GRAND AVENUE (US 60) AT
55TH AVENUE AND MARYLAND AVENUE
TRACS No. H5600
Contract No. 01-90

Final Drainage Report

Prepared for:

Arizona Department of Transportation
205 South 17th Avenue
Phoenix, Arizona 85007

Prepared by:

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October 1, 2002

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1.0 INTRODUCTION

1.1 Purpose of Report

This final drainage report has been prepared as part of the Stage IV design for the grade separation at the 55th/Maryland Avenue location. The intent of this report is to document the assumptions and methodologies used to develop on-site and off-site hydrology and to design the hydraulic appurtenances for the project. Design criteria and data presented in this report have been established based on the ADOT *Highway Drainage Design Manual, Hydrology* and the ADOT *Roadway Design Guidelines, Chapter 600-Highway Drainage Design.*

This project was developed and designed in English units.

1.2 Project Location

This segment of Grand Avenue (SR 60) is located in Maricopa County, in the City of Glendale, as shown in Figure 1. The project is located at the intersection of 55th Avenue and Maryland Avenue (MP 155.4) The project area along Maryland Avenue, as shown in Figure 2, starts at 54th Avenue and ends at 57th Avenue.

1.3 Project Description

Maryland Avenue will be reconstructed as an overpass of Grand Avenue on an alignment to the north of the existing Maryland Avenue centerline. The overpass alignment is a three-curve alignment geometry with acceptable tangent lengths between the curves. Access to adjoining properties in the northeast quadrant of Grand Avenue/Maryland Avenue will be maintained with two-way street connectors.

The south leg of 55th Avenue (south of Grand Avenue) will not have access to Grand Avenue. An east-west connector street (Claremont Street) between 55th Avenue and 57th Avenue will provide access to the south leg.

The north leg of 55th Avenue (north of Grand Avenue) will have access to Grand Avenue through right turns on and off of Grand Avenue.

Traffic signals will be provided at the 57th Avenue and 54th Avenue intersections with Maryland Avenue.

Roadway and drainage plans are contained in Appendix A.

1.4 Development (Future and Present)

Along the north side of Maryland Avenue, present land use west of Grand Avenue consists of some light industrial, and present land use east of Grand Avenue consists of a Post Office on a mostly vacant city block and single-family homes north and east of the mostly vacant city block.

Along the south side of Maryland Avenue, present land use west of Grand Avenue consists of mostly agriculture with the Liefgreen Seed Company building, and present land use east of Grand Avenue consists of Sands Chevy, an Automobile dealership.

Future land use within the project limits immediately west of Grand Avenue, based on existing M-1 zoning, will be Light Industrial. Future land use immediately east of Grand Avenue will consist of General Commercial (C-2) and Light Industrial (M-1) north of Maryland Avenue, and Heavy Commercial (C-3) south of Maryland Avenue. Northeast of the commercial and industrial areas, the land is zoned Multiple Residence (R-3).

Future land use is anticipated to consist of development consistent with the current zoning. For example, Sands Chevy, located in the southeast quadrant of the intersection, is currently doing site design to re-orient their auto dealership facilities. Owners of the parcel located in the southwest quadrant of the intersection have indicated that existing agricultural land will be developed as their business expands.

Figure 1
Project Location Map

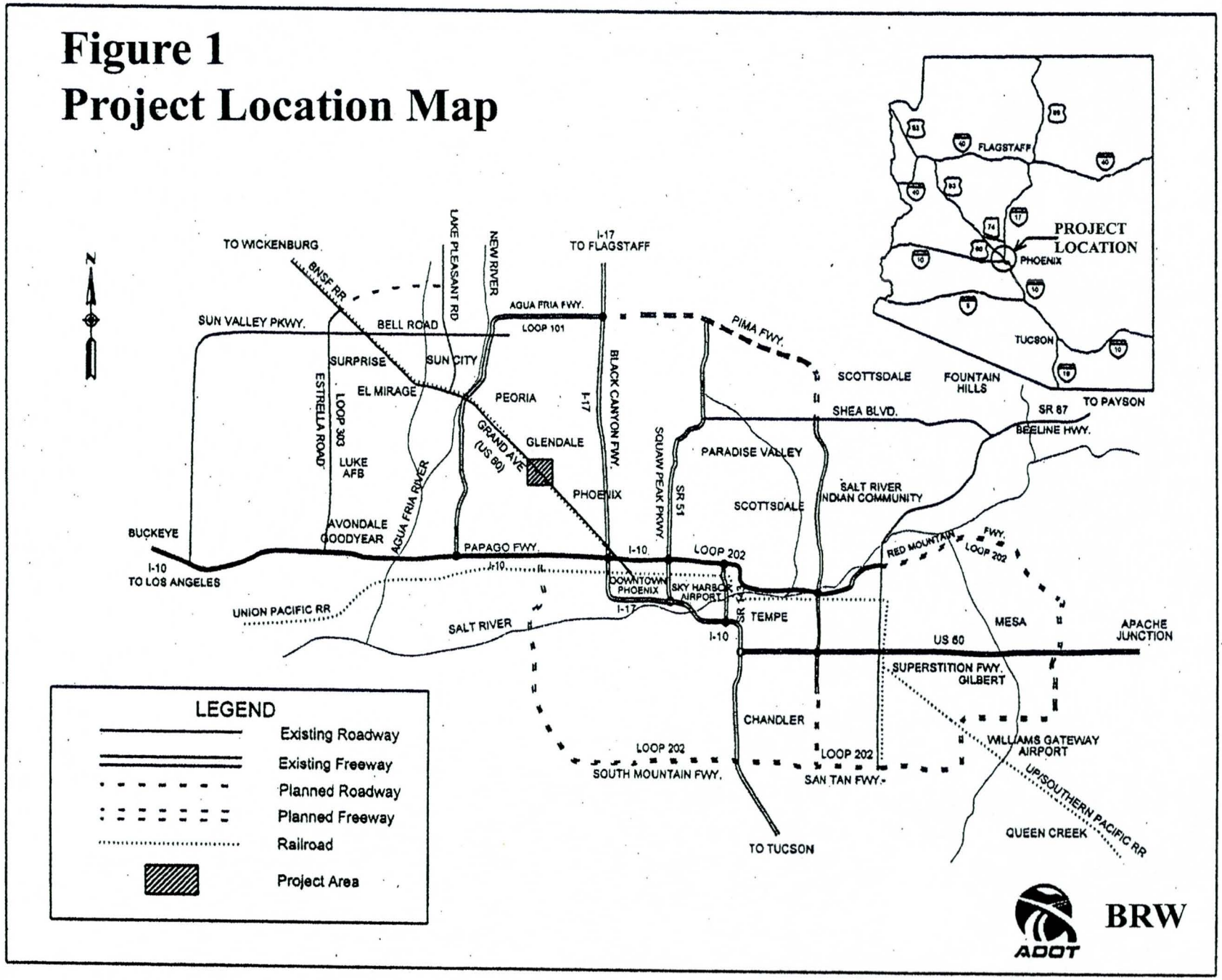

Figure 1
Project Location Map

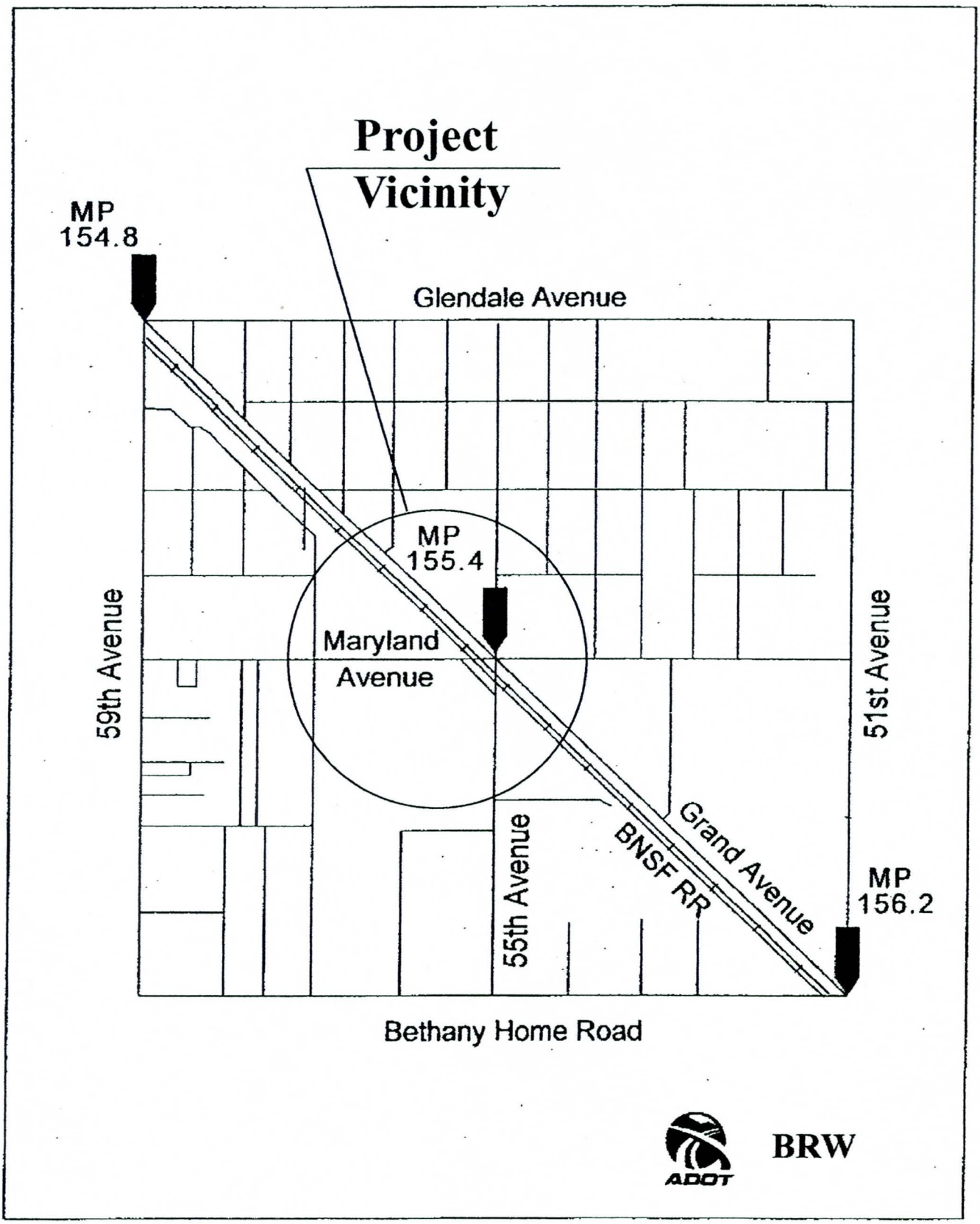

Figure 2
Vicinity Map

2.0 DRAINAGE DESIGN DEVELOPMENT

2.1 Discussion

The development of the drainage design for this project required the review and evaluation of drainage concepts recommended by PEC (Project Engineering consultants, LTD.) during the alternative selection studies for this project.

2.2 Drainage Design Developed by PEC

PEC developed preliminary drainage concepts for both the off-site and on-site drainage systems. These concepts are described in the following documents:

- "Drainage Study Analysis Report, Maryland Avenue Overpass", PEC, Revised-July 3, 2001.
- "Draft Alternative Selection Report, Maryland Avenue Overpass at Grand Avenue (US 60)/ 55TH Avenue", Contract 99-25, TRACS No. H5600, URS, June 20, 2001.

In the 1990's, the Flood Control District of Maricopa County (FCDMC) identified a regional drainage system to solve the flooding problems in the Maryvale area. The plan included conceptual drainage facilities in the areas of probable flooding. The FCDMC and City of Glendale are currently implementing this plan, but funding for the entire system has not been programmed. A drainage system compatible with the FCDMC regional drainage system was analyzed, developed and initially proposed for the Maryland Avenue overpass project. Since the Bethany Home Road storm drain, required outfall for the ADOT system, will not be available for several years, this option was withdrawn.

Instead, the conceptual drainage system proposed for the Maryland Avenue overpass will only mitigate the impact of the proposed improvements and not deal with regional drainage issues. The conceptual drainage system will consist of a local storm drain system combined with small retention basins to store, as a minimum, the on-site runoff. The basins would be located at each end of the approach embankments. Flow in excess of basin capacities would pass onto downstream parcels in a manner similar to pre-project conditions.

2.3 Drainage Design Developed by BRW

The general overall preliminary drainage concepts are maintained in the BRW drainage design for construction documents. BRW performed the on-site hydrology necessary to determine the location and size of inlet facilities for the roadway runoff and for the proposed retention facilities. The off-site hydrology, based on the Maryvale ADMS model as modified by BRW, is estimated to be 315 cfs for the 100-year event at the Grand/55th/Maryland Avenue intersection.

Interpolation of the Maryvale ADMS peak runoffs was necessary to develop a concentration point at the half-mile Grand/55th/Maryland Avenue intersection. The

Maryvale ADMS model subareas are along major arterial streets, and therefore, the concentration points are located at the one-mile intersections. The Maryland/55th Avenue intersection is a half-mile intersection. It would be very difficult to revise the large Maryvale Model (12,386 input lines) to obtain runoff peaks at the project site.

Instead development of the off-site runoff at the site is based on on-site flows within the area bounded by Grand Avenue on the west, 51st Avenue on the east, Glendale Avenue on the north, and Maryland Avenue on the south. A review of the Maryvale ADMS indicates that the on-site peak runoff for Section 8 overshadows the off-site peak runoff, and therefore, the on-site peak runoff is the controlling peak flow in Section 8. The peak flows at key intersections have been determined by prorating the total contributing area at each intersection with the Section 8 on-site peak flow of 902 cfs for 320 acres. Development of the off-site hydrology along with a map depicting applicable design flows is contained in Appendix I.

3.0 ON-SITE DRAINAGE DESIGN

3.1 Discussion

The on-site drainage system shown on the drainage plans contained in Appendix A will drain all areas within the highway right-of-way to the appropriate off-site drainage facility. This system is comprised of pavement catch basins that will maintain storm water encroachment on the roadway below acceptable limits. The Maryland Avenue storm drain system for the overpass is sized for the 10-year storm event.

The on-site drainage system for the Grand/55th/Maryland Avenue project is shown in Appendix A. These systems are:

- ***Maryland Avenue System:*** Install an on-site storm drain system from 57th Avenue to the west curb return of Sierra Vista Drive (currently 54th Avenue) that meets current on-site drainage criteria. From the west curb return of Sierra Vista Drive (currently 54th Avenue) east to the end of the project, combined on-site runoff and off-site runoff (from north and east of the roadway) will be captured by two large curb-opening type catch basins (located at station 125+78 LT & RT).
- ***Sierra Vista Drive and 54th Avenue System:*** Install an off-site storm drain system that will capture combined on-site and off-site runoff (from north of the roadway).
- ***55th Avenue Connection to Grand Avenue:*** Maintain the existing lateral storm drain system that discharges to the existing 24" storm drain system located in Grand Avenue.
- ***Claremont Street:*** This Street will be constructed with a rural section and roadway ditches along both sides of the street. There is no logical outfall for these ditches, and therefore, the runoff will pond in these ditches and discharge through drywells. These ditches will drain east to west creating localized ponding at each drywell. To minimize flooding of the pavement, it is necessary to create two ponding areas, one at 57th Avenue and one halfway between 57th Avenue and 54th Avenue. Drywells will be installed at each location.

3.2 Facility Selection

Storm water interception for the Maryland Avenue storm drain system will be accomplished with curb-opening catch basins and where necessary with a combination catch basin and special scupper. The selected catch basin types are:

- ADOT Catch Basin Type 3, Drawing C-15.20

Storm water interception for the Sierra Vista Drive and 54th Avenue storm drain system will be accomplished with curb-opening catch basins at low spots for both on-site and off-site runoff. A portion of the off-site flows from the north on 54th Avenue will be captured by two curb-opening catch basins near the north end of the reconstructed 54th Avenue. These catch basins will minimize the amount of water that will flow south to CB 27, which is located at the dead-end of existing 54th Avenue. The remaining off-site flow will be captured by two curb-opening sag catch basins located in Sierra Vista Drive, Station 76+67. During the 100-year event, peak flows may overflow the south curb line of Sierra Vista Drive into Retention Basin 3. Bank protection along the north side of the basin will not

be required, because this overflow will occur when both the basin bank and the street are under water. The selected catch basin types are:

- ADOT Catch Basin Type 3, Drawing C-15.20
- ADOT Catch Basin Type 4 – Double, Drawing C-15.30

3.3 Pavement and Embankment Drainage (Hydrology)

The Rational Method was employed to determine the peak runoffs from pavement and landscape areas. Parameters used were:

Design storm	-	10-year and (check for 50 year)
Time of concentration	-	10 minutes
Rainfall intensity (10 yr.)	-	4.28 inches/hr. Max.
Rainfall intensity (50 yr.)	-	5.69 inches/hr Max.
Runoff Coefficients	-	Paved areas = 0.95, Unpaved area (Moderate Urban, 40% Impervious) = 0.70 Commerical areas = 0.90

Peak runoff values are calculated based on the Rational Equation (English Version) of the HDDM as follows:

$$Q = C\,I\,A$$

where, Q = the peak discharge in cfs, of selected return period

C = Rational Method runoff coefficient

I = the average rainfall intensity in inches/hr for the selected rainfall return period

A = the contributing drainage area in acres

The above listed values of "C" were based on Figure 2-3 of the HDDM with a 50-year, 1-Hour rainfall depth of 2.05 inches.

The initial time of concentration is calculated from Equation 2-2 of the HDDM as illustrated below:

$$T_c = 11.4\, L^{0.5}\, K_b^{0.52} S^{-.31}\, I^{-0.38}$$

where, T_c = time of concentration, in hours

L = the length of the longest flow path, in miles

K_b = the watershed resistance coefficient from Table 2-1

S = the slope of the longest flow path, in feet/mile

I = the average rainfall intensity, in inches/hr, for a duration of rainfall equal to T_c

This method calculates a T_c through an iterative process because T_c is based on an intensity (I), which varies with T_c. The minimum T_c used for calculation was ten minutes. All pavement drainage areas analyzed had a T_c less than ten minutes, and therefore, the minimum ten-minute value was applied.

The project specific rainfall intensity calculations are contained in Appendix K.

3.4 Inlet/Catch Basin Spacing Design

Catch basin spacing and pavement spread calculations were determined by employing Hydraulic Engineering Circular No. 12, *Drainage of Highway Pavements,* FHWA, March 1984. The actual calculations were completed by a computer program obtained from McTrans Center for Microcomputers in Transportation, University of Florida, Gainesville, Florida. This program, entitled "SMF Pavement Drainage Program, HEC-12, Version 2.11", analyzes an entire system of catch basins including by-pass flow, and it is capable of evaluating up to 100 catch basins. Design parameters used to design and locate the catch basins are:

- Allowable Ponding Depth

  Allowable ponding depth should not exceed the height of the curb for the 10-year runoff.

  10-Year Runoff: One-half of the right travel lane encroachment and no left travel lane encroachment for roadways with more than one lane in each direction. No lane encroachment for one-lane roadways.

  50-Year Runoff: One full right travel lane encroachment and no left travel lane encroachment for roadways with more than one lane in each direction. No lane encroachment for one-lane roadways.

  Local Roadways: Use the ADOT design criteria for design runoff and allowable spread width.

  A depressed roadway is defined as any roadway whose ultimate ponded depth (assuming no outflow at the sag) is 29 inches or more.

- Catch Basin Capture Ratios

	Inlet Capture Ratio	
Type	Sump	On-Grade
Curb-opening	80	80
Grate inlets	50	50
Slotted drain	50	67
Slotted drain/Grate inlets	50/50	67/50

- Grates

  If used, catch basin grates on local streets, cross roads and ramp termini will be bicycle and motorcycle safe.

The selected locations for the new catch basins were based on roadway profiles, catch basin spacing required to maintain water spread on the pavement below maximum allowable, near superelevation crossover points to minimize sheet flow across the pavement, at intersections to prevent storm water runoff from flowing out and across the main street pavements, and at the low point in sag areas.

Catch basins were sized based on the 10-year event and checked for the 50-year event. The drainage areas, peak discharges (10-year and 50-year) and time of concentration for the on-site drainage are contained in Appendix C. Calculations for spacing and sizing the catch basins are contained in Appendix D.

3.5 Storm Sewer Design

Storm sewer pipe sizes and the hydraulic grade line were determined with a computer program. STORMCAD For Windows is a computer program that designs and analyzes any new and existing storm sewer system for non-uniform flow , and the hydraulic grade line (HGL). STORMCAD is a registered trademark of Haestad Methods, Inc., 37 Brookside Road, Waterbury, Connecticut, 06708. The storm sewer design was based on criteria contained in ADOT's Roadway Design Guidelines Manual dated May 1996, Metric Version with English Appendix. These are:

- Minimum Pipe Size

  Trunk Lines - 24-inch, except 18-inch pipes may be used where conflicts occur with utilities or other highway appurtenances.
  Laterals - 18-inch (Based on ADOT'S review comments from previous projects, an attempt will be made to obtain a minimum size of 24-inch.)

- Pipe Material and Roughness

  Pipe material was selected based on the requirements of ADOT's Pipe Selection Guidelines and Procedures, February 1, 1996. Manning's "n" values used for the selected pipe materials are:

Pipe Material	Manning's "n"
Concrete Pipe	0.012
Cast-in-Place Concrete Pipe	0.014
Plastic Pipe, Smooth	0.012

- Pipe Size Design

Pipe size selection was based on full flow with the 10-year storm event for non-depressed roadways and full flow with the 50-year storm event for depressed roadways. The hydraulic grade line was set a minimum 6 inches below the top of grate for the selected design storm event.

The storm sewer calculations for pipe sizes and hydraulic grade lines are contained in Appendix G. The new pipe summary sheets and the storm sewer profiles are contained in Appendices E and F, respectively.

3.6 Bridge Drainage Design

Catch basins will not be installed in the bridge deck, which will reduce roadway maintenance problems. Instead, catch basins will be installed in the roadway off the bridge ends. The pavement flooding width was determined by procedures outlined in the Hydraulic Engineering Circular No. 21, *Design of Bridge Deck Drainage,* FHWA, May 1993. Calculations for actual pavement flooding width on the bridge are contained in Appendix D.

3.7 Retention Basin Design

The lack of outfalls for the on-site runoff requires the use of retention basins with drywells to drain the basins within 36-hours. Retention basin designs are based on the following criteria:

- Required Storage Volume: The retention basin will be sized to retain, as a minimum, 100% of the 100-year, 2-hour storm event falling on the area contained within the right-of-way.
- Freeboard: When possible, provide one-foot of freeboard from the water surface elevation to the gutter of the upstream street or the adjacent existing ground surface. Otherwise, the design water depth should not exceed the level of the surrounding natural ground.
- Setback from Right-of-Way: When possible, provide 20-foot setback from each property line or roadway section.
- Basin Depth: When possible, the 100-year, 2-hour storm event volume should produce a maximum water depth of 3 feet at the basin edges (All basins are deeper than 3-feet to meet site geometric constraints). Depth may be increased toward the center of the basin to assure positive drainage to a drywell. The maximum depth of the basin should not exceed 25 feet.
- Drainage of Basin: Positive drainage of the basin should be accomplished with a minimum bottom slope of 0.5%.
- Side Slopes: Side slopes adjacent to public rights-of-way, or when there is pedestrian access to that portion of the basin should be 4:1 or flatter. (At City of Glendale's request, 6:1 slopes were used near the adjacent street for Channel 3. However, 4:1 slopes were necessary to meet site geometric constraints at Retention

Basins 1, 2 and 3. Slopes of 3:1 were used on the roadway side for basins 2 and 3)

- Erosion Control: At inlet and outlet point, erosion control items, such as riprap, grouted riprap or concrete slabs, should be installed.
- Maintenance Access: When possible, a 15-foot wide all weather maintenance-road should be provided around the outside of the basin. (Maintenance-roads will not be installed around these basins to minimize both construction and right-of-way costs.)
- Drainage within 36-Hours: Retained water should be disposed of within 36-hours after the storm event. Acceptable methods are discharge to a storm drain system, drainage channel, or drywells. The industry standard is to construct drywells with a capacity of 0.50 cfs and to assume a deterioration of capacity over time to 0.25 cfs. The special provisions will contain a requirement that the drywells need to be tested and certified to have an initial capacity of 0.50 cfs.

Three retention basins will be installed with this project, one at the west end of the Maryland Avenue approach embankment and the other two at the east end of the approach embankment. The west retention basin (Basin No. 1) is sized for both on-site and a small amount of off-site runoff, and the east retention basins (Basins No. 2 and 3) are sized for on-site runoff and a small amount of off-site runoff. The location of these basins is depicted on the project drawings contained in Appendix A. The calculations along with plans and elevations are contained in Appendix J. All retention basins will be drained with drywells within 36-hours after the rainfall event.

4.0 OFF-SITE DRAINAGE DESIGN

4.1 Discussion

Off-site runoff is from the north along the entire length of this project. An off-site drainage study was performed by PEC as discussed in subsection 2.2 of this report. Off-site drainage systems designed with this project are discussed in this section under the headings: "West of Grand Avenue and North of Maryland Avenue" and "East of Grand Avenue and North of Maryland Avenue." The off-site drainage systems are depicted on project drawings contained in Appendix A.

4.2 West of Grand Avenue and North of Maryland Avenue

The BNSF Railroad embankment functions as a dam preventing overtopping in the vicinity of the project during the 100-year event. Therefore, the drainage system west of Grand Avenue can be designed to accommodate the local 100-year runoff event. Collected off-site and on-site runoff will be conveyed to proposed retention basin No. 1. The basin will be sized to hold the 100-year, 2-hour runoff volume from both on-site and off-site areas.

The retention basin will be located in the southeast quadrant of the 57th Avenue/Maryland Avenue intersection.

Runoff will be conveyed to this retention basin with earthen channels along the north and south sides of the embankment, and a storm drain system within the street. The North Channel will collect both off-site and embankment runoff, and the south-channel will collect embankment runoff. The storm drain will collect pavement runoff from Maryland Avenue. Calculations for the offroad channels are contained in Appendix H, and calculations for the retention basin sizing are contained in Appendix J.

4.3 East of Grand Avenue and North of Maryland Avenue

As stated in the previous section, the BNSF Railroad embankment functions as a dam preventing overtopping in the vicinity of the project during the 100-year event. Therefore, the large off-site regional flows from the north and the east would pass through this area and be conveyed south and north along the railroad embankment to "ponding areas." A map depicting the south "ponding area", which is a triangular area created by the 51st Avenue and Grand Avenue embankments, is contained in Appendix I.

The proposed off-site drainage system will convey these large flows through the proposed Grand Avenue embankment in a manner similar to existing conditions. The proposed system will only mitigate the impact of the roadway improvements. The previous drainage study concluded that solutions for the regional drainage issues could not be implemented with this project due to inadequate funding and the unavailability of an adequate outfall system for several years after completion of these roadway improvements.

The proposed pass-through system will need to convey the 100-year off-site flows (estimated at 146 cfs) through the Maryland Avenue embankment area. The remaining

169 cfs along 55th Avenue will disperse south (through the Grand Avenue overpass bridge opening) and north along Grand Avenue. The drainage map and accompanying hydrologic/hydraulic calculations are contained in Appendix I.

The proposed pass-through system will consist of a double 10'x4' concrete box culvert to convey the offsite flows north to south through the new embankment for Maryland Avenue. The invert elevations need to be below the existing ground surface in order to not increase the upstream water surface elevation during the 100-year event. Earthen retention basins will be installed at the entrance/discharge ends of the box culvert. A drainage system consisting of catch basins and a channel will collect the street flow from north on 54th Avenue and from east on Maryland Avenue and discharge it to Retention Basin 3. Retention Basin 2 will receive the box culvert discharge and evenly distribute it back to sheet flow downstream of the embankment.

A safety railing will be installed along the interface between the south side of Sierra Vista Drive and the north edge of Retention Basin 3. A railing instead of fence is recommended to minimize impedance of sheet flow during the 100-year event.

The retention basins will be drained within 36-hours after the rainfall event through drywells. Drywells are needed because the basin inverts are below all outfall inverts (e.g., existing 24" storm drain along Grand Avenue).

The complexity of proposed grades at the Maryland Avenue/Sierra Vista/54th Avenue intersection required development of a HEC-RAS model to determine the flow paths for the off-site runoff. Furthermore, a HEC-RAS model for existing conditions at the Maryland Avenue/54th Avenue intersection was also developed to compare pre- and post 100-Year water surface elevations. These calculations along with a summary table for comparison purposes are contained in Appendix I. Calculations for the retention basin sizing are contained in Appendix J. For ease of review, the Summary Table is duplicated on the next page. Three critical points along the residential area at the Maryland/54th Avenue intersection were evaluated for both existing and proposed conditions. The proposed improvements will drop the water surface from 0.39 to 048 feet below existing conditions during the 100-year storm event. Even with this drop in elevation, the potential for flooding of adjacent homes still exists.

Summary
of
100-Year Water Surface Elevations
for
Existing and Proposed Conditions
at
Critical Locations

Location	Station	Water Surface Elevation (WSE)			Comments
		Existing msl (ft)	Proposed msl (ft)	Change in Elevation (ft)	
Maryland Ave	126+10	1156.14	1155.66	-0.48	Entrance to 8'x3' CBC under Sierra Vista Dr. Proposed 100-Year WSE is lower than existing WSE because of the improved outfall under Maryland Avenue (2-10'x4' CBC with less tailwater than existing conditions).
54th Ave	86' North of Existing Maryland Ave	1156.14	1155.66	-0.48	Located 20'(+or-) South of CB 27. During the 100-Year Event, the proposed water surface elevation will be the same as on Maryland, Station 126+10 by equalization through CB 27.
54th Ave	52+75 or 319' North of Existing Maryland Ave	1156.18	1155.79	-0.39	North End of 54th Street Reconstruction. Proposed WSE is lower than existing 100-Year WSE because of the improved outfall under Maryland Avenue (2-10'x4' CBC with less tailwater than existing conditions).

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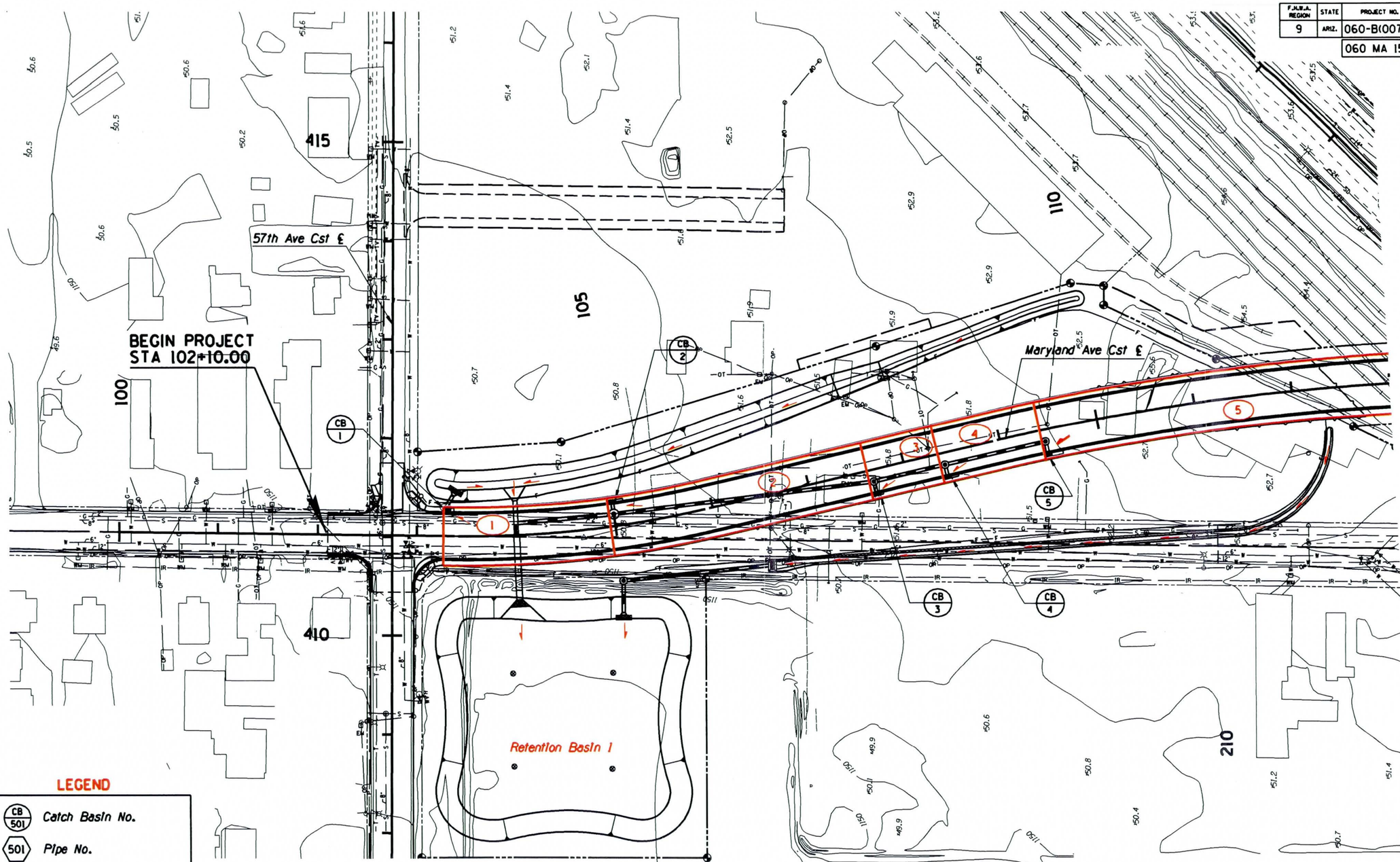
5.0 REFERENCES

1. Arizona Department of Transportation, Highways Division, Draft Roadway Design Guidelines, Chapter 600-Highway Drainage Design, May 11, 1994.
2. Arizona Department of Transportation, Highway Drainage Design Manual, Hydrology, March 1993.
3. Arizona Department of Transportation, Highways Division, Urban Highways Section, Design Procedures Manual, March 1988 and Revisions.
4. Arizona Highway Department, Bridge Division, Hydrologic Design for Highway Drainage in Arizona, revised March 1969.
5. Arizona Highway Department, Structures Section, Hydraulics Division, Hydrologic and Hydraulic Training Session Manual, October 16-18, 1972, revised December 1973.
6. Arizona Department of Transportation, Highways Division, Construction Standard Drawings, April 2000.
7. Arizona Department of Transportation, Highways Division, Structures Section, Standard Drawings, June 1992.
8. U.S. Department of Transportation, Federal Highway Administration, Hydraulic Design of Highway Culverts, Hydraulic Design Series No. 5, September 1982.
9. U.S. Department of Transportation, Federal Highway Administration, Drainage of Highway Pavements, Hydraulic Engineering Circular No. 12, March 1984.
10. U,S, Department of Transportation, Federal Highway Administration, Urban Drainage Design Manual, Hydraulic Engineering Circular No. 22, November 1966.
11. Arizona Department of Transportation, Intermodel Transportation Division, Roadway Engineering Group Design Section, Pipe Selection Guidelines and Procedures, February 1, 1996.
12. U.S. Department of Transportation, Federal Highway Administration, Design of Bridge Deck Drainage, Hydraulic Engineering Circular No. 20, May 1993.
13. Arizona Department of Transportation, Drainage Study Analysis Report, Maryland Avenue Overpass, Revised-July 3, 2001.
14. City of Glendale, Design Guidelines for Site Development and Infrastructure Construction and Addendums No. 1, 2 and 3, July 15, 1998.
15. Flood Control District of Maricopa County, Final Report, Maryvale Area Drainage Master Study, Floodplain Mitigation Study, November 1997.

Appendix A
Roadway Drainage System and Drainage Area Map

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	060-B(007)B			
		060 MA 155			



LEGEND

- CB 501 — Catch Basin No.
- 501 — Pipe No.
- MH 601 — Manhole No.
- DI 593 — Drop Inlet
- Drainage Area Boundary
- 501 — Drainage Basin No.
- Flow Direction

ROADWAY DRAINAGE SYSTEM PLAN AND DRAINAGE AREA MAP

	NAME	DATE
DESIGN	RS	09/02
DRAWN	MSK	09/02
CHECKED	DJS	09/02

BRW — 7720 N. 16th Street, Suite 100, Phoenix, Arizona 85020, (602) 234-1591

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION

DRAINAGE SHEET
STA 102+10.00 TO 113+00

ROUTE: US 60
LOCATION: GRAND AVE AT 55TH AVE AND MARYLAND AVE

TRACS NO. H5601 01 C
060-B(007)B

PRELIMINARY
STAGE IV
Review
NOT FOR CONSTRUCTION OR RECORDING

DWG. NO. D-1.1
___ OF ___

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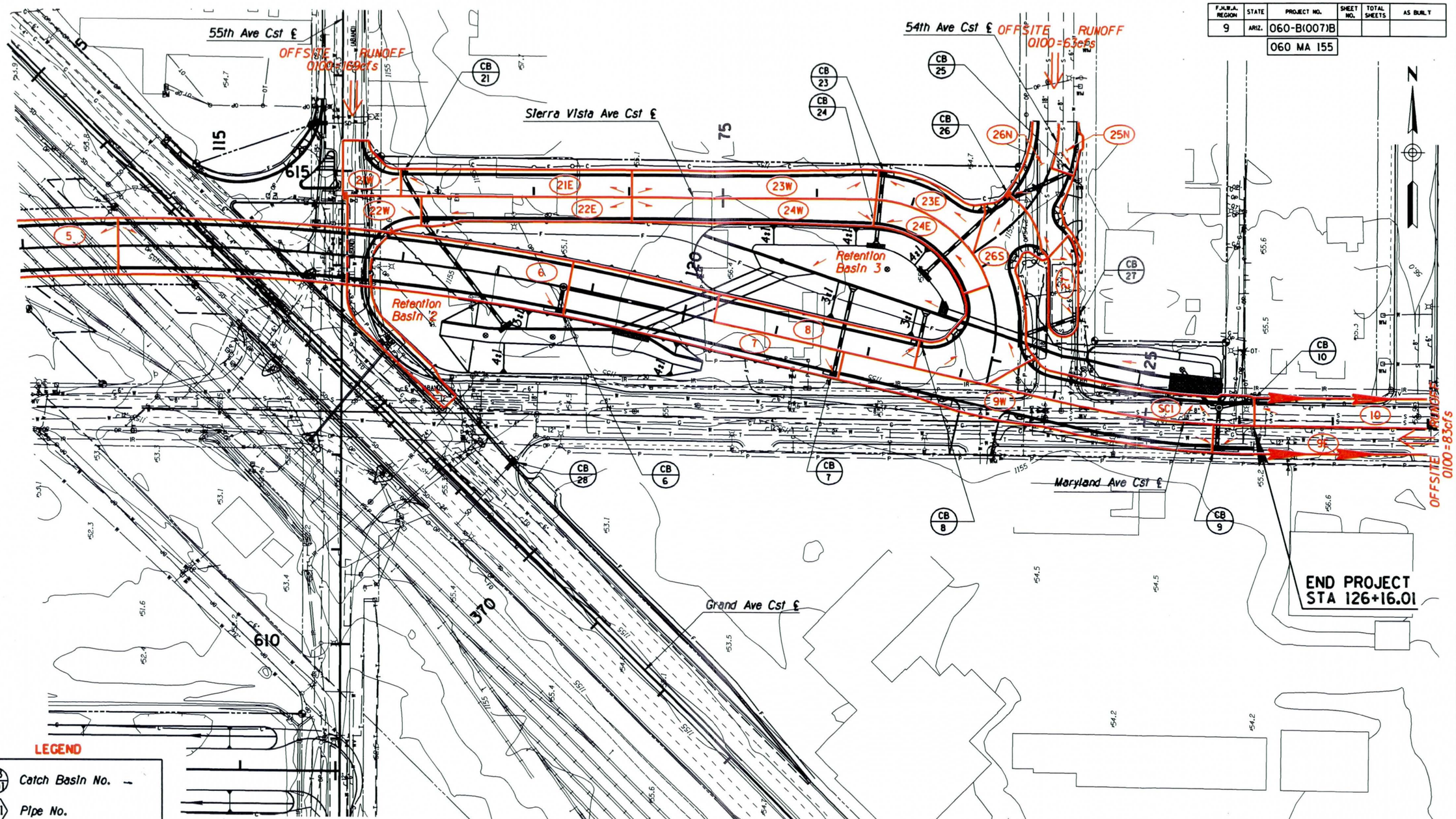
F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	060-B(007)B			

060 MA 155



LEGEND

- CB 501 — Catch Basin No.
- 501 — Pipe No.
- MH 601 — Manhole No.
- DI 593 — Drop Inlet
- Drainage Area Boundary
- 501 — Drainage Basin No.
- Flow Direction

ROADWAY DRAINAGE SYSTEM PLAN AND DRAINAGE AREA MAP

	NAME	DATE
DESIGN	RS	09/02
DRAWN	MSK	09/02
CHECKED	DJS	09/02

BRW — 7720 N. 16th Street, Suite 100, Phoenix, Arizona 85020, (602) 234-1591

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION

DRAINAGE SHEET
STA 113+00 TO 126+16.01

ROUTE: US 60

LOCATION: GRAND AVE AT 55TH AVE AND MARYLAND AVE

TRACS NO. H5601 01 C

060-B(007)B

PRELIMINARY
STAGE IV
Review
NOT FOR CONSTRUCTION OR RECORDING

DWG. NO. D-1.2

___ OF ___

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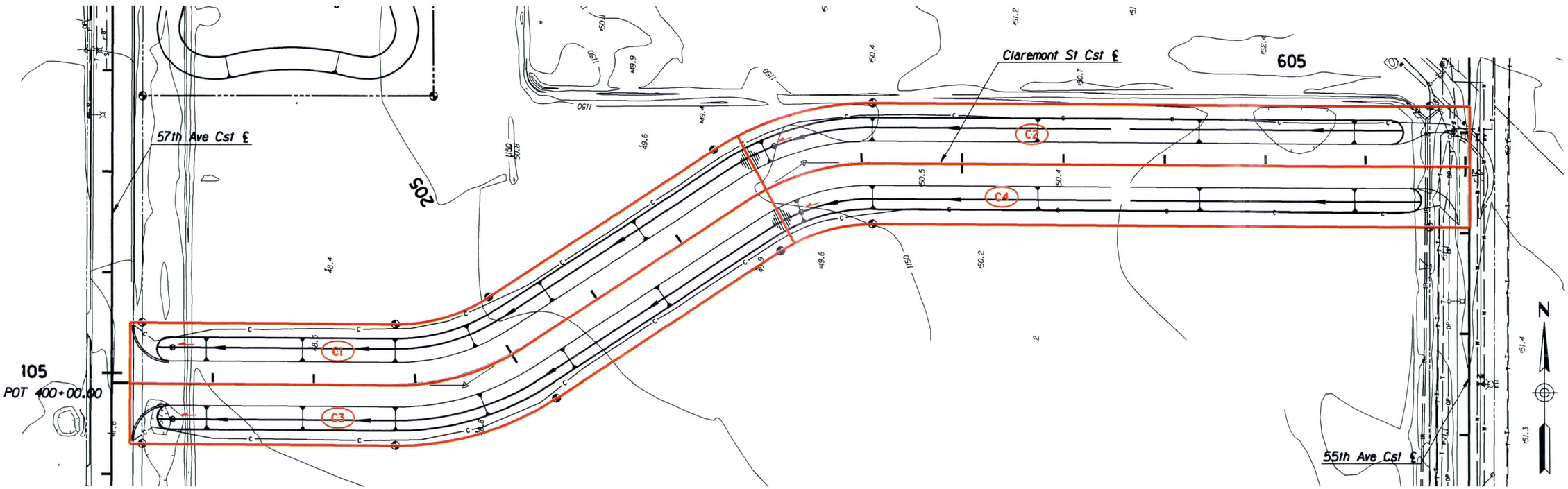
F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	060-B(007)B			

060 MA 155



LEGEND

- CB 501 — Catch Basin No.
- 501 — Pipe No.
- MH 601 — Manhole No.
- DI 593 — Drop Inlet
- Drainage Area Boundary
- 501 — Drainage Basin No.
- Flow Direction

ROADWAY DRAINAGE SYSTEM PLAN AND DRAINAGE AREA MAP

	NAME	DATE
DESIGN	RS	09/02
DRAWN	KDP	09/02
CHECKED	DJS	09/02

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ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION

DRAINAGE SHEET
CLAREMONT STREET

PRELIMINARY
STAGE IV
Review
NOT FOR CONSTRUCTION OR RECORDING

ROUTE: US 60
LOCATION: GRAND AVE AT 55TH AVE AND MARYLAND AVE
DWG. NO. D-1.3

TRACS NO. H5601 01 C — 060-B(007)B — ___ OF ___

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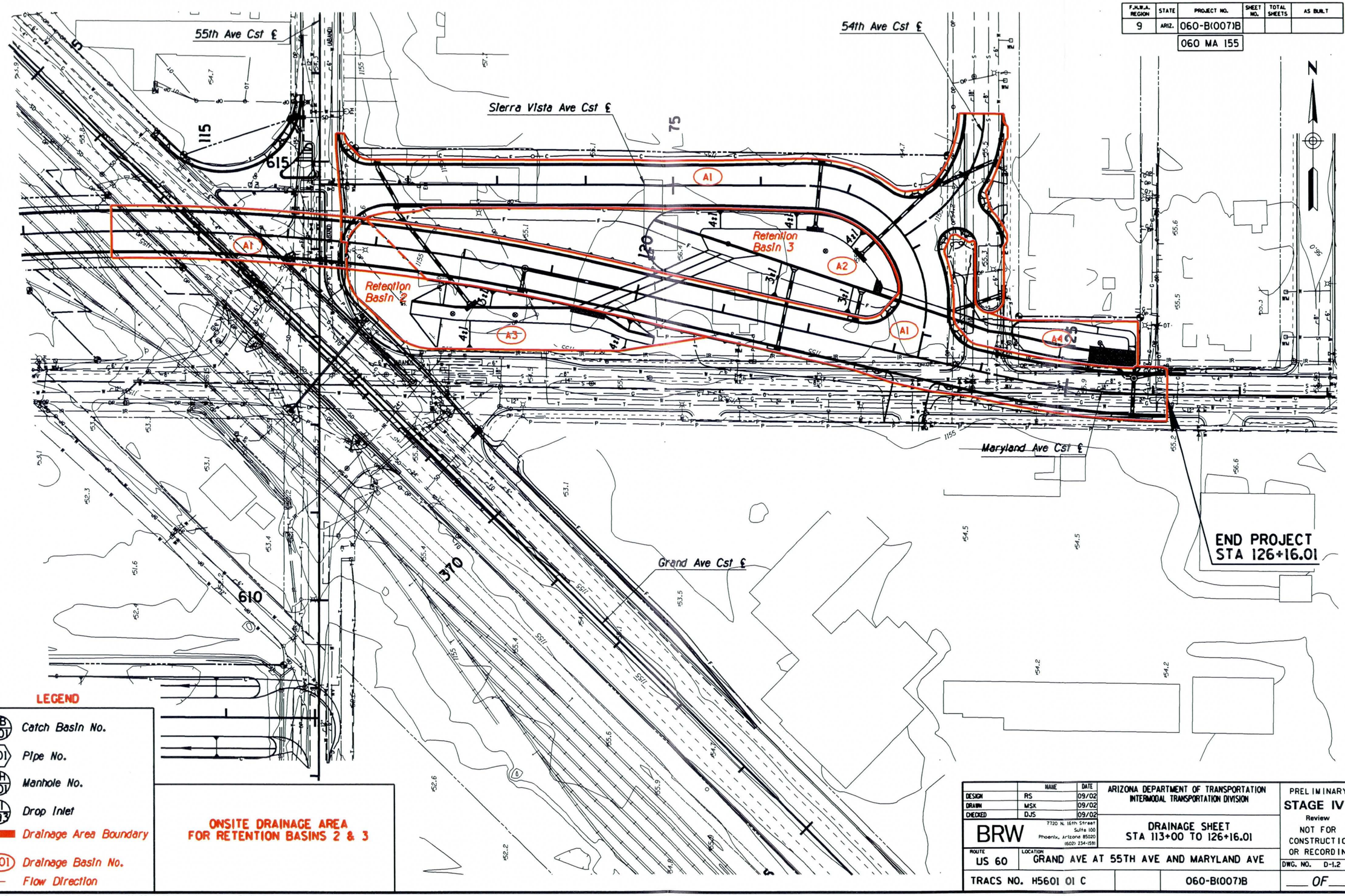
F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	060-B(007)B			
		060 MA 155			



	NAME	DATE
DESIGN	RS	09/02
DRAWN	MSK	09/02
CHECKED	DJS	09/02

BRW
7720 N. 16th Street
Suite 100
Phoenix, Arizona 85020
(602) 234-1591

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION

DRAINAGE SHEET
STA 113+00 TO 126+16.01

ROUTE: US 60
LOCATION: GRAND AVE AT 55TH AVE AND MARYLAND AVE

TRACS NO. H5601 01 C
060-B(007)B

PRELIMINARY
STAGE IV
Review
NOT FOR CONSTRUCTION OR RECORDING

DWG. NO. D-1.2
___ OF ___

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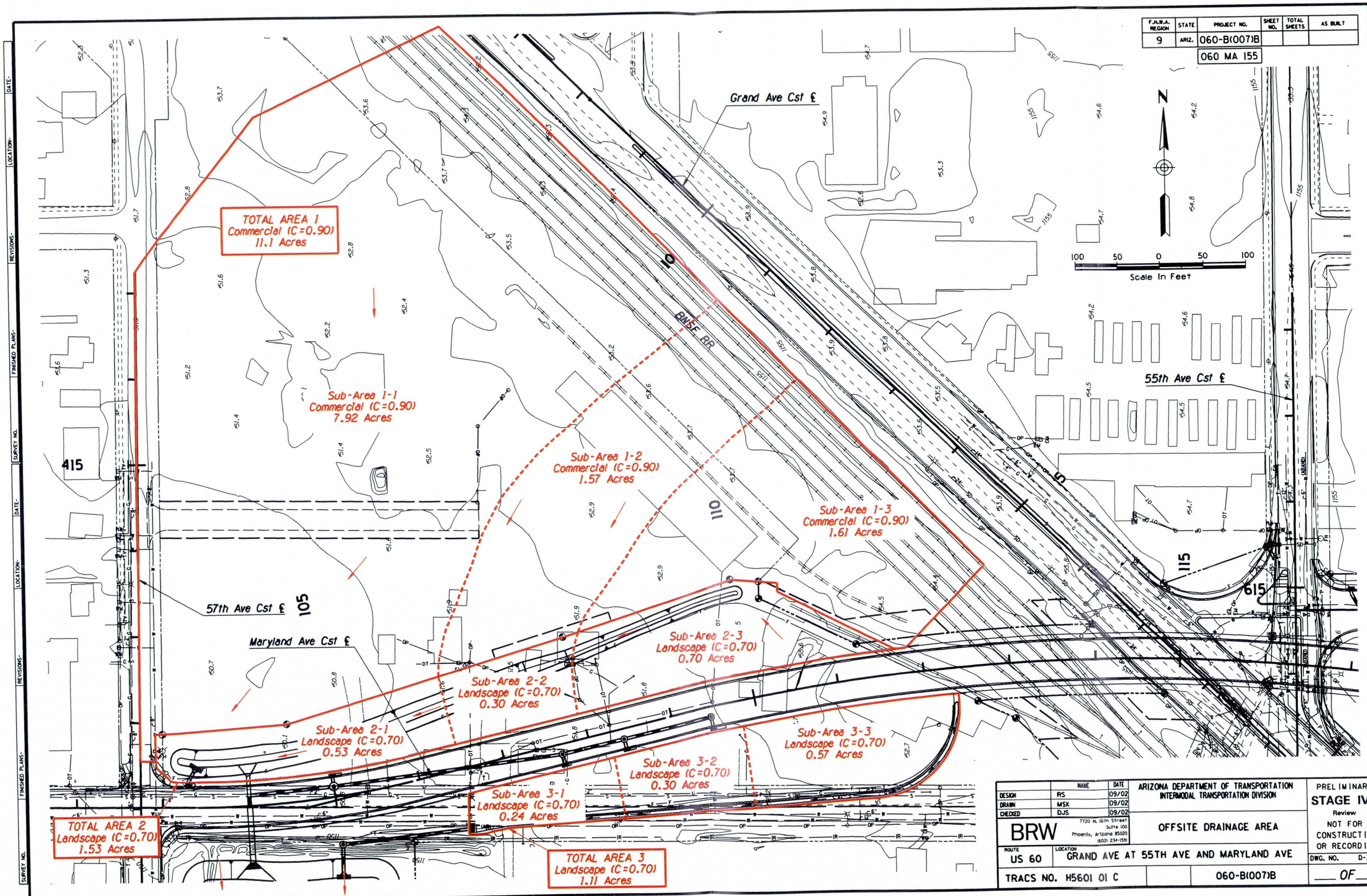
F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	060-B(007)B			
		060 MA 155			



	NAME	DATE
DESIGN	RS	09/02
DRAWN	MSK	09/02
CHECKED	DJS	09/02

BRW
7720 N. 16th Street
Suite 100
Phoenix, Arizona 85020
(602) 234-1591

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION

OFFSITE DRAINAGE AREA

ROUTE: US 60
LOCATION: GRAND AVE AT 55TH AVE AND MARYLAND AVE

TRACS NO. H5601 01 C
060-B(007)B

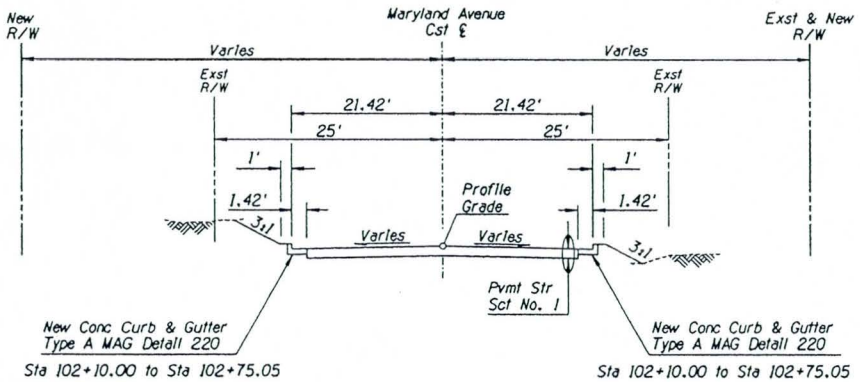
PRELIMINARY
STAGE IV
Review
NOT FOR CONSTRUCTION OR RECORDING

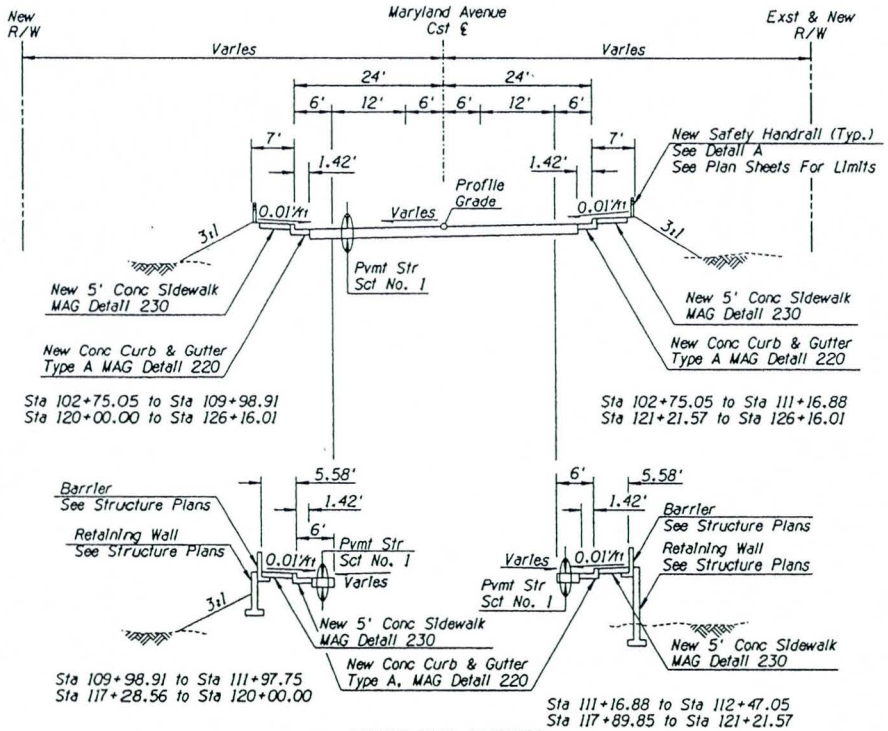
DWG. NO. D-3.1
___ OF ___

r:\11344239\mic\Dgn\D-offsite.dgn 09/27/2002 kpendergast 04:06:17 PM

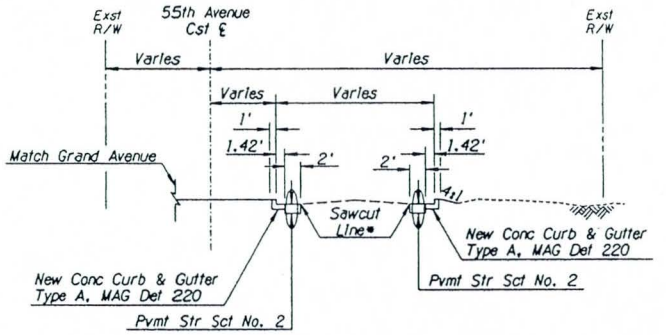
Appendix B
Roadway Typical Sections and Drainage Typical Sections

F.A.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	060-B(007)B			
		060 MA 155			





MARYLAND AVENUE
TYPICAL SECTION



*Match Exst

55TH AVENUE
TYPICAL SECTION

Note:
When the pavement slopes away from the gutter, the slope of the gutter shall match the pavement cross slope.

	NAME	DATE
DESIGN	J.L.C	09/02
DRAWN	M.U	09/02
CHECKED	CPR	09/02

BRW
1720 N. 16th Street
Suite 100
Phoenix, Arizona 85020
(602) 234-1159

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION

TYPICAL SECTIONS

PRELIMINARY
STAGE IV
Review
NOT FOR CONSTRUCTION OR RECORDING

ROUTE: US 60
LOCATION: GRAND AVE AT 55TH AVE AND MARYLAND AVE

DWG. NO. G-3.1

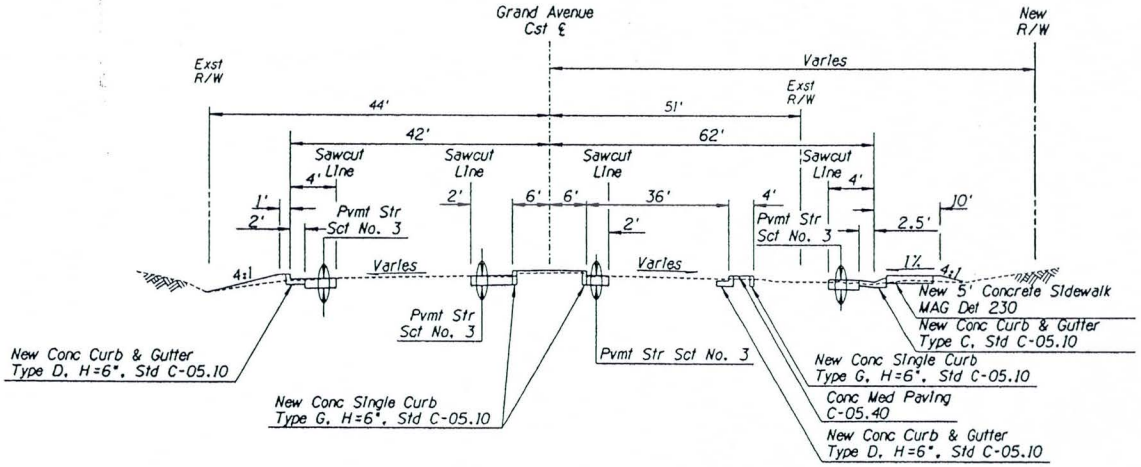
TRACS NO. H5601 01 C

060-B(007)B

___ OF ___

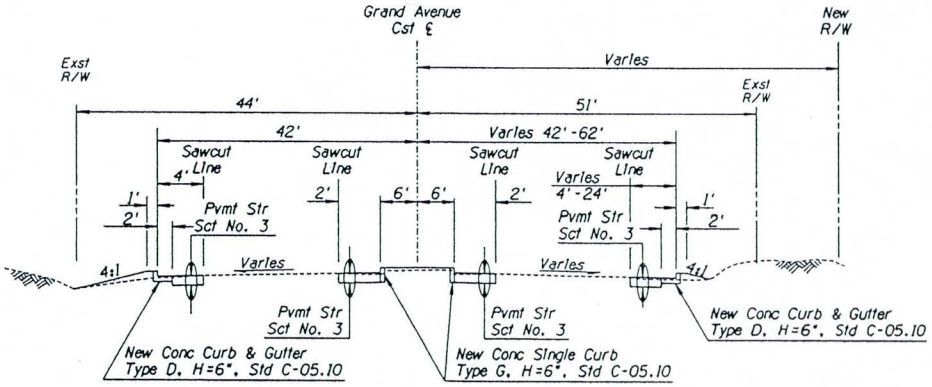
DATE:
LOCATION:
REVISIONS:
FINISHED PLANS:
SURVEY NO.
DATE:
LOCATION:
REVISIONS:
FINISHED PLANS:
SURVEY NO.

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	060-B(007)B			
		060 MA 155			



Sta 371+73.30 to Sta 0+59.13

GRAND AVENUE
TYPICAL SECTION



Sta 371+10.44 to Sta 371+73.30
Sta 0+59.13 to Sta 1+69.98

Sta 366+21.86 to Sta 371+73.30
Sta 0+59.13 to Sta 3+58.46

Sta 371+44.98 to Sta 371+73.30
Sta 0+59.13 to Sta 3+91.84

Sta 368+88.55 to Sta 371+73.30
Sta 0+59.13 to Sta 3+12.64

GRAND AVENUE
TYPICAL SECTION

	NAME	DATE
DESIGN	J.L.C	09/02
DRAWN	M.U	09/02
CHECKED	CPR	09/02

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ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION

TYPICAL SECTIONS

PRELIMINARY
STAGE IV
Review
NOT FOR CONSTRUCTION OR RECORDING

ROUTE: US 60
LOCATION: GRAND AVE AT 55TH AVE AND MARYLAND AVE

DWG. NO. G-3.2

TRACS NO. H5601 01 C

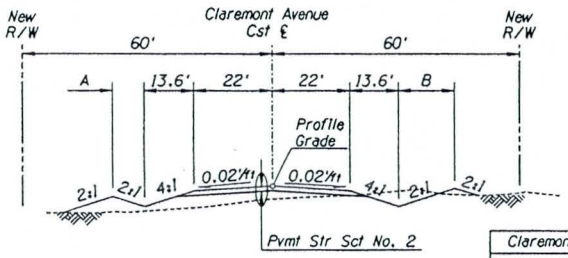
060-B(007)B

___ OF ___

DATE: LOCATION: REVISIONS: FINISHED PLANS: SURVEY NO. DATE: LOCATION: REVISIONS: FINISHED PLANS: SURVEY NO.

F.A.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	060-B(007)B			
		060 MA 155			

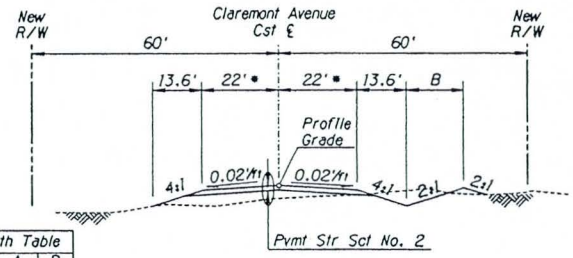
*Varies 214+27.02 to 215+04.35



Sta 201+18.00 to Sta 209+00.00

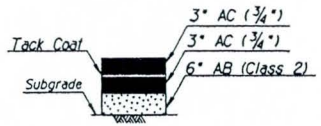
CLAREMONT STREET
TYPICAL SECTION

Claremont Street Ditch Width Table		
Station	A	B
201+18.00 to 205+00.00	14'	14'
205+50.00 to 208+50.00	11'	11'
209+00.00 to 209+50.00	N/A	11'
209+50.00 to 214+94.35	N/A	8'



Sta 209+00.00 to Sta 215+04.35

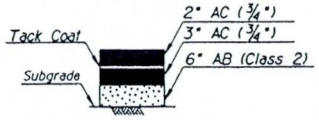
CLAREMONT STREET
TYPICAL SECTION



Total Thickness = 12"

SECTION NO. 1

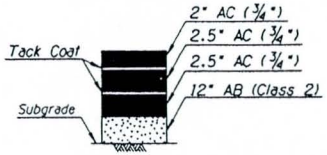
Maryland Avenue



Total Thickness = 11"

SECTION NO. 2

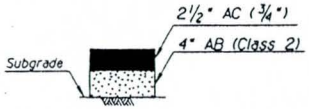
55th Avenue
57th Avenue
54th Avenue
Claremont Street
Sierra Vista Drive



Total Thickness = 19"

SECTION NO. 3

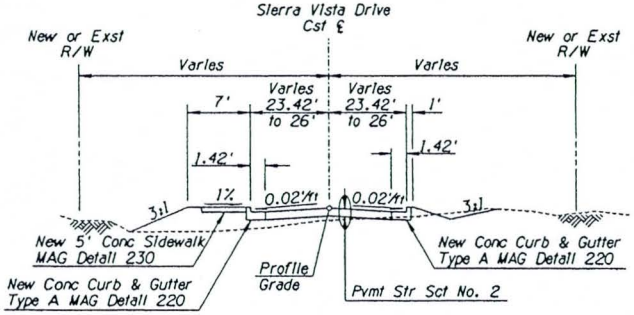
Grand Avenue



Total Thickness = 6 1/2"

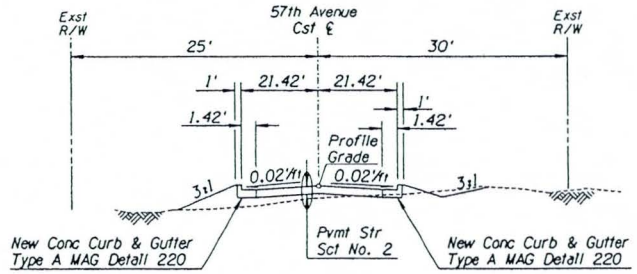
SECTION NO. 4

Temp Widening



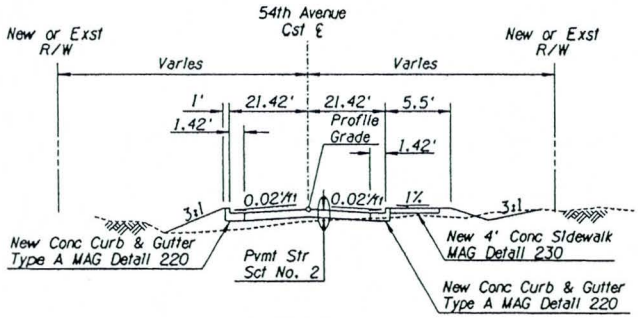
Sta 71+18.00 to Sta 79+25.77

SIERRA VISTA DRIVE
TYPICAL SECTION



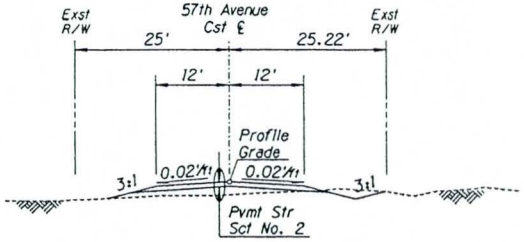
Sta 410+44.00 to Sta 411+01.48

57TH AVENUE
TYPICAL SECTION



Sta 51+25.50 to Sta 52+74.62

54TH AVENUE
TYPICAL SECTION



Sta 411+01.48 to Sta 411+75.00

57TH AVENUE
TYPICAL SECTION

	NAME	DATE
DESIGN	J.C	09/02
DRAWN	HOT	09/02
CHECKED	CPR	09/02

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ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION

TYPICAL SECTIONS

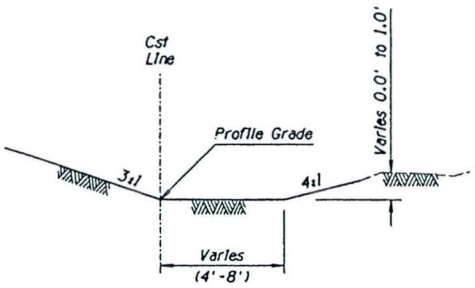
PRELIMINARY
STAGE IV
Review
NOT FOR CONSTRUCTION OR RECORDING

ROUTE: US 60 — LOCATION: GRAND AVE AT 55TH AVE AND MARYLAND AVE

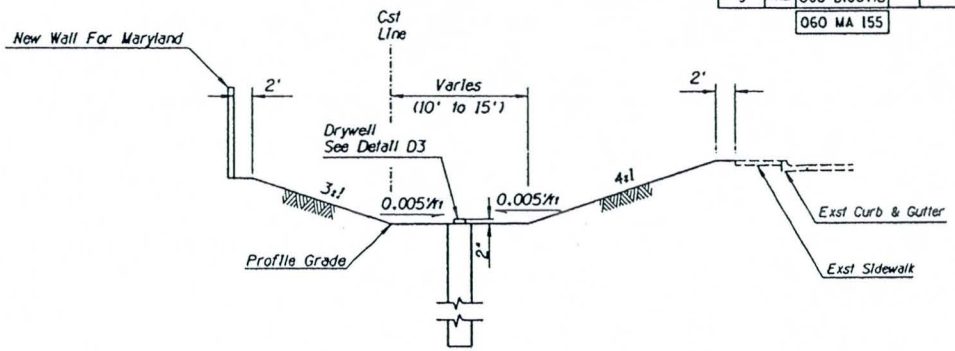
DWG. NO. G-3.3

TRACS NO. H5601 01 C — 060-B(007)B — ___ OF ___

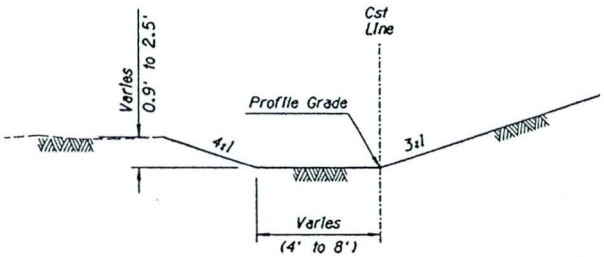
F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	060-B(007)B			
		060 MA 155			



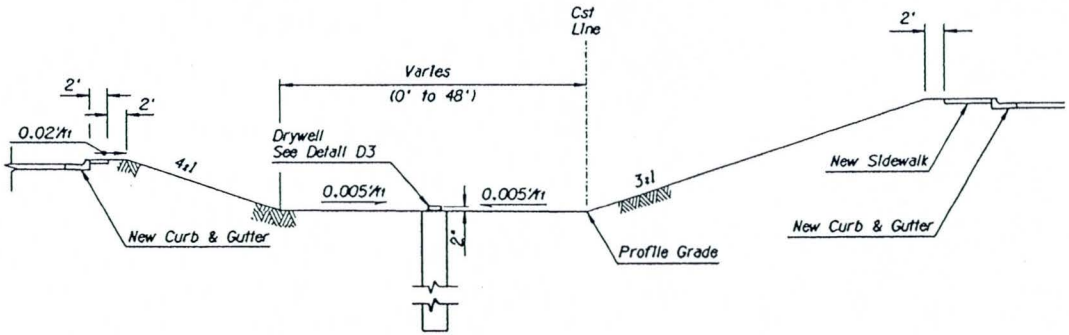
TYPICAL EARTHEN CHANNEL 1 (A / D-1.1)



RETENTION BASIN 2 (C / D-2.12)



TYPICAL EARTHEN CHANNEL 2 (B / D-1.1)



RETENTION BASIN 3 (D / D-2.12)

DETAIL D2

	NAME	DATE
DESIGN	DJS	09/02
DRAWN	KDP	09/02
CHECKED	DJS	09/02

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ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION

DRAINAGE DETAIL
TYPICAL SECTIONS,
CHANNELS/BASINS

PRELIMINARY
STAGE IV
Review
NOT FOR CONSTRUCTION OR RECORDING

ROUTE: US 60
LOCATION: GRAND AVE AT 55TH AVE AND MARYLAND AVE
DWG. NO. G-7.2

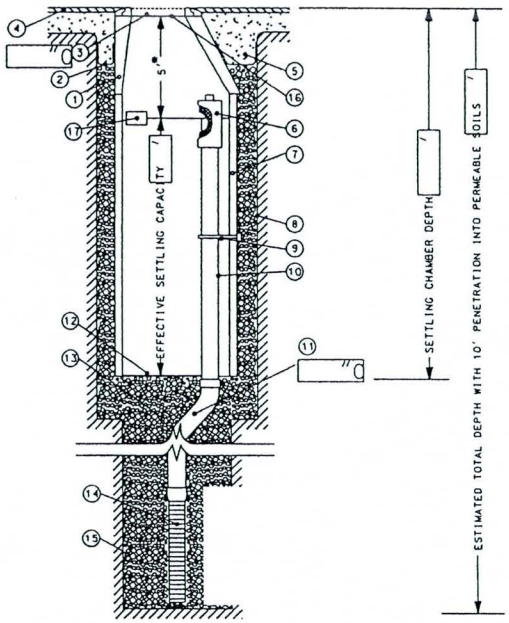
TRACS NO. H5601 01 C | 060-B(007)B | ___ OF ___

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	060-B(007)B			
		060 MA 155			

MaxWell IV Drainage System Detail And Specifications

1. MANHOLE CONE - MODIFIED FLAT BOTTOM.
2. MOISTURE MEMBRANE - 6 MIL PLASTIC. PLACE SECURELY AGAINST CONE AND HOLE SIDEWALL.
3. BOLTED RING & GRATE - CLEAN CAST IRON WITH WORDING "STORM WATER ONLY" IN RAISED LETTERS AND BOLTED IN TWO LOCATIONS. SECURED TO CONE WITH MORTAR. RIM ELEVATION ±0.02' OF PLANS.
4. GRADED BASIN OR PAVING - (BY OTHERS).
5. COMPACTED BASE MATERIAL - (BY OTHERS).
6. PUREFLO®DEBRIS SHIELD - ROLLED 16 GA. STEEL X 24" LENGTH WITH VENTED ANTI-SIPHON AND INTERNAL .265" MAX. SWO FLATTENED EXPANDED STEEL SCREEN X 12" LENGTH. FUSION BONDED EPOXY COATED.
7. PRECAST LINER - 4000 PSI CONCRETE 48" ID. 54" OD. CENTER IN HOLE AND ALIGN SECTIONS TO MAXIMIZE BEARING SURFACE.
8. MIN. 6' O DRILLED SHAFT.
9. SUPPORT BRACKET - FORMED 12 GA. STEEL. FUSION BONDED EPOXY COATED.
10. OVERFLOW PIPE - SCH 40 PVC MATED TO DRAINAGE PIPE BELOW BASE SEAL.
11. DRAINAGE PIPE - AOS HIGHWAY GRADE WITH MDI-A COUPLER. SUSPEND PIPE DURING BACKFILL OPERATIONS TO PREVENT BUCKLING OR BREAKAGE.
12. BASE SEAL - GEOTEXTILE. POLY LINER OR CONCRETE SLURRY.
13. ROCK - CLEAN AND WASHED. SIZED BETWEEN 3/8" AND 1-1/2". TO BEST COMPLEMENT SOIL CONDITIONS.
14. FLOFAST® DRAINAGE SCREEN - SCHEDULE 40 PVC 0.120 SLOTTED WELL SCREEN WITH 32 SLOTS PER ROW/FT. 96" OVERALL LENGTH WITH MDI-B COUPLER.
15. MIN. 4' O SHAFT - DRILLED IN A MANNER TO MAINTAIN PERMEABILITY OF DRAINAGE SOILS.
16. FABRIC SEAL - UV RESISTANT GEOTEXTILE - TO BE REMOVED BY CUSTOMER AT PROJECT COMPLETION.
17. ABSORBENT - HYDROPHOBIC PETROCHEMICAL SPONGE. MIN. 100 OZ. CAPACITY.

*FREEBOARD DEPTH VARIES WITH INLET PIPE ELEVATION. INCREASE INTERCEPTOR/SETTLING CHAMBER DEPTH AS NEEDED TO MAINTAIN ALL INLET PIPE ELEVATIONS ABOVE CONNECTOR PIPE OVERFLOW.



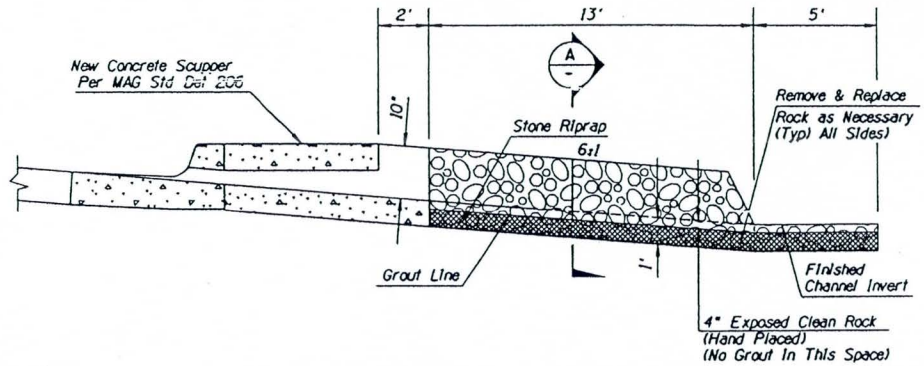
AZ Lic. 70465 A7067, ADWR 363
CA Lic. 528080, HAZ.
NV Lic. 35350

The MaxWell® IV
Manufactured and Installed by
McGUCKIN DRILLING, INC.
ARIZONA 602/268-0785
NEVADA 702/366-1234
CALIFORNIA 805/947-9836

U.S. Patent No. 4,923,330
©Trademark 1974, 1987, McGuckin Drilling, Inc.

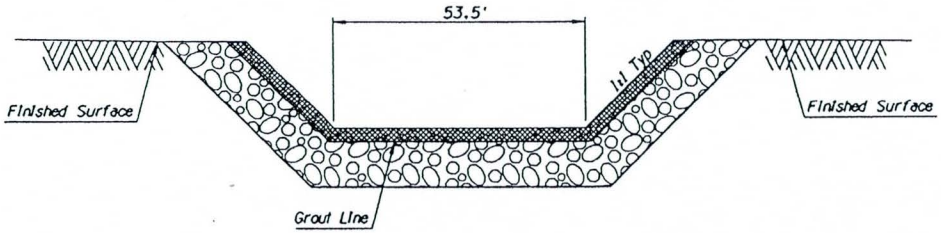
DRYWELL DETAIL

DETAIL D3



TYPICAL AT SCUPPER/STONE RIPRAP

Sta 125+50, Lt
Maryland Ave ℄



SECTION A
NTS

SCUPPER/STONE RIPRAP DETAIL

DETAIL D4

	NAME	DATE
DESIGN	RS	09/02
DRAWN	WSK	09/02
CHECKED	DJS	09/02

BRW — 7720 N. 16th Street, Suite 100, Phoenix, Arizona 85020, (602) 331-0191

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION

DRAINAGE DETAIL
DRYWELL &
SCUPPER/STONE RIPRAP DETAILS

ROUTE: US 60
LOCATION: GRAND AVE AT 55TH AVE AND MARYLAND AVE

TRACS NO. H5601 01 C | 060-B(007)B

PRELIMINARY
STAGE IV
Review
NOT FOR CONSTRUCTION OR RECORDING

DWG. NO. G-7.3

___ OF ___

Appendix C
On-site Areas and Times of Concentration
(Storm Sewer Runoff Calculation Record)

- Ten-Year Storm Event
- Fifty-Year Storm Event

- Ten-Year Storm Event

STORM SEWER RUNOFF CALCULATION RECORD

BRW INC.
Engineering
Transportation
Planning
Urban Design
Landscape Architects

LOCATION DATA

STREET: 55TH AVE. & MARYLAND AVE.
LOCATION: MARYLAND AVE.
PROJ. NO.:

DESIGN DATA

FREQUENCY: 10 years
P6= 1.94 Inches P24= 2.40 Inches P1= 1.50 Inches

RUNOFF CALCULATIONS

	DRAINAGE AREA			PAVEMENT SLOPES & SPREAD (1)			PAVEMENT			DESERT LANDSCAPING							Tc	INTENSITY	Q (2)
CB- NO.	Station		ACRES	SX	SL	T	C	A	CA	C	A	CA	C	A	CA	SUM CA	min	inches/hr	cfs
1	105+00	103+30L	0.24				0.95	0.24	0.23	0.70	0.00	0.00	0.00	0.00	0.00	0.23	10	4.28	0.98
2	107+66	105+00L	0.39				0.95	0.39	0.37	0.70	0.00	0.00	0.00	0.00	0.00	0.37	10	4.28	1.59
51 (3)		106+45R	1.27				0.95	0.00	0.00	0.70	1.27	0.89	0.00	0.00	0.00	0.89	10	4.28	3.80
3	108+10	107+66R	0.06				0.95	0.06	0.06	0.70	0.00	0.00	0.00	0.00	0.00	0.06	10	4.28	0.24
4	109+45	108+10R	0.19				0.95	0.19	0.18	0.70	0.00	0.00	0.00	0.00	0.00	0.18	10	4.28	0.77
5	114+00	109+45R	0.65				0.95	0.65	0.62	0.70	0.00	0.00	0.00	0.00	0.00	0.62	10	4.28	2.64
6	114+00	118+70R	0.67				0.95	0.67	0.64	0.70	0.00	0.00	0.00	0.00	0.00	0.64	10	4.28	2.72
7	118+70	121+70R	0.33				0.95	0.33	0.31	0.70	0.00	0.00	0.00	0.00	0.00	0.31	10	4.28	1.34
8	120+33	122+50L	0.15				0.95	0.15	0.14	0.70	0.00	0.00	0.00	0.00	0.00	0.14	10	4.28	0.61
SC-1 W	123+60	125+50L	0.14				0.95	0.14	0.13	0.70	0.00	0.00	0.00	0.00	0.00	0.13	10	4.28	0.57
SC-1 E	126+15	125+50L	0.05				0.95	0.05	0.05	0.70	0.00	0.00	0.00	0.00	0.00	0.05	10	4.28	0.20
9 W	121+70	125+78R	0.29				0.95	0.29	0.28	0.70	0.00	0.00	0.00	0.00	0.00	0.28	10	4.28	1.18
9 E	129+45	125+78R	0.26				0.95	0.26	0.25	0.70	0.00	0.00	0.00	0.00	0.00	0.25	10	4.28	1.06
10	143+50	126+15L	1.23				0.95	1.23	1.17	0.70	0.00	0.00	0.00	0.00	0.00	1.17	10	4.28	5.00

Sx: Cross-Slope SL: Longitudinal Slope T: Spread (feet) CB: Catch Basin SC: Scupper

Computed by: RS Date: SEPTEMBER 30, 2002 Checked by: DJS

NOTES:
(1) - SEE STORM SEWER INLET CALCULATION RECORD FOR PAVEMENT PARAMETERS
(2) - SEE HEC12 RESULTS FOR ACTUAL Q INTERCEPTION AT CATCH BASIN
(3) - OFF ROAD CATCH BASIN
(4) - OFFSITE RUNOFF

STORM SEWER RUNOFF CALCULATION RECORD

BRW INC.
Engineering
Transportation
Planning
Urban Design
Landscape Architects

LOCATION DATA

STREET 55TH AVE. & MARYLAND AVE.

LOCATION SIERRA VISTA DR.

PROJ. NO.

DESIGN DATA

FREQUENCY 10 years

P6= 1.94 Inches P24= 2.40 Inches P1= 1.50 Inches

RUNOFF CALCULATIONS

	DRAINAGE AREA			PAVEMENT SLOPES & SPREAD (1)			PAVEMENT			DESERT LANDSCAPING							Tc	INTENSITY	Q (2)
CB- NO.	Station		ACRES	SX	SL	T	C	A	CA	C	A	CA	C	A	CA	SUM CA	min	inches/hr	cfs
21 W	71+00	71+61L	0.04				0.95	0.04	0.04	0.70	0.00	0.00	0.00	0.00	0.00	0.04	10	4.28	0.16
21 E	74+03	71+61L	0.17				0.95	0.17	0.16	0.70	0.00	0.00	0.00	0.00	0.00	0.16	10	4.28	0.69
22 W	71+00	71+84R	0.09				0.95	0.09	0.09	0.70	0.00	0.00	0.00	0.00	0.00	0.09	10	4.28	0.37
22 E	74+03	71+84R	0.16				0.95	0.16	0.15	0.70	0.00	0.00	0.00	0.00	0.00	0.15	10	4.28	0.65
23		76+67L	0.00				0.95	0.00	0.00	0.70	0.00	0.00	0.00	0.00	0.00	0.00	10	4.28	18.7 (4)
24		76+67R	0.00				0.95	0.00	0.00	0.70	0.00	0.00	0.00	0.00	0.00	0.00	10	4.28	18.7 (4)
27		78+59L	0.00				0.95	0.00	0.00	0.70	0.00	0.00	0.00	0.00	0.00	0.00	10	4.28	5 (4)

Sx: Cross-Slope SL: Longitudinal Slope T: Spread (feet) CB: Catch Basin SC: Scupper

Computed by: RS Date: SEPTEMBER 30, 2002 Checked by: DJS

NOTES:

(1) - SEE STORM SEWER INLET CALCULATION RECORD FOR PAVEMENT PARAMETERS

(2) - SEE HEC12 RESULTS FOR ACTUAL Q INTERCEPTION AT CATCH BASIN

(3) - OFF ROAD CATCH BASIN

(4) - OFFSITE RUNOFF

STORM SEWER RUNOFF CALCULATION RECORD

BRW INC.
Engineering
Transportation
Planning
Urban Design
Landscape Architects

LOCATION DATA

STREET 55TH AVE. & MARYLAND AVE.

LOCATION 54TH AVE.

PROJ. NO.

DESIGN DATA

FREQUENCY 10 years

P6= 1.94 Inches P24= 2.40 Inches P1= 1.50 Inches

RUNOFF CALCULATIONS

	DRAINAGE AREA			PAVEMENT SLOPES & SPREAD (1)			PAVEMENT			DESERT LANDSCAPING							Tc	INTENSITY	Q (2)
CB- NO.	Station		ACRES	SX	SL	T	C	A	CA	C	A	CA	C	A	CA	SUM CA	min	inches/hr	cfs
25		52+25R	0.00				0.95	0.00	0.00	0.70	0.00	0.00	0.00	0.00	0.00	0.00	10	4.28	13.3 (4)
26		51+60L	0.00				0.95	0.00	0.00	0.70	0.00	0.00	0.00	0.00	0.00	0.00	10	4.28	11.4 (4)

Sx: Cross-Slope SL: Longitudinal Slope T: Spread (feet) CB: Catch Basin SC: Scupper

Computed by: RS Date: SEPTEMBER 30, 2002 Checked by: DJS

NOTES:

(1) - SEE STORM SEWER INLET CALCULATION RECORD FOR PAVEMENT PARAMETERS

(2) - SEE HEC12 RESULTS FOR ACTUAL Q INTERCEPTION AT CATCH BASIN

(3) - OFF ROAD CATCH BASIN

(4) - OFFSITE RUNOFF 100 YEAR

- **Fifty-Year Storm Event**

STORM SEWER RUNOFF CALCULATION RECORD

BRW INC.
Engineering
Transportation
Planning
Urban Design
Landscape Architects

LOCATION DATA

STREET 55TH AVE. & MARYLAND AVE.

LOCATION MARYLAND AVE.

PROJ. NO.

DESIGN DATA

FREQUENCY 50 years

P6= 2.68 Inches P24= 3.38 Inches P1= 2.05 Inches

RUNOFF CALCULATIONS

	DRAINAGE AREA			PAVEMENT SLOPES & SPREAD (1)			PAVEMENT			DESERT LANDSCAPING							Tc	INTENSITY	Q (2)
CB- NO.	Station		ACRES	SX	SL	T	C	A	CA	C	A	CA	C	A	CA	SUM CA	min	inches/hr	cfs
1	105+00	103+30L	0.24				0.95	0.24	0.23	0.70	0.00	0.00	0.00	0.00	0.00	0.23	10	5.69	1.30
2	107+66	105+00L	0.39				0.95	0.39	0.37	0.70	0.00	0.00	0.00	0.00	0.00	0.37	10	5.69	2.11
51 (3)		106+45R	1.27				0.95	0.00	0.00	0.70	1.27	0.89	0.00	0.00	0.00	0.89	10	5.69	5.06
3	108+10	107+66R	0.06				0.95	0.06	0.06	0.70	0.00	0.00	0.00	0.00	0.00	0.06	10	5.69	0.32
4	109+45	108+10R	0.19				0.95	0.19	0.18	0.70	0.00	0.00	0.00	0.00	0.00	0.18	10	5.69	1.03
5	114+00	109+45R	0.65				0.95	0.65	0.62	0.70	0.00	0.00	0.00	0.00	0.00	0.62	10	5.69	3.51
6	114+00	118+70R	0.67				0.95	0.67	0.64	0.70	0.00	0.00	0.00	0.00	0.00	0.64	10	5.69	3.62
7	118+70	121+70R	0.33				0.95	0.33	0.31	0.70	0.00	0.00	0.00	0.00	0.00	0.31	10	5.69	1.78
8	120+33	122+50L	0.15				0.95	0.15	0.14	0.70	0.00	0.00	0.00	0.00	0.00	0.14	10	5.69	0.81
SC-1 W	123+60	125+50L	0.14				0.95	0.14	0.13	0.70	0.00	0.00	0.00	0.00	0.00	0.13	10	5.69	0.76
SC-1 E	126+15	125+50L	0.05				0.95	0.05	0.05	0.70	0.00	0.00	0.00	0.00	0.00	0.05	10	5.69	0.27
9 W	121+70	125+78R	0.29				0.95	0.29	0.28	0.70	0.00	0.00	0.00	0.00	0.00	0.28	10	5.69	1.57
9 E	129+45	125+78R	0.26				0.95	0.26	0.25	0.70	0.00	0.00	0.00	0.00	0.00	0.25	10	5.69	1.41
10	143+50	126+15L	1.23				0.95	1.23	1.17	0.70	0.00	0.00	0.00	0.00	0.00	1.17	10	5.69	6.65

Sx: Cross-Slope SL: Longitudinal Slope T: Spread (feet) CB: Catch Basin SC: Scupper

Computed by: RS Date: SEPTEMBER 30, 2002 Checked by: DJS

NOTES:

(1) - SEE STORM SEWER INLET CALCULATION RECORD FOR PAVEMENT PARAMETERS

(2) - SEE HEC12 RESULTS FOR ACTUAL Q INTERCEPTION AT CATCH BASIN

(3) - OFF ROAD CATCH BASIN

(4) - OFFSITE RUNOFF 100 YEAR

STORM SEWER RUNOFF CALCULATION RECORD

BRW INC.
Engineering
Transportation
Planning
Urban Design
Landscape Architects

LOCATION DATA

STREET 55TH AVE. & MARYLAND AVE.

LOCATION SIERRA VISTA DR.

PROJ. NO.

DESIGN DATA

FREQUENCY 50 years

P6= 2.68 Inches P24= 3.38 Inches P1= 2.05 Inches

RUNOFF CALCULATIONS

	DRAINAGE AREA			PAVEMENT SLOPES & SPREAD (1)			PAVEMENT			DESERT LANDSCAPING							Tc	INTENSITY	Q (2)
CB- NO.	Station		ACRES	SX	SL	T	C	A	CA	C	A	CA	C	A	CA	SUM CA	min	inches/hr	cfs
21 W	71+00	71+61L	0.04				0.95	0.04	0.04	0.70	0.00	0.00	0.00	0.00	0.00	0.04	10	5.69	0.22
21 E	74+03	71+61L	0.17				0.95	0.17	0.16	0.70	0.00	0.00	0.00	0.00	0.00	0.16	10	5.69	0.92
22 W	71+00	71+84R	0.09				0.95	0.09	0.09	0.70	0.00	0.00	0.00	0.00	0.00	0.09	10	5.69	0.49
22 E	74+03	71+84R	0.16				0.95	0.16	0.15	0.70	0.00	0.00	0.00	0.00	0.00	0.15	10	5.69	0.86
23		76+67L	0.00				0.95	0.00	0.00	0.70	0.00	0.00	0.00	0.00	0.00	0.00	10	5.69	18.7 (4)
24		76+67R	0.00				0.95	0.00	0.00	0.70	0.00	0.00	0.00	0.00	0.00	0.00	10	5.69	18.7 (4)
27		78+59L	0.00				0.95	0.00	0.00	0.70	0.00	0.00	0.00	0.00	0.00	0.00	10	5.69	5 (4)

Sx: Cross-Slope SL: Longitudinal Slope T: Spread (feet) CB: Catch Basin SC: Scupper

Computed by: RS Date: SEPTEMBER 30, 2002 Checked by: DJS

NOTES:

(1) - SEE STORM SEWER INLET CALCULATION RECORD FOR PAVEMENT PARAMETERS

(2) - SEE HEC12 RESULTS FOR ACTUAL Q INTERCEPTION AT CATCH BASIN

(3) - OFF ROAD CATCH BASIN

(4) - OFFSITE RUNOFF 100 YEAR

STORM SEWER RUNOFF CALCULATION RECORD

BRW INC.
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Urban Design
Landscape Architects

LOCATION DATA

STREET 55TH AVE. & MARYLAND AVE.

LOCATION 54TH AVE.

PROJ. NO.

DESIGN DATA

FREQUENCY 50 years

P6= 2.68 Inches P24= 3.38 Inches P1= 2.05 Inches

RUNOFF CALCULATIONS

	DRAINAGE AREA			PAVEMENT SLOPES & SPREAD (1)			PAVEMENT			DESERT LANDSCAPING							Tc	INTENSITY	Q (2)
CB- NO.	Station		ACRES	SX	SL	T	C	A	CA	C	A	CA	C	A	CA	SUM CA	min	inches/hr	cfs
25		52+25R	0.00				0.95	0.00	0.00	0.70	0.00	0.00	0.00	0.00	0.00	0.00	10	5.69	13.3 (4)
26		51+60L	0.00				0.95	0.00	0.00	0.70	0.00	0.00	0.00	0.00	0.00	0.00	10	5.69	11.4 (4)

Sx: Cross-Slope SL: Longitudinal Slope T: Spread (feet) CB: Catch Basin SC: Scupper

Computed by: RS Date: SEPTEMBER 30, 2002 Checked by: DJS

NOTES:
(1) - SEE STORM SEWER INLET CALCULATION RECORD FOR PAVEMENT PARAMETERS
(2) - SEE HEC12 RESULTS FOR ACTUAL Q INTERCEPTION AT CATCH BASIN
(3) - OFF ROAD CATCH BASIN
(4) - OFFSITE RUNOFF 100 YEAR

Appendix D
Pavement Drainage Analysis (HEC-12)
(Storm Inlet Calculations Record)

- Ten-Year Storm Event
- Fifty-Year Storm Event

- **Ten-Year Storm Event**

STORM SEWER INLET CALCULATION RECORD

BRW INC.

Engineering
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Urban Design
Landscape Architects

LOCATION DATA

STREET: 55 TH & MARYLAND AVE.
LOCATION: MARYLAND AVE.
PRO. NO.:

DESIGN DATA

FREQUENCY: 10 years
P6= 1.94 Inches
P24= 2.40 Inches
P1= 1.50 Inches

STORM SEWER INLET CALCULATIONS

Inlet			Q	Carryover	Design Q	Inlet	Curb Opening	Wing / Slot	Gutter	Pavement		Spread T(ft)		Intercepted	Flowby	
No.	Station	Offset	(cfs)	(cfs)	(cfs)	Std.	L (ft)	L (ft)	Type	Sx	Sl	Actual	Allow	Flow (cfs)	(cfs)	Notes
1	103+30	22.58' LT	0.98	0.0	0.98	3	7	3.5 E	16	0.020	0.0166	5.91	6.0	0.98	0.0	
2	105+00	22.58' LT	1.59	0.0	1.59	3	7	7.5 E	16	0.020	0.0369	5.81	6.0	1.59	0.0	
51	106+45	71' RT	3.80	0.0	3.80	2								3.80	0.0	OFFROAD CATCH BASIN
3	107+66	22.58' RT	0.24	0.0	0.24	3	7	3.5 E	16	0.005	0.0473	4.38	6.0	0.24	0.0	
4	108+10	22.58' RT	0.77	0.0	0.77	3	11	7.5 E	16	0.010	0.0473	5.20	6.0	0.77	0.0	
5	109+45	22.58' RT	2.64	0.0	2.64	3	23	19.5 E	16	0.025	0.0475	5.87	6.0	2.64	0.0	
6	118+70	22.58' RT	2.72	0.0	2.72	3	23	19.5 W	16	0.025	0.0500	5.89	6.0	2.72	0.0	
7	121+70	22.58' RT	1.34	0.0	1.34	3	11	7.5 W	16	0.020	0.0353	5.51	6.0	1.34	0.0	
8	122+50	22.58' LT	0.61	0.0	0.61	3	7	3.5 W	16	0.020	0.0284	4.11	6.0	0.61	0.0	
SC-1	125+50	24' LT	0.77	0.0	0.77	9	48		16	0.020	SAG	0.99	6.0	0.77	0.0	
9	125+78	22.58' RT	2.24	0.0	2.24	4	43	19.5	16	0.020	SAG	2.15	6.0	2.24	0.0	
10	126+15	22.58' LT	5.00	0.0	5.00	3	23	19.5 E	16	0.020	0.0020	16.56	6.0	5.00	0.0	FLOOD CONDITION

Sx: Cross-Slope Sl: Longitudinal Slope CB: Catch Basin SC: Scupper

Computed by: RS Date: SEPTEMBER 30, 2002 Checked by: DJS

NOTE: FOR ACTUAL Q CALCULATIONS, SEE APPENDIX B.

1- ADOT C-15.30 (SINGLE)
2- ADOT C-15.30 (DOUBLE)
3- ADOT C-15.20 (ONE WING)
4- ADOT C-15.20 (TWO WINGS)
5- ADOT C-05.10 (CURB & GUTTER TYPE D)
6- MAG 531
7- MAG 532
8- MAG 534, Type E
9- SCUPPER
10- ADOT C-15.10 (Double)
11- ADOT C-05.10 (SINGLE CURB TYPE A1)
12- CONCRETE BARRIER
13- ADOT C-15.10 (SINGLE)
14- ADOT C-05.10 (CURB & GUTTER TYPE B)
15- ADOT C-05.10 (CURB & GUTTER TYPE C)
16- MAG 220 (CURB & GUTTER TYPE A)
17- ADOT C-15.91
18- ADOT C-15.91 (SPECIAL)
19- ADOT C-15.80
20- ADOT C-15.20 (SUMP ONLY)

STORM SEWER INLET CALCULATION RECORD

BRW INC.

Engineering
Transportation
Planning
Urban Design
Landscape Architects

LOCATION DATA

STREET: 55 TH & MARYLAND AVE.
LOCATION: SIERRA VISTA DR.
PRO. NO.:

DESIGN DATA

FREQUENCY: 10 years
P6= 1.94 Inches
P24= 2.40 Inches
P1= 1.50 Inches

STORM SEWER INLET CALCULATIONS

Inlet			Q	Carryover	Design Q	Inlet	Curb Opening	Wing / Slot	Gutter	Pavement		Spread T(ft)		Intercepted	Flowby	
No.	Station	Offset	(cfs)	(cfs)	(cfs)	Std.	L (ft)	L (ft)	Type	Sx	SI	Actual	Allow	Flow (cfs)	(cfs)	Notes
21	71+61	22' LT	0.87	0.0	0.87	20	3		16	0.020	SAG	4.61	6.0	0.87	0.0	
22	71+84	22' RT	1.02	0.0	1.02	20	3		16	0.020	SAG	5.18	6.0	1.02	0.0	
23	76+67	24.58' LT	18.70	0.0	18.70	4	19	7.5	16	0.020	SAG	15.18	6.0	18.70	0.0	FLOOD CONDITION
24	76+67	24.58' RT	18.70	0.0	18.70	4	19	7.5	16	0.020	SAG	15.18	6.0	18.70	0.0	FLOOD CONDITION
27	78+59	84.42' LT	5.00	0.0	5.00	3	11	7.5 N	16	0.020	SAG	7.25	6.0	5.00	0.0	FLOOD CONDITION

Sx: Cross-Slope SI: Longitudinal Slope CB: Catch Basin SC: Scupper

Computed by: RS Date: SEPTEMBER 30, 2002 Checked by: DJS

NOTE: FOR ACTUAL Q CALCULATIONS, SEE APPENDIX B.

1- ADOT C-15.30 (SINGLE)
2- ADOT C-15.30 (DOUBLE)
3- ADOT C-15.20 (ONE WING)
4- ADOT C-15.20 (TWO WINGS)
5- ADOT C-05.10 (CURB & GUTTER TYPE D)
6- MAG 531
7- MAG 532
8- MAG 534, Type E
9- SCUPPER
10- ADOT C-15.10 (Double)
11- ADOT C-05.10 (SINGLE CURB TYPE A1)
12- CONCRETE BARRIER
13- ADOT C-15.10 (SINGLE)
14- ADOT C-05.10 (CURB & GUTTER TYPE B)
15- ADOT C-05.10 (CURB & GUTTER TYPE C)
16- MAG 220 (CURB & GUTTER TYPE A)
17- ADOT C-15.91
18- ADOT C-15.91 (SPECIAL)
19- ADOT C-15.80
20- ADOT C-15.20 (SUMP ONLY)

STORM SEWER INLET CALCULATION RECORD

BRW INC.

Engineering
Transportation
Planning
Urban Design
Landscape Architects

LOCATION DATA

STREET: 55 TH & MARYLAND AVE.
LOCATION: 54TH AVE.
PRO. NO:

DESIGN DATA

FREQUENCY: 10 years
P6= 1.94 Inches
P24= 2.40 Inches
P1= 1.50 Inches

STORM SEWER INLET CALCULATIONS

Inlet			Q	Carryover	Design Q	Inlet	Curb Opening	Wing / Slot	Gutter	Pavement		Spread T(ft)		Intercepted	Flowby	
No.	Station	Offset	(cfs)	(cfs)	(cfs)	Std.	L (ft)	L (ft)	Type	Sx	SI	Actual	Allow	Flow (cfs)	(cfs)	Notes
25	52+25	20' RT	13.30	0.0	13.30	3	15	11.5 N	16	0.020	SAG	15.18	6.0	13.30	0.0	FLOOD CONDITION
26	51+60	20' LT	11.40	0.0	11.40	3	15	11.5 N	16	0.020	SAG	15.10	6.0	11.40	0.0	FLOOD CONDITION

Sx: Cross-Slope SI: Longitudinal Slope CB: Catch Basin SC: Scupper

Computed by: RS Date: SEPTEMBER 30, 2002 Checked by: DJS

NOTE: FOR ACTUAL Q CALCULATIONS, SEE APPENDIX B.

1- ADOT C-15.30 (SINGLE)
2- ADOT C-15.30 (DOUBLE)
3- ADOT C-15.20 (ONE WING)
4- ADOT C-15.20 (TWO WINGS)
5- ADOT C-05.10 (CURB & GUTTER TYPE D)
6- MAG 531
7- MAG 532
8- MAG 534, Type E
9- SCUPPER
10- ADOT C-15.10 (Double)
11- ADOT C-05.10 (SINGLE CURB TYPE A1)
12- CONCRETE BARRIER
13- ADOT C-15.10 (SINGLE)
14- ADOT C-05.10 (CURB & GUTTER TYPE B)
15- ADOT C-05.10 (CURB & GUTTER TYPE C)
16- MAG 220 (CURB & GUTTER TYPE A)
17- ADOT C-15.91
18- ADOT C-15.91 (SPECIAL)
19- ADOT C-15.80
20- ADOT C-15.20 (SUMP ONLY)

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Project : MARYLAND AVE.

```
Sta 109+45R                                INPUT
Intens.= 4.28 C1=0.95  A1= 0.62 Qadd   =  0.0    Slope1= 6.0000 Gutter= 1.42 Area  = 0.00
CB ID  = 5    C2=0.70  A2= 0.00 Qrunoff=  2.5    Slope2= 0.0417 a     = 2.00 Perim = 0.00
Curb Opening  C3=0.00  A3= 0.00 Grade  =  0.0467 Slope3= 0.0250 W     = 1.42 Length=23.00
.......................................................................................
                                           OUTPUT
Flowby=  0.0 Qtotal=  2.5 Qint=  2.5 Flowby dn=  0.0 Depth=0.17 Spread=  5.89 Veloc= 5.61
---------------------------------------------------------------------------------------
Sta 108+10R                                INPUT
Intens.= 4.28 C1=0.95  A1= 0.18 Qadd   =  0.0    Slope1= 6.0000 Gutter= 1.42 Area  = 0.00
CB ID  = 4    C2=0.70  A2= 0.00 Qrunoff=  0.7    Slope2= 0.0417 a     = 2.00 Perim = 0.00
Curb Opening  C3=0.00  A3= 0.00 Grade  =  0.0473 Slope3= 0.0103 W     = 1.42 Length=11.00
.......................................................................................
                                           OUTPUT
Flowby=  0.0 Qtotal=  0.7 Qint=  0.7 Flowby dn=  0.0 Depth=0.10 Spread=  5.87 Veloc= 3.52
---------------------------------------------------------------------------------------
Sta 107+66R                                INPUT
Intens.= 4.28 C1=0.95  A1= 0.06 Qadd   =  0.0    Slope1= 6.0000 Gutter= 1.42 Area  = 0.00
CB ID  = 3    C2=0.70  A2= 0.00 Qrunoff=  0.2    Slope2= 0.0417 a     = 2.00 Perim = 0.00
Curb Opening  C3=0.00  A3= 0.00 Grade  =  0.0473 Slope3= 0.0050 W     = 1.42 Length= 7.00
.......................................................................................
                                           OUTPUT
Flowby=  0.0 Qtotal=  0.2 Qint=  0.2 Flowby dn=  0.0 Depth=0.07 Spread=  4.38 Veloc= 2.88
---------------------------------------------------------------------------------------
Sta 105+00L                                INPUT
Intens.= 4.28 C1=0.95  A1= 0.38 Qadd   =  0.0    Slope1= 6.0000 Gutter= 1.42 Area  = 0.00
CB ID  = 2    C2=0.70  A2= 0.00 Qrunoff=  1.6    Slope2= 0.0417 a     = 2.00 Perim = 0.00
Curb Opening  C3=0.00  A3= 0.00 Grade  =  0.0369 Slope3= 0.0200 W     = 1.42 Length=11.00
.......................................................................................
                                           OUTPUT
Flowby=  0.0 Qtotal=  1.6 Qint=  1.5 Flowby dn=  0.0 Depth=0.15 Spread=  5.81 Veloc= 4.31
---------------------------------------------------------------------------------------
Sta 103+21L                                INPUT
Intens.= 4.28 C1=0.95  A1= 0.26 Qadd   =  0.0    Slope1= 6.0000 Gutter= 1.42 Area  = 0.00
CB ID  = 1    C2=0.70  A2= 0.00 Qrunoff=  1.0    Slope2= 0.0417 a     = 2.00 Perim = 0.00
Curb Opening  C3=0.00  A3= 0.00 Grade  =  0.0162 Slope3= 0.0200 W     = 1.42 Length= 7.00
.......................................................................................
                                           OUTPUT
Flowby=  0.0 Qtotal=  1.1 Qint=  1.0 Flowby dn=  0.0 Depth=0.15 Spread=  5.91 Veloc= 2.87
---------------------------------------------------------------------------------------
                                        CRITERIA
Runoff computed by Rational Method   Manning's n Gutter=0.012  Manning's n Pavement=0.016
Clogging Factors in Sag Location:
----- Curb Opening= 1.25 Grate= 2.00 Slotted Drain= 2.00 Comb-Curb= 1.25 Comb-Grate= 2.00
Clogging Factors on Continuous Grade:
----- Curb Opening= 1.25 Grate= 2.00 Slotted Drain= 1.50 Comb-Curb= 1.50 Comb-Grate= 2.00
---------------------------------------------------------------------------------------
Prepared by:          Date:09/27/10    Time:16:59:32     Checked by:        Date:
```
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Project : MARYLAND AVE.

```
Sta 118+70R                                INPUT
Intens.= 4.28 C1=0.95  A1= 0.64 Qadd   =  0.0    Slope1= 6.0000 Gutter= 1.42 Area  = 0.00
CB ID  = 6    C2=0.70  A2= 0.00 Qrunoff=  2.6    Slope2= 0.0417 a     = 2.00 Perim = 0.00
Curb Opening  C3=0.00  A3= 0.00 Grade  =  0.0500 Slope3= 0.0250 W     = 1.42 Length=23.00
.......................................................................................
                                           OUTPUT
Flowby=  0.0 Qtotal=  2.6 Qint=  2.6 Flowby dn=  0.0 Depth=0.17 Spread=  5.89 Veloc= 5.79
---------------------------------------------------------------------------------------
Sta 121+70R                                INPUT
Intens.= 4.28 C1=0.95  A1= 0.33 Qadd   =  0.0    Slope1= 6.0000 Gutter= 1.42 Area  = 0.00
CB ID  = 7    C2=0.70  A2= 0.00 Qrunoff=  1.4    Slope2= 0.0417 a     = 2.00 Perim = 0.00
Curb Opening  C3=0.00  A3= 0.00 Grade  =  0.0353 Slope3= 0.0200 W     = 1.42 Length=11.00
.......................................................................................
                                           OUTPUT
Flowby=  0.0 Qtotal=  1.4 Qint=  1.4 Flowby dn=  0.0 Depth=0.14 Spread=  5.51 Veloc= 4.14
---------------------------------------------------------------------------------------
Sta 125+78R                                INPUT
Intens.= 4.28 C1=0.95  A1= 0.55 Qadd   =  0.0    Slope1= 6.0000 Gutter= 1.42 Area  = 0.00
CB ID  = 9    C2=0.70  A2= 0.00 Qrunoff=  2.3    Slope2= 0.0417 a     = 2.00 Perim = 0.00
Curb Opening  C3=0.00  A3= 0.00 Grade  =  0.0000 Slope3= 0.0200 W     = 1.42 Length=43.00
.......................................................................................
                                           OUTPUT
Flowby=  0.0 Qtotal=  2.3 Qint=  2.3 Flowby dn=  0.0 Depth=0.09 Spread=  2.15 Veloc= 0.00
---------------------------------------------------------------------------------------
Sta 122+50L                                INPUT
Intens.= 4.28 C1=0.95  A1= 0.15 Qadd   =  0.0    Slope1= 6.0000 Gutter= 1.42 Area  = 0.00
CB ID  = 8    C2=0.70  A2= 0.00 Qrunoff=  0.6    Slope2= 0.0417 a     = 2.00 Perim = 0.00
Curb Opening  C3=0.00  A3= 0.00 Grade  =  0.0284 Slope3= 0.0200 W     = 1.42 Length= 7.00
.......................................................................................
                                           OUTPUT
Flowby=  0.0 Qtotal=  0.6 Qint=  0.6 Flowby dn=  0.0 Depth=0.11 Spread=  4.11 Veloc= 3.21
---------------------------------------------------------------------------------------
Sta 125+50L                                INPUT
Intens.= 4.28 C1=0.95  A1= 0.19 Qadd   =  0.0    Slope1= 6.0000 Gutter= 1.42 Area  = 0.00
CB ID  = SC1  C2=0.70  A2= 0.00 Qrunoff=  0.8    Slope2= 0.0417 a     = 2.00 Perim = 0.00
Curb Opening  C3=0.00  A3= 0.00 Grade  =  0.0000 Slope3= 0.0200 W     = 1.42 Length=48.00
.......................................................................................
                                           OUTPUT
Flowby=  0.0 Qtotal=  0.8 Qint=  0.8 Flowby dn=  0.0 Depth=0.04 Spread=  0.99 Veloc= 0.00
---------------------------------------------------------------------------------------
Sta 126+15L                                INPUT
Intens.= 4.28 C1=0.95  A1= 1.22 Qadd   =  0.0    Slope1= 6.0000 Gutter= 1.42 Area  = 0.00
CB ID  = 10   C2=0.70  A2= 0.00 Qrunoff=  5.0    Slope2= 0.0417 a     = 2.00 Perim = 0.00
Curb Opening  C3=0.00  A3= 0.00 Grade  =  0.0020 Slope3= 0.0200 W     = 1.42 Length=23.00
.......................................................................................
                                           OUTPUT
Flowby=  0.0 Qtotal=  5.0 Qint=  5.0 Flowby dn=  0.0 Depth=0.36 Spread= 16.56 Veloc= 1.80
```

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Project : MARYLAND AVE.

CRITERIA

Runoff computed by Rational Method Manning's n Gutter=0.012 Manning's n Pavement=0.016
Clogging Factors in Sag Location:
----- Curb Opening= 1.25 Grate= 2.00 Slotted Drain= 2.00 Comb-Curb= 1.25 Comb-Grate= 2.00
Clogging Factors on Continuous Grade:
----- Curb Opening= 1.25 Grate= 2.00 Slotted Drain= 1.50 Comb-Curb= 1.50 Comb-Grate= 2.00

Prepared by: Date:09/28/10 Time:14:45:37 Checked by: Date:
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Project : SIERRA VISTA DR.

```
Sta 71+61L                                INPUT
Intens.= 4.28 C1=0.95  A1= 0.21 Qadd   =  0.0    Slope1= 6.0000 Gutter= 1.42 Area  = 0.00
CB ID  = 21   C2=0.70  A2= 0.00 Qrunoff=  0.9    Slope2= 0.0417 a     = 2.00 Perim = 0.00
Curb Opening  C3=0.00  A3= 0.00 Grade  =  0.0000 Slope3= 0.0200 W     = 1.42 Length= 3.00
.......................................................................................
                                          OUTPUT
Flowby=  0.0 Qtotal=  0.9 Qint=  0.9 Flowby dn=  0.0 Depth=0.19 Spread=  4.61 Veloc= 0.00
---------------------------------------------------------------------------------------
Sta 71+84R                                INPUT
Intens.= 4.28 C1=0.95  A1= 0.25 Qadd   =  0.0    Slope1= 6.0000 Gutter= 1.42 Area  = 0.00
CB ID  = 22   C2=0.70  A2= 0.00 Qrunoff=  1.0    Slope2= 0.0417 a     = 2.00 Perim = 0.00
Curb Opening  C3=0.00  A3= 0.00 Grade  =  0.0000 Slope3= 0.0200 W     = 1.42 Length= 3.00
.......................................................................................
                                          OUTPUT
Flowby=  0.0 Qtotal=  1.0 Qint=  1.0 Flowby dn=  0.0 Depth=0.22 Spread=  5.18 Veloc= 0.00
---------------------------------------------------------------------------------------
Sta 76+67L                                INPUT
Intens.= 4.28 C1=0.95  A1= 0.00 Qadd   = 18.7    Slope1= 6.0000 Gutter= 1.42 Area  = 0.00
CB ID  = 23   C2=0.70  A2= 0.00 Qrunoff= 18.7    Slope2= 0.0417 a     = 2.00 Perim = 0.00
Curb Opening  C3=0.00  A3= 0.00 Grade  =  0.0000 Slope3= 0.0200 W     = 1.42 Length=19.00
.......................................................................................
                                          OUTPUT
Flowby=  0.0 Qtotal= 18.7 Qint= 18.7 Flowby dn=  0.0 Depth=0.50 Spread= 15.18 Veloc= 0.00
---------------------------------------------------------------------------------------
Sta 76+67R                                INPUT
Intens.= 4.28 C1=0.95  A1= 0.00 Qadd   = 18.7    Slope1= 6.0000 Gutter= 1.42 Area  = 0.00
CB ID  = 24   C2=0.70  A2= 0.00 Qrunoff= 18.7    Slope2= 0.0417 a     = 2.00 Perim = 0.00
Curb Opening  C3=0.00  A3= 0.00 Grade  =  0.0000 Slope3= 0.0200 W     = 1.42 Length=19.00
.......................................................................................
                                          OUTPUT
Flowby=  0.0 Qtotal= 18.7 Qint= 18.7 Flowby dn=  0.0 Depth=0.50 Spread= 15.18 Veloc= 0.00
---------------------------------------------------------------------------------------
Sta 78+59L                                INPUT
Intens.= 4.28 C1=0.95  A1= 0.00 Qadd   =  5.0    Slope1= 6.0000 Gutter= 1.42 Area  = 0.00
CB ID  = 27   C2=0.70  A2= 0.00 Qrunoff=  5.0    Slope2= 0.0417 a     = 2.00 Perim = 0.00
Curb Opening  C3=0.00  A3= 0.00 Grade  =  0.0000 Slope3= 0.0200 W     = 1.42 Length=11.00
.......................................................................................
                                          OUTPUT
Flowby=  0.0 Qtotal=  5.0 Qint=  5.0 Flowby dn=  0.0 Depth=0.34 Spread=  7.25 Veloc= 0.00
---------------------------------------------------------------------------------------
                                        CRITERIA
Runoff computed by Rational Method   Manning's n Gutter=0.012  Manning's n Pavement=0.016
Clogging Factors in Sag Location:
----- Curb Opening= 1.25 Grate= 2.00 Slotted Drain= 2.00 Comb-Curb= 1.25 Comb-Grate= 2.00
Clogging Factors on Continuous Grade:
----- Curb Opening= 1.25 Grate= 2.00 Slotted Drain= 1.50 Comb-Curb= 1.50 Comb-Grate= 2.00
---------------------------------------------------------------------------------------
Prepared by:        Date:09/28/10    Time:11:54:35     Checked by:        Date:
```
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Project : 54TH AVE.

Sta 52+25R INPUT
Intens.= 4.28 C1=0.95 A1= 0.00 Qadd = 13.3 Slope1= 6.0000 Gutter= 1.42 Area = 0.00
CB ID = 25 C2=0.70 A2= 0.00 Qrunoff= 13.3 Slope2= 0.0417 a = 2.00 Perim = 0.00
Curb Opening C3=0.00 A3= 0.00 Grade = 0.0000 Slope3= 0.0200 W = 1.42 Length=15.00

.....

OUTPUT
Flowby= 0.0 Qtotal= 13.3 Qint= 13.3 Flowby dn= 0.0 Depth=0.50 Spread= 15.18 Veloc= 0.00

Sta 51+60L INPUT
Intens.= 4.28 C1=0.95 A1= 0.00 Qadd = 11.4 Slope1= 6.0000 Gutter= 1.42 Area = 0.00
CB ID = 26 C2=0.70 A2= 0.00 Qrunoff= 11.4 Slope2= 0.0417 a = 2.00 Perim = 0.00
Curb Opening C3=0.00 A3= 0.00 Grade = 0.0000 Slope3= 0.0200 W = 1.42 Length=15.00

.....

OUTPUT
Flowby= 0.0 Qtotal= 11.4 Qint= 11.4 Flowby dn= 0.0 Depth=0.50 Spread= 15.10 Veloc= 0.00

CRITERIA
Runoff computed by Rational Method Manning's n Gutter=0.012 Manning's n Pavement=0.016
Clogging Factors in Sag Location:
----- Curb Opening= 1.25 Grate= 2.00 Slotted Drain= 2.00 Comb-Curb= 1.25 Comb-Grate= 2.00
Clogging Factors on Continuous Grade:
----- Curb Opening= 1.25 Grate= 2.00 Slotted Drain= 1.50 Comb-Curb= 1.50 Comb-Grate= 2.00

Prepared by: Date:09/28/10 Time:11:45:55 Checked by: Date:
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- **Fifty-Year Storm Event**

STORM SEWER INLET CALCULATION RECORD

BRW INC.

Engineering
Transportation
Planning
Urban Design
Landscape Architects

LOCATION DATA

STREET: 55 TH & MARYLAND AVE.
LOCATION: MARYLAND AVE.
PRO. NO.:

DESIGN DATA

FREQUENCY: 50 years
P6= 2.68 Inches
P24= 3.38 Inches
P1= 2.05 Inches

STORM SEWER INLET CALCULATIONS

Inlet			Q	Carryover	Design Q	Inlet	Curb Opening	Wing / Slot	Gutter	Pavement		Spread T(ft)		Intercepted	Flowby	
No.	Station	Offset	(cfs)	(cfs)	(cfs)	Std.	L (ft)	L (ft)	Type	Sx	Sl	Actual	Allow	Flow (cfs)	(cfs)	Notes
1	103+30	22.58' LT	1.30	0.0	1.30	3	7	3.5 E	16	0.020	0.0166	6.86	12.0	1.30	0.0	
2	105+00	22.58' LT	2.11	0.0	2.11	3	7	7.5 E	16	0.020	0.0369	6.56	12.0	2.11	0.0	
51	106+45	71' RT	5.06	0.0	5.06	2								5.06	0.0	OFFROAD CATCH BASIN
3	107+66	22.58' RT	0.32	0.0	0.32	3	7	3.5 E	16	0.005	0.0473	5.58	12.0	0.32	0.0	
4	108+10	22.58' RT	1.03	0.0	1.03	3	11	7.5 E	16	0.010	0.0473	6.74	12.0	1.03	0.0	
5	109+45	22.58' RT	3.51	0.0	3.51	3	23	19.5 E	16	0.025	0.0475	6.61	12.0	3.51	0.0	
6	118+70	22.58' RT	3.62	0.0	3.62	3	23	19.5 W	16	0.025	0.0500	6.61	12.0	3.62	0.0	
7	121+70	22.58' RT	1.78	0.0	1.78	3	11	7.5 W	16	0.020	0.0353	6.26	12.0	1.78	0.0	
8	122+50	22.58' LT	0.81	0.0	0.81	3	7	3.5 W	16	0.020	0.0284	4.66	12.0	0.81	0.0	
SC-1	125+50	24' LT	1.03	0.0	1.03	9	48.0		16	0.020	SAG	1.24	12.0	1.03	0.0	
9	125+78	22.58' RT	2.98	0.0	2.98	4	43	19.5	16	0.020	SAG	2.60	12.0	2.98	0.0	
10	126+15	22.58' LT	6.65	0.0	6.65	3	23	19.5 E	16	0.020	0.0020	18.51	12.0	6.65	0.0	FLOOD CODITION

Sx: Cross-Slope Sl: Longitudinal Slope CB: Catch Basin SC: Scupper

Computed by: RS Date: SEPTEMBER 30, 2002 Checked by: DJS

NOTE: FOR ACTUAL Q CALCULATIONS, SEE APPENDIX B.

1- ADOT C-15.30 (SINGLE)
2- ADOT C-15.30 (DOUBLE)
3- ADOT C-15.20 (ONE WING)
4- ADOT C-15.20 (TWO WINGS)
5- ADOT C-05.10 (CURB & GUTTER TYPE D)
6- MAG 531
7- MAG 532
8- MAG 534, Type E
9- SCUPPER
10- ADOT C-15.10 (Double)
11- ADOT C-05.10 (SINGLE CURB TYPE A1)
12- CONCRETE BARRIER
13- ADOT C-15.10 (SINGLE)
14- ADOT C-05.10 (CURB & GUTTER TYPE B)
15- ADOT C-05.10 (CURB & GUTTER TYPE C)
16- MAG 220 (CURB & GUTTER TYPE A)
17- ADOT C-15.91
18- ADOT C-15.91 (SPECIAL)
19- ADOT C-15.80
20- ADOT C-15.20 (SUMP ONLY)

STORM SEWER INLET CALCULATION RECORD

BRW INC.

Engineering
Transportation
Planning
Urban Design
Landscape Architects

LOCATION DATA

STREET: 55 TH & MARYLAND AVE.
LOCATION: SIERRA VISTA DR.
PRO. NO.:

DESIGN DATA

FREQUENCY: 50 years
P6= 2.68 Inches
P24= 3.38 Inches
P1= 2.05 Inches

STORM SEWER INLET CALCULATIONS

Inlet			Q	Carryover	Design Q	Inlet	Curb Opening	Wing / Slot	Gutter	Pavement		Spread T(ft)		Intercepted	Flowby	
No.	Station	Offset	(cfs)	(cfs)	(cfs)	Std.	L (ft)	L (ft)	Type	Sx	Sl	Actual	Allow	Flow (cfs)	(cfs)	Notes
21	71+61	22' LT	1.14	0.0	1.14	20	3		16	0.020	SAG	1.74	12.0	1.14	0.0	
22	71+84	22' RT	1.35	0.0	1.35	20	3		16	0.020	SAG	3.17	12.0	1.35	0.0	
23	76+67	24.58' LT	18.70	0.0	18.70	4	19	7.5	16	0.020	SAG	15.18	12.0	18.70	0.0	FLOOD CONDITION
24	76+67	22.58' RT	18.70	0.0	18.70	4	19	7.5	16	0.020	SAG	15.18	12.0	18.70	0.0	FLOOD CONDITION
27	78+59	84.42 LT	5.00	0.0	5.00	3	11	7.5 N	16	0.020	SAG	7.25	12.0	5.00	0.0	FLOOD CONDITION

Sx: Cross-Slope Sl: Longitudinal Slope CB: Catch Basin SC: Scupper

Computed by: RS Date: SEPTEMBER 30, 2002 Checked by: DJS

NOTE: FOR ACTUAL Q CALCULATIONS, SEE APPENDIX B.

1- ADOT C-15.30 (SINGLE)
2- ADOT C-15.30 (DOUBLE)
3- ADOT C-15.20 (ONE WING)
4- ADOT C-15.20 (TWO WINGS)
5- ADOT C-05.10 (CURB & GUTTER TYPE D)
6- MAG 531
7- MAG 532
8- MAG 534, Type E
9- SCUPPER
10- ADOT C-15.10 (Double)
11- ADOT C-05.10 (SINGLE CURB TYPE A1)
12- CONCRETE BARRIER
13- ADOT C-15.10 (SINGLE)
14- ADOT C-05.10 (CURB & GUTTER TYPE B)
15- ADOT C-05.10 (CURB & GUTTER TYPE C)
16- MAG 220 (CURB & GUTTER TYPE A)
17- ADOT C-15.91
18- ADOT C-15.91 (SPECIAL)
19- ADOT C-15.80
20- ADOT C-15.20 (SUMP ONLY)

STORM SEWER INLET CALCULATION RECORD

BRW INC.

Engineering
Transportation
Planning
Urban Design
Landscape Architects

LOCATION DATA

STREET: 55 TH & MARYLAND AVE.
LOCATION: 54TH AVE.
PRO. NO.:

DESIGN DATA

FREQUENCY: 50 years
P6= 2.68 Inches
P24= 3.38 Inches
P1= 2.05 Inches

STORM SEWER INLET CALCULATIONS

Inlet			Q	Carryover	Design Q	Inlet	Curb Opening	Wing / Slot	Gutter	Pavement		Spread T(ft)		Intercepted	Flowby	
No.	Station	Offset	(cfs)	(cfs)	(cfs)	Std.	L (ft)	L (ft)	Type	Sx	SI	Actual	Allow	Flow (cfs)	(cfs)	Notes
25	52+25	20' RT	13.30	0.0	13.30	3	15	11.5 N	16	0.020	SAG	15.18	12.0	13.30	0.0	FLOOD CONDITION
26	51+60	20' LT	11.40	0.0	11.40	3	15	11.5 N	16	0.020	SAG	15.10	12.0	11.40	0.0	FLOOD CONDITION

Sx: Cross-Slope SI: Longitudinal Slope CB: Catch Basin SC: Scupper

Computed by: RS Date: SEPTEMBER 30, 2002 Checked by: DJS

NOTE: FOR ACTUAL Q CALCULATIONS, SEE APPENDIX B.

1- ADOT C-15.30 (SINGLE)
2- ADOT C-15.30 (DOUBLE)
3- ADOT C-15.20 (ONE WING)
4- ADOT C-15.20 (TWO WINGS)
5- ADOT C-05.10 (CURB & GUTTER TYPE D)
6- MAG 531
7- MAG 532
8- MAG 534, Type E
9- SCUPPER
10- ADOT C-15.10 (Double)
11- ADOT C-05.10 (SINGLE CURB TYPE A1)
12- CONCRETE BARRIER
13- ADOT C-15.10 (SINGLE)
14- ADOT C-05.10 (CURB & GUTTER TYPE B)
15- ADOT C-05.10 (CURB & GUTTER TYPE C)
16- MAG 220 (CURB & GUTTER TYPE A)
17- ADOT C-15.91
18- ADOT C-15.91 (SPECIAL)
19- ADOT C-15.80
20- ADOT C-15.20 (SUMP ONLY)

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Project : MARYLAND AVE.

```
Sta 109+45R                                INPUT
Intens.= 5.69 C1=0.95  A1= 0.62 Qadd   =  0.0    Slope1= 6.0000 Gutter= 1.42 Area  = 0.00
CB ID  = 5    C2=0.70  A2= 0.00 Qrunoff=  3.4    Slope2= 0.0417 a     = 2.00 Perim = 0.00
Curb Opening  C3=0.00  A3= 0.00 Grade  =  0.0467 Slope3= 0.0250 W     = 1.42 Length=23.00
.......................................................................................
                                           OUTPUT
Flowby=  0.0 Qtotal=  3.4 Qint=  3.4 Flowby dn=  0.0 Depth=0.19 Spread=  6.61 Veloc= 5.97
---------------------------------------------------------------------------------------
Sta 108+10R                                INPUT
Intens.= 5.69 C1=0.95  A1= 0.18 Qadd   =  0.0    Slope1= 6.0000 Gutter= 1.42 Area  = 0.00
CB ID  = 4    C2=0.70  A2= 0.00 Qrunoff=  1.0    Slope2= 0.0417 a     = 2.00 Perim = 0.00
Curb Opening  C3=0.00  A3= 0.00 Grade  =  0.0473 Slope3= 0.0103 W     = 1.42 Length=11.00
.......................................................................................
                                           OUTPUT
Flowby=  0.0 Qtotal=  1.0 Qint=  1.0 Flowby dn=  0.0 Depth=0.11 Spread=  6.74 Veloc= 3.68
---------------------------------------------------------------------------------------
Sta 107+66R                                INPUT
Intens.= 5.69 C1=0.95  A1= 0.06 Qadd   =  0.0    Slope1= 6.0000 Gutter= 1.42 Area  = 0.00
CB ID  = 3    C2=0.70  A2= 0.00 Qrunoff=  0.3    Slope2= 0.0417 a     = 2.00 Perim = 0.00
Curb Opening  C3=0.00  A3= 0.00 Grade  =  0.0473 Slope3= 0.0050 W     = 1.42 Length= 7.00
.......................................................................................
                                           OUTPUT
Flowby=  0.0 Qtotal=  0.3 Qint=  0.3 Flowby dn=  0.0 Depth=0.08 Spread=  5.58 Veloc= 2.84
---------------------------------------------------------------------------------------
Sta 105+00L                                INPUT
Intens.= 5.69 C1=0.95  A1= 0.38 Qadd   =  0.0    Slope1= 6.0000 Gutter= 1.42 Area  = 0.00
CB ID  = 2    C2=0.70  A2= 0.00 Qrunoff=  2.1    Slope2= 0.0417 a     = 2.00 Perim = 0.00
Curb Opening  C3=0.00  A3= 0.00 Grade  =  0.0369 Slope3= 0.0200 W     = 1.42 Length=11.00
.......................................................................................
                                           OUTPUT
Flowby=  0.0 Qtotal=  2.1 Qint=  1.9 Flowby dn=  0.1 Depth=0.16 Spread=  6.56 Veloc= 4.56
---------------------------------------------------------------------------------------
Sta 103+21L                                INPUT
Intens.= 5.69 C1=0.95  A1= 0.26 Qadd   =  0.0    Slope1= 6.0000 Gutter= 1.42 Area  = 0.00
CB ID  = 1    C2=0.70  A2= 0.00 Qrunoff=  1.4    Slope2= 0.0417 a     = 2.00 Perim = 0.00
Curb Opening  C3=0.00  A3= 0.00 Grade  =  0.0162 Slope3= 0.0200 W     = 1.42 Length= 7.00
.......................................................................................
                                           OUTPUT
Flowby=  0.1 Qtotal=  1.5 Qint=  1.4 Flowby dn=  0.2 Depth=0.17 Spread=  6.86 Veloc= 3.09
---------------------------------------------------------------------------------------
                                        CRITERIA
Runoff computed by Rational Method   Manning's n Gutter=0.012  Manning's n Pavement=0.016
Clogging Factors in Sag Location:
----- Curb Opening= 1.25 Grate= 2.00 Slotted Drain= 2.00 Comb-Curb= 1.25 Comb-Grate= 2.00
Clogging Factors on Continuous Grade:
----- Curb Opening= 1.25 Grate= 2.00 Slotted Drain= 1.50 Comb-Curb= 1.50 Comb-Grate= 2.00
---------------------------------------------------------------------------------------
Prepared by:        Date:09/08/10    Time:12:25:42     Checked by:        Date:
```
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Project : MARYLAND AVE.

```
Sta 118+70R                                INPUT
Intens.= 5.69 C1=0.95  A1= 0.64 Qadd   =  0.0    Slope1= 6.0000 Gutter= 1.42 Area  = 0.00
CB ID  = 6    C2=0.70  A2= 0.00 Qrunoff=  3.5    Slope2= 0.0417 a     = 2.00 Perim = 0.00
Curb Opening  C3=0.00  A3= 0.00 Grade  =  0.0500 Slope3= 0.0250 W     = 1.42 Length=23.00
.......................................................................................
                                           OUTPUT
Flowby=  0.0 Qtotal=  3.5 Qint=  3.5 Flowby dn=  0.0 Depth=0.19 Spread=  6.61 Veloc= 6.16
---------------------------------------------------------------------------------------
Sta 121+70R                                INPUT
Intens.= 5.69 C1=0.95  A1= 0.33 Qadd   =  0.0    Slope1= 6.0000 Gutter= 1.42 Area  = 0.00
CB ID  = 7    C2=0.70  A2= 0.00 Qrunoff=  1.8    Slope2= 0.0417 a     = 2.00 Perim = 0.00
Curb Opening  C3=0.00  A3= 0.00 Grade  =  0.0353 Slope3= 0.0200 W     = 1.42 Length=11.00
.......................................................................................
                                           OUTPUT
Flowby=  0.0 Qtotal=  1.8 Qint=  1.7 Flowby dn=  0.1 Depth=0.16 Spread=  6.26 Veloc= 4.33
---------------------------------------------------------------------------------------
Sta 125+78R                                INPUT
Intens.= 5.69 C1=0.95  A1= 0.55 Qadd   =  0.0    Slope1= 6.0000 Gutter= 1.42 Area  = 0.00
CB ID  = 9    C2=0.70  A2= 0.00 Qrunoff=  3.0    Slope2= 0.0417 a     = 2.00 Perim = 0.00
Curb Opening  C3=0.00  A3= 0.00 Grade  =  0.0000 Slope3= 0.0200 W     = 1.42 Length=43.00
.......................................................................................
                                           OUTPUT
Flowby=  0.1 Qtotal=  3.1 Qint=  3.1 Flowby dn=  0.0 Depth=0.11 Spread=  2.64 Veloc= 0.00
---------------------------------------------------------------------------------------
Sta 122+50L                                INPUT
Intens.= 5.69 C1=0.95  A1= 0.15 Qadd   =  0.0    Slope1= 6.0000 Gutter= 1.42 Area  = 0.00
CB ID  = 8    C2=0.70  A2= 0.00 Qrunoff=  0.8    Slope2= 0.0417 a     = 2.00 Perim = 0.00
Curb Opening  C3=0.00  A3= 0.00 Grade  =  0.0284 Slope3= 0.0200 W     = 1.42 Length= 7.00
.......................................................................................
                                           OUTPUT
Flowby=  0.0 Qtotal=  0.8 Qint=  0.8 Flowby dn=  0.0 Depth=0.12 Spread=  4.66 Veloc= 3.40
---------------------------------------------------------------------------------------
Sta 125+50L                                INPUT
Intens.= 5.69 C1=0.95  A1= 0.19 Qadd   =  0.0    Slope1= 6.0000 Gutter= 1.42 Area  = 0.00
CB ID  = SC1  C2=0.70  A2= 0.00 Qrunoff=  1.0    Slope2= 0.0417 a     = 2.00 Perim = 0.00
Curb Opening  C3=0.00  A3= 0.00 Grade  =  0.0000 Slope3= 0.0200 W     = 1.42 Length=48.00
.......................................................................................
                                           OUTPUT
Flowby=  0.0 Qtotal=  1.1 Qint=  1.1 Flowby dn=  0.0 Depth=0.05 Spread=  1.22 Veloc= 0.00
---------------------------------------------------------------------------------------
Sta 126+15L                                INPUT
Intens.= 5.69 C1=0.95  A1= 1.22 Qadd   =  0.0    Slope1= 6.0000 Gutter= 1.42 Area  = 0.00
CB ID  = 10   C2=0.70  A2= 0.00 Qrunoff=  6.6    Slope2= 0.0417 a     = 2.00 Perim = 0.00
Curb Opening  C3=0.00  A3= 0.00 Grade  =  0.0020 Slope3= 0.0200 W     = 1.42 Length=23.00
.......................................................................................
                                           OUTPUT
Flowby=  0.0 Qtotal=  6.6 Qint=  6.6 Flowby dn=  0.0 Depth=0.40 Spread= 18.46 Veloc= 1.93
```

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Project : MARYLAND AVE.

CRITERIA

Runoff computed by Rational Method Manning's n Gutter=0.012 Manning's n Pavement=0.016
Clogging Factors in Sag Location:
----- Curb Opening= 1.25 Grate= 2.00 Slotted Drain= 2.00 Comb-Curb= 1.25 Comb-Grate= 2.00
Clogging Factors on Continuous Grade:
----- Curb Opening= 1.25 Grate= 2.00 Slotted Drain= 1.50 Comb-Curb= 1.50 Comb-Grate= 2.00

Prepared by: Date:09/28/10 Time:14:49:17 Checked by: Date:
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Licensed to: BRW, Inc., Phoenix, AZ 85012
Project : SIERRA VISTA DR.

Sta 71+61L INPUT
Intens.= 5.69 C1=0.95 A1= 0.21 Qadd = 0.0 Slope1= 6.0000 Gutter= 1.42 Area = 0.00
CB ID = 21 C2=0.70 A2= 0.00 Qrunoff= 1.1 Slope2= 0.0417 a = 2.00 Perim = 0.00
Curb Opening C3=0.00 A3= 0.00 Grade = 0.0000 Slope3= 0.0200 W = 1.42 Length= 3.00

OUTPUT
Flowby= 0.0 Qtotal= 1.1 Qint= 1.1 Flowby dn= 0.0 Depth=0.23 Spread= 1.74 Veloc= 0.00

Sta 71+84R INPUT
Intens.= 5.69 C1=0.95 A1= 0.25 Qadd = 0.0 Slope1= 6.0000 Gutter= 1.42 Area = 0.00
CB ID = 22 C2=0.70 A2= 0.00 Qrunoff= 1.4 Slope2= 0.0417 a = 2.00 Perim = 0.00
Curb Opening C3=0.00 A3= 0.00 Grade = 0.0000 Slope3= 0.0200 W = 1.42 Length= 3.00

OUTPUT
Flowby= 0.0 Qtotal= 1.4 Qint= 1.4 Flowby dn= 0.0 Depth=0.26 Spread= 3.17 Veloc= 0.00

Sta 76+67L INPUT
Intens.= 5.69 C1=0.95 A1= 0.00 Qadd = 18.7 Slope1= 6.0000 Gutter= 1.42 Area = 0.00
CB ID = 23 C2=0.70 A2= 0.00 Qrunoff= 18.7 Slope2= 0.0417 a = 2.00 Perim = 0.00
Curb Opening C3=0.00 A3= 0.00 Grade = 0.0000 Slope3= 0.0200 W = 1.42 Length=19.00

OUTPUT
Flowby= 0.0 Qtotal= 18.7 Qint= 18.7 Flowby dn= 0.0 Depth=0.50 Spread= 15.18 Veloc= 0.00

Sta 76+67R INPUT
Intens.= 5.69 C1=0.95 A1= 0.00 Qadd = 18.7 Slope1= 6.0000 Gutter= 1.42 Area = 0.00
CB ID = 24 C2=0.70 A2= 0.00 Qrunoff= 18.7 Slope2= 0.0417 a = 2.00 Perim = 0.00
Curb Opening C3=0.00 A3= 0.00 Grade = 0.0000 Slope3= 0.0200 W = 1.42 Length=19.00

OUTPUT
Flowby= 0.0 Qtotal= 18.7 Qint= 18.7 Flowby dn= 0.0 Depth=0.50 Spread= 15.18 Veloc= 0.00

Sta 78+59L INPUT
Intens.= 5.69 C1=0.95 A1= 0.00 Qadd = 5.0 Slope1= 6.0000 Gutter= 1.42 Area = 0.00
CB ID = 27 C2=0.70 A2= 0.00 Qrunoff= 5.0 Slope2= 0.0417 a = 2.00 Perim = 0.00
Curb Opening C3=0.00 A3= 0.00 Grade = 0.0000 Slope3= 0.0200 W = 1.42 Length=11.00

OUTPUT
Flowby= 0.0 Qtotal= 5.0 Qint= 5.0 Flowby dn= 0.0 Depth=0.34 Spread= 7.25 Veloc= 0.00

CRITERIA
Runoff computed by Rational Method Manning's n Gutter=0.012 Manning's n Pavement=0.016
Clogging Factors in Sag Location:
----- Curb Opening= 1.25 Grate= 2.00 Slotted Drain= 2.00 Comb-Curb= 1.25 Comb-Grate= 2.00
Clogging Factors on Continuous Grade:
----- Curb Opening= 1.25 Grate= 2.00 Slotted Drain= 1.50 Comb-Curb= 1.50 Comb-Grate= 2.00

Prepared by: Date:09/28/10 Time:11:58:50 Checked by: Date:
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Project : 54TH AVE.

Sta 52+25R INPUT
Intens.= 5.69 C1=0.95 A1= 0.00 Qadd = 13.3 Slope1= 6.0000 Gutter= 1.42 Area = 0.00
CB ID = 25 C2=0.70 A2= 0.00 Qrunoff= 13.3 Slope2= 0.0417 a = 2.00 Perim = 0.00
Curb Opening C3=0.00 A3= 0.00 Grade = 0.0000 Slope3= 0.0200 W = 1.42 Length=15.00

.....

OUTPUT
Flowby= 0.0 Qtotal= 13.3 Qint= 13.3 Flowby dn= 0.0 Depth=0.50 Spread= 15.18 Veloc= 0.00

Sta 51+60L INPUT
Intens.= 5.69 C1=0.95 A1= 0.00 Qadd = 11.4 Slope1= 6.0000 Gutter= 1.42 Area = 0.00
CB ID = 26 C2=0.70 A2= 0.00 Qrunoff= 11.4 Slope2= 0.0417 a = 2.00 Perim = 0.00
Curb Opening C3=0.00 A3= 0.00 Grade = 0.0000 Slope3= 0.0200 W = 1.42 Length=15.00

.....

OUTPUT
Flowby= 0.0 Qtotal= 11.4 Qint= 11.4 Flowby dn= 0.0 Depth=0.50 Spread= 15.10 Veloc= 0.00

CRITERIA
Runoff computed by Rational Method Manning's n Gutter=0.012 Manning's n Pavement=0.016
Clogging Factors in Sag Location:
----- Curb Opening= 1.25 Grate= 2.00 Slotted Drain= 2.00 Comb-Curb= 1.25 Comb-Grate= 2.00
Clogging Factors on Continuous Grade:
----- Curb Opening= 1.25 Grate= 2.00 Slotted Drain= 1.50 Comb-Curb= 1.50 Comb-Grate= 2.00

Prepared by: Date:09/28/10 Time:11:49:41 Checked by: Date:
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Appendix E
New Pipe Summary Sheets

Latest Set 9/24/02

NOTE:
THE ZEROS IN PARENTHESIS (0, 0.0 & 0.00) IN THE HEADING OF SOME OF THE COLUMNS ARE THE RECOMMENDED PRECISION OF THE VALUE TO BE ENTERED IN THE COLUMN.

NOTE:
FOR PIPE CULVERT PLACEMENT SEE STANDARD DRAWING C-13.15

NOTE:
PIPE OPTIONS SELECTED ARE THOSE REQUIRED TO MEET MINIMUM SERVICE LIFE.
SHADED PIPE OPTION FIELDS ARE NOT ALLOWABLE ALTERNATES.

CSP - CORRUGATED STEEL PIPE
CAP - CORRUGATED ALUMINUM PIPE
RCP - REINFORCED CONCRETE PIPE
NRCP - NON-REINFORCED CONCRETE PIPE
NRCIPCP - NON-REINFORCED CAST-IN-PLACE CONCRETE PIPE
CHDPEPP - CORRUGATED HIGH DENSTIY POLYETHYLENE PLASTIC PIPE

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	060-B(007)B			
		060 MA 155			

Station	Plan Ref No.	Controlling Fill Height Range	Size, Corrugated (In.)	Size, Smooth (In.)	Length (0) (Ft.)	Skew (0) (Degree)	Corrugation	Wall Thickness (0.00)	Zinc	Bit. Coated Zinc	Aluminum	Bit. Coated Aluminum	Corrugation	Wall Thickness (0.00)	Uncoated	Bit. Coated (Coating)	Class - Non Trench (In.)	Class - Trench	Min Wall Thickness (0)	AASHTO M-294 Type C	AASHTO M-294 Type S	C-13.20 & C-13.25 Detail -	Size, (In) Manhole (In.)	Standard or Detail (End Sec)	S-Single / D-Double (Each)	Location (Catch basin, Manhole, Headwall & Junction Structure)	H (0.0) (Ea)	L Wing (0.0) (Ft.)	L 18' Slotted Drn (0) (Ft.)	L 24' Slotted Drn (0) (Ft.)	Type (Grate)	Elev. (0.00)	Depth (Ft.)	L (0.0) (Ft.)	Inlet Depression Pipe Exc (0) (In.)	Pipe Bkfl (0) (Ft.)	Drn Exc (0) (Ft.)	Berm/Dike Emb (0) (Ft.)	REMARKS
103+30																								C-15.20	S	Lt	4	3.5E				1150.49	2	7					CB-1
	1	1		24	18												III	III			X														9	4			To Channel 2, 1-Bend (1)
103+35																								(2)		Lt													Hdwl (7)
105+00																								C-15.20	S	Lt	5	7.5E				1155.04	2	11					CB-2
	2	1		24	12												III	III			X														8	3			To MH-102
105+00																							30	(5)		Lt	5					1155.48							MH-102, Shallow
	102	1		24	94												III	III			X														64	21			To CBC-1
107+66																								C-15.20	S	Rt	6	3.5E				1167.96	2	7					CB-3
	3	1		24	12												III	III			X														10	3			To MH-103
107+66																							30	(5)		Rt	6					1168.24							MH-103, Shallow
	103	1		24	226												III	III			X														200	59			To MH-102
108+10																								C-15.20	S	Rt	5	7.5E				1170.04	2	11					CB-4
	4	1		24	12												III	III			X														8	3			To MH-104
108+40																							30	(5)		Rt	5					1170.38							MH-104, Shallow
	104	1		24	74												III	III			X														56	16			To MH-103
109+45																								C-15.20	S	Rt	6	19.5E				1176.45	2	23					CB-5
	5	1		24	12												III	III			X														10	3			To MH-105
109+45																							30	(5)		Rt	6					1176.94							MH-105, Shallow
	105	1		24	102												III	III			X														77	22			To MH-104
Sheet Total																							4												442	134			

FILL HEIGHT RANGE TABLE (Ft.)													
RANGE NO.		1	2	3	4	5	6	7	8	9	10	11	12
FILL	>	1	3	5	8	11	15	20	25	30	40	55	70
HEIGHT (Ft.)	≤	3	5	8	11	15	20	25	30	40	55	70	90

SHOULD FIELD CONDITIONS VARY FROM THE RANGE INDICATED, CONTACT DESIGN FOR RE-EVALUATION OF PIPE DESIGN REQUIREMENTS.

PIPE CORRUGATION			
A	2⅔x½	D	6x2
B	3x1	E	3x1 or 9x2½
C	9x2½		

(1) Concrete Collar C-13.80
(2) Headwall, MAG 501-4
(5) Manhole, MAG 520
(7) Access Barrier Gate

	NAME	DATE
DESIGN	RS	09/02
DRAWN	KOP	09/02
CHECKED	DJS	09/02

BRW 1720 N. 16th Street Suite 100 Phoenix, Arizona 85020 (602) 234-1918

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION

NEW PIPE SUMMARY SHEET

ROUTE: US 60
LOCATION: GRAND AVE AT 55TH AVE AND MARYLAND AVE

TRACS NO. H5601 01 C
060-B(007)B

PRELIMINARY
STAGE IV
Review
NOT FOR CONSTRUCTION OR RECORDING

DWG. NO. G-5.1
OF

NOTE:
THE ZEROS IN PARENTHESIS (0, 0.0 & 0.00) IN THE HEADING OF SOME OF THE COLUMNS ARE THE RECOMMENDED PRECISION OF THE VALUE TO BE ENTERED IN THE COLUMN.

NOTE:
FOR PIPE CULVERT PLACEMENT SEE STANDARD DRAWING C-13.15

NOTE:
PIPE OPTIONS SELECTED ARE THOSE REQUIRED TO MEET MINIMUM SERVICE LIFE.
SHADED PIPE OPTION FIELDS ARE NOT ALLOWABLE ALTERNATES.

CSP - CORRUGATED STEEL PIPE
CAP - CORRUGATED ALUMINUM PIPE
RCP - REINFORCED CONCRETE PIPE
NRCP - NON-REINFORCED CONCRETE PIPE
NRCIPCP - NON-REINFORCED CAST-IN-PLACE CONCRETE PIPE
CHDPEPP - CORRUGATED HIGH DENSTIY POLYETHYLENE PLASTIC PIPE

FHWA REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	060-B(007)B			
		060 MA 155			

Station	Plan Ref No.	Controlling Fill Height Range	Size, Corrugated (In.)	Size, Smooth (In.)	Length (0) (Ft.)	Skew (0) (Degree)	CSP: Corrugation	CSP: Wall Thickness (0.00)	CSP: Zinc Coating	CSP: Bit. Coated Zinc Coating	CAP: Aluminum Coating	CAP: Bit. Coated Aluminum Coating	CAP: Corrugation	CAP: Wall Thickness (0.00)	RCP: Uncoated	RCP: Bit. Coated	RCP: Class - Non Trench	RCP: Class - Trench	RCP: Class	RCP: Min Wall Thickness (0)	NRCP: AASHTO M-294 Type C	NRCIPCP: AASHTO M-294 Type S	NRCIPCP: C-13.20 & C-13.25	CHDPEPP: Detail - Size, (In) Manhole (In.)	CHDPEPP: Standard or Detail (End Sec)	CHDPEPP: S-Single / D-Double	End Treatment: Location	End Treatment: H (0.0) (Ft.)	End Treatment: L Wing (0.0) (Ft.)	End Treatment: L 18" Slotted Drn (0) (Ft.)	End Treatment: L 24" Slotted Drn (0) (Ft.)	End Treatment: Type (Each)	End Treatment: Elev. (0.00) (Ft.)	End Treatment: Grate Depth (Ft.)	End Treatment: Grate L (0.0) (Ft.)	Inlet Depression (In.)	Quantities: Pipe Exc (0) (Cubic Yard)	Quantities: Pipe Bk fl (0) (Cubic Yard)	Quantities: Drn Exc (0) (Cubic Yard)	Quantities: Berm/Dike Emb (0) (Cubic Yard)	Remarks
106+45																								C-15.30	D	Rt	4.5				(3)	1149.80							CB-51 (4)
	51	1		24	148											III	III			X																112	33		To MH-151
105+00																							30	(5)		Rt	5.7					1150.00							MH-151, Shallow
	151	1		24	30											III	III			X																19	7		To Basin 1
104+96																								(2)		Rt													Hdwl (7)
118+70																								C-15.20	S	Rt	5.4	19.5W				1175.71	2	23					CB-6
	6	1		24	24											III	III			X																16	6		To MH-106
118+70																							30	(5)		℄	6					1176.50							MH-106, Shallow
	106	6		24	114											IV	IV																			262	25		To CBC-2, 2-Bends (1)
121+70																								C-15.20	S	Rt	4.8	7.5W				1162.06	2	11					CB-7
	7	4		24	92											III	III																			139	20		To Basin 3, 2-Bends (1)
121+70																								(2)		Lt													Hdwl (7)
122+50																								C-15.20	S	Lt	5	3.5W				1159.51	2	7					CB-8
	8	1		24	32											III	III			X																22	7		To Basin 3, 2-Bends (1)
122+50																								(2)		Lt													Hdwl (7)
125+78																								C-15.20	D	Rt	6	19.5				1154.87	2	43					CB-9
	9	3		24	42											II	II			X																63	9		To MH-107, 2-Bends (1)
125+78																							30	(5)		Lt	11.5					1155.19							MH-107
	107	3		30	48											II	II			X																46	12		To Drywell
126+15																								C-15.20	S	Lt	8	19.5E				1154.92	2	23					CB-10
	10	2		24	36											II	II			X																37	8		To MH-107, 1-Bend (1)
Sheet Total																							3													716	127		

FILL HEIGHT RANGE TABLE (Ft.)

RANGE NO.		1	2	3	4	5	6	7	8	9	10	11	12
FILL	>	1	3	5	8	11	15	20	25	30	40	55	70
HEIGHT (Ft.)	≤	3	5	8	11	15	20	25	30	40	55	70	90

SHOULD FIELD CONDITIONS VARY FROM THE RANGE INDICATED, CONTACT DESIGN FOR RE-EVALUATION OF PIPE DESIGN REQUIREMENTS.

PIPE CORRUGATION

A	2⅔x½	D	6x2
B	3x1	E	3x1 or 9x2½
C	9x2½		

(1) Concrete Collar C-13.80
(2) Headwall, MAG 501-4
(3) Pedestrian & Bicycle-Safe Grate C-15.50
(4) Concrete Apron, C-15.80
(5) Manhole, MAG 520
(7) Access Barrier Gate

	NAME	DATE
DESIGN	RS	09/02
DRAWN	WSK	09/02
CHECKED	DJS	09/02

BRW 7720 N. 16th Street, Suite 100, Phoenix, Arizona 85020, (602) 234-1591

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION

NEW PIPE SUMMARY SHEET

ROUTE: US 60
LOCATION: GRAND AVE AT 55TH AVE AND MARYLAND AVE

TRACS NO. H5601 01 C
060-B(007)B

PRELIMINARY
STAGE IV
Review
NOT FOR CONSTRUCTION OR RECORDING

DWG. NO. C-5.2
___ OF ___

NOTE:
THE ZEROS IN PARENTHESIS (0, 0.0 & 0.00) IN THE HEADING OF SOME OF THE COLUMNS ARE THE RECOMMENDED PRECISION OF THE VALUE TO BE ENTERED IN THE COLUMN.

NOTE:
FOR PIPE CULVERT PLACEMENT SEE STANDARD DRAWING C-13.15

NOTE:
PIPE OPTIONS SELECTED ARE THOSE REQUIRED TO MEET MINIMUM SERVICE LIFE.
SHADED PIPE OPTION FIELDS ARE NOT ALLOWABLE ALTERNATES.

CSP - CORRUGATED STEEL PIPE
CAP - CORRUGATED ALUMINUM PIPE
RCP - REINFORCED CONCRETE PIPE
NRCP - NON-REINFORCED CONCRETE PIPE
NRCIPCP - NON-REINFORCED CAST-IN-PLACE CONCRETE PIPE
CHDPEPP - CORRUGATED HIGH DENSTIY POLYETHYLENE PLASTIC PIPE

FHWA REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	060-B(007)B			
		060 MA 155			

Station	Plan Ref No.	● Controlling Fill Height Range	Size, Corrugated (In.)	Size, Smooth (In.)	Length (0) (Ft.)	Skew (0) (Degree)	◪ Corrugation	Wall Thickness (0.00)	Zinc	Blt. Coated Zinc	Aluminum	Blt. Coated Aluminum	◪ Corrugation	Wall Thickness (0.00)	Uncoated	Blt. Coated	Class - Non Trench	Class - Trench	Class	Min Wall Thickness (0)	AASHTO M-294 Type C	AASHTO M-294 Type S	C-13.20 & C-13.25 Detail - Size, (In) Manhole	Standard or Detail	End Sec (Each) S-Single / D-Double	Location (Catch basin, Manhole, Headwall & Junction Structure)	H (0.0) (Ft.)	L Wing (0.0) (Ft.)	L 18" Slotted Drn (0) (Ft.)	L 24" Slotted Drn (0) (Ft.)	Type (Grate)	Elev. (0.00) (Ft.)	Depth (In.)	L (0.0) (Ft.)	Inlet Depression Pipe Exc (0) (Cubic Yard)	Pipe Bk-fl (0) (Cubic Yard)	Drn Exc (0) (Cubic Yard)	Berm/Dike Emb (0) (Cubic Yard)	REMARKS
	20A	1		15	10											IV	IV																		4	2			From Exist Pipe
615+49.81																								C-15.20		Lt	2.8					1153.42	2	3					CB-20
	20B	1		15	18											IV	IV																		5	3			To Exist Pipe, 1-Bend (1)
614+43.68																								C-15.30	S	Lt	2.9				(3)	1153.00							CB-52, (4)
71+61																								C-15.20		Lt	4.8					1153.13	2	3					CB-21
	21	1		24	54											III	III				X														36	12			To CB-22, 2-Bends (1)
71+84																								C-15.20		Rt	5.0					1153.24	2	3					CB-22
	22	9		24	138											V	V																		95	30			To Basin 2, 1-Bend (1)
118+13																								(2)		Rt													Hdwl (7)
76+67																								C-15.20	D	Lt	4.3	7.5				1153.14	2	19					CB-23
	23	1		30	54											II	II				X														36	14			To CB-24
76+67																								C-15.2	D	Rt	4.55	7.5				1153.14	2	19					CB-24
	24	1		36	16											II	II				X														13	5			To Basin 3
76+67																								(2)		Rt													Hdwl (7)
52+25																								C-15.20	S	Rt	4.5	11.5				1154.84	2	15					CB-25
	25	1		24	66											III	III				X														36	15			To CB-26
51+60																								C-15.20	S	Lt	4.5	11.5				1153.83	2	15					CB-26
	26	2		30	118											III	III				X														83	31			To Basin 3
77+63																								(2)		Rt													Hdwl (7)
78+59																								C-15.20	S	Lt	5.0	7.5N				1154.80	2	11					CB-27
	27	1		24	60											III	III				X														37	13			To CBC-3
370+82																								C-15.20		Rt	3.4					1154.66	1	3					CB-28
	28	1		18	10											IV	IV				X														5	2			Connect To Exist Pipe (1)
Sheet Total																																			350	127			

FILL HEIGHT RANGE TABLE (Ft.)

RANGE NO.		1	2	3	4	5	6	7	8	9	10	11	12
FILL	>	1	3	5	8	11	15	20	25	30	40	55	70
HEIGHT (Ft.)	≤	3	5	8	11	15	20	25	30	40	55	70	90

● SHOULD FIELD CONDITIONS VARY FROM THE RANGE INDICATED, CONTACT DESIGN FOR RE-EVALUATION OF PIPE DESIGN REQUIREMENTS.

◪ PIPE CORRUGATION			
A	2⅔x½	D	6x2
B	3x1	E	3x1 or 9x2½
C	9x2½		

(1) Concrete Collar C-13.80
(2) Headwall, MAG 501-4
(3) Pedestrian & Bicycle-Safe Grate C-15.50
(4) Concrete Apron, C-15.80
(7) Access Barrier Gate

	NAME	DATE
DESIGN	RS	09/02
DRAWN	MSK	09/02
CHECKED	DJS	09/02

BRW — 1720 N. 16th Street, Suite 100, Phoenix, Arizona 85020, (602) 234-0555

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION

NEW PIPE SUMMARY SHEET

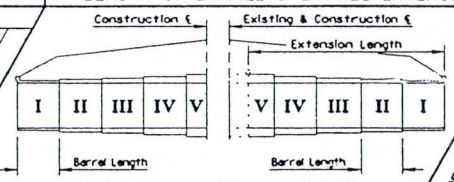
ROUTE: US 60
LOCATION: GRAND AVE AT 55TH AVE AND MARYLAND AVE

TRACS NO. H5601 01 C
060-B(007)B

PRELIMINARY
STAGE IV
Review
NOT FOR CONSTRUCTION OR RECORDING

DWG. NO. C-5.3
___ OF ___

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	060-B(007)8			
		060 MA 155			



Plan Ref No. ◯ & ✱	Structure No.	New	Extend	No. of Barrels	Barrel Span (0.0)	Barrel Height (0.0)	Culvert Length (0.0)	Skew (Degrees) (0)	B-01.10 Misc Details	B-01.11 Ext Details	◪ Standard or Detail	▲ Location	Inlet Wings	Outlet Wings	◪ Standard or Detail	Apron	◪ Standard or Detail	Scour/Bank Protection	◪ Standard or Detail	Energy Dissipaters	Detail	Linear Feet (0.0) ▲ Left of ℄ I	II	III	IV	V	V	IV	III	II	I	◑ Reinforcing Steel (0)	◑ Place Dowels	◑ Class S Conc Fcc=3,000 psi	◑ Remove Str Conc (0)	◑ Str Exc (0)	◑ Structure Backfill (0)	Berm Emb (0)	Dike Emb (0)	Drainage Exc (0)	REMARKS
1	N/A	X		1	6	4	101.4	0	X		B-02.10	Left	X		B-04.30	X	D6					35										4109		31		85	119				
Station: 104+00												Right		X	B-04.10	X	B-06.10													66		7838		58		207	199				
Existing:																															Box Culvert Total	11947		89		292	318				
2	N/A	X		2	10	4	161.3	45 RT	X		B-02.20	Left	X		(1)	X	D6							106.4								37264		304		1043	407				
Station: 119+77.04 To 120+14.16												Right		X	B-08.10													54.9				18986		155		589	187				B-08.10, Type B
Existing:																															Box Culvert Total	56250		459		1632	594				
3	N/A	X		1	8	3	158.0	0	X		B-02.10	Left	X		D5							101.3										12438		85		293	233				
Station: 78+72 Sierra Vista Dr ℄												Right		X	(2)															56.7		7867		59		221	143				
Existing:																															Box Culvert Total	20305		144		514	376				
												Left																													
Station:												Right																													
Existing:																															Box Culvert Total										
												Left																													
Station:												Right																													
Existing:																															Box Culvert Total										
												Left																													
Station:												Right																													
Existing:																															Box Culvert Total										
												Left																													
Station:												Right																													
Existing:																															Box Culvert Total										
												Left																													
Station:												Right																													
Existing:																															Box Culvert Total										
												Left																													
Station:												Right																													
Existing:																															Box Culvert Total										
												Left																													
Station:												Right																													
Existing:																															Box Culvert Total										
																															Sheet Total	88502		692		2438	1288				

(1) B-04.70 Modified
Rt Wing @ 45° G=14'-6"
Lt Wing @ 25° E=24'-6"

(2) B-04.10 Modified
Rt Wing @ 90°, G=10'-0"
Lt wing @ 45°, E=14'-0"

NOTE:
FOR STRUCTURAL EXCAVATION, STRUCTURE BACKFILL PLACEMENT AND MEASUREMENT, SEE STANDARD DRAWING B-19.50

NOTE:
THE ZEROS IN PARENTHESIS (0, 0.0 & 0.00) IN THE HEADING OF SOME OF THE COLUMNS ARE THE RECOMMENDED PRECISION OF THE VALUE TO BE ENTERED IN THE COLUMN.

◑ TOTALS SHOWN FOR THE BOX CULVERT INCLUDE THE QUANTITIES FOR HEADWALLS, WINGS, APRONS, CURBS, CUT-OFF WALLS AND LAPS AT CONSTRUCTION JOINTS.

◪ STRUCTURES SECTION STANDARD DRAWINGS JUNE, 1992 (PUBLICATION NO. 31-002) (ENGLISH EDITION)

▲ Construction ℄ Looking Ahead

	NAME	DATE
DESIGN	RS	09/02
DRAWN	MSK	09/02
CHECKED	DJS	09/02

BRW
7720 N. 16th Street Suite 100 Phoenix, Arizona 85020 (602) 331-9191

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION

REINFORCED CONC BOX CULVERT AND BOX CULVERT EXTENSION
SUMMARY SHEET

ROUTE: US 60
LOCATION: GRAND AVE AT 55TH AVE AND MARYLAND AVE

TRACS NO. H5601 01 C
060-B(007)8

PRELIMINARY
STAGE IV
Review
NOT FOR CONSTRUCTION OR RECORDING

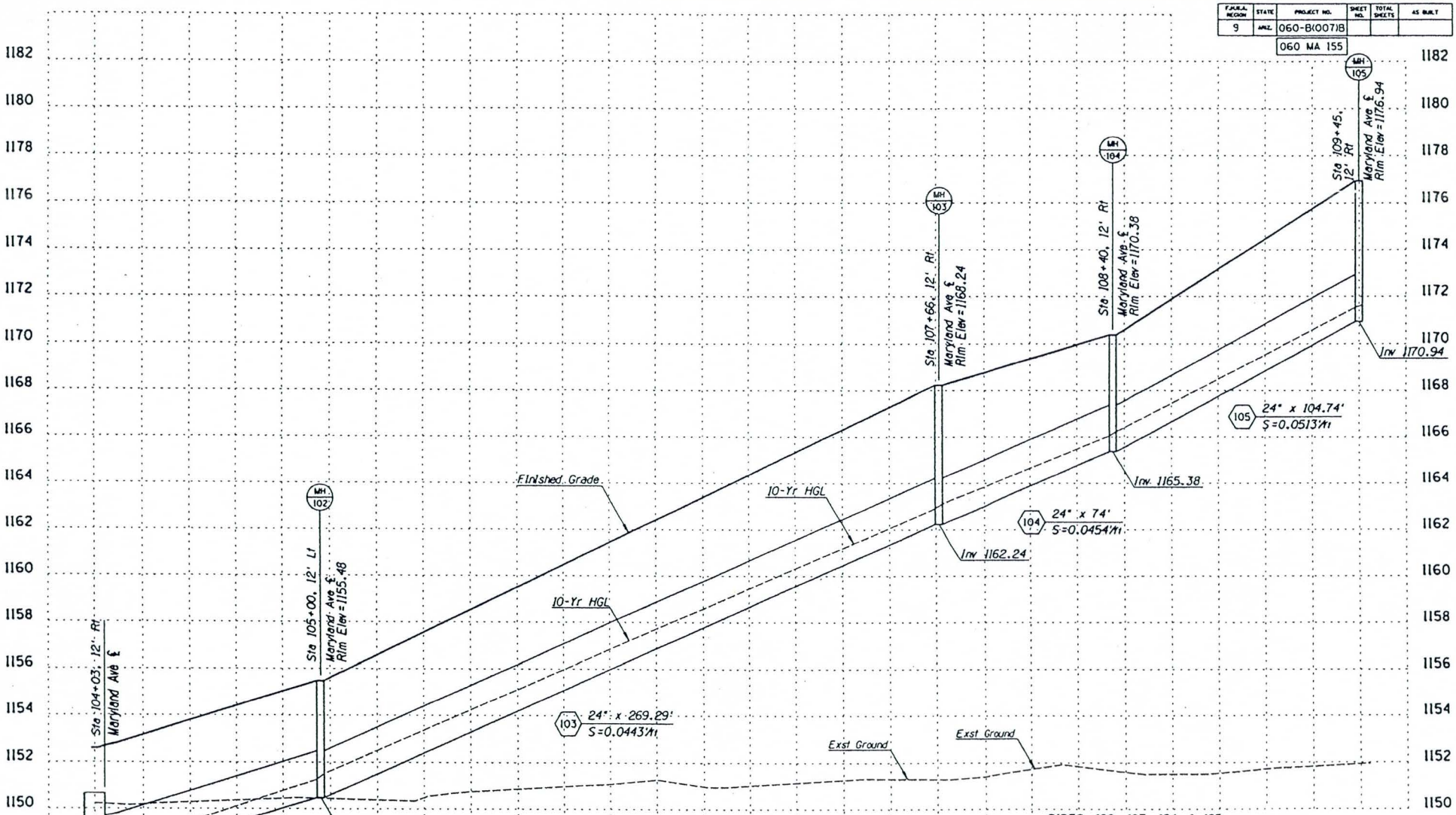
DWG. NO. G-5.4
___ OF ___

REV. DATE: 01-03-2000

Appendix F
Drainage System Profiles

F.A.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	060-B(007)B			

060 MA 155



PIPES: 102, 103, 104, & 105

	NAME	DATE
DESIGN	RBB	09/02
DRAWN	MSK	09/02
CHECKED	DJS	09/02

BRW 7720 N. 16th Street Suite 100 Phoenix, Arizona 85020 (602) 734-1118

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION

STORM DRAIN PROFILES

ROUTE: US 60

LOCATION: GRAND AVE AT 55TH AVE AND MARYLAND AVE

TRACS NO. H5601 01 C

060-B(007)B

PRELIMINARY
STAGE IV
Review
NOT FOR CONSTRUCTION OR RECORDING

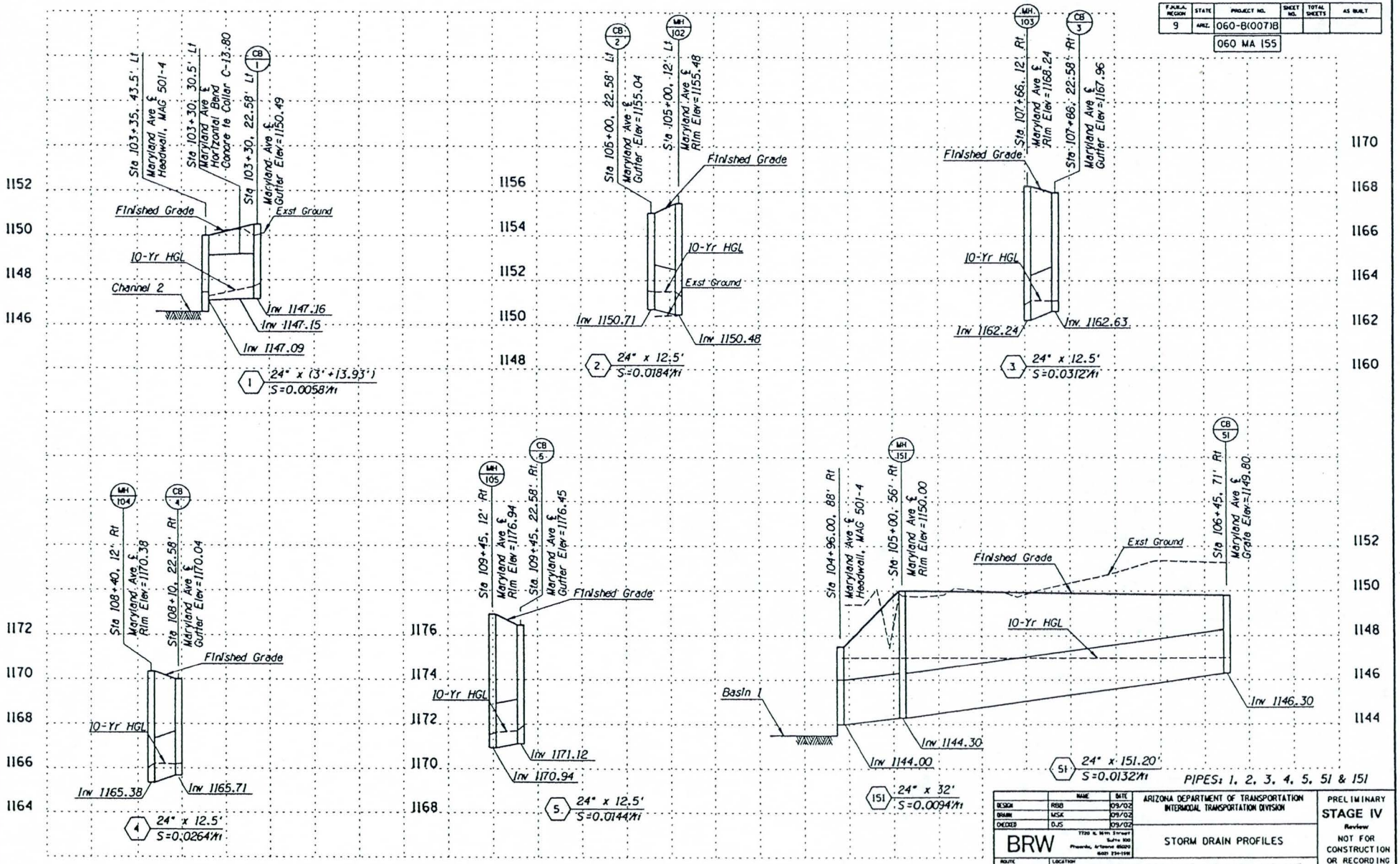
DWG. NO. D-2.1

___ OF ___

SURVEY NO. | FINISHED PLANS | LOCATION | DATE | SURVEY NO. | FINISHED PLANS | REVISIONS | LOCATION | DATE

n:\1134239\acad\dgn\d_pro11.dgn 09/24/2002 10:13:17 AM

F.A.H.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	060-B(007)B			
		060 MA 155			



PIPES: 1, 2, 3, 4, 5, 51 & 151

	NAME	DATE
DESIGN	RBB	09/02
DRAWN	MSK	09/02
CHECKED	DJS	09/02

BRW 7720 N. 16th Street Suite 100 Phoenix, Arizona 85020 (602) 234-1999

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION

STORM DRAIN PROFILES

ROUTE: US 60
LOCATION: GRAND AVE AT 55TH AVE AND MARYLAND AVE

TRACS NO. H5601 01 C

060-B(007)B

PRELIMINARY
STAGE IV
Review
NOT FOR CONSTRUCTION OR RECORDING

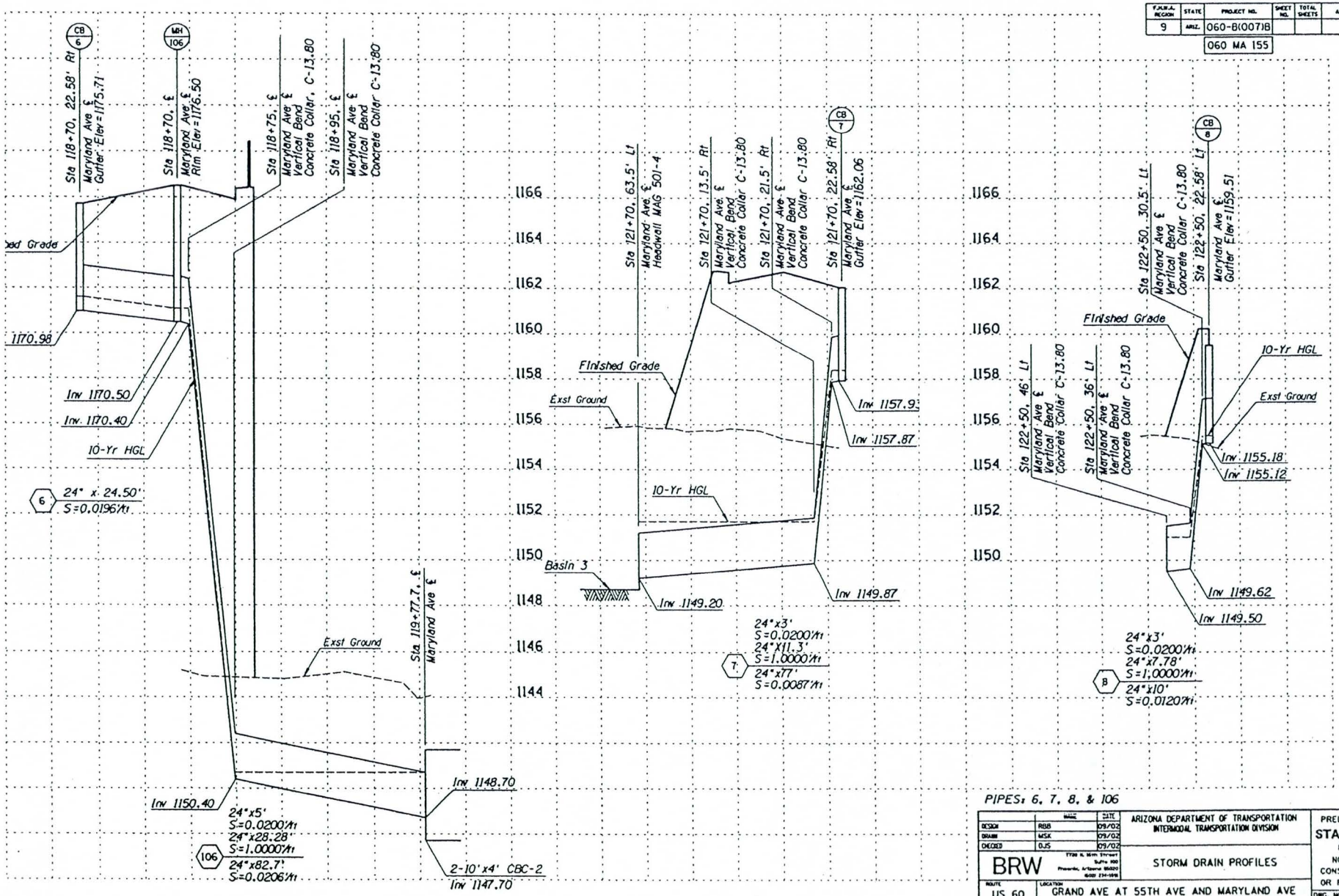
DWG. NO. D-2.2

___ OF ___

DATE: LOCATION: REVISIONS: FINISHED PLANS: SURVEY NO.

n:\1344239\acad\dgn\d_pcr18.dgn 09/24/2002 10:13:15 AM

F.A.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	060-B(007)B			
		060 MA 155			



PIPES: 6, 7, 8, & 106

	NAME	DATE
DESIGN	RBB	09/02
DRAWN	MSK	09/02
CHECKED	DJS	09/02

BRW — 7720 N. 16th Street, Suite 100, Phoenix, Arizona 85020, (602) 734-1696

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION

STORM DRAIN PROFILES

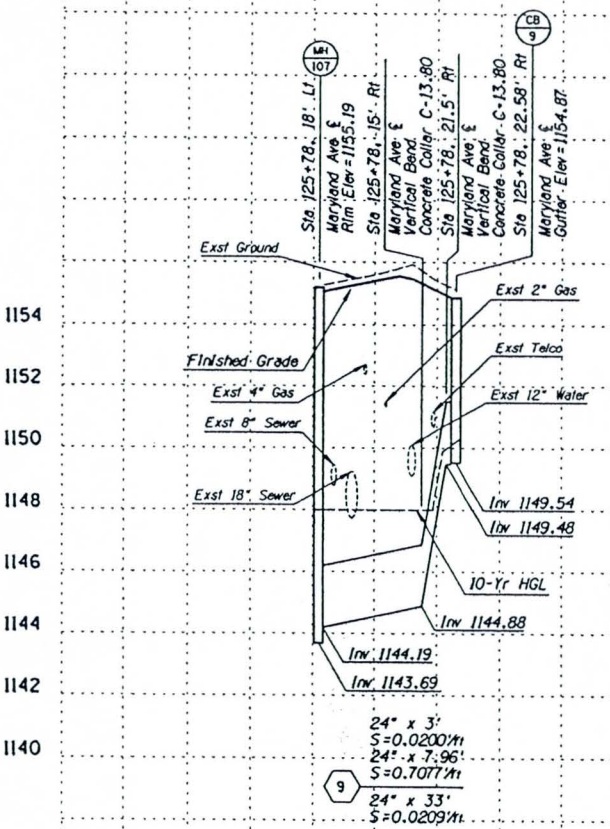
PRELIMINARY
STAGE IV
Review
NOT FOR CONSTRUCTION OR RECORDING

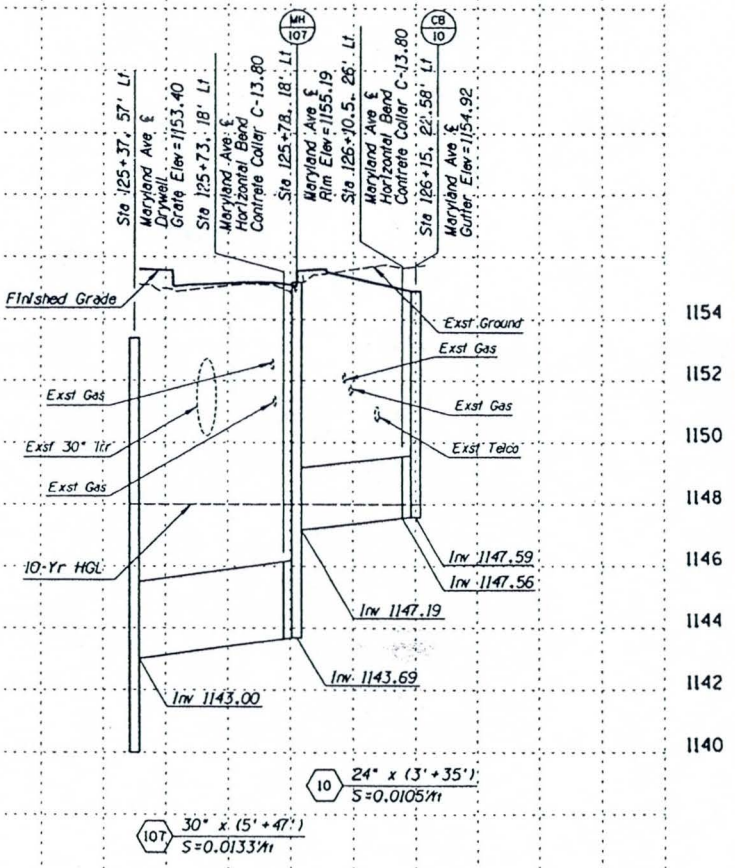
ROUTE: US 60
LOCATION: GRAND AVE AT 55TH AVE AND MARYLAND AVE
DWG. NO. D-2.3

TRACS NO. H5601 01 C | 060-B(007)B | ___ OF ___

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	060-B(007)B			

060 MA 155

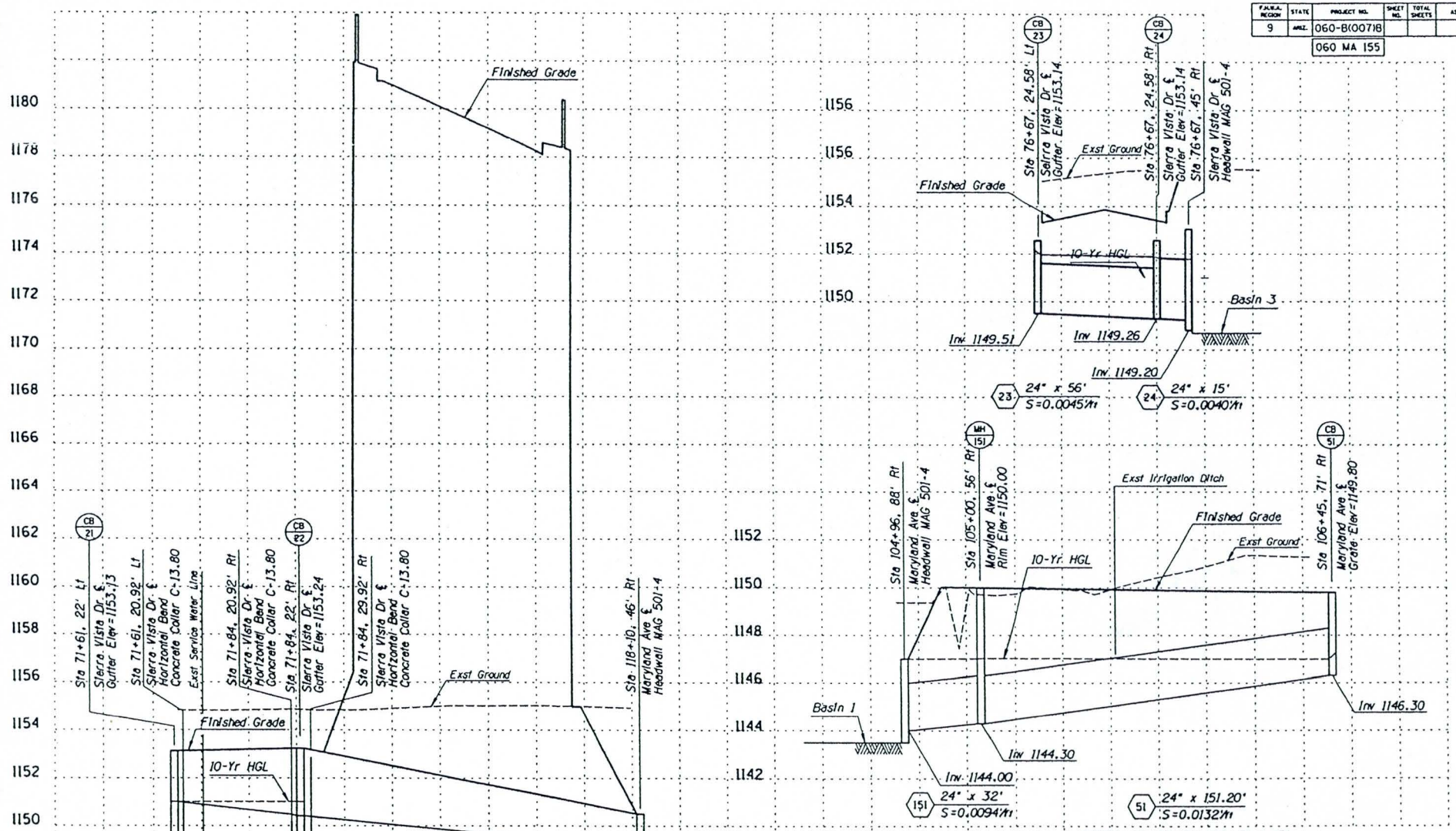




PIPES: 9, 10, & 107

	NAME	DATE	ARIZONA DEPARTMENT OF TRANSPORTATION INTERMODAL TRANSPORTATION DIVISION	PRELIMINARY STAGE IV Review NOT FOR CONSTRUCTION OR RECORDING
DESIGN	RDB	09/02		
DRAWN	MSK	09/02		
CHECKED	DJS	09/02		
BRW	7700 N. 16th Street Suite 100 Phoenix, Arizona 85020 (602) 734-7700		STORM DRAIN PROFILES	
ROUTE US 60	LOCATION GRAND AVE AT 55TH AVE AND MARYLAND AVE			DWG. NO. D-2.4
TRACS NO. H5601 01 C			060-B(007)B	___ OF ___

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	060-B(007)B			
		060 MA 155			



PIPES: 21, 22, 23, 24, 51 & 151

	NAME	DATE
DESIGN	RBB	09/02
DRAWN	MSK	09/02
CHECKED	DJS	09/02

BRW — 7720 N. 16th Street, Suite 100, Phoenix, Arizona 85020, (602) 254-1996

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION

STORM DRAIN PROFILES

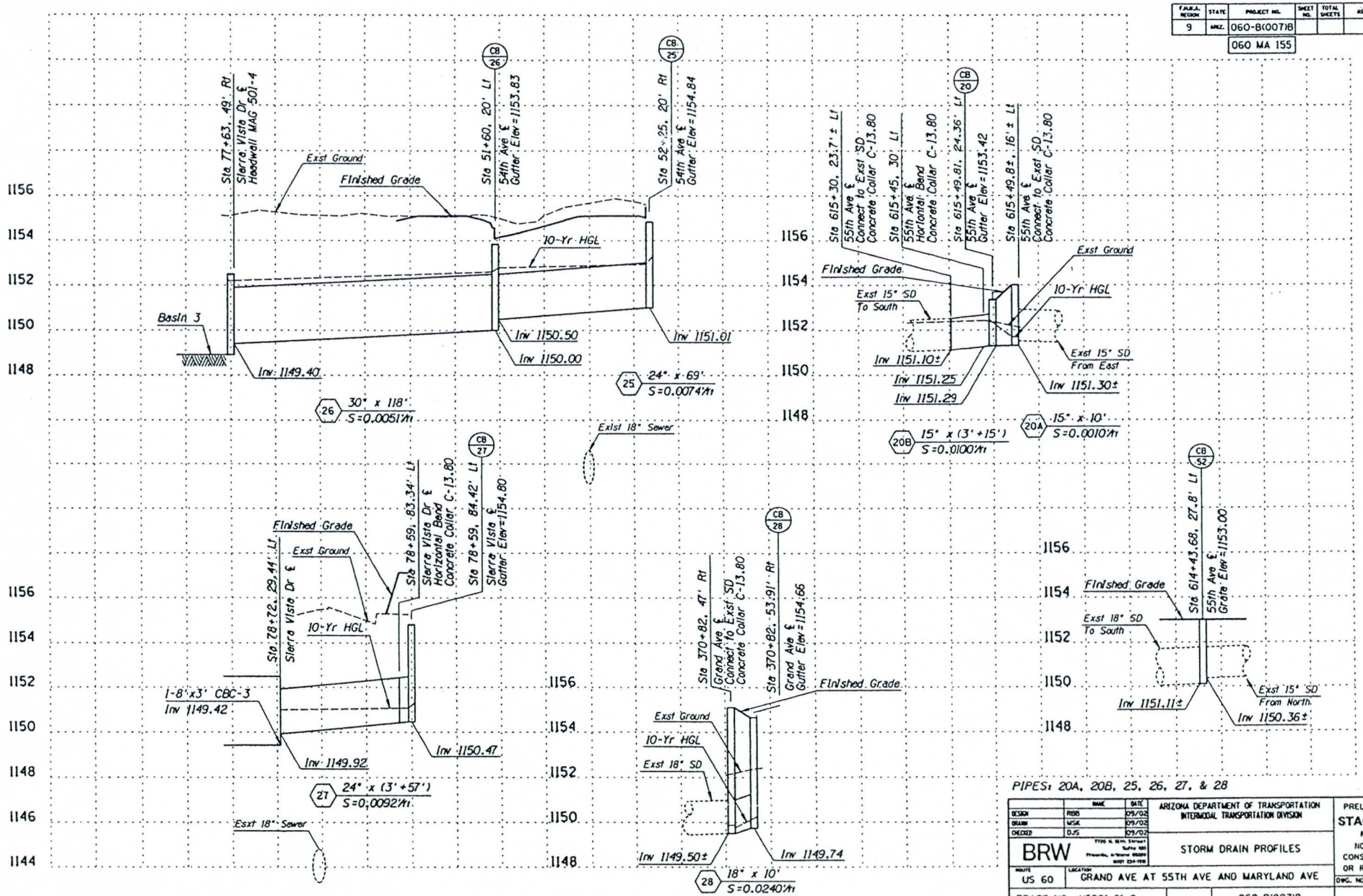
ROUTE: US 60 — LOCATION: GRAND AVE AT 55TH AVE AND MARYLAND AVE

PRELIMINARY
STAGE IV
Review
NOT FOR CONSTRUCTION OR RECORDING

DWG. NO. D-2.5

TRACS NO. H5601 01 C — 060-B(007)B — ___ OF ___

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	060-B(007)B			
		060 MA 155			



PIPES: 20A, 20B, 25, 26, 27, & 28

	NAME	DATE
DESIGN	RBB	09/02
DRAWN	WSK	09/02
CHECKED	DJS	09/02

BRW 7720 N. 16th Street Suite 100 Phoenix, Arizona 85020 (602) 234-1998

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION

STORM DRAIN PROFILES

ROUTE: US 60 | LOCATION: GRAND AVE AT 55TH AVE AND MARYLAND AVE

TRACS NO. H5601 01 C | 060-B(007)B

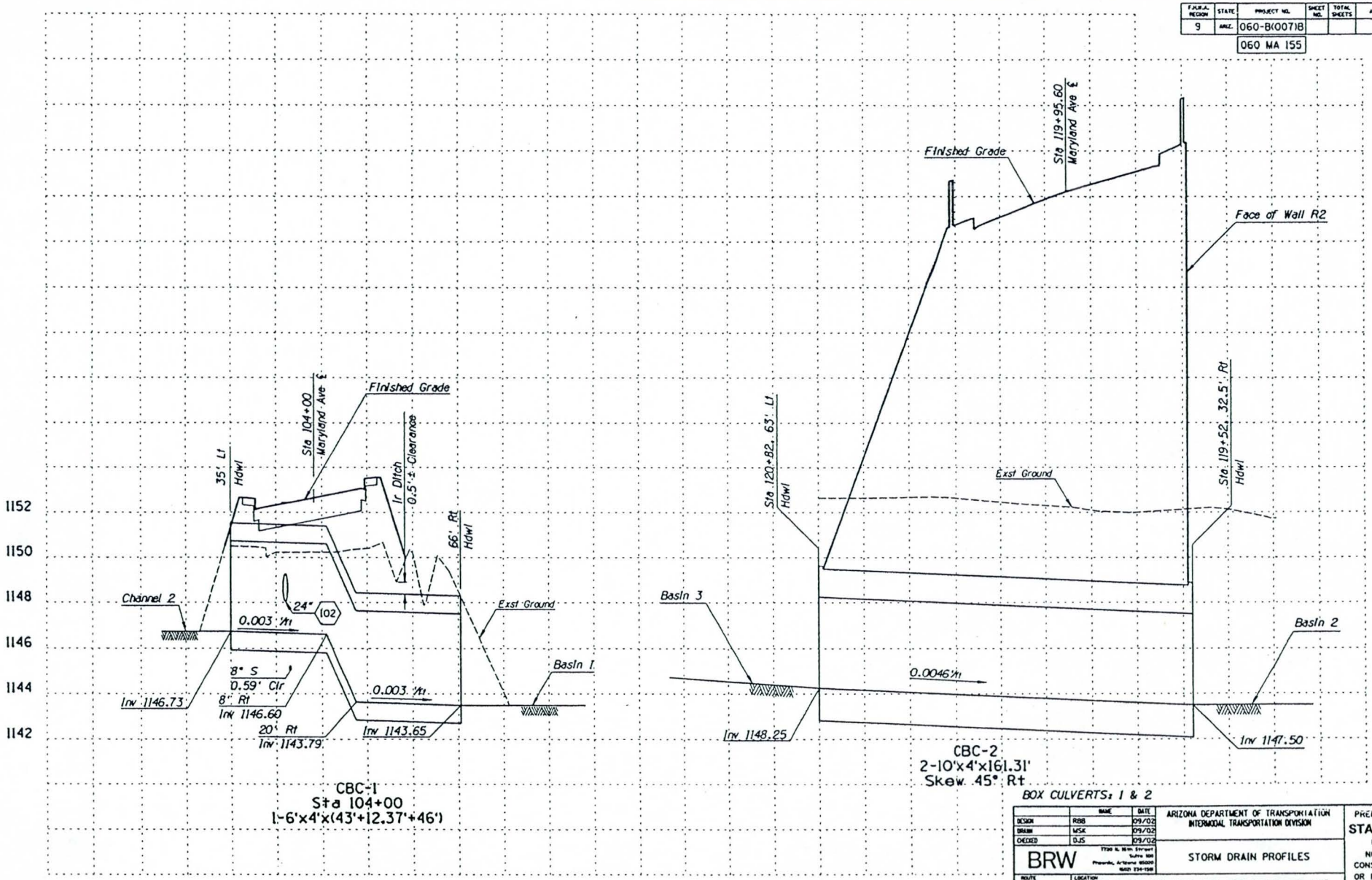
PRELIMINARY
STAGE IV
Review
NOT FOR CONSTRUCTION OR RECORDING

DWG. NO. D-2.6

___ OF ___

F.A.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	060-B(007)B			

060 MA 155



	NAME	DATE
DESIGN	RBB	09/02
DRAWN	WSK	09/02
CHECKED	DJS	09/02

BRW
7730 S. 16th Street
Suite 100
Phoenix, Arizona 85020
(602) 234-1346

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION

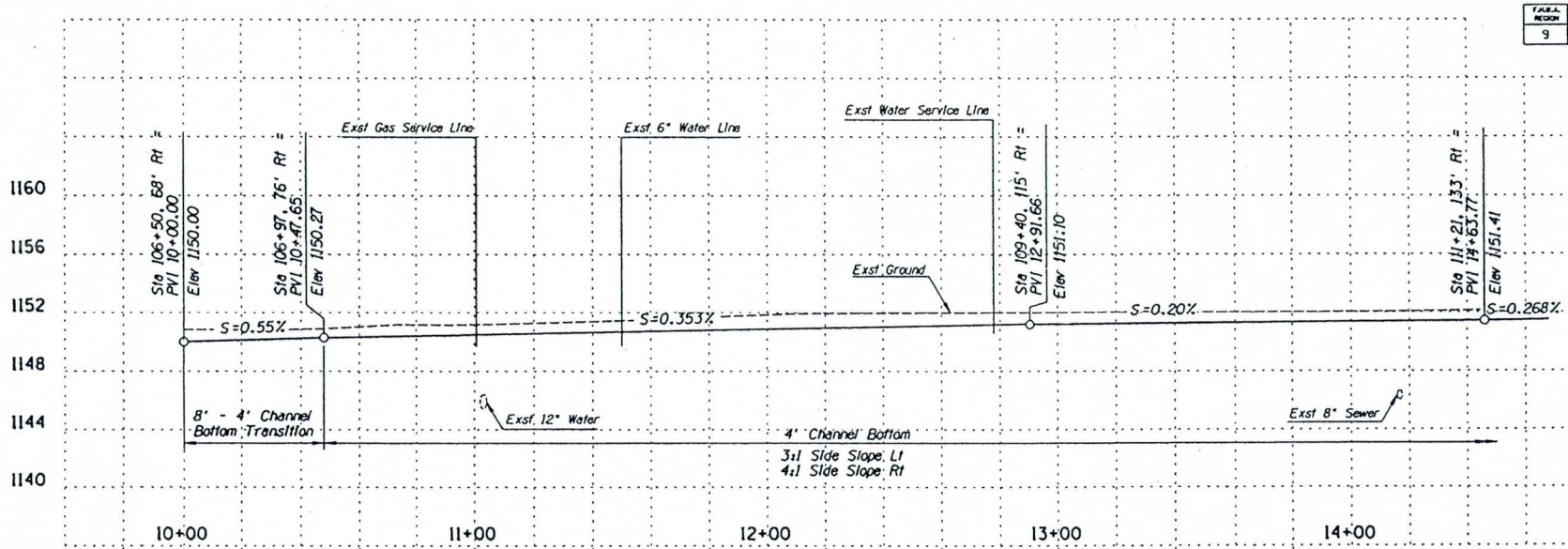
STORM DRAIN PROFILES

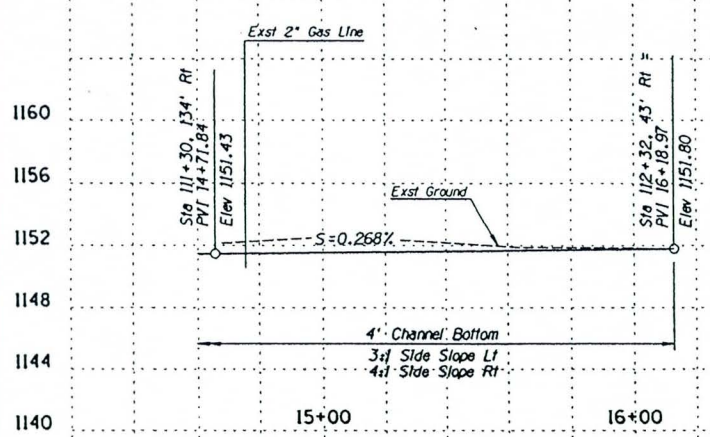
PRELIMINARY
STAGE IV
Review
NOT FOR CONSTRUCTION OR RECORDING

ROUTE: US 60
LOCATION: GRAND AVE AT 55TH AVE AND MARYLAND AVE
DWG. NO. D-2.7

TRACS NO. H5601 01 C | 060-B(007)B | ___ OF ___

F.A.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	060-B(007)B			
		060 MA 155			





	NAME	DATE
DESIGN	RBB	09/02
DRAWN	MSK	09/02
CHECKED	DJS	09/02

BRW
7730 S. 48th Street
Suite 100
Phoenix, Arizona 85020
(602) 234-1518

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION

EARTHEN CHANNEL I
PROFILE

ROUTE: US 60
LOCATION: GRAND AVE AT 55TH AVE AND MARYLAND AVE

TRACS NO. H5601 01 C

060-B(007)B

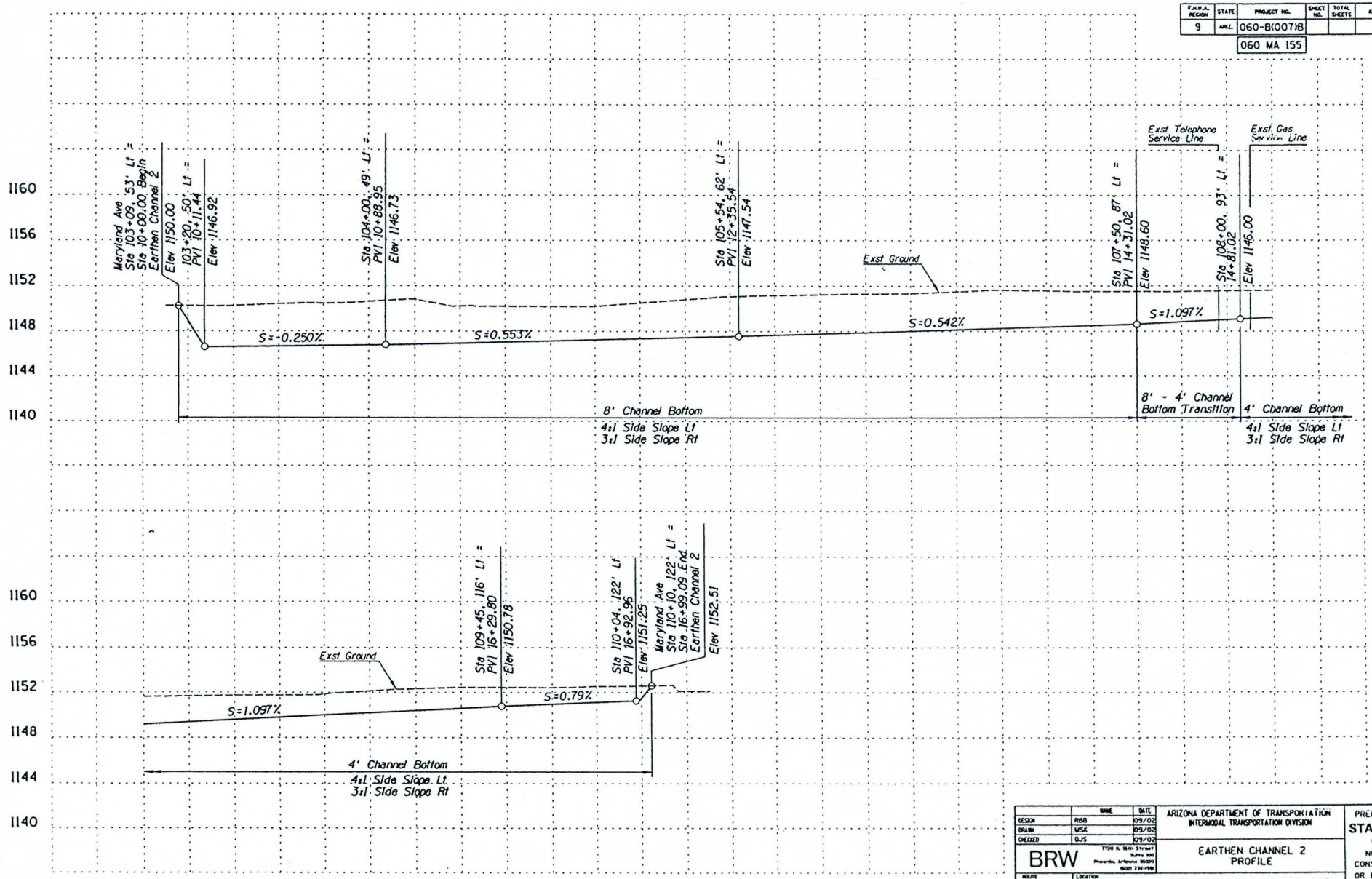
PRELIMINARY
STAGE IV
Review
NOT FOR CONSTRUCTION OR RECORDING

DWG. NO. D-2.8

___ OF ___

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	060-B(007)B			

060 MA 155



	NAME	DATE
DESIGN	RBB	09/02
DRAWN	MSK	09/02
CHECKED	DJS	09/02

BRW
7720 N. 16th Street
Suite 100
Phoenix, Arizona 85020
(602) 234-1988

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION

EARTHEN CHANNEL 2
PROFILE

PRELIMINARY
STAGE IV
Review
NOT FOR CONSTRUCTION OR RECORDING

ROUTE: US 60
LOCATION: GRAND AVE AT 55TH AVE AND MARYLAND AVE

DWG. NO. 0-2.9

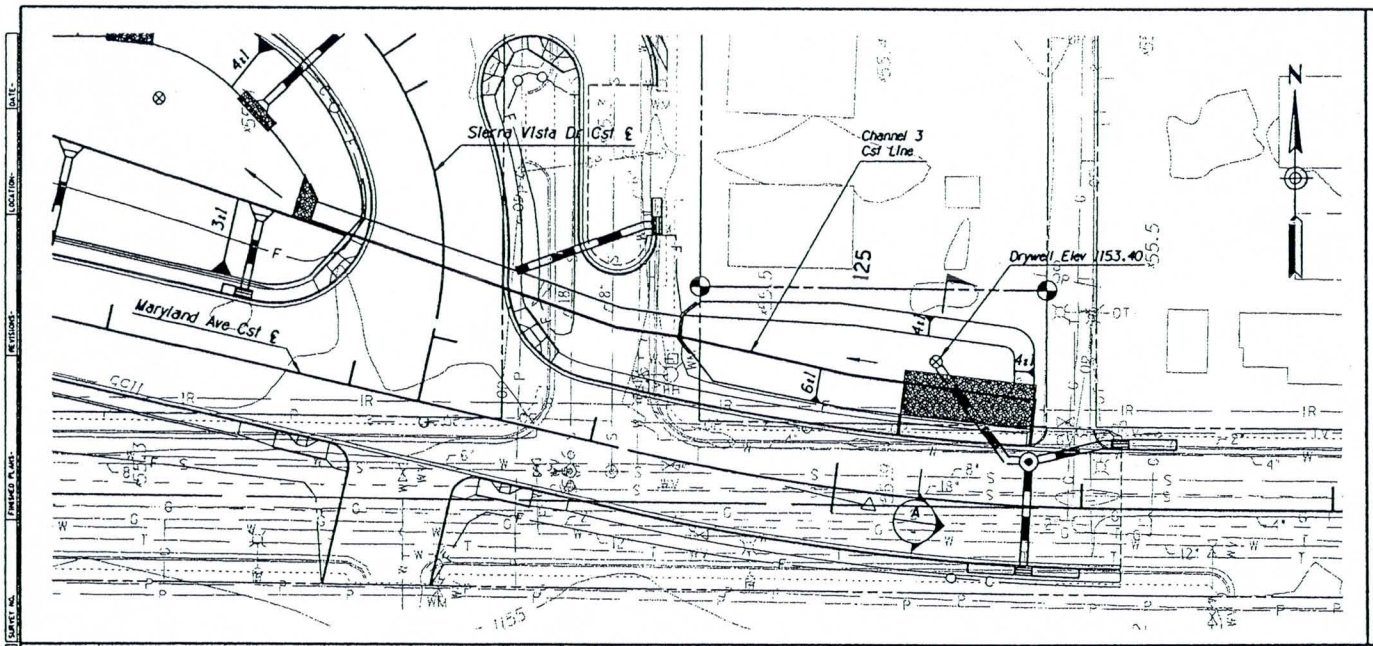
TRACS NO. H5601 01 C

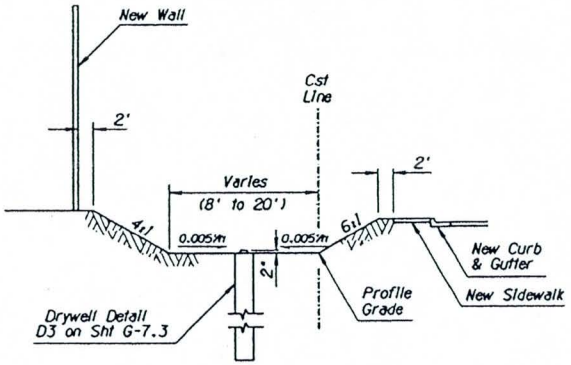
060-B(007)B

___ OF ___

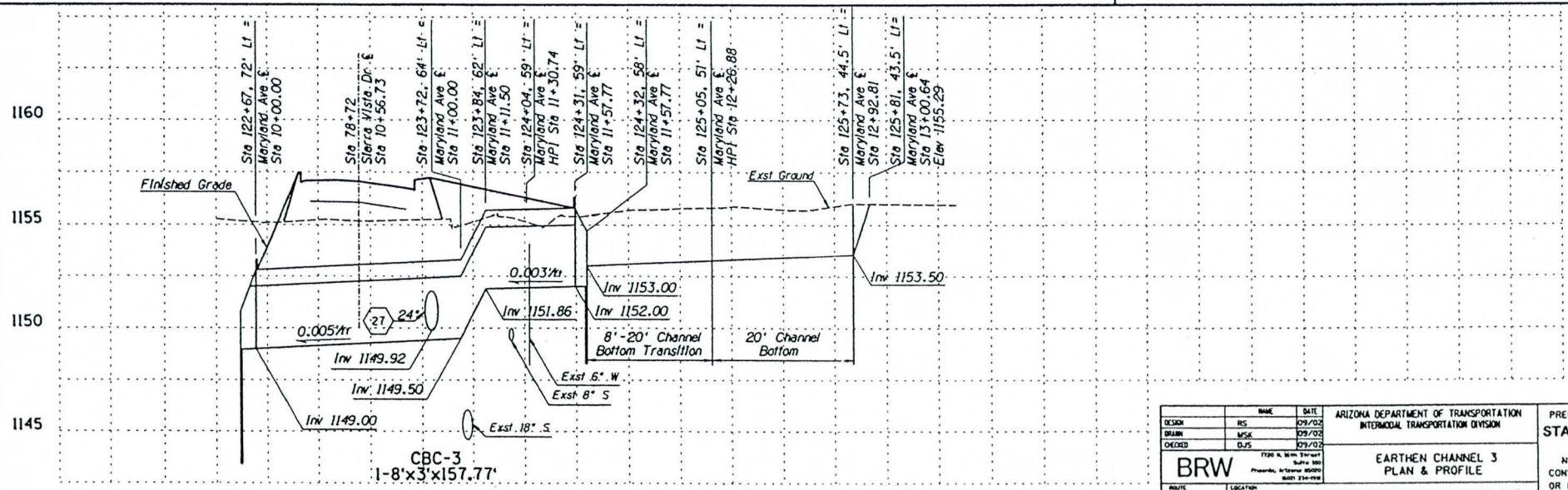
FAUSA REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	060-B(007)B			

060 MA 155





SECTION A



	NAME	DATE
DESIGN	RS	09/02
DRAWN	MSK	09/02
CHECKED	DJS	09/02

BRW 7720 N. 16th Street Suite 100 Phoenix, Arizona 85020 (602) 336-1188

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION

EARTHEN CHANNEL 3
PLAN & PROFILE

PRELIMINARY
STAGE IV
Review
NOT FOR CONSTRUCTION OR RECORDING

ROUTE: US 60
LOCATION: GRAND AVE AT 55TH AVE AND MARYLAND AVE

TRACS NO. H5601 01 C

060-B(007)B

DWG. NO. D-2.10

___ OF ___

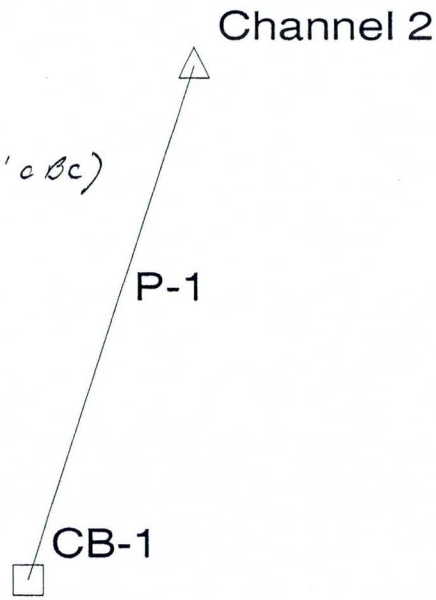
Appendix G
Storm Sewer Hydraulic Calculations
(StormCAD Tables)

Maryland Ave.

Sta. 103+30

10-YEAR PEAK RUNOFF

TW = 1149.71 (100-YR HW, 8'x4' CBC)



Combined Pipe/Node Report

Pipe	Upstream Node	Downstream Node	Length (ft)	Inlet Area (acres)	Inlet C Coefficient	Inlet CA (acres)	Total CA (acres)	Inlet Discharge (cfs)	Section Size	Capacity (cfs)	Average Velocity (ft/s)	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)
P-1	CB-1	Channel 2	16.93	0.24	0.95	0.23	0.23	1.06	24 inch	15.76	0.34	1,147.16	1,147.09	0.004135

Pipe Report

Pipe	Up stream Node	Down stream Node	System Intensity (in/hr)	Discharge (cfs)	Length (ft)	Constructed Slope (ft/ft)	Section Size	" n "	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)	Upstream HGL (ft)	Downstream HGL (ft)
P-1	CB-1	Channel 2	4.62	1.06	16.93	0.004135	24 inch	0.012	1,147.16	1,147.09	1,150.49	1,150.59	1,149.71	1,149.71

Node Report

Node	Inlet Area (acres)	Inlet CA (acres)	Inlet TC (min)	System Flow Time (min)	System Intensity (in/hr)	Discharge (cfs)	Ground Elevation (ft)	Rim Elevation (ft)	HGL In (ft)	HGL Out (ft)	Inlet Intensity (in/hr)	Inlet Discharge (cfs)
CB-1	0.24	0.23	10.00	10.00	4.62	1.06	1,150.49	1,150.49	1,149.71	1,149.71	4.62	1.06
Channel 2	N/A	N/A	N/A	10.84	4.45	N/A	1,150.59	1,150.59	1,149.71	1,149.71	N/A	N/A

DOT Report

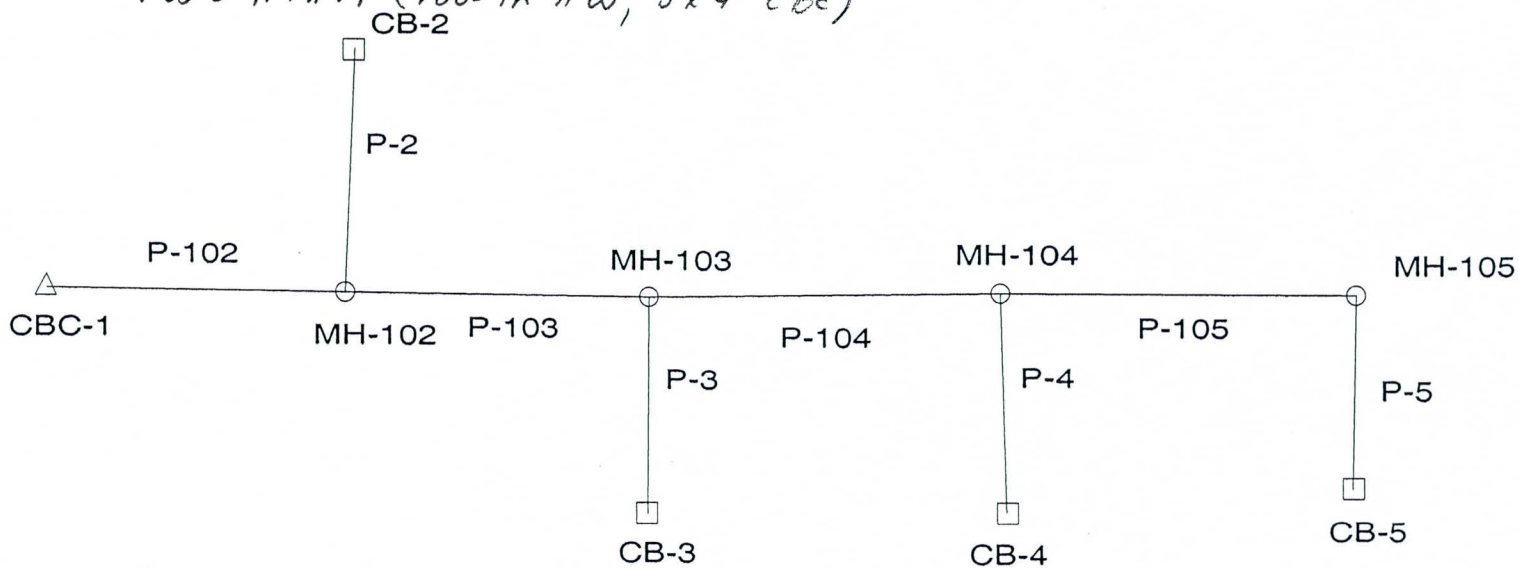
Pipe	-Node- Upstream Downstream	Inlet Area (acres)	Inlet CA (acres)	Total CA (acres)	-Ground- Upstream Downstream (ft)	-HGL- Upstream Downstream (ft)	-Slope- Energy Constructed (ft/ft)	-Section- Discharge Capacity (cfs)	-Section- Shape Size	Length (ft)	Average Velocity (ft/s)
P-1	CB-1	0.24	0.23	0.23	1,150.49	1,149.71	0.000019	1.06	Circular	16.93	0.34
	Channel 2				1,150.59	1,149.71	0.004135	15.76	24 inch		

Maryland Ave.

Sta. 104+00 to Sta. 109+45

10-YEAR PEAK RUNOFF

Tw = 1149.71 (100-YR HW, 8'x4' CBC)



Combined Pipe/Node Report

Pipe	Upstream Node	Downstream Node	Length (ft)	Inlet Area (acres)	Inlet C Coefficient	Inlet CA (acres)	Total CA (acres)	Inlet Discharge (cfs)	Section Size	Capacity (cfs)	Average Velocity (ft/s)	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)
P-5	CB-5	MH-105	12.50	0.65	0.95	0.62	0.62	2.87	24 inch	29.41	3.33	1,171.12	1,170.94	0.014400
P-105	MH-105	MH-104	104.74	N/A	N/A	N/A	0.62	N/A	24 inch	56.46	2.96	1,170.94	1,165.38	0.053084
P-4	CB-4	MH-104	12.50	0.19	0.95	0.18	0.18	0.84	24 inch	39.82	0.99	1,165.71	1,165.38	0.026400
P-3	CB-3	MH-103	12.50	0.06	0.95	0.06	0.06	0.27	24 inch	43.29	0.32	1,162.63	1,162.24	0.031200
P-104	MH-104	MH-103	74.00	N/A	N/A	N/A	0.80	N/A	24 inch	50.48	3.32	1,165.38	1,162.24	0.042432
P-103	MH-103	MH-102	265.29	N/A	N/A	N/A	0.86	N/A	24 inch	51.60	3.16	1,162.24	1,150.48	0.044329
P-2	CB-2	MH-102	12.50	0.39	0.95	0.37	0.37	1.72	24 inch	33.24	1.27	1,150.71	1,150.48	0.018400
P-102	MH-102	CBC-1	95.86	N/A	N/A	N/A	1.23	N/A	24 inch	42.03	3.00	1,150.48	1,147.66	0.029418

Pipe Report

Pipe	Up stream Node	Down stream Node	System Intensity (in/hr)	Discharge (cfs)	Length (ft)	Constructed Slope (ft/ft)	Section Size	" n "	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)	Upstream HGL (ft)	Downstream HGL (ft)
P-5	CB-5	MH-105	4.62	2.87	12.50	0.014400	24 inch	0.012	1,171.12	1,170.94	1,176.45	1,176.94	1,171.71	1,171.64
P-105	MH-105	MH-104	4.60	2.86	104.74	0.053084	24 inch	0.012	1,170.94	1,165.38	1,176.94	1,170.38	1,171.53	1,166.24
P-4	CB-4	MH-104	4.62	0.84	12.50	0.026400	24 inch	0.012	1,165.71	1,165.38	1,170.04	1,170.38	1,166.22	1,166.24
P-3	CB-3	MH-103	4.62	0.27	12.50	0.031200	24 inch	0.012	1,162.63	1,162.24	1,167.96	1,168.24	1,163.12	1,163.12
P-104	MH-104	MH-103	4.48	3.61	74.00	0.042432	24 inch	0.012	1,165.38	1,162.24	1,170.38	1,168.24	1,166.04	1,163.12
P-103	MH-103	MH-102	4.41	3.80	265.29	0.044329	24 inch	0.012	1,162.24	1,150.48	1,168.24	1,155.48	1,162.92	1,151.51
P-2	CB-2	MH-102	4.62	1.72	12.50	0.018400	24 inch	0.012	1,150.71	1,150.48	1,155.04	1,155.48	1,151.50	1,151.51
P-102	MH-102	CBC-1	4.12	5.09	95.86	0.029418	24 inch	0.012	1,150.48	1,147.66	1,155.48	1,152.39	1,151.28	1,149.71

Node Report

Node	Inlet Area (acres)	Inlet CA (acres)	Inlet TC (min)	System Flow Time (min)	System Intensity (in/hr)	Discharge (cfs)	Ground Elevation (ft)	Rim Elevation (ft)	HGL In (ft)	HGL Out (ft)	Inlet Intensity (in/hr)	Inlet Discharge (cfs)
CB-5	0.65	0.62	10.00	10.00	4.62	2.87	1,176.45	1,176.45	1,171.97	1,171.71	4.62	2.87
MH-105	N/A	N/A	N/A	10.06	4.60	2.86	1,176.94	1,176.94	1,171.64	1,171.53	N/A	N/A
CB-4	0.19	0.18	10.00	10.00	4.62	0.84	1,170.04	1,170.04	1,166.25	1,166.22	4.62	0.84
CB-3	0.06	0.06	10.00	10.00	4.62	0.27	1,167.96	1,167.96	1,163.12	1,163.12	4.62	0.27
MH-104	N/A	N/A	N/A	10.65	4.48	3.61	1,170.38	1,170.38	1,166.24	1,166.04	N/A	N/A
MH-103	N/A	N/A	N/A	11.02	4.41	3.80	1,168.24	1,168.24	1,163.12	1,162.92	N/A	N/A
CB-2	0.39	0.37	10.00	10.00	4.62	1.72	1,155.04	1,155.04	1,151.54	1,151.50	4.62	1.72
MH-102	N/A	N/A	N/A	12.42	4.12	5.09	1,155.48	1,155.48	1,151.51	1,151.28	N/A	N/A
CBC-1	N/A	N/A	N/A	12.95	4.02	N/A	1,152.39	1,152.39	1,149.71	1,149.71	N/A	N/A

DOT Report

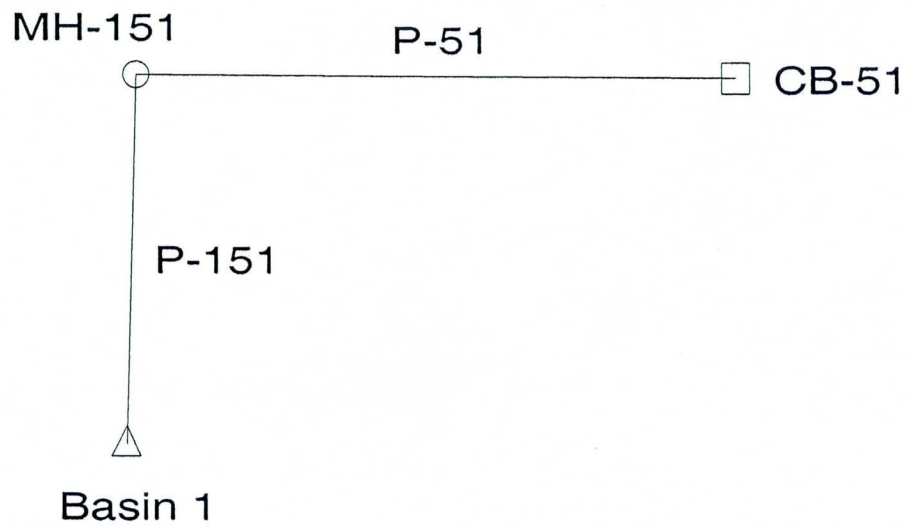
Pipe	-Node- Upstream Downstream	Inlet Area (acres)	Inlet CA (acres)	Total CA (acres)	-Ground- Upstream Downstream (ft)	-HGL- Upstream Downstream (ft)	-Slope- Energy Constructed (ft/ft)	-Section- Discharge Capacity (cfs)	-Section- Shape Size	Length (ft)	Average Velocity (ft/s)
P-5	CB-5	0.65	0.62	0.62	1,176.45	1,171.71	0.012161	2.87	Circular	12.50	3.33
	MH-105				1,176.94	1,171.64	0.014400	29.41	24 inch		
P-105	MH-105	N/A	N/A	0.62	1,176.94	1,171.53	0.051817	2.86	Circular	104.74	2.96
	MH-104				1,170.38	1,166.24	0.053084	56.46	24 inch		
P-4	CB-4	0.19	0.18	0.18	1,170.04	1,166.22	0.000231	0.84	Circular	12.50	0.99
	MH-104				1,170.38	1,166.24	0.026400	39.82	24 inch		
P-3	CB-3	0.06	0.06	0.06	1,167.96	1,163.12	0.000020	0.27	Circular	12.50	0.32
	MH-103				1,168.24	1,163.12	0.031200	43.29	24 inch		
P-104	MH-104	N/A	N/A	0.80	1,170.38	1,166.04	0.041233	3.61	Circular	74.00	3.32
	MH-103				1,168.24	1,163.12	0.042432	50.48	24 inch		
P-103	MH-103	N/A	N/A	0.86	1,168.24	1,162.92	0.043634	3.80	Circular	265.29	3.16
	MH-102				1,155.48	1,151.51	0.044329	51.60	24 inch		
P-2	CB-2	0.39	0.37	0.37	1,155.04	1,151.50	0.000292	1.72	Circular	12.50	1.27
	MH-102				1,155.48	1,151.51	0.018400	33.24	24 inch		
P-102	MH-102	N/A	N/A	1.23	1,155.48	1,151.28	0.019006	5.09	Circular	95.86	3.00
	CBC-1				1,152.39	1,149.71	0.029418	42.03	24 inch		

Maryland Ave.

Sta. 105+00 to Sta. 106+45

10-YEAR PEAK RUNOFF

TW = 1147.0 (100-YR, 2-HOUR W.S. Elev., Retention Basin #1)



Combined Pipe/Node Report

Pipe	Upstream Node	Downstream Node	Length (ft)	Inlet Area (acres)	Inlet C Coefficient	Inlet CA (acres)	Total CA (acres)	Inlet Discharge (cfs)	Section Size	Capacity (cfs)	Average Velocity (ft/s)	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)
P-51	CB-51	MH-151	151.20	1.27	0.70	0.89	0.89	3.83	24 inch	28.18	2.62	1,146.30	1,144.30	0.013228
P-151	MH-151	Basin 1	32.00	N/A	N/A	N/A	0.89	N/A	24 inch	23.73	1.18	1,144.30	1,144.00	0.009375

Pipe Report

Pipe	Up stream Node	Down stream Node	System Intensity (in/hr)	Discharge (cfs)	Length (ft)	Constructed Slope (ft/ft)	Section Size	" n "	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)	Upstream HGL (ft)	Downstream HGL (ft)
P-51	CB-51	MH-151	4.28	3.83	151.20	0.013228	24 inch	0.012	1,146.30	1,144.30	1,149.80	1,150.00	1,146.99	1,147.03
P-151	MH-151	Basin 1	4.15	3.72	32.00	0.009375	24 inch	0.012	1,144.30	1,144.00	1,150.00	1,146.00	1,147.01	1,147.00

Node Report

Node	Inlet Area (acres)	Inlet CA (acres)	Inlet TC (min)	System Flow Time (min)	System Intensity (in/hr)	Discharge (cfs)	Ground Elevation (ft)	Rim Elevation (ft)	HGL In (ft)	HGL Out (ft)	Inlet Intensity (in/hr)	Inlet Discharge (cfs)
CB-51	1.27	0.89	10.00	10.00	4.28	3.83	1,149.80	1,149.80	1,147.29	1,146.99	4.28	3.83
MH-151	N/A	N/A	N/A	10.96	4.15	3.72	1,150.00	1,150.00	1,147.03	1,147.01	N/A	N/A
Basin 1	N/A	N/A	N/A	11.41	4.09	N/A	1,146.00	1,146.00	1,147.00	1,147.00	N/A	N/A

DOT Report

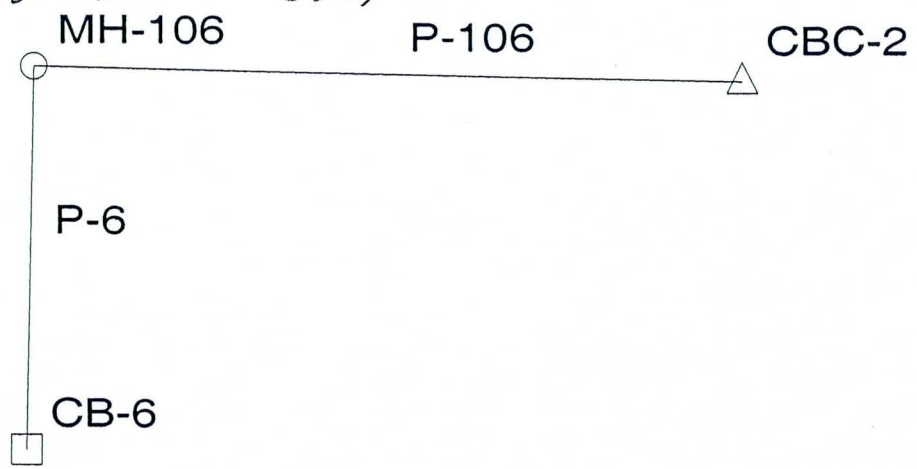
Pipe	-Node- Upstream Downstream	Inlet Area (acres)	Inlet CA (acres)	Total CA (acres)	-Ground- Upstream Downstream (ft)	-HGL- Upstream Downstream (ft)	-Slope- Energy Constructed (ft/ft)	-Section- Discharge Capacity (cfs)	-Section- Shape Size	Length (ft)	Average Velocity (ft/s)
P-51	CB-51	1.27	0.89	0.89	1,149.80	1,146.99	0.001223	3.83	Circular	151.20	2.62
	MH-151				1,150.00	1,147.03	0.013228	28.18	24 inch		
P-151	MH-151	N/A	N/A	0.89	1,150.00	1,147.01	0.000230	3.72	Circular	32.00	1.18
	Basin 1				1,146.00	1,147.00	0.009375	23.73	24 inch		

Maryland Ave.

Sta. 118+70

10-YEAR PEAK RUNOFF

TW = 1152.25 (CROWN OF 2-10'x4' CBC)



Combined Pipe/Node Report

Pipe	Upstream Node	Downstream Node	Length (ft)	Inlet Area (acres)	Inlet C Coefficient	Inlet CA (acres)	Total CA (acres)	Inlet Discharge (cfs)	Section Size	Capacity (cfs)	Average Velocity (ft/s)	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)
P-6	CB-6	MH-106	24.50	0.67	0.95	0.64	0.64	2.96	24 inch	34.30	3.36	1,170.98	1,170.50	0.019592
P-106	MH-106	CBC-2	115.98	N/A	N/A	N/A	0.64	N/A	24 inch	106.25	2.33	1,170.50	1,148.70	0.187963

Pipe Report

Pipe	Up stream Node	Down stream Node	System Intensity (in/hr)	Discharge (cfs)	Length (ft)	Constructed Slope (ft/ft)	Section Size	" n "	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)	Upstream HGL (ft)	Downstream HGL (ft)
P-6	CB-6	MH-106	4.62	2.96	24.50	0.019592	24 inch	0.012	1,170.98	1,170.50	1,175.71	1,176.50	1,171.58	1,171.21
P-106	MH-106	CBC-2	4.59	2.95	115.98	0.187963	24 inch	0.012	1,170.50	1,148.70	1,176.50	1,171.15	1,171.10	1,152.25

Node Report

Node	Inlet Area (acres)	Inlet CA (acres)	Inlet TC (min)	System Flow Time (min)	System Intensity (in/hr)	Discharge (cfs)	Ground Elevation (ft)	Rim Elevation (ft)	HGL In (ft)	HGL Out (ft)	Inlet Intensity (in/hr)	Inlet Discharge (cfs)
CB-6	0.67	0.64	10.00	10.00	4.62	2.96	1,175.71	1,175.71	1,171.84	1,171.58	4.62	2.96
MH-106	N/A	N/A	N/A	10.12	4.59	2.95	1,176.50	1,176.50	1,171.21	1,171.10	N/A	N/A
CBC-2	N/A	N/A	N/A	10.95	4.42	N/A	1,171.15	1,171.15	1,152.25	1,152.25	N/A	N/A

DOT Report

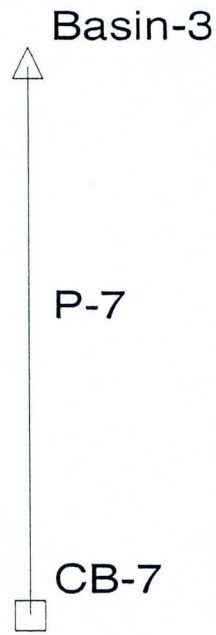
Pipe	-Node- Upstream Downstream	Inlet Area (acres)	Inlet CA (acres)	Total CA (acres)	-Ground- Upstream Downstream (ft)	-HGL- Upstream Downstream (ft)	-Slope- Energy Constructed (ft/ft)	-Section- Discharge Capacity (cfs)	-Section- Shape Size	Length (ft)	Average Velocity (ft/s)
P-6	CB-6	0.67	0.64	0.64	1,175.71	1,171.58	0.018445	2.96	Circular	24.50	3.36
	MH-106				1,176.50	1,171.21	0.019592	34.30	24 inch		
P-106	MH-106	N/A	N/A	0.64	1,176.50	1,171.10	0.164260	2.95	Circular	115.98	2.33
	CBC-2				1,171.15	1,152.25	0.187963	106.25	24 inch		

Maryland Ave.

Sta. 121+70

10-YEAR PEAK RUNOFF

TW = 1152.25 (Crown of 2-10'x4' CBC)



Combined Pipe/Node Report

Pipe	Upstream Node	Downstream Node	Length (ft)	Inlet Area (acres)	Inlet C Coefficient	Inlet CA (acres)	Total CA (acres)	Inlet Discharge (cfs)	Section Size	Capacity (cfs)	Average Velocity (ft/s)	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)
P-7	CB-7	Basin-3	84.31	0.33	0.95	0.31	0.31	1.46	24 inch	79.08	1.77	1,157.98	1,149.20	0.104139

Pipe Report

Pipe	Up stream Node	Down stream Node	System Intensity (in/hr)	Discharge (cfs)	Length (ft)	Constructed Slope (ft/ft)	Section Size	" n "	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)	Upstream HGL (ft)	Downstream HGL (ft)
P-7	CB-7	Basin-3	4.62	1.46	84.31	0.104139	24 inch	0.012	1,157.98	1,149.20	1,162.06	1,153.70	1,158.40	1,152.25

Node Report

Node	Inlet Area (acres)	Inlet CA (acres)	Inlet TC (min)	System Flow Time (min)	System Intensity (in/hr)	Discharge (cfs)	Ground Elevation (ft)	Rim Elevation (ft)	HGL In (ft)	HGL Out (ft)	Inlet Intensity (in/hr)	Inlet Discharge (cfs)
CB-7	0.33	0.31	10.00	10.00	4.62	1.46	1,162.06	1,162.06	1,158.57	1,158.40	4.62	1.46
Basin-3	N/A	N/A	N/A	10.80	4.45	N/A	1,153.70	1,153.70	1,152.25	1,152.25	N/A	N/A

DOT Report

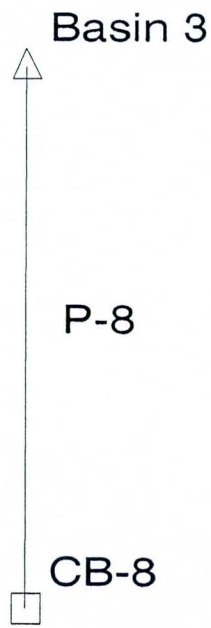
Pipe	-Node- Upstream Downstream	Inlet Area (acres)	Inlet CA (acres)	Total CA (acres)	-Ground- Upstream Downstream (ft)	-HGL- Upstream Downstream (ft)	-Slope- Energy Constructed (ft/ft)	-Section- Discharge Capacity (cfs)	-Section- Shape Size	Length (ft)	Average Velocity (ft/s)
P-7	CB-7	0.33	0.31	0.31	1,162.06	1,158.40	0.074609	1.46	Circular	84.31	1.77
	Basin-3				1,153.70	1,152.25	0.104139	79.08	24 inch		

Maryland Ave.

Sta. 122+50

10-YEAR PEAK RUNOFF

TW = 1152.25 (Crown of 2-10'x4'CBC)



Combined Pipe/Node Report

Pipe	Upstream Node	Downstream Node	Length (ft)	Inlet Area (acres)	Inlet C Coefficient	Inlet CA (acres)	Total CA (acres)	Inlet Discharge (cfs)	Section Size	Capacity (cfs)	Average Velocity (ft/s)	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)
P-8	CB-8	Basin 3	20.78	0.15	0.95	0.14	0.14	0.66	24 inch	128.12	1.35	1,155.18	1,149.50	0.273340

Pipe Report

Pipe	Up stream Node	Down stream Node	System Intensity (in/hr)	Discharge (cfs)	Length (ft)	Constructed Slope (ft/ft)	Section Size	" n "	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)	Upstream HGL (ft)	Downstream HGL (ft)
P-8	CB-8	Basin 3	4.62	0.66	20.78	0.273340	24 inch	0.012	1,155.18	1,149.50	1,159.51	1,154.00	1,155.46	1,152.25

Node Report

Node	Inlet Area (acres)	Inlet CA (acres)	Inlet TC (min)	System Flow Time (min)	System Intensity (in/hr)	Discharge (cfs)	Ground Elevation (ft)	Rim Elevation (ft)	HGL In (ft)	HGL Out (ft)	Inlet Intensity (in/hr)	Inlet Discharge (cfs)
CB-8	0.15	0.14	10.00	10.00	4.62	0.66	1,159.51	1,159.51	1,155.57	1,155.46	4.62	0.66
Basin 3	N/A	N/A	N/A	10.26	4.56	N/A	1,154.00	1,154.00	1,152.25	1,152.25	N/A	N/A

DOT Report

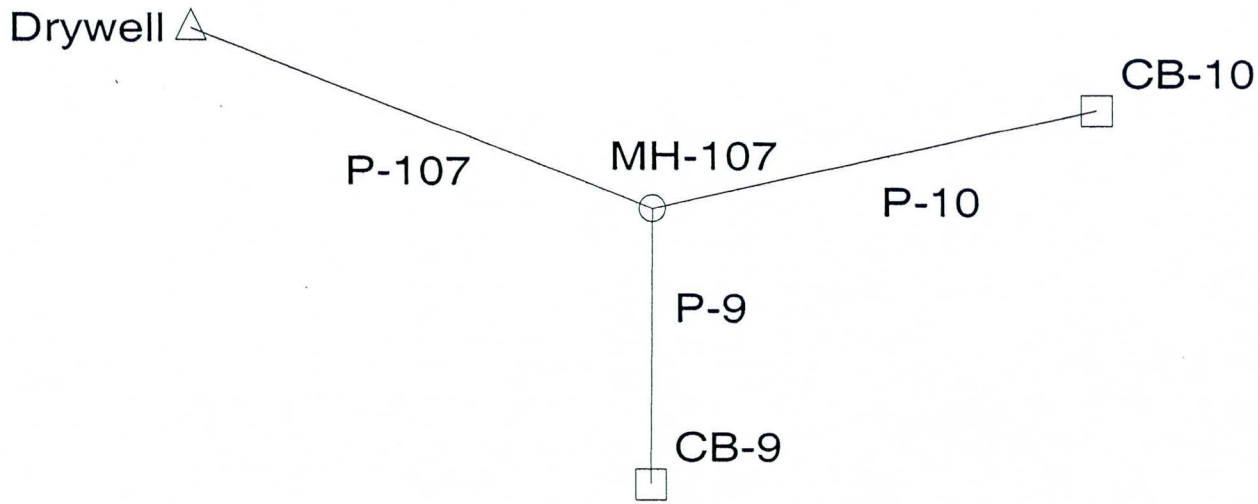
Pipe	-Node- Upstream Downstream	Inlet Area (acres)	Inlet CA (acres)	Total CA (acres)	-Ground- Upstream Downstream (ft)	-HGL- Upstream Downstream (ft)	-Slope- Energy Constructed (ft/ft)	-Section- Discharge Capacity (cfs)	-Section- Shape Size	Length (ft)	Average Velocity (ft/s)
P-8	CB-8	0.15	0.14	0.14	1,159.51	1,155.46	0.159040	0.66	Circular	20.78	1.35
	Basin 3				1,154.00	1,152.25	0.273340	128.12	24 inch		

Maryland Ave.

Sta. 125+78

10-YEAR PEAK RUNOFF

Tw = 1153.9 (0.5' above Drywell Grate Elevation)



Combined Pipe/Node Report

Pipe	Upstream Node	Downstream Node	Length (ft)	Inlet Area (acres)	Inlet C Coefficient	Inlet CA (acres)	Total CA (acres)	Inlet Discharge (cfs)	Section Size	Capacity (cfs)	Average Velocity (ft/s)	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)
P-9	CB-9	MH-107	43.96	0.55	0.95	0.52	0.52	2.43	24 inch	85.49	0.77	1,149.54	1,144.19	0.121702
P-10	CB-10	MH-107	38.00	0.23	0.95	0.22	0.22	1.02	24 inch	25.14	0.32	1,147.59	1,147.19	0.010526
P-107	MH-107	Drywell	52.00	N/A	N/A	N/A	0.74	N/A	30 inch	51.18	0.64	1,143.69	1,143.00	0.013269

Pipe Report

Pipe	Up stream Node	Down stream Node	System Intensity (in/hr)	Discharge (cfs)	Length (ft)	Constructed Slope (ft/ft)	Section Size	" n "	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)	Upstream HGL (ft)	Downstream HGL (ft)
P-9	CB-9	MH-107	4.62	2.43	43.96	0.121702	24 inch	0.012	1,149.54	1,144.19	1,154.87	1,155.19	1,153.91	1,153.91
P-10	CB-10	MH-107	4.62	1.02	38.00	0.010526	24 inch	0.012	1,147.59	1,147.19	1,154.92	1,155.19	1,153.91	1,153.91
P-107	MH-107	Drywell	4.22	3.15	52.00	0.013269	30 inch	0.012	1,143.69	1,143.00	1,155.19	1,153.40	1,153.90	1,153.90

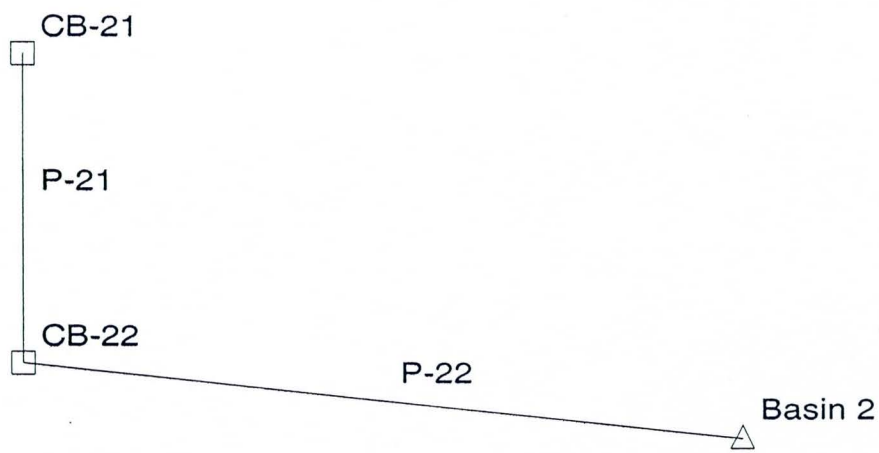
Node Report

Node	Inlet Area (acres)	Inlet CA (acres)	Inlet TC (min)	System Flow Time (min)	System Intensity (in/hr)	Discharge (cfs)	Ground Elevation (ft)	Rim Elevation (ft)	HGL In (ft)	HGL Out (ft)	Inlet Intensity (in/hr)	Inlet Discharge (cfs)
CB-9	0.55	0.52	10.00	10.00	4.62	2.43	1,154.87	1,154.87	1,153.92	1,153.91	4.62	2.43
CB-10	0.23	0.22	10.00	10.00	4.62	1.02	1,154.92	1,154.92	1,153.91	1,153.91	4.62	1.02
MH-107	N/A	N/A	N/A	11.96	4.22	3.15	1,155.19	1,155.19	1,153.91	1,153.90	N/A	N/A
Drywell	N/A	N/A	N/A	13.31	3.94	N/A	1,153.40	1,153.40	1,153.90	1,153.90	N/A	N/A

DOT Report

Pipe	-Node- Upstream Downstream	Inlet Area (acres)	Inlet CA (acres)	Total CA (acres)	-Ground- Upstream Downstream (ft)	-HGL- Upstream Downstream (ft)	-Slope- Energy Constructed (ft/ft)	-Section- Discharge Capacity (cfs)	-Section- Shape Size	Length (ft)	Average Velocity (ft/s)
P-9	CB-9	0.55	0.52	0.52	1,154.87	1,153.91	0.000098	2.43	Circular	43.96	0.77
	MH-107				1,155.19	1,153.91	0.121702	85.49	24 inch		
P-10	CB-10	0.23	0.22	0.22	1,154.92	1,153.91	0.000017	1.02	Circular	38.00	0.32
	MH-107				1,155.19	1,153.91	0.010526	25.14	24 inch		
P-107	MH-107	N/A	N/A	0.74	1,155.19	1,153.90	0.000050	3.15	Circular	52.00	0.64
	Drywell				1,153.40	1,153.90	0.013269	51.18	30 inch		

Sierra Vista Dr.
Sta. 71+61
10-YEAR PEAK RUNOFF
Tw = 1152.25 (crown of 10'x4' CBC)



Combined Pipe/Node Report

Pipe	Upstream Node	Downstream Node	Length (ft)	Inlet Area (acres)	Inlet C Coefficient	Inlet CA (acres)	Total CA (acres)	Inlet Discharge (cfs)	Section Size	Capacity (cfs)	Average Velocity (ft/s)	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)
P-21	CB-21	CB-22	56.75	0.21	0.95	0.20	0.20	0.93	24 inch	24.99	0.30	1,149.00	1,148.41	0.010396
P-22	CB-22	Basin 2	138.76	0.25	0.95	0.24	0.44	1.10	24 inch	24.17	0.56	1,148.41	1,147.06	0.009729

Pipe Report

Pipe	Up stream Node	Down stream Node	System Intensity (in/hr)	Discharge (cfs)	Length (ft)	Constructed Slope (ft/ft)	Section Size	" n "	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)	Upstream HGL (ft)	Downstream HGL (ft)
P-21	CB-21	CB-22	4.62	0.93	56.75	0.010396	24 inch	0.012	1,149.00	1,148.41	1,153.13	1,153.24	1,152.26	1,152.26
P-22	CB-22	Basin 2	3.97	1.75	138.76	0.009729	24 inch	0.012	1,148.41	1,147.06	1,153.24	1,152.06	1,152.26	1,152.25

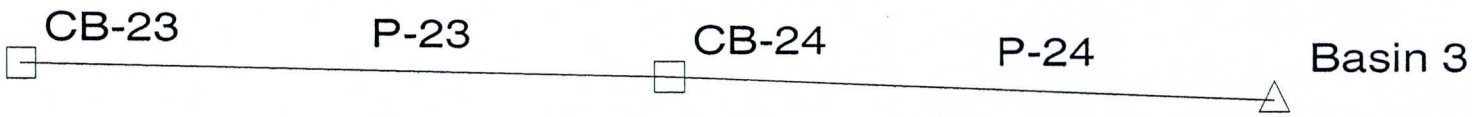
Node Report

Node	Inlet Area (acres)	Inlet CA (acres)	Inlet TC (min)	System Flow Time (min)	System Intensity (in/hr)	Discharge (cfs)	Ground Elevation (ft)	Rim Elevation (ft)	HGL In (ft)	HGL Out (ft)	Inlet Intensity (in/hr)	Inlet Discharge (cfs)
CB-21	0.21	0.20	10.00	10.00	4.62	0.93	1,153.13	1,153.13	1,152.26	1,152.26	4.62	0.93
CB-22	0.25	0.24	10.00	13.20	3.97	1.75	1,153.24	1,153.24	1,152.26	1,152.26	4.62	1.10
Basin 2	N/A	N/A	N/A	17.36	3.41	N/A	1,152.06	1,152.06	1,152.25	1,152.25	N/A	N/A

DOT Report

Pipe	-Node- Upstream Downstream	Inlet Area (acres)	Inlet CA (acres)	Total CA (acres)	-Ground- Upstream Downstream (ft)	-HGL- Upstream Downstream (ft)	-Slope- Energy Constructed (ft/ft)	-Section- Discharge Capacity (cfs)	-Section- Shape Size	Length (ft)	Average Velocity (ft/s)
P-21	CB-21	0.21	0.20	0.20	1,153.13	1,152.26	0.000014	0.93	Circular	56.75	0.30
	CB-22				1,153.24	1,152.26	0.010396	24.99	24 inch		
P-22	CB-22	0.25	0.24	0.44	1,153.24	1,152.26	0.000051	1.75	Circular	138.76	0.56
	Basin 2				1,152.06	1,152.25	0.009729	24.17	24 inch		

Sierra Vista Dr.
Sta. 76+67
10-YEAR PEAK RUNOFF
TW = 1152.25 (crown of 2-10'x4' CBC)



Combined Pipe/Node Report

Pipe	Upstream Node	Downstream Node	Length (ft)	Inlet Area (acres)	Inlet C Coefficient	Inlet CA (acres)	Total CA (acres)	Inlet Discharge (cfs)	Section Size	Capacity (cfs)	Average Velocity (ft/s)	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)
P-23	CB-23	CB-24	56.00	0.00	0.00	0.00	0.00	0.00	30 inch	29.69	3.81	1,149.51	1,149.26	0.004464
P-24	CB-24	Basin 3	15.00	0.00	0.00	0.00	0.00	0.00	36 inch	45.70	5.29	1,149.26	1,149.20	0.004000

Pipe Report

Pipe	Up stream Node	Down stream Node	System Intensity (in/hr)	Discharge (cfs)	Length (ft)	Constructed Slope (ft/ft)	Section Size	" n "	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)	Upstream HGL (ft)	Downstream HGL (ft)
P-23	CB-23	CB-24	4.62	18.70	56.00	0.004464	30 inch	0.012	1,149.51	1,149.26	1,153.14	1,153.14	1,152.48	1,152.38
P-24	CB-24	Basin 3	4.57	37.40	15.00	0.004000	36 inch	0.012	1,149.26	1,149.20	1,153.14	1,153.70	1,152.29	1,152.25

Node Report

Node	Inlet Area (acres)	Inlet CA (acres)	Inlet TC (min)	System Flow Time (min)	System Intensity (in/hr)	Discharge (cfs)	Ground Elevation (ft)	Rim Elevation (ft)	HGL In (ft)	HGL Out (ft)	Inlet Intensity (in/hr)	Inlet Discharge (cfs)
CB-23	0.00	0.00	10.00	10.00	4.62	18.70	1,153.14	1,153.14	1,152.75	1,152.48	4.62	0.00
CB-24	0.00	0.00	10.00	10.24	4.57	37.40	1,153.14	1,153.14	1,152.38	1,152.29	4.62	0.00
Basin 3	N/A	N/A	N/A	10.29	4.56	N/A	1,153.70	1,153.70	1,152.25	1,152.25	N/A	N/A

DOT Report

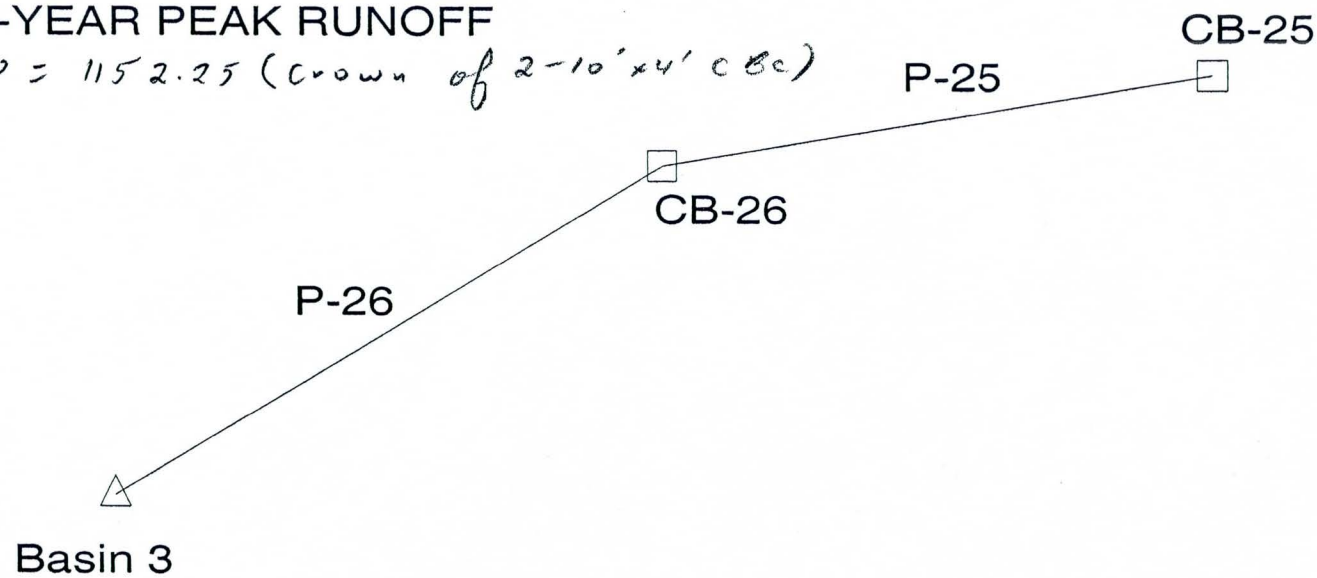
Pipe	-Node- Upstream Downstream	Inlet Area (acres)	Inlet CA (acres)	Total CA (acres)	-Ground- Upstream Downstream (ft)	-HGL- Upstream Downstream (ft)	-Slope- Energy Constructed (ft/ft)	-Section- Discharge Capacity (cfs)	-Section- Shape Size	Length (ft)	Average Velocity (ft/s)
P-23	CB-23	0.00	0.00	0.00	1,153.14	1,152.48	0.001771	18.70	Circular	56.00	3.81
	CB-24				1,153.14	1,152.38	0.004464	29.69	30 inch		
P-24	CB-24	0.00	0.00	0.00	1,153.14	1,152.29	0.002679	37.40	Circular	15.00	5.29
	Basin 3				1,153.70	1,152.25	0.004000	45.70	36 inch		

54th Ave.

Sta. 51+60 to Sta. 52+25

10-YEAR PEAK RUNOFF

TW = 1152.25 (Crown of 2-10'x4' CBC)



Combined Pipe/Node Report

Pipe	Upstream Node	Downstream Node	Length (ft)	Inlet Area (acres)	Inlet C Coefficient	Inlet CA (acres)	Total CA (acres)	Inlet Discharge (cfs)	Section Size	Capacity (cfs)	Average Velocity (ft/s)	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)
P-25	CB-25	CB-26	69.00	0.00	0.00	0.00	0.00	0.00	24 inch	21.07	4.23	1,151.01	1,150.50	0.007391
P-26	CB-26	Basin 3	118.00	0.00	0.00	0.00	0.00	0.00	30 inch	31.68	5.03	1,150.00	1,149.40	0.005085

Pipe Report

Pipe	Up stream Node	Down stream Node	System Intensity (in/hr)	Discharge (cfs)	Length (ft)	Constructed Slope (ft/ft)	Section Size	" n "	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)	Upstream HGL (ft)	Downstream HGL (ft)
P-25	CB-25	CB-26	6.64	13.30	69.00	0.007391	24 inch	0.012	1,151.01	1,150.50	1,154.84	1,153.83	1,153.01	1,152.81
P-26	CB-26	Basin 3	6.59	24.70	118.00	0.005085	30 inch	0.012	1,150.00	1,149.40	1,153.83	1,152.50	1,152.61	1,152.25

Node Report

Node	Inlet Area (acres)	Inlet CA (acres)	Inlet TC (min)	System Flow Time (min)	System Intensity (in/hr)	Discharge (cfs)	Ground Elevation (ft)	Rim Elevation (ft)	HGL In (ft)	HGL Out (ft)	Inlet Intensity (in/hr)	Inlet Discharge (cfs)
CB-25	0.00	0.00	0.00	0.00	6.64	13.30	1,154.84	1,154.84	1,153.35	1,153.01	6.64	0.00
CB-26	0.00	0.00	0.00	0.27	6.59	24.70	1,153.83	1,153.83	1,152.81	1,152.61	6.64	0.00
Basin 3	N/A	N/A	N/A	0.66	6.51	N/A	1,152.50	1,152.50	1,152.25	1,152.25	N/A	N/A

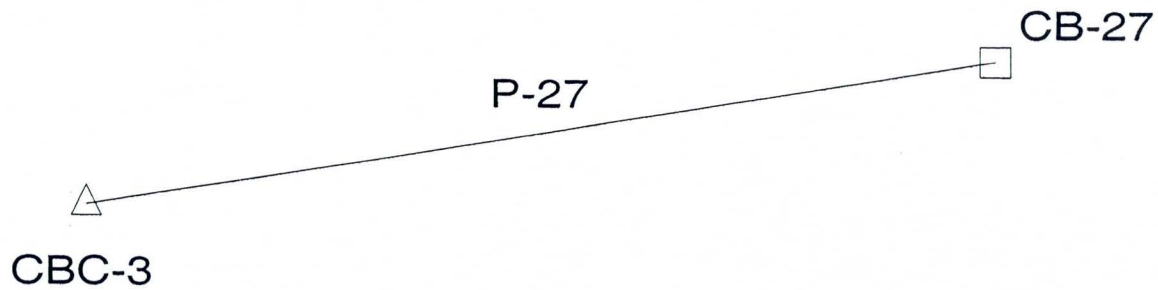
DOT Report

Pipe	-Node- Upstream Downstream	Inlet Area (acres)	Inlet CA (acres)	Total CA (acres)	-Ground- Upstream Downstream (ft)	-HGL- Upstream Downstream (ft)	-Slope- Energy Constructed (ft/ft)	-Section- Discharge Capacity (cfs)	-Section- Shape Size	Length (ft)	Average Velocity (ft/s)
P-25	CB-25	0.00	0.00	0.00	1,154.84	1,153.01	0.002945	13.30	Circular	69.00	4.23
	CB-26				1,153.83	1,152.81	0.007391	21.07	24 inch		
P-26	CB-26	0.00	0.00	0.00	1,153.83	1,152.61	0.003090	24.70	Circular	118.00	5.03
	Basin 3				1,152.50	1,152.25	0.005085	31.68	30 inch		

Sierra Vista Dr.

Sta. 78+59

10-YEAR PEAK RUNOFF



Combined Pipe/Node Report

Pipe	Upstream Node	Downstream Node	Length (ft)	Inlet Area (acres)	Inlet C Coefficient	Inlet CA (acres)	Total CA (acres)	Inlet Discharge (cfs)	Section Size	Capacity (cfs)	Average Velocity (ft/s)	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)
P-27	CB-27	CBC-3	60.00	0.00	0.00	0.00	0.00	0.00	24 inch	23.46	1.64	1,150.47	1,149.92	0.009167

Pipe Report

Pipe	Up stream Node	Down stream Node	System Intensity (in/hr)	Discharge (cfs)	Length (ft)	Constructed Slope (ft/ft)	Section Size	" n "	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)	Upstream HGL (ft)	Downstream HGL (ft)
P-27	CB-27	CBC-3	6.64	5.00	60.00	0.009167	24 inch	0.012	1,150.47	1,149.92	1,154.80	1,157.00	1,152.27	1,152.25

Node Report

Node	Inlet Area (acres)	Inlet CA (acres)	Inlet TC (min)	System Flow Time (min)	System Intensity (in/hr)	Discharge (cfs)	Ground Elevation (ft)	Rim Elevation (ft)	HGL In (ft)	HGL Out (ft)	Inlet Intensity (in/hr)	Inlet Discharge (cfs)
CB-27	0.00	0.00	0.00	0.00	6.64	5.00	1,154.80	1,154.80	1,152.32	1,152.27	6.64	0.00
CBC-3	N/A	N/A	N/A	0.61	6.52	N/A	1,157.00	1,157.00	1,152.25	1,152.25	N/A	N/A

DOT Report

Pipe	-Node- Upstream Downstream	Inlet Area (acres)	Inlet CA (acres)	Total CA (acres)	-Ground- Upstream Downstream (ft)	-HGL- Upstream Downstream (ft)	-Slope- Energy Constructed (ft/ft)	-Section- Discharge Capacity (cfs)	-Section- Shape Size	Length (ft)	Average Velocity (ft/s)
P-27	CB-27	0.00	0.00	0.00	1,154.80	1,152.27	0.000401	5.00	Circular	60.00	1.64
	CBC-3				1,157.00	1,152.25	0.009167	23.46	24 inch		

Appendix H
Offroad Channel and Offroad Catch Basin Analyses (100-year)

BRW

JOB GRAND AVE. SHEET NO.
MADE BY VMP DATE 7/2/02 JOB NO.
CHECKED BY DATE SEC SHT. NO.
CALCULATIONS FOR North & South Channel

PROBLEM STATEMENT:

DETERMINE THE AMOUNT FLOW THROUGH THE DESIGNATED AREA USING THE 100yr, 10min RAINFALL INTENSITY. CALCULATE THE DEPTH FLOW AND CHANNEL DEPTH.

SOLUTION:

1. MEASURE AREAS USING MICROSTATION, APPLY APPROPRIATE C FACTORS AND ADD THEM UP
2. CALCULATE THE INTIAL INTENSITY, USING THE 100yr, 10min INTENSITY
3. MEASURE WATER COURSE LENGTH FOR EACH DRAINAGE BASIN USING MICROSTATION
4. COMPUTE THE WEIGHTED COEFFICIENT FOR EACH DRAINAGE BASIN
5. MEASURE TOP AND BOTTOM ELEVATION FOR EACH DRAINAGE BASIN
6. CALCULATE THE SLOPE FOR EACH DRAINAGE BASIN
7. CALCULATE CHANNEL DEPTH USING TWO SIDE SLOPES: 4:1 R/W SIDE OF CHANNEL AND 3:1 Roadway SIDE OF CHANNEL
8. COMPUTE THE DESIGN FLOW FOR EACH DRAINAGE BASIN USING 100yr, 10min, RAINFALL INTENSITY

BRW

JOB GRAND AVE. SHEET NO.
MADE BY VMD DATE 7/2/02 JOB NO.
CHECKED BY DATE SEC SHT. NO.
CALCULATIONS FOR NORTH & SOUTH CHANNEL

CONCLUSION:

NORTH CHANNEL (EARTHEN CHANNEL 2)

- CHANNEL BOTTOM WIDTH EQUALS 4' THE EAST END OF THE CHANNEL DUE THE LOW FLOW WITHIN THAT AREA. THE CHANNEL BOTTOM WIDTH IS TAPERED TO 8' AS THE FLOW INCREASES DOWNSTREAM
- THE FLOW CALCULATED FOR $A1_3$ AND $A2_3$ EQUALS 12. cfs
- THE FLOW CALCULATED FOR $A1_2$ AND $A2_2$ (INCLUDES FLOW AT $A1_3$ AND $A2_3$) EQUALS 22. cfs.
- THE FLOW CALCULATED FOR A1 AND A2 (TOTAL DESIGN FLOW) EQUALS 70 cfs.
- CHANNEL DEPTH RANGES FROM 1.55' to 2.99'
- LENGTH OF CHANNEL EQUALS 699 ft
- CHANNEL SLOPE RANGES FROM .25% to 1%

SOUTH CHANNEL (Earthen Channel 1)

- CHANNEL BOTTOM WIDTH EQUALS 4' DUE TO THE LOW FLOW WITHIN AREA 3
- THE FLOW CALCULATED FOR $A3_3$ EQUALS 3. cfs
- THE FLOW CALCULATED FOR $A3_2$ (INCLUDES FLOW AT $A3_2$) EQUALS .4 cfs
- THE FLOW CALCULATED FOR A3 (TOTAL DESIGN FLOW) EQUALS 5 cfs
- CHANNEL DEPTH RANGES FROM 0.38' to 0.54'
- LENGTH OF CHANNEL EQUALS 619'
- CHANNEL SLOPE RANGES FROM .20% to 51%

Hydrology Using Arizona Department of Transportation Methodology
RATIONAL METHOD

100-Year Peak Runoffs
for
Roadway Channels, Ditches & Maryland Avenue Pavement Located West of Grand Avenue

Tributary Name	Tributary Area By Land Category			Drainage Basin Parameters								Runoff Flow Rate				
Sub-Basin	Cw,p = 0.95(1) Pvm't/Conc (Acres)	Cw,p = 0.9(1) Commercial (Acres)	Cw, Is = 0.7(1) Desert Landscape (Acres)	Total Tributary Area At (Acres)	Weighted Coeff. Cwt	Water Course Length Lwc (ft)	Top Elev E2 (msl)	Bot Elev E1 (msl)	Slope S (ft/ft)	Slope S (ft/mi)	Kb(2)	I, Init. (in/hr)	Tc(3) (hr)	Tc (min)	Grand Ave. Intensity I,p(4) (in/hr)	Flow Q (cfs)
Sub-Area 1-3 & 2-3		1.61	0.7	2.31	0.84	412	1155.98	1151.39	0.011141	58.82	0.0200	7.52	0.05	3.28	6.3	12
Sub-Area 1-2, 2-2, 1-3 & 2-3		3.18	1	4.18	0.85	580	1156.1	1148.53	0.013052	68.91	0.0200	7.52	0.06	3.71	6.3	22
NW Quadrant, Area 1 & Area 2, Maryland/Grand		11.1	1.53	12.63	0.88	912	1154.3	1150	0.004715	24.89	0.0200	7.52	0.11	6.38	6.3	70
Maryland Avenue Pavement	1.53	0	0	1.53	0.95	620	1176.6	1150.5	0.042097	222.27	0.0400	7.52	0.06	3.82	6.3	9
TOTAL @ CBC Entrance	**1.53**	**11.10**	**1.53**	**14.16**	**0.88**	**855**	**1154.3**	**1150**	**0.005029**	**26.55**	**0.0200**	**7.52**	**0.10**	**6.05**	**6.3**	**79**
Sub-Area 3-3			0.57	0.57	0.70	367	1151.8	1151.18	0.001689	8.92	0.0500	7.52	0.15	8.95	6.3	3
Sub-Area 3-2 & 3-3			0.87	0.87	0.70	442	1151.8	1150.69	0.002511	13.26	0.0500	7.52	0.14	8.69	6.3	4
South Roadway Embankment, Area 3			1.11	1.11	0.70	571	1151.8	1150.27	0.00268	14.15	0.0500	7.52	0.16	9.68	6.3	5

(1) ADOT Figure 2-3, Developed Watersheds
(2) ADOT Table 2-1, Kb = 0.02 (Paved Parking Lots), .05 (Defined Earthen Channel), & .04 (Residential, L is less than 1000 feet)
(3) $T_c = 11.4L^{0.5}K_b^{0.52}S^{-0.31}I^{-0.38}$
(4) Rainfall Intensity is based on calculated Tc or 10 Minutes, whichever is greater.

Culvert Calculator Report
Maryland Ave, Sta 104+00, 6'x4' CBC

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	1,160.00	ft	Headwater Depth/ Height	0.75	
Computed Headwater Elevation	1,149.71	ft	Discharge	79.00	cfs
Inlet Control HW Elev	1,149.57	ft	Tailwater Elevation	1,147.00	ft
Outlet Control HW Elev	1,149.71	ft	Control Type	Entrance Control	

← HW Retention Basin 1 during 100-YR, 2-Hour Runoff

Grades					
Upstream Invert	1,146.73	ft	Downstream Invert	1,143.65	ft
Length	101.32	ft	Constructed Slope	0.030399	ft/ft

Hydraulic Profile					
Profile	CompositeS1S2		Depth, Downstream	3.35	ft
Slope Type	Steep		Normal Depth	0.86	ft
Flow Regime	N/A		Critical Depth	1.75	ft
Velocity Downstream	3.93	ft/s	Critical Slope	0.003772	ft/ft

Section					
Section Shape	Box		Mannings Coefficient	0.013	
Section Material	Concrete		Span	6.00	ft
Section Size	6 x 4 ft		Rise	4.00	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev	1,149.71	ft	Upstream Velocity Head	0.88	ft
Ke	0.40		Entrance Loss	0.35	ft

Inlet Control Properties					
Inlet Control HW Elev	1,149.57	ft	Flow Control	Unsubmerged	
Inlet Type	45 ° wingwall flare, d=0.0430		Area Full	24.0	ft^2
K	0.51000		HDS 5 Chart	9	
M	0.66700		HDS 5 Scale	1	
C	0.03090		Equation Form	2	
Y	0.80000				

Rating Table Report
Maryland Ave, Sta 104+00, 6'x4' CBC

Range Data:

	Minimum	Maximum	Increment
Discharge	0.00	120.00	10.00 cfs

Discharge (cfs)	HW Elev (ft)
0.00	1,146.73
10.00	1,147.48
20.00	1,147.92
30.00	1,148.29
40.00	1,148.62
50.00	1,148.93
60.00	1,149.21
70.00	1,149.48
80.00	1,149.74
90.00	1,149.98
100.00	1,150.22
110.00	1,150.45
120.00	1,150.67

Table 1
Catch Basin 51
Station 106+45 RT

STAGE DISCHARGE TABLE FOR OFF-ROAD CATCH BASIN 51, Station 106+45 Rt (WATER SURFACE ELEVATION) GRAND AVENUE AT 55TH AVENUE AND MARYLAND AVENUE								
DISCHARGE	GRATE CHARACTERISTICS					WATER DEPTHS		WATER SURFACE ELEVATION
Q	A	C0	W	L	Grate	WEIR	ORIFICE	CONTROLLING
(cfs)	(ft^2)	Coefficient	(ft)	(ft)	Elevation	d (depth)	d (depth)	
	clear (net) opening				(ft)	(ft)	(ft)	(ft)
1.00	7.200	0.67	2.000	6.729	1149.80	0.15	0.00	1149.95
2.00	7.200	0.67	2.000	6.729	1149.80	0.23	0.01	1150.03
3.00	7.200	0.67	2.000	6.729	1149.80	0.31	0.02	1150.11
4.00	7.200	0.67	2.000	6.729	1149.80	0.37	0.04	1150.17
Q100 → 5.00	7.200	0.67	2.000	6.729	1149.80	0.43	0.07	1150.23 ←
6.00	7.200	0.67	2.000	6.729	1149.80	0.48	0.10	1150.28
7.00	7.200	0.67	2.000	6.729	1149.80	0.54	0.13	1150.34
8.00	7.200	0.67	2.000	6.729	1149.80	0.59	0.17	1150.39
9.00	7.200	0.67	2.000	6.729	1149.80	0.63	0.22	1150.43
10.00	7.200	0.67	2.000	6.729	1149.80	0.68	0.27	1150.48
11.00	7.200	0.67	2.000	6.729	1149.80	0.73	0.32	1150.53
12.00	7.200	0.67	2.000	6.729	1149.80	0.77	0.38	1150.57
13.00	7.200	0.67	2.000	6.729	1149.80	0.81	0.45	1150.61
14.00	7.200	0.67	2.000	6.729	1149.80	0.85	0.52	1150.65
15.00	7.200	0.67	2.000	6.729	1149.80	0.89	0.60	1150.69
16.00	7.200	0.67	2.000	6.729	1149.80	0.93	0.68	1150.73
17.00	7.200	0.67	2.000	6.729	1149.80	0.97	0.77	1150.77
18.00	7.200	0.67	2.000	6.729	1149.80	1.01	0.87	1150.81
19.00	7.200	0.67	2.000	6.729	1149.80	1.04	0.96	1150.84
20.00	7.200	0.67	2.000	6.729	1149.80	1.08	1.07	1150.88
21.00	7.200	0.67	2.000	6.729	1149.80	1.12	1.18	1150.98
22.00	7.200	0.67	2.000	6.729	1149.80	1.15	1.29	1151.09
23.00	7.200	0.67	2.000	6.729	1149.80	1.19	1.41	1151.21
24.00	7.200	0.67	2.000	6.729	1149.80	1.22	1.54	1151.34
25.00	7.200	0.67	2.000	6.729	1149.80	1.25	1.67	1151.47
26.00	7.200	0.67	2.000	6.729	1149.80	1.29	1.81	1151.61
27.00	7.200	0.67	2.000	6.729	1149.80	1.32	1.95	1151.75
28.00	7.200	0.67	2.000	6.729	1149.80	1.35	2.10	1151.90
29.00	7.200	0.67	2.000	6.729	1149.80	1.38	2.25	1152.05
30.00	7.200	0.67	2.000	6.729	1149.80	1.42	2.41	1152.21

HEC-RAS Version 3.0.1 Mar 2001
U.S. Army Corp of Engineers
Hydrologic Engineering Center
609 Second Street, Suite D
Davis, California 95616-4687
(916) 756-1104

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

****

PROJECT DATA
Project Title: South Channel
Project File : sc.prj
Run Date and Time: 9/30/02 8:23:56 AM

Project in English units

Project Description:
Earthen Channel 1 (South Channel), Station 106+50 68' Rt to Station 112+32, 43' Rt

****

PLAN DATA

Plan Title: South Channel Plan
Plan File : r:\11344239\Drn\HEC-RAS\sc.p02

Geometry Title: South Channel Geom Channel 1
Geometry File : r:\11344239\Drn\HEC-RAS\sc.g01

Flow Title : 100-Year Peak Flow
Flow File : r:\11344239\Drn\HEC-RAS\sc.f02

Plan Summary Information:

Number of:	Cross Sections =	6	Mulitple Openings =	0
	Culverts =	0	Inline Weirs =	0
	Bridges =	0		

Computational Information
Water surface calculation tolerance = 0.003

```
    Critical depth calculaton tolerance =  0.003
    Maximum number of interations       =  20
    Maximum difference tolerance        =  0.1
    Flow tolerance factor               =  0.001

Computation Options
    Critical depth computed only where necessary
    Conveyance Calculation Method: At breaks in n values only
    Friction Slope Method:         Average Conveyance
    Computational Flow Regime:     Subcritical Flow


*******************************************************************************

FLOW DATA

Flow Title: 100-Year Peak Flow
Flow File : r:\11344239\Drn\HEC-RAS\sc.f02

Flow Data (cfs)
*************************************************************
* River           Reach           RS      *            PF 1 *
* 1               South Channel   6       *               3 *
* 1               South Channel   4       *               4 *
* 1               South Channel   2       *               5 *
*************************************************************

Boundary Conditions
*****************************************************************************************************
* River           Reach           Profile          *           Upstream                Downstream    *
*****************************************************************************************************
* 1               South Channel   PF 1             *                              Known WS = 1150.23 *
*****************************************************************************************************


*******************************************************************************

GEOMETRY DATA

Geometry Title: South Channel Geom
Geometry File : r:\11344239\Drn\HEC-RAS\sc.g01

CROSS SECTION          RIVER: 1
REACH: South Channel      RS: 6

INPUT
Description: Sta 112+32 = Chl Station 16+18.97
Station Elevation Data    num=       6
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
*******************************************************************************
      34  1154.8      40  1152.8      43  1151.8      47  1151.8      51  1152.8
      61  1152.8
```

```
Manning's n Values          num=       3
     Sta   n Val      Sta   n Val      Sta   n Val
*********************************************
      34    .035      40    .035      51    .035

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
            40      51              111     111     111              .1       .3

CROSS SECTION OUTPUT    Profile #PF 1
*****************************************************************************************
* E.G. Elev (ft)         * 1152.24  * Element                 *  Left OB *  Channel * Right OB *
* Vel Head (ft)          *    0.03  * Wt. n-Val.              *          *   0.035  *          *
* W.S. Elev (ft)         * 1152.22  * Reach Len. (ft)        *  111.00  *  111.00  *  111.00  *
* Crit W.S. (ft)         *          * Flow Area (sq ft)       *          *    2.28  *          *
* E.G. Slope (ft/ft)     *0.004330  * Area (sq ft)            *          *    2.28  *          *
* Q Total (cfs)          *    3.00  * Flow (cfs)              *          *    3.00  *          *
* Top Width (ft)         *    6.92  * Top Width (ft)          *          *    6.92  *          *
* Vel Total (ft/s)       *    1.32  * Avg. Vel. (ft/s)        *          *    1.32  *          *
* Max Chl Dpth (ft)      *    0.42  * Hydr. Depth (ft)        *          *    0.33  *          *
* Conv. Total (cfs)      *    45.6  * Conv. (cfs)             *          *    45.6  *          *
* Length Wtd. (ft)       *  111.00  * Wetted Per. (ft)        *          *    7.04  *          *
* Min Ch El (ft)         * 1151.80  * Shear (lb/sq ft)        *          *    0.09  *          *
* Alpha                  *    1.00  * Stream Power (lb/ft s)  *          *    0.12  *          *
* Frctn Loss (ft)        *    0.25  * Cum Volume (acre-ft)    *          *    0.04  *          *
* C & E Loss (ft)        *    0.00  * Cum SA (acres)          *          *    0.11  *          *
*****************************************************************************************

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less
         than 0.7 or greater than 1.4.  This may indicate the need for additional cross sections.

CROSS SECTION          RIVER: 1
REACH: South Channel      RS: 5

INPUT
Description: Sta 111+21 = Chl Station 14+63.77
Station Elevation Data     num=       6
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
*********************************************************************************
     124 1154.41   129.8 1152.46     133 1151.41     137 1151.41   141.2 1152.46
   151.2 1152.46

Manning's n Values          num=       3
     Sta   n Val      Sta   n Val      Sta   n Val
*********************************************
     124    .035   129.8    .035   141.2    .035

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         129.8   141.2              156     156     156              .1       .3

CROSS SECTION OUTPUT    Profile #PF 1
*****************************************************************************************
* E.G. Elev (ft)         * 1151.99  * Element                 *  Left OB *  Channel * Right OB *
```

Vel Head (ft)	0.01	Wt. n-Val.		0.035		
W.S. Elev (ft)	1151.98	Reach Len. (ft)	156.00	156.00	156.00	
Crit W.S. (ft)		Flow Area (sq ft)		3.44		
E.G. Slope (ft/ft)	0.001341	Area (sq ft)		3.44		
Q Total (cfs)	3.00	Flow (cfs)		3.00		
Top Width (ft)	8.03	Top Width (ft)		8.03		
Vel Total (ft/s)	0.87	Avg. Vel. (ft/s)		0.87		
Max Chl Dpth (ft)	0.57	Hydr. Depth (ft)		0.43		
Conv. Total (cfs)	81.9	Conv. (cfs)		81.9		
Length Wtd. (ft)	156.00	Wetted Per. (ft)		8.19		
Min Ch El (ft)	1151.41	Shear (lb/sq ft)		0.04		
Alpha	1.00	Stream Power (lb/ft s)		0.03		
Frctn Loss (ft)	0.20	Cum Volume (acre-ft)		0.04		
C & E Loss (ft)	0.00	Cum SA (acres)		0.09		

CROSS SECTION RIVER: 1
REACH: South Channel RS: 4

INPUT
Description: Sta 109+40 = Chl Station 12+91.66
Station Elevation Data num= 6

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
106	1154.1	112.4	1151.97	115	1151.1	119	1151.1	122.5	1151.97
132.5	1151.97								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
106	.035	112.4	.035	122.5	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
112.4	122.5	243	243	243	.1	.3

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	1151.80	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.01	Wt. n-Val.		0.035	
W.S. Elev (ft)	1151.78	Reach Len. (ft)	243.00	243.00	243.00
Crit W.S. (ft)		Flow Area (sq ft)		4.36	
E.G. Slope (ft/ft)	0.001225	Area (sq ft)		4.36	
Q Total (cfs)	4.00	Flow (cfs)		4.00	
Top Width (ft)	8.78	Top Width (ft)		8.78	
Vel Total (ft/s)	0.92	Avg. Vel. (ft/s)		0.92	
Max Chl Dpth (ft)	0.68	Hydr. Depth (ft)		0.50	
Conv. Total (cfs)	114.3	Conv. (cfs)		114.3	
Length Wtd. (ft)	243.00	Wetted Per. (ft)		8.98	
Min Ch El (ft)	1151.10	Shear (lb/sq ft)		0.04	
Alpha	1.00	Stream Power (lb/ft s)		0.03	
Frctn Loss (ft)	0.64	Cum Volume (acre-ft)		0.02	
C & E Loss (ft)	0.00	Cum SA (acres)		0.06	

```
*****************************************************************************************

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less
         than 0.7 or greater than 1.4.  This may indicate the need for additional cross sections.

CROSS SECTION          RIVER: 1
REACH: South Channel      RS: 3

INPUT
Description: Sta 108+20 = Chl Station 11+70.65
Station Elevation Data    num=       6
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
*******************************************************************************
   86.74  1153.7   93.94 1151.31   95.74  1150.7   99.74  1150.7  102.14 1151.31
  112.14 1151.31

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
*********************************************
   86.74    .035   93.94    .035  102.14    .035

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         93.94  102.14               47      47      47             .1       .3

CROSS SECTION OUTPUT    Profile #PF 1
*****************************************************************************************
* E.G. Elev (ft)         * 1151.15  * Element                 *  Left OB *  Channel * Right OB *
* Vel Head (ft)          *    0.05  * Wt. n-Val.              *          *   0.035  *          *
* W.S. Elev (ft)         * 1151.10  * Reach Len. (ft)        *   47.00  *   47.00  *   47.00  *
* Crit W.S. (ft)         *          * Flow Area (sq ft)      *          *    2.15  *          *
* E.G. Slope (ft/ft)     *0.009096  * Area (sq ft)           *          *    2.15  *          *
* Q Total (cfs)          *    4.00  * Flow (cfs)              *          *    4.00  *          *
* Top Width (ft)         *    6.75  * Top Width (ft)          *          *    6.75  *          *
* Vel Total (ft/s)       *    1.86  * Avg. Vel. (ft/s)        *          *    1.86  *          *
* Max Chl Dpth (ft)      *    0.40  * Hydr. Depth (ft)        *          *    0.32  *          *
* Conv. Total (cfs)      *    41.9  * Conv. (cfs)             *          *    41.9  *          *
* Length Wtd. (ft)       *   47.00  * Wetted Per. (ft)        *          *    6.86  *          *
* Min Ch El (ft)         * 1150.70  * Shear (lb/sq ft)        *          *    0.18  *          *
* Alpha                  *    1.00  * Stream Power (lb/ft s)  *          *    0.33  *          *
* Frctn Loss (ft)        *    0.32  * Cum Volume (acre-ft)    *          *    0.01  *          *
* C & E Loss (ft)        *    0.00  * Cum SA (acres)          *          *    0.02  *          *
*****************************************************************************************

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less
         than 0.7 or greater than 1.4.  This may indicate the need for additional cross sections.

CROSS SECTION          RIVER: 1
REACH: South Channel      RS: 2

INPUT
Description: Sta 106+97 = Chl Station 10+47.65
Station Elevation Data    num=       6
```

```
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
*****************************************************************************
      67 1153.27    74.2 1150.88      76 1150.27      80 1150.27    82.4 1150.88
    92.4 1150.88

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
*********************************************
      67    .035    74.2    .035    82.4    .035

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          74.2    82.4               47      47      47             .1       .3

CROSS SECTION OUTPUT    Profile #PF 1
*****************************************************************************************
* E.G. Elev (ft)         * 1150.83  * Element                 *  Left OB *  Channel * Right OB *
* Vel Head (ft)          *    0.04  * Wt. n-Val.              *          *    0.035 *          *
* W.S. Elev (ft)         * 1150.79  * Reach Len. (ft)         *   47.00  *   47.00  *   47.00  *
* Crit W.S. (ft)         * 1150.60  * Flow Area (sq ft)       *          *     2.97 *          *
* E.G. Slope (ft/ft)     *0.005576  * Area (sq ft)            *          *     2.97 *          *
* Q Total (cfs)          *    5.00  * Flow (cfs)              *          *     5.00 *          *
* Top Width (ft)         *    7.55  * Top Width (ft)          *          *     7.55 *          *
* Vel Total (ft/s)       *    1.68  * Avg. Vel. (ft/s)        *          *     1.68 *          *
* Max Chl Dpth (ft)      *    0.52  * Hydr. Depth (ft)        *          *     0.39 *          *
* Conv. Total (cfs)      *    67.0  * Conv. (cfs)             *          *     67.0 *          *
* Length Wtd. (ft)       *   47.00  * Wetted Per. (ft)        *          *     7.70 *          *
* Min Ch El (ft)         * 1150.27  * Shear (lb/sq ft)        *          *     0.13 *          *
* Alpha                  *    1.00  * Stream Power (lb/ft s)  *          *     0.23 *          *
* Frctn Loss (ft)        *    0.50  * Cum Volume (acre-ft)    *          *     0.00 *          *
* C & E Loss (ft)        *    0.01  * Cum SA (acres)          *          *     0.01 *          *
*****************************************************************************************

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less
         than 0.7 or greater than 1.4.  This may indicate the need for additional cross sections.

CROSS SECTION          RIVER: 1
REACH: South Channel      RS: 1

INPUT
Description: Sta 106+42 = Chl Station 10+00
Station Elevation Data    num=       6
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
*****************************************************************************
      59    1153    65.7 1150.76      68    1150      76    1150      79 1150.76
      93 1150.82

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
*********************************************
      59    .035    65.7    .035      79    .035

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
```

```
          65.7      79                0       0       0             .1       .3

CROSS SECTION OUTPUT    Profile #PF 1
*****************************************************************************************
* E.G. Elev (ft)         * 1150.33  * Element                 *  Left OB *  Channel * Right OB *
* Vel Head (ft)          *    0.09  * Wt. n-Val.              *          *   0.035  *          *
* W.S. Elev (ft)         * 1150.23  * Reach Len. (ft)         *          *          *          *
* Crit W.S. (ft)         * 1150.22  * Flow Area (sq ft)       *          *    2.02  *          *
* E.G. Slope (ft/ft)     *0.027231  * Area (sq ft)            *          *    2.02  *          *
* Q Total (cfs)          *    5.00  * Flow (cfs)               *          *    5.00  *          *
* Top Width (ft)         *    9.60  * Top Width (ft)           *          *    9.60  *          *
* Vel Total (ft/s)       *    2.47  * Avg. Vel. (ft/s)         *          *    2.47  *          *
* Max Chl Dpth (ft)      *    0.23  * Hydr. Depth (ft)         *          *    0.21  *          *
* Conv. Total (cfs)      *    30.3  * Conv. (cfs)              *          *    30.3  *          *
* Length Wtd. (ft)       *          * Wetted Per. (ft)         *          *    9.67  *          *
* Min Ch El (ft)         * 1150.00  * Shear (lb/sq ft)         *          *    0.36  *          *
* Alpha                  *    1.00  * Stream Power (lb/ft s)   *          *    0.88  *          *
* Frctn Loss (ft)        *          * Cum Volume (acre-ft)     *          *          *          *
* C & E Loss (ft)        *          * Cum SA (acres)           *          *          *          *
*****************************************************************************************

*******************************************************************************

SUMMARY OF MANNING'S N VALUES

River:1
*****************************************************************
*     Reach       *   River Sta.   *   n1     *   n2     *   n3     *
*****************************************************************
*South Channel    *    6           *     .035*     .035*     .035*
*South Channel    *    5           *     .035*     .035*     .035*
*South Channel    *    4           *     .035*     .035*     .035*
*South Channel    *    3           *     .035*     .035*     .035*
*South Channel    *    2           *     .035*     .035*     .035*
*South Channel    *    1           *     .035*     .035*     .035*
*****************************************************************

*********************************************************************************

SUMMARY OF REACH LENGTHS

River: 1
*****************************************************************
*     Reach       *   River Sta.   *  Left    * Channel *  Right  *
*****************************************************************
*South Channel    *    6           *      111*      111*      111*
*South Channel    *    5           *      156*      156*      156*
*South Channel    *    4           *      243*      243*      243*
*South Channel    *    3           *       47*       47*       47*
*South Channel    *    2           *       47*       47*       47*
*South Channel    *    1           *        0*        0*        0*
*****************************************************************
```

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: 1

Reach	River Sta.	Contr.	Expan.
South Channel	6	.1	.3
South Channel	5	.1	.3
South Channel	4	.1	.3
South Channel	3	.1	.3
South Channel	2	.1	.3
South Channel	1	.1	.3

Profile Output Table - Standard Table 1

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
South Channel	6	3.00	1151.80	1152.22		1152.24	0.004330	1.32	2.28	6.92	0.40
South Channel	5	3.00	1151.41	1151.98		1151.99	0.001341	0.87	3.44	8.03	0.23
South Channel	4	4.00	1151.10	1151.78		1151.80	0.001225	0.92	4.36	8.78	0.23
South Channel	3	4.00	1150.70	1151.10		1151.15	0.009096	1.86	2.15	6.75	0.58
South Channel	2	5.00	1150.27	1150.79	1150.60	1150.83	0.005576	1.68	2.97	7.55	0.47
South Channel	1	5.00	1150.00	1150.23	1150.22	1150.33	0.027231	2.47	2.02	9.60	0.95

Profile Output Table - Standard Table 2

Reach	River Sta	E.G. Elev (ft)	W.S. Elev (ft)	Vel Head (ft)	Frctn Loss (ft)	C & E Loss (ft)	Q Left (cfs)	Q Channel (cfs)	Q Right (cfs)	Top Width (ft)
South Channel	6	1152.24	1152.22	0.03	0.25	0.00		3.00		6.92
South Channel	5	1151.99	1151.98	0.01	0.20	0.00		3.00		8.03
South Channel	4	1151.80	1151.78	0.01	0.64	0.00		4.00		8.78
South Channel	3	1151.15	1151.10	0.05	0.32	0.00		4.00		6.75
South Channel	2	1150.83	1150.79	0.04	0.50	0.01		5.00		7.55
South Channel	1	1150.33	1150.23	0.09				5.00		9.60

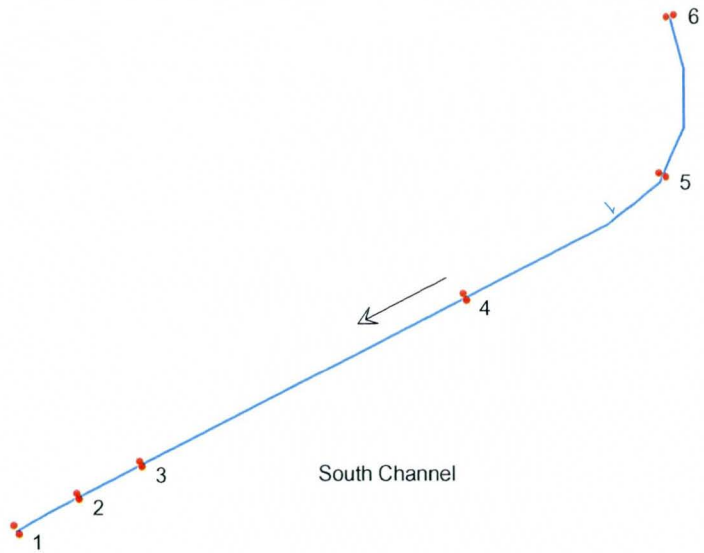
****

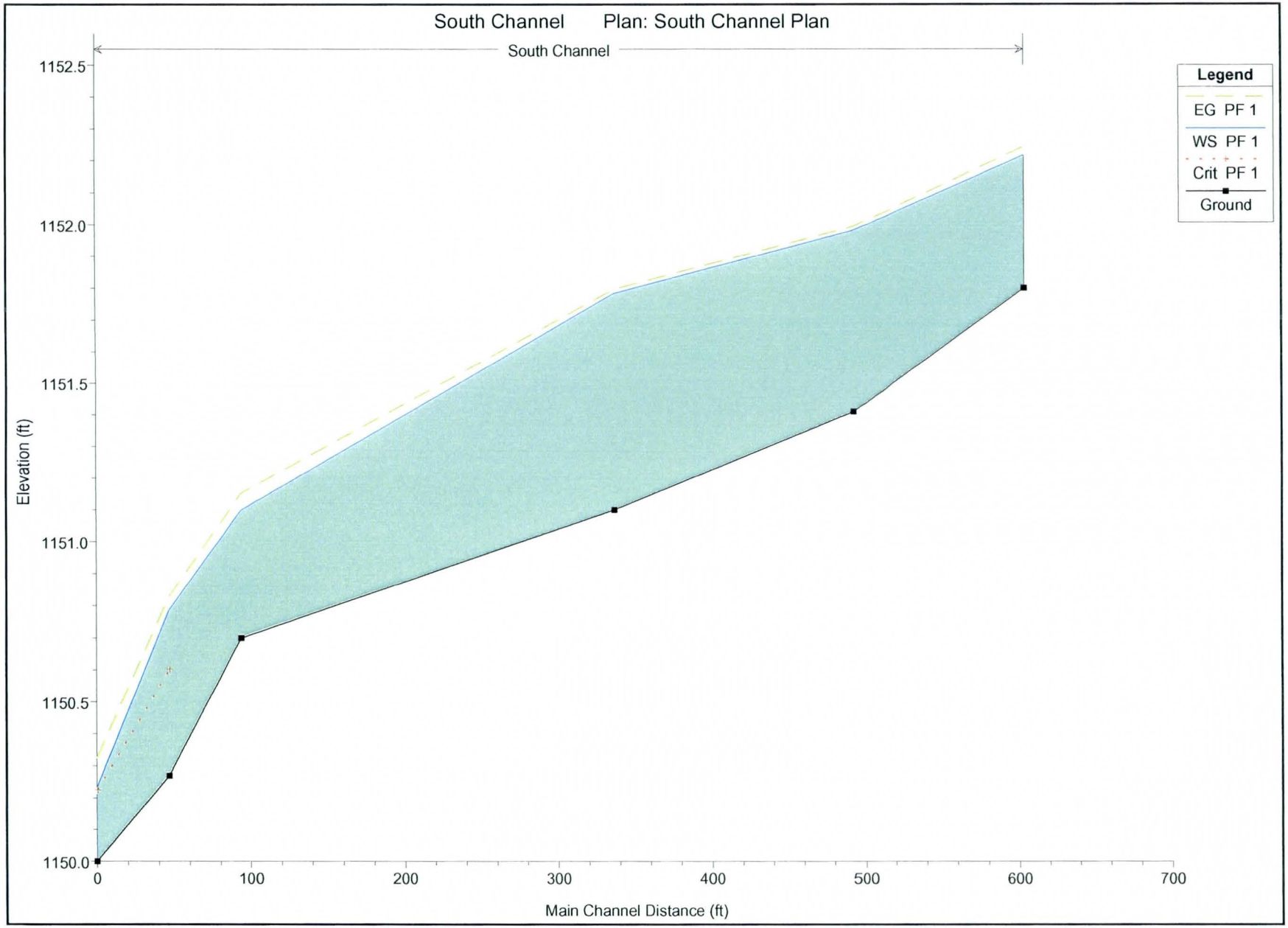
HEC-RAS Plan: Plan 02 River: 1 Reach: South Channel Profile: PF 1

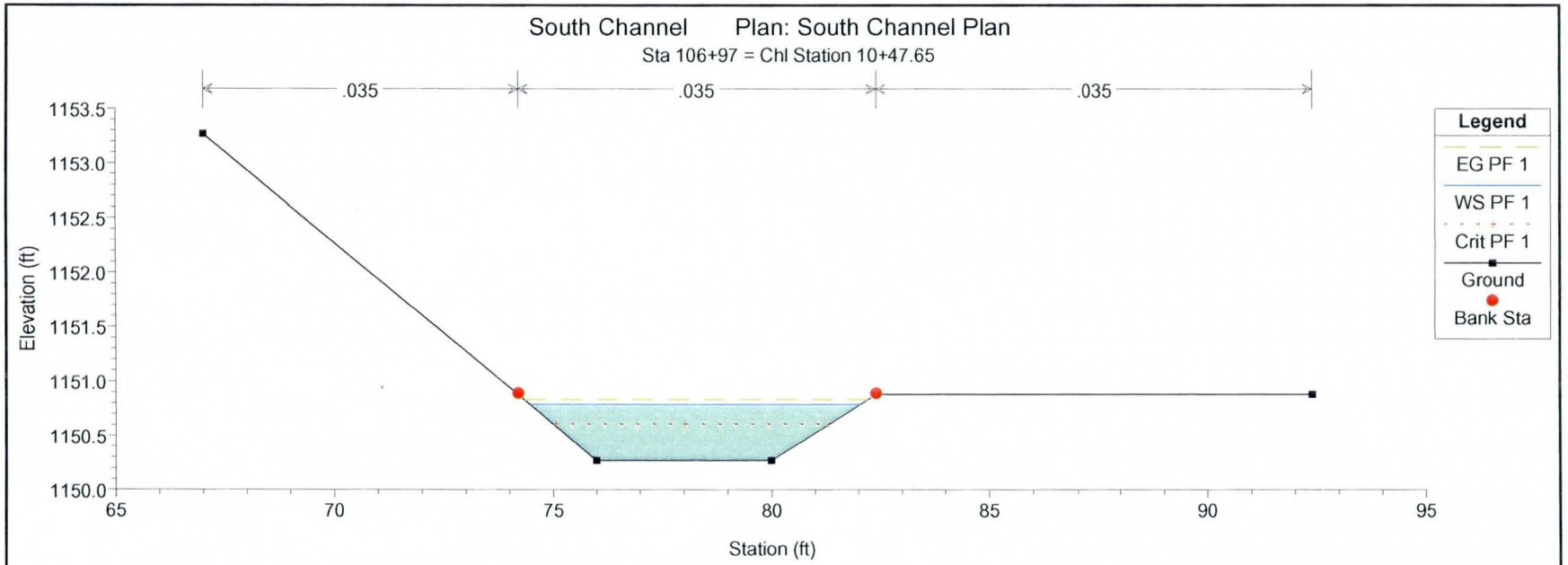
Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
South Channel	6	3.00	1151.80	1152.22		1152.24	0.004330	1.32	2.28	6.92	0.40
South Channel	5	3.00	1151.41	1151.98		1151.99	0.001341	0.87	3.44	8.03	0.23
South Channel	4	4.00	1151.10	1151.78		1151.80	0.001225	0.92	4.36	8.78	0.23
South Channel	3	4.00	1150.70	1151.10		1151.15	0.009096	1.86	2.15	6.75	0.58
South Channel	2	5.00	1150.27	1150.79	1150.60	1150.83	0.005576	1.68	2.97	7.55	0.47
South Channel	1	5.00	1150.00	1150.23	1150.22	1150.33	0.027231	2.47	2.02	9.60	0.95

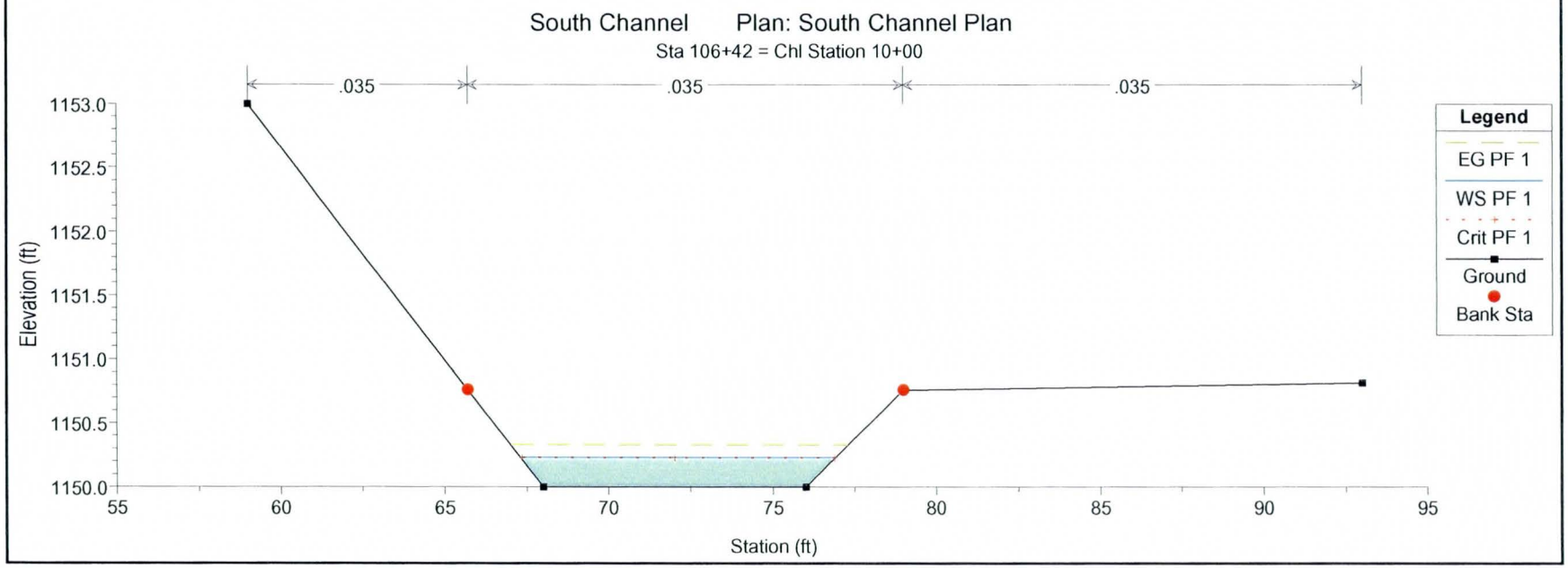
HEC-RAS Plan: Plan 02 River: 1 Reach: South Channel Profile: PF 1

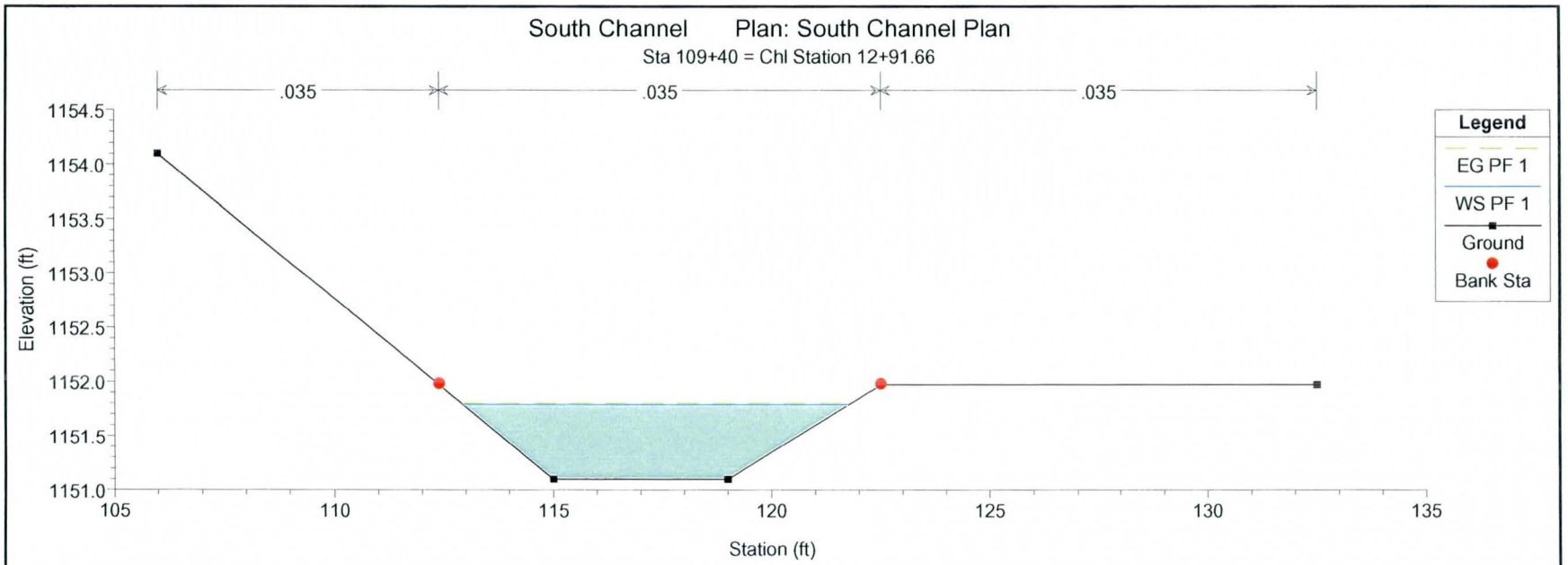
Reach	River Sta	E.G. Elev	W.S. Elev	Vel Head	Frctn Loss	C & E Loss	Q Left	Q Channel	Q Right	Top Width
		(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)
South Channel	6	1152.24	1152.22	0.03	0.25	0.00		3.00		6.92
South Channel	5	1151.99	1151.98	0.01	0.20	0.00		3.00		8.03
South Channel	4	1151.80	1151.78	0.01	0.64	0.00		4.00		8.78
South Channel	3	1151.15	1151.10	0.05	0.32	0.00		4.00		6.75
South Channel	2	1150.83	1150.79	0.04	0.50	0.01		5.00		7.55
South Channel	1	1150.33	1150.23	0.09				5.00		9.60

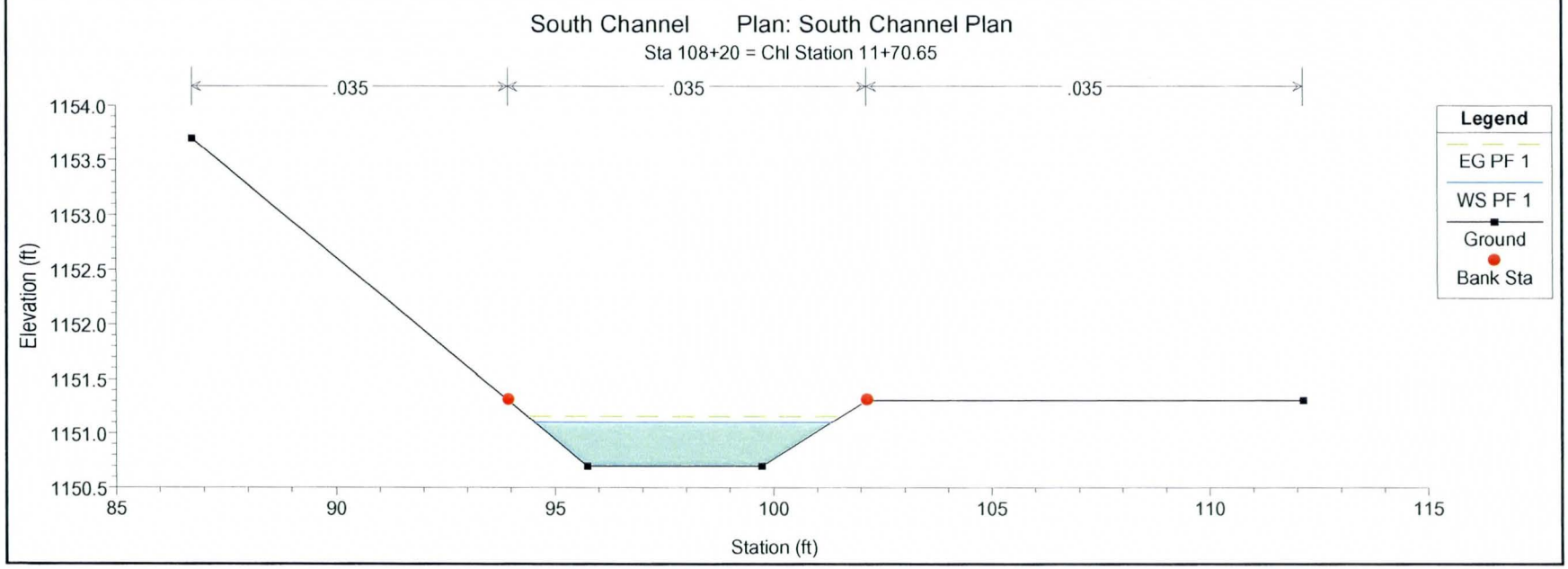

6
5
4
3
2
1
South Channel

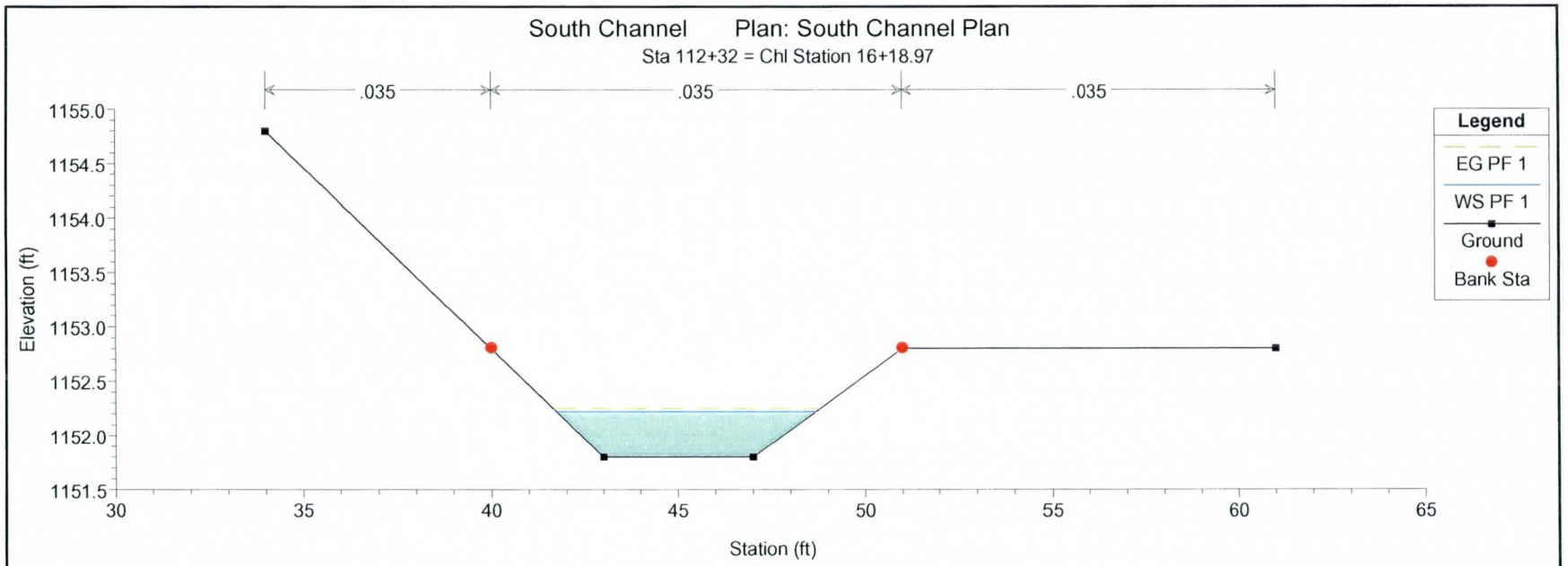

South Channel Plan: South Channel Plan
South Channel
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Elevation (ft)
1152.5
1152.0
1151.5
1151.0
1150.5
1150.0
0
100
200
300
400
500
600
700
Main Channel Distance (ft)

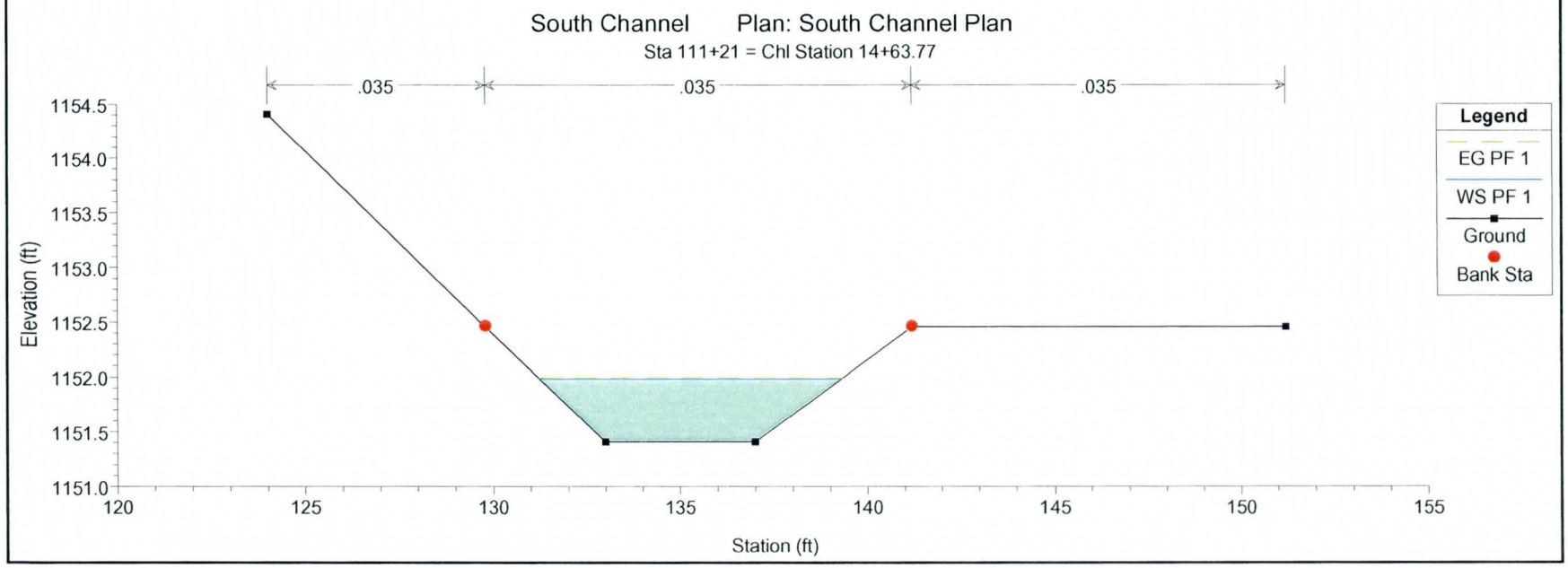

South Channel Plan: South Channel Plan
Sta 106+97 = Chl Station 10+47.65
.035
.035
.035
Elevation (ft)
1153.5
1153.0
1152.5
1152.0
1151.5
1151.0
1150.5
1150.0
65
70
75
80
85
90
95
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta


South Channel Plan: South Channel Plan
Sta 106+42 = Chl Station 10+00
.035
.035
.035
Elevation (ft)
1153.0
1152.5
1152.0
1151.5
1151.0
1150.5
1150.0
55
60
65
70
75
80
85
90
95
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta


South Channel Plan: South Channel Plan
Sta 109+40 = Chl Station 12+91.66
.035
.035
.035
Elevation (ft)
1154.5
1154.0
1153.5
1153.0
1152.5
1152.0
1151.5
1151.0
105
110
115
120
125
130
135
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta


South Channel Plan: South Channel Plan
Sta 108+20 = Chl Station 11+70.65
.035
.035
.035
Elevation (ft)
1154.0
1153.5
1153.0
1152.5
1152.0
1151.5
1151.0
1150.5
85
90
95
100
105
110
115
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta


South Channel Plan: South Channel Plan
Sta 112+32 = Chl Station 16+18.97
.035
.035
.035
Elevation (ft)
1155.0
1154.5
1154.0
1153.5
1153.0
1152.5
1152.0
1151.5
30
35
40
45
50
55
60
65
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta


South Channel Plan: South Channel Plan
Sta 111+21 = Chl Station 14+63.77
.035
.035
.035
Elevation (ft)
1154.5
1154.0
1153.5
1153.0
1152.5
1152.0
1151.5
1151.0
120
125
130
135
140
145
150
155
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta

```
                    HEC-RAS Version 3.0.1  Mar 2001
                      U.S. Army Corp of Engineers
                     Hydrologic Engineering Center
                       609 Second Street, Suite D
                      Davis, California 95616-4687
                             (916) 756-1104

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

****

PROJECT DATA
Project Title: North Channel
Project File : nc.prj
Run Date and Time: 9/28/02 3:00:36 PM

Project in English units

Project Description:
Earthen Channel 2 (North Channel), Station 104+00, 49' Lt to 110+04, 122' Lt)

****

PLAN DATA

Plan Title: North Channel Plan
Plan File : r:\11344239\Drn\HEC-RAS\nc.p02

Geometry Title: North Channel Geom Channel 2
Geometry File : r:\11344239\Drn\HEC-RAS\nc.g01

Flow Title : 100-Year Peak Flow
Flow File : r:\11344239\Drn\HEC-RAS\nc.f01

Plan Summary Information:

Number of:	Cross Sections =	6	Mulitple Openings =	0
	Culverts =	0	Inline Weirs =	0
	Bridges =	0		

Computational Information
Water surface calculation tolerance = 0.003
Critical depth calculaton tolerance = 0.003

```
    Maximum number of interations        =  20
    Maximum difference tolerance         =  0.1
    Flow tolerance factor                =  0.001

Computation Options
    Critical depth computed only where necessary
    Conveyance Calculation Method: At breaks in n values only
    Friction Slope Method:         Average Conveyance
    Computational Flow Regime:     Subcritical Flow


*****************************************************************************

FLOW DATA

Flow Title: 100-Year Peak Flow
Flow File : r:\11344239\Drn\HEC-RAS\nc.f01

Flow Data (cfs)
************************************************************
* River           Reach           RS      *            PF 1 *
* 1               North Channel   6       *              12 *
* 1               North Channel   3       *              22 *
* 1               North Channel   1       *              70 *
************************************************************

Boundary Conditions
*****************************************************************************************************
* River           Reach           Profile          *            Upstream                Downstream    *
*****************************************************************************************************
* 1               North Channel   PF 1             *                                Known WS = 1149.71 *
*****************************************************************************************************

*****************************************************************************

GEOMETRY DATA

Geometry Title: North Channel Geom
Geometry File : r:\11344239\Drn\HEC-RAS\nc.g01

CROSS SECTION          RIVER: 1
REACH: North Channel      RS: 6

INPUT
Description: Sta 110+04 = Chl Sta 16+92.96
Station Elevation Data    num=       6
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
*****************************************************************************
     100 1158.58   117.1  1152.9     122 1151.25     126 1151.25   132.6  1152.9
   142.6    1153

Manning's n Values        num=       3
```

← HW 1-8'x4' CBC

```
     Sta   n Val     Sta   n Val     Sta   n Val
*********************************************
     100    .035   117.1    .035   132.6    .035

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         117.1   132.6               59      59      59             .1       .3

CROSS SECTION OUTPUT    Profile #PF 1
*****************************************************************************************
* E.G. Elev (ft)          * 1152.11  * Element                 *  Left OB *  Channel * Right OB *
* Vel Head (ft)           *    0.08  * Wt. n-Val.              *          *   0.035  *          *
* W.S. Elev (ft)          * 1152.03  * Reach Len. (ft)        *   59.00  *   59.00  *   59.00  *
* Crit W.S. (ft)          *          * Flow Area (sq ft)      *          *    5.27  *          *
* E.G. Slope (ft/ft)      *0.006488  * Area (sq ft)           *          *    5.27  *          *
* Q Total (cfs)           *   12.00  * Flow (cfs)              *          *   12.00  *          *
* Top Width (ft)          *    9.46  * Top Width (ft)          *          *    9.46  *          *
* Vel Total (ft/s)        *    2.28  * Avg. Vel. (ft/s)        *          *    2.28  *          *
* Max Chl Dpth (ft)       *    0.78  * Hydr. Depth (ft)        *          *    0.56  *          *
* Conv. Total (cfs)       *   149.0  * Conv. (cfs)             *          *   149.0  *          *
* Length Wtd. (ft)        *   59.00  * Wetted Per. (ft)        *          *    9.68  *          *
* Min Ch El (ft)          * 1151.25  * Shear (lb/sq ft)        *          *    0.22  *          *
* Alpha                   *    1.00  * Stream Power (lb/ft s)  *          *    0.50  *          *
* Frctn Loss (ft)         *    0.55  * Cum Volume (acre-ft)    *          *    0.30  *          *
* C & E Loss (ft)         *    0.01  * Cum SA (acres)          *          *    0.23  *          *
*****************************************************************************************

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less
         than 0.7 or greater than 1.4.  This may indicate the need for additional cross sections.

CROSS SECTION          RIVER: 1
REACH: North Channel      RS: 5

INPUT
Description: Sta 109+45 = Chl Sta 16+29.80
Sta 109+58
Station Elevation Data    num=       6
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
*********************************************************************************
     100 1156.11   109.6  1152.9     116 1150.78     120 1150.78   128.5  1152.9
   138.5    1153

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
*********************************************
     100    .035   109.6    .035   128.5    .035

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         109.6   128.5              145     145     145             .1       .3

CROSS SECTION OUTPUT    Profile #PF 1
*****************************************************************************************
* E.G. Elev (ft)          * 1151.56  * Element                 *  Left OB *  Channel * Right OB *
```

Vel Head (ft)	0.14	Wt. n-Val.		0.035		
W.S. Elev (ft)	1151.42	Reach Len. (ft)	145.00	145.00	145.00	
Crit W.S. (ft)	1151.33	Flow Area (sq ft)		3.96		
E.G. Slope (ft/ft)	0.014471	Area (sq ft)		3.96		
Q Total (cfs)	12.00	Flow (cfs)		12.00		
Top Width (ft)	8.46	Top Width (ft)		8.46		
Vel Total (ft/s)	3.03	Avg. Vel. (ft/s)		3.03		
Max Chl Dpth (ft)	0.63	Hydr. Depth (ft)		0.47		
Conv. Total (cfs)	99.8	Conv. (cfs)		99.8		
Length Wtd. (ft)	145.00	Wetted Per. (ft)		8.64		
Min Ch El (ft)	1150.78	Shear (lb/sq ft)		0.41		
Alpha	1.00	Stream Power (lb/ft s)		1.25		
Frctn Loss (ft)	1.56	Cum Volume (acre-ft)		0.29		
C & E Loss (ft)	0.01	Cum SA (acres)		0.22		

Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION RIVER: 1
REACH: North Channel RS: 4

INPUT
Description: Sta 108+00 = Chl Sta 14+81.02
Station Elevation Data num= 6

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
72	1156.15	85.4	1151.7	93	1149.15	97	1149.15	107.2	1151.7
117.2	1151.8								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
72	.035	85.4	.035	107.2	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
85.4	107.2	50	50	50	.1	.3

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	1149.98	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.10	Wt. n-Val.		0.035	
W.S. Elev (ft)	1149.88	Reach Len. (ft)	50.00	50.00	50.00
Crit W.S. (ft)		Flow Area (sq ft)		4.81	
E.G. Slope (ft/ft)	0.008348	Area (sq ft)		4.81	
Q Total (cfs)	12.00	Flow (cfs)		12.00	
Top Width (ft)	9.12	Top Width (ft)		9.12	
Vel Total (ft/s)	2.49	Avg. Vel. (ft/s)		2.49	
Max Chl Dpth (ft)	0.73	Hydr. Depth (ft)		0.53	
Conv. Total (cfs)	131.3	Conv. (cfs)		131.3	
Length Wtd. (ft)	50.00	Wetted Per. (ft)		9.33	
Min Ch El (ft)	1149.15	Shear (lb/sq ft)		0.27	

```
* Alpha                    *    1.00  * Stream Power (lb/ft s) *          *    0.67  *          *
* Frctn Loss (ft)          *    0.11  * Cum Volume (acre-ft)   *          *    0.28  *          *
* C & E Loss (ft)          *    0.02  * Cum SA (acres)         *          *    0.19  *          *
*****************************************************************************************************

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less
         than 0.7 or greater than 1.4.  This may indicate the need for additional cross sections.

CROSS SECTION          RIVER: 1
REACH: North Channel      RS: 3

INPUT
Description: Sta 107+50 = Chl Sta 14+31.02
Station Elevation Data    num=       6
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
*****************************************************************************************
      66  1155.6      78  1151.6      87  1148.6      95  1148.6     107  1151.6
     117  1151.7

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
*********************************************
      66    .035      78    .035     107    .035

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
            78     107              186     186     186             .1       .3

CROSS SECTION OUTPUT    Profile #PF 1
*****************************************************************************************************
* E.G. Elev (ft)          * 1149.85  * Element                 *  Left OB *  Channel * Right OB *
* Vel Head (ft)           *    0.03  * Wt. n-Val.              *          *    0.035  *          *
* W.S. Elev (ft)          * 1149.81  * Reach Len. (ft)         *  186.00  *   186.00  *  186.00  *
* Crit W.S. (ft)          *          * Flow Area (sq ft)       *          *    14.85  *          *
* E.G. Slope (ft/ft)      *0.001441  * Area (sq ft)            *          *    14.85  *          *
* Q Total (cfs)           *   22.00  * Flow (cfs)               *          *    22.00  *          *
* Top Width (ft)          *   16.49  * Top Width (ft)           *          *    16.49  *          *
* Vel Total (ft/s)        *    1.48  * Avg. Vel. (ft/s)         *          *     1.48  *          *
* Max Chl Dpth (ft)       *    1.21  * Hydr. Depth (ft)         *          *     0.90  *          *
* Conv. Total (cfs)       *   579.6  * Conv. (cfs)              *          *    579.6  *          *
* Length Wtd. (ft)        *  186.00  * Wetted Per. (ft)         *          *    16.83  *          *
* Min Ch El (ft)          * 1148.60  * Shear (lb/sq ft)         *          *     0.08  *          *
* Alpha                   *    1.00  * Stream Power (lb/ft s)   *          *     0.12  *          *
* Frctn Loss (ft)         *    0.06  * Cum Volume (acre-ft)     *          *     0.27  *          *
* C & E Loss (ft)         *    0.01  * Cum SA (acres)           *          *     0.18  *          *
*****************************************************************************************************

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less
         than 0.7 or greater than 1.4.  This may indicate the need for additional cross sections.

CROSS SECTION          RIVER: 1
REACH: North Channel      RS: 2
```

```
INPUT
Description: Sta 105+54 =  Chl Sta 12+35.54
Station Elevation Data     num=       6
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
*******************************************************************************
    43.2  1153.8    52.2  1150.8      62 1147.54      70 1147.54    83.1  1150.8
    93.1  1150.9

Manning's n Values         num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
***********************************************
    43.2    .035    52.2    .035    83.1    .035

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          52.2    83.1              154     154     154              .1       .3

CROSS SECTION OUTPUT    Profile #PF 1
*************************************************************************************************
* E.G. Elev (ft)         * 1149.78  * Element                 *  Left OB *  Channel * Right OB *
* Vel Head (ft)          *    0.01  * Wt. n-Val.              *          *   0.035  *          *
* W.S. Elev (ft)         * 1149.78  * Reach Len. (ft)         *  154.00  *  154.00  *  154.00  *
* Crit W.S. (ft)         *          * Flow Area (sq ft)       *          *   35.43  *          *
* E.G. Slope (ft/ft)     *0.000130  * Area (sq ft)            *          *   35.43  *          *
* Q Total (cfs)          *   22.00  * Flow (cfs)               *          *   22.00  *          *
* Top Width (ft)         *   23.70  * Top Width (ft)           *          *   23.70  *          *
* Vel Total (ft/s)       *    0.62  * Avg. Vel. (ft/s)         *          *    0.62  *          *
* Max Chl Dpth (ft)      *    2.24  * Hydr. Depth (ft)         *          *    1.49  *          *
* Conv. Total (cfs)      *  1931.9  * Conv. (cfs)              *          *  1931.9  *          *
* Length Wtd. (ft)       *  154.00  * Wetted Per. (ft)         *          *   24.34  *          *
* Min Ch El (ft)         * 1147.54  * Shear (lb/sq ft)         *          *    0.01  *          *
* Alpha                  *    1.00  * Stream Power (lb/ft s)   *          *    0.01  *          *
* Frctn Loss (ft)        *    0.04  * Cum Volume (acre-ft)     *          *    0.16  *          *
* C & E Loss (ft)        *    0.00  * Cum SA (acres)           *          *    0.09  *          *
*************************************************************************************************

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less
         than 0.7 or greater than 1.4.  This may indicate the need for additional cross sections.

CROSS SECTION          RIVER: 1
REACH: North Channel      RS: 1

INPUT
Description: Sta 104+00 = Chl Sta 10+88.95
Station Elevation Data     num=       6
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
*******************************************************************************
    32.3  1152.3    36.8  1150.8      49 1146.73      57 1146.73    73.3  1150.8
    83.3  1150.9

Manning's n Values         num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
***********************************************
```

```
    32.3     .035     36.8     .035     73.3     .035

Bank Sta: Left    Right     Lengths: Left Channel    Right      Coeff Contr.    Expan.
          36.8     73.3                 0       0        0              .1        .3

CROSS SECTION OUTPUT     Profile #PF 1
*****************************************************************************************
* E.G. Elev (ft)          * 1149.74  * Element                 *  Left OB *  Channel * Right OB *
* Vel Head (ft)           *    0.03  * Wt. n-Val.              *          *   0.035  *          *
* W.S. Elev (ft)          * 1149.71  * Reach Len. (ft)         *          *          *          *
* Crit W.S. (ft)          * 1147.85  * Flow Area (sq ft)       *          *   54.93  *          *
* E.G. Slope (ft/ft)      *0.000397  * Area (sq ft)            *          *   54.93  *          *
* Q Total (cfs)           *   70.00  * Flow (cfs)               *          *   70.00  *          *
* Top Width (ft)          *   28.87  * Top Width (ft)           *          *   28.87  *          *
* Vel Total (ft/s)        *    1.27  * Avg. Vel. (ft/s)         *          *    1.27  *          *
* Max Chl Dpth (ft)       *    2.98  * Hydr. Depth (ft)         *          *    1.90  *          *
* Conv. Total (cfs)       *  3512.5  * Conv. (cfs)              *          *  3512.5  *          *
* Length Wtd. (ft)        *          * Wetted Per. (ft)         *          *   29.72  *          *
* Min Ch El (ft)          * 1146.73  * Shear (lb/sq ft)         *          *    0.05  *          *
* Alpha                   *    1.00  * Stream Power (lb/ft s)   *          *    0.06  *          *
* Frctn Loss (ft)         *          * Cum Volume (acre-ft)     *          *          *          *
* C & E Loss (ft)         *          * Cum SA (acres)           *          *          *          *
*****************************************************************************************

*****************************************************************************

SUMMARY OF MANNING'S N VALUES

River:1
*****************************************************************
*     Reach       *   River Sta.   *   n1     *   n2     *   n3     *
*****************************************************************
*North Channel   *     6          *     .035*     .035*     .035*
*North Channel   *     5          *     .035*     .035*     .035*
*North Channel   *     4          *     .035*     .035*     .035*
*North Channel   *     3          *     .035*     .035*     .035*
*North Channel   *     2          *     .035*     .035*     .035*
*North Channel   *     1          *     .035*     .035*     .035*
*****************************************************************

*******************************************************************************

SUMMARY OF REACH LENGTHS

River: 1
*****************************************************************
*     Reach       *   River Sta.   *  Left    * Channel *  Right  *
*****************************************************************
*North Channel   *     6          *       59*       59*       59*
*North Channel   *     5          *      145*      145*      145*
*North Channel   *     4          *       50*       50*       50*
*North Channel   *     3          *      186*      186*      186*
```

North Channel	2	154	154	154
North Channel	1	0	0	0

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: 1

Reach	River Sta.	Contr.	Expan.
North Channel	6	.1	.3
North Channel	5	.1	.3
North Channel	4	.1	.3
North Channel	3	.1	.3
North Channel	2	.1	.3
North Channel	1	.1	.3

Profile Output Table - Standard Table 1

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
North Channel	6	12.00	1151.25	1152.03		1152.11	0.006488	2.28	5.27	9.46	0.54
North Channel	5	12.00	1150.78	1151.42	1151.33	1151.56	0.014471	3.03	3.96	8.46	0.78
North Channel	4	12.00	1149.15	1149.88		1149.98	0.008348	2.49	4.81	9.12	0.61
North Channel	3	22.00	1148.60	1149.81		1149.85	0.001441	1.48	14.85	16.49	0.28
North Channel	2	22.00	1147.54	1149.78		1149.78	0.000130	0.62	35.43	23.70	0.09
North Channel	1	70.00	1146.73	1149.71	1147.85	1149.74	0.000397	1.27	54.93	28.87	0.16

Profile Output Table - Standard Table 2

Reach	River Sta	E.G. Elev (ft)	W.S. Elev (ft)	Vel Head (ft)	Frctn Loss (ft)	C & E Loss (ft)	Q Left (cfs)	Q Channel (cfs)	Q Right (cfs)	Top Width (ft)
North Channel	6	1152.11	1152.03	0.08	0.55	0.01		12.00		9.46
North Channel	5	1151.56	1151.42	0.14	1.56	0.01		12.00		8.46
North Channel	4	1149.98	1149.88	0.10	0.11	0.02		12.00		9.12

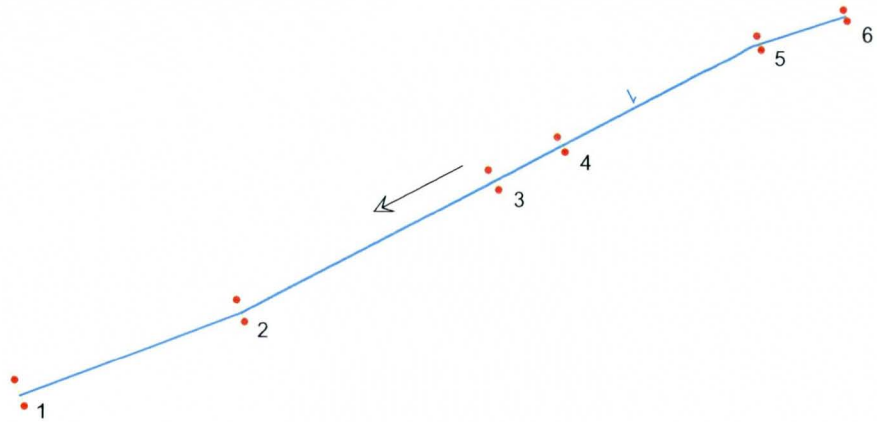
North Channel	3	1149.85	1149.81	0.03	0.06	0.01		22.00		16.49
North Channel	2	1149.78	1149.78	0.01	0.04	0.00		22.00		23.70
North Channel	1	1149.74	1149.71	0.03				70.00		28.87

HEC-RAS Plan: Plan 01 River: 1 Reach: North Channel Profile: PF 1

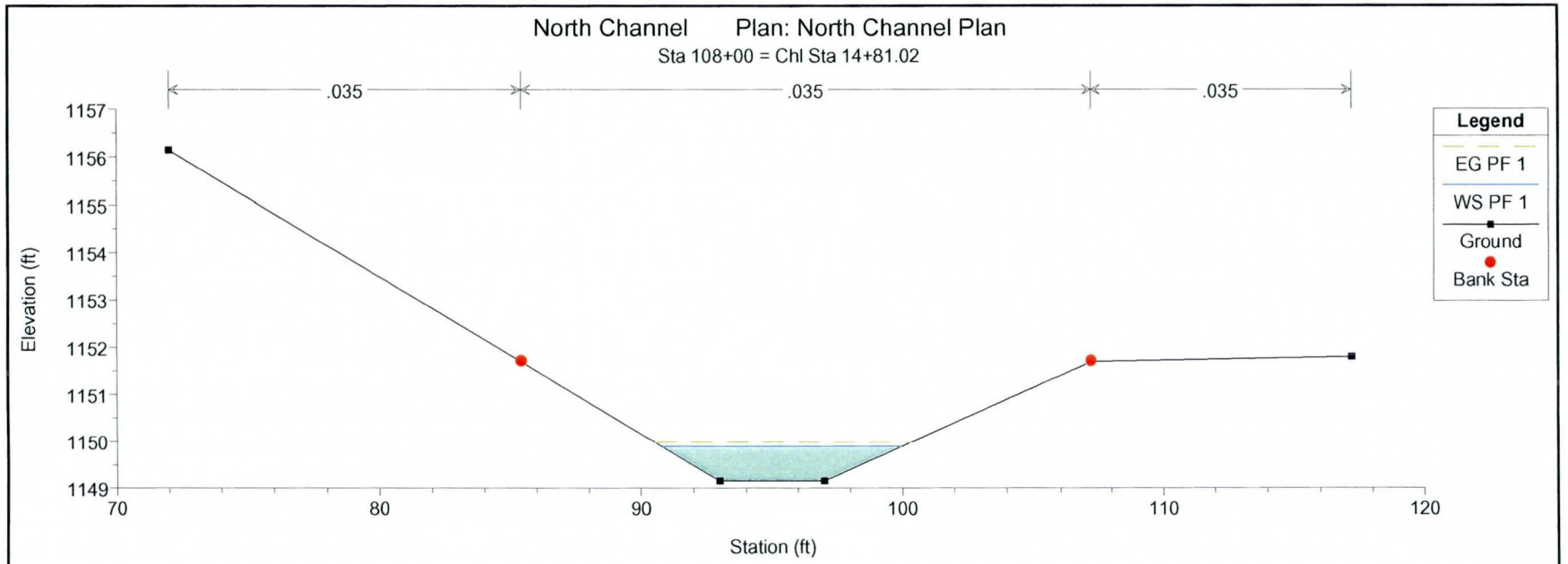
Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
North Channel	6	12.00	1151.25	1152.03		1152.11	0.006488	2.28	5.27	9.46	0.54
North Channel	5	12.00	1150.78	1151.42	1151.33	1151.56	0.014471	3.03	3.96	8.46	0.78
North Channel	4	12.00	1149.15	1149.88		1149.98	0.008348	2.49	4.81	9.12	0.61
North Channel	3	22.00	1148.60	1149.81		1149.85	0.001441	1.48	14.85	16.49	0.28
North Channel	2	22.00	1147.54	1149.78		1149.78	0.000130	0.62	35.43	23.70	0.09
North Channel	1	70.00	1146.73	1149.71	1147.85	1149.74	0.000397	1.27	54.93	28.87	0.16

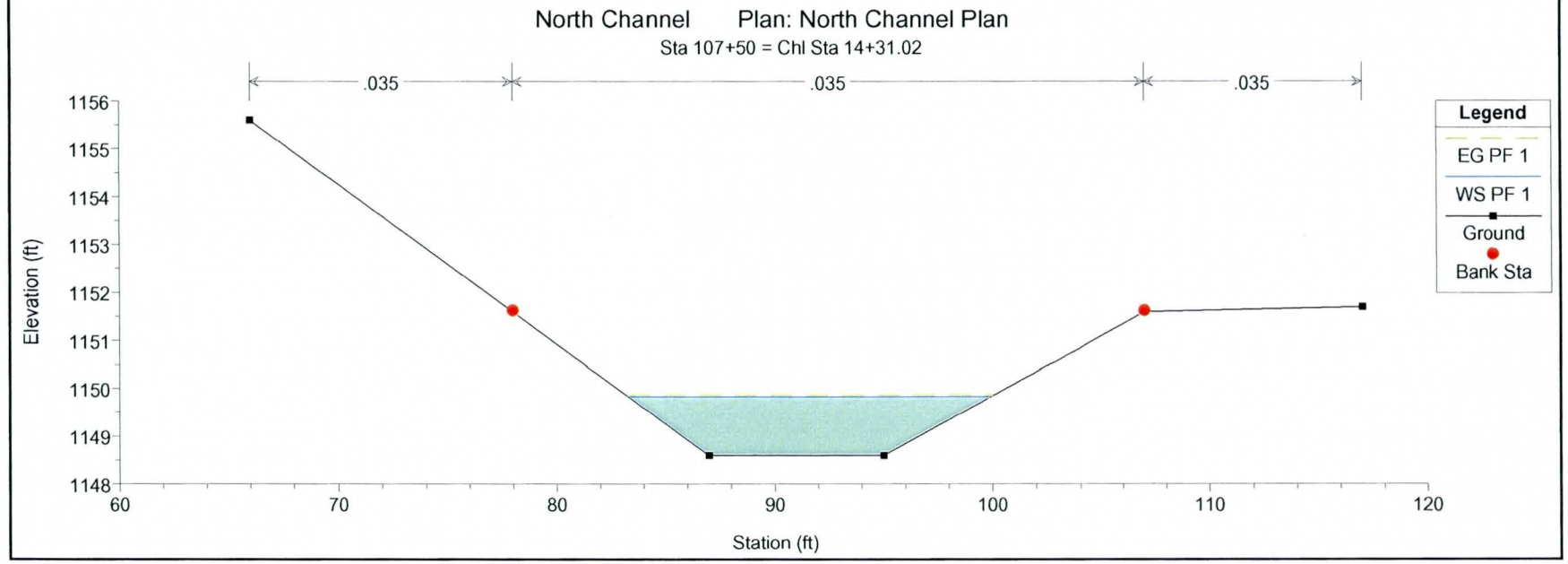
HEC-RAS Plan: Plan 01 River: 1 Reach: North Channel Profile: PF 1

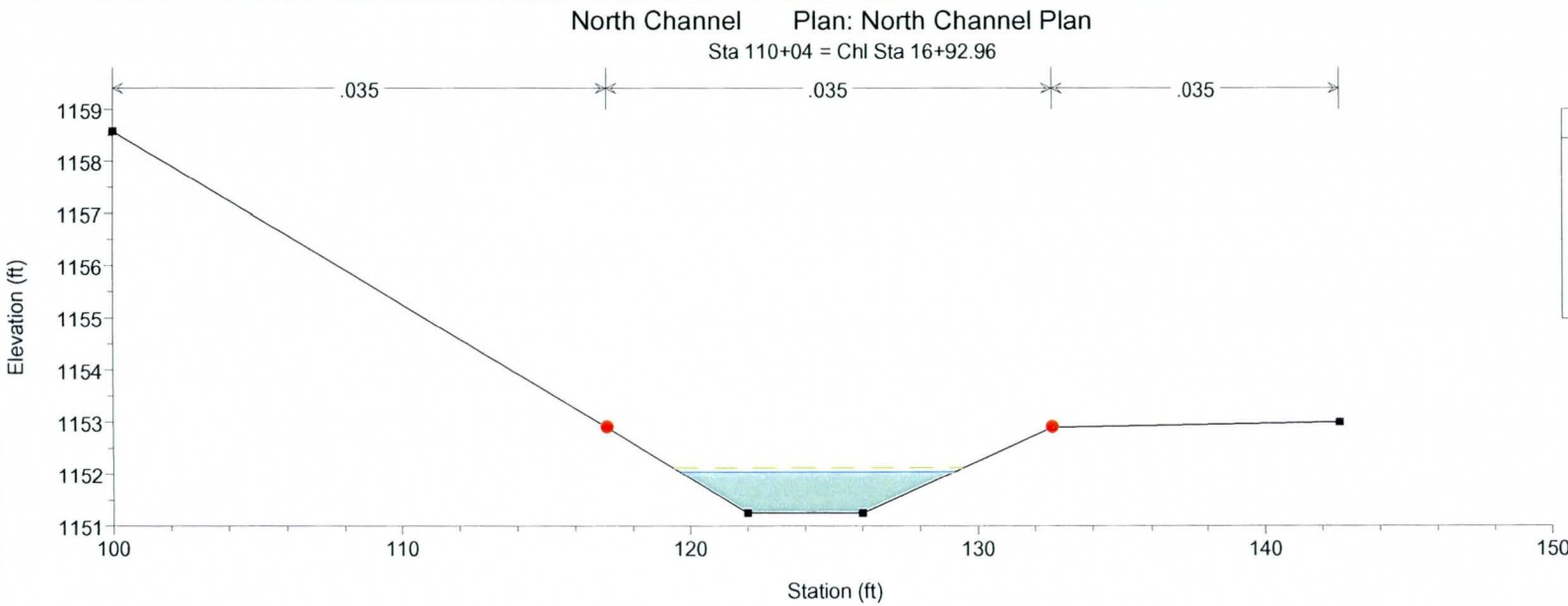
Reach	River Sta	E.G. Elev	W.S. Elev	Vel Head	Frctn Loss	C & E Loss	Q Left	Q Channel	Q Right	Top Width
		(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)
North Channel	6	1152.11	1152.03	0.08	0.55	0.01		12.00		9.46
North Channel	5	1151.56	1151.42	0.14	1.56	0.01		12.00		8.46
North Channel	4	1149.98	1149.88	0.10	0.11	0.02		12.00		9.12
North Channel	3	1149.85	1149.81	0.03	0.06	0.01		22.00		16.49
North Channel	2	1149.78	1149.78	0.01	0.04	0.00		22.00		23.70
North Channel	1	1149.74	1149.71	0.03				70.00		28.87

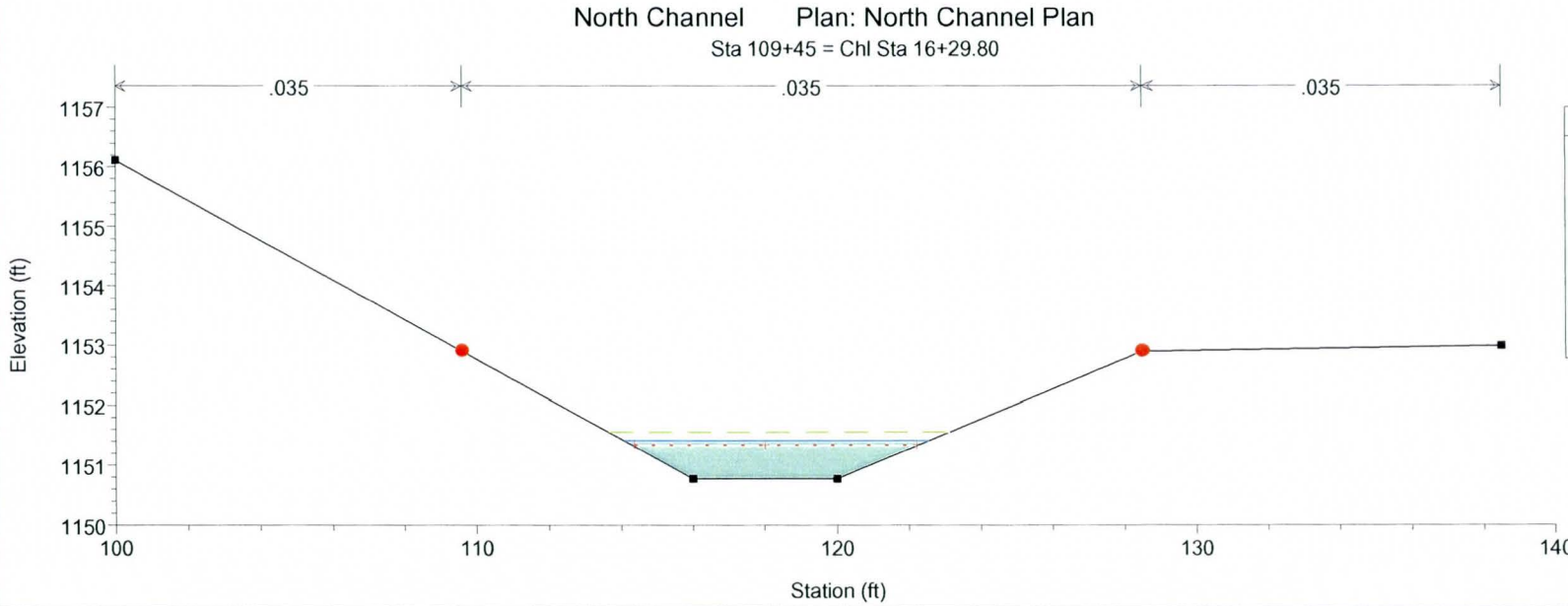


North Channel


North Channel Plan: North Channel Plan
Sta 108+00 = Chl Sta 14+81.02
.035
.035
.035
Elevation (ft)
1157
1156
1155
1154
1153
1152
1151
1150
1149
70
80
90
100
110
120
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta


North Channel Plan: North Channel Plan
Sta 107+50 = Chl Sta 14+31.02
.035
.035
.035
Elevation (ft)
1156
1155
1154
1153
1152
1151
1150
1149
1148
60
70
80
90
100
110
120
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta


North Channel Plan: North Channel Plan
Sta 110+04 = Chl Sta 16+92.96
.035
.035
.035
Elevation (ft)
1159
1158
1157
1156
1155
1154
1153
1152
1151
100
110
120
130
140
150
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta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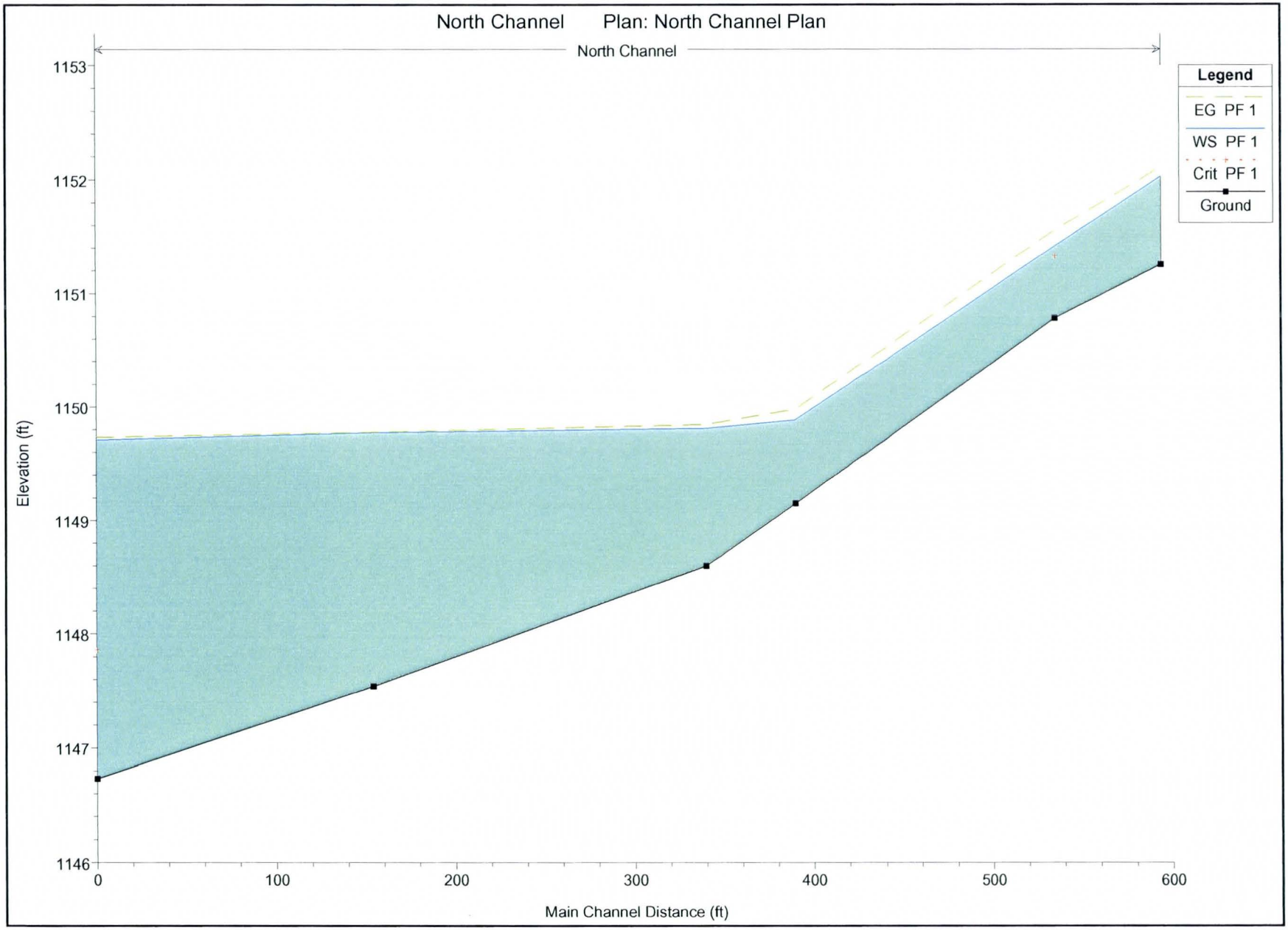
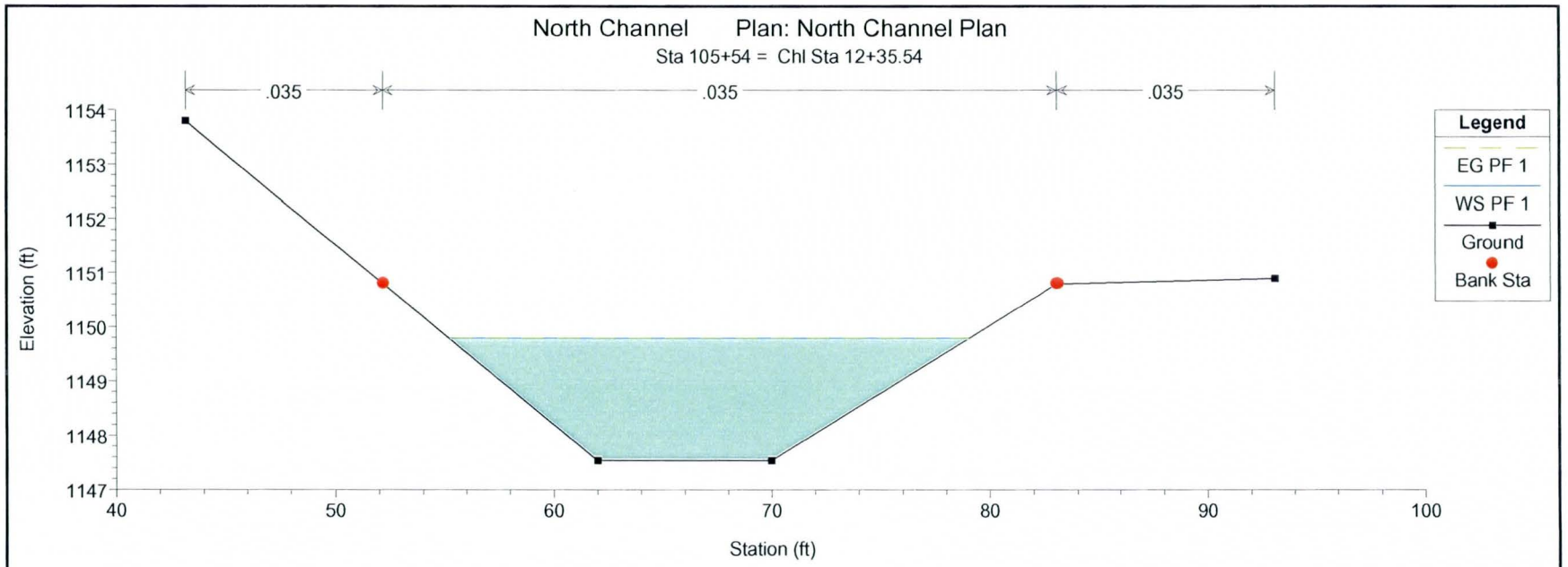
Sta 109+45 = Chl Sta 16+29.80
.035
.035
.035
Elevation (ft)
1157
1156
1155
1154
1153
1152
1151
1150
100
110
120
130
140
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta


North Channel Plan: North Channel Plan
North Channel
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Elevation (ft)
1153
1152
1151
1150
1149
1148
1147
1146
0
100
200
300
400
500
600
Main Channel Distance (ft)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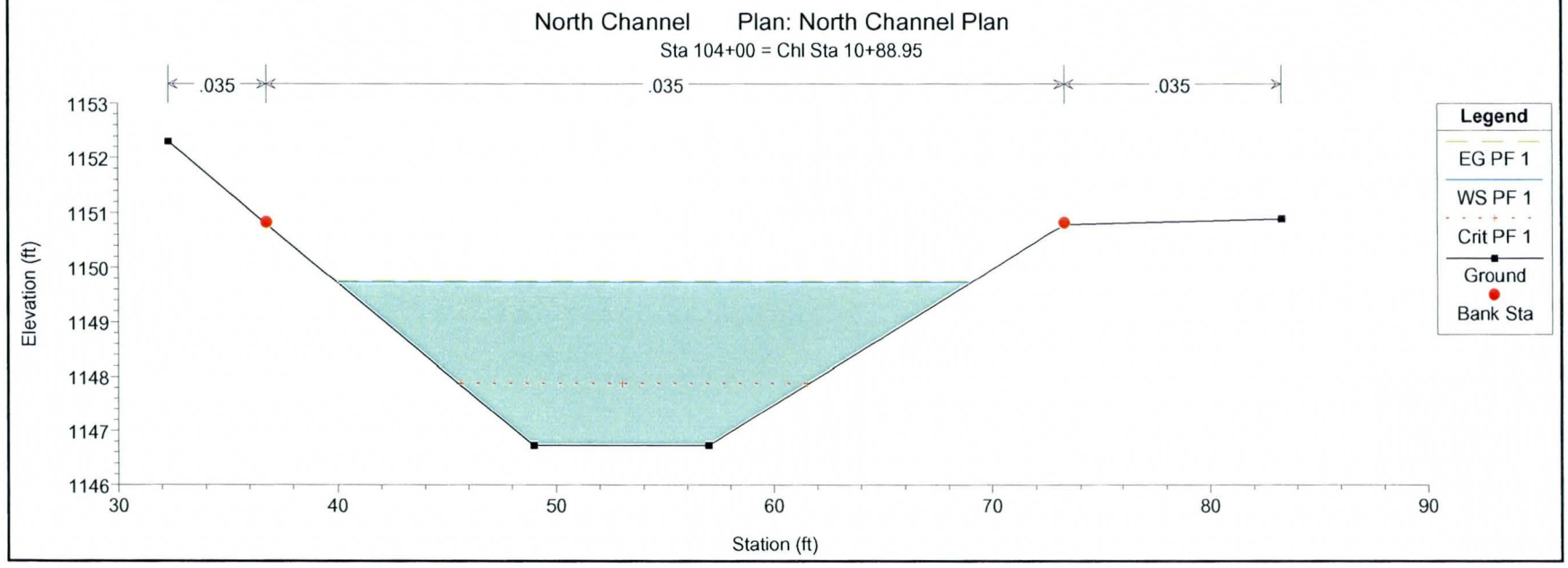
Sta 105+54 = Chl Sta 12+35.54
.035
.035
.035
Elevation (ft)
1154
1153
1152
1151
1150
1149
1148
1147
40
50
60
70
80
90
100
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta


North Channel Plan: North Channel Plan
Sta 104+00 = Chl Sta 10+88.95
.035
.035
.035
Elevation (ft)
1153
1152
1151
1150
1149
1148
1147
1146
30
40
50
60
70
80
90
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta

Appendix I
Off-Site Hydrology and Hydraulic Analyses
(100-year)

Summary
of
100-Year Water Surface Elevations
for
Existing and Proposed Conditions
at
Critical Locations

Location	Station	Water Surface Elevation (WSE)			Comments
		Existing msl (ft)	Proposed msl (ft)	Change in Elevation (ft)	
Maryland Ave	126+10	1156.14	1155.66	-0.48	Entrance to 8'x3' CBC under Sierra Vista Dr. Proposed 100-Year WSE is lower than existing WSE because of the improved outfall under Maryland Avenue (2-10'x4' CBC with less tailwater than existing conditions).
54th Ave	86' North of Existing Maryland Ave	1156.14	1155.66	-0.48	Located 20'(+or-) South of CB 27. During the 100-Year Event, the proposed water surface elevation will be the same as on Maryland, Station 126+10 by equalization through CB 27.
54th Ave	52+75 or 319' North of Existing Maryland Ave	1156.18	1155.79	-0.39	North End of 54th Street Reconstruction. Proposed WSE is lower than existing 100-Year WSE because of the improved outfall under Maryland Avenue (2-10'x4' CBC with less tailwater than existing conditions).

TABLE 1
Off-Site Hydrology
Using Maryvale ADMS Section 8 Peak Runoff(1)
100-Year, 6-Hour Peak Runoffs

C.P.	North-South Length	East-West Length	Area From Northeast	Area From Previous Point North	Area From Previous Point East	Total Area @ C.P.	% Split South(2)	Area Split South	% Split West(2)	Area Split West	Q100 = (Total Area)x(902/320)(1)
No.	(ft)	(ft)	Acres	Acres	Acres	Acres	%	Acres	%	Acres	(cfs)
1	620	1350	19.2	0.0	0.0	19.2	56	10.8	44	8.5	54
2	590	380	5.1	0.0	8.5	13.6	56	7.6	44	6.0	38
3	590	395	5.4	0.0	6.0	11.3	56	6.3	44	5.0	32
4	590	370	5.0	0.0	5.0	10.0	56	5.6	44	4.4	28
5	650	395	5.9	0.0	4.4	10.3	56	5.8	44	4.5	29
6	655	1350	20.3	10.8	0.0	31.1	56	17.4	44	13.7	88
7	655	380	5.7	7.6	13.7	27.0	56	15.1	44	11.9	76
8	655	395	5.9	6.3	11.9	24.2	56	13.5	44	10.6	68
9	655	370	5.6	5.6	10.6	21.8	56	12.2	44	9.6	61
10	655	395	5.9	5.8	9.6	21.3	56	11.9	44	9.4	60
11	670	380	5.8	15.1	0.0	21.0	56	11.7	44	9.2	59
12	670	395	6.1	13.5	9.2	28.8	56	16.1	44	12.7	81
13	670	370	5.7	12.2	12.7	30.6	0	0.0	100	30.6	86
14	670	395	6.1	11.9	30.6	48.6	100	48.6	0	0.0	137
15	1300	1350	40.3	17.4	0.0	57.7	0	0.0	100	57.7	163
16			0.0	0.0	57.7	57.7	78.9	45.5	21.1	12.2	163
17	650	380	5.7	11.7	12.2	29.6	0	0.0	100	29.6	83
18	650	395	5.9	16.1	29.6	51.6	0	0.0	100	51.6	146
19	650	765	11.4	48.6	51.6	111.6	0	0.0	0	0.0	315
18N	650	395	5.9	16.1	0.0	22.0	0	0.0	100	22.0	62
19N	442	765	7.8	48.6	0.0	56.3	0	0.0	0	0.0	159
19E	208	765	3.7	0.0	51.6	55.3	0	0.0	0	0.0	156

(1) A review of the Maryvale ADMS indicates that the onsite peak runoff for Section 8 is the controlling peak flow in Section 8. It over shadows the offsite peak runoffs. Therefore, the peak flows at key intersections have been determined by prorating the total contributing area at each intersection with the Section 8 onsite peak flow of 902 cfs for 320 acres.

(2) Flow splits are based on prorating using the hydraulic capacity of each street. The residential streets are considered having equivalent sections, and therefore, the hydraulic capacity can be based on the square root of the slope of each street. All north-south streets have an approximate slope of .0435 ft/ft to the south and all east-west street have an approximate slope of 0.0270 ft/ft to the west.

TABLE 2
Off-Site Peak Runoffs
10-Year and 100-Year Events
for
Maryland Avenue
53rd Drive to 55th Avenue

NOTE: Peak discharges were developed with the Rational Method for comparison with the area proration method shown in Table 1. The peak discharges shown in Table 1 have been selected to design the off-site drainage facilities.

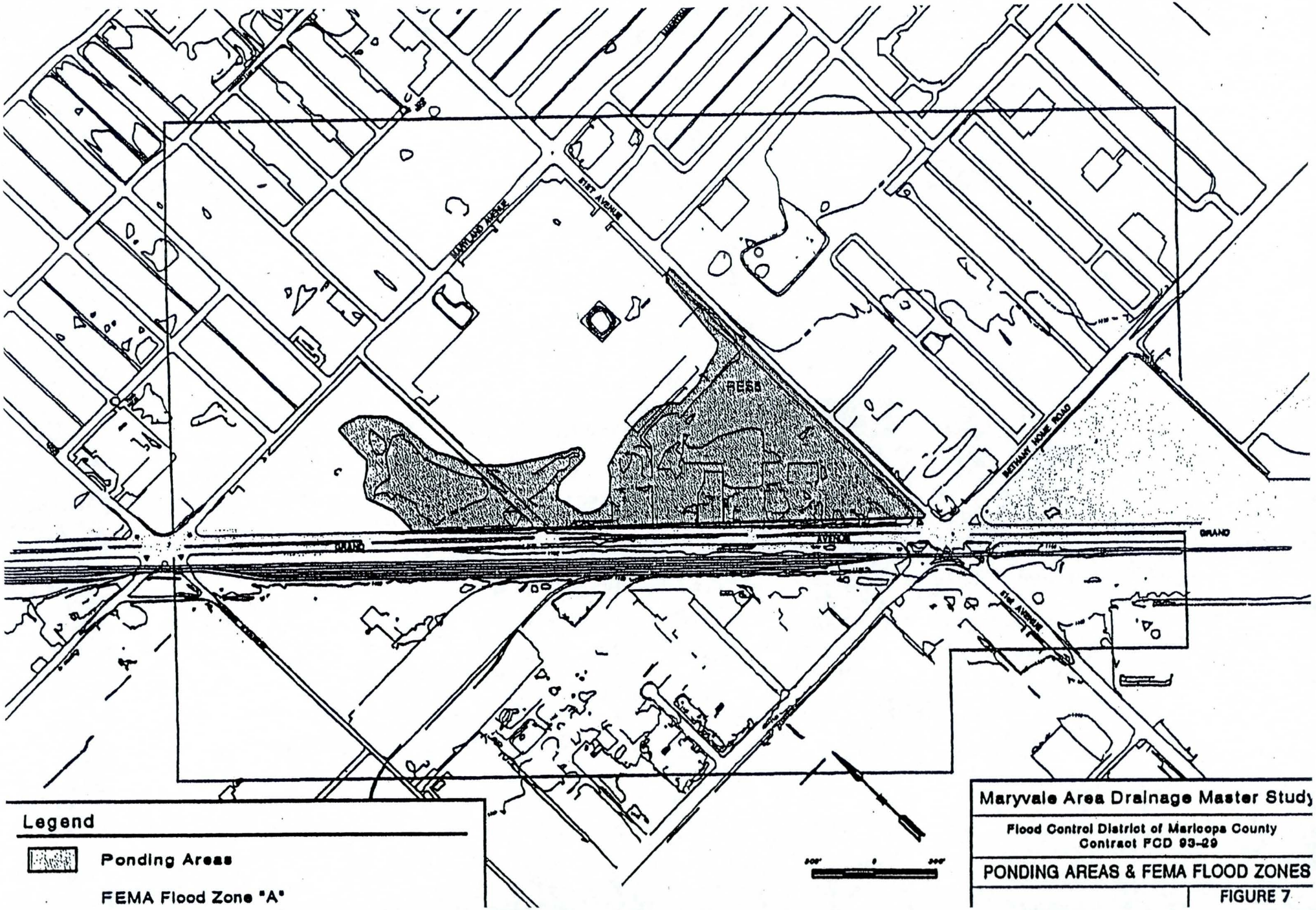
100-Year Event

Tributary Name	Tributary Area By Land Category			Drainage Basin Parameters								Runoff Flow Rate					
	Cw,p = 0.95[1] Pvm't/Conc[6]	Cw,p = 0.9[1] Commercial	Cw, Is = 0.56[5] Desert Landscape[6]	Total Tributary Area[7]	Weighted Coeff.	Water Course Length	Top Elev	Bot Elev	Slope	Slope		I, Init.	Tc[3]	Tc	Grand Ave. Intensity	Flow Q	Flow (Q) from Table 1
Sub-Basin	(Acres)	(Acres)	(Acres)	(Acres)	Cwt	Lwc (ft)	E2 (msl)	E1 (msl)	S (ft/ft)	S (ft/mi)	Kb[2]	(in/hr)	(hr)	(min)	I,p[4] (in/hr)	(cfs)	(cfs)
CP 17	11.84		17.76	29.6	0.72	3580	1167	1155.9	0.003101	16.37	0.0250	4.93	0.32	18.97	4.93	104	83
CP 18	20.64		30.96	51.6	0.72	3950	1167	1155	0.003038	16.04	0.0250	4.78	0.34	20.28	4.78	177	146
CP 19	44.64		66.96	111.6	0.72	4690	1167	1154	0.002772	14.64	0.0250	4.41	0.39	23.45	4.41	352	315
CP 18N	8.8		13.2	22	0.72	4000	1167	1155	0.003	15.84	0.0250	4.74	0.34	20.56	4.74	75	62
CP 19N	22.52		33.78	56.3	0.72	4560	1167	1154	0.002851	15.05	0.0250	4.5	0.38	22.74	4.5	181	159
CP 19E	22.12		33.18	55.3	0.72	4690	1167	1154	0.002772	14.64	0.0250	4.41	0.39	23.45	4.41	175	156

10-Year Event

Tributary Name	Tributary Area By Land Category			Drainage Basin Parameters								Runoff Flow Rate				
	Cw,p = 0.95[1a] Pvm't/Conc[6]	Cw,p = 0.9[1a] Commercial	Cw, Is = 0.56[5] Desert Landscape[6]	Total Tributary Area At	Weighted Coeff.	Water Course Length	Top Elev	Bot Elev	Slope	Slope		I, Init.	Tc[3]	Tc	Grand Ave. Intensity	Flow Q
Sub-Basin	(Acres)	(Acres)	(Acres)	(Acres)	Cwt	Lwc (ft)	E2 (msl)	E1 (msl)	S (ft/ft)	S (ft/mi)	Kb[2]	(in/hr)	(hr)	(min)	I,p[4] (in/hr)	(cfs)
CP 17	11.84		17.76	29.6	0.72	3580	1167	1155.9	0.003101	16.37	0.0250	2.98	0.38	22.96	2.98	63
CP 18	20.64		30.96	51.6	0.72	3950	1167	1155	0.003038	16.04	0.0250	2.84	0.41	24.72	2.84	105
CP 19	44.64		66.96	111.6	0.72	4690	1167	1154	0.002772	14.64	0.0250	2.49	0.49	29.14	2.49	199
CP 18N	8.8		13.2	22	0.72	4000	1167	1155	0.003	15.84	0.0250	2.81	0.42	25.08	2.81	44
CP 19N	22.52		33.78	56.3	0.72	4560	1167	1154	0.002851	15.05	0.0250	2.57	0.47	28.14	2.57	104
CP 19E	22.12		33.18	55.3	0.72	4690	1167	1154	0.002772	14.64	0.0250	2.49	0.49	29.14	2.49	99

(1) ADOT Figure 2-3, Developed Watersheds, P-1 Hour for 100-Years = 2.28 Inches
(1a) ADOT Figure 2-3, Developed Watersheds, P-1 Hour for 10-Year = 1.50 Inches
(2) ADOT Table 2-1, Kb = 0.025 (Residential, L is greater than 1000 feet)
(3) $T_c = 11.4L^{0.5}K_b^{0.52}S^{-0.31}I^{-0.38}$
(4) Rainfall Intensity is based on calculated T_c or 10 Minutes, whichever is greater.
(5) City of Scottsdale, Figure 2.2-17, Desert Landscaping, HSG D
(6) Assume Moderate Urban with 40% Impervious.
(7) Total Area at Concentration Point is obtained from Table 1.

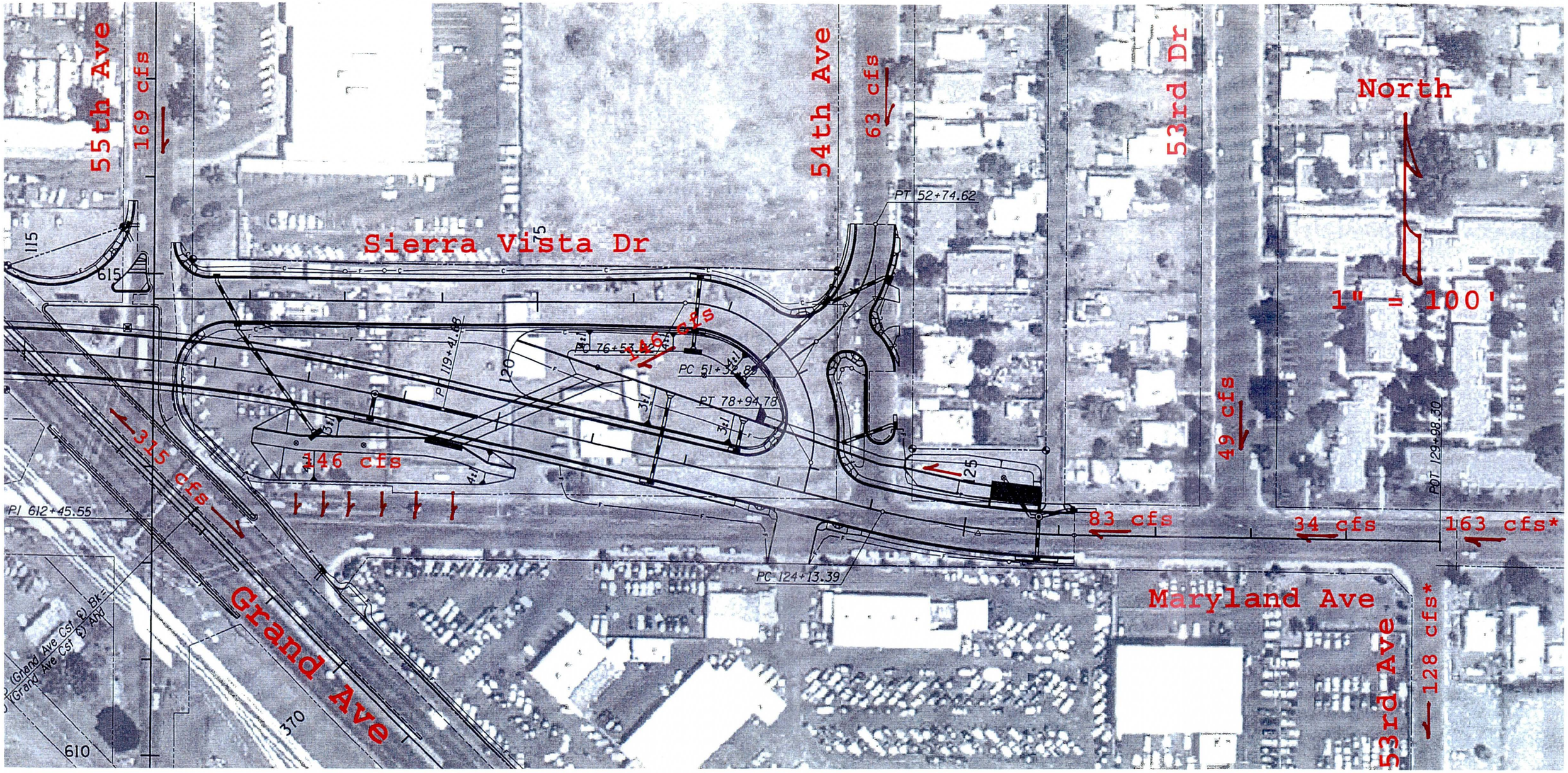


Maryvale Area Drainage Master Study

Flood Control District of Maricopa County
Contract FCD 93-29

PONDING AREAS & FEMA FLOOD ZONES

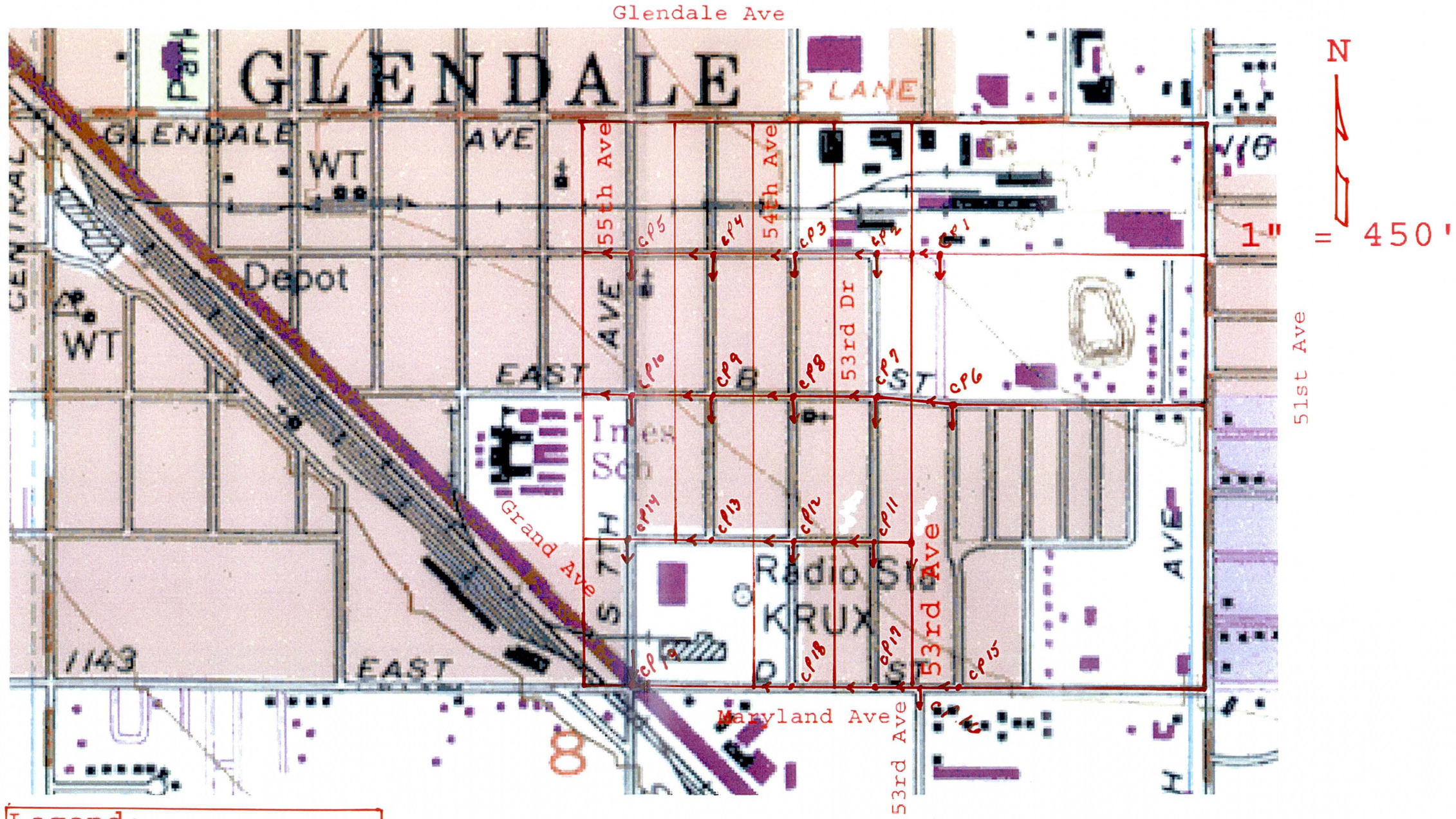
FIGURE 7



Notes: 1. Flows are based on on-site flows within the area bounded by Grand Ave on the West, 51st Ave on the East, Glendale Ave on the North, and Maryland Ave on the South.
2. On-site flows within the area described in note 1 are, for the most part, larger than off-site flows.

*Off-site flows may be larger than on-site flows at this location, but this fact does not affect the 34 cfs flow west of the intersection.

Grand Ave at
55th Ave & Maryland Ave
Peak Discharges
100-Year, 6-Hour Event



Legend:

CPX	Concentration Point #X
	Intersection Flow Splits
	Drainage Divide

Grand Ave at
55th Ave & Maryland Ave
Areas & Concentration Points
for 100-Year, 6-Hour Event

DCM GROUP BRW
A DAMES & MOORE GROUP COMPANY

JOB Grand Ave/55th Ave/Maryland Ave SHEET NO. 1/21
MADE BY D. Schaub DATE 6/30/02 JOB NO.
CHECKED BY R. Beckett DATE 7/1/02 SEC SHT. NO. 1/21
CALCULATIONS FOR Flow within Maryland Ave East of Project (STA 125+78)

PROBLEM STATEMENT: Determine Street flow within Maryland Avenue during the 100-year event at a location just east of the Project Limit (Proposed Catch Basin Location, Sta 125+78).

SOLUTION: 1. Q_{100} = 523 cfs flows west along Maryland Ave on the west leg of the Maryland Ave/51st Ave intersection - "Drainage Study Analysis Report, Maryland Avenue overpass, Revised July 3, 2001."

2. The overbank area south of the right-of-way along Maryland Ave between 51st Ave and 53rd Ave sloped down toward the south. Therefore, any water above the top of the ground elevations at the south right-of-way line will breakout and sheet flow south over private property. The length of this breakout

For summaries, see sheet 6

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JOB _____ SHEET NO. _____
MADE BY D. Schaub DATE 6/30/02 JOB NO. _____
CHECKED BY R. Beckett DATE 7/1/02 SEC SHT. NO. 2/21
CALCULATIONS FOR _____

between 51st Ave and 53rd Ave, is approximately 1360±. Therefore only flow between the right-of-way lines will flow west along Maryland Avenue and reach the intersection of Maryland Avenue and 53rd Ave.

3. Use "Flow split at intersections methodology" to determine the distribution of flows at the Maryland Ave / 53rd Ave intersection. (See back of these calculations for a copy of the methodology).

4. Flow from 53rd Drive to the North needs to be added to the flow within Maryland Ave from the east. A wall along the north property line of Sanders Chevrolet prevents the water from escaping to the South. The design flow is located just west of the Maryland Ave/53rd Dr Int.

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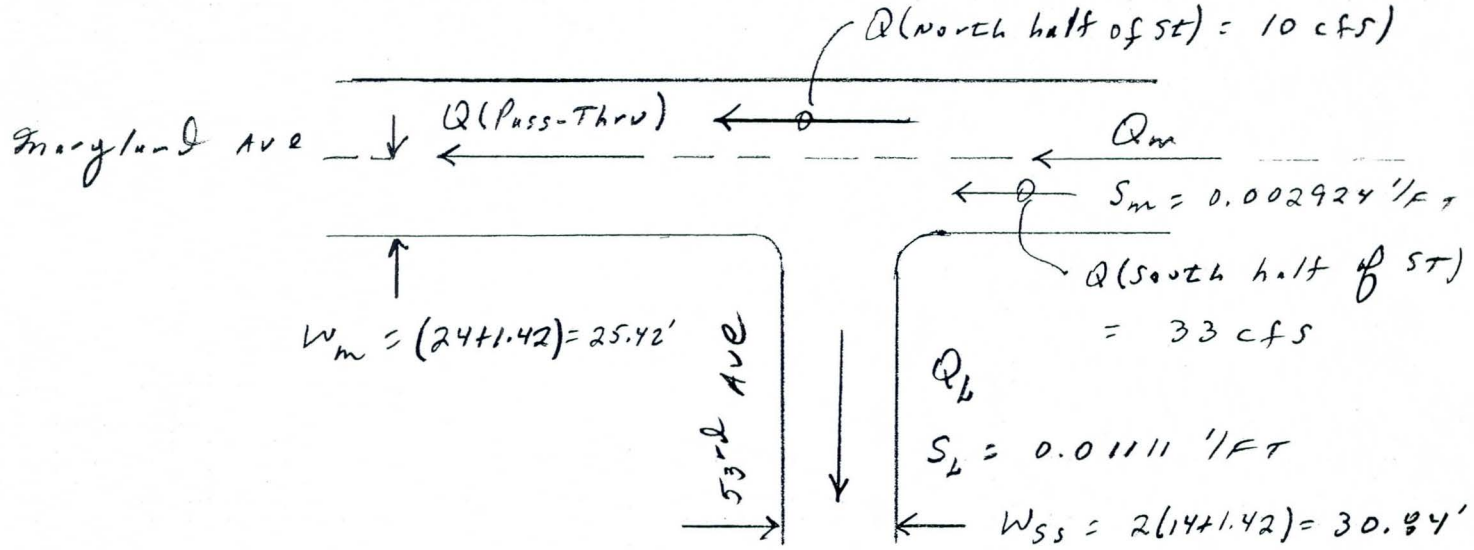
JOB _____ SHEET NO. _____
MADE BY D. Schous DATE 6/30/02 JOB NO. _____
CHECKED BY R. Beeft DATE 7/1/02 SEC SHT. NO. 2/2 1
CALCULATIONS FOR _____

Calculations:

1. Determine Flow splits at the Maryland Ave / 53rd Avenue intersection.



- NOTE: a. Ground elevations at South R/W are below the the Rdwy crown elevation along Maryland Ave. Therefore flow along the North half of Maryland Ave will pass through the intersection (Q = 10 cfs).

b. From Flowmaster, flows along the South half of Maryland Ave are distributed as 26.2 cfs (street)

and 6.8 cfs (overbank).

Lateral Flow to Side Street $Q_L = 0.042 \left[\dfrac{Q_m^{0.93} \, W_{ss}^{0.85}}{S_m^{0.41} \, W_m^{0.79}} \right]$

$$Q_L = 0.042 \left[\frac{(26.2^{0.93})(30.84)^{.85}}{(0.002924)^{.41}(25.42)^{0.79}} \right]$$

$Q_L = 13.7$ cfs

Overbank Flow to Side Street $Q_o = 46.8 \, Y_o \, W_{ss} \, S_s^{0.5} - Q_L$

$Q_o = 46.8(.27')(30.84)(0.01111)^{.5} - 13.7$ cfs

$Q_o = 27.4$ cfs $>$ 6.8 cfs (Actual overbank flow)

$\therefore Q_o = 6.8$ cfs

- Total Side Flow into 53rd Ave
  $= Q_L + Q_o = 13.7 + 6.8 = 20.5$ cfs
- Total thru flow along Maryland Ave
  $= 10$ cfs $+ (33$ cfs $- 20.5$ cfs$) = 22.5$ cfs

Note: These flow conditions exist for storms greater than a 10-year event.

Maryland Avenue (South Half) X-Section, Sta 130+71 (Looking East, East of 53rd Avenue south)
Cross Section for Irregular Channel

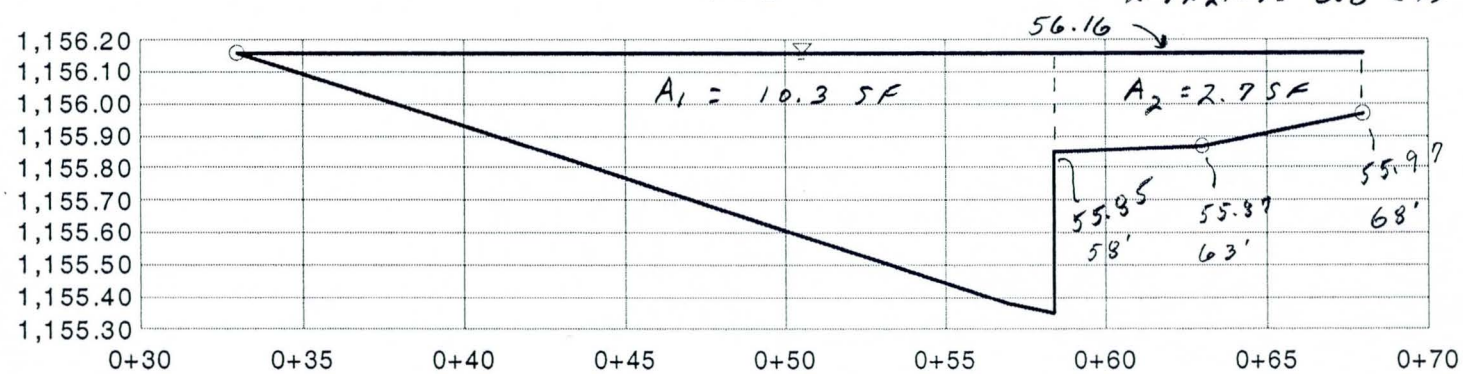
Project Description	
Worksheet	Maryland X-Section (So Half), Sta 130+71 (To East, East of 53rd Ave Soutr
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data	
Mannings Coefficient	0.016
Slope	0.002924 ft/ft
Water Surface Elevation	1,156.16 ft
Elevation Range	1,155.35 to 1,156.16
Discharge	33.00 cfs

$Q_T = Q_1 + Q_2 = 26.2 + 6.8 = 33.0 \text{ cfs} = 33.00 \text{ cfs}$ ✓

$Q_1 = A_1 V_{av}$
$= 10.3 \times 2.54 = 26.2$

$Q_2 = A_2 V_{av}$
$= 2.7 \times 2.54 = 6.8 \text{ cfs}$



$Area\ 2 = 5 \times (56.16 - 55.86) + 5(56.16 - 55.92)$
$= 2.7 \text{ S.F.}$

$AREA\ 1 = 13.0 - 2.7 = 10.3 \text{ SF}$

V:10.0
H:1
NTS

5/21

Maryland Avenue (South Half) X-Section, Sta 130+71 (Looking East, East of 53rd Avenue south)
Worksheet for Irregular Channel

Project Description	
Worksheet	Maryland X-Section (So Half), Sta 130+71 (To East, East of 53rd Ave Soutl
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Slope	0.002924	ft/ft
Discharge	33.00	cfs

Options	
Current Roughness Method	Improved Lotter's Method
Open Channel Weighting Metho	Improved Lotter's Method
Closed Channel Weighting Meth	Horton's Method

Results		
Mannings Coefficient	0.016	
Water Surface Elevation	1,156.16	ft
Elevation Range	1,155.35 to 1,156.16	
Flow Area	13.0	ft²
Wetted Perimeter	35.64	ft
Top Width	34.94	ft
Actual Depth	0.81	ft
Critical Elevation	1,156.08	ft
Critical Slope	0.005708	ft/ft
Velocity	2.54	ft/s
Velocity Head	0.10	ft
Specific Energy	1,156.26	ft
Froude Number	0.73	
Flow Type	Subcritical	

Calculation Messages:
Water elevation exceeds lowest end station by 0.18798118 ft.

Roughness Segments		
Start Station	End Station	Mannings Coefficient

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Maryland Avenue (South Half) X-Section, Sta 130+71 (Looking East, East of 53rd Avenue south)
Worksheet for Irregular Channel

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+33	0+63	0.016
0+63	0+68	0.024

Natural Channel Points	
Station (ft)	Elevation (ft)
0+33	1,156.16
0+57	1,155.38
0+58	1,155.35
0+58	1,155.85
0+63	1,155.87
0+68	1,155.97

2/2

Maryland Avenue (South Half) X-Section, Sta 130+71 (Looking East, East of 53rd Avenue South)

Rating Table for Irregular Channel

Project Description	
Worksheet	Maryland X-Section (So Half), Sta 130+71 (To East, East of 53rd Ave Soutt
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Slope	0.002924 ft/ft

Options	
Current Roughness Method	Improved Lotter's Method
Open Channel Weighting Metho	Improved Lotter's Method
Closed Channel Weighting Meth	Horton's Method

Attribute	Minimum	Maximum	Increment
Discharge (cfs)	0.00	60.00	2.00

Discharge (cfs)	Water Surface Elevation (ft)	Velocity (ft/s)	Flow Area (ft²)	Wetted Perimeter (ft)	Top Width (ft)
0.00	1,155.35	0.00	0.0	0.00	0.00
2.00	1,155.64	1.40	1.4	9.71	9.41
4.00	1,155.73	1.67	2.4	12.57	12.19
6.00	1,155.79	1.84	3.3	14.63	14.18
8.00	1,155.88	1.75	4.6	22.03	21.53
10.00	1,155.93	1.73	5.8	26.14	25.63
12.00	1,155.97	1.75	6.9	29.37	28.86
14.00	1,155.99	1.83	7.6	30.38	29.85
16.00	1,156.02	1.92	8.3	31.13	30.57
18.00	1,156.04	1.99	9.0	31.83	31.25
20.00	1,156.06	2.06	9.7	32.50	31.90
22.00	1,156.08	2.13	10.3	33.13	32.51
24.00	1,156.10	2.19	11.0	33.74	33.10
26.00	1,156.12	2.25	11.6	34.31	33.65
28.00	1,156.12	2.42	11.6	34.31	33.65
30.00	1,156.13	2.47	12.1	34.84	34.16
32.00	1,156.15	2.52	12.7	35.38	34.68

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Maryland Avenue (South Half) X-Section, Sta 130+71 (Looking East, East of 53rd Avenue south)
Rating Table for Irregular Channel

Discharge (cfs)	Water Surface Elevation (ft)	Velocity (ft/s)	Flow Area (ft^2)	Wetted Perimeter (ft)	Top Width (ft)
34.00	1,156.17	2.57	13.2	35.71	35.00
36.00	1,156.18	2.62	13.7	35.74	35.00
38.00	1,156.19	2.68	14.2	35.77	35.00
40.00	1,156.21	2.73	14.7	35.79	35.00
42.00	1,156.22	2.78	15.1	35.82	35.00
44.00	1,156.23	2.83	15.5	35.85	35.00
46.00	1,156.24	2.88	16.0	35.87	35.00
48.00	1,156.26	2.93	16.4	35.89	35.00
50.00	1,156.27	2.97	16.8	35.92	35.00
52.00	1,156.28	3.02	17.2	35.94	35.00
54.00	1,156.29	3.06	17.6	35.97	35.00
56.00	1,156.30	3.10	18.0	35.99	35.00
58.00	1,156.31	3.15	18.4	36.01	35.00
60.00	1,156.32	3.19	18.8	36.03	35.00

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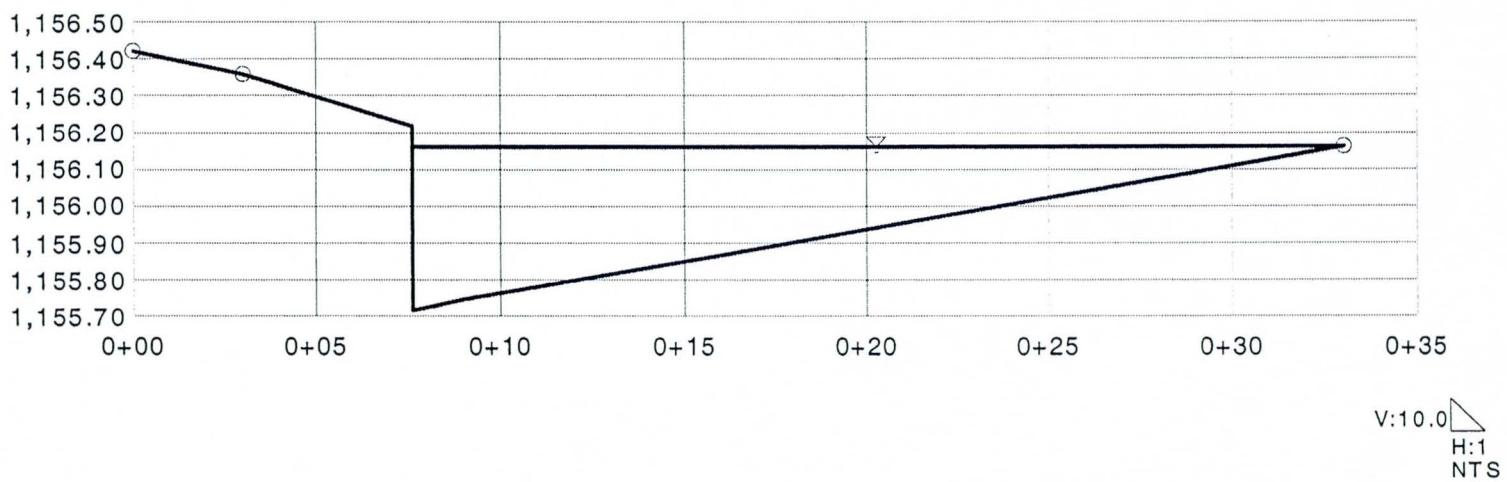
Maryland Avenue X-Section, Sta 130+71 (Looking East (North Half), East of 53rd Avenue south)
Cross Section for Irregular Channel

Project Description	
Worksheet	Maryland X-Section (North Half), Sta 130+71 (Looking East, East of 53rd Ave Soutl
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficient	0.016	
Slope	0.002924	ft/ft
Water Surface Elevation	1,156.16	ft
Elevation Range	1,155.72 to 1,156.42	
Discharge	10.00	cfs



10/21

Maryland Avenue X-Section (North Half), Sta 130+71 (Looking East, East of 53rd Avenue south)
Worksheet for Irregular Channel

Project Description	
Worksheet	Maryland X-Section (North Half), Sta 130+71 (Looking East, East of 53rd Ave Sout
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Slope	0.002924	ft/ft
Discharge	10.00	cfs

Options	
Current Roughness Method	Improved Lotter's Method
Open Channel Weighting Metho	Improved Lotter's Method
Closed Channel Weighting Meth	Horton's Method

Results		
Mannings Coefficient	0.016	
Water Surface Elevation	1,156.16	ft
Elevation Range	1,155.72 to 1,156.42	
Flow Area	5.6	ft²
Wetted Perimeter	25.87	ft
Top Width	25.42	ft
Actual Depth	0.44	ft
Critical Elevation	1,156.10	ft
Critical Slope	0.006679	ft/ft
Velocity	1.80	ft/s
Velocity Head	0.05	ft
Specific Energy	1,156.21	ft
Froude Number	0.68	
Flow Type	Subcritical	

Calculation Messages:
Water elevation exceeds lowest end station by 0.11841372e-2 ft.

Roughness Segments		
Start Station	End Station	Mannings Coefficient

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Maryland Avenue X-Section (North Half), Sta 130+71 (Looking East, East of 53rd Avenue south)
Worksheet for Irregular Channel

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+00	0+03	0.024
0+03	0+33	0.016

Natural Channel Points	
Station (ft)	Elevation (ft)
0+00	1,156.42
0+03	1,156.36
0+08	1,156.22
0+08	1,155.72
0+09	1,155.75
0+33	1,156.16

12/21

Maryland Avenue X-Section (North Half), Sta 130+71 (Looking East, East of 53rd Avenue south)
Rating Table for Irregular Channel

Project Description	
Worksheet	Maryland X-Section (North Half), Sta 130+71 (Looking East, East of 53rd Ave Soutl
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Slope	0.002924 ft/ft

Options	
Current Roughness Method	Improved Lotter's Method
Open Channel Weighting Metho	Improved Lotter's Method
Closed Channel Weighting Meth	Horton's Method

Attribute	Minimum	Maximum	Increment
Discharge (cfs)	0.00	80.00	2.00

Discharge (cfs)	Water Surface Elevation (ft)	Velocity (ft/s)	Flow Area (ft²)	Wetted Perimeter (ft)	Top Width (ft)
0.00	1,155.72	0.00	0.0	0.00	0.00
2.00	1,155.96	1.20	1.7	14.18	13.93
4.00	1,156.03	1.43	2.8	18.40	18.08
6.00	1,156.09	1.58	3.8	21.42	21.06
8.00	1,156.13	1.70	4.7	23.87	23.46
10.00	1,156.16	1.80	5.6	25.87	25.42
12.00	1,156.19	1.94	6.2	25.92	25.42
14.00	1,156.21	2.06	6.8	25.96	25.42
16.00	1,156.23	2.15	7.4	26.49	25.91
18.00	1,156.26	2.23	8.1	27.31	26.71
20.00	1,156.28	2.30	8.7	28.09	27.46
22.00	1,156.30	2.36	9.3	28.83	28.18
24.00	1,156.33	2.42	9.9	29.53	28.86
26.00	1,156.35	2.48	10.5	30.20	29.51
28.00	1,156.37	2.52	11.1	31.02	30.31
30.00	1,156.39	2.51	11.9	32.39	31.65
32.00	1,156.42	2.51	12.7	33.66	32.90

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Maryland Avenue X-Section (North Half), Sta 130+71 (Looking East, East of 53rd Avenue south)
Rating Table for Irregular Channel

Discharge (cfs)	Water Surface Elevation (ft)	Velocity (ft/s)	Flow Area (ft²)	Wetted Perimeter (ft)	Top Width (ft)
34.00	1,156.43	2.56	13.3	33.79	33.00
36.00	1,156.45	2.62	13.7	33.82	33.00
38.00	1,156.46	2.68	14.2	33.85	33.00
40.00	1,156.47	2.73	14.6	33.88	33.00
42.00	1,156.49	2.79	15.1	33.90	33.00
44.00	1,156.50	2.84	15.5	33.93	33.00
46.00	1,156.51	2.89	15.9	33.96	33.00
48.00	1,156.53	2.94	16.4	33.98	33.00
50.00	1,156.54	2.98	16.8	34.01	33.00
52.00	1,156.55	3.03	17.2	34.03	33.00
54.00	1,156.56	3.07	17.6	34.05	33.00
56.00	1,156.57	3.16	17.7	34.06	33.00
58.00	1,156.57	3.27	17.7	34.06	33.00
60.00	1,156.57	3.35	17.9	34.08	33.00
62.00	1,156.59	3.39	18.3	34.10	33.00
64.00	1,156.60	3.43	18.7	34.12	33.00
66.00	1,156.61	3.47	19.0	34.14	33.00
68.00	1,156.62	3.50	19.4	34.17	33.00
70.00	1,156.63	3.54	19.8	34.19	33.00
72.00	1,156.64	3.58	20.1	34.21	33.00
74.00	1,156.65	3.62	20.5	34.23	33.00
76.00	1,156.66	3.65	20.8	34.25	33.00
78.00	1,156.67	3.69	21.1	34.27	33.00
80.00	1,156.68	3.72	21.5	34.29	33.00

14/21

BRW Inc
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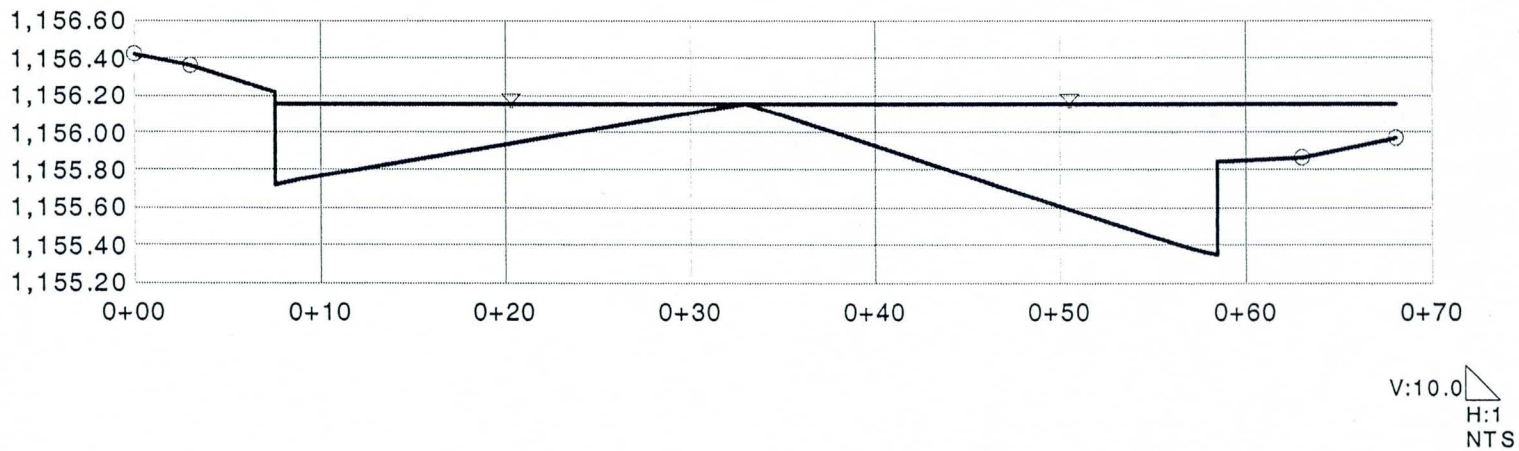
Maryland Avenue X-Section, Sta 130+71 (Looking East, East of 53rd Avenue south)
Cross Section for Irregular Channel

Project Description	
Worksheet	Maryland X-Section, Station 130+71 (Looking East, East of 53rd Ave Soutl
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficient	0.017	
Slope	0.002924	ft/ft
Water Surface Elevation	1,156.16	ft
Elevation Range	1,155.35 to 1,156.42	
Discharge	40.00	cfs



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Maryland Avenue X-Section, Sta 130+71 (Looking East, East of 53rd Avenue south)
Worksheet for Irregular Channel

Project Description	
Worksheet	Maryland X-Section, Sta 130+71 (Looking East, East of 53rd Ave Sout
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Slope	0.002924	ft/ft
Discharge	40.00	cfs

Options	
Current Roughness Method	Improved Lotter's Method
Open Channel Weighting Metho	Improved Lotter's Method
Closed Channel Weighting Meth	Horton's Method

Results		
Mannings Coefficient	0.017	
Water Surface Elevation	1,156.16	ft
Elevation Range	1,155.35 to 1,156.42	
Flow Area	18.5	ft^2
Wetted Perimeter	61.50	ft
Top Width	60.35	ft
Actual Depth	0.81	ft
Critical Elevation	1,156.08	ft
Critical Slope	0.006551	ft/ft
Velocity	2.16	ft/s
Velocity Head	0.07	ft
Specific Energy	1,156.23	ft
Froude Number	0.69	
Flow Type	Subcritical	

Calculation Messages:
Water elevation exceeds lowest end station by 0.18924052 ft.
Flow is divided.

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Maryland Avenue X-Section, Sta 130+71 (Looking East, East of 53rd Avenue south)
Worksheet for Irregular Channel

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+00	0+03	0.024
0+03	0+63	0.016
0+63	0+68	0.024

Natural Channel Points	
Station (ft)	Elevation (ft)
0+00	1,156.42
0+03	1,156.36
0+08	1,156.22
0+08	1,155.72
0+09	1,155.75
0+33	1,156.16
0+57	1,155.38
0+58	1,155.35
0+58	1,155.85
0+63	1,155.87
0+68	1,155.97

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Maryland Avenue X-Section, Sta 130+71 (Looking East, East of 53rd Avenue south)
Rating Table for Irregular Channel

Project Description	
Worksheet	Maryland X-Section, Sta 130+71 (Looking East, East of 53rd Ave Sout
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Slope	0.002924 ft/ft

Options	
Current Roughness Method	Improved Lotter's Method
Open Channel Weighting Metho	Improved Lotter's Method
Closed Channel Weighting Meth	Horton's Method

Attribute	Minimum	Maximum	Increment
Discharge (cfs)	0.00	80.00	2.00

Discharge (cfs)	Water Surface Elevation (ft)	Velocity (ft/s)	Flow Area (ft²)	Wetted Perimeter (ft)	Top Width (ft)
0.00	1,155.35	0.00	0.0	0.00	0.00
2.00	1,155.64	1.40	1.4	9.71	9.41
4.00	1,155.73	1.62	2.5	13.44	13.03
6.00	1,155.81	1.62	3.7	20.21	19.65
8.00	1,155.88	1.53	5.2	30.96	30.29
10.00	1,155.91	1.54	6.5	36.28	35.57
12.00	1,155.94	1.62	7.4	39.69	38.96
14.00	1,155.97	1.64	8.5	43.60	42.84
16.00	1,155.99	1.70	9.4	45.67	44.88
18.00	1,156.00	1.76	10.3	47.33	46.50
20.00	1,156.02	1.81	11.1	48.88	48.01
22.00	1,156.04	1.83	12.1	50.74	49.83
24.00	1,156.06	1.87	12.8	52.14	51.20
26.00	1,156.07	1.91	13.6	53.48	52.51
28.00	1,156.09	1.95	14.3	54.76	53.76
30.00	1,156.10	1.99	15.1	55.98	54.96
32.00	1,156.11	2.03	15.8	57.17	56.11

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Maryland Avenue X-Section, Sta 130+71 (Looking East, East of 53rd Avenue south)
Rating Table for Irregular Channel

Discharge (cfs)	Water Surface Elevation (ft)	Velocity (ft/s)	Flow Area (ft^2)	Wetted Perimeter (ft)	Top Width (ft)
34.00	1,156.12	2.06	16.5	58.30	57.23
36.00	1,156.14	2.10	17.2	59.40	58.30
38.00	1,156.15	2.13	17.9	60.47	59.34
40.00	1,156.16	2.16	18.5	61.50	60.35
42.00	1,156.16	2.24	18.8	61.57	60.42
44.00	1,156.17	2.28	19.3	61.59	60.42
46.00	1,156.18	2.32	19.8	61.61	60.42
48.00	1,156.19	2.36	20.3	61.63	60.42
50.00	1,156.20	2.40	20.9	61.64	60.42
52.00	1,156.21	2.44	21.4	61.66	60.42
54.00	1,156.21	2.47	21.8	61.68	60.42
56.00	1,156.22	2.51	22.3	61.76	60.49
58.00	1,156.23	2.54	22.9	62.05	60.77
60.00	1,156.24	2.57	23.4	62.34	61.05
62.00	1,156.25	2.59	23.9	62.62	61.33
64.00	1,156.26	2.62	24.4	62.90	61.60
66.00	1,156.26	2.65	24.9	63.18	61.86
68.00	1,156.27	2.68	25.4	63.45	62.12
70.00	1,156.28	2.70	25.9	63.71	62.38
72.00	1,156.29	2.73	26.4	63.98	62.64
74.00	1,156.30	2.75	26.9	64.24	62.89
76.00	1,156.30	2.78	27.4	64.49	63.14
78.00	1,156.31	2.80	27.8	64.75	63.39
80.00	1,156.32	2.83	28.3	65.00	63.63

19/21

Maryland Avenue X-Section, Sta 130+71 (Looking East, East of 53rd Avenue south)
Rating Table for Irregular Channel

Project Description	
Worksheet	Maryland X-Section, Sta 130+71 (Looking East, East of 53rd Ave Sout
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Slope	0.002924 ft/ft

Options	
Current Roughness Method	Improved Lotter's Method
Open Channel Weighting Metho	Improved Lotter's Method
Closed Channel Weighting Meth	Horton's Method

Attribute	Minimum	Maximum	Increment
Discharge (cfs)	0.00	200.00	5.00

Discharge (cfs)	Water Surface Elevation (ft)	Velocity (ft/s)	Flow Area (ft²)	Wetted Perimeter (ft)	Top Width (ft)
0.00	1,155.35	0.00	0.0	0.00	0.00
5.00	1,155.78	1.60	3.1	17.27	16.78
10.00	1,155.91	1.54	6.5	36.28	35.57
15.00	1,155.98	1.67	9.0	44.80	44.03
20.00	1,156.02	1.81	11.1	48.88	48.01
25.00	1,156.06	1.89	13.2	52.82	51.87
30.00	1,156.10	1.99	15.1	55.98	54.96
35.00	1,156.13	2.08	16.8	58.86	57.77
40.00	1,156.16	2.16	18.5	61.50	60.35
45.00	1,156.18	2.30	19.6	61.60	60.42
50.00	1,156.20	2.40	20.9	61.64	60.42
55.00	1,156.22	2.49	22.1	61.68	60.42
60.00	1,156.24	2.57	23.4	62.34	61.05
65.00	1,156.26	2.64	24.7	63.04	61.73
70.00	1,156.28	2.70	25.9	63.71	62.38
75.00	1,156.30	2.77	27.1	64.37	63.02
80.00	1,156.32	2.83	28.3	65.00	63.63

20/21

Maryland Avenue X-Section, Sta 130+71 (Looking East, East of 53rd Avenue south)
Rating Table for Irregular Channel

Discharge (cfs)	Water Surface Elevation (ft)	Velocity (ft/s)	Flow Area (ft²)	Wetted Perimeter (ft)	Top Width (ft)
85.00	1,156.34	2.88	29.5	65.61	64.23
90.00	1,156.35	2.94	30.6	66.21	64.81
95.00	1,156.37	2.98	31.9	67.14	65.71
100.00	1,156.40	3.00	33.3	68.20	66.76
105.00	1,156.41	3.07	34.2	68.89	67.43
110.00	1,156.42	3.17	34.8	69.30	67.83
115.00	1,156.43	3.21	35.8	69.49	68.00
120.00	1,156.45	3.26	36.8	69.52	68.00
125.00	1,156.46	3.31	37.7	69.55	68.00
130.00	1,156.47	3.36	38.7	69.58	68.00
135.00	1,156.49	3.41	39.6	69.61	68.00
140.00	1,156.50	3.46	40.5	69.63	68.00
145.00	1,156.51	3.50	41.4	69.66	68.00
150.00	1,156.52	3.57	42.0	69.68	68.00
155.00	1,156.54	3.61	42.9	69.70	68.00
160.00	1,156.55	3.66	43.7	69.73	68.00
165.00	1,156.56	3.70	44.6	69.75	68.00
170.00	1,156.57	3.74	45.4	69.78	68.00
175.00	1,156.59	3.79	46.2	69.80	68.00
180.00	1,156.60	3.83	47.0	69.83	68.00
185.00	1,156.61	3.87	47.8	69.85	68.00
190.00	1,156.62	3.91	48.6	69.87	68.00
195.00	1,156.63	3.95	49.4	69.90	68.00
200.00	1,156.64	3.98	50.2	69.92	68.00

21/21

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Culvert Calculator Report
Maryland Ave, Sta 104+00, 2-10'x4' CBC

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	1,160.00	ft	Headwater Depth/ Height	1.76	
Computed Headwater Elevation	1,155.29	ft	Discharge	146.00	cfs
Inlet Control HW Elev	1,155.20	ft	Tailwater Elevation	1,155.20	ft ← W.S. Elev Exst. Maryland STA 119+55
Outlet Control HW Elev	1,155.29	ft	Control Type	Outlet Control	

Grades					
Upstream Invert	1,148.25	ft	Downstream Invert	1,147.50	ft
Length	106.40	ft	Constructed Slope	0.007049	ft/ft

Hydraulic Profile					
Profile	Pressure		Depth, Downstream	7.70	ft
Slope Type	N/A		Normal Depth	0.91	ft
Flow Regime	N/A		Critical Depth	1.18	ft
Velocity Downstream	1.82	ft/s	Critical Slope	0.003091	ft/ft

Section					
Section Shape	Box		Mannings Coefficient	0.013	
Section Material	Concrete		Span	10.00	ft
Section Size	10 x 4 ft		Rise	4.00	ft
Number Sections	2				

Outlet Control Properties					
Outlet Control HW Elev	1,155.29	ft	Upstream Velocity Head	0.05	ft
Ke	0.40		Entrance Loss	0.02	ft

Inlet Control Properties					
Inlet Control HW Elev	1,155.20	ft	Flow Control	Unsubmerged	
Inlet Type	45 ° wingwall flare, d=0.0430		Area Full	80.0	ft²
K	0.51000		HDS 5 Chart	9	
M	0.66700		HDS 5 Scale	1	
C	0.03090		Equation Form	2	
Y	0.80000				

Culvert Calculator Report
Sierra Vista Dr, Sta 78+72, 1-8'x3' CBC

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	1,160.00	ft	Headwater Depth/ Height	0.91	
Computed Headwater Elevation	1,155.66	ft	Discharge	83.00	cfs
Inlet Control HW Elev	1,155.29	ft	Tailwater Elevation	1,155.29	ft ← HW (2-10'x4' CBC)
Outlet Control HW Elev	1,155.66	ft	Control Type	Outlet Control	

Grades					
Upstream Invert	1,152.00	ft	Downstream Invert	1,149.00	ft
Length	101.30	ft	Constructed Slope	0.029615	ft/ft

Hydraulic Profile					
Profile	CompositePressureS1		Depth, Downstream	6.29	ft
Slope Type	N/A		Normal Depth	0.90	ft
Flow Regime	Subcritical		Critical Depth	1.81	ft
Velocity Downstream	3.46	ft/s	Critical Slope	0.003793	ft/ft

Section					
Section Shape	Box		Mannings Coefficient	0.013	
Section Material	Concrete		Span	6.00	ft
Section Size	6 x 4 ft ≃ 8'x3' CBC		Rise	4.00	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev	1,155.66	ft	Upstream Velocity Head	0.28	ft
Ke	0.40		Entrance Loss	0.11	ft

Inlet Control Properties					
Inlet Control HW Elev	1,155.29	ft	Flow Control	Unsubmerged	
Inlet Type45 ° bevels; 10 - 45 ° skewed headwall			Area Full	24.0	ft²
K	0.49800		HDS 5 Chart	11	
M	0.66700		HDS 5 Scale	4	
C	0.03270		Equation Form	2	
Y	0.75000				

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```
                    HEC-RAS Version 3.0.1  Mar 2001
                      U.S. Army Corp of Engineers
                     Hydrologic Engineering Center
                       609 Second Street, Suite D
                      Davis, California 95616-4687
                            (916) 756-1104

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

*******************************************************************************

PROJECT DATA
Project Title: Grand Ave @ 55th Ave & Maryland Ave
Project File : NSV.prj
Run Date and Time: 9/29/02 9:33:58 PM

Project in English units

Project Description:
Proposed 54th Ave/Sierra Vista Intersection

*******************************************************************************

PLAN DATA

Plan Title: Proposed Construction
Plan File : r:\11344239\Drn\HEC-RAS\NSV.p01

          Geometry Title: Proposed 54th Ave/Sierra Vista Dr
          Geometry File : r:\11344239\Drn\HEC-RAS\NSV.g01

          Flow Title    : Q100 = 63 cfs
          Flow File     : r:\11344239\Drn\HEC-RAS\NSV.f01

Plan Summary Information:
Number of:  Cross Sections =    7    Mulitple Openings =    0
            Culverts       =    0    Inline Weirs      =    0
            Bridges        =    0

Computational Information
    Water surface calculation tolerance =  0.003
    Critical depth calculaton tolerance =  0.003
```

```
    Maximum number of interations        =  20
    Maximum difference tolerance         =  0.1
    Flow tolerance factor                =  0.001

Computation Options
    Critical depth computed only where necessary
    Conveyance Calculation Method: At breaks in n values only
    Friction Slope Method:         Average Conveyance
    Computational Flow Regime:     Subcritical Flow


*******************************************************************************

FLOW DATA

Flow Title: Q100 = 63 cfs
Flow File : r:\11344239\Drn\HEC-RAS\NSV.f01

Flow Data (cfs)
*************************************************************
* River           Reach           RS      *            PF 1 *
* 1               54th Ave        7       *              63 *
* 1               54th Ave        6       *            48.7 *
* 1               54th Ave        5       *            37.3 *
*************************************************************

Boundary Conditions
*****************************************************************************************************
* River           Reach           Profile          *            Upstream                Downstream    *
*****************************************************************************************************
* 1               54th Ave        PF 1             *          Normal S = .015       Known WS = 1155.29 *
*****************************************************************************************************

*******************************************************************************

GEOMETRY DATA

Geometry Title: Proposed 54th Ave/Sierra Vista Dr
Geometry File : r:\11344239\Drn\HEC-RAS\NSV.g01

CROSS SECTION           RIVER: 1
REACH: 54th Ave            RS: 7

INPUT
Description: Sta 52+75, 54th Ave Rdwy X-Section, 62.0 cfs
Station Elevation Data    num=      14
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
*******************************************************************************
       0  1155.5      12  1155.6    13.5    1156      19 1155.94    19.1 1155.44
    20.5  1155.6    40.5 1155.15      56  1155.5    60.5  1155.6    61.9  1155.4
      62  1155.9      63 1155.91    64.5 1155.45      80    1155
```

← HW (2-10'x4' CBC)

```
Manning's n Values          num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
**********************************************
       0    .024    13.5    .016      63    .024

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          13.5      63               82      75      60             .1       .3
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
888        F
888        F

CROSS SECTION OUTPUT    Profile #PF 1
*************************************************************************************************
* E.G. Elev (ft)          * 1155.99  * Element                 *  Left OB *  Channel * Right OB *
* Vel Head (ft)           *    0.21  * Wt. n-Val.              *          *    0.016 *          *
* W.S. Elev (ft)          * 1155.79  * Reach Len. (ft)         *   82.00  *    75.00 *   60.00  *
* Crit W.S. (ft)          * 1155.79  * Flow Area (sq ft)       *          *    17.18 *          *
* E.G. Slope (ft/ft)      *0.005399  * Area (sq ft)            *    2.88  *    17.18 *    8.86  *
* Q Total (cfs)           *   63.00  * Flow (cfs)               *          *    63.00 *          *
* Top Width (ft)          *   72.23  * Top Width (ft)           *   12.69  *    42.95 *   16.59  *
* Vel Total (ft/s)        *    3.67  * Avg. Vel. (ft/s)         *          *     3.67 *          *
* Max Chl Dpth (ft)       *    0.78  * Hydr. Depth (ft)         *          *     0.40 *          *
* Conv. Total (cfs)       *   857.4  * Conv. (cfs)              *          *    857.4 *          *
* Length Wtd. (ft)        *   75.17  * Wetted Per. (ft)         *          *    43.58 *          *
* Min Ch El (ft)          * 1155.15  * Shear (lb/sq ft)         *          *     0.13 *          *
* Alpha                   *    1.00  * Stream Power (lb/ft s)   *          *     0.49 *          *
* Frctn Loss (ft)         *    0.17  * Cum Volume (acre-ft)     *    0.01  *     0.61 *    0.05  *
* C & E Loss (ft)         *    0.05  * Cum SA (acres)           *    0.04  *     0.59 *    0.13  *
*************************************************************************************************

Warning: The energy equation could not be balanced within the specified number of iterations.  The
         program used critical depth for the water surface and continued on with the calculations.
Warning: Divided flow computed for this cross-section.
Warning: The cross-section end points had to be extended vertically for the computed water surface.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less
         than 0.7 or greater than 1.4.  This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to
         critical depth, the calculated water surface came back below critical depth.  This indicates
         that there is not a valid subcritical answer.  The program defaulted to critical depth.
Warning: The parabolic search method failed to converge on critical depth.  The program will try the
         cross section slice/secant method to find critical depth.
Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid,
         water surface was used.

CROSS SECTION          RIVER: 1
REACH: 54th Ave           RS: 6

INPUT
Description: Sta 52+00, 54th Ave Rdwy X-Section, Skewed, 48.7 cfs, CB25 US
Station Elevation Data    num=      16
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
```

```
*********************************************************************************
       0  1156.5       2  1156.5    17.5 1155.46    19.6 1155.15      32 1155.06
    33.5 1155.06    39.5    1155    39.6  1154.5      41 1154.56      61 1154.96
      81 1154.56    82.4  1154.5    82.5    1155    83.5 1155.01    84.5 1154.55
     111  1154.8

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
***********************************************
       0    .024    39.5    .016    83.5    .024

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          39.5    83.5               35      50      35            .1        .3
Ineffective Flow     num=       1
   Sta L   Sta R    Elev  Permanent
888        F

CROSS SECTION OUTPUT    Profile #PF 1
*************************************************************************************************
* E.G. Elev (ft)         * 1155.34  * Element                 *  Left OB *  Channel * Right OB *
* Vel Head (ft)          *    0.06  * Wt. n-Val.              *   0.024  *   0.016  *          *
* W.S. Elev (ft)         * 1155.28  * Reach Len. (ft)        *   35.00  *   50.00  *   35.00  *
* Crit W.S. (ft)         * 1155.09  * Flow Area (sq ft)      *    4.08  *   23.32  *          *
* E.G. Slope (ft/ft)     *0.001073  * Area (sq ft)           *    4.08  *   23.32  *   16.56  *
* Q Total (cfs)          *   48.70  * Flow (cfs)              *    2.79  *   45.91  *          *
* Top Width (ft)         *   92.29  * Top Width (ft)         *   20.79  *   44.00  *   27.50  *
* Vel Total (ft/s)       *    1.78  * Avg. Vel. (ft/s)       *    0.68  *    1.97  *          *
* Max Chl Dpth (ft)      *    0.78  * Hydr. Depth (ft)       *    0.20  *    0.53  *          *
* Conv. Total (cfs)      *  1486.5  * Conv. (cfs)            *    85.2  *  1401.3  *          *
* Length Wtd. (ft)       *   49.03  * Wetted Per. (ft)       *   20.80  *   44.83  *          *
* Min Ch El (ft)         * 1154.50  * Shear (lb/sq ft)       *    0.01  *    0.03  *          *
* Alpha                  *    1.16  * Stream Power (lb/ft s) *    0.01  *    0.07  *          *
* Frctn Loss (ft)        *    0.02  * Cum Volume (acre-ft)   *    0.00  *    0.58  *    0.04  *
* C & E Loss (ft)        *    0.01  * Cum SA (acres)         *    0.01  *    0.51  *    0.10  *
*************************************************************************************************

Warning: The cross-section end points had to be extended vertically for the computed water surface.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less
         than 0.7 or greater than 1.4.  This may indicate the need for additional cross sections.

CROSS SECTION          RIVER: 1
REACH: 54th Ave           RS: 5

INPUT
Description: Sta 51+58, 54th Ave Rdwy X-Section, Skewed, 37.3 cfs, CB26 US
Station Elevation Data    num=      21
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
*********************************************************************************
       0  1155.8      26 1155.89    30.5 1155.84    30.6 1155.34      32  1155.4
    60.6  1155.4      62 1155.34    62.1 1155.84    98.1 1155.42    98.2 1154.98
    99.6 1155.04   107.9 1154.86   116.6 1154.68     126 1154.48     133 1154.33
   146.1 1154.06   147.5    1154   147.6  1154.5   152.5 1154.55   153.9    1155
```

```
   181.2    1155

Manning's n Values        num=       5
     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val
*******************************************************************************
       0    .024      26    .016      62    .024    98.1    .016   152.5    .024

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
            26   152.5               52      40      19             .1       .3

CROSS SECTION OUTPUT    Profile #PF 1
*********************************************************************************************
* E.G. Elev (ft)         * 1155.31  * Element                 *  Left OB *  Channel * Right OB *
* Vel Head (ft)          *    0.01  * Wt. n-Val.              *          *   0.016  *   0.024  *
* W.S. Elev (ft)         * 1155.30  * Reach Len. (ft)         *   52.00  *   40.00  *   19.00  *
* Crit W.S. (ft)         *          * Flow Area (sq ft)       *          *   41.03  *    8.87  *
* E.G. Slope (ft/ft)     *0.000122  * Area (sq ft)            *          *   41.03  *    8.87  *
* Q Total (cfs)          *   37.30  * Flow (cfs)               *          *   34.55  *    2.75  *
* Top Width (ft)         *   83.07  * Top Width (ft)           *          *   54.37  *   28.70  *
* Vel Total (ft/s)       *    0.75  * Avg. Vel. (ft/s)         *          *    0.84  *    0.31  *
* Max Chl Dpth (ft)      *    1.30  * Hydr. Depth (ft)         *          *    0.75  *    0.31  *
* Conv. Total (cfs)      *  3380.9  * Conv. (cfs)              *          *  3131.8  *   249.1  *
* Length Wtd. (ft)       *   38.35  * Wetted Per. (ft)         *          *   55.05  *   29.07  *
* Min Ch El (ft)         * 1154.00  * Shear (lb/sq ft)         *          *    0.01  *    0.00  *
* Alpha                  *    1.19  * Stream Power (lb/ft s)   *          *    0.00  *    0.00  *
* Frctn Loss (ft)        *    0.01  * Cum Volume (acre-ft)     *          *    0.54  *    0.03  *
* C & E Loss (ft)        *    0.00  * Cum SA (acres)           *          *    0.46  *    0.08  *
*********************************************************************************************

Warning: The cross-section end points had to be extended vertically for the computed water surface.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less
         than 0.7 or greater than 1.4.  This may indicate the need for additional cross sections.

CROSS SECTION          RIVER: 1
REACH: 54th Ave           RS: 4

INPUT
Description: Sta 77+91, Sierra Vista Dr Rdwy X-Section, Skewed, 37.3 cfs
Station Elevation Data    num=      12
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
*******************************************************************************
       0 1155.48     7.5 1155.25    14.5    1155      22 1154.75      32  1154.5
    44.5 1154.25    46.9  1154.2    48.3 1154.14    48.4 1154.54      56  1154.6
    61.5    1155    75.5    1155

Manning's n Values        num=       2
     Sta   n Val     Sta   n Val
*******************************
       0    .016      56    .024

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0      56               19      10       5             .1       .3
```

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	1155.30	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.02	Wt. n-Val.		0.016	0.024
W.S. Elev (ft)	1155.29	Reach Len. (ft)	19.00	10.00	5.00
Crit W.S. (ft)		Flow Area (sq ft)		31.87	6.68
E.G. Slope (ft/ft)	0.000243	Area (sq ft)		31.87	6.68
Q Total (cfs)	37.30	Flow (cfs)		34.18	3.12
Top Width (ft)	69.17	Top Width (ft)		49.67	19.50
Vel Total (ft/s)	0.97	Avg. Vel. (ft/s)		1.07	0.47
Max Chl Dpth (ft)	1.15	Hydr. Depth (ft)		0.64	0.34
Conv. Total (cfs)	2392.7	Conv. (cfs)		2192.4	200.3
Length Wtd. (ft)	9.51	Wetted Per. (ft)		50.00	19.80
Min Ch El (ft)	1154.14	Shear (lb/sq ft)		0.01	0.01
Alpha	1.14	Stream Power (lb/ft s)		0.01	0.00
Frctn Loss (ft)	0.00	Cum Volume (acre-ft)		0.51	0.02
C & E Loss (ft)	0.00	Cum SA (acres)		0.41	0.07

Warning: The cross-section end points had to be extended vertically for the computed water surface.

CROSS SECTION RIVER: 1
REACH: 54th Ave RS: 3

INPUT
Description: Sta 77+72, Sierra Vista Drive Rdwy X-Section, Skewed, 37.3 cfs
Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1155.73	2	1155.71	2.1	1155.21	3.5	1155.27	34	1155.08
35	1155.05	40.5	1154.9	49.5	1154.65	61	1154.34	65.9	1154.2
67.3	1154.14	67.4	1154.64	74.5	1154.71	80	1155	95	1155

Manning's n Values num= 2

Sta	n Val	Sta	n Val
0	.016	74.5	.024

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	74.5	37	24	10	.1	.3

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	1155.30	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.02	Wt. n-Val.		0.016	0.024
W.S. Elev (ft)	1155.28	Reach Len. (ft)	37.00	24.00	10.00
Crit W.S. (ft)		Flow Area (sq ft)		29.91	6.62
E.G. Slope (ft/ft)	0.000467	Area (sq ft)		29.91	6.62
Q Total (cfs)	37.30	Flow (cfs)		33.17	4.13
Top Width (ft)	92.91	Top Width (ft)		72.41	20.50
Vel Total (ft/s)	1.02	Avg. Vel. (ft/s)		1.11	0.62

Max Chl Dpth (ft)	1.14	Hydr. Depth (ft)		0.41	0.32	
Conv. Total (cfs)	1725.4	Conv. (cfs)		1534.1	191.3	
Length Wtd. (ft)	22.94	Wetted Per. (ft)		72.90	20.79	
Min Ch El (ft)	1154.14	Shear (lb/sq ft)		0.01	0.01	
Alpha	1.09	Stream Power (lb/ft s)		0.01	0.01	
Frctn Loss (ft)	0.00	Cum Volume (acre-ft)		0.50	0.02	
C & E Loss (ft)	0.00	Cum SA (acres)		0.39	0.07	

Warning: The cross-section end points had to be extended vertically for the computed water surface.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

CROSS SECTION RIVER: 1
REACH: 54th Ave RS: 2

INPUT
Description: Sta 77+44, Sierra Vista Drive Rdwy X-Section, 37.3 cfs
Station Elevation Data num= 14

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1154.54	2	1154.52	2.1	1154.02	3.5	1154.08	7	1154.15
19	1154.4	28.2	1154.59	35.9	1154.44	52.5	1154.11	53.9	1154.05
54	1154.55	60	1154.61	64	1155	82	1155		

Manning's n Values num= 2

Sta	n Val	Sta	n Val
0	.016	60	.024

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	60	0	75	240	.1	.3

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	1155.29	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.01	Wt. n-Val.		0.016	0.024
W.S. Elev (ft)	1155.29	Reach Len. (ft)	0.00	75.00	240.00
Crit W.S. (ft)		Flow Area (sq ft)		55.66	7.10
E.G. Slope (ft/ft)	0.000055	Area (sq ft)		55.66	7.10
Q Total (cfs)	37.30	Flow (cfs)		35.78	1.52
Top Width (ft)	82.00	Top Width (ft)		60.00	22.00
Vel Total (ft/s)	0.59	Avg. Vel. (ft/s)		0.64	0.21
Max Chl Dpth (ft)	1.27	Hydr. Depth (ft)		0.93	0.32
Conv. Total (cfs)	5037.2	Conv. (cfs)		4832.5	204.8
Length Wtd. (ft)	78.35	Wetted Per. (ft)		61.58	22.31
Min Ch El (ft)	1154.02	Shear (lb/sq ft)		0.00	0.00
Alpha	1.13	Stream Power (lb/ft s)		0.00	0.00
Frctn Loss (ft)	0.00	Cum Volume (acre-ft)		0.48	0.02
C & E Loss (ft)	0.00	Cum SA (acres)		0.36	0.06

```
Warning: The cross-section end points had to be extended vertically for the computed water surface.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less
         than 0.7 or greater than 1.4.  This may indicate the need for additional cross sections.

CROSS SECTION          RIVER: 1
REACH: 54th Ave           RS: 1

INPUT
Description: So. Pav't Edge of Sierra Vista Dr, 37.3 cfs, CB 23 & 24 in Sump
Station Elevation Data    num=      16
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
*******************************************************************************
       0  1154.9     2.5 1154.24    42.5 1153.78      64  1153.5      84  1153.4
   105.5 1153.42   130.5 1153.53   155.5 1153.64   180.5 1153.77   205.5 1153.87
   230.5 1153.97     255 1154.07   280.5 1154.17   305.5 1154.27   330.5 1154.35
   355.5 1154.37

Manning's n Values        num=       1
     Sta   n Val
****************
       0    .016

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0   355.5                 0       0       0             .1       .3

CROSS SECTION OUTPUT    Profile #PF 1
*********************************************************************************************
* E.G. Elev (ft)         * 1155.29  * Element                 *  Left OB *  Channel * Right OB *
* Vel Head (ft)          *    0.00  * Wt. n-Val.              *          *   0.016  *          *
* W.S. Elev (ft)         * 1155.29  * Reach Len. (ft)         *          *          *          *
* Crit W.S. (ft)         * 1153.65  * Flow Area (sq ft)       *          *  499.78  *          *
* E.G. Slope (ft/ft)     *0.000000  * Area (sq ft)            *          *  499.78  *          *
* Q Total (cfs)          *   37.30  * Flow (cfs)              *          *   37.30  *          *
* Top Width (ft)         *  355.50  * Top Width (ft)          *          *  355.50  *          *
* Vel Total (ft/s)       *    0.07  * Avg. Vel. (ft/s)        *          *    0.07  *          *
* Max Chl Dpth (ft)      *    1.89  * Hydr. Depth (ft)        *          *    1.41  *          *
* Conv. Total (cfs)      * 58095.5  * Conv. (cfs)             *          * 58095.5  *          *
* Length Wtd. (ft)       *          * Wetted Per. (ft)        *          *  356.90  *          *
* Min Ch El (ft)         * 1153.40  * Shear (lb/sq ft)        *          *    0.00  *          *
* Alpha                  *    1.00  * Stream Power (lb/ft s)  *          *    0.00  *          *
* Frctn Loss (ft)        *          * Cum Volume (acre-ft)    *          *          *          *
* C & E Loss (ft)        *          * Cum SA (acres)          *          *          *          *
*********************************************************************************************

*****************************************************************************

SUMMARY OF MANNING'S N VALUES

River:1
*******************************************************************************
*     Reach      *  River Sta.   *   n1    *   n2    *   n3    *   n4    *   n5    *
*******************************************************************************
```

54th Ave	7	.024	.016	.024			
54th Ave	6	.024	.016	.024			
54th Ave	5	.024	.016	.024	.016	.024	
54th Ave	4	.016	.024				
54th Ave	3	.016	.024				
54th Ave	2	.016	.024				
54th Ave	1	.016					

SUMMARY OF REACH LENGTHS

River: 1

Reach	River Sta.	Left	Channel	Right
54th Ave	7	82	75	60
54th Ave	6	35	50	35
54th Ave	5	52	40	19
54th Ave	4	19	10	5
54th Ave	3	37	24	10
54th Ave	2	0	75	240
54th Ave	1	0	0	0

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: 1

Reach	River Sta.	Contr.	Expan.
54th Ave	7	.1	.3
54th Ave	6	.1	.3
54th Ave	5	.1	.3
54th Ave	4	.1	.3
54th Ave	3	.1	.3
54th Ave	2	.1	.3
54th Ave	1	.1	.3

Profile Output Table - Standard Table 1

Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	

54th Ave	7		63.00	1155.15	1155.79	1155.79	1155.99	0.005399	3.67	17.18	72.23
54th Ave	6		48.70	1154.50	1155.28	1155.09	1155.34	0.001073	1.97	27.40	92.29
54th Ave	5		37.30	1154.00	1155.30		1155.31	0.000122	0.84	49.90	83.07
54th Ave	4		37.30	1154.14	1155.29		1155.30	0.000243	1.07	38.55	69.17
54th Ave	3		37.30	1154.14	1155.28		1155.30	0.000467	1.11	36.54	92.91
54th Ave	2		37.30	1154.02	1155.29		1155.29	0.000055	0.64	62.76	82.00
54th Ave	1		37.30	1153.40	1155.29	1153.65	1155.29	0.000000	0.07	499.78	355.50

Profile Output Table - Standard Table 2

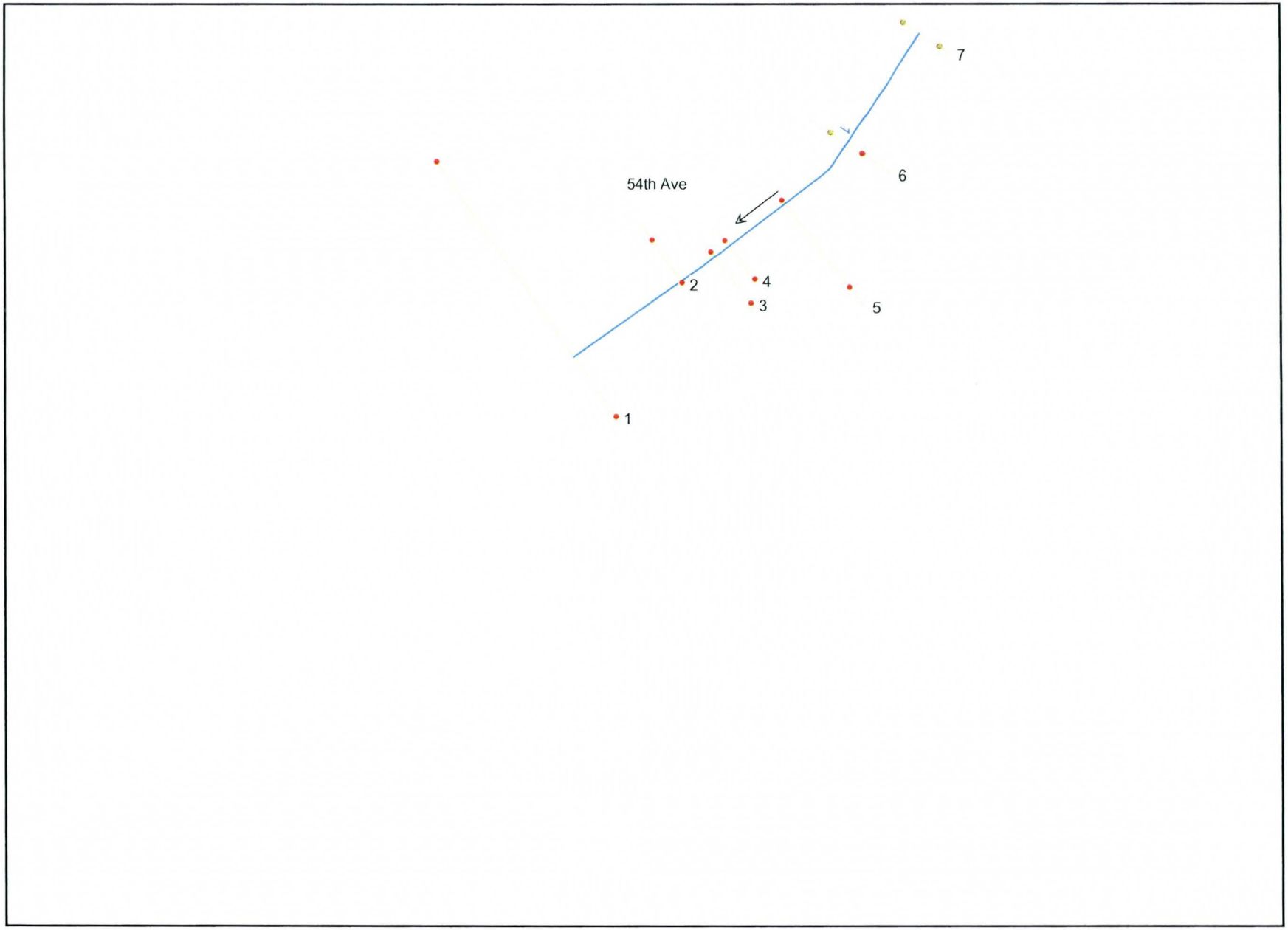
Reach	River Sta		E.G. Elev (ft)	W.S. Elev (ft)	Vel Head (ft)	Frctn Loss (ft)	C & E Loss (ft)	Q Left (cfs)	Q Channel (cfs)	Q Right (cfs)	Top Width (ft)
54th Ave	7		1155.99	1155.79	0.21	0.17	0.05		63.00		72.23
54th Ave	6		1155.34	1155.28	0.06	0.02	0.01	2.79	45.91		92.29
54th Ave	5		1155.31	1155.30	0.01	0.01	0.00		34.55	2.75	83.07
54th Ave	4		1155.30	1155.29	0.02	0.00	0.00		34.18	3.12	69.17
54th Ave	3		1155.30	1155.28	0.02	0.00	0.00		33.17	4.13	92.91
54th Ave	2		1155.29	1155.29	0.01	0.00	0.00		35.78	1.52	82.00
54th Ave	1		1155.29	1155.29	0.00				37.30		355.50

HEC-RAS Plan: Plan 01 River: 1 Reach: 54th Ave Profile: PF 1

Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
54th Ave	7	63.00	1155.15	1155.79	1155.79	1155.99	0.005399	3.67	17.18	72.23	1.02
54th Ave	6	48.70	1154.50	1155.28	1155.09	1155.34	0.001073	1.97	27.40	92.29	0.48
54th Ave	5	37.30	1154.00	1155.30		1155.31	0.000122	0.84	49.90	83.07	0.17
54th Ave	4	37.30	1154.14	1155.29		1155.30	0.000243	1.07	38.55	69.17	0.24
54th Ave	3	37.30	1154.14	1155.28		1155.30	0.000467	1.11	36.54	92.91	0.30
54th Ave	2	37.30	1154.02	1155.29		1155.29	0.000055	0.64	62.76	82.00	0.12
54th Ave	1	37.30	1153.40	1155.29	1153.65	1155.29	0.000000	0.07	499.78	355.50	0.01

HEC-RAS Plan: Plan 01 River: 1 Reach: 54th Ave Profile: PF 1

Reach	River Sta	E.G. Elev	W.S. Elev	Vel Head	Frctn Loss	C & E Loss	Q Left	Q Channel	Q Right	Top Width
		(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)
54th Ave	7	1155.99	1155.79	0.21	0.17	0.05		63.00		72.23
54th Ave	6	1155.34	1155.28	0.06	0.02	0.01	2.79	45.91		92.29
54th Ave	5	1155.31	1155.30	0.01	0.01	0.00		34.55	2.75	83.07
54th Ave	4	1155.30	1155.29	0.02	0.00	0.00		34.18	3.12	69.17
54th Ave	3	1155.30	1155.28	0.02	0.00	0.00		33.17	4.13	92.91
54th Ave	2	1155.29	1155.29	0.01	0.00	0.00		35.78	1.52	82.00
54th Ave	1	1155.29	1155.29	0.00				37.30		355.50



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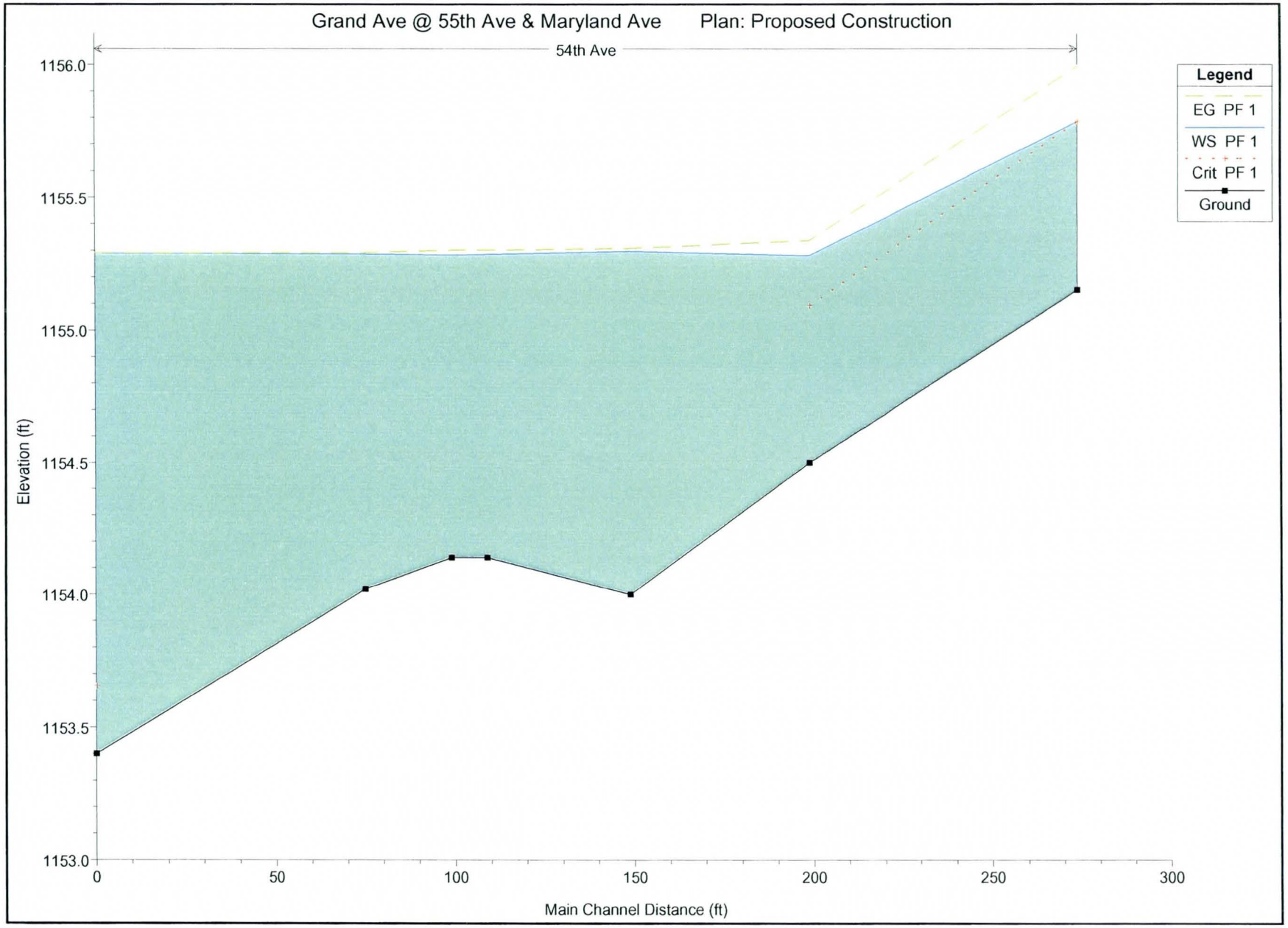
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Plan: Proposed Construction
54th Ave
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Elevation (ft)
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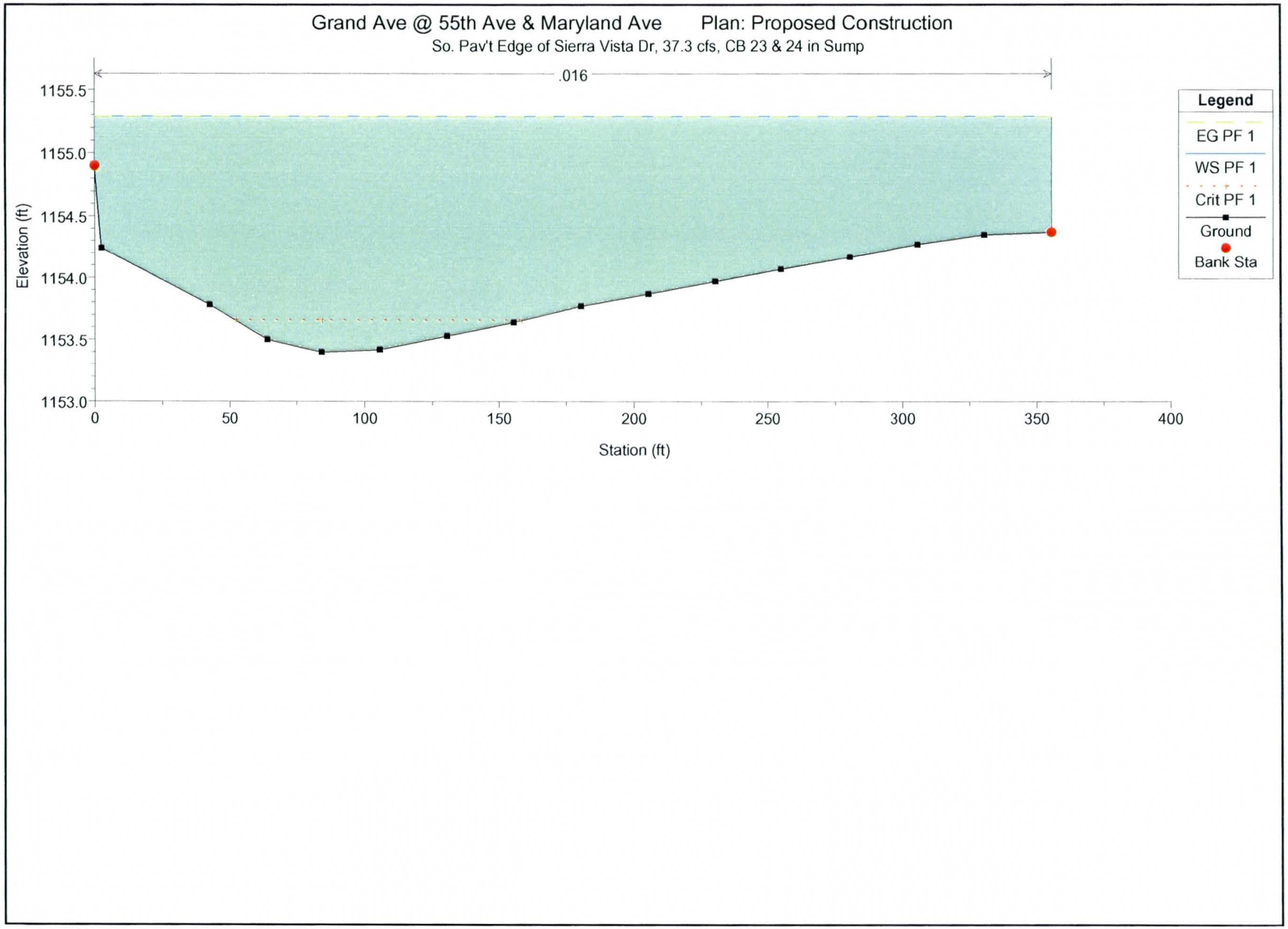
1155.5
1155.0
1154.5
1154.0
1153.5
1153.0
0
50
100
150
200
250
300
Main Channel Distance (ft)


Grand Ave @ 55th Ave & Maryland Ave Plan: Proposed Construction
So. Pav't Edge of Sierra Vista Dr, 37.3 cfs, CB 23 & 24 in Sump
.016
Elevation (ft)
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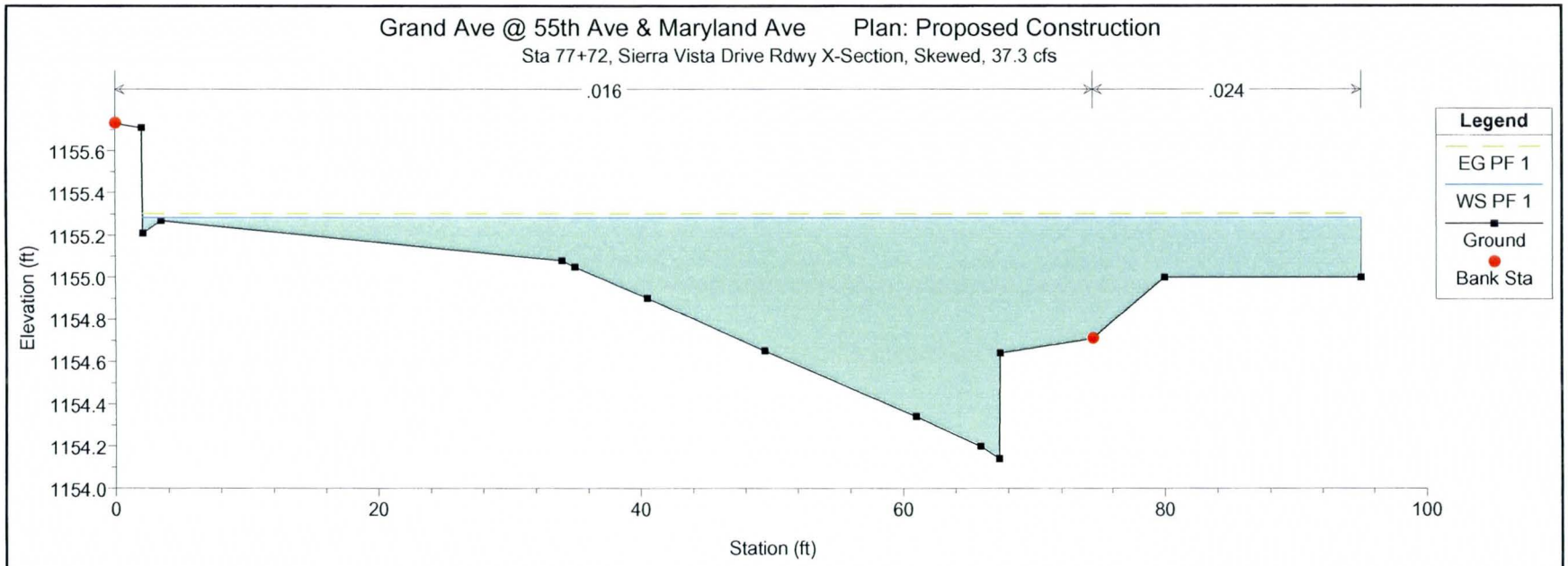
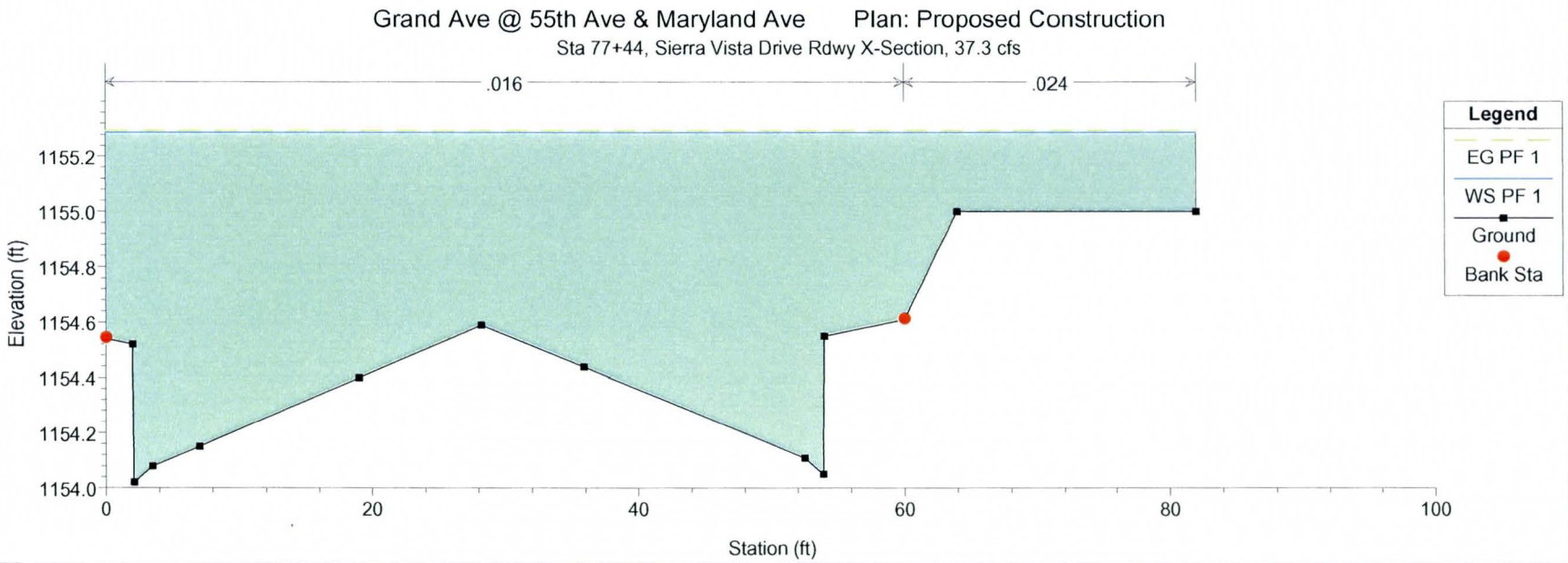
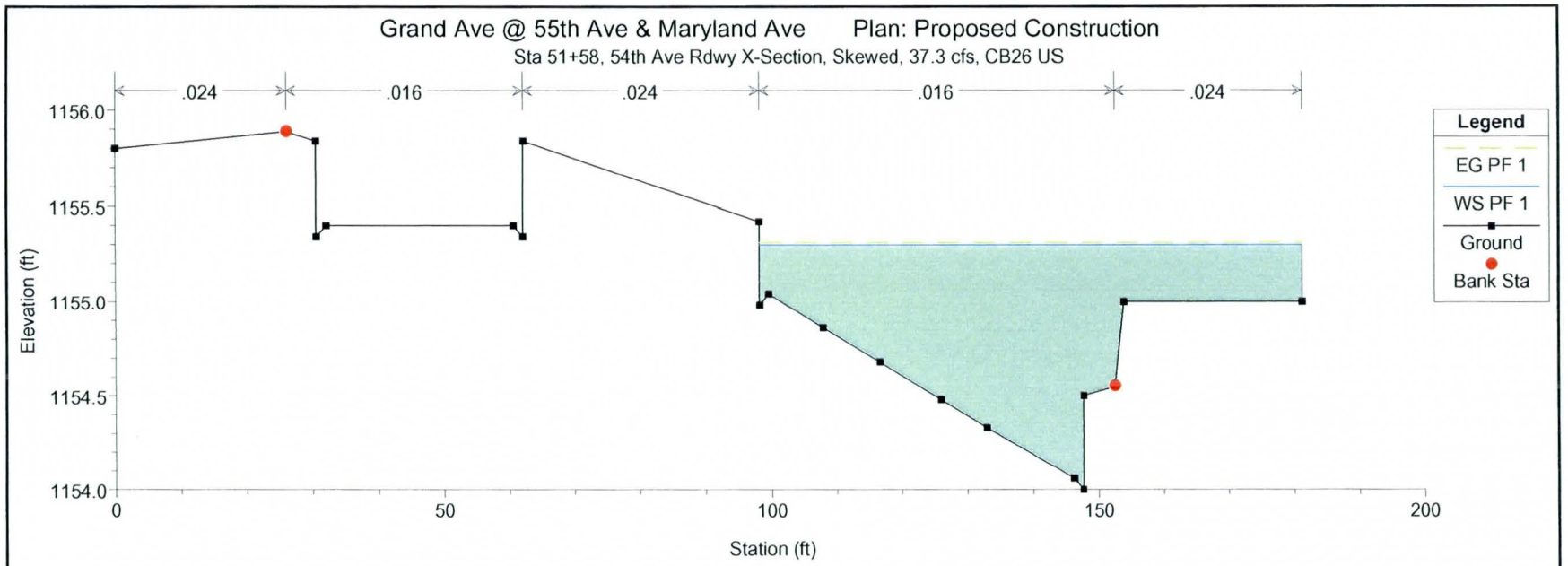
1155.0
1154.5
1154.0
1153.5
1153.0
0
50
100
150
200
250
300
350
400
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta


Grand Ave @ 55th Ave & Maryland Ave Plan: Proposed Construction
Sta 77+72, Sierra Vista Drive Rdwy X-Section, Skewed, 37.3 cfs
.016
.024
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
1155.6
1155.4
1155.2
1155.0
1154.8
1154.6
1154.4
1154.2
1154.0
0
20
40
60
80
100
Station (ft)


Grand Ave @ 55th Ave & Maryland Ave Plan: Proposed Construction
Sta 77+44, Sierra Vista Drive Rdwy X-Section, 37.3 cfs
.016
.024
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
1155.2
1155.0
1154.8
1154.6
1154.4
1154.2
1154.0
0
20
40
60
80
100
Station (ft)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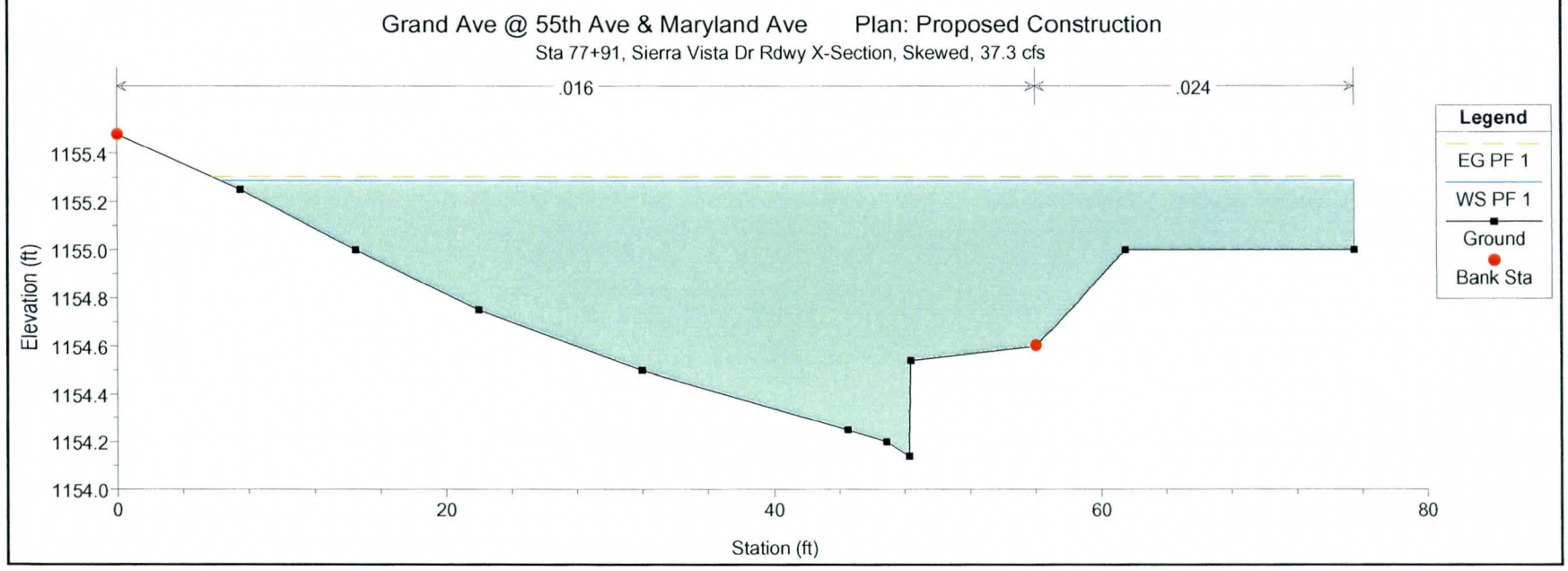
Sta 51+58, 54th Ave Rdwy X-Section, Skewed, 37.3 cfs, CB26 US
.024
.016
.024
.016
.024
Elevation (ft)
1156.0
1155.5
1155.0
1154.5
1154.0
0
50
100
150
200
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta


Grand Ave @ 55th Ave & Maryland Ave Plan: Proposed Construction
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.016
.024
Elevation (ft)
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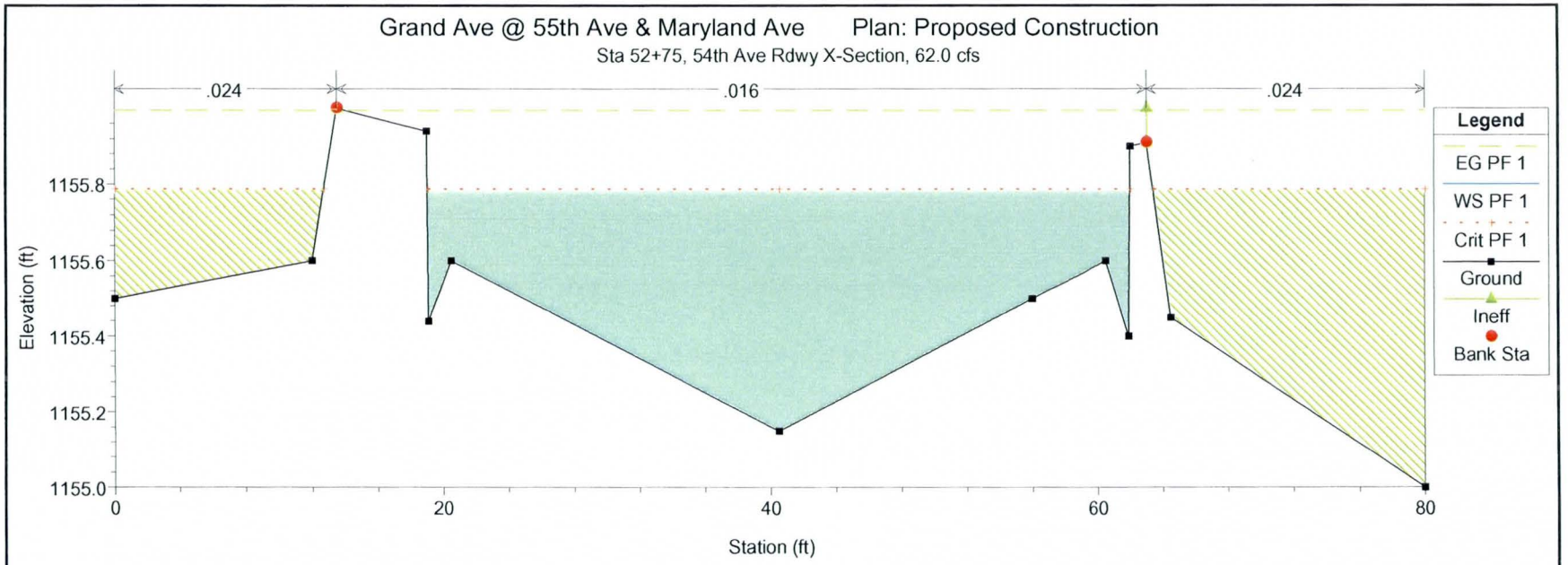
1155.2
1155.0
1154.8
1154.6
1154.4
1154.2
1154.0
0
20
40
60
80
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta


Grand Ave @ 55th Ave & Maryland Ave Plan: Proposed Construction
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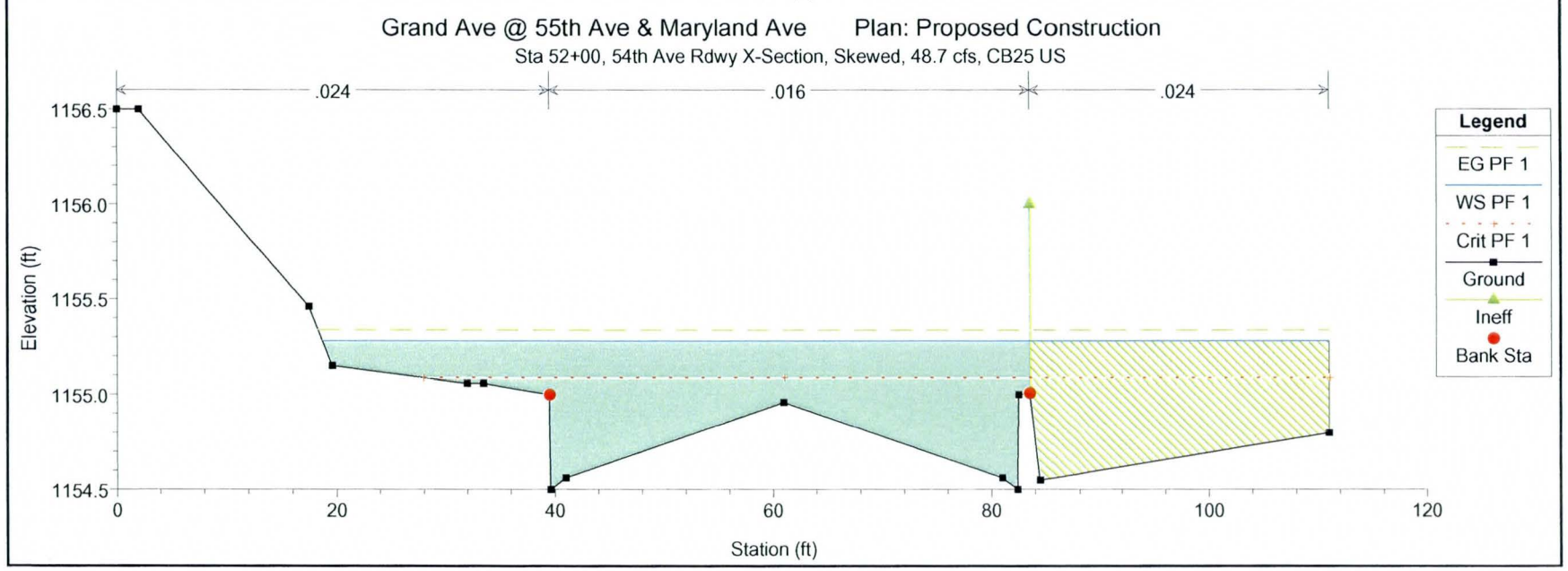
.024
.016
.024
Elevation (ft)
1155.8
1155.6
1155.4
1155.2
1155.0
0
20
40
60
80
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta


Grand Ave @ 55th Ave & Maryland Ave Plan: Proposed Construction
Sta 52+00, 54th Ave Rdwy X-Section, Skewed, 48.7 cfs, CB25 US
.024
.016
.024
Elevation (ft)
1156.5
1156.0
1155.5
1155.0
1154.5
0
20
40
60
80
100
120
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta

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U.S. Army Corp of Engineers
Hydrologic Engineering Center
609 Second Street, Suite D
Davis, California 95616-4687
(916) 756-1104

```
X     X  XXXXXX    XXXX        XXXX       XX      XXXX
X     X  X        X    X       X   X     X  X    X
X     X  X        X            X   X    X    X   X
XXXXXXX  XXXX     X       XXX  XXXX     XXXXXX    XXXX
X     X  X        X            X  X     X    X        X
X     X  X        X    X       X   X    X    X        X
X     X  XXXXXX    XXXX        X    X   X    X   XXXXX
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****

PROJECT DATA
Project Title: Grand Ave @ 55th Ave & Maryland Ave
Project File : 54M.prj
Run Date and Time: 9/29/02 8:18:18 PM

Project in English units

Project Description:
GRAND AVENUE at 55th Ave and Maryland Ave

****

PLAN DATA

Plan Title: Existing 54th Ave/Maryland Ave
Plan File : r:\11344239\Drn\HEC-RAS\54M.p01

Geometry Title: Existing 54th Ave/Maryland Ave
Geometry File : r:\11344239\Drn\HEC-RAS\54M.g01

Flow Title : 100-Year Peak Flow
Flow File : r:\11344239\Drn\HEC-RAS\54M.f01

Plan Summary Information:

Number of:	Cross Sections =	8	Mulitple Openings =	0
	Culverts =	0	Inline Weirs =	0
	Bridges =	0		

Computational Information
Water surface calculation tolerance = 0.003
Critical depth calculaton tolerance = 0.003

```
    Maximum number of interations        =  20
    Maximum difference tolerance         =  0.1
    Flow tolerance factor                =  0.001

Computation Options
    Critical depth computed only where necessary
    Conveyance Calculation Method: At breaks in n values only
    Friction Slope Method:         Average Conveyance
    Computational Flow Regime:     Subcritical Flow


*******************************************************************************

FLOW DATA

Flow Title: 100-Year Peak Flow
Flow File : r:\11344239\Drn\HEC-RAS\54M.f01

Flow Data (cfs)
*************************************************************
* River           Reach           RS      *            PF 1 *
* 1               54th Ave.       3       *              63 *
* 2               Maryand Ave.    3       *              34 *
* 2               Maryand Ave.    2       *              83 *
* 3               Maryland Ave.   2       *             146 *
*************************************************************

Boundary Conditions
*****************************************************************************************************
* River           Reach           Profile          *            Upstream                 Downstream    *
*****************************************************************************************************
* 3               Maryland Ave.   PF 1             *                                Normal S = .0014 *
*****************************************************************************************************

*******************************************************************************

GEOMETRY DATA

Geometry Title: Existing 54th Ave/Maryland Ave
Geometry File : r:\11344239\Drn\HEC-RAS\54M.g01

Reach Connection Table
*******************************************************************************
* River           Reach           *  Upstream Boundary  * Downstream Boundary *
*******************************************************************************
* 1               54th Ave.       *                     *   1                 *
* 2               Maryand Ave.    *                     *   1                 *
* 3               Maryland Ave.   *   1                 *                     *
*******************************************************************************

JUNCTION INFORMATION
```

Slope of EXST MARYLAND AVE West of 54th Ave.

Name: 1
Description: Confluence of 54th Avenue & Maryland Ave
Momentum computation Method
Add Friction
Do Not Add Weight

Length across Junction River	Reach		Tributary River	Reach	Length	Angle
2	Maryand Ave.	to 3		Maryland Ave.	81.4	0
1	54th Ave.	to 3		Maryland Ave.	128	90

CROSS SECTION RIVER: 1
REACH: 54th Ave. RS: 3

INPUT
Description: 54th Ave, 319' North of Existing Maryland Ave
Station Elevation Data num= 14

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1155.5	12	1156.6	13.5	1156	19	1155.94	19.1	1155.44
20.5	1155.6	40.5	1155.15	56	1155.5	60.5	1155.6	61.9	1155.4
62	1155.9	63	1155.91	64.5	1155.45	80	1155		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.024	13.5	.016	63	.024

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
13.5	63	99	99	99	.1	.3

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	1156.21	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.02	Wt. n-Val.	0.024	0.016	0.024
W.S. Elev (ft)	1156.18	Reach Len. (ft)	99.00	99.00	99.00
Crit W.S. (ft)		Flow Area (sq ft)	2.59	35.79	15.62
E.G. Slope (ft/ft)	0.000308	Area (sq ft)	2.59	35.79	15.62
Q Total (cfs)	63.00	Flow (cfs)	1.28	46.43	15.28
Top Width (ft)	74.42	Top Width (ft)	7.92	49.50	17.00
Vel Total (ft/s)	1.17	Avg. Vel. (ft/s)	0.49	1.30	0.98
Max Chl Dpth (ft)	1.18	Hydr. Depth (ft)	0.33	0.72	0.92
Conv. Total (cfs)	3592.1	Conv. (cfs)	73.2	2647.4	871.5
Length Wtd. (ft)	99.00	Wetted Per. (ft)	8.67	50.35	18.26
Min Ch El (ft)	1155.15	Shear (lb/sq ft)	0.01	0.01	0.02
Alpha	1.09	Stream Power (lb/ft s)	0.00	0.02	0.02
Frctn Loss (ft)	0.03	Cum Volume (acre-ft)	0.06	0.37	0.07
C & E Loss (ft)	0.00	Cum SA (acres)	0.07	0.28	0.08

Warning: Divided flow computed for this cross-section.
Warning: The cross-section end points had to be extended vertically for the computed water surface.

CROSS SECTION RIVER: 1
REACH: 54th Ave. RS: 2

INPUT
Description: 54th Ave, 220' North of Existing Maryland Ave
Station Elevation Data num= 11

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1155.78	14	1155.53	19	1155.19	19	1155.09	20	1155.12
40	1155.49	60	1155	61	1154.97	61	1155.41	66	1155.75
80	1156.03								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.024	14	.016	66	.024

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
14	66	134	134	134	.1	.3

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	1156.18	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.02	Wt. n-Val.	0.024	0.016	0.024
W.S. Elev (ft)	1156.16	Reach Len. (ft)	134.00	134.00	134.00
Crit W.S. (ft)		Flow Area (sq ft)	7.01	44.31	3.72
E.G. Slope (ft/ft)	0.000244	Area (sq ft)	7.01	44.31	3.72
Q Total (cfs)	63.00	Flow (cfs)	4.20	57.32	1.48
Top Width (ft)	80.00	Top Width (ft)	14.00	52.00	14.00
Vel Total (ft/s)	1.14	Avg. Vel. (ft/s)	0.60	1.29	0.40
Max Chl Dpth (ft)	1.19	Hydr. Depth (ft)	0.50	0.85	0.27
Conv. Total (cfs)	4035.2	Conv. (cfs)	268.9	3671.7	94.6
Length Wtd. (ft)	134.00	Wetted Per. (ft)	14.38	52.57	14.13
Min Ch El (ft)	1154.97	Shear (lb/sq ft)	0.01	0.01	0.00
Alpha	1.18	Stream Power (lb/ft s)	0.00	0.02	0.00
Frctn Loss (ft)	0.02	Cum Volume (acre-ft)	0.05	0.28	0.05
C & E Loss (ft)	0.00	Cum SA (acres)	0.04	0.16	0.04

Warning: The cross-section end points had to be extended vertically for the computed water surface.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

CROSS SECTION RIVER: 1
REACH: 54th Ave. RS: 1

INPUT
Description: 54th Ave, 86' North of Existing Maryland Ave
Station Elevation Data num= 11

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev

0	1155.52	14	1155.34	19	1155.4	19	1154.88	20	1154.97
40	1155.3	60	1154.87	61	1154.8	61	1155.29	66	1155.16
80	1155.23								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.024	14	.016	66	.024

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
14	66	0	0	0	.1	.3

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	1156.16	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.01	Wt. n-Val.	0.024	0.016	0.024
W.S. Elev (ft)	1156.14	Reach Len. (ft)	128.00	128.00	128.00
Crit W.S. (ft)		Flow Area (sq ft)	9.98	52.30	13.27
E.G. Slope (ft/ft)	0.000108	Area (sq ft)	9.98	52.30	13.27
Q Total (cfs)	63.00	Flow (cfs)	4.99	50.10	7.91
Top Width (ft)	80.00	Top Width (ft)	14.00	52.00	14.00
Vel Total (ft/s)	0.83	Avg. Vel. (ft/s)	0.50	0.96	0.60
Max Chl Dpth (ft)	1.34	Hydr. Depth (ft)	0.71	1.01	0.95
Conv. Total (cfs)	6051.5	Conv. (cfs)	479.1	4812.3	760.2
Length Wtd. (ft)	128.00	Wetted Per. (ft)	14.62	53.03	14.91
Min Ch El (ft)	1154.80	Shear (lb/sq ft)	0.00	0.01	0.01
Alpha	1.14	Stream Power (lb/ft s)	0.00	0.01	0.00
Frctn Loss (ft)		Cum Volume (acre-ft)	0.02	0.13	0.02
C & E Loss (ft)		Cum SA (acres)			

CROSS SECTION RIVER: 2
REACH: Maryand Ave. RS: 3

INPUT
Description: STA 128+22.7 (East of 53rd Dr)
Station Elevation Data num= 11

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1156.19	4	1156.11	8	1156.11	9	1155.65	10	1155.73
35	1155.68	58	1155.19	60	1155.19	61	1155.65	64	1155.77
68	1155.85								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.024	8	.016	61	.024

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
8	61	212	212	212	.1	.3

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	1156.27	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.01	Wt. n-Val.	0.024	0.016	0.024
W.S. Elev (ft)	1156.26	Reach Len. (ft)	212.00	212.00	212.00
Crit W.S. (ft)		Flow Area (sq ft)	1.01	36.57	3.42
E.G. Slope (ft/ft)	0.000149	Area (sq ft)	1.01	36.57	3.42
Q Total (cfs)	34.00	Flow (cfs)	0.19	32.27	1.54
Top Width (ft)	68.00	Top Width (ft)	8.00	53.00	7.00
Vel Total (ft/s)	0.83	Avg. Vel. (ft/s)	0.19	0.88	0.45
Max Chl Dpth (ft)	1.07	Hydr. Depth (ft)	0.13	0.69	0.49
Conv. Total (cfs)	2786.8	Conv. (cfs)	15.6	2644.6	126.6
Length Wtd. (ft)	212.00	Wetted Per. (ft)	8.07	53.21	7.41
Min Ch El (ft)	1155.19	Shear (lb/sq ft)	0.00	0.01	0.00
Alpha	1.09	Stream Power (lb/ft s)	0.00	0.01	0.00
Frctn Loss (ft)	0.05	Cum Volume (acre-ft)	0.04	0.49	0.05
C & E Loss (ft)	0.00	Cum SA (acres)	0.08	0.45	0.06

Warning: The cross-section end points had to be extended vertically for the computed water surface.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

CROSS SECTION RIVER: 2
REACH: Maryand Ave. RS: 2

INPUT
Description: Station 126+10 (East of 54th Ave)
Station Elevation Data num= 11

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1155.9	5	1155.8	9	1155.72	10	1155.28	11	1155.35
35	1155.34	59	1154.9	61	1154.84	61	1155.43	65	1155.51
68	1155.57								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.024	9	.016	61	.024

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
9	61	164	164	164	.1	.3

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	1156.21	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.04	Wt. n-Val.	0.024	0.016	0.024
W.S. Elev (ft)	1156.18	Reach Len. (ft)	164.00	164.00	164.00
Crit W.S. (ft)		Flow Area (sq ft)	3.31	49.53	4.74
E.G. Slope (ft/ft)	0.000308	Area (sq ft)	3.31	49.53	4.74
Q Total (cfs)	83.00	Flow (cfs)	1.81	77.43	3.76
Top Width (ft)	68.00	Top Width (ft)	9.00	52.00	7.00
Vel Total (ft/s)	1.44	Avg. Vel. (ft/s)	0.55	1.56	0.79

Max Chl Dpth (ft)	1.34	Hydr. Depth (ft)	0.37	0.95	0.68
Conv. Total (cfs)	4732.2	Conv. (cfs)	103.1	4414.7	214.4
Length Wtd. (ft)	164.00	Wetted Per. (ft)	9.28	52.69	7.61
Min Ch El (ft)	1154.84	Shear (lb/sq ft)	0.01	0.02	0.01
Alpha	1.11	Stream Power (lb/ft s)	0.00	0.03	0.01
Frctn Loss (ft)	0.04	Cum Volume (acre-ft)	0.03	0.28	0.03
C & E Loss (ft)	0.00	Cum SA (acres)	0.03	0.20	0.03

Warning: The cross-section end points had to be extended vertically for the computed water surface.

CROSS SECTION RIVER: 2
REACH: Maryand Ave. RS: 1

INPUT
Description: Station 124+46.4 (East of 54th Ave)
Station Elevation Data num= 11

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1155.52	5	1155.42	9	1155.39	10	1154.9	11	1154.98
35	1155.34	59	1154.82	61	1154.78	61	1155.26	65	1155.3
68	1155.36								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.024	9	.016	61	.024

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
9	61	0	0	0	.1	.3

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	1156.17	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.03	Wt. n-Val.	0.024	0.016	0.024
W.S. Elev (ft)	1156.14	Reach Len. (ft)	81.40	81.40	81.40
Crit W.S. (ft)		Flow Area (sq ft)	6.32	53.99	5.89
E.G. Slope (ft/ft)	0.000212	Area (sq ft)	6.32	53.99	5.89
Q Total (cfs)	83.00	Flow (cfs)	4.30	74.29	4.41
Top Width (ft)	68.00	Top Width (ft)	9.00	52.00	7.00
Vel Total (ft/s)	1.25	Avg. Vel. (ft/s)	0.68	1.38	0.75
Max Chl Dpth (ft)	1.36	Hydr. Depth (ft)	0.70	1.04	0.84
Conv. Total (cfs)	5699.8	Conv. (cfs)	295.3	5101.6	302.9
Length Wtd. (ft)	81.40	Wetted Per. (ft)	9.62	52.61	7.78
Min Ch El (ft)	1154.78	Shear (lb/sq ft)	0.01	0.01	0.01
Alpha	1.11	Stream Power (lb/ft s)	0.01	0.02	0.01
Frctn Loss (ft)		Cum Volume (acre-ft)	0.01	0.08	0.01
C & E Loss (ft)		Cum SA (acres)			

Warning: The parabolic search method failed to converge on critical depth. The program will try the cross section slice/secant method to find critical depth.

CROSS SECTION RIVER: 3
REACH: Maryland Ave. RS: 2

INPUT
Description: Station 123+65 (West of 54th Ave)
Station Elevation Data num= 11

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1155.29	5	1155.19	9	1155.16	9	1154.69	11	1154.8
38	1155.49	59	1154.8	61	1154.74	61	1155.26	65	1155.31
68	1155.37								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.024	9	.016	61	.024

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
9	61	150	150	150	.1	.3

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	1155.97	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.21	Wt. n-Val.	0.024	0.016	0.024
W.S. Elev (ft)	1155.77	Reach Len. (ft)	150.00	150.00	150.00
Crit W.S. (ft)	1155.69	Flow Area (sq ft)	5.00	33.86	3.20
E.G. Slope (ft/ft)	0.003041	Area (sq ft)	5.00	33.86	3.20
Q Total (cfs)	146.00	Flow (cfs)	11.14	128.60	6.26
Top Width (ft)	68.00	Top Width (ft)	9.00	52.00	7.00
Vel Total (ft/s)	3.47	Avg. Vel. (ft/s)	2.23	3.80	1.95
Max Chl Dpth (ft)	1.08	Hydr. Depth (ft)	0.56	0.65	0.46
Conv. Total (cfs)	2647.6	Conv. (cfs)	201.9	2332.1	113.6
Length Wtd. (ft)	150.00	Wetted Per. (ft)	9.48	53.01	7.40
Min Ch El (ft)	1154.69	Shear (lb/sq ft)	0.10	0.12	0.08
Alpha	1.10	Stream Power (lb/ft s)	0.22	0.46	0.16
Frctn Loss (ft)	0.30	Cum Volume (acre-ft)	0.02	0.13	0.01
C & E Loss (ft)	0.02	Cum SA (acres)	0.03	0.18	0.02

Warning: The cross-section end points had to be extended vertically for the computed water surface.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

CROSS SECTION RIVER: 3
REACH: Maryland Ave. RS: 1

INPUT
Description: Station 121+15 (West of 54th Ave)
Station Elevation Data num= 10

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev

```
      0 1154.84       5 1154.74       9 1154.68      10 1154.19      11 1154.27
     40  1155.1      59  1154.5      61  1154.9      65  1154.9      68 1154.96

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
***********************************************
       0    .024       9    .016      61    .024

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             9      61                 0       0       0              .1       .3

CROSS SECTION OUTPUT    Profile #PF 1
*****************************************************************************************
* E.G. Elev (ft)         * 1155.65  * Element                 *  Left OB *  Channel * Right OB *
* Vel Head (ft)          *    0.13  * Wt. n-Val.              *   0.024  *   0.016  *   0.024  *
* W.S. Elev (ft)         * 1155.52  * Reach Len. (ft)         *          *          *          *
* Crit W.S. (ft)         * 1155.28  * Flow Area (sq ft)       *    6.91  *   42.03  *    4.27  *
* E.G. Slope (ft/ft)     *0.001400  * Area (sq ft)            *    6.91  *   42.03  *    4.27  *
* Q Total (cfs)          *  146.00  * Flow (cfs)              *   12.79  *  126.46  *    6.75  *
* Top Width (ft)         *   68.00  * Top Width (ft)           *    9.00  *   52.00  *    7.00  *
* Vel Total (ft/s)       *    2.74  * Avg. Vel. (ft/s)         *    1.85  *    3.01  *    1.58  *
* Max Chl Dpth (ft)      *    1.33  * Hydr. Depth (ft)         *    0.77  *    0.81  *    0.61  *
* Conv. Total (cfs)      *  3901.5  * Conv. (cfs)              *   341.7  *  3379.5  *   180.3  *
* Length Wtd. (ft)       *          * Wetted Per. (ft)         *    9.68  *   52.18  *    7.56  *
* Min Ch El (ft)         * 1154.19  * Shear (lb/sq ft)         *    0.06  *    0.07  *    0.05  *
* Alpha                  *    1.10  * Stream Power (lb/ft s)   *    0.12  *    0.21  *    0.08  *
* Frctn Loss (ft)        *          * Cum Volume (acre-ft)     *          *          *          *
* C & E Loss (ft)        *          * Cum SA (acres)           *          *          *          *
*****************************************************************************************

*******************************************************************************

SUMMARY OF MANNING'S N VALUES

River:1
*****************************************************************
*     Reach       *   River Sta.   *   n1    *   n2    *   n3    *
*****************************************************************
*54th Ave.        *    3           *     .024*     .016*     .024*
*54th Ave.        *    2           *     .024*     .016*     .024*
*54th Ave.        *    1           *     .024*     .016*     .024*
*****************************************************************

River:2
*****************************************************************
*     Reach       *   River Sta.   *   n1    *   n2    *   n3    *
*****************************************************************
*Maryand Ave.     *    3           *     .024*     .016*     .024*
*Maryand Ave.     *    2           *     .024*     .016*     .024*
*Maryand Ave.     *    1           *     .024*     .016*     .024*
*****************************************************************
```

River:3

Reach	River Sta.	n1	n2	n3
Maryland Ave.	2	.024	.016	.024
Maryland Ave.	1	.024	.016	.024

SUMMARY OF REACH LENGTHS

River: 1

Reach	River Sta.	Left	Channel	Right
54th Ave.	3	99	99	99
54th Ave.	2	134	134	134
54th Ave.	1	0	0	0

River: 2

Reach	River Sta.	Left	Channel	Right
Maryand Ave.	3	212	212	212
Maryand Ave.	2	164	164	164
Maryand Ave.	1	0	0	0

River: 3

Reach	River Sta.	Left	Channel	Right
Maryland Ave.	2	150	150	150
Maryland Ave.	1	0	0	0

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: 1

Reach	River Sta.	Contr.	Expan.
54th Ave.	3	.1	.3
54th Ave.	2	.1	.3
54th Ave.	1	.1	.3

River: 2

Reach	River Sta.	Contr.	Expan.
Maryand Ave.	3	.1	.3
Maryand Ave.	2	.1	.3
Maryand Ave.	1	.1	.3

River: 3

Reach	River Sta.	Contr.	Expan.
Maryland Ave.	2	.1	.3
Maryland Ave.	1	.1	.3

Profile Output Table - Standard Table 1

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
3	Maryland Ave.	2	146.00	1154.69	1155.77	1155.69	1155.97	0.003041	3.80	42.06	68.00	0.83
3	Maryland Ave.	1	146.00	1154.19	1155.52	1155.28	1155.65	0.001400	3.01	53.21	68.00	0.59
2	Maryand Ave.	3	34.00	1155.19	1156.26		1156.27	0.000149	0.88	41.00	68.00	0.19
2	Maryand Ave.	2	83.00	1154.84	1156.18		1156.21	0.000308	1.56	57.59	68.00	0.28
2	Maryand Ave.	1	83.00	1154.78	1156.14		1156.17	0.000212	1.38	66.20	68.00	0.24
1	54th Ave.	3	63.00	1155.15	1156.18		1156.21	0.000308	1.30	54.01	74.42	0.27
1	54th Ave.	2	63.00	1154.97	1156.16		1156.18	0.000244	1.29	55.04	80.00	0.25
1	54th Ave.	1	63.00	1154.80	1156.14		1156.16	0.000108	0.96	75.55	80.00	0.17

Profile Output Table - Standard Table 2

River	Reach	River Sta	E.G. Elev (ft)	W.S. Elev (ft)	Vel Head (ft)	Frctn Loss (ft)	C & E Loss (ft)	Q Left (cfs)	Q Channel (cfs)	Q Right (cfs)	Top Width (ft)

```
*****************************************************************************************************************************************
*************
* 3           * Maryland Ave.* 2          *     1155.97 *  1155.77 *     0.21 *      0.30 *      0.02 *    11.14 *   128.60 *
6.26 *    68.00 *
* 3           * Maryland Ave.* 1          *     1155.65 *  1155.52 *     0.13 *           *           *    12.79 *   126.46 *
6.75 *    68.00 *
* 2           * Maryand Ave.* 3           *     1156.27 *  1156.26 *     0.01 *      0.05 *      0.00 *     0.19 *    32.27 *     1.54
*    68.00 *
* 2           * Maryand Ave.* 2           *     1156.21 *  1156.18 *     0.04 *      0.04 *      0.00 *     1.81 *    77.43 *     3.76
*    68.00 *
* 2           * Maryand Ave.* 1           *     1156.17 *  1156.14 *     0.03 *           *           *     4.30 *    74.29 *     4.41
*    68.00 *
* 1           * 54th Ave.   * 3           *     1156.21 *  1156.18 *     0.02 *      0.03 *      0.00 *     1.28 *    46.43 *    15.28
*    74.42 *
* 1           * 54th Ave.   * 2           *     1156.18 *  1156.16 *     0.02 *      0.02 *      0.00 *     4.20 *    57.32 *     1.48
*    80.00 *
* 1           * 54th Ave.   * 1           *     1156.16 *  1156.14 *     0.01 *           *           *     4.99 *    50.10 *     7.91
*    80.00 *
*****************************************************************************************************************************************
*************
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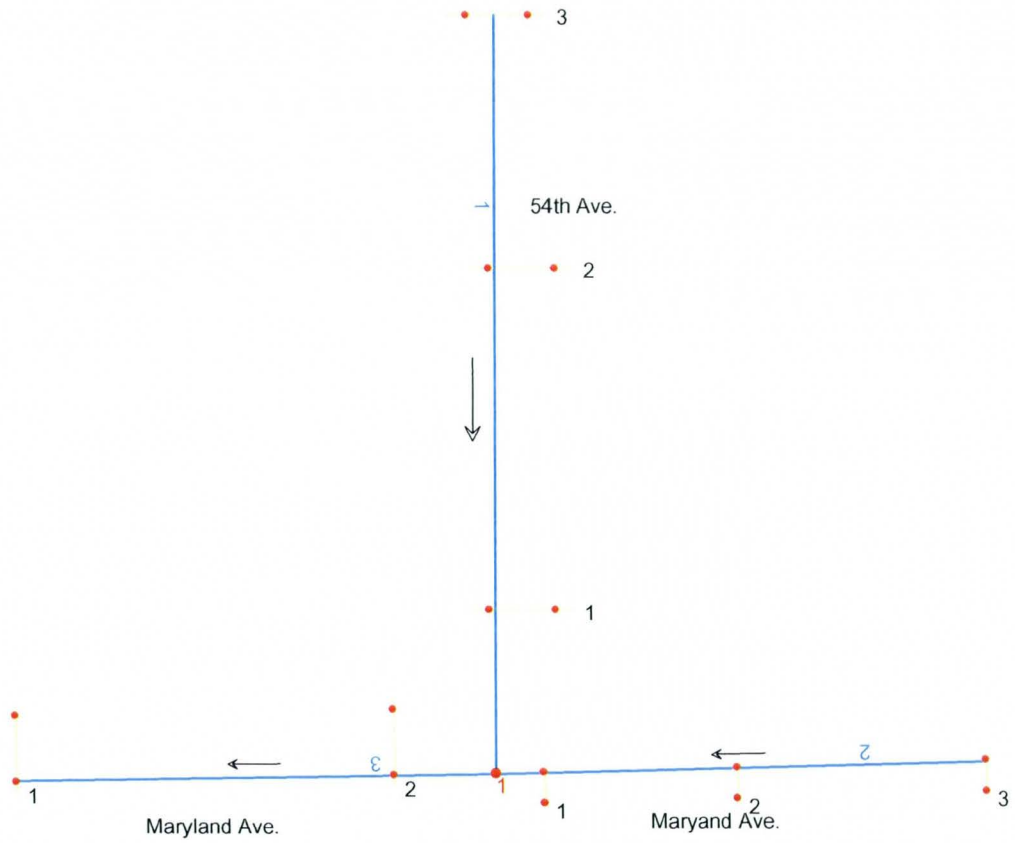
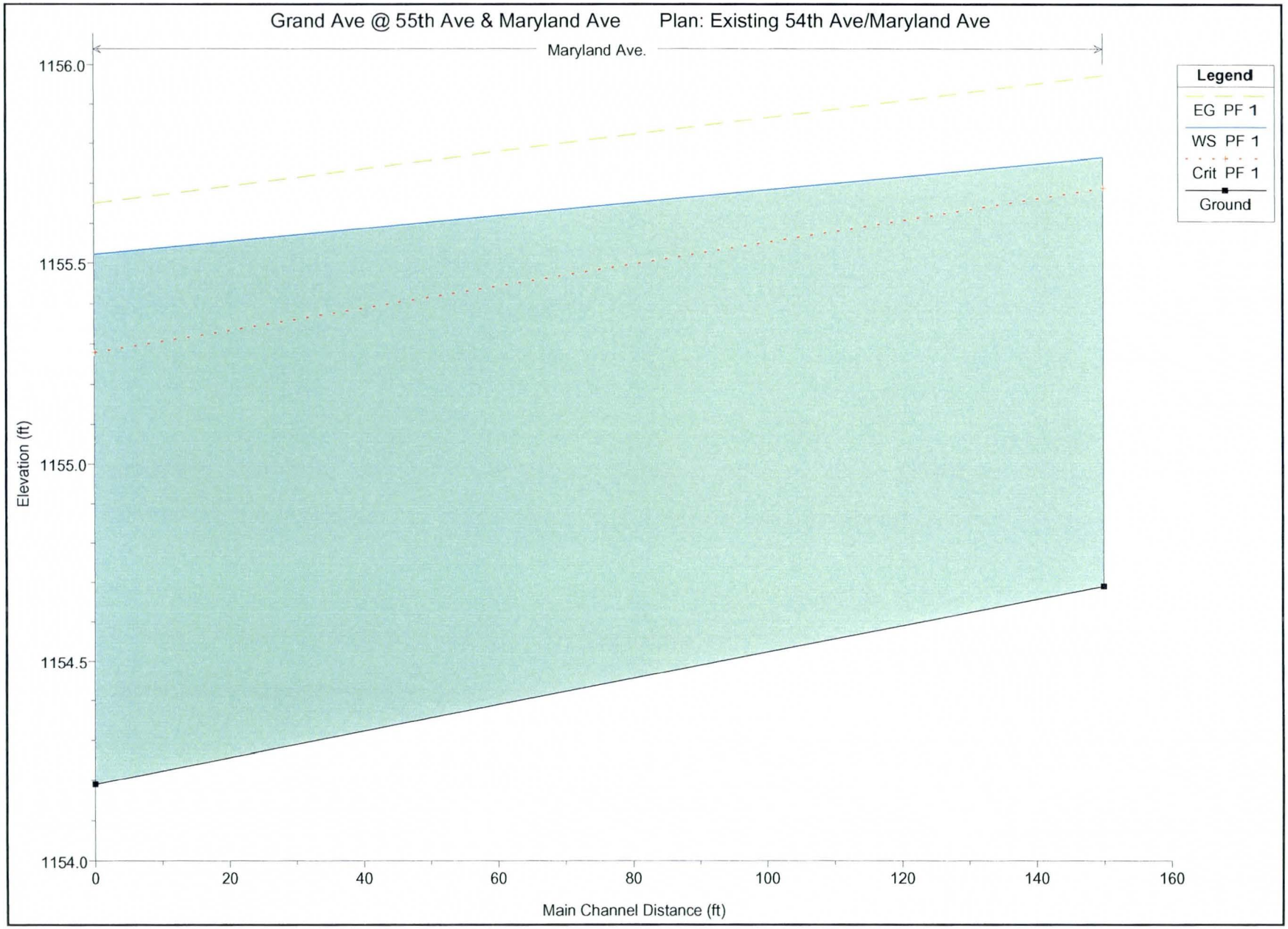
HEC-RAS Plan: 54thMarylnd Profile: PF 1

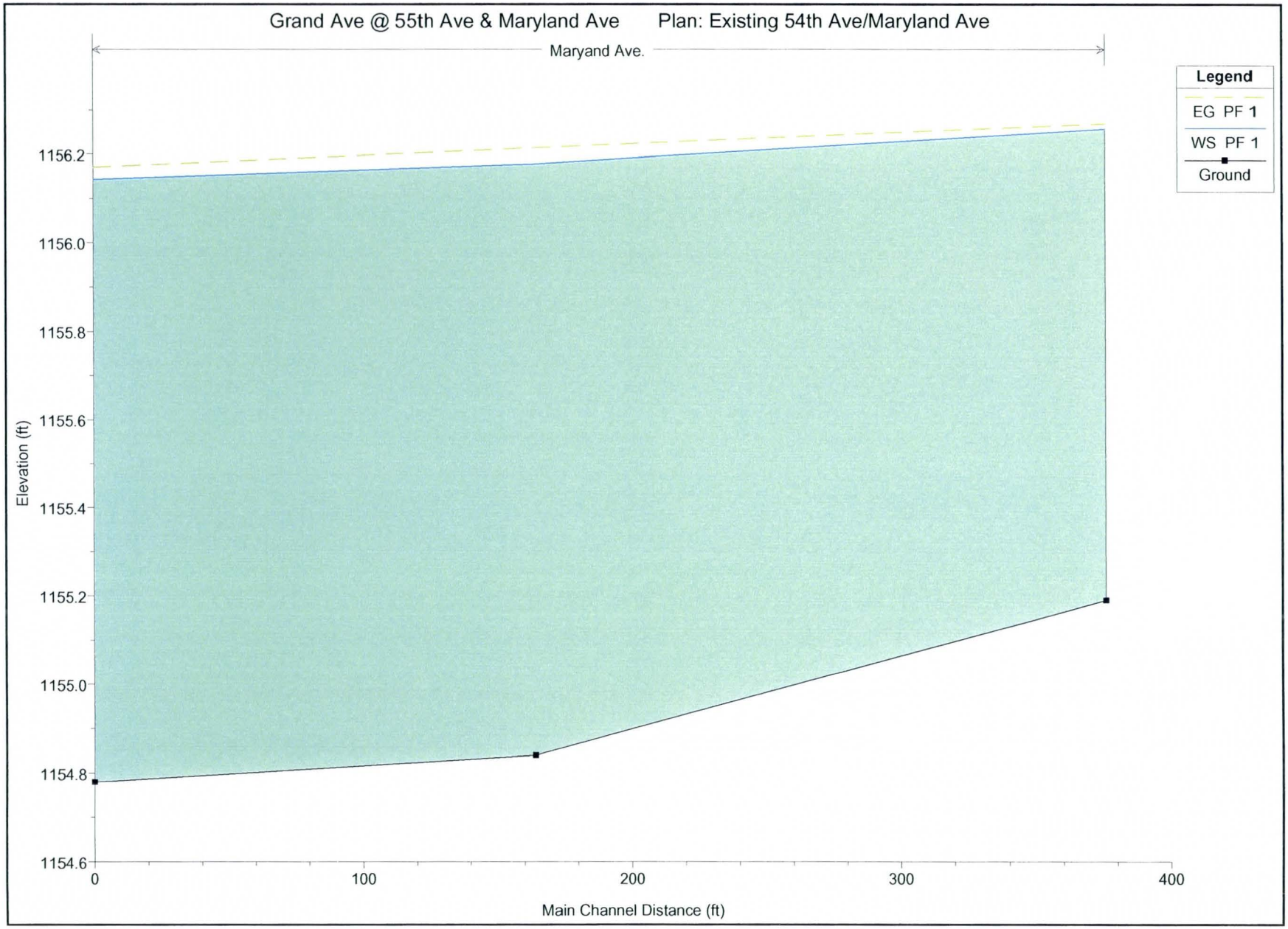
River	Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
3	Maryland Ave.	2	146.00	1154.69	1155.77	1155.69	1155.97	0.003041	3.80	42.06	68.00	0.83
3	Maryland Ave.	1	146.00	1154.19	1155.52	1155.28	1155.65	0.001400	3.01	53.21	68.00	0.59
2	Maryand Ave.	3	34.00	1155.19	1156.26		1156.27	0.000149	0.88	41.00	68.00	0.19
2	Maryand Ave.	2	83.00	1154.84	1156.18		1156.21	0.000308	1.56	57.59	68.00	0.28
2	Maryand Ave.	1	83.00	1154.78	1156.14		1156.17	0.000212	1.38	66.20	68.00	0.24
1	54th Ave.	3	63.00	1155.15	1156.18		1156.21	0.000308	1.30	54.01	74.42	0.27
1	54th Ave.	2	63.00	1154.97	1156.16		1156.18	0.000244	1.29	55.04	80.00	0.25
1	54th Ave.	1	63.00	1154.80	1156.14		1156.16	0.000108	0.96	75.55	80.00	0.17

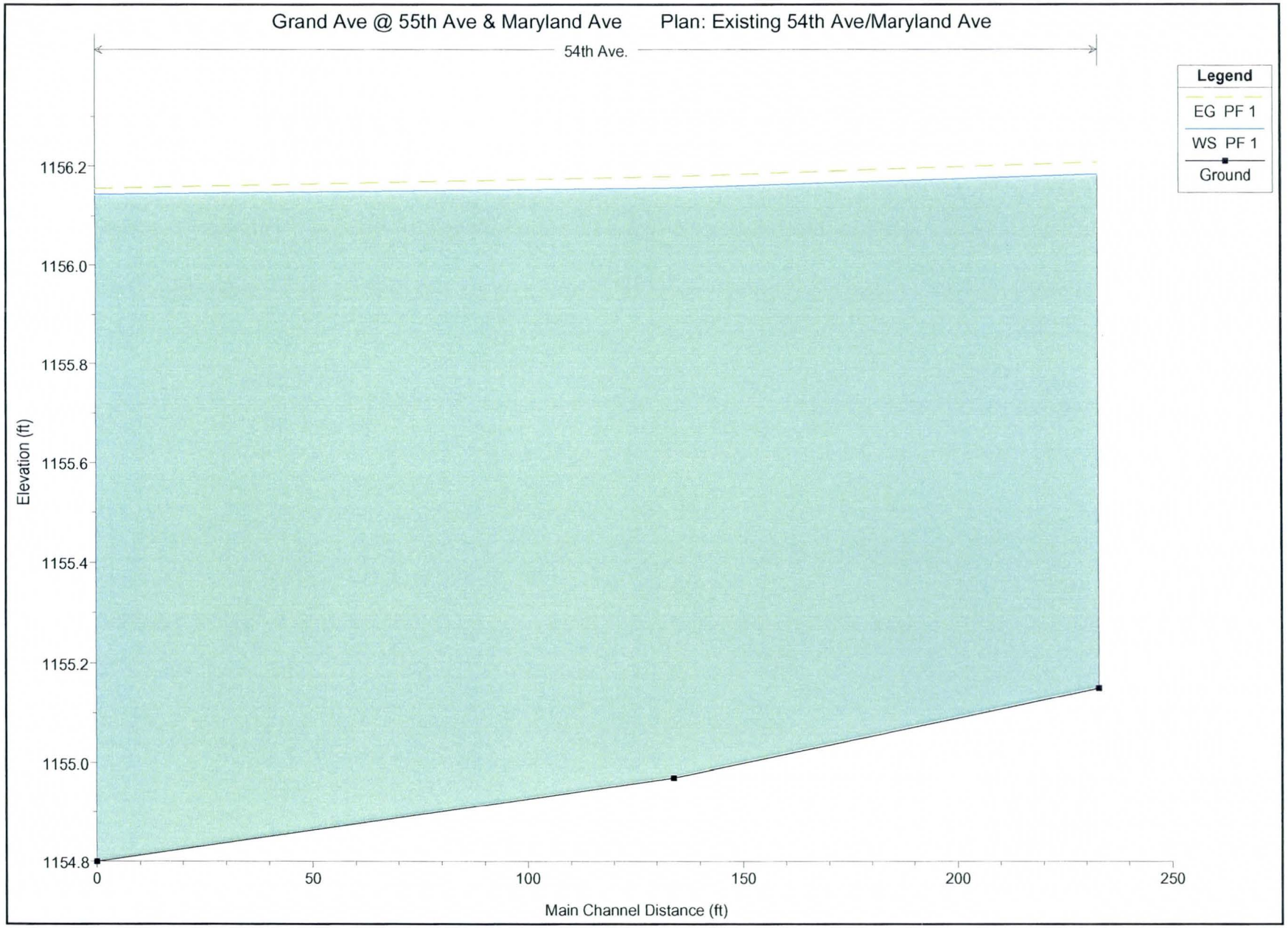
HEC-RAS Plan: 54thMarylnd Profile: PF 1

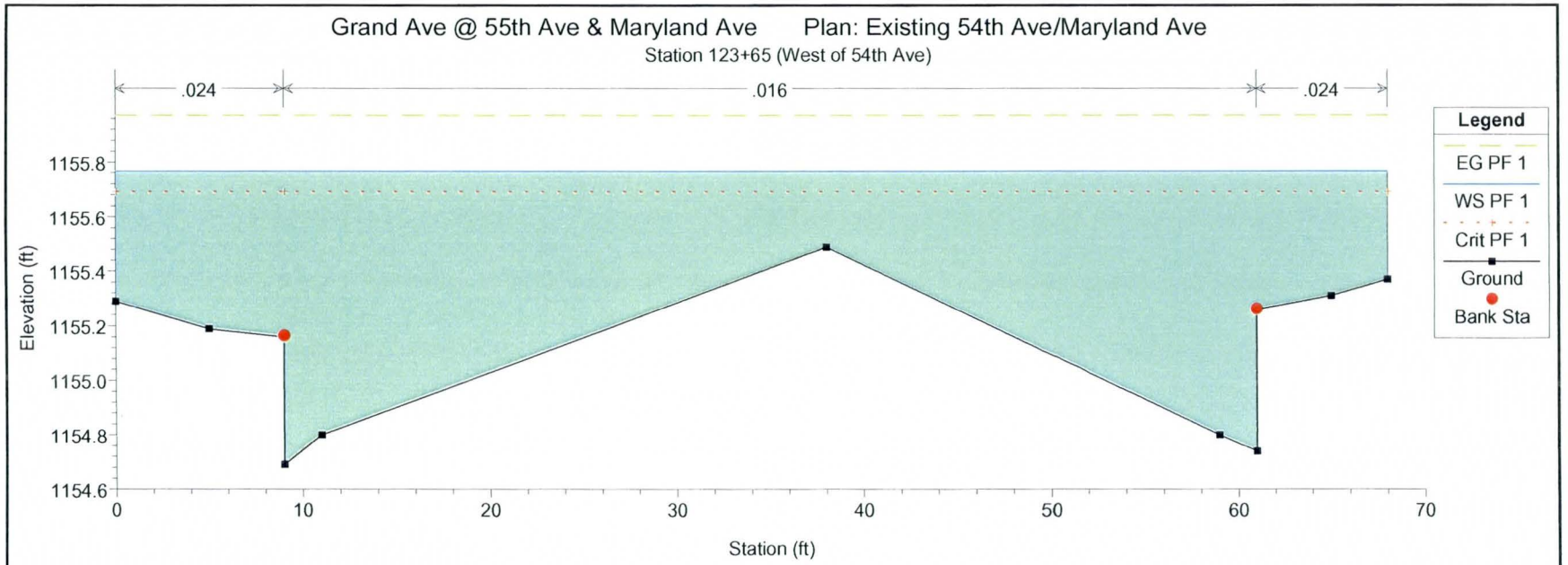
River	Reach	River Sta	E.G. Elev	W.S. Elev	Vel Head	Frctn Loss	C & E Loss	Q Left	Q Channel	Q Right	Top Width
			(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)
3	Maryland Ave.	2	1155.97	1155.77	0.21	0.30	0.02	11.14	128.60	6.26	68.00
3	Maryland Ave.	1	1155.65	1155.52	0.13			12.79	126.46	6.75	68.00
2	Maryand Ave.	3	1156.27	1156.26	0.01	0.05	0.00	0.19	32.27	1.54	68.00
2	Maryand Ave.	2	1156.21	1156.18	0.04	0.04	0.00	1.81	77.43	3.76	68.00
2	Maryand Ave.	1	1156.17	1156.14	0.03			4.30	74.29	4.41	68.00
1	54th Ave.	3	1156.21	1156.18	0.02	0.03	0.00	1.28	46.43	15.28	74.42
1	54th Ave.	2	1156.18	1156.16	0.02	0.02	0.00	4.20	57.32	1.48	80.00
1	54th Ave.	1	1156.16	1156.14	0.01			4.99	50.10	7.91	80.00

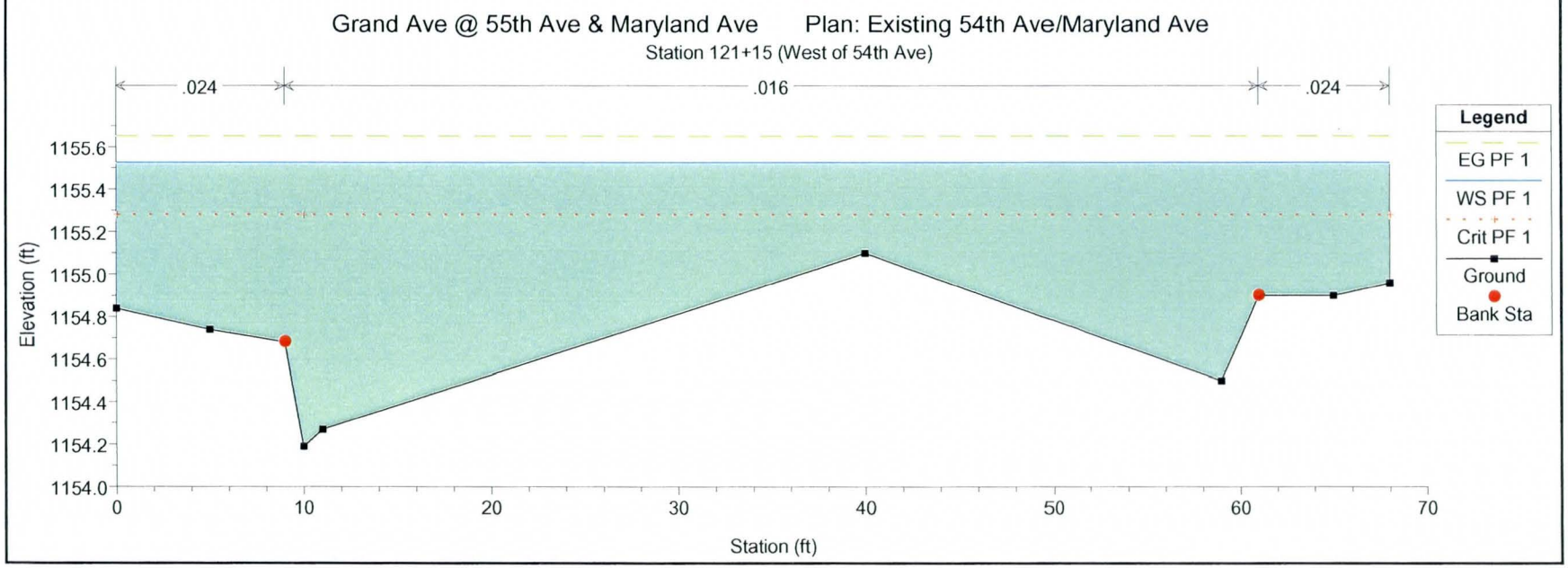

3
54th Ave.
2
1
1
2
3
1
2
1
2
3
Maryland Ave.
Maryand Ave.

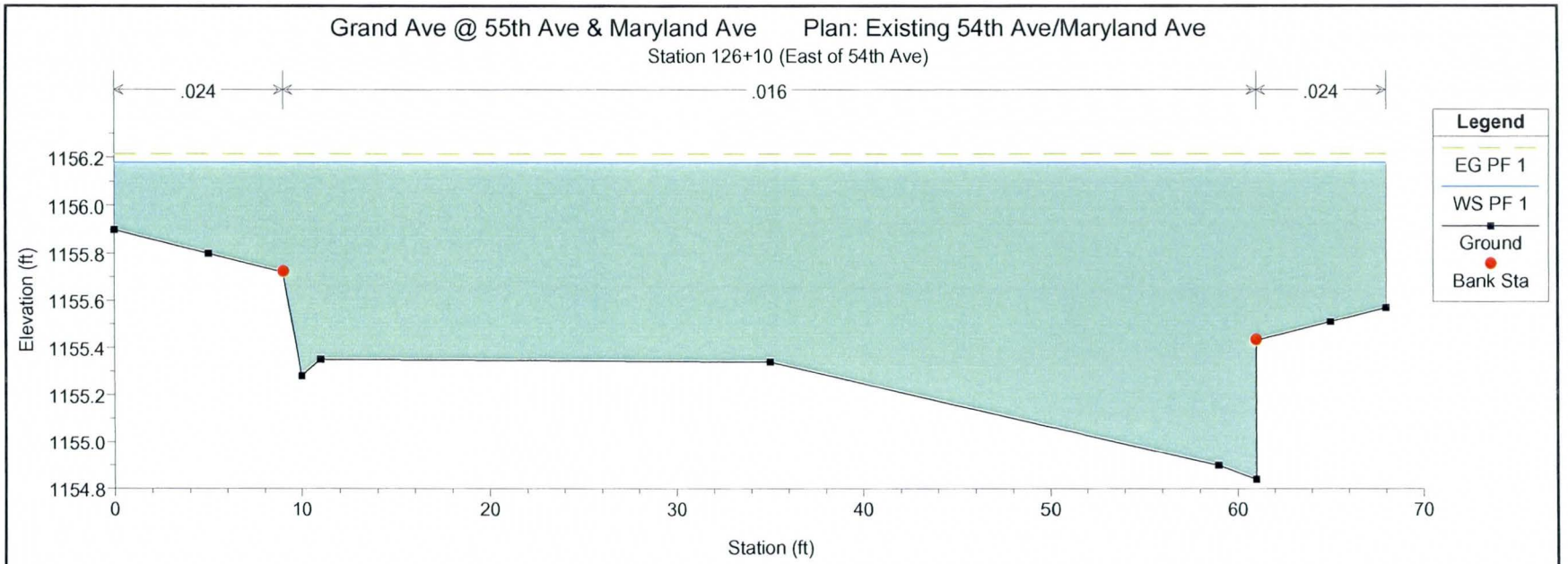

Grand Ave @ 55th Ave & Maryland Ave
Plan: Existing 54th Ave/Maryland Ave
Maryland Ave.
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Elevation (ft)
1156.0
1155.5
1155.0
1154.5
1154.0
0
20
40
60
80
100
120
140
160
Main Channel Distance (ft)

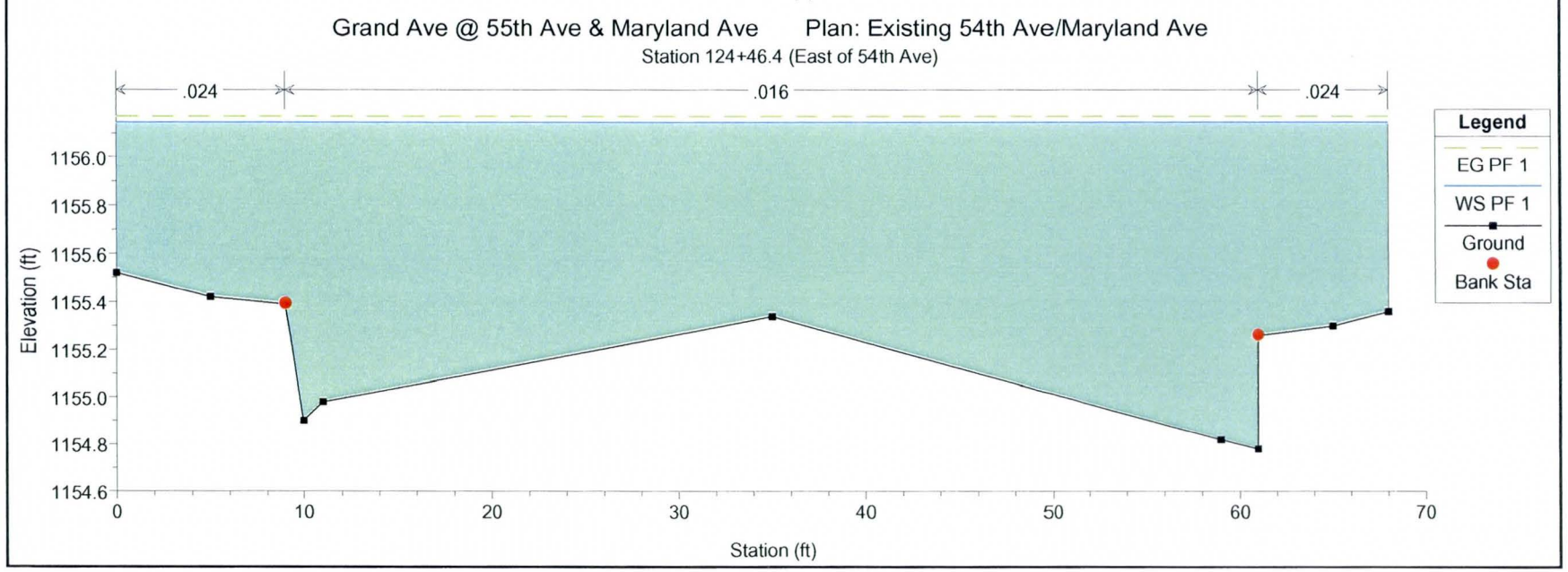

Grand Ave @ 55th Ave & Maryland Ave
Plan: Existing 54th Ave/Maryland Ave
Maryand Ave.
Legend
EG PF 1
WS PF 1
Ground
Elevation (ft)
1156.2
1156.0
1155.8
1155.6
1155.4
1155.2
1155.0
1154.8
1154.6
0
100
200
300
400
Main Channel Distance (ft)

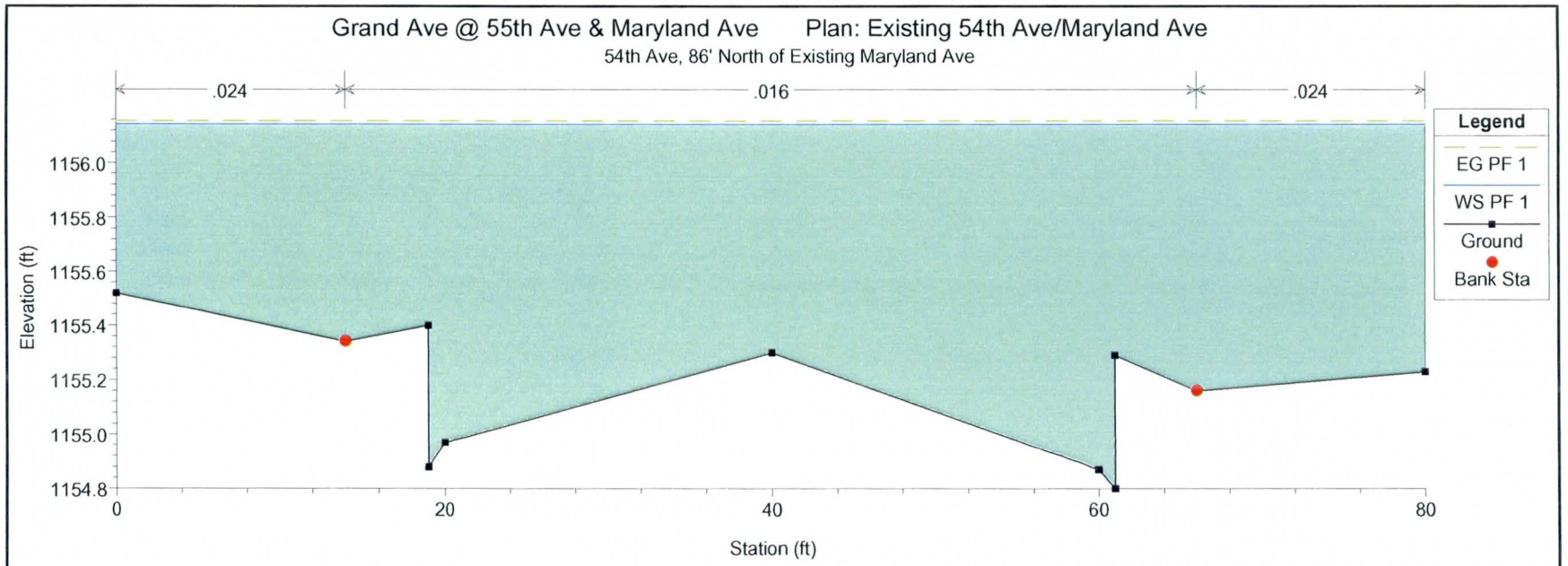

Grand Ave @ 55th Ave & Maryland Ave
Plan: Existing 54th Ave/Maryland Ave
54th Ave.
Legend
EG PF 1
WS PF 1
Ground
Elevation (ft)
1156.2
1156.0
1155.8
1155.6
1155.4
1155.2
1155.0
1154.8
0
50
100
150
200
250
Main Channel Distance (ft)

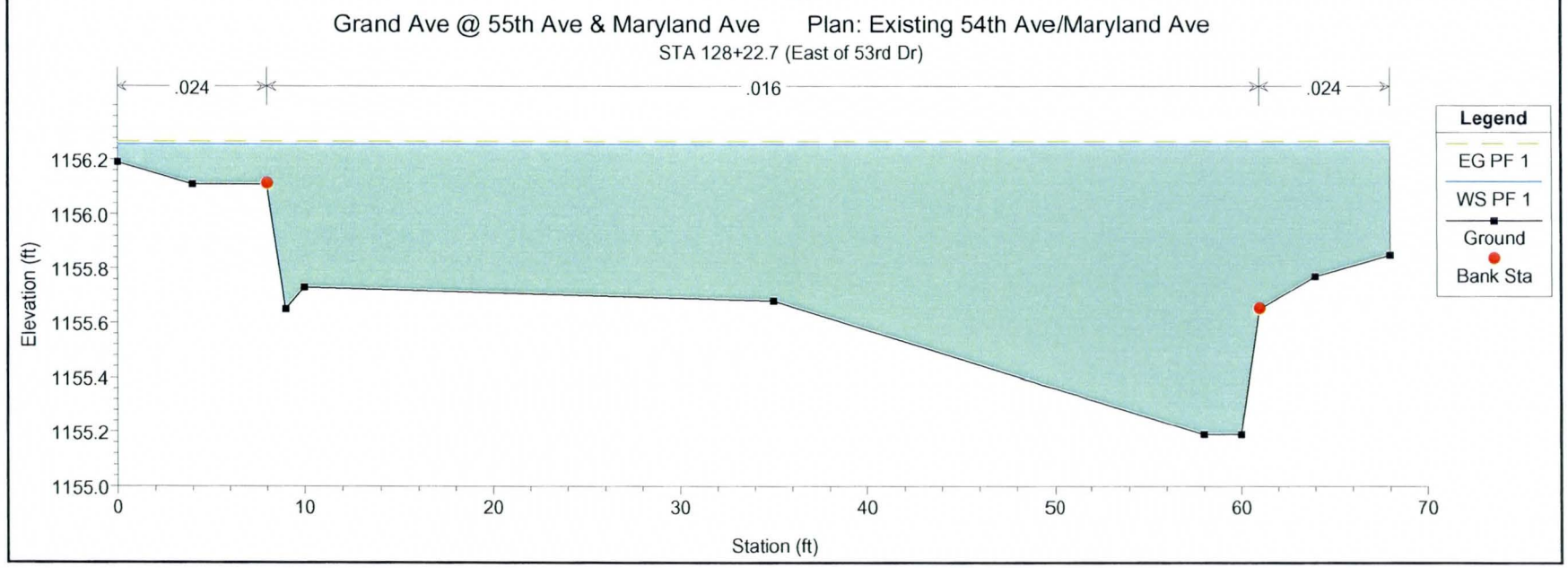

Grand Ave @ 55th Ave & Maryland Ave Plan: Existing 54th Ave/Maryland Ave
Station 123+65 (West of 54th Ave)
.024
.016
.024
Elevation (ft)
1155.8
1155.6
1155.4
1155.2
1155.0
1154.8
1154.6
0
10
20
30
40
50
60
70
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta

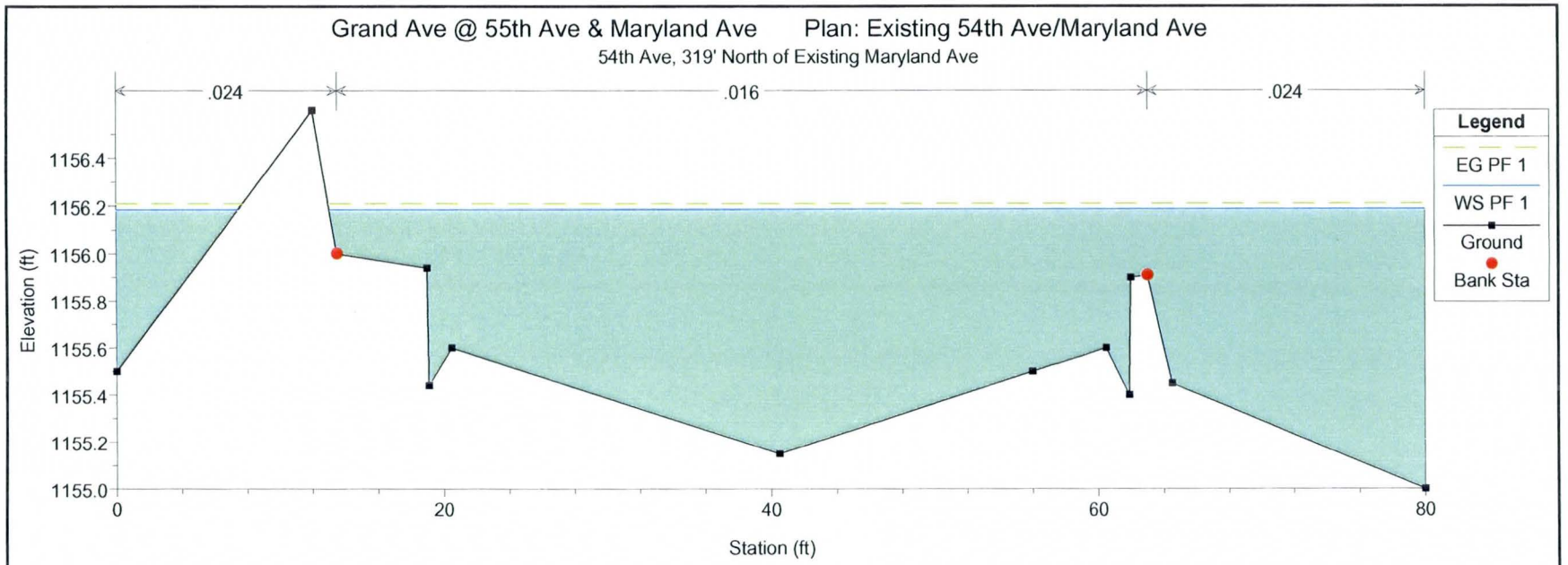

Grand Ave @ 55th Ave & Maryland Ave Plan: Existing 54th Ave/Maryland Ave
Station 121+15 (West of 54th Ave)
.024
.016
.024
Elevation (ft)
1155.6
1155.4
1155.2
1155.0
1154.8
1154.6
1154.4
1154.2
1154.0
0
10
20
30
40
50
60
70
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta

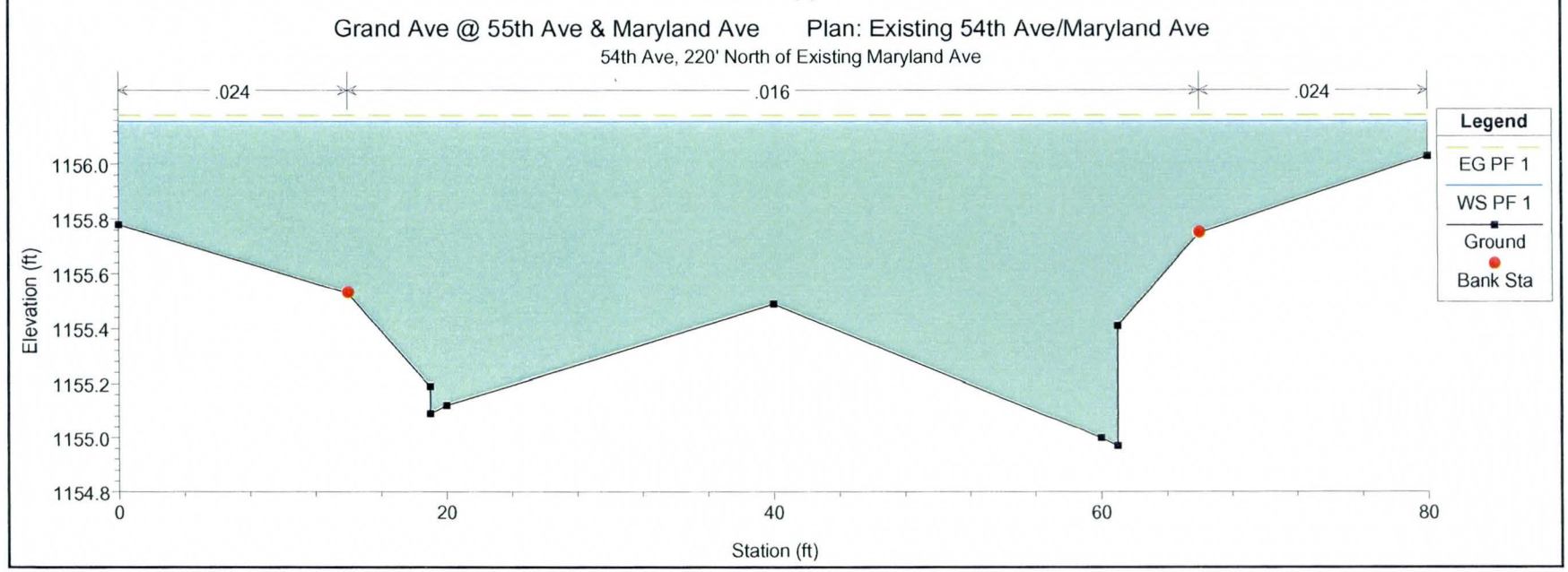

Grand Ave @ 55th Ave & Maryland Ave Plan: Existing 54th Ave/Maryland Ave
Station 126+10 (East of 54th Ave)
.024
.016
.024
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
1156.2
1156.0
1155.8
1155.6
1155.4
1155.2
1155.0
1154.8
0
10
20
30
40
50
60
70
Station (ft)


Grand Ave @ 55th Ave & Maryland Ave Plan: Existing 54th Ave/Maryland Ave
Station 124+46.4 (East of 54th Ave)
.024
.016
.024
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
1156.0
1155.8
1155.6
1155.4
1155.2
1155.0
1154.8
1154.6
0
10
20
30
40
50
60
70
Station (ft)


Grand Ave @ 55th Ave & Maryland Ave Plan: Existing 54th Ave/Maryland Ave
54th Ave, 86' North of Existing Maryland Ave
.024
.016
.024
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
1156.0
1155.8
1155.6
1155.4
1155.2
1155.0
1154.8
0
20
40
60
80
Station (ft)

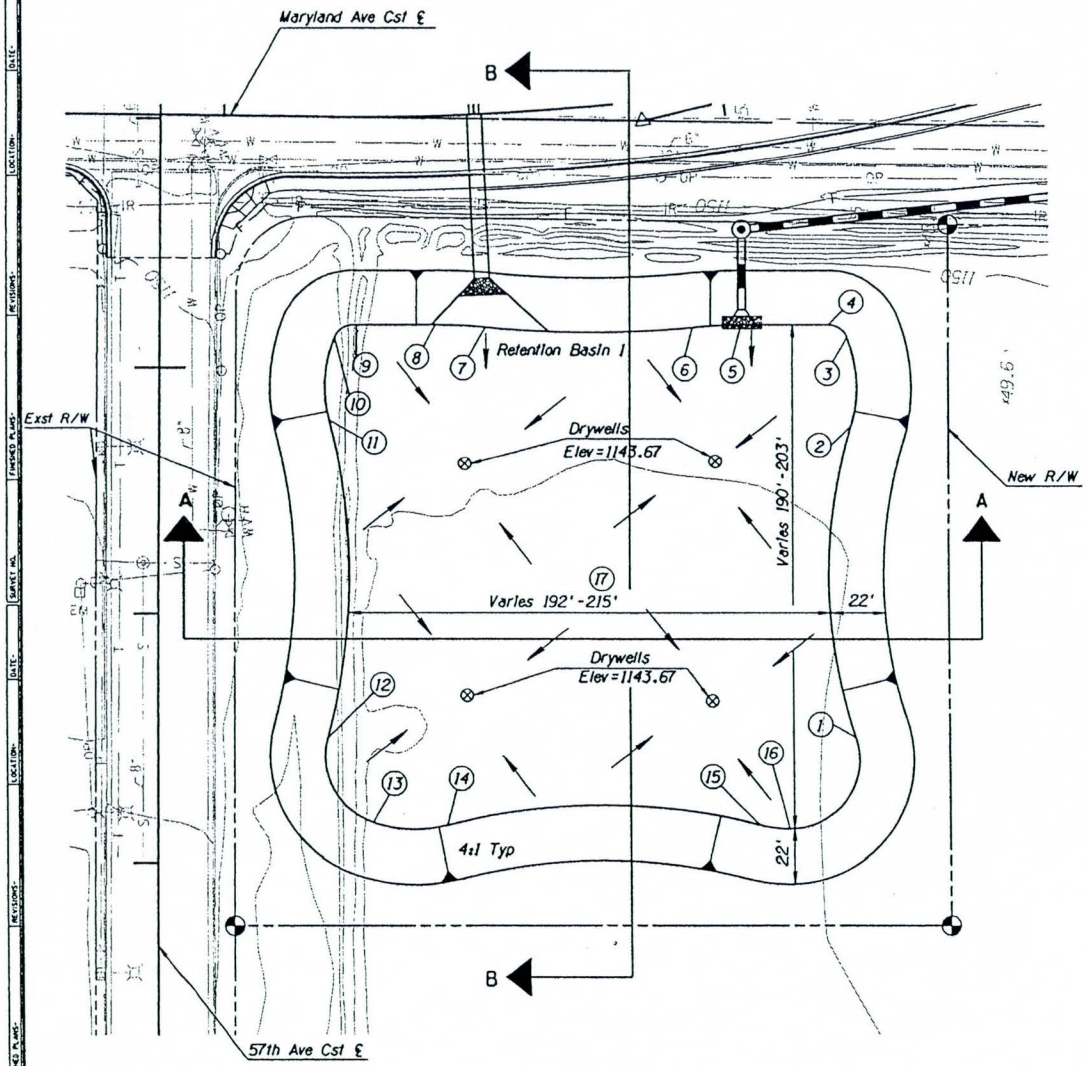

Grand Ave @ 55th Ave & Maryland Ave Plan: Existing 54th Ave/Maryland Ave
STA 128+22.7 (East of 53rd Dr)
.024
.016
.024
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
1156.2
1156.0
1155.8
1155.6
1155.4
1155.2
1155.0
0
10
20
30
40
50
60
70
Station (ft)

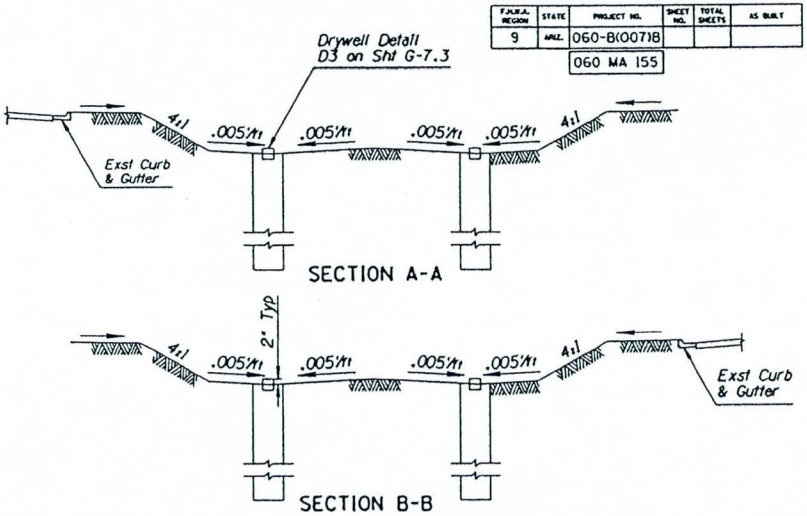

Grand Ave @ 55th Ave & Maryland Ave Plan: Existing 54th Ave/Maryland Ave
54th Ave, 319' North of Existing Maryland Ave
.024
.016
.024
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
1156.4
1156.2
1156.0
1155.8
1155.6
1155.4
1155.2
1155.0
0
20
40
60
80
Station (ft)


Grand Ave @ 55th Ave & Maryland Ave Plan: Existing 54th Ave/Maryland Ave
54th Ave, 220' North of Existing Maryland Ave
.024
.016
.024
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
1156.0
1155.8
1155.6
1155.4
1155.2
1155.0
1154.8
0
20
40
60
80
Station (ft)

Appendix J
Retention Basin Analysis (100-year, 2-hour)
(Including Plans and Elevations)

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	060-B(007)B			
		060 MA 155			





BASIN COORDINATES

Pt No	Desc	Radius	Northing	Easting	Elevation
1	PCC	211.00'	920846.98	619569.67	1143.65
2	PCC	51.94'	920973.67	619568.35	1143.65
3	PCC	8.00'	921008.74	619566.58	1143.65
4	PT	-	921013.66	619559.19	1143.65
5	PC	200.00'	921013.66	619524.26	1143.65
6	PCC	422.00'	921012.69	619504.56	1143.65
7	PCC	200.00'	921012.69	619421.41	1143.65
8	PT	-	921013.66	619401.71	1143.65
9	PC	8.00'	921013.66	619369.92	1143.65
10	PCC	51.94'	921008.74	619361.02	1143.65
11	PCC	250.00'	920975.96	619358.79	1143.65
12	PCC	28.00'	920846.76	619357.84	1143.65
13	PCC	51.94'	920812.81	619375.82	1143.65
14	PCC	250.00'	920811.72	619405.60	1143.65
15	PCC	48.07'	920811.82	619530.98	1143.65
16	PCC	28.00'	920810.29	619543.12	1143.65
17	-	-	920910.75	619465.76	1143.65

	NAME	DATE
DESIGN	RS	09/02
DRAWN	WSK	09/02
CHECKED	DJS	09/02

BRW
7720 N. 16th Street
Suite 100
Phoenix, Arizona 85020
(602) 234-1518

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION

RETENTION BASIN 1
PLAN & ELEVATION

PRELIMINARY
STAGE IV
Review
NOT FOR CONSTRUCTION OR RECORDING

ROUTE: US 60
LOCATION: GRAND AVE AT 55TH AVE AND MARYLAND AVE

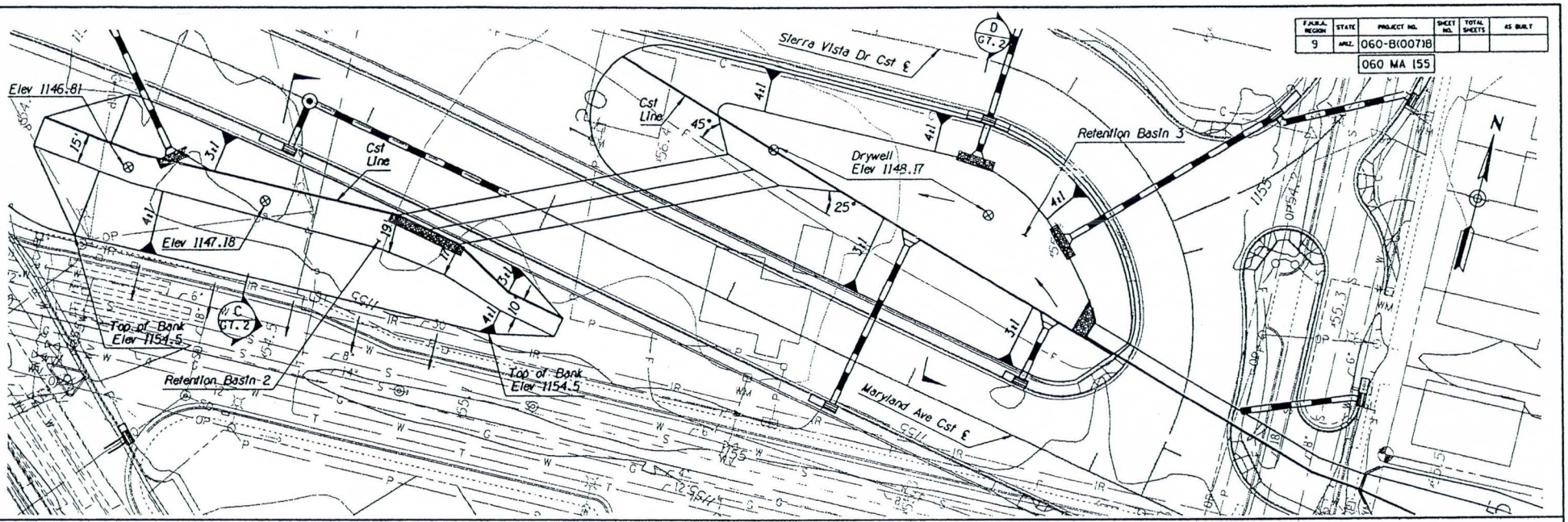
DWG. NO. D-2.11

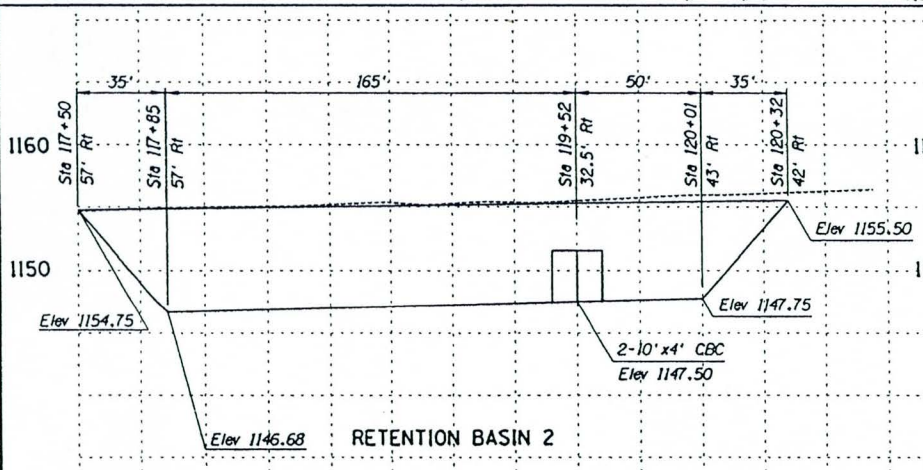
TRACS NO. H5601 01 C

060-B(007)B

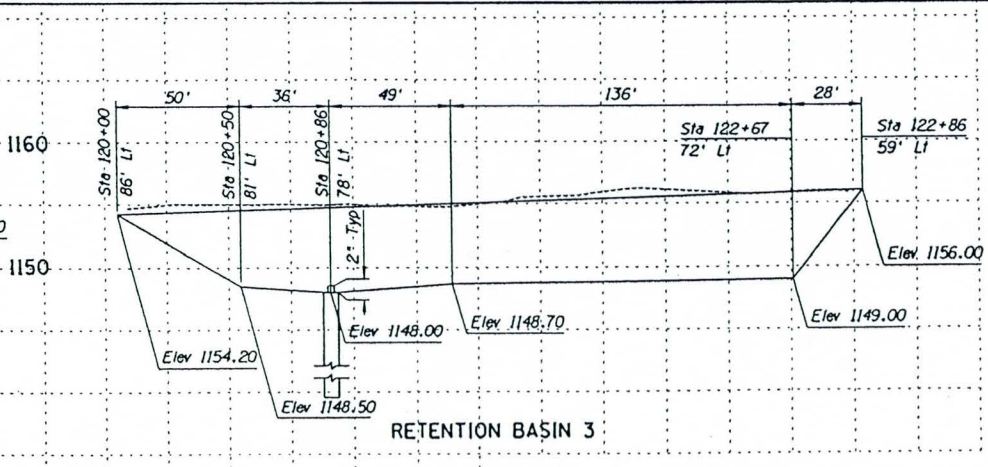
___ OF ___

F.A.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	060-B(007)B			
		060 MA 155			





RETENTION BASIN 2



RETENTION BASIN 3

	NAME	DATE
DESIGN	RS	09/02
DRAWN	MSK	09/02
CHECKED	DJS	09/02

BRW
7720 N. 16th Street
Suite 100
Phoenix, Arizona 85020
(602) 734-1599

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION

RETENTION BASINS 2 & 3
PLAN & PROFILES

PRELIMINARY
STAGE IV
Review
NOT FOR CONSTRUCTION OR RECORDING

ROUTE: US 60
LOCATION: GRAND AVE AT 55TH AVE AND MARYLAND AVE

TRACS NO. H5601 01 C

060-B(007)B

DWG. NO. D-2.12

___ OF ___

BRW
A DAMES & MOORE GROUP COMPANY

JOB MARYLAND SHEET NO. 1 OF 6
MADE BY R. BEECROFT DATE SEPT. 30, 02 JOB NO.
CHECKED BY DATE SEC SHT. NO.
CALCULATIONS FOR RETENTION BASINS

PROBLEM STATEMENT: DETERMINE THE SIZE OF BASINS REQUIRED TO HOLD A 100 YEAR 2 HOUR STORM, THE # OF DRYWELLS REQUIRED, AND THE WATER SURFACE ELEVATIONS.

SOLUTION:
1. MEASURE THE AREAS USING MICROSTATION, APPLY THE APPROPRIATE C FACTORS AND ADD THEM UP.
2. CALCULATE THE VOLUME REQUIRED USING $P_{100,2}$
3. COMPUTE THE # OF DRYWELLS REQ'D.
4. DESIGN A RETENTION BASIN LARGE ENOUGH TO HOLD THE REQUIRED VOLUME KEEPING THE WATER DEPTH TO A MAX. OF 3' IF POSSIBLE USING MICROSTATION AND AVERAGE END METHOD. SIDE SLOPES TO BE 4:1 UNLESS OTHERWISE NOTED.

BRW
A DAMES & MOORE GROUP COMPANY

JOB MARYLAND SHEET NO. 2 OF 6
MADE BY R. BEECROFT DATE SEPT. 30, 02 JOB NO.
CHECKED BY DATE SEC SHT. NO.
CALCULATIONS FOR RETENTION BASIN 1 - DRYWELL CALCS.

MARYLAND AVE: A·C = 58,050 SF [A = STA 103+25 TO 114+00
↳ .90 A = 1075' x 60' = 64,520 SF]

EARTHEN CHANNEL 1 (SOUTH): STA 10+00 TO 16+18.97

A·C = 33,846 SF
↳ .70

EARTHEN CHANNEL 2 (NORTH): STA 10+00 TO 16+99.09

SUB AREAS: 2-1, 2-2, 2-3 (FROM D-3.1)

A·C = 46,653 SF
↳ .70

SUB AREAS: 1-1, 1-2, 1-3 (FROM D-3.1)

A·C = 435,164 SF
↳ .90

BASIN 1: 81,149 SF x .7 = 56,804 SF

Σ C·A = 630,517 SF

$P_{100,2}$ = 2.53" = 100 YR - 2 HR STORM

VOLUME REQ'D = CPA

= 630,517 SF x 2.53"/12 = 132,934 CF

OF DRYWELLS REQ'D

$$\frac{132{,}934 \text{ CF}}{\left(.25 \frac{\text{CFS}}{\text{WELL}}\right)\left(36 \text{ HR}\right)\left(60 \times 60 \frac{\text{SEC}}{\text{HR}}\right)} = 4.1$$

USE 4 DRY WELLS

BRW
A DAMES & MOORE GROUP COMPANY

JOB MARYLAND SHEET NO. 3 OF 6
MADE BY R. BEECROFT DATE SEPT. 30, 02 JOB NO.
CHECKED BY DATE SEC SHT. NO.
CALCULATIONS FOR DET. RETENTION BASINS 2-3 & CHANNELS 1-2-3 FOR DRYWELLS

WSE 1154.5 FOR ALL

DETENTION BASIN 2 (STA 117+50 TO 120+32) = 60,429 CF

DETENTION BASIN 3 (STA 119+95 TO 122+89) = 77,206 CF

EARTHEN CHANNEL 3 (STA 124+27 TO 125+84) = 4,541 CF

BOX FOR BASIN 2-3 (STA 119+51 TO 120+84) = 13,120 CF
2ea 10'x4'

BOX FOR BASIN 3 TO CH 3 (STA 122+86 TO 124+27) = 4,823 CF

Actual Volume = 160,119 CF

$$\#\text{ OF DRYWELLS REQ'D} = \frac{160{,}119 \text{ CF}}{\left[.25 \frac{\text{CF}}{\text{S-WELL}}\right](36\text{HR})\left(\frac{60 \text{ MIN}}{1\text{HR}}\right)\left(\frac{60\text{SEC}}{1\text{MIN}}\right)}$$

= 4.94

USE 5 DRYWELLS

BRW
A DAMES & MOORE GROUP COMPANY

JOB MARYLAND SHEET NO. 4 of 6
MADE BY R. BEERPOFT DATE SEPT 30, 02 JOB NO.
CHECKED BY DATE SEC SHT. NO.
CALCULATIONS FOR RETENTION BASINS 2, 3 & CH. 3
AREAS FROM SHT D.-1.2

(A1) 130,669 sf x .90 = 117,602 sf

(A2) 37,918 sf x .70 = 26,543 sf

(A3) 20,247 sf x .70 = 14,173 sf

(A4) 11,343 sf x .70 = 7940 sf

166,258 sf

(100-YR, 2-HOUR VOL)
VOLUME REQD = 166,258 sf x 2.53"/12 = 35,052 cf

BRW
A DAMES & MOORE GROUP COMPANY

JOB MARYLAND SHEET NO. 5 of 6
MADE BY R. BEECROFT DATE SEPT 20, 02 JOB NO.
CHECKED BY DATE SEC SHT. NO.
CALCULATIONS FOR CUT VOLUMES

RETENTION BASIN 1: 261,684 CF (9,692 CY)

DETENTION BASIN 2: 66,787 CF (2,474 CY)
DETENTION BASIN 3: 97,319 CF (3,604 CY)

EARTHEN CHANNEL 1: 3,719 CF (138 CY)
" " 2: 38,171 CF (1,414 CY)
" " 3: 9,500 CF (352 CF)

} 215,496 CF

TOTAL CUT 477,180 CF (17,673 CY)

BRW
A DAMES & MOORE GROUP COMPANY

JOB MAYLAND SHEET NO. 6 of 6
MADE BY RBB DATE SEPT 30, 02 JOB NO.
CHECKED BY DATE SEC SHT. NO.
CALCULATIONS FOR CONCLUSION

CONCLUSION RETENTION BASIN #1:

- VOLUME REQ'D TO HOLD THE 100 YEAR, 2 HOUR STORM = 132,934
- ACTUAL VOLUME = 260,726 CF @ LOW ELE. 1147.90
- # OF DRYWELLS REQ'D = 4
- MAX. WATER DEPTH AT DRYWELLS = 3.1'
- 4:1 SIDE SLOPES

CONCLUSION RETENTION BASIN 2, 3 & CHANNEL 2

- VOLUME REQ'D TO HOLD 100 YEAR, 2 HR STORM = 35,052 CF
- ACTUAL VOLUME = 160,119 CF
- # OF DRYWELLS REQ'D = 5
- MAX. WATER DEPTH AT DRYWELLS VARIES FROM

  1.1' TO 7.69'

BRW
A DAMES & MOORE GROUP COMPANY

JOB MARYLAND SHEET NO. 1 OF 12
MADE BY RBR DATE JULY 1, 02 JOB NO.
CHECKED BY DATE SEC SHT. NO.
CALCULATIONS FOR CLAREMONT CALCULATIONS EXPLANATION

PROBLEM STATEMENT: DETERMINE THE DEPTH OF WATER AT THE DRYWELLS WITHIN THE RIGHT OF WAY & THE VOLUME OF WATER FOR THE 100 YEAR, 2 HOUR STORM & COMPARE TO THE MAX. VOLUME OF STORAGE POSSIBLE WHILE KEEPING WSE BELOW EDGE OF PAVEMENT.

SOLUTION: 1. COMPUTE THE MAXIMUM WATER STORAGE VOLUME USING THE AVERAGE END METHOD (FOR THE CHANNELS)

2. DETERMINE THE AREA OF PAVEMENT & DESERT LANDSCAPING AREAS, APPLY THE APPROPRIATE C VALUES TO GET AREA.
3. COMPUTE VOLUME OF STORMWATER USING $P_{100,2}$
4. COMPUTE THE # OF DRYWELLS NEEDED USING 100 YR, 2 HR STORM.
5. COMPUTE THE VOLUME OF WATER FOR A 10 YEAR, 10 MIN. STORM
6. CALCULATE THE FLOW IN CFS FOR $Q_{10,10}$
7. USE FLOWMASTER BY HAESTAD METHODS TO GET A WATER DEPTH FOR $Q_{10,10}$
8. ASSUME A WATER DEPTH, COMPUTE THE VOLUME USING AVERAGE END METHOD TO COMPARE WITH THE COMPUTED VOLUME USING $P_{100,2}$. IF THE NEW COMPUTED VOLUME IS GREATER THAN THE VOLUME USING $P_{100,2}$, THAT IS FINE. IF THE VOLUME IS LOWER, ASSUME A GREATER WATER DEPTH & RETRY.

STEPS 1, 2, 3, & 8 ARE USED TO GET WATER DEPTH FOR A 100 YEAR, 2 HR STORM

STEPS 2, 3, 4, 5, 6, & 7 ARE USED TO GET A WSE FOR $Q_{10,10}$

THERE WAS ONLY 2 SEPARATE SLOPES FOR THE ROAD. CROSS-SECTIONS WERE THE SAME FOR ALL OF CLAREMONT FOR THE ROADWAY & ONLY A FEW ELEVATION VARIATIONS IN THE SHOULDER.

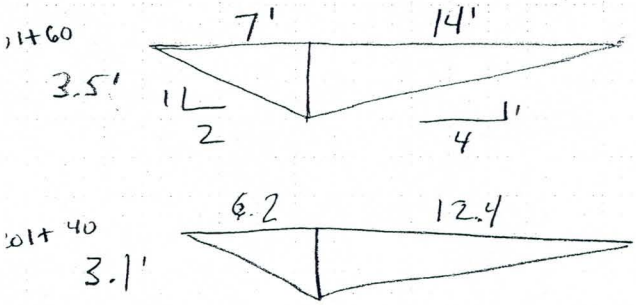
BRW
A DAMES & MOORE GROUP COMPANY

JOB MARYLAND SHEET NO. 2 OF 12
MADE BY RBB DATE JUNE 26, 02 JOB NO.
CHECKED BY DATE SEC SHT. NO.
CALCULATIONS FOR CLAREMONT - WATER VOLUME TOTAL STORAGE BELOW PAVEMENT

• MAXIMUM AVAILABLE STORAGE VOLUME

NORTH SIDE FROM STA. 201+00 TO 208+00

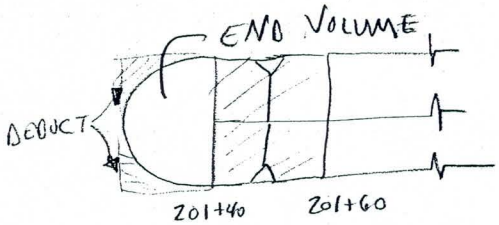
MAX VOLUME OF WATER: 201+40 TO 201+60 @ -2.0000% SLOPE



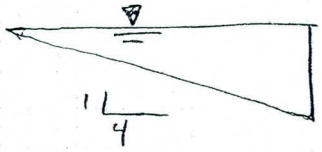
36.75 SF

28.83 SF

$\frac{36.75 + 28.83}{2} \times 20' = 655.8$



$(28.83\ SF)(12.4\ ft)\ \frac{1}{2} \times .5 = 89\ CF$



$\frac{1}{2}\ bh$

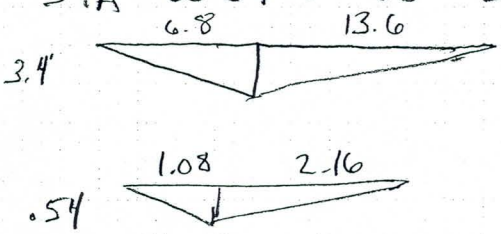
.0052%

SLOPE .0052%
STA 201+60 A = 36.75 SF
STA 208+00 WSE = .17 A = .51

$\frac{36.75\ SF + .51}{2} \times 640' = 11{,}923\ CF$

TOTAL = 12,668 CF

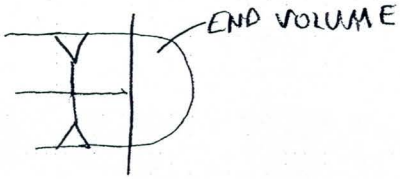
NORTH
STA 208+00 TO 214+50



34.68 SF

Ø

$\frac{(34.68 + Ø)}{2} \times 650 = 11{,}271\ C$



$(.Ø\ SF)(4 \times .54)(\frac{1}{2})(.5) = Ø\ CF$

TOTAL = 11,271 CF

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JOB _____ SHEET NO. 3 OF 12
MADE BY RBB DATE JUNE 26, 02 JOB NO. _____
CHECKED BY _____ DATE _____ SEC SHT. NO. _____
CALCULATIONS FOR CLAREMONT - WATER DEPTH IN DITCH

ACTUAL W.S.E. for 100-yr, 2 hr event

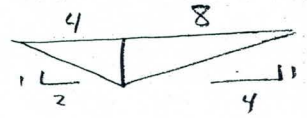
NORTH SIDE FROM STA 201+40 TO 208+00 BACK CHECK

FIND: WSE for $P_{100,2}$ VOLUME = 6,942 CF (see sht 5)

APPROXIMATE: $\frac{6{,}942 \text{ cf}}{12{,}668 \text{ cf MAX}} \times 3.5' = 1.93' \approx \underline{2.0'}$

CHECK:

1+60
2'



12 SF

1+40
1.6'

9.6 SF

$\frac{12 + 9.6 \text{ SF}}{2} \times 20' = \underline{216 \text{ CF}}$

$(9.6 \text{ sf})(4 \times 1.6)\frac{1}{2} \times .5 = \underline{15.4 \text{ cf}}$

STA 201+60: A = 12 SF
STA 206+39.4: A = Ø

$\frac{(12 + Ø)}{2} \times 479.4' = \underline{2876.6}$

TOTAL = 3108 CF NOPE

ASSUME 2.75' WATER DEPTH

1+60
2.75

22.7 SF

1+40
2.35

16.6

$\frac{(22.7 + 16.6)}{2} \times 20 = \underline{392.6 \text{ CF}}$

END VOLUME $(16.6 \text{ sf})(4 \times 2.35)\frac{1}{2} \times .5 = \underline{39. \text{ cf}}$

STA. 201+60: A = 22.7 F
STA 206+88.8: A = Ø

$\frac{(22.7 + 0)}{2} \times 528.8' = \underline{6002 \text{ CF}}$

TOTAL = 6,434 CF NO

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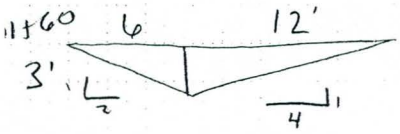
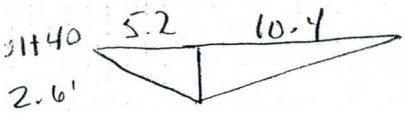
JOB _____ SHEET NO. 4 OF 12
MADE BY RBB DATE JUNE 28,02 JOB NO. _____
CHECKED BY _____ DATE _____ SEC SHT. NO. _____
CALCULATIONS FOR CLAREMONT - WATER DEPTH IN DITCH FOR VOLUME

ASSUME 3.00' WATER DEPTH



= 27 sf



= 20.28 sf

$$\frac{27 + 20.28}{2} \times 20' = 472 \text{ cf}$$

$$(20.28 \text{ sf})(4 \times 2.6)\tfrac{1}{2} \times .5 = 53 \text{ cf}$$

STA. 201+60 : A = 27
STA. 207+37 : A = Ø

$$\frac{(27 + Ø)}{2} \times 576.9' = 7788.15 \text{ cf}$$

8314 cf

ASSUME 2.9'

25.83
19.4

4.52 cf

48 cf

7202

7702 cf

CONCLUSION

ASSUME 2.87' WATER DEPTH FOR A VOLUME OF 7295 CF OK

W.S.E. IS BELOW PAVEMENT SURFACE. (FROM EXCEL MICROSOFT)

* THIS DEPTH OF 2.9' AT THE DRYWELLS IS FOR EACH OF THE 4 DRYWELL LOCATIONS SINCE THE VOLUMES OF WATER FOR THE 100 YEAR 2 HOUR STORM ARE CLOSE TO EACHOTHER.

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JOB MARYLAND SHEET NO. 5 OF 12
MADE BY RBB DATE JUNE 26,02 JOB NO.
CHECKED BY DATE SEC SHT. NO.
CALCULATIONS FOR CLAREMONT-DRYWELL, VOLUME, & FLOW

• VOLUME/RUNOFF

NORTH SIDE OF CLAREMONT FROM ℄ TO R/W STA. 201+00 TO 208+00

$AREA_{PAVED} = 16,267 \times 0.95 = 15,454$ SF

$AREA_{DESERT} = 24,963 \times 0.70 = 17,474$ SF

32,928 SF

OF DRYWELLS

$P_{100,2} = 2.53''$ $V_{OLUME} = (32,928 \text{ sf})(2.53'')\left(\frac{1 ft}{12 IN}\right) = 6,942$ CF

$$\# \text{ WELLS REQD} = \frac{(6,942 \text{ cf})}{\left(.25 \frac{cfs}{well}\right)(36 HR)\left(\frac{60 MIN}{1 HR}\right)\left(\frac{60 SEC}{1 MIN}\right)} = 0.21$$

VOLUME OF WATER USING 10 YEAR, 10 MIN. STORM

$P_{10,10} = 0.71$ IN $V_{10,10} = (32,928 \text{ sf})(0.71 IN)\left(\frac{1 ft}{12 IN}\right) = 1,948$ CF

FLOW OF WATER FOR A 10 YEAR, 10 MIN STORM

$I_{10,10} = 4.28 \frac{IN}{HR}$

$Q_{10,10} = (32,928 \text{ sf})\left(4.28 \frac{IN}{HR}\right)\left(\frac{1 HR}{60 MIN}\right)\left(\frac{1 MIN}{60 SEC}\right)\left(\frac{1 ft}{12 IN}\right) = 3.26$ cfs

⇒ WATER DEPTH for $Q_{10,10} = 3.26$ cfs IS 0.84 ft

USING FLOWMASTER BY HAESTAD METHODS

(see attached calculations)

BRW
A DAMES & MOORE GROUP COMPANY

JOB MARYLAND SHEET NO. 6 OF 12
MADE BY RBB DATE JUNE 26, 02 JOB NO.
CHECKED BY DATE SEC SHT. NO.
CALCULATIONS FOR CLAREMONT - DRYWELL, VOLUME, & FLOW

• Volume / Runoff

NORTH SIDE FROM ℄ TO R/W STA 208+00 TO 215+04.35

$AREA_P = 16{,}334.8 \text{ sf} \times 0.95 = 15{,}518 \text{ sf}$

$AREA_D = 26{,}934.5 \text{ sf} \times 0.70 = 18{,}854.2 \text{ sf}$

34,372 sf

OF DRYWELLS REQUIRED USING 100 YEAR, 2 HOUR STORM

$P_{100,2} = 2.53 \quad V = (34{,}372)(2.53 \text{ in})\left(\frac{1 \text{ ft}}{12 \text{ in}}\right) = 7{,}247 \text{ CF}$

OF DRYWELLS : (7,247 cf) / [.25 × 36 × 60 × 60) ⇒ 0.22

VOLUME OF WATER (10 YEAR, 10 MIN) $P_{10,10} = 0.71$ IN

$V_{10,10} = (34{,}372 \text{ sf})(0.71 \text{ in})\left(\frac{1 \text{ ft}}{12 \text{ in}}\right) = 2{,}034 \text{ CF}$

FLOW OF WATER FOR $I_{10,10} = 4.28 \frac{\text{IN}}{\text{HR}}$

$Q_{10,10} = (34{,}372 \text{ sf})\left(4.28 \frac{\text{in}}{\text{hr}}\right)\left(\frac{1 \text{ hr}}{60 \text{ min}}\right)\left(\frac{1 \text{ min}}{60 \text{ sec}}\right)\left(\frac{1 \text{ ft}}{12 \text{ in}}\right) = 3.41 \text{ cfs}$

(10 YR, 10 MIN)

⇒ USING FLOWMASTER BY HAESTAD METHODS THE DEPTH IS 0.86 ft FOR $Q_{10,10} = 3.41$ (see attached Calculations)

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JOB _____ SHEET NO. 7 OF 12
MADE BY RBB DATE JUNE 26, 02 JOB NO. _____
CHECKED BY _____ DATE _____ SEC SHT. NO. _____
CALCULATIONS FOR CLAREMONT - DRYWELL, VOLUME & FLOW

• Volume/Runoff

SOUTH SIDE FROM STA. 208+00 TO 215+04.35

$AREA_P = 16,095.8 \text{ SF} \times 0.95 = 15,291 \text{ SF}$

$AREA_D = 25,168.8 \text{ SF} \times 0.70 = 17,618.2 \text{ SF}$

$32,909.2 \text{ SF}$

OF DRYWELLS

$$V_{100,2} = (32,909.2 \text{ sf})(2.53 \text{ IN})\left(\frac{1 \text{ ft}}{12 \text{ IN}}\right) = 6,938 \text{ CF}$$

$$\# \text{ DW REQ'D} = \frac{(6,938 \text{ cf})}{\left(.25 \frac{\text{cfs}}{\text{WELL}}\right)(36 \text{ HR})\left(\frac{60 \text{ MIN}}{1 \text{ HR}}\right)\left(\frac{60 \text{ SEC}}{\text{MIN}}\right)} = 0.21$$

VOLUME OF WATER USING $P_{10,10} = 0.71$ IN

$$V_{10,10} = (32,909.2 \text{ sf})(0.71 \text{ IN})\left(\frac{1 \text{ ft}}{12 \text{ IN}}\right) = 1947 \text{ CF}$$

FLOW OF WATER FOR $I_{10,10} = 4.28 \frac{\text{IN}}{\text{HR}}$

$$Q_{10,10} = (32,909.2 \text{ cf})\left(4.28 \frac{\text{IN}}{\text{HR}}\right)\left(\frac{1 \text{ HR}}{60 \text{ MIN}}\right)\left(\frac{1 \text{ MIN}}{60 \text{ SEC}}\right)\left(\frac{1 \text{ ft}}{12 \text{ IN}}\right) = 3.26 \text{ CFS}$$

> WATER DEPTH FOR $Q_{10,10} = 3.26$ CFS IS 0.84 ft (See attached Calculations)

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JOB MARYLAND SHEET NO. 8 OF 12
MADE BY RBR DATE JUNE 26, 02 JOB NO.
CHECKED BY DATE SEC SHT. NO.
CALCULATIONS FOR CLAREMONT - DRYWELL, VOLUME, & FLOW

• Volume / Runoff

SOUTH SIDE FROM ℄ TO R/W STA. 201+00 TO 208+00

AREA P = 16,501 SF x 0.95 = 15,676 SF

AREA O = 26,245 SF x 0.70 = 18,372 SF

34,048 SF

OF DRY WELLS REQ'D USING $P_{100,2}$ = 2.53"

$$\text{VOLUME} = (34{,}048\ \text{SF})(2.53\ \text{IN})\left(\frac{1\ \text{ft}}{12\ \text{IN}}\right) = 7{,}178\ \text{CF}$$

$$\#\ \text{OF DW} = \frac{(7{,}178\ \text{CF})}{\left(.25\ \frac{\text{CFS}}{\text{WELL}}\right)(36\ \text{HR})\left(\frac{60\ \text{MIN}}{1\ \text{HR}}\right)\left(\frac{60\ \text{SEC}}{1\ \text{MIN}}\right)} = \underline{0.22}$$

VOLUME OF WATER USING 10 YEAR, 10 MIN STORM

$P_{10,10}$ = 0.71 IN $\quad V_{10,10} = (34{,}048\ \text{SF})(.71\ \text{IN})\left(\frac{1\ \text{ft}}{12\ \text{IN}}\right) = \underline{2{,}014\ \text{CF}}$

FLOW OF WATER $\quad I_{10,10} = 4.28\ \frac{\text{IN}}{\text{HR}}$

$$Q_{10,10} = (34{,}048\ \text{SF})\left(4.28\ \frac{\text{IN}}{\text{HR}}\right)\left(\frac{1\ \text{HR}}{60\ \text{MIN}}\right)\left(\frac{1\ \text{MIN}}{60\ \text{SEC}}\right)\left(\frac{1\ \text{ft}}{12\ \text{IN}}\right) = \underline{3.37\ \text{CFS}}$$

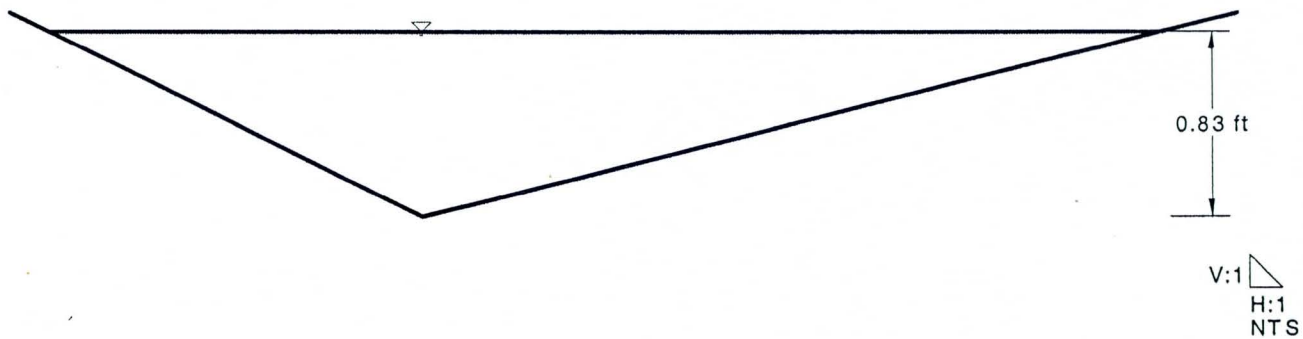
⇒ WATER DEPTH AT 3.37 CFS = $Q_{10,10}$ IS 0.86 ft

(see attached Calculations)

Claremont Street V-Ditch
Cross Section for Triangular Channel

Project Description	
Worksheet	Claremont Street V-Ditch
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficient	0.035	
Slope	0.005200	ft/ft
Depth	0.83	ft
Left Side Slope	0.50	V : H
Right Side Slope	0.25	V : H
Discharge	3.41	cfs



Claremont Street V-Ditch
Worksheet for Triangular Channel

Project Description	
Worksheet	Claremont Street V-Ditch
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.035	
Slope	0.005200	ft/ft
Left Side Slope	0.50	V : H
Right Side Slope	0.25	V : H
Discharge	3.41	cfs

Results		
Depth	0.83	ft
Flow Area	2.1	ft²
Wetted Perimeter	5.29	ft
Top Width	4.99	ft
Critical Depth	0.60	ft
Critical Slope	0.028752	ft/ft
Velocity	1.64	ft/s
Velocity Head	0.04	ft
Specific Energy	0.87	ft
Froude Number	0.45	
Flow Type	Subcritical	

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Claremont Street V-Ditch
Rating Table for Triangular Channel

Project Description	
Worksheet	Claremont Street V-Ditch
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.035	
Slope	0.005200	ft/ft
Left Side Slope	0.50	V : H
Right Side Slope	0.25	V : H

Attribute	Minimum	Maximum	Increment
Discharge (cfs)	0.00	4.00	0.25

Discharge (cfs)	Depth (ft)	Velocity (ft/s)	Flow Area (ft²)	Wetted Perimeter (ft)	Top Width (ft)
0.00	0.00	0.00	0.0	0.00	4.99
0.25	0.31	0.85	0.3	1.99	1.87
0.50	0.41	1.02	0.5	2.58	2.43
0.75	0.47	1.12	0.7	3.00	2.83
1.00	0.53	1.21	0.8	3.34	3.15
1.25	0.57	1.28	1.0	3.63	3.43
1.50	0.61	1.34	1.1	3.89	3.67
1.75	0.65	1.39	1.3	4.12	3.89
2.00	0.68	1.44	1.4	4.33	4.09
2.25	0.71	1.48	1.5	4.53	4.27
2.50	0.74	1.52	1.6	4.71	4.44
2.75	0.77	1.56	1.8	4.88	4.61
3.00	0.79	1.59	1.9	5.04	4.76
3.25	0.82	1.62	2.0	5.20	4.90
3.50	0.84	1.65	2.1	5.34	5.04
3.75	0.86	1.68	2.2	5.48	5.17
4.00	0.88	1.71	2.3	5.62	5.30

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JOB MARYLAND SHEET NO. 12 OF 12
MADE BY RBB DATE JULY 1, 02 JOB NO.
CHECKED BY DATE SEC SHT. NO.
CALCULATIONS FOR CLAREMONT - CONCLUSION

- CONCLUSIONS

  - Retention Storage and Drywell operating Characteristic
    - Each Drywell location has available storage of 12668 C.F. (Pavement Edge Elevation for assumed W.S.E., depth = 3.5') @ the wetwell.
    - Required 100-YR, 2-HR storage volume is 6,942 C.F.
    - Actual water depth is 2.9 feet ≤ 3.5' max
    - Each wetwell will be drilled to obtain an initial Capacity of 0.50 cfs. Using a design Capacity of 0.25 cfs, one wetwell is required at each location.
  - 10-YR Runoff
    - Flow depth in roadway ditch will be 0.8 to 0.9 feet.
    - Actual water depth is 1.86 feet @ the wetwell.

Appendix K
Rainfall Intensity Calculations

ARIZONA DEPARTMENT OF TRANSPORTATION
HYDROLOGIC DESIGN DATA

Project No.		TRACS No.	
Project Name	55TH AVE. & MARYLAND AVE.	Date	APRIL 5, 2002
Location	GRAND AVE. (US 60)		
Designer	REZA SHEIBANI	Checker	DAVE J. SCHAUB

Figure 1-2
Rainfall Depth-Duration-Frequency (D-D-F) Worksheet

PART A

Determine rainfall depths from the isopluvial maps (Appendix):

2-year, 6-hour		P 2, 6'	=	1.20
2-year, 24-hour		P 2, 24'	=	1.40
100-year, 6-hour		P 100, 6'	=	3.00
100-year, 24-hour		P 100, 24'	=	3.80

PART B

Compute the following:

2-year, 1-hour	$-0.011+\frac{.942(P_{2,6'})^2}{(P_{2,24'})}$	=	-0.011	+	$\frac{.942\ (\ 1.20\ )^2}{1.40}$			=	0.96
100-year, 1-hour	$0.494+\frac{.755(P_{100,6'})^2}{(P_{100,24'})}$	=	0.494	+	$\frac{.755\ (\ 3.00\ )^2}{3.80}$			=	2.28
2-year, 2-hour	$.341(P_{2,6'}) + .659(P_{2,1'})$	=	0.341 (1.20)	+	0.659 (0.96)	=			1.04
2-year, 3-hour	$.569(P_{2,6'}) + .431(P_{2,1'})$	=	0.569 (1.20)	+	0.431 (0.96)	=			1.10
2-year, 12-hour	$.500(P_{2,6'}) + .500(P_{2,24'})$	=	0.500 (1.20)	+	0.500 (1.40)	=			1.30
100-year, 2-hour	$.341(P_{100,6'}) + .431(P_{100,1'})$	=	0.341 (3.00)	+	0.659 (2.28)	=			2.53
100-year, 3-hour	$.569(P_{100,6'}) + .431(P_{100,1'})$	=	0.569 (3.00)	+	0.431 (2.28)	=			2.69
100-year, 12-hour	$.500(P_{100,6'}) + .500(P_{100,24'})$	=	0.500 (3.00)	+	0.500 (3.80)	=			3.40

Note: 5" denotes 5 mintes, etc; 1' denotes 1 hour, etc.

Figure 1-2
Rainfall Depth-Duration-Frequency (D-D-F) Worksheet
(Continued)

Part C

Determine the short-duration zone (Figure 1-1):

Zone = 8

Determine the short-duration rainfall ratios (Table 1-1):

Duration (Minutes)	Ratio			
	2-year		100-year	
5	A=	0.34	E=	0.30
10	B=	0.51	F=	0.46
15	C=	0.62	G=	0.59
30	D=	0.82	H=	0.80

Compute the following:

2-year, 5-min	(A) ($P_{2,1'}$)	=	0.34	*	0.96	$P_{2,5''}$	=	0.33
2-year, 10-min	(B) ($P_{2,1'}$)	=	0.51	*	0.96	$P_{2,10''}$	=	0.49
2-year, 15-min	(C) ($P_{2,1'}$)	=	0.62	*	0.96	$P_{2,15''}$	=	0.59
2-year, 30-min	(D) ($P_{2,1'}$)	=	0.82	*	0.96	$P_{2,30''}$	=	0.79
100-year, 5-min	(E) ($P_{100,1'}$)	=	0.30	*	2.28	$P_{100,5''}$	=	0.68
100-year, 10-min	(F) ($P_{100,1'}$)	=	0.46	*	2.28	$P_{100,10''}$	=	1.05
100-year, 15-min	(G) ($P_{100,1'}$)	=	0.59	*	2.28	$P_{100,15''}$	=	1.35
100-year, 30-min	(H) ($P_{100,1'}$)	=	0.80	*	2.28	$P_{100,30''}$	=	1.83

Note: 5" denotes 5 minutes, etc; 1' denotes 1 hour, etc.

Figure 1-2
Rainfall Depth-Duration-Frequency (D-D-F) Worksheet
(Continued)

Part D

For any flood frequency (T-yr) other than 2-year or 100-year, calculate the rainfall depth for each rainfall duration (t) by the following equation:

$$P_{T,t} = (X)\,(P_{2,t}) + (Y)\,(P_{100,t})$$

where X and Y for a selected frequency (T-yr) are:

Frequency (T-yr)	X	Y
5-year	0.674	0.278
10-year	0.496	0.449
25-year	0.293	0.669
50-year	0.146	0.835
500-year	-0.337	1.381

Selected frequency (T-yr) = 5 yr X = 0.674 Y = 0.278

5-min	$(X)\,(P_{2,5'}) + (Y)\,(P_{100,5'})$	=	(	0.674	) (	0.33	) + (	0.278	) (	0.68	)	$P_{5,5'}$	=	0.41
10-min	$(X)\,(P_{2,10'}) + (Y)\,(P_{100,10'})$	=	(	0.674	) (	0.49	) + (	0.278	) (	1.05	)	$P_{5,10'}$	=	0.62
15-min	$(X)\,(P_{2,15'}) + (Y)\,(P_{100,15'})$	=	(	0.674	) (	0.59	) + (	0.278	) (	1.35	)	$P_{5,15'}$	=	0.77
30-min	$(X)\,(P_{2,30'}) + (Y)\,(P_{100,30'})$	=	(	0.674	) (	0.79	) + (	0.278	) (	1.83	)	$P_{5,30'}$	=	1.04
1-hour	$(X)\,(P_{2,1'}) + (Y)\,(P_{100,1'})$	=	(	0.674	) (	0.96	) + (	0.278	) (	2.28	)	$P_{5,1'}$	=	1.28
2-hour	$(X)\,(P_{2,2'}) + (Y)\,(P_{100,2'})$	=	(	0.674	) (	1.04	) + (	0.278	) (	2.53	)	$P_{5,2'}$	=	1.40
3-hour	$(X)\,(P_{2,3'}) + (Y)\,(P_{100,3'})$	=	(	0.674	) (	1.10	) + (	0.278	) (	2.69	)	$P_{5,3'}$	=	1.49
6-hour	$(X)\,(P_{2,6'}) + (Y)\,(P_{100,6'})$	=	(	0.674	) (	1.20	) + (	0.278	) (	3.00	)	$P_{5,6'}$	=	1.64
12-hour	$(X)\,(P_{2,12'}) + (Y)\,(P_{100,12'})$	=	(	0.674	) (	1.30	) + (	0.278	) (	3.40	)	$P_{5,12'}$	=	1.82
24-hour	$(X)\,(P_{2,24'}) + (Y)\,(P_{100,24'})$	=	(	0.674	) (	1.40	) + (	0.278	) (	3.80	)	$P_{5,24'}$	=	2.00

Note: 5" denotes 5 minutes, etc; 1' denotes 1 hour, etc.

Figure 1-2

Rainfall Depth-Duration-Frequency (D-D-F) Worksheet

(Continued)

Part D

For any flood frequency (T-yr) other than 2-year or 100-year, calculate the rainfall depth for each rainfall duration (t) by the following equation:

$$P_{T,t} = (X)(P_{2,t}) + (Y)(P_{100,t})$$

where X and Y for a selected frequency (T-yr) are:

Frequency (T-yr)	X	Y
5-year	0.674	0.278
10-year	0.496	0.449
25-year	0.293	0.669
50-year	0.146	0.835
500-year	-0.337	1.381

Selected frequency (T-yr) = 10 yr X = 0.496 Y = 0.449

5-min	$(X)(P_{2,5'}) + (Y)(P_{100,5'})$	=	(	0.496)	(	0.33)	+ (	0.449)	(	0.68)	$P_{10,5'}$	=	0.47
10-min	$(X)(P_{2,10'}) + (Y)(P_{100,10'})$	=	(	0.496)	(	0.49)	+ (	0.449)	(	1.05)	$P_{10,10'}$	=	0.71
15-min	$(X)(P_{2,15'}) + (Y)(P_{100,15'})$	=	(	0.496)	(	0.59)	+ (	0.449)	(	1.35)	$P_{10,15'}$	=	0.90
30-min	$(X)(P_{2,30'}) + (Y)(P_{100,30'})$	=	(	0.496)	(	0.79)	+ (	0.449)	(	1.83)	$P_{10,30'}$	=	1.21
1-hour	$(X)(P_{2,1'}) + (Y)(P_{100,1'})$	=	(	0.496)	(	0.96)	+ (	0.449)	(	2.28)	$P_{10,1'}$	=	1.50
2-hour	$(X)(P_{2,2'}) + (Y)(P_{100,2'})$	=	(	0.496)	(	1.04)	+ (	0.449)	(	2.53)	$P_{10,2'}$	=	1.65
3-hour	$(X)(P_{2,3'}) + (Y)(P_{100,3'})$	=	(	0.496)	(	1.10)	+ (	0.449)	(	2.69)	$P_{10,3'}$	=	1.75
6-hour	$(X)(P_{2,6'}) + (Y)(P_{100,6'})$	=	(	0.496)	(	1.20)	+ (	0.449)	(	3.00)	$P_{10,6'}$	=	1.94
12-hour	$(X)(P_{2,12'}) + (Y)(P_{100,12'})$	=	(	0.496)	(	1.30)	+ (	0.449)	(	3.40)	$P_{10,12'}$	=	2.17
24-hour	$(X)(P_{2,24'}) + (Y)(P_{100,24'})$	=	(	0.496)	(	1.40)	+ (	0.449)	(	3.80)	$P_{10,24'}$	=	2.40

Note: 5" denotes 5 minutes, etc; 1' denotes 1 hour, etc.

Figure 1-2
Rainfall Depth-Duration-Frequency (D-D-F) Worksheet
(Continued)

Part D

For any flood frequency (T-yr) other than 2-year or 100-year, calculate the rainfall depth for each rainfall duration (t) by the following equation:

$$P_{T,t} = (X)(P_{2,t}) + (Y)(P_{100,t})$$

where X and Y for a selected frequency (T-yr) are:

Frequency (T-yr)	X	Y
5-year	0.674	0.278
10-year	0.496	0.449
25-year	0.293	0.669
50-year	0.146	0.835
500-year	-0.337	1.381

Selected frequency (T-yr) = 25 yr X = 0.293 Y = 0.669

5-min	$(X)(P_{2,5'}) + (Y)(P_{100,5'})$	=	(	0.293)	(	0.33)	+ (	0.669)	(	0.68)	$P_{25,5'}$	=	0.55
10-min	$(X)(P_{2,10'}) + (Y)(P_{100,10'})$	=	(	0.293)	(	0.49)	+ (	0.669)	(	1.05)	$P_{25,10'}$	=	0.85
15-min	$(X)(P_{2,15'}) + (Y)(P_{100,15'})$	=	(	0.293)	(	0.59)	+ (	0.669)	(	1.35)	$P_{25,15'}$	=	1.07
30-min	$(X)(P_{2,30'}) + (Y)(P_{100,30'})$	=	(	0.293)	(	0.79)	+ (	0.669)	(	1.83)	$P_{25,30'}$	=	1.45
1-hour	$(X)(P_{2,1'}) + (Y)(P_{100,1'})$	=	(	0.293)	(	0.96)	+ (	0.669)	(	2.28)	$P_{25,1'}$	=	1.81
2-hour	$(X)(P_{2,2'}) + (Y)(P_{100,2'})$	=	(	0.293)	(	1.04)	+ (	0.669)	(	2.53)	$P_{25,2'}$	=	2.00
3-hour	$(X)(P_{2,3'}) + (Y)(P_{100,3'})$	=	(	0.293)	(	1.10)	+ (	0.669)	(	2.69)	$P_{25,3'}$	=	2.12
6-hour	$(X)(P_{2,6'}) + (Y)(P_{100,6'})$	=	(	0.293)	(	1.20)	+ (	0.669)	(	3.00)	$P_{25,6'}$	=	2.36
12-hour	$(X)(P_{2,12'}) + (Y)(P_{100,12'})$	=	(	0.293)	(	1.30)	+ (	0.669)	(	3.40)	$P_{25,12'}$	=	2.66
24-hour	$(X)(P_{2,24'}) + (Y)(P_{100,24'})$	=	(	0.293)	(	1.40)	+ (	0.669)	(	3.80)	$P_{25,24'}$	=	2.95

Note: 5" denotes 5 minutes, etc; 1' denotes 1 hour, etc.

Figure 1-2
Rainfall Depth-Duration-Frequency (D-D-F) Worksheet
(Continued)

Part D

For any flood frequency (T-yr) other than 2-year or 100-year, calculate the rainfall depth for each rainfall duration (t) by the following equation:

$$P_{T,t} = (X)(P_{2,t}) + (Y)(P_{100,t})$$

where X and Y for a selected frequency (T-yr) are:

Frequency (T-yr)	X	Y
5-year	0.674	0.278
10-year	0.496	0.449
25-year	0.293	0.669
50-year	0.146	0.835
500-year	-0.337	1.381

Selected frequency (T-yr) = 50 yr X = 0.146 Y = 0.835

5-min	$(X)(P_{2,5'}) + (Y)(P_{100,5'})$	=	(	0.146)	(	0.33)	+ (	0.835)	(	0.68)	$P_{50,5'}$	=	0.62
10-min	$(X)(P_{2,10'}) + (Y)(P_{100,10'})$	=	(	0.146)	(	0.49)	+ (	0.835)	(	1.05)	$P_{50,10'}$	=	0.95
15-min	$(X)(P_{2,15'}) + (Y)(P_{100,15'})$	=	(	0.146)	(	0.59)	+ (	0.835)	(	1.35)	$P_{50,15'}$	=	1.21
30-min	$(X)(P_{2,30'}) + (Y)(P_{100,30'})$	=	(	0.146)	(	0.79)	+ (	0.835)	(	1.83)	$P_{50,30'}$	=	1.64
1-hour	$(X)(P_{2,1'}) + (Y)(P_{100,1'})$	=	(	0.146)	(	0.96)	+ (	0.835)	(	2.28)	$P_{50,1'}$	=	2.05
2-hour	$(X)(P_{2,2'}) + (Y)(P_{100,2'})$	=	(	0.146)	(	1.04)	+ (	0.835)	(	2.53)	$P_{50,2'}$	=	2.26
3-hour	$(X)(P_{2,3'}) + (Y)(P_{100,3'})$	=	(	0.146)	(	1.10)	+ (	0.835)	(	2.69)	$P_{50,3'}$	=	2.41
6-hour	$(X)(P_{2,6'}) + (Y)(P_{100,6'})$	=	(	0.146)	(	1.20)	+ (	0.835)	(	3.00)	$P_{50,6'}$	=	2.68
12-hour	$(X)(P_{2,12'}) + (Y)(P_{100,12'})$	=	(	0.146)	(	1.30)	+ (	0.835)	(	3.40)	$P_{50,12'}$	=	3.03
24-hour	$(X)(P_{2,24'}) + (Y)(P_{100,24'})$	=	(	0.146)	(	1.40)	+ (	0.835)	(	3.80)	$P_{50,24'}$	=	3.38

Note: 5" denotes 5 minutes, etc; 1' denotes 1 hour, etc.

Figure 1-2
Rainfall Depth-Duration-Frequency (D-D-F) Worksheet
(Continued)

Part D

For any flood frequency (T-yr) other than 2-year or 100-year, calculate the rainfall depth for each rainfall duration (t) by the following equation:

$$P_{T,t} = (X)\,(P_{2,t}) + (Y)\,(P_{100,t})$$

where X and Y for a selected frequency (T-yr) are:

Frequency (T-yr)	X	Y
5-year	0.674	0.278
10-year	0.496	0.449
25-year	0.293	0.669
50-year	0.146	0.835
500-year	-0.337	1.381

Selected frequency (T-yr) = 500 yr X = -0.337 Y = 1.381

5-min	$(X)\,(P_{2,5'}) + (Y)\,(P_{100,5'})$	=	(	-0.337	) (	0.33	) + (	1.381	) (	0.68	)	$P_{500,5'}$	=	0.84
10-min	$(X)\,(P_{2,10'}) + (Y)\,(P_{100,10'})$	=	(	-0.337	) (	0.49	) + (	1.381	) (	1.05	)	$P_{500,10'}$	=	1.29
15-min	$(X)\,(P_{2,15'}) + (Y)\,(P_{100,15'})$	=	(	-0.337	) (	0.59	) + (	1.381	) (	1.35	)	$P_{500,15'}$	=	1.66
30-min	$(X)\,(P_{2,30'}) + (Y)\,(P_{100,30'})$	=	(	-0.337	) (	0.79	) + (	1.381	) (	1.83	)	$P_{500,30'}$	=	2.26
1-hour	$(X)\,(P_{2,1'}) + (Y)\,(P_{100,1'})$	=	(	-0.337	) (	0.96	) + (	1.381	) (	2.28	)	$P_{500,1'}$	=	2.83
2-hour	$(X)\,(P_{2,2'}) + (Y)\,(P_{100,2'})$	=	(	-0.337	) (	1.04	) + (	1.381	) (	2.53	)	$P_{500,2'}$	=	3.14
3-hour	$(X)\,(P_{2,3'}) + (Y)\,(P_{100,3'})$	=	(	-0.337	) (	1.10	) + (	1.381	) (	2.69	)	$P_{500,3'}$	=	3.35
6-hour	$(X)\,(P_{2,6'}) + (Y)\,(P_{100,6'})$	=	(	-0.337	) (	1.20	) + (	1.381	) (	3.00	)	$P_{500,6'}$	=	3.74
12-hour	$(X)\,(P_{2,12'}) + (Y)\,(P_{100,12'})$	=	(	-0.337	) (	1.30	) + (	1.381	) (	3.40	)	$P_{500,12'}$	=	4.26
24-hour	$(X)\,(P_{2,24'}) + (Y)\,(P_{100,24'})$	=	(	-0.337	) (	1.40	) + (	1.381	) (	3.80	)	$P_{500,24'}$	=	4.78

Note: 5" denotes 5 minutes, etc; 1' denotes 1 hour, etc.

Figure 1-2
Rainfall Depth-Duration-Frequency (D-D-F) Worksheet
(Continued)

Part E

Tabulate the rainfall Depth-Duration-Frequency statistics below:

Duration	Rainfall Depth, in inches Frequency, in Years						
	2	5	10	25	50	100	500
5-min	0.33	0.41	0.47	0.55	0.62	0.68	0.84
10-min *	0.49	0.62	0.71	0.85	0.95	1.05	1.29
15-min	0.59	0.77	0.90	1.07	1.21	1.35	1.66
30-min *	0.79	1.04	1.21	1.45	1.64	1.83	2.26
1-hour	0.96	1.28	1.50	1.81	2.05	2.28	2.83
2-hour	1.04	1.40	1.65	2.00	2.26	2.53	3.14
3-hour	1.10	1.49	1.75	2.12	2.41	2.69	3.35
6-hour	1.20	1.64	1.94	2.36	2.68	3.00	3.74
12-hour	1.30	1.82	2.17	2.66	3.03	3.40	4.26
24-hour	1.40	2.00	2.40	2.95	3.38	3.80	4.78

* Note: 10-min and 30-min values are not coded into the PH record
5" denotes 5 minute, etc; 1' denotes 1 hour, etc.

Rainfall Intensity-Duration-Frequency (D-D-F) Worksheet

Part F

Tabulate the rainfall Intensity-Duration-Frequency statistics below:

Duration	Rainfall Intensity, in inches/hour Frequency, in Years						
	2	5	10	25	50	100	500
5-min	3.91	4.92	5.63	6.64	7.43	8.22	10.03
10-min	2.93	3.73	4.28	5.07	5.69	6.30	7.71
15-min	2.38	3.10	3.60	4.30	4.84	5.39	6.64
30-min	1.57	2.07	2.42	2.90	3.28	3.65	4.51
1-hour	0.96	1.28	1.50	1.81	2.05	2.28	2.83
2-hour	0.52	0.70	0.83	1.00	1.13	1.26	1.57
3-hour	0.37	0.50	0.58	0.71	0.80	0.90	1.12
6-hour	0.20	0.27	0.32	0.39	0.45	0.50	0.62
12-hour	0.11	0.15	0.18	0.22	0.25	0.28	0.35
24-hour	0.06	0.08	0.10	0.12	0.14	0.16	0.20

* Note: 10-min and 30-min values are not coded into the PH record
5" denotes 5 minute, etc; 1' denotes 1 hour, etc.