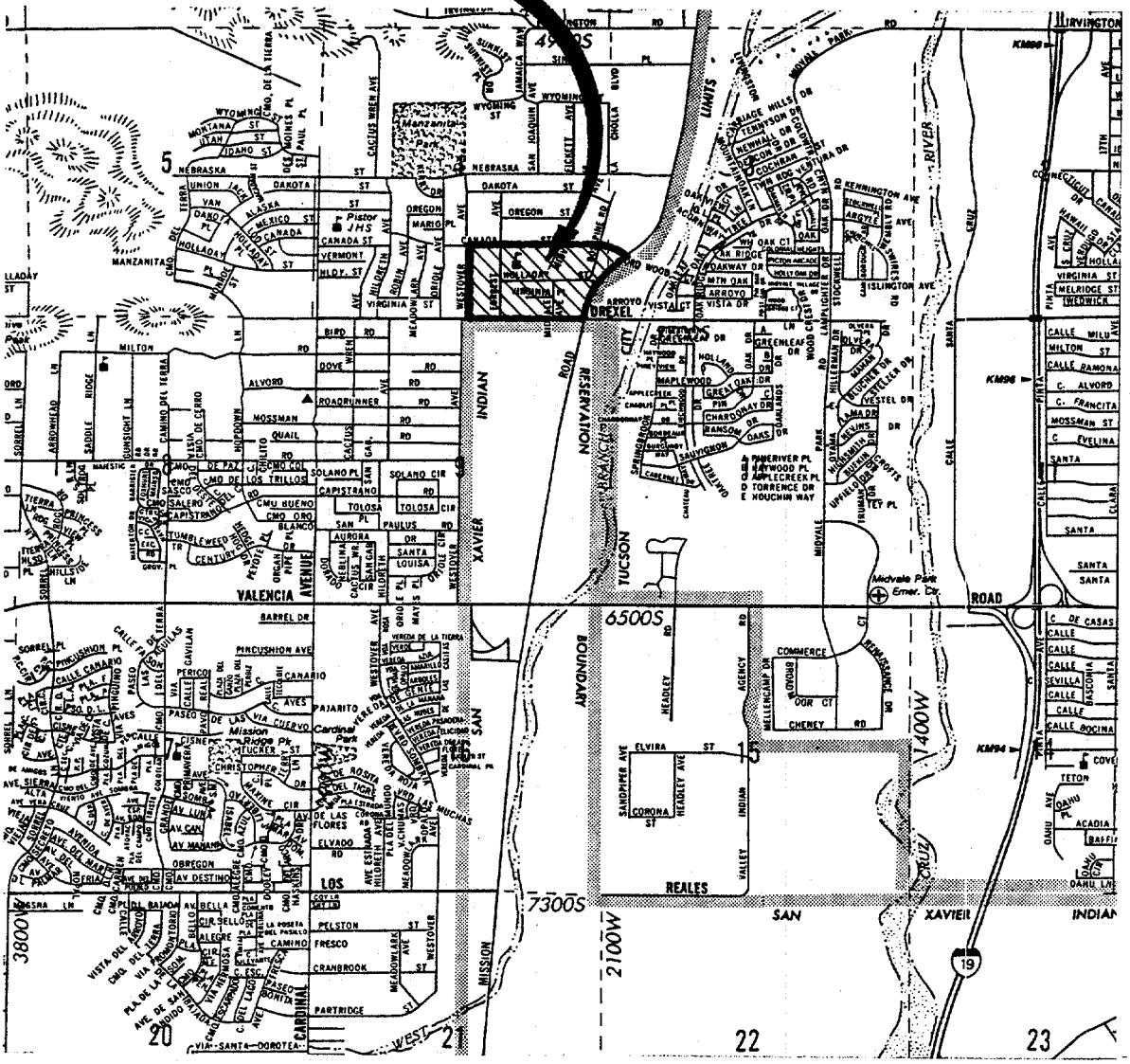
3. Determine a method to reduce/alleviate existing flood hazards.

4. Minimize maintenance requirements.



005

PROJECT LIMITS




# LOCATION MAP

1 inch : 1 km.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1.4 Procedures.

The 100-year discharges were calculated using the Hydrology Manual for Engineering Design and Floodplain Management within Pima County, Arizona, September, 1979.

Mannings equation was used to rate the minor washes.

The roughness coefficients "n" for asphalt (.016), concrete (0.013) and natural conditions (0.035) were used (Reference 2).

Offsite watersheds (see Figure 2) were delineated using aerial photogrammetry, 1 inch = 200 feet, 2 foot contour interval prepared by Cooper Aerial Survey.

Flowsplits and diversions were analyzed based on the split flows operating as weirs. The weir sections were modelled using the dominant roadway slope as the weir crest. The geometrics of the intersections analyzed were derived from field surveys. The resultant information was used to balance the water surfaces in both the flow direction and perpendicular to flow. The results were then summated with the associated calculated discharges at each concentration point to provide the peak flow at each respective Concentration Point.

Hydrographs were calculated using the Pima County dimensionless hydrograph method. Travel time for summated hydrographs were calculated by dividing the distance travelled by an average velocity of 5 f.p.s.

## 2.0 EXISTING BASIN CONDITIONS

### 2.1 Geology.

The project area is underlain by undifferentiated alluvial deposits. The alluvium deposits range from gravel and gravelly sand to sandy silt. These sediment deposits are layered chronologically into rock terraces which are continually formed during successive periods of erosion and deposition.

### 2.2 Basin Description.

The Holladay Street watershed is characterized by concentrated street flow which overtops the pavement in the downstream reach. The upstream portion collects flow splits from Canada Street, Drexel Road and Oriole Avenue in sheet flow condition. The flow concentrates at the intersection of Holladay Street/Forrest Avenue after flowing through and around numerous inhabited structures.

### 2.3 Existing Improvements.

The only flood control improvement in the project area is the open channel constructed in conjunction with the Mission Road improvements. The channel currently collects the runoff from Holladay Street and prevents it from impacting Mission Road.

## 3.0 HYDROLOGY

### 3.1 Climate.

The study is situated in an arid climatic zone characterized by hot summers, lasting from May to September, during which maximum daily temperatures average more than 90°F. Winters are mild, with early morning temperatures usually above the freezing point, and afternoon temperatures generally between 65°F and 70°F. Average annual precipitation is between 10 and 16 inches, slightly increasing to between 12 and 18 inches at the basin's extreme upper elevations. The study basin is subject to three major wet seasons, the first of which, during the winter months, is invoked by Pacific storms producing gentle, widespread showers and the second of which, during the summer months, is characterized by thunderstorms produced by moist air from the Gulf of Mexico. Late summer to fall rain is also delivered through tropical thunderstorms arising in the Pacific.

### 3.2 Soils.

There is one major soils group found within the project watersheds. The one group has been taken from the Revised SCS Soils Study and is described in the following paragraph.



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Sahuarita - Mohave Complex 100% B.

This group is located on nearly level intermediate and low fan terraces incised by narrow drainageways. The group is formed in moderately fine textured alluvium derived from dominantly igneous rock. Permeability is moderate. Runoff is medium with the hazard of water erosion being moderate.

3.3 Vegetation.

The project area is located in the Palo Verde - Cacti - Mixed Scrub series of the Arizona Upland Subdivision of the Sonoran Desert Scrub (Brown, 1982). The dominant natural plants on the site include cholla, mesquite, palo verde and triangle bursage. Numerous non-native plants have been introduced by the local homeowners.

3.4 Rainfall.

All hydrologic calculations were accomplished in accordance with the "Hydrology Manual for Engineering Design and Floodplain Management with Pima County."

One-hour precipitation depths were calculated for the 2, 5, 10, 25, 50 and 100 year events. The respective depths are 1.28, 1.62, 1.86, 2.15, 2.42 and 2.68 inches per hour. Precipitation depths for periods longer than one hour may be obtained from the rainfall data sheets and depth-duration diagram.



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3.5 Peak Discharge Determination.

Peak discharges for concentration points throughout the basin were calculated using the Pima County Hydrology Method (Reference 1). Table 2 summarizes the respective Q10 and Q100 values for each concentration point. Table 1 represents the hydrologic parameters used for the discharge calculations.

TABLE 1

| WATERSHED TYPE | BASIN FACTOR | IMPERVIOUS | COVER DENSITY (%) |
|---|---|---|---|
| Suburban Urbanization (CR-1) | 0.030 | 20% | 25% |
| Moderate Urbanization (CR-5) | 0.022 | 50% | 25% |
| Suburban Ranch (<CR-1) | 0.034 | 15% | 25% |

Discharge concentration points were selected at all major street crossings within the study area. Concentration points were also chosen at locations were drainage structures currently exist. Hydrograph summation was used to calculate peak discharges. A travel time was calculated using a flow velocity of 5.0 fps based on the velocities shown in the cross-sections analyzed.



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TABLE 2

EXISTING DISCHARGE TABLE

| CONCENTRATION * POINT | Q10 (cfs) | Q100 (cfs) |
|---|---|---|
| 1 | 298 | 568 |
| 2 | 61 | 135 |
| 3 | 38 | 63 |
| 4 | 46 | 109 |
| 5 | 56 | 86 |
| 6 | 72 | 210 |
| 7 | 72 | 210 |
| 8 | 28 | 57 |
| 9 | 94 | 261 |

* See Figure 2



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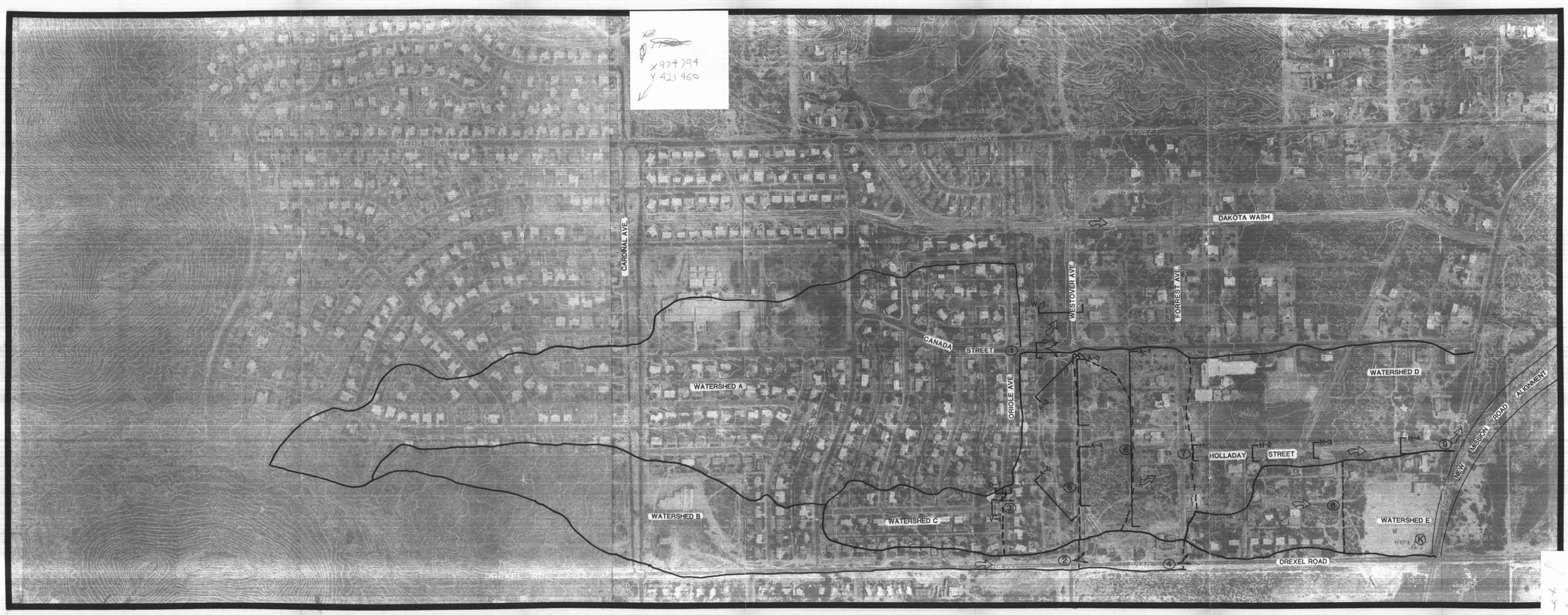
# WATERSHED MAP FOR HOLLADAY STREET/FORREST AVENUE FLOOD STUDY




LEGEND

- WATERSHED BOUNDARY
- ③ CONCENTRATION POINT
- A-2 CROSS-SECTION LOCATION
- FLOW ARROW
- FLOW SPLIT

SCALE: 1 inch =200 feet

CONTOUR INTERVAL=2 feet

FIGURE 2

X 980113
Y 918900

JAN 18 1990

DATE OF PHOTO: MAY, 1983
MMLD Job No. 88143-03-45

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# FLOODPLAIN MAP FOR HOLLADAY STREET / FORREST AVENUE FLOOD STUDY


EXISTING DISCHARGE TABLE

| CONCENTRATION POINT | Q10 (cfs) | Q100 (cfs) |
|---|---|---|
| 1 | 298 | 568 |
| 2 | 61 | 135 |
| 3 | 38 | 63 |
| 4 | 46 | 109 |
| 5 | 56 | 86 |
| 6 | 72 | 210 |
| 7 | 72 | 210 |
| 8 | 28 | 57 |
| 9 | 94 | 261 |

| HOME # | FFE | EXISTING WSEL Q10 | Q100 |
|---|---|---|---|
| 1 | 2477.77 | 2477.60 (N.I.) | 2477.93 |
| 2 | 2478.85 | 2477.60 (N.I.) | 2477.93 |
| 3 | 2475.55 | 2477.60 (N.I.) | 2477.93 |
| 4 | 2472.84 | 2472.40 (N.I.) | 2472.60 |
| 5 | 2472.80 | 2472.40 (N.I.) | 2472.60 |
| 6 | 2471.45 | 2472.40 | 2472.60 |
| 7 | 2470.52 | 2472.40 | 2472.60 |
| 8 | 2470.70 | 2472.40 | 2472.60 |
| 9 | 2470.10 | 2472.40 | 2472.60 |
| 10 | 2471.45 | 2472.40 | 2472.60 |
| 11 | 2468.50 | 2467.32 | 2467.77 |
| 12 | 2455.70 | 2456.32 | 2457.05 |
| 13 | 2455.70 | 2456.32 | 2457.05 |
| 14 | 2455.50 | 2456.32 | 2457.05 |
| 15 | 2454.75 | 2456.32 | 2457.05 |

LEGEND

- FLOODPLAIN BOUNDARY
- CONCENTRATION POINT (3)
- FLOODPLAIN FRINGE (DEPTH 0.5' OR LESS)
- FLOW ARROW
- FLOW SPLIT
- FIELD SURVEYED HOMES (13)

SCALE: 1 inch = 100 feet

CONTOUR INTERVAL = 2 feet

FIGURE 3

DATE OF PHOTO: MAY, 1983
MMLD Job. No. 88143-03-45

JAN 18 1990


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## 4.0 FLOODING AND POTENTIAL FLOODING HAZARD

### 4.1 Historical Flooding.

Based on Pima County Floodplain Section Management records, the subject area is currently impacted by shallow sheetflows during periodic moderate storm events. Pima County records indicate specific flooding complaints within the study area. Downstream of Westover numerous flooding complaints have been registered by homeowners in the existing subdivision.

### 4.2 Flow Splits and Diversions.

Watershed A concentrates flow at the intersection of Canada/ Oriole (C.P.#1). The flow is combined with some flow from Watershed C (39 cfs, Q100 and 14 cfs, Q10) at the intersection of Canada/ Oriole and results in a combined 100-year peak of 568 cfs. The runoff flows east in Canada until the curbs end two hundred feet west of the intersection with Westover Avenue - (10 feet east of cross-section C-1 - Figure 2). The flow then weirs over the natural ground along both sides of Canada Street with 16% (92 cfs) flowing south and the remaining 476 cfs flowing north into the Dakota Wash by way of the El Paso Gas easement and Westover Avenue. No breakout occurs to the south during the 10-year event and all runoff flows north into the Dakota Wash.



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Watershed B concentrates runoff at the intersection of Drexel Road/Westover Avenue (C.P. #2) and at the intersection of Drexel Road/Forrest Avenue (C.P. #4). The flow is contained within drainage swale north of Drexel Road and the west bound lane of Drexel Road. At concentration point 2 the 100 year peak discharge is 135 cfs and the 10 year peak discharge is 61 cfs. There is a minimal amount of runoff which flows north in Westover Avenue (Q100 - 30 cfs and Q10 - 18 cfs). The remaining discharges of 105 cfs and 43 cfs continue east within the swale and right-of-way of Drexel Road. At the intersection of Drexel Road/Forrest Avenue (C.P. #4) another minor flow split occurs. Of the 109 cfs and 46 cfs which collects during the 100 year and 10-year events, 19 cfs - 100 year event and 7 cfs - 10 year event flows onto Forrest Avenue. The remaining flow 90 cfs and 38 cfs continues east along Drexel Road until it sheetflows over the intersection of Mission Road/Drexel Road. At both concentration points (C.P.#2 and C.P. #4) the split flows to north were added to the hydrograph which impacts Holladay Street. There was no increase in the peak discharge along Holladay Street, however these two splits do increase the volume of water which flow in Holladay Street.



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Watershed C collects at C.P. #3 at the intersection of Oriole Avenue and Virginia Street where there is a sump and a small drainageway to control the low flows. The 100-year discharge at C.P. #3 is 63 cfs. During a 100-year storm 39 cfs flows north on Oriole Avenue and 24 cfs flows through the depressed curb and into the drainageway which carries flow east to Westover Avenue. During a 10 year storm, 24 cfs flows through the curb and 14 cfs flows north on Oriole Avenue.

At C.P. #5 the depth of flow over Westover Avenue is 0.67 feet. The flow contines east where it concentrates at C.P. #6. Watersheds A and C combine with Watershed D at C.P. #6 and produce a broad shallow floodplain which impacts three structures directly to the east (structures #7, 8, 9 on Figure 3). The 100-year discharge at C.P. #6 is 210 cfs. A fourth home would also be impacted (structure #10, Figure 3) but the owners have constructed a four foot high block wall which prevents runoff from entering the home. Structure #8 has a 1 foot high block wall and structures #7 and 9 have 1 foot high earthen berms with chain link fences. The 1 foot high blockage of flow on the back lot line of structures # 7, 8 and 9 does not provide significant storage to attenuate the peak flows. The structure act as a broad crested weir over which flow passes to drain toward the

intersection of Forrest Avenue and Holladay Street. The depth of flow in the floodprone areas west of Structures #7, 8 and 9 ranges from 1.9 feet along the lot line to less than 0.5 feet in the sheet flow areas between the lot line and Westover Avenue. The depth of flow across parcels with structures #7, 8 and 9 is approximately 0.7 feet deep.

Watershed E concentrates at C.P. #8 with a 100-year discharge of 57 cfs and a 10-year discharge of 28 cfs. The runoff flows onto the Circle K parcel to the east by way of a 24 foot wide clear opening in the screen wall constructed in conjunction with Circle K.

Between Forrest Avenue and Mission Road the majority of flow is contained in Holladay Street, however, overtopping of the pavement occurs (see Figure 3) but at depths of less than 0.5 feet during a 100-year event.

Table 3 summarizes the water surface elevations adjacent to the homes numbered on Figure 3 for both the 10-year and 100-year events. The area the flow depth is 0.5 feet or less, is defined as the floodplain fringe on Figure 3 (highlighted in pink).

Appendix A contains the individual hydro-sheets for the 100-year and 10-year storms. Triangular hydrographs have also been included to indicate the respective peak discharges at concentration points 5, 6 and 9.

Appendix B contains the street discharge rating curves, graphical representation of the cross-sections illustrated on Figure 2 and existing roadway geometry.

Appendix C contains the proposed typical sections which if constructed will reduce the flooding problems in the study area.



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TABLE 3

EXISTING WATER - SURFACE ELEVATIONS

| HOME # | FFE | EXISTING WSEL Q10 | Q100 |
|---|---|---|---|
| 1 | 2477.77 | 2477.60 (N.I.) | 2477.93 |
| 2 | 2478.85 | 2477.60 (N.I.) | 2477.93 |
| 3 | 2475.55 | 2477.60 (N.I.) | 2477.93 |
| 4 | 2472.84 | 2472.40 (N.I.) | 2472.60 |
| 5 | 2472.80 | 2472.40 (N.I.) | 2472.60 |
| 6 | 2471.45 | 2472.40 | 2472.60 |
| 7 | 2470.52 | 2472.40 | 2472.60 |
| 8 | 2470.70 | 2472.40 | 2472.60 |
| 9 | 2470.10 | 2472.40 | 2472.60 |
| 10 | 2471.45 | 2472.40 | 2472.60 |
| 11 | 2468.50 | 2467.32 | 2467.77 |
| 12 | 2455.70 | 2456.32 | 2457.05 |
| 13 | 2455.70 | 2456.32 | 2457.05 |
| 14 | 2455.50 | 2456.32 | 2457.05 |
| 15 | 2454.75 | 2456.32 | 2457.05 |

* N.I. Denotes No Impact - flow is contained between curbs or in a drainageway.



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## 5.0 RECOMMENDED DRAINAGE IMPROVEMENT PLAN

The following plan is recommended to reduce the existing flooding problems in the study area.

1. Prevent the breakout along Canada Street by a) constructing a 2.0 foot high earthen berm along the south side of the right-of-way to be terminated at the intersection of Westover Avenue/Canada Street. This will prevent the 92 cfs from flowing to the south during a 100 year event and mitigate the flooding potential for structures #1-2-3. It will also reduce the amount of ponding along Cross-section A-1 by about 0.3 feet, but will not remove Structures #7, 8, 9 and 10 from potential flooding.

   The 92 cfs will flow north and enter the Dakota Wash via, the E.P.G.E. and Westover Avenue. This 92 cfs increase during a 100-year event will not significantly increase the current peak flow in Dakota Wash (existing 3,055 cfs - proposed 3,083 cfs). The increase of 92 cfs results in 0.15 feet rise in water surface at Section W-1 on Figure 2. To prevent this rise in water surface elevations, it is recommended that the conveyance capacity along the E.P.G.E. be increased by grading a 25 foot swale along Westover Avenue. The limits of grading should extend from Canada Street to the Dakota Wash. The proposed slope is 0.5% while



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the existing slope is 0.6%. The velocity in the improved swale is 3.5 f.p.s. This velocity is considered non-erosive and therefore the confluence of the swale and the Dakota Wash will not require any structural improvements. A cross-section is provided in Appendix B for the existing condition and Appendix C for the proposed condition.

2. Construct a drainageway between structures 9 and 10 to outlet the sheetflow which concentrates at C.P. #6 directly to Holladay Street. The drainageway should be 15 feet wide with 1.5 foot extruded curb to contain the runoff. The post-project 100-year discharge at C.P. #6 is 118 cfs, the channel has capacity for 204 cfs. The drainage will provide an outlet for the ponded water instead of flowing over the walls and berm constructed by the homeowners. The channel has the conveyance capacity to remove the flooding potential along the rear lot lines of structures 7, 8 and 9. As previously mentioned on Page 11, structures 7, 8 and 9 have 1 foot high berms/wall along the rear lot lines. This acts as a broad crested weir at depths greater than 1.0 feet. The construction of the proposed drainageway will provide a positive flow direction for the runoff which collects along the berms/wall. However, if the breakout (See #1, Page 15) is not prevented the depth of flow will be greater than 0.5 feet as it weirs over of the wall/berms.

The inlet will require a taper from 25 feet down to 15 feet with a 1 to 1 contraction. This improvement will require acquisition of right-of-way and the removal of some private improvements on Lots 9 and 10. The outlet of the channel will require 8 inch curb to be placed along structure 11 property line within Forrest Avenue right-of-way. The intersection improvement will be done in conjunction with item 4.

3. In conjunction with this drainageway between structures 9 and 10, it is recommended that Pima County obtain, another 15 foot drainage easement from the two lots directly to the west. This easement is illustrated on Figure 3 and could be obtained by requiring 7.5 feet from each property owner during the permitting process. Though no specific improvements are recommended at this time for this easement, it will allow flexibility with any future improvements along Westover Avenue at Concentration Point 5.

4. Improve Holladay Street from Forrest Avenue to Mission Road including the intersection of Forrest Avenue/Holladay Street. A typical section is in Appendix B. The improved roadway will fully contain the 100-year event assuming no breakout from Canada Street. Construction of this roadway cross-section will eliminate the existing potential for



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flooding of residential areas along Holladay Street. If the 92 cfs breakout is not mitigated then overtopping of curbs will occur downstream of Midvale Drive due to the decrease in longitudinal slope and the decrease in conveyance capacity and increase in 100-year discharge.

Table 4 on the following page shows the 100-year water surface elevations for the with - projected conditions.



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TABLE 4

PROPOSED WATER - SURFACE ELEVATIONS
IF RECOMMENDED SOLUTION IS CONSTRUCTED

| HOME # | FFE | PROPOSED WSEL Q10 | Q100 |
|---|---|---|---|
| 1 | 2477.77 | 2477.60 (N.I.) | 2477.75 (N.I.) |
| 2 | 2478.85 | 2477.60 (N.I.) | 2477.75 (N.I.) |
| 3 | 2475.55 | 2477.60 (N.I.) | 2477.75 (N.I.) |
| 4 | 2472.84 | 2472.40 (N.I.) | 2472.60 (N.I.) |
| 5 | 2472.80 | 2472.40 (N.I.) | 2472.00 (N.I.) |
| 6 | 2471.45 | 2472.40 (N.I.) | 2472.60 (N.I.) |
| 7 | 2470.52 | 2472.40 (N.I.) | 2472.51 (N.I.) |
| 8 | 2470.70 | 2472.40 (N.I.) | 2472.51 (N.I.) |
| 9 | 2470.10 | 2472.40 (N.I.) | 2473.00 (N.I.) |
| 10 | 2471.45 | 2472.40 (N.I.) | 2472.51 (N.I.) |
| 11 | 2468.50 | 2467.95 (N.I.) | 2468.20 (N.I.) |
| 12 | 2455.70 | 2455.95 (N.I.) | 2456.40 (N.I.) |
| 13 | 2455.70 | 2455.95 (N.I.) | 2456.20 (N.I.) |
| 14 | 2455.50 | 2454.90 (N.I.) | 2455.15 (N.I.) |
| 15 | 2454.75 | 2454.90 (N.I.) | 2455.15 (N.I.) |

* N.I. Denotes No Impact - flow is contained between curbs or in a drainageway.



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## 6.0 REFERENCES


1. Pima County Department of Transportation and Flood Control District, "Hydrology Manual for Engineering and Design and Floodplain Management within Pima County, Arizona", September, 1979.

2. Chow, H.H., "Open Channel Hydraulics. U.S.A: McGraw Hills, 1959.

3. P.C.D.O.T. and F.C.D., "Drainage and Channel Design Standards for Local Drainage", May, 1984.

4. Brater and King; 1976, Handbook of Hydraulics.

5. Chow, V.T.; 1964, Handbook of Applied Hydrology.




022

## PRECIPITATION VALUES

for

Forrest Avenue/Holladay Street
Watershed Study

| RETURN PERIOD (YEARS) | PRECIPITATION VALUES (INCHES) | | | |
|---|---|---|---|---|
| | 6 HOUR DURATION | | 24 HOUR DURATION | |
| | MAP VALUE | CORRECTED VALUE | MAP VALUE | CORRECTED VALUE |
| 2 | 1.65 | 1.64 | 1.95 | 1.95 |
| 5 | 2.1 | 2.14 | 2.62 | 2.63 |
| 10 | 2.5 | 2.48 | 3.05 | 3.09 |
| 25 | 2.95 | 2.92 | 3.75 | 3.67 |
| 50 | 3.3 | 3.32 | 4.2 | 4.21 |
| 100 | 3.7 | 3.70 | 4.7 | 4.73 |

MMLD Job No. 88143-03-45

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HYDROLOGIC DATA SHEET
PCP.PAS

Project Name and Location: FLOOD STUDY for FORREST & HOLLADAY 88143-03-45
Drainage Concentration Point: WATERSHED A @ C.P. # 1

Watershed Area= 87.60 acres
Length of Watercourse (Lc): 4740 ft.
Length to Center of Gravity (Lca): 2370 ft.

Incremental Change in Length (Li)-ft.
L(1)= 3050
L(2)= 1690

Incremental Change in Elevation (Hi)-ft.
H(1)= 87.0
H(2)= 24.0

Mean Slope (Sc): 0.0216 ft/ft

Basin Factor (Nbw): 0.022

FLOOD FREQUENCY: 10-Year

P24 = 3.09
P6 = 2.48
P1 = 1.86
P2 = 2.07
P3 = 2.21

Impervious Cover = 50.0 %

Soil Group: B
Cover Type = Desert Brush
% of Pervious Area = 100.0
CN= 82.00
CN* = 83.89
Cover Density = 25.0 %

Time of Concentration (Tc) = 9.8 min
Intensity = 5.02 in./hr.
Weighted Runoff to Rainfall Ratio (Cw) = 0.64
Runoff Supply Rate at Tc = 3.22

PEAK DISCHARGE: 284.0 cfs

# PIMA COUNTY HYDROGRAPH

WASH:
AT:
RET. PER.:
DATE:
BY:
Peak Q = 284 cfs.
Tc = 9.8 min.
TL = 17.22 min.
δT = 1.722 min.

| | | |
|---|---|---|
| T= 1.72 min. | q= 6.8 cfs. | ΣQ= 351.6 cu. ft. |
| T= 3.44 min. | q= 24.4 cfs. | ΣQ= 1965.7 cu. ft. |
| T= 5.17 min. | q= 46.2 cfs. | ΣQ= 5613.6 cu. ft. |
| T= 6.89 min. | q= 69.9 cfs. | ΣQ= 11610.4 cu. ft. |
| T= 8.61 min. | q= 96.5 cfs. | ΣQ= 20206.8 cu. ft. |
| T= 10.33 min. | q= 128.0 cfs. | ΣQ= 31802.9 cu. ft. |
| T= 12.05 min. | q= 165.8 cfs. | ΣQ= 46977.7 cu. ft. |
| T= 13.78 min. | q= 208.9 cfs. | ΣQ= 66333.4 cu. ft. |
| T= 15.50 min. | q= 252.2 cfs. | ΣQ= 90156.3 cu. ft. |
| T= 17.22 min. | q= 282.8 cfs. | ΣQ= 117796.6 cu. ft. |
| T= 18.94 min. | q= 260.5 cfs. | ΣQ= 145865.5 cu. ft. |
| T= 20.66 min. | q= 238.1 cfs. | ΣQ= 171627.1 cu. ft. |
| T= 22.39 min. | q= 216.1 cfs. | ΣQ= 195090.8 cu. ft. |
| T= 24.11 min. | q= 194.6 cfs. | ΣQ= 216307.1 cu. ft. |
| T= 25.83 min. | q= 174.2 cfs. | ΣQ= 235358.9 cu. ft. |
| T= 27.55 min. | q= 154.8 cfs. | ΣQ= 252354.9 cu. ft. |
| T= 29.27 min. | q= 136.8 cfs. | ΣQ= 267422.8 cu. ft. |
| T= 31.00 min. | q= 120.2 cfs. | ΣQ= 280703.7 cu. ft. |
| T= 32.72 min. | q= 105.1 cfs. | ΣQ= 292347.1 cu. ft. |
| T= 34.44 min. | q= 91.5 cfs. | ΣQ= 302506.4 cu. ft. |
| T= 36.16 min. | q= 79.4 cfs. | ΣQ= 311334.8 cu. ft. |
| T= 37.88 min. | q= 68.7 cfs. | ΣQ= 318982.5 cu. ft. |
| T= 39.61 min. | q= 59.3 cfs. | ΣQ= 325593.8 cu. ft. |
| T= 41.33 min. | q= 51.2 cfs. | ΣQ= 331304.9 cu. ft. |
| T= 43.05 min. | q= 44.3 cfs. | ΣQ= 336242.3 cu. ft. |
| T= 44.77 min. | q= 38.5 cfs. | ΣQ= 340521.2 cu. ft. |
| T= 46.49 min. | q= 33.6 cfs. | ΣQ= 344244.9 cu. ft. |
| T= 48.22 min. | q= 29.5 cfs. | ΣQ= 347504.7 cu. ft. |
| T= 49.94 min. | q= 26.1 cfs. | ΣQ= 350378.9 cu. ft. |
| T= 51.66 min. | q= 23.3 cfs. | ΣQ= 352933.6 cu. ft. |
| T= 53.38 min. | q= 21.0 cfs. | ΣQ= 355223.1 cu. ft. |
| T= 55.10 min. | q= 19.0 cfs. | ΣQ= 357290.5 cu. ft. |
| T= 56.83 min. | q= 17.3 cfs. | ΣQ= 359168.7 cu. ft. |
| T= 58.55 min. | q= 15.8 cfs. | ΣQ= 360881.5 cu. ft. |
| T= 60.27 min. | q= 14.4 cfs. | ΣQ= 362444.9 cu. ft. |
| T= 61.99 min. | q= 13.1 cfs. | ΣQ= 363868.3 cu. ft. |
| T= 63.71 min. | q= 11.8 cfs. | ΣQ= 365156.2 cu. ft. |
| T= 65.44 min. | q= 10.5 cfs. | ΣQ= 366310.0 cu. ft. |
| T= 67.16 min. | q= 9.2 cfs. | ΣQ= 367328.9 cu. ft. |
| T= 68.88 min. | q= 7.9 cfs. | ΣQ= 368211.5 cu. ft. |
| T= 70.60 min. | q= 6.6 cfs. | ΣQ= 368957.9 cu. ft. |
| T= 72.32 min. | q= 5.3 cfs. | ΣQ= 369570.8 cu. ft. |
| T= 74.05 min. | q= 4.1 cfs. | ΣQ= 370056.7 cu. ft. |
| T= 75.77 min. | q= 3.1 cfs. | ΣQ= 370426.9 cu. ft. |
| T= 77.49 min. | q= 2.2 cfs. | ΣQ= 370699.0 cu. ft. |

PIMA COUNTY HYDROGRAPH

WASH:
AT:
RET. PER.:
DATE:
BY:

HYDROLOGIC DATA SHEET
PCP.PAS

Project Name and Location: FLOOD STUDY for FORREST & HOLLADAY 88143-03-45
Drainage Concentration Point: WATERSHED A @ C.P. # 1

Watershed Area= 87.60 acres
Length of Watercourse (Lc): 4740 ft.
Length to Center of Gravity (Lca): 2370 ft.

Incremental Change in Length (Li)-ft.
L(1)= 3050
L(2)= 1690

Incremental Change in Elevation (Hi)-ft.
H(1)= 87.0
H(2)= 24.0

Mean Slope (Sc): 0.0216 ft/ft

Basin Factor (Nbw): 0.022

FLOOD FREQUENCY: 100-Year

P24 = 4.73
P6 = 3.70
P1 = 2.68
P2 = 3.03
P3 = 3.26

Impervious Cover = 50.0 %

Soil Group: B
Cover Type = Desert Brush
% of Pervious Area = 100.0
CN= 82.00
CN* = 86.56
Cover Density = 25.0 %

Time of Concentration (Tc) = 7.9 min
Intensity = 8.03 in./hr.
Weighted Runoff to Rainfall Ratio (Cw) = 0.75
Runoff Supply Rate at Tc = 5.99

PEAK DISCHARGE: 528.5 cfs

Peak Q = 529 cfs.
Tc = 7.9 min.
TL = 15.79 min.
δT = 1.579 min.

| | | |
|---|---|---|
| T= 1.58 min. | q= 12.7 cfs. | ΣQ= 600.3 cu. ft. |
| T= 3.16 min. | q= 45.5 cfs. | ΣQ= 3356.1 cu. ft. |
| T= 4.74 min. | q= 86.0 cfs. | ΣQ= 9584.3 cu. ft. |
| T= 6.32 min. | q= 130.2 cfs. | ΣQ= 19823.4 cu. ft. |
| T= 7.89 min. | q= 179.7 cfs. | ΣQ= 34501.1 cu. ft. |
| T= 9.47 min. | q= 238.3 cfs. | ΣQ= 54299.9 cu. ft. |
| T= 11.05 min. | q= 308.6 cfs. | ΣQ= 80208.1 cu. ft. |
| T= 12.63 min. | q= 389.0 cfs. | ΣQ= 113254.4 cu. ft. |
| T= 14.21 min. | q= 469.7 cfs. | ΣQ= 153928.9 cu. ft. |
| T= 15.79 min. | q= 530.1 cfs. | ΣQ= 201288.4 cu. ft. |
| T= 17.37 min. | q= 485.4 cfs. | ΣQ= 249392.3 cu. ft. |
| T= 18.95 min. | q= 443.7 cfs. | ΣQ= 293403.5 cu. ft. |
| T= 20.53 min. | q= 402.6 cfs. | ΣQ= 333490.8 cu. ft. |
| T= 22.11 min. | q= 362.7 cfs. | ΣQ= 369739.9 cu. ft. |
| T= 23.69 min. | q= 324.5 cfs. | ΣQ= 402292.5 cu. ft. |
| T= 25.26 min. | q= 288.5 cfs. | ΣQ= 431333.8 cu. ft. |
| T= 26.84 min. | q= 255.0 cfs. | ΣQ= 457081.8 cu. ft. |
| T= 28.42 min. | q= 224.1 cfs. | ΣQ= 479777.5 cu. ft. |
| T= 30.00 min. | q= 196.0 cfs. | ΣQ= 499675.9 cu. ft. |
| T= 31.58 min. | q= 170.6 cfs. | ΣQ= 517038.6 cu. ft. |
| T= 33.16 min. | q= 148.0 cfs. | ΣQ= 532127.7 cu. ft. |
| T= 34.74 min. | q= 128.0 cfs. | ΣQ= 545199.4 cu. ft. |
| T= 36.32 min. | q= 110.6 cfs. | ΣQ= 556500.1 cu. ft. |
| T= 37.90 min. | q= 95.5 cfs. | ΣQ= 566262.6 cu. ft. |
| T= 39.48 min. | q= 82.7 cfs. | ΣQ= 574702.6 cu. ft. |
| T= 41.05 min. | q= 71.8 cfs. | ΣQ= 582017.1 cu. ft. |
| T= 42.63 min. | q= 62.6 cfs. | ΣQ= 588382.7 cu. ft. |
| T= 44.21 min. | q= 55.0 cfs. | ΣQ= 593955.0 cu. ft. |
| T= 45.79 min. | q= 48.7 cfs. | ΣQ= 598868.1 cu. ft. |
| T= 47.37 min. | q= 43.5 cfs. | ΣQ= 603234.9 cu. ft. |
| T= 48.95 min. | q= 39.1 cfs. | ΣQ= 607148.4 cu. ft. |
| T= 50.53 min. | q= 35.5 cfs. | ΣQ= 610682.1 cu. ft. |
| T= 52.11 min. | q= 32.3 cfs. | ΣQ= 613892.3 cu. ft. |
| T= 53.69 min. | q= 29.5 cfs. | ΣQ= 616819.7 cu. ft. |
| T= 55.26 min. | q= 26.9 cfs. | ΣQ= 619491.7 cu. ft. |
| T= 56.84 min. | q= 24.4 cfs. | ΣQ= 621924.7 cu. ft. |
| T= 58.42 min. | q= 22.0 cfs. | ΣQ= 624126.4 cu. ft. |
| T= 60.00 min. | q= 19.6 cfs. | ΣQ= 626098.9 cu. ft. |
| T= 61.58 min. | q= 17.2 cfs. | ΣQ= 627840.8 cu. ft. |
| T= 63.16 min. | q= 14.7 cfs. | ΣQ= 629350.2 cu. ft. |
| T= 64.74 min. | q= 12.3 cfs. | ΣQ= 630627.0 cu. ft. |
| T= 66.32 min. | q= 9.9 cfs. | ΣQ= 631675.6 cu. ft. |
| T= 67.90 min. | q= 7.7 cfs. | ΣQ= 632507.4 cu. ft. |
| T= 69.48 min. | q= 5.7 cfs. | ΣQ= 633141.9 cu. ft. |
| T= 71.06 min. | q= 4.1 cfs. | ΣQ= 633608.4 cu. ft. |
| T= 72.63 min. | q= 3.1 cfs. | ΣQ= 633948.9 cu. ft. |

PIMA COUNTY HYDROGRAPH

WASH:
AT:
RET. PER.:
DATE:
BY:

HYDROLOGIC DATA SHEET
PCP.PAS

Project Name and Location: FLOOD STUDY for FORREST & HOLLADAY 88143-03-45
Drainage Concentration Point: WATERSHED B @ C.P. # 2

Watershed Area= 30.90 acres
Length of Watercourse (Lc): 4050 ft.
Length to Center of Gravity (Lca): 2025 ft.

Incremental Change in Length (Li)-ft.
L(1)= 2350
L(2)= 1700
Mean Slope (Sc): 0.0210 ft/ft

Incremental Change in Elevation (Hi)-
H(1)= 40.0
H(2)= 50.0

Basin Factor (Nbw): 0.030

FLOOD FREQUENCY: 10-Year

P24 = 3.09
P6 = 2.48
P1 = 1.86
P2 = 2.07
P3 = 2.21

Impervious Cover = 20.0 %

Soil Group: B
Cover Type = Desert Brush
% of Pervious Area = 100.0
CN= 82.00
CN* = 83.89
Cover Density = 25.0 %

Time of Concentration (Tc) = 14.9 min
Intensity = 4.24 in./hr.
Weighted Runoff to Rainfall Ratio (Cw) = 0.46
Runoff Supply Rate at Tc = 1.96

PEAK DISCHARGE: 61.1 cfs

Peak Q = 61 cfs.
Tc = 14.9 min.
TL = 20.66 min.
δT = 2.066 min.

| | | |
|---|---|---|
| T= 2.07 min. | q= 1.5 cfs. | ΣQ= 90.6 cu. ft. |
| T= 4.13 min. | q= 5.2 cfs. | ΣQ= 506.6 cu. ft. |
| T= 6.20 min. | q= 9.9 cfs. | ΣQ= 1446.6 cu. ft. |
| T= 8.26 min. | q= 15.0 cfs. | ΣQ= 2992.1 cu. ft. |
| T= 10.33 min. | q= 20.7 cfs. | ΣQ= 5207.4 cu. ft. |
| T= 12.40 min. | q= 27.5 cfs. | ΣQ= 8195.8 cu. ft. |
| T= 14.46 min. | q= 35.6 cfs. | ΣQ= 12106.4 cu. ft. |
| T= 16.53 min. | q= 44.9 cfs. | ΣQ= 17094.4 cu. ft. |
| T= 18.59 min. | q= 54.2 cfs. | ΣQ= 23233.7 cu. ft. |
| T= 20.66 min. | q= 60.7 cfs. | ΣQ= 30356.5 cu. ft. |
| T= 22.73 min. | q= 56.0 cfs. | ΣQ= 37589.7 cu. ft. |
| T= 24.79 min. | q= 51.1 cfs. | ΣQ= 44228.2 cu. ft. |
| T= 26.86 min. | q= 46.4 cfs. | ΣQ= 50274.6 cu. ft. |
| T= 28.92 min. | q= 41.8 cfs. | ΣQ= 55741.8 cu. ft. |
| T= 30.99 min. | q= 37.4 cfs. | ΣQ= 60651.3 cu. ft. |
| T= 33.06 min. | q= 33.3 cfs. | ΣQ= 65030.9 cu. ft. |
| T= 35.12 min. | q= 29.4 cfs. | ΣQ= 68913.7 cu. ft. |
| T= 37.19 min. | q= 25.8 cfs. | ΣQ= 72336.0 cu. ft. |
| T= 39.25 min. | q= 22.6 cfs. | ΣQ= 75336.3 cu. ft. |
| T= 41.32 min. | q= 19.7 cfs. | ΣQ= 77954.2 cu. ft. |
| T= 43.39 min. | q= 17.0 cfs. | ΣQ= 80229.1 cu. ft. |
| T= 45.45 min. | q= 14.7 cfs. | ΣQ= 82199.8 cu. ft. |
| T= 47.52 min. | q= 12.7 cfs. | ΣQ= 83903.4 cu. ft. |
| T= 49.58 min. | q= 11.0 cfs. | ΣQ= 85375.0 cu. ft. |
| T= 51.65 min. | q= 9.5 cfs. | ΣQ= 86647.3 cu. ft. |
| T= 53.72 min. | q= 8.3 cfs. | ΣQ= 87749.9 cu. ft. |
| T= 55.78 min. | q= 7.2 cfs. | ΣQ= 88709.4 cu. ft. |
| T= 57.85 min. | q= 6.3 cfs. | ΣQ= 89549.4 cu. ft. |
| T= 59.91 min. | q= 5.6 cfs. | ΣQ= 90290.0 cu. ft. |
| T= 61.98 min. | q= 5.0 cfs. | ΣQ= 90948.3 cu. ft. |
| T= 64.05 min. | q= 4.5 cfs. | ΣQ= 91538.3 cu. ft. |
| T= 66.11 min. | q= 4.1 cfs. | ΣQ= 92071.0 cu. ft. |
| T= 68.18 min. | q= 3.7 cfs. | ΣQ= 92555.0 cu. ft. |
| T= 70.24 min. | q= 3.4 cfs. | ΣQ= 92996.4 cu. ft. |
| T= 72.31 min. | q= 3.1 cfs. | ΣQ= 93399.3 cu. ft. |
| T= 74.38 min. | q= 2.8 cfs. | ΣQ= 93766.0 cu. ft. |
| T= 76.44 min. | q= 2.5 cfs. | ΣQ= 94097.9 cu. ft. |
| T= 78.51 min. | q= 2.3 cfs. | ΣQ= 94395.2 cu. ft. |
| T= 80.57 min. | q= 2.0 cfs. | ΣQ= 94657.7 cu. ft. |
| T= 82.64 min. | q= 1.7 cfs. | ΣQ= 94885.1 cu. ft. |
| T= 84.71 min. | q= 1.4 cfs. | ΣQ= 95077.4 cu. ft. |
| T= 86.77 min. | q= 1.1 cfs. | ΣQ= 95235.4 cu. ft. |
| T= 88.84 min. | q= 0.9 cfs. | ΣQ= 95360.6 cu. ft. |
| T= 90.90 min. | q= 0.7 cfs. | ΣQ= 95456.0 cu. ft. |
| T= 92.97 min. | q= 0.5 cfs. | ΣQ= 95526.2 cu. ft. |

PIMA COUNTY HYDROGRAPH

WASH:
AT:
RET. PER.:
DATE:
BY:

HYDROLOGIC DATA SHEET
PCP.PAS

Project Name and Location: FLOOD STUDY for FORREST & HOLLADAY 88143-03-45
Drainage Concentration Point: WATERSHED B @ C.P. # 2

Watershed Area= 30.90 acres
Length of Watercourse (Lc): 4050 ft.
Length to Center of Gravity (Lca): 2025 ft.

Incremental Change in Length (Li)-ft.
L(1)= 2350
L(2)= 1700

Incremental Change in Elevation (Hi)-
H(1)= 40.0
H(2)= 50.0

Mean Slope (Sc): 0.0210 ft/ft

Basin Factor (Nbw): 0.030

FLOOD FREQUENCY: 100-Year

P24 = 4.73
P6 = 3.70
P1 = 2.68
P2 = 3.03
P3 = 3.26

Impervious Cover = 20.0 %

Soil Group: B
Cover Type = Desert Brush
% of Pervious Area = 100.0
CN= 82.00
CN* = 86.56
Cover Density = 25.0 %

Time of Concentration (Tc) = 10.9 min
Intensity = 7.01 in./hr.
Weighted Runoff to Rainfall Ratio (Cw) = 0.62
Runoff Supply Rate at Tc = 4.34

PEAK DISCHARGE: 135.1 cfs

Peak Q = 135 cfs.
Tc = 10.9 min.
TL = 18.00 min.
δT = 1.8 min.

| | | |
|---|---|---|
| T= 1.80 min. | q= 3.2 cfs. | ΣQ= 174.7 cu. ft. |
| T= 3.60 min. | q= 11.6 cfs. | ΣQ= 976.6 cu. ft. |
| T= 5.40 min. | q= 21.9 cfs. | ΣQ= 2789.0 cu. ft. |
| T= 7.20 min. | q= 33.2 cfs. | ΣQ= 5768.5 cu. ft. |
| T= 9.00 min. | q= 45.9 cfs. | ΣQ= 10039.6 cu. ft. |
| T= 10.80 min. | q= 60.8 cfs. | ΣQ= 15801.0 cu. ft. |
| T= 12.60 min. | q= 78.8 cfs. | ΣQ= 23340.4 cu. ft. |
| T= 14.40 min. | q= 99.3 cfs. | ΣQ= 32957.0 cu. ft. |
| T= 16.20 min. | q= 119.9 cfs. | ΣQ= 44793.1 cu. ft. |
| T= 18.00 min. | q= 134.4 cfs. | ΣQ= 58527.0 cu. ft. |
| T= 19.80 min. | q= 123.9 cfs. | ΣQ= 72474.6 cu. ft. |
| T= 21.60 min. | q= 113.2 cfs. | ΣQ= 85275.9 cu. ft. |
| T= 23.40 min. | q= 102.7 cfs. | ΣQ= 96935.4 cu. ft. |
| T= 25.20 min. | q= 92.5 cfs. | ΣQ= 107478.3 cu. ft. |
| T= 27.00 min. | q= 82.8 cfs. | ΣQ= 116945.7 cu. ft. |
| T= 28.80 min. | q= 73.6 cfs. | ΣQ= 125391.6 cu. ft. |
| T= 30.60 min. | q= 65.1 cfs. | ΣQ= 132879.4 cu. ft. |
| T= 32.40 min. | q= 57.2 cfs. | ΣQ= 139479.4 cu. ft. |
| T= 34.20 min. | q= 50.0 cfs. | ΣQ= 145265.6 cu. ft. |
| T= 36.00 min. | q= 43.5 cfs. | ΣQ= 150314.3 cu. ft. |
| T= 37.80 min. | q= 37.7 cfs. | ΣQ= 154701.7 cu. ft. |
| T= 39.60 min. | q= 32.6 cfs. | ΣQ= 158502.4 cu. ft. |
| T= 41.40 min. | q= 28.2 cfs. | ΣQ= 161788.1 cu. ft. |
| T= 43.20 min. | q= 24.4 cfs. | ΣQ= 164626.4 cu. ft. |
| T= 45.00 min. | q= 21.1 cfs. | ΣQ= 167080.2 cu. ft. |
| T= 46.80 min. | q= 18.3 cfs. | ΣQ= 169206.7 cu. ft. |
| T= 48.60 min. | q= 16.0 cfs. | ΣQ= 171057.4 cu. ft. |
| T= 50.40 min. | q= 14.0 cfs. | ΣQ= 172677.5 cu. ft. |
| T= 52.20 min. | q= 12.4 cfs. | ΣQ= 174105.9 cu. ft. |
| T= 54.00 min. | q= 11.1 cfs. | ΣQ= 175375.6 cu. ft. |
| T= 55.80 min. | q= 10.0 cfs. | ΣQ= 176513.4 cu. ft. |
| T= 57.60 min. | q= 9.0 cfs. | ΣQ= 177540.8 cu. ft. |
| T= 59.40 min. | q= 8.2 cfs. | ΣQ= 178474.2 cu. ft. |
| T= 61.20 min. | q= 7.5 cfs. | ΣQ= 179325.5 cu. ft. |
| T= 63.00 min. | q= 6.9 cfs. | ΣQ= 180102.5 cu. ft. |
| T= 64.80 min. | q= 6.2 cfs. | ΣQ= 180809.9 cu. ft. |
| T= 66.60 min. | q= 5.6 cfs. | ΣQ= 181450.1 cu. ft. |
| T= 68.40 min. | q= 5.0 cfs. | ΣQ= 182023.5 cu. ft. |
| T= 70.20 min. | q= 4.4 cfs. | ΣQ= 182529.8 cu. ft. |
| T= 72.00 min. | q= 3.7 cfs. | ΣQ= 182968.5 cu. ft. |
| T= 73.80 min. | q= 3.1 cfs. | ΣQ= 183339.5 cu. ft. |
| T= 75.60 min. | q= 2.5 cfs. | ΣQ= 183644.2 cu. ft. |
| T= 77.40 min. | q= 2.0 cfs. | ΣQ= 183885.8 cu. ft. |
| T= 79.20 min. | q= 1.5 cfs. | ΣQ= 184070.0 cu. ft. |
| T= 81.00 min. | q= 1.1 cfs. | ΣQ= 184205.4 cu. ft. |

PIMA COUNTY HYDROGRAPH

WASH:
AT:
RET. PER.:
DATE:
BY:

HYDROLOGIC DATA SHEET
PCP.PAS

Project Name and Location: FLOOD STUDY for FORREST & HOLLADAY 88143-03-45
Drainage Concentration Point: WATERSHED C @ C.P. # 3

Watershed Area= 9.10 acres
Length of Watercourse (Lc): 1100 ft.
Length to Center of Gravity (Lca): 550 ft.

Incremental Change in Length (Li)-ft.
L(1)= 1100

Incremental Change in Elevation (Hi)-
H(1)= 17.0

Mean Slope (Sc): 0.0155 ft/ft

Basin Factor (Nbw): 0.022

FLOOD FREQUENCY: 10-Year

P24 = 3.09
P6 = 2.48
P1 = 1.86
P2 = 2.07
P3 = 2.21

Impervious Cover = 50.0 %

Soil Group: B
Cover Type = Desert Brush
% of Pervious Area = 100.0
CN= 82.00
CN* = 83.89
Cover Density = 25.0 %

Time of Concentration (Tc) = 4.8 min
Intensity = 6.46 in./hr.
Weighted Runoff to Rainfall Ratio (Cw) = 0.64
Runoff Supply Rate at Tc = 4.15

PEAK DISCHARGE: 38.0 cfs

Peak Q = 38 cfs.
Tc = 4.8 min.
TL = 13.12 min.
δT = 1.312 min.

| | | |
|---|---|---|
| T= 1.31 min. | q= 0.9 cfs. | ΣQ= 35.8 cu. ft. |
| T= 2.62 min. | q= 3.3 cfs. | ΣQ= 200.3 cu. ft. |
| T= 3.94 min. | q= 6.2 cfs. | ΣQ= 571.9 cu. ft. |
| T= 5.25 min. | q= 9.3 cfs. | ΣQ= 1183.0 cu. ft. |
| T= 6.56 min. | q= 12.9 cfs. | ΣQ= 2058.9 cu. ft. |
| T= 7.87 min. | q= 17.1 cfs. | ΣQ= 3240.4 cu. ft. |
| T= 9.18 min. | q= 22.2 cfs. | ΣQ= 4786.4 cu. ft. |
| T= 10.50 min. | q= 27.9 cfs. | ΣQ= 6758.4 cu. ft. |
| T= 11.81 min. | q= 33.7 cfs. | ΣQ= 9185.7 cu. ft. |
| T= 13.12 min. | q= 38.1 cfs. | ΣQ= 12012.1 cu. ft. |
| T= 14.43 min. | q= 34.9 cfs. | ΣQ= 14883.3 cu. ft. |
| T= 15.74 min. | q= 31.9 cfs. | ΣQ= 17510.5 cu. ft. |
| T= 17.06 min. | q= 28.9 cfs. | ΣQ= 19903.5 cu. ft. |
| T= 18.37 min. | q= 26.1 cfs. | ΣQ= 22067.5 cu. ft. |
| T= 19.68 min. | q= 23.3 cfs. | ΣQ= 24010.9 cu. ft. |
| T= 20.99 min. | q= 20.7 cfs. | ΣQ= 25744.7 cu. ft. |
| T= 22.30 min. | q= 18.3 cfs. | ΣQ= 27281.9 cu. ft. |
| T= 23.62 min. | q= 16.1 cfs. | ΣQ= 28636.9 cu. ft. |
| T= 24.93 min. | q= 14.1 cfs. | ΣQ= 29825.0 cu. ft. |
| T= 26.24 min. | q= 12.3 cfs. | ΣQ= 30861.6 cu. ft. |
| T= 27.55 min. | q= 10.6 cfs. | ΣQ= 31762.6 cu. ft. |
| T= 28.86 min. | q= 9.2 cfs. | ΣQ= 32543.1 cu. ft. |
| T= 30.18 min. | q= 7.9 cfs. | ΣQ= 33217.9 cu. ft. |
| T= 31.49 min. | q= 6.9 cfs. | ΣQ= 33800.8 cu. ft. |
| T= 32.80 min. | q= 5.9 cfs. | ΣQ= 34304.8 cu. ft. |
| T= 34.11 min. | q= 5.2 cfs. | ΣQ= 34741.6 cu. ft. |
| T= 35.42 min. | q= 4.5 cfs. | ΣQ= 35121.7 cu. ft. |
| T= 36.74 min. | q= 4.0 cfs. | ΣQ= 35454.4 cu. ft. |
| T= 38.05 min. | q= 3.5 cfs. | ΣQ= 35747.8 cu. ft. |
| T= 39.36 min. | q= 3.1 cfs. | ΣQ= 36008.6 cu. ft. |
| T= 40.67 min. | q= 2.8 cfs. | ΣQ= 36242.3 cu. ft. |
| T= 41.98 min. | q= 2.5 cfs. | ΣQ= 36453.3 cu. ft. |
| T= 43.30 min. | q= 2.3 cfs. | ΣQ= 36645.0 cu. ft. |
| T= 44.61 min. | q= 2.1 cfs. | ΣQ= 36819.8 cu. ft. |
| T= 45.92 min. | q= 1.9 cfs. | ΣQ= 36979.3 cu. ft. |
| T= 47.23 min. | q= 1.8 cfs. | ΣQ= 37124.6 cu. ft. |
| T= 48.54 min. | q= 1.6 cfs. | ΣQ= 37256.1 cu. ft. |
| T= 49.86 min. | q= 1.4 cfs. | ΣQ= 37373.9 cu. ft. |
| T= 51.17 min. | q= 1.2 cfs. | ΣQ= 37477.9 cu. ft. |
| T= 52.48 min. | q= 1.1 cfs. | ΣQ= 37568.1 cu. ft. |
| T= 53.79 min. | q= 0.9 cfs. | ΣQ= 37644.4 cu. ft. |
| T= 55.10 min. | q= 0.7 cfs. | ΣQ= 37707.1 cu. ft. |
| T= 56.42 min. | q= 0.6 cfs. | ΣQ= 37756.8 cu. ft. |
| T= 57.73 min. | q= 0.4 cfs. | ΣQ= 37794.7 cu. ft. |
| T= 59.04 min. | q= 0.3 cfs. | ΣQ= 37822.6 cu. ft. |
| T= 60.35 min. | q= 0.2 cfs. | ΣQ= 37842.9 cu. ft. |

PIMA COUNTY HYDROGRAPH

WASH:
AT:
RET. PER.:
DATE:
BY:

HYDROLOGIC DATA SHEET
PCP.PAS

Project Name and Location: FLOOD STUDY for FORREST & HOLLADAY 88143-03-45
Drainage Concentration Point: WATERSHED C @ C.P. # 3

Watershed Area= 9.10 acres
Length of Watercourse (Lc): 1100 ft.
Length to Center of Gravity (Lca): 550 ft.

Incremental Change in Length (Li)-ft. Incremental Change in Elevation (Hi)-
L(1)= 1100 H(1)= 17.0
Mean Slope (Sc): 0.0155 ft/ft

Basin Factor (Nbw): 0.022 FLOOD FREQUENCY: 100-Year

P24 = 4.73
P6 = 3.70
P1 = 2.68
P2 = 3.03
P3 = 3.26

Impervious Cover = 50.0 %

Soil Group: B
Cover Type = Desert Brush
% of Pervious Area = 100.0
CN= 82.00
CN* = 86.56
Cover Density = 25.0 %

Time of Concentration (Tc) = 4.1 min
Intensity = 9.34 in./hr.
Weighted Runoff to Rainfall Ratio (Cw) = 0.75
Runoff Supply Rate at Tc = 6.97

PEAK DISCHARGE: 63.9 cfs

Peak Q = 64 cfs.
Tc = 4.1 min.
TL = 12.42 min.
δT = 1.242 min.

| | | |
|---|---|---|
| T= 1.24 min. | q= 1.5 cfs. | ΣQ= 57.1 cu. ft. |
| T= 2.48 min. | q= 5.5 cfs. | ΣQ= 319.4 cu. ft. |
| T= 3.73 min. | q= 10.4 cfs. | ΣQ= 912.0 cu. ft. |
| T= 4.97 min. | q= 15.7 cfs. | ΣQ= 1886.4 cu. ft. |
| T= 6.21 min. | q= 21.7 cfs. | ΣQ= 3283.1 cu. ft. |
| T= 7.45 min. | q= 28.8 cfs. | ΣQ= 5167.1 cu. ft. |
| T= 8.69 min. | q= 37.3 cfs. | ΣQ= 7632.5 cu. ft. |
| T= 9.94 min. | q= 47.1 cfs. | ΣQ= 10777.2 cu. ft. |
| T= 11.18 min. | q= 56.8 cfs. | ΣQ= 14647.7 cu. ft. |
| T= 12.42 min. | q= 64.1 cfs. | ΣQ= 19154.4 cu. ft. |
| T= 13.66 min. | q= 58.7 cfs. | ΣQ= 23732.1 cu. ft. |
| T= 14.90 min. | q= 53.7 cfs. | ΣQ= 27920.4 cu. ft. |
| T= 16.15 min. | q= 48.7 cfs. | ΣQ= 31735.3 cu. ft. |
| T= 17.39 min. | q= 43.9 cfs. | ΣQ= 35184.9 cu. ft. |
| T= 18.63 min. | q= 39.3 cfs. | ΣQ= 38282.8 cu. ft. |
| T= 19.87 min. | q= 34.9 cfs. | ΣQ= 41046.5 cu. ft. |
| T= 21.11 min. | q= 30.9 cfs. | ΣQ= 43496.9 cu. ft. |
| T= 22.36 min. | q= 27.1 cfs. | ΣQ= 45656.7 cu. ft. |
| T= 23.60 min. | q= 23.7 cfs. | ΣQ= 47550.4 cu. ft. |
| T= 24.84 min. | q= 20.6 cfs. | ΣQ= 49202.8 cu. ft. |
| T= 26.08 min. | q= 17.9 cfs. | ΣQ= 50638.8 cu. ft. |
| T= 27.32 min. | q= 15.5 cfs. | ΣQ= 51882.8 cu. ft. |
| T= 28.57 min. | q= 13.4 cfs. | ΣQ= 52958.2 cu. ft. |
| T= 29.81 min. | q= 11.6 cfs. | ΣQ= 53887.3 cu. ft. |
| T= 31.05 min. | q= 10.0 cfs. | ΣQ= 54690.5 cu. ft. |
| T= 32.29 min. | q= 8.7 cfs. | ΣQ= 55386.6 cu. ft. |
| T= 33.53 min. | q= 7.6 cfs. | ΣQ= 55992.5 cu. ft. |
| T= 34.78 min. | q= 6.7 cfs. | ΣQ= 56522.8 cu. ft. |
| T= 36.02 min. | q= 5.9 cfs. | ΣQ= 56990.3 cu. ft. |
| T= 37.26 min. | q= 5.3 cfs. | ΣQ= 57405.9 cu. ft. |
| T= 38.50 min. | q= 4.7 cfs. | ΣQ= 57778.3 cu. ft. |
| T= 39.74 min. | q= 4.3 cfs. | ΣQ= 58114.6 cu. ft. |
| T= 40.99 min. | q= 3.9 cfs. | ΣQ= 58420.1 cu. ft. |
| T= 42.23 min. | q= 3.6 cfs. | ΣQ= 58698.8 cu. ft. |
| T= 43.47 min. | q= 3.3 cfs. | ΣQ= 58953.1 cu. ft. |
| T= 44.71 min. | q= 3.0 cfs. | ΣQ= 59184.6 cu. ft. |
| T= 45.95 min. | q= 2.7 cfs. | ΣQ= 59394.2 cu. ft. |
| T= 47.20 min. | q= 2.4 cfs. | ΣQ= 59581.9 cu. ft. |
| T= 48.44 min. | q= 2.1 cfs. | ΣQ= 59747.7 cu. ft. |
| T= 49.68 min. | q= 1.8 cfs. | ΣQ= 59891.3 cu. ft. |
| T= 50.92 min. | q= 1.5 cfs. | ΣQ= 60012.9 cu. ft. |
| T= 52.16 min. | q= 1.2 cfs. | ΣQ= 60112.7 cu. ft. |
| T= 53.41 min. | q= 0.9 cfs. | ΣQ= 60191.9 cu. ft. |
| T= 54.65 min. | q= 0.7 cfs. | ΣQ= 60252.3 cu. ft. |
| T= 55.89 min. | q= 0.5 cfs. | ΣQ= 60296.7 cu. ft. |
| T= 57.13 min. | q= 0.4 cfs. | ΣQ= 60329.1 cu. ft. |

PIMA COUNTY HYDROGRAPH

WASH:
AT:
RET. PER.:
DATE:
BY:

HYDROLOGIC DATA SHEET
PCP.PAS

Project Name and Location: FLOOD STUDY for FORREST & HOLLADAY 88143-03-45
Drainage Concentration Point: WATERSHED B @ C.P. # 4

Watershed Area= 33.90 acres
Length of Watercourse (Lc): 4700 ft.
Length to Center of Gravity (Lca): 2350 ft.

Incremental Change in Length (Li)-ft.
L(1)= 1700
L(2)= 3000
Mean Slope (Sc): 0.0195 ft/ft

Incremental Change in Elevation (Hi)-
H(1)= 50.0
H(2)= 48.0

Basin Factor (Nbw): 0.030

FLOOD FREQUENCY: 10-Year

P24 = 3.09
P6 = 2.48
P1 = 1.86
P2 = 2.07
P3 = 2.21

Impervious Cover = 20.0 %

Soil Group: B
Cover Type = Desert Brush
% of Pervious Area = 100.0
CN= 82.00
CN* = 83.89
Cover Density = 25.0 %

Time of Concentration (Tc) = 17.2 min
Intensity = 4.01 in./hr.
Weighted Runoff to Rainfall Ratio (Cw) = 0.46
Runoff Supply Rate at Tc = 1.86

PEAK DISCHARGE: 63.5 cfs

eff

Peak Q = 64 cfs.
Tc = 17.2 min.
TL = 22.10 min.
δT = 2.21 min.

| | | |
|---|---|---|
| T= 2.21 min. | q= 1.5 cfs. | ΣQ= 101.7 cu. ft. |
| T= 4.42 min. | q= 5.5 cfs. | ΣQ= 568.4 cu. ft. |
| T= 6.63 min. | q= 10.4 cfs. | ΣQ= 1623.3 cu. ft. |
| T= 8.84 min. | q= 15.8 cfs. | ΣQ= 3357.4 cu. ft. |
| T= 11.05 min. | q= 21.7 cfs. | ΣQ= 5843.2 cu. ft. |
| T= 13.26 min. | q= 28.8 cfs. | ΣQ= 9196.5 cu. ft. |
| T= 15.47 min. | q= 37.3 cfs. | ΣQ= 13584.5 cu. ft. |
| T= 17.68 min. | q= 47.1 cfs. | ΣQ= 19181.5 cu. ft. |
| T= 19.89 min. | q= 56.8 cfs. | ΣQ= 26070.4 cu. ft. |
| T= 22.10 min. | q= 63.7 cfs. | ΣQ= 34064.2 cu. ft. |
| T= 24.31 min. | q= 58.7 cfs. | ΣQ= 42182.8 cu. ft. |
| T= 26.52 min. | q= 53.7 cfs. | ΣQ= 49634.2 cu. ft. |
| T= 28.72 min. | q= 48.7 cfs. | ΣQ= 56421.1 cu. ft. |
| T= 30.94 min. | q= 43.9 cfs. | ΣQ= 62558.0 cu. ft. |
| T= 33.15 min. | q= 39.3 cfs. | ΣQ= 68069.0 cu. ft. |
| T= 35.36 min. | q= 34.9 cfs. | ΣQ= 72985.3 cu. ft. |
| T= 37.57 min. | q= 30.8 cfs. | ΣQ= 77344.1 cu. ft. |
| T= 39.78 min. | q= 27.1 cfs. | ΣQ= 81186.0 cu. ft. |
| T= 41.99 min. | q= 23.7 cfs. | ΣQ= 84554.3 cu. ft. |
| T= 44.20 min. | q= 20.6 cfs. | ΣQ= 87493.2 cu. ft. |
| T= 46.41 min. | q= 17.9 cfs. | ΣQ= 90047.3 cu. ft. |
| T= 48.62 min. | q= 15.5 cfs. | ΣQ= 92259.8 cu. ft. |
| T= 50.83 min. | q= 13.4 cfs. | ΣQ= 94172.5 cu. ft. |
| T= 53.04 min. | q= 11.6 cfs. | ΣQ= 95824.8 cu. ft. |
| T= 55.25 min. | q= 10.0 cfs. | ΣQ= 97253.3 cu. ft. |
| T= 57.46 min. | q= 8.7 cfs. | ΣQ= 98491.2 cu. ft. |
| T= 59.67 min. | q= 7.6 cfs. | ΣQ= 99568.6 cu. ft. |
| T= 61.88 min. | q= 6.7 cfs. | ΣQ= 100511.7 cu. ft. |
| T= 64.09 min. | q= 5.9 cfs. | ΣQ= 101343.3 cu. ft. |
| T= 66.30 min. | q= 5.3 cfs. | ΣQ= 102082.4 cu. ft. |
| T= 68.51 min. | q= 4.7 cfs. | ΣQ= 102744.8 cu. ft. |
| T= 70.72 min. | q= 4.3 cfs. | ΣQ= 103342.9 cu. ft. |
| T= 72.93 min. | q= 3.9 cfs. | ΣQ= 103886.3 cu. ft. |
| T= 75.14 min. | q= 3.6 cfs. | ΣQ= 104381.8 cu. ft. |
| T= 77.35 min. | q= 3.3 cfs. | ΣQ= 104834.1 cu. ft. |
| T= 79.56 min. | q= 3.0 cfs. | ΣQ= 105245.9 cu. ft. |
| T= 81.77 min. | q= 2.7 cfs. | ΣQ= 105618.6 cu. ft. |
| T= 83.98 min. | q= 2.4 cfs. | ΣQ= 105952.4 cu. ft. |
| T= 86.19 min. | q= 2.1 cfs. | ΣQ= 106247.2 cu. ft. |
| T= 88.40 min. | q= 1.8 cfs. | ΣQ= 106502.6 cu. ft. |
| T= 90.61 min. | q= 1.5 cfs. | ΣQ= 106718.6 cu. ft. |
| T= 92.82 min. | q= 1.2 cfs. | ΣQ= 106896.0 cu. ft. |
| T= 95.03 min. | q= 0.9 cfs. | ΣQ= 107036.6 cu. ft. |
| T= 97.24 min. | q= 0.7 cfs. | ΣQ= 107143.8 cu. ft. |
| T= 99.45 min. | q= 0.5 cfs. | ΣQ= 107222.6 cu. ft. |

PIMA COUNTY HYDROGRAPH

WASH:
AT:
RET. PER.:
DATE:
BY:

042

HYDROLOGIC DATA SHEET
PCP.PAS

Project Name and Location: FLOOD STUDY for FORREST & HOLLADAY 88143-03-45
Drainage Concentration Point: WATERSHED B @ C.P. # 4

Watershed Area= 33.90 acres
Length of Watercourse (Lc): 4700 ft.
Length to Center of Gravity (Lca): 2350 ft.

Incremental Change in Length (Li)-ft.
L(1)= 1700
L(2)= 3000

Incremental Change in Elevation (Hi)-
H(1)= 50.0
H(2)= 48.0

Mean Slope (Sc): 0.0195 ft/ft

Basin Factor (Nbw): 0.030

FLOOD FREQUENCY: 100-Year

P24 = 4.73
P6 = 3.70
P1 = 2.68
P2 = 3.03
P3 = 3.26

Impervious Cover = 20.0 %

Soil Group: B
Cover Type = Desert Brush
% of Pervious Area = 100.0
CN= 82.00
CN* = 86.56
Cover Density = 25.0 %

Time of Concentration (Tc) = 12.5 min
Intensity = 6.55 in./hr.
Weighted Runoff to Rainfall Ratio (Cw) = 0.62
Runoff Supply Rate at Tc = 4.06

PEAK DISCHARGE: 138.6 cfs

Peak Q = 139 cfs.
Tc = 12.5 min.
TL = 19.09 min.
δT = 1.909 min.

| | | |
|---|---|---|
| T= 1.91 min. | q= 3.3 cfs. | ΣQ= 190.7 cu. ft. |
| T= 3.82 min. | q= 12.0 cfs. | ΣQ= 1066.2 cu. ft. |
| T= 5.73 min. | q= 22.6 cfs. | ΣQ= 3045.0 cu. ft. |
| T= 7.64 min. | q= 34.2 cfs. | ΣQ= 6297.9 cu. ft. |
| T= 9.55 min. | q= 47.2 cfs. | ΣQ= 10961.0 cu. ft. |
| T= 11.45 min. | q= 62.6 cfs. | ΣQ= 17251.1 cu. ft. |
| T= 13.36 min. | q= 81.1 cfs. | ΣQ= 25482.2 cu. ft. |
| T= 15.27 min. | q= 102.2 cfs. | ΣQ= 35981.1 cu. ft. |
| T= 17.18 min. | q= 123.4 cfs. | ΣQ= 48903.4 cu. ft. |
| T= 19.09 min. | q= 139.3 cfs. | ΣQ= 63949.2 cu. ft. |
| T= 21.00 min. | q= 127.5 cfs. | ΣQ= 79230.5 cu. ft. |
| T= 22.91 min. | q= 116.6 cfs. | ΣQ= 93211.0 cu. ft. |
| T= 24.82 min. | q= 105.8 cfs. | ΣQ= 105945.0 cu. ft. |
| T= 26.73 min. | q= 95.3 cfs. | ΣQ= 117459.6 cu. ft. |
| T= 28.63 min. | q= 85.3 cfs. | ΣQ= 127799.8 cu. ft. |
| T= 30.54 min. | q= 75.8 cfs. | ΣQ= 137024.7 cu. ft. |
| T= 32.45 min. | q= 67.0 cfs. | ΣQ= 145203.3 cu. ft. |
| T= 34.36 min. | q= 58.9 cfs. | ΣQ= 152412.3 cu. ft. |
| T= 36.27 min. | q= 51.5 cfs. | ΣQ= 158732.7 cu. ft. |
| T= 38.18 min. | q= 44.8 cfs. | ΣQ= 164247.7 cu. ft. |
| T= 40.09 min. | q= 38.9 cfs. | ΣQ= 169040.3 cu. ft. |
| T= 42.00 min. | q= 33.6 cfs. | ΣQ= 173192.2 cu. ft. |
| T= 43.91 min. | q= 29.0 cfs. | ΣQ= 176781.6 cu. ft. |
| T= 45.82 min. | q= 25.1 cfs. | ΣQ= 179882.3 cu. ft. |
| T= 47.72 min. | q= 21.7 cfs. | ΣQ= 182563.0 cu. ft. |
| T= 49.63 min. | q= 18.9 cfs. | ΣQ= 184886.1 cu. ft. |
| T= 51.54 min. | q= 16.5 cfs. | ΣQ= 186908.0 cu. ft. |
| T= 53.45 min. | q= 14.5 cfs. | ΣQ= 188677.8 cu. ft. |
| T= 55.36 min. | q= 12.8 cfs. | ΣQ= 190238.2 cu. ft. |
| T= 57.27 min. | q= 11.4 cfs. | ΣQ= 191625.3 cu. ft. |
| T= 59.18 min. | q= 10.3 cfs. | ΣQ= 192868.3 cu. ft. |
| T= 61.09 min. | q= 9.3 cfs. | ΣQ= 193990.7 cu. ft. |
| T= 63.00 min. | q= 8.5 cfs. | ΣQ= 195010.3 cu. ft. |
| T= 64.91 min. | q= 7.7 cfs. | ΣQ= 195940.2 cu. ft. |
| T= 66.81 min. | q= 7.1 cfs. | ΣQ= 196788.9 cu. ft. |
| T= 68.72 min. | q= 6.4 cfs. | ΣQ= 197561.7 cu. ft. |
| T= 70.63 min. | q= 5.8 cfs. | ΣQ= 198261.0 cu. ft. |
| T= 72.54 min. | q= 5.2 cfs. | ΣQ= 198887.5 cu. ft. |
| T= 74.45 min. | q= 4.5 cfs. | ΣQ= 199440.7 cu. ft. |
| T= 76.36 min. | q= 3.9 cfs. | ΣQ= 199920.0 cu. ft. |
| T= 78.27 min. | q= 3.2 cfs. | ΣQ= 200325.4 cu. ft. |
| T= 80.18 min. | q= 2.6 cfs. | ΣQ= 200658.6 cu. ft. |
| T= 82.09 min. | q= 2.0 cfs. | ΣQ= 200922.8 cu. ft. |
| T= 84.00 min. | q= 1.5 cfs. | ΣQ= 201124.2 cu. ft. |
| T= 85.91 min. | q= 1.1 cfs. | ΣQ= 201272.3 cu. ft. |
| T= 87.81 min. | q= 0.8 cfs. | ΣQ= 201380.3 cu. ft. |

PIMA COUNTY HYDROGRAPH

WASH:
AT:
RET. PER.:
DATE:
BY:

HYDROLOGIC DATA SHEET
PCP.PAS

Project Name and Location: FLOOD STUDY for FORREST & HOLLADAY 88143-03-54
Drainage Concentration Point: WATERSHED D @ C.P. # 5

Watershed Area= 10.60 acres
Length of Watercourse (Lc): 500 ft.
Length to Center of Gravity (Lca): 250 ft.

Incremental Change in Length (Li)-ft.
L(1)= 500

Incremental Change in Elevation (Hi)-
H(1)= 6.0

Mean Slope (Sc): 0.0120 ft/ft

Basin Factor (Nbw): 0.030

FLOOD FREQUENCY: 10-Year

P24 = 3.09
P6 = 2.48
P1 = 1.86
P2 = 2.07
P3 = 2.21

Impervious Cover = 20.0 %

Soil Group: B
Cover Type = Desert Brush
% of Pervious Area = 100.0
CN= 82.00
CN* = 83.89
Cover Density = 25.0 %

Time of Concentration (Tc) = 5.1 min
Intensity = 6.46 in./hr.
Weighted Runoff to Rainfall Ratio (Cw) = 0.46
Runoff Supply Rate at Tc = 2.99

PEAK DISCHARGE: 32.0 cfs

Peak Q = 32 cfs.
Tc = 5.1 min.
TL = 13.41 min.
δT = 1.341 min.

| | | |
|---|---|---|
| T= 1.34 min. | q= 0.8 cfs. | ΣQ= 30.9 cu. ft. |
| T= 2.68 min. | q= 2.8 cfs. | ΣQ= 172.5 cu. ft. |
| T= 4.02 min. | q= 5.2 cfs. | ΣQ= 492.5 cu. ft. |
| T= 5.36 min. | q= 7.9 cfs. | ΣQ= 1018.7 cu. ft. |
| T= 6.71 min. | q= 10.9 cfs. | ΣQ= 1772.9 cu. ft. |
| T= 8.05 min. | q= 14.4 cfs. | ΣQ= 2790.4 cu. ft. |
| T= 9.39 min. | q= 18.7 cfs. | ΣQ= 4121.8 cu. ft. |
| T= 10.73 min. | q= 23.5 cfs. | ΣQ= 5820.0 cu. ft. |
| T= 12.07 min. | q= 28.4 cfs. | ΣQ= 7910.2 cu. ft. |
| T= 13.41 min. | q= 31.9 cfs. | ΣQ= 10335.5 cu. ft. |
| T= 14.75 min. | q= 29.4 cfs. | ΣQ= 12798.5 cu. ft. |
| T= 16.09 min. | q= 26.8 cfs. | ΣQ= 15059.1 cu. ft. |
| T= 17.43 min. | q= 24.3 cfs. | ΣQ= 17118.1 cu. ft. |
| T= 18.77 min. | q= 21.9 cfs. | ΣQ= 18979.9 cu. ft. |
| T= 20.12 min. | q= 19.6 cfs. | ΣQ= 20651.7 cu. ft. |
| T= 21.46 min. | q= 17.4 cfs. | ΣQ= 22143.2 cu. ft. |
| T= 22.80 min. | q= 15.4 cfs. | ΣQ= 23465.5 cu. ft. |
| T= 24.14 min. | q= 13.6 cfs. | ΣQ= 24631.0 cu. ft. |
| T= 25.48 min. | q= 11.8 cfs. | ΣQ= 25652.8 cu. ft. |
| T= 26.82 min. | q= 10.3 cfs. | ΣQ= 26544.3 cu. ft. |
| T= 28.16 min. | q= 8.9 cfs. | ΣQ= 27319.1 cu. ft. |
| T= 29.50 min. | q= 7.7 cfs. | ΣQ= 27990.3 cu. ft. |
| T= 30.84 min. | q= 6.7 cfs. | ΣQ= 28570.5 cu. ft. |
| T= 32.18 min. | q= 5.8 cfs. | ΣQ= 29071.7 cu. ft. |
| T= 33.53 min. | q= 5.0 cfs. | ΣQ= 29505.0 cu. ft. |
| T= 34.87 min. | q= 4.3 cfs. | ΣQ= 29880.6 cu. ft. |
| T= 36.21 min. | q= 3.8 cfs. | ΣQ= 30207.4 cu. ft. |
| T= 37.55 min. | q= 3.3 cfs. | ΣQ= 30493.5 cu. ft. |
| T= 38.89 min. | q= 2.9 cfs. | ΣQ= 30745.7 cu. ft. |
| T= 40.23 min. | q= 2.6 cfs. | ΣQ= 30969.9 cu. ft. |
| T= 41.57 min. | q= 2.4 cfs. | ΣQ= 31170.8 cu. ft. |
| T= 42.91 min. | q= 2.1 cfs. | ΣQ= 31352.3 cu. ft. |
| T= 44.25 min. | q= 2.0 cfs. | ΣQ= 31517.1 cu. ft. |
| T= 45.59 min. | q= 1.8 cfs. | ΣQ= 31667.4 cu. ft. |
| T= 46.94 min. | q= 1.6 cfs. | ΣQ= 31804.6 cu. ft. |
| T= 48.28 min. | q= 1.5 cfs. | ΣQ= 31929.6 cu. ft. |
| T= 49.62 min. | q= 1.3 cfs. | ΣQ= 32042.6 cu. ft. |
| T= 50.96 min. | q= 1.2 cfs. | ΣQ= 32143.9 cu. ft. |
| T= 52.30 min. | q= 1.0 cfs. | ΣQ= 32233.3 cu. ft. |
| T= 53.64 min. | q= 0.9 cfs. | ΣQ= 32310.8 cu. ft. |
| T= 54.98 min. | q= 0.7 cfs. | ΣQ= 32376.3 cu. ft. |
| T= 56.32 min. | q= 0.6 cfs. | ΣQ= 32430.1 cu. ft. |
| T= 57.66 min. | q= 0.5 cfs. | ΣQ= 32472.7 cu. ft. |
| T= 59.00 min. | q= 0.3 cfs. | ΣQ= 32505.2 cu. ft. |
| T= 60.35 min. | q= 0.2 cfs. | ΣQ= 32529.1 cu. ft. |

PIMA COUNTY HYDROGRAPH

WASH:
AT:
RET. PER.:
DATE:
BY:

HYDROLOGIC DATA SHEET
PCP.PAS

Project Name and Location: FLOOD STUDY for FORREST & HOLLADAY 88143-03-54
Drainage Concentration Point: WATERSHED D @ C.P. # 5

Watershed Area= 10.60 acres
Length of Watercourse (Lc): 500 ft.
Length to Center of Gravity (Lca): 250 ft.

Incremental Change in Length (Li)-ft. Incremental Change in Elevation (Hi)-
L(1)= 500 H(1)= 6.0
Mean Slope (Sc): 0.0120 ft/ft

Basin Factor (Nbw): 0.030 FLOOD FREQUENCY: 100-Year

P24 = 4.73
P6 = 3.70
P1 = 2.68
P2 = 3.03
P3 = 3.26

Impervious Cover = 20.0 %

Soil Group: B
Cover Type = Desert Brush
% of Pervious Area = 100.0
CN= 82.00
CN* = 86.56
Cover Density = 25.0 %

Time of Concentration (Tc) = 4.1 min
Intensity = 9.34 in./hr.
Weighted Runoff to Rainfall Ratio (Cw) = 0.62
Runoff Supply Rate at Tc = 5.78

PEAK DISCHARGE: 61.8 cfs

047

HYDROLOGIC DATA SHEET
PCP.PAS

Project Name and Location: FLOOD STUDY for FORREST & HOLLADAY 88143-03-45
Drainage Concentration Point: WATERSHED D @ C.P. # 6

Watershed Area= 18.30 acres
Length of Watercourse (Lc): 900 ft.
Length to Center of Gravity (Lca): 450 ft.

Incremental Change in Length (Li)-ft. Incremental Change in Elevation (Hi)-f
L(1)= 900 H(1)= 10.0
Mean Slope (Sc): 0.0111 ft/ft

Basin Factor (Nbw): 0.031 FLOOD FREQUENCY: 10-Year

P24 = 3.09
P6 = 2.48
P1 = 1.86
P2 = 2.07
P3 = 2.21

Impervious Cover = 20.0 %

Soil Group: B
Cover Type = Desert Brush
% of Pervious Area = 100.0
CN= 82.00
CN* = 83.89
Cover Density = 25.0 %

Time of Concentration (Tc) = 7.5 min
Intensity = 5.55 in./hr.
Weighted Runoff to Rainfall Ratio (Cw) = 0.46
Runoff Supply Rate at Tc = 2.57

PEAK DISCHARGE: 47.5 cfs

Peak Q = 62 cfs.
Tc = 4.1 min.
TL = 12.42 min.
δT = 1.242 min.

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| | | |
|---|---|---|
| T= 1.24 min. | q= 1.5 cfs. | ΣQ= 55.3 cu. ft. |
| T= 2.48 min. | q= 5.3 cfs. | ΣQ= 309.4 cu. ft. |
| T= 3.73 min. | q= 10.1 cfs. | ΣQ= 883.5 cu. ft. |
| T= 4.97 min. | q= 15.3 cfs. | ΣQ= 1827.4 cu. ft. |
| T= 6.21 min. | q= 21.1 cfs. | ΣQ= 3180.5 cu. ft. |
| T= 7.45 min. | q= 27.9 cfs. | ΣQ= 5005.7 cu. ft. |
| T= 8.69 min. | q= 36.2 cfs. | ΣQ= 7394.0 cu. ft. |
| T= 9.94 min. | q= 45.6 cfs. | ΣQ= 10440.4 cu. ft. |
| T= 11.18 min. | q= 55.0 cfs. | ΣQ= 14190.0 cu. ft. |
| T= 12.42 min. | q= 62.1 cfs. | ΣQ= 18555.9 cu. ft. |
| T= 13.66 min. | q= 56.9 cfs. | ΣQ= 22990.5 cu. ft. |
| T= 14.90 min. | q= 52.0 cfs. | ΣQ= 27047.9 cu. ft. |
| T= 16.15 min. | q= 47.2 cfs. | ΣQ= 30743.5 cu. ft. |
| T= 17.39 min. | q= 42.5 cfs. | ΣQ= 34085.4 cu. ft. |
| T= 18.63 min. | q= 38.0 cfs. | ΣQ= 37086.5 cu. ft. |
| T= 19.87 min. | q= 33.8 cfs. | ΣQ= 39763.8 cu. ft. |
| T= 21.11 min. | q= 29.9 cfs. | ΣQ= 42137.6 cu. ft. |
| T= 22.36 min. | q= 26.3 cfs. | ΣQ= 44230.0 cu. ft. |
| T= 23.60 min. | q= 23.0 cfs. | ΣQ= 46064.5 cu. ft. |
| T= 24.84 min. | q= 20.0 cfs. | ΣQ= 47665.2 cu. ft. |
| T= 26.08 min. | q= 17.3 cfs. | ΣQ= 49056.3 cu. ft. |
| T= 27.32 min. | q= 15.0 cfs. | ΣQ= 50261.4 cu. ft. |
| T= 28.57 min. | q= 13.0 cfs. | ΣQ= 51303.3 cu. ft. |
| T= 29.81 min. | q= 11.2 cfs. | ΣQ= 52203.3 cu. ft. |
| T= 31.05 min. | q= 9.7 cfs. | ΣQ= 52981.5 cu. ft. |
| T= 32.29 min. | q= 8.4 cfs. | ΣQ= 53655.8 cu. ft. |
| T= 33.53 min. | q= 7.3 cfs. | ΣQ= 54242.7 cu. ft. |
| T= 34.78 min. | q= 6.4 cfs. | ΣQ= 54756.4 cu. ft. |
| T= 36.02 min. | q= 5.7 cfs. | ΣQ= 55209.4 cu. ft. |
| T= 37.26 min. | q= 5.1 cfs. | ΣQ= 55612.0 cu. ft. |
| T= 38.50 min. | q= 4.6 cfs. | ΣQ= 55972.8 cu. ft. |
| T= 39.74 min. | q= 4.2 cfs. | ΣQ= 56298.6 cu. ft. |
| T= 40.99 min. | q= 3.8 cfs. | ΣQ= 56594.5 cu. ft. |
| T= 42.23 min. | q= 3.5 cfs. | ΣQ= 56864.4 cu. ft. |
| T= 43.47 min. | q= 3.2 cfs. | ΣQ= 57110.8 cu. ft. |
| T= 44.71 min. | q= 2.9 cfs. | ΣQ= 57335.1 cu. ft. |
| T= 45.95 min. | q= 2.6 cfs. | ΣQ= 57538.1 cu. ft. |
| T= 47.20 min. | q= 2.3 cfs. | ΣQ= 57720.0 cu. ft. |
| T= 48.44 min. | q= 2.0 cfs. | ΣQ= 57880.5 cu. ft. |
| T= 49.68 min. | q= 1.7 cfs. | ΣQ= 58019.7 cu. ft. |
| T= 50.92 min. | q= 1.4 cfs. | ΣQ= 58137.5 cu. ft. |
| T= 52.16 min. | q= 1.2 cfs. | ΣQ= 58234.2 cu. ft. |
| T= 53.41 min. | q= 0.9 cfs. | ΣQ= 58310.9 cu. ft. |
| T= 54.65 min. | q= 0.7 cfs. | ΣQ= 58369.4 cu. ft. |
| T= 55.89 min. | q= 0.5 cfs. | ΣQ= 58412.4 cu. ft. |
| T= 57.13 min. | q= 0.4 cfs. | ΣQ= 58443.8 cu. ft. |

PIMA COUNTY HYDROGRAPH

WASH:
AT:
RET. PER.:
DATE:
BY:

Peak Q = 48 cfs.
Tc = 7.5 min.
TL = 15.48 min.
δT = 1.548 min.

| | | |
|---|---|---|
| T= 1.55 min. | q= 1.2 cfs. | ΣQ= 53.4 cu. ft. |
| T= 3.10 min. | q= 4.1 cfs. | ΣQ= 298.7 cu. ft. |
| T= 4.64 min. | q= 7.8 cfs. | ΣQ= 853.1 cu. ft. |
| T= 6.19 min. | q= 11.8 cfs. | ΣQ= 1764.5 cu. ft. |
| T= 7.74 min. | q= 16.3 cfs. | ΣQ= 3070.9 cu. ft. |
| T= 9.29 min. | q= 21.6 cfs. | ΣQ= 4833.2 cu. ft. |
| T= 10.84 min. | q= 28.0 cfs. | ΣQ= 7139.3 cu. ft. |
| T= 12.38 min. | q= 35.3 cfs. | ΣQ= 10081.0 cu. ft. |
| T= 13.93 min. | q= 42.6 cfs. | ΣQ= 13701.4 cu. ft. |
| T= 15.48 min. | q= 47.8 cfs. | ΣQ= 17901.1 cu. ft. |
| T= 17.03 min. | q= 44.0 cfs. | ΣQ= 22165.2 cu. ft. |
| T= 18.58 min. | q= 40.2 cfs. | ΣQ= 26078.7 cu. ft. |
| T= 20.12 min. | q= 36.5 cfs. | ΣQ= 29643.0 cu. ft. |
| T= 21.67 min. | q= 32.9 cfs. | ΣQ= 32865.8 cu. ft. |
| T= 23.22 min. | q= 29.4 cfs. | ΣQ= 35759.8 cu. ft. |
| T= 24.77 min. | q= 26.2 cfs. | ΣQ= 38341.4 cu. ft. |
| T= 26.32 min. | q= 23.1 cfs. | ΣQ= 40630.0 cu. ft. |
| T= 27.86 min. | q= 20.3 cfs. | ΣQ= 42647.1 cu. ft. |
| T= 29.41 min. | q= 17.8 cfs. | ΣQ= 44415.5 cu. ft. |
| T= 30.96 min. | q= 15.5 cfs. | ΣQ= 45958.4 cu. ft. |
| T= 32.51 min. | q= 13.4 cfs. | ΣQ= 47299.2 cu. ft. |
| T= 34.06 min. | q= 11.6 cfs. | ΣQ= 48460.6 cu. ft. |
| T= 35.60 min. | q= 10.0 cfs. | ΣQ= 49464.6 cu. ft. |
| T= 37.15 min. | q= 8.7 cfs. | ΣQ= 50331.8 cu. ft. |
| T= 38.70 min. | q= 7.5 cfs. | ΣQ= 51081.6 cu. ft. |
| T= 40.25 min. | q= 6.5 cfs. | ΣQ= 51731.3 cu. ft. |
| T= 41.80 min. | q= 5.7 cfs. | ΣQ= 52296.8 cu. ft. |
| T= 43.34 min. | q= 5.0 cfs. | ΣQ= 52791.8 cu. ft. |
| T= 44.89 min. | q= 4.4 cfs. | ΣQ= 53228.3 cu. ft. |
| T= 46.44 min. | q= 3.9 cfs. | ΣQ= 53616.2 cu. ft. |
| T= 47.99 min. | q= 3.5 cfs. | ΣQ= 53963.9 cu. ft. |
| T= 49.54 min. | q= 3.2 cfs. | ΣQ= 54277.9 cu. ft. |
| T= 51.08 min. | q= 2.9 cfs. | ΣQ= 54563.1 cu. ft. |
| T= 52.63 min. | q= 2.7 cfs. | ΣQ= 54823.3 cu. ft. |
| T= 54.18 min. | q= 2.4 cfs. | ΣQ= 55060.7 cu. ft. |
| T= 55.73 min. | q= 2.2 cfs. | ΣQ= 55276.8 cu. ft. |
| T= 57.28 min. | q= 2.0 cfs. | ΣQ= 55472.4 cu. ft. |
| T= 58.82 min. | q= 1.8 cfs. | ΣQ= 55647.6 cu. ft. |
| T= 60.37 min. | q= 1.6 cfs. | ΣQ= 55802.2 cu. ft. |
| T= 61.92 min. | q= 1.3 cfs. | ΣQ= 55936.2 cu. ft. |
| T= 63.47 min. | q= 1.1 cfs. | ΣQ= 56049.4 cu. ft. |
| T= 65.02 min. | q= 0.9 cfs. | ΣQ= 56142.4 cu. ft. |
| T= 66.56 min. | q= 0.7 cfs. | ΣQ= 56216.1 cu. ft. |
| T= 68.11 min. | q= 0.5 cfs. | ΣQ= 56272.3 cu. ft. |
| T= 69.66 min. | q= 0.4 cfs. | ΣQ= 56313.5 cu. ft. |

PIMA COUNTY HYDROGRAPH

WASH:
AT:
RET. PER.:
DATE:
BY:

050

HYDROLOGIC DATA SHEET
PCP.PAS

Project Name and Location: FLOOD STUDY for FORREST & HOLLADAY 88143-03-45
Drainage Concentration Point: WATERSHED D @ C.P. # 6

Watershed Area= 18.30 acres
Length of Watercourse (Lc): 900 ft.
Length to Center of Gravity (Lca): 450 ft.

Incremental Change in Length (Li)-ft. Incremental Change in Elevation (Hi)--
L(1)= 900 H(1)= 10.0
Mean Slope (Sc): 0.0111 ft/ft

Basin Factor (Nbw): 0.031 FLOOD FREQUENCY: 100-Year

P24 = 4.73
P6 = 3.70
P1 = 2.68
P2 = 3.03
P3 = 3.26

Impervious Cover = 20.0 %

Soil Group: B
Cover Type = Desert Brush
% of Pervious Area = 100.0
CN= 82.00
CN* = 86.56
Cover Density = 25.0 %

Time of Concentration (Tc) = 5.8 min
Intensity = 8.91 in./hr.
Weighted Runoff to Rainfall Ratio (Cw) = 0.62
Runoff Supply Rate at Tc = 5.52

PEAK DISCHARGE: 101.8 cfs

Peak Q = 102 cfs.
Tc = 5.8 min.
TL = 14.05 min.
δT = 1.4 min.

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| | | |
|---|---|---|
| T= 1.40 min. | q= 2.4 cfs. | ΣQ= 101.9 cu. ft. |
| T= 2.80 min. | q= 8.7 cfs. | ΣQ= 570.3 cu. ft. |
| T= 4.20 min. | q= 16.5 cfs. | ΣQ= 1629.6 cu. ft. |
| T= 5.60 min. | q= 25.0 cfs. | ΣQ= 3371.7 cu. ft. |
| T= 7.00 min. | q= 34.5 cfs. | ΣQ= 5868.8 cu. ft. |
| T= 8.40 min. | q= 45.7 cfs. | ΣQ= 9236.0 cu. ft. |
| T= 9.80 min. | q= 59.2 cfs. | ΣQ= 13640.6 cu. ft. |
| T= 11.20 min. | q= 74.6 cfs. | ΣQ= 19257.9 cu. ft. |
| T= 12.60 min. | q= 90.1 cfs. | ΣQ= 26175.4 cu. ft. |
| T= 14.00 min. | q= 101.9 cfs. | ΣQ= 34242.7 cu. ft. |
| T= 15.40 min. | q= 93.9 cfs. | ΣQ= 42467.8 cu. ft. |
| T= 16.80 min. | q= 85.9 cfs. | ΣQ= 50017.7 cu. ft. |
| T= 18.20 min. | q= 78.0 cfs. | ΣQ= 56898.6 cu. ft. |
| T= 19.60 min. | q= 70.3 cfs. | ΣQ= 63124.6 cu. ft. |
| T= 21.00 min. | q= 62.9 cfs. | ΣQ= 68719.5 cu. ft. |
| T= 22.40 min. | q= 56.0 cfs. | ΣQ= 73714.4 cu. ft. |
| T= 23.80 min. | q= 49.5 cfs. | ΣQ= 78146.1 cu. ft. |
| T= 25.20 min. | q= 43.6 cfs. | ΣQ= 82055.2 cu. ft. |
| T= 26.60 min. | q= 38.1 cfs. | ΣQ= 85485.1 cu. ft. |
| T= 28.00 min. | q= 33.2 cfs. | ΣQ= 88480.1 cu. ft. |
| T= 29.40 min. | q= 28.8 cfs. | ΣQ= 91084.8 cu. ft. |
| T= 30.80 min. | q= 24.9 cfs. | ΣQ= 93342.7 cu. ft. |
| T= 32.20 min. | q= 21.6 cfs. | ΣQ= 95295.8 cu. ft. |
| T= 33.60 min. | q= 18.6 cfs. | ΣQ= 96984.0 cu. ft. |
| T= 35.00 min. | q= 16.1 cfs. | ΣQ= 98443.9 cu. ft. |
| T= 36.40 min. | q= 14.0 cfs. | ΣQ= 99709.5 cu. ft. |
| T= 37.80 min. | q= 12.2 cfs. | ΣQ= 100810.9 cu. ft. |
| T= 39.20 min. | q= 10.7 cfs. | ΣQ= 101774.9 cu. ft. |
| T= 40.60 min. | q= 9.5 cfs. | ΣQ= 102624.6 cu. ft. |
| T= 42.00 min. | q= 8.5 cfs. | ΣQ= 103379.5 cu. ft. |
| T= 43.40 min. | q= 7.6 cfs. | ΣQ= 104055.8 cu. ft. |
| T= 44.80 min. | q= 6.9 cfs. | ΣQ= 104666.2 cu. ft. |
| T= 46.20 min. | q= 6.3 cfs. | ΣQ= 105220.6 cu. ft. |
| T= 47.60 min. | q= 5.7 cfs. | ΣQ= 105726.2 cu. ft. |
| T= 49.00 min. | q= 5.2 cfs. | ΣQ= 106187.9 cu. ft. |
| T= 50.40 min. | q= 4.8 cfs. | ΣQ= 106608.6 cu. ft. |
| T= 51.80 min. | q= 4.3 cfs. | ΣQ= 106989.8 cu. ft. |
| T= 53.20 min. | q= 3.8 cfs. | ΣQ= 107332.0 cu. ft. |
| T= 54.60 min. | q= 3.4 cfs. | ΣQ= 107634.9 cu. ft. |
| T= 56.00 min. | q= 2.9 cfs. | ΣQ= 107898.2 cu. ft. |
| T= 57.40 min. | q= 2.4 cfs. | ΣQ= 108121.9 cu. ft. |
| T= 58.80 min. | q= 2.0 cfs. | ΣQ= 108306.5 cu. ft. |
| T= 60.20 min. | q= 1.5 cfs. | ΣQ= 108453.8 cu. ft. |
| T= 61.60 min. | q= 1.2 cfs. | ΣQ= 108566.9 cu. ft. |
| T= 63.00 min. | q= 0.8 cfs. | ΣQ= 108650.5 cu. ft. |
| T= 64.40 min. | q= 0.6 cfs. | ΣQ= 108711.4 cu. ft. |

PIMA COUNTY HYDROGRAPH

WASH:
AT:
RET. PER.:
DATE:
BY:

D52

HYDROLOGIC DATA SHEET
PCP.PAS

Project Name and Location: FLOOD STUDY for FORREST & HOLLADAY 88143-03-45
Drainage Concentration Point: WATERSHED E @ C.P. # 8

Watershed Area= 9.20 acres
Length of Watercourse (Lc): 1000 ft.
Length to Center of Gravity (Lca): 500 ft.

Incremental Change in Length (Li)-ft.
L(1)= 1000

Incremental Change in Elevation (Hi)-
H(1)= 12.0

Mean Slope (Sc): 0.0120 ft/ft

Basin Factor (Nbw): 0.028

FLOOD FREQUENCY: 10-Year

P24 = 3.09
P6 = 2.48
P1 = 1.86
P2 = 2.07
P3 = 2.21

Impervious Cover = 30.0 %

Soil Group: B
Cover Type = Desert Brush
% of Pervious Area = 100.0
CN= 82.00
CN* = 83.89
Cover Density = 25.0 %

Time of Concentration (Tc) = 6.7 min
Intensity = 5.85 in./hr.
Weighted Runoff to Rainfall Ratio (Cw) = 0.52
Runoff Supply Rate at Tc = 3.06

PEAK DISCHARGE: 28.4 cfs

HYDROLOGIC DATA SHEET
FCP.PAS

Project Name and Location: FLOOD STUDY for FORREST & HOLLADAY 88143-03-45
Drainage Concentration Point: WATERSHED E @ C.P. # 8

Watershed Area= 9.20 acres
Length of Watercourse (Lc): 1000 ft.
Length to Center of Gravity (Lca): 500 ft.

Incremental Change in Length (Li)-ft. Incremental Change in Elevation (Hi)
L(1)= 1000 H(1)= 12.0
Mean Slope (Sc): 0.0120 ft/ft

Basin Factor (Nbw): 0.028 FLOOD FREQUENCY: 100-Year

P24 = 4.73
P6 = 3.70
P1 = 2.68
P2 = 3.03
P3 = 3.26

Impervious Cover = 30.0 %

Soil Group: B
Cover Type = Desert Brush
% of Pervious Area = 100.0
CN= 82.00
CN* = 86.56
Cover Density = 25.0 %

Time of Concentration (Tc) = 5.4 min
Intensity = 9.34 in./hr.
Weighted Runoff to Rainfall Ratio (Cw) = 0.66
Runoff Supply Rate at Tc = 6.18

PEAK DISCHARGE: 57.3 cfs

HYDROLOGIC DATA SHEET
PCP.PAS

Project Name and Location: FLOOD STUDY for FORREST & HOLLADAY 88143-03-45
Drainage Concentration Point: WATERSHED D @ C.P. # 9

Watershed Area= 38.70 acres
Length of Watercourse (Lc): 2250 ft.
Length to Center of Gravity (Lca): 1125 ft.

Incremental Change in Length (Li)-ft. Incremental Change in Elevation (Hi)-f
L(1)= 2250 H(1)= 24.0
Mean Slope (Sc): 0.0107 ft/ft

Basin Factor (Nbw): 0.034 FLOOD FREQUENCY: 10-Year

P24 = 3.09
P6 = 2.48
P1 = 1.86
P2 = 2.07
P3 = 2.21

Impervious Cover = 15.0 %

Soil Group: B
Cover Type = Desert Brush
% of Pervious Area = 100.0
CN= 82.00
CN* = 83.89
Cover Density = 25.0 %

Time of Concentration (Tc) = 16.2 min
Intensity = 4.12 in./hr.
Weighted Runoff to Rainfall Ratio (Cw) = 0.43
Runoff Supply Rate at Tc = 1.79

PEAK DISCHARGE: 69.7 cfs

Peak Q = 70 cfs.
Tc = 16.2 min.
TL = 21.48 min.
δT = 2.148 min.

| | | |
|---|---|---|
| T= 2.15 min. | q= 1.7 cfs. | ΣQ= 108.1 cu. ft. |
| T= 4.30 min. | q= 6.0 cfs. | ΣQ= 604.3 cu. ft. |
| T= 6.44 min. | q= 11.4 cfs. | ΣQ= 1725.8 cu. ft. |
| T= 8.59 min. | q= 17.2 cfs. | ΣQ= 3569.5 cu. ft. |
| T= 10.74 min. | q= 23.8 cfs. | ΣQ= 6212.4 cu. ft. |
| T= 12.89 min. | q= 31.5 cfs. | ΣQ= 9777.5 cu. ft. |
| T= 15.04 min. | q= 40.9 cfs. | ΣQ= 14442.7 cu. ft. |
| T= 17.18 min. | q= 51.5 cfs. | ΣQ= 20393.4 cu. ft. |
| T= 19.33 min. | q= 62.2 cfs. | ΣQ= 27717.5 cu. ft. |
| T= 21.48 min. | q= 69.7 cfs. | ΣQ= 36215.6 cu. ft. |
| T= 23.63 min. | q= 64.2 cfs. | ΣQ= 44845.7 cu. ft. |
| T= 25.78 min. | q= 58.7 cfs. | ΣQ= 52766.5 cu. ft. |
| T= 27.92 min. | q= 53.3 cfs. | ΣQ= 59980.8 cu. ft. |
| T= 30.07 min. | q= 48.0 cfs. | ΣQ= 66504.1 cu. ft. |
| T= 32.22 min. | q= 42.9 cfs. | ΣQ= 72362.0 cu. ft. |
| T= 34.37 min. | q= 38.2 cfs. | ΣQ= 77587.8 cu. ft. |
| T= 36.52 min. | q= 33.7 cfs. | ΣQ= 82220.8 cu. ft. |
| T= 38.66 min. | q= 29.6 cfs. | ΣQ= 86304.4 cu. ft. |
| T= 40.81 min. | q= 25.9 cfs. | ΣQ= 89884.5 cu. ft. |
| T= 42.96 min. | q= 22.6 cfs. | ΣQ= 93008.3 cu. ft. |
| T= 45.11 min. | q= 19.6 cfs. | ΣQ= 95722.9 cu. ft. |
| T= 47.26 min. | q= 16.9 cfs. | ΣQ= 98074.5 cu. ft. |
| T= 49.40 min. | q= 14.6 cfs. | ΣQ= 100107.4 cu. ft. |
| T= 51.55 min. | q= 12.6 cfs. | ΣQ= 101863.5 cu. ft. |
| T= 53.70 min. | q= 10.9 cfs. | ΣQ= 103381.7 cu. ft. |
| T= 55.85 min. | q= 9.5 cfs. | ΣQ= 104697.4 cu. ft. |
| T= 58.00 min. | q= 8.3 cfs. | ΣQ= 105842.4 cu. ft. |
| T= 60.14 min. | q= 7.3 cfs. | ΣQ= 106844.8 cu. ft. |
| T= 62.29 min. | q= 6.4 cfs. | ΣQ= 107728.6 cu. ft. |
| T= 64.44 min. | q= 5.7 cfs. | ΣQ= 108514.1 cu. ft. |
| T= 66.59 min. | q= 5.2 cfs. | ΣQ= 109218.1 cu. ft. |
| T= 68.74 min. | q= 4.7 cfs. | ΣQ= 109853.8 cu. ft. |
| T= 70.88 min. | q= 4.3 cfs. | ΣQ= 110431.3 cu. ft. |
| T= 73.03 min. | q= 3.9 cfs. | ΣQ= 110958.0 cu. ft. |
| T= 75.18 min. | q= 3.6 cfs. | ΣQ= 111438.7 cu. ft. |
| T= 77.33 min. | q= 3.2 cfs. | ΣQ= 111876.4 cu. ft. |
| T= 79.48 min. | q= 2.9 cfs. | ΣQ= 112272.4 cu. ft. |
| T= 81.62 min. | q= 2.6 cfs. | ΣQ= 112627.2 cu. ft. |
| T= 83.77 min. | q= 2.3 cfs. | ΣQ= 112940.5 cu. ft. |
| T= 85.92 min. | q= 1.9 cfs. | ΣQ= 113211.9 cu. ft. |
| T= 88.07 min. | q= 1.6 cfs. | ΣQ= 113441.4 cu. ft. |
| T= 90.22 min. | q= 1.3 cfs. | ΣQ= 113629.9 cu. ft. |
| T= 92.36 min. | q= 1.0 cfs. | ΣQ= 113779.3 cu. ft. |
| T= 94.51 min. | q= 0.8 cfs. | ΣQ= 113893.2 cu. ft. |
| T= 96.66 min. | q= 0.5 cfs. | ΣQ= 113976.9 cu. ft. |

PIMA COUNTY HYDROGRAPH

WASH:
AT:
RET. PER.:
DATE:
BY:

HYDROLOGIC DATA SHEET
PCP.PAS

Project Name and Location: FLOOD STUDY for FORREST & HOLLADAY 88143-03-45
Drainage Concentration Point: WATERSHED D @ C.P. # 9

Watershed Area= 38.70 acres
Length of Watercourse (Lc): 2250 ft.
Length to Center of Gravity (Lca): 1125 ft.

Incremental Change in Length (Li)-ft. Incremental Change in Elevation (Hi)-
L(1)= 2250 H(1)= 24.0
Mean Slope (Sc): 0.0107 ft/ft

Basin Factor (Nbw): 0.034 FLOOD FREQUENCY: 100-Year

P24 = 4.73
P6 = 3.70
P1 = 2.68
P2 = 3.03
P3 = 3.26

Impervious Cover = 15.0 %

Soil Group: B
Cover Type = Desert Brush
% of Pervious Area = 100.0
CN= 82.00
CN* = 86.56
Cover Density = 25.0 %

Time of Concentration (Tc) = 11.7 min
Intensity = 6.76 in./hr.
Weighted Runoff to Rainfall Ratio (Cw) = 0.60
Runoff Supply Rate at Tc = 4.05

PEAK DISCHARGE: 157.8 cfs

057

Peak Q = 158 cfs.
Tc = 11.7 min.
TL = 18.55 min.
δT = 1.855 min.

---

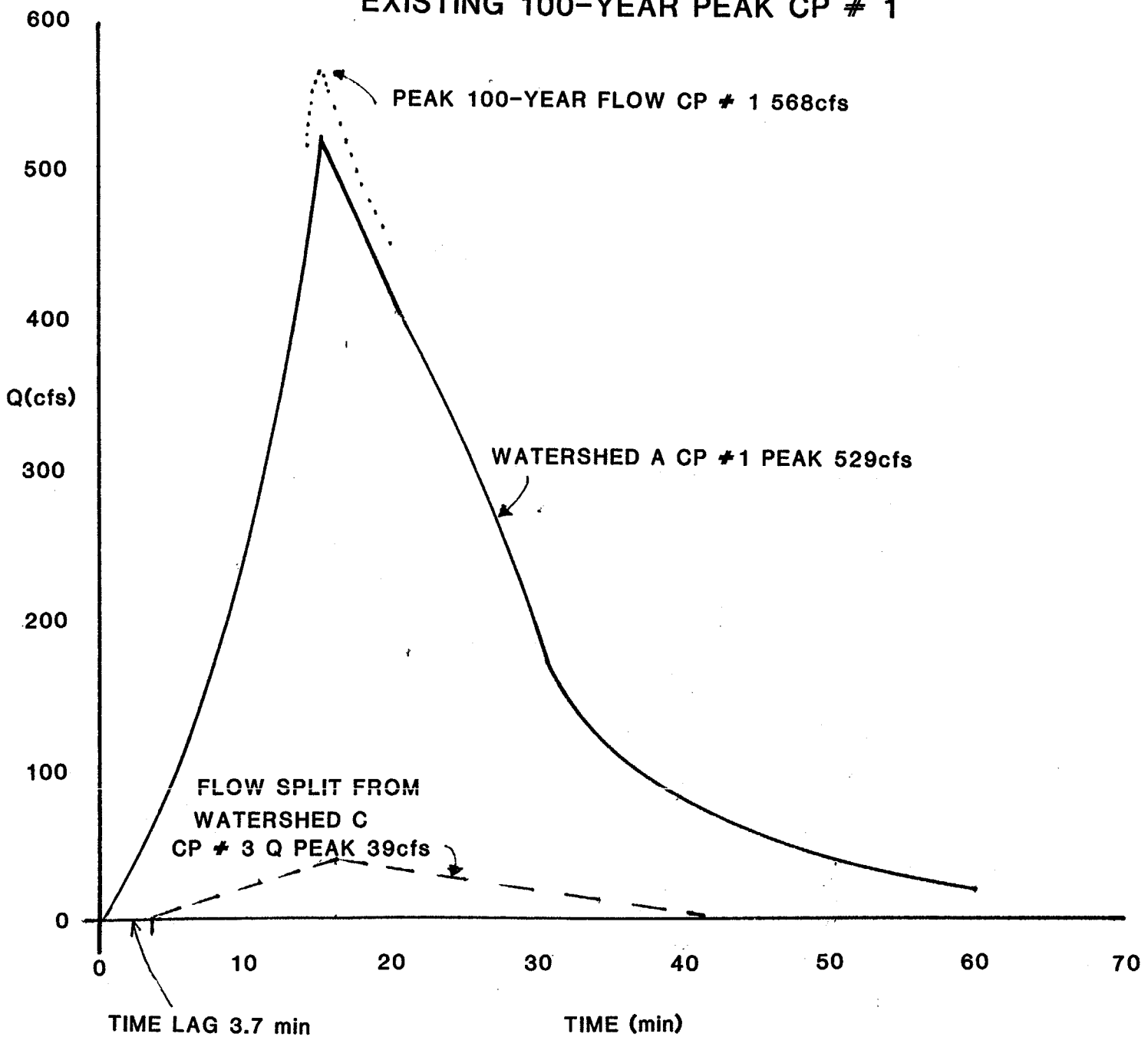
| | | |
|---|---|---|
| T= 1.86 min. | q= 3.8 cfs. | ΣQ= 210.7 cu. ft. |
| T= 3.71 min. | q= 13.6 cfs. | ΣQ= 1177.7 cu. ft. |
| T= 5.57 min. | q= 25.7 cfs. | ΣQ= 3363.4 cu. ft. |
| T= 7.42 min. | q= 38.9 cfs. | ΣQ= 6956.5 cu. ft. |
| T= 9.28 min. | q= 53.7 cfs. | ΣQ= 12107.2 cu. ft. |
| T= 11.13 min. | q= 71.2 cfs. | ΣQ= 19055.1 cu. ft. |
| T= 12.99 min. | q= 92.2 cfs. | ΣQ= 28146.9 cu. ft. |
| T= 14.84 min. | q= 116.2 cfs. | ΣQ= 39743.8 cu. ft. |
| T= 16.70 min. | q= 140.3 cfs. | ΣQ= 54017.4 cu. ft. |
| T= 18.55 min. | q= 158.3 cfs. | ΣQ= 70636.4 cu. ft. |
| T= 20.41 min. | q= 145.0 cfs. | ΣQ= 87515.2 cu. ft. |
| T= 22.26 min. | q= 132.5 cfs. | ΣQ= 102956.8 cu. ft. |
| T= 24.12 min. | q= 120.2 cfs. | ΣQ= 117021.6 cu. ft. |
| T= 25.97 min. | q= 108.3 cfs. | ΣQ= 129739.5 cu. ft. |
| T= 27.83 min. | q= 96.9 cfs. | ΣQ= 141160.3 cu. ft. |
| T= 29.68 min. | q= 86.2 cfs. | ΣQ= 151349.1 cu. ft. |
| T= 31.54 min. | q= 76.2 cfs. | ΣQ= 160382.4 cu. ft. |
| T= 33.39 min. | q= 66.9 cfs. | ΣQ= 168344.6 cu. ft. |
| T= 35.25 min. | q= 58.5 cfs. | ΣQ= 175325.4 cu. ft. |
| T= 37.10 min. | q= 50.9 cfs. | ΣQ= 181416.5 cu. ft. |
| T= 38.96 min. | q= 44.2 cfs. | ΣQ= 186709.9 cu. ft. |
| T= 40.81 min. | q= 38.2 cfs. | ΣQ= 191295.5 cu. ft. |
| T= 42.67 min. | q= 33.0 cfs. | ΣQ= 195259.8 cu. ft. |
| T= 44.52 min. | q= 28.5 cfs. | ΣQ= 198684.4 cu. ft. |
| T= 46.38 min. | q= 24.7 cfs. | ΣQ= 201645.1 cu. ft. |
| T= 48.23 min. | q= 21.4 cfs. | ΣQ= 204211.0 cu. ft. |
| T= 50.09 min. | q= 18.7 cfs. | ΣQ= 206444.0 cu. ft. |
| T= 51.94 min. | q= 16.4 cfs. | ΣQ= 208398.8 cu. ft. |
| T= 53.80 min. | q= 14.5 cfs. | ΣQ= 210122.3 cu. ft. |
| T= 55.65 min. | q= 13.0 cfs. | ΣQ= 211654.2 cu. ft. |
| T= 57.51 min. | q= 11.7 cfs. | ΣQ= 213027.0 cu. ft. |
| T= 59.36 min. | q= 10.6 cfs. | ΣQ= 214266.7 cu. ft. |
| T= 61.22 min. | q= 9.6 cfs. | ΣQ= 215392.8 cu. ft. |
| T= 63.07 min. | q= 8.8 cfs. | ΣQ= 216419.8 cu. ft. |
| T= 64.93 min. | q= 8.0 cfs. | ΣQ= 217357.2 cu. ft. |
| T= 66.78 min. | q= 7.3 cfs. | ΣQ= 218210.7 cu. ft. |
| T= 68.64 min. | q= 6.6 cfs. | ΣQ= 218983.1 cu. ft. |
| T= 70.49 min. | q= 5.9 cfs. | ΣQ= 219675.0 cu. ft. |
| T= 72.35 min. | q= 5.1 cfs. | ΣQ= 220286.1 cu. ft. |
| T= 74.20 min. | q= 4.4 cfs. | ΣQ= 220815.6 cu. ft. |
| T= 76.06 min. | q= 3.7 cfs. | ΣQ= 221263.5 cu. ft. |
| T= 77.91 min. | q= 3.0 cfs. | ΣQ= 221631.3 cu. ft. |
| T= 79.77 min. | q= 2.3 cfs. | ΣQ= 221922.9 cu. ft. |
| T= 81.62 min. | q= 1.7 cfs. | ΣQ= 222145.3 cu. ft. |
| T= 83.48 min. | q= 1.2 cfs. | ΣQ= 222308.9 cu. ft. |
| T= 85.33 min. | q= 0.9 cfs. | ΣQ= 222428.2 cu. ft. |

# PIMA COUNTY HYDROGRAPH

WASH: **WATERSHED A**
AT: **DOWNSTREAM of INTERSECTION of CANADA & ORIOLE**
RET. PER.:
DATE: **6-21-89**
BY: **WEZ**
Peak Q = 529 cfs.
Tc = 7.9 min.
TL = 15.80 min.
DT = 1.58 min.

| | | |
|---|---|---|
| T= 1.58 min. | q= 12.7 cfs. | ΣQ= 600.8 cu. ft. |
| T= 3.16 min. | q= 45.5 cfs. | ΣQ= 3358.7 cu. ft. |
| T= 4.74 min. | q= 86.0 cfs. | ΣQ= 9591.7 cu. ft. |
| T= 6.32 min. | q= 130.2 cfs. | ΣQ= 19838.5 cu. ft. |
| T= 7.90 min. | q= 179.7 cfs. | ΣQ= 34527.2 cu. ft. |
| T= 9.48 min. | q= 238.3 cfs. | ΣQ= 54341.2 cu. ft. |
| T= 11.06 min. | q= 308.7 cfs. | ΣQ= 80269.3 cu. ft. |
| T= 12.64 min. | q= 389.0 cfs. | ΣQ= 113341.2 cu. ft. |
| T= 14.22 min. | q= 469.7 cfs. | ΣQ= 154046.8 cu. ft. |
| T= 15.80 min. | q= 526.8 cfs. | ΣQ= 201284.3 cu. ft. |
| T= 17.38 min. | q= 485.4 cfs. | ΣQ= 249262.4 cu. ft. |
| T= 18.96 min. | q= 443.7 cfs. | ΣQ= 293297.7 cu. ft. |
| T= 20.54 min. | q= 402.5 cfs. | ΣQ= 333406.3 cu. ft. |
| T= 22.12 min. | q= 362.6 cfs. | ΣQ= 369674.2 cu. ft. |
| T= 23.70 min. | q= 324.5 cfs. | ΣQ= 402243.1 cu. ft. |
| T= 25.28 min. | q= 288.5 cfs. | ΣQ= 431298.4 cu. ft. |
| T= 26.86 min. | q= 255.0 cfs. | ΣQ= 457058.4 cu. ft. |
| T= 28.44 min. | q= 224.1 cfs. | ΣQ= 479764.2 cu. ft. |
| T= 30.02 min. | q= 195.9 cfs. | ΣQ= 499671.1 cu. ft. |
| T= 31.60 min. | q= 170.5 cfs. | ΣQ= 517041.0 cu. ft. |
| T= 33.18 min. | q= 147.9 cfs. | ΣQ= 532136.0 cu. ft. |
| T= 34.76 min. | q= 128.0 cfs. | ΣQ= 545212.6 cu. ft. |
| T= 36.34 min. | q= 110.5 cfs. | ΣQ= 556517.5 cu. ft. |
| T= 37.92 min. | q= 95.5 cfs. | ΣQ= 566283.3 cu. ft. |
| T= 39.50 min. | q= 82.6 cfs. | ΣQ= 574726.1 cu. ft. |
| T= 41.08 min. | q= 71.7 cfs. | ΣQ= 582042.9 cu. ft. |
| T= 42.66 min. | q= 62.6 cfs. | ΣQ= 588410.6 cu. ft. |
| T= 44.24 min. | q= 55.0 cfs. | ΣQ= 593984.9 cu. ft. |
| T= 45.82 min. | q= 48.7 cfs. | ΣQ= 598899.7 cu. ft. |
| T= 47.40 min. | q= 43.5 cfs. | ΣQ= 603268.2 cu. ft. |
| T= 48.98 min. | q= 39.1 cfs. | ΣQ= 607183.1 cu. ft. |
| T= 50.56 min. | q= 35.5 cfs. | ΣQ= 610718.2 cu. ft. |
| T= 52.14 min. | q= 32.3 cfs. | ΣQ= 613929.7 cu. ft. |
| T= 53.72 min. | q= 29.5 cfs. | ΣQ= 616858.2 cu. ft. |
| T= 55.30 min. | q= 26.9 cfs. | ΣQ= 619531.4 cu. ft. |
| T= 56.88 min. | q= 24.4 cfs. | ΣQ= 621965.4 cu. ft. |
| T= 58.46 min. | q= 22.0 cfs. | ΣQ= 624167.8 cu. ft. |
| T= 60.04 min. | q= 19.6 cfs. | ΣQ= 626140.8 cu. ft. |
| T= 61.62 min. | q= 17.2 cfs. | ΣQ= 627883.0 cu. ft. |
| T= 63.20 min. | q= 14.7 cfs. | ΣQ= 629392.5 cu. ft. |
| T= 64.78 min. | q= 12.2 cfs. | ΣQ= 630669.5 cu. ft. |
| T= 66.36 min. | q= 9.9 cfs. | ΣQ= 631718.4 cu. ft. |
| T= 67.94 min. | q= 7.7 cfs. | ΣQ= 632550.1 cu. ft. |
| T= 69.52 min. | q= 5.7 cfs. | ΣQ= 633184.3 cu. ft. |
| T= 71.10 min. | q= 4.1 cfs. | ΣQ= 633650.6 cu. ft. |

# EXISTING 100-YEAR PEAK CP # 1




PROJECT NAME _____ PROJECT NO. _____

MADE BY _____ DATE _____

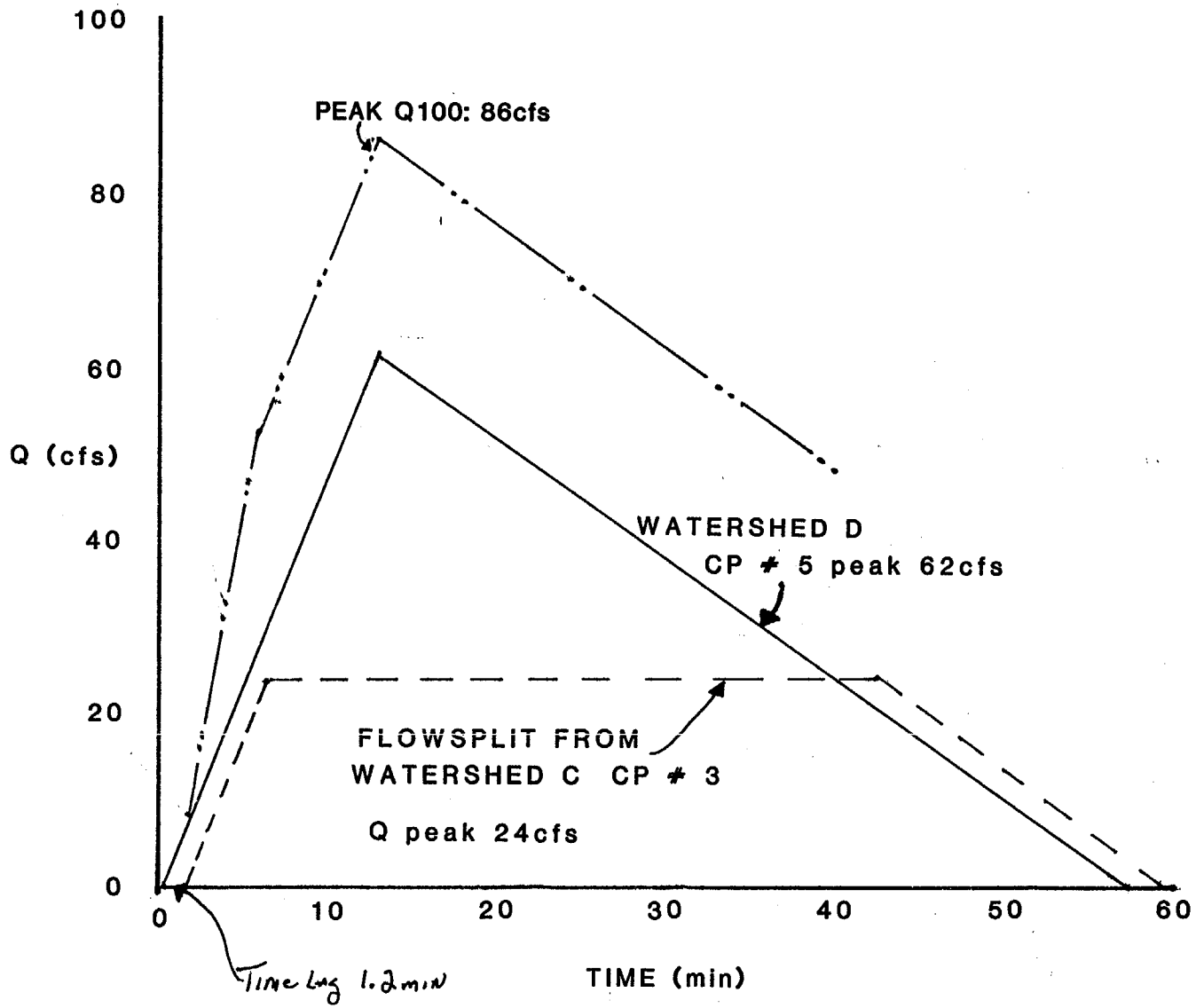
CHECKED BY _____ DATE _____ REFERENCE _____

McGovern, MacVittie, Lodge & Associates, Inc.

ENGINEERING
PLANNING
SURVEYING

060

# EXISTING 100-YEAR PEAK CP # 5




PROJECT NAME _____ PROJECT NO. _____

MADE BY _____ DATE _____

CHECKED BY _____ DATE _____ REFERENCE _____

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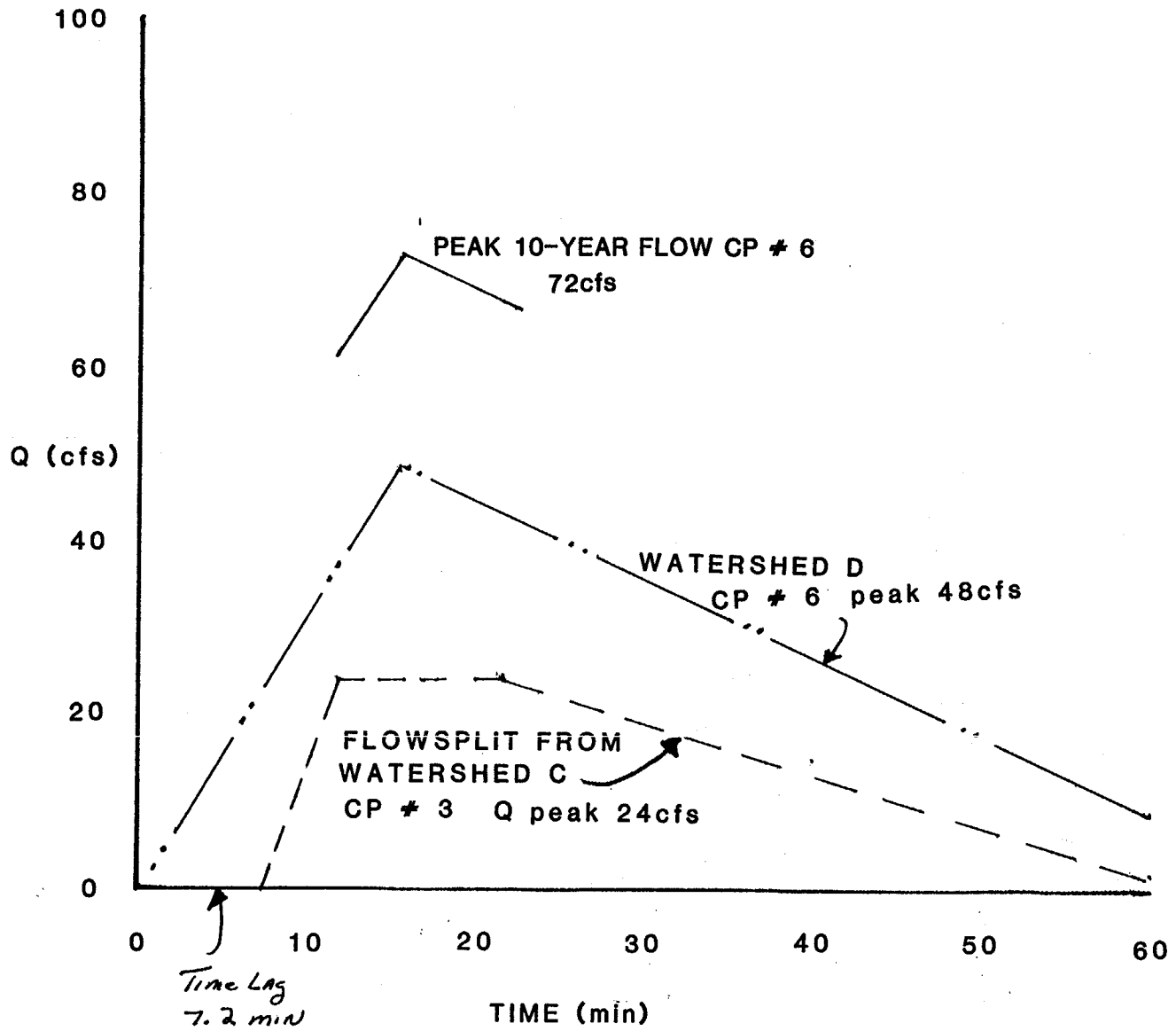
# EXISTING 10-YEAR PEAK CP # 6




PROJECT NAME _____ PROJECT NO. _____

MADE BY _____ DATE _____

CHECKED BY _____ DATE _____ REFERENCE _____

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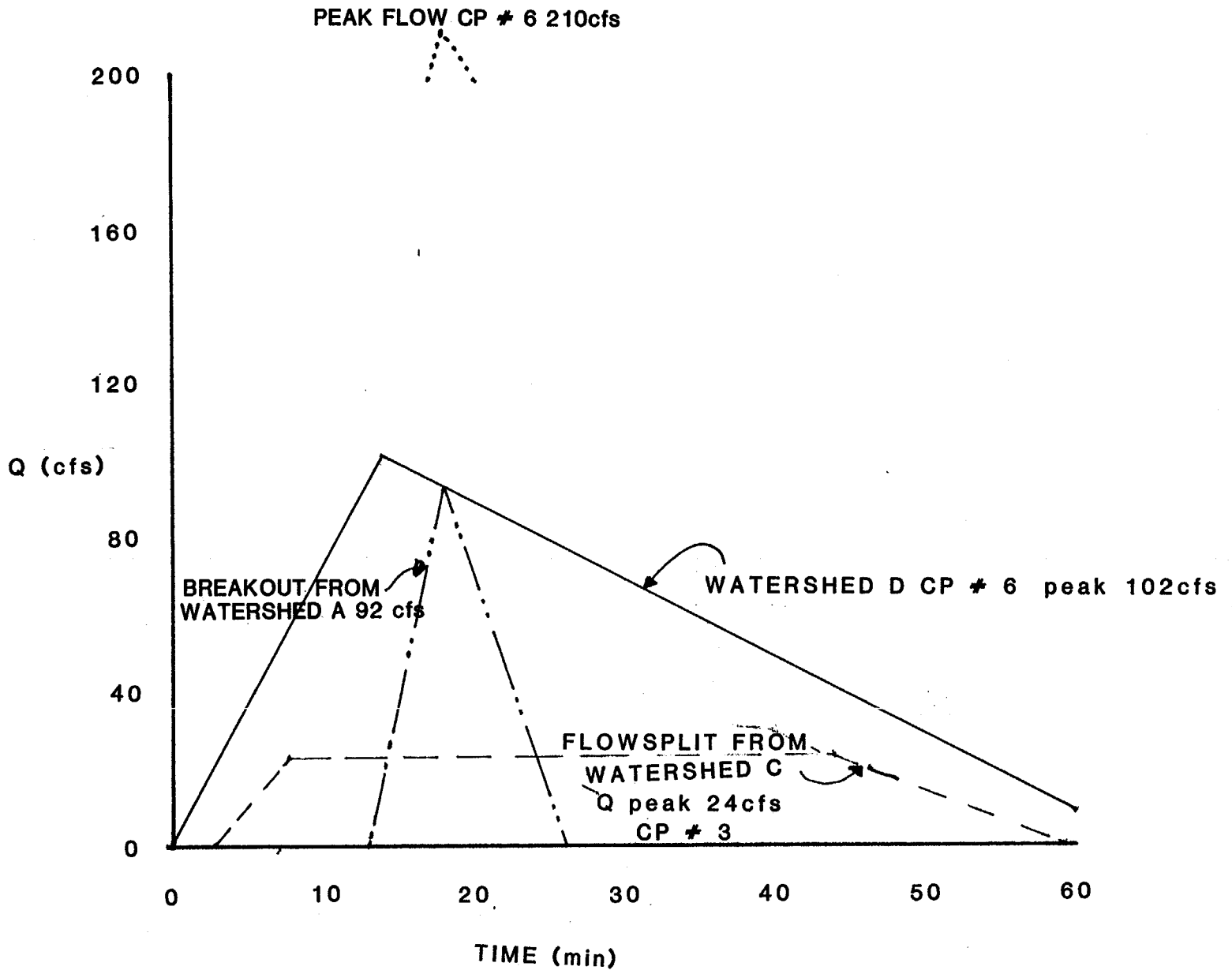
# EXISTING 100-YEAR PEAK CP # 6




PROJECT NAME _____ PROJECT NO. _____

MADE BY _____ DATE _____

CHECKED BY _____ DATE _____ REFERENCE _____

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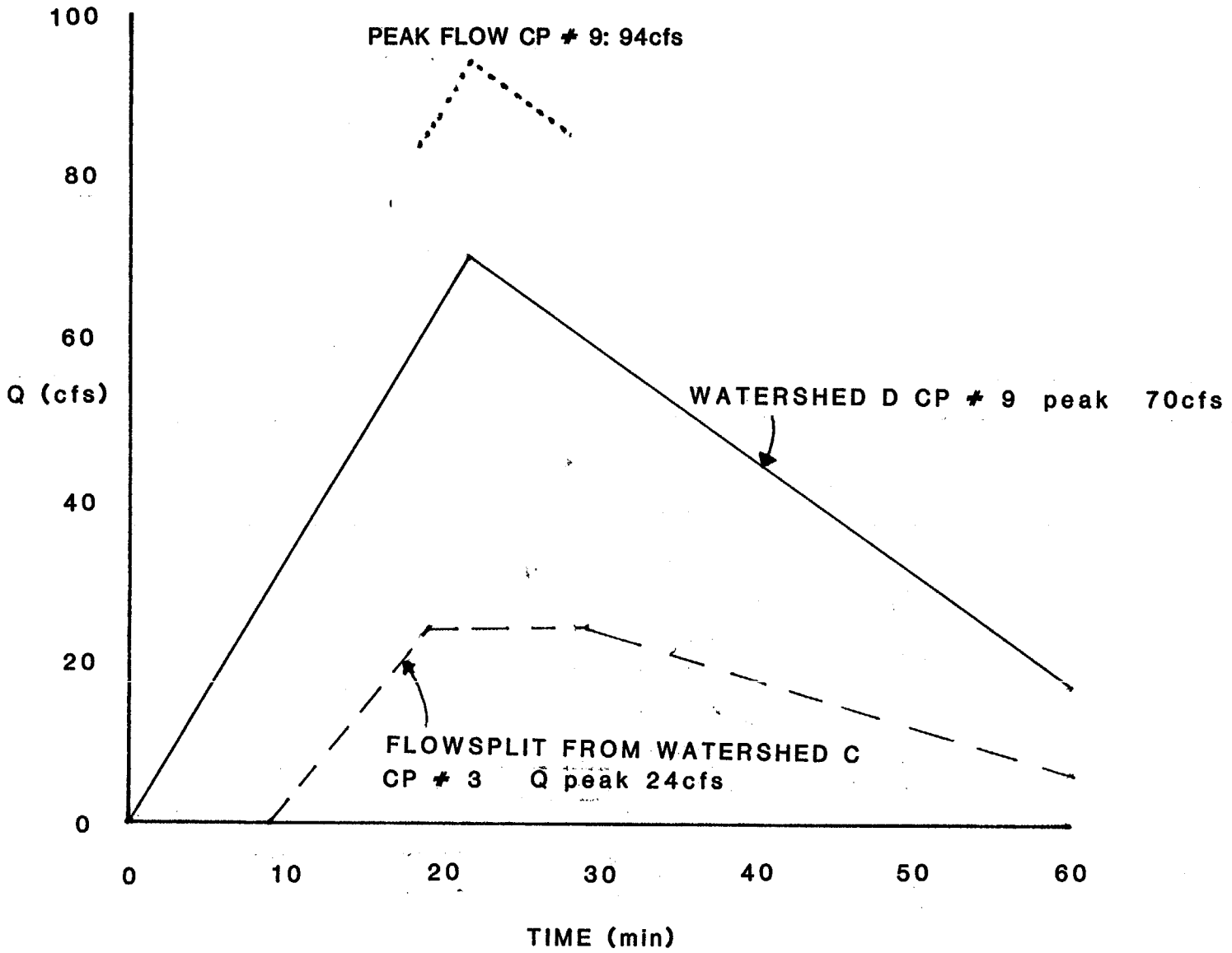
# EXISTING 10-YEAR PEAK CP # 9




PROJECT NAME _____ PROJECT NO. _____
MADE BY _____ DATE _____
CHECKED BY _____ DATE _____ REFERENCE _____

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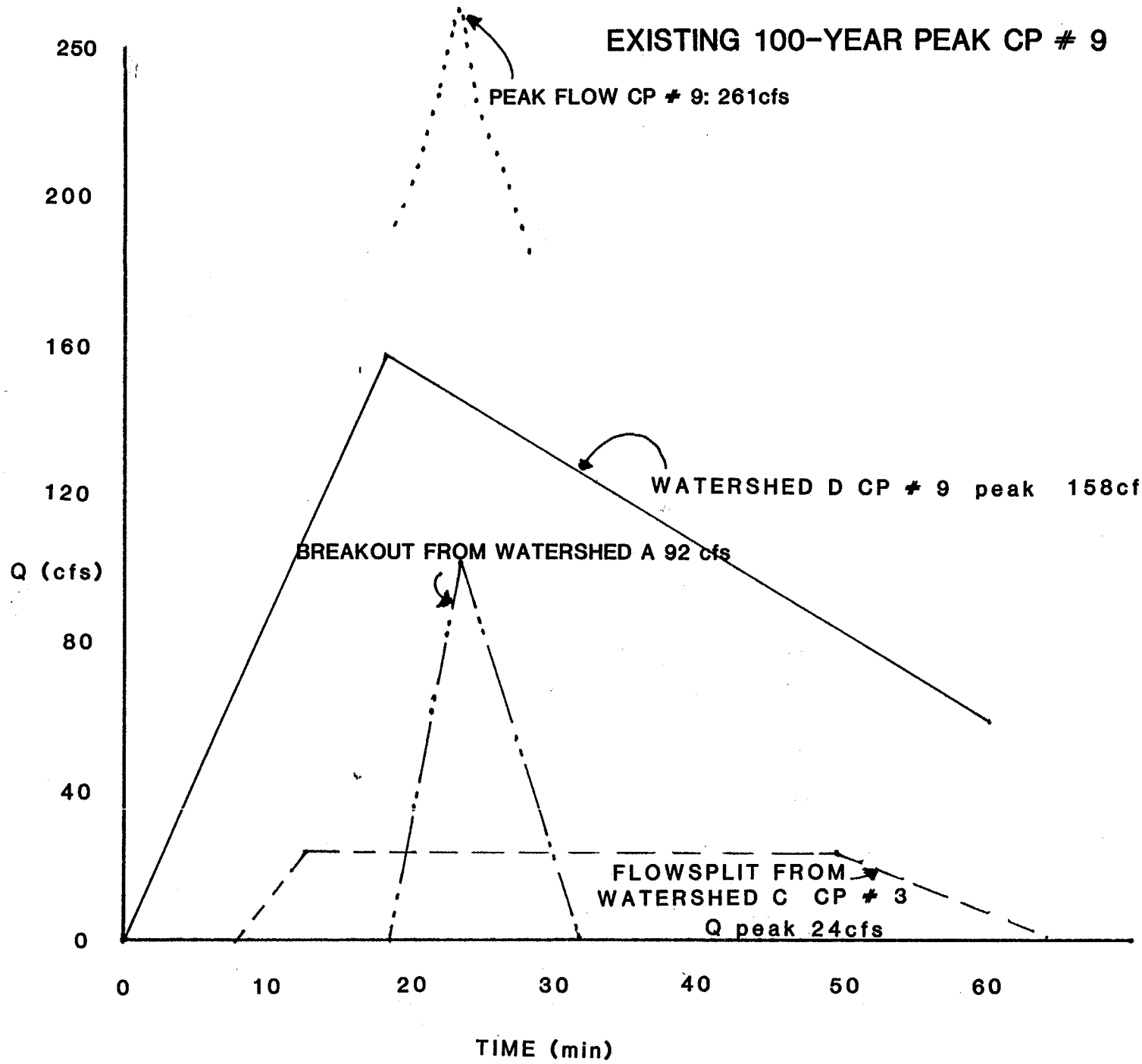


PROJECT NAME _____ PROJECT NO. _____

MADE BY _____ DATE _____

CHECKED BY _____ DATE _____

REFERENCE _____

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ENGINEERING
PLANNING
SURVEYING

045

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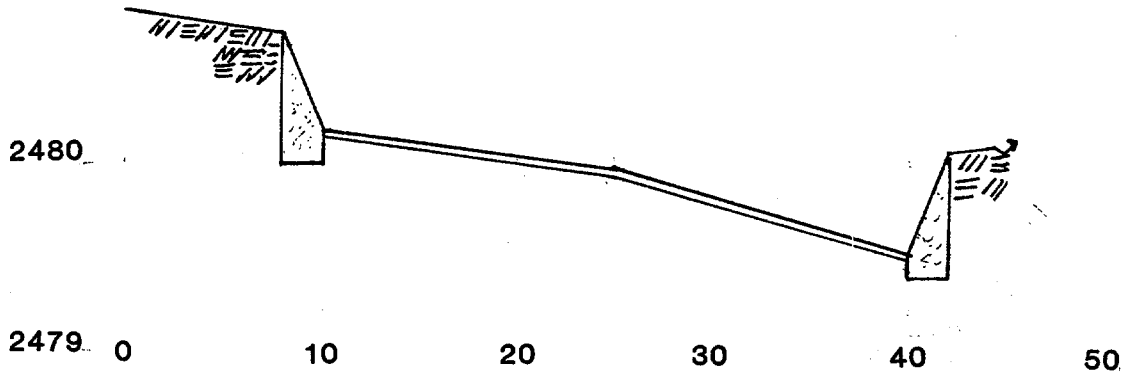
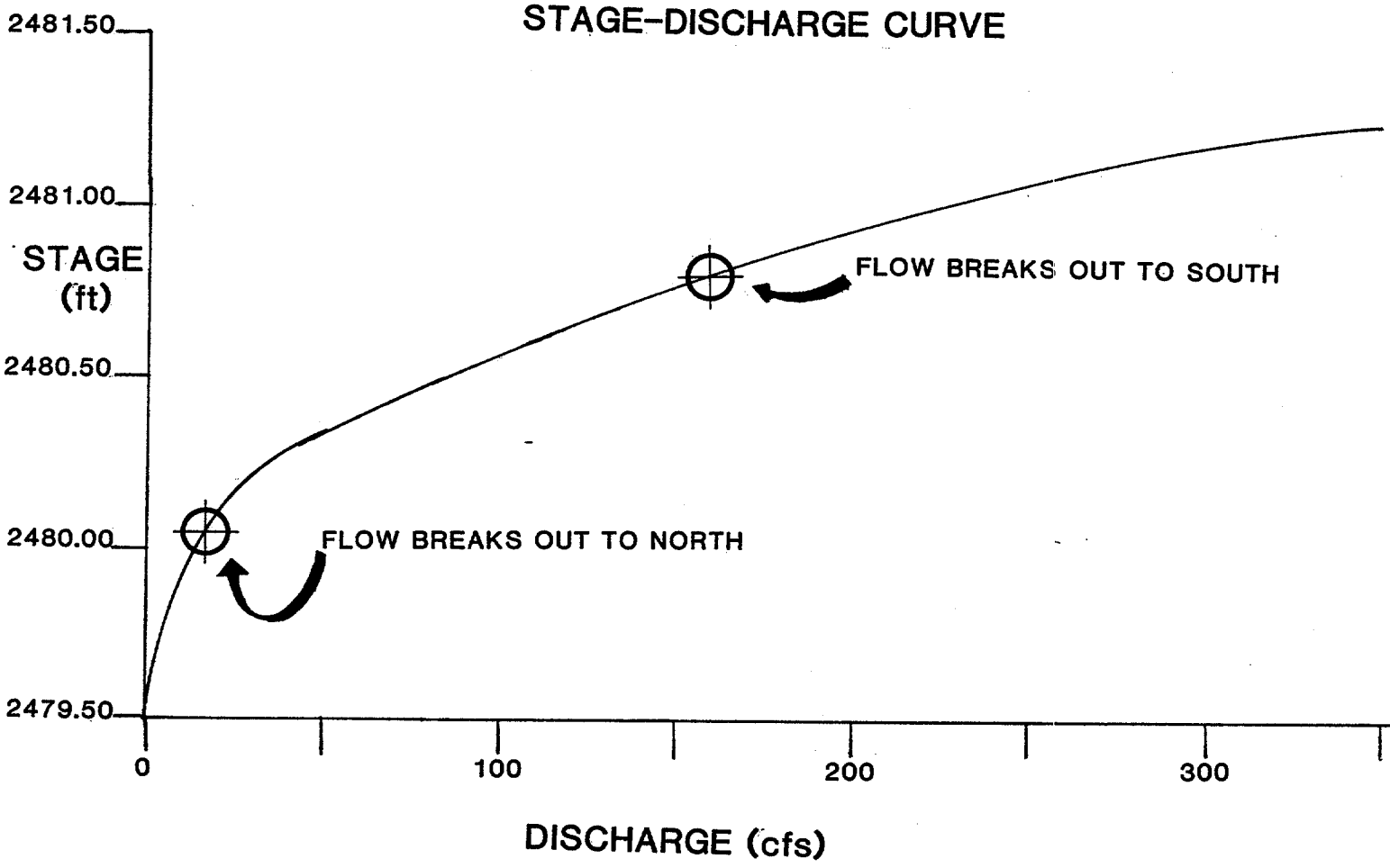
SURVEYING
McGovern, MacVittie, Lodge & Associates, Inc.

HOLLADAY STREET/FORREST
PROJECT NAME AVENUE WATERSHED STUDY PROJECT NO. 88143-03-45
MADE BY WEZ DATE 6-21-89
CHECKED BY _____ DATE _____ REFERENCE _____

## CANADA STREET SECTION 1 (C-1)




## STAGE-DISCHARGE CURVE



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PROJECT NAME Holladay/Forrest PROJECT NO. 88143-03-45
MADE BY wez DATE
CHECKED BY DATE REFERENCE

1/3

Canada Street Weir

Flow split along Canada Street Between Oriole Ave & Westover Ave.

Depth of flow in street were curb ends is 2.16 ft Vertical wall assumed @ Top of Curbs.

* Depth of ~~weir~~ weir to South is 1.01 ft

** Depth of Weir to North is 1.66 ft

First weir length 25 ft -

$q$ to South $= CLH^{3/2}$

$C = 2.6$
$H = 1.01$ ft
$L = 25$ ft

$q = 66$ cfs

$q$ to North $= CLH^{3/2}$

$C = 2.6$
$H = 1.66$ ft
$L = 25$ ft

$q = 139$ cfs

$q_T = 205$ cfs -

568 cfs - 205 cfs = 363 cfs

Second weir length = 25 ft

Depth of flow in street = 1.74 ft

$q$ to south $= CLH^{3/2}$

$C = 2.6$
$H = 0.48$ ft
$L = 25$ ft
$q = 22$ cfs

$q$ to North $= CLH^{3/2}$

$C = 2.6$
$H = 1.23$ ft
$L = 25$ ft
$q = 89$ cfs

$q_T = 111$ cfs

047

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PROJECT NAME _____ PROJECT NO. _____
MADE BY _____ DATE _____
CHECKED BY _____ DATE _____ REFERENCE _____



363 cfs − 111 cfs = 252 cfs

Third weir Length = 25 ft

Depth of flow in street = 1.50 ft

Q to South = $CLH^{3/2}$

C = 2.6
H = 0.16 ft
L = 25 ft
Q = 4 cfs

Q to North = $CLH^{3/2}$

C = 2.6
H = 0.99 ft
L = 25 ft
Q = 64 cfs

$Q_T$ = 68 cfs

252 cfs − 68 cfs = 184 cfs

fourth weir Length = 25 ft

Depth of flow in street = 1.34 ft

Q to south = 0 due to earthen berm along Roadway −

Flow to North = $CLH^{3/2}$

C = 2.6
H = 0.83 ft
L = 25 ft

~~Q = [illegible]~~
Q = 99 cfs ∴ 184 − 99 = 135 cfs −

Upon review of topography − figure 3 & field investigation the street section is warped to a degree that for a conservative estimate the remaining flow (135 cfs) could enter Dakota Wash by way of Westover Ave.

DLS

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PROJECT NAME _____ PROJECT NO. _____
MADE BY _____ DATE _____
CHECKED BY _____ DATE _____ REFERENCE _____



Results –

$Q_{TOTAL}$ to South –

66cfs + 22cfs + 4 cfs = 92cfs

$Q_{TOTAL}$ to North –

139cfs + 89 cfs + 64cfs + 49cfs + 135cfs = 476cfs

Note: Some flow (not quantified) will flow EAST in Canada Street. The amount is assumed to be small due to the existing topography & should not constitute a HAZARD to any homes/lots east of Westover Ave. To be conservative the discharge west of Westover Ave was assumed to break in either the North or South directions, thereby analyzing a worst case condition.

# STREET RATING DATA

JOB # 88143-03-45

HOLLADAY/FORREST STREETS WATERSHED STUDY

BY: WEZ
6-19-89

CROSS SECTION CANADA STREET SECTION 1

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION | 2480.80 |
| STATION | 8.00 | ELEVATION | 2480.69 |
| STATION | 10.00 | ELEVATION | 2480.19 |
| STATION | 25.00 | ELEVATION | 2479.99 |
| STATION | 40.00 | ELEVATION | 2479.54 |
| STATION | 42.00 | ELEVATION | 2480.04 |

RESULTS

Manning's 'n' 0.016
Channel Slope 0.500%
W.S. Elevation 2480.20
Area 8.92 SF
Perimeter 32.10 Ft.
Near Bank 10.0
Far Bank 42.0
Discharge 24.96 cfs
Velocity 2.80 fps

JOB # 88143-03-45

HOLLADAY/FORREST STREETS WATERSHED STUDY

BY: WEZ
6-19-89

CROSS SECTION CANADA STREET SECTION 1

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION | 2480.80 |
| STATION | 8.00 | ELEVATION | 2480.69 |
| STATION | 10.00 | ELEVATION | 2480.19 |
| STATION | 25.00 | ELEVATION | 2479.99 |
| STATION | 40.00 | ELEVATION | 2479.54 |
| STATION | 42.00 | ELEVATION | 2480.04 |

RESULTS

Manning's 'n' 0.016
Channel Slope 0.500%
W.S. Elevation 2480.34
Area 13.66 SF
Perimeter 32.71 Ft.
Near Bank 9.4
Far Bank 42.0
Discharge 50.12 cfs
Velocity 3.67 fps

JOB # 88143-03-45

HOLLADAY/FORREST STREETS WATERSHED STUDY

BY: WEZ
6-19-89

CROSS SECTION CANADA STREET SECTION 1

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION | 2480.80 |
| STATION | 8.00 | ELEVATION | 2480.69 |
| STATION | 10.00 | ELEVATION | 2480.19 |
| STATION | 25.00 | ELEVATION | 2479.99 |
| STATION | 40.00 | ELEVATION | 2479.54 |
| STATION | 42.00 | ELEVATION | 2480.04 |

RESULTS

| | |
|---|---|
| Manning's 'n' | 0.016 |
| Channel Slope | 0.500% |
| W.S. Elevation | 2480.46 |
| Area | 17.51 SF |
| Perimeter | 33.19 Ft. |
| Near Bank | 8.9 |
| Far Bank | 42.0 |
| Discharge | 75.07 cfs |
| Velocity | 4.29 fps |

JOB # 88143-03-45

HOLLADAY/FORREST STREETS WATERSHED STUDY

BY: WEZ
6-19-89

CROSS SECTION CANADA STREET SECTION 1

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION | 2480.80 |
| STATION | 8.00 | ELEVATION | 2480.69 |
| STATION | 10.00 | ELEVATION | 2480.19 |
| STATION | 25.00 | ELEVATION | 2479.99 |
| STATION | 40.00 | ELEVATION | 2479.54 |
| STATION | 42.00 | ELEVATION | 2480.04 |

RESULTS

Manning's 'n' 0.016
Channel Slope 0.500%
W.S. Elevation 2480.56
Area 20.91 SF
Perimeter 33.61 Ft.
Near Bank 8.5
Far Bank 42.0
Discharge 100.10 cfs
Velocity 4.79 fps

JOB # 88143-03-45

HOLLADAY/FORREST STREETS WATERSHED STUDY

BY: WEZ
6-19-89

CROSS SECTION CANADA STREET SECTION 1

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION | 2480.80 |
| STATION | 8.00 | ELEVATION | 2480.69 |
| STATION | 10.00 | ELEVATION | 2480.19 |
| STATION | 25.00 | ELEVATION | 2479.99 |
| STATION | 40.00 | ELEVATION | 2479.54 |
| STATION | 42.00 | ELEVATION | 2480.04 |

RESULTS

Manning's 'n' 0.016
Channel Slope 0.500%
W.S. Elevation 2480.93
Area 34.70 SF
Perimeter 42.13 Ft.
Near Bank %10000000000.0
Far Bank 42.0
Discharge 200.23 cfs
Velocity 5.77 fps

JOB # 88143-03-45

HOLLADAY/FORREST STREETS WATERSHED STUDY

BY: WEZ
6-19-89

CROSS SECTION CANADA STREET SECTION 1

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION | 2480.80 |
| STATION | 8.00 | ELEVATION | 2480.69 |
| STATION | 10.00 | ELEVATION | 2480.19 |
| STATION | 25.00 | ELEVATION | 2479.99 |
| STATION | 40.00 | ELEVATION | 2479.54 |
| STATION | 42.00 | ELEVATION | 2480.04 |

RESULTS

Manning's 'n' 0.016
Channel Slope 0.500%
W.S. Elevation 2481.04
Area 39.61 SF
Perimeter 42.13 Ft.
Near Bank %10000000000.0
Far Bank 42.0
Discharge 249.66 cfs
Velocity 6.30 fps

JOB # 88143-03-45

HOLLADAY/FORREST STREETS WATERSHED STUDY

BY: WEZ
6-19-89

CROSS SECTION CANADA STREET SECTION 1

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION | 2480.80 |
| STATION | 8.00 | ELEVATION | 2480.69 |
| STATION | 10.00 | ELEVATION | 2480.19 |
| STATION | 25.00 | ELEVATION | 2479.99 |
| STATION | 40.00 | ELEVATION | 2479.54 |
| STATION | 42.00 | ELEVATION | 2480.04 |

RESULTS

Manning's 'n' 0.016
Channel Slope 0.500%
W.S. Elevation 2481.22
Area 46.81 SF
Perimeter 42.13 Ft.
Near Bank %10000000000.0
Far Bank 42.0
Discharge 329.76 cfs
Velocity 7.04 fps

JOB # 88143-03-45

HOLLADAY/FORREST STREETS WATERSHED STUDY

BY: WEZ
6-19-89

CROSS SECTION CANADA STREET SECTION 1

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION | 2480.80 |
| STATION | 8.00 | ELEVATION | 2480.69 |
| STATION | 10.00 | ELEVATION | 2480.19 |
| STATION | 25.00 | ELEVATION | 2479.99 |
| STATION | 40.00 | ELEVATION | 2479.54 |
| STATION | 42.00 | ELEVATION | 2480.04 |

RESULTS

Manning's 'n' 0.016
Channel Slope 0.500%
W.S. Elevation 2481.26
Area 48.49 SF
Perimeter 42.13 Ft.
Near Bank %10000000000.0
Far Bank 42.0
Discharge 349.74 cfs
Velocity 7.21 fps

JOB # 88143-03-45

HOLLADAY/FORREST STREETS WATERSHED STUDY

BY: WEZ
6-19-89

CROSS SECTION CANADA STREET SECTION 1

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION | 2480.80 |
| STATION | 8.00 | ELEVATION | 2480.69 |
| STATION | 10.00 | ELEVATION | 2480.19 |
| STATION | 25.00 | ELEVATION | 2479.99 |
| STATION | 40.00 | ELEVATION | 2479.54 |
| STATION | 42.00 | ELEVATION | 2480.04 |

RESULTS

Manning's 'n' 0.016
Channel Slope 0.500%
W.S. Elevation 2481.35
Area 52.53 SF
Perimeter 42.13 Ft.
Near Bank %10000000000.0
Far Bank 42.0
Discharge 399.64 cfs
Velocity 7.61 fps

JOB # 88143-03-45

HOLLADAY/FORREST STREETS WATERSHED STUDY

BY: WEZ
6-19-89

CROSS SECTION CANADA STREET SECTION 1

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION | 2480.80 |
| STATION | 8.00 | ELEVATION | 2480.69 |
| STATION | 10.00 | ELEVATION | 2480.19 |
| STATION | 25.00 | ELEVATION | 2479.99 |
| STATION | 40.00 | ELEVATION | 2479.54 |
| STATION | 42.00 | ELEVATION | 2480.04 |

RESULTS

Manning's 'n' 0.016
Channel Slope 0.500%
W.S. Elevation 2481.44
Area 56.39 SF
Perimeter 42.13 Ft.
Near Bank %10000000000.0
Far Bank 42.0
Discharge 449.72 cfs
Velocity 7.98 fps

JOB # 88143-03-45

HOLLADAY/FORREST STREETS WATERSHED STUDY

BY: WEZ
6-19-89

CROSS SECTION CANADA STREET SECTION 1

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION | 2480.80 |
| STATION | 8.00 | ELEVATION | 2480.69 |
| STATION | 10.00 | ELEVATION | 2480.19 |
| STATION | 25.00 | ELEVATION | 2479.99 |
| STATION | 40.00 | ELEVATION | 2479.54 |
| STATION | 42.00 | ELEVATION | 2480.04 |

RESULTS

Manning's 'n' 0.016
Channel Slope 0.500%
W.S. Elevation 2481.53
Area 60.08 SF
Perimeter 42.13 Ft.
Near Bank %10000000000.0
Far Bank 42.0
Discharge 499.85 cfs
Velocity 8.32 fps

JOB # 88143-03-45

HOLLADAY/FORREST STREETS WATERSHED STUDY

BY: WEZ
6-19-89

CROSS SECTION CANADA STREET SECTION 1

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION | 2480.80 |
| STATION | 8.00 | ELEVATION | 2480.69 |
| STATION | 10.00 | ELEVATION | 2480.19 |
| STATION | 25.00 | ELEVATION | 2479.99 |
| STATION | 40.00 | ELEVATION | 2479.54 |
| STATION | 42.00 | ELEVATION | 2480.04 |

RESULTS

Manning's 'n' 0.016
Channel Slope 0.500%
W.S. Elevation 2481.62
Area 63.61 SF
Perimeter 42.13 Ft.
Near Bank %10000000000.0
Far Bank 42.0
Discharge 549.71 cfs
Velocity 8.64 fps

JOB # 88143-03-45

HOLLADAY/FORREST STREETS WATERSHED STUDY

BY: WEZ
6-19-89

CROSS SECTION CANADA STREET SECTION 1

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION | 2480.80 |
| STATION | 8.00 | ELEVATION | 2480.69 |
| STATION | 10.00 | ELEVATION | 2480.19 |
| STATION | 25.00 | ELEVATION | 2479.99 |
| STATION | 40.00 | ELEVATION | 2479.54 |
| STATION | 42.00 | ELEVATION | 2480.04 |

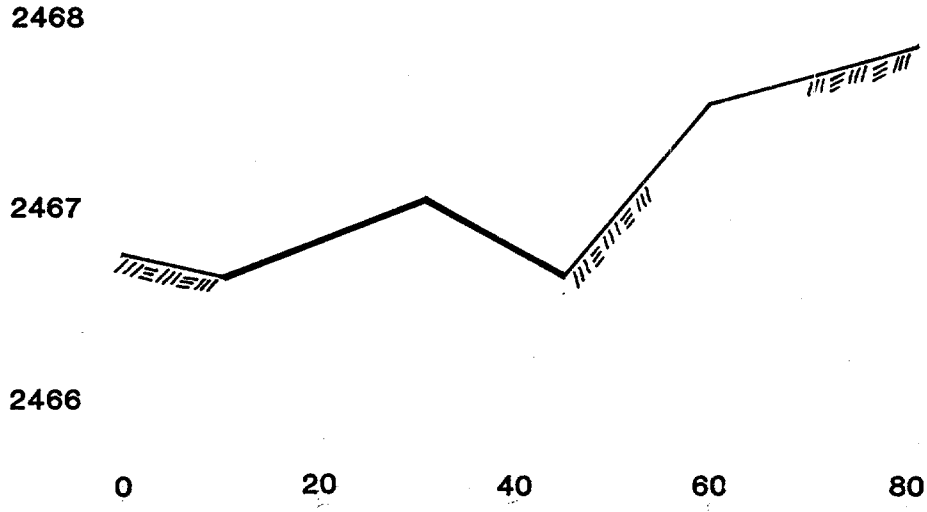
RESULTS

Manning's 'n' 0.016
Channel Slope 0.500%
W.S. Elevation 2481.70
Area 67.11 SF
Perimeter 42.13 Ft.
Near Bank %10000000000.0
Far Bank 42.0
Discharge 601.15 cfs
Velocity 8.96 fps

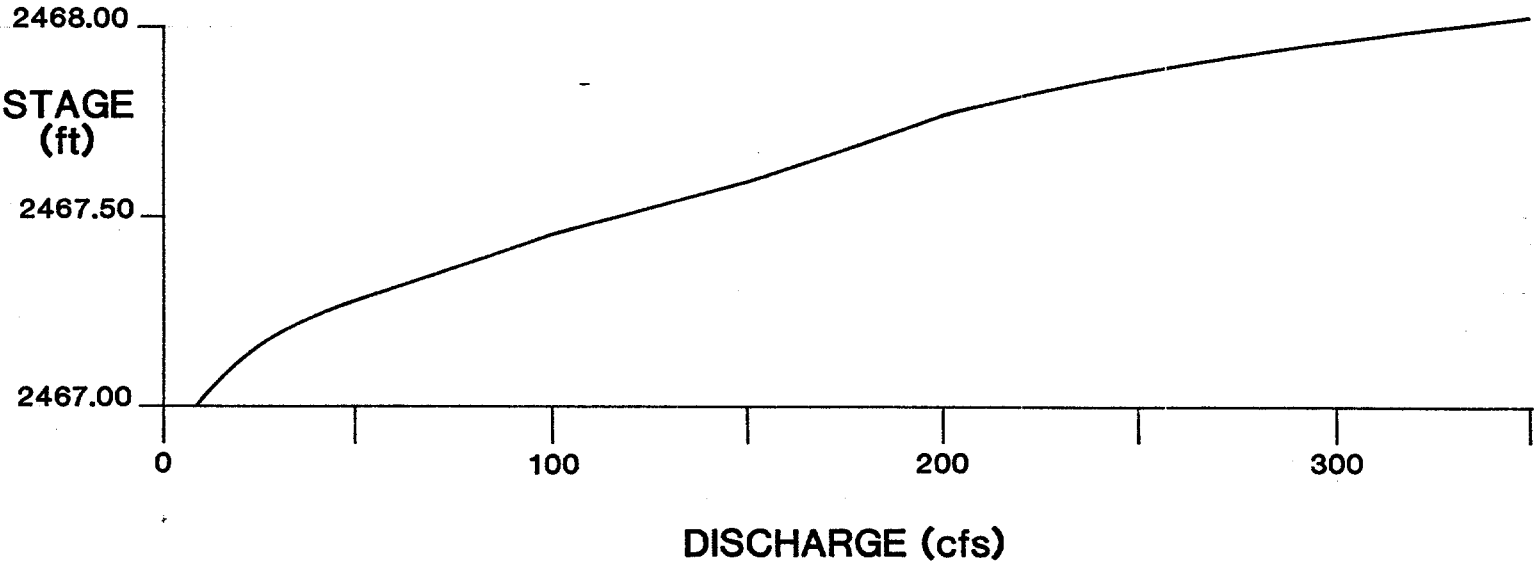
ENGINEERING
PLANNING
SURVEYING
McGovern. MacVittie. Lodge & Associates. Inc.

PROJECT NAME HOLLADAY STREET/FORREST AVENUE WATERSHED STUDY PROJECT NO. 88143-03-45
MADE BY WEZ DATE 6-21-89
CHECKED BY _____ DATE _____ REFERENCE _____

## HOLLADAY STREET SECTION 1 (H-1)




## STAGE-DISCHARGE CURVE



JOB # 88143-03-45

HOLLADAY/FORREST STREETS WATERSHED STUDY

BY: WEZ
12-01-1989

CROSS SECTION HOLLADAY STREET H-1

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION | 2467.80 |
| STATION | 10.00 | ELEVATION | 2467.70 |
| STATION | 16.00 | ELEVATION | 2466.92 |
| STATION | 31.00 | ELEVATION | 2467.11 |
| STATION | 45.00 | ELEVATION | 2466.72 |
| STATION | 60.00 | ELEVATION | 2467.60 |
| STATION | 81.00 | ELEVATION | 2467.90 |

## EXISTING 100-YEAR DISCHARGE RATING

RESULTS

| | | |
|---|---|---|
| Manning's 'n' | 0.020 | |
| Channel Slope | 0.0143 | ft/ft |
| W.S. Elevation | 2467.77 | ft |
| Area | 36.19 | sq.ft |
| Perimeter | 68.32 | ft |
| Near Bank | 3.39 | ft |
| Far Bank | 71.63 | ft |
| Discharge | 210.54 | cfs |
| Velocity | 5.82 | fps |

# STREET RATING DATA

JOB # 88143-03-45

HOLLADAY/FORREST STREETS WATERSHED STUDY

BY: WEZ
6-19-89

CROSS SECTION HOLLADAY STREET SECTION 1

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION 2467.80 | MANNING'S 'n' 0.000 |
| STATION | 10.00 | ELEVATION 2467.70 | MANNING'S 'n' 0.030 |
| STATION | 16.00 | ELEVATION 2466.92 | MANNING'S 'n' 0.030 |
| STATION | 31.00 | ELEVATION 2467.11 | MANNING'S 'n' 0.016 |
| STATION | 45.00 | ELEVATION 2466.72 | MANNING'S 'n' 0.016 |
| STATION | 60.00 | ELEVATION 2467.60 | MANNING'S 'n' 0.030 |
| STATION | 81.00 | ELEVATION 2467.90 | MANNING'S 'n' 0.030 |

RESULTS

Equivalent Manning's 'n' 0.020
Channel Slope 1.430%
W.S. Elevation 2467.17
Area 7.94 SF
Perimeter 38.68 Ft.
Near Bank 14.1
Far Bank 52.7
Discharge 25.19 cfs
Velocity 3.17 fps

JOB # 88143-03-45

HOLLADAY/FORREST STREETS WATERSHED STUDY

BY: WEZ
6-19-89

CROSS SECTION HOLLADAY STREET SECTION 1

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION 2467.80 | MANNING'S 'n' 0.000 |
| STATION | 10.00 | ELEVATION 2467.70 | MANNING'S 'n' 0.030 |
| STATION | 16.00 | ELEVATION 2466.92 | MANNING'S 'n' 0.030 |
| STATION | 31.00 | ELEVATION 2467.11 | MANNING'S 'n' 0.016 |
| STATION | 45.00 | ELEVATION 2466.72 | MANNING'S 'n' 0.016 |
| STATION | 60.00 | ELEVATION 2467.60 | MANNING'S 'n' 0.030 |
| STATION | 81.00 | ELEVATION 2467.90 | MANNING'S 'n' 0.030 |

RESULTS

Equivalent Manning's 'n' 0.020
Channel Slope 1.430%
W.S. Elevation 2467.28
Area 12.40 SF
Perimeter 41.45 Ft.
Near Bank 13.2
Far Bank 54.6
Discharge 50.20 cfs
Velocity 4.05 fps

088

JOB # 88143-03-45

HOLLADAY/FORREST STREETS WATERSHED STUDY

BY: WEZ
6-19-89

CROSS SECTION HOLLADAY STREET SECTION 1

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION 2467.80 | MANNING'S 'n' 0.000 |
| STATION | 10.00 | ELEVATION 2467.70 | MANNING'S 'n' 0.030 |
| STATION | 16.00 | ELEVATION 2466.92 | MANNING'S 'n' 0.030 |
| STATION | 31.00 | ELEVATION 2467.11 | MANNING'S 'n' 0.016 |
| STATION | 45.00 | ELEVATION 2466.72 | MANNING'S 'n' 0.016 |
| STATION | 60.00 | ELEVATION 2467.60 | MANNING'S 'n' 0.030 |
| STATION | 81.00 | ELEVATION 2467.90 | MANNING'S 'n' 0.030 |

RESULTS

Equivalent Manning's 'n' 0.020
Channel Slope 1.430%
W.S. Elevation 2467.37
Area 16.23 SF
Perimeter 43.68 Ft.
Near Bank 12.5
Far Bank 56.1
Discharge 75.18 cfs
Velocity 4.63 fps

JOB # 88143-03-45

HOLLADAY/FORREST STREETS WATERSHED STUDY

BY: WEZ
6-19-89

CROSS SECTION HOLLADAY STREET SECTION 1

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION 2467.80 | MANNING'S 'n' 0.000 |
| STATION | 10.00 | ELEVATION 2467.70 | MANNING'S 'n' 0.030 |
| STATION | 16.00 | ELEVATION 2466.92 | MANNING'S 'n' 0.030 |
| STATION | 31.00 | ELEVATION 2467.11 | MANNING'S 'n' 0.016 |
| STATION | 45.00 | ELEVATION 2466.72 | MANNING'S 'n' 0.016 |
| STATION | 60.00 | ELEVATION 2467.60 | MANNING'S 'n' 0.030 |
| STATION | 81.00 | ELEVATION 2467.90 | MANNING'S 'n' 0.030 |

RESULTS

Equivalent Manning's 'n' 0.020
Channel Slope 1.430%
W.S. Elevation 2467.45
Area 19.73 SF
Perimeter 45.63 Ft.
Near Bank 11.9
Far Bank 57.5
Discharge 100.20 cfs
Velocity 5.08 fps

JOB # 88143-03-45

HOLLADAY/FORREST STREETS WATERSHED STUDY

BY: WEZ
6-19-89

CROSS SECTION HOLLADAY STREET SECTION 1

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION 2467.80 | MANNING'S 'n' 0.000 |
| STATION | 10.00 | ELEVATION 2467.70 | MANNING'S 'n' 0.030 |
| STATION | 16.00 | ELEVATION 2466.92 | MANNING'S 'n' 0.030 |
| STATION | 31.00 | ELEVATION 2467.11 | MANNING'S 'n' 0.016 |
| STATION | 45.00 | ELEVATION 2466.72 | MANNING'S 'n' 0.016 |
| STATION | 60.00 | ELEVATION 2467.60 | MANNING'S 'n' 0.030 |
| STATION | 81.00 | ELEVATION 2467.90 | MANNING'S 'n' 0.030 |

RESULTS

Equivalent Manning's 'n' 0.020
Channel Slope 1.430%
W.S. Elevation 2467.59
Area 26.15 SF
Perimeter 49.01 Ft.
Near Bank 10.9
Far Bank 59.8
Discharge 150.17 cfs
Velocity 5.74 fps

JOB # 88143-03-45

HOLLADAY/FORREST STREETS WATERSHED STUDY

BY: WEZ
6-19-89

CROSS SECTION HOLLADAY STREET SECTION 1

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION 2467.80 | MANNING'S 'n' 0.000 |
| STATION | 10.00 | ELEVATION 2467.70 | MANNING'S 'n' 0.030 |
| STATION | 16.00 | ELEVATION 2466.92 | MANNING'S 'n' 0.030 |
| STATION | 31.00 | ELEVATION 2467.11 | MANNING'S 'n' 0.016 |
| STATION | 45.00 | ELEVATION 2466.72 | MANNING'S 'n' 0.016 |
| STATION | 60.00 | ELEVATION 2467.60 | MANNING'S 'n' 0.030 |
| STATION | 81.00 | ELEVATION 2467.90 | MANNING'S 'n' 0.030 |

RESULTS

Equivalent Manning's 'n' 0.021
Channel Slope 1.430%
W.S. Elevation 2467.77
Area 36.29 SF
Perimeter 68.57 Ft.
Near Bank 3.2
Far Bank 71.7
Discharge 200.55 cfs
Velocity 5.53 fps

JOB # 88143-03-45

HOLLADAY/FORREST STREETS WATERSHED STUDY

BY: WEZ
6-19-89

CROSS SECTION HOLLADAY STREET SECTION 1

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION 2467.80 | MANNING'S 'n' 0.000 |
| STATION | 10.00 | ELEVATION 2467.70 | MANNING'S 'n' 0.030 |
| STATION | 16.00 | ELEVATION 2466.92 | MANNING'S 'n' 0.030 |
| STATION | 31.00 | ELEVATION 2467.11 | MANNING'S 'n' 0.016 |
| STATION | 45.00 | ELEVATION 2466.72 | MANNING'S 'n' 0.016 |
| STATION | 60.00 | ELEVATION 2467.60 | MANNING'S 'n' 0.030 |
| STATION | 81.00 | ELEVATION 2467.90 | MANNING'S 'n' 0.030 |

RESULTS

Equivalent Manning's 'n' 0.022
Channel Slope 1.430%
W.S. Elevation 2467.88
Area 44.80 SF
Perimeter 79.73 Ft.
Near Bank %10000000000.0
Far Bank 79.6
Discharge 249.57 cfs
Velocity 5.57 fps

JOB # 88143-03-45

HOLLADAY/FORREST STREETS WATERSHED STUDY

BY: WEZ
6-19-89

CROSS SECTION HOLLADAY STREET SECTION 1

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION 2467.80 | MANNING'S 'n' 0.000 |
| STATION | 10.00 | ELEVATION 2467.70 | MANNING'S 'n' 0.030 |
| STATION | 16.00 | ELEVATION 2466.92 | MANNING'S 'n' 0.030 |
| STATION | 31.00 | ELEVATION 2467.11 | MANNING'S 'n' 0.016 |
| STATION | 45.00 | ELEVATION 2466.72 | MANNING'S 'n' 0.016 |
| STATION | 60.00 | ELEVATION 2467.60 | MANNING'S 'n' 0.030 |
| STATION | 81.00 | ELEVATION 2467.90 | MANNING'S 'n' 0.030 |

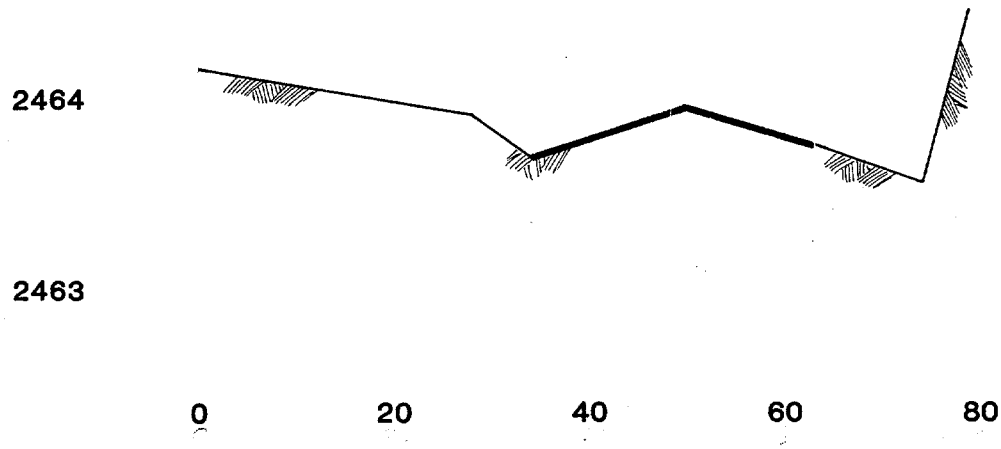
RESULTS

Equivalent Manning's 'n' 0.022
Channel Slope 1.430%
W.S. Elevation 2467.96
Area 50.87 SF
Perimeter 81.09 Ft.
Near Bank %10000000000.0
Far Bank 74.0
Discharge 299.71 cfs
Velocity 5.89 fps

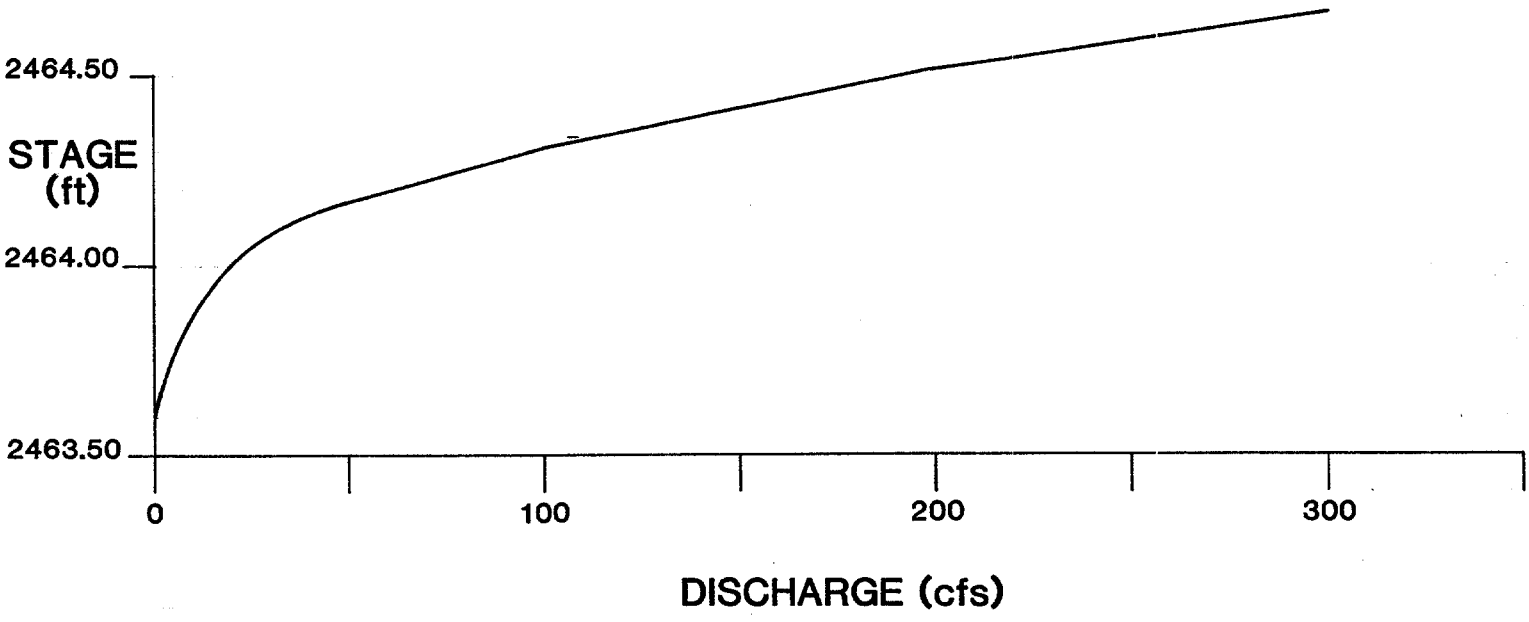
ENGINEERING
PLANNING
SURVEYING
McGovern. MacVittie. Lodge & Associates, Inc.

PROJECT NAME HOLLADAY STREET/FORREST AVENUE WATERSHED STUDY PROJECT NO. 88143-03-45
MADE BY WEZ DATE 6-21-89
CHECKED BY _____ DATE _____ REFERENCE _____

## HOLLADAY STREET SECTION 2 (H-2)




## STAGE-DISCHARGE CURVE



JOB # 88143-03-45

HOLLADAY/FORREST STREETS WATERSHED STUDY

BY: WEZ
12-01-1989

CROSS SECTION HOLLADAY STREET H-2

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION | 2464.20 |
| STATION | 28.00 | ELEVATION | 2463.97 |
| STATION | 34.00 | ELEVATION | 2463.75 |
| STATION | 50.00 | ELEVATION | 2463.99 |
| STATION | 63.00 | ELEVATION | 2463.78 |
| STATION | 74.00 | ELEVATION | 2463.60 |
| STATION | 79.00 | ELEVATION | 2464.50 |

## EXISTING 100-YEAR DISCHARGE RATING

RESULTS

| | | |
|---|---|---|
| Manning's 'n' | 0.023 | |
| Channel Slope | 0.0100 | ft/ft |
| W.S. Elevation | 2464.55 | ft |
| Area | 48.36 | sq.ft |
| Perimeter | 79.09 | ft |
| Near Bank | %10000000000.00 | ft |
| Far Bank | 77.33 | ft |
| Discharge | 225.09 | cfs |
| Velocity | 4.65 | fps |

# STREET RATING DATA

JOB # 88143-03-45

HOLLADAY/FORREST STREETS WATERSHED STUDY

BY: WEZ
6-19-89

CROSS SECTION HOLLADAY STREET SECTION 2

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION 2464.20 | MANNING'S 'n' 0.000 |
| STATION | 28.00 | ELEVATION 2463.97 | MANNING'S 'n' 0.030 |
| STATION | 34.00 | ELEVATION 2463.75 | MANNING'S 'n' 0.016 |
| STATION | 50.00 | ELEVATION 2463.99 | MANNING'S 'n' 0.016 |
| STATION | 63.00 | ELEVATION 2463.78 | MANNING'S 'n' 0.016 |
| STATION | 74.00 | ELEVATION 2463.60 | MANNING'S 'n' 0.030 |
| STATION | 79.00 | ELEVATION 2464.50 | MANNING'S 'n' 0.030 |

RESULTS

Equivalent Manning's 'n' 0.022
Channel Slope 1.000%
W.S. Elevation 2464.05
Area 11.28 SF
Perimeter 58.73 Ft.
Near Bank 17.8
Far Bank 76.5
Discharge 25.13 cfs
Velocity 2.23 fps

JOB # 88143-03-45

HOLLADAY/FORREST STREETS WATERSHED STUDY

BY: WEZ
6-19-89

CROSS SECTION HOLLADAY STREET SECTION 2

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION 2464.20 | MANNING'S 'n' 0.000 |
| STATION | 28.00 | ELEVATION 2463.97 | MANNING'S 'n' 0.030 |
| STATION | 34.00 | ELEVATION 2463.75 | MANNING'S 'n' 0.016 |
| STATION | 50.00 | ELEVATION 2463.99 | MANNING'S 'n' 0.016 |
| STATION | 63.00 | ELEVATION 2463.78 | MANNING'S 'n' 0.016 |
| STATION | 74.00 | ELEVATION 2463.60 | MANNING'S 'n' 0.030 |
| STATION | 79.00 | ELEVATION 2464.50 | MANNING'S 'n' 0.030 |

RESULTS

Equivalent Manning's 'n' 0.022
Channel Slope 1.000%
W.S. Elevation 2464.17
Area 18.76 SF
Perimeter 73.20 Ft.
Near Bank 4.0
Far Bank 77.1
Discharge 50.35 cfs
Velocity 2.68 fps

099

JOB # 88143-03-45

HOLLADAY/FORREST STREETS WATERSHED STUDY

BY: WEZ
6-19-89

CROSS SECTION HOLLADAY STREET SECTION 2

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION 2464.20 | MANNING'S 'n' 0.000 |
| STATION | 28.00 | ELEVATION 2463.97 | MANNING'S 'n' 0.030 |
| STATION | 34.00 | ELEVATION 2463.75 | MANNING'S 'n' 0.016 |
| STATION | 50.00 | ELEVATION 2463.99 | MANNING'S 'n' 0.016 |
| STATION | 63.00 | ELEVATION 2463.78 | MANNING'S 'n' 0.016 |
| STATION | 74.00 | ELEVATION 2463.60 | MANNING'S 'n' 0.030 |
| STATION | 79.00 | ELEVATION 2464.50 | MANNING'S 'n' 0.030 |

RESULTS

Equivalent Manning's 'n' 0.023
Channel Slope 1.000%
W.S. Elevation 2464.24
Area 24.57 SF
Perimeter 77.64 Ft.
Near Bank %10000000000.0
Far Bank 77.6
Discharge 74.89 cfs
Velocity 3.05 fps

JOB # 88143-03-45

HOLLADAY/FORREST STREETS WATERSHED STUDY

BY: WEZ
6-19-89

CROSS SECTION HOLLADAY STREET SECTION 2

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION 2464.20 | MANNING'S 'n' 0.000 |
| STATION | 28.00 | ELEVATION 2463.97 | MANNING'S 'n' 0.030 |
| STATION | 34.00 | ELEVATION 2463.75 | MANNING'S 'n' 0.016 |
| STATION | 50.00 | ELEVATION 2463.99 | MANNING'S 'n' 0.016 |
| STATION | 63.00 | ELEVATION 2463.78 | MANNING'S 'n' 0.016 |
| STATION | 74.00 | ELEVATION 2463.60 | MANNING'S 'n' 0.030 |
| STATION | 79.00 | ELEVATION 2464.50 | MANNING'S 'n' 0.030 |

RESULTS

Equivalent Manning's 'n' 0.023
Channel Slope 1.000%
W.S. Elevation 2464.31
Area 29.39 SF
Perimeter 77.99 Ft.
Near Bank %10000000000.0
Far Bank 77.9
Discharge 99.88 cfs
Velocity 3.40 fps

JOB # 88143-03-45

HOLLADAY/FORREST STREETS WATERSHED STUDY

BY: WEZ
6-19-89

CROSS SECTION HOLLADAY STREET SECTION 2

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION 2464.20 | MANNING'S 'n' 0.000 |
| STATION | 28.00 | ELEVATION 2463.97 | MANNING'S 'n' 0.030 |
| STATION | 34.00 | ELEVATION 2463.75 | MANNING'S 'n' 0.016 |
| STATION | 50.00 | ELEVATION 2463.99 | MANNING'S 'n' 0.016 |
| STATION | 63.00 | ELEVATION 2463.78 | MANNING'S 'n' 0.016 |
| STATION | 74.00 | ELEVATION 2463.60 | MANNING'S 'n' 0.030 |
| STATION | 79.00 | ELEVATION 2464.50 | MANNING'S 'n' 0.030 |

RESULTS

Equivalent Manning's 'n' 0.023
Channel Slope 1.000%
W.S. Elevation 2464.41
Area 37.79 SF
Perimeter 78.60 Ft.
Near Bank %10000000000.0
Far Bank 78.5
Discharge 149.75 cfs
Velocity 3.96 fps

JOB # 88143-03-45

HOLLADAY/FORREST STREETS WATERSHED STUDY

BY: WEZ
6-19-89

CROSS SECTION HOLLADAY STREET SECTION 2

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION 2464.20 | MANNING'S 'n' 0.000 |
| STATION | 28.00 | ELEVATION 2463.97 | MANNING'S 'n' 0.030 |
| STATION | 34.00 | ELEVATION 2463.75 | MANNING'S 'n' 0.016 |
| STATION | 50.00 | ELEVATION 2463.99 | MANNING'S 'n' 0.016 |
| STATION | 63.00 | ELEVATION 2463.78 | MANNING'S 'n' 0.016 |
| STATION | 74.00 | ELEVATION 2463.60 | MANNING'S 'n' 0.030 |
| STATION | 79.00 | ELEVATION 2464.50 | MANNING'S 'n' 0.030 |

RESULTS

Equivalent Manning's 'n' 0.023
Channel Slope 1.000%
W.S. Elevation 2464.51
Area 45.27 SF
Perimeter 79.09 Ft.
Near Bank %10000000000.0
Far Bank 77.3
Discharge 200.41 cfs
Velocity 4.43 fps

JOB # 88143-03-45

HOLLADAY/FORREST STREETS WATERSHED STUDY

BY: WEZ
6-19-89

CROSS SECTION HOLLADAY STREET SECTION 2

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION 2464.20 | MANNING'S 'n' 0.000 |
| STATION | 28.00 | ELEVATION 2463.97 | MANNING'S 'n' 0.030 |
| STATION | 34.00 | ELEVATION 2463.75 | MANNING'S 'n' 0.016 |
| STATION | 50.00 | ELEVATION 2463.99 | MANNING'S 'n' 0.016 |
| STATION | 63.00 | ELEVATION 2463.78 | MANNING'S 'n' 0.016 |
| STATION | 74.00 | ELEVATION 2463.60 | MANNING'S 'n' 0.030 |
| STATION | 79.00 | ELEVATION 2464.50 | MANNING'S 'n' 0.030 |

RESULTS

Equivalent Manning's 'n' 0.023
Channel Slope 1.000%
W.S. Elevation 2464.59
Area 51.83 SF
Perimeter 79.09 Ft.
Near Bank %10000000000.0
Far Bank 77.3
Discharge 250.19 cfs
Velocity 4.83 fps

JOB # 88143-03-45

HOLLADAY/FORREST STREETS WATERSHED STUDY

BY: WEZ
6-19-89

CROSS SECTION HOLLADAY STREET SECTION 2

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION 2464.20 | MANNING'S 'n' 0.000 |
| STATION | 28.00 | ELEVATION 2463.97 | MANNING'S 'n' 0.030 |
| STATION | 34.00 | ELEVATION 2463.75 | MANNING'S 'n' 0.016 |
| STATION | 50.00 | ELEVATION 2463.99 | MANNING'S 'n' 0.016 |
| STATION | 63.00 | ELEVATION 2463.78 | MANNING'S 'n' 0.016 |
| STATION | 74.00 | ELEVATION 2463.60 | MANNING'S 'n' 0.030 |
| STATION | 79.00 | ELEVATION 2464.50 | MANNING'S 'n' 0.030 |

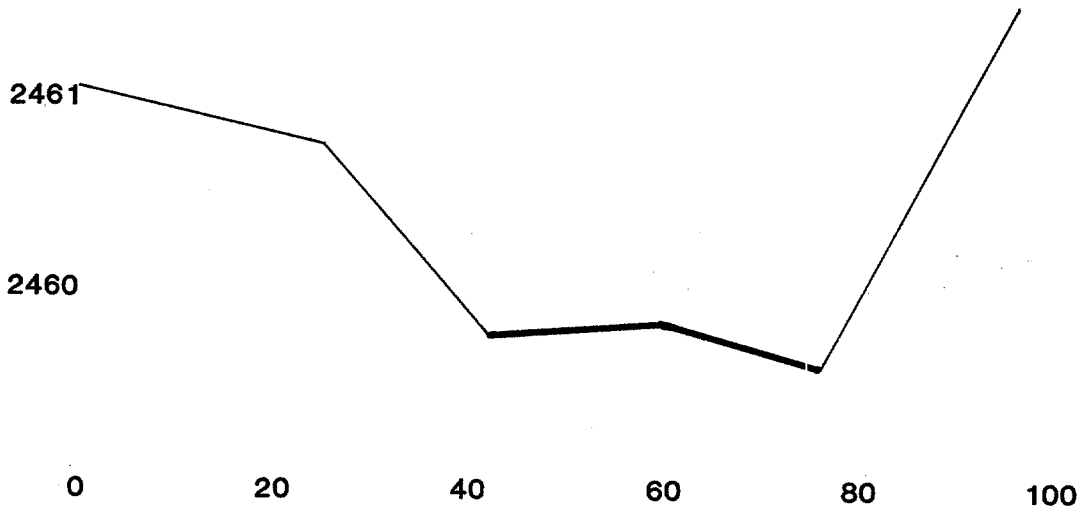
RESULTS

Equivalent Manning's 'n' 0.023
Channel Slope 1.000%
W.S. Elevation 2464.67
Area 57.93 SF
Perimeter 79.09 Ft.
Near Bank %10000000000.0
Far Bank 77.3
Discharge 300.34 cfs
Velocity 5.18 fps

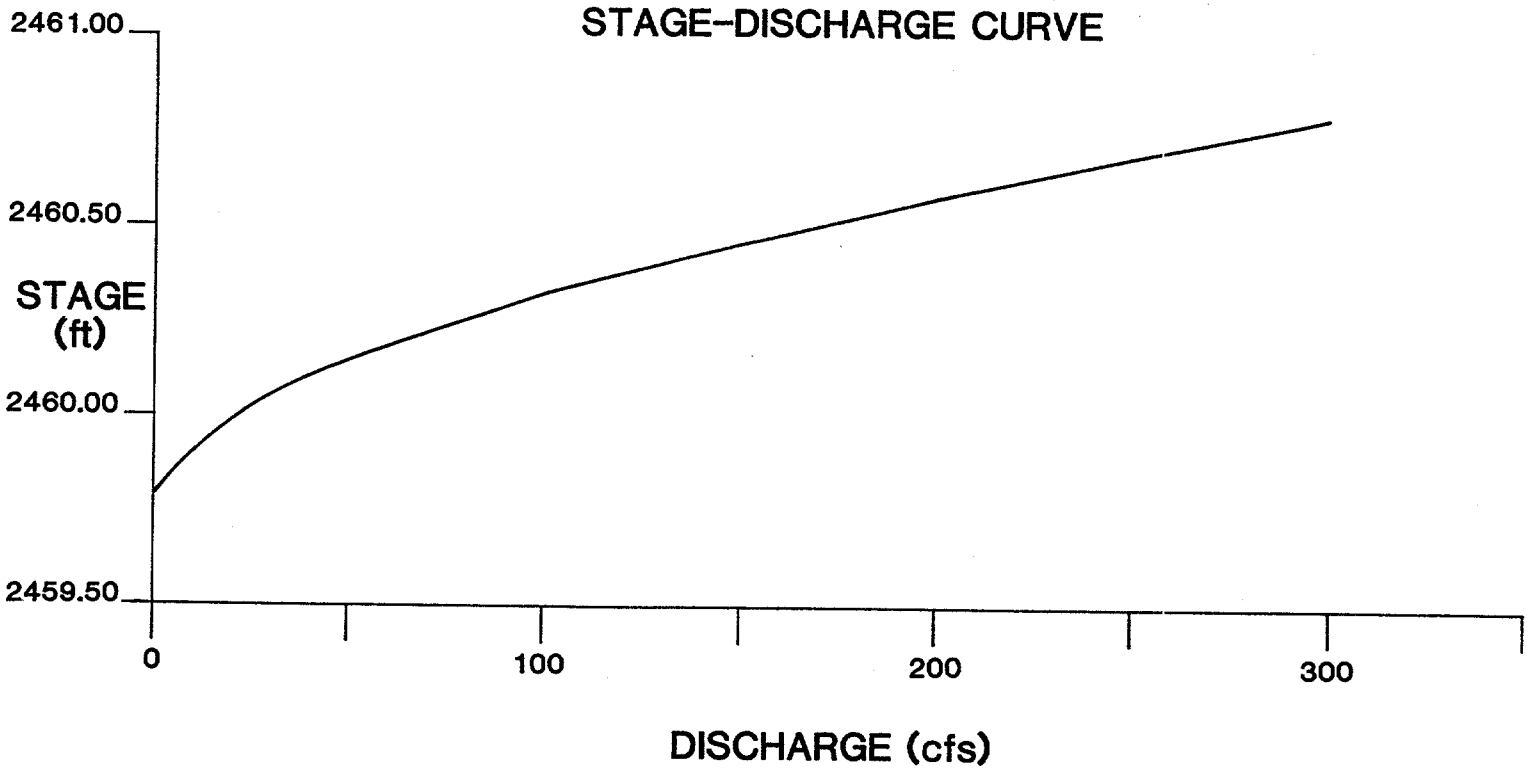
ENGINEERING
PLANNING
SURVEYING
McGovern, MacVittie, Lodge & Associates, Inc.

HOLLADAY STREET/FORREST
PROJECT NAME AVENUE WATERSHED STUDY PROJECT NO. 88143-03-45
MADE BY WEZ DATE 6-21-89
CHECKED BY _____ DATE _____ REFERENCE _____

## HOLLADAY STREET SECTION 3 (H-3)




## STAGE-DISCHARGE CURVE



JOB # 88143-03-45

HOLLADAY/FORREST STREETS WATERSHED STUDY

BY: WEZ
12-01-1989

CROSS SECTION HOLLADAY STREET H-3

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION | 2461.10 |
| STATION | 25.00 | ELEVATION | 2460.80 |
| STATION | 42.00 | ELEVATION | 2459.80 |
| STATION | 60.00 | ELEVATION | 2459.88 |
| STATION | 76.00 | ELEVATION | 2459.65 |
| STATION | 96.00 | ELEVATION | 2461.53 |

## EXISTING 100-YEAR DISCHARGE RATING

RESULTS

| | | |
|---|---|---|
| Manning's 'n' | 0.020 | |
| Channel Slope | 0.0100 | ft/ft |
| W.S. Elevation | 2460.68 | ft |
| Area | 41.93 | sq.ft |
| Perimeter | 59.96 | ft |
| Near Bank | 27.06 | ft |
| Far Bank | 86.95 | ft |
| Discharge | 245.39 | cfs |
| Velocity | 5.85 | fps |

# STREET RATING DATA

JOB # 88143-03-45

HOLLADAY/FORREST STREETS WATERSHED STUDY

BY: WEZ
6-19-89

CROSS SECTION HOLLADAY STREET SECTION 3

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION 2461.10 | MANNING'S 'n' 0.000 |
| STATION | 25.00 | ELEVATION 2460.80 | MANNING'S 'n' 0.030 |
| STATION | 42.00 | ELEVATION 2459.80 | MANNING'S 'n' 0.030 |
| STATION | 60.00 | ELEVATION 2459.88 | MANNING'S 'n' 0.016 |
| STATION | 76.00 | ELEVATION 2459.65 | MANNING'S 'n' 0.016 |
| STATION | 96.00 | ELEVATION 2461.53 | MANNING'S 'n' 0.030 |

RESULTS

Equivalent Manning's 'n' 0.018
Channel Slope 1.000%
W.S. Elevation 2460.03
Area 8.67 SF
Perimeter 41.84 Ft.
Near Bank 38.2
Far Bank 80.0
Discharge 25.19 cfs
Velocity 2.91 fps

JOB # 88143-03-45

HOLLADAY/FORREST STREETS WATERSHED STUDY

BY: WEZ
6-19-89

CROSS SECTION HOLLADAY STREET SECTION 3

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION 2461.10 | MANNING'S 'n' 0.000 |
| STATION | 25.00 | ELEVATION 2460.80 | MANNING'S 'n' 0.030 |
| STATION | 42.00 | ELEVATION 2459.80 | MANNING'S 'n' 0.030 |
| STATION | 60.00 | ELEVATION 2459.88 | MANNING'S 'n' 0.016 |
| STATION | 76.00 | ELEVATION 2459.65 | MANNING'S 'n' 0.016 |
| STATION | 96.00 | ELEVATION 2461.53 | MANNING'S 'n' 0.030 |

RESULTS

Equivalent Manning's 'n' 0.018
Channel Slope 1.000%
W.S. Elevation 2460.14
Area 13.69 SF
Perimeter 45.04 Ft.
Near Bank 36.2
Far Bank 81.2
Discharge 50.20 cfs
Velocity 3.67 fps

JOB # 88143-03-45

HOLLADAY/FORREST STREETS WATERSHED STUDY

BY: WEZ
6-19-89

CROSS SECTION HOLLADAY STREET SECTION 3

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION 2461.10 | MANNING'S 'n' 0.000 |
| STATION | 25.00 | ELEVATION 2460.80 | MANNING'S 'n' 0.030 |
| STATION | 42.00 | ELEVATION 2459.80 | MANNING'S 'n' 0.030 |
| STATION | 60.00 | ELEVATION 2459.88 | MANNING'S 'n' 0.016 |
| STATION | 76.00 | ELEVATION 2459.65 | MANNING'S 'n' 0.016 |
| STATION | 96.00 | ELEVATION 2461.53 | MANNING'S 'n' 0.030 |

RESULTS

Equivalent Manning's 'n' 0.019
Channel Slope 1.000%
W.S. Elevation 2460.23
Area 18.04 SF
Perimeter 47.65 Ft.
Near Bank 34.6
Far Bank 82.2
Discharge 75.22 cfs
Velocity 4.17 fps

JOB # 88143-03-45

HOLLADAY/FORREST STREETS WATERSHED STUDY

BY: WEZ
6-19-89

CROSS SECTION HOLLADAY STREET SECTION 3

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION 2461.10 | MANNING'S 'n' 0.000 |
| STATION | 25.00 | ELEVATION 2460.80 | MANNING'S 'n' 0.030 |
| STATION | 42.00 | ELEVATION 2459.80 | MANNING'S 'n' 0.030 |
| STATION | 60.00 | ELEVATION 2459.88 | MANNING'S 'n' 0.016 |
| STATION | 76.00 | ELEVATION 2459.65 | MANNING'S 'n' 0.016 |
| STATION | 96.00 | ELEVATION 2461.53 | MANNING'S 'n' 0.030 |

RESULTS

Equivalent Manning's 'n' 0.019
Channel Slope 1.000%
W.S. Elevation 2460.32
Area 22.03 SF
Perimeter 49.92 Ft.
Near Bank 33.2
Far Bank 83.1
Discharge 100.18 cfs
Velocity 4.55 fps

JOB # 88143-03-45

HOLLADAY/FORREST STREETS WATERSHED STUDY

BY: WEZ
6-19-89

CROSS SECTION HOLLADAY STREET SECTION 3

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION 2461.10 | MANNING'S 'n' 0.000 |
| STATION | 25.00 | ELEVATION 2460.80 | MANNING'S 'n' 0.030 |
| STATION | 42.00 | ELEVATION 2459.80 | MANNING'S 'n' 0.030 |
| STATION | 60.00 | ELEVATION 2459.88 | MANNING'S 'n' 0.016 |
| STATION | 76.00 | ELEVATION 2459.65 | MANNING'S 'n' 0.016 |
| STATION | 96.00 | ELEVATION 2461.53 | MANNING'S 'n' 0.030 |

RESULTS

Equivalent Manning's 'n' 0.019
Channel Slope 1.000%
W.S. Elevation 2460.46
Area 29.39 SF
Perimeter 53.85 Ft.
Near Bank 30.8
Far Bank 84.6
Discharge 150.28 cfs
Velocity 5.11 fps

JOB # 88143-03-45

HOLLADAY/FORREST STREETS WATERSHED STUDY

BY: WEZ
6-19-89

CROSS SECTION HOLLADAY STREET SECTION 3

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION 2461.10 | MANNING'S 'n' 0.000 |
| STATION | 25.00 | ELEVATION 2460.80 | MANNING'S 'n' 0.030 |
| STATION | 42.00 | ELEVATION 2459.80 | MANNING'S 'n' 0.030 |
| STATION | 60.00 | ELEVATION 2459.88 | MANNING'S 'n' 0.016 |
| STATION | 76.00 | ELEVATION 2459.65 | MANNING'S 'n' 0.016 |
| STATION | 96.00 | ELEVATION 2461.53 | MANNING'S 'n' 0.030 |

RESULTS

Equivalent Manning's 'n' 0.020
Channel Slope 1.000%
W.S. Elevation 2460.58
Area 36.19 SF
Perimeter 57.25 Ft.
Near Bank 28.7
Far Bank 85.9
Discharge 200.21 cfs
Velocity 5.53 fps

JOB # 88143-03-45

HOLLADAY/FORREST STREETS WATERSHED STUDY

BY: WEZ
6-19-89

CROSS SECTION HOLLADAY STREET SECTION 3

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION 2461.10 | MANNING'S 'n' 0.000 |
| STATION | 25.00 | ELEVATION 2460.80 | MANNING'S 'n' 0.030 |
| STATION | 42.00 | ELEVATION 2459.80 | MANNING'S 'n' 0.030 |
| STATION | 60.00 | ELEVATION 2459.88 | MANNING'S 'n' 0.016 |
| STATION | 76.00 | ELEVATION 2459.65 | MANNING'S 'n' 0.016 |
| STATION | 96.00 | ELEVATION 2461.53 | MANNING'S 'n' 0.030 |

RESULTS

Equivalent Manning's 'n' 0.020
Channel Slope 1.000%
W.S. Elevation 2460.69
Area 42.66 SF
Perimeter 60.30 Ft.
Near Bank 26.9
Far Bank 87.1
Discharge 250.29 cfs
Velocity 5.87 fps

JOB # 88143-03-45

HOLLADAY/FORREST STREETS WATERSHED STUDY

BY: WEZ
6-19-89

CROSS SECTION HOLLADAY STREET SECTION 3

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION 2461.10 | MANNING'S 'n' 0.000 |
| STATION | 25.00 | ELEVATION 2460.80 | MANNING'S 'n' 0.030 |
| STATION | 42.00 | ELEVATION 2459.80 | MANNING'S 'n' 0.030 |
| STATION | 60.00 | ELEVATION 2459.88 | MANNING'S 'n' 0.016 |
| STATION | 76.00 | ELEVATION 2459.65 | MANNING'S 'n' 0.016 |
| STATION | 96.00 | ELEVATION 2461.53 | MANNING'S 'n' 0.030 |

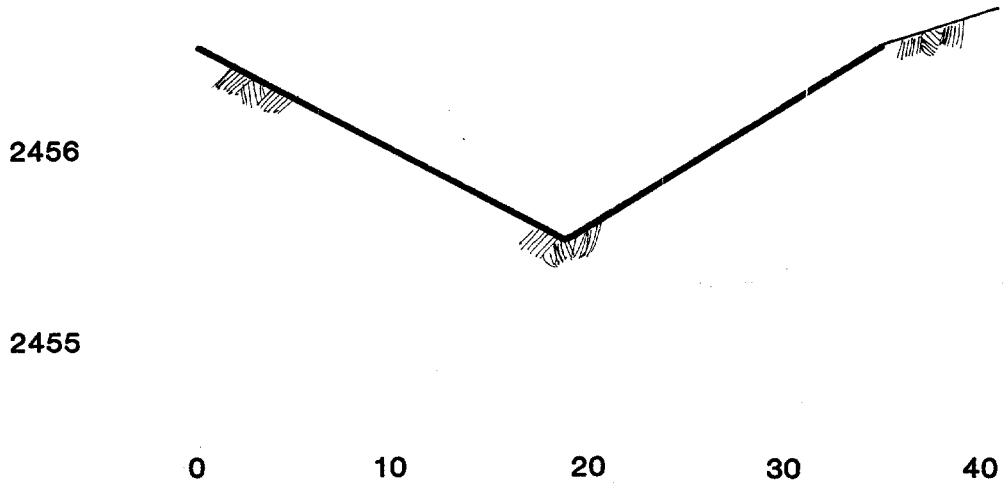
RESULTS

Equivalent Manning's 'n' 0.020
Channel Slope 1.000%
W.S. Elevation 2460.79
Area 48.89 SF
Perimeter 63.10 Ft.
Near Bank 25.1
Far Bank 88.2
Discharge 300.62 cfs
Velocity 6.15 fps

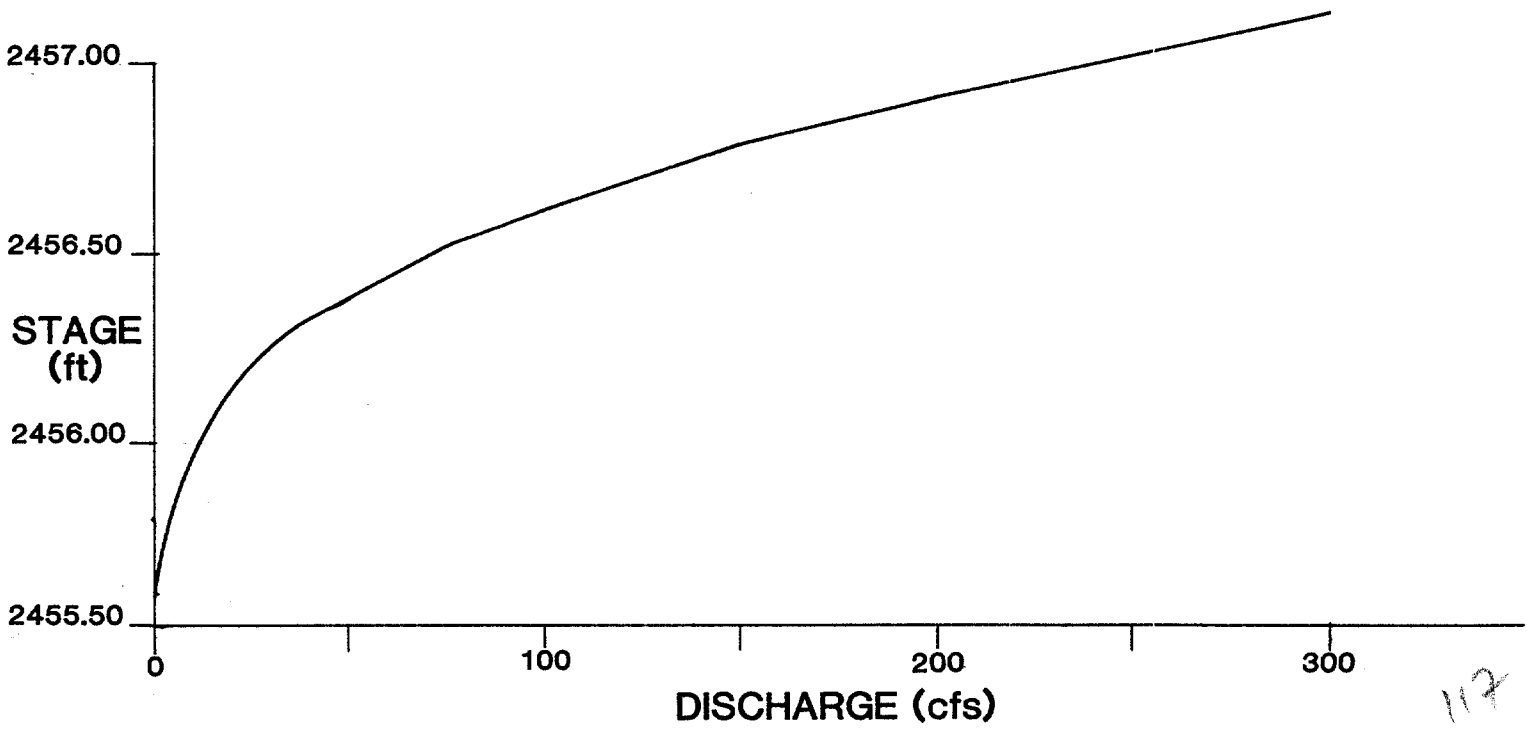
ENGINEERING
PLANNING
SURVEYING
McGovern, MacVittie, Lodge & Associates, Inc.

HOLLADAY STREET/FORREST
PROJECT NAME AVENUE WATERSHED STUDY PROJECT NO. 88143-03-45
MADE BY WEZ DATE 6-21-89
CHECKED BY _____ DATE _____ REFERENCE _____

## HOLLADAY STREET SECTION 4 (H-4)




## STAGE-DISCHARGE CURVE



JOB # 88143-03-45

HOLLADAY/FORREST STREETS WATERSHED STUDY

BY: WEZ
12-01-1989

CROSS SECTION HOLLADAY STREET H-4

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION | 2456.61 |
| STATION | 19.00 | ELEVATION | 2455.58 |
| STATION | 35.00 | ELEVATION | 2456.60 |
| STATION | 41.00 | ELEVATION | 2456.70 |

## EXISTING 100-YEAR DISCHARGE RATING

RESULTS

| | | |
|---|---|---|
| Manning's 'n' | 0.017 | |
| Channel Slope | 0.0083 | ft/ft |
| W.S. Elevation | 2457.05 | ft |
| Area | 35.90 | sq.ft |
| Perimeter | 41.06 | ft |
| Near Bank | %10000000000.00 | ft |
| Far Bank | 35.60 | ft |
| Discharge | 261.45 | cfs |
| Velocity | 7.28 | fps |

# STREET RATING DATA

JOB # 88143-03-45

HOLLADAY/FORREST STREETS WATERSHED STUDY

BY: WEZ
6-19-89

CROSS SECTION HOLLADAY STREET SECTION 4

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION 2456.61 | MANNING'S 'n' 0.000 |
| STATION | 19.00 | ELEVATION 2455.58 | MANNING'S 'n' 0.016 |
| STATION | 35.00 | ELEVATION 2456.60 | MANNING'S 'n' 0.016 |
| STATION | 41.00 | ELEVATION 2456.70 | MANNING'S 'n' 0.030 |

RESULTS

Equivalent Manning's 'n' 0.016
Channel Slope 0.830%
W.S. Elevation 2456.20
Area 6.50 SF
Perimeter 21.09 Ft.
Near Bank 7.6
Far Bank 28.7
Discharge 25.06 cfs
Velocity 3.86 fps

JOB # 88143-03-45

HOLLADAY/FORREST STREETS WATERSHED STUDY

BY: WEZ
6-19-89

CROSS SECTION HOLLADAY STREET SECTION 4

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION 2456.61 | MANNING'S 'n' 0.000 |
| STATION | 19.00 | ELEVATION 2455.58 | MANNING'S 'n' 0.016 |
| STATION | 35.00 | ELEVATION 2456.60 | MANNING'S 'n' 0.016 |
| STATION | 41.00 | ELEVATION 2456.70 | MANNING'S 'n' 0.030 |

RESULTS

Equivalent Manning's 'n' 0.016
Channel Slope 0.830%
W.S. Elevation 2456.38
Area 10.92 SF
Perimeter 27.35 Ft.
Near Bank 4.2
Far Bank 31.5
Discharge 50.08 cfs
Velocity 4.59 fps

JOB # 88143-03-45

HOLLADAY/FORREST STREETS WATERSHED STUDY

BY: WEZ
6-19-89

CROSS SECTION HOLLADAY STREET SECTION 4

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION 2456.61 | MANNING'S 'n' 0.000 |
| STATION | 19.00 | ELEVATION 2455.58 | MANNING'S 'n' 0.016 |
| STATION | 35.00 | ELEVATION 2456.60 | MANNING'S 'n' 0.016 |
| STATION | 41.00 | ELEVATION 2456.70 | MANNING'S 'n' 0.030 |

RESULTS

Equivalent Manning's 'n' 0.016
Channel Slope 0.830%
W.S. Elevation 2456.51
Area 14.80 SF
Perimeter 31.84 Ft.
Near Bank 1.8
Far Bank 33.6
Discharge 75.12 cfs
Velocity 5.08 fps

JOB # 88143-03-45

HOLLADAY/FORREST STREETS WATERSHED STUDY

BY: WEZ
6-19-89

CROSS SECTION HOLLADAY STREET SECTION 4

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION 2456.61 | MANNING'S 'n' 0.000 |
| STATION | 19.00 | ELEVATION 2455.58 | MANNING'S 'n' 0.016 |
| STATION | 35.00 | ELEVATION 2456.60 | MANNING'S 'n' 0.016 |
| STATION | 41.00 | ELEVATION 2456.70 | MANNING'S 'n' 0.030 |

RESULTS

Equivalent Manning's 'n' 0.016
Channel Slope 0.830%
W.S. Elevation 2456.62
Area 18.49 SF
Perimeter 36.31 Ft.
Near Bank %10000000000.0
Far Bank 36.2
Discharge 99.75 cfs
Velocity 5.39 fps

JOB # 88143-03-45

HOLLADAY/FORREST STREETS WATERSHED STUDY

BY: WEZ
6-19-89

CROSS SECTION HOLLADAY STREET SECTION 4

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION 2456.61 | MANNING'S 'n' 0.000 |
| STATION | 19.00 | ELEVATION 2455.58 | MANNING'S 'n' 0.016 |
| STATION | 35.00 | ELEVATION 2456.60 | MANNING'S 'n' 0.016 |
| STATION | 41.00 | ELEVATION 2456.70 | MANNING'S 'n' 0.030 |

RESULTS

Equivalent Manning's 'n' 0.016
Channel Slope 0.830%
W.S. Elevation 2456.79
Area 25.22 SF
Perimeter 41.06 Ft.
Near Bank %10000000000.0
Far Bank 35.6
Discharge 149.87 cfs
Velocity 5.94 fps

JOB # 88143-03-45

HOLLADAY/FORREST STREETS WATERSHED STUDY

BY: WEZ
6-19-89

CROSS SECTION HOLLADAY STREET SECTION 4

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION 2456.61 | MANNING'S 'n' 0.000 |
| STATION | 19.00 | ELEVATION 2455.58 | MANNING'S 'n' 0.016 |
| STATION | 35.00 | ELEVATION 2456.60 | MANNING'S 'n' 0.016 |
| STATION | 41.00 | ELEVATION 2456.70 | MANNING'S 'n' 0.030 |

RESULTS

Equivalent Manning's 'n' 0.017
Channel Slope 0.830%
W.S. Elevation 2456.91
Area 30.27 SF
Perimeter 41.06 Ft.
Near Bank %10000000000.0
Far Bank 35.6
Discharge 199.89 cfs
Velocity 6.60 fps

JOB # 88143-03-45

HOLLADAY/FORREST STREETS WATERSHED STUDY

BY: WEZ
6-19-89

CROSS SECTION HOLLADAY STREET SECTION 4

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION 2456.61 | MANNING'S 'n' 0.000 |
| STATION | 19.00 | ELEVATION 2455.58 | MANNING'S 'n' 0.016 |
| STATION | 35.00 | ELEVATION 2456.60 | MANNING'S 'n' 0.016 |
| STATION | 41.00 | ELEVATION 2456.70 | MANNING'S 'n' 0.030 |

RESULTS

Equivalent Manning's 'n' 0.017
Channel Slope 0.830%
W.S. Elevation 2457.02
Area 34.80 SF
Perimeter 41.06 Ft.
Near Bank %10000000000.0
Far Bank 35.6
Discharge 249.68 cfs
Velocity 7.17 fps

JOB # 88143-03-45

HOLLADAY/FORREST STREETS WATERSHED STUDY

BY: WEZ
6-19-89

CROSS SECTION HOLLADAY STREET SECTION 4

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION 2456.61 | MANNING'S 'n' 0.000 |
| STATION | 19.00 | ELEVATION 2455.58 | MANNING'S 'n' 0.016 |
| STATION | 35.00 | ELEVATION 2456.60 | MANNING'S 'n' 0.016 |
| STATION | 41.00 | ELEVATION 2456.70 | MANNING'S 'n' 0.030 |

RESULTS

Equivalent Manning's 'n' 0.017
Channel Slope 0.830%
W.S. Elevation 2457.13
Area 39.05 SF
Perimeter 41.06 Ft.
Near Bank %10000000000.0
Far Bank 35.6
Discharge 300.25 cfs
Velocity 7.69 fps

ENGINEERING
PLANNING
SURVEYING
McGovern, MacVittie, Lodge & Associates, Inc.

PROJECT NAME Holladay/Forest PROJECT NO. _____
MADE BY _____ DATE _____
CHECKED BY _____ DATE _____ REFERENCE _____

Flow split at Concentration Point #3

Invert of 15 ft DRAINAGEWAY = $82^{62}$

Low-point of Oriole Ave at ridge 15 ft to North
= $82^{85}$

0.23 ft before flow goes north

Wier at DRAINAGEWAY-

$Q = CLH^{3/2}$

where C = 2.6
L = 15 ft
H = VARIES

| Q | H |
|---|---|
| 1 cfs | 0.1 ft |
| 3 cfs | 0.2 ft |
| 6 cfs | 0.3 ft |
| 10 cfs | 0.4 ft |
| 14 cfs | 0.5 ft |
| 18 cfs | 0.6 ft |
| 23 cfs | 0.7 ft |
| 28 cfs | 0.8 ft |
| 33 cfs | 0.9 ft |
| 39 cfs | 1.0 ft |

Wier @ Oriole Ave

$Q = CLH^{3/2}$

where C = 2.6
L = 34 ft
H = VARIES

| ~~Oriole Ave~~ Q | H (relative) |
|---|---|
| 3 cfs | 0.1 ft |
| 8 cfs | 0.2 ft |
| 15 cfs | 0.3 ft |
| 22 cfs | 0.4 ft |
| 31 cfs | 0.5 ft |
| 41 cfs | 0.6 ft |
| 52 cfs | 0.7 ft |
| 63 cfs | 0.8 ft |
| 76 cfs | 0.9 ft |
| 88 cfs | 1.0 ft |

$Q_{100} = 63$ cfs

Due to irregularities in Roadway surface at wier Depth of flow at DRAINAGEWAY wier as is 0.72 ft
24 cfs IN DRAINAGE-
63 - 24 cfs = 39 cfs IN Oriole Ave.

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# STREET RATING DATA

JOB # 88143-03-45

HOLLADAY/FORREST WATERSHED STUDY

BY: WEZ
6-19-89

CROSS SECTION ORIOLE AVENUE SECTION 1

| | | |
|---|---|---|
| STATION | 0.00 | ELEVATION 2483.66 |
| STATION | 2.00 | ELEVATION 2483.13 |
| STATION | 18.00 | ELEVATION 2483.15 |
| STATION | 34.00 | ELEVATION 2482.85 |
| STATION | 36.00 | ELEVATION 2483.27 |

RESULTS

Manning's 'n' 0.016
Channel Slope 0.800%
W.S. Elevation 2483.23
Area 5.63 SF
Perimeter 34.28 Ft.
Near Bank 1.6
Far Bank 35.8
Discharge 14.04 cfs
Velocity 2.49 fps

JOB # 88143-08-45

HOLLADAY/FORREST WATERSHED STUDY

BY: WEZ
6-19-89

CROSS SECTION ORIOLE AVENUE SECTION 1

| | | |
|---|---|---|
| STATION | 0.00 | ELEVATION 2483.66 |
| STATION | 2.00 | ELEVATION 2483.13 |
| STATION | 18.00 | ELEVATION 2483.15 |
| STATION | 34.00 | ELEVATION 2482.85 |
| STATION | 36.00 | ELEVATION 2483.27 |

RESULTS

Manning's 'n' 0.016
Channel Slope 0.800%
W.S. Elevation 2483.27
Area 6.86 SF
Perimeter 34.59 Ft.
Near Bank 1.5
Far Bank 36.0
Discharge 19.38 cfs
Velocity 2.82 fps

JOB # 88143-03-45

HOLLADAY/FORREST WATERSHED STUDY

BY: WEZ
6-19-89

CROSS SECTION ORIOLE AVENUE SECTION 1

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION | 2483.66 |
| STATION | 2.00 | ELEVATION | 2483.13 |
| STATION | 18.00 | ELEVATION | 2483.15 |
| STATION | 34.00 | ELEVATION | 2482.85 |
| STATION | 36.00 | ELEVATION | 2483.27 |

RESULTS

| | |
|---|---|
| Manning's 'n' | 0.016 |
| Channel Slope | 0.800% |
| W.S. Elevation | 2483.37 |
| Area | 10.46 SF |
| Perimeter | 35.00 Ft. |
| Near Bank | 1.1 |
| Far Bank | 36.0 |
| Discharge | 38.86 cfs |
| Velocity | 3.71 fps |

JOB # 88143-03-45

HOLLADAY/FORREST WATERSHED STUDY

BY: WEZ
6-19-89

CROSS SECTION VIRGINIA STREET SECTION 1

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION | 2483.96 |
| STATION | 2.00 | ELEVATION | 2483.46 |
| STATION | 18.00 | ELEVATION | 2483.71 |
| STATION | 34.00 | ELEVATION | 2483.36 |
| STATION | 36.00 | ELEVATION | 2483.86 |

RESULTS

Manning's 'n' 0.016
Channel Slope 1.180%
W.S. Elevation 2483.83
Area 9.24 SF
Perimeter 35.44 Ft.
Near Bank 0.5
Far Bank 35.9
Discharge 38.03 cfs
Velocity 4.12 fps

JOB # 88143-03-45

HOLLADAY/FORREST WATERSHED STUDY

BY: WEZ
6-19-89

CROSS SECTION VIRGINIA STREET SECTION 1

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION | 2483.96 |
| STATION | 2.00 | ELEVATION | 2483.46 |
| STATION | 18.00 | ELEVATION | 2483.71 |
| STATION | 34.00 | ELEVATION | 2483.36 |
| STATION | 36.00 | ELEVATION | 2483.86 |

RESULTS

Manning's 'n' 0.016
Channel Slope 1.180%
W.S. Elevation 2483.86
Area 10.42 SF
Perimeter 35.72 Ft.
Near Bank 0.4
Far Bank 36.0
Discharge 46.27 cfs
Velocity 4.44 fps

JOB # 88143-03-45

HOLLADAY/FORREST WATERSHED STUDY

BY: WEZ
6-19-89

CROSS SECTION VIRGINIA STREET SECTION 1

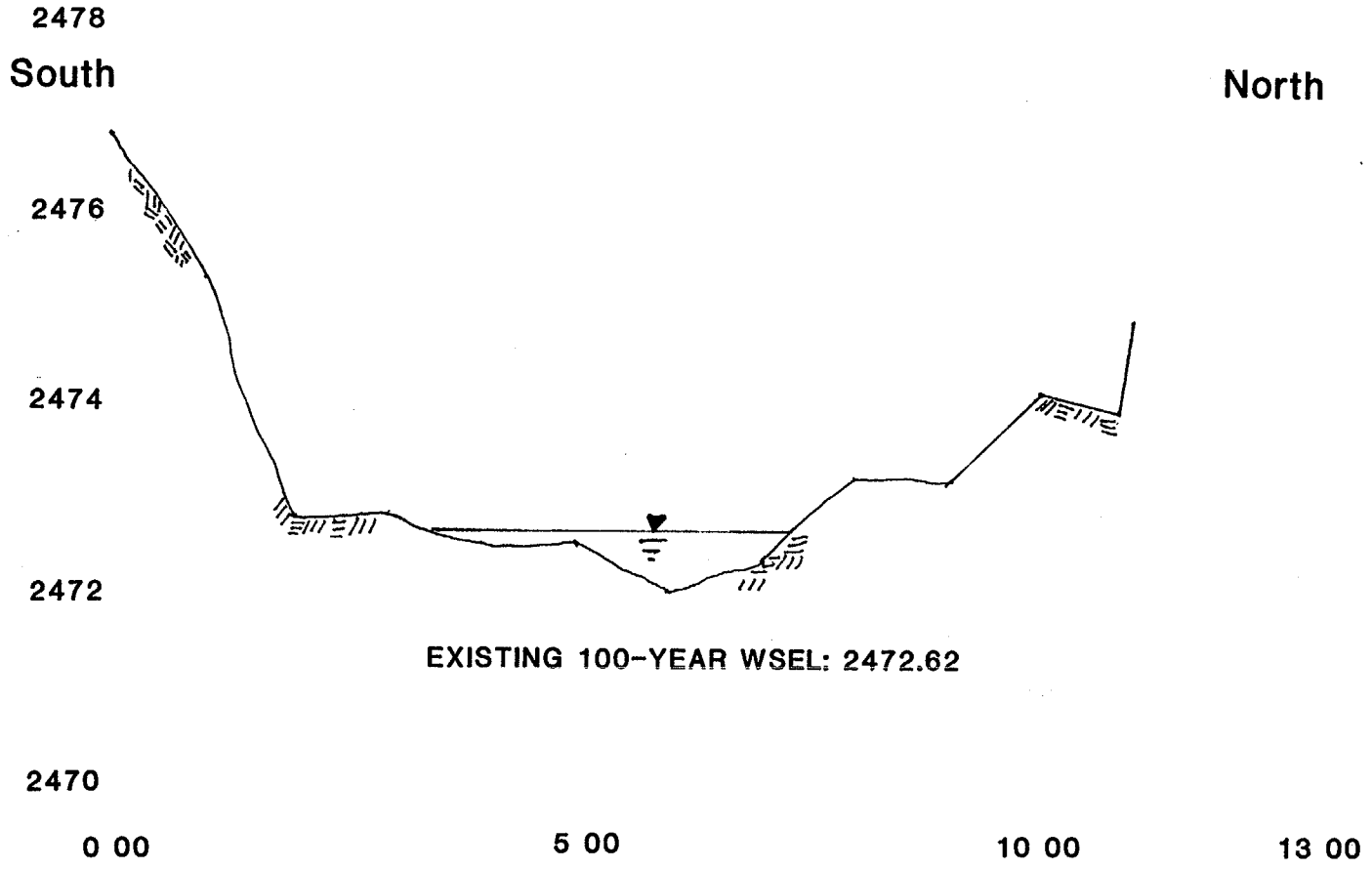
| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION | 2483.96 |
| STATION | 2.00 | ELEVATION | 2483.46 |
| STATION | 18.00 | ELEVATION | 2483.71 |
| STATION | 34.00 | ELEVATION | 2483.36 |
| STATION | 36.00 | ELEVATION | 2483.86 |

RESULTS

Manning's 'n' 0.016
Channel Slope 1.180%
W.S. Elevation 2483.92
Area 12.57 SF
Perimeter 35.96 Ft.
Near Bank 0.2
Far Bank 36.0
Discharge 62.92 cfs
Velocity 5.01 fps

# SECTION A-1

CROSS-SECTION SURVEYED IMMEDIATELY
UPSTREAM OF EXISTING PRIVATE IMPROVEMENTS
(ie. earthen berms,block wall )




EXISTING 100-YEAR WSEL: 2472.62

Top of wall & berms is 1.0 ft above existing ground elevation

Hor. 1":200'
Vert. 1":2'

PROJECT NAME HOLLADAY/FORREST PROJECT NO. 88143-03-45
MADE BY WEZ DATE
CHECKED BY DATE REFERENCE

McGovern, MacVittie, Lodge & Associates, Inc.
ENGINEERING
PLANNING
SURVEYING

13

JOB # 88143-03-45

HOLLADAY/FORREST STREET WATERSHED STUDY

BY: WEZ
12-09-1989

CROSS SECTION A-1  EXISTING 100-YEAR WSEL Q100=210CFS

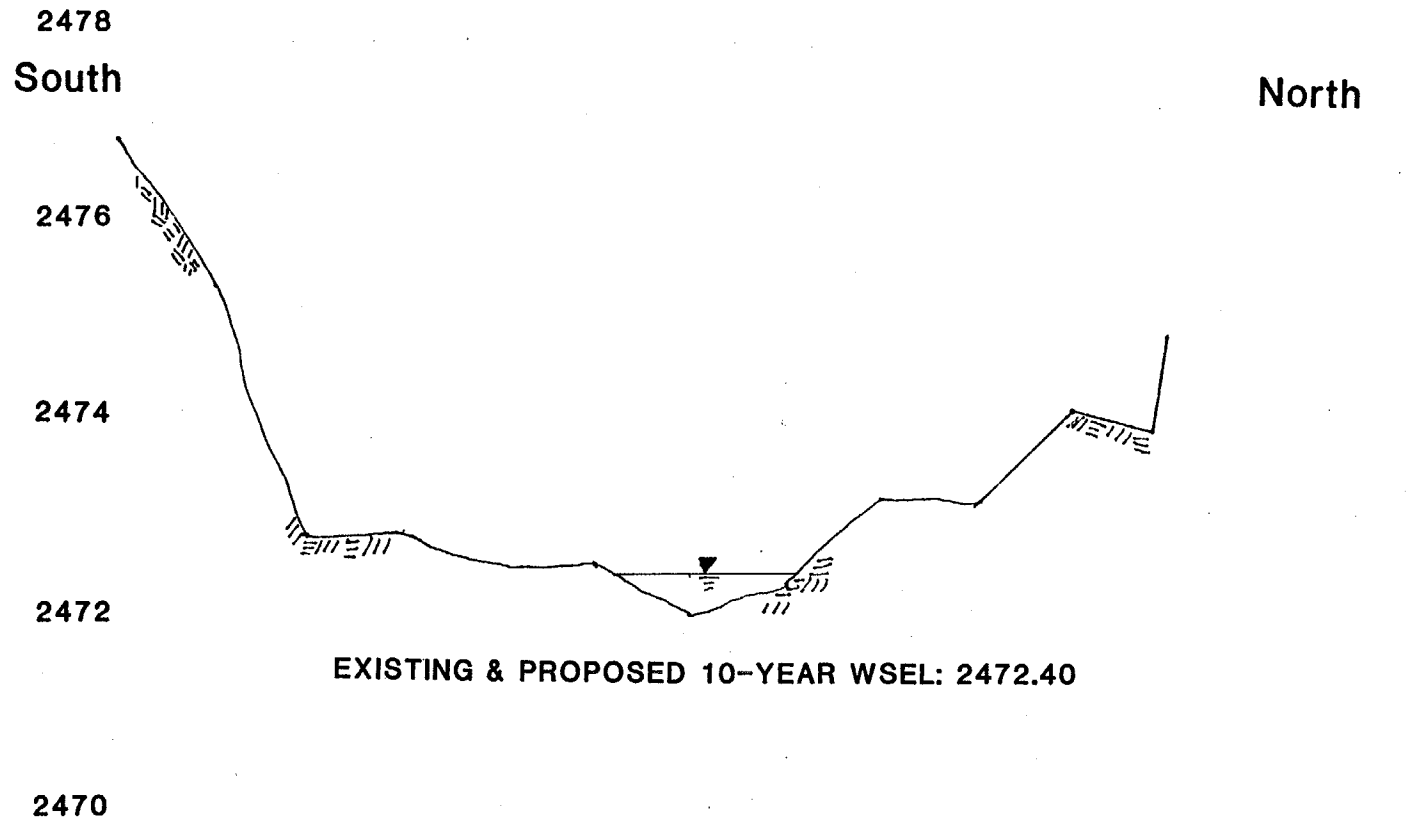
| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION | 2476.80 |
| STATION | 100.00 | ELEVATION | 2475.30 |
| STATION | 200.00 | ELEVATION | 2472.80 |
| STATION | 300.00 | ELEVATION | 2472.82 |
| STATION | 400.00 | ELEVATION | 2472.50 |
| STATION | 500.00 | ELEVATION | 2472.51 |
| STATION | 600.00 | ELEVATION | 2472.00 |
| STATION | 700.00 | ELEVATION | 2472.30 |
| STATION | 800.00 | ELEVATION | 2473.20 |
| STATION | 900.00 | ELEVATION | 2473.10 |
| STATION | 1000.00 | ELEVATION | 2474.10 |
| STATION | 1085.00 | ELEVATION | 2473.90 |
| STATION | 1100.00 | ELEVATION | 2474.84 |

RESULTS

| | | |
|---|---|---|
| Manning's 'n' | 0.035 | |
| Channel Slope | 0.0133 | ft/ft |
| W.S. Elevation | 2472.62 | ft |
| Area | 102.07 | sq.ft |
| Perimeter | 372.06 | ft |
| Near Bank | 363.23 | ft |
| Far Bank | 735.30 | ft |
| Discharge | 211.00 | cfs |
| Velocity | 2.07 | fps |

# SECTION A-1

CROSS-SECTION SURVEYED IMMEDIATELY
UPSTREAM OF EXISTING PRIVATE IMPROVEMENTS
(ie. earthen berms,block wall )




EXISTING & PROPOSED 10-YEAR WSEL: 2472.40

Top of wall & berms is 1.0 ft above existing ground elevation

Hor. 1":200'
Vert. 1":2'

PROJECT NAME HOLLADAY/FORREST PROJECT NO. 88143-03-45
MADE BY WEZ DATE
CHECKED BY DATE
REFERENCE

McGovern, MacVittie, Lodge & Associates, Inc.
ENGINEERING
PLANNING
SURVEYING

13

JOB # 88143-03-45

HOLLADAY/FORREST STREET WATERSHED STUDY

BY: WEZ
12-09-1989

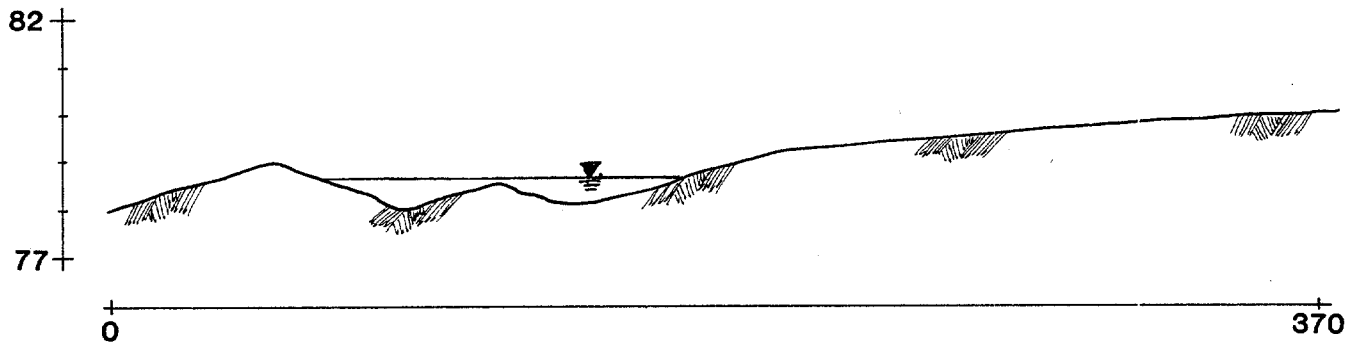
CROSS SECTION A-1 **EXISTING & PROPOSED 10-YEAR WSEL**

**Q10: 72cfs**

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION | 2476.80 |
| STATION | 100.00 | ELEVATION | 2475.30 |
| STATION | 200.00 | ELEVATION | 2472.80 |
| STATION | 300.00 | ELEVATION | 2472.82 |
| STATION | 400.00 | ELEVATION | 2472.50 |
| STATION | 500.00 | ELEVATION | 2472.51 |
| STATION | 600.00 | ELEVATION | 2472.00 |
| STATION | 700.00 | ELEVATION | 2472.30 |
| STATION | 800.00 | ELEVATION | 2473.20 |
| STATION | 900.00 | ELEVATION | 2473.10 |
| STATION | 1000.00 | ELEVATION | 2474.10 |
| STATION | 1085.00 | ELEVATION | 2473.90 |
| STATION | 1100.00 | ELEVATION | 2474.84 |

RESULTS

| | | |
|---|---|---|
| Manning's 'n' | 0.035 | |
| Channel Slope | 0.0133 | ft/ft |
| W.S. Elevation | 2472.40 | ft |
| Area | 40.99 | sq.ft |
| Perimeter | 189.13 | ft |
| Near Bank | 521.83 | ft |
| Far Bank | 710.96 | ft |
| Discharge | 72.41 | cfs |
| Velocity | 1.77 | fps |




## SECTION A-2

WSEL = 2478.64
100 YEAR

NO

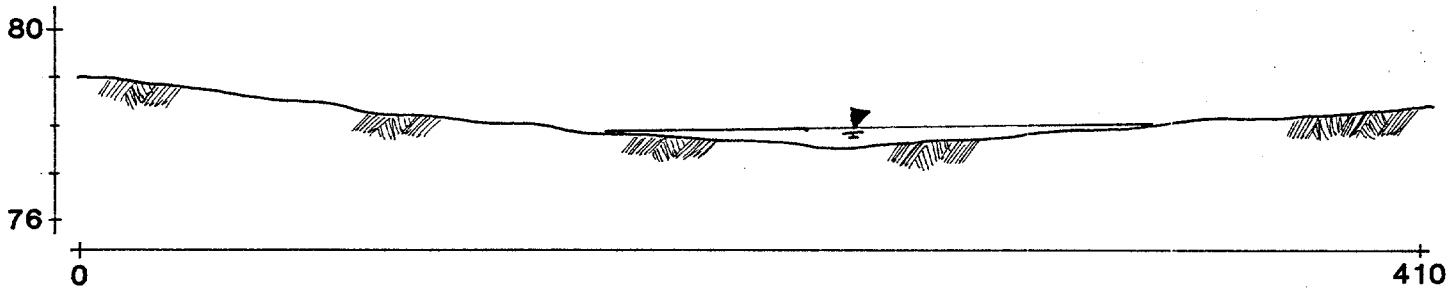
JOB # 88143-03-45
HOLLADAY STUDY
BY: WEZ
11-30-1989

CROSS SECTION A-2 100-YEAR

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION | 2478.00 |
| STATION | 50.00 | ELEVATION | 2479.00 |
| STATION | 90.00 | ELEVATION | 2478.00 |
| STATION | 120.00 | ELEVATION | 2478.50 |
| STATION | 140.00 | ELEVATION | 2478.00 |
| STATION | 210.00 | ELEVATION | 2479.30 |
| STATION | 370.00 | ELEVATION | 2480.00 |

RESULTS

| | | |
|---|---|---|
| Manning's 'n' | 0.035 | |
| Channel Slope | 0.0080 | ft/ft |
| W.S. Elevation | 2478.64 | ft |
| Area | 49.26 | sq.ft |
| Perimeter | 142.39 | ft |
| Near Bank | 64.32 | ft |
| Far Bank | 174.57 | ft |
| Discharge | 92.17 | cfs |
| Velocity | 1.87 | fps |




## SECTION A-3

WSEL = 2477.93
100 YEAR

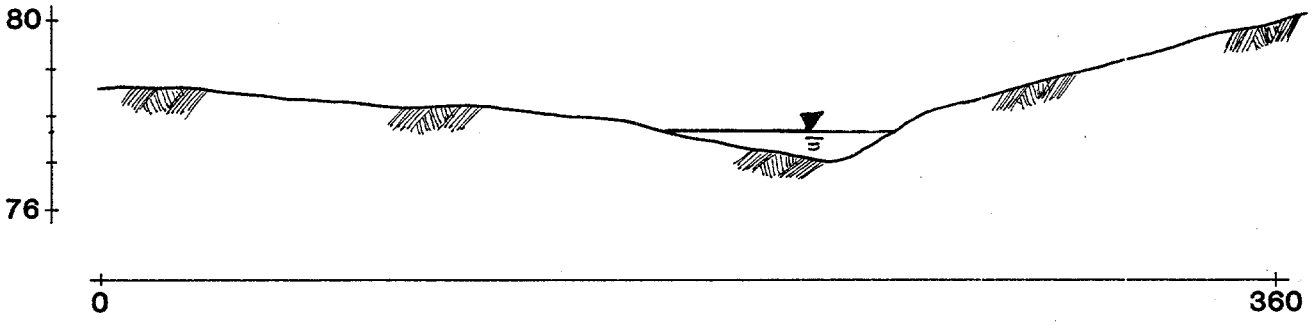
JOB # 88143-03-45
HOLLADAY STUDY
BY: WEZ
11-30-1989

CROSS SECTION A-3 100-YEAR

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION | 2479.00 |
| STATION | 130.00 | ELEVATION | 2478.00 |
| STATION | 240.00 | ELEVATION | 2477.50 |
| STATION | 350.00 | ELEVATION | 2478.00 |
| STATION | 410.00 | ELEVATION | 2478.30 |

RESULTS

| | | |
|---|---|---|
| Manning's 'n' | 0.035 | |
| Channel Slope | 0.0210 | ft/ft |
| W.S. Elevation | 2477.93 | ft |
| Area | 41.50 | sq.ft |
| Perimeter | 191.11 | ft |
| Near Bank | 144.45 | ft |
| Far Bank | 335.55 | ft |
| Discharge | 92.25 | cfs |
| Velocity | 2.22 | fps |




## SECTION A-4

10 YEAR WSEL = 2477.57
100 YEAR WSEL = 2477.67

JOB # 88143-03-45
HOLLADAY STUDY
BY: WEZ
8-2-89

CROSS SECTION SECTION A-4 10 YEAR

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION | 2478.50 |
| STATION | 125.00 | ELEVATION | 2478.00 |
| STATION | 225.00 | ELEVATION | 2477.00 |
| STATION | 250.00 | ELEVATION | 2478.00 |
| STATION | 360.00 | ELEVATION | 2480.00 |

RESULTS

Manning's 'n' 0.035
Channel Slope 2.200%
W.S. Elevation 2477.57
Area 20.54 SF
Perimeter 71.67 Ft.
Near Bank 167.7
Far Bank 239.3
Discharge 56.22 cfs
Velocity 2.74 fps

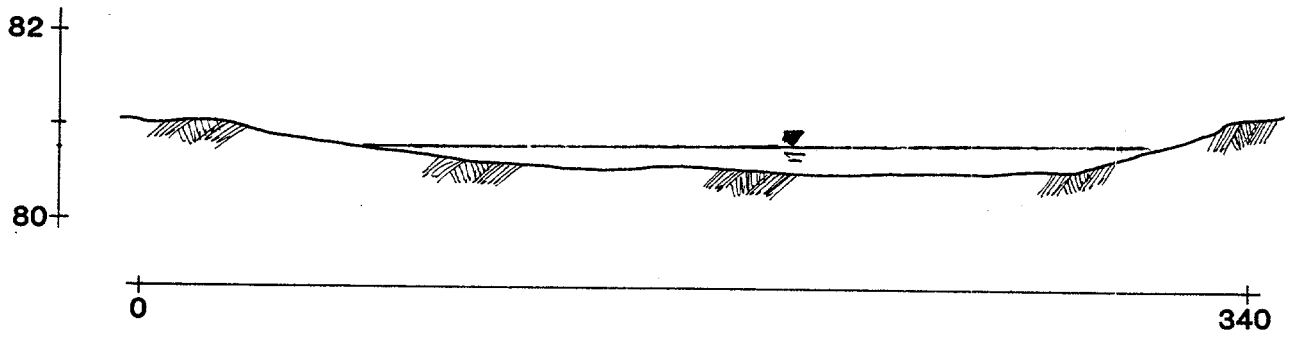
JOB # 88143-03-45
HOLLADAY STUDY
BY: WEZ
8-2-89

CROSS SECTION SECTION A-4 100 YEAR

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION | 2478.50 |
| STATION | 125.00 | ELEVATION | 2478.00 |
| STATION | 225.00 | ELEVATION | 2477.00 |
| STATION | 250.00 | ELEVATION | 2478.00 |
| STATION | 360.00 | ELEVATION | 2480.00 |

RESULTS

Manning's 'n' 0.035
Channel Slope 2.200%
W.S. Elevation 2477.67
Area 28.30 SF
Perimeter 84.12 Ft.
Near Bank 157.7
Far Bank 241.8
Discharge 86.18 cfs
Velocity 3.05 fps




## SECTION A-5

10 YEAR WSEL = 2480.69
100 YEAR WSEL = 2480.74

JOB # 88143-03-45
HOLLADAY STUDY
BY: WEZ
8-2-89

CROSS SECTION SECTION A-5 10 -YEAR

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION | 2481.00 |
| STATION | 130.00 | ELEVATION | 2480.50 |
| STATION | 290.00 | ELEVATION | 2480.50 |
| STATION | 340.00 | ELEVATION | 2481.00 |

RESULTS

| | |
|---|---|
| Manning's 'n' | 0.035 |
| Channel Slope | 1.500% |
| W.S. Elevation | 2480.69 |
| Area | 36.61 SF |
| Perimeter | 227.94 Ft. |
| Near Bank | 80.9 |
| Far Bank | 308.9 |
| Discharge | 56.24 cfs |
| Velocity | 1.54 fps |

JOB # 88143-03-45
HOLLADAY STUDY
BY: WEZ
8-2-89

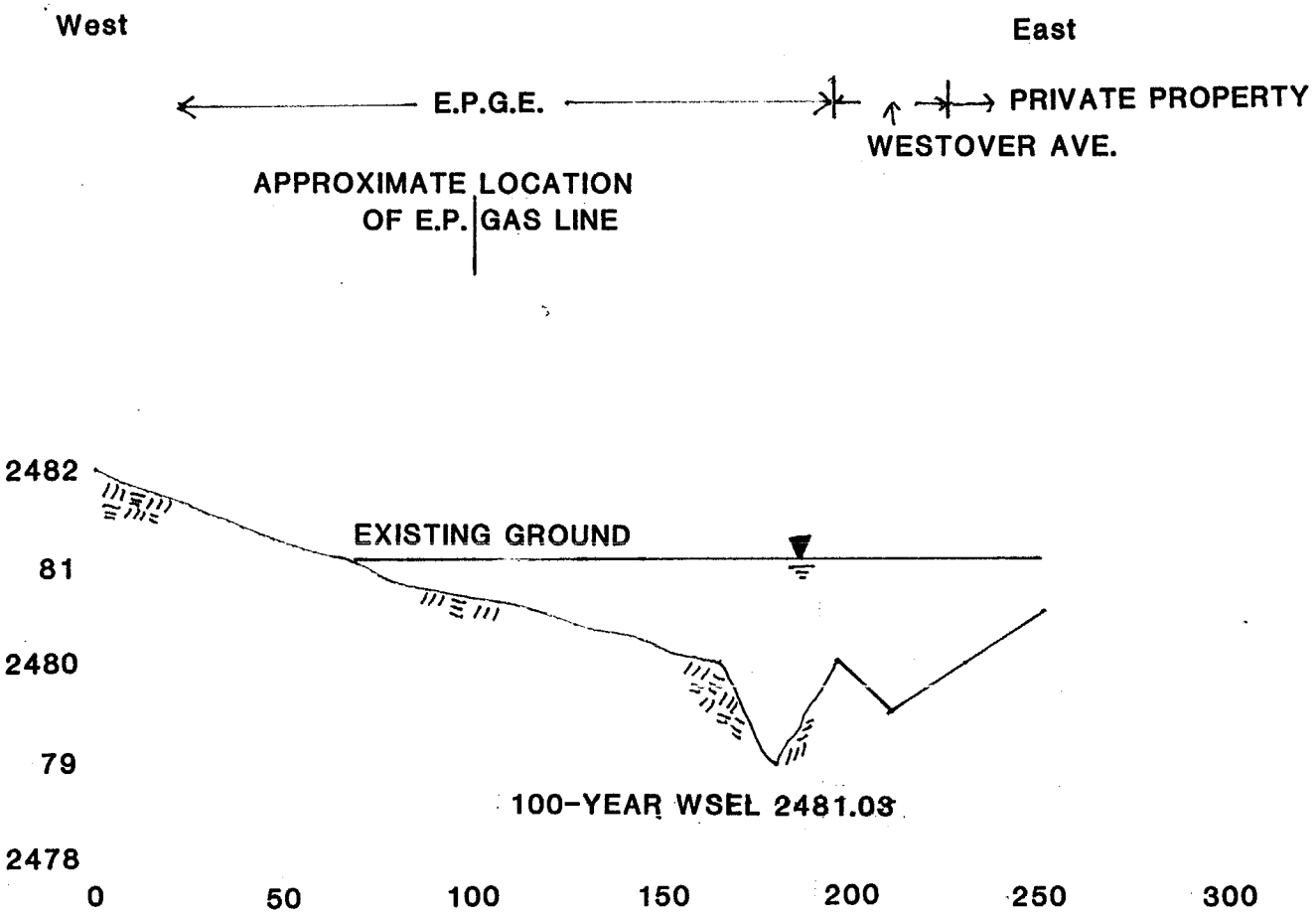
CROSS SECTION SECTION A-5 100-YEAR

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION | 2481.00 |
| STATION | 130.00 | ELEVATION | 2480.50 |
| STATION | 290.00 | ELEVATION | 2480.50 |
| STATION | 340.00 | ELEVATION | 2481.00 |

RESULTS

Manning's 'n' 0.035
Channel Slope 1.500%
W.S. Elevation 2480.74
Area 49.01 SF
Perimeter 246.75 Ft.
Near Bank 67.3
Far Bank 314.1
Discharge 86.75 cfs
Velocity 1.77 fps

# SECTION W-1 EXISTING




McGovern, MacVittie, Lodge & Associates, Inc.
ENGINEERING
PLANNING
SURVEYING

PROJECT NAME HOLLADAY/FORREST PROJECT NO. 88143-03-45
MADE BY WEZ DATE
CHECKED BY DATE REFERENCE

JOB # 88143-03-45
holladay street
BY: wez
10-6-89

# EXISTING CONDITIONS

CROSS SECTION SECTION W-1 WESTOVER AVENUE

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION | 2482.00 |
| STATION | 165.00 | ELEVATION | 2480.00 |
| STATION | 180.00 | ELEVATION | 2479.00 |
| STATION | 195.00 | ELEVATION | 2480.00 |
| STATION | 210.00 | ELEVATION | 2479.50 |
| STATION | 230.00 | ELEVATION | 2480.00 |
| STATION | 250.00 | ELEVATION | 2480.50 |

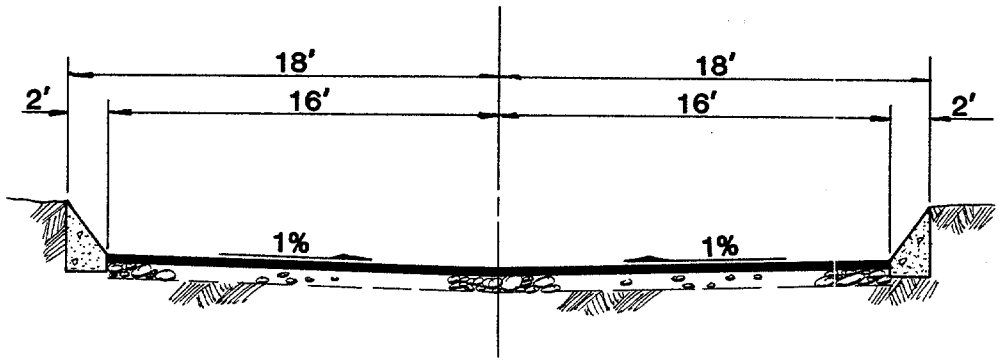
RESULTS

Manning's 'n' 0.032
Channel Slope 0.600%
W.S. Elevation 2481.03
Area 150.15 SF
Perimeter 170.11 Ft.
Near Bank 80.0
Far Bank 250.0
Discharge 496.97 cfs
Velocity 3.31 fps

ENGINEERING
PLANNING
SURVEYING
McGovern. MacVittie. Lodge & Associates. Inc.

PROJECT NAME HOLLADAY STREET/FORREST AVENUE WATERSHED STUDY PROJECT NO. 88143-03-45
MADE BY WEZ DATE 6-21-89
CHECKED BY _____ DATE _____ REFERENCE _____

# HOLLADAY STREET PROPOSED CROSS-SECTION




**CURB HEIGHT 8 inches**

**EXISTING R.O.W. 60 ft**

JOB # 88143-03-45
HOLLADAY STUDY
BY: WEZ
8-2-89

CROSS SECTION HOLLADAY STREET PROPOSED X-SECTION

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION | 0.83 |
| STATION | 2.00 | ELEVATION | 0.16 |
| STATION | 18.00 | ELEVATION | 0.00 |
| STATION | 34.00 | ELEVATION | 0.16 |
| STATION | 36.00 | ELEVATION | 0.83 |

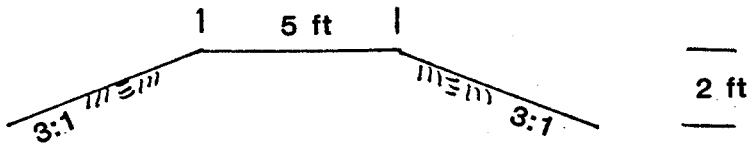
RESULTS

Manning's 'n' 0.016
Channel Slope 1.000%
W.S. Elevation 0.83
Area 25.34 SF
Perimeter 36.22 Ft.
Near Bank 0.0
Far Bank 36.0
Discharge 185.47 cfs
Velocity 7.32 fps

ENGINEERING
PLANNING
SURVEYING
McGovern, MacVittie, Lodge & Associates, Inc.

PROJECT NAME Holladay/Forrest PROJECT NO. 88143-03-45
MADE BY _____ DATE _____
CHECKED BY _____ DATE _____ REFERENCE _____

# PROPOSED BERM
# SOUTH SIDE CANADA DRIVE



Q PROGRAM

TRAPEZOIDAL and RECTANGULAR CHANNELS

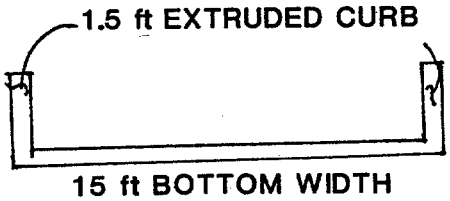
| Input | Output |
|---|---|
| NORMAL DEPTH, ft = ? 1.5 | Q = 204.199 |
| MANNING'S COEFFICIENT = ? 0.019 | VELOCITY = 9.076 |
| CHANNEL SLOPE, ft/ft = ? 0.01 | TOP WIDTH, ft = 15.000 |
| CHANNEL BOTTOM WIDTH = ? 15 | AREA = 22.500 |
| SIDE SLOPE RATIO (h/v) = ? 0 | WET PERIM = 18.000 |
| | HYD RAD = 1.250 |
| | CONVEYANCE = 2041.993 |
| | DM = 1.500 |
| | E = 2.779 |
| | FROUDE NO. = 1.306 |
| | CRITICAL DEPTH, ft = 1.792 |
| | VELOCITY @ CRITICAL DEPTH, ft/sec = 7. |
| | CRITICAL SLOPE, ft/ft = 0.005 |

Hit <Return> Key to Continue . . .

Proposed 15' Drainageway between homes 9 & 10 Figure 3

Post $Q_{100}$ = 118cfs

Existing $Q_{100}$ = 188cfs




Inlet condition -

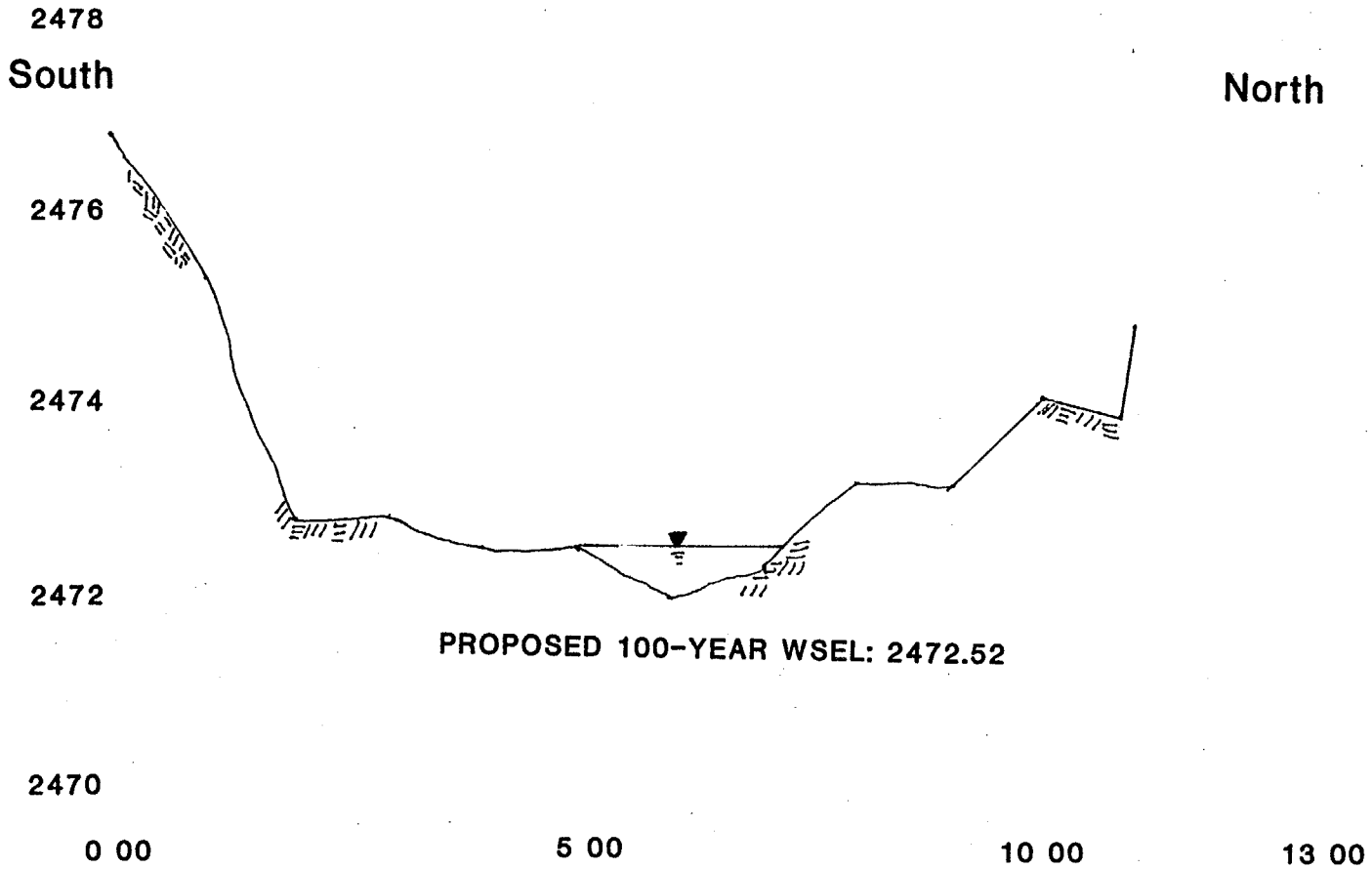
$$L = \frac{Q}{eCH^{3/2}} = \frac{118cfs}{(2.6)(1.5)^{3/2}}$$

L = 25 ft  Taper inlet 1:1 for 5 ft each side

55

# SECTION A-1

CROSS-SECTION SURVEYED IMMEDIATELY
UPSTREAM OF EXISTING PRIVATE IMPROVEMENTS
(ie. earthen berms,block wall )




PROPOSED 100-YEAR WSEL: 2472.52

Top of wall & berms is 1.0 ft above existing ground elevation

Hor. 1":200'
Vert. 1":2'

PROJECT NAME HOLLADAY/FORREST PROJECT NO. 88143-03-45
MADE BY WEZ DATE
CHECKED BY DATE REFERENCE

McGovern, MacVittie, Lodge & Associates, Inc.

JOB # 88143-03-45

HOLLADAY/FORREST STREET WATERSHED STUDY

BY: WEZ
12-09-1989

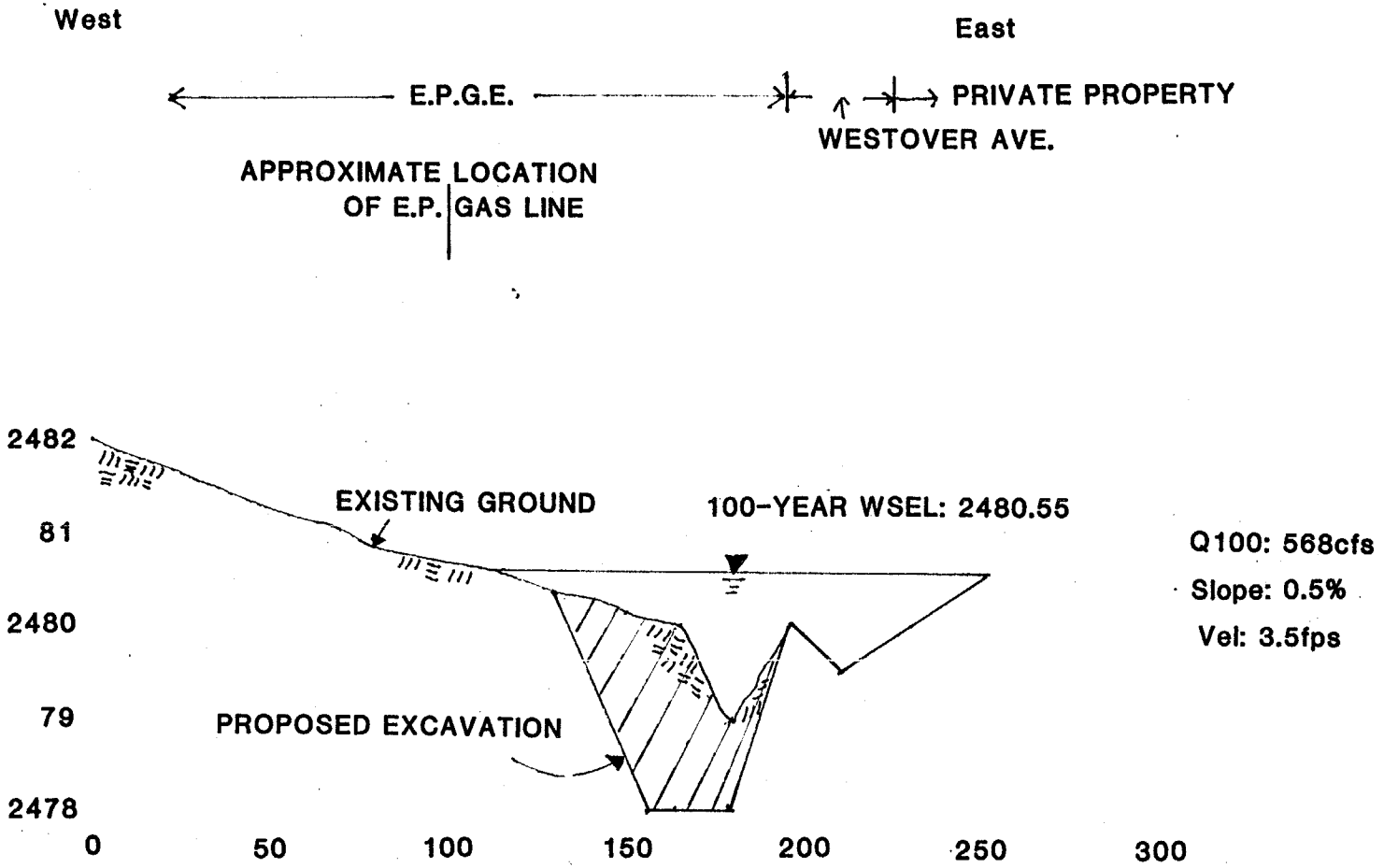
CROSS SECTION A-1 **PROPOSED 100-YEAR WSEL Q100: 118cfs**

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION | 2476.80 |
| STATION | 100.00 | ELEVATION | 2475.30 |
| STATION | 200.00 | ELEVATION | 2472.80 |
| STATION | 300.00 | ELEVATION | 2472.82 |
| STATION | 400.00 | ELEVATION | 2472.50 |
| STATION | 500.00 | ELEVATION | 2472.51 |
| STATION | 600.00 | ELEVATION | 2472.00 |
| STATION | 700.00 | ELEVATION | 2472.30 |
| STATION | 800.00 | ELEVATION | 2473.20 |
| STATION | 900.00 | ELEVATION | 2473.10 |
| STATION | 1000.00 | ELEVATION | 2474.10 |
| STATION | 1085.00 | ELEVATION | 2473.90 |
| STATION | 1100.00 | ELEVATION | 2474.84 |

RESULTS

| | | |
|---|---|---|
| Manning's 'n' | 0.035 | |
| Channel Slope | 0.0133 | ft/ft |
| W.S. Elevation | 2472.52 | ft |
| Area | 69.21 | sq.ft |
| Perimeter | 332.56 | ft |
| Near Bank | 392.37 | ft |
| Far Bank | 724.93 | ft |
| Discharge | 119.01 | cfs |
| Velocity | 1.72 | fps |

# SECTION W-1 PROPOSED




PROJECT NAME HOLLADAY/FORREST PROJECT NO. 88143-03-45
MADE BY WEZ DATE
CHECKED BY DATE REFERENCE

McGovern, MacVittie, Lodge & Associates, Inc.
ENGINEERING
PLANNING
SURVEYING

58

JOB # 88143-03-45
HOLLADAY/FORREST
BY: WEZ
12-09-1989

CROSS SECTION W-1 WESTOVER AVENUE PROPOSED IMPROVEMENTS

| | | | |
|---|---|---|---|
| STATION | 0.00 | ELEVATION | 2482.00 |
| STATION | 130.00 | ELEVATION | 2480.20 |
| STATION | 155.00 | ELEVATION | 2478.00 |
| STATION | 180.00 | ELEVATION | 2478.00 |
| STATION | 195.00 | ELEVATION | 2480.00 |
| STATION | 210.00 | ELEVATION | 2479.50 |
| STATION | 230.00 | ELEVATION | 2480.00 |
| STATION | 250.00 | ELEVATION | 2480.50 |

RESULTS

| | | |
|---|---|---|
| Manning's 'n' | 0.032 | |
| Channel Slope | 0.0050 | ft/ft |
| W.S. Elevation | 2480.55 | ft |
| Area | 161.26 | sq.ft |
| Perimeter | 145.33 | ft |
| Near Bank | 104.93 | ft |
| Far Bank | 250.00 | ft |
| Discharge | 567.53 | cfs |
| Velocity | 3.52 | fps |

# PIMA COUNTY HYDROGRAPH

WASH: **DAKOTA WASH**
AT: **UPSTREAM of MISSION ROAD**
RET. PER.:
DATE: **6-21-89**
BY: **WEZ**
Peak Q = 3055 cfs.
Tc = 36 min.
TL = 33.50 min.
DT = 3.35 min.

| | | |
|---|---|---|
| T= 3.35 min. | q= 73.2 cfs. | ΣQ= 7356.2 cu. ft. |
| T= 6.70 min. | q= 262.8 cfs. | ΣQ= 41125.6 cu. ft. |
| T= 10.05 min. | q= 496.6 cfs. | ΣQ= 117446.1 cu. ft. |
| T= 13.40 min. | q= 751.8 cfs. | ΣQ= 242913.7 cu. ft. |
| T= 16.75 min. | q= 1037.8 cfs. | ΣQ= 422770.6 cu. ft. |
| T= 20.10 min. | q= 1376.3 cfs. | ΣQ= 665384.0 cu. ft. |
| T= 23.45 min. | q= 1782.7 cfs. | ΣQ= 982863.0 cu. ft. |
| T= 26.80 min. | q= 2246.7 cfs. | ΣQ=1387814.0 cu. ft. |
| T= 30.15 min. | q= 2712.8 cfs. | ΣQ=1886235.4 cu. ft. |
| T= 33.50 min. | q= 3061.5 cfs. | ΣQ=2466550.4 cu. ft. |
| T= 36.85 min. | q= 2803.0 cfs. | ΣQ=3055932.3 cu. ft. |
| T= 40.20 min. | q= 2562.1 cfs. | ΣQ=3595124.9 cu. ft. |
| T= 43.55 min. | q= 2324.6 cfs. | ΣQ=4086233.0 cu. ft. |
| T= 46.90 min. | q= 2094.2 cfs. | ΣQ=4530322.2 cu. ft. |
| T= 50.25 min. | q= 1873.9 cfs. | ΣQ=4929113.5 cu. ft. |
| T= 53.60 min. | q= 1666.1 cfs. | ΣQ=5284883.5 cu. ft. |
| T= 56.95 min. | q= 1472.4 cfs. | ΣQ=5600303.8 cu. ft. |
| T= 60.30 min. | q= 1294.0 cfs. | ΣQ=5878326.5 cu. ft. |
| T= 63.65 min. | q= 1131.4 cfs. | ΣQ=6122077.7 cu. ft. |
| T= 67.00 min. | q= 984.9 cfs. | ΣQ=6334764.6 cu. ft. |
| T= 70.35 min. | q= 854.2 cfs. | ΣQ=6519595.6 cu. ft. |
| T= 73.70 min. | q= 739.0 cfs. | ΣQ=6679713.1 cu. ft. |
| T= 77.05 min. | q= 638.4 cfs. | ΣQ=6818136.0 cu. ft. |
| T= 80.40 min. | q= 551.5 cfs. | ΣQ=6937714.1 cu. ft. |
| T= 83.75 min. | q= 477.2 cfs. | ΣQ=7041092.3 cu. ft. |
| T= 87.10 min. | q= 414.3 cfs. | ΣQ=7130683.5 cu. ft. |
| T= 90.45 min. | q= 361.5 cfs. | ΣQ=7208654.0 cu. ft. |
| T= 93.80 min. | q= 317.6 cfs. | ΣQ=7276908.3 cu. ft. |
| T= 97.15 min. | q= 281.2 cfs. | ΣQ=7337088.0 cu. ft. |
| T=100.50 min. | q= 251.0 cfs. | ΣQ=7390578.5 cu. ft. |
| T=103.85 min. | q= 225.9 cfs. | ΣQ=7438515.2 cu. ft. |
| T=107.20 min. | q= 204.8 cfs. | ΣQ=7481800.7 cu. ft. |
| T=110.55 min. | q= 186.5 cfs. | ΣQ=7521123.7 cu. ft. |
| T=113.90 min. | q= 170.3 cfs. | ΣQ=7556962.5 cu. ft. |
| T=117.25 min. | q= 155.4 cfs. | ΣQ=7589713.9 cu. ft. |
| T=120.60 min. | q= 141.2 cfs. | ΣQ=7619517.0 cu. ft. |
| T=123.95 min. | q= 127.2 cfs. | ΣQ=7646485.5 cu. ft. |
| T=127.30 min. | q= 113.2 cfs. | ΣQ=7670643.9 cu. ft. |
| T=130.65 min. | q= 99.1 cfs. | ΣQ=7691975.9 cu. ft. |
| T=134.00 min. | q= 84.8 cfs. | ΣQ=7710458.7 cu. ft. |
| T=137.35 min. | q= 70.7 cfs. | ΣQ=7726095.7 cu. ft. |
| T=140.70 min. | q= 57.0 cfs. | ΣQ=7738938.4 cu. ft. |
| T=144.05 min. | q= 44.3 cfs. | ΣQ=7749122.9 cu. ft. |
| T=147.40 min. | q= 33.0 cfs. | ΣQ=7756887.9 cu. ft. |
| T=150.75 min. | q= 23.8 cfs. | ΣQ=7762597.7 cu. ft. |

NOV 1991
FLOOD
PLAIN
MANAGEMENT

# DRAINAGE RELIEF ASSESSMENT

# FOR THE DREXEL/WESTOVER INTERSECTION

Prepared by:

CMG DRAINAGE ENGINEERING, INC.
85 WEST FRANKLIN STREET
TUCSON, AZ 85701

Prepared for:

PIMA COUNTY DEPARTMENT OF TRANSPORTATION
AND FLOOD CONTROL DISTRICT
201 N. STONE AVENUE
TUCSON, AZ 85701


NOVEMBER 25, 1991

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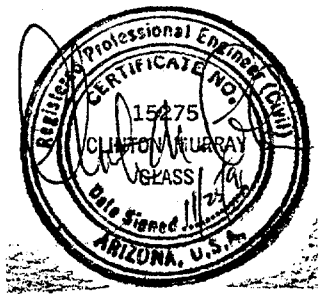

## I. INTRODUCTION

This report presents the results of engineering analyses conducted to address drainage improvement alternatives for the Drexel/Westover intersection area. The need for modification to the existing drainage patterns is associated with residential flooding along Forest Avenue about midway between Drexel Road and Canada Street. The flooding problems in this area were initially addressed in a report prepared by McGovern, MacVittie, Lodge & Associates (MMLA) entitled Holladay Street and Forest Avenue Watershed Study, December 6, 1989. Pima County's review of this report and field inspections led to the conclusion that there may be an error in the report's estimation of the split flow quantities at the Drexel/Westover intersection. The calculations presented in the MMLA report determined the quantity of flow arriving at the Drexel/Westover intersection (CP#2) to be 61 cfs for the 10-year event, and 135 cfs for the 100-year return period event. Their calculations further estimated that only 18 cfs and 30 cfs drained north in Westover Avenue during the 10-year and 100-year return period events, respectively. The remaining discharges of 43 cfs and 105 cfs continue east within the swale and right-of-way of Drexel Road. CMG Drainage Engineering, Inc., did not conduct any additional split flow analyses; however, field observations led to agreement with Pima County's conclusions that most of the flow arriving at CP#2 probably drains north within Westover Avenue and to the point of the aforementioned residential flooding. Field surveys found that the existing drainage swale on the west side of Westover Avenue slopes north. CMG Drainage Engineering did not attempt the split flow calculations because flow patterns approaching the intersection are very undefined and runoff is probably

spread over a wide area. These conditions make estimation of split flow quantities difficult. For the purposes of this analysis, it should be assumed that all of the runoff discharging to CP#2 could drain north along Westover Avenue, even though this is slighly conservative. The CP#2 runoff combines with CP#5 to yield a 100-year discharge of 221 cfs at the dip crossing in Westover Avenue, 600 feet north of Drexel Road.

## II. DEVELOPMENT AND EVALUATION OF ALTERNATIVES

On November 1, 1991, CMG Drainage Engineering conducted a survey of the intersection area to obtain existing ground elevations and locate culture. The results of this survey led to the conclusion that there are three possible alternatives for reducing flood damage potential to the residential structures along Forest Avenue. These alternatives include:

1. Alternative A - Construction of a combined drainage swale/dike along the west side of Westover Avenue from its intersection with Drexel Road to a point about 600 feet north thereof, and construction of the 15-foot drainageway from Westover Avenue to Forest Avenue as proposed by the MMLA drainage report.
2. Alternative B - Construction of a 3-foot deep drop inlet basin at the northwest corner of the Drexel/Westover intersection, installation of three, 24-inch RCP's under the Drexel/Westover intersection, and construction of an earthen drainage swale on the south side of Drexel Road from the Drexel/Westover intersection to a point approximately 270 feet east thereof.
3. Alternative C - Construction of a dip section on Westover Avenue just north of the Drexel Road intersection, and construction of an earthen drainage swale on the north side of Drexel Road from the Drexel/Westover intersection to a point approximately 1800 feet east thereof.

CMG Drainage Engineering, Inc., has attempted to avoid altering the roadway profiles as a solution because of added costs and attendant problems such as

changes in drainage conditions, residential/commercial access, and utility modifications.

## III. ALTERNATIVE A

Alternative A proposes to maintain the existing drainage patterns but to construct an improved drainage swale and dike along the west side of Westover Avenue to provide more effective conveyance of the flow north to the existing dip section. This swale/dike would have to be constructed within EPNG right-of-way since there is inadequate room in the road right-of-way. The point of termination for this drainage swale (600 feet north of Drexel Road) would be at the inlet to the 15-foot drainageway proposed by MMLA in their December 1989 report. The combined drainage swale/dike on the west side of Westover Avenue would have a topwidth of 30 feet, depth of 1.5 feet, and slope of 0.5 percent. This cross section would have adequate capacity to convey the 100-year discharge of about 221 cfs (CP#5).

The 15-foot wide drainageway proposed by MMLA in their December 1989 drainage report has a depth of 1.5 feet and an estimated capacity of about 260 cfs without freeboard. MMLA's split flow calculations determined that the 100-year discharge arriving to this drainageway would be 118 cfs, so the channel was designed with available freeboard.

Under Alternative A, Pima County could either deepen the drainageway by as much as another 0.5 feet (a total depth of 2.0 feet), or leave the drainageway in its present design of 1.5 feet depth and provide only 0.1 feet of freeboard with the revised 100-year discharge estimate of 221 cfs. A channel rating for the drainageway is provided in Appendix A.

There are several residential improvements such as a masonary wall, chainlink fence, and sheds within the 15-foot drainageway area. These improvements belong to the adjoining homes on Forrest Avenue and would have to be removed and replaced as a part of project construction.

The drawings given by MMLA in their December 1989 report show the 15-foot drainageway extending due west to east from Westover Avenue to Forest Avenue between two existing residential structures. Examination of these concept drawings has led to the conclusion that some additional drainage improvements may be needed where the swale crosses Westover Road to insure that flow enters the 15-foot drainageway. At present, the existing grades may not work to effectively capture flow crossing Westover Avenue within the 15-foot drainageway without significant inundation of the vacant lot on the south side of the drainageway. These improvements may require construction of an interceptor dike or masonary wall on the east side of Westover Avenue at the dip section to direct flow north to the point of entry for the 15-foot drainageway (see Figure 1). A cross section of the proposed swale/dike on the west side of Westover Avenue is given on Figure 2.

The estimated cost to construct Alternative A is $111,680. A breakdown of this cost estimate is provided on Table 1 attached with this memorandum.

1" = 200'

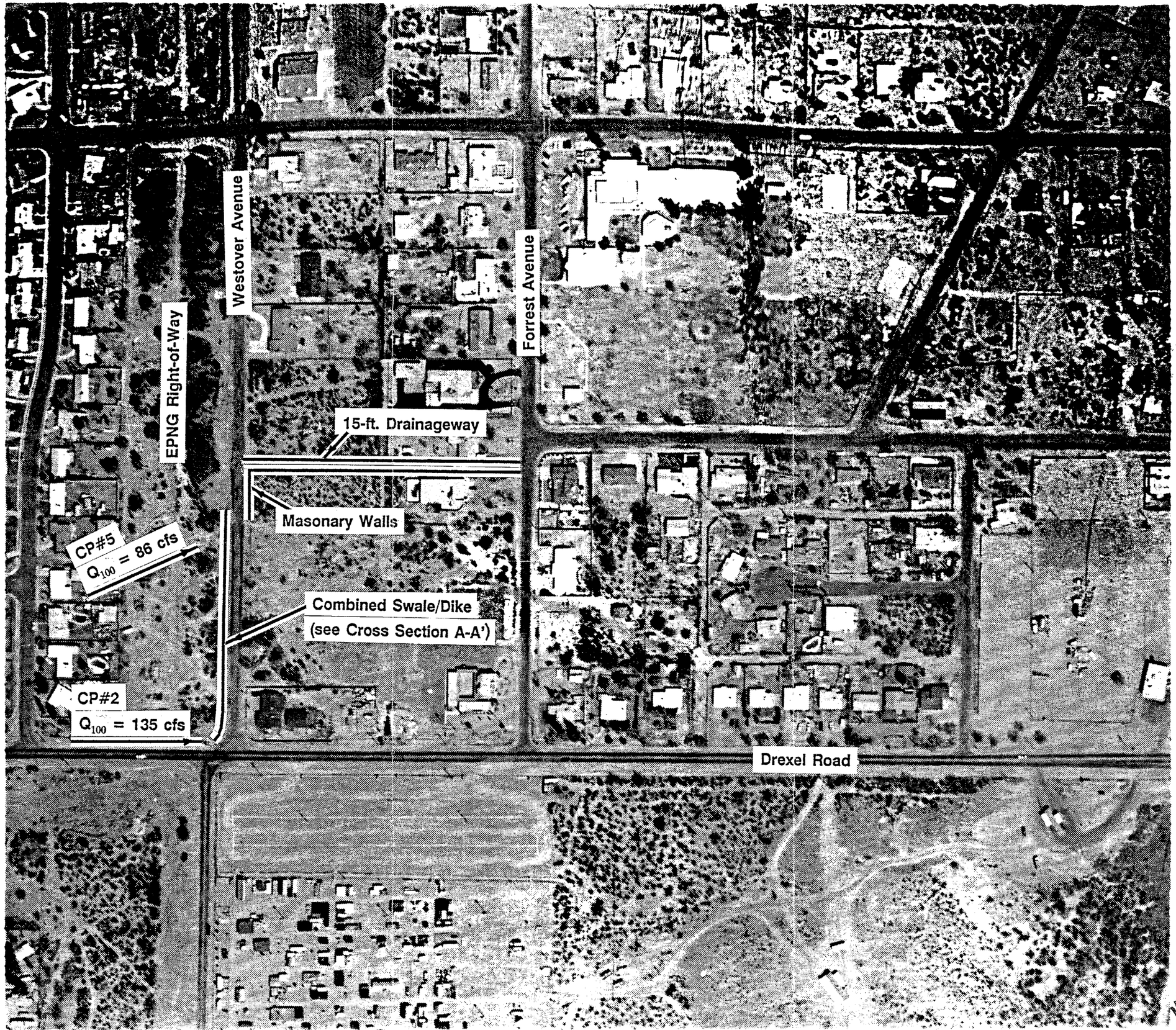


FIGURE 1 - ALTERNATIVE A --

WESTOVER SWALE/DIKE & 15-FT. DRAINAGEWAY

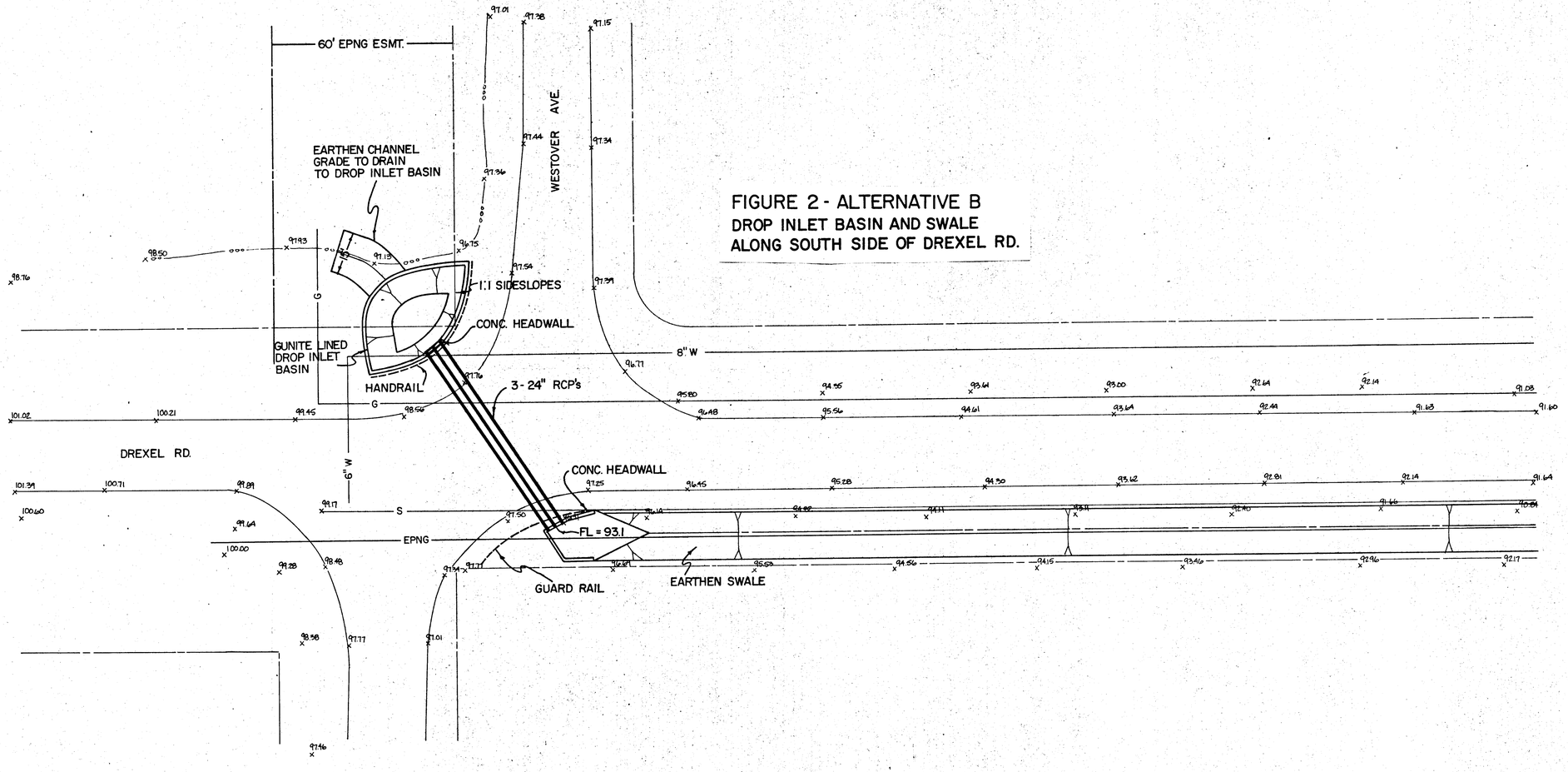


FIGURE 2 - ALTERNATIVE B
DROP INLET BASIN AND SWALE
ALONG SOUTH SIDE OF DREXEL RD.

FIGURE 2 - ALTERNATIVE B
DROP INLET BASIN AND SWALE
ALONG SOUTH SIDE OF DREXEL RD.

| DESIGNED | DATE |
|---|---|
| DRAWN | |
| CHECKED | |
| PROJ ENGR | |

| NO. | REVISION | DESCRIPTION | DIV/SECT ENGR. | DATE |
|---|---|---|---|---|
| | | | | |

SCALES | HORZ. 1" = | VERT. 1" =

SHEET OF

## TABLE 1 - COST ESTIMATE FOR ALTERNATIVE A --

## WESTOVER AVENUE COLLECTOR SWALE/DIKE

| Item | Quantity | Unit Cost | Item Cost |
|---|---|---|---|
| Removals & Obstructions | LS | 20,000 | $ 20,000 |
| Clearing and Grubbing | LS | 5,000 | 5,000 |
| Utility Relocations | LS | 0 | 0 |
| Mobilization | LS | 5,000 | 5,000 |
| Drainage Excavation | 600 $yd^3$ | $5.00/$yd^3$ | 3,000 |
| Compacted Fill (Berms) | 200 $yd^3$ | $5.00/$yd^3$ | 1,000 |
| Curbing | 1,160 ft | | |
| Masonary Wall | LS | $2,000 | 2,000 |
| Drainageway Lining | 8,700 $ft^2$ | $2.00/$ft^2$ | 17,400 |
| Right-of-Way | 18,650 $ft^2$ | $1.00/$ft^2$ | 18,650 |
| 15% Contingency | | | 10,810 |
| 25% Design & PM | | | 18,010 |
| 15% Inspection & Administration | | | 10,810 |
| TOTAL COST | | | $111,680 |

## IV. ALTERNATIVE B

The concept for Alternative B proposes interception of as much flow as possible at CP#2 with a 3-foot deep drop inlet basin at the northwest corner of the intersection of Drexel/Westover. This drop inlet basin would contain the inlet to three, 24-inch RCP's which would discharge 72 cfs beneath the intersection to its southeast corner. The drop inlet basin would be constructed within existing road right-of-way and within the El Paso Natural Gas right-of-way. At the outlet to the three, 24-inch RCP's, there would be an excavated drainage swale which would convey runoff east along the south side of Drexel Road within existing road right-of-way.

The amount of water that can be captured and conveyed across Drexel Road within these drainage improvements is limited by several factors. First, the flow conditions approaching the Drexel/Westover intersection are undefined and runoff is spread across a broad area. Therefore, only a portion of flow can probably be captured without extensive upstream channel improvements. Secondly, the existing grades surrounding the intersection and the existence of several underground utilities limit the depths for the flowline of the 24-inch RCP pipes to about 3 feet below existing grade (which places a constraint on the maximum pipe size). Third, the capacity of the proposed drainage swale on the south side of Drexel Road is adequate to convey the design discharge of 72 cfs until it nears the intersection with Mission Road (a point about 1800 feet east of Westover Avenue). At this point, the swale becomes undefined and flow spreads



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northeasterly across Drexel Road, and through an existing Circle K parking lot, then across Mission Road.

Figure 3 presents a concept plan for Alternative B. This plan shows:

1. a gunite-lined drop inlet basin at the northwest corner of the Drexel/Westover intersection;
2. excavation of an earthen channel on the north side of Drexel Road to further improve the interception capacity of the drop inlet basin;
3. three, 24-inch RCP pipes beneath the Drexel/Westover intersection with inlet and outlet headwalls;
4. an 16-foot topwidth earthen swale on the south side of Drexel Road from the 24-inch RCP outlet to a point of grade out about 270 feet east thereof; and
5. three, 24-inch RCP pipes beneath the westernmost access road to the Westover Swap Meet.

The estimated cost for Alternative B is $68,005 (see Table 2). Examination of Figure 2 will show that the three, 24-inch RCP's and the drop inlet basin are in the area of an 8-inch water line, a natural gas line, a sewer line, and the El Paso Natural Gas high pressure line. The project does not conflict with the sewer line. It is not known whether or not the project improvements conflict with the water line or the gas line; however, it is believed that only minor modifications to these two utilities may need to be implemented to facilitate the project. It is also not known at present whether or not the swale along the south side of Drexel Road



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N

1" = 200'

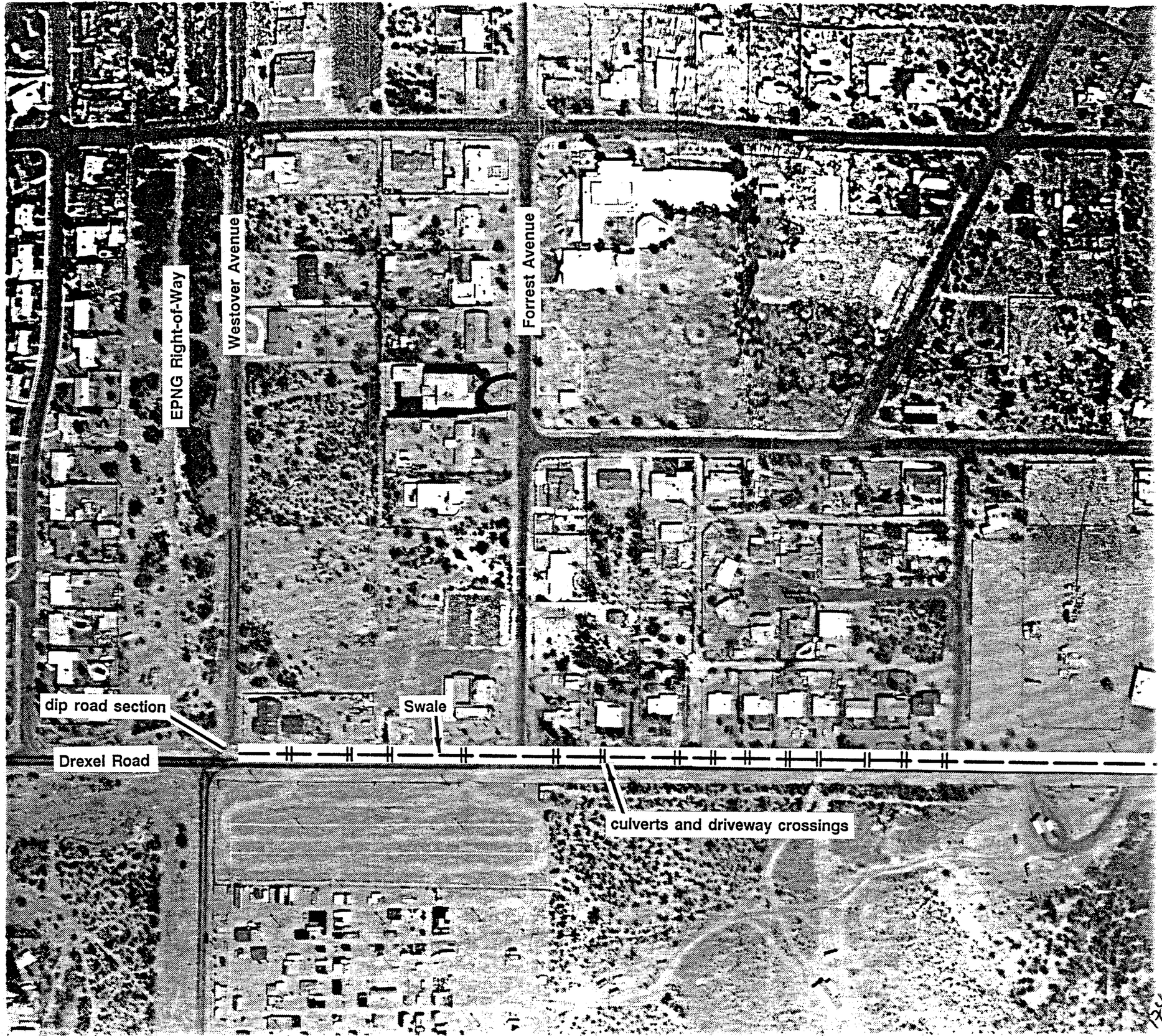


FIGURE 3 - ALTERNATIVE C –

SWALE ON NORTH SIDE OF DREXEL ROAD

## TABLE 2 - COST ESTIMATE FOR ALTERNATIVE B --

## THREE, 24-INCH RCP'S UNDER DREXEL/WESTOVER INTERSECTION AND SWALE ON SOUTH SIDE OF DREXEL ROAD

| Item | Quantity | Unit Cost | Item Cost |
|---|---|---|---|
| Removals & Obstructions | LS | 2000 | $ 2,000 |
| Clearing and Grubbing | LS | 2000 | 2,000 |
| Utility Relocations | LS | 0 | 0 |
| Pavement Removal | 20 $yd^2$ | 2.00/$yd^2$ | 40 |
| Pavement Replacement | 20 $yd^2$ | 10.00/$yd^2$ | 200 |
| Mobilization | LS | 5,000 | 5,000 |
| 24" RCP | 300 ft | 72.00/ft | 21,600 |
| Outlet Headwall | 10 $yd^3$ | 300.00/$yd^3$ | 3,000 |
| Inlet Headwall | 2.5 $yd^3$ | 300.00/$yd^3$ | 750 |
| Gunite w/ WW Fabric | 850 $ft^2$ | 2.50/$ft^2$ | 2,125 |
| Drainage Excavation | 400 $yd^3$ | 5.00/$yd^3$ | 2,000 |
| Guard Rail | 60 ft | 25.00/ft | 1,500 |
| Breakaway Terminals | 2 | 1500 | 3,000 |
| Hand Rail | 55 ft | 12.00/ft | 660 |
| 15% Contingency | | | 6,580 |
| 25% Design & PM | | | 10,970 |
| 15% Inspection & Administration | | | 6,580 |
| TOTAL COST | | | $ 68,005 |

will conflict with the El Paso Natural Gas high pressure line. Based upon the information provided by Pima County, it is believed that the depth of this line is below the proposed flowline for the swale; however, minimum clearance requirements may not be met.

This alternative offers a means of diverting a portion of the runoff away from the area of residential flooding between Westover Avenue and Forest Avenue. If Pima County is able to obtain an easement for the 15-foot drainageway between the existing residential structures, then it is suggested that Alternative A defined above also be constructed to prevent residential damages associated with the portion of flow arriving at CP#5 (86 cfs) and portions of the flow arriving at CP#2 which are not captured by the drop inlet basin. The principal unknown factor relating to this alternative is whether or not the swale along the south side of Drexel Road will conflict with the El Paso Natural Gas high pressure gas line in a manner that would prohibit its construction. Another concern would be the additional flow crossing Drexel Road just west of the Mission Road intersection, and the impact of the additional discharges upon flooding through the Circle K parking lot. Hydraulic computations determined the existing amount of runoff arriving at the Drexel/Mission Road intersection to be 915 cfs and 1791 cfs, respectively, for the 10-year and 100-year return period events. Hydraulic computations indicate that the depths of flow in the Drexel/Mission Road intersection area would be increased by 0.06 and 0.04 feet for the 10-year and 100-year events respectively, with the additional runoff directed to this area by

Alternative B. In either case, there will be a large amount of runoff arriving at this intersection.

The drainage swale on the south side of Drexel Road can be constructed entirely within existing right-of-way (see Figure 2). Utility conflicts for this project are minimal. A meeting was held with Mr. Paul Steiner of the PCDOT & FCD Traffic Engineering Department to obtain the applicable design criteria from his department. Mr. Steiner provided the clear zone requirements for different design speeds and the minimum for pedestrian access. The clear zone requirement are:

8 feet for pedestrian access

12 feet for 25 mph zone

15 feet for 35 mph zone

20 feet for 45 mph zone

If the clear zone requirements cannot be met, then guardrail (with breakaway terminal end treatments) are generally required. Paul stated that this requirement can be waived in some instances, such as along a straight road section. At those locations where the clear zone criteria can be met, Paul suggested use of handrail on the headwalls and adjoining sideslopes of the drop inlet basin rather than guardrail.

The minimum standard for pedestrian access will be provided from the edge of pavement along Drexel Road to the edge of the proposed drainage swale. The Traffic Engineering Department's maximum sideslope standard for the drainage



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swale (6 horizontal to 1 vertical) cannot be provided; therefore, this requirement must be waived or guardrail must be provided along the entire length of the improved drainage swale along Drexel Road. The clear zone requirements as specified above cannot be met for the outlet headwall at the southeast corner of the Drexel/Westover intersection; therefore, guardrail will be required at this location. The minimum clear zone requirements will be met at the inlet headwall and therefore only standard handrail will be needed adjoining the headwall and the 1:1 sideslope of the drop inlet basin.

## V. ALTERNATIVE C

Alternative C proposes modifying the pavement grades on Westover just north of its intersection with Drexel Road to create a small dip section, and excavation of a drainage swale on the north side of Drexel Road for a distance of 1800 feet east of the Westover Avenue intersection. The pavement modifications would lower the existing pavement elevations on Westover Avenue by about 1 foot for a distance of 30 feet north of Drexel Road. The depth of flow in the dip section would be 1.1 ft. for a 100-year discharge of 135 cfs. The drainage swale would have a topwidth of 20 feet, depth of 2 feet, slope of 1.5 percent. The capacity of this swale would be about 135 cfs with freeboard of 0.5 feet.

A field survey of existing conditions along the north side of Drexel Road between Westover Avenue and Mission Road found that this will be a difficult alternative to construct because of conflicts with residential driveway access, roadway intersections, and utilities. Available right-of-way information indicates that there is 30 feet of right-of-way space from the north edge of pavement on Drexel Road. Within this 30-foot right-of-way, there is an 8-inch water line, a gas line, and an overhead electric power line. Because of the shallow depth of swale, it is believed that it is possible that none of these utilities will require relocation. The principal problem with this alternative is providing access to 14 residential structures which must cross the drainage swale, and two roadway crossings which would require pavement modifications and/or the installation of pipe culverts. Field surveys also found that the patio walls surrounding the residential structure at the northeast corner of the intersection of Drexel/Westover has been

constructed within the right-of-way and would have to be removed as a part of this project.

This alternative is not recommended because of the difficulty of modifying the street intersections and residential access to accommodate the drainage swale. The dip in the profile of Westover Avenue may not meet Pima County's roadway design criteria. Additionally, if the channel banks were overtopped by flow (due to problems such as culvert clogging at roadway and residential structure accesses), then flow would overtop the north bank and drain into residential areas not currently subject to flooding problems. The drainageway location also does not comply with the Traffic Engineering Department's clear zone requirements.

## VI. RECOMMENDATIONS

Alternative A is the most costly ($111,680) of the alternatives analyzed. This approach is, however, the only option which keeps runoff draining along its existing patterns.

The least-cost approach to reducing flood damage potential to residential structures between Forest Avenue and Westover Avenue is implementation of Alternative B. The estimated cost of this alternative is $68,005.

Alternative B provides a means of diverting about 72 cfs away from the residential area between Forest Avenue and Westover Avenue. This alternative provides a means of alleviating some of the flooding problems to the residential area. The principal problems associated with Alternative B are potential conflicts with utilities and the unknown impact of additional flows delivered to the area of the Drexel Road/Mission Road intersection where the swale loses capacity and floodwaters sheetflow across the parking lot of the Circle K and the roadway intersection.

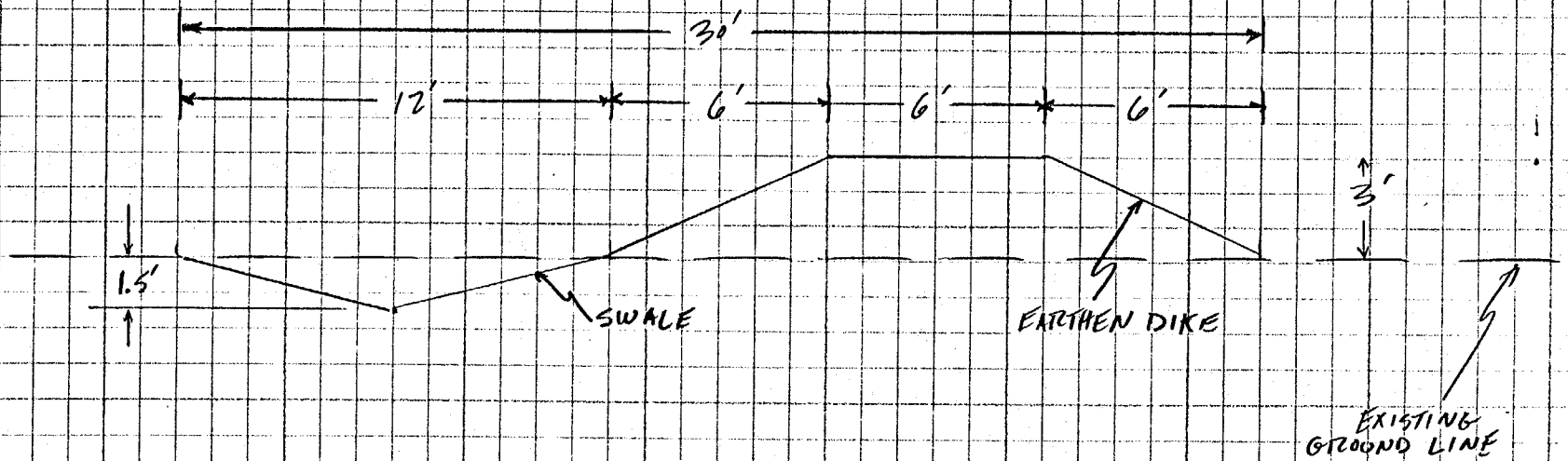
Alternative C is not recommended because of potential conflicts with roadway intersections and residential access along Drexel Road. Alternative C also presents the same concerns as Alternative B with respect to increases in the quantity of flow arriving in the vicinity of the Drexel Road/Mission Road intersection.

# APPENDIX A

# ENGINEERING COMPUTATIONS SHEETS

FIGURE 1 COMBINED SWALE/DIKE ON WEST SIDE OF WESTOVER AVE.

CROSS-SECTION A-A'

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PROJECT NAME AND LOCATION: MISSION/DREXEL RD. INTERSECTION

DRAINAGE CONCENTRATION POINT: 1

WATERSHED AREA (A): 438.00 acres

LENGTH OF WATERCOURSE (Lc): 7040. ft

LENGTH TO CENTER OF GRAVITY (Lca): 3000. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft INCREMENTAL CHANGE IN ELEV (Hi) - ft

7040. 135.0

MEAN SLOPE (Sc): .0192 ft BASIN FACTOR (Nb): .0410

WATERSHED TYPE(S): SUBURBAN

RAINFALL VALUES

| | EVENT | | | | | |
|---|---|---|---|---|---|---|
| | 2-YR | 5-YR | 10-YR | 25-YR | 50-YR | 100-YR |
| P 1 | 1.30 | 1.64 | 1.87 | 2.16 | 2.43 | 2.69 |
| P 2 | 1.42 | 1.82 | 2.08 | 2.42 | 2.73 | 3.04 |
| P 3 | 1.50 | 1.93 | 2.22 | 2.59 | 2.93 | 3.27 |
| P 6 | 1.65 | 2.15 | 2.49 | 2.92 | 3.31 | 3.70 |
| P24 | 1.95 | 2.62 | 3.08 | 3.65 | 4.18 | 4.70 |

SOIL GROUPS

100. % D, CN= 92, COVER TYPE= DESERT BRUSH , COVER DENSITY= 10 %

IMPERVIOUS COVER= 19. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

| | EVENT | | | | | |
|---|---|---|---|---|---|---|
| | 2-YR | 5-YR | 10-YR | 25-YR | 50-YR | 100-YR |
| RUNOFF SUPPLY RATE (q/i): | .507 | .619 | .675 | .729 | .767 | .797 |
| Tc ( FUNCTION OF i ) : | 49.45 | 45.65 | 44.12 | 42.77 | 41.91 | 41.28 |
| SOLUTION OF Tc (MINUTES): | 40 | 32 | 28 | 25 | 23 | 22 |
| RAINFL INT. @ Tc (IN/HR): | 1.708 | 2.484 | 3.071 | 3.789 | 4.473 | 5.090 |
| RUNOFF RATE @ Tc (IN/HR): | .867 | 1.538 | 2.072 | 2.763 | 3.432 | 4.056 |
| PEAK DISCHARGE (CFS) : | 383. | 679. | 915. | 1220. | 1515. | 1791. |

MANNING RATING (INPUT FILE:MISS-DREX.NMI)
CROSS-SECTION - CROSS-SECTION #1 10 YR FLOW EXISTING CONDITIONS

| | | | | |
|---|---|---|---|---|
| STA: | .00 | 20.00 | 90.00 | 150.00 |
| ELEV: | 100.00 | 98.00 | 98.00 | 100.00 |

DISCHARGE = 915. WSEL = 99.66 SLOPE = .0060

SECTION AND SUBSECTION HYDRAULIC DATA

| | TOTAL SECTION | SUBSECTION #: 1 |
|---|---|---|
| DISCHARGE (CFS) = | 915.00 | 915.00 |
| VELOCITY (FT/S) = | 5.35 | 5.35 |
| AREA (SQUARE FT) = | 170.95 | 170.95 |
| TOPWIDTH (FT) = | 136.29 | 136.29 |
| DEPTH (FT) = | 1.66 | 1.66 |
| HYD. DEPTH (FT) = | 1.25 | 1.25 |
| WET. PERIM. (FT) = | 136.40 | 136.40 |
| HYD. RADIUS (FT) = | 1.25 | 1.25 |
| FROUDE NUMBER = | .84 | .84 |
| MANNINGS N VALUE = | .0250 | .0250 |

SUBSECTION 1 = STATION .00 TO STATION 150.00

MANNING RATING (INPUT FILE:MISS-DREX.NMI)
CROSS-SECTION - CROSS-SECTION #1 10 YR FLOW DIVERSION CONDITIONS

| | | | | |
|---|---|---|---|---|
| STA: | .00 | 20.00 | 90.00 | 150.00 |
| ELEV: | 100.00 | 98.00 | 98.00 | 100.00 |

DISCHARGE = 976. WSEL = 99.72 SLOPE = .0060

SECTION AND SUBSECTION HYDRAULIC DATA

| | TOTAL SECTION | SUBSECTION #: 1 |
|---|---|---|
| DISCHARGE (CFS) = | 975.99 | 975.99 |
| VELOCITY (FT/S) = | 5.46 | 5.46 |
| AREA (SQUARE FT) = | 178.90 | 178.90 |
| TOPWIDTH (FT) = | 138.61 | 138.61 |
| DEPTH (FT) = | 1.72 | 1.72 |
| HYD. DEPTH (FT) = | 1.29 | 1.29 |
| WET. PERIM. (FT) = | 138.72 | 138.72 |
| HYD. RADIUS (FT) = | 1.29 | 1.29 |
| FROUDE NUMBER = | .85 | .85 |
| MANNINGS N VALUE = | .0250 | .0250 |

SUBSECTION 1 = STATION .00 TO STATION 150.00

MANNING RATING (INPUT FILE:MISS-DREX.NMI)
CROSS-SECTION - CROSS-SECTION #1 100 YR FLOW EXISTING CONDITIONS

| STA: | .00 | 20.00 | 90.00 | 150.00 |
|---|---|---|---|---|
| ELEV: | 100.00 | 98.00 | 98.00 | 100.00 |

DISCHARGE = 1791. WSEL = 100.31 SLOPE = .0060

SECTION AND SUBSECTION HYDRAULIC DATA

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| | TOTAL SECTION | SUBSECTION #: 1 |
|---|---|---|
| DISCHARGE (CFS) = | 1791.00 | 1791.00 |
| VELOCITY (FT/S) = | 6.74 | 6.74 |
| AREA (SQUARE FT) = | 265.77 | 265.77 |
| TOPWIDTH (FT) = | 150.00 | 150.00 |
| DEPTH (FT) = | 2.31 | 2.31 |
| HYD. DEPTH (FT) = | 1.77 | 1.77 |
| WET. PERIM. (FT) = | 150.13 | 150.13 |
| HYD. RADIUS (FT) = | 1.77 | 1.77 |
| FROUDE NUMBER = | .89 | .89 |
| MANNINGS N VALUE = | .0250 | .0250 |

SUBSECTION 1 = STATION .00 TO STATION 150.00

MANNING RATING (INPUT FILE:MISS-DREX.NMI)
CROSS-SECTION - CROSS-SECTION #1 100 YR FLOW DIVERSION CONDITIONS

| | | | | |
|---|---|---|---|---|
| STA: | .00 | 20.00 | 90.00 | 150.00 |
| ELEV: | 100.00 | 98.00 | 98.00 | 100.00 |

DISCHARGE = 1863. WSEL = 100.35 SLOPE = .0060

SECTION AND SUBSECTION HYDRAULIC DATA

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| | TOTAL SECTION | SUBSECTION #: 1 |
|---|---|---|
| DISCHARGE (CFS) = | 1862.52 | 1862.52 |
| VELOCITY (FT/S) = | 6.85 | 6.85 |
| AREA (SQUARE FT) = | 272.09 | 272.09 |
| TOPWIDTH (FT) = | 150.00 | 150.00 |
| DEPTH (FT) = | 2.35 | 2.35 |
| HYD. DEPTH (FT) = | 1.81 | 1.81 |
| WET. PERIM. (FT) = | 150.13 | 150.13 |
| HYD. RADIUS (FT) = | 1.81 | 1.81 |
| FROUDE NUMBER = | .90 | .90 |
| MANNINGS N VALUE = | .0250 | .0250 |

SUBSECTION 1 = STATION .00 TO STATION 150.00