FINAL DRAINAGE REPORT – VOLUME 1

RED MOUNTAIN FREEWAY (SR 202L)
Power Road to University Drive

ADOT Contract No. 04-15
ADOT TRACS No H5782 01 C
SCI Project No. 17000
April 2005

Prepared for: **Arizona Department of Transportation**
205 S 17th Ave
Phoenix, AZ

ADOT

Prepared by: **Stanley Consultants**
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Stanley Consultants INC.

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ARIZONA, U.S.A.

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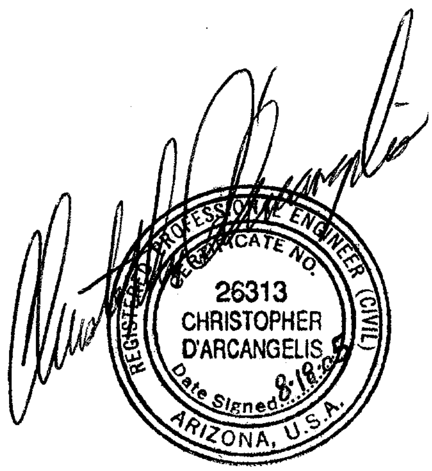

1 INTRODUCTION

The Red Mountain Freeway (SR 202L) is part of the Maricopa Association of Governments (MAG) Regional Freeway System and will connect Interstate 10 (I-10) to the Superstition Freeway (US 60) through the east valley. The freeway will serve the cities of Phoenix (COP), Tempe (COT) and Mesa (COM), the Salt River Pima-Maricopa Indian Community (SRPMIC) and unincorporated portions of Maricopa County.

This report addresses drainage issues and drainage design associated with an approximate 4.5 mile segment of the Red Mountain Freeway (SR 202L) that extends from Power Road to approximately University Drive. The freeway alignment passes over the existing Spook Hill Flood Retarding Structure (FRS) at two locations and through the FRS flood pool. This project will require the partial reconstruction of the Spook Hill FRS to maintain regional flood protection.

The drainage and flood control improvements presented in this report were designed to meet the drainage requirements of the Red Mountain Freeway without adversely impacting the operation of existing local drainage facilities and at a minimum maintain the current level of flood protection provided by the existing Spook Hill FRS.

Separate reports are provided for the Spook Hill FRS Flood Inundation Study and the geotechnical design of the Spook Hill FRS modifications and freeway levee.

1.1 PROJECT DESCRIPTION

This 4.5 mile segment of the Red Mountain Freeway, extending from Power Road to University Drive, is located within the City of Mesa in Maricopa County, Arizona. A Vicinity Map and a Location Map are provided in Figure 1 and Figure 2, respectively.

The SR 202L freeway mainline will include three general-purpose lanes in each direction of travel, separated by an open median. The open median is designed to accommodate a future HOV and general-purpose lane in each direction of travel between the north and south CAP Canal overpasses. Auxiliary lanes will be provided between successive entrance and exit ramps between each traffic interchange in both directions of travel.

In accordance with the Red Mountain Freeway Final Environmental Impact Statement (FEIS), the freeway alignment will be located immediately upstream of the FRS and the Central Arizona Project (CAP) Canal. The SR 202L will pass over Power Road, the CAP Canal, and the FRS. Within the FRS flood pool (herein referred to as the flood pool), the freeway profile will be designed near the existing ground elevation between McDowell and Brown Roads. The freeway will be protected by a levee located immediately east of the freeway mainline. This levee will be designed to protect the freeway up to the 100-year flood event. South of Brown Road, the freeway will pass over the FRS and CAP Canal and transition to a depressed freeway at University Drive.

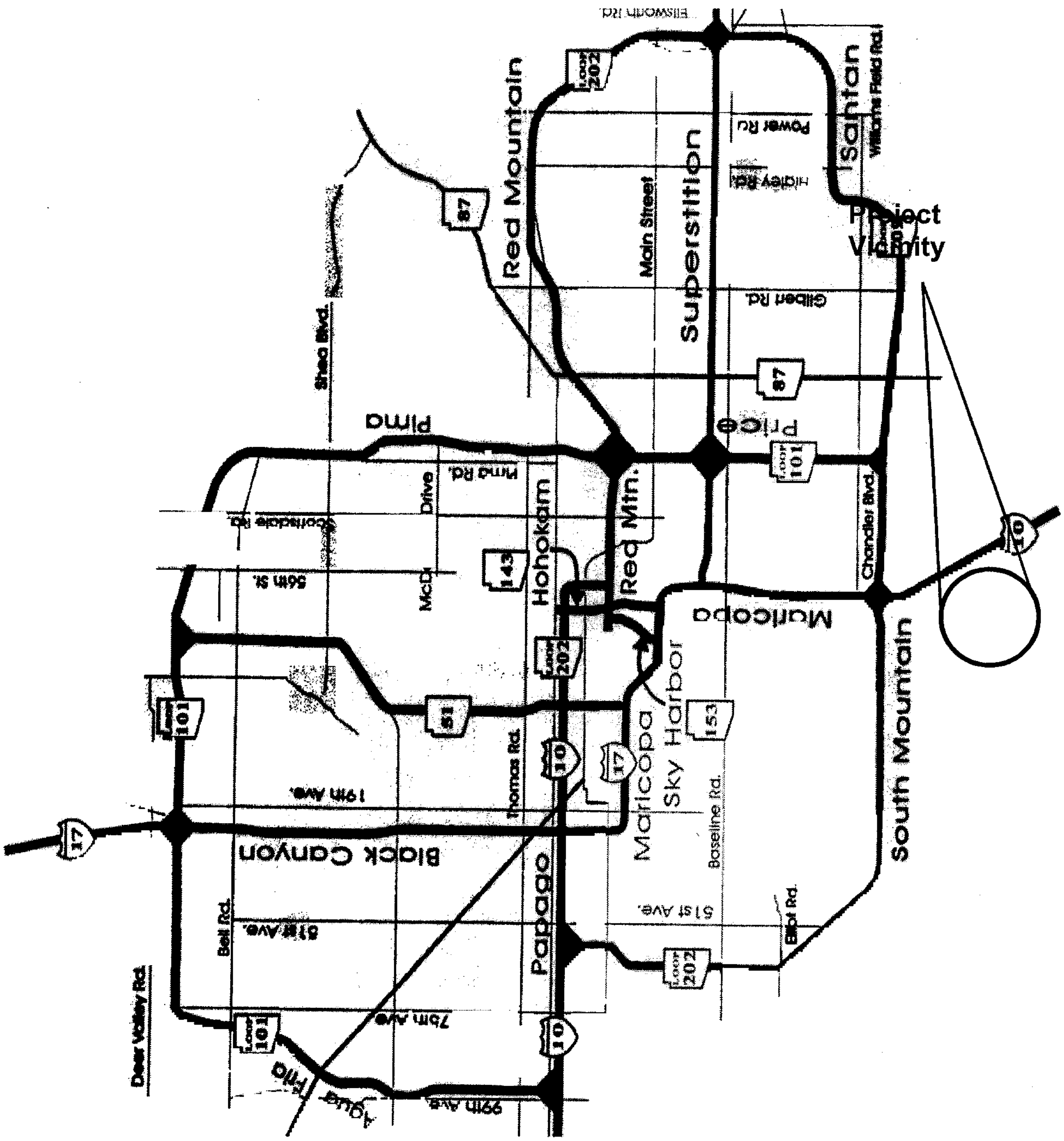

Figure 1-1: Vicinity Map

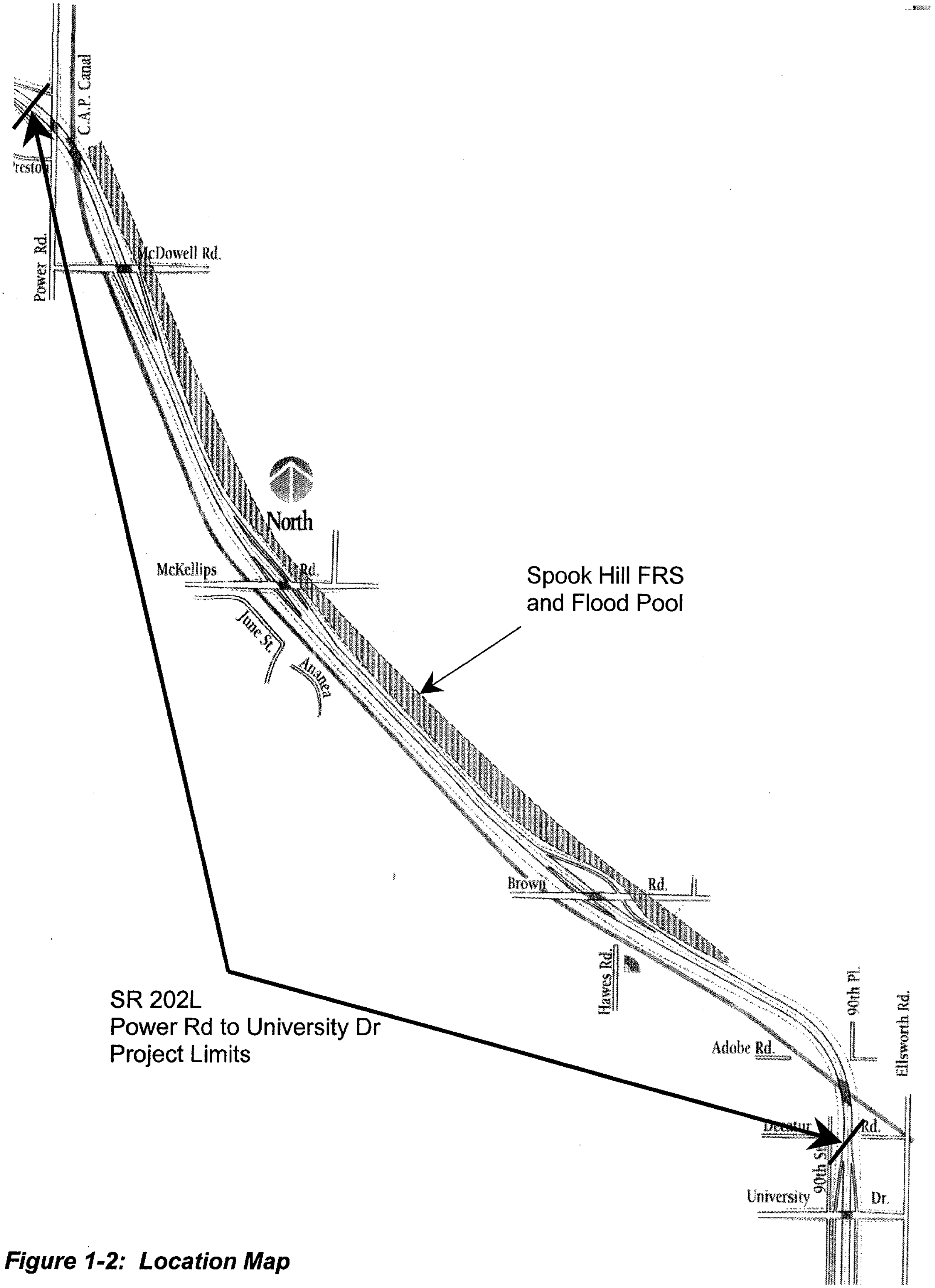

Figure 1-2: Location Map

A half-diamond traffic interchange will be provided at Power Road with ramps to the west. The interchange crossroad and ramps are being constructed as part of the Higley Road to Power Road segment of the Red Mountain Freeway.

A half-diamond traffic interchange will also be provided at McDowell Rd with ramps to the south. Roundabout interchanges will be constructed at McKellips and Brown Roads, providing full access to the freeway mainline. The arterial streets will pass over the CAP Canal, the FRS, the SR 202L mainline and the flood pool at each interchange. The crossroads will be widened through the project limits to achieve the desired traffic operational characteristics.

A full diamond interchange will be constructed at University Drive, providing freeway access to the north. One-way northbound and southbound collector roads will be constructed south of University to provide access to Apache Trail and Broadway Road. This project will provide the north ramp connections to University Drive.

At the north end of the project, freeway overpasses will be constructed to carry the SR 202L over Power Road and the CAP Canal. Another CAP Canal overpass will be constructed north of University Drive. Two bridges will be constructed to carry each crossroad over the CAP Canal and the SR 202L mainline. Box culverts will be provided for each flood pool crossroad crossing.

The freeway drainage system is designed such that the storm drain main line drains to a lengthy reinforced concrete box culvert for temporary storage. A pump station located northeast of McKellips Road and the flood pool will drainage from temporary storage into the flood pool.

Within the limits of the FRS, all freeway elements and FRS modifications required to mitigate the impact of the freeway construction will be built within the FCDMC right-of-way. The freeway project is designed to ensure the FRS will continue to operate as a flood retarding structure with adequate conveyance capacity and flood storage volume.

1.2 EXISTING FLOOD CONTROL AND DRAINAGE FACILITIES

The development of the onsite and offsite drainage systems is governed by existing local and regional drainage facilities and the proposed freeway drainage requirements. The existing drainage facilities identified within the freeway corridor include the:

- Spook Hill FRS and FRS flood pool,
- Spook Hill Principal and Emergency Spillways,
- Spook Hill and Signal Butte Floodways,
- offsite drainage systems located east of the flood pool,
- crossroad culverts at McDowell, McKellips and Brown Roads, and
- offsite drainage channels/washes located southwest of the Spook Hill FRS for the contributing drainage area to the CAP Canal Overchute No.1.

In addition, for the purposes of this report, the proposed drainage improvements associated with the Red Mountain Freeway that are located west of Power Road and to the south of University Drive are considered existing improvements.

1.2.1 Spook Hill FRS and Spook Hill Floodway

The Spook Hill FRS and Spook Hill Floodway (herein referred to as the floodway) are located in the north central part of the Buckhorn-Mesa watershed in Maricopa County, about ten miles northeast of downtown Mesa, Arizona. The Spook Hill FRS is a combined conveyance and impoundment structure. Flows discharged from the Signal Butte Floodway, in conjunction with stormwater runoff from the contributing watershed, are detained by the Spook Hill FRS. The FRS conveys floodwaters north to the principal and emergency spillways at Power Road. The design intent is to safely impound and discharge flood events equal to or less than the 100-year flood through the principal spillway to the floodway without discharging over the emergency spillway.

The Spook Hill FRS and floodway are the most downstream components of the Buckhorn-Mesa Watershed project facilities which consist of three floodwater retarding structures, four floodway channels and one diversion structure that were all designed and constructed to detain and convey a 100-year flood event to the Salt River. The Spook Hill FRS and Floodway are also the only flood control facilities in the Buckhorn-Mesa watershed project that are directly impacted by the proposed freeway alignment.

The Spook Hill FRS parallels the CAP Canal. It begins ½ mile north of McDowell Road, east of Power Road and extends to the southeast to approximately ¼ mile south of Brown Road. The Spook Hill FRS drains into the Spook Hill Floodway through the principal spillway. For approximately 1.5 miles north of the principal spillway, the floodway consists of an unlined trapezoidal channel. Water is then discharge into a more natural system until crossing under the Bush Highway where it is again channelized and flows into a sedimentation basin prior to discharging into the Salt River immediately upstream of the Granite Reef Diversion Dam

While facilities upstream of the Spook Hill FRS and Floodway are not directly impacted by the proposed freeway, all these facilities impact the Spook Hill FRS and Floodway. These upstream facilities that are part of the Buckhorn-Mesa Watershed project include:

<u>Apache Junction FRS and Floodway</u>

These facilities include 1.6 miles of earthen dam and a 1500-foot floodway that diverts floodwater from a wash above the dam into the reservoir area. The structure drains six square miles north of the Town of Apache Junction.

<u>Bulldog Floodway</u>

This 1.7 mile floodway conveys stormwater impounded by the Apache Junction Dam, and the contributing watershed, to the reservoir behind the Signal Butte Dam.

Pass Mountain Diversion and Outlet

These facilities consist of a 1.2 mile long earth embankment and a 2,800-foot long outlet channel that drains floodwaters from a four square mile area to the Signal Butte Dam.

Signal Butte FRS and Floodway

These facilities consist of a 1.3 mile long earthen dam and a 2.7 mile long floodway that conveys floodwaters discharged from the Signal Butte Dam and the contributing watershed to the Spook Hill Dam. This structure drains 16 square miles north of the Apache Trail near the Maricopa - Pinal County boarder.

1.2.2 Existing Flood Pool Inlet Structures

There are a number of local drainage inflow points into the flood pool. Most inflow points are small natural washes or ditches. Some adjacent developments route offsite runoff directly to the flood pool through open channels. Other developments indirectly discharge runoff to the FRS through retention basin emergency spillways or retention basin outlets. The most significant existing inflow structures and locations include:

Las Sendas Channel

This channel is a large soil cement trapezoidal drainage channel that primarily serves the Las Sendas residential development north of McDowell Rd and east of the Spook Hill FRS. The channel runs along the north side of McDowell Rd and discharges into the Spook Hill FRS.

Grayfox at Las Sendas Development

This development is located east side of the FCDMC right-of-way between McDowell Rd. and Hermosa Vista Drive. Significant offsite and onsite flows are directed from this development to the flood pool at two locations just north of Hermosa Vista Drive.

Saguaro Vista Estates

This development is located east of the FCDMC right-of-way between Hermosa Vista Dr. and McKellips Road. Offsite drainage has been routed around and through this development and discharges into the flood pool at two locations north of McKellips.

86th Street Channel

The 86th Street channel is a lined trapezoidal drainage channel located south of the Brown Road. The channel extends south from Brown Road along the alignment of 86th St. and discharges into the Spook Hill FRS flood pool through a grouted spillway. The channel provides drainage for developments located north and east of Brown Road.

Grace Church Channel

A shallow lined drainage ditch is located south of Brown Road and parallels the west side of the Grace Church property, which discharges to the flood pool.

Signal Butte Floodway and Energy Dissipation Basin

The Signal Butte Floodway is a large concrete rectangular floodway that discharges directly into the Spook Hill FRS south of Brown Road. A large grouted riprap lined energy dissipation basin that is approximately 11 feet deeper than the flood pool provides erosion and scour protection at the point of discharge. The existing basin does not provide ready access to the basin bottom for maintenance nor is there a means to drain water ponding in the basin after the passage of a storm event.

1.2.3 Existing Freeway and Crossroad Drainage Systems

There are no significant roadway drainage systems at McDowell, McKellips, or Brown Road and being new construction, no freeway elements currently exist. Presently, the cross roads have no curb or gutter in the vicinity of the flood pool. Roadway drainage collects into ditches along the side of the roads and drains into the flood pool.

1.3 PROPOSED FLOOD CONTROL AND DRAINAGE FACILITIES

New and upgraded flood control and drainage facilities to be constructed as part of the Red Mountain Freeway extension are briefly described in this section. Additional and more detailed information is provided in subsequent sections of this report.

1.3.1 Freeway Drainage System

The freeway storm drain system is designed in accordance with ADOT guidelines to convey the 50-year event for the ultimate freeway configuration which provides HOV lanes in the freeway median. Generally, the storm drain main line will drain to a large multi-barrel reinforced concrete box vault located north of McKellips Rd. for temporary storage. A pump station located at the northwest corner of McKellips and 76th St. will pump stormwater from the storage vault into the flood pool just north of McKellips Road.

1.3.2 Cross Road Drainage System

East of the FRS, cross road drainage will be collected in catch basins and a storm drain system will convey runoff to the freeway storm drain main line, adjacent drainage conveyances or discharge into the flood pool.

West of the FRS, the proposed storm drain system on Brown Road will drain to an existing City of Mesa storm drain located in Brown Road. No additional storm drain will be added to the west leg of McDowell Road or McKellips Road. Pavement runoff from these areas will be collected by existing local storm drain systems as directed by the City of Mesa.

1.3.3 Spook Hill FRS and Freeway Levee

The existing Spook Hill FRS, located primarily between the freeway and the CAP Canal, will remain intact when possible but reconstructed when necessary to maintain the integrity of the structure and to ensure the existing level of flood protection is, at a minimum, maintained. The FRS is designed not to be overtopped during the Probable Maximum Flood event and ensure excessive floodwater is released through the emergency spillway. The existing FRS emergency spillway located north of McDowell Road will not be modified.

The freeway levee should not be confused with the FRS. The freeway levee is a separate new levee constructed between the freeway and the flood pool to protect the freeway from the 100-year flood event. For larger rainfall events, the freeway levee is expected to be overtopped inundating the freeway. The freeway prism will serve to provide additional temporary floodwater storage during such an extreme event.

1.3.4 Spook Hill FRS Flood Pool Drainage Facilities

<u>Flood Pool Grading and Low Flow Channel</u>

The entire flood pool will be regraded and a new low flow channel constructed to convey drainage to the principal spillway outlet.

<u>Cross Road Culverts</u>

The existing large diameter CMP culverts across the cross roads will be replaced with RCB culverts. At each crossing there will be two RCB culverts. One culvert will be located in the low flow channel for drainage. The other culvert will be set at a slightly higher elevation and tied into a trail system to provide equestrian and pedestrian access across the roads.

<u>Principal Spillway and Spook Hill Floodway Realignment</u>

The Spook Hill Floodway near the principal spillway will be realigned and a new principal spillway outlet for the flood pool with a higher outlet capacity will be constructed adjacent to the existing spillway. The existing principal spillway will be removed and the floodway will be backfilled to realign the channel to the new principal spillway outlet.

<u>Offsite Drainage Collection Ditch and Flood Pool Inlets</u>

Along the east side of the flood pool, a drainage ditch will collect offsite drainage and convey it to flood pool inlets. The inlets are sized according to the amount of drainage runoff concentrated at each location. Inlet types include a small grated CMP drop inlet, a larger concrete drop inlet, a double concrete drop inlet and an inlet weir for the largest concentrated flows.

Las Sendas Channel Transition and Baffled Drop Spillway

Modifications are necessary for the Las Sendas channel inlet due to an expansion and lowering of the flood pool. The proposed modifications include transitioning the soil cement trapezoidal channel into a rectangular concrete section, the construction of a new baffled chute spillway and a 4-12'x8' RCBC in the channel to stabilize flow in the channel and for maintenance access across the channel.

86th Street Channel Transition

Modification to the 86th Street channel will also be necessary due to the expansion and lowering the flood pool. The proposed modifications include a channel transition from a trapezoidal section to a rectangular channel section, a concrete drop and a RCBC culvert that discharges into the flood pool.

Signal Butte Energy Dissipation Basin

At the request of the FCDMC, a maintenance ramp will be provided for the Signal Butte energy dissipation basin and a small lift station will be designed to drain water from the basin.

1.3.5 CAP Canal Overchute Detention Basin

The proposed freeway alignment crosses over the CAP canal just south of an existing CAP drainage overchute. To maintain the existing drainage patterns, drainage ditches along the east side of the freeway will convey runoff to a 6'x6' RCBC. The RCBC will pass under the freeway to drain the existing contributing watershed to the CAP overchute. A 2 acre-ft detention basin will be constructed between the freeway and the CAP Canal to attenuate the peak discharge from the freeway prior to discharging to the CAP Canal overchute and CAP Detention Basin No. 1.

1.3.6 Power Road Detention Basin

The existing Power Road detention basin was constructed during the previous section of the Red Mountain Freeway (Higley to Power) that was designed to accommodate a portion of freeway drainage from the extension of the freeway to University Drive.

1.3.7 CAP Underpass Detention Basin

At the south end of the project and west of the CAP canal, a detention basin is proposed to collect stormwater runoff from an isolated region in the west right of way.

1.3.8 Northeast Channel

The Northeast Channel is a concrete lined channel located east of the freeway between the Spook Hill FRS and the CAP canal at the south end of the project. The channel will intercept offsite runoff from east of the Red Mountain Freeway and from an existing drainage ditch along the east side of the CAP canal and convey it to a 6'x6' RCB culvert across the freeway. The RCB culvert outlets to the CAP overchute which conveys runoff across the CAP canal and into the CAP Basin No. 1 detention basin.

1.3.9 East Channel

As part of this project, the concrete lined East Channel constructed as part of the segment of the Red Mountain Freeway south of University Drive, will be extended to the north to intercept and convey runoff for areas east of the freeway.

1.3.10 Proposed Spook Hill ADMP Improvements

The Spook Hill Area Drainage Master Plan (ADMP) was completed in September 2002. As part of the ADMP, drainage improvements were recommended along McDowell Road, McKellips Road and Hermosa Vista Drive. The recommended improvements along McDowell Road are not significantly affected by the proposed changes to the Spook Hill FRS flood pool and facilities, however, recommendations for large diameter storm drains on McKellips Road and Hermosa Vista Drive are impacted.

On Hermosa Vista Drive, a 90'-96" CMP storm drain is recommended to discharge into the flood pool. At this general location, a weir flood pool inlet is proposed to handle offsite drainage. There is no indication that a 90"-96" storm drain could not also discharge to the flood pool at this general location.

On McKellips Road, a 84"-90" CMP storm drain is recommended. In this area, retaining walls, the freeway pump station, and cross road culverts may make it difficult to discharge drainage into the flood pool north of McKellips Road. However, it would be possible to discharge into the flood pool south of McKellips Road without going through retaining walls and with less disruption.

2 OFFSITE HYDROLOGY

2.1 GENERAL

The objective of the offsite hydrologic analysis is to identify and quantify offsite stormwater runoff concentration points along the freeway corridor. Most of the offsite hydrology was been completed previously under various studies and projects. Therefore, this report presents only the design hydrology and modifications that may have been made subsequent to the 30% design phase. For more detailed information regarding hydrologic parameters and development of the design hydrology, refer to previous hydrologic studies, in particular, design and technical reports prepared by DMJM+Harris (see Section 2.2.1)

The offsite hydrology is broken into two distinct watersheds, the Buckhorn-Mesa watershed and the East Mesa Area Drainage Master Plan (ADMP) watershed. The Buckhorn-Mesa watershed encompasses the contributory area to the Spook Hill FRS with the ultimate outfall being the Salt River. South of the Buckhorn-Mesa watershed, the East Mesa ADMP watershed shed includes much of the City of Mesa and encompasses the contributory area to the East Maricopa Floodway with the ultimate outfall being the Gila River.

2.2 PREVIOUS HYDROLOGIC STUDIES

Previous regional and local studies provide the basis for the project hydrology. In particular, the reports completed by DMJM+Harris during the initial and pre-design phases of the Red Mountain Freeway project provide most of the offsite project design hydrology (See Section 2.2.1).

2.2.1 Red Mountain Freeway Drainage Studies

The development of the design hydrology was accomplished during the initial design phase of this project and documented in four technical reports, an engineering concept drainage report, a design concepts report for the FRS, and an initial drainage report prepared by DMJM+Harris. These reports are briefly summarized below.

<u>Red Mountain Freeway (SR 202L) Power Road to University Drive Spook Hill Floodwater Retarding Structure Stage Phase II (30%) Initial Drainage Report</u>

This report provides a summary of previous studies, models and methods used to develop the design hydrology along with the 100-year and the Probable Maximum Flood (PMF) hydrology used for the design of the Spook Hill FRS structures. It serves as the principal reference for the development and documentation of the project design hydrology. Herein, this report is referred to as the 30% Initial Drainage Report.

Red Mountain Freeway (SR 202L) Power Road to University Drive Spook Hill Engineering Concept Drainage Report (ECDR)

This report presents drainage design concepts in support of the Red Mountain Freeway Power Road to University Drive Engineering Concept Report and to quantify proposed hydraulic conditions for the 100-year and the Probably Maximum Flood events.

Spook Hill FRS Modifications Design Concepts Report

This report presents the results of a site investigation and study to develop design concepts for modifications to the Spook Hill FRS.

Red Mountain Freeway (SR 202L) Power Road to University Drive Spook Hill Floodwater Retarding Structure Technical Reports:

Technical Report No. 1: Existing Conditions Hydrology
This report documents the development of the existing conditions hydrology Probable Maximum Flood (PMF) and the 1/2 Probable Maximum Flood event for the Spook Hill FRS.

Technical Report No. 2: Probable Maximum Flood (PMF) Hydraulics
The report documents the existing hydraulic conditions for the Spook Hill FRS as it is related to ADWR dam safety rules and regulations.

Technical Report No. 3: Existing Conditions Hydrology & Hydraulics, 50-Year and 100-Year Floods
The report documents the existing hydrologic and hydraulic conditions for the 50-year and the 100-year flood events for the Spook Hill FRS.

Technical Report No. 4: Existing Conditions and Value Analysis Recommendations
The report quantifies the Spook Hill Floodway existing conditions hydrology and the hydraulic constraints from the Spook Hill FRS principal spillway to the Salt River. The report also documents the value engineering process and analysis to propose design recommendations for possible implementation into the project design.

These reports are herein referred to by the report number (e.g. Technical Report No. 3).

2.2.2 Other Offsite Drainage Studies

Spook Hill Area Drainage Master Plan (ADMP) Update

This study quantifies the existing and proposed condition hydrology for the Buckhorn-Mesa Project watershed. The 100-year existing condition hydrology from this study is the basis of the Spook Hill FRS hydrology.

East Mesa Area Drainage Master Plan (ADMP)

This study quantifies existing and future condition hydrology for east Mesa, primarily between the Buckhorn-Mesa Project watershed and the East Maricopa Floodway (EMF).

Red Mountain Freeway (SR 202L), Initial Drainage Report (Stage II Design), University Drive to Southern Avenue

The initial design of this segment of the Red Mountain Freeway updates the East Mesa ADMP 100-year existing condition hydrology to include the freeway improvements between University Drive and Southern Avenue.

Local Development Drainage Reports

Information and data from numerous and primarily residential development drainage reports and studies was used to supplement the regional hydrology

SCS Spook Hill Floodwater Retarding Structure Design Studies:

Evaluation of Preliminary Design Report
The primary purpose of this report (1975) was to review the preliminary design hydrology for the Spook Hill FRS. According to the report, computations for determining the required reservoir capacity, principal spillway size, and the emergency spillway crest elevation were found to be satisfactory.

Final Design Report
This report was finalized by the SCS in 1976 to document the basis of the hydrologic, hydraulic, structural, foundation and embankment designs for the Spook Hill FRS.

Final Design Report-Spook Hill Outlet Channel & Sediment Basin
This report was finalized by the SCS in 1993 and documents the basis of the hydrologic, hydraulic and structural designs for the outlet channel from Bush Highway to the existing sediment basin, and for the sediment basin outlet channel into the Salt River just upstream of the Granite Reef Dam.

2.3 DESIGN HYDROLOGY

Offsite hydrology consists of two separate watersheds, the Buckhorn-Mesa watershed and the East Mesa Area Drainage Master Plan (ADMP) watershed.

2.3.1 Buckhorn-Mesa Watershed

2.3.1.1 General

The Buckhorn-Mesa watershed includes the contributory area to the Spook Hill FRS with the ultimate outfall being the Salt River. Since the freeway alignment passes over the Spook Hill FRS and through the flood pool, the extension of this segment of the freeway has the most significant impact on the Buckhorn-Mesa Watershed.

Initial hydrology for this watershed was developed as part of the design of the Buckhorn-Mesa project facilities by the National Resource Conservation Service. Subsequent studies updated the hydrology and developed hydrologic models for the watershed. The Spook Hill ADMP provided the initial hydrologic model for the watershed that was revised as part of the initial 30% design phase of this project to develop the design hydrology.

2.3.1.2 Spook Hill FRS

The Spook Hill FRS design hydrology consists of the existing conditions 100-year, 24-hour hydrology and the existing conditions Probable Maximum Flood (PMF), 6-hour hydrology. The design hydrology was modeled using the U.S. Army Corp of Engineers (USCOE) Hydrologic Engineering Center (HEC) HEC-1 computer software package (Version 4.1, 1998) and was developed using methodologies documented in the Drainage Design Manual (DDM) for Maricopa County, Volume I, Hydrology (1995).

<u>100-Year, 24 Hour</u>

The existing conditions 100-year, 24-hour hydrology is used for the design of the freeway levee. Details of the 100-year analyses used for design are provided in *Technical Report No. 3.* The results of the analyses are summarized in the table below.

Table 2-1: 100-Year, 24-Hour Peak Design Discharges

100-Year Inflow Location	HEC-1 Concentration Point	HEC-RAS Cross Section	Peak Discharge (cfs)
Signal Butte Floodway Outfall	C320	3.805	2,546
South of Brown Rd	340C	3.804	1,303
Brown Rd – McKellips Rd	360C	2.731	1,286
Brown Rd – McKellips Rd	380C	2.396	1,313.
McKellips Rd	400C	1.818	712
McKellips Rd – McDowell Rd	C420	1.145	805
McDowell Rd/ Las Sendas Channel	R415	0.447	1527
North of McDowell Rd	C455	0.370	169

Probable Maximum Flood (PMF)

The PMF is used to ensure the Spook Hill FRS will not be overtopped during the PMF event and that excessive floodwater is released through the emergency spillway. The PMF is based on the Probable Maximum Precipitation (PMP). The PMP was estimated for both a general and local storm based on procedures presented in the U.S. Army Corps of Engineers Hydrometeorological Report No. 49 [HMR 49 (1977)] and correspondence with ADWR. The local storm PMP defined the design existing hydrologic conditions. Details of the PMF analysis used for design are provided in *Technical Report No. 2*. The results of the analyses are summarized in the table below.

Table 2-2: PMF Peak Design Discharges

PMF Inflow Location	HEC-1 Concentration Point	HEC-RAS Cross Section	Peak Inflow Discharges (cfs)
Signal Butte Floodway	DIVI	3.805	2,872
Brown Rd	S-A1	3.804	3,197
North of Brown Rd/ South of McKellips Road	S-B1	3.042	11,044
McKellips Road	S-B2	2.396	2,907
McDowell Road	S-C1	1.486	10,683
North of McDowell Road	S-D1	0.370	4,833

2.3.1.3 Spook Hill Flood Pool Inflow Structures

Discussion of Spook Hill inflow structures and the determination of design discharges are provided in Section B by J2 Engineering and Environmental Design.

2.3.2 East Mesa ADMP Watershed

2.3.2.1 General

South of the Buckhorn-Mesa watershed, the East Mesa ADMP watershed includes much of the City of Mesa and encompasses the contributory area to the East Maricopa Floodway (EMF) and the Sossaman Channel with the ultimate outfall being the Gila River. Only a small portion of the East Mesa ADMP watershed located east of the CAP and south of the Spook Hill FRS is impacted by the freeway project.

The East Mesa ADMP provided the initial hydrology for this watershed. The hydrologic analysis has been revised several times as part of the design of the Red Mountain Freeway corridor north of the Superstition Freeway (US 60) and as part of the initial 30% design phase of this project. The East Mesa design hydrology consists of the existing conditions 100-year, 24-hour hydrology. The design hydrology was modeled using the HEC-1 computer software package (Version 4.1, 1998) and was developed using methodologies documented in the Drainage Design Manual (DDM) for Maricopa County, Volume I, Hydrology (1995).

2.3.2.2 CAP Overchute

As part of the freeway drainage design criteria, it is necessary to document that the freeway will not adversely impact conditions downstream of the freeway. Generally, this is accomplished in the design of the Spook Hill FRS. However, at the south end of the project, the freeway briefly extends beyond the Spook Hill FRS prior to crossing the CAP canal. In this area, a 3-54" steel pipe overchute conveys drainage across the CAP canal into a small regional detention basin (CAP Detention Basin No. 1).

The impacted area was limited to Sub-basin 50 of the East Mesa ADMP 100-year hydrology. To assess the impact of the freeway project and design any recommended improvements, Sub-basin 50 was subdivided into three smaller drainage areas for the proposed conditions hydrology. This required a similar subdivision of Sub-basin 50 in the existing conditions hydrology since subdividing the basin itself (with no other changes to the hydrologic parameters) was sufficient to produce adverse downstream conditions when compared to original existing conditions. Therefore, to provide a relative assessment of the impact of the proposed freeway improvements on downstream hydrology, the existing condition was also modified to subdivide basin 50 into three basins (50A, 50B and 50C).

The hydrologic model for the proposed conditions resulted in a slight increase in peak discharge downstream of CAP Detention Basin No. 1. To attenuate the peak discharge, a detention basin is provided between the freeway and the CAP overchute to detain freeway drainage. The basin attenuates the peak discharge immediately downstream of the basin but due to timing differences, the analysis indicates flow is increased 1 cfs at a concentration point further downstream (C18C). This increase is considered insignificant and would have no adverse impacts downstream. Detailed analysis and documentation of the hydrology is provided in the Appendix A. Table 2-4 presents the results of the existing conditions and the proposed conditions hydrology.

Table 2-3: CAP Overchute 100-Year Discharge Comparison

Description	HEC-1 Hydrograph	Existing Conditions 100-Year (cfs)	Proposed Conditions 100-Year (cfs)
Combination of 50A, 50B and 50C	COABC	264	252
CAP Overchute	CAP1	264	252
CAP Detention Basin No. 1	BASIN1	161	152
Routing hydrograph from Basin1	RCAP1	136	128
1st downstream combination hydrograph	C18C	401	402

2.3.2.3 Northeast Channel Hydrology

Hydrology for the northeast channel is based upon the CAP Overchute proposed conditions hydrology for subbasin 50 of the East Mesa ADMP watershed hydrology (see previous section). However, the 50-year precipitation value was used to determine the design discharges for the channel north of the RCB culvert, for the channel south of the RCB culvert and for the confluence a the RCB culvert. The results of the hydrologic analysis are shown in the table below.

Table 2-4: Northeast Channel 50-Year Peak Discharge

Description	HEC-1 Hydrograph	50-Year Proposed Conditions (cfs)
Northeast Channel – North Section	50AFWY	73
Northeast Channel – South Section	50BFWY	134
Peak Discharge at 6'x6' RCB Culvert	COAB	200

3 OFFSITE DRAINAGE

3.1 GENERAL

The purpose of the offsite drainage system is to protect the freeway and maintain the operational characteristics of the Spook Hill FRS. Discussion of the offsite drainage systems in this section is separated based on improvement type and location.

During the initial phase of design for this segment of the Red Mountain Freeway, a field survey was conducted to define the conversion factor between the National Geodetic Vertical Datum of 1929 (NGVD 29) and the North American Vertical Datum of 1988 (NAVD 88). Based on the results of this survey, a consensus was obtained from the review agencies that the NGVD 29 datum (the basis of the Spook Hill FRS as-built plans) to NAVD 88 datum adjustment factor would be +2.01 feet. Unless otherwise specified, the elevation data presented in this report is based upon the NAVD 88 datum.

3.2 DESIGN CRITERIA

The design criteria summarized is this section was applied to the design of offsite drainage facilities. The majority of criteria are obtained in the *ADOT Roadway Design Guidelines* (RDG), *May 1996.* Additional design criteria was taken from the Flood Control District of Maricopa County's *Drainage Design Manual for Maricopa County, Arizona, Volume II Hydraulics, November 1991* (revised January 1996). Other criteria were established through discussions with the FCMDC, ADOT Drainage Group or with ADWR. Exceptions to the identified design criteria are noted and are explained in italics.

3.2.1 Channels

3.2.1.1 Cross Section

Side Slopes

- Aggregate and unlined channels – 3:1 (H:V)
- Channels adjacent to a roadway without barrier protection – 4:1 (H:V).
- Concrete lined channels – 1.5:1 (H:V) maximum; 2:1 (H:V) preferred.

The Las Sendas channel and the 86th St channel both transition to a concrete rectangular channel before passing through culverts.

Bottom Width

- Channels adjacent to a roadway without barrier protection – 4 ft. absolute minimum, 8 ft. preferred minimum.
- Concrete lined channel – 4 ft. absolute minimum, 8 ft. preferred minimum.

Cross-Slope

- 2% cross-slope to one side across the total channel bottom width with a one-foot maximum drop. The channel profile grade line is defined as the low edge of the channel bottom.

The existing Las Sendas and 86th Street channel do not have cross slopes, therefore, no cross slope is implemented with the Stage II design.

3.2.1.2 Profile

- Earth and grass lined channels - minimum grade of 0.2%
- Concrete/Smooth paved channels - preferred minimum grade of 0.1%.

The grade of the flood pool low flow channels is limited by the fall across the entire flood pool basin. Since the channel is within the flood pool itself, milder slopes will have no impact on flooding.

3.2.1.3 Alignment

- Horizontal and vertical channel alignments are independent of the freeway.

3.2.1.4 Transitions

- Transitions between channel sections will be developed based on criteria presented in Table 608.3 of the RDG.

3.2.1.5 Hydraulic Analysis

Flow Regime

- Channels designed to convey flows in the subcritical flow regime should maintain Froude Numbers less than 0.86.
- Channels to be designed to convey flows in the supercritical flow regime should maintain a Froude Number between 1.13 and 2.0. *Exceptions are allowed at drop structures and at designated locations where controlled hydraulic jumps occur. An exception is also made for the channel transitions at the Las Sendas Channel and the 86th Street channel were the existing channel Froude numbers may already exceed the supercritical flow design criteria.*

Manning's "n" value

- Earth channel: 0.020 to 0.025
- Concrete lined channel: 0.013 to 0.018

Manning's n values for the HEC-RAS analysis of the Spook Hill Flood Pool are estimated based upon expected land use, surface material and/or vegetation type and density.

Energy Loss Coefficients

- Vertical wall transition at culverts: Expansion - 0.3, Contraction - 0.1
- Gradual channel section transitions: Expansion - 0.3, Contraction - 0.1
- Bridge/Culvert transitions: Expansion - 0.5, Contraction - 0.3

3.2.1.6 Flow Depth

- Channel flow depth shall be limited to preclude saturation of the roadway pavement structural section.

3.2.1.7 Freeboard

- Water-surface elevation below natural ground - Minimum of one foot
- For subcritical regimes (Froude Number<1), the minimum freeboard is:

$$Fb = 0.25(y + \frac{V^2}{2g})$$

Where: y = normal depth of flow (feet)
V = normal velocity (feet)
g = acceleration of gravity (32.2 feet/s^2)

or one foot, whichever value is greater.

- For water-surface elevations above natural ground, calculate per the below ground freeboard requirements plus one additional foot.
- For supercritical flow regimes (Froude Number>1) the minimum freeboard is calculated as depicted from the above equation or two feet, whichever value is greater.

The existing channel along the CAP channel that flows into the south end of the Northeast Channel does not to contain the 50-year design criteria much less meet the above freeboard criteria. Consequently, a portion of the south section of the Northeast Channel cannot reasonably contain the design discharge or meet freeboard criteria without extensive offsite grading and channel improvements. Therefore, an exception is necessary for the south section of the Northeast Channel.

3.2.1.8 Energy Dissipators

- Energy dissipators will be designed in accordance with FHWA *HEC No. 14 Hydraulic Design of Energy Dissipators for Culverts and Channels* or the USBR *Hydraulic Design of Stilling Basins and Energy Dissipators.*

3.2.1.9 Maintenance Access

- As a minimum, one continuous 12-foot wide maintenance access road is required along the offsite drainage channel system. Adjacent roadside ditches that convey small amounts of runoff will not require construction of maintenance roads.

Per ADOT's RDG, offsite channels must be designed in a manner to provide for the 50-year frequency storm with freeboard. The 100-year storm must be checked to verify that the flows are contained within the right-of-way and do not create any adverse conditions upon adjacent properties. The size of offsite stormwater facilities is often governed by minimum bottom widths and minimum box culvert heights. The difference between the 50 and 100-year discharges often does not result in significantly different facility sizes. For these reasons, the 100-year frequency is generally used for the design storm. Offsite channel extensions or transitions are designed in accordance with the initial channel design criteria if available or for the 100-year discharge.

3.2.2 Detention Basins

This criterion does not apply to the Spook Hill FRS, its associated operational structures or the freeway levee. Design criteria for those structures are presented separately.

3.2.2.1 Cross Section

Side Slopes

- Aggregate, grass and unlined slopes – 3:1 (H:V) maximum, 4:1 preferred.

Cross Slope

- A one percent minimum cross-slope, perpendicular to the low flow channel, shall apply for all detention basin bottoms.

3.2.2.2 Low Flow Channel

- Earth and grass lined channels - minimum grade of 0.2%, preferred minimum grade of 0.3%.
- Concrete lined channels - minimum grade of 0.1%, preferred minimum grade of 0.2%.

3.2.2.3 Emergency Spillways

- ADOT detention basins with piped low flow outlets shall have emergency spillways sized for the 100-year peak inflow assuming the outlet pipe is 100 percent clogged and no storage attenuation.

3.2.2.4 Freeboard

- For water-surface elevations below natural ground, the minimum freeboard from the maximum 100-year water-surface elevation to the surrounding natural ground shall be one foot.

3.2.2.5 Energy Dissipators

- Energy dissipators will be designed in accordance with *FHWA HEC No. 14 Hydraulic Design of Energy Dissipators for Culverts and Channels* or the USBR *Hydraulic Design of Stilling Basins and Energy Dissipators.*

3.2.2.6 Maintenance Access

- As a minimum, one continuous 12-foot wide maintenance access road is required along the perimeter of any offsite detention basin.
- An access ramp from the perimeter road to the basin bottom shall be provided at strategic locations, preferably near the basin outlet structure(s).

3.2.3 Freeway Levee

The freeway levee hydrologic and hydraulic design criteria established by ADWR requires that the top of the levee be above the existing condition 100-year water surface elevation along the length of the levee and that the levee be armored against erosion such that the structural section shall remain intact following a Probable Maximum Storm event. Usual freeboard criteria that might be normally required have been relaxed due to the additional flood protection provided by the depressed section of the Red Mountain Freeway and the Spook Hill FRS itself.

The structural design criteria for the freeway levee are dictated by ADWR regulations. The freeway levee will impound floodwaters upstream of the freeway, classifying the levee as an "Appurtenant Structure" according to ADWR regulations. The levee must therefore be designed as a dam in accordance with ADWR Regulation 1216 (excepting freeboard requirements).

3.2.4 Spook Hill FRS

The Spook Hill FRS hydrologic and hydraulic design criteria require:

- The 100-year water-surface elevations for the proposed condition shall be less than or equal to the existing (pre-project) condition. *(Note: This is criteria is primarily applicable to the freeway levee since it is designed to contain the 100-year event).*
- The PMF water-surface elevations for the proposed condition shall be less than or equal to the existing (pre-project) condition.
- The proposed flood pool low-flow channel shall provide a minimum capacity that equals or exceeds the existing (pre-project) condition.

The structural and geotechnical criteria are documented in separate reports.

3.2.5 Spook Hill FRS Principal Spillway Outlet

The Spook Hill FRS Principal Spillway Outlet consists of a rectangular box drop inlet with an anti-vortex panel and an SAF energy dissipator outlet. The SAF energy dissipator is designed in accordance to guidelines provided in *FHWA HEC No. 14 Hydraulic Design of Energy Dissipators for Culverts and Channels or the USBR Hydraulic Design of Stilling Basins and Energy Dissipators.*

Design reference material for rectangular drop inlets and antivortex walls is empirically based and limited to specific sizes and configurations of the inlet. The proposed Principal Spillway drop inlet size and configuration was set at the preliminary 30% design stage and is atypical of the available design reference material. However, general recommendations for the relevant design feature of the antivortex wall are provided in the *USDA ARS-NC-33 Hydraulics of Closed Conduit Spillways Part XIV: Antivortex Walls for Drop Inlets, Part XV: Low Stage Inlet for the Two-Way Drop Inlet, March 1976.*

3.3 HYDRAULIC DESIGN AND ANALYSES

Numerous hydraulic analyses were performed during the initial design process of onsite and offsite drainage and flood control facilities. These initial analyses were performed to assess existing conditions; to evaluate/develop alternatives or methodologies; or to address specific issues that arose during the initial design phase. For various reasons, not all of these analyses or issues were readdressed in subsequent design phases. In most cases, however, it was because the initial approach, methodology, and design was determined, approved, and essentially finalized during previous design phases and these issues were not to be readdressed but simply adopted in the final design effort.

With the exception of the analysis of the Spook Hill FRS, the design of hydraulic structures is based upon steady state flow conditions and normal depth methods. For the Spook Hill FRS, an unsteady flow HEC-RAS analysis was utilized to model the operation of the flood pool.

The general methodologies, equations, and analyses used in the design of offsite facilities are presented in this section.

3.3.1 Open Channels

HEC-RAS (Version 3.1.1) steady-state hydraulic models were used to analyze and design significant open channels

3.3.1.1 Northeast Channel

The Northeast Channel is a concrete lined channel located east of the freeway between the CAP canal and the Spook Hill FRS at the south end of the project. The channel consists of a north section, south section, and a 6'x6' RCB culvert across the freeway. The north section primarily collects sheet flow and drainage from small undefined drainage channel and conveys it south to the RCB culvert. Due to the existing grade, the channel is fairly steep and the 73 cfs design flow is supercritical. The hydraulic analysis of the channel indicates there is sufficient freeboard for the supercritical channel.

The south section of the channel intercepts drainage runoff and reroutes an existing drainage ditch along the CAP canal north along the freeway to the RCB culvert. Due to the existing grade, the channel is mildly sloped and actually fighting the natural grade to convey runoff to the RCB culvert. Because the channel is fighting grade, the channel is deeper near the RCB culvert and gets much shallower as it transitions into the existing channel along the CAP channel. Consequently the channel does not meet freeboard requirements along its entire length. Nor does the channel appear to contain the design 134 cfs flow as it approaches the existing drainage channel along the CAP canal. The inability to contain flow is because the design discharge is not contained within the existing CAP channel and that the existing ground drops in elevation as the new channel continues upstream to tie into the existing CAP drainage ditch. While flow will not be contained within the channel, overtopping flow should not produce adverse flooding conditions since water will be pond along the freeway embankment until the channel depth recedes and water drains back into the channel.

The RCB culvert conveys drainage across the freeway to the CAP overchute which discharges across the CAP canal and into CAP Detention Basin No. 1. The analysis indicates the culvert has adequate capacity to convey the design discharge of 200 cfs. Supporting hydraulic analysis and calculations are provided in Appendix A.

3.3.1.2 Las Sendas Channel

Discussion of the design and analysis of East Channel is provided in Section B by J2 Engineering and Environmental Design.

3.3.1.3 86th Street Channel

Discussion of the design and analysis of 86th Street Channel is provided in Section B by J2 Engineering and Environmental Design.

3.3.1.4 East Channel

Discussion of the design and analysis of East Channel is provided in Section B by J2 Engineering and Environmental Design.

3.3.2 Culverts

Culvert analyses were performed using the Federal Highway Administration's HY-8 Culvert Analysis Program (Version 6.1), Haestad Methods CulvertMaster (Version 3.0) or the Nebraska Department of Roads Broken-Back Culvert Analysis Program (BCAP). These programs automate the design methods described in the FHWA publications HDS-5, "Hydraulic Design of Highway Culverts," and HEC-14, "Hydraulic Design of Energy Dissipators for Culverts and Channels". HDS-5 culvert nomographs were also used for some simple pipe capacity calculations. HY-8 was also used to provide general estimates for the size and extent of erosion protection at typical culvert outlets.

3.3.3 CAP Overchute Detention Basin

The CAP overchute detention basin is a 2 acre-ft detention basin located between the freeway and the CAP Canal to attenuate the peak discharge from the freeway prior to discharging to the CAP Canal overchute and CAP Detention Basin No. 1. The design of the basin is based upon the hydrologic analyses presented in Section 2.3.2.2.

3.3.4 Flood Pool Inlets

Discussion of the design and analysis of Spook Hill inflow structures is provided in Section B by J2 Engineering and Environmental Design.

3.3.5 Las Sendas Channel Baffled Chute Spillway

Discussion of the design and analysis of the Las Sendas channel and the baffled cute spillway is provided in Section B by J2 Engineering and Environmental Design.

3.3.6 Screen Walls

The construction of the Red Mountain Freeway necessitated the construction of screen walls at specific locations along the east side of the flood pool adjacent to residential areas where there are no walls currently. With offsite flows approaching from the east, the screen walls will be built with openings that will provide a means by which offsite flows will be allowed to readily reach the flood pool. Specifically the proposed screen walls will be constructed at about collector channel stationing: 54+50 to 71+50, (1/3 mile to ½ mile south of McDowell Road); 182+00 to 185+00, (just north of Brown Road); and 189+60 to 194+50, (just south of Brown Road). The proposed openings in the screen walls will allow flows to enter the flood pool in much the same manner that offsite flows currently enter the flood pool.

3.3.7 Signal Butte Energy Dissipation Basin

At the request of the FCDMC, a ramp with an 8:1 slope will be provided for the Signal Butte energy dissipation basin for maintenance. A small pumping facility will be designed to drain water from the basin. Discussion of the Signal Butte energy dissipation pump station is provided in Section 6.2.

3.3.8 Spook Hill FRS Principal Spillway

3.3.8.1 Background

As part of the modifications to the Spook Hill FRS, ADOT and the FCDMC agreed with a Value Engineering recommendation to construct a new principal spillway for the Spook Hill FRS to utilize excess capacity in the existing downstream Spook Hill

Floodway. The results of the Value Engineering study are documented in *Technical Report No. 4.*

The new principal spillway configuration was determined during the initial 30% design phase of this project and documented in the *30% Initial Drainage Report.* It should be noted that an assessment of the new principal spillway's impact on the floodway was performed during the initial design phase and it was not intended to be readdressed in subsequent design efforts.

The initial 30% design analyses indicated that, in general, the floodway channel had a significant amount of excess capacity and that the actual capacity of the floodway was limited by structures at the road crossings, in particular, the Bush Highway crossing. However, the analyses also indicated that discharges from the principal spillway had a relatively insignificant impact on peak discharges at the Bush Highway crossing. Since the principal spillway discharge in subsequent design phases is essentially the same as the initial design, the Spook Hill Floodway will not differ significantly.

3.3.8.2 Principal Spillway Design

The Spook Hill FRS principal spillway outlet consists of a rectangular box drop inlet with an anti-vortex panel, a RCB culvert conduit, and an SAF energy dissipator outlet.

<u>Rectangular Drop Inlet and Antivortex Wall</u>

The 12'x14'x8' (width x length x drop) drop inlet size and configuration was set at the preliminary 30% design stage and based upon estimated capacity of the Spook Hill Floodway and the discharge capacity of the principal spillway (see Principal Spillway Outlet Rating Curve).

The Principal Spillway antivortex wall design is based upon design guidance provided in the *USDA ARS-NC-33 Hydraulics of Closed Conduit Spillways Part XIV: Antivortex Walls for Drop Inlets, Part XV: Low Stage Inlet for the Two-Way Drop Inlet, March 1976.* The guidance indicates that given a rectangular drop inlet of width D, the antivortex wall should extend D/2 beyond the outside of the drop inlet sidewalls and it's height be at least 1.5D, preferably 2D, or extends to the maximum water surface elevations, whichever is less.

<u>SAF Energy Dissipator Design</u>

The Spook Hill FRS Principal Spillway Outlet consists of a rectangular box drop inlet with an anti-vortex panel and an SAF energy dissipator outlet. The SAF energy dissipator is designed in accordance to guidelines provided in *FHWA HEC No. 14 Hydraulic Design of Energy Dissipators for Culverts and Channels or the USBR Hydraulic Design of*

Stilling Basins and Energy Dissipators. Detailed calculations are provided In Appendix B.

3.3.9 Spook Hill FRS Emergency Spillway

The existing 260 ft. wide, Type C, reinforced concrete, straight drop emergency spillway for the Spook Hill FRS will remain intact without modification.

3.3.10 HEC-RAS Combined Spillways Outlet Rating Curve

The *principal spillway outlet rating curve* together with the *emergency spillway outlet rating curve* comprise the *combined spillways outlet rating curve* which is used as a boundary condition in the unsteady flow HEC-RAS analysis of the Spook Hill FRS operation.

3.3.10.1 Principal Spillway Outlet Rating Curve

The principal spillway outlet rating curve was based upon the discharge capacity of the 12'x8' RCB outlet conduit and the inlet capacity of the drop inlet. The discharge capacity of the RCB outlet conduit was estimated using HY-8 culvert analyses. The inlet capacity of the 12'x14' drop inlet was estimated using the weir equation. The capacity of each component was then estimated and compared over a range of flood pool stage elevations. The principal spillway outlet rating curve was then determined based upon the capacity of the component that limited discharge through the spillway at each specific flood pool stage elevation (see Tables 3-1 and 3-2).

Rating curves were developed for both the existing principal spillway (7'x7.5' RCB with 7'x14' drop inlet) and the proposed principal spillway (12'x8' RCB with 12'x14' drop inlet). The rating curves are shown in the Figure 3-1.

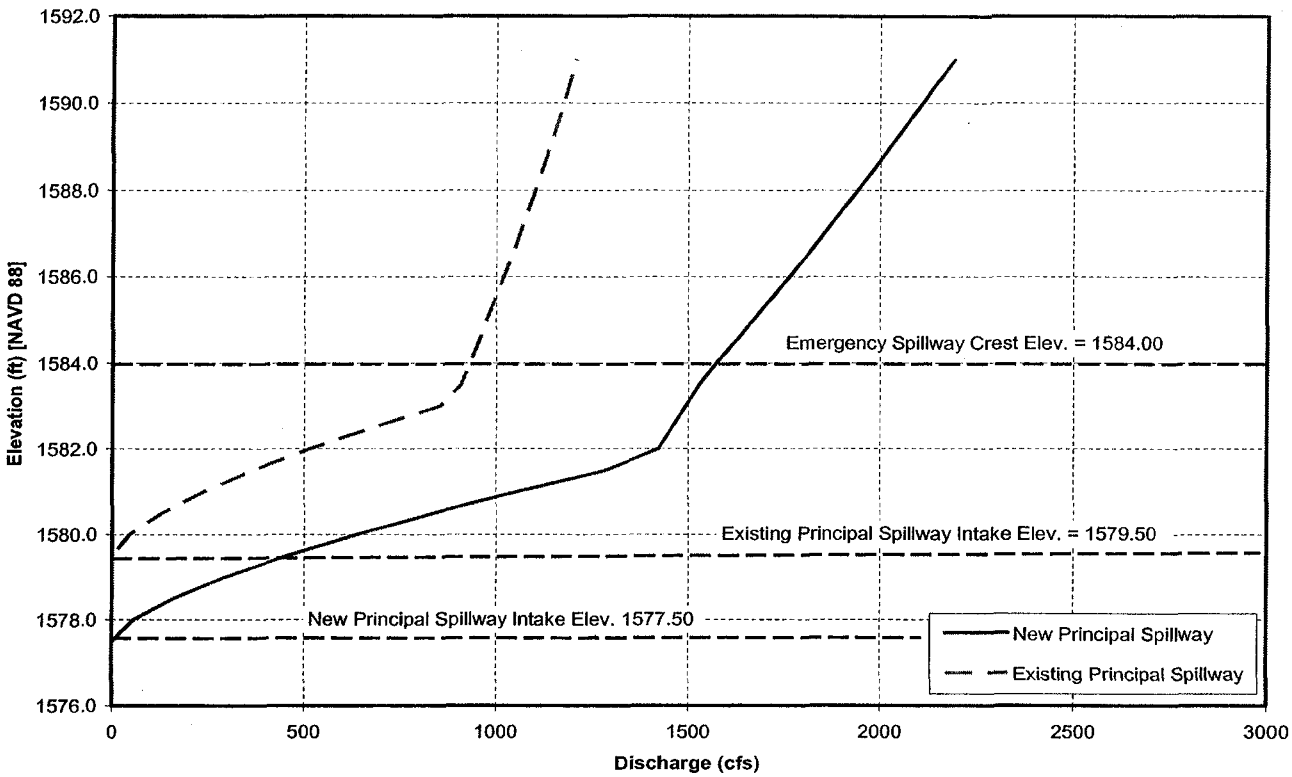

Figure 3-1: Principal Spillway Outlet Rating Curves

3.3.10.2 Emergency Spillway Outlet Rating Curve

The emergency spillway outlet rating curve is shown as part of the New Combined Spillway Outlet Rating Curve in Figure 3.2. Supporting documentation for the determination of the emergency spillway discharge rating curve is provided in the 30% Initial Drainage Report.

3.3.10.3 Combined Spillway Outlet Rating Curve

The combined spillway outlet rating curve is simply the addition of the new principal spillway outlet rating curve and the emergency outlet rating curve to create a combined rating curve representing the total discharge from the Spook Hill FRS for a range of flood pool stage elevations.

The calculated rating curve for the existing spillway configuration and the new combined spillways outlet rating curve are presented in Tables 3-1 and 3-2, respectively. The new combined spillways outlet rating curve is shown in Figure 3-2. A graphical comparison of the rating curves is shown in Figure 3-3.

Table 3-1: Revised Existing FRS Outlet Rating

Elevation NAVD 88 (ft)	Drop Inlet			7'x7.5' RCBC Discharge[2] (cfs)	Principal Spillway Discharge[3] (cfs)	Emergency Spillway Discharge[4] (cfs)	Combined Spillway Discharge (cfs)
	L (ft)	H (ft)	Q[1] (cfs)				
1577.30	42	0.0	0	N.A.	1	0	1[5]
1578.00	42	0.0	0	N.A.	2	0	2[5]
1579.00	42	0.0	0	N.A.	3	0	3[5]
1579.50	42	0.0	0	N.A.	4	0	4[5]
1580.00	42	0.5	46	719	46	0	46
1580.50	42	1.0	130	749	130	0	130
1581.00	42	1.5	239	779	239	0	239
1581.50	42	2.0	368	805	368	0	368
1582.00	42	2.5	515	831	515	0	515
1582.50	42	3.0	677	857	677	0	677
1583.00	42	3.5	853	883	853	0	853
1583.50	42	4.0	1,042	908	908	0	908
1584.00[6]	42	4.5	1,243	931	931	0	931
1584.50	42	5.0	1,456	954	954	465	1,419
1585.00	42	5.5	1,679	976	976	930	1,906
1585.50	42	6.0	1,914	999	999	1,395	2,394
1586.00	42	6.5	2,158	1,021	1,021	1,860	2,881
1586.50	42	7.0	2,411	1,044	1,044	2,780	3,824
1587.00	42	7.5	2,674	1,063	1,063	3,700	4,763
1587.50	42	8.0	2,946	1,083	1,083	4,800	5,883
1588.00	42	8.5	3,227	1,103	1,103	5,900	7,003
1588.50	42	9.0	3,515	1,123	1,123	7,325	8,448
1589.00	42	9.5	3,812	1,143	1,143	8,750	9,893
1589.50	42	10.0	4,117	1,162	1,162	10,175	11,337
1590.00	42	10.5	4,430	1,180	1,180	11,600	12,780
1590.50	42	11.0	4,750	1,196	1,196	13,200	14,396
1591.00	42	11.5	5,078	1,212	1,212	14,800	16,012

Notes
1. Based on weir equation (represents weir inlet capacity).
2. Based on interpolated values from HY-8 analysis (represents actual RCB conduit capacity).
3. Smallest value of either the inlet capacity (weir equation) or the conduit capacity (HY-8 analysis).
4. Based upon previous assessment of emergency spillway capacity.
5. Nominal values inserted for HEC-RAS modeling purposes.
6. Actual emergency spillway crest elevation is estimated to be 1583.86 based upon conversion from NAD29 to NGVD88 (+1.86 ft). Elevation 1584 used for rating curve for ease of use and will not have a significant impact on results.

Table 3-2: Proposed FRS Outlet Rating Curve

Elevation NAVD 88 (ft)	Drop Inlet			12'x8' RCBC Discharge[2] (cfs)	Principal Spillway Discharge[3] (cfs)	Emergency Spillway Discharge[4] (cfs)	Combined Spillway Discharge (cfs)
	L (ft)	H (ft)	Q[1] (cfs)				
1577.30	52	0.0	0	N.A.	0	0	1[5]
1577.50	52	0.0	0	N.A.	0	0	2[5]
1578.00	52	0.5	57	977	57	0	57
1578.50	52	1.0	161	1,087	161	0	161
1579.00	52	1.5	296	1,150	296	0	296
1579.50	52	2.0	456	1,207	456	0	456
1580.00	52	2.5	637	1,264	637	0	637
1580.50	52	3.0	838	1,321	838	0	838
1581.00	52	3.5	1,056	1,356	1,056	0	1,056
1581.50	52	4.0	1,290	1,391	1,290	0	1,290
1582.00	52	4.5	1,539	1,425	1,425	0	1,425
1582.50	52	5.0	1,802	1,460	1,460	0	1,460
1583.00	52	5.5	2,079	1,495	1,495	0	1,495
1583.50	52	6.0	2,369	1,530	1,530	0	1,530
1584.00[6]	52	6.5	2,671	1,574	1,574	0	1,574
1584.50	52	7.0	2,985	1,622	1,622	465	2,087
1585.00	52	7.5	3,311	1,670	1,670	930	2,600
1585.50	52	8.0	3,648	1,717	1,717	1,395	3,112
1586.00	52	8.5	3,995	1,764	1,764	1,860	3,624
1586.50	52	9.0	4,352	1,809	1,809	2,780	4,589
1587.00	52	9.5	4,720	1,853	1,853	3,700	5,553
1587.50	52	10.0	5,098	1,897	1,897	4,800	6,697
1588.00	52	10.5	5,485	1,942	1,942	5,900	7,842
1588.50	52	11.0	5,881	1,986	1,986	7,325	9,311
1589.00	52	11.5	6,287	2,027	2,027	8,750	10,777
1589.50	52	12.0	6,701	2,068	2,068	10,175	12,243
1590.00	52	12.5	7,124	2,110	2,110	11,600	13,710
1590.50	52	13.0	7,556	2,151	2,151	13,200	15,351
1591.00	52	13.5	7,996	2,193	2,193	14,800	16,993

Notes
1. Based on weir equation (represents weir inlet capacity).
2. Based on interpolated values from HY-8 analysis (represents actual RCB conduit capacity).
3. Smallest value of either the inlet capacity (weir equation) or the conduit capacity (HY-8 analysis).
4. Based upon previous assessment of emergency spillway capacity.
5. Nominal values inserted for HEC-RAS modeling purposes.
6. Actual emergency spillway crest elevation is estimated to be 1583.86 based upon conversion from NAD29 to NGVD88 (+1.86 ft). Elevation 1584 used for rating curve for ease of use and will not have a significant impact on results.

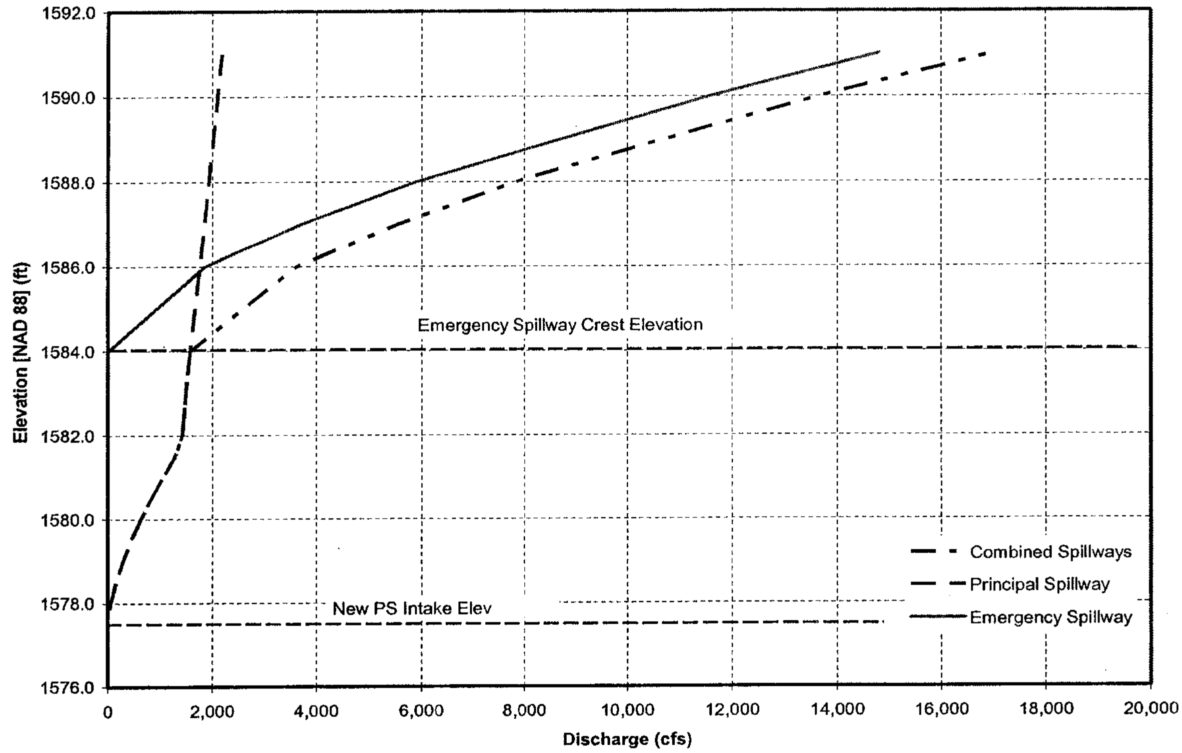

Figure 3-2: New Combined Spillways Outlet Rating Curve

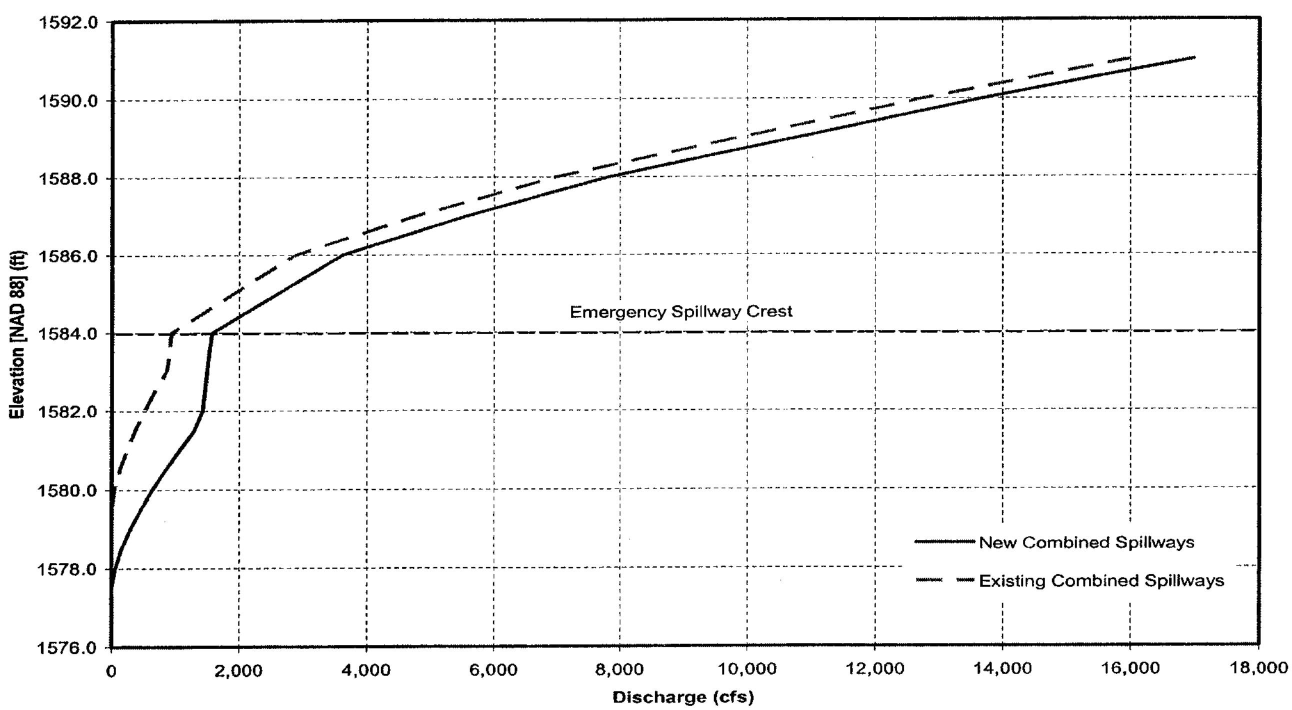

Figure 3-3: Existing vs. New Combined Spillways Outlet Rating Curve

3.3.11 Spook Hill FRS Stage-Storage Curve

The storage capacity of the Spook Hill FRS flood pool and the freeway prism at various water surface elevations were estimated from the flood pool grading DTM. Table 3-3 shows the design storage provided at critical elevations along with storage capacity for the existing conditions. A stage storage curve for the Spook Hill FRS is also provided in Figure 3-4. It should be noted that the freeway prism volume is not included in the storage capacity of the flood pool until the water surface elevation exceeds the lowest elevation of the freeway levee. It should also be noted that both the existing conditions and the design conditions do not reflect the estimated storage set aside for the accumulation of sediment (271 acre-ft for existing conditions, 241 acre-ft for design conditions)

Table 3-3 Spook Hill FRS Stage-Storage

Description	Design Condition		Existing Condition[1]	
	Elevation[2] (ft)	Storage Volume (acre-ft)[3]	Elevation[4] (ft)	Storage Volume (acre-ft)
Spook Hill FRS Flood Pool Bottom Elevation	1568.1	0	1567.9	0
Principal Spillway Crest Elevation	1577.5	207	1579.5	243
Freeway Levee Crest Elevation (lowest)[5]	1582.1	917	N/A	N/A
Just Above Freeway Levee Crest Elevation[6]	1582.2	1991	N/A	N/A
Emergency Spillway Crest Elevation	1584.0	2544	1583.9	1120
Spook Hill FRS Crest Elevation (lowest)[7]	1591.4	5045	1592.5	4000

1. Obtained from DMJM+Harris Technical Report No. 1, Oct 2001, Appendix C.
2. NAD88
3. Volumes at non-integral elevations interpolated. Freeway volume only included at or above the freeway levee crest elevation. 241 acre-ft is subtracted from available storage volume to account for sedimentation.
4. Elevations converted from NGVD29 to NAD88. Elevation may differ due to changes in design or location of elevation.
5. Freeway levee elevation varies from 1582.1 feet to 1585.0 feet.
6. At 1582.2, assume freeway prism volume of ~1058 acre-ft is available for storage.
7. FRS levee crest elevation at the principal spillway is ~1591.4 feet. Generally, the FRS crest elevation is ~1593.5 feet.

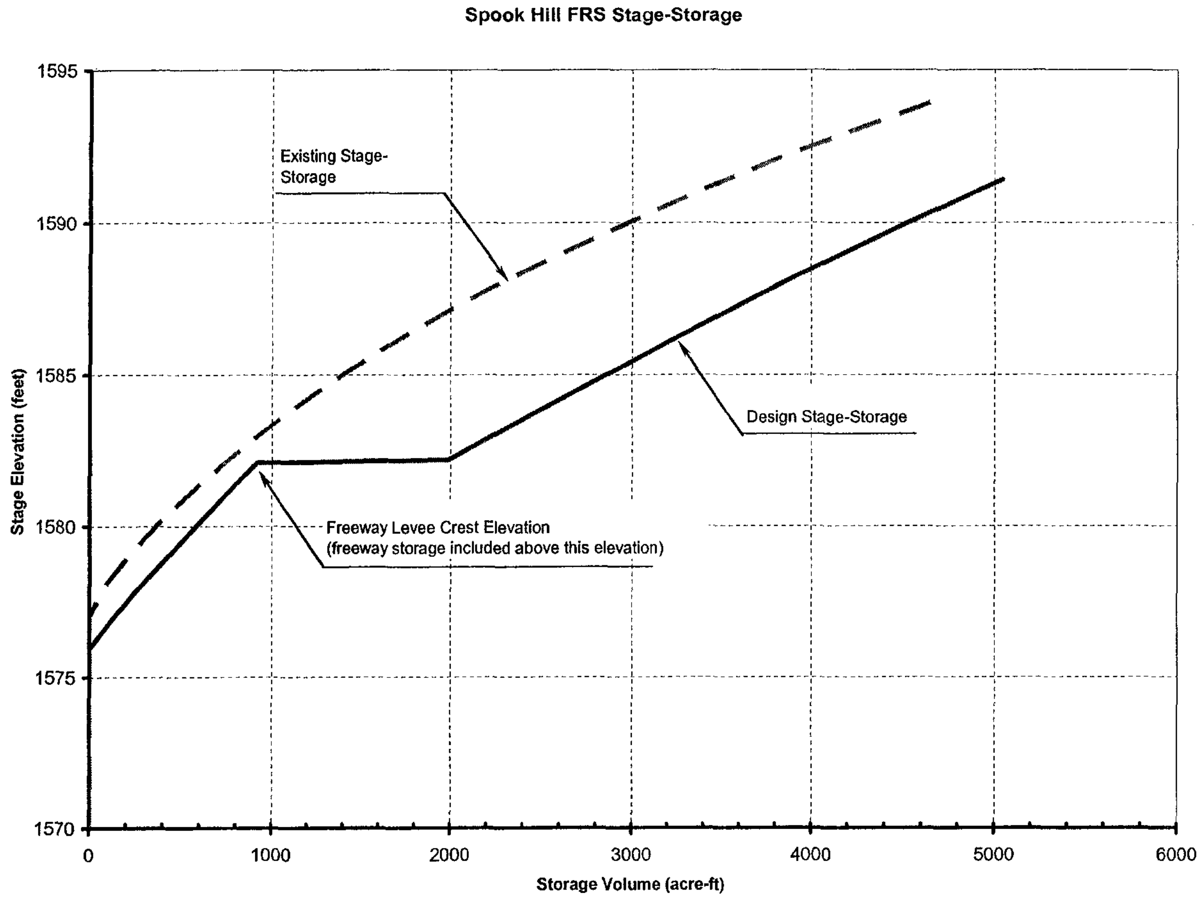

Figure 3-4: Spook Hill FRS Stage-Storage Curve

3.3.12 Spook Hill Floodway Analyses

The Spook Hill Floodway was studied in detail in Technical Report No. 4. The report indicated that the existing floodway had additional capacity for the 100-year event. The report also included a Value Engineering Assessment which recommended the construction of a new principal spillway with a larger discharge capacity that would reduce the reservoir storage requirement of the Spook Hill FRS. This recommendation was adopted by both ADOT and the FCDMC.

During the 30% design phase a new principal spillway was design and analyzed. The analysis indicated that the new principal spillway has no significant impact on the floodway. An insignificant increase in flow was realized at the Bush Highway (increasing from 2892 cfs to 2895 cfs). The culvert crossing at Bush Highway was estimated to have a capacity of approximately 3030 cfs prior to overtopping. However, the floodway capacity is approximately 2700 cfs immediately downstream of the highway, due to the apparent inability of the existing channel to contain subcritical flow. Documentation of the design is provided in the 30% Initial Drainage Report.

Reassessment of the floodway capacity after the initial floodway evaluation was excluded from the scope of subsequent design efforts. Changes to the design of the new principal spillway and to the Spook Hill flood pool grading do not differ greatly from the initial design. Therefore, the impact on the Spook Hill Floodway is expected to be minor and that the floodway has adequate capacity for the 100-year event.

3.3.13 Spook Hill Flood Pool Unsteady Flow HEC-RAS Analysis

3.3.13.1 General

The approach, methodology, and hydraulic models for the operational and design analysis of the Spook Hill FRS facilities was developed and approved during the pre-design and initial design phases of this project. The hydraulic models presented in the 30% Initial Drainage Report were utilized for the analysis of the flood pool and freeway prism for both the PMF and 100-year flood events for the existing and proposed Spook Hill FRS facilities.

The design concept is that the freeway levee, located east (upstream) of the freeway, will provide floodwater protection up to the 100-year event. For floods exceeding the 100-year event, floodwater will overtop the freeway levee and the freeway prism will provide additional floodwater storage and flood protection. A pump station will drain the freeway by pumping water back into the flood pool. The flood pool will be drained through the principal spillway to the Spook Hill Floodway. During extreme flood events, the existing emergency spillway will provide a controlled discharge outlet for floodwater and protect the integrity of the FRS. However, with no downstream conveyance, floodwater will present hazardous flood conditions downstream of the spillway. This issue is addressed in the Spook Hill FRS Flood Inundation Study provided separately.

This section discusses the hydraulic parameters, assumptions and methodologies associated with the analysis of the final Spook Hill FRS design. For information on the hydraulic analysis of the existing Spook Hill FRS facilities, refer to the 30% Initial Drainage Report.

3.3.13.2 Hydraulic Modeling Data

The operational characteristics of the Spook Hill FRS (including the freeway prism) were analyzed using HEC-RAS (Version 3.1.1) unsteady flow hydraulic models. *Utilizing a different version of HEC-RAS may produce different results and/or error messages.* The model extends from the principal spillway outlet located at the north end of the project to the outlet of the Signal Butte Floodway located approximately 2 miles to the south east. The input parameters and methodologies used to develop the hydraulic models are summarized below.

<u>GEOMETRIC DATA</u>

Reaches

There are three analysis reaches in the HEC-RAS model: the Upper FRS Reach, the Lower FRS Reach, and the Freeway Reach.

Upper FRS Reach. This reach represents the flood pool upstream of the confluence with the Freeway Reach. It includes the inflow hydrographs for much of the Buckhorn Mesa watershed including the Signal Butte Floodway (the upstream boundary hydrograph), lateral weirs for the top of the freeway levee, and all the cross road culverts for the flood pool.

Lower FRS Reach. This reach represents the flood pool downstream of the confluence of the Upper FRS Reach and the Freeway Reach. It includes the emergency and principal spillways (both represented by the rating curve for the downstream boundary condition) and an inflow hydrograph for the Las Sendas channel located north of McDowell Road.

Freeway Reach. This reach represents the incised freeway prism from south of Brown Road to the confluence with the flood pool reach just north of McDowell Road. The Spook Hill FRS itself (west of the freeway) is included in this reach and contains flood water within the freeway prism. The freeway reach contains freeway bridge crossings at McDowell, McKellips, and Brown Roads and also receives flood water overtopping the freeway levee along the right embankment (east side of the freeway).

Junctions

A junction or confluence for the freeway reach and the flood pool is placed just north (downstream) of McDowell Road. The junction is essentially the "downstream" end of the freeway where the incised freeway begins to transition to an elevated section as the freeway rises to pass over the CAP Canal. A short segment of the freeway levee just north of the freeway bridge at McDowell Road would allow flood water above the freeway levee elevation to reenter the flood pool.

Junction calculations are performed using the energy equation (as opposed to the momentum equation which considers junction angle) since the energy loss due to the confluence angle is expected to be insignificant. A comparative analysis indicated that the selection of the computational approach does not significantly impact the results.

Lateral Structures

The freeway levee between the flood pool and the freeway is defined as a series of lateral weir structures in the FRS Reach. The lateral weirs are set at the left overbank of the FRS cross sections with weir elevations based set at the top of freeway levee elevation or by the proposed ground at the left overbank. Flow overtopping the freeway levee is diverted to the Freeway Reach at specific cross section locations based upon the location of the lateral weir.

Cross Sections

A composite digital terrain model (DTM) comprised of existing topographic information and the proposed project grading was used to cut cross sections for the hydraulic model analysis.

An exhibit showing cross-section locations is provided in Appendix C. The exhibit shows many cross sections extending across both the FRS Reach and the Freeway Reach. However, cross sections for each reach were typically truncated at the freeway levee to simplify the geometric data, clarify the separation between the two reaches and to help define the top of the freeway levee as a lateral weir structure. Therefore, the exhibit shows the proper location and orientation of cross sections but not necessarily the cross section length that might be described in the reaches.

Sedimentation

Requirements established during the initial design phases specify that 241 acre-ft of sediment will be accounted for in the hydraulic modeling of the FRS by setting a fixed sediment elevation. The elevation will be based upon the volume of storage provided by the FRS below the elevation. Based upon the proposed flood pool grading, it is estimated that an elevation of 1575.95 feet will provide 241 acre-ft of storage. The application of a fixed sediment level essentially flattens the flood pool by filling in the low flow channel for much of the flood pool.

Bridge and Culvert Cross Sections

At skewed bridge crossings, cross sections were adjusted to define an equivalent section perpendicular to the flow direction using the skew angle option in HEC-RAS. Profile data used for culvert and bridge routines approximate the roadway and bridge low cord elevations presented in the plans.

Bank Stations

Bank stations for the FRS Reaches are generally set at the top of levee or flood pool elevation. In the Freeway Reach, bank stations are set at approximately the outside curb or shoulder locations.

Levee Options

Generally the HEC-RAS levee option is used to prevent water from entering a portion of the cross section unless the levee elevation is exceeded. In the project models, the levee option is used occasionally to remove portions of the cross section from flow calculations without having to truncate the cross section.

Ineffective Flow Areas

Ineffective flow areas were set at locations where water does not actively convey flow. Ineffective flow areas are set at the culvert cross sections at McDowell, McKellips, and Brown Roads where flow in the wide flood pool cross section is constricted to essentially the size of the culvert openings. Other isolated locations are defined as ineffective flow areas due to either upstream or downstream conditions or geometry.

Expansion/Contraction Coefficients

Contraction and expansion coefficients of 0.1 and 0.3, respectively, were generally used for the study reaches. At bridge or culvert sections, contraction and expansion coefficients of 0.3 and 0.5, respectively, were used.

Manning's Roughness Coefficients

For proposed conditions, a Manning's 'n' value of 0.040 was used for the reconfigured Spook Hill FRS flood pool. This variable was selected to account for proposed modifications within the flood pool for landform grading and landscaping. Calculations supporting the proposed condition Manning's 'n' value are provided in the Initial Design Report.

To address concerns that the Initial Design Report Manning's 'n' values were too low, supplemental analyses were performed for both the 100-year hydrology and the PMF hydrology using a higher Manning's 'n' value of 0.08 across the bottom of the flood pool east of the low flow channel and along the east side slopes of the flood pool. The sideslopes of the freeway levee and the area west of the low flow channel were considered to be areas where landscaping would be severely restricted and vegetative growth would be actively discouraged in order to protect the integrity of the freeway levee. For these areas, the initial Manning's 'n' value of 0.040 was maintained.

Pilot Channels

Pilot channels are a modeling option that can help stabilize hydraulic calculations in the HEC-RAS model at low flows. The pilot channel area and conveyance is used during periods of low flow but when flow rates and channels depths increase, the area and conveyance of the pilot channel are ignored. Therefore, pilot channels do not impact the hydraulic results in the channel once flow rates are sufficient to enable hydraulic calculations to converge on a solution.

UNSTEADY FLOW DATA

Downstream Boundary Condition

A downstream boundary hydrograph is necessary to establish flow conditions and initial starting water surface elevations for unsteady flow calculations. The model developed during the initial design phases of this project and approved by the FCDMC utilizes a rating curve to establish the boundary conditions at the downstream limits of the flood pool. The rating curve is the combined spillways outlet rating curve discussed in Section 3.3.9.3 and establishes the starting water surface elevation passed upon the routed discharge at the end cross section.

Upstream Boundary Condition

For unsteady flow calculations, an upstream boundary hydrograph is necessary for each analysis reach. For the Upper FRS Reach, the upstream boundary hydrograph is the HEC-1 hydrograph for the Signal Butte Spillway. For the Freeway Reach, there is no upstream conveyance for the freeway since it does not realize flow until the freeway levee is overtopped. However, an upstream boundary condition hydrograph must be defined, therefore, a "dummy" hydrograph with a constant zero discharge rate is specified.

Inflow Hydrograph Boundary Conditions

Hydrographs from the HEC-1 watershed models are imported into the unsteady flow data as inflow hydrographs at cross sections along the length of the flood pool. Since the HEC-1 models regional watershed models, the subbasin areas and hydrographs are generally not subdivided in sufficient detail to provide specific hydrograph data for every local inflow point to the flood pool, the inflow hydrographs are imported into the HEC-RAS model as "uniform inflow hydrographs" which distribute flow uniformly between specified cross section locations. For comparison, the HEC-RAS model was also run importing all the HEC-1 hydrograph data simply as flow hydrographs (which input all flow at a specific cross section). No significant differences were found between the results of the analyses.

Initial Conditions.

HEC-RAS requires a non-zero initial conditions flow value for the beginning of the simulation at the upper end of each reach. A nominal value of 1 cfs was used as the initial flow conditions for each reach.

3.3.13.3 Refinements to 30% HEC-RAS Unsteady Flow Model

While it was directed that the initial 30% HEC-RAS modeling approach of the Spook Hill FRS was to be used for more detailed design, modifications were made to improve model stability and decrease calculation time. In addition, refinements were made for changes in flood pool grading and other project changes that might impact the hydraulic analysis. The most significant refinements to the HEC-RAS model are described below.

GEOMETRIC DATA

Lateral Weirs.

The number of lateral weirs was reduced to help stabilize the model and decrease the model calculation time without significantly impacting calculation results. Lateral weirs elevations were also adjusted as necessary to agree with new grading data.

Ineffective Flow Areas at Culvert Crossings.

Ineffective flow areas at culvert crossings were revised to define in better detail the effective flow of the cross sections as they approach the culverts. This had an impact of raising the flood pool water surface elevations over time but did not significantly impact maximum waters surface elevations.

Cross Sections

As mentioned, new cross sections were cut for changes in the flood pool grading. In addition, additional cross sections were added to better model some culvert/bridge cross sections and the freeway.

Fixed Sediment Level Elevation

Per the 30% Initial Design Report, 241 acre-ft of sediment is to be accounted for in the flood pool. A fixed sediment level across the flood pool was to be used to account for the sediment volume. It is estimated that with the proposed grading to the flood pool, 241 acre ft of sediment volume is obtained at an elevation of 1575.95.

Removal of Freeway In-line Weir and Gated Outlet

A fictional in-line weir with a gated outlet was initially used at the downstream end of the Freeway Reach to stabilize the hydraulic model and represent the confluence with the flood pool. Instability problems with the freeway reach were resolved with the use of pilot channels making the in-line weir and gated outlet unnecessary. A new cross section that defines the "inlet" cross section to the flood pool was added to the freeway reach.

Truncation of Cross Sections

As previously mentioned in the Hydraulic Modeling Data Section, initially, cross sections in the FRS Reaches were extended across the Freeway Reach and used to model both reaches. Levees and ineffective flow areas restricted flow to the proper reach and to the proper areas.

For clarity, cross sections were truncated to include only the geometric data relevant to that reach. This is primarily cosmetic and did not impact the model results. Typically the cross sections were truncated at the freeway levee to simplify the geometric data, to clarify the separation between the two reaches, and to help define the top of the freeway levee as a lateral weir structure.

Pilot Channels

Pilot channels are used for all the reaches. In the FRS Reaches, accounting for sedimentation of the flood pool with a fixed elevation creates a flat channel with no slope for much of the flood pool making it difficult for hydraulic calculations to converge on a solution. A small sloped pilot channel allows hydraulic calculations to proceed for low initial flows in the flat flood pool. In the Freeway Reach, the vertical alignment of the freeway has adverse slopes which create instabilities. A small sloped pilot channel resolves instability problems.

UNSTEADY FLOW DATA

Upstream Boundary Hydrographs

For the 30% design model, the upstream boundary conditions hydrographs for the Upper FRS and the Freeway Reaches were modified such that the initial hydrograph flows were non-zero. This was found not to be necessary. For the Upper FRS, the upstream boundary hydrograph was modified to be in complete agreement with the HEC-1 hydrograph. For the Freeway Reach, the dummy upstream boundary hydrograph was revised to constantly be zero. These modifications have little impact on the overall results of the analysis but do represent a refinement of the 30% design model.

PMF Boundary Hydrograph at Lower FRS Reach Cross Section 0.370

For the PMF hydrograph at Lower FRS Reach Cross Section 0.370, the 30% design model utilized the 100-year, 24-hour hydrograph. This was corrected and the PMF hydrograph was utilized.

Model Calculation Tolerances

Instabilities in the 30% design model necessitated the relaxation of unsteady flow analysis calculation tolerances from the typical default values. The revised hydraulic model and the modifications to increase stability have the additional benefit of allowing for tighter tolerances in hydraulic calculations so that default values can be used

3.3.13.4 Summary of HEC-RAS Unsteady Flow Model Results

The results of the design analysis indicate that the proposed Spook Hill FRS design will restrict the 100-year and PMF flood water surface elevations to below the estimated existing Spook Hill FRS flood water surface elevations as determined in the 30% Initial Design Report. The proposed freeway levee will protect the freeway from the 100-year event. During the PMF event, while flow will discharge from the emergency spillway, the FRS will not be overtopped.

A summary of the existing conditions and the proposed conditions Spook Hill FRS water surface elevations are provided in Table 3-3. Supporting calculations and documentation for the proposed conditions are provided in Appendix C. Detailed results for the 100-year and PMF existing condition hydraulic analyses are provided in the *30% Initial Design Report.*

Table 3-4: Existing vs. Proposed FRS Water Surface Elevations

Location	FRS Water Surface Elevation					
	Existing FRS		Proposed FRS		Difference	
	100-yr (ft)	PMF (ft)	100-yr (ft)	PMF (ft)	100-yr (ft)	PMF (ft)
FRS Principal Spillway – McDowell Rd	1581.8	1590.7	1580.4	1589.9	-1.4	-0.8
McDowell Rd – McKellips Rd	1582.1	1591.2	1581.2	1590.0	-0.9	-1.2
McKellips Rd – Brown Rd	1583.0	1591.5	1582.3	1590.2	-0.7	-1.3
Brown Rd – Signal Butte Floodway	1585.1	1590.9	1584.0	1590.2	-1.1	-0.7

Note- Existing WSELs based upon Spook Hill FRS Technical Reports No. 2 & 3
Relocated FRS crest elevation set at 1593.5
Proposed freeway levee crest elevations set at 1582.1 (N of McDowell to McKellips), 1583.0 (McKellips-Brown) and 1585.0 (Brown to Signal Butte Floodway)

3.3.13.5 Increased Manning's 'n' Value Analyses

As previously mentioned, to address concerns that the Initial Design Report Manning's 'n' values were too low, supplemental analyses for both the 100-year hydrology and the PMF hydrology were performed using a higher 'n' value of 0.08 across the bottom of the flood pool east of the low flow channel and along the east side slopes of the flood pool. The sideslopes of the freeway levee and the area west of the low flow channel were considered to be areas where landscaping would be severely restricted and vegetative growth would be actively discouraged in order to protect the integrity of the freeway levee. For these areas, the initial Manning's 'n' value of 0.040 was maintained.

The results of the analyses are shown in Table 3-4 in comparison to the existing conditions and the proposed conditions (using the Initial Design Report 'n' values). The results indicate that the increase in 'n' values will not raise the flood pool maximum water surface elevations above the calculated existing conditions flood pool maximum water surface elevations. The results also indicate that the increase in the 'n' values does not significantly raise water surface elevations in comparison to the proposed conditions analysis.

It should be noted that the increased Manning's 'n' value analyses are supplemental analyses and that the proposed conditions analyses based upon the Initial Design Report 'n' values still serve as the basis for the Spook Hill FRS design.

Table 3-5: Increased Flood Pool Manning's 'n' Value Analyses

Location	FRS Water Surface Elevation					
	Existing FRS		Proposed FRS		Increased 'n'	
	100-yr (ft)	PMF (ft)	100-yr (ft)	PMF (ft)	100-yr (ft)	PMF (ft)
FRS Principal Spillway – McDowell	1581.8	1590.7	1580.4	1589.9	1580.2	1589.6
McDowell Rd – McKellips Rd	1582.1	1591.2	1581.2	1590.0	1581.2	1590.1
McKellips Rd – Brown Rd	1583.0	1591.5	1582.3	1590.2	1582.5	1590.3
Brown Rd – Signal Butte Floodway	1585.1	1590.9	1584.0	1590.2	1584.3	1590.3

Note- Existing WSELs based upon Spook Hill FRS Technical Reports No. 2 & 3
Relocated FRS crest elevation set at 1593.5
Proposed freeway levee crest elevations set at 1582.1 (N of McDowell to McKellips), 1583.0 (McKellips-Brown) and 1585.0 (Brown to Signal Butte Floodway)

3.3.13.6 Assessment of Methodology and Model Results

In an attempt to verify the results of the initial 30% design approach to modeling the Spook Hill FRS facilities various approaches and preliminary models were investigated including:

- a HEC-1 flood storage routing model,
- a mass inflow-outflow hydrograph storage analysis, and
- several different HEC-RAS models utilizing different approaches and methodologies.

In nearly all instances, the 30% design approach provided the most conservative results in terms of flood pool water surface elevations. Based upon these findings, the results of the HEC-RAS Unsteady Flow design model analysis are considered conservative.

3.3.13.7 Impact of Ultimate Freeway Configuration

The planned ultimate freeway configuration replaces the unpaved median area with HOV lanes. A paved median is not reflected in the Spook Hill FRS hydraulic analysis, however, the freeway prism itself would remain essentially the same as indicated in the hydraulic analysis. The possible volume displaced in paving the medians would be negligible compared to the total storage provided by the entire Spook Hill FRS and would have little, if any, impact on the operation of the Spook Hill FRS facilities. In the future, if additional lanes are added to provide more freeway lanes than the actual planned ultimate freeway section. They would likely replace sloped embankments and add additional storage to the freeway prism. Still the increased storage volume would likely have no significant impact on the operation of the FRS or on the flood water surface elevation.

3.4 SPOOK HILL FRS FLOOD INUNDATION STUDY (FIS)

In support of the freeway and Spook Hill FRS design, a flood inundation study was conducted to assess the extent and magnitude of flooding downstream (west) of the FRS should the embankment be breached or should flow pass through the emergency spillway in an extreme flood event. The FIS is an update to the existing Spook Hill FRS Inundation Study and the Principal Spillway Dam Breach Analysis and will be used to revise the Spook Hill FRS Emergency Action Plan (EAP) and help develop the Red Mountain Freeway Emergency Response Plan (ERP).

The FIS presents the results of analyses used to determine the extent and magnitude of flooding downstream of the FRS, which would occur from the following four flow distribution scenarios:

1) Flow through the FRS emergency spillway approaches one-third capacity.
2) Flow through the FRS emergency spillway approaches two-third capacity.
3) Flow through the FRS emergency spillway at full capacity; and
4) A breach in the FRS in the vicinity of the principal spillway outlet.

The results and details of the study are documented in a separate report entitled *Red Mountain Freeway (202L) Power Road to University Drive Spook Hill Floodwater Retarding Structure Flood Inundation Study Progress Report.*

3.5 CONDITIONAL LETTER OF MAP REVISION (CLOMR)

3.5.1 Existing Floodplain Hazard

The floodplain for the Spook Hill FRS and the Spook Hill Floodway is delineated as Zone A according to Flood Insurance Rate Map (FIRM) No. 04013C2210E1 (dated July 19, 2001) and FIRM No. 04013C2220E (dated July 19, 2001). A Special Flood Hazard Zone A is defined as an area where no base flood elevations have been determined.

3.5.2 FEMA Submittal

The proposed alignment of the Red Mountain Freeway extension will pass over the Spook Hill FRS at two locations and through the FRS flood pool requiring the partial reconstruction of the Spook Hill FRS and the excavation of a new flood pool to maintain regional flood protection for the 100-year flood and the Probable Maximum Flood (PMF) events. The impact of the project on the regulatory floodplain requires that a Conditional Letter of Map Revision (CLOMR) be submitted to the Federal Emergency Management Agency (FEMA) for approval to redefine the 100-year floodplain limits. The revision of the floodplain limits will ultimately depend upon the approval of the CLOMR by FEMA, however, the revised limits are essentially defined by the footprint of the new incised flood pool and the freeway levee.

4 ONSITE DRAINAGE

4.1 GENERAL DISCUSSION

This section summarizes the design criteria, approach, assumptions and analytical results supporting the design of the onsite drainage systems for the segment of the Red Mountain Freeway between Power Road and University Drive. Drainage systems including catch basins and storm drains were designed for the freeway mainline and ramps. Drainage systems were also developed for McDowell Road, McKellips Road and Brown Road as well as the crossroad roundabouts.

The freeway drainage system also includes a large pump station at the northwest corner of McKellips Road and 76th Street. This new pump station will receive runoff from the freeway trunk line system and was designed with a long 10'x10' RCBC for storage. There were also several smaller pump stations that have been designed to drain the proposed maintenance underpasses and the Signal Butt Energy Basin. A discussion of the pump station designs is provided in Sections 5 and 6.

Several long and narrow areas exist along the eastbound lanes of the freeway between the existing Spook Hill FRS and the proposed freeway. These areas will drain utilizing infield ditches and area type inlets. Single, double and triple area inlets were designed to facilitate draining these isolated locations. Median and infield ditches were designed to convey runoff discharges to the area inlets.

Several detention basins were designed to drain onsite drainage systems that do not contribute flow to the pump station or the new flood pool. These detention basins drain roadway and area type inlets that are isolated from gravity draining to the pump station or the flood pool.

For the most part, this section of the Red Mountain Freeway passes thru a flood zone. In order to accommodate the freeway design a new flood pool and levee system was proposed. The result of this design locates the majority of the freeway mainline in between the existing FRS and the proposed new levee. Generally the freeway mainline will be constructed below grade. Some sections are proposed at grade but these sections are still below grade relative to the FRS and the proposed levee. As a result onsite systems that could not gravity drain to another source were designed to accommodate the 50-year design storm.

Best Management Practices (BMPs) were developed for discharges from the pump station and storm drains that directly discharge into the flood pool. These BMPs were developed thru coordination with ADOT and the FCDMC. The FCDMC has accepted these proposed BMPs as they relate to the storm water quality of direct discharges into the flood pool.

4.2 DESIGN CRITERIA AND PROCEDURES

4.2.1 Catch Basin Design

Catch basin design criteria for the mainline and crossroads is based on ADOT's Highway Drainage Design Manual-Hydrology (1993) and ADOT's Roadway Design Guidelines (1996). The following paragraphs summarize the key assumptions, criteria and general design procedures for the catch basin design.

Rational Method discharge calculations performed for the mainline portion of the freeway system were calculated based on the anticipated ultimate lane configuration. The ultimate lane configuration was assumed to be a closed (paved) median with traffic separated by concrete median barrier. The closed median will accommodate four additional lanes along the mainline freeway, one HOV lane and one general purpose lane in each direction.

Inlet hydraulics were calculated using ADOT's computer program PDA1, which facilitates the standard pavement drainage methods and procedures outlined in FHWA Hydraulic Engineering Circular No. 22, Urban Drainage Design Manual (1996). Computer printouts for the individual catch basins can be found in Appendix D.

Onsite runoff for inlet design was estimated using the Rational Method. A site-specific Intensity Duration Frequency (IDF) curve was developed and used for the runoff calculations. Rainfall runoff was calculated assuming a time of concentration of ten minutes for all the inlet hydraulic design. Sub-basin areas were delineated in CADD and documented in an excel spreadsheet. Runoff coefficients of 0.95 and 0.70 were used for paved and pervious areas respectively. See Appendix F for information on Rational Method discharges and associated Rational Method parameters.

Catch basins located in non-depressed sections were designed for the 10-year storm runoff. Inlets located in depressed sections of the corridor were designed for the 50-year storm runoff. Bypass flows from upstream catch basins were directly added to the subsequent downstream catch basin runoff calculations. In cases when a catch basin located on an elevated section contributed bypass flow to a downstream catch basin located in a depressed section the 50-year bypass flow was calculated and added to the downstream catch basin.

Maximum spread for the 10-year storm along elevated sections of the mainline and ramps with more than one lane included the shoulder and half the adjacent travel lane. Maximum spread for the 50-year storm in depressed sections included the shoulder and the adjacent travel lane. Maximum spread for depressed ramps with only one lane was limited to the shoulder for the 50-year storm. Maximum design spread along the crossroads was set to maintain a twelve-foot dry lane in each direction.

Roadway catch basins are located at all vertical sag low points and sized for 100 percent interception at acceptable flow depths and spread. Roadway catch basins located on grade are designed to meet acceptable flow depths and spread, and are generally sized for 80 percent interception with 100 percent interception at critical locations. Roadway catch basins are also located upstream of points with zero percent super-elevation, and at gore areas to prevent runoff from concentrating and crossing travel lanes. Inlet and catch basin efficiencies conform to ADOT standards and are indicated on the inlet program output. Inlet capture ratios were applied to all the inlet calculations. These clogging factors directly reduce the inlet efficiencies to yield a conservative design. The following capture ratios were applied to the inlet hydraulic design.

- Grated inlets, on grade and in sump, capture ratio = 0.50
- Curb inlets, on grade and in sump, capture ratio = 0.80
- Slotted inlets on grade, capture ratio = 0.67
- Slotted inlets in sump, capture ratio = 0.50

Local inlet depressions were used for many of the inlets designed. Roadway curb and grate inlets were generally designed with a one inch local depression. Roadway inlets adjacent to concrete barrier were designed without a local inlet depression.

Generally, catch basin inlets on this project may be classified into two groups, interim and ultimate. For the most part, catch basins located on the outside lanes of the freeway mainline are in their ultimate location, while catch basins located in the median can be removed and replaced by roadway inlets in the future. The exception to this is at the extreme north and south ends of the project where the roadway is also proposed to be widened on the outside. A few of the catch basins located in these areas will need to be removed and relocated in the future. Catch basin locations and storm drain alignments have been developed with consideration for the ultimate roadway configuration and will be easily modified to the ultimate configuration in the future.

ADOT approved a design criteria variation for the minimum vertical profile grade for this segment of the Red Mountain Freeway from 0.4 to 0.25 percent, which decreases spacing between catch basins. Due to the minimal profile grades along the mainline, the design of the ramp to mainline transitions becomes tedious. Spread criteria in these locations results in inlets being designed very close together. At some locations along the westbound ramp to mainline transitions the spread criteria dictates an inlet spacing of forty feet and less. In order to avoid undesirable drainage networks and/or numerous lateral connections to the trunk line, slotted drain was used to reduce the number of inlets and pipe laterals needed.

For these ramp to mainline transitions inlets were designed and located as usual based on the maximum allowable spread. Once the inlets were located, key inlet locations were retained and slotted drain was located to extend beyond the next calculated upstream inlet(s) location(s). By running the slotted drain past the next upstream inlet(s) construction cost was reduced and the number of inlets and pipe laterals were decreased. Inlet hydraulic calculations for these inlets were also included in Appendix D and are identified with a "C" scribed inside a circle on the calculation output. These inlets identified with the letter "C" inside a circle will not be constructed but will be replaced with a long section of slotted drain as aforementioned. To ease the design and review process catch basin identification numbers match between the summary tables, calculations and plans. Refer to Appendix J for a reduced copy of the drainage plans.

4.2.2 Median and Infield Ditch Design

Design for the median and infield ditches is based on ADOT's Highway Drainage Design Manual-Hydrology (1993) and ADOT's Roadway Design Guidelines (1996).

Median and infield ditches were designed utilizing Haestad Methods' FlowMaster (version 7.0). This computer program facilitates the calculation of Manning's equation. Ditches were designed to convey the 50-year rational discharge at an elevation below the edge of pavement. An exception to this is catch basin number 142. Due to grading constraints this inlet is perched on fill behind barrier and above the adjacent ramp grade. For this case the ditch was designed to contain the 50-year discharge below the top of the adjacent barrier.

A roughness coefficient of 0.025 was used in all the calculations to estimate the roughness of bare ground. When steep slopes were encountered along the median, inlet spacing was reduced to alleviate the potential for high velocities to cause erosion. Ditch flow line elevations are indicated on the drainage plans, ditch side slopes can be verified from the roadway cross-sections. Hydrology for the ditch design is summarized in the median catch basin design summary table located in Appendix D. The FlowMaster output for the ditch design can be found in Appendix E.

4.2.3 Storm Drain Design

The onsite storm drain design criteria for the mainline and crossroads is based on ADOT's Highway Drainage Design Manual-Hydrology (1993) and ADOT's Roadway Design Guidelines (1996).

The following list summarizes key assumptions and the general design approach for the onsite storm drain systems:

- In anticipation of construction of the future HOV and general purpose lanes, the storm drain systems are designed to accommodate the future pavement runoff.
- Due to the significant impacts associated with relocating the levee in the future, the freeway has been designed to build the roadway section at the

ultimate width with an extra wide median to accommodate one HOV and one general purpose lane in each direction of travel.

- To reduce the size of the storm drain trunk lines along the freeway and the incoming flows to the storm water pump station at McKellips Road, contributing areas with an elevation above the freeway levee are directly drained to the new flood pool or detention basins designed for this purpose.

- The onsite drainage system for this segment of the freeway is designed to collect and convey both the on and the off-road flows originating within the right-of-way corridor, which includes the pervious areas between the freeway levee and the Spook Hill FRS. Off-road catch basins collect this local drainage and convey the flow using storm drain laterals to the freeway trunk line.

- Storm drain systems will not penetrate the Spook Hill FRS without the proper filter design to eliminate the possibility of piping. Where possible storm drains have been located to avoid penetrating the FRS.

- The tail water elevation used in the StormCad analyses for the freeway storm drain system is based on the maximum 50-year operating water surface elevation of the pump station.

- The proposed pump station implements additional wet well storage to reduce the number of pumps. A single cell 10'x10' RCBC is proposed between the confluence of the freeway trunk lines to the pump station wet well to provide both conveyance and storage volume for the pump station.

Storm drain hydraulic grade lines (HGLs) were computed using Haestad Method's StormCAD storm drain analysis and design program (Version 5.0). A site-specific Intensity Duration Frequency (IDF) curve was developed and input into the rainfall table in StormCAD. The contributing areas and runoff coefficients used for the inlet design were entered into the program.

The time of concentration to the first inlet was calculated for systems that have large contributing areas. For systems that have small contributing areas, and a flow time of less than ten minutes the time of concentration to the first inlet was set to three minutes. Although the time of concentration is less than ten minutes for many of the inlets the rainfall intensity defaults to the intensity associated with a time of concentration equal to ten minutes. Once the flow time exceeds ten minutes the intensity begins to reduce based on the IDF curves.

There is a slight difference between the StormCAD discharge calculations and the runoff calculations presented for the inlet design. The reason for this is that the typical application of the rational equation assumes that the conversion from acre-inches per hour to cubic feet per second is 1.0000. This is the approach that was used to calculate the discharges for the purpose of inlet hydraulics. StormCAD calculates discharges using the actual conversion from acre-inches per hour to cubic feet per second, a factor of 1.0083.

Storm drain hydrology was calculated with the same contributing areas as delineated for the storm drain inlets. Bypass flows were not accounted for in the storm drain analysis. All the runoff that discharges to an individual catch basin was input into the storm drain at the inlet location. This approach will result in a slightly conservative storm drain design, and eases the calculation and review processes. This assumption is based on the concept that the first inlet in a storm drain system will have a bypass flow. By assuming no bypass flows for the storm drain analysis, a slightly larger discharge will be designed into the system than if bypass flows were accounted for in the analysis.

Friction losses along with minor losses at manholes, junctions, catch basins and bends are calculated based on the HEC-22 energy loss methodology. For the purpose of calculating the storm drain hydraulics all storm drains were assumed to be reinforced concrete pipe (RCP), and a Manning's roughness coefficient of 0.013 was used. Storm drain pipes are numbered and identified similarly in the hydraulic calculations as in the drainage plans. Refer to Appendix F for the StormCAD hydraulic analysis output and Appendix J for the storm drain plans.

All storm drains within ADOT right-of-way are a minimum of 24 inches in diameter unless a special case prohibits their use and then 18-inch diameter pipes are used. For storm drains that discharge to the pump station the HGL is designed to be a minimum of 6 inches below the inlet grate elevation for the 50-year design storm. The remaining storm drains discharge to the flood pool, detention basins or the adjoining freeway project to the south (University Drive to Southern Ave). The HGL for these storm drain system was designed to be at least six inches below the inlet grate elevation for the 10-year design storm.

4.2.4 Detention Basin Design

The onsite detention basin design criteria is based on ADOT's Highway Drainage Design Manual-Hydrology (1993) and ADOT's Roadway Design Guidelines (1996).

Drainage design for this section of the Red Mountain Freeway utilizes two onsite detention basins.

- Existing Power Road Detention Basin
- CAP Underpass Detention Basin

The existing Power Road Detention Basin is located at the north end of the project just west of Power Road. The portion of the mainline west of the Spook Hill FRS is isolated and is designed to drain into the existing drainage basin. This existing drainage basin was graded with the previous section of the Red Mountain Freeway (Higley to Power). Based on the as-built plans this detention basin was designed to drain utilizing an area inlet fitted with a seven inch orifice plate. This inlet then drains into the existing storm drain system located under Power Road Ramp B.

The hydrology and routing design for this existing basin was researched but not found. In the absence of a previous design the existing basin volume was estimated from the as-built plans and the contributing area was measured. The 10-year discharge into the basin was calculated using the Rational Method. The peak discharge was then distributed using the urban SCS hydrograph following procedures outlined in ADOT's Highway Drainage Design Manual-Hydrology (1993). Analysis indicates that the basin will drain in 36-hours utilizing the existing seven inch orifice plate. Volume calculations prove the existing estimated volume in the Power Road Detention Basin is more than adequate for the 10-year runoff volume reaching the drainage basin. The calculated runoff volume reflects drainage from the previous project and the additional flows added by the design of this project.

The freeway section between the end of the south CAP Canal Bridge and the CAP underpass creates an isolated area. Roadway drainage in this area is collected in a detention basin located in the west right-of-way. This detention basin located adjacent to the CAP underpass was designed similarly to the analysis of the existing Power Road Detention Basin, using the Rational Method and the SCS approach for a 10-year storm. This basin was designed to drain within 36 hours utilizing a seven inch orifice plate located inside an area inlet. The area inlet then drains to a storm drain system located under the CAP Underpass. The graded volume provided in the CAP Underpass Detention Basin is greater than the calculated runoff volume. This basin was graded with 3:1 side slopes and a bottom that slopes to the outlet at about 1 percent. Refer to Appendix G for the detention basin runoff volume calculations and the detention basin volumes provided. Refer to Appendix J for the detention basin plans.

The existing Power Road Detention basin was partially constructed on fill with a levee separating the detention basin and the depressed portion of Power Road Ramp B. Overtopping of this basin would result in the runoff volume flowing into the Power Road Ramp B sump. Similarly in the event that the CAP underpass detention basin was to overtop, the flow would be contained within the CAP underpass.

4.3 PROPOSED DRAINAGE & ROADWAY IMPROVEMENTS

Onsite drainage facilities for the freeway corridor and crossroads include ADOT standard curb and gutter, graded ditches, grated catch basins, slotted drain, median catch basins, curb opening catch basins, scuppers, storm drain pipe, pump station storage box, mainline pump station, and several smaller pump stations.

The major onsite drainage systems for this segment of the Red Mountain Freeway are summarized below:

- The north mainline storm drain system from the north Power Road/CAP Canal Bridge to McKellips Road varies in size from 24-inches to 78-inches in diameter. In addition to collecting mainline pavement drainage, the drainage system also collects runoff from a portion of McDowell Road, McDowell Ramps C and D, McKellips Road Ramps A and B, and the infield areas between the freeway levee and the Spook Hill FRS.

- The south mainline storm drain system begins south of Brown Road near the FRS crossing and conveys runoff north to McKellips Road. The system varies in size from 24-inches to 96-inches in diameter. In addition to the mainline pavement drainage, the drainage system also collects runoff from a portion of McKellips Road, McKellips Ramps C and D, Brown Road, Brown Road Ramps, and the infield areas between the freeway levee and the Spook Hill FRS.

- These north and south mainline storm drains comprise the trunk line drainage system. Both storm drains flow into the new 1540'x10'x10' RCBC (pump station storage box).

- Portions of the pump station storage box were realigned to follow an alignment similar to the storm drain trunk line. Aligning the storage box along the route of the storm drain trunk line eliminates 885' of large diameter storm drain and a large junction structure.

- Between the FRS to the south CAP Canal Bridge, runoff is collected in a series of laterals that discharge to a drainage ditch which conveys runoff to the CAP detention basin; upstream of CAP Overchute No. 1.

- The drainage system between the CAP Canal and University Drive is a continuation of the drainage system provided with the University Drive to Southern Avenue project. The storm drain trunk line conveyance system consists of 24-inch to 30-inch diameter pipes.

- Roadway drainage for the segments of McDowell and McKellips Roads west of the CAP canal will be allowed to flow westward in the streets. Drainage will be intercepted by catch basins connected to the City of Mesa storm sewer systems west of Power Road. The City of Mesa has accepted increased flows arriving at the McDowell/Power Roads and McKellips/Power Roads intersections.

- For that portion of Brown Road west of the west roundabout circle, pavement drainage will be directed to catch basins located near the 80th Street intersection. These catch basins will be connected to the City of

Mesa storm drain system that terminates just east of the 80th Street intersection. At the 30% design phase, several catch basin systems were located from the west roundabout to Brown Road. These systems intercepted runoff and directed flows to the existing detention basin situated in the southeast quadrant of 80th Street and Brown Road. In the final design process the City of Mesa elected to forego this option since the existing detention basin would need to be enlarged to handle to increased flows to it. The City of Mesa has agreed to the proposed catch basin configuration and the increased flows that will arrive at the 80th Street intersection.

- For the east legs of McDowell, McKellips, and Brown Roads, pavement drainage will be collected by a series of catch basins and conveyed to the flood pool by a system of small diameter pipes

This section of the Red Mountain Freeway begins immediately west of Power Road and passes over Power Road, the CAP canal, and the Spook Hill FRS. Once the mainline has passed the Spook Hill FRS the profile dives down into the existing flood pool. The mainline then rolls thru several gentle vertical curves as it passes under McDowell, McKellips and Brown Roads. After passing under Brown Road the Mainline climbs over the Spook Hill FRS and the CAP canal and then dives down passing under University Drive. This section of the Red Mountain Freeway terminates just short of University Drive. The proposed mainline typical sections consist of three to four 12-foot travel lanes in each direction with shoulders varying from 10 to 12-feet. Auxiliary lanes were added between some of the cross roads varying the number of lanes from four to five.

The proposed McDowell Road profile passes over the existing CAP canal and FRS, and the proposed mainline and flood pool. Freeway ramps are located on the south side McDowell Road. The proposed McDowell Road typical section consists of three 11-foot travel lanes and a 6-foot bike lane in each direction.

The proposed McKellips Road and Brown Road profiles pass over the existing CAP canal and FRS, and the proposed mainline and flood pool. Freeway ramps are located on the north and south side of each cross road. The proposed typical sections consist of three 11-foot travel lanes, 6-foot bike lane in each direction for both McKellips Road and Brown Road.

4.4 STORM WATER QUALITY

4.4.1 Storm Water Quality Background

With regard to storm water quality, ADOT has a Municipal Stormwater permit on file with the Arizona Department of Environmental Quality (ADEQ) as part of the Arizona Pollutant Discharge Elimination System (AZPDES) program. As part of this permit ADOT is responsible for ensuring all new facilities constructed by ADOT are in compliance with the provisions of the permit. In conjunction with the ADOT permit, the FCDMC also has an AZPDES permit for their municipal separate storm sewer systems. As part of this permit, FCDMC has a water quality program which allows the FCDMC to make reasonable conditions for and restriction on discharges entering or connecting to District structures. Since 1999, FCDMC has imposed "first flush" as a minimum standard/requirement upon any entity connecting to a District structure.

For this project ADOT will discharge freeway stormwater into the Spook Hill Floodwater Retarding Structure (FRS) flood pool. The flood pool stretches from the freeway north FRS crossing, east of Power Road, to the freeway south FRS crossing, about ½ mile southeast of Brown Road. Freeway stormwater will either be routed through the pump station at McKellips Road or discharged directly into the flood pool. The pump station will discharge stormwater via a 90-inch diameter pipe into the FCDMC flood pool just north of McKellips Road. At various locations along the freeway stormwater will be discharged directly into the flood pool via small diameter (24-inch) pipes.

4.4.2 BMP Measures Implemented

The implementation of best management practices (BMPs) for storm water quality on this project is provided with both non-structural as well as structural measures.

The non-structural measures include the following:

- Public Outreach and Education,
- Environmental Training for ADOT Construction & Maintenance Staff,
- Highway and Street Sweeping Program,
- Debris and Litter Pick-up,
- Hazardous Materials Spill Response Team,
- Storm Sewer System Maintenance,
- Outfall Inspection, and
- Pump Station Maintenance

A description elaborating on the details for each of the above non-structural measures can be found in the letter addressed to the FCDMC from ADOT on December 6, 2004. See Appendix F.

Specific structural measures for storm water quality that are implemented on this project include:

- McKellips Road Main Pump Station Operation
- Storm Sewer System

- Concrete Pad at Principal Spillway Inlet
- Signal Butte Energy Dissipation Basin & Lift Station

4.4.3 McKellips Road Main Pump Station Operation

For the McKellips Road pump station several features are incorporated in the design that improve storm water quality. Among these are the pump station storage box, the inlet bar rack, and the wet well itself. The storage box to the pump station is 1500 feet of 10ft X 10ft box culvert constructed on a very flat slope (0.001 ft/ft). Sediment and debris will settle in this chamber as a result of relatively slow velocities through the structure. The inlet bar rack within the wet well screens out mid-size (2-inch in diameter) and larger debris from the storm water before it arrives at the pump inlets. The wet well is also a part of the BMP system since smaller storm event volumes are held here when none of the large main pumps turn on, (The wet well volume below the main pump ON elevation can only be evacuated by the manually operated nuisance pump).

Another feature of the pump station that provides water quality treatment is the combustible gas detection system. This system prevents pump start-up or shuts down the pump operation when a hazardous spill occurs or when flammable liquids or gases are detected in the wet well. This allows for proper clean-up of the spill before pumps are put back in operation.

4.4.4 Storm Sewer System

The storm sewer trunk lines that connect to the storage box also provide an opportunity for sediment and debris to fall out of the storm water. As with the storage box, the storm drain trunk lines (a total of 2.5 miles long), which are comprised of pipe ranging from 60-inch to 96-inch in diameter, are designed at a 0.001 ft/ft slope.

At various locations along the freeway, storm water from the freeway is routed directly into the flood pool. There are 16 locations where 24-inch diameter pipes discharge flow to the flood pool. These pipe systems are connected to 33 catch basins that intercept runoff from freeway and cross road pavement areas or median areas. The BMP feature of these systems will be a deepened catch basin to create a sump condition inside the structure. In addition, for each of the direct discharge systems to the flood pool, the last catch basin or inlet in line will be fitted with a hinged flap gate over the outlet pipe. This flap gate will be designed to trap floatable debris in the catch basin while encouraging larger debris to settle in the catch basin sump volume. See Detail D21 Appendix J.

4.4.5 Concrete Pad at Principal Spillway

At the northern end of the Spook Hill FRS, the downstream end of the flood pool system, the current principal spillway intake arrangement traps most debris and sediment in the flood pool area. Currently it is difficult to maintain and access this area with maintenance vehicles. This project will improve these conditions by constructing a 50ft X 50ft concrete pad at the principal spillway inlet. This improvement will accommodate a maintenance vehicle and allow easier clean-up of debris.

4.4.6 Signal Butte Energy Dissipation Basin Lift Station

Other improvements that will be constructed with this project to improve water quality are the installation of lift station at the Signal Butte energy dissipation basin and the construction of an access ramp to the basin bottom. The dissipation basin was built to provide a pool to dissipate energy from flows exiting the Signal Butte floodway U-channel. The dissipation basin is a grouted riprap lined structure built at 2:1 sideslopes, covering about 0.43 acres, and 20 feet deep. Since the lower 11 feet of this basin was built below grade, storm water cannot positively drain from this area. This creates an undesirable condition of standing water making it an ideal environment for vectors, such as mosquitoes, to survive.

With the addition of the lift station at this location the entire volume of the basin will now be pumped out to the flood pool low flow channel. The concrete access ramp will allow for maintenance crews to easily clean debris and sediment from the basin bottom.

4.4.7 Criteria

As mentioned previously the FCDMC uses "first flush" as a minimum requirement with respect to treating storm water. The term "first flush" refers to the treatment of the first ½ inch of rain over the concerned watershed for a given storm event. Storm water can be treated on either a volume or flow rate basis.

The criteria used by FCDMC to determine the volume of storm water needed to be captured for the "first flush" is:

$$V = CPA$$

Where:
- V = Total runoff volume
- C = Runoff coefficient (assumed to be 1)
- P = Total precipitation in inches
- A = Area in acres

For this project the contributing watershed to the pump station is 147 acres. Using the above formula yields

$$V = 1*(0.5/12)*146 = 6.08 \text{ ac-ft}$$

For this project the volume provided for treatment of storm water flows is the combined volume of the pump station wet well (82,322 cu. ft.), pump station storage box (154,00 cu. ft.), and the large diameter trunk lines (464,244 cu. ft.) to the storage box. The aggregate volume for these improvements total 700,566 cu. ft. or 16.08 ac-ft. The dead storage volume, (dead storage is the maximum volume in the wet well before the first main pump is called ON), is about 25,300 cu. ft or 0.6 acre-ft.

4.5 BRIDGE SCOUR

The bridges for McDowell, McKellips, and Brown Roads are all positioned within the Spook Hill FRS flood pool. As such these structures will be subjected to flood waters for the 100-year and PMF events. The Initial Drainage Report recommended that the bridge piers and abutments for both the McKellips Road and Brown Road be protected from scour with slope paving and cut-off walls. This concept was carried forward in the final design of these structures.

For the McDowell Road bridge the scour protection treatment was similar to that provided at the other two cross roads. Except that instead of slope paving (3½ -inch thick) the McDowell Road system of scour protection will be a 6-inch reinforced concrete floor that will cover the area between the east abutment wall to the west abutment wall. The freeway itself will be the concrete floor for the bottom portion of the cross section. For this system of reinforced concrete floor the cut-off walls will extend to a depth of 6 feet. This system of concrete flooring is recognized by ADOT as a proven means to effectively prevent scour from occurring at bridge abutments and piers. The basis for utilizing a concrete floor for scour protection is cited in the Federal Highway Administration's Publication No. FHWA NHI 01-003, March 2001, *Bridge Scour and Stream Instability Countermeasures, Experience, Selection, and Design Guidance, Second Edition.*

The Power Road bridge over the CAP canal will be subjected to scour from flows overtopping the emergency spillway for very large storm events such as the PMF. The initial design recommended the pier columns and abutments for this bridge be founded on drilled shafts. The bridge substructure will be ten-foot diameter columns supporting straddle bents and six-foot diameter columns supporting the remaining structure. This concept was carried forward through the final design of this bridge. The drilled shafts will be set below the predicted scour as cited in the DMJM Initial Drainage Report.

5 McKELLIPS ROAD PUMP STATION DESIGN

5.1 GENERAL OVERVIEW & DISCUSSION

The freeway pump station is located northwest of the corner of the McKellips Road and 76th Street. The pump station will handle onsite flows for the depressed portion of SR 202L from approximately McDowell Road to a quarter mile south of Brown Road and some offsite flows from the cross roads of McDowell, McKellips and Brown.

The freeway storm drainage system discharges into a long 10' x 10' x 1540' reinforced concrete box culvert that serves as additional storage for the pump station. The RCB culvert discharges into the pump station wet well which also provides storage for the pump station.

The pump station structure, number of pumps and pump sizes are based on previous design configurations and methods used by ADOT for other pump stations in the metropolitan Phoenix area. The pump station consists of four levels with the engine room at ground level and the wet well at the lowest level. The pump station has five main pumps designed to pump the inflow hydrograph associated with the freeway drainage runoff for the 50-year design storm event. A smaller manually operated submersible pump will be used to pump nuisance flows associated with small storm events or to pump water remaining in the wet well after a larger storm event has occurred.

Storm water from the wet well will be pumped vertically through 30" diameter pipes to a discharge box on the third level of the pump station. A 96" RGRCP pipe will drain the discharge box to the Spook Hill FRS flood pool.

All supporting calculations and documentation for the pump station design are provided in Appendix H. Design plans for the pump station and the RCB culvert are provided in the project drawings.

5.2 PUMP STATION INFLOW HYDROGRAPH

The required capacity, design and operation of the pump station are dictated by the hydrograph of drainage runoff collected into the freeway storm drain system. A hydrologic analysis of the freeway drainage areas was performed using the Rational Method routed through the freeway storm drain system. The estimated peak discharge and time of concentration for the storm drain system at the pump station was then used to derive a synthetic hydrograph based upon the Baumgardner Method II for Determining Design Inflow Hydrographs – Rational Equation/SCS Hydrograph Method, as described in ADOT's *"Storm Water Pump Station Design Documents, Volume I, Design Guidelines"*, dated 1991.

Based upon the routing of storm water through the storm drain system, the estimated 50-year peak discharge at the pump station is 414 cfs with a time of concentration of 0.73 hrs. Using the Baumgardner Method, these translate to the derived synthetic hydrograph shown in Figure 6-1 with a peak discharge of 414 cfs and a time to peak of approximately 2.6 hours.

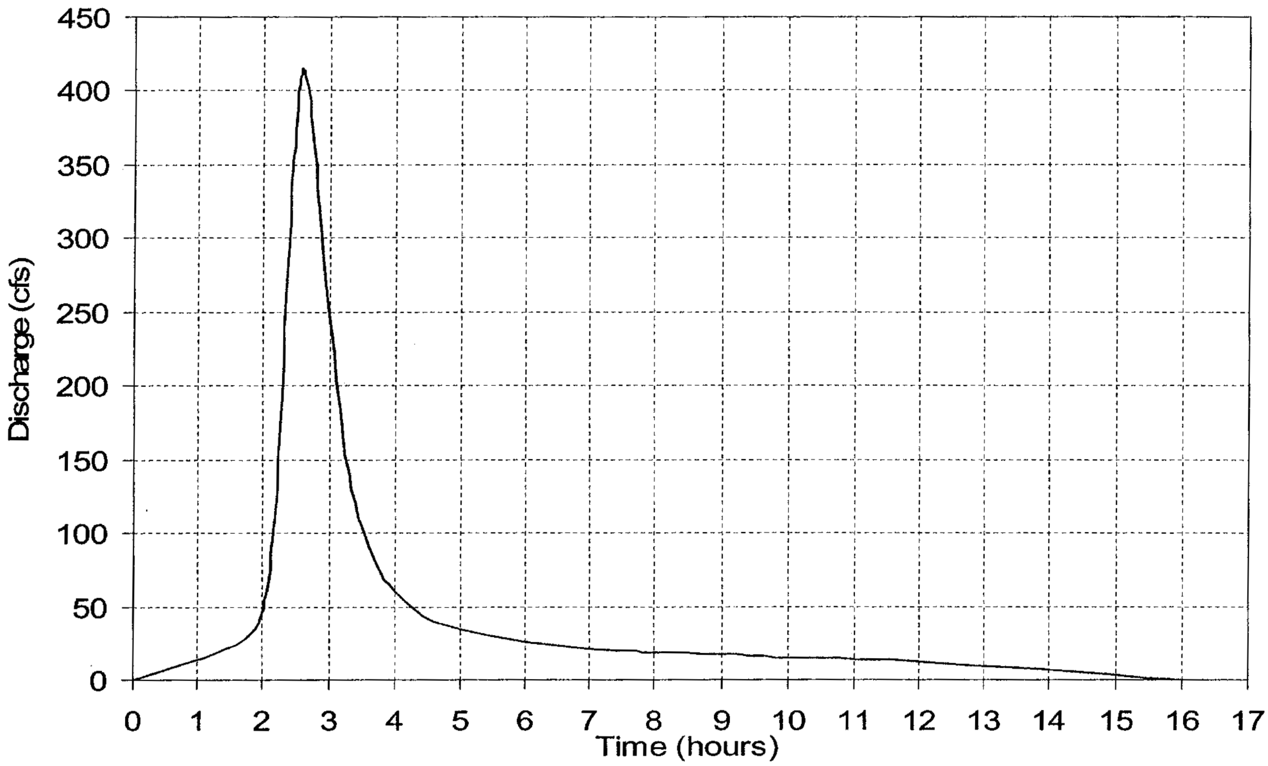

Figure 5-1: Pump Station Inflow Hydrograph

5.3 STORAGE

Storage for freeway drainage system and the pump station is provided by the pump station wet well and a 10' x 10' x 1540' reinforced concrete box culvert. The utilization of a long RCB culvert and increased storage capacity for the pump station reduces overall project costs by:

- reducing the necessary size of the wet well;
- increasing storage thereby reducing the number of pumps required;
- reduced pump cycling;
- higher water surface elevation ranges before engaging additional pumps and;
- doubling as a conveyance line, the RCB culvert eliminates the need for an additional 1540 feet of storm drain pipe.

An iterative process between inflow, storage and outflow was utilized in order to estimate amount of storage necessary for the pump station design. While additional storage would be provided by pipes in the freeway storm drain system, the estimated available storage to the pump station is limited to the wet well and the RCB culvert. The stage-storage capacity of the culvert and wet well are summarized in Table 6-1. Supporting calculations and documentation are provided along with in Appendix H. Pump station and storm drain profile sheets are provided in the design plans.

Table 5-1: Pump Station Stage-Storage Capacity

WSEL (ft)	Depth in Wet Well (ft)	Volume		Total Volume (cu ft)	WSEL (ft)
		Wet Well (cu ft)	RCBC (cu ft)		
1543	0	0	0	0	1543
1544	1	2,006	0	2,006	1544
1545	2	4,334	0	4,334	1545
1546	3	6,982	0	6,982	1546
1547	4	9,952	0	9,952	1547
1548	5	13,244	0	13,244	1548
1549	6	16,839	0	16,839	1549
1550	7	20,687	0	20,687	1550
1551	8	24,796	4,990	29,786	1551
1552	9	28,905	18,925	47,830	1552
1553	10	33,014	34,325	67,339	1553
1554	11	37,123	49,725	86,848	1554
1555	12	41,232	65,125	106,357	1555
1556	13	45,341	80,525	125,866	1556
1557	14	49,450	95,925	145,375	1557
1558	15	53,559	111,325	164,884	1558
1559	16	57,668	126,725	184,393	1559
1560	17	61,777	142,125	203,902	1560
1561	18	65,886	152,535	218,421	1561
1562	19	69,995	154,000	223,995	1562
1563	20	74,104	154,000	228,104	1563
1564	21	78,213	154,000	232,213	1564
1565	22	82,322	154,000	236,322	1565

5.4 DISCHARGE BOX

Five 30-inch diameter DIP discharge pipes from the mixed flow pumps, and a 12-inch diameter DIP discharge pipe from the submersible pump, carry flow to the discharge box. The box is a 73 ft long rectangular concrete box that is divided in two lengthwise by a baffle wall. The baffle wall is used to stabilize the head on the outlet pipes and acts as a discharge weir into the other side of the discharge box which is a concrete rectangular channel parallel to the baffle wall that drains to a 96" RCP outlet that discharges to the flood pool. The top of wall/weir crest elevation and the size of the receiving rectangular channel are set to ensure that the baffle wall would operate in a non-submerged weir condition.

The baffle wall is 73 feet in length and the top of the wall is set at 1588.90 feet. The baffle wall/weir was sized using the standard weir equation:

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

where:
- Q = weir capacity (cfs)
- C = weir coefficient (assumed 3.33 for sharp crested weirs)
- L = weir length (feet)
- H = depth of flow on weir crest (feet)

Given a maximum discharge of approximately 300 cfs and a weir length of 73 feet, the estimated head on the weir is approximately 1.15 ft for a maximum water surface elevation in the discharge box of 1590.05 feet.

The receiving rectangular channel is 10 feet wide and has a slope of approximately 0.0137 ft/ft. At 300 cfs the flow depth would be less than 2 feet or more than 4 feet below the weir crest ensuring an unsubmerged weir condition.

5.5 PUMPING SYSTEM

5.5.1 Main Pumps

The five main pumps are mixed flow pumps operating in parallel at 880 RPM with a nominal diameter of 30" and a pump capacity of 24,000 GPM (53.5 cfs). Natural gas fueled engines will drive the pumps and lift water vertically 50± feet. There are no planned backup pumps or engines.

ADOT Pump Maintenance personnel do not desire the pump stations to be automatically "renumbered" after each on/off cycle. The No. 1 pump will remain the No. 1 pump until such time as it is manually changed. Personnel also do not desire to have the pump engines warmed up in advance of the need to pump. Consequently, due to the lag time between engine activation and actually pumping begins, additional storage required to handle the sharp increase in flow to the pump station during the rising limb of the inflow hydrograph.

5.5.2 Pump Engines

The specifications for the pump engines are contained in the special provisions.

5.5.3 Low Flow Pump

A manually operated electric submersible pump operating at 1170 RPM with a nominal diameter of 12" and a pumping capacity of 2,300 GPM (5.12 cfs) will be used to pump water remaining in the wet well below the activation level of the main pumps. There will not be a back up generator or ventilation fans for the low flow pump.

5.5.4 Main Pump Stage-Discharge Curves

To evaluate the operation of the pump station, the operating capacity of the pumps must be determined throughout the range of wet well water surface elevations. The operational stage-discharge capacity of each pump depends upon the pump performance curve and the system curve.

Pump performance curves are provided by the pump manufacturer and are specific to the pump model, configuration and operational characteristics (such as RPM). The pumping curve shows the discharge capacity of a pump based upon the amount of head produced by the pump (pumps discharge less when required to produce higher head).

The system curve indicates the amount of head a pump must overcome to maintain a specific flow rate in the overall discharge system and is dependent upon static head (elevation change), velocity head, and system losses such as pipe friction and other minor losses (expansion/contraction, fittings, valves etc). Together these factors are called the total dynamic head (TDH). Pump losses are accounted for in the pump performance curves themselves. The total dynamic head of a system increases as discharge increases.

When pump and system curves are plotted on the same graph, the intersection of the curves represents the point at which the head produced by the pump is just the amount needed to overcome total dynamic head of the system. However, while the water surface elevation in the discharge box will remain relatively stable during the operation of the pumps, the water surface elevation in the wet well will vary significantly. Therefore system curves must be developed across the range of expected wet well water surface elevations in order to determine the operational discharge of the pumps as the water surface elevation in the wet well changes.

Figure 6-2 shows the pump operation curve for each main pump. Supporting calculations and documentation for the design, operation and capacity of the pumps provided in Appendix H. The pump station design and configuration is provided in the design plans.

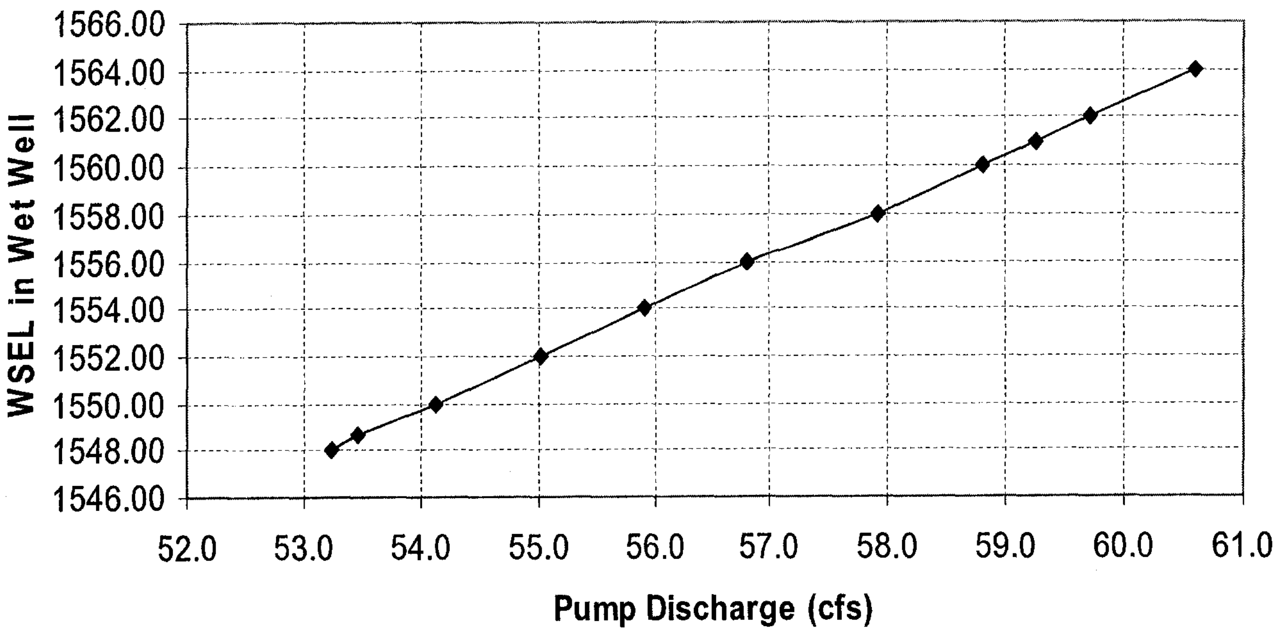

Figure 5-2: Single Pump Operating Discharge Curve

5.5.5 Engine Warm-Up Cycle

The five main pump engines require three minutes of warm-up before engaging the pumps. The warm-up cycle allows engine components to be brought up to operating temperature and helps minimizes engine wear. The warm-up time is accounted for the in analysis of the operation of each pump in the pump station.

5.6 PUMP STATION ROUTING METHODOLOGY

The routing of the inflow hydrograph from the freeway storm drain system through the pump station was modeled by using Visual Basic macros in a Microsoft Excel spreadsheet. An iterative process using the spreadsheet model is necessary to determine storage requirements, pumping requirements and acceptable on/off elevations for the pump engines that will meet the design requirement of pumping the 50-year inflow hydrograph to the pump station.

The spreadsheet models the relationship between the inflow hydrograph, storage, and pumping rate (outflow hydrograph) for the five main pumps at specified time intervals. A time step interval of 9 seconds (0.0025 hours) was used in calculating the inflow versus pumping rate for a particular amount of storage in the system. A 9 second time step interval is sufficient to provide a reasonable instantaneous estimation of the inflow and outflow hydrographs. A smaller time step would be too burdensome for spreadsheet calculations.

At each time interval the spreadsheet model determines/calculates:

- The inflow rate from the inflow hydrograph;
- The wet well/RCB storage volume based upon inflow and outflow calculations for the pump station;
- The water surface elevation in the wet well based upon the stage-storage in the wet well and the RCB culvert)
- Whether each separate pump engine should be operating based upon the wet well water surface elevation and set on/off elevations for each pump engine;
- Whether each separate pump is engaged based upon whether the pump engines are operating and the warm-up time necessary prior to engaging the pumps;
- The outflow rate based upon the pump operation curves and the wet well water surface elevation.

The spreadsheet model used for the iterative process of determining an adequate hydrograph routing through the pump station along with supporting calculations and documentation are provided in Appendix H.

5.7 RESULTS

The peak inflow of 414 cfs occurs at 2.6 hours after the initiation of the storm event. The maximum water surface in the wet well is approximately 1561.59 feet. That corresponds to a maximum storage volume of approximately 221,700 ft^3 (5.1 acre-ft). The peak pumping outflow rate for the five pumps is approximately 298 cfs occurring approximately 2.9 hours after the initial storm runoff occurs.

A summary of the pump operations and configuration is provided in Table 6-2. The pump station inflow and outflow hydrographs are shown in Figure 6-3. Supporting calculations and documentation are provided in Appendix H.

Table 5-2: Pump Operational Characteristics

Description	Pump				
	No. 1	No. 2	No. 3	No. 4	No. 5
On Elevation	1550.5 ft	1551.5 ft	1552.0 ft	1552.5 ft	1553.0 ft
Off Elevation	1548.7 ft	1548.7 ft	1548.7 ft	1548.7 ft	1548.7 ft
Max. Pump Capacity	60 cfs	60 cfs	60 cfs	60 cfs	60 cfs
Max. Pump Run Time[1]	216 min.	92 min.	78 min.	68 min.	62 min.
Note: [1]Based upon the first 6 hours of the storm event.					

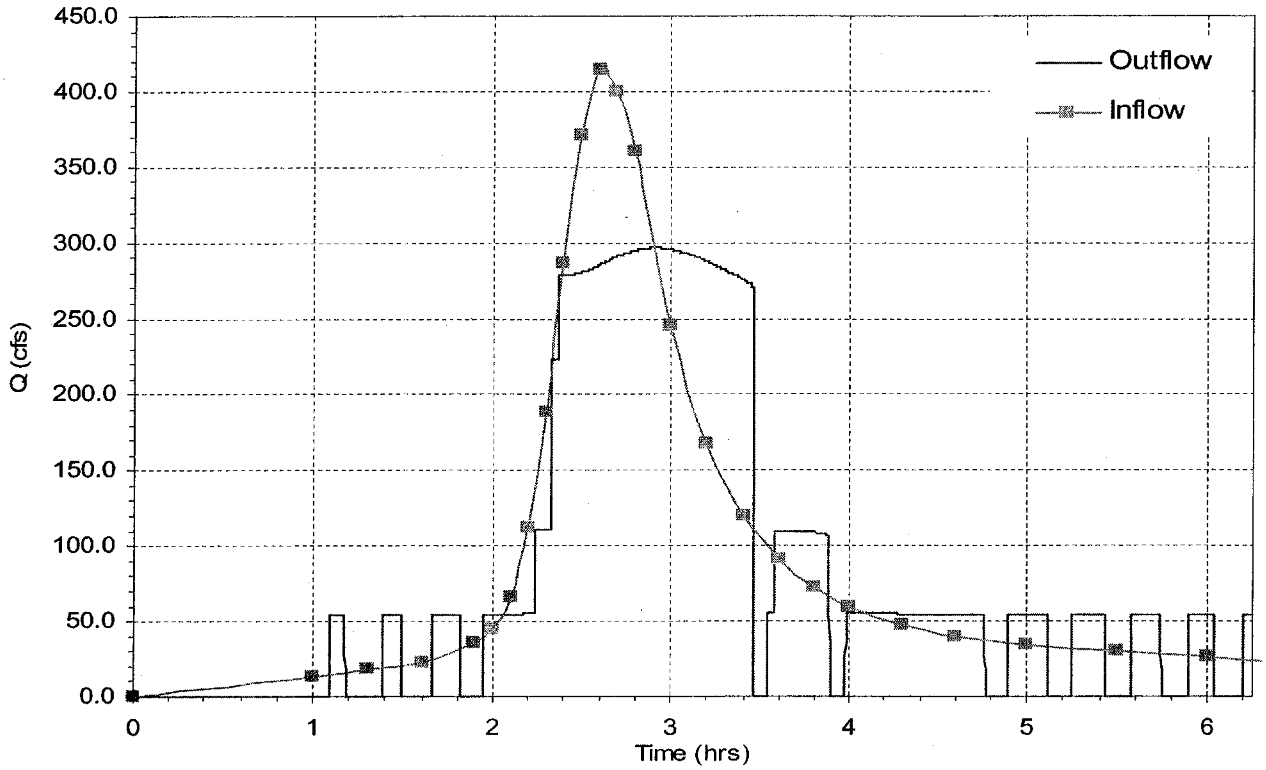

Figure 5-3: Inflow/Outflow Hydrographs from Pump Station Analysis

6 LIFT STATION DESIGNS

6.1 GENERAL OVERVIEW & DISCUSSION

Several small lift stations were designed to drain standing water from problem areas which cannot be drained by gravity. Lift stations are necessary to drain several equipment underpasses along the CAP canal and the FRS. Another small lift station was designed to drain the Signal Butte energy dissipation basin.

6.2 SIGNAL BUTTE ENERGY DISSIPATION BASIN LIFT STATION

As previously cited in the Storm Water Quality section of this report the Signal Butte energy dissipation basin will be improved by addition of a lift station. This station will de-water the 11 feet of below grade volume of the existing basin. The pump used to de-water the basin is a 550 gpm pump that will discharge to the low flow channel. The size of the pump was determined by requiring that the depressed basin volume of 152,588 cubic feet is pumped within 36 hours. The design and supporting calculations of the lift station is provided in Appendix I.

6.3 EQUIPMENT UNDERPASS LIFT STATIONS

Small lift stations are necessary to drain nuisance water that will collect in five equipment underpasses that provide unimpeded maintenance access along the CAP canal through the major cross roads and the Red Mountain Freeway. The five equipment underpass locations are:

- CAP LT Equipment Underpass (SR202/McDowell)
- CAP RT Equipment Underpass (SR202/McKellips)
- CAP LT Equipment Underpass (SR202/McKellips)
- CAP LT Equipment Underpass (SR202/Brown)
- Spook Hill FRS Equipment Underpass (202L Med Cst CL Station 1268+90)

The drainage system for each equipment underpass is similar in design and consists of:

- a trench drain to capture drainage
- a 36" open grate manhole to capture & store drainage
- a 6" DIP drainage connection from the manhole to the lift station
- a 60" RCP manhole with a submersible 80 gpm pump and a 2" discharge
- and a 3" PVC force main outlet pipe with a grouted riprap discharge chute

The design and supporting calculations of the lift stations are provided in Appendix I.

7 SUMMARY

The Red Mountain Freeway (SR 202L) is part of the MAG Regional Freeway System and will connect I-10 to the Superstition Freeway (US 60) just west of Ellsworth Road. This 4.5-mile segment extends from Power Road on the north to University Drive on the south. The freeway alignment passes over the Spook Hill Floodwater Retarding Structure (FRS) at two locations and through the FRS flood pool and will require significant off site drainage and flood control improvements to ensure the Spook Hill FRS will, at a minimum, provide the current level of flood protection to the area.

Drainage improvements for this segment of the freeway can be separated into offsite improvements which primarily consist of modifications to the Spook Hill FRS facilities, onsite improvements consisting of the freeway drainage system, and the pump station which drains the freeway drainage system into the Spook Hill flood pool.

7.1 OFFSITE DRAINAGE IMPROVEMENTS

The existing Spook Hill FRS, located primarily between the freeway and the CAP Canal, will remain intact but will require reconstruction when necessary to maintain the integrity of the structure and to ensure the existing level of flood protection is maintained.

A levee will be constructed between the freeway and the flood pool to protect the freeway from the 100-year flood event. For larger rainfall events, the levee will be overtopped and the freeway prism will serve to provide additional floodwater storage.

The flood pool will be regraded and a new low flow channel constructed to convey drainage to the principal spillway outlet.

At each crossroad new 2-14'x16' RCB culverts will be constructed. One culvert will be located in the low flow channel for drainage. The other culvert will be set at a slightly higher elevation and tied into a trail system to provide equestrian and pedestrian access across the roads.

The Spook Hill Floodway near the principal spillway will be realigned and a new principal spillway outlet for the flood pool will be constructed. The existing principal spillway will be removed and a portion of the existing floodway will be backfilled to complement the new floodway alignment to the new principal spillway outlet.

Along the east side of the flood pool, a drainage ditch (located at the top of the slope) will collect offsite drainage and convey it to new flood pool inlets sized to accommodate contributory runoff.

The Las Sendas channel will be modified to transition from a soil cement trapezoidal channel into a rectangular concrete section and a baffled chute spillway into the flood pool and a 4-12'x8' RCBC across the channel will be constructed.

The 86th Street channel will be modified to include a channel transition from a trapezoidal section to a rectangular channel section, a concrete drop structure and a RCBC culvert that discharges into the flood pool.

At the south end of the project where the proposed freeway alignment crosses over the CAP canal just south of an existing CAP drainage overchute, a 2 acre-ft detention basin will be constructed between the freeway and the CAP Canal. This will attenuate the peak discharge from the freeway prior to discharging to the CAP Canal overchute and Detention Basin No. 1. Drainage ditches along the east side of the freeway will convey runoff to a 6'x6' RCBC. The RCBC will pass under the freeway to drain the existing contributing watershed to the CAP overchute.

At the south end of the project, the east channel constructed as part of the segment of the Red Mountain Freeway south of University Drive, will be extended to the north to intercept and convey runoff for areas south of the CAP Canal

7.2 ONSITE DRAINAGE

Due to the flat profile grades along the mainline, the design of the ramp to mainline transitions becomes tedious. Spread criteria in these locations results in inlets being designed very close together. In order to avoid undesirable drainage networks and/or numerous lateral connections to the trunk line, slotted drain was used to reduce the number of inlets and pipe laterals needed. For these ramp to mainline transitions inlets were designed and located as usual based on the maximum allowable spread. Once the inlets were located, key inlet locations were retained and slotted drain was located to extend beyond the next upstream inlet(s). By running the slotted drain past the next upstream inlet(s) construction cost was reduced and the number of inlets was decreased.

The storm drain system between the south CAP Canal crossing to University Drive connects to the University Drive to Southern Avenue drainage system. The design of this storm drain system was coordinated with the design of the University Drive to Southern Avenue section. In order to minimize drainage discharges to the next section of the Red Mountain Freeway several design changes were implemented. First, catch basins were relocated in order to minimize the amount of runoff reaching the southern section. Second, a detention basin was designed to impound flows reaching the southern section; essentially lowering the peak discharge experienced at the project interface. Third, an orifice plate was added to the catch basin draining the CAP underpass. Again reducing the peak discharge realized at the southern project interface.

The CAP underpass drainage basin is designed to be perched above the CAP underpass behind a retaining wall. In the event that the CAP underpass detention basin was to overtop, the flow would be contained within the CAP underpass. The existing

Power Road Detention basin was partially constructed on fill with a levee separating the detention basin and the depressed portion of Power Road Ramp B. Overtopping of this basin would result in the runoff volume being contained in the Power Road Ramp B sump.

A roadway edge sump exists adjacent to the eastbound lanes at 202L Median Station 1266+98. This edge sump is created by the roadway cross slope changing from 2 to 5 percent thru a roadway section with minimal longitudinal grade. This edge sump is isolated between the Spook Hill FRS, Spook Hill FRS Underpass and a noise wall. In order to drain the low point, a catch basin was located down station from the sump and 100' of slotted drain was designed to connect the low point and the catch basin. This configuration was adopted to avoid penetrating the Spook Hill FRS with the lateral storm drain pipe.

During the early design phase for the 60% submittal the pump station storage box was evaluated to see if any cost savings could be realized from an alternative design to what was proposed in the 30% submittal. By changing the storage box from a four cell to a single cell the box length was extended. The extended box was partially located within the proposed trunk line alignment. This change in the storage box configuration eliminated a large junction structure and over 885' of large diameter trunk line pipe.

The new mainline pump station and multiple other smaller storm drains discharge directly into the new flood pool. Best Management Practices (BMP's) were developed In order to ensure the water quality of these storm drain discharges. These BMP's were developed in coordination with ADOT and the FCDMC. These BMPs have previously been accepted by the FCDMC to meet their requirements for storm water quality as it relates to direct discharges into the new flood pool.

7.3 PUMP STATION

The freeway pump station is located northwest of the corner of the McKellips Road and 76th Street. The pump station will handle onsite flows for the depressed portion of SR 202L from approximately McDowell Road to a quarter mile south of Brown Road and some offsite flows from the cross roads of McDowell, McKellips and Brown.

The pump station wet well and a 10' x 10' x 1540' reinforced concrete box culvert will provide storage for the pump station. Five mixed flow pumps operating in parallel at 880 RPM with a nominal diameter of 30" and a nominal pump capacity of 24,000 GPM (53.5 cfs) will serve to pump the freeway storm drain system runoff hydrograph for the 50-year design storm event (414 cfs peak inflow).

The pumps will be driven by five natural gas engines located on the top level of the pump station. The engines have a 3-minute warm up cycle that allows all engine components to be brought up to operating temperature and to minimize engine wear before the pumps are engaged.

A manually operated electric submersible pump operating at 1170 RPM with a nominal diameter of 12" and a pumping capacity of 2,300 GPM (5.12 cfs) will be used to pump water remaining in the wet well below the activation level of the main pumps.

Storm water from the wet well will be pumped vertically through five 30" diameter pipes (five main pumps) and a 12" diameter DIP (low flow pump) to a discharge box on the third level of the pump station. A 96" RGRCP pipe will drain the discharge box to the Spook Hill FRS flood pool.

7.4 EQUIPMENT UNDERPASS & SIGNAL BUTTE LIFT STATIONS

Small lift stations are necessary to drain nuisance water that will collect in five equipment underpasses that provide unimpeded maintenance access along the CAP canal through the major cross roads and the Red Mountain Freeway. The drainage system for each equipment underpass is similar in design and consists of:

- a trench drain to capture drainage;
- a 36" open grate manhole to capture & store drainage;
- a 6" DIP drainage connection from the manhole to the lift station;
- a 60" manhole with a 80 gpm submersible pump with a 2" discharge and;
- a 3" PVC force main outlet pipe with a grouted riprap discharge chute.

At the request of the FCDMC, a maintenance ramp was provided at the Signal Butte energy dissipation basin and a small lift station was designed to drain water from the basin. The Signal Butte lift station includes a 550 gpm submersible pump to dewater 11 feet of water retained in the energy dissipation basin within 36 hours. The energy dissipation basin maintenance ramp is a concrete slab approximately 12 ft wide with a 0.1 ft/ft downgrade. The ramp sideslopes are grouted riprap at 2:1 (H:V).

7.5 FUTURE SPOOK HILL ADMP IMPROVEMENTS

This project is contained within the area covered by the Spook Hill Area Drainage Master Plan (ADMP) 2002, completed by Flood Control District of Maricopa County. As part of the Spook Hill ADMP a series of storm drain improvements are proposed along the McDowell Road, Hermosa Vista Drive and McKellips Road alignments. The current Spook Hill ADMP shows that a large diameter storm drain is planned along McKellips Road as well as Hermosa Vista Drive to convey stormwater from the Hawes Road alignment to the Spook Hill FRS flood pool. The storm drain alignments in the ADMP are limited to very large scale schematics as shown in the Recommended Drainage Alternative.

With the extension of the depressed Red Mountain Freeway system along the east side of the Spook Hill FRS, a pump station will be built in the northwest quadrant of

McKellips Road and 76th Street to manage pavement and roadside area stormwater by pumping it to the flood pool. Construction of the pump station and outlet works on the north side of McKellips Road may limit the location of the future storm drain alignment along McKellips Road as referenced in the Spook Hill ADMP.

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APPENDIX A

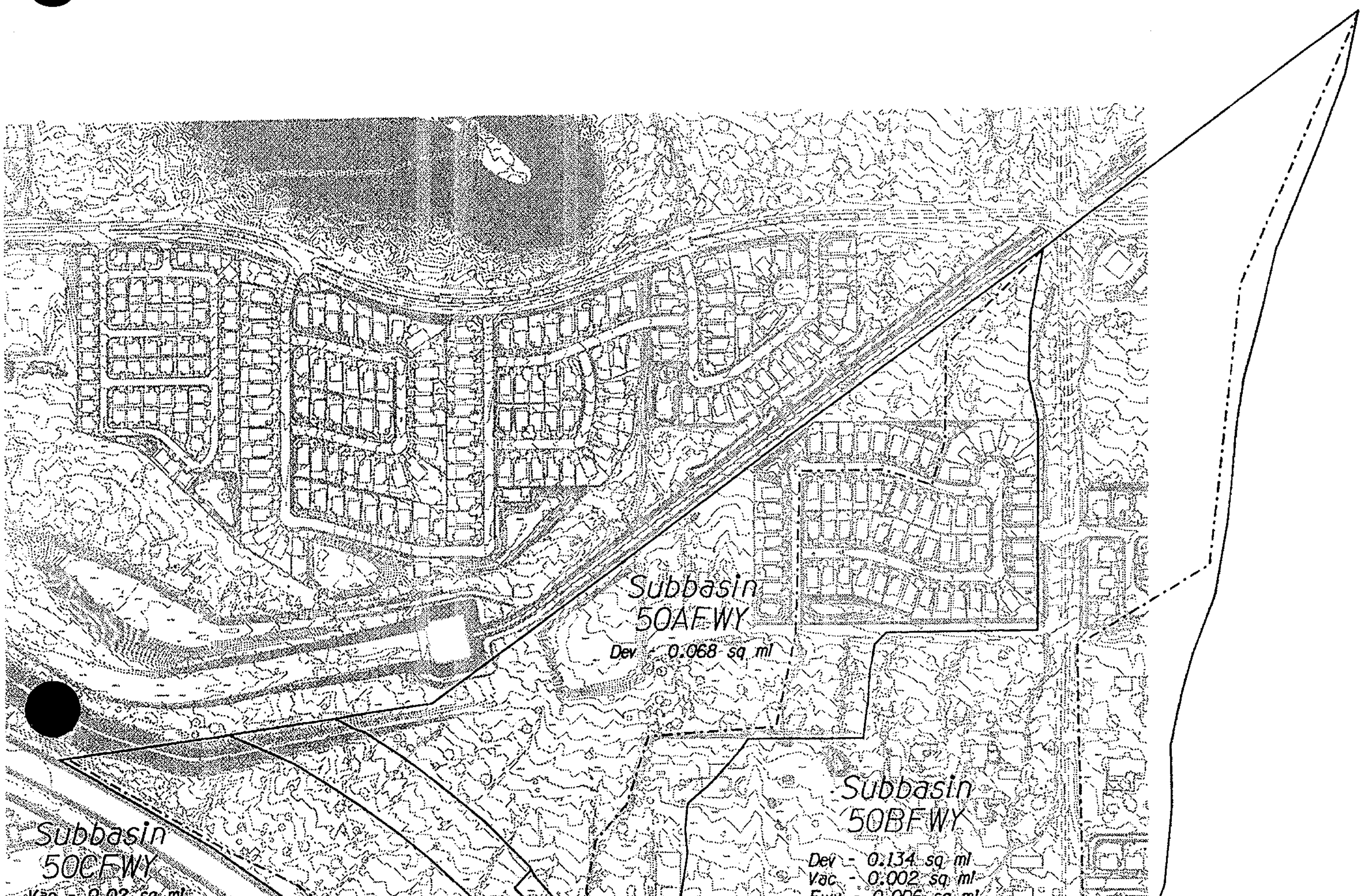
CAP OVERCHUTE BASIN

- Revised CAP Hydrology Parameters (DDMS)
- Updated Existing Conditions Hydrology (HEC-1)
- Proposed Conditions Hydrology (HEC-1)
- Northeast Channel 50-Year Hydrology
- Northeast Channel HEC-RAS Analysis
- CAP Overchute Capacity Analysis (CulvertMaster)
- 6’x6’ RCB Freeway Culvert Analysis (CulvertMaster)
- CAP Basin Outlet (CulvertMaster)

APPENDIX A

CAP OVERCHUTE BASIN

Revised CAP Hydrology Parameters (DDMS)


Subbasin
50AFWY
Dev - 0.068 sq mi
Subbasin
50BFWY
Dev - 0.134 sq mi
Vac - 0.002 sq mi
Fwy - 0.006 sq mi
Total - 0.142 sq mi
Subbasin
50CFWY
Vac - 0.02 sq mi
Fwy - 0.008 sq mi
Total - 0.028 sq mi
600 ft

Subbasins of Basin 50 Hydrologic Parameters

Measured Basin Areas

Subbasin	Area	Soil Map Unit Areas Aguila/Carefree 98	113	115	Land Use: Large Lot Residental	Vacant	Freeway	Flow Length		Length to Centroid		Elevations U/S	D/S	Slope
	(sq mi)	(sq mi)	(sq mi)	(sq mi)	(sq mi)	(sq mi)	(sq mi)	(mi)	(ft)	(mi)	(ft)	(ft)	(ft)	(ft/mi)
Original Basin														
50ORIG	0.275	0.064	0.069	0.142	0.098	0.177	0	0.86		0.43				81.4
Updated Existing														
50A	0.068	0.016	0.017	0.035	0.036	0.032	0.000	0.653	3450	0.284	1500	1629.0	1583.0	70.4
50B	0.142	0.033	0.036	0.073	0.134	0.008	0.000	1.184	6250	0.663	3500	1647.0	1567.7	67.0
50C	0.028	0.007	0.007	0.014	0.000	0.028	0.000	0.411	2170	0.199	1050	1576.0	1567.7	20.2
Revised Basins														
50AFWY	0.068	0.016	0.017	0.035	0.036	0.032	0.000	0.653	3450	0.284	1500	1629.0	1583.0	70.4
50BFWY	0.142	0.033	0.036	0.073	0.134	0.002	0.006	1.231	6500	0.663	3500	1647.0	1567.7	64.4
50CFWY	0.028	0.007	0.007	0.014	0.000	0.02	0.008	0.345	1820	0.161	850	1576.0	1570.0	17.4

Adjusted Basin Areas

Subbasin	Adjusted Area	Soil Map Unit Areas Aguila/Carefree 98	113	115	Land Use: Large Lot Residental	Vacant	Freeway	Flow Length		Length to Centroid		Elevations U/S	D/S	Slope
	(sq mi)	(sq mi)	(sq mi)	(sq mi)	(sq mi)	(sq mi)	(sq mi)	(mi)	(ft)	(mi)	(ft)	(ft)	(ft)	(ft/mi)
Original Basin														
50ORIG	0.275	0.064	0.069	0.142	0.098	0.177	0.000	0.86	0	0.43	0	0.0	0.0	81.4
Updated Existing														
50A	0.079	0.018	0.020	0.041	0.042	0.037	0.000	0.653	3450	0.284	1500	1629.0	1583.0	70.4
50B	0.164	0.038	0.040	0.086	0.155	0.009	0.000	1.184	6250	0.663	3500	1647.0	1567.7	67.0
50C	0.032	0.008	0.008	0.017	0.000	0.032	0.000	0.411	2170	0.199	1050	1576.0	1567.7	20.2
Revised Basins														
50AFWY	0.079	0.018	0.020	0.041	0.042	0.037	0.000	0.653	3450	0.284	1500	1629.0	1583.0	70.4
50BFWY	0.164	0.038	0.040	0.086	0.155	0.002	0.007	1.231	6500	0.663	3500	1647.0	1567.7	64.4
50CFWY	0.032	0.008	0.008	0.016	0.000	0.023	0.009	0.345	1820	0.161	850	1576.0	1570.0	17.4

Note: *The measured areas totaling 0.238 sq mi were adjusted proportionally to agree with original Basin 50 area of 0.275 sq mi*

Sub Basin Data

3/21/2005

Basin:01 Storms:Single Duration: 24 Hour Loss Method: Green-Ampt Unit Hydrograph: S-Graph

	Sub Basin Parameters								Rainfall Losses				
Sub Basin ID	Area (sq mi)	Length (mi)	Slope (ft/mi)	S-Graph	Lca (mi)	Lag (min)	Kn	Vel (f/s)	IA (in)	DTHETA	PSIF (in)	XKSAT (in/hr)	RTIMP (%)
50ORIG	0.28	0.86	81.4	Valley	0.43	33	0.076	2.29	0.33	0.32	3.29	0.72	5
50A	0.08	0.65	70.4	Valley	0.28	23	0.069	2.50	0.32	0.30	4.00	0.47	8
50B	0.16	1.18	67.0	Valley	0.66	31	0.052	3.36	0.30	0.26	4.00	0.54	14
50C	0.03	0.41	20.2	Valley	0.20	28	0.090	1.29	0.35	0.35	4.00	0.39	
50AFWY	0.08	0.65	70.4	Valley	0.28	23	0.069	2.50	0.32	0.30	4.00	0.47	8
50BFWY	0.16	1.23	64.4	Valley	0.66	30	0.049	3.61	0.29	0.25	4.00	0.54	18
50CFWY	0.03	0.41	14.6	Valley	0.20	23	0.070	1.57	0.27	0.32	4.00	0.41	25

* Non default value

Land Use Data

Sub Basin ID	Land Use Code	Area	Area Pct (%)	DTHETA Condition	Vegetation Cover (%)	RTIMP (%)	IA (in)	Kn
Major Basin: 01								
50ORIG	LLOTRES	0.098	35.6	Normal	50.0	15	0.30	0.050
	VACANT	0.177	64.4	Dry	10.0		0.35	0.090
50A	LLOTRES	0.042	53.2	Normal	50.0	15	0.30	0.050
	VACANT	0.037	46.8	Dry	10.0		0.35	0.090
50B	LLOTRES	0.155	94.5	Normal	50.0	15	0.30	0.050
	VACANT	0.009	5.5	Dry	10.0		0.35	0.090
50C	VACANT	0.032	100.0	Dry	10.0		0.35	0.090
50AFWY	LLOTRES	0.042	53.2	Normal	50.0	15	0.30	0.050
	VACANT	0.037	46.8	Dry	10.0		0.35	0.090
50BFWY	LLOTRES	0.155	94.5	Normal	50.0	15	0.30	0.050
	VACANT	0.002	1.2	Dry	10.0		0.35	0.090
	FREEWAY	0.007	4.3	Normal	30.0	90	0.05	0.020
50CFWY	VACANT	0.023	71.9	Dry	10.0		0.35	0.090
	FREEWAY	0.009	28.1	Normal	30.0	90	0.05	0.020

Soil Data

	Sub Basin ID	Soil Survey	Map Unit	Area	Area Pct (%)	XKSAT	Rock Outcrop (%)	Effective (%
Major Basin 01								
	50Orig	Aguila/Carefree	98	0.064	23.3	0.37		
		Aguila/Carefree	113	0.069	25.1	0.39		
		Aguila/Carefree	115	0.142	51.6	*		
	50A	Aguila/Carefree	98	0.018	22.8	0.37		
		Aguila/Carefree	113	0.020	25.3	0.39		
		Aguila/Carefree	115	0.041	51.9	0.39		
	50B	Aguila/Carefree	98	0.038	23.2	0.37		
		Aguila/Carefree	113	0.040	24.4	0.39		
		Aguila/Carefree	115	0.086	52.4	0.39		
	50C	Aguila/Carefree	98	0.008	25.0	0.37		
		Aguila/Carefree	113	0.008	25.0	0.39		
		Aguila/Carefree	115	0.016	50.0	0.39		
	50AFW	Aguila/Carefree	98	0.018	22.8	0.37		
		Aguila/Carefree	113	0.020	25.3	0.39		
		Aguila/Carefree	115	0.041	51.9	0.39		
	50BFW	Aguila/Carefree	98	0.038	23.2	0.37		
		Aguila/Carefree	113	0.040	24.4	0.39		
		Aguila/Carefree	115	0.086	52.4	0.39		
	50CFW	Aguila/Carefree	98	0.008	25.0	0.37		
		Aguila/Carefree	113	0.008	25.0	0.39		
		Aguila/Carefree	115	0.016	50.0	0.39		

* Custom Value (not default value)

APPENDIX A

CAP OVERCHUTE BASIN

Updated Existing Conditions Hydrology (HEC-1)

```
1****************************************                ***************************************
*                                       *                *                                     *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                *  U.S. ARMY CORPS OF ENGINEERS       *
*              JUN   1998               *                *  HYDROLOGIC ENGINEERING CENTER      *
*            VERSION 4.1                *                *        609 SECOND STREET            *
*                                       *                *     DAVIS, CALIFORNIA 95616         *
* RUN DATE   08SEP04   TIME  14:09:00   *                *         (916) 756-1104              *
*                                       *                *                                     *
****************************************                ***************************************


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


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

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


1                                          HEC-1 INPUT                                          PAGE  1

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

                *      File:        SC-UPDEX.DAT
                *      Date:        9-08-04
                *      Revised by:  SCI
                *      Hydrology:   100-year, 24-hr Existing Conditions
                *
                *      Quick Note:  THIS IS THE BASE EXISTING CONDITIONS MODEL TO
                *                   BE USED FOR COMPARISON TO MODEL REFLECTING
                *                   FREEWAY IMPACT.
                *
                *
                *      This is a modified, truncated version of HEC-1 file NE200245.DAT.
                *      This model is used to evaluate the impact of the Loop 202 extension
                *      through Subbasin 50 on the local area and the immediate downstream
                *      watershed area.
                *
                *      This model consists of Subbasin 50 and the watershed downstream to
                *      routed hydrograph 31T381.  All else has been removed
                *
                *      Outside of the initial model truncation, the modifications of
                *      this model include:
                *
                *       1) Subdividing Basin 50 into 3 subbasins (50A, 50B & 50C).
                *          The original East Mesa ADMP land use and soil hydrologic
                *          were used but subdivided into three areas.
                *
                *       2) CAP1 revised to agree with new elevation data and
                *          analysis of the CAP 3-54" overchute.
                *          In addition, CAP1 was found to provide no significant effective
                *          storage behind the canal and had little attenuating impact
                *          on the hydrology due to the amount of flow draining to the
                *          overchute, the capacity of the overchute pipes themselves and the
                *          temporary nature of the storage (due to the capacity of the
                *          overchute pipes.
                *          CAP1 could essentially be removed from the hydrology, however,
                *          as the removal of CAP1 might be questioned, it was instead
                *          revised to show no storage behind the canal (all volume or
                *          area data was set to zero).
                *          This is also considered a conservative assumption since some
                *          temporary ponding must occur to push flow through the pipes.
                *          Ponding should not adversely impact adajacent residential
                *          properties above the existing conditions.
                *
                *       3) Revised BASIN1 retention storage data for new topo information.
                *
                *          The Subbasin 50 basin hydrologic parameters are based upon
                *          the existing conditions and developed using DDMSW V2.1.0.
                *
   1            ID
   2            ID  ***************************************************************************
   3            ID  ***************************************************************************
   4            ID  ***************************************************************************
   5            ID  MODEL NAME: NE200245.DAT   Revised by PARSONS BRINCKERHOFF - December 2003
   6            ID
   7            ID  This model includes the following revisions to DMJM+HARRIS model
   8            ID  NE202USR.DAT dated December 2003.
1                                          HEC-1 INPUT                                          PAGE  2
```

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

        ID
        ID     1. The storage volumes for the NE-1, NE-2, NW-1, NW-2 and Southern Avenue
        ID        detention basins have been updated per the final basin geometry.
        ID
        ID     2. The discharge rates for detention basins NW-1 and NW-2 have been revised
        ID        to reflect the revisions to the outlet structures and emergency
        ID        spillways.
        ID
        ID     3. The diversion at the box culvert system at Southern Avenue and Hawes
        ID        Road was revised to simulate blockage of 2 barrels of the existing 3
        ID        barrel box culvert under Southern.
        ID
        ID     4. The diversion at the lateral weir in the Southern Avenue Channel was
        ID        revised to reflect the final weir geometry and rating analysis.
        ID
        ID  ****************************************************************************
        ID  ****************************************************************************
        ID  ****************************************************************************
        ID
        ID    MODEL NAME: Ne2002us.DAT                    Revised by DMJM+HARRIS - August 2003
        ID
        ID    This model includes various revisions to incorporate the Red Mountain Freeway
        ID    in association with the University Drive to Southern Avenue.
        ID
        ID    CHANGES TO THIS MODEL INCLUDE THE FOLLOWING:
        ID
        ID    1. In order to reflect the proposed 202 Freeway Loopand to facilitate design,
        ID       drainage basins 18D, 18C and 24 were further subdivided.  Additional
        ID       concentration points were added to provide discharges at more locations.
        ID
        ID    2. Drainage basin areas for 50 and 202A were modified to reflect design
        ID       refinements to the Power to University segment of the Red Mountain Freeway
        ID
        ID  ****************************************************************************
        ID  ****************************************************************************
        ID
        ID    MODEL NAME: Ne200235.DAT                    Revised by DMJM+HARRIS - July 2002
        ID
        ID    This model includes various revisions to incorporate the Red Mountain Freeway
        ID    in association with the 202L/US60 Traffic Interchange Design Concept Report.
        ID
        ID    CHANGES TO THIS MODEL INCLUDE THE FOLLOWING:
        ID
        ID     1. In order to reflect the proposed 202 Freeway Loop, basin areas for 18C,
        ID        23, 24, 31A and 31B were revised.  Drainage basins 18D, 202A, 202B, and
        ID        202D were added. Basin 38 was split into 38A and 38B due to the 202 Loop.
        ID
        ID     2. Several concentration points have been added and basins have been routed
        ID        to reflect the proposed Red Mountain Freeway alignment.
        ID
        ID     3. Existing detention basins (ADOT) have been removed and new detention
        ID        basins are proposed as part of the freeway construction.
        ID
        ID     4. Modifications were made to the previous (Ne20030) model per the City of
        ID        Mesa to remove the connection of the Southern Ave. Channel from the
1                                   HEC-1 INPUT                                              PAGE  3

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

        ID        structure at Hawes Rd. and instead connect to the Hawes Channel south of
        ID        the intersection.
        ID
        ID  ****************************************************************************
        ID  ****************************************************************************
        ID   ** Previous ** MODEL NAME: NE2002.DAT
        ID
        ID    THIS MODEL COVERS THE AREA EAST OF HAWES ROAD AND THE SOSSAMAN CHANNEL
        ID    MAJOR CHANGES TO THIS MODEL INCLUDE THE FOLLOWING:
        ID
        ID     1. OLD SUBBASIN 18A HAS BEEN SPLIT INTO TWO SUBBASINS. SUBBASIN 18C REMAINS
        ID        IN THIS MODEL AS PART OF THE HAWES CHANNEL INFRASTRUCTURE
        ID     2. OLD SUBBASIN 30 HAS BEEN SPLIT INTO SUBBASIN 30A AND SUBBASIN 30B.
        ID        SUBBASIN 30 GETS INTERCEPTED BY A CHANNEL ON THE NORTH SIDE OF CORALBELL
        ID        AND GETS ROUTED TO SUBBASIN 31A. SUBBASIN 30B STILL GOES SOUTH ALONG
        ID        ELLSWORTH ROAD
        ID     3. FOR THE 2002 YEAR CONDITION, ALL CAP DETENTION BASINS HAVE BEEN PLACED IN
        ID        THE MODEL. THEIR OUTLET CHANNELS HAVE FOR THE MOST PART NOT BEEN INCLUDED
        ID        IN THIS MODEL. THE OUTLET CHANNELS WILL BE IN THE FUTURE MODEL
        ID  ****************************************************************************
        ID
        ID    SOUTHEAST MESA AREA DRAINAGE MASTER PLAN
        ID    AREA NORTH OF SUPERSTITION FREEWAY
        ID
        ID
        ID    REVISED BY VALERIE SWICK, OCTOBER-NOVEMBER 1996
        ID    TO INCORPORATE THE SUPERSITION STRUCTURES AND COMBINE MODELS
        ID
        ID    FILENAME:  MESANE.DAT
        ID
        ID    THIS MODEL REPRESENTS THE EXISTING CONDITION OF THE WATERSHED.
        ID    TOTAL DRAINAGE AREA IS APPROXIMATELY 17 SQ. MI.
```

```
     96          ID
     97          ID   100-YEAR 24-HOUR FREQUENCY
     98          ID
     99          ID
    100          ID   METHODOLOGY
    101          ID   THE US CORPS OF ENGINEERS FLOOD HYDROLOGY MODEL HEC-1 DATED SEP1990 VER 4.0
    102          ID   SCS TYPE II RAINFALL DISTRIBUTION
    103          ID   S-GRAPH HYDROGRAPH
    104          ID   GREEN AND AMPT INFILTRATION EQUATION USED FOR CALCULATING LOSSES
    105          ID   NORMAL DEPTH STORAGE CHANNEL ROUTING
    106          ID   APPROXIMATE DIRECTION, LOCATION, AND LENGTH OF THE WASHES HAVE BEEN
    107          ID   EVALUATED BASED ON FIELD INVESTIGATION, USGS MAPS, LANDIS AERIAL SURVEYS
    108          ID   DATED 1994
    109          ID   THE NOAA TECHNICAL MEMORANDUM NOAA ATLAS 2 DEPTH AREA RATIOS
    110          ID
    111          ID   INITIAL STUDY PERFORMED BY LISA C. YOUNG
    112          ID   REVIEWED BY VALERIE A. SWICK
    113          ID   HYDROLOGY BRANCH ENGINEERING DIVISION, FLOOD CONTROL
    114          ID   DISTRICT OF MARICOPA COUNTY, DECEMBER - JULY 1995.
    115          ID
    116          ID   ASSUMED VELOCITY OF 1 FT/SEC FOR SHEET FLOW, 2 FT/SEC FOR WASH/NATURAL
    117          ID   CHANNEL, 3 FT/SEC FOR ROAD AND GRASS CHANNEL, 10FT/SEC FOR CONCRETE CHANNEL
    118          ID
1                                     HEC-1 INPUT                                              PAGE  4

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

    119          ID
    120          ID    LAST UPDATED ON  3/13/98
    121          ID
    122          ID    UPDATE WAS BASED UPON NEW MAG LAND USE DEFINITIONS FOR SINGLE FAMILY HOUSING
    123          ID
    124          ID   DDM MCUHP2 MESA AREA DRAINAGE MASTER PLAN
                 *DIAGRAM
    125          IT       5  1APR97    0000    1000
    126          IO       5
    127          IN      15
    128          JD   3.600     .01
                 *
                 * ****************************************************************************
                 * DMJM+HARRIS - PC data is from the original East Mesa ADMP.
                 * ****************************************************************************
                 *
    129          PC    .000     .002     .005     .008     .011     .014     .017     .020     .023     .026
    130          PC    .029     .032     .035     .038     .041     .044     .048     .052     .056     .060
    131          PC    .064     .068     .072     .076     .080     .085     .090     .095     .100     .105
    132          PC    .110     .115     .120     .126     .133     .140     .147     .155     .163     .172
    133          PC    .181     .191     .203     .218     .236     .257     .283     .387     .663     .707
    134          PC    .735     .758     .776     .791     .804     .815     .825     .834     .842     .849
    135          PC    .856     .863     .869     .875     .881     .887     .893     .898     .903     .908
    136          PC    .913     .918     .922     .926     .930     .934     .938     .942     .946     .950
    137          PC    .953     .956     .959     .962     .965     .968     .971     .974     .977     .980
    138          PC    .983     .986     .989     .992     .995     .998    1.000
    139          JD    3.58      1.0
    140          JD    3.49      5.0
    141          JD    3.38     10.0
    142          JD    3.24     30.0
    143          JD    3.10     60.0
    144          JD    3.05     90.0
    145          JD    3.00    120.0
    146          JD    2.97    150.0
                 *
                 * DDM    ***** Updated *****
                 *
                 * ****************************************************************************
                 * SCI - Subbasins 50A, 50B and 50C comprise the area of the original
                 *                Basin 50
                 * ****************************************************************************
                 *

    147          KK     50A   BASIN
    148          BA     .08
    149          LG     .32      .30     4.00      .47     8.00
    150          UI     12.      44.      67.      96.     136.      96.      68.      43.      20.      13.
    151          UI      6.       4.       4.       0.       0.       0.       0.       0.       0.       0.
    152          UI      0.       0.       0.       0.       0.       0.       0.       0.       0.       0.
                 *
1                                     HEC-1 INPUT                                              PAGE  5

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

    153          KK     50B   BASIN
    154          BA     .16
    155          LG     .30      .26     4.00      .54    14.00
    156          UI     18.      43.      83.     106.     136.     205.     190.     145.     113.      86.
    157          UI     51.      31.      23.      16.       5.       5.       5.       5.       0.       0.
    158          UI      0.       0.       0.       0.       0.       0.       0.       0.       0.       0.
                 *

    159          KK     50C   BASIN
    160          BA     .03
    161          LG     .35      .35     4.00      .39      .00
    162          UI      4.      11.      19.      25.      36.      46.      34.      26.      19.      11.
```

```
 163          UI      7.       4.       3.       1.       1.       1.       0.       0.       0.       0.
 164          UI      0.       0.       0.       0.       0.       0.       0.       0.       0.       0.
              *

 165          KK    COABC
 166          KM     Combines subbasins 50A, 50B and 50C.
 167          HC        3
              *
              *
              * ****************************************************************************
              * DMJM+HARRIS -  Below is the original Basin 50 hydrologic parameters
              * ****************************************************************************
              *
              * KK     50
              * KM BASIN 50
              * KM  THE FOLLOWING PARAMETERS WERE PROVIDED FOR THIS BASIN
              * KM  L=        .9  Lca=        .4   S=    81.4  Kn= .037  LAG=  15.8
              * KM  PHOENIX VALLEY S-GRAPH WAS USED FOR THIS BASIN
              * BA   .28
              * LG   .33      .31    4.00      .49     5.00
              * UI97.    306.     543.     575.     342.     149.      71.      21.      18.       0.
              * UI 0.      0.       0.       0.       0.       0.       0.       0.       0.       0.
              * UI 0.      0.       0.       0.       0.       0.       0.       0.       0.       0.
              *
              * DDM    ***** Preserved *****
              *
              * ****************************************************************************
              * DMJM+HARRIS  - CAP1 revised to provide no storage behind CAP canal and for new
              *                beginning of the analysis)
              * ****************************************************************************
              *

 168          KK    CAP1
 169          RS       1     STOR       -1
 170          SA       0        0        0        0        0
 171          SE  1567.7     1568     1570     1572     1574
 172          SQ       0        2       81      246      434
              *
              * KK  CAP1
              * KO     1
              * RS     1     FLOW       -1
              * SV     0    0.091    0.575    3.319   13.256
              * SE  1566     1568     1570     1572     1574
              * SQ     5       90      275      470      610
              *
              *
              * ****************************************************************************
              * DMJM+HARRIS  - BASIN1 revised to reflect As-built basin storage
              *                SA record modified based upon new topo data.
              *                SE record modified to agree with topo data
              *                SL record modified to set outlet at bottom of basin
              *                SS record modified to set weir crest at top of basin
              * ****************************************************************************
              *
1                                        HEC-1 INPUT                                              PAGE  6

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


 173          KK  BASIN1
 174          KM        DETENTION BASIN LOCATED DOWNSTREAM FROM CAP1 OVERCHUTE
 175          KM        WITH 24-INCH OUTFALL
              * KO      1
 176          RS       1     STOR       -1
 177          SA    0.01     0.08     0.28     0.58     1.43     2.43     3.65     4.02
 178          SE    1555     1556     1557     1558     1559     1560     1561     1562
 179          SL    1555     3.14      .62       .5
 180          SS    1560       50      2.5      1.5
              *
              * KKBASIN1
              * KM      NEW DETENTION BASIN LOCATED DOWNSTREAM FROM CAP1
              * KM      WITH 24-INCH OUTFALL
              * RS     1     STOR       -1
              * SA  0.01     1.94     3.10     3.49     3.94     4.40     4.85
              * SE    60       61       62       63       64       65       66
              * SL  60.2     3.14      .62       .5
              * SS    64       50      2.5      1.5
              *
              * DDM    ***** Preserved *****

 181          KK    RCAP1
 182          KM    ROUTE CAP OVERCHUTE #1 TO SUBBASIN 18A
 183          RS      11     FLOW       -1
 184          RC     .05     .045      .05     7000      .02
 185          RX     100      200      300      301      303      304      404      505
 186          RY       6        5        2        0        0        2        5        6
              *
              * ** Revised by DMJM+HARRIS to reflect Red Mountain Freeway Design Concepts
              * ** Additional Refinements were made with the University to Southern Segment
              *
              * DDM    ***** Updated *****

 187          KK      18C    BASIN
 188          KM    BASIN 18c
```

```
                  *
 189              KM    THIS IS THE FUTURE SUBBASIN WITH LESS AREA DUE TO 202L FREEWAY
                  *
 190              BA    0.386
 191              LG    0.21     0.27    4.10    0.50      31
 192              UI      50      159     265     349     552     522     383     282     184      88
 193              UI      64       37      15      16      15       0       0       0       0       0
 194              UI       0        0       0       0       0       0       0       0       0       0
                  *
                  *  KM  THE FOLLOWING PARAMETERS WERE PROVIDED FOR THIS BASIN
                  *  KM  L=       1.0  Lca=        .5   S=   60.6  Kn= .071  LAG=  24.1
                  *    KM  L=       1.2  Lca=        .7   S=   66.1  Kn= .061  LAG=  37.2
                  *
                  * **** Revised by DMJM to reflect Red Mountain Freeway Design Concepts *****
                  *
 195              KM    PHOENIX VALLEY S-GRAPH WAS USED FOR THIS BASIN
                  * BA .4172
                  * LG   .28      .29    4.10     .48   19.00
                  * UI 58.    207.    326.    450.    691.    528.    384.    266.    127.     83.
                  * UI 49.     18.     18.     18.      0.      0.      0.      0.      0.      0.
                  * UI 0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
                  * BA   .50
                  * LG   .22      .25    4.00     .57   44.00
                  * UI 45.     75.    180.    237.    287.    355.    507.    531.    407.    335.
                  * UI268.    214.    140.     80.     72.     45.     34.     14.     14.     14.
                  * UI 14.     14.      0.      0.      0.      0.      0.      0.      0.      0.
                  * UI  0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
                  *
                  *   KK  D18c
                  *   KM  RETAIN THE 100 YEAR 2 HOUR VOLUME (53% OF BASIN HAS RETENTION)
                  *   DT  D18c      20
                  *   DI     0   10000
                  *   DQ     0   10000
                  *
1                                                  HEC-1 INPUT                                          PAGE  7

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


 196              KK  RET18C
 197              KM    RETAIN THE 100 YEAR 2 HOUR VOLUME (16% OF BASIN HAS RETENTION)
 198              DT    D18C    5.00
 199              DI       0   10000
 200              DQ       0    1600
                  *
                  * DDM    ***** Preserved *****

 201              KK    C18C
 202              KM    COMBINE FLOWS FROM ROUTED FLOW OF SUBBASIN 50 WITH FLOW FROM 18c
 203              KM    BEFORE CROSSING UNDERNEATH APACHE BLVD AND GOING INTO THE HAWES CHANNEL
 204              HC       2
                  *
                  * DDM    ***** Preserved *****

 205              KK   18T24
 206              KM   REACH HS-6, HS-7, HS-8
 207              KM   ROUTE FLOWS FROM SUBBASIN 18A TO SUBBASIN 24.
 208              RS       1    FLOW      -1
 209              RC    .025    .015    .025    2730  0.0017
 210              RX       0       8      16      26      46      58      65      73
 211              RY     5.0     5.1     5.2       0       0     5.2     5.1     5.0
                  *  THE ABOVE CHANNEL DIMS ARE BASED ON THE NARROWEST DESIGN REACH.
                  *
                  *

 212              KK     18D   BASIN
 213              KM   BASIN 18D
 214              BA   0.044
 215              LG    0.20    0.27    4.00    0.54      34
 216              UI      33     103     128      53      17       5       0       0       0       0
 217              UI       0       0       0       0       0       0       0       0       0       0
                  * KM  THIS IS THE FUTURE SUBBASIN CREATED BY 202L BISECTING 18C
                  * KM  THE FOLLOWING PARAMETERS WERE PROVIDED FOR THIS BASIN
                  *   KM  L=       1.2  Lca=        .7   S=   66.1  Kn= .061  LAG=  37.2
                  * KM  L=        .7  Lca=        .4   S=   50.0  Kn= .071  LAG=  29.7
                  * KM  PHOENIX VALLEY S-GRAPH WAS USED FOR THIS BASIN
                  * BA .1367
                  * LG   .28      .29    4.10     .48   19.00
                  * UI 16.     40.     75.     96.    127.    188.    152.    117.     89.     64.
                  * UI 33.     25.     16.      8.      5.      5.      5.      0.      0.      0.
                  * UI  0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
                  *

 218              KK  18DT24
 219              KM   ROUTE FLOWS FROM SUBBASIN 18D TO C24A
 220              RS       2    FLOW      -1
 221              RC    .035    .025    .035    2820  0.0071
 222              RX       0       5      20      36      44      60      75      80
 223              RY     4.4     4.3     4.0       0       0     4.0     4.3     4.4
                  *
1                                                  HEC-1 INPUT                                          PAGE  8

 LINE             ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10
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```
224          KK     24A    BASIN
225          KM    BASIN 24A
226          BA    0.044
227          LG     0.11     0.30     4.00     0.52      36
228          UI       62      179       79       16       0       0       0       0       0       0
229          UI        0        0        0        0       0       0       0       0       0       0
             *

230          KK     C24A
231          KM    COMBINE FLOWS FROM 18D AND 24A
232          HC        2
             *

233          KK    24ATB
234          KM     ROUTE C24A TO C24B VIA CONCRETE CHANNEL
             *   KM VELOCITY = 5FT/S
235          RS        2     FLOW       -1
             *
236          RC    0.045    0.022    0.042     2630  0.0095
             *
237          RX        0      102      103      106     121     124     128     270
238          RY        7      6.5        6        0       0       3       5       7
             *
             *
             * **** Revised by DMJM+HARRIS to reflect Red Mountain Freeway Design Concepts **
             *   ** Additional Refinements were made with the University to Southern Segment
             *
             * DDM   ***** Updated *****
             * DDM   ***** Inserted *****
             *

239          KK     24B    BASIN
240          KM    BASIN 24B
241          BA    0.258
242          LG     0.24     0.26     4.00     0.54      31
243          UI       67      230      353      549     372     232      97      56      16      15
244          UI        0        0        0        0       0       0       0       0       0       0
245          UI        0        0        0        0       0       0       0       0       0       0
             * KK    24
             * KM BASIN 24
             * KM  THE FOLLOWING PARAMETERS WERE PROVIDED FOR THIS BASIN
             *   KM  L=        .9  Lca=       .5    S=    43.5  Kn= .047  LAG=  24.6
             * KM  L=        .9  Lca=       .5    S=    43.5  Kn= .052  LAG=  30.4
             * KM  PHOENIX VALLEY S-GRAPH WAS USED FOR THIS BASIN
             * BA .4272
             * BA .4272
             * LG   .23      .26     4.00     .56    38.00
             * UI 47.     117.     223.     286.    373.    562.    484.    372.    285.    214.
             * UI116.      80.      53.      34.     15.     15.     15.     15.      0.      0.
             * UI  0.       0.       0.       0.      0.      0.      0.      0.      0.      0.
             *   BA   .29
             *     LG   .23     .26    4.00     .58    38.00
             * UI 40.     138.     220.     300.    469.    376.    275.    195.    100.     63.
             * UI 40.      12.      12.      12.      0.      0.      0.      0.      0.      0.
             * UI  0.       0.       0.       0.      0.      0.      0.      0.      0.      0.
             *
1                                        HEC-1 INPUT                                             PAGE  9

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


246          KK  RET24B
247          KM    RETAIN THE 100 YEAR 2 HOUR VOLUME (18% OF BASIN HAS RETENTION)
248          DT    D24B    3.35
249          DI       0   10000
250          DQ       0    1800
             *
             * **** Revised by DMJM+HARRIS to reflect Red Mountain Freeway Design Concepts **
             *   ** Additional Refinements were made with the University to Southern Segment
             *

251          KK     C24B
252          KM    COMBINE FLOWS FROM C24A AND BASIN 24B
             *   KK    C24
             *   KM COMBINE FLOWS FROM S18C AND S24
             *   ZW     A=HAWES RD @ BROADWAY RD    B=HAWES CHANNEL PROJECT   C=FLOW    F=HYDROGRA
253          HC        2
             *

254          KK     C24C
255          KM    COMBINE FLOWS FROM C24B AND C18C
             *   KK    C24
             *   KM COMBINE FLOWS FROM S18C AND S24
256          ZW     A=HAWES RD @ BROADWAY RD    B=HAWES CHANNEL PROJECT   C=FLOW    F=HYDROGRAPH
257          HC        2
             *
             *
             * DDM   ***** Preserved *****

258          KK  BRDHAW
259          KM    DIVERT FLOW OF 360 CFS TO THE WEST PER THE CITY OF MESA FUTURE DRAINAGE
260          KM    SYSTEM
261          DT  DIVBRD
```

```
 262          DI       0     200     400     500     700    1000
 263          DQ       0       0       0       0       0       0
              * DI     0     200     400     500     700    1000
              * DQ     0     200     360     360     360     360
              *

 264          KK  RT31B1
 265          KM   THIS ROUTING STEP HAS BEEN BROKEN OUT OF A LARGER SEQUENCE FOR SIMPLICITY
 266          KM   REACH HS-5 plus culvert HSC-4
 267          KM   ROUTE FLOWS FROM HAWES ROAD AND BROADWAY ROAD (C24) TO CORAL BELL AVENUE.
 268          KO                                      21                      10
 269          ZW   A=FLOW AFTER 360 CFS DIVERT TO WEST B=HAWES CHANNEL PROJECT C=FLOW  F=HYDRO
 270          RS       1    FLOW      -1
 271          RC    .025    .015    .025    1312  0.0015
 272          RX       0       8      15      28      68      81      89      97
 273          RY     6.2     6.4     6.5       0       0     6.5     6.4     6.2
              *
1                                       HEC-1 INPUT                                        PAGE 10

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


 274          KK  RT31B2
 275          KM   THIS ROUTING STEP HAS BEEN BROKEN OUT OF A LARGER SEQUENCE FOR SIMPLICITY
 276          KM   REACH HS-4A AND HS4-B plus culvert HSC-3
 277          KM   ROUTE FLOWS FROM CORAL BELL AVENUE TO EMELITA AVENUE.
 278          RS       1    FLOW      -1
 279          RC    .025    .015    .025    2080  0.0018
 280          RX       0       8    15.9      16      66    66.1      74      82
 281          RY     5.8     5.9     6.1       0       0     6.1     5.9     5.8
              *

 282          KK  RT31B3
 283          KM   THIS ROUTING STEP HAS BEEN BROKEN OUT OF A LARGER SEQUENCE FOR SIMPLICITY
 284          KM   REACH HS-3
 285          KM    THIS REACH IS AN EXISTING CHANNEL FOR THE CRESCENT RUN MOBILE HOME PARK.
 286          KM    The existing channel 5.6 ft deep has no freeboard.  Overbank flows in street
 287          KM    Routing values per channel design plans,
 288          KM    Sheet 2 of 19, City of Mesa Project 97-69.
 289          KM   ROUTE FLOWS FROM EMELITA AVENUE TO SOUTHERN AVENUE (C31) WITHIN SUBBASIN 31B.
 290          RS       1    FLOW      -1
 291          RC    .025    .015    .025    1935  0.0033
 292          RX       0    35.6    41.6      50    66.7    75.1    81.1    92.0
 293          RY     5.4     4.7     5.6       0       0     5.6     7.6     7.7
              *
              * DDM    ***** Updated *****
              *

 294          KK     31B
 295          KM   BASIN  31B
 296          KM    THE FOLLOWING PARAMETERS WERE PROVIDED FOR THIS BASIN
              *     KM  L=       1.2  Lca=        .5    S=    29.7  Kn= .049  LAG=  30.8
 297          KM    L=       1.2  Lca=        .5    S=    29.7  Kn= .077  LAG=  23.2
 298          KM    PHOENIX VALLEY S-GRAPH WAS USED FOR THIS BASIN
              *
 299          BA     .44
 300          LG    0.31    0.32    4.45    0.35      11
 301          UI      31      31      88     132     162     184     218     263     356     375
 302          UI     302     254     217     187     152     124      77      54      51      36
 303          UI      31      19      10       9       9      10       9      10       0       0
 304          UI       0       0       0       0       0       0       0       0       0       0
              * BA  .720
              * LG   .31     .32    4.45     .35   11.00
              * UI104.    391.    602.    859.   1236.    884.    629.    407.    187.    125.
              * UI 59.    32.     32.     0.      0.      0.      0.      0.      0.      0.
              * UI  0.    0.      0.      0.      0.      0.      0.      0.      0.      0.
              *
              * BA   .47
              * LG   .24     .25    4.45     .46   37.00
              * UI 52.    125.    240.    309.    399.    601.    544.    416.    321.    243.
              * UI141.    88.     63.     44.     16.     16.     16.     16.     0.      0.
              * UI  0.    0.      0.      0.      0.      0.      0.      0.      0.      0.
              *
1                                       HEC-1 INPUT                                        PAGE 11

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


 305          KK    D31BS
 306          KM     RETAIN 100 YEAR 2 HOUR, (66% FOR FUTURE DEVELOPMENT)
 307          DT    D31BS       23
 308          DI       0   10000
 309          DQ       0   10000
              *
              * DDM    ***** Preserved *****
              *
              *
              * ***** Revised by DMJM to reflect Red Mountain Freeway Design Concepts *****
              *

 310          KK    C31B
 311          KM    COMBINE FLOWS FROM C24 AND 31B
 312          ZW    A=FLOW SOUTHERN AND HAWES BEFORE SPLIT BOX B=HAWES CHANNEL PROJ C=FLOW F=HYDR
 313          HC       2
```

```
                    *
                    *
                    * DDM    ***** Preserved *****
                    *     KK  D31W
                    *

      314           KK     D31S
                    *
      315           KM     THIS DIVERT RECORD IS FOR THE BOX CULVERT SYSTEM AT SOUTHERN AVE AND HAWES
      316           KM     IT IS BASED UPON A HEC-RAS ANALYSIS OF THE FOLLOWING STRUCTURES:
      317           KM     3-8'X4' CBC SOUTH,  2-10'X6' CBC TO THE WEST
      318           KM     THE CULVERT TO THE SOUTH HAS THE TWO THAT ARE THERE NOW WITH AN ADDITIONAL
      319           KM     ONE CONSTRUCTED
                    * KO    1
      320           DT     D31W
                    *
                    * **** Revised by DMJM to reflect Red Mountain Freeway Design Concepts *****
                    *
                    *   *  THESE NEW CARDS BASED UPON HEC-RAS ANALYSIS
                    *  DI  0     144     182     252     380     454     544     671     758     844
                    *  DI976    1098    1184    1280    1412    1544    1646    1738    1830
                    *  DQ  0       0       0     220     316     358     400     460     520     580
                    *   DQ640     690     740     800     860     920     980    1030    1080
                    *
                    *  THESE CARDS BASED UPON HEC-RAS ANALYSIS *** As Intended ***
                    *
                    *  DI  0     144     182     252     380     454     544     671     758     844
                    *  DI976    1098    1184    1280    1412    1544    1646    1738    1830
                    *  DQ  0     144     182     220     316     358     400     460     520     580
                    *  DQ   640     690     740     800     860     920     980    1030    1080
                    *
                    *  ** Revised to help allow proper function of NW Detention Basins (Off-line Typ
                    *  *** Simulating 75% blockage of the Southern Avenue culverts ***
                    *
                    * DI    0      62     111     230     309     403     504     611     727     847
                    * DI 971    1098    1223    1346
                    * DQ    0      62     111     214     283     362     445     533     629     729
                    * DQ 834     941    1049    1155
                    *
                    * *** Revised by PB to simulate blockage of 2 barrels leaving 1 barrel open ***
                    * *** of the Southern Avenue Culverts                                       ***
                    *
1                                             HEC-1 INPUT                                          PAGE 12

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

      321           DI        0      62     111     229     306     401     521     636     759     887
      322           DQ        0      62     111     214     283     362     445     533     629     730
                    *
                    *

      323           KK  31T381  ROUTED IN TWO STEPS DUE TO CHANNEL DISSIMILARITY.
      324           KM   REACH HS-2 plus culvert HSC-2
      325           KM      ROUTE FLOWS FROM SOUTHERN AVENUE (C31) IN THE HAWES CHANNEL.
      326           KM   REACH HS-2 IS A PROPOSED CHANNEL SOON-TO-BE-CONSTRUCTED.  IT IS 4.5 FEET
      327           KM      DEEP, WITH FREEBOARD. CHANNEL CROSS-SECTION FROM DESIGN PLANS FOR
      328           KM      SOUTHERN AVENUE DRAINAGE IMPROVEMENTS.  SHEET 28 OF 43
      329           KM      CITY OF MESA PROJECT NO. 97-56.1 DESIGN PLANS BY ENTELLUS
      330           KM      DATED 8/8/97 REV. 12/19/97
      331           RS        1    FLOW      -1
      332           RC   0.025   0.015   0.025    1248   .0022
      333           RX        0      32      37      46      56      65      73      75
      334           RY        5     7.0     4.5       0       0     4.5     9.0     9.5
                    *
      335           ZZ
1
         SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
 LINE    (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

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

  147       50A
             .
             .
  153        .          50B
             .           .
             .           .
  159        .           .          50C
             .           .           .
             .           .           .
  165     COABC.......................
             V
             V
  168       CAP1
             V
             V
  173     BASIN1
             V
             V
  181      RCAP1
             .
             .
  187        .          18C
```

```
                    .           .
                    .           .
198                 .           .------->    D18C
196                 .       RET18C
                    .           .
                    .           .
201               C18C............
                    V
                    V
205              18T24
                    .
                    .
212                 .          18D
                    .           V
                    .           V
218                 .       18DT24
                    .           .
                    .           .
224                 .           .          24A
                    .           .           .
                    .           .           .
230                 .         C24A............
                    .           V
                    .           V
233                 .        24ATB
                    .           .
                    .           .
239                 .           .          24B
                    .           .           .
                    .           .           .
248                 .           .           .------->    D24B
246                 .           .       RET24B
                    .           .           .
                    .           .           .
251                 .         C24B............
                    .           .
                    .           .
254               C24C............
                    .
                    .
261                 .------->   DIVBRD
258             BRDHAW
                    V
                    V
264             RT31B1
                    V
                    V
274             RT31B2
                    V
                    V
282             RT31B3
                    .
                    .
294                 .          31B
                    .           .
                    .           .
307                 .           .------->   D31BS
305                 .        D31BS
                    .           .
                    .           .
310              C31B ............
                    .
                    .
320                 .------->   D31W
314               D31S
                    V
                    V
323             31T381

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION
1*****************************************                           ***************************************
*                                       *                           *                                     *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                           *   U.S. ARMY CORPS OF ENGINEERS      *
*              JUN   1998               *                           *   HYDROLOGIC ENGINEERING CENTER     *
*            VERSION 4.1                *                           *         609 SECOND STREET           *
*                                       *                           *      DAVIS, CALIFORNIA 95616        *
*  RUN DATE   08SEP04  TIME  14:09:00   *                           *          (916) 756-1104             *
*                                       *                           *                                     *
*****************************************                           ***************************************


                            ***************************************************************************
                            ***************************************************************************
                            ***************************************************************************
                            MODEL NAME: NE200245.DAT   Revised by PARSONS BRINCKERHOFF - December 2003

                            This model includes the following revisions to DMJM+HARRIS model
                            NE202USR.DAT dated December 2003.

                             1. The storage volumes for the NE-1, NE-2, NW-1, NW-2 and Southern Avenue
```

detention basins have been updated per the final basin geometry.

2. The discharge rates for detention basins NW-1 and NW-2 have been revised to reflect the revisions to the outlet structures and emergency spillways.

3. The diversion at the box culvert system at Southern Avenue and Hawes Road was revised to simulate blockage of 2 barrels of the existing 3 barrel box culvert under Southern.

4. The diversion at the lateral weir in the Southern Avenue Channel was revised to reflect the final weir geometry and rating analysis.

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

MODEL NAME: Ne2002us.DAT Revised by DMJM+HARRIS - August 2003

This model includes various revisions to incorporate the Red Mountain Freeway in association with the University Drive to Southern Avenue.

CHANGES TO THIS MODEL INCLUDE THE FOLLOWING:

1. In order to reflect the proposed 202 Freeway Loopand to facilitate design, drainage basins 18D, 18C and 24 were further subdivided. Additional concentration points were added to provide discharges at more locations.

2. Drainage basin areas for 50 and 202A were modified to reflect design refinements to the Power to University segment of the Red Mountain Freeway

****
****

MODEL NAME: Ne200235.DAT Revised by DMJM+HARRIS - July 2002

This model includes various revisions to incorporate the Red Mountain Freeway in association with the 202L/US60 Traffic Interchange Design Concept Report.

CHANGES TO THIS MODEL INCLUDE THE FOLLOWING:

1. In order to reflect the proposed 202 Freeway Loop, basin areas for 18C, 23, 24, 31A and 31B were revised. Drainage basins 18D, 202A, 202B, and 202D were added. Basin 38 was split into 38A and 38B due to the 202 Loop.

2. Several concentration points have been added and basins have been routed to reflect the proposed Red Mountain Freeway alignment.

3. Existing detention basins (ADOT) have been removed and new detention basins are proposed as part of the freeway construction.

4. Modifications were made to the previous (Ne20030) model per the City of Mesa to remove the connection of the Southern Ave. Channel from the structure at Hawes Rd. and instead connect to the Hawes Channel south of the intersection.

****
****
** Previous ** MODEL NAME: NE2002.DAT

THIS MODEL COVERS THE AREA EAST OF HAWES ROAD AND THE SOSSAMAN CHANNEL
MAJOR CHANGES TO THIS MODEL INCLUDE THE FOLLOWING:

1. OLD SUBBASIN 18A HAS BEEN SPLIT INTO TWO SUBBASINS. SUBBASIN 18C REMAINS IN THIS MODEL AS PART OF THE HAWES CHANNEL INFRASTRUCTURE
2. OLD SUBBASIN 30 HAS BEEN SPLIT INTO SUBBASIN 30A AND SUBBASIN 30B. SUBBASIN 30 GETS INTERCEPTED BY A CHANNEL ON THE NORTH SIDE OF CORALBELL AND GETS ROUTED TO SUBBASIN 31A. SUBBASIN 30B STILL GOES SOUTH ALONG ELLSWORTH ROAD
3. FOR THE 2002 YEAR CONDITION, ALL CAP DETENTION BASINS HAVE BEEN PLACED IN THE MODEL. THEIR OUTLET CHANNELS HAVE FOR THE MOST PART NOT BEEN INCLUDED IN THIS MODEL. THE OUTLET CHANNELS WILL BE IN THE FUTURE MODEL

****

SOUTHEAST MESA AREA DRAINAGE MASTER PLAN
AREA NORTH OF SUPERSTITION FREEWAY

REVISED BY VALERIE SWICK, OCTOBER-NOVEMBER 1996
TO INCORPORATE THE SUPERSITION STRUCTURES AND COMBINE MODELS

FILENAME: MESANE.DAT

THIS MODEL REPRESENTS THE EXISTING CONDITION OF THE WATERSHED.
TOTAL DRAINAGE AREA IS APPROXIMATELY 17 SQ. MI.

100-YEAR 24-HOUR FREQUENCY

METHODOLOGY
THE US CORPS OF ENGINEERS FLOOD HYDROLOGY MODEL HEC-1 DATED SEP1990 VER 4.0
SCS TYPE II RAINFALL DISTRIBUTION
S-GRAPH HYDROGRAPH
GREEN AND AMPT INFILTRATION EQUATION USED FOR CALCULATING LOSSES

NORMAL DEPTH STORAGE CHANNEL ROUTING
APPROXIMATE DIRECTION, LOCATION, AND LENGTH OF THE WASHES HAVE BEEN
EVALUATED BASED ON FIELD INVESTIGATION, USGS MAPS, LANDIS AERIAL SURVEYS
DATED 1994
THE NOAA TECHNICAL MEMORANDUM NOAA ATLAS 2 DEPTH AREA RATIOS

INITIAL STUDY PERFORMED BY LISA C. YOUNG
REVIEWED BY VALERIE A. SWICK
HYDROLOGY BRANCH ENGINEERING DIVISION, FLOOD CONTROL
DISTRICT OF MARICOPA COUNTY, DECEMBER - JULY 1995.

ASSUMED VELOCITY OF 1 FT/SEC FOR SHEET FLOW, 2 FT/SEC FOR WASH/NATURAL
CHANNEL, 3 FT/SEC FOR ROAD AND GRASS CHANNEL, 10FT/SEC FOR CONCRETE CHANNEL

LAST UPDATED ON 3/13/98

UPDATE WAS BASED UPON NEW MAG LAND USE DEFINITIONS FOR SINGLE FAMILY HOUSING

DDM MCUHP2 MESA AREA DRAINAGE MASTER PLAN

126 IO OUTPUT CONTROL VARIABLES

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

IT HYDROGRAPH TIME DATA

NMIN	5	MINUTES IN COMPUTATION INTERVAL
IDATE	1APR97	STARTING DATE
ITIME	0000	STARTING TIME
NQ	1000	NUMBER OF HYDROGRAPH ORDINATES
NDDATE	4APR97	ENDING DATE
NDTIME	1115	ENDING TIME
ICENT	19	CENTURY MARK

COMPUTATION INTERVAL .08 HOURS
TOTAL TIME BASE 83.25 HOURS

ENGLISH UNITS

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

128 JD INDEX STORM NO. 1

STRM	3.60	PRECIPITATION DEPTH
TRDA	.01	TRANSPOSITION DRAINAGE AREA

129 PI PRECIPITATION PATTERN

.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.01	.00	.01
.01	.01	.01	.01	.01	.01	.01	.01	.03	.03
.03	.09	.09	.09	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
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.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00		

139 JD INDEX STORM NO. 2

STRM	3.58	PRECIPITATION DEPTH
TRDA	1.00	TRANSPOSITION DRAINAGE AREA

0 PI PRECIPITATION PATTERN

.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
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                   .00     .00     .00     .00     .00     .00     .00     .01     .00     .01
                   .01     .01     .01     .01     .01     .01     .01     .01     .03     .03
                   .03     .09     .09     .09     .01     .01     .01     .01     .01     .01
                   .01     .01     .01     .01     .01     .01     .00     .00     .00     .00
                   .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
                   .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
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                   .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
                   .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
                   .00     .00     .00     .00     .00     .00     .00     .00

140 JD        INDEX STORM NO. 3
                 STRM        3.49  PRECIPITATION DEPTH
                 TRDA        5.00  TRANSPOSITION DRAINAGE AREA

  0 PI          PRECIPITATION PATTERN
                   .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
                   .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
                   .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
                   .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
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                   .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
                   .00     .00     .00     .00     .00     .00     .00     .01     .00     .01
                   .01     .01     .01     .01     .01     .01     .01     .01     .03     .03
                   .03     .09     .09     .09     .01     .01     .01     .01     .01     .01
                   .01     .01     .01     .01     .01     .01     .00     .00     .00     .00
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                   .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
                   .00     .00     .00     .00     .00     .00     .00     .00

141 JD        INDEX STORM NO. 4
                 STRM        3.38  PRECIPITATION DEPTH
                 TRDA       10.00  TRANSPOSITION DRAINAGE AREA

  0 PI          PRECIPITATION PATTERN
                   .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
                   .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
                   .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
                   .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
                   .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
                   .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
                   .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
                   .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
                   .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
                   .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
                   .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
                   .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
                   .00     .00     .00     .00     .00     .00     .00     .01     .00     .01
                   .01     .01     .01     .01     .01     .01     .01     .01     .03     .03
                   .03     .09     .09     .09     .01     .01     .01     .01     .01     .01
                   .01     .01     .01     .01     .01     .01     .00     .00     .00     .00
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                   .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
                   .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
                   .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
                   .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
                   .00     .00     .00     .00     .00     .00     .00     .00

142 JD        INDEX STORM NO. 5
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STRM 3.24 PRECIPITATION DEPTH
TRDA 30.00 TRANSPOSITION DRAINAGE AREA

0 PI PRECIPITATION PATTERN

.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
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.00	.00	.00	.00	.00	.00	.00	.01	.00	.01
.01	.01	.01	.01	.01	.01	.01	.01	.03	.03
.03	.09	.09	.09	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.00	.00	.00	.00
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.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00		

143 JD INDEX STORM NO. 6
STRM 3.10 PRECIPITATION DEPTH
TRDA 60.00 TRANSPOSITION DRAINAGE AREA

0 PI PRECIPITATION PATTERN

.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
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.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.01	.00	.01
.01	.01	.01	.01	.01	.01	.01	.01	.03	.03
.03	.09	.09	.09	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
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144 JD INDEX STORM NO. 7
STRM 3.05 PRECIPITATION DEPTH
TRDA 90.00 TRANSPOSITION DRAINAGE AREA

0 PI PRECIPITATION PATTERN

.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
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.00	.00	.00	.00	.00	.00	.00	.01	.00	.01
.01	.01	.01	.01	.01	.01	.01	.01	.03	.03
.03	.09	.09	.09	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.00	.00	.00	.00
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145 JD          INDEX STORM NO. 8
                   STRM       3.00  PRECIPITATION DEPTH
                   TRDA     120.00  TRANSPOSITION DRAINAGE AREA

  0 PI            PRECIPITATION PATTERN
                     .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                     .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
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                     .01      .01      .01      .01      .01      .01      .01      .01      .03      .03
                     .03      .09      .09      .09      .01      .01      .01      .01      .01      .01
                     .01      .01      .01      .01      .01      .01      .00      .00      .00      .00
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146 JD          INDEX STORM NO. 9
                   STRM       2.97  PRECIPITATION DEPTH
                   TRDA     150.00  TRANSPOSITION DRAINAGE AREA

  0 PI            PRECIPITATION PATTERN
                     .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                     .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
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                     .00      .00      .00      .00      .00      .00      .00      .01      .00      .01
                     .01      .01      .01      .01      .01      .01      .01      .01      .03      .03
                     .03      .09      .09      .09      .01      .01      .01      .01      .01      .01
                     .01      .01      .01      .01      .01      .01      .00      .00      .00      .00
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  -----DSS---ZOPEN:  Existing File Opened,  File: SC-UPDEX.DSS
                     Unit:  71;  DSS Version: 6-JG
-----DSS---ZWRITE Unit  71; Vers.    2:  /HAWES RD @ BROADWAY RD/HAWES CHANNEL PROJECT/FLOW/31MAR1997/5MIN/HYDROGRAPH/
-----DSS---ZWRITE Unit  71; Vers.    2:  /HAWES RD @ BROADWAY RD/HAWES CHANNEL PROJECT/FLOW/01APR1997/5MIN/HYDROGRAPH/
-----DSS---ZWRITE Unit  71; Vers.    2:  /HAWES RD @ BROADWAY RD/HAWES CHANNEL PROJECT/FLOW/02APR1997/5MIN/HYDROGRAPH/
-----DSS---ZWRITE Unit  71; Vers.    2:  /HAWES RD @ BROADWAY RD/HAWES CHANNEL PROJECT/FLOW/03APR1997/5MIN/HYDROGRAPH/
-----DSS---ZWRITE Unit  71; Vers.    2:  /HAWES RD @ BROADWAY RD/HAWES CHANNEL PROJECT/FLOW/04APR1997/5MIN/HYDROGRAPH/


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

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

```
264 KK        *    RT31B1  *
              *            *
              **************

268 KO         OUTPUT CONTROL VARIABLES
                    IPRNT          5  PRINT CONTROL
                    IPLOT          0  PLOT CONTROL
                    QSCAL         0.  HYDROGRAPH PLOT SCALE
                    IPNCH          0  PUNCH COMPUTED HYDROGRAPH
                     IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                    ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                    ISAV2       1000  LAST ORDINATE PUNCHED OR SAVED
                   TIMINT      1.000  TIME INTERVAL IN HOURS

-----DSS---ZWRITE Unit  71; Vers.    2:  /FLOW AFTER 360 CFS DIVERT TO WES/HAWES CHANNEL PROJECT/FLOW/31MAR1997/5MIN/HYD/
-----DSS---ZWRITE Unit  71; Vers.    2:  /FLOW AFTER 360 CFS DIVERT TO WES/HAWES CHANNEL PROJECT/FLOW/01APR1997/5MIN/HYD/
-----DSS---ZWRITE Unit  71; Vers.    2:  /FLOW AFTER 360 CFS DIVERT TO WES/HAWES CHANNEL PROJECT/FLOW/02APR1997/5MIN/HYD/
-----DSS---ZWRITE Unit  71; Vers.    2:  /FLOW AFTER 360 CFS DIVERT TO WES/HAWES CHANNEL PROJECT/FLOW/03APR1997/5MIN/HYD/
-----DSS---ZWRITE Unit  71; Vers.    2:  /FLOW AFTER 360 CFS DIVERT TO WES/HAWES CHANNEL PROJECT/FLOW/04APR1997/5MIN/HYD/
-----DSS---ZWRITE Unit  71; Vers.    2:  /FLOW SOUTHERN AND HAWES BEFORE S/HAWES CHANNEL PROJ/FLOW/31MAR1997/5MIN/HYDR/
-----DSS---ZWRITE Unit  71; Vers.    2:  /FLOW SOUTHERN AND HAWES BEFORE S/HAWES CHANNEL PROJ/FLOW/01APR1997/5MIN/HYDR/
-----DSS---ZWRITE Unit  71; Vers.    2:  /FLOW SOUTHERN AND HAWES BEFORE S/HAWES CHANNEL PROJ/FLOW/02APR1997/5MIN/HYDR/
-----DSS---ZWRITE Unit  71; Vers.    2:  /FLOW SOUTHERN AND HAWES BEFORE S/HAWES CHANNEL PROJ/FLOW/03APR1997/5MIN/HYDR/
-----DSS---ZWRITE Unit  71; Vers.    2:  /FLOW SOUTHERN AND HAWES BEFORE S/HAWES CHANNEL PROJ/FLOW/04APR1997/5MIN/HYDR/
1
```

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	50A	89.	12.25	8.	2.	1.	.08		
+	HYDROGRAPH AT	50B	152.	12.33	18.	5.	2.	.16		
+	HYDROGRAPH AT	50C	32.	12.33	3.	1.	0.	.03		
+	3 COMBINED AT	COABC	264.	12.33	30.	8.	3.	.27		
+	ROUTED TO	CAP1	264.	12.33	30.	8.	3.	.27		
+	ROUTED TO	BASIN1	161.	12.50	30.	8.	3.	.27		
+	ROUTED TO	RCAP1	136.	13.08	30.	8.	3.	.27		
+	HYDROGRAPH AT	18C	453.	12.25	57.	18.	6.	.39		
+	DIVERSION TO	D18C	72.	12.25	9.	3.	1.	.39		
+	HYDROGRAPH AT	RET18C	380.	12.25	48.	15.	5.	.39		
+	2 COMBINED AT	C18C	401.	12.33	77.	23.	8.	.66		
+	ROUTED TO	18T24	379.	12.33	77.	23.	8.	.66		
+	HYDROGRAPH AT	18D	80.	12.08	7.	2.	1.	.04		
+	ROUTED TO	18DT24	69.	12.17	7.	2.	1.	.04		
+	HYDROGRAPH AT	24A	90.	12.00	7.	2.	1.	.04		
+	2 COMBINED AT	C24A	135.	12.08	13.	4.	1.	.09		
+	ROUTED TO	24ATB	124.	12.17	13.	4.	1.	.09		
+	HYDROGRAPH AT	24B	374.	12.17	37.	12.	4.	.26		
+	DIVERSION TO	D24B	67.	12.17	6.	2.	1.	.26		
+	HYDROGRAPH AT	RET24B	307.	12.17	31.	10.	3.	.26		
	2 COMBINED AT									

+		C24B	430.	12.17	45.	14.	5.	.35
	2 COMBINED AT							
+		C24C	706.	12.25	122.	37.	12.	1.00
	DIVERSION TO							
+		DIVBRD	0.	.00	0.	0.	0.	1.00
	HYDROGRAPH AT							
+		BRDHAW	706.	12.25	122.	37.	12.	1.00
	ROUTED TO							
+		RT31B1	700.	12.25	122.	37.	12.	1.00
	ROUTED TO							
+		RT31B2	677.	12.33	122.	37.	12.	1.00
	ROUTED TO							
+		RT31B3	665.	12.33	122.	37.	12.	1.00
	HYDROGRAPH AT							
+		31B	320.	12.67	52.	14.	5.	.44
	DIVERSION TO							
+		D31BS	320.	12.67	45.	12.	4.	.44
	HYDROGRAPH AT							
+		D31BS	96.	13.17	9.	3.	1.	.44
	2 COMBINED AT							
+		C31B	665.	12.33	130.	40.	13.	1.44
	DIVERSION TO							
+		D31W	551.	12.33	118.	37.	12.	1.44
	HYDROGRAPH AT							
+		D31S	108.	12.33	10.	3.	1.	1.44
	ROUTED TO							
+		31T381	106.	12.42	10.	3.	1.	1.44

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


    -----DSS---ZCLOSE Unit:  71,    File: SC-UPDEX.DSS
              Pointer Utilization:    .25
              Number of Records:      15
              File Size:      31.9  Kbytes
              Percent Inactive:     .0
??

??

??

??
```

Updated Existing Conditions for CAP Overchute Analysis

C:\HECEXE\SC-UPDEX.OUT\
Page 1 of 16

APPENDIX A

CAP OVERCHUTE BASIN

Proposed Conditions Hydrology (HEC-1)

```
1***************************************                        ***************************************
*                                       *                       *                                     *
*   FLOOD HYDROGRAPH PACKAGE   (HEC-1)  *                       *   U.S. ARMY CORPS OF ENGINEERS      *
*              JUN    1998              *                       *   HYDROLOGIC ENGINEERING CENTER     *
*            VERSION 4.1                *                       *        609 SECOND STREET            *
*                                       *                       *     DAVIS, CALIFORNIA 95616         *
*  RUN DATE    08SEP04   TIME  14:16:58 *                       *        (916) 756-1104               *
*                                       *                       *                                     *
*****************************************                       ***************************************
```

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

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

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

```
1                                      HEC-1 INPUT                                          PAGE  1

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

                *      File:        SCFINAL.DAT
                *      Date:        9-07-04
                *      Revised by:  DMJM+HARRIS
                *      Hydrology:   100-year, 24-hr Existing Conditions
                *
                *      Quick Note:  THIS IS THE REVISED MODEL TO REFLECT THE EXTENSION
                *                   OF THE LOOP 202 THROUGH BASIN 50.
                *                   IT SHOULD BE COMPARED TO THE UPDATED EXISTING
                *                   CONDITIONS MODEL UPEXST.DAT.
                *
                *      This is a modified, truncated version of HEC-1 file NE200245.DAT.
                *      This model is used to evaluate the impact of the Loop 202 extension
                *      through Subbasin 50 on the local area and the immediate downstream
                *      watershed area.
                *
                *      This model consists of Subbasin 50 and the watershed downstream to
                *      routed hydrograph 31T381.  All else has been removed
                *
                *      Outside of the initial model truncation, the modifications of
                *      this model include:
                *
                *       1) Subdividing Basin 50 into 3 subbasins (50AFWY, 50BFWY & 50CFWY).
                *          The original East Mesa ADMP land use and soil hydrologic
                *          were used but subdivided into three areas.  The landuse was then
                *          updated in each basin to account for the impact of the proposed
                *          extension of the Loop 202 freeway.
                *
                *       2) CAP1 revised to agree with new elevation data and
                *          analysis of the CAP 3-54" overchute.
                *          In addition, CAP1 was found to provide no significant effective
                *          storage behind the canal and had little attenuating impact
                *          on the hydrology due to the amount of flow draining to the
                *          overchute, the capacity of the overchute pipes themselves and the
                *          temporary nature of the storage (due to the capacity of the
                *          overchute pipes.
                *          CAP1 could essentially be removed from the hydrology, however,
                *          as the removal of CAP1 might be questioned, it was instead
                *          revised to show no storage behind the canal (all volume or
                *          area data was set to zero).
                *          This is also considered a conservative assumption since some
                *          temporary ponding must occur to push flow through the pipes.
                *          Ponding should not adversely impact adajacent residential
                *          properties above the existing conditions.
                *
                *       3) Revised BASIN1 retention storage data for new topo information.
                *
                *          The Subbasin 50 basin hydrologic parameters are based upon
                *          the existing conditions and developed using DDMSW V2.1.0.
                *
      1         ID
      2         ID  ****************************************************************************
      3         ID  ****************************************************************************
      4         ID  ****************************************************************************
      5         ID  MODEL NAME: NE200245.DAT   Revised by PARSONS BRINCKERHOFF - December 2003
      6         ID
1                                      HEC-1 INPUT                                          PAGE  2
```

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

         ID  This model includes the following revisions to DMJM+HARRIS model
         ID  NE202USR.DAT dated December 2003.
         ID
         ID   1. The storage volumes for the NE-1, NE-2, NW-1, NW-2 and Southern Avenue
         ID      detention basins have been updated per the final basin geometry.
         ID
         ID   2. The discharge rates for detention basins NW-1 and NW-2 have been revised
         ID      to reflect the revisions to the outlet structures and emergency
         ID      spillways.
         ID
         ID   3. The diversion at the box culvert system at Southern Avenue and Hawes
         ID      Road was revised to simulate blockage of 2 barrels of the existing 3
         ID      barrel box culvert under Southern.
         ID
         ID   4. The diversion at the lateral weir in the Southern Avenue Channel was
         ID      revised to reflect the final weir geometry and rating analysis.
         ID
         ID *****************************************************************************
         ID *****************************************************************************
         ID *****************************************************************************
         ID
         ID  MODEL NAME: Ne2002us.DAT                 Revised by DMJM+HARRIS - August 2003
         ID
         ID  This model includes various revisions to incorporate the Red Mountain Freeway
         ID  in association with the University Drive to Southern Avenue.
         ID
         ID  CHANGES TO THIS MODEL INCLUDE THE FOLLOWING:
         ID
         ID  1. In order to reflect the proposed 202 Freeway Loopand to facilitate design,
         ID     drainage basins 18D, 18C and 24 were further subdivided.  Additional
         ID     concentration points were added to provide discharges at more locations.
         ID
         ID  2. Drainage basin areas for 50 and 202A were modified to reflect design
         ID     refinements to the Power to University segment of the Red Mountain Freeway
         ID
         ID *****************************************************************************
         ID *****************************************************************************
         ID
         ID  MODEL NAME: Ne200235.DAT                 Revised by DMJM+HARRIS - July 2002
         ID
         ID  This model includes various revisions to incorporate the Red Mountain Freeway
         ID  in association with the 202L/US60 Traffic Interchange Design Concept Report.
         ID
         ID  CHANGES TO THIS MODEL INCLUDE THE FOLLOWING:
         ID
         ID   1. In order to reflect the proposed 202 Freeway Loop, basin areas for 18C,
         ID      23, 24, 31A and 31B were revised.  Drainage basins 18D, 202A, 202B, and
         ID      202D were added. Basin 38 was split into 38A and 38B due to the 202 Loop.
         ID
         ID   2. Several concentration points have been added and basins have been routed
         ID      to reflect the proposed Red Mountain Freeway alignment.
         ID
         ID   3. Existing detention basins (ADOT) have been removed and new detention
         ID      basins are proposed as part of the freeway construction.
         ID
1                                    HEC-1 INPUT                                          PAGE  3

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

         ID   4. Modifications were made to the previous (Ne20030) model per the City of
         ID      Mesa to remove the connection of the Southern Ave. Channel from the
         ID      structure at Hawes Rd. and instead connect to the Hawes Channel south of
         ID      the intersection.
         ID
         ID *****************************************************************************
         ID *****************************************************************************
         ID  ** Previous ** MODEL NAME: NE2002.DAT
         ID
         ID  THIS MODEL COVERS THE AREA EAST OF HAWES ROAD AND THE SOSSAMAN CHANNEL
         ID  MAJOR CHANGES TO THIS MODEL INCLUDE THE FOLLOWING:
         ID
         ID   1. OLD SUBBASIN 18A HAS BEEN SPLIT INTO TWO SUBBASINS. SUBBASIN 18C REMAINS
         ID      IN THIS MODEL AS PART OF THE HAWES CHANNEL INFRASTRUCTURE
         ID   2. OLD SUBBASIN 30 HAS BEEN SPLIT INTO SUBBASIN 30A AND SUBBASIN 30B.
         ID      SUBBASIN 30 GETS INTERCEPTED BY A CHANNEL ON THE NORTH SIDE OF CORALBELL
         ID      AND GETS ROUTED TO SUBBASIN 31A. SUBBASIN 30B STILL GOES SOUTH ALONG
         ID      ELLSWORTH ROAD
         ID   3. FOR THE 2002 YEAR CONDITION, ALL CAP DETENTION BASINS HAVE BEEN PLACED IN
         ID      THE MODEL. THEIR OUTLET CHANNELS HAVE FOR THE MOST PART NOT BEEN INCLUDED
         ID      IN THIS MODEL. THE OUTLET CHANNELS WILL BE IN THE FUTURE MODEL
         ID *****************************************************************************
         ID
         ID  SOUTHEAST MESA AREA DRAINAGE MASTER PLAN
         ID  AREA NORTH OF SUPERSTITION FREEWAY
         ID
         ID
         ID  REVISED BY VALERIE SWICK, OCTOBER-NOVEMBER 1996
         ID  TO INCORPORATE THE SUPERSITION STRUCTURES AND COMBINE MODELS
         ID
         ID  FILENAME:  MESANE.DAT
         ID
         ID  THIS MODEL REPRESENTS THE EXISTING CONDITION OF THE WATERSHED.
         ID  TOTAL DRAINAGE AREA IS APPROXIMATELY 17 SQ. MI.
```

```
 96         ID
 97         ID   100-YEAR 24-HOUR FREQUENCY
 98         ID
 99         ID
100         ID   METHODOLOGY
101         ID   THE US CORPS OF ENGINEERS FLOOD HYDROLOGY MODEL HEC-1 DATED SEP1990 VER 4.0
102         ID   SCS TYPE II RAINFALL DISTRIBUTION
103         ID   S-GRAPH HYDROGRAPH
104         ID   GREEN AND AMPT INFILTRATION EQUATION USED FOR CALCULATING LOSSES
105         ID   NORMAL DEPTH STORAGE CHANNEL ROUTING
106         ID   APPROXIMATE DIRECTION, LOCATION, AND LENGTH OF THE WASHES HAVE BEEN
107         ID   EVALUATED BASED ON FIELD INVESTIGATION, USGS MAPS, LANDIS AERIAL SURVEYS
108         ID   DATED 1994
109         ID   THE NOAA TECHNICAL MEMORANDUM NOAA ATLAS 2 DEPTH AREA RATIOS
110         ID
111         ID   INITIAL STUDY PERFORMED BY LISA C. YOUNG
112         ID   REVIEWED BY VALERIE A. SWICK
113         ID   HYDROLOGY BRANCH ENGINEERING DIVISION, FLOOD CONTROL
114         ID   DISTRICT OF MARICOPA COUNTY, DECEMBER - JULY 1995.
115         ID
116         ID   ASSUMED VELOCITY OF 1 FT/SEC FOR SHEET FLOW, 2 FT/SEC FOR WASH/NATURAL
1                                       HEC-1 INPUT                                            PAGE  4

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

117         ID   CHANNEL, 3 FT/SEC FOR ROAD AND GRASS CHANNEL, 10FT/SEC FOR CONCRETE CHANNEL
118         ID
119         ID
120         ID    LAST UPDATED ON  3/13/98
121         ID
122         ID    UPDATE WAS BASED UPON NEW MAG LAND USE DEFINITIONS FOR SINGLE FAMILY HOUSING
123         ID
124         ID   DDM MCUHP2 MESA AREA DRAINAGE MASTER PLAN
            *DIAGRAM
125         IT       5  1APR97     0000     1000
126         IO       5
127         IN      15
128         JD   3.600      .01
            *
            * ****************************************************************************
            * DMJM+HARRIS - PC data is from the original East Mesa ADMP.
            * ****************************************************************************
            *
129         PC    .000     .002     .005     .008     .011     .014     .017     .020     .023     .026
130         PC    .029     .032     .035     .038     .041     .044     .048     .052     .056     .060
131         PC    .064     .068     .072     .076     .080     .085     .090     .095     .100     .105
132         PC    .110     .115     .120     .126     .133     .140     .147     .155     .163     .172
133         PC    .181     .191     .203     .218     .236     .257     .283     .387     .663     .707
134         PC    .735     .758     .776     .791     .804     .815     .825     .834     .842     .849
135         PC    .856     .863     .869     .875     .881     .887     .893     .898     .903     .908
136         PC    .913     .918     .922     .926     .930     .934     .938     .942     .946     .950
137         PC    .953     .956     .959     .962     .965     .968     .971     .974     .977     .980
138         PC    .983     .986     .989     .992     .995     .998    1.000
139         JD    3.58      1.0
140         JD    3.49      5.0
141         JD    3.38     10.0
142         JD    3.24     30.0
143         JD    3.10     60.0
144         JD    3.05     90.0
145         JD    3.00    120.0
146         JD    2.97    150.0
            *
            * DDM    ***** Updated *****
            *
            * ****************************************************************************
            * SCI - Subbasins 50AFWY, 50BFWY and 50CFWY comprise the area of the original
            *             Basin 50
            * ****************************************************************************
            *

147         KK  50AFWY   BASIN
148         BA     .08
149         LG     .32      .30     4.00      .47     8.00
150         UI     12.      44.      67.      96.     136.      96.      68.      43.      20.      13.
151         UI      6.       4.       4.       0.       0.       0.       0.       0.       0.       0.
152         UI      0.       0.       0.       0.       0.       0.       0.       0.       0.       0.
            *
1                                       HEC-1 INPUT                                            PAGE  5

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

153         KK  50BFWY   BASIN
154         BA     .16
155         LG     .29      .25     4.00      .54    18.00
156         UI     18.      47.      87.     113.     148.     222.     183.     141.     108.      79.
157         UI     41.      31.      19.      11.       6.       6.       6.       0.       0.       0.
158         UI      0.       0.       0.       0.       0.       0.       0.       0.       0.       0.
            *

159         KK    COAB
160         KM    Combines subbasins 50AFWY and 50BFWY.
161         HC       2
            *
            * ****************************************************************************
```

```
                * DMJM+HARRIS - Subbasins 50CFWY is subbasin 50C revised to include Loop
                *               202 freeway extension.
                *               Total volume of runoff from 50CFWY is approximately 5 acre-ft
                * ****************************************************************************
                *

162             KK  50CFWY   BASIN
163             BA     .03
164             LG     .27     .32    4.00     .41   25.00
165             UI      5.     18.     27.     39.     55.     39.     28.     18.      8.      5.
166             UI      2.      1.      1.      0.      0.      0.      0.      0.      0.      0.
167             UI      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
                *

168             KK  CBASIN
                * KO     1
169             RS       1    FLOW      -1
170             SA       0   0.087   0.530   0.790   0.891   1.038   1.226
171             SE  1569.5    1570    1571    1572    1573    1574    1575
172             SQ       0       0       3       9      13      63     150
                *

173             KK    COABC
174             KM    Combines subbasins 50AFWY, 50BFWY and 50CFWY.
175             HC       2
                *
                * ****************************************************************************
                * DMJM+HARRIS -  Below is the original Basin 50 hydrologic parameters
                * ****************************************************************************
                *
                * KK     50
                * KM BASIN 50
                * KM  THE FOLLOWING PARAMETERS WERE PROVIDED FOR THIS BASIN
                * KM  L=        .9  Lca=       .4    S=   81.4  Kn= .037  LAG=  15.8
                * KM  PHOENIX VALLEY S-GRAPH WAS USED FOR THIS BASIN
                * BA    .28
                * LG   .33     .31    4.00     .49    5.00
                * UI97.    306.    543.    575.    342.    149.     71.     21.     18.      0.
                * UI 0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
                * UI 0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
                *
                * DDM    ***** Preserved *****
                *
                * ****************************************************************************
                * DMJM+HARRIS  - CAP1 revised to provide no storage behind CAP canal and for new
                *                beginning of the analysis)
                * ****************************************************************************
                *
1                                      HEC-1 INPUT                                        PAGE  6

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

176             KK    CAP1
177             RS       1    STOR      -1
178             SA       0       0       0       0       0
179             SE  1567.7    1568    1570    1572    1574
180             SQ       0       2      81     246     434
                *
                * KK  CAP1
                * KO     1
                * RS     1    FLOW      -1
                * SV     0   0.091   0.575   3.319  13.256
                * SE  1566    1568    1570    1572    1574
                * SQ     5      90     275     470     610
                *
                *
                * ****************************************************************************
                * DMJM+HARRIS  - BASIN1 revised to reflect As-built basin storage
                *                SA record modified based upon new topo data.
                *                SE record modified to agree with topo data
                *                SL record modified to set outlet at bottom of basin
                *                SS record modified to set weir crest at top of basin
                * ****************************************************************************
                *

181             KK  BASIN1
182             KM        DETENTION BASIN LOCATED DOWNSTREAM FROM CAP1 OVERCHUTE
183             KM        WITH 24-INCH OUTFALL
                * KO     1
184             RS       1    STOR      -1
185             SA    0.01    0.08    0.28    0.58    1.43    2.43    3.65    4.02
186             SE    1555    1556    1557    1558    1559    1560    1561    1562
187             SL    1555    3.14     .62      .5
188             SS    1560      50     2.5     1.5
                *
                * KKBASIN1
                * KM        NEW DETENTION BASIN LOCATED DOWNSTREAM FROM CAP1
                * KM        WITH 24-INCH OUTFALL
                * RS     1    STOR      -1
                * SA  0.01    1.94    3.10    3.49    3.94    4.40    4.85
                * SE    60      61      62      63      64      65      66
                * SL  60.2    3.14     .62      .5
                * SS    64      50     2.5     1.5
                *
```

```
                * DDM    ***** Preserved *****

     189        KK    RCAP1
     190        KM    ROUTE CAP OVERCHUTE #1 TO SUBBASIN 18A
     191        RS      11     FLOW      -1
     192        RC     .05     .045     .05     7000     .02
     193        RX     100      200     300      301     303     304     404     505
     194        RY       6        5       2        0       0       2       5       6
                *
                * ** Revised by DMJM+HARRIS to reflect Red Mountain Freeway Design Concepts
                * ** Additional Refinements were made with the University to Southern Segment
                *
                * DDM    ***** Updated *****
1                                         HEC-1 INPUT                                                PAGE  7

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


     195        KK      18C    BASIN
     196        KM    BASIN 18c
                *
     197        KM     THIS IS THE FUTURE SUBBASIN WITH LESS AREA DUE TO 202L FREEWAY
                *
     198        BA    0.386
     199        LG     0.21     0.27    4.10     0.50      31
     200        UI       50      159     265      349     552     522     383     282     184      88
     201        UI       64       37      15       16      15       0       0       0       0       0
     202        UI        0        0       0        0       0       0       0       0       0       0
                *
                *   KM  THE FOLLOWING PARAMETERS WERE PROVIDED FOR THIS BASIN
                *   KM  L=       1.0  Lca=        .5    S=   60.6  Kn= .071  LAG=  24.1
                *     KM  L=       1.2  Lca=        .7   S=    66.1  Kn= .061  LAG=  37.2
                *
                * **** Revised by DMJM to reflect Red Mountain Freeway Design Concepts *****
                *
     203        KM     PHOENIX VALLEY S-GRAPH WAS USED FOR THIS BASIN
                * BA .4172
                * LG    .28      .29     4.10     .48    19.00
                * UI 58.     207.    326.    450.    691.    528.    384.    266.    127.     83.
                * UI 49.      18.     18.     18.      0.      0.      0.      0.      0.      0.
                * UI 0.       0.      0.      0.      0.      0.      0.      0.      0.      0.
                * BA    .50
                * LG    .22      .25     4.00     .57    44.00
                * UI 45.      75.    180.    237.    287.    355.    507.    531.    407.    335.
                * UI268.     214.    140.     80.     72.     45.     34.     14.     14.     14.
                * UI 14.      14.      0.      0.      0.      0.      0.      0.      0.      0.
                * UI  0.       0.      0.      0.      0.      0.      0.      0.      0.      0.
                *
                *   KK  D18c
                *   KM  RETAIN THE 100 YEAR 2 HOUR VOLUME (53% OF BASIN HAS RETENTION)
                *   DT  D18c       20
                *   DI     0    10000
                *   DQ     0    10000
                *

     204        KK   RET18C
     205        KM     RETAIN THE 100 YEAR 2 HOUR VOLUME (16% OF BASIN HAS RETENTION)
     206        DT     D18C     5.00
     207        DI        0    10000
     208        DQ        0     1600
                *
                * DDM    ***** Preserved *****

     209        KK     C18C
     210        KM     COMBINE FLOWS FROM ROUTED FLOW OF SUBBASIN 50 WITH FLOW FROM 18c
     211        KM     BEFORE CROSSING UNDERNEATH APACHE BLVD AND GOING INTO THE HAWES CHANNEL
     212        HC       2
                *
                * DDM    ***** Preserved *****
1                                         HEC-1 INPUT                                                PAGE  8

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


     213        KK    18T24
     214        KM    REACH HS-6, HS-7, HS-8
     215        KM    ROUTE FLOWS FROM SUBBASIN 18A TO SUBBASIN 24.
     216        RS       1     FLOW      -1
     217        RC     .025     .015    .025     2730  0.0017
     218        RX       0        8      16       26      46      58      65      73
     219        RY     5.0      5.1     5.2        0       0     5.2     5.1     5.0
                *  THE ABOVE CHANNEL DIMS ARE BASED ON THE NARROWEST DESIGN REACH.
                *
                *

     220        KK      18D    BASIN
     221        KM    BASIN 18D
     222        BA    0.044
     223        LG     0.20     0.27    4.00     0.54      34
     224        UI       33      103     128       53      17       5       0       0       0       0
     225        UI        0        0       0        0       0       0       0       0       0       0
                * KM  THIS IS THE FUTURE SUBBASIN CREATED BY 202L BISECTING 18C
                * KM  THE FOLLOWING PARAMETERS WERE PROVIDED FOR THIS BASIN
                *   KM  L=       1.2  Lca=        .7   S=    66.1  Kn= .061  LAG=  37.2
                * KM  L=        .7  Lca=        .4   S=    50.0  Kn= .071  LAG=  29.7
```

```
             * KM  PHOENIX VALLEY S-GRAPH WAS USED FOR THIS BASIN
             * BA .1367
             * LG   .28      .29    4.10     .48   19.00
             * UI 16.      40.     75.     96.    127.    188.    152.    117.     89.     64.
             * UI 33.      25.     16.      8.      5.      5.      5.      0.      0.      0.
             * UI  0.       0.      0.      0.      0.      0.      0.      0.      0.      0.
             *

 226         KK  18DT24
 227         KM   ROUTE FLOWS FROM SUBBASIN 18D TO C24A
 228         RS       2    FLOW      -1
 229         RC    .035    .025    .035    2820  0.0071
 230         RX       0       5      20      36      44      60      75      80
 231         RY     4.4     4.3     4.0       0       0     4.0     4.3     4.4
             *

 232         KK     24A   BASIN
 233         KM   BASIN 24A
 234         BA   0.044
 235         LG    0.11    0.30    4.00    0.52      36
 236         UI      62     179      79      16       0       0       0       0       0       0
 237         UI       0       0       0       0       0       0       0       0       0       0
             *

 238         KK    C24A
 239         KM   COMBINE FLOWS FROM 18D AND 24A
 240         HC       2
             *
1                                        HEC-1 INPUT                                              PAGE  9

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


 241         KK   24ATB
 242         KM   ROUTE C24A TO C24B VIA CONCRETE CHANNEL
             *   KM VELOCITY = 5FT/S
 243         RS       2    FLOW      -1
             *
 244         RC   0.045   0.022   0.042    2630  0.0095
             *
 245         RX       0     102     103     106     121     124     128     270
 246         RY       7     6.5       6       0       0       3       5       7
             *
             *
             * **** Revised by DMJM+HARRIS to reflect Red Mountain Freeway Design Concepts **
             *   ** Additional Refinements were made with the University to Southern Segment
             *
             * DDM    ***** Updated *****
             * DDM    ***** Inserted *****
             *

 247         KK     24B   BASIN
 248         KM   BASIN 24B
 249         BA   0.258
 250         LG    0.24    0.26    4.00    0.54      31
 251         UI      67     230     353     549     372     232      97      56      16      15
 252         UI       0       0       0       0       0       0       0       0       0       0
 253         UI       0       0       0       0       0       0       0       0       0       0
             * KK     24
             * KM BASIN 24
             * KM  THE FOLLOWING PARAMETERS WERE PROVIDED FOR THIS BASIN
             *   KM  L=        .9  Lca=        .5   S=   43.5  Kn= .047  LAG=  24.6
             * KM  L=        .9  Lca=        .5   S=   43.5  Kn= .052  LAG=  30.4
             * KM  PHOENIX VALLEY S-GRAPH WAS USED FOR THIS BASIN
             * BA .4272
             * BA .4272
             * LG   .23      .26    4.00     .56   38.00
             * UI 47.     117.    223.    286.    373.    562.    484.    372.    285.    214.
             * UI116.      80.     53.     34.     15.     15.     15.     15.      0.      0.
             * UI  0.       0.      0.      0.      0.      0.      0.      0.      0.      0.
             *   BA   .29
             *     LG   .23      .26    4.00     .58   38.00
             * UI 40.     138.    220.    300.    469.    376.    275.    195.    100.     63.
             * UI 40.      12.     12.     12.      0.      0.      0.      0.      0.      0.
             * UI  0.       0.      0.      0.      0.      0.      0.      0.      0.      0.
             *

 254         KK  RET24B
 255         KM    RETAIN THE 100 YEAR 2 HOUR VOLUME (18% OF BASIN HAS RETENTION)
 256         DT    D24B    3.35
 257         DI       0   10000
 258         DQ       0    1800
             *
             * **** Revised by DMJM+HARRIS to reflect Red Mountain Freeway Design Concepts **
             *   ** Additional Refinements were made with the University to Southern Segment
             *
1                                        HEC-1 INPUT                                              PAGE 10

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


 259         KK    C24B
 260         KM   COMBINE FLOWS FROM C24A AND BASIN 24B
             *   KK   C24
             *   KM COMBINE FLOWS FROM S18C AND S24
```

```
                    *   ZW   A=HAWES RD @ BROADWAY RD   B=HAWES CHANNEL PROJECT  C=FLOW   F=HYDROGRA
 261                HC       2
                    *

 262                KK    C24C
 263                KM    COMBINE FLOWS FROM C24B AND C18C
                    *   KK   C24
                    *   KM COMBINE FLOWS FROM S18C AND S24
 264                ZW      A=HAWES RD @ BROADWAY RD   B=HAWES CHANNEL PROJECT  C=FLOW   F=HYDROGRAPH
 265                HC       2
                    *
                    *
                    * DDM    ***** Preserved *****

 266                KK  BRDHAW
 267                KM     DIVERT FLOW OF 360 CFS TO THE WEST PER THE CITY OF MESA FUTURE DRAINAGE
 268                KM     SYSTEM
 269                DT  DIVBRD
 270                DI       0     200     400     500     700    1000
 271                DQ       0       0       0       0       0       0
                    * DI     0     200     400     500     700    1000
                    * DQ     0     200     360     360     360     360
                    *

 272                KK  RT31B1
 273                KM    THIS ROUTING STEP HAS BEEN BROKEN OUT OF A LARGER SEQUENCE FOR SIMPLICITY
 274                KM    REACH HS-5 plus culvert HSC-4
 275                KM    ROUTE FLOWS FROM HAWES ROAD AND BROADWAY ROAD (C24) TO CORAL BELL AVENUE.
 276                KO                                     21                              10
 277                ZW    A=FLOW AFTER 360 CFS DIVERT TO WEST B=HAWES CHANNEL PROJECT C=FLOW   F=HYDRO
 278                RS       1    FLOW      -1
 279                RC    .025    .015    .025    1312  0.0015
 280                RX       0       8      15      28      68      81      89      97
 281                RY     6.2     6.4     6.5       0       0     6.5     6.4     6.2
                    *

 282                KK  RT31B2
 283                KM    THIS ROUTING STEP HAS BEEN BROKEN OUT OF A LARGER SEQUENCE FOR SIMPLICITY
 284                KM    REACH HS-4A AND HS4-B plus culvert HSC-3
 285                KM    ROUTE FLOWS FROM CORAL BELL AVENUE TO EMELITA AVENUE.
 286                RS       1    FLOW      -1
 287                RC    .025    .015    .025    2080  0.0018
 288                RX       0       8    15.9      16      66    66.1      74      82
 289                RY     5.8     5.9     6.1       0       0     6.1     5.9     5.8
                    *
1                                            HEC-1 INPUT                                                 PAGE 11

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


 290                KK  RT31B3
 291                KM    THIS ROUTING STEP HAS BEEN BROKEN OUT OF A LARGER SEQUENCE FOR SIMPLICITY
 292                KM    REACH HS-3
 293                KM     THIS REACH IS AN EXISTING CHANNEL FOR THE CRESCENT RUN MOBILE HOME PARK.
 294                KM     The existing channel 5.6 ft deep has no freeboard.  Overbank flows in street
 295                KM     Routing values per channel design plans,
 296                KM     Sheet 2 of 19, City of Mesa Project 97-69.
 297                KM    ROUTE FLOWS FROM EMELITA AVENUE TO SOUTHERN AVENUE (C31) WITHIN SUBBASIN 31B.
 298                RS       1    FLOW      -1
 299                RC    .025    .015    .025    1935  0.0033
 300                RX       0    35.6    41.6      50    66.7    75.1    81.1    92.0
 301                RY     5.4     4.7     5.6       0       0     5.6     7.6     7.7
                    *
                    * DDM    ***** Updated *****
                    *

 302                KK     31B
 303                KM    BASIN  31B
 304                KM     THE FOLLOWING PARAMETERS WERE PROVIDED FOR THIS BASIN
                    *      KM  L=      1.2  Lca=       .5    S=    29.7  Kn= .049  LAG=  30.8
 305                KM     L=      1.2  Lca=       .5    S=    29.7  Kn= .077  LAG=  23.2
 306                KM     PHOENIX VALLEY S-GRAPH WAS USED FOR THIS BASIN
                    *
 307                BA     .44
 308                LG    0.31    0.32    4.45    0.35      11
 309                UI      31      31      88     132     162     184     218     263     356     375
 310                UI     302     254     217     187     152     124      77      54      51      36
 311                UI      31      19      10       9       9      10       9      10       0       0
 312                UI       0       0       0       0       0       0       0       0       0       0
                    * BA  .720
                    * LG   .31     .32    4.45     .35   11.00
                    * UI104.    391.    602.    859.   1236.    884.    629.    407.    187.    125.
                    * UI 59.     32.     32.      0.      0.      0.      0.      0.      0.      0.
                    * UI  0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
                    *
                    * BA   .47
                    * LG   .24     .25    4.45     .46   37.00
                    * UI 52.    125.    240.    309.    399.    601.    544.    416.    321.    243.
                    * UI141.     88.     63.     44.     16.     16.     16.     16.      0.      0.
                    * UI  0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
                    *

 313                KK    D31BS
 314                KM     RETAIN 100 YEAR 2 HOUR, (66% FOR FUTURE DEVELOPMENT)
 315                DT    D31BS       23
```

```
 316            DI       0   10000
 317            DQ       0   10000
                *
                * DDM    ***** Preserved *****
                *
                *
                * ***** Revised by DMJM to reflect Red Mountain Freeway Design Concepts *****
                *
1                                        HEC-1 INPUT                                        PAGE 12

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


 318            KK   C31B
 319            KM   COMBINE FLOWS FROM C24 AND 31B
 320            ZW   A=FLOW SOUTHERN AND HAWES BEFORE SPLIT BOX B=HAWES CHANNEL PROJ C=FLOW F=HYDR
 321            HC       2
                *
                *
                * DDM    ***** Preserved *****
                *     KK  D31W
                *

 322            KK    D31S
                *
 323            KM    THIS DIVERT RECORD IS FOR THE BOX CULVERT SYSTEM AT SOUTHERN AVE AND HAWES
 324            KM    IT IS BASED UPON A HEC-RAS ANALYSIS OF THE FOLLOWING STRUCTURES:
 325            KM    3-8'X4' CBC SOUTH,  2-10'X6' CBC TO THE WEST
 326            KM    THE CULVERT TO THE SOUTH HAS THE TWO THAT ARE THERE NOW WITH AN ADDITIONAL
 327            KM    ONE CONSTRUCTED
                * KO   1
 328            DT    D31W
                *
                * **** Revised by DMJM to reflect Red Mountain Freeway Design Concepts *****
                *
                *   *  THESE NEW CARDS BASED UPON HEC-RAS ANALYSIS
                *  DI  0      144     182     252     380     454     544     671     758     844
                *  DI976     1098    1184    1280    1412    1544    1646    1738    1830
                *  DQ  0        0       0     220     316     358     400     460     520     580
                *   DQ640     690     740     800     860     920     980    1030    1080
                *
                *  THESE CARDS BASED UPON HEC-RAS ANALYSIS *** As Intended ***
                *
                *  DI  0      144     182     252     380     454     544     671     758     844
                *  DI976     1098    1184    1280    1412    1544    1646    1738    1830
                *  DQ  0      144     182     220     316     358     400     460     520     580
                *  DQ   640     690     740     800     860     920     980    1030    1080
                *
                *  ** Revised to help allow proper function of NW Detention Basins (Off-line Typ
                *  *** Simulating 75% blockage of the Southern Avenue culverts ***
                *
                * DI    0      62     111     230     309     403     504     611     727     847
                * DI 971     1098    1223    1346
                * DQ    0      62     111     214     283     362     445     533     629     729
                * DQ 834      941    1049    1155
                *
                * *** Revised by PB to simulate blockage of 2 barrels leaving 1 barrel open ***
                * *** of the Southern Avenue Culverts                                    ***
                *
 329            DI       0      62     111     229     306     401     521     636     759     887
 330            DQ       0      62     111     214     283     362     445     533     629     730
                *
                *
1                                        HEC-1 INPUT                                        PAGE 13

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


 331            KK  31T381  ROUTED IN TWO STEPS DUE TO CHANNEL DISSIMILARITY.
 332            KM   REACH HS-2 plus culvert HSC-2
 333            KM     ROUTE FLOWS FROM SOUTHERN AVENUE (C31) IN THE HAWES CHANNEL.
 334            KM   REACH HS-2 IS A PROPOSED CHANNEL SOON-TO-BE-CONSTRUCTED.  IT IS 4.5 FEET
 335            KM     DEEP, WITH FREEBOARD. CHANNEL CROSS-SECTION FROM DESIGN PLANS FOR
 336            KM     SOUTHERN AVENUE DRAINAGE IMPROVEMENTS.  SHEET 28 OF 43
 337            KM     CITY OF MESA PROJECT NO. 97-56.1 DESIGN PLANS BY ENTELLUS
 338            KM     DATED 8/8/97 REV. 12/19/97
 339            RS       1    FLOW      -1
 340            RC   0.025   0.015   0.025    1248   .0022
 341            RX       0      32      37      46      56      65      73      75
 342            RY       5     7.0     4.5       0       0     4.5     9.0     9.5
                *
 343            ZZ
1
       SCHEMATIC DIAGRAM OF STREAM NETWORK
INPUT
 LINE     (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

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

 147      50AFWY
            .
            .
 153        .         50BFWY
            .           .
            .           .
```

```
 159      COAB............
              .
 162          .     50CFWY
              .          V
              .          V
 168          .     CBASIN
              .          .
              .          .
 173     COABC............
              V
              V
 176      CAP1
              V
              V
 181    BASIN1
              V
              V
 189     RCAP1
              .
              .
 195          .        18C
              .          .
              .          .
 206          .          .------->    D18C
 204          .     RET18C
              .          .
              .          .
 209      C18C............
              V
              V
 213     18T24
              .
              .
 220          .        18D
              .          V
              .          V
 226          .     18DT24
              .          .
              .          .
 232          .          .         24A
              .          .           .
              .          .           .
 238          .       C24A............
              .          V
              .          V
 241          .      24ATB
              .          .
              .          .
 247          .          .         24B
              .          .           .
              .          .           .
 256          .          .           .------->    D24B
 254          .          .      RET24B
              .          .           .
              .          .           .
 259          .       C24B............
              .          .
              .          .
 262      C24C............
              .
              .
 269          .------->   DIVBRD
 266    BRDHAW
              V
              V
 272    RT31B1
              V
              V
 282    RT31B2
              V
              V
 290    RT31B3
              .
              .
 302          .        31B
              .          .
              .          .
 315          .          .------->   D31BS
 313          .      D31BS
              .          .
              .          .
 318     C31B ............
              .
              .
 328          .------->     D31W
 322      D31S
              V
              V
 331    31T381
```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************                    ***************************************
 *                                       *                    *                                     *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                    *   U.S. ARMY CORPS OF ENGINEERS      *
```

```
*                 JUN    1998                 *
*              VERSION 4.1                    *
*                                             *
*  RUN DATE    08SEP04   TIME   14:16:58      *
*                                             *
***********************************************
```

```
*     HYDROLOGIC ENGINEERING CENTER     *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
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******************************************************************************
MODEL NAME: NE200245.DAT    Revised by PARSONS BRINCKERHOFF - December 2003

This model includes the following revisions to DMJM+HARRIS model
NE202USR.DAT dated December 2003.

 1. The storage volumes for the NE-1, NE-2, NW-1, NW-2 and Southern Avenue
    detention basins have been updated per the final basin geometry.

 2. The discharge rates for detention basins NW-1 and NW-2 have been revised
    to reflect the revisions to the outlet structures and emergency
    spillways.

 3. The diversion at the box culvert system at Southern Avenue and Hawes
    Road was revised to simulate blockage of 2 barrels of the existing 3
    barrel box culvert under Southern.

 4. The diversion at the lateral weir in the Southern Avenue Channel was
    revised to reflect the final weir geometry and rating analysis.

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

MODEL NAME: Ne2002us.DAT                  Revised by DMJM+HARRIS - August 2003

This model includes various revisions to incorporate the Red Mountain Freeway
in association with the University Drive to Southern Avenue.

CHANGES TO THIS MODEL INCLUDE THE FOLLOWING:

1. In order to reflect the proposed 202 Freeway Loopand to facilitate design,
   drainage basins 18D, 18C and 24 were further subdivided.  Additional
   concentration points were added to provide discharges at more locations.

2. Drainage basin areas for 50 and 202A were modified to reflect design
   refinements to the Power to University segment of the Red Mountain Freeway

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MODEL NAME: Ne200235.DAT                  Revised by DMJM+HARRIS - July 2002

This model includes various revisions to incorporate the Red Mountain Freeway
in association with the 202L/US60 Traffic Interchange Design Concept Report.

CHANGES TO THIS MODEL INCLUDE THE FOLLOWING:

 1. In order to reflect the proposed 202 Freeway Loop, basin areas for 18C,
    23, 24, 31A and 31B were revised.  Drainage basins 18D, 202A, 202B, and
    202D were added. Basin 38 was split into 38A and 38B due to the 202 Loop.

 2. Several concentration points have been added and basins have been routed
    to reflect the proposed Red Mountain Freeway alignment.

 3. Existing detention basins (ADOT) have been removed and new detention
    basins are proposed as part of the freeway construction.

 4. Modifications were made to the previous (Ne20030) model per the City of
    Mesa to remove the connection of the Southern Ave. Channel from the
    structure at Hawes Rd. and instead connect to the Hawes Channel south of
    the intersection.

******************************************************************************
******************************************************************************
 ** Previous ** MODEL NAME: NE2002.DAT

THIS MODEL COVERS THE AREA EAST OF HAWES ROAD AND THE SOSSAMAN CHANNEL
MAJOR CHANGES TO THIS MODEL INCLUDE THE FOLLOWING:

 1. OLD SUBBASIN 18A HAS BEEN SPLIT INTO TWO SUBBASINS. SUBBASIN 18C REMAINS
    IN THIS MODEL AS PART OF THE HAWES CHANNEL INFRASTRUCTURE
 2. OLD SUBBASIN 30 HAS BEEN SPLIT INTO SUBBASIN 30A AND SUBBASIN 30B.
    SUBBASIN 30 GETS INTERCEPTED BY A CHANNEL ON THE NORTH SIDE OF CORALBELL
    AND GETS ROUTED TO SUBBASIN 31A. SUBBASIN 30B STILL GOES SOUTH ALONG
    ELLSWORTH ROAD
 3. FOR THE 2002 YEAR CONDITION, ALL CAP DETENTION BASINS HAVE BEEN PLACED IN
    THE MODEL. THEIR OUTLET CHANNELS HAVE FOR THE MOST PART NOT BEEN INCLUDED
    IN THIS MODEL. THE OUTLET CHANNELS WILL BE IN THE FUTURE MODEL
******************************************************************************
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                    SOUTHEAST MESA AREA DRAINAGE MASTER PLAN
                    AREA NORTH OF SUPERSTITION FREEWAY

                    REVISED BY VALERIE SWICK, OCTOBER-NOVEMBER 1996
                    TO INCORPORATE THE SUPERSITION STRUCTURES AND COMBINE MODELS

                    FILENAME:  MESANE.DAT

                    THIS MODEL REPRESENTS THE EXISTING CONDITION OF THE WATERSHED.
                    TOTAL DRAINAGE AREA IS APPROXIMATELY 17 SQ. MI.

                    100-YEAR 24-HOUR FREQUENCY


                    METHODOLOGY
                    THE US CORPS OF ENGINEERS FLOOD HYDROLOGY MODEL HEC-1 DATED SEP1990 VER 4.0
                    SCS TYPE II RAINFALL DISTRIBUTION
                    S-GRAPH HYDROGRAPH
                    GREEN AND AMPT INFILTRATION EQUATION USED FOR CALCULATING LOSSES
                    NORMAL DEPTH STORAGE CHANNEL ROUTING
                    APPROXIMATE DIRECTION, LOCATION, AND LENGTH OF THE WASHES HAVE BEEN
                    EVALUATED BASED ON FIELD INVESTIGATION, USGS MAPS, LANDIS AERIAL SURVEYS
                    DATED 1994
                    THE NOAA TECHNICAL MEMORANDUM NOAA ATLAS 2 DEPTH AREA RATIOS

                    INITIAL STUDY PERFORMED BY LISA C. YOUNG
                    REVIEWED BY VALERIE A. SWICK
                    HYDROLOGY BRANCH ENGINEERING DIVISION, FLOOD CONTROL
                    DISTRICT OF MARICOPA COUNTY, DECEMBER - JULY 1995.

                    ASSUMED VELOCITY OF 1 FT/SEC FOR SHEET FLOW, 2 FT/SEC FOR WASH/NATURAL
                    CHANNEL, 3 FT/SEC FOR ROAD AND GRASS CHANNEL, 10FT/SEC FOR CONCRETE CHANNEL


                     LAST UPDATED ON  3/13/98

                     UPDATE WAS BASED UPON NEW MAG LAND USE DEFINITIONS FOR SINGLE FAMILY HOUSING

                    DDM MCUHP2 MESA AREA DRAINAGE MASTER PLAN

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

    IT          HYDROGRAPH TIME DATA
                       NMIN          5  MINUTES IN COMPUTATION INTERVAL
                      IDATE     1APR97  STARTING DATE
                      ITIME       0000  STARTING TIME
                         NQ       1000  NUMBER OF HYDROGRAPH ORDINATES
                     NDDATE     4APR97  ENDING DATE
                     NDTIME       1115  ENDING TIME
                      ICENT         19  CENTURY MARK

                  COMPUTATION INTERVAL     .08 HOURS
                       TOTAL TIME BASE   83.25 HOURS

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

128 JD          INDEX STORM NO. 1
                       STRM       3.60  PRECIPITATION DEPTH
                       TRDA        .01  TRANSPOSITION DRAINAGE AREA

129 PI            PRECIPITATION PATTERN
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139 JD          INDEX STORM NO. 2
                     STRM       3.58  PRECIPITATION DEPTH
                     TRDA       1.00  TRANSPOSITION DRAINAGE AREA

  0 PI            PRECIPITATION PATTERN
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140 JD          INDEX STORM NO. 3
                     STRM       3.49  PRECIPITATION DEPTH
                     TRDA       5.00  TRANSPOSITION DRAINAGE AREA

  0 PI            PRECIPITATION PATTERN
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141 JD          INDEX STORM NO. 4
                     STRM       3.38  PRECIPITATION DEPTH
                     TRDA      10.00  TRANSPOSITION DRAINAGE AREA

  0 PI            PRECIPITATION PATTERN
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142 JD INDEX STORM NO. 5
STRM 3.24 PRECIPITATION DEPTH
TRDA 30.00 TRANSPOSITION DRAINAGE AREA

0 PI PRECIPITATION PATTERN

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143 JD INDEX STORM NO. 6
STRM 3.10 PRECIPITATION DEPTH
TRDA 60.00 TRANSPOSITION DRAINAGE AREA

0 PI PRECIPITATION PATTERN

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144 JD INDEX STORM NO. 7
STRM 3.05 PRECIPITATION DEPTH
TRDA 90.00 TRANSPOSITION DRAINAGE AREA

0 PI PRECIPITATION PATTERN

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145 JD          INDEX STORM NO. 8
                   STRM       3.00  PRECIPITATION DEPTH
                   TRDA     120.00  TRANSPOSITION DRAINAGE AREA

 0 PI             PRECIPITATION PATTERN
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                    .01      .01      .01      .01      .01      .01      .01      .01      .03      .03
                    .03      .09      .09      .09      .01      .01      .01      .01      .01      .01
                    .01      .01      .01      .01      .01      .01      .00      .00      .00      .00
                    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                    .00      .00      .00      .00      .00      .00      .00      .00

146 JD          INDEX STORM NO. 9
                   STRM       2.97  PRECIPITATION DEPTH
                   TRDA     150.00  TRANSPOSITION DRAINAGE AREA

 0 PI             PRECIPITATION PATTERN
                    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                    .00      .00      .00      .00      .00      .00      .00      .01      .00      .01
                    .01      .01      .01      .01      .01      .01      .01      .01      .03      .03
                    .03      .09      .09      .09      .01      .01      .01      .01      .01      .01
                    .01      .01      .01      .01      .01      .01      .00      .00      .00      .00
                    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
```

```
                  .00       .00       .00       .00       .00       .00       .00       .00
    -----DSS---ZOPEN:  New File Opened,  File: SCFINAL1.DSS
                       Unit:  71;  DSS Version: 6-JG
 -----DSS---ZWRITE Unit  71; Vers.   1:  /HAWES RD @ BROADWAY RD/HAWES CHANNEL PROJECT/FLOW/31MAR1997/5MIN/HYDROGRAPH/
 -----DSS---ZWRITE Unit  71; Vers.   1:  /HAWES RD @ BROADWAY RD/HAWES CHANNEL PROJECT/FLOW/01APR1997/5MIN/HYDROGRAPH/
 -----DSS---ZWRITE Unit  71; Vers.   1:  /HAWES RD @ BROADWAY RD/HAWES CHANNEL PROJECT/FLOW/02APR1997/5MIN/HYDROGRAPH/
 -----DSS---ZWRITE Unit  71; Vers.   1:  /HAWES RD @ BROADWAY RD/HAWES CHANNEL PROJECT/FLOW/03APR1997/5MIN/HYDROGRAPH/
 -----DSS---ZWRITE Unit  71; Vers.   1:  /HAWES RD @ BROADWAY RD/HAWES CHANNEL PROJECT/FLOW/04APR1997/5MIN/HYDROGRAPH/


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


            **************
            *            *
  272 KK    *   RT31B1   *
            *            *
            **************

  276 KO        OUTPUT CONTROL VARIABLES
                     IPRNT          5  PRINT CONTROL
                     IPLOT          0  PLOT CONTROL
                     QSCAL         0.  HYDROGRAPH PLOT SCALE
                     IPNCH          0  PUNCH COMPUTED HYDROGRAPH
                      IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2       1000  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT      1.000  TIME INTERVAL IN HOURS

 -----DSS---ZWRITE Unit  71; Vers.   1:  /FLOW AFTER 360 CFS DIVERT TO WES/HAWES CHANNEL PROJECT/FLOW/31MAR1997/5MIN/HYD/
 -----DSS---ZWRITE Unit  71; Vers.   1:  /FLOW AFTER 360 CFS DIVERT TO WES/HAWES CHANNEL PROJECT/FLOW/01APR1997/5MIN/HYD/
 -----DSS---ZWRITE Unit  71; Vers.   1:  /FLOW AFTER 360 CFS DIVERT TO WES/HAWES CHANNEL PROJECT/FLOW/02APR1997/5MIN/HYD/
 -----DSS---ZWRITE Unit  71; Vers.   1:  /FLOW AFTER 360 CFS DIVERT TO WES/HAWES CHANNEL PROJECT/FLOW/03APR1997/5MIN/HYD/
 -----DSS---ZWRITE Unit  71; Vers.   1:  /FLOW AFTER 360 CFS DIVERT TO WES/HAWES CHANNEL PROJECT/FLOW/04APR1997/5MIN/HYD/
 -----DSS---ZWRITE Unit  71; Vers.   1:  /FLOW SOUTHERN AND HAWES BEFORE S/HAWES CHANNEL PROJ/FLOW/31MAR1997/5MIN/HYDR/
 -----DSS---ZWRITE Unit  71; Vers.   1:  /FLOW SOUTHERN AND HAWES BEFORE S/HAWES CHANNEL PROJ/FLOW/01APR1997/5MIN/HYDR/
 -----DSS---ZWRITE Unit  71; Vers.   1:  /FLOW SOUTHERN AND HAWES BEFORE S/HAWES CHANNEL PROJ/FLOW/02APR1997/5MIN/HYDR/
 -----DSS---ZWRITE Unit  71; Vers.   1:  /FLOW SOUTHERN AND HAWES BEFORE S/HAWES CHANNEL PROJ/FLOW/03APR1997/5MIN/HYDR/
 -----DSS---ZWRITE Unit  71; Vers.   1:  /FLOW SOUTHERN AND HAWES BEFORE S/HAWES CHANNEL PROJ/FLOW/04APR1997/5MIN/HYDR/
1
```

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	50AFWY	89.	12.25	8.	2.	1.	.08		
+	HYDROGRAPH AT	50BFWY	162.	12.33	20.	6.	2.	.16		
+	2 COMBINED AT	COAB	243.	12.33	28.	8.	3.	.24		
+	HYDROGRAPH AT	50CFWY	41.	12.25	4.	1.	0.	.03		
+	ROUTED TO	CBASIN	11.	12.58	4.	1.	0.	.03		
+	2 COMBINED AT	COABC	252.	12.33	32.	9.	3.	.27		
+	ROUTED TO	CAP1	252.	12.33	32.	9.	3.	.27		
+	ROUTED TO	BASIN1	152.	12.50	32.	9.	3.	.27		
+	ROUTED TO	RCAP1	128.	13.17	32.	9.	3.	.27		
+	HYDROGRAPH AT	18C	453.	12.25	57.	18.	6.	.39		
+	DIVERSION TO	D18C	72.	12.25	9.	3.	1.	.39		
+	HYDROGRAPH AT	RET18C	380.	12.25	48.	15.	5.	.39		
+	2 COMBINED AT	C18C	402.	12.25	80.	24.	8.	.66		
+	ROUTED TO	18T24	380.	12.33	80.	24.	8.	.66		
+	HYDROGRAPH AT	18D	80.	12.08	7.	2.	1.	.04		
	ROUTED TO									

+		18DT24	69.	12.17	7.	2.	1.	.04
+	HYDROGRAPH AT	24A	90.	12.00	7.	2.	1.	.04
+	2 COMBINED AT	C24A	135.	12.08	13.	4.	1.	.09
+	ROUTED TO	24ATB	124.	12.17	13.	4.	1.	.09
+	HYDROGRAPH AT	24B	374.	12.17	37.	12.	4.	.26
+	DIVERSION TO	D24B	67.	12.17	6.	2.	1.	.26
+	HYDROGRAPH AT	RET24B	307.	12.17	31.	10.	3.	.26
+	2 COMBINED AT	C24B	430.	12.17	45.	14.	5.	.35
+	2 COMBINED AT	C24C	708.	12.25	124.	38.	13.	1.00
+	DIVERSION TO	DIVBRD	0.	.00	0.	0.	0.	1.00
+	HYDROGRAPH AT	BRDHAW	708.	12.25	124.	38.	13.	1.00
+	ROUTED TO	RT31B1	702.	12.25	124.	38.	13.	1.00
+	ROUTED TO	RT31B2	679.	12.33	124.	38.	13.	1.00
+	ROUTED TO	RT31B3	667.	12.33	124.	38.	13.	1.00
+	HYDROGRAPH AT	31B	320.	12.67	52.	14.	5.	.44
+	DIVERSION TO	D31BS	320.	12.67	45.	12.	4.	.44
+	HYDROGRAPH AT	D31BS	96.	13.17	9.	3.	1.	.44
+	2 COMBINED AT	C31B	667.	12.33	132.	41.	14.	1.44
+	DIVERSION TO	D31W	553.	12.33	121.	38.	13.	1.44
+	HYDROGRAPH AT	D31S	109.	12.33	10.	3.	1.	1.44
+	ROUTED TO	31T381	106.	12.42	10.	3.	1.	1.44

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


    -----DSS---ZCLOSE Unit:  71,   File: SCFINAL1.DSS
             Pointer Utilization:    .25
             Number of Records:     15
             File Size:     31.9  Kbytes
             Percent Inactive:     .0
```

??

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??

??

CAP Overchute Analysis for the Proposed Freeway

C:\HECEXE\SCFINAL1.OUT
Page 15 of 16

??

??

??

??

CAP Overchute Analysis for Proposed Freeway

APPENDIX A

CAP OVERCHUTE BASIN

Northeast Channel 50-Year Hydrology

```
1***************************************                    **************************************
*                                     *                    *                                    *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                    *   U.S. ARMY CORPS OF ENGINEERS     *
*              JUN   1998              *                    *   HYDROLOGIC ENGINEERING CENTER    *
*              VERSION 4.1             *                    *         609 SECOND STREET          *
*                                     *                    *      DAVIS, CALIFORNIA 95616       *
*  RUN DATE    11APR05  TIME  11:38:24 *                    *         (916) 756-1104             *
*                                     *                    *                                    *
***************************************                    **************************************


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


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

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

1                                         HEC-1 INPUT                                          PAGE  1

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

          1         ID
          2         ID  ****************************************************************************
          3         ID  ****************************************************************************
          4         ID  ****************************************************************************
          5         ID       File:        SC1FINAL5.DAT
          6         ID       Date:        4-04-05
          7         ID       By:          SCI
          8         ID       Hydrology:   50-year, 24-hr Existing Conditions
          9         ID
         10         ID       Quick Note:  THIS IS THE REVISED MODEL TO REFLECT THE EXTENSION
         11         ID                    OF THE LOOP 202 THROUGH BASIN 50.
         12         ID
         13         ID       This model is used to evaluate the impact of the Loop 202 extension
         14         ID       on Subbasin 50 and to determine the 50-year runoff for purposes of
         15         ID       design for an ADOT channel and RCB culvert across the freeway to
         16         ID       the CAP overchute.
         17         ID
         18         ID  ****************************************************************************
         19         ID  ****************************************************************************
         20         ID  ****************************************************************************
                    *
                    *DIAGRAM
         21         IT       5  1APR97     0000     1000
         22         IO       5
                    *
                    * DDM   ***** Updated *****
                    *
                    * ***************************************************************************
                    * SCI - Subbasins 50AFWY, 50BFWY and 50CFWY comprise the area of the original
                    *              Basin 50
                    * ***************************************************************************
                    *


         23         KK  50AFWY   BASIN
         24         BA     .08
         25         IN      15
         26         PB   3.184
         27         PC   0.000   0.002   0.005   0.008   0.011   0.014   0.017   0.020   0.023   0.026
         28         PC   0.029   0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056   0.060
         29         PC   0.064   0.068   0.072   0.076   0.080   0.085   0.090   0.095   0.100   0.105
         30         PC   0.110   0.115   0.120   0.126   0.133   0.140   0.147   0.155   0.163   0.172
         31         PC   0.181   0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
         32         PC   0.735   0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
         33         PC   0.856   0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
         34         PC   0.913   0.918   0.922   0.926   0.930   0.934   0.938   0.942   0.946   0.950
         35         PC   0.953   0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977   0.980
         36         PC   0.983   0.986   0.989   0.992   0.995   0.998   1.000
         37         LG     .32     .30    4.00     .47    8.00
         38         UI     12.     44.     67.     96.    136.     96.     68.     43.     20.     13.
         39         UI      6.      4.      4.      0.      0.      0.      0.      0.      0.      0.
         40         UI      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
                    *
1                                         HEC-1 INPUT                                          PAGE  2

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

```
41             KK   50BFWY    BASIN
42             BA     .16
43             LG     .29      .25     4.00     .54    18.00
44             UI     18.      47.      87.     113.    148.     222.     183.     141.     108.      79.
45             UI     41.      31.      19.      11.      6.       6.       6.       0.       0.       0.
46             UI      0.       0.       0.       0.      0.       0.       0.       0.       0.       0.
               *

47             KK    COAB
48             KM    Combines subbasins 50AFWY and 50BFWY.
49             HC       2
               *
               * ****************************************************************************
               * DMJM+HARRIS - Subbasins 50CFWY is subbasin 50C revised to include Loop
               *               202 freeway extension.
               *               Total volume of runoff from 50CFWY is approximately 5 acre-ft
               * ****************************************************************************
               *

50             KK   50CFWY    BASIN
51             BA     .03
52             LG     .27      .32     4.00     .41    25.00
53             UI      5.      18.      27.      39.     55.      39.      28.      18.       8.       5.
54             UI      2.       1.       1.       0.      0.       0.       0.       0.       0.       0.
55             UI      0.       0.       0.       0.      0.       0.       0.       0.       0.       0.
               *

56             KK   CBASIN
               * KO      1
57             RS        1    FLOW       -1
58             SA        0   0.087    0.530    0.790   0.891    1.038    1.226
59             SE   1569.5    1570     1571     1572    1573     1574     1575
60             SQ        0       0        3        9      13       63      150
               *

61             KK   COABC
62             KM   Combines subbasins 50AFWY, 50BFWY and 50CFWY.
63             HC       2
               *
64             ZZ
1
              SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING           (--->) DIVERSION OR PUMP FLOW

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

   23       50AFWY
               .
               .
   41          .          50BFWY
               .               .
               .               .
   47         COAB...........
               .
               .
   50          .          50CFWY
               .               V
               .               V
   56          .          CBASIN
               .               .
               .               .
   61        COABC...........

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION
1****************************************                                       ****************************************
 *                                       *                                      *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                                      *    U.S. ARMY CORPS OF ENGINEERS      *
 *              JUN   1998               *                                      *    HYDROLOGIC ENGINEERING CENTER     *
 *            VERSION 4.1                *                                      *          609 SECOND STREET           *
 *                                       *                                      *       DAVIS, CALIFORNIA 95616        *
 *  RUN DATE   11APR05  TIME  11:38:24   *                                      *           (916) 756-1104             *
 *                                       *                                      *                                      *
 ****************************************                                       ****************************************


                ****************************************************************************
                ****************************************************************************
                ****************************************************************************
                      File:         SC1FINAL5.DAT
                      Date:         4-04-05
                      By:           SCI
                      Hydrology:    50-year, 24-hr Existing Conditions

                      Quick Note:   THIS IS THE REVISED MODEL TO REFLECT THE EXTENSION
                                    OF THE LOOP 202 THROUGH BASIN 50.

                      This model is used to evaluate the impact of the Loop 202 extension
                      on Subbasin 50 and to determine the 50-year runoff for purposes of
                      design for an ADOT channel and RCB culvert across the freeway to
                      the CAP overchute.
```

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

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

   IT         HYDROGRAPH TIME DATA
                     NMIN          5  MINUTES IN COMPUTATION INTERVAL
                    IDATE     1APR97  STARTING DATE
                    ITIME       0000  STARTING TIME
                       NQ       1000  NUMBER OF HYDROGRAPH ORDINATES
                   NDDATE     4APR97  ENDING DATE
                   NDTIME       1115  ENDING TIME
                    ICENT         19  CENTURY MARK

                COMPUTATION INTERVAL     .08 HOURS
                     TOTAL TIME BASE   83.25 HOURS

       ENGLISH UNITS
            DRAINAGE AREA          SQUARE MILES
            PRECIPITATION DEPTH    INCHES
            LENGTH, ELEVATION      FEET
            FLOW                   CUBIC FEET PER SECOND
            STORAGE VOLUME         ACRE-FEET
            SURFACE AREA           ACRES
            TEMPERATURE            DEGREES FAHRENHEIT
1
```

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
	HYDROGRAPH AT									
+		50AFWY	73.	12.25	7.	2.	1.	.08		
	HYDROGRAPH AT									
+		50BFWY	134.	12.33	16.	5.	2.	.16		
	2 COMBINED AT									
+		COAB	200.	12.33	23.	7.	2.	.24		
	HYDROGRAPH AT									
+		50CFWY	34.	12.25	4.	1.	0.	.03		
	ROUTED TO									
+		CBASIN	10.	12.58	4.	1.	0.	.03		
+									1572.20	12.58
	2 COMBINED AT									
+		COABC	209.	12.33	26.	8.	3.	.27		

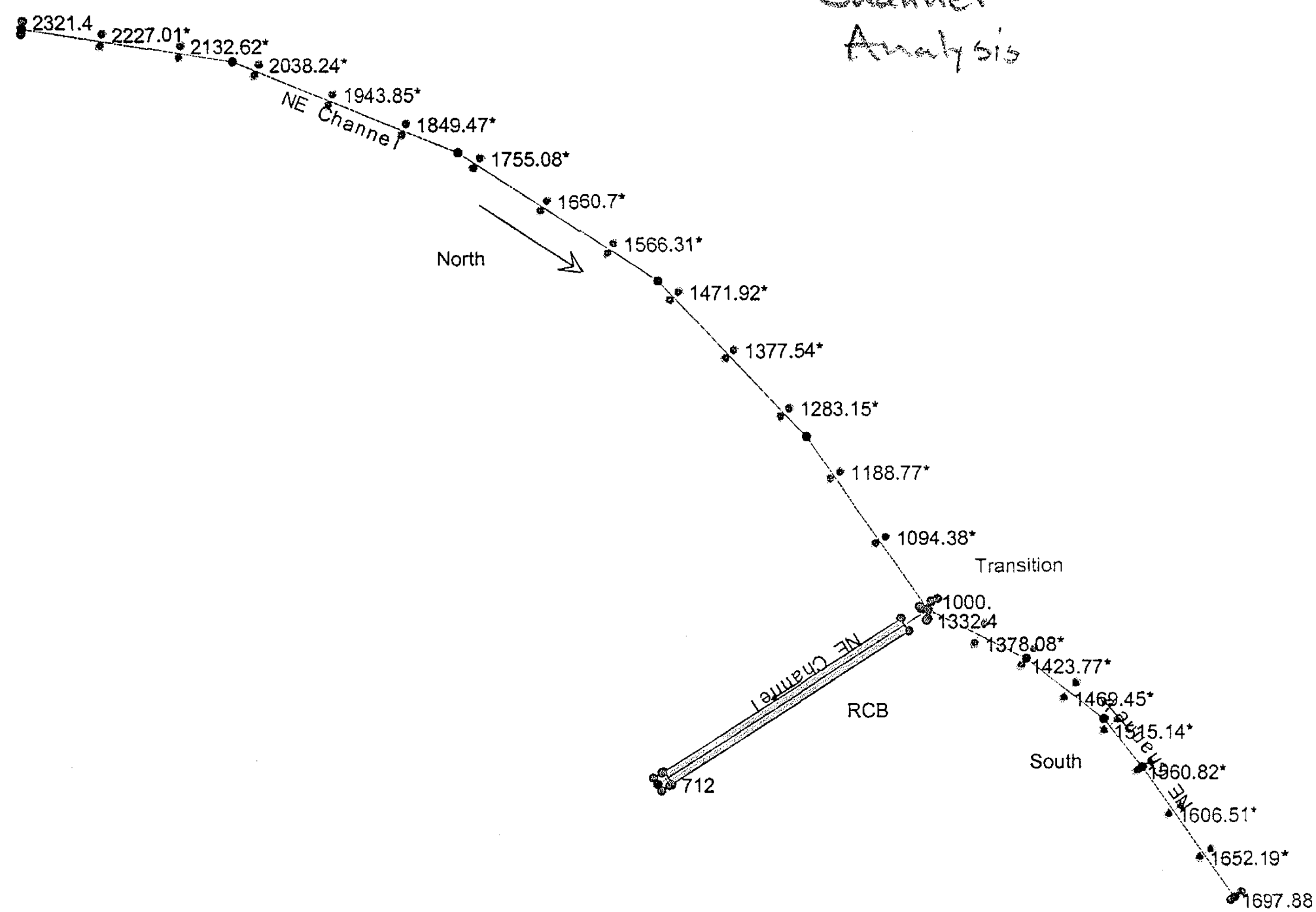
*** NORMAL END OF HEC-1 ***

APPENDIX A

CAP OVERCHUTE BASIN

Northeast Channel HEC-RAS Analysis

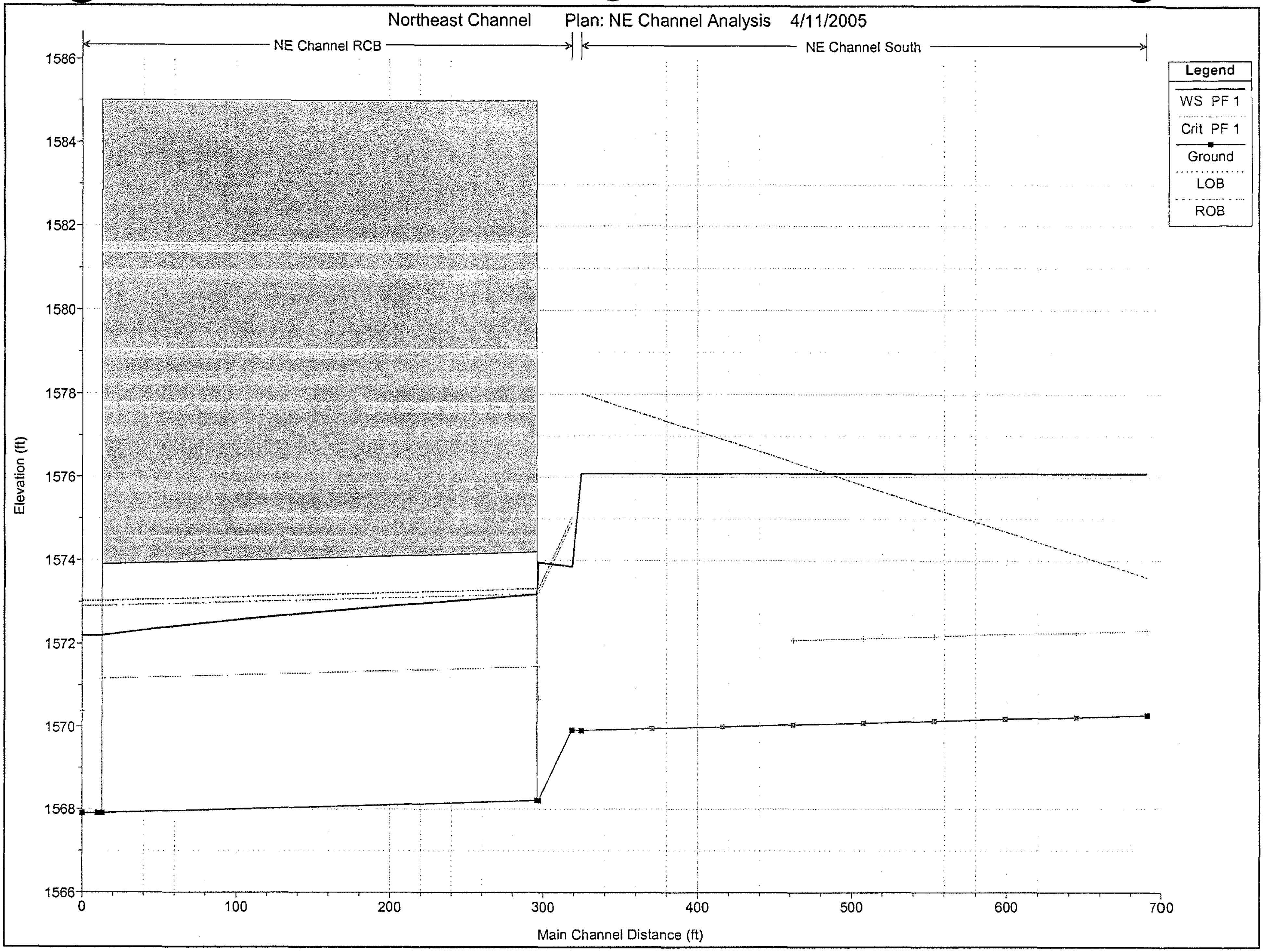
Northeast
Channel
Analysis



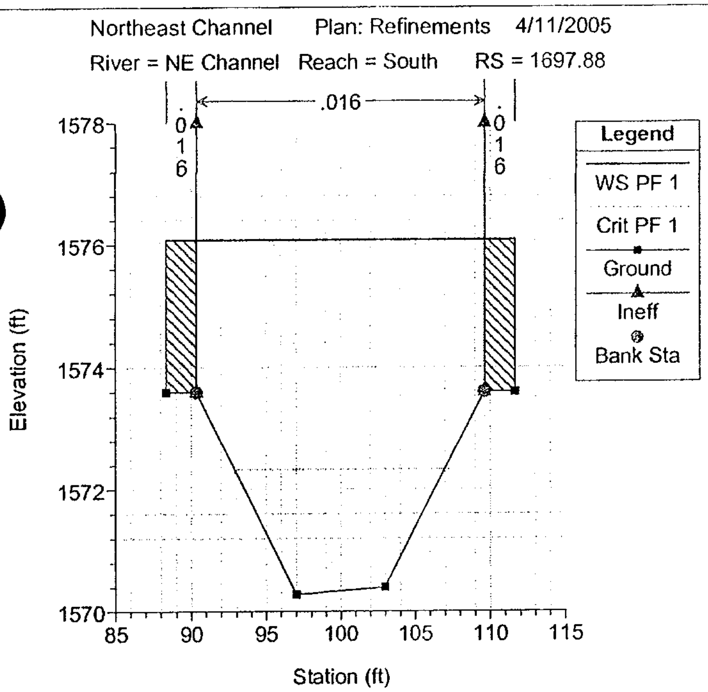
Some schematic data outside default extents (see View/Set Schematic Plot Extents...)
Partial GIS data

HEC-RAS Plan: NE Channel Profile: PF 1

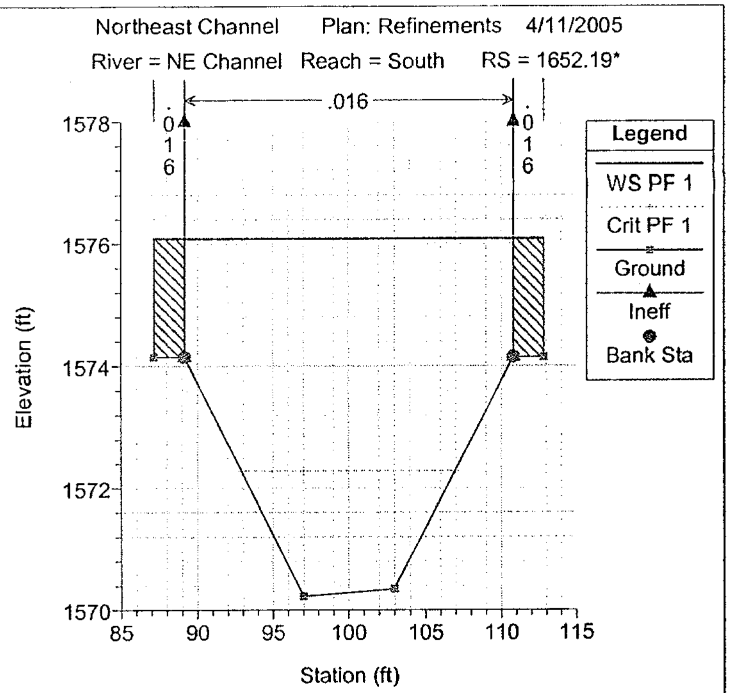
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
RCB	700	PF 1	200.00	1567.90	1572.19	1570.37	1572.35	0.000357	3.22	62.11	22.96	0.34
RCB	710	PF 1	200.00	1567.90	1572.19		1572.35	0.000356	3.22	62.20	22.97	0.34
RCB	712	PF 1	200.00	1567.90	1572.19		1572.36	0.000356	3.21	62.22	22.98	0.34
RCB	996		Culvert									
RCB	997	PF 1	200.00	1568.20	1573.95	1570.67	1574.02	0.000088	2.00	101.79	30.00	0.18
RCB	1019	PF 1	200.00	1569.92	1573.85		1574.07	0.000517	3.69	54.18	21.55	0.41
South	1332.4	PF 1	135.00	1569.91	1576.08		1576.10	0.000034	1.21	111.84	30.62	0.11
South	1378.08*	PF 1	135.00	1569.96	1576.08		1576.10	0.000035	1.22	110.39	30.43	0.11
South	1423.77*	PF 1	135.00	1570.00	1576.08		1576.11	0.000036	1.24	109.21	30.28	0.11
South	1469.45*	PF 1	135.00	1570.05	1576.08	1572.10	1576.11	0.000037	1.25	107.79	30.10	0.12
South	1515.14*	PF 1	135.00	1570.09	1576.08	1572.14	1576.11	0.000037	1.27	106.51	32.84	0.12
South	1560.82*	PF 1	135.00	1570.14	1576.08	1572.19	1576.11	0.000035	1.30	103.96	30.44	0.12
South	1606.51*	PF 1	135.00	1570.19	1576.08	1572.25	1576.11	0.000035	1.35	100.19	28.06	0.12
South	1652.19*	PF 1	135.00	1570.23	1576.08	1572.28	1576.12	0.000036	1.42	95.27	25.66	0.12
South	1697.88	PF 1	135.00	1570.28	1576.08	1572.33	1576.12	0.000038	1.52	89.07	23.28	0.12
North	1000.	PF 1	75.00	1573.01	1576.08		1576.15	0.000218	2.07	36.16	18.03	0.26
North	1094.38*	PF 1	75.00	1573.76	1576.05	1575.25	1576.21	0.000726	3.22	23.29	14.91	0.45
North	1188.77*	PF 1	75.00	1574.51	1575.75	1576.00	1576.65	0.007947	7.58	9.89	10.73	1.39
North	1283.15*	PF 1	75.00	1575.26	1576.50	1576.75	1577.40	0.007947	7.58	9.89	10.73	1.39
North	1377.54*	PF 1	75.00	1576.01	1577.25	1577.50	1578.15	0.007947	7.58	9.89	10.73	1.39
North	1471.92*	PF 1	75.00	1576.76	1578.00	1578.25	1578.90	0.007947	7.58	9.89	10.73	1.39
North	1566.31*	PF 1	75.00	1577.51	1578.75	1579.00	1579.65	0.008068	7.62	9.84	10.71	1.40
North	1660.7*	PF 1	75.00	1578.27	1579.51	1579.75	1580.40	0.007950	7.59	9.89	10.71	1.39
North	1755.08*	PF 1	75.00	1579.02	1580.26	1580.51	1581.16	0.008031	7.61	9.86	10.71	1.40
North	1849.47*	PF 1	75.00	1579.77	1581.01	1581.26	1581.91	0.008031	7.61	9.86	10.71	1.40
North	1943.85*	PF 1	75.00	1580.52	1581.76	1582.01	1582.66	0.008031	7.61	9.86	10.71	1.40
North	2038.24*	PF 1	75.00	1581.27	1582.51	1582.76	1583.41	0.007965	7.59	9.88	10.72	1.39
North	2132.62*	PF 1	75.00	1582.02	1583.29	1583.51	1584.13	0.007270	7.35	10.21	10.84	1.33
North	2227.01*	PF 1	75.00	1582.77	1583.96	1584.26	1584.96	0.009384	8.04	9.33	10.52	1.50
North	2321.4	PF 1	75.00	1583.52	1585.01	1585.01	1585.55	0.003984	5.94	12.63	11.70	1.01



Northeast Channel Plan: NE Channel Analysis 4/11/2005
NE Channel RCB
NE Channel South
Legend
WS PF 1
Crit PF 1
Ground
LOB
ROB
Elevation (ft)
Main Channel Distance (ft)
1586
1584
1582
1580
1578
1576
1574
1572
1570
1568
1566
0
100
200
300
400
500
600
700



Northeast Channel Plan: Refinements 4/11/2005
River = NE Channel Reach = South RS = 1697.88
.016
Legend
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)



Northeast Channel Plan: Refinements 4/11/2005
River = NE Channel Reach = South RS = 1652.19*
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Legend
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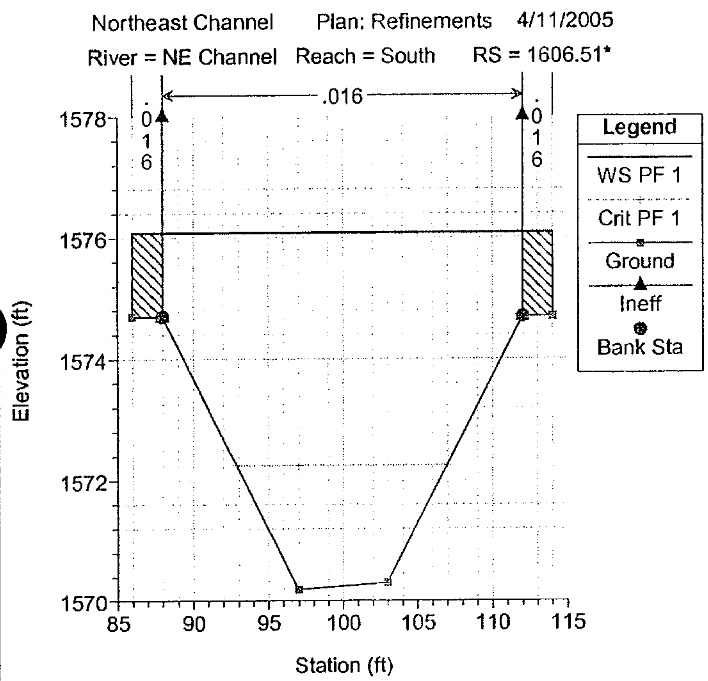
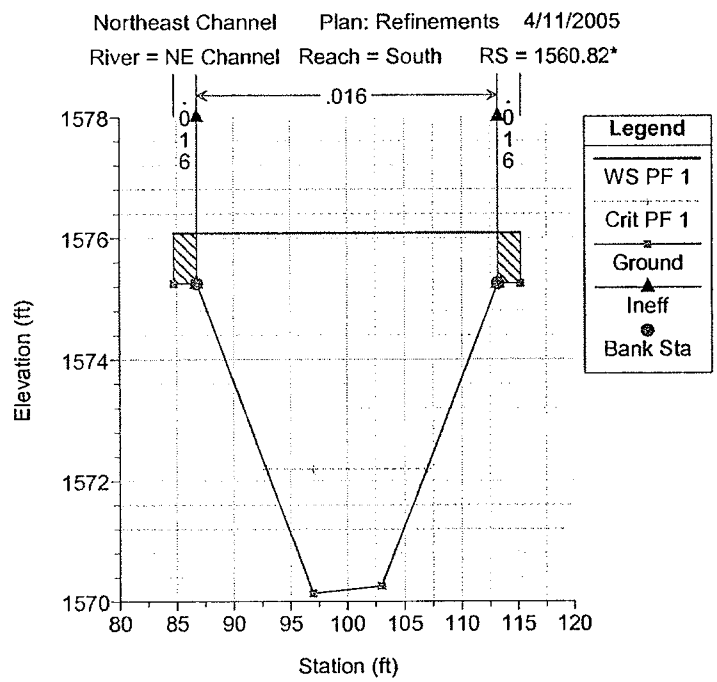
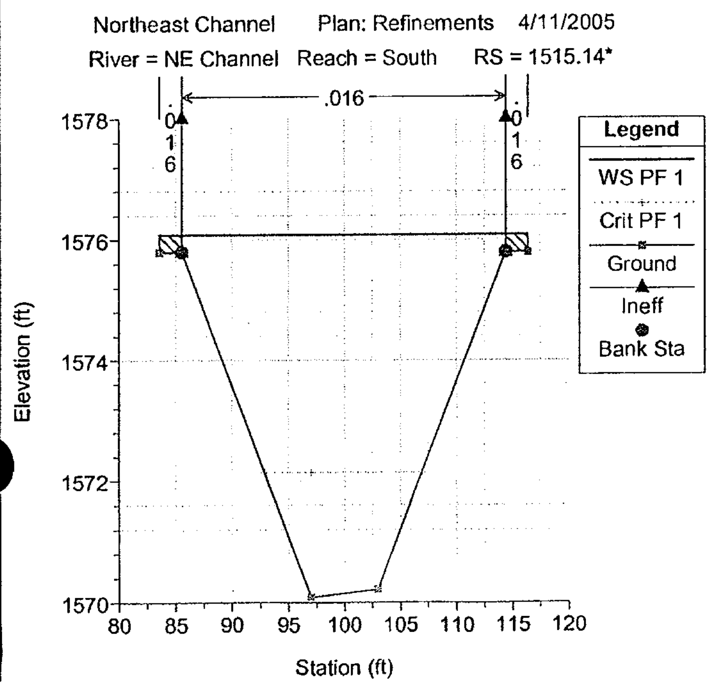
Crit PF 1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)



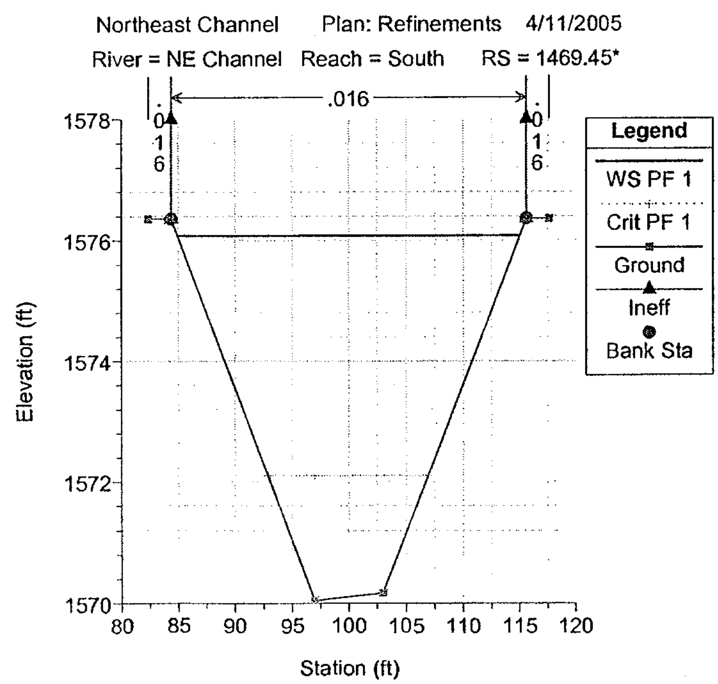
Northeast Channel Plan: Refinements 4/11/2005
River = NE Channel Reach = South RS = 1606.51*
.016
Legend
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)



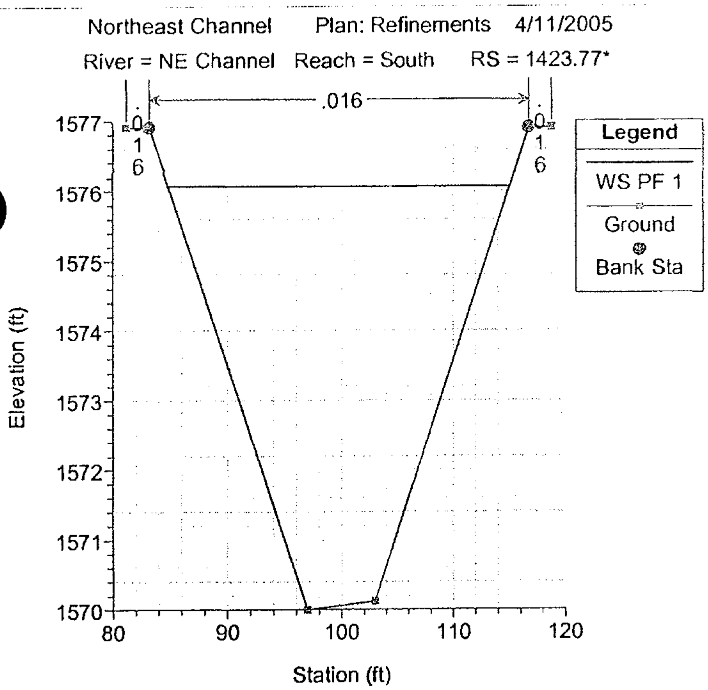
Northeast Channel Plan: Refinements 4/11/2005
River = NE Channel Reach = South RS = 1560.82*
.016
Legend
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

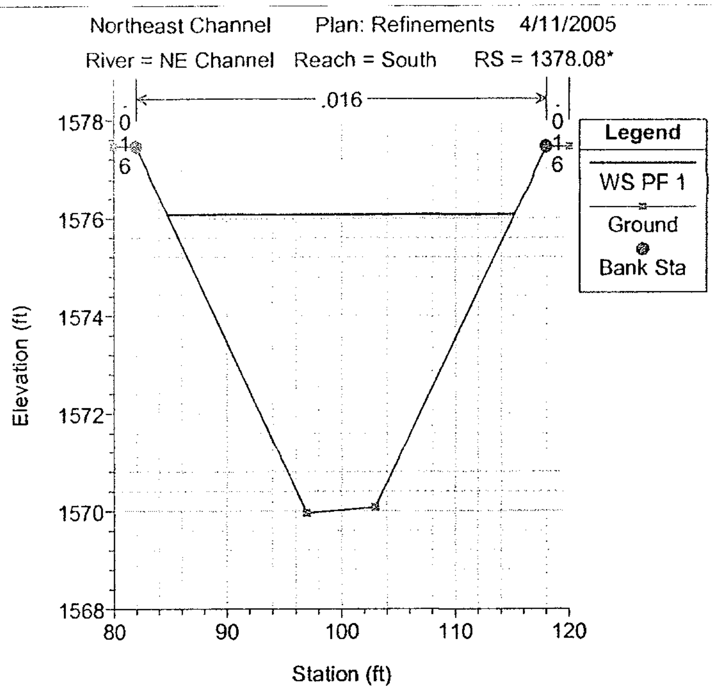


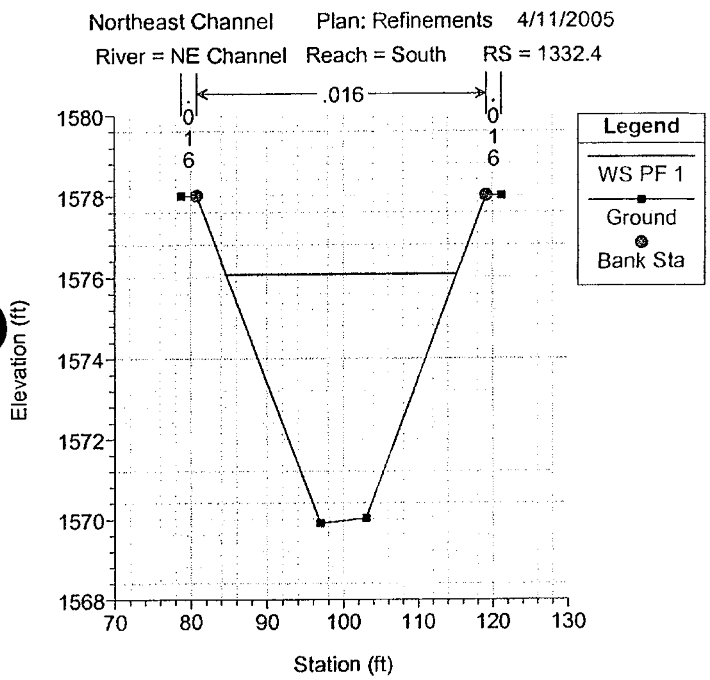
Northeast Channel Plan: Refinements 4/11/2005
River = NE Channel Reach = South RS = 1515.14*
.016
Legend
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

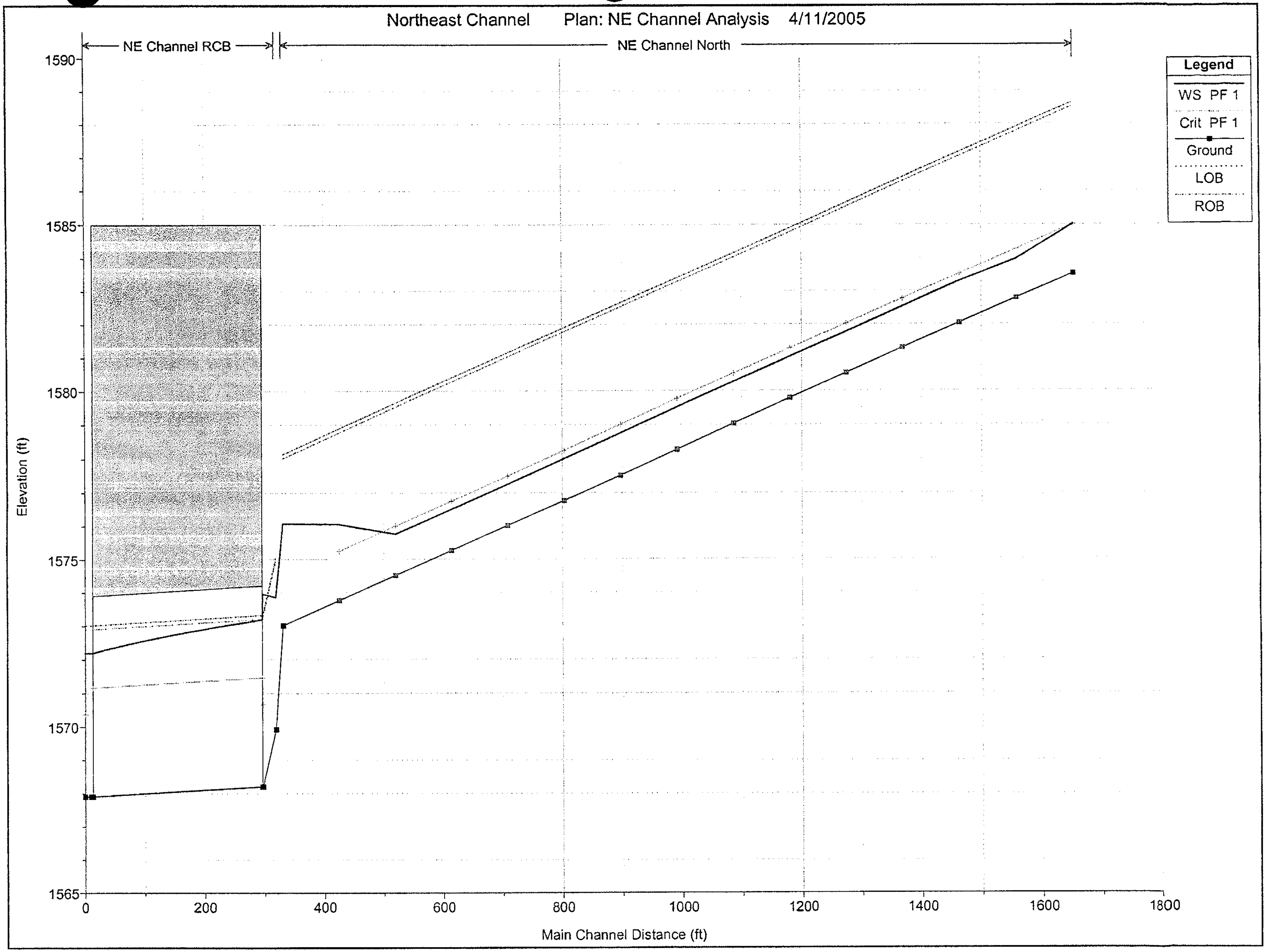


Northeast Channel Plan: Refinements 4/11/2005
River = NE Channel Reach = South RS = 1469.45*
.016
Legend
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

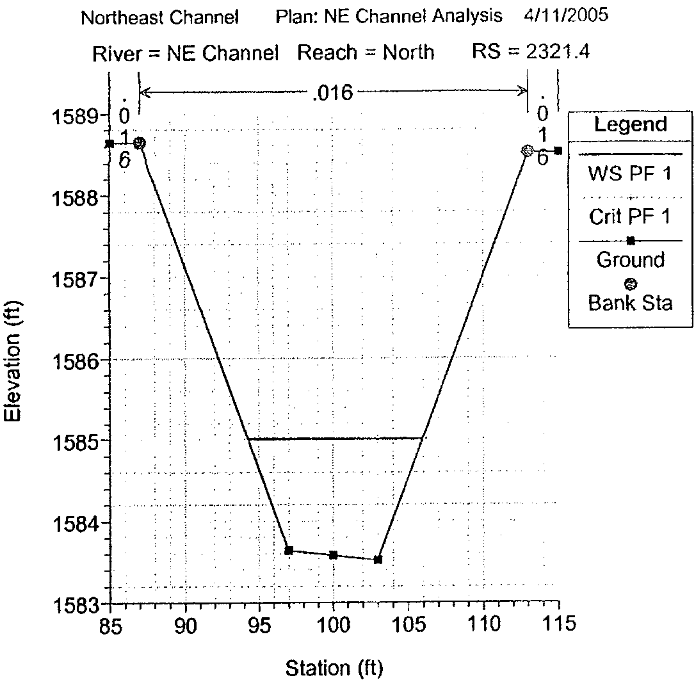

Northeast Channel Plan: Refinements 4/11/2005
River = NE Channel Reach = South RS = 1423.77*
.016
Legend
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)

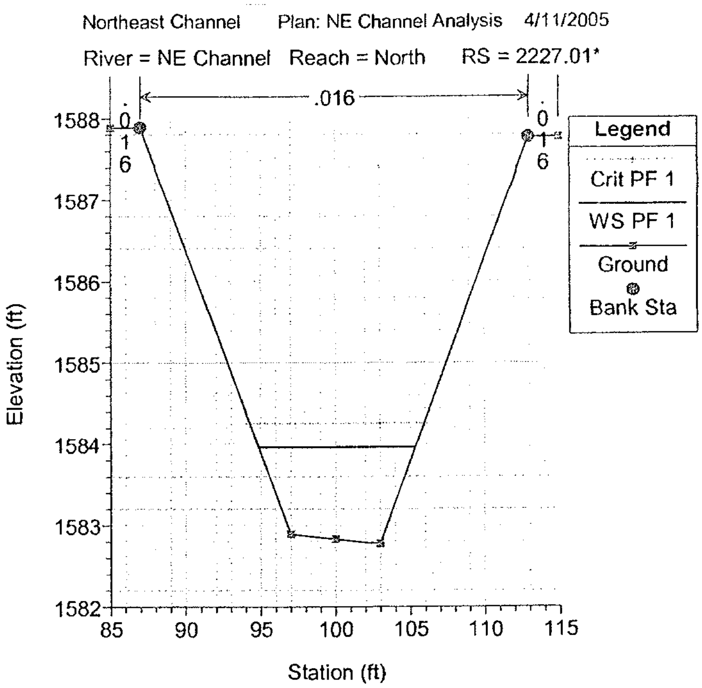

Northeast Channel Plan: Refinements 4/11/2005
River = NE Channel Reach = South RS = 1378.08*
.016
Legend
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)

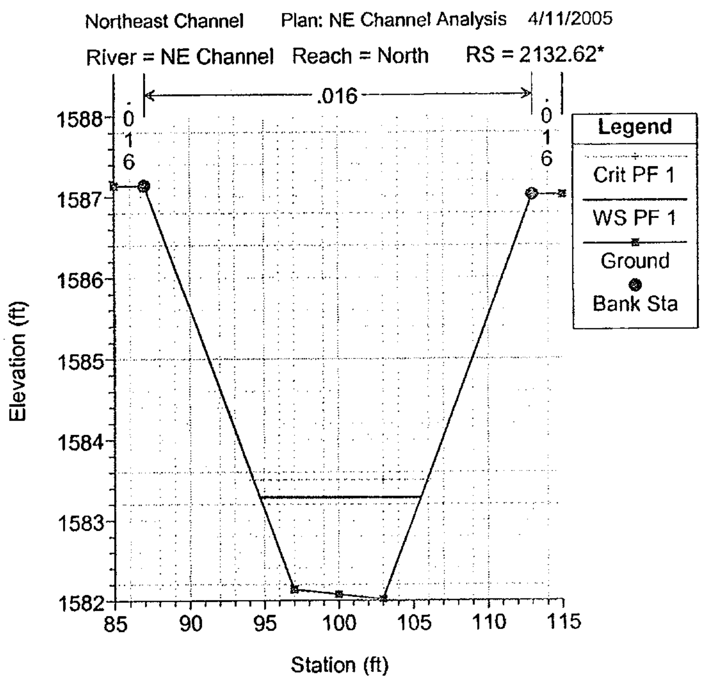

Northeast Channel Plan: Refinements 4/11/2005
River = NE Channel Reach = South RS = 1332.4
.016
Legend
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)

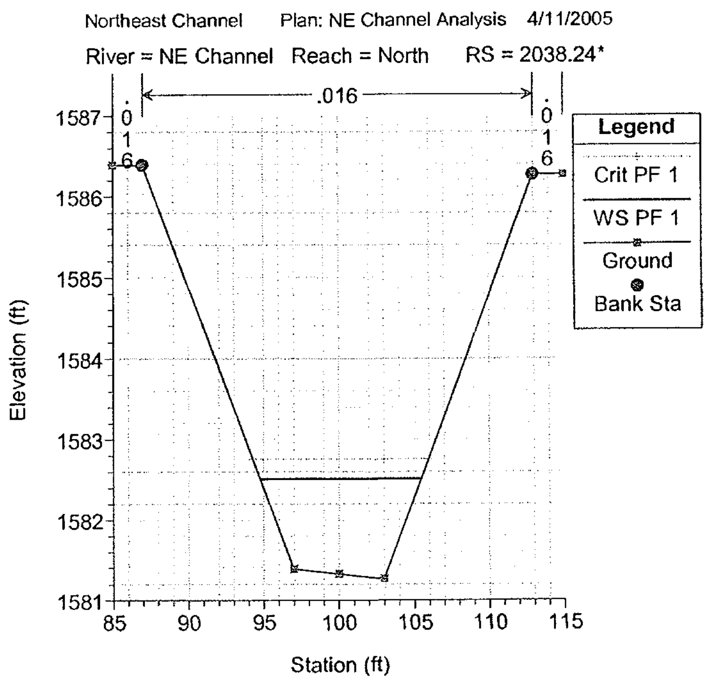


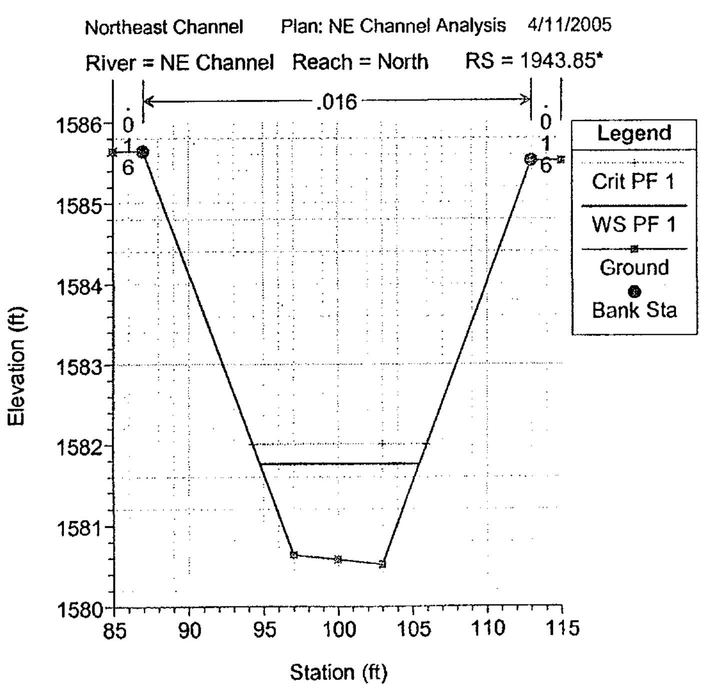
Northeast Channel Plan: NE Channel Analysis 4/11/2005
NE Channel RCB
NE Channel North
Legend
WS PF 1
Crit PF 1
Ground
LOB
ROB
Elevation (ft)
1590
1585
1580
1575
1570
1565
0
200
400
600
800
1000
1200
1400
1600
1800
Main Channel Distance (ft)

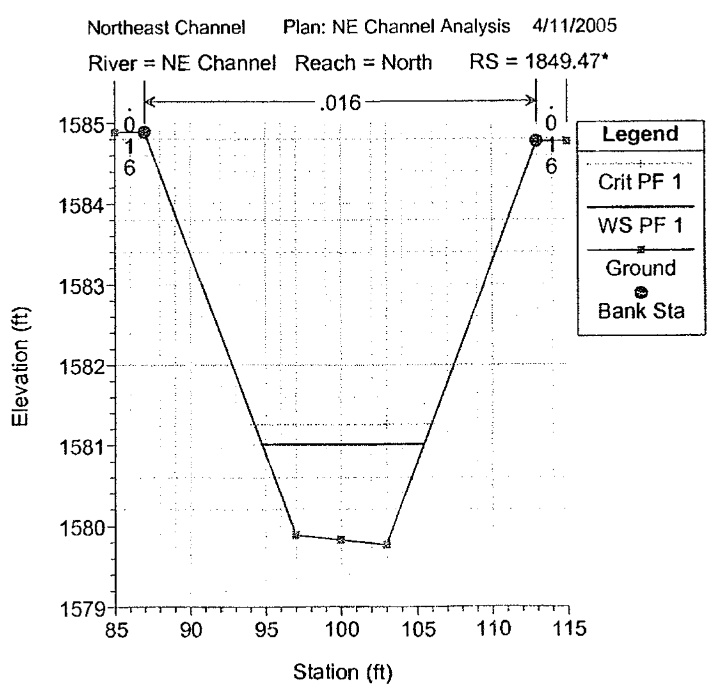

Northeast Channel Plan: NE Channel Analysis 4/11/2005
River = NE Channel Reach = North RS = 2321.4
.016
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)

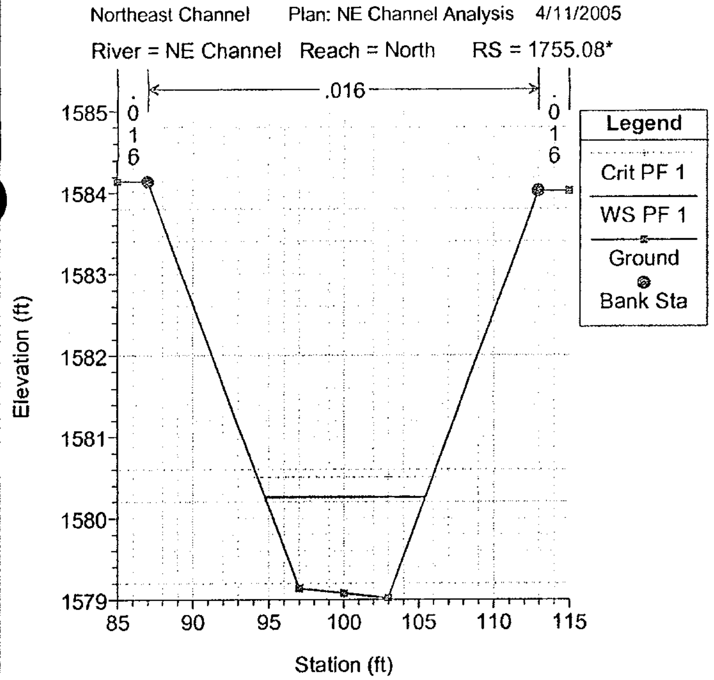

Northeast Channel Plan: NE Channel Analysis 4/11/2005
River = NE Channel Reach = North RS = 2227.01*
.016
Legend
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)

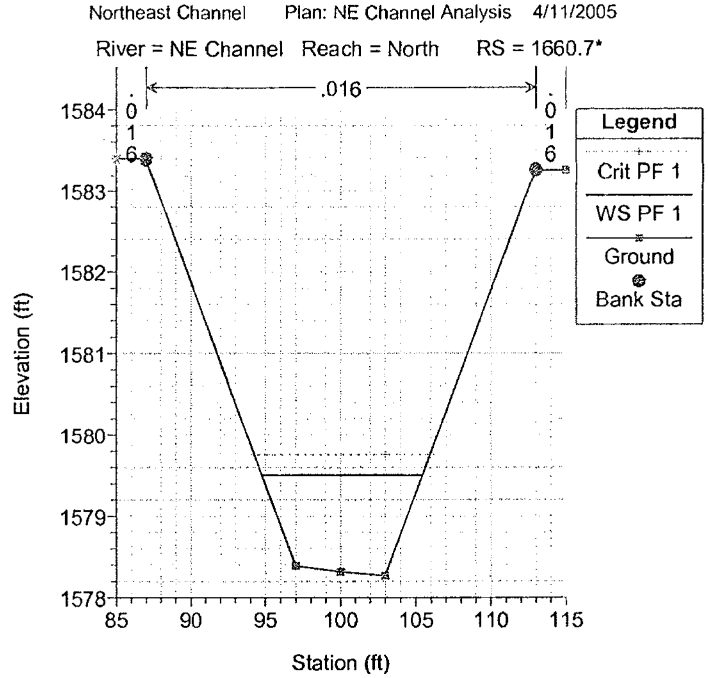

Northeast Channel Plan: NE Channel Analysis 4/11/2005
River = NE Channel Reach = North RS = 2132.62*
.016
Legend
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)

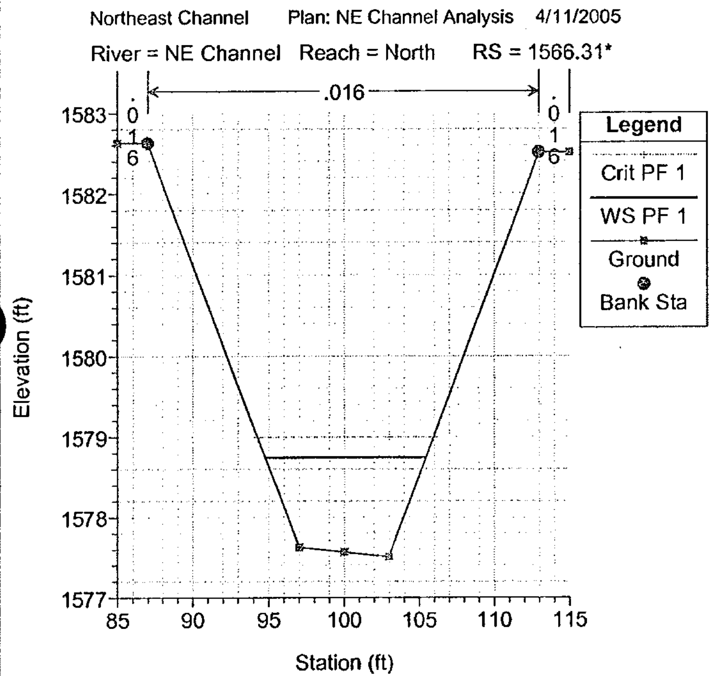

Northeast Channel Plan: NE Channel Analysis 4/11/2005
River = NE Channel Reach = North RS = 2038.24*
.016
Legend
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)

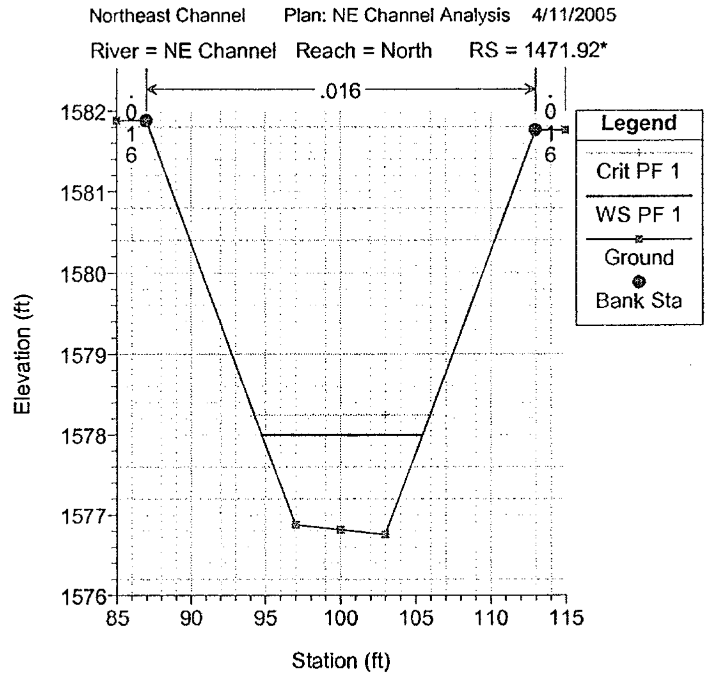

Northeast Channel Plan: NE Channel Analysis 4/11/2005
River = NE Channel Reach = North RS = 1943.85*
.016
Legend
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)

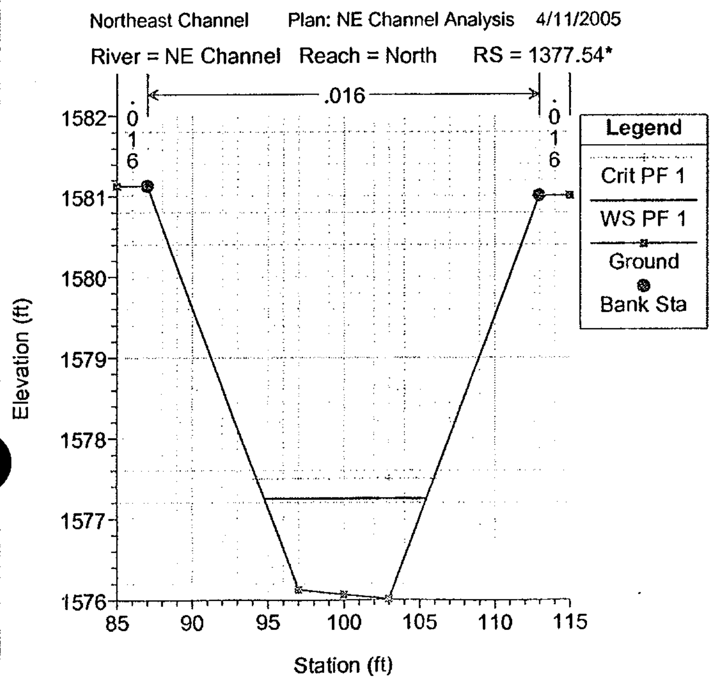

Northeast Channel Plan: NE Channel Analysis 4/11/2005
River = NE Channel Reach = North RS = 1849.47*
.016
Legend
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)

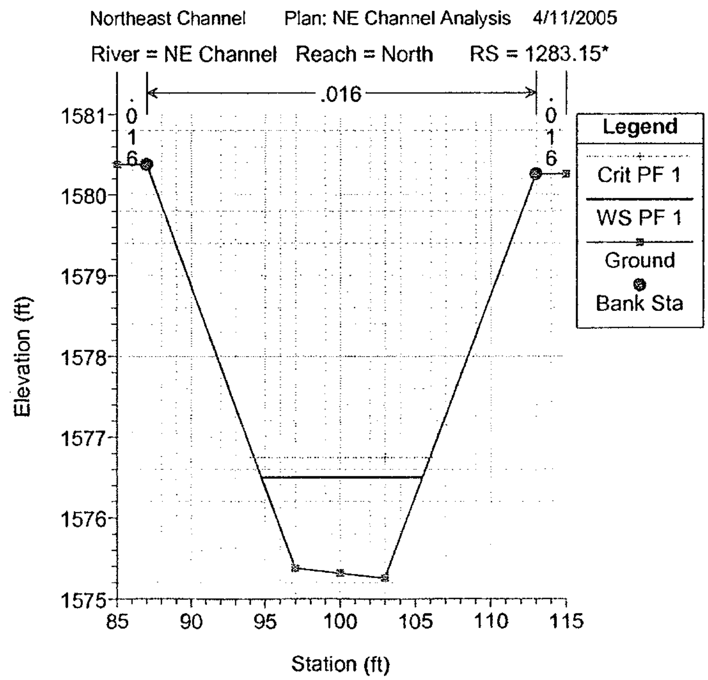

Northeast Channel Plan: NE Channel Analysis 4/11/2005
River = NE Channel Reach = North RS = 1755.08*
.016
Legend
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)

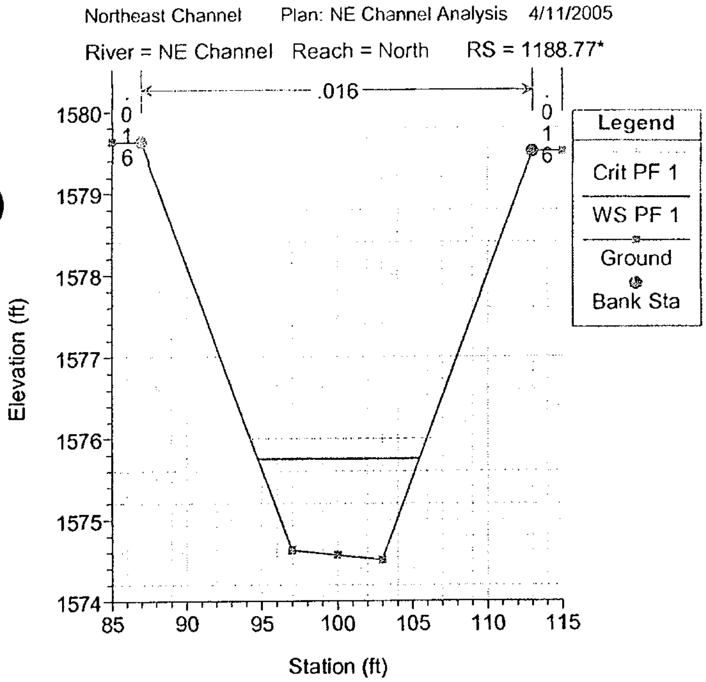

Northeast Channel Plan: NE Channel Analysis 4/11/2005
River = NE Channel Reach = North RS = 1660.7*
.016
Legend
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)

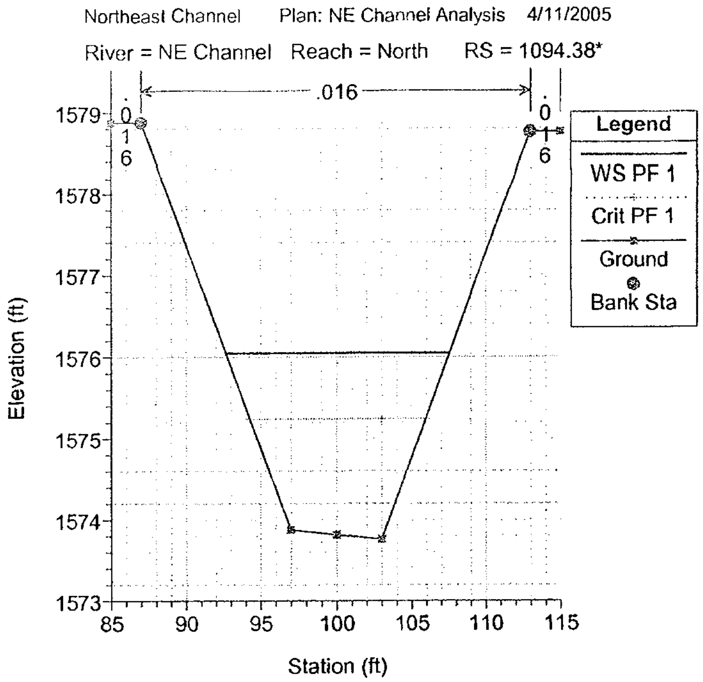

Northeast Channel Plan: NE Channel Analysis 4/11/2005
River = NE Channel Reach = North RS = 1566.31*
.016
Legend
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)

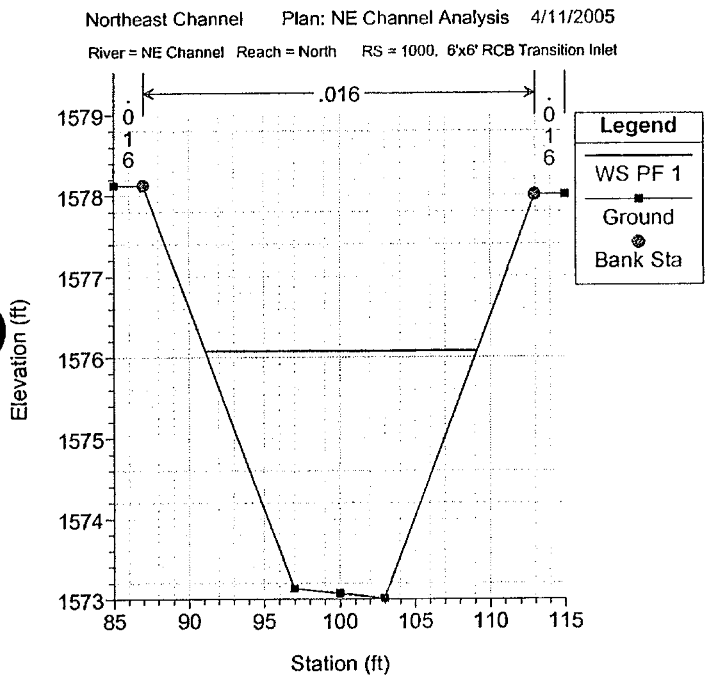

Northeast Channel Plan: NE Channel Analysis 4/11/2005
River = NE Channel Reach = North RS = 1471.92*
.016
Legend
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)


Northeast Channel Plan: NE Channel Analysis 4/11/2005
River = NE Channel Reach = North RS = 1377.54*
.016
Legend
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)


Northeast Channel Plan: NE Channel Analysis 4/11/2005
River = NE Channel Reach = North RS = 1283.15*
.016
Legend
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)


Northeast Channel Plan: NE Channel Analysis 4/11/2005
River = NE Channel Reach = North RS = 1188.77*
.016
Legend
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)


Northeast Channel Plan: NE Channel Analysis 4/11/2005
River = NE Channel Reach = North RS = 1094.38*
.016
Legend
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)


Northeast Channel Plan: NE Channel Analysis 4/11/2005
River = NE Channel Reach = North RS = 1000. 6'x6' RCB Transition Inlet
.016
Legend
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)

APPENDIX A

CAP OVERCHUTE BASIN

CAP Overchute Capacity Analysis (CulvertMaster)

Culvert Designer/Analyzer Report
CAP Overchute

Component:Culvert-1

Culvert Summary			
Computed Headwater Elev:	1,572.19 ft	Discharge	264.00 cfs
Inlet Control HW Elev.	1,571.84 ft	Tailwater Elevation	N/A ft
Outlet Control HW Elev.	1,572.19 ft	Control Type	Entrance Control
Headwater Depth/Height	1.00		

Grades			
Upstream Invert	1,567.70 ft	Downstream Invert	1,566.90 ft
Length	165.00 ft	Constructed Slope	0.004848 ft/ft

Hydraulic Profile			
Profile	S2	Depth, Downstream	2.62 ft
Slope Type	Steep	Normal Depth	2.62 ft
Flow Regime	Supercritical	Critical Depth	2.75 ft
Velocity Downstream	9.14 ft/s	Critical Slope	0.004197 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.013
Section Material	CMP	Span	4.50 ft
Section Size	54 inch	Rise	4.50 ft
Number Sections	3		

Outlet Control Properties			
Outlet Control HW Elev.	1,572.19 ft	Upstream Velocity Head	1.16 ft
Ke	0.50	Entrance Loss	0.58 ft

Inlet Control Properties			
Inlet Control HW Elev.	1,571.84 ft	Flow Control	N/A
Inlet Type	Headwall	Area Full	47.7 ft^2
K	0.00780	HDS 5 Chart	2
M	2.00000	HDS 5 Scale	1
C	0.03790	Equation Form	1
Y	0.69000		

Culvert Designer/Analyzer Report
CAP Overchute

Analysis Component			
Storm Event	Design	Discharge	264.00 cfs

Peak Discharge Method: User-Specified			
Design Discharge	264.00 cfs	Check Discharge	300.00 cfs

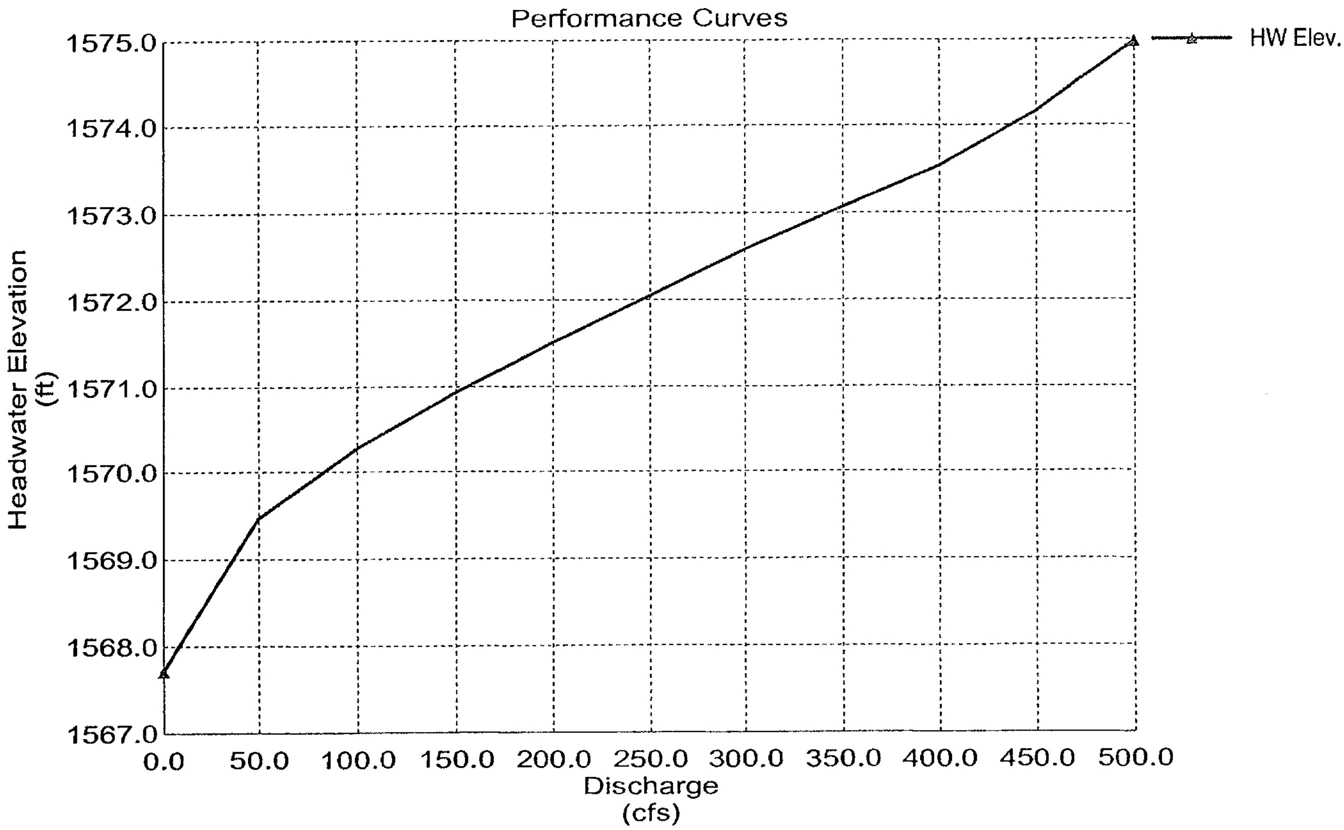
Tailwater Conditions: Constant Tailwater	
Tailwater Elevation	N/A ft

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	3-54 inch Circular	264.00 cfs	1,572.19 ft	9.14 ft/s
Weir	Not Considered	N/A	N/A	N/A

Performance Curves Report
CAP Overchute

Range Data:

	Minimum	Maximum	Increment	
Discharge	0.00	500.00	50.00	cfs



APPENDIX A

CAP OVERCHUTE BASIN

6'x6' RCB Freeway Culvert Analysis (CulvertMaster)

Culvert Designer/Analyzer Report
6x6 RCB Crossing

Analysis Component			
Storm Event	Design	Discharge	240.00 cfs

Peak Discharge Method: User-Specified			
Design Discharge	240.00 cfs	Check Discharge	250.00 cfs

Tailwater Conditions: Tailwater Rating

Discharge (cfs)	TW Elev. (ft)
0.00	1,567.70
2.00	1,568.00
28.00	1,569.00
81.00	1,570.00
157.00	1,571.00
246.00	1,572.00
320.00	1,573.00
434.00	1,574.00
496.00	1,575.00

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-6 x 6 ft Box	240.00 cfs	1,574.70 ft	9.92 ft/s
Weir	Not Considered	N/A	N/A	N/A

Culvert Designer/Analyzer Report
6x6 RCB Crossing

Component:Culvert-1

Culvert Summary

Computed Headwater Eleva	1,574.70 ft	Discharge	240.00 cfs
Inlet Control HW Elev.	1,574.14 ft	Tailwater Elevation	1,571.93 ft
Outlet Control HW Elev.	1,574.70 ft	Control Type	Outlet Control
Headwater Depth/Height	1.08		

Grades

Upstream Invert	1,568.20 ft	Downstream Invert	1,567.90 ft
Length	283.00 ft	Constructed Slope	0.001060 ft/ft

Hydraulic Profile

Profile	M2	Depth, Downstream	4.03 ft
Slope Type	Mild	Normal Depth	N/A ft
Flow Regime	Subcritical	Critical Depth	3.68 ft
Velocity Downstream	9.92 ft/s	Critical Slope	0.004637 ft/ft

Section

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

Outlet Control Properties

Outlet Control HW Elev.	1,574.70 ft	Upstream Velocity Head	0.99 ft
Ke	0.50	Entrance Loss	0.50 ft

Inlet Control Properties

Inlet Control HW Elev.	1,574.14 ft	Flow Control	Unsubmerged
Inlet Type	30 to 75° wingwall flares	Area Full	36.0 ft²
K	0.02600	HDS 5 Chart	8
M	1.00000	HDS 5 Scale	1
C	0.03470	Equation Form	1
Y	0.86000		

APPENDIX A

CAP OVERCHUTE BASIN

CAP Basin Outlet (CulvertMaster)

Culvert Designer/Analyzer Report
CAP Basin Outlet

Analysis Component			
Storm Event	Design	Discharge	50.00 cfs

Peak Discharge Method: User-Specified			
Design Discharge	50.00 cfs	Check Discharge	100.00 cfs

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.			
Discharge	50.00 cfs	Bottom Elevation	1,569.80 ft
Depth	0.93 ft	Velocity	2.60 ft/s

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-24 inch Circular	19.79 cfs	1,573.75 ft	7.35 ft/s
Weir	Broad Crested	30.23 cfs	1,573.75 ft	N/A
Total	----------------	50.03 cfs	1,573.75 ft	N/A

Culvert Designer/Analyzer Report
CAP Basin Outlet

Component:Culvert-1

Culvert Summary

Computed Headwater Eleva	1,573.75 ft	Discharge	19.79 cfs
Inlet Control HW Elev.	1,572.62 ft	Tailwater Elevation	1,570.73 ft
Outlet Control HW Elev.	1,573.75 ft	Control Type	Outlet Control
Headwater Depth/Height	1.87		

Grades

Upstream Invert	1,570.00 ft	Downstream Invert	1,569.80 ft
Length	50.00 ft	Constructed Slope	0.002000 ft/ft

Hydraulic Profile

Profile	CompositeM2PressureProfile	Depth, Downstream	1.60 ft
Slope Type	Mild	Normal Depth	N/A ft
Flow Regime	Subcritical	Critical Depth	1.60 ft
Velocity Downstream	7.35 ft/s	Critical Slope	0.027358 ft/ft

Section

Section Shape	Circular	Mannings Coefficient	0.024
Section Material	CMP	Span	2.00 ft
Section Size	24 inch	Rise	2.00 ft
Number Sections	1		

Outlet Control Properties

Outlet Control HW Elev.	1,573.75 ft	Upstream Velocity Head	0.62 ft
Ke	0.20	Entrance Loss	0.12 ft

Inlet Control Properties

Inlet Control HW Elev.	1,572.62 ft	Flow Control	N/A
Inlet Type	Beveled ring, 33.7° (1.5:1) bevels	Area Full	3.1 ft^2
K	0.00180	HDS 5 Chart	3
M	2.50000	HDS 5 Scale	B
C	0.02430	Equation Form	1
Y	0.83000		

Culvert Designer/Analyzer Report
CAP Basin Outlet

Component:Weir

Hydraulic Component(s): Broad Crested

Discharge	30.23	cfs	Allowable HW Elevation	1,573.75	ft
Weir Coefficient	2.60	US	Length	18.00	ft
Crest Elevation	1,573.00	ft	Headwater Elevation	1,573.75	ft

APPENDIX B

PRINCIPAL SPILLWAY OUTLET

- Spook Hill FRS Outlet Rating Curve Data
- SAF Energy Dissipator Calculations
- Design Example Hydraulic Design of Energy Dissipators for Culverts and Channels (HEC-14)
- Structural Calculations

APPENDIX B

PRINCIPAL SPILLWAY OUTLET

Spook Hill FRS Outlet Rating Curve Data

FRS Principal and Emergency Spillway Discharge Rating Curve

Weir Coeff. C	Elevation NAD88 (ft)	Proposed 12x8 Principal Spillway					P.S. with Emergency Spillway		
		Drop Inlet			12x8 RCB	P.S.	Emer. Spill.	Total FRS	Elevation
		L (ft)	H (ft)	Q[1] (cfs)	Q[2] (cfs)	Q[3] (cfs)	Q[4] (cfs)	Discharge (cfs)	NAD88 (ft)
3.1	1577.00	52	0.0	0	797	0	0	0	1577.0
3.1	1577.50	52	0.0	0	871	0	0	0	1577.5
3.1	1578.00	52	0.5	57	977	57	0	57	1578.0
3.1	1578.50	52	1.0	161	1087	161	0	161	1578.5
3.1	1579.00	52	1.5	296	1150	296	0	296	1579.0
3.1	1579.50	52	2.0	456	1207	456	0	456	1579.5
3.1	1580.00	52	2.5	637	1264	637	0	637	1580.0
3.1	1580.50	52	3.0	838	1321	838	0	838	1580.5
3.1	1581.00	52	3.5	1056	1356	1056	0	1056	1581.0
3.1	1581.50	52	4.0	1290	1391	1290	0	1290	1581.5
3.1	1582.00	52	4.5	1539	1425	1425	0	1425	1582.0
3.1	1582.50	52	5.0	1802	1460	1460	0	1460	1582.5
3.1	1583.00	52	5.5	2079	1495	1495	0	1495	1583.0
3.1	1583.50	52	6.0	2369	1530	1530	0	1530	1583.5
3.1	1584.00	52	6.5	2671	1574	1574	0	1574	1584.0
3.1	1584.50	52	7.0	2985	1622	1622	465	2087	1584.5
3.1	1585.00	52	7.5	3311	1670	1670	930	2600	1585.0
3.1	1585.50	52	8.0	3648	1717	1717	1395	3112	1585.5
3.1	1586.00	52	8.5	3995	1764	1764	1860	3624	1586.0
3.1	1586.50	52	9.0	4352	1809	1809	2780	4589	1586.5
3.1	1587.00	52	9.5	4720	1853	1853	3700	5553	1587.0
3.1	1587.50	52	10.0	5098	1897	1897	4800	6697	1587.5
3.1	1588.00	52	10.5	5485	1942	1942	5900	7842	1588.0
3.1	1588.50	52	11.0	5881	1986	1986	7325	9311	1588.5
3.1	1589.00	52	11.5	6287	2027	2027	8750	10777	1589.0
3.1	1589.50	52	12.0	6701	2068	2068	10175	12243	1589.5
3.1	1590.00	52	12.5	7124	2110	2110	11600	13710	1590.0
3.1	1590.50	52	13.0	7556	2151	2151	13200	15351	1590.5
3.1	1591.00	52	13.5	7996	2193	2193	14800	16993	1591.0

1. Based on weir equation (represents weir inlet capacity)
2. Based on interpolated values from HY-8 analysis (represents actual RCB conduit capacity)
3. Smallest value of either the inlet capacity (weir equation) or the conduit capacity (HY-8 analysis).
4. Based upon previous assessment of emergency spillway capacity

HY-8 Analysis Data for Principal Spillway Rating Curve

Existing 7x7.5 Filename: EXIST.INP		Proposed 12x8 Filename: PS-FINAL.INP	
Elevation (ft)	Discharge (cfs)	Elevation (ft)	Discharge (cfs)
1568.01	0	**1568.10**	**0**
1568.50	17	1568.50	21
1569.00	35	1569.00	48
1569.50	53	1569.50	75
1570.00	70	1570.00	101
1570.50	88	1570.50	128
1571.00	106	1571.00	154
1571.50	123	1571.50	181
1571.69	**130**	1572.00	208
1572.00	150	**1572.23**	**220**
1573.70	**260**	1572.50	248
1574.00	282	1573.00	300
1575.44	**390**	1573.50	351
1575.50	395	1574.00	403
1576.00	438	**1574.36**	**440**
1576.50	480	1574.50	458
1576.97	**520**	1575.00	522
1577.00	522	1575.50	587
1577.50	557	1576.00	651
1578.00	592	**1576.07**	**660**
1578.50	626	1576.50	723
1578.84	**650**	1577.00	797
1579.00	660	1577.50	871
1579.50	689	**1577.56**	**880**
1580.00	719	1578.00	977
1580.50	749	1578.50	1087
1581.00	779	**1578.56**	**1100**
1581.02	**780**	1579.00	1150
1581.50	805	1579.50	1207
1582.00	831	1580.00	1264
1582.50	857	**1580.49**	**1320**
1583.00	883	1580.50	1321
1583.50	908	1581.00	1356
1583.53	**910**	1581.50	1391
1584.00	931	1582.00	1425
1584.50	954	1582.50	1460
1585.00	976	1583.00	1495
1585.50	999	1583.50	1530
1586.00	1021	**1583.64**	**1540**
1586.41	**1040**	1584.00	1574
1586.50	1044	1584.50	1622
1587.00	1063	1585.00	1670
1587.50	1083	1585.50	1717
1588.00	1103	**1585.95**	**1760**
1588.50	1123	1586.00	1764
1589.00	1143	1586.50	1809
1589.50	1162	1587.00	1853
1589.69	**1170**	1587.50	1897
1590.00	1180	1588.00	1942
1590.50	1196	**1588.43**	**1980**
1591.00	1212	1588.50	1986
1591.50	1229	1589.00	2027
1592.00	1245	1589.50	2068
1592.50	1261	1590.00	2110
1593.00	**1277.2**	1590.50	2151
		1591.00	2193
		1591.09	**2200**

BOLD is HY-8 data
Normal is interpolated data

For Outlet Rating Curve

CURRENT DATE: 02-15-2005
CURRENT TIME: 13:23:53

FILE DATE: 02-15-2005
FILE NAME: PS-95EX

FHWA CULVERT ANALYSIS
HY-8, VERSION 6.0

CULV NO.	SITE DATA			CULVERT SHAPE, MATERIAL, INLET				
	INLET ELEV. (ft)	OUTLET ELEV. (ft)	CULVERT LENGTH (ft)	BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	1568.10	1568.00	92.00	1 RCB	12.00	8.00	.012	CONVENTIONAL
2								
3								
4								
5								
6								

SUMMARY OF CULVERT FLOWS (cfs)   FILE: PS-95EX   DATE: 02-15-2005

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
1568.10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1572.23	220.0	220.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1574.36	440.0	440.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1576.07	660.0	660.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1577.56	880.0	880.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1578.56	1100.0	1100.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1580.49	1320.0	1320.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1583.64	1540.0	1540.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1585.95	1760.0	1760.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1588.43	1980.0	1980.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1591.09	2200.0	2200.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1593.00	2317.0	2317.0	0.0	0.0	0.0	0.0	0.0	OVERTOPPING	

SUMMARY OF ITERATIVE SOLUTION ERRORS   FILE: PS-95EX   DATE: 02-15-2005

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
1568.10	0.000	0.00	0.00	0.00
1572.23	0.000	220.00	0.00	0.00
1574.36	0.000	440.00	0.00	0.00

CURRENT DATE: 02-15-2005
CURRENT TIME: 13:23:53

FILE DATE: 02-15-2005
FILE NAME: PS-95EX

PERFORMANCE CURVE FOR CULVERT 1 - 1(12.00 (ft) BY 8.00 (ft)) RCB

DIS- CHARGE FLOW (cfs)	HEAD- WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	1568.10	0.00	-0.10	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
220.00	1572.23	3.49	4.13	3-M1t	2.86	2.19	3.73	3.73	4.92	1.58
440.00	1574.36	5.42	6.26	3-M1t	4.68	3.48	5.44	5.44	6.74	1.95
660.00	1576.07	7.10	7.97	3-M1t	6.32	4.56	6.74	6.74	8.16	2.18
880.00	1577.56	8.73	9.46	3-M2t	8.00	5.52	7.82	7.82	9.38	2.37
1100.00	1578.57	10.47	8.66	3-M2t	8.00	6.40	7.82	8.76	11.73	2.52
1320.00	1580.49	12.39	9.50	3-M2t	8.00	7.23	7.82	9.60	14.07	2.64
1540.00	1583.64	14.56	15.54	4-FFt	8.00	8.00	8.00	10.36	16.04	2.76
1760.00	1585.95	17.04	17.85	4-FFt	8.00	8.00	8.00	11.06	18.33	2.86
1980.00	1588.43	19.84	20.33	4-FFt	8.00	8.00	8.00	11.72	20.63	2.95
2200.00	1591.09	22.97	22.99	4-FFt	8.00	8.00	8.00	12.33	22.92	3.03

El. inlet face invert 1568.10 ft El. outlet invert 1568.00 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **************

INLET STATION	1000.00 ft
INLET ELEVATION	1568.10 ft
OUTLET STATION	1092.00 ft
OUTLET ELEVATION	1568.00 ft
NUMBER OF BARRELS	1
SLOPE (V/H)	0.0011
CULVERT LENGTH ALONG SLOPE	92.00 ft

***** CULVERT DATA SUMMARY ************************

BARREL SHAPE	BOX
BARREL SPAN	12.00 ft
BARREL RISE	8.00 ft
BARREL MATERIAL	CONCRETE
BARREL MANNING'S n	0.012
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	1:1 BEVEL
INLET DEPRESSION	NONE

CURRENT DATE: 02-15-2005
CURRENT TIME: 13:23:53

FILE DATE: 02-15-2005
FILE NAME: PS-95EX

TAILWATER

******* REGULAR CHANNEL CROSS SECTION ****************

BOTTOM WIDTH	28.00 ft
SIDE SLOPE H/V (X:1)	2.5
CHANNEL SLOPE V/H (ft/ft)	0.000
MANNING'S n (.01-0.1)	0.027
CHANNEL INVERT ELEVATION	1568.00 ft
CULVERT NO.1 OUTLET INVERT ELEVATION	1568.00 ft

******* UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	1568.00	0.000	0.00	0.00	0.00
220.00	1571.73	0.144	3.73	1.58	0.05
440.00	1573.44	0.147	5.44	1.95	0.07
660.00	1574.74	0.148	6.74	2.18	0.08
880.00	1575.82	0.149	7.82	2.37	0.10
1100.00	1576.76	0.150	8.76	2.52	0.11
1320.00	1577.60	0.150	9.60	2.64	0.12
1540.00	1578.36	0.151	10.36	2.76	0.13
1760.00	1579.06	0.151	11.06	2.86	0.14
1980.00	1579.72	0.152	11.72	2.95	0.15
2200.00	1580.33	0.152	12.33	3.03	0.15

ROADWAY OVERTOPPING DATA

ROADWAY SURFACE	GRAVEL
EMBANKMENT TOP WIDTH	14.00 ft
CREST LENGTH	100.00 ft
OVERTOPPING CREST ELEVATION	1593.00 ft

For Principal Spillway Design

CURRENT DATE: 04-25-2005
CURRENT TIME: 15:38:28

FILE DATE: 04-25-2005
FILE NAME: PS-95FUT

FHWA CULVERT ANALYSIS
HY-8, VERSION 6.0

CULV NO.	SITE DATA: INLET ELEV. (ft)	SITE DATA: OUTLET ELEV. (ft)	SITE DATA: CULVERT LENGTH (ft)	CULVERT SHAPE, MATERIAL, INLET: BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	1568.10	1568.00	98.25	1 RCB	12.00	8.00	.012	CONVENTIONAL
2								
3								
4								
5								
6								

SUMMARY OF CULVERT FLOWS (cfs)   FILE: PS-95FUT   DATE: 04-25-2005

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
1568.10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1572.57	220.0	220.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1574.76	440.0	440.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1576.47	660.0	660.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1578.22	880.0	880.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1580.17	1100.0	1100.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1582.22	1320.0	1320.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1584.42	1540.0	1540.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1586.77	1760.0	1760.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1589.28	1980.0	1980.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1590.11	2050.0	2050.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1593.00	2282.8	2282.8	0.0	0.0	0.0	0.0	0.0	OVERTOPPING	

SUMMARY OF ITERATIVE SOLUTION ERRORS   FILE: PS-95FUT   DATE: 04-25-2005

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
1568.10	0.000	0.00	0.00	0.00
1572.57	0.000	220.00	0.00	0.00
1574.76	0.000	440.00	0.00	0.00
1576.47	0.000	660.00	0.00	0.00
1578.22	0.000	880.00	0.00	0.00
1580.17	0.000	1100.00	0.00	0.00
1582.22	0.000	1320.00	0.00	0.00
1584.42	0.000	1540.00	0.00	0.00
1586.77	0.000	1760.00	0.00	0.00
1589.28	0.000	1980.00	0.00	0.00
1590.11	0.000	2050.00	0.00	0.00

<1> TOLERANCE (ft) = 0.010   <2> TOLERANCE (%) = 1.000

CURRENT DATE: 04-25-2005
CURRENT TIME: 15:38:28

FILE DATE: 04-25-2005
FILE NAME: PS-95FUT

PERFORMANCE CURVE FOR CULVERT 1 - 1(12.00 (ft) BY 8.00 (ft)) RCB

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	1568.10	0.00	-0.10	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
220.00	1572.57	3.49	4.47	3-M1t	2.95	2.19	4.16	4.16	4.41	1.63
440.00	1574.76	5.42	6.66	3-M1t	4.84	3.48	5.99	5.99	6.12	1.99
660.00	1576.48	7.10	8.38	3-M1t	6.55	4.56	7.36	7.36	7.48	2.22
880.00	1578.22	8.73	10.12	4-FFt	8.00	5.52	8.00	8.48	9.17	2.40
1100.00	1580.17	10.47	12.07	4-FFt	8.00	6.40	8.00	9.46	11.46	2.55
1320.00	1582.22	12.39	14.12	4-FFt	8.00	7.23	8.00	10.32	13.75	2.67
1540.00	1584.42	14.56	16.32	4-FFt	8.00	8.00	8.00	11.11	16.04	2.78
1760.00	1586.77	17.04	18.67	4-FFt	8.00	8.00	8.00	11.83	18.33	2.88
1980.00	1589.28	19.84	21.18	4-FFt	8.00	8.00	8.00	12.51	20.63	2.97
2050.00	1590.11	20.80	22.01	4-FFt	8.00	8.00	8.00	12.71	21.35	3.00

El. inlet face invert 1568.10 ft   El. outlet invert 1568.00 ft
El. inlet throat invert 0.00 ft   El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **************

INLET STATION	1000.00 ft
INLET ELEVATION	1568.10 ft
OUTLET STATION	1098.25 ft
OUTLET ELEVATION	1568.00 ft
NUMBER OF BARRELS	1
SLOPE (V/H)	0.0010
CULVERT LENGTH ALONG SLOPE	98.25 ft

***** CULVERT DATA SUMMARY ************************

BARREL SHAPE	BOX
BARREL SPAN	12.00 ft
BARREL RISE	8.00 ft
BARREL MATERIAL	CONCRETE
BARREL MANNING'S n	0.012
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	1:1 BEVEL
INLET DEPRESSION	NONE

CURRENT DATE: 04-25-2005
CURRENT TIME: 15:38:28

FILE DATE: 04-25-2005
FILE NAME: PS-95FUT

TAILWATER

******* REGULAR CHANNEL CROSS SECTION ****************

BOTTOM WIDTH	22.00 ft
SIDE SLOPE H/V (X:1)	2.5
CHANNEL SLOPE V/H (ft/ft)	0.0002 ft/ft
MANNING'S n (.01-0.1)	0.027
CHANNEL INVERT ELEVATION	1568.00 ft
CULVERT NO.1 OUTLET INVERT ELEVATION	1568.00 ft

******* UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	1568.00	0.000	0.00	0.00	0.00
220.00	1572.16	0.141	4.16	1.63	0.05
440.00	1573.99	0.143	5.99	1.99	0.08
660.00	1575.36	0.144	7.36	2.22	0.09
880.00	1576.48	0.145	8.48	2.40	0.11
1100.00	1577.46	0.146	9.46	2.55	0.12
1320.00	1578.32	0.147	10.32	2.67	0.13
1540.00	1579.11	0.147	11.11	2.78	0.14
1760.00	1579.83	0.148	11.83	2.88	0.15
1980.00	1580.51	0.148	12.51	2.97	0.16
2050.00	1580.71	0.148	12.71	3.00	0.16

ROADWAY OVERTOPPING DATA

ROADWAY SURFACE	GRAVEL
EMBANKMENT TOP WIDTH	14.00 ft
CREST LENGTH	100.00 ft
OVERTOPPING CREST ELEVATION	1593.00 ft

REFERENCE
Hydraulic Design of Energy Dissipators for Culverts and Channels
Hydraulic Engineering Circular No. 14, Sept 1983
US DOT, FHWA

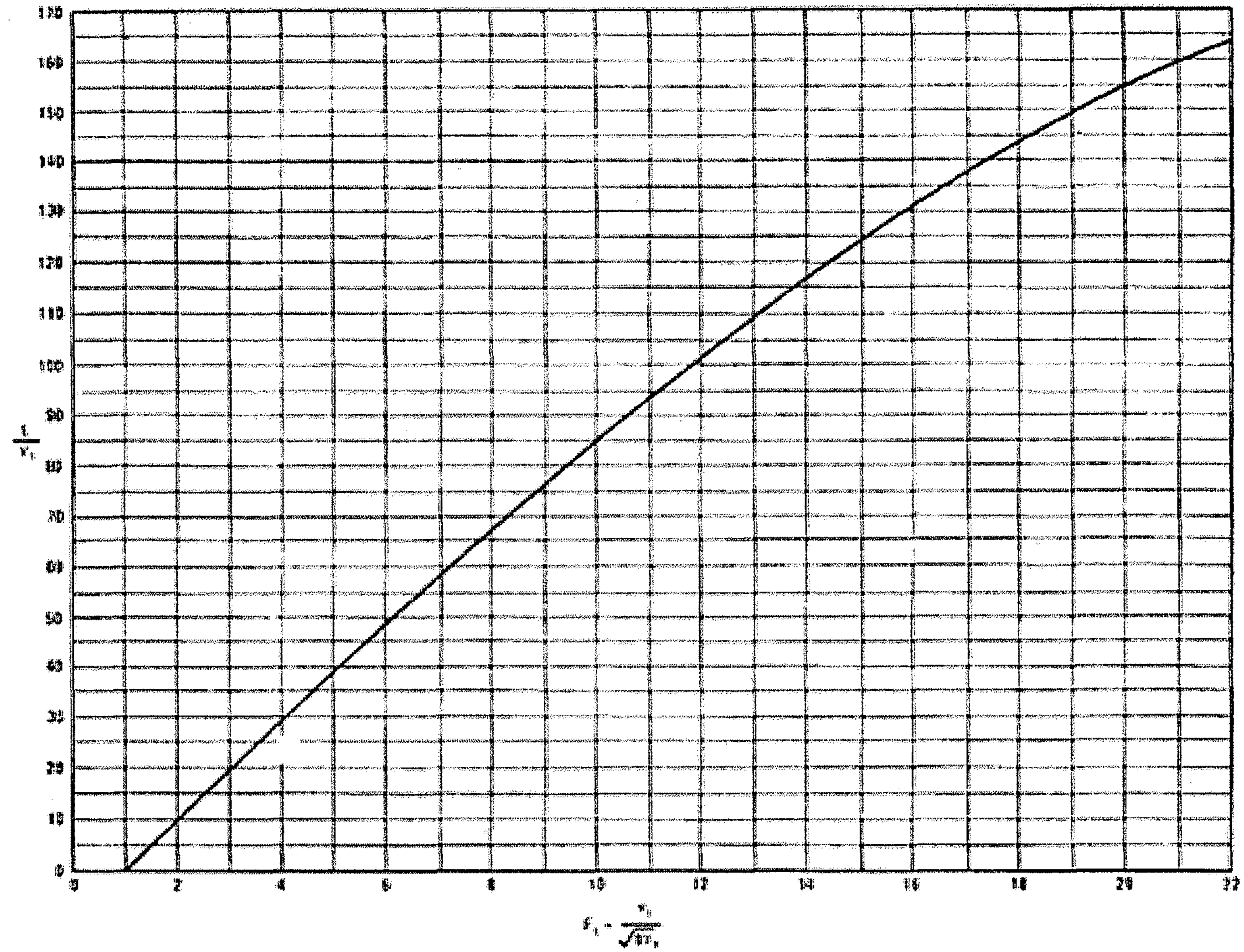


FIGURE VI-11. LENGTH OF JUMP IN TERMS OF y_1, RECTANGULAR CHANNEL

APPENDIX B

PRINCIPAL SPILLWAY OUTLET

SAF Energy Dissipator Calculations

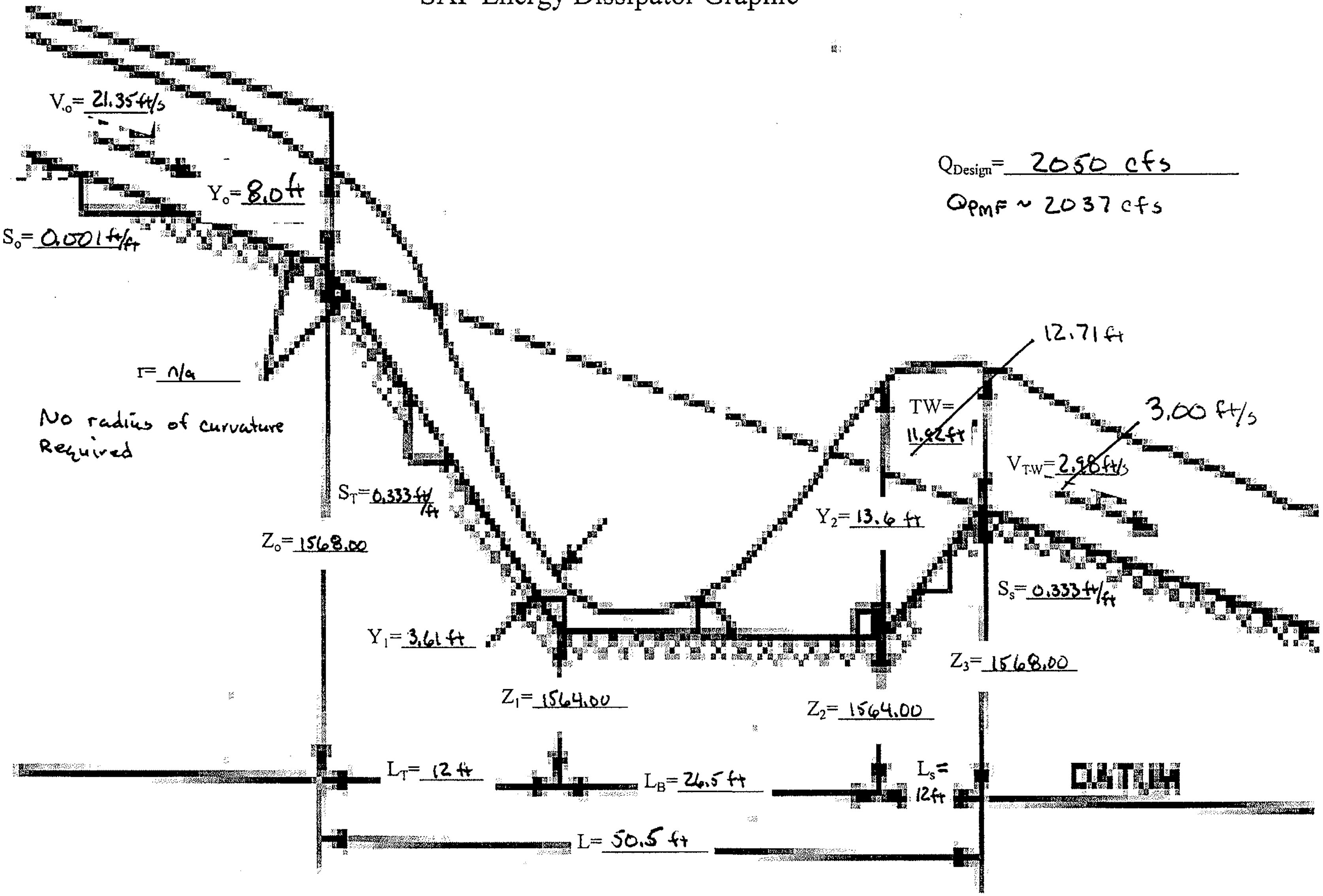
SAF Stilling Basin Design Analysis Worksheet

Q (cfs)	n	Initial Width W_o (ft)	Side Slope (H:V)	Channel Slopes: Up Stream S_O (ft/ft)	Channel Slopes: Into Basin S_T (ft/ft)	Channel Slopes: Out of Basin S_S (ft/ft)	Channel Slopes: Down-Stream S_{TW} (ft/ft)	Elevations: Z_O (ft)	Elevations: Z_1 (ft)	Elevations: Z_2 (ft)	Elevations: Z_3 (ft)	Basin Lengths: L_T (ft)	Basin Lengths: L_B (ft)	Basin Lengths: L_S (ft)	Basin Lengths: L (ft)	Y_O (ft)	V_O (ft/s)	Fr_O	(TW) Y_n (ft)	(TW) V_n (ft/s)	Y_j (ft)	Y_2 (ft)	Width at U/S Toe of Basin W_B (ft)	Calc. Max. W_{Bmax} (ft)	Calculate Y_1 by Trial & Error: Y_1 (ft)	Calculated V_1 (ft/s)	Calculated Q (cfs)	Design Q (cfs)	Fr_1	$Y_2+Z_2 < Z_3+TW$?: Y_2+Z_2	Z_3+TW	Y_o/r	r (ft)	Comment
417	0.030	10.0	2.0	0.065	0.500	0.500	0.065	100.00	91.50	91.50	97.44	17.00	10.5	11.88	39.42	1.50	27.80	**4.00**	1.9	15.90	9.2	7.82	10	13.2	1.14	36.7	418	417	6.05	99.32	99.34	0.1	15	Prob. VII-G-3
2050	0.012	12.0	0.0	0.000	0.333	0.333	0.0002	1,568.00	1564.00	1564.00	1568.00	12.01	26.4	12.01	50.38	8.00	21.35	**1.33**	12.71	3.00	13.2	13.63	18	18.3	3.61	31.6	2,051	2,050	2.93	1577.63	1580.71	0	n/a	~Q PMF

SAF Stilling Basin Analysis and Design Summary Table

	Basin								Chute Blocks				Baffle Blocks									Dist from Chute Blks to Baffle Blocks (ft)	End Sill Height (ft)	Side Wall Height (ft)	Comments
					Incoming		Jump Height			Width/Spacing				Width/Spacing											
Q (cfs)	Width W_B (ft)	Bottom Elevation Z_1 (ft)	Bottom Length L_B (ft)	Total Length L (ft)	Depth Y_1 (ft)	Froude Fr_1	Theor. Y_j (ft)	Calc. Y_2 (ft)	Block Height h_1 (ft)	Initial W_1 (ft)	Adjusted Adj W_1 (ft)	Number of Blocks N_C	Block Height h_3 (ft)	Initial W_3 (ft)	Adjusted Adj W_3 (ft)	Basin Width at Block, W_{B2} (ft)	Basin Width at Sill (ft)	Number of Blocks N_C	Total Block Width (ft)	Percent of Basin Width	Approp. Percent Blocked? (40%-55%)				
417	10	91.50	10.5	39.42	1.14	6.05	9.2	7.82	1.14	0.855	0.833	6	1.14	0.855	0.833	10.0	10.0	6	5.0	50%	Yes	3.5	0.64	10.9	EXAMPLE VII-G-3
2050	18	1564.00	26.4	50.38	3.61	2.93	13.2	13.63	3.61	2.71	2.250	4	3.61	2.7075	2.250	18.0	18.0	4	9.0	50%	Yes	8.8	0.93	18.0	~ Q PMF

SAF Energy Dissipator Graphic



SAF Stilling Basin Design Analysis Worksheet

				Channel Slopes				Elevations				Basin Lengths													Calculate Y_1 by Trial & Error					$Y_2+Z_2 < Z_3+TW$?				
																										Calculated		Design						
Q (cfs)	n	Initial Width W_o (ft)	Side Slope (H:V)	Up Stream S_O (ft/ft)	Into Basin S_T (ft/ft)	Out of Basin S_S (ft/ft)	Down-Stream S_{TW} (ft/ft)	Z_O (ft)	Z_1 (ft)	Z_2 (ft)	Z_3 (ft)	L_T (ft)	L_B (ft)	L_S (ft)	L (ft)	Y_O (ft)	V_O (ft/s)	Fr_O	(TW) Y_n (ft)	(TW) V_n (ft/s)	Y_j (ft)	Y_2 (ft)	Width at U/S Toe of Basin W_B (ft)	Calc. Max. W_{Bmax} (ft)	Y_1 (ft)	V_1 (ft/s)	Q (cfs)	Q (cfs)	Fr_1	Y_2+Z_2	Z_3+TW	Y_o/r	r (ft)	Comment
417	0.030	10.0	2.0	0.065	0.500	0.500	0.065	100.00	91.50	91.50	97.44	17.00	10.5	11.88	39.42	1.50	27.80	**4.00**	1.9	15.90	9.2	7.82	10	13.2	1.14	36.7	418	417	6.05	99.32	99.34	0.1	15	Prob. VII-G-3
2050	0.012	12.0	0.0	0.000	0.333	0.333	0.002	1,568.00	1564.00	1564.00	1568.00	12.01	26.4	12.01	50.38	8.00	21.35	**1.33**	11.92	2.98	13.2	13.63	18	18.3	3.61	31.6	2,051	2,050	2.93	1577.63	1579.92	0	n/a	~Q PMF

SAF Stilling Basin Analysis and Design Summary Table

	Basin								Chute Blocks				Baffle Blocks									Dist from			
		Bottom	Bottom	Total	Incoming		Jump Height		Block	Width/Spacing		Number	Block	Width/Spacing		Basin	Basin	Number	Total	Percent	Approp.	Chute Blks	End	Side	
	Width	Elevation	Length	Length	Depth	Froude	Theor.	Calc.	Height	Initial	Adjusted	of Blocks	Height	Initial	Adjusted	Width at	Width at	of Blocks	Block	of Basin	Percent	to Baffle	Sill	Wall	
Q	W_B	Z_1	L_B	L	Y_1	Fr_1	Y_j	Y_2	h_1	W_1	Adj W_1	N_C	h_3	W_3	Adj W_3	Block, W_{B2}	Sill	N_C	Width	Width	Blocked?	Blocks	Height	Height	Comments
(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)		(ft)	(ft)	(ft)	(ft)	(ft)		(ft)	(ft)	(ft)	(ft)	(ft)		(ft)		(40%-55%)	(ft)	(ft)	(ft)	
417	10	91.50	10.5	39.42	1.14	6.05	9.2	7.82	1.14	0.855	0.833	6	1.14	0.855	0.833	10.0	10.0	6	5.0	50%	Yes	3.5	0.64	10.9	EXAMPLE VII-G-3
2050	18	1564.00	26.4	50.38	3.61	2.93	13.2	13.63	3.61	2.71	2.250	4	3.61	2.7075	2.250	18.0	18.0	4	9.0	50%	Yes	8.8	0.93	18.0	~ Q PMF

APPENDIX B

PRINCIPAL SPILLWAY OUTLET

Design Example Hydraulic Design of Energy Dissipators for Culverts and Channels (HEC-14)

FHWA-EPD-86-110

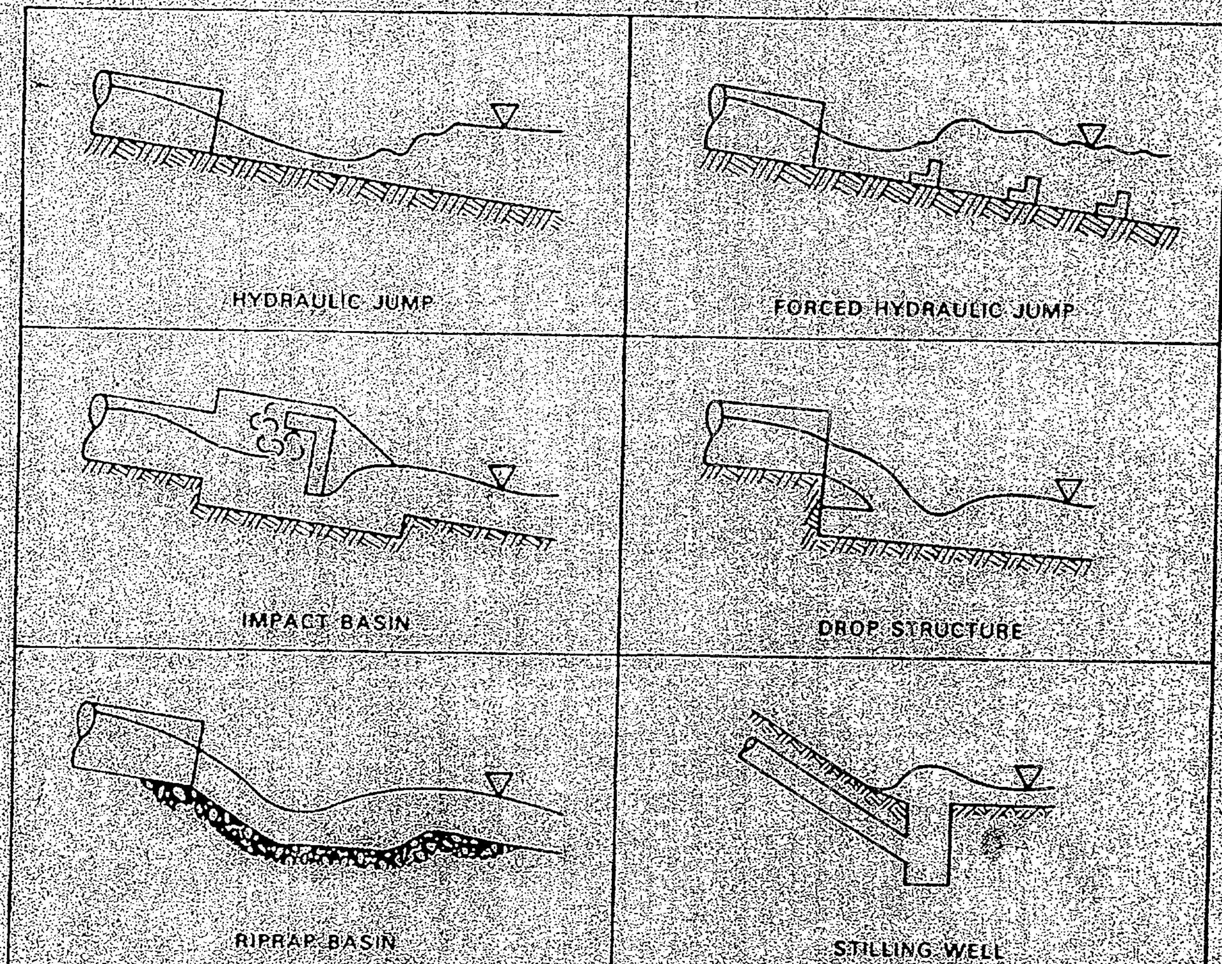
Hydraulic Design of Energy Dissipators for Culverts and Channels

Hydraulic Engineering Circular No. 14

September 1983

U.S. Department of Transportation

Federal Highway Administration



VII-G. SAF STILLING BASIN

The St. Anthony Falls or SAF stilling basin is a generalized design that uses a hydraulic jump to dissipate energy. The design is based on model studies conducted by the Soil Conservation Service at the St. Anthony Falls Hydraulic Laboratory of the University of Minnesota (VII-G-1).

The design provides special appurtenances, chute blocks, baffle or floor blocks and an end sill, which allow the basin to be shorter than free hydraulic jump basins. It is recommended for use at small structures such as spillways, outlet works, and canals where Fr = 1.7 to 17. Fr is the Froude number at the dissipator entrance. The reduction in basin length achieved through the use of appurtenances is about 80 percent of the free hydraulic jump length.

At the design flow, the SAF stilling basin provides an economical method of dissipating energy and preventing dangerous stream bed erosion.

Design Recommendations

The width W_B of the stilling basin is equal to the culvert width W_O. For circular conduits, W_B is the larger of D_O or

$$W_B = 0.3D(Q/D^{2.5}) \quad \text{. . . . . .VII-G-1}$$

The basin can be flared to fit an existing channel as indicated on figure VII-G-1. The sidewall flare dimension z should not be smaller than 2, i.e., 2:1, 3:1, or flatter.

The length L_B of the stilling basin for Froude numbers between Fr =1.7 and Fr=17 is proportional to the theoretical sequent depth y_j found from the hydraulic jump equation

$$y_j = y_1(\sqrt{1+8Fr_1^2}-1)/2 \quad \text{. . . . . .VII-G-2}$$

and

$$L_B = 4.5y_j/Fr^{0.76} \quad \text{. . . . . .VII-G-3}$$

The height of the chute block is y_1, and the width and spacing are approximately $0.75y_1$.

Floor or baffle blocks should be staggered with respect to the chute blocks and should be placed downstream a distance $L_B/3$. They should occupy between 40 and 55 percent of the stilling basin width. Widths and spacings of the floor blocks for diverging stilling basins should be increased in proportion to the increase in stilling-basin width at the floor-block location. No floor block should be placed closer to the side wall than $3y_1/8$.

Height of the end sill is $0.07y_j$, where y_j is the theoretical sequent depth corresponding to y_1.

The depth of tailwater y_2 above the stilling basin floor is:

$Fr=1.7$ to 5.5, $y_2=(1.1-Fr_1^2/120)y_j$ VII-G-4
$Fr=5.5$ to 11, $y_2=0.85y_j$. VII-G-5
$Fr=11$ to 17, $y_2=(1.0-Fr_1^2/800)y_j$ VII-G-6

Wingwalls should be equal in height and length to the stilling basin sidewalls. The top of the wingwall should have a 1:1 slope. Flaring wingwalls are preferred to perpendicular or parallel wingwalls. The best overall conditions are obtained if the triangular wingwalls are located at an angle of 45° to the outlet centerline.

The stilling basin sidewalls may be parallel (rectangular stilling basin) or diverge as an extension of the transition sidewalls (flared stilling basin). The height of the side wall above the maximum tailwater depth to be expected during the life of the structure is given by $y_j/3$.

A cut-off wall of adequate depth should be used at the end of the stilling basin to prevent undermining. The depth of the cut-off wall must be greater than the maximum depth of anticipated erosion at the end of the stilling basin.

Design Procedure

1. Choose basin configuration and flare diemension, z.

2. Determine basin width (W_B), elevation (z_1), length (L_B), total length (L), incoming depth (y_1), incoming Froude number (Fr_1), and jump height (y_2) by using the design procedure in section IV-B, Supercritical Expansion Into Hydraulic Jump Basins. For step 5E: y_2 is found from equation VII-G-4, 5, or 6 and y_j from equation VII-G-2. For step 5F: use equation VII-G-3 for L_B.

3. Chute Block:
height, $h_1=y_1$
width, (W_1)=spacing, $(W_2)=.75y_1$
Number, $N_c=W_B/2W_1$ rounded to a whole number
Adjusted $W_1=W_2=W_B/2N_c$
N_c includes the 1/2 block at each wall.

4. Baffle Block:
   height, $h_3=y_1$
   Width, (W_3)=Spacing, $(W_4)=.75y_1$
   Basin width at baffle blocks, $W_{B2}=W_B+2L_B/3z$
   Number of blocks, $N_B=W_{B2}/2W_3$ rounded to a whole number
   Adjusted $W_3=W_4=W_{B2}/2N_B$
   Check total block width to insure that at least 40 to 55 percent of W_{B2} is occupied by blocks

   Distance from chute blocks to baffle blocks = $L_B/3$

5. End Sill height, $h_4=.07y_j$

6. Side wall height = $y_2+y_j/3$

<u>Example Problem</u>

Given: Same conditions as VII-D
10X6 RCB, Q=417 cfs, S =6.5%
Elevation of outlet invert z_o=100 ft.
V_o=27.8 fps, y_o=1.5 ft.
Downstream channel is a 10 ft. bottom trapezoidal channel with 2:1 side slopes

Find: Dimensions for a SAF Basin

Solution:

1. Use rectangular basin with no flare

2. Determine basin elevation using design procedure in section IV-B, Supercritical Expansion Into Hydraulic Jump Basins.

   Steps from IV-B:

   1. V_o=27.8 fps, y_o=1.5 ft., Fr_o=4

   2. Downstream channel $TW=y_n$=1.9 ft., V_n=15.9 fps

   3. From equations VII-G-2&4:
      $y_j=y_1[(1+8Fr_1^2)^{1/2}-1]/2=1.5[(1+8x16)^{1/2}-1]/2=7.8$ ft.
      $y_2=(1.1-Fr_1^2/120)y_j=(1.1-16/120)7.8=7.5$ ft.

   4. Since y_2>TW, 7.5>1.9 drop the basin

   5. Use z_1=91.5 ft.

      A. W_B=10 ft., $S_T=S_S$=.5

      B. W_B-OK no flare

C. $Q=10y_1[2g(100-91.5+1.5-y_1)+27.8^2]^{1/2}$
$Q=10y_1[64.4(10-y_1)+772.8]^{1/2}$
$y_1=1.14$ ft.
$V_1=417/1.14(10)=36.6$ fps

D. $Fr_1=36.6/(g1.14)^{1/2}=6.04$

E. $y_j=y_1[\sqrt{(1+8Fr^2)}-1]/2=1.14[\sqrt{1+8(6.04)^2}-1]/2=9.2$ ft.
equation VII-G-5, $y_2=.85y_j=.85(9.2)=7.8$ ft.

F. Equation VII-G-3, $L_B=4.5y_j/Fr^{0.76}$
$=4.5(9.2)/3.9=10.5$ ft.
$L_T=(z_o-z_1)/S_T=(100-91.5)/.5=17$ ft.
$z_3=[100-(10.5+17-91.5/.5).065]/1.13=97.4$ ft.

G. $y_2+z_2=99.3$
$TW+z_3=99.3$ OK

6. $L_T=17$ft., $L_B=10.5$ ft.
$L_S=(z_3-z_2)/S_S=(97.4-91.5)/.5=12$ ft.
$L=17+10.5+12=39.5$ ft.

7. $Fr_o=4$ from figure IV-B-5, $y_o/r=.1$
$r=1.5/.1=15$ ft.

Basin Width, $W_B=10$ ft.
Basin Elevation, $z_1=91.5$ ft.
Basin Length, $L_B \approx 11$ ft.
Total Length, $L \approx 40$ ft.
Incoming depth, $y_1=1.14$ ft.
Incoming $Fr_1=6.04$
Theoretical jump height, $y_j=9.2$ ft.
Jump height, $y_2=7.8$ ft.

3. Chute Blocks:
$h_1 \approx 1.2$ ft.
$W_1 \approx .75y_1=.9$ ft.$=W_2$
$N_C=W_B/2W_1=10/2(.9)=5.6$, use 6 blocks
Adjusted $W_1=W_B/2N_C=10/2(6)=.8$ ft.
This gives 5 full blocks, 6 spaces, and a half block at each wall.

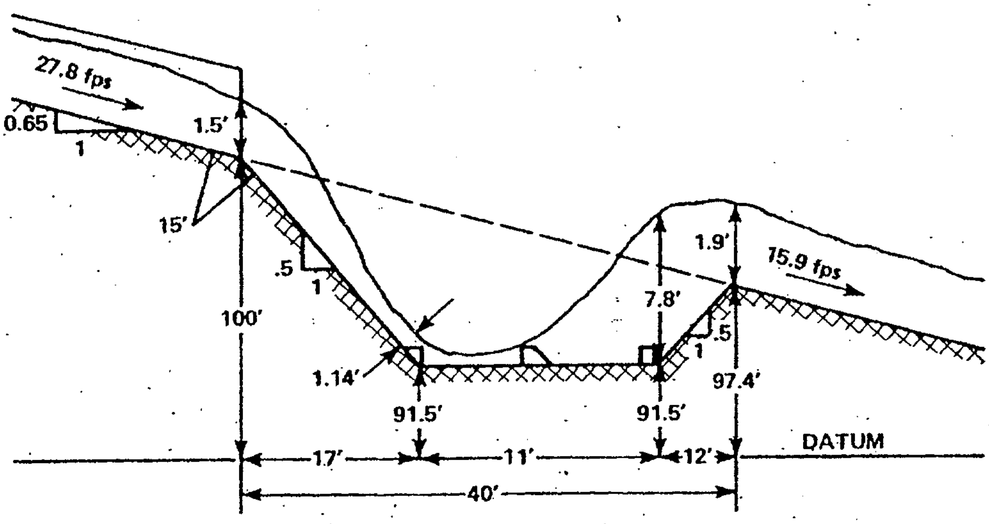
4. Baffle Blocks:
$h_3 \approx y_1=1.2$ ft.
$W_3 \approx .75y_1=.9$ ft.$=W_4$
Basin Width, $W_{B2}=W_B+2L_B/3z=10+0=10$ ft.
$N_B=W_{B2}/2W_3=10/2(9)=5.6$ ft., use 6 blocks
Adjust $W_3=W_4=10/2(6)=.8$ ft.
Total block width $= 6(.8)=4.8$ ft.
Check percent $4.8/10=.48$, $.4<.48<.55$ OK
This gives 6 blocks, 5 spaces, and a half space at each wall
Distance from chute block $= L_B/3=11/3=3.7$ ft.

5. End Sill:
$h_4 = .07y_j = .07(9.2) = .6$ ft.

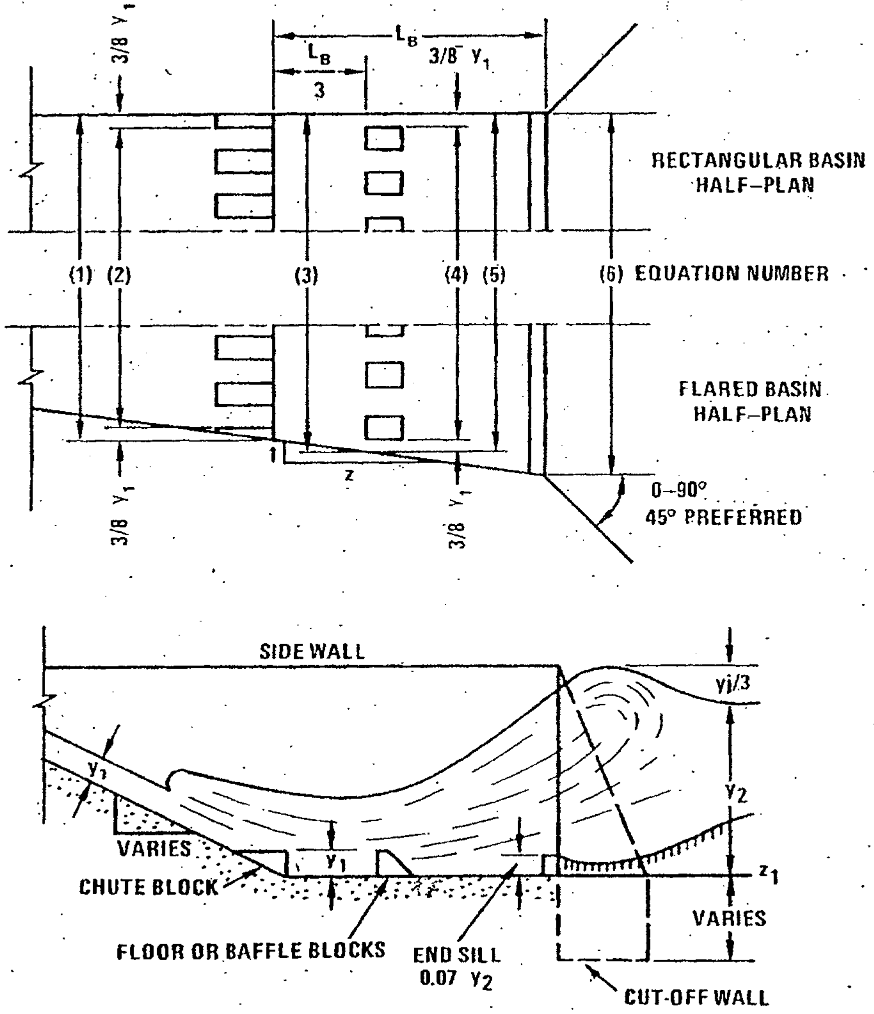
6. Side Wall:

Height $= y_2 + y_j/3 = 7.8 + 9.2/3 = 11$ ft.

VII-G-1. Blaisdell, F.W., THE SAF STILLING BASIN, U.S. Government Printing Office, 1959.



EXAMPLE PROBLEM SKETCH (VII-G)



(1) W_B = BASIN WIDTH UPSTREAM

(2) n BLOCKS AT 3/4 y_1 ±

(3) $0.40\,W_{B2} \leq$ AGGREGATE BLOCK WIDTH $\leq 0.55\,W_{B2}$

(4) n BLOCKS AT 3/4 $y_1 \; \frac{W_{B2}}{W_B} \pm$

(5) $W_{B2} = W_B + 2L_B/3z$

(6) $W_{B3} = W_B + 2L_B/z$

FIGURE VII-G-1. SAF STILLING BASIN-FROM REFERENCE VII-G-1

Comparison of baffle block basins:

The three USBR basins, Types II, III, and IV, and the St. Anthony Falls basin (SAF) were all designed using the same flow conditions:

Box Culvert 10x6
Discharge, Q=417 cfs
Velocity, V_O=27.8 fps
Depth, y_O=1.5 feet
Slope, S_O=6.5%
Froude Number, Fr_O=4.0

Type*	y_1	Fr_1	TW Req'd (ft)	L_B (ft)	L (ft)	Basin Elevation (ft)**
USBR						
II	1.0	7.6	11	48	97	84.5
III	1.04	6.9	9.7	26	67	87.5
IV	1.0	7.5	10	63	113	85
SAF	1.1	6.0	7.8	11	40	91.5

*All basins same width, 10 feet, rectangular, with constant cross section.
**The reference elevation of 100 ft. is the culvert outlet invert

SUPERCRITICAL FLOW EXPANSION

Supercritical expansion design has in part been discussed in section IV-A. The procedure outlined in that section should be used to determine apron or expansion flow conditions if the culvert exit Froude number (Fr) is less than 3, if the location where the flow conditions are desired is within 3 culvert diameters of the outlet, and if S_o is less than 10 percent.

For expansions outside these limits, the energy equation can be used to determine flow conditions leaving the transition. Normally, these parameters would then be used as the input values for a basin design.

Expansions Into Hydraulic Jump Basins

The expansion shown in figure IV-B-4 is used to convert depth or potential energy at the culvert outlet to kinectic energy by allowing the flow to expand, drop, or both. The result is the depth decreases, the velocity increases, and the Froude number increases. The higher Froude number Fr results in a more efficient jump and a shorter basin.

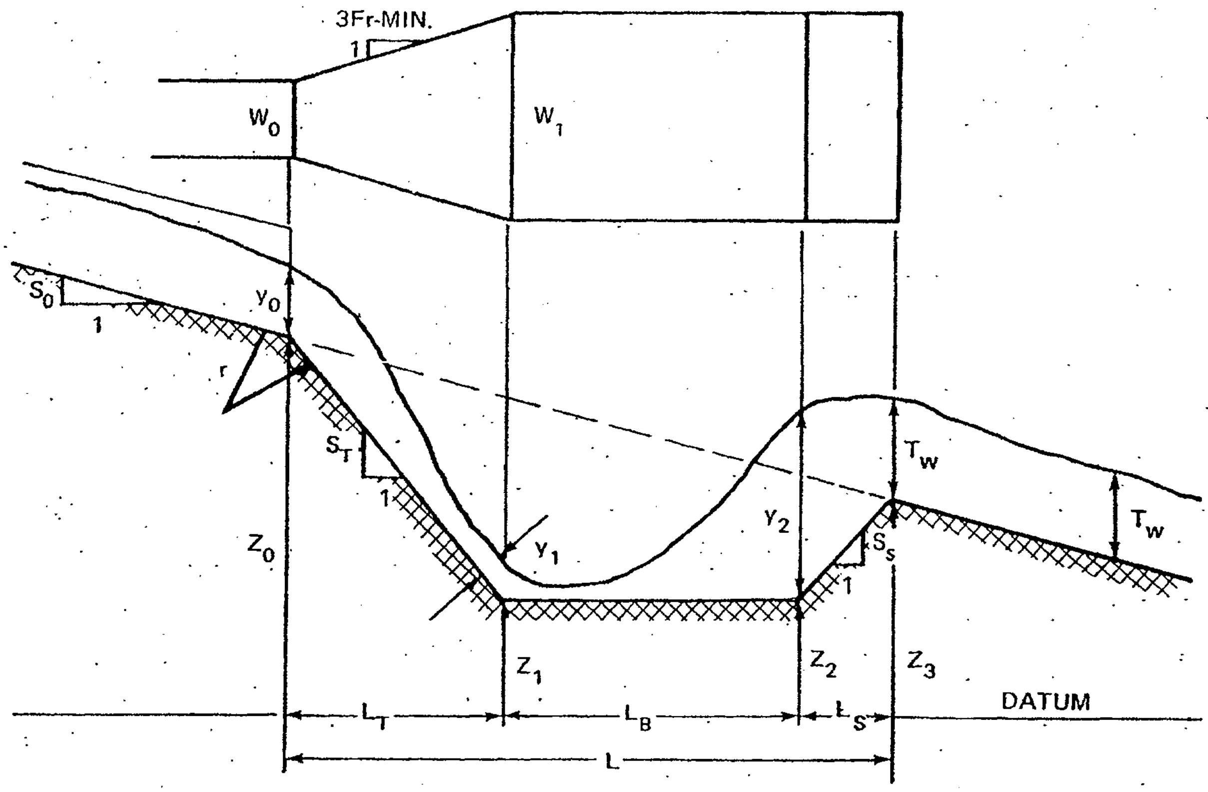


FIGURE IV-B-4. DEFINITION SKETCH BASIN TRANSITION

The energy balance is written from the culvert outlet to the basin, section 1. Substituting Q/y_1W_B for V_1 and solving for Q results in:

$$Q=y_1W_B[2g(z_o-z_1+y_o-y_1)+V_o^2]^{1/2} \quad \text{IV-B-7}$$

This expression has three unknowns y_1, W_B, and z_1. The depth y_1 can be determined by trial and error if W_B and z_1 are assumed. W_B should be limited to the width that a jet would flare naturally in the slope distance L .

$$W_B<W_o+2L_T\sqrt{S_T^2+1}/3Fr_o \quad \text{IV-B-8}$$

Since the flow is supercritical, the trial y_1 value should start near zero and increase until the design Q is reached. This depth y_1 is used to find the sequent depth, y_2 using the hydraulic jump equation:

$$y_2=C_1y_1[\sqrt{1+8Fr^2}-1]/2 \quad \text{IV-B-9}$$

where $C_1=TW/y_2$ ratio. For USBR basins, C_1 is found on figure VII-D-2; for the hydraulic jump, $C_1=1.0$; and for the SAF basin, C_1 varies with Fr (see section VII-H for the expressions). The above value of y_2+z_2 must be equal to or less than $TW+z_3$ for the jump to occur. In order to perform this check, z_3 is obtained graphically or by using the following expressions:

$$L_T=(z_o-z_1)/S_T \quad \text{IV-B-10}$$

$$L_S=(z_3-z_2)/S_S \quad \text{IV-B-11}$$

$$L_B=f(y_1,Fr_1) \quad \text{IV-B-12}$$

$$L=L_T+L_B+L_S=(z_o-z_3)/S_o$$

Solving for z_3 yields

$$z_3=[z_o-(L_T+L_B-z_2/S_S)S_o]/(S_o/S_S+1) \quad \text{IV-B-13}$$

This expression is valid only if z_2 is less than or equal to z_3.

If z_2+y_2 is greater than z_3+TW, the basin must be lowered and the trial and error process repeated until sufficient tailwater exists to force the jump.

Design Procedure

1. Calculate culvert brink depth y_o using figure III-9 or 10, velocity V_o, and $Fr_o=V_o/\sqrt{gy_o}$.

2. Determine y_n (tailwater, TW) in downstream channel with the aid of table III-1.

3. Find y_2 using equation IV-B-9.

4. Compare y_2 and TW. If $y_2 < TW$, the jump will form. If $Y_2 > TW$, lower the basin to provide additional tailwater.

5. Determine the elevation of the basin by trial and error.

   Choose trial basin elevation, z_1

   A. Choose basin width, W_B and basin slopes S_T and S_S. A slope of 0.5(2:1) or 0.33(3:1) is satisfactory for either S_T or S_S.
   B. Check W_B using equation IV-B-8
   C. Calculate y_1 by trial and error using equation IV-B-7 and calculate V_1
   D. Calculate $Fr_1 = V_1/\sqrt{gy_1}$
   E. Determine y_2 using equation IV-B-9 with C_1 corresponding to basin type
   F. Find z_3 using equation IV-B-13
   G. Calculate y_2+z_2 and z_3+TW. If y_2+z_2 is greater than z_3+TW, choose another z_1 and repeat steps 4A through G until balance is reached.

6. Calculate L_T, L_S, and L_B using equation IV-B-10, 11, and 12. The horizontal distance downstream to the sill crest, L, is $L_T+L_S+L_B$.

7. Determine radius to use between culvert and transition from figure IV-B-5.

IV-B-1. Meshgin, K., Moore, W. L., DESIGN ASPECTS AND PERFORMANCE CHARACTERISTICS OF RADIAL FLOW ENERGY DISSIPATORS, University of Texas at Austin, Research Report 116-2F, August 1970.

Example Problem

Given: 10x6RCB, $Q=417$ cfs, $S_o=6.5\%$
Elevation outlet invert $z_o=100$ feet
$V_o=27.8$ fps, $y_o=1.5$ feet
Downstream channel is a 10 ft. bottom trapezoidal channel with 2:1 side slopes and $n=.03$

Find: Dimensions for hydraulic jump basin

Solution:

1. $V_o=27.8$ fps, $y_o=1.5$ ft.

   $Fr_o=27.8/\sqrt{g1.5}=4$

2. $Qn/b^{8/3}S^{1/2}=417(.03)/10^{8/3}(.065)^{1/2}=.1057$

   $d/b=y_n/b=.19$, $y_n=TW=1.9$ ft., $V_n=15.9$ fps

3. $y_2=C_1y_1[\sqrt{1+8Fr^2}-1]/2=1.5[\sqrt{1+8(4)^2}-1]/2=7.8$ ft.

4. Since $y_2>TW$, $7.7>1.9$, The basin is too high.

5. Try $z_1=94$ ft. since $y_2-TW=6$ ft.
   A. $W_B=10$ ft., $S_T=S_s=.5$

   B. $W_B=W_o+2(z_o-Z_1)\sqrt{S_T^2+1}/3Fr_oS_T$

      $W_B=10+2(100-94)\sqrt{.5^2+1}/3(4).5=12.2$ ft.>10 ft. o.k.
   C. $Q=y_1 10[2g(100-94+1.5-y_1)+27.8^2]^{1/2}$
      $Q=10y_1[64.4(7.5-y_1)+772.8]^{1/2}$
      Try $y_1=1$ ft., $Q=345$-low
      $y_1=2$ ft., $Q=671$-high
      $y_1=1.22$ ft., $Q=418$-OK
      $V=417/1.22(10)=34.2$ fps
   D. $Fr_1=34.2/\sqrt{g1.22}=5.45$
   E. for $C_1=1$, $y_2=1.22[\sqrt{1+8(5.45)^2}-1]/2=8.81$
   F. $L_B=43(1.22)=53$ ft. figure VI-11
      $L_T=(z_o-z_1)/S_T=(100-94)/.5=12$ ft.
      $z_3=[100-(12+53-94/.5).065]/(.065/.5+1)$
      $z_3=[100+8]/1.13=95.6$ ft.
   G. $y_2+z_2=94+8.8=102.8$ ft.
      $z_3+TW=95.6+1.9=97.5$ ft.
      $102.8>97.5$ try $z_1=90$ ft.

   Try $z_1=90$ ft.
   A. $W_B=10$ ft., $S_T=S_s=.5$
   B. $W_B=10$ ft. OK
   C. $Q=10y_1[64.4(11.5-y_1)+772.8]^{1/2}$
      $y_1=1.1$ ft., $V_1=37.9$ fps

D. $Fr_1=37.9/\sqrt{g1.1}=6.37$

E. $y_2=1.1[\sqrt{1+8(6.37)^2}-1]/2=9.37$

F. $L_B=53(1.1)=58$ ft.

$L_T=(100-90)/.5=20$ ft.

$z_3=[100-(20+58-90/.5).065]/1.13$

$z_3=94.4$ ft.

G. $y_2+z_2=9.37+90=99.4$ ft.

$z_3+TW=94.4+1.9=96.3$ ft.

since $99.4>96.3$ try $z_1=85$ ft.

Try $z_1=85$

A. $W_B=10$ ft., $S_T=S_S=.5$

B. $W_B=10$ ft. OK

C. $Q=10y_1[64.4(16.5-y_1)+772.8]^{1/2}$

$y_1=.99$ ft., $V_1=42.1$ fps

D. $Fr_1=42.1/\sqrt{g.99}=7.46$

E. $y_2=.99[\sqrt{1+8(7.46)^2}-1]/2=9.96$

F. $L_B=64(0.99)=63$ ft.

$L_T=(100-85)/.5=30$ ft.

$z_3=[100-(30+63-85/.5).065]/1.13$

$z_3=92.9$

G. $y_2+z_2=95$ ft.

$z_3+TW=94.8$ ft. OK use $z_1=85$ ft.

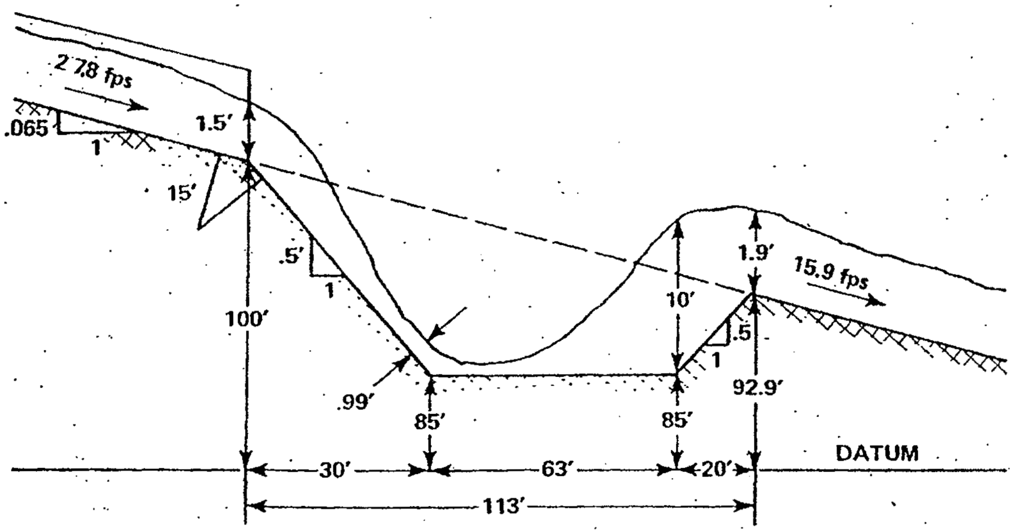
5. $L_T=30$ ft., $L_B=63$ ft.

$L_S=(z_3-z_2)/S_S=(\cancel{94.8}\ 92.9-85)/.5=\cancel{19.6}\ 15.8$ ft.

$L=30+63+\cancel{19.6}\ 15.8=112.6$ ft.

108.8 ⇒ 109

6. $Fr_o=4$ from figure IV-B-5 $y_o/r=.1$



EXAMPLE PROBLEM SKETCH (IV-B)

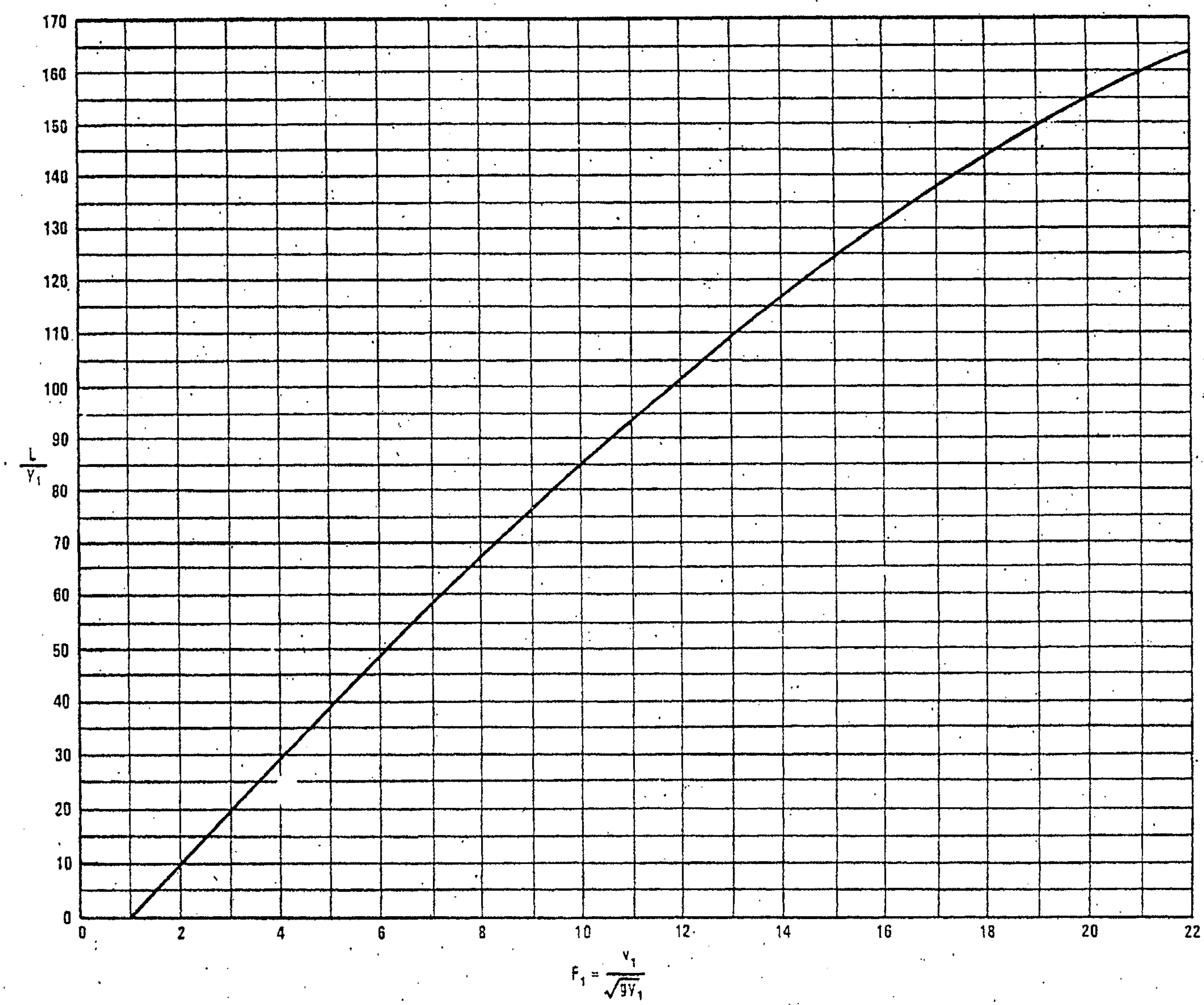


FIGURE VI-11. LENGTH OF JUMP IN TERMS OF Y_1, RECTANGULAR CHANNEL

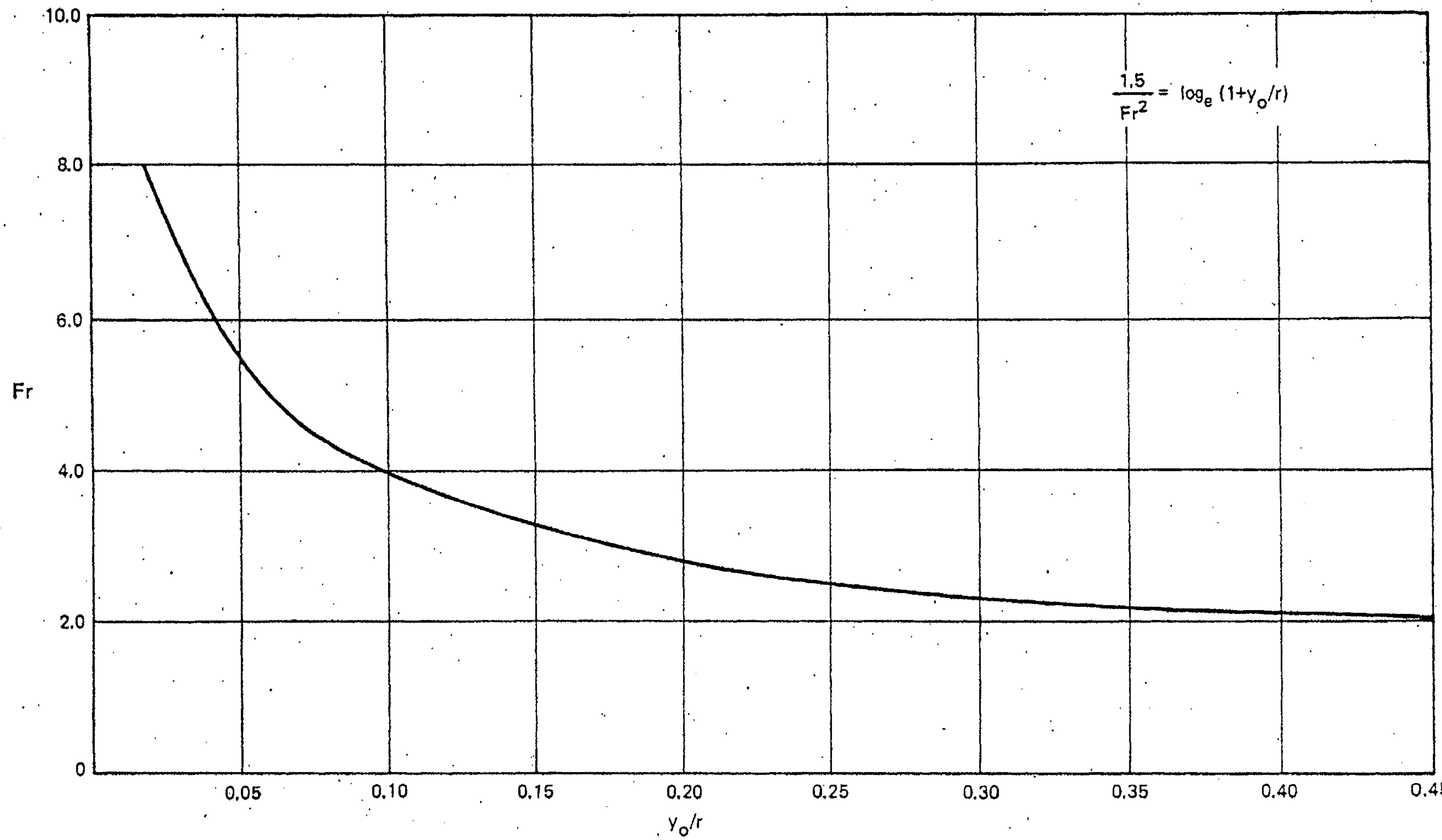


FIGURE IV-B-5 Fr Vs. y_o/r FOR TRANSITION FROM REFERENCE IV-B-1

APPENDIX B

PRINCIPAL SPILLWAY OUTLET

Structural Calculations

Stanley Consultants INC

Structural Calculations

Project:	Principal Spillway, Inlet and Outlet Structures
Client:	Arizona Department of Transportation
SCI Project No:	17000
Date:	August 1, 2005

Designed:	D. Joder
Checked:	J. Lange and N. Vivar
Approved:	D. Shiosaka

Table of Contents

DESIGN CRITERIA:

Design Code: AASHTO Standard Specification for Highway Bridges, 16th Ed.
17th Edition, 2002

Concrete Design: Allowable Stress Design (ASD)

Loading: Lateral Earth Pressure - 35 pcf Equivalent Fluid Pressure
Hydrostatic Loading - 62.4 pcf

Allowable Stresses:

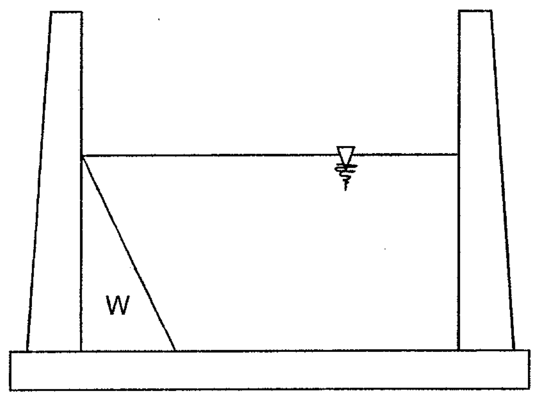
$f'c$ = 3,000 psi
fy = 60,000 psi
$f_{c\text{-allow}}$ = 1200 psi
$f_{s\text{-allow}}$ = 24,000 psi

U-Channel Outlet:

During a flood event water will flow around the ends of the wingwalls and the u-channel will have roughly equal water levels on both sides of the walls (i.e. no load to the walls). During extremely high flows there might be some inequality of water levels (hydraulic jump) but it is not possible to determine exactly what the nature of that inequality will be. Ergo, a conservative approach is to design for 10' of hydrostatic water pressure on the inside of the u-channel only. Designing for a full 18' water depth is overly conservative and not a realistic loading scenario.

Geometry & Design Moments:

Water Depth, H =	10	ft
EFP =	62.4	pcf
W =	3.120	kips
Wall Thickness @ Top =	10	in
Wall Thickness @ Bottom =	22	in



Reinforcing (ASD):

f'_c =	3000	psi
f_y =	60000	psi
$f_{c\text{-allow}}$ =	1200	psi
$f_{s\text{-allow}}$ =	24000	psi
E_{conc} =	3122019	psi
E_{steel} =	29000000	psi
n =	9.3	
analysis width, b =	12	in

@ base of wall (S1 bars):

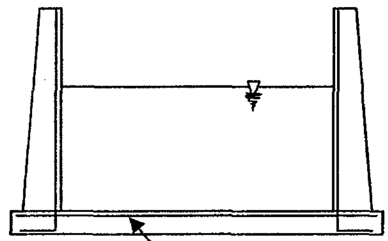
Fraction of Wall Height =	1.00	(as measured from the top down)
Wall thickness =	22.0	in
Bar Size =	6	
Bar Diameter =	0.75	in
Bar Area =	0.44	in2
Cover =	2	in
d =	19.63	in
Spacing =	12.00	in

$M_{design\ load}$ =	10.4	k*ft (working load)
A_s =	0.442	in^2 per b
ρ =	0.0019	
k =	0.170	
kd (in) =	3.3	
$M_{rebar\ capacity}$ (k-ft) =	16.36	**OK! > $M_{design\ load}$**
@ $M_{design\ load}$, f_c (psi) =	337	**OK, < $f_{c-allow}$**

Minum Rebar Checks (per AASHTO 8.17.1.1 & ADOT BPG pg 5-6):

I_{gross} (in^4) =	10648	
f_r (psi) =	411	AASHTO 8.15.2.1.1
1.2*M_{cr} (k-ft) =	40	AASHTO 8.13.3
1.2*M_{max} (k-ft) =	12.5	**OK!**

Footing Design: For hydrostatic condition, assume moment at base of wall is transferred directly to footing. Check soil bearing assuming uniform loading since system is not subject to rotation.



Footing Thickness =	22.0	in
Bar Size =	6	
Bar Diameter =	0.75	in
Bar Area =	0.44	in2
Cover =	2	in
d =	19.63	in
Spacing =	12.00	in

$M_{design\ load}$ =	10.4	k*ft (working load)
A_s =	0.442	in^2 per b
ρ =	0.0019	
k =	0.170	
kd (in) =	3.3	
$M_{rebar\ capacity}$ (k-ft) =	16.36	**OK! > $M_{design\ load}$**
@ $M_{design\ load}$, f_c (psi) =	337	**OK, < $f_{c\text{-}allow}$**

Minum Rebar Checks (per AASHTO 8.17.1.1 & ADOT BPG pg 5-6):

I_{gross} (in^4) =	10648	
f_r (psi) =	411	AASHTO 8.15.2.1.1
1.2*M_{cr} (k-ft) =	40	AASHTO 8.13.3
1.2*M_{max} (k-ft) =	12.5	**OK!**

Soil Bearing:

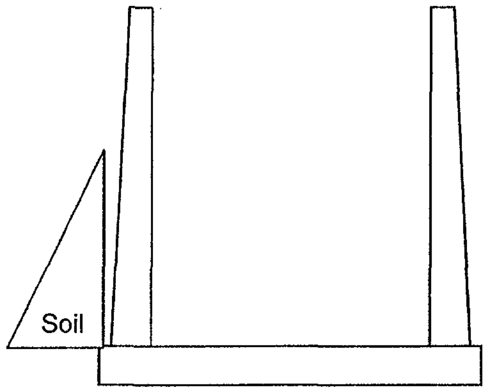
Allowable =	2500	psf (per Prelim. Geotech Rpt, May 2004, P. 34)
Wall Weight =	4000	plf of U-Channel (for both walls combined)
Slab Width =	22.67	ft
Slab Weight =	6234	plf of U-Channel
Channel Width =	18	ft
Water =	11232	plf of U-Channel
Total Wt of Channel + Water =	21466	plf
Unit Bearing Load to Soil =	947	psf (assumes walls are distributed)
	OK!	

U-Channel Outlet:

While the walls are not to be backfilled, the possibility remains that some backfilling may occur during current or future earthwork activity. Conservatively apply 14' of backfill to wall. By observation, this loading will control over a full-height wind load with no backfill. Given the conservative nature of this loading scenario, neglect any wind load above the 14' soil profile.

Geometry & Design Moments:

Wall Height, H =	18	ft
Soil Depth, h =	14	
EFP =	35	pcf
W =	3.430	kips
Wall Thickness @ Top =	10	in
Wall Thickness @ Bottom =	22	in



Reinforcing (ASD):

f'_c =	3000	psi
f_y =	60000	psi
$f_{c\text{-allow}}$ =	1200	psi
$f_{s\text{-allow}}$ =	24000	psi
E_{conc} =	3122019	psi
E_{steel} =	29000000	psi
n =	9.3	
analysis width, b =	12	in

@ base of wall (S1 bars):

Fraction of Wall Height =	1.00	(as measured from the top down)
Wall thickness =	22.0	in
Bar Size =	8	
Bar Diameter =	1	in
Bar Area =	0.79	in2
Cover =	2	in
d =	19.50	in
Spacing =	12.00	in

$M_{design\ load}$ =	16.0	k*ft (working load)
A_s =	0.785	in^2 per b
ρ =	0.0034	
k =	0.220	
kd (in) =	4.3	
$M_{rebar\ capacity}$ (k-ft) =	28.38	**OK! > $M_{design\ load}$**
@ $M_{design\ load}$, f_c (psi) =	412	**OK, < $f_{c\text{-}allow}$**

Minum Rebar Checks (per AASHTO 8.17.1.1 & ADOT BPG pg 5-6):

I_{gross} (in^4) =	10648	
f_r (psi) =	411	AASHTO 8.15.2.1.1
1.2*M_{cr} (k-ft) =	40	AASHTO 8.13.3
1.2*M_{max} (k-ft) =	19.2	**OK!**

Footing Design:

Footing Thickness =	22.0	in
Bar Size =	8	
Bar Diameter =	1	in
Bar Area =	0.79	in2
Cover =	3	in
d =	18.50	in
Spacing =	12.00	in

$M_{design\ load}$ =	16.0	k*ft (working load)
A_s =	0.785	in^2 per b
ρ =	0.0035	
k =	0.226	
kd (in) =	4.2	
$M_{rebar\ capacity}$ (k-ft) =	26.87	**OK! > $M_{design\ load}$**
@ $M_{design\ load}$, f_c (psi) =	448	**OK, < $f_{c\text{-}allow}$**

Minum Rebar Checks (per AASHTO 8.17.1.1 & ADOT BPG pg 5-6):

I_{gross} (in^4) =	10648	
f_r (psi) =	411	AASHTO 8.15.2.1.1
1.2*M_{cr} (k-ft) =	40	AASHTO 8.13.3
1.2*M_{max} (k-ft) =	19.2	**OK!**

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Computed by N.L. VIVAR	Date 03 MAR 2005	Project No. 17000	Page No. 8
Checked by [initials]	Date	Subject SPILLWAY OUTLET CONCRETE QTY	
Approved by DRS	Date 01AUG05	Sheet No. 1 of 4	

→ BAFFLES

$$\frac{12'' \times 3'}{2} \times (3'\text{-}8) \times (2.25') = 16.50 \text{ FT}^3/\text{BAFFLE}$$

BAFFLE SUBTOTAL = 4 × 16.50 = $\boxed{66.00 \text{ FT}^3}$ ✓

→ CHUTE BLOCK

$$\tfrac{1}{2}(10'\text{-}10) \times (3'\text{-}8) \times (2'\text{-}3) = 44.69 \text{ FT}^3/\text{BLOCK}$$

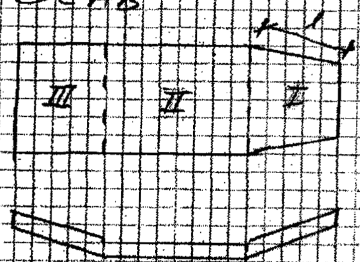
SAY 3.5 BLOCKS TOTAL

CHUTE BLOCK SUBTOTAL = $\boxed{156.41 \text{ FT}^3}$ ✓

→ END SILL

$$1' \times 1' \times 18' = 18.00 \text{ FT}^3$$

→ SLAB



IF $H = 14'$ $t_{WALL} = 19\tfrac{1}{3}''$

$$V_{I} = 12' \times \frac{[12' + 2(19\tfrac{1}{3}'') + 1'] + (22'\text{-}8)}{2} \times 1'\text{-}10 = 427.\overline{7}$$

$$V_{II} = (17'\text{-}8 + 8'\text{-}10) \times (22'\text{-}8) \times (1'\text{-}10) = 1101.\overline{2}$$

$$V_{III} = 12' \times \frac{(22'\text{-}8) + [18 + 2(19\tfrac{1}{3}) + 1]}{2} \times (1'\text{-}10) = 493.\overline{7}$$

SLAB SUBTOTAL = $\boxed{2022.76 \text{ FT}^3}$ ✓

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Project No. 17000 Page No. 9

Subject

Computed by N. L. VIVAR Date 05 MAR 2005

Checked by [signature] 8.1.05 Date

Approved by [signature] DRS Date 01 AUG 05 Sheet No. 2 of 4

→ HEADWALL CURB

$10'' \times (12' + 20'') \times (4'-11) = \boxed{56.00 \ FT^3}$

→ WALLS

$\cancel{h = \sqrt{4^2 + 1^2} = \sqrt{17}}$

$\cancel{l = 12 \frac{\sqrt{17}}{4} = 12.37 \ FT}$

LEVEL PORTION, II

$\frac{10 + (1'-10)}{2} \times 18' \times [(17'-8) + (8'-10)] = 636 \ FT^3$

SLOPING PORTIONS, I & III

$A_1 = \frac{10' \times 1'-10}{2} \times 18 = 24$

$\frac{22''-10''}{18'} = 2/3 \ IN/FT$

$t_{BOT-2} = 10 + \frac{2}{3}(14) = 19 \frac{1}{3}$

$A_2 = \frac{10 + 19\frac{1}{3}}{2} \times 14' = 17.\overline{1}$

$\frac{24 + 17.\overline{1}}{2} \times 12 = 246.\overline{6}$

WALL SUBTOTAL $= 2(636) + 4(246.\overline{6}) = \boxed{2258.67 \ FT^3}$

SC 3020 R2 199

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Project No. 17000	Page No. 10
Subject	
Computed by N. G. VIVAR	Date 05 MAR 2005
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Approved by DRS	Date 01 AUG 05
Sheet No. 3 of 4	

→ CUTOFF WALL

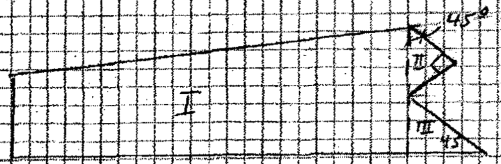
$1' \times 18' \times [6' - (1'\text{-}10)] = 75.00$

$1 \times 9.5 \times [6 - (1'\text{-}3)] = 45.125$

SUBTOTAL $= 75.00 + 2 \times 45.125 = \boxed{165.25 \ FT^3}$

→ WING WALL FOOTINGS

$(1'\text{-}3) \times \dfrac{(4'\text{-}3) + 8'}{2} \times 9.5 = 72.73 = V_I$



$A_{II} = \frac{1}{2}\left[(4'\text{-}7) \sin 45\right]^2 = 5.251$

$A_{III} = \frac{1}{2}\left[2.25\right]^2 = 2.531$

$2\left[72.33 + (2.531 + 5.251) \times 1.25\right] = \boxed{164.12 \ FT^3}$

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Project No. 17000 Page No. 11

Subject

Computed by N. L. Vivar Date 05 MAR 2005

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Approved by DRS Date 01 AUG 05 Sheet No. 4 of 4

→ WING WALLS

$$A_1 = \frac{10 + (1.5 \cdot 2)}{2} \times 14 = 14 \ FT^2$$

$$A_2 = 10'' \times 6.5' = 5.42 \ FT^2$$

$$A_1 \times 9'' = 10.5 \ FT^3$$

$$\frac{A_1 + A_2}{2} \times 8'\text{-}9 = 84.96$$

SUBTOTAL = 169.93

→ TOTAL

66 + 156.41 + 2022.76 + 56 + 2258.67 + 165.25
+ 164.12 = 4889.21 FT³

= 181.1 YD³

SC 3020 R2 199

Stanley Consultants INC.

Job No. 17000 Page No. 12
Subject Spillway Outlet Rebar Quantity

Computed by N. L. Vivar Date 05 Apr 2005
Checked by [illegible] Date 4.1.05
Approved by DRS Date 01AUG05
Sheet No. of

Bar Size	Weight (lb/ft)
3	0.376
4	0.668
5	1.043
6	1.502
7	2.044
8	2.67
9	3.4
10	4.303
11	5.313
14	7.65
18	13.6

Length along Wing Wall	Height	Assumed Design Height
0	14.00	14
1	13.21	14
2	12.42	14
3	11.63	12
4	10.84	12
5	10.05	12
6	9.26	10
7	8.47	10
8	7.68	10
9	6.89	7
9.5	6.50	7

Size	Quantity (ea)	Length (ft)	Weight per Length (lb/ft)	Weight (lb)	Comment
Bottom Slab					
4	18	3	0.668	36.1	Dowels
4	42	15.32	0.668	429.7	Long. chute
4	46	27.50	0.668	845.0	Long. lower slab
4	46	15.32	0.668	470.6	Long. inclined slab
6	14	22.33	1.502	469.6	Trans. chute
8	14	19.33	2.67	722.7	Trans. chute
6	29	25.67	1.502	1118.0	Trans. lower slab
8	29	22.67	2.67	1755.1	Trans. lower slab
6	14	25.67	1.502	539.7	Trans. inclined slab
8	14	22.67	2.67	847.3	Trans. inclined slab
Chute Blocks					
4	5	12.08	0.668	40.4	0 Trans. Vert. U-bar
4	5	11.42	0.668	38.1	1 Trans. Vert. U-bar
4	5	10.75	0.668	35.9	2 Trans. Vert. U-bar
4	5	10.08	0.668	33.7	3 Trans. Vert. U-bar
4	5	9.42	0.668	31.5	4 Trans. Vert. U-bar
4	5	8.75	0.668	29.2	5 Trans. Vert. U-bar
4	5	8.08	0.668	27.0	6 Trans. Vert. U-bar
4	5	7.42	0.668	24.8	7 Trans. Vert. U-bar
4	5	6.75	0.668	22.5	8 Trans. Vert. U-bar
4	5	6.08	0.668	20.3	9 Trans. Vert. U-bar
4	5	23.17	0.668	77.4	0 Trans. Horiz. U-bar
4	5	17.17	0.668	57.3	1 Trans. Horiz. U-bar
4	5	11.17	0.668	37.3	2 Trans. Horiz. U-bar
4	25	16.83	0.668	281.1	Long. U-bar
Baffle Blocks					
5	20	7.289689439	1.043	152.1	Vert. U-bar
4	8	1.416666667	0.668	7.6	Horiz. U-bar
4	8	2.416666667	0.668	12.9	Horiz. U-bar
4	8	3.416666667	0.668	18.3	Horiz. U-bar
4	8	4.416666667	0.668	23.6	Horiz. U-bar
End Sill					
4	19	4.333333333	0.668	55.0	Vert. U-bar
4	2	19	0.668	25.4	Trans.
Channel cutoff wall					
4	23	6.185286842	0.668	95.0	Vert. L-bar
4	23	4.601953508	0.668	70.7	Vert. L-bar
4	9	22	0.668	132.3	Horiz. Bar
Headwall curb					
4	11	13	0.668	95.5	
4	14	5.25	0.668	49.1	
Chute walls					
4	64	12.36931688	0.668	528.8	Horiz. Bar
6	4	12.36931688	1.502	74.3	Horiz. Bar
6	28	14.08333333	1.502	592.3	Vert. Bar
8	28	10.41666667	2.67	778.8	Vert. Bar
5	28	6.083333333	1.043	177.7	Vert. Bar
5	28	9.416666667	1.043	275.0	Vert. Bar

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Job No. 17000 Page No. 13
Subject Spillway Outlet Rebar Quantity

Computed by N.L. Vivat Date 05 Apr 2005
Checked by [signature] Date 8.1.05
Approved by [signature] DRS 01AUG05 Date
Sheet No. of

Bar Size	Weight (lb/ft)
3	0.376
4	0.668
5	1.043
6	1.502
7	2.044
8	2.67
9	3.4
10	4.303
11	5.313
14	7.65
18	13.6

Length along Wing Wall	Height	Assumed Design Height
0	14.00	14
1	13.21	14
2	12.42	14
3	11.63	12
4	10.84	12
5	10.05	12
6	9.26	10
7	8.47	10
8	7.68	10
9	6.89	7
9.5	6.50	7

Size	Quantity (ea)	Length (ft)	Weight per Length (lb/ft)	Weight (lb)	Comment
18' walls					
4	72	23.5	0.668	1130.3	Horiz. Bar
6	4	23.5	1.502	141.2	Horiz. Bar
6	56	14.08333333	1.502	1184.6	Vert. Bar
6	56	8.666666667	1.502	729.0	Vert. Bar
8	56	10.41666667	2.67	1557.5	Vert. Bar
5	56	8.083333333	1.043	472.1	Vert. Bar
5	56	11.41666667	1.043	666.8	Vert. Bar
Channel end walls					
4	64	12	0.668	513.0	Horiz. Bar
6	4	12	1.502	72.1	Horiz. Bar
6	26	14.08333333	1.502	550.0	Vert. Bar
6	26	8.666666667	1.502	338.5	Vert. Bar
8	26	10.41666667	2.67	723.1	Vert. Bar
5	26	6.083333333	1.043	165.0	Vert. Bar
5	26	9.416666667	1.043	255.4	Vert. Bar
Wing walls (walls, footings, & cutoff walls)					
4	16	9.5	0.668	101.5	Wall Horizontal Bar
5	22	11.91666667	1.043	273.4	Wall Vertical bar (comp. side)
5	22	6	1.043	137.7	Footing transverse bot. bar
4	32	9.5	0.668	203.1	Footing long. bar
5	22	12	1.043	275.4	Cutoff wall U-bar
4	20	9.5	0.668	126.9	Cutoff wall long. Bar
7	6	7	2.044	85.8	Vert. Bar -- S1, 14'
6	6	5.25	1.502	47.3	Vert. Bar -- S1, 12'
6	6	11.75	1.502	105.9	Vert. Bar -- S1, 10'
5	4	8.5	1.043	35.5	Vert. Bar -- S1, 7'
5	6	15.75	1.043	98.6	Vert. Bar -- S2, 14'
5	6	13.75	1.043	86.0	Vert. Bar -- S2, 12'
7	6	8.666666667	2.044	106.3	Footing transverse top bar -- T, 14'
6	6	7.666666667	1.502	69.1	Footing transverse top bar -- T, 12'
6	6	6.666666667	1.502	60.1	Footing transverse top bar -- T, 10'
5	4	5.166666667	1.043	21.6	Footing transverse top bar -- T, 7'
			Total Weight =	21487.1	lbs.

OK - by comparison to ADOT Std 3.20
ADJ 8-1-05

```
STAAD PLANE BOX CULVERT
START JOB INFORMATION
JOB NAME 17000
JOB CLIENT ADOT
JOB NO 17000
ENGINEER NAME N.L. Vivar
ENGINEER DATE 06-Apr-05
END JOB INFORMATION
INPUT WIDTH 79
UNIT FEET KIP
JOINT COORDINATES
1 0 9.54 0; 2 13.25 9.54 0; 3 0 0 0; 4 13.25 0 0;
MEMBER INCIDENCES
1 1 2; 2 3 1; 3 4 2;
DEFINE MATERIAL START
ISOTROPIC CONCRETE
E 453600
POISSON 0.17
DENSITY 0.14999
ALPHA 5.5e-006
DAMP 0.05
END DEFINE MATERIAL
MEMBER PROPERTY AMERICAN
2 3 PRIS YD 1.25 ZD 1
1 PRIS YD 1.08333 ZD 1
CONSTANTS
MATERIAL CONCRETE MEMB 1 TO 3
SUPPORTS
3 4 FIXED
LOAD 1 LOADTYPE Dead  TITLE DEAD
SELFWEIGHT Y -1
LOAD 2 LOADTYPE None  TITLE SOIL -- SATURATED
MEMBER LOAD
1 UNI GY -0.36
2 TRAP GX 1.016 0.3
3 TRAP GX -1.016 -0.3
LOAD 3 LOADTYPE None  TITLE LIVE
MEMBER LOAD
1 UNI GY -3.05 4 9.25
LOAD 4 LOADTYPE None  TITLE SOIL -- SUBMERGED
MEMBER LOAD
1 UNI GY -0.36
2 TRAP GX 1.309 0.45
3 TRAP GX -1.309 -0.45
LOAD COMB 10 COMBINATION LOAD
2 1.5 3 2.16667 1 1.5
LOAD COMB 11 COMBINATION LOAD -- SUBMERGED SOIL LOAD
4 1.5 1 1.0
PERFORM ANALYSIS PRINT STATICS CHECK
FINISH
```

Job Information

	Engineer	Checked	Approved
Name:	N.L. Vivar		
Date:	06-Apr-05		

Structure Type	PLANE FRAME

Number of Nodes	4	Highest Node	4
Number of Elements	3	Highest Beam	3

Number of Basic Load Cases	4
Number of Combination Load Cases	2

Included in this printout are data for

All	The Whole Structure

Included in this printout are results for load cases

Type	L/C	Name
Primary	1	DEAD
Primary	2	SOIL -- SATURATED
Primary	3	LIVE
Primary	4	SOIL -- SUBMERGED
Combination	10	COMBINATION LOAD
Combination	11	COMBINATION LOAD -- SUBMERGED S(

Beam Force Detail

Sign convention as diagrams:- positive above line, negative below line except Fx where positive is compression. Distance d is given from beam e(A.

			Axial	Shear		Torsion	Bending	
Beam	**L/C**	**d** (ft)	**Fx** (kip)	**Fy** (kip)	**Fz** (kip)	**Mx** (kip`ft)	**My** (kip`ft)	**Mz** (kip`ft)
1	1:DEAD	0.000	0.296	1.076	0.000	0.000	0.000	1.910
		1.325	0.296	0.861	0.000	0.000	0.000	0.642
		2.650	0.296	0.646	0.000	0.000	0.000	-0.349
		3.975	0.296	0.431	0.000	0.000	0.000	-1.062
		5.300	0.296	0.215	0.000	0.000	0.000	-1.498
		6.625	0.296	-0.000	0.000	0.000	0.000	-1.656
		7.950	0.296	-0.215	0.000	0.000	0.000	-1.498
		9.275	0.296	-0.431	0.000	0.000	0.000	-1.062
		10.600	0.296	-0.646	0.000	0.000	0.000	-0.349
		11.925	0.296	-0.861	0.000	0.000	0.000	0.642
		13.250	0.296	-1.076	0.000	0.000	0.000	1.910
	2:SOIL -- SATU	0.000	2.545	2.385	0.000	0.000	0.000	5.076
		1.325	2.545	1.908	0.000	0.000	0.000	2.267
		2.650	2.545	1.431	0.000	0.000	0.000	0.072

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Software licensed to STANLEY CONSULTANTS INC	Job No 17000	Sheet No 2	Rev
	Part		
Job Title 17000	Ref		
	By N.L. Vivar	Date 06-Apr-05	Chd
Client ADOT	File spillway_inlet.std	Date/Time 13-Apr-2005 09:58	

Beam Force Detail Cont...

			Axial	Shear		Torsion	Bending	
Beam	L/C	d (ft)	Fx (kip)	Fy (kip)	Fz (kip)	Mx (kip`ft)	My (kip`ft)	Mz (kip`ft)
		3.975	2.545	0.954	0.000	0.000	0.000	-1.508
		5.300	2.545	0.477	0.000	0.000	0.000	-2.473
		6.625	2.545	0.000	0.000	0.000	0.000	-2.825
		7.950	2.545	-0.477	0.000	0.000	0.000	-2.473
		9.275	2.545	-0.954	0.000	0.000	0.000	-1.508
		10.600	2.545	-1.431	0.000	0.000	0.000	0.072
		11.925	2.545	-1.908	0.000	0.000	0.000	2.267
		13.250	2.545	-2.385	0.000	0.000	0.000	5.076
	3:LIVE	0.000	3.127	8.006	0.000	0.000	0.000	20.189
		1.325	3.127	8.006	0.000	0.000	0.000	9.580
		2.650	3.127	8.006	0.000	0.000	0.000	-1.028
		3.975	3.127	7.244	0.000	0.000	0.000	-11.477
		5.300	3.127	4.041	0.000	0.000	0.000	-19.370
		6.625	3.127	0.000	0.000	0.000	0.000	-22.345
		7.950	3.127	-4.041	0.000	0.000	0.000	-19.370
		9.275	3.127	-7.244	0.000	0.000	0.000	-11.477
		10.600	3.127	-8.006	0.000	0.000	0.000	-1.028
		11.925	3.127	-8.006	0.000	0.000	0.000	9.580
		13.250	3.127	-8.006	0.000	0.000	0.000	20.189
	4:SOIL -- SUBI	0.000	3.264	2.385	0.000	0.000	0.000	5.374
		1.325	3.264	1.908	0.000	0.000	0.000	2.565
		2.650	3.264	1.431	0.000	0.000	0.000	0.370
		3.975	3.264	0.954	0.000	0.000	0.000	-1.210
		5.300	3.264	0.477	0.000	0.000	0.000	-2.175
		6.625	3.264	0.000	0.000	0.000	0.000	-2.527
		7.950	3.264	-0.477	0.000	0.000	0.000	-2.175
		9.275	3.264	-0.954	0.000	0.000	0.000	-1.210
		10.600	3.264	-1.431	0.000	0.000	0.000	0.370
		11.925	3.264	-1.908	0.000	0.000	0.000	2.565
		13.250	3.264	-2.385	0.000	0.000	0.000	5.374
	10:COMBINAT	0.000	11.035	22.539	0.000	0.000	0.000	54.220
		1.325	11.035	21.501	0.000	0.000	0.000	25.120
		2.650	11.035	20.462	0.000	0.000	0.000	-2.642
		3.975	11.035	17.772	0.000	0.000	0.000	-28.723
		5.300	11.035	9.795	0.000	0.000	0.000	-47.925
		6.625	11.035	-0.000	0.000	0.000	0.000	-55.135
		7.950	11.035	-9.795	0.000	0.000	0.000	-47.925
		9.275	11.035	-17.772	0.000	0.000	0.000	-28.723
		10.600	11.035	-20.462	0.000	0.000	0.000	-2.642
		11.925	11.035	-21.501	0.000	0.000	0.000	25.120
		13.250	11.035	-22.539	0.000	0.000	0.000	54.220
	11:COMBINAT	0.000	5.192	4.654	0.000	0.000	0.000	9.970
		1.325	5.192	3.723	0.000	0.000	0.000	4.489
		2.650	5.192	2.792	0.000	0.000	0.000	0.207

Job No 17000	Sheet No 3	Rev

Software licensed to STANLEY CONSULTANTS INC

Part	
Job Title 17000	Ref
	By N.L. Vivar Date 06-Apr-05 Chd
Client ADOT	File spillway_inlet.std Date/Time 13-Apr-2005 09:58

Beam Force Detail Cont...

Beam	L/C	d (ft)	Axial Fx (kip)	Shear Fy (kip)	Shear Fz (kip)	Torsion Mx (kip·ft)	Bending My (kip·ft)	Bending Mz (kip·ft)
		3.975	5.192	1.862	0.000	0.000	0.000	-2.877
		5.300	5.192	0.931	0.000	0.000	0.000	-4.761
		6.625	5.192	-0.000	0.000	0.000	0.000	-5.446
		7.950	5.192	-0.931	0.000	0.000	0.000	-4.761
		9.275	5.192	-1.862	0.000	0.000	0.000	-2.877
		10.600	5.192	-2.792	0.000	0.000	0.000	0.207
		11.925	5.192	-3.723	0.000	0.000	0.000	4.489
		13.250	5.192	-4.654	0.000	0.000	0.000	9.970
2	1:DEAD	0.000	2.865	-0.296	0.000	0.000	0.000	-0.912
		0.954	2.686	-0.296	0.000	0.000	0.000	-0.630
		1.908	2.507	-0.296	0.000	0.000	0.000	-0.347
		2.862	2.329	-0.296	0.000	0.000	0.000	-0.065
		3.816	2.150	-0.296	0.000	0.000	0.000	0.217
		4.770	1.971	-0.296	0.000	0.000	0.000	0.499
		5.724	1.792	-0.296	0.000	0.000	0.000	0.781
		6.678	1.613	-0.296	0.000	0.000	0.000	1.063
		7.632	1.434	-0.296	0.000	0.000	0.000	1.345
		8.586	1.255	-0.296	0.000	0.000	0.000	1.627
		9.540	1.076	-0.296	0.000	0.000	0.000	1.910
	2:SOIL -- SATU	0.000	2.385	3.733	0.000	0.000	0.000	5.313
		0.954	2.385	2.801	0.000	0.000	0.000	2.250
		1.908	2.385	1.937	0.000	0.000	0.000	0.019
		2.862	2.385	1.138	0.000	0.000	0.000	-1.441
		3.816	2.385	0.406	0.000	0.000	0.000	-2.191
		4.770	2.385	-0.260	0.000	0.000	0.000	-2.291
		5.724	2.385	-0.850	0.000	0.000	0.000	-1.726
		6.678	2.385	-1.373	0.000	0.000	0.000	-0.646
		7.632	2.385	-1.830	0.000	0.000	0.000	0.888
		8.586	2.385	-2.220	0.000	0.000	0.000	2.815
		9.540	2.385	-2.545	0.000	0.000	0.000	5.076
	3:LIVE	0.000	8.006	-3.127	0.000	0.000	0.000	-9.639
		0.954	8.006	-3.127	0.000	0.000	0.000	-6.656
		1.908	8.006	-3.127	0.000	0.000	0.000	-3.674
		2.862	8.006	-3.127	0.000	0.000	0.000	-0.691
		3.816	8.006	-3.127	0.000	0.000	0.000	2.292
		4.770	8.006	-3.127	0.000	0.000	0.000	5.275
		5.724	8.006	-3.127	0.000	0.000	0.000	8.257
		6.678	8.006	-3.127	0.000	0.000	0.000	11.240
		7.632	8.006	-3.127	0.000	0.000	0.000	14.223
		8.586	8.006	-3.127	0.000	0.000	0.000	17.206
		9.540	8.006	-3.127	0.000	0.000	0.000	20.189
	4:SOIL -- SUBI	0.000	2.385	5.126	0.000	0.000	0.000	7.739
		0.954	2.385	3.923	0.000	0.000	0.000	3.493
		1.908	2.385	2.799	0.000	0.000	0.000	0.323

Beam Force Detail Cont...

			Axial	Shear		Torsion	Bending	
Beam	L/C	d (ft)	Fx (kip)	Fy (kip)	Fz (kip)	Mx (kip`ft)	My (kip`ft)	Mz (kip`ft)
		2.862	2.385	1.755	0.000	0.000	0.000	-1.842
		3.816	2.385	0.791	0.000	0.000	0.000	-3.076
		4.770	2.385	-0.094	0.000	0.000	0.000	-3.449
		5.724	2.385	-0.887	0.000	0.000	0.000	-2.933
		6.678	2.385	-1.601	0.000	0.000	0.000	-1.721
		7.632	2.385	-2.235	0.000	0.000	0.000	0.116
		8.586	2.385	-2.790	0.000	0.000	0.000	2.505
		9.540	2.385	-3.264	0.000	0.000	0.000	5.374
	10:COMBINAT	0.000	25.222	-1.619	0.000	0.000	0.000	-14.283
		0.954	24.954	-3.016	0.000	0.000	0.000	-11.991
		1.908	24.685	-4.313	0.000	0.000	0.000	-8.452
		2.862	24.417	-5.511	0.000	0.000	0.000	-3.757
		3.816	24.149	-6.609	0.000	0.000	0.000	2.004
		4.770	23.881	-7.608	0.000	0.000	0.000	8.740
		5.724	23.612	-8.492	0.000	0.000	0.000	16.474
		6.678	23.344	-9.277	0.000	0.000	0.000	24.979
		7.632	23.076	-9.963	0.000	0.000	0.000	34.166
		8.586	22.807	-10.549	0.000	0.000	0.000	43.943
		9.540	22.539	-11.035	0.000	0.000	0.000	54.220
	11:COMBINAT	0.000	6.443	7.393	0.000	0.000	0.000	10.697
		0.954	6.264	5.588	0.000	0.000	0.000	4.609
		1.908	6.085	3.903	0.000	0.000	0.000	0.137
		2.862	5.906	2.337	0.000	0.000	0.000	-2.829
		3.816	5.727	0.891	0.000	0.000	0.000	-4.397
		4.770	5.548	-0.436	0.000	0.000	0.000	-4.675
		5.724	5.369	-1.626	0.000	0.000	0.000	-3.619
		6.678	5.191	-2.697	0.000	0.000	0.000	-1.518
		7.632	5.012	-3.648	0.000	0.000	0.000	1.520
		8.586	4.833	-4.480	0.000	0.000	0.000	5.385
		9.540	4.654	-5.192	0.000	0.000	0.000	9.970
3	1:DEAD	0.000	2.865	0.296	0.000	0.000	0.000	0.912
		0.954	2.686	0.296	0.000	0.000	0.000	0.630
		1.908	2.507	0.296	0.000	0.000	0.000	0.347
		2.862	2.329	0.296	0.000	0.000	0.000	0.065
		3.816	2.150	0.296	0.000	0.000	0.000	-0.217
		4.770	1.971	0.296	0.000	0.000	0.000	-0.499
		5.724	1.792	0.296	0.000	0.000	0.000	-0.781
		6.678	1.613	0.296	0.000	0.000	0.000	-1.063
		7.632	1.434	0.296	0.000	0.000	0.000	-1.345
		8.586	1.255	0.296	0.000	0.000	0.000	-1.627
		9.540	1.076	0.296	0.000	0.000	0.000	-1.910
	2:SOIL -- SAT(	0.000	2.385	-3.733	0.000	0.000	0.000	-5.313
		0.954	2.385	-2.801	0.000	0.000	0.000	-2.250
		1.908	2.385	-1.937	0.000	0.000	0.000	-0.019

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		Job No	Sheet No	Rev
Software licensed to STANLEY CONSULTANTS INC		17000	5	
		Part		
Job Title 17000		Ref		
		By N.L. Vivar	Date 06-Apr-05	Chd
Client ADOT		File spillway_inlet.std	Date/Time 13-Apr-2005 09:58	

Beam Force Detail Cont...

			Axial	Shear		Torsion	Bending	
Beam	L/C	d (ft)	Fx (kip)	Fy (kip)	Fz (kip)	Mx (kip`ft)	My (kip`ft)	Mz (kip`ft)
		2.862	2.385	-1.138	0.000	0.000	0.000	1.441
		3.816	2.385	-0.406	0.000	0.000	0.000	2.191
		4.770	2.385	0.260	0.000	0.000	0.000	2.291
		5.724	2.385	0.850	0.000	0.000	0.000	1.726
		6.678	2.385	1.373	0.000	0.000	0.000	0.646
		7.632	2.385	1.830	0.000	0.000	0.000	-0.888
		8.586	2.385	2.220	0.000	0.000	0.000	-2.815
		9.540	2.385	2.545	0.000	0.000	0.000	-5.076
	3:LIVE	0.000	8.006	3.127	0.000	0.000	0.000	9.639
		0.954	8.006	3.127	0.000	0.000	0.000	6.656
		1.908	8.006	3.127	0.000	0.000	0.000	3.674
		2.862	8.006	3.127	0.000	0.000	0.000	0.691
		3.816	8.006	3.127	0.000	0.000	0.000	-2.292
		4.770	8.006	3.127	0.000	0.000	0.000	-5.275
		5.724	8.006	3.127	0.000	0.000	0.000	-8.257
		6.678	8.006	3.127	0.000	0.000	0.000	-11.240
		7.632	8.006	3.127	0.000	0.000	0.000	-14.223
		8.586	8.006	3.127	0.000	0.000	0.000	-17.206
		9.540	8.006	3.127	0.000	0.000	0.000	-20.189
	4:SOIL -- SUBI	0.000	2.385	-5.126	0.000	0.000	0.000	-7.739
		0.954	2.385	-3.923	0.000	0.000	0.000	-3.493
		1.908	2.385	-2.799	0.000	0.000	0.000	-0.323
		2.862	2.385	-1.755	0.000	0.000	0.000	1.842
		3.816	2.385	-0.791	0.000	0.000	0.000	3.076
		4.770	2.385	0.094	0.000	0.000	0.000	3.449
		5.724	2.385	0.887	0.000	0.000	0.000	2.933
		6.678	2.385	1.601	0.000	0.000	0.000	1.721
		7.632	2.385	2.235	0.000	0.000	0.000	-0.116
		8.586	2.385	2.790	0.000	0.000	0.000	-2.505
		9.540	2.385	3.264	0.000	0.000	0.000	-5.374
	10:COMBINAT	0.000	25.222	1.619	0.000	0.000	0.000	14.283
		0.954	24.954	3.016	0.000	0.000	0.000	11.991
		1.908	24.685	4.313	0.000	0.000	0.000	8.452
		2.862	24.417	5.511	0.000	0.000	0.000	3.757
		3.816	24.149	6.609	0.000	0.000	0.000	-2.004
		4.770	23.881	7.608	0.000	0.000	0.000	-8.740
		5.724	23.612	8.492	0.000	0.000	0.000	-16.474
		6.678	23.344	9.277	0.000	0.000	0.000	-24.979
		7.632	23.076	9.963	0.000	0.000	0.000	-34.166
		8.586	22.807	10.549	0.000	0.000	0.000	-43.943
		9.540	22.539	11.035	0.000	0.000	0.000	-54.220
	11:COMBINAT	0.000	6.443	-7.393	0.000	0.000	0.000	-10.697
		0.954	6.264	-5.588	0.000	0.000	0.000	-4.609
		1.908	6.085	-3.903	0.000	0.000	0.000	-0.137

Software licensed to STANLEY CONSULTANTS INC	Job No 17000	Sheet No 6	Rev
	Part		
Job Title 17000	Ref		
	By N.L. Vivar	Date 06-Apr-05	Chd
Client ADOT	File spillway_inlet.std	Date/Time 13-Apr-2005 09:58	

Beam Force Detail Cont...

			Axial	Shear		Torsion	Bending	
Beam	L/C	d (ft)	Fx (kip)	Fy (kip)	Fz (kip)	Mx (kip`ft)	My (kip`ft)	Mz (kip`ft)
		2.862	5.906	-2.337	0.000	0.000	0.000	2.829
		3.816	5.727	-0.891	0.000	0.000	0.000	4.397
		4.770	5.548	0.436	0.000	0.000	0.000	4.675
		5.724	5.369	1.626	0.000	0.000	0.000	3.619
		6.678	5.191	2.697	0.000	0.000	0.000	1.518
		7.632	5.012	3.648	0.000	0.000	0.000	-1.520
		8.586	4.833	4.480	0.000	0.000	0.000	-5.385
		9.540	4.654	5.192	0.000	0.000	0.000	-9.970

Stanley Consultants INC.

Project No. 17000 Page No. 21

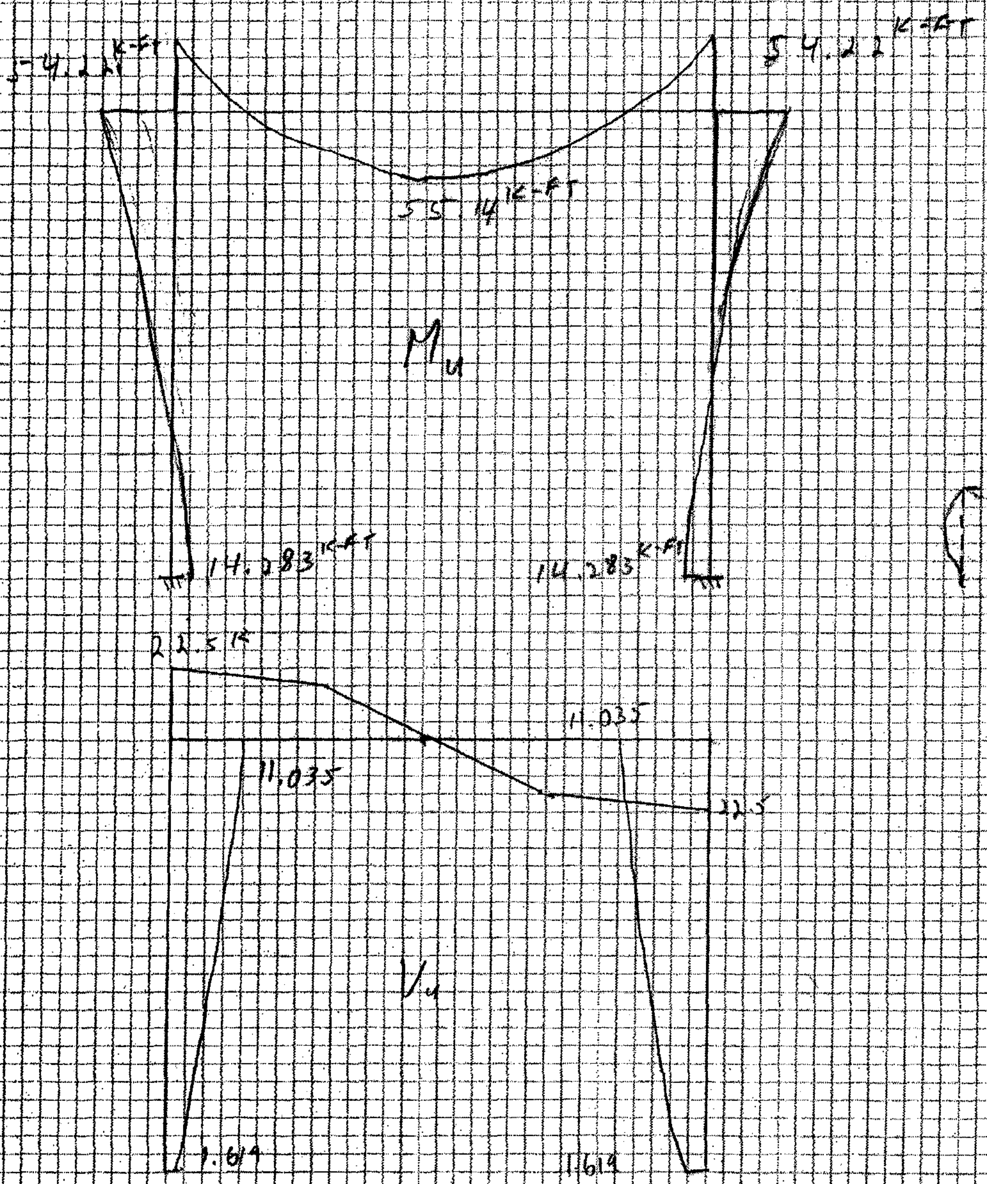
Subject SPILLWAY INLET

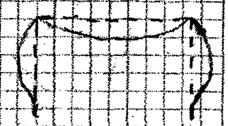
Computed by N. L. VIVAR Date 08 APR 2005

Checked by Date

Approved by DRS Date 01 AUG 05

Sheet No. 1 of 3





TOP SLAB REBAR

MIDDLE

$M_u = 55.4^{K\text{-}FT} = 664.8^{K\text{-}IN}$

TRY #7 @ 6 → $A_s = 1.20$, $d = 13 - 2 - \frac{0.875}{2} = 10.56$

$\rho = \frac{1.20}{12 \times 10.56} = 0.00947$

$\phi M_n = 0.9 \, A_s f_y \, d \left(1 - 0.6 \frac{\rho f_y}{f'_c}\right) = 617.63^{K\text{-}IN}$

($A_s = 1.20$, $f_y = 60$, $d = 10.56$, $\rho = 0.00947$, $f_y = 60$, $f'_c = 3.5$)

TRY #8 @ 6 → $A_s = 1.58$ $d = 10.5$

$\rho = \frac{1.58}{12 \times 10.5} = 0.01254$

$\phi M_n = 0.9(1.58)(60)(10.5)\left(1 - 0.6 \frac{0.01254 \times 60}{3.5}\right) = 780.3^{K\text{-}IN}$

USE #7 @ 6 (MODEL IS VERY CONSERVATIVE
7.6% OVERSTRESS
TRUCK NOT LIKELY TO EVER
LOAD END SECTION)

ENDS

$M_u = 54.22 = 650.6$ USE #7 @ 6

USE SAME FOR BOTOM SLAB

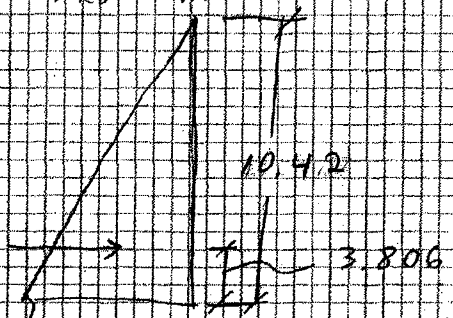
LONG. REBAR

$A_s = \max \begin{cases} 0.004 \times 12 \times 10.5 = 0.504 \\ 0.5(1.20) = 0.6 \end{cases}$

USE 2 LAYERS OF #5 @ 12

DESIGN FRONT & SIDE WALL OF INLET

FRONT WALL



62.4 × 10.42 = 650

$M = \frac{1}{2}(650)(11.417) \times 3.806$

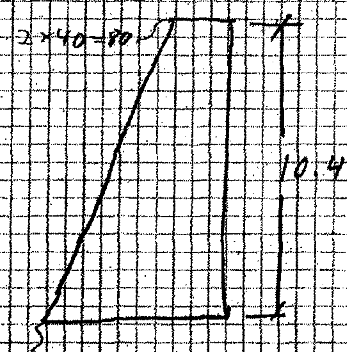
$= 14.12^{\,K\text{-}FT}$

$M_u = 1.3\,\frac{5}{3}\,(14.12^{\,K\text{-}FT}) = 30.6^{\,K\text{-}FT}$

USE SAME BAR FOR CORNER AS BARREL SECTION

SIDE WALL

SAY FILL IS TO TOP, FULLY SUBMERGED



80 + 90×10.42 = 1018

$P = 10.42\left(\frac{80+1018}{2}\right) = 5.72$

$\bar{x} = \frac{10.42\,[2(80)+1018]}{3\,(1018+80)} = 3.72$

$M = 5.72 \times 3.72 = 21.3^{\,K\text{-}FT}$

$M_u = 1.5(21.3) = 31.95$

USE SAME FOR SIDE WALL

Stanley Consultants INC.

Job No.	17000	Page No.	24
Subject	Dissipator Rebar Quantity		
	INLET		
Sheet No.		of	

Computed by N.L. Vivar Date 01 Apr 2005
Checked by Date
Approved by DRS Date 01AUG05

Bar Size	Weight (lb/ft)
3	0.376
4	0.668
5	1.043
6	1.502
7	2.044
8	2.67
9	3.4
10	4.303
11	5.313
14	7.65
18	13.6

Size	Quantity (ea)	Length (ft)	Weight per Length (lb/ft)	Weight (lb)	Comment
Bottom Slab					
7	50	14.5	2.044	1481.9	top, trans
6	15	24.25	1.502	546.4	top, long
7	100	16.92	2.044	3457.8	bot. trans. Bent
5	15	24.25	1.043	379.4	bot. long
Top Slab					
5	10	9	1.043	93.9	top, long
5	15	9	1.043	140.8	bot. long
7	38	16.92	2.044	1314.0	top, trans. Bent
7	19	14.5	2.044	563.1	bot, trans
4	30	2.166666667	0.668	43.4	edge beam bent
6	4	14.5	1.502	87.1	edge beam
Side Walls					
5	26	11	1.043	298.3	inside face, barrel
4	36	11	0.668	264.5	inside face, mouth
4	28	24.75	0.668	462.9	inside and outside faces, long
Front Wall					
4	12	14.5	0.668	116.2	horiz bar, inside & ouside faces
4	27	11	0.668	198.4	vert., inside face
5	23	7.916666667	1.043	189.9	vert. splice bar, outside face
4	16	4	0.668	42.8	corner angle bar
7	27	16.91666667	2.044	933.6	bot corner bent bar
Lip					
6	4	16.5	1.502	99.1	
6	4	14.5	1.502	87.1	
4	4	4	0.668	10.7	corner angle bar
Pedestal					
4	5	2.5	0.668	8.4	
4	6	4.5	0.668	18.0	

Ears

5	32	12	1.043	400.5	
5	14	26.5	1.043	387.0	
5	4	9	1.043	37.5	
5	4	8	1.043	33.4	
5	4	7	1.043	29.2	
5	4	6	1.043	25.0	
5	4	5	1.043	20.9	
5	4	3	1.043	12.5	
5	4	12	1.043	50.1	0 Outside Edge.
5	4	12.5	1.043	52.2	1
5	4	13	1.043	54.2	2
5	4	13.5	1.043	56.3	3
5	4	14	1.043	58.4	4
5	4	14.5	1.043	60.5	5
5	4	15	1.043	62.6	6
5	4	15.5	1.043	64.7	7
5	4	16	1.043	66.8	8
5	4	16.5	1.043	68.8	9
5	4	17	1.043	70.9	10
5	4	17.5	1.043	73.0	11
5	4	18	1.043	75.1	12
5	4	18.5	1.043	77.2	13
5	4	19	1.043	79.3	14 Inside Edge
5	40	12	1.043	500.6	
5	8	3.5	1.043	29.2	
5	4	11.75	1.043	49.0	
			Total Weight =	13332.5 lbs.	

Concrete Quantity Calcuation

Reference:K:\Technical_Programs\Structural\ST084 ACI 318-2002 Mathcad Electronic Book.mcd

Units:

$k := 1000\cdot lbf \quad kpf := \frac{k}{ft} \quad ksf := \frac{k}{ft^2} \quad ksi := \frac{k}{in^2} \quad kcf := \frac{k}{ft^3} \quad ppf := \frac{lbf}{ft} \quad psf := \frac{lbf}{ft^2} \quad psi := \frac{lbf}{in^2} \quad pcf := \frac{lbf}{ft^3}$

$\gamma_{soil} := 110\cdot pcf \quad \gamma_{water} := 62.4\cdot pcf \quad \gamma_{conc} := 150\cdot pcf \quad f_c := 4\cdot ksi \quad f_y := 60\cdot ksi \quad F_y := 50\cdot ksi \quad E := 29000\cdot ksi$

$rpm := \frac{2\cdot\pi\cdot rad}{min} \quad cps := \frac{2\cdot\pi\cdot rad}{sec}$

Description

This computation calculates the volume of concrete for
the energy dissipator end section.

Design Criteria

Provide the design criteria and other information that is known and will be used in the calculations.

$Vsides := 2\cdot(24\cdot ft + 3\cdot in)\cdot(9\cdot ft + 1\cdot in)\cdot(1\cdot ft + 3\cdot in)$ $\qquad Vsides = 550.677\ ft^3$

$Vbot := 2\cdot ft\cdot(24\cdot ft + 3\cdot in)\cdot(14\cdot ft + 6\cdot in)$ $\qquad Vbot = 703.25\ ft^3$

$Vfront := 1.25\cdot ft\cdot[12\cdot ft\cdot(9\cdot ft + 1\cdot in) - 2ft\cdot 2ft]$ $\qquad Vfront = 131.25\ ft^3$

$Vtop := (1\cdot ft + 1\cdot in)\cdot(24\cdot ft + 3\cdot in - 14\cdot ft - 1.25\cdot ft)\cdot 12\cdot ft$ $\qquad Vtop = 117\ ft^3$

$Vped := 2.5\cdot ft\cdot 1\cdot ft\cdot 5\cdot ft$ $\qquad Vped = 12.5\ ft^3$

$Vears := 2(13.25\cdot ft\cdot 18\cdot ft - 1\cdot ft\cdot 8\cdot ft - 0.5\cdot 6\cdot ft\cdot 6ft - 6.5\cdot ft\cdot 7.25\cdot ft)\cdot 10\cdot in$ $\qquad Vears = 275.625\ ft^3$

$Vtot := Vsides + Vbot + Vfront + Vped + Vears$ $\qquad Vtot = 1673.302\ ft^3$

$Vtot = 61.974\ yd^3$

APPENDIX C

HEC-RAS UNSTEADY FLOW ANALYSES

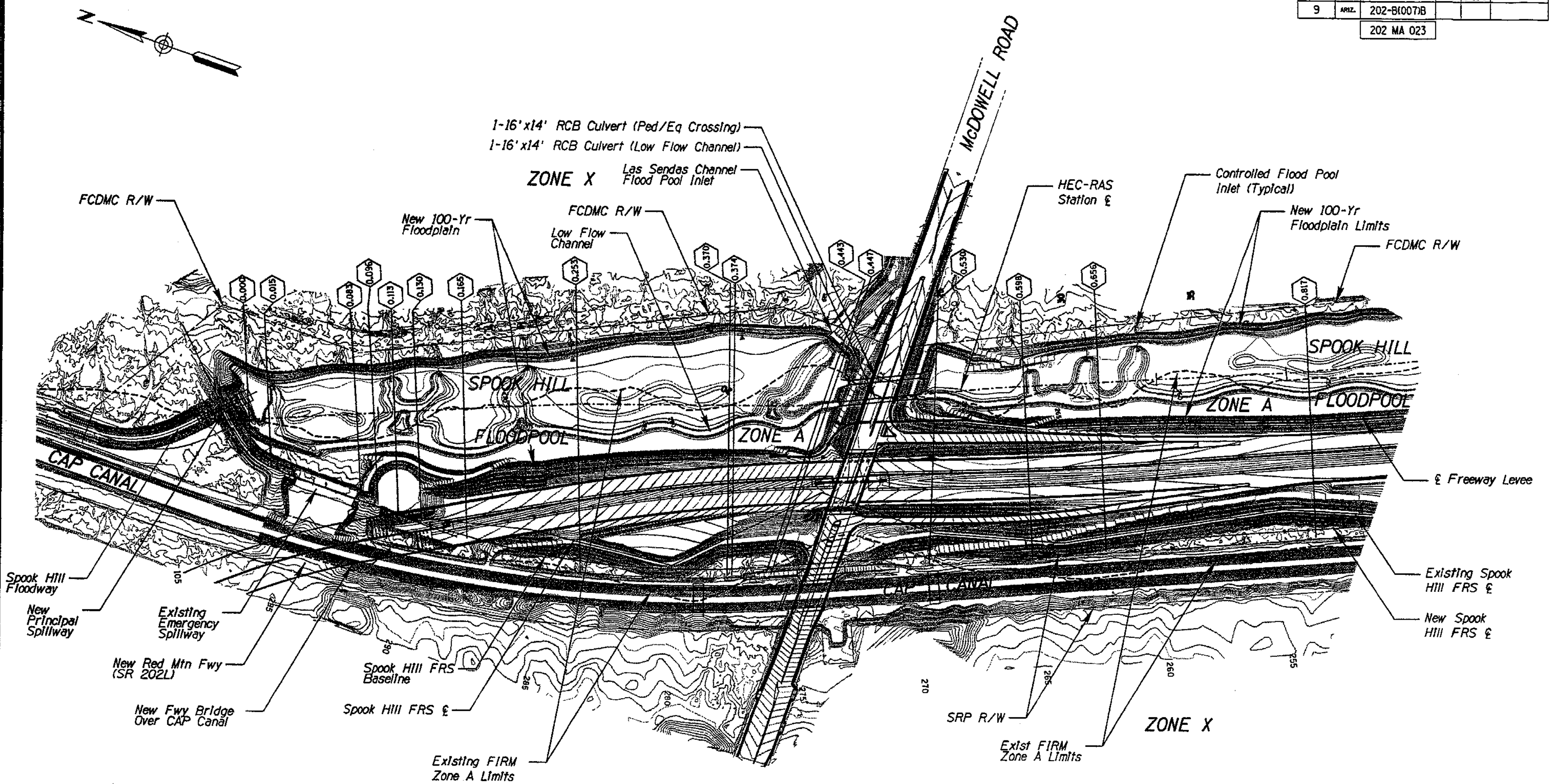
- 100-Year Analysis
- PMF Analysis
- Emergency Spillway Overtopping Analysis
- Spook Hill FRS Drawdown Time

APPENDIX C

HEC-RAS UNSTEADY FLOW ANALYSES

100-Year Analysis

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	202-B(007)B			
		202 MA 023			

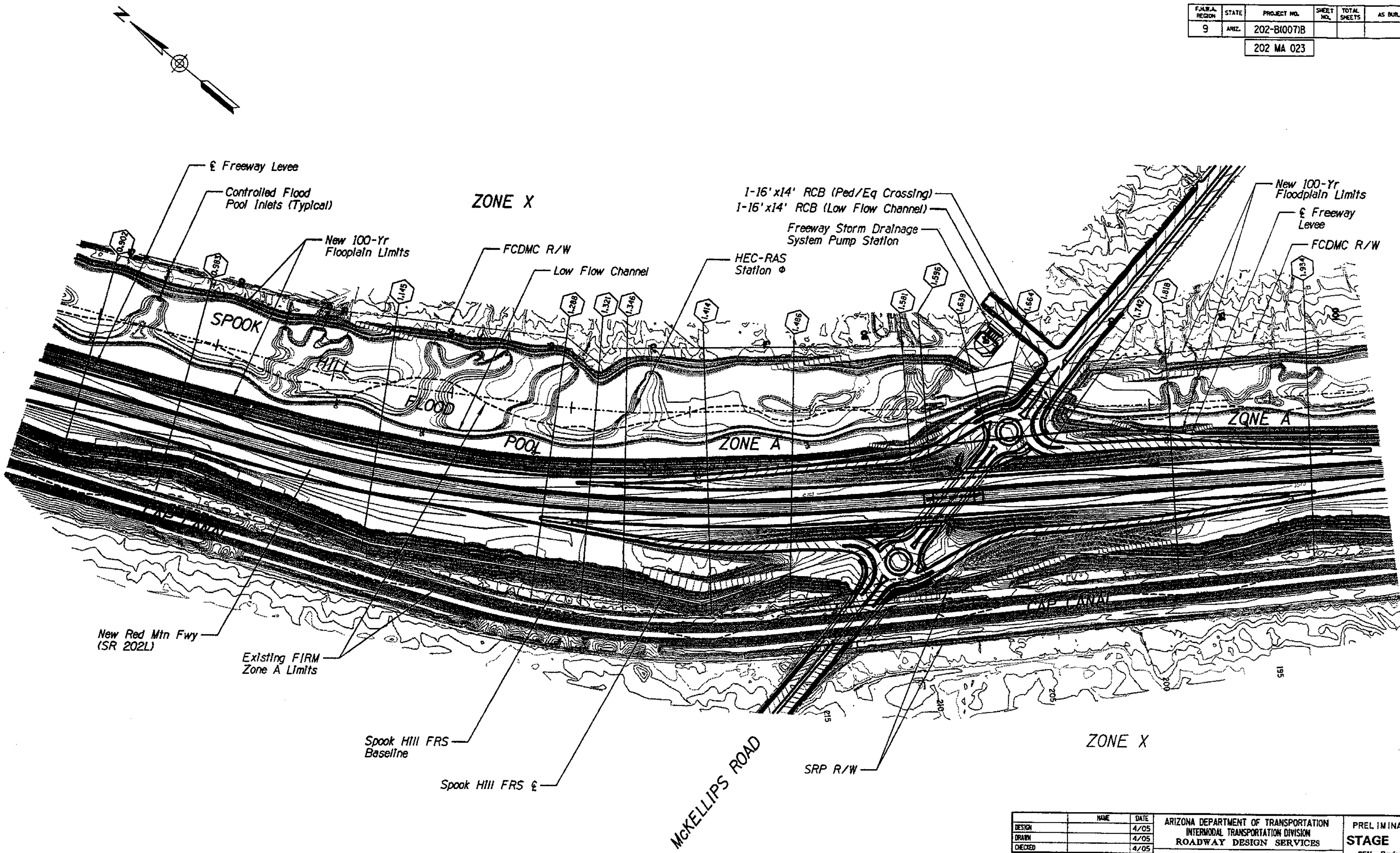


	NAME	DATE	ARIZONA DEPARTMENT OF TRANSPORTATION INTERMODAL TRANSPORTATION DIVISION ROADWAY DESIGN SERVICES	PRELIMINARY STAGE IV 95% Review NOT FOR CONSTRUCTION OR RECORDING
DESIGN		4/05		
DRAWN		4/05		
CHECKED		4/05		
Stanley Consultants INC. 2929 East Camelback Road, Suite 130 Phoenix, Arizona 85016 Phone (602) 912-6500			HEC-RAS CROSS SECTION EXHIBIT	
ROUTE 202L	LOCATION RED MTN FWY, POWER ROAD - UNIVERSITY DRIVE			DWG NO.
TRACS NO. H 5782 01C			202-B(007)B	1 OF 4

4/28/2005

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	202-B(007)B			

202 MA 023



	NAME	DATE
DESIGN		4/05
DRAWN		4/05
CHECKED		4/05

Stanley Consultants INC.

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION
ROADWAY DESIGN SERVICES

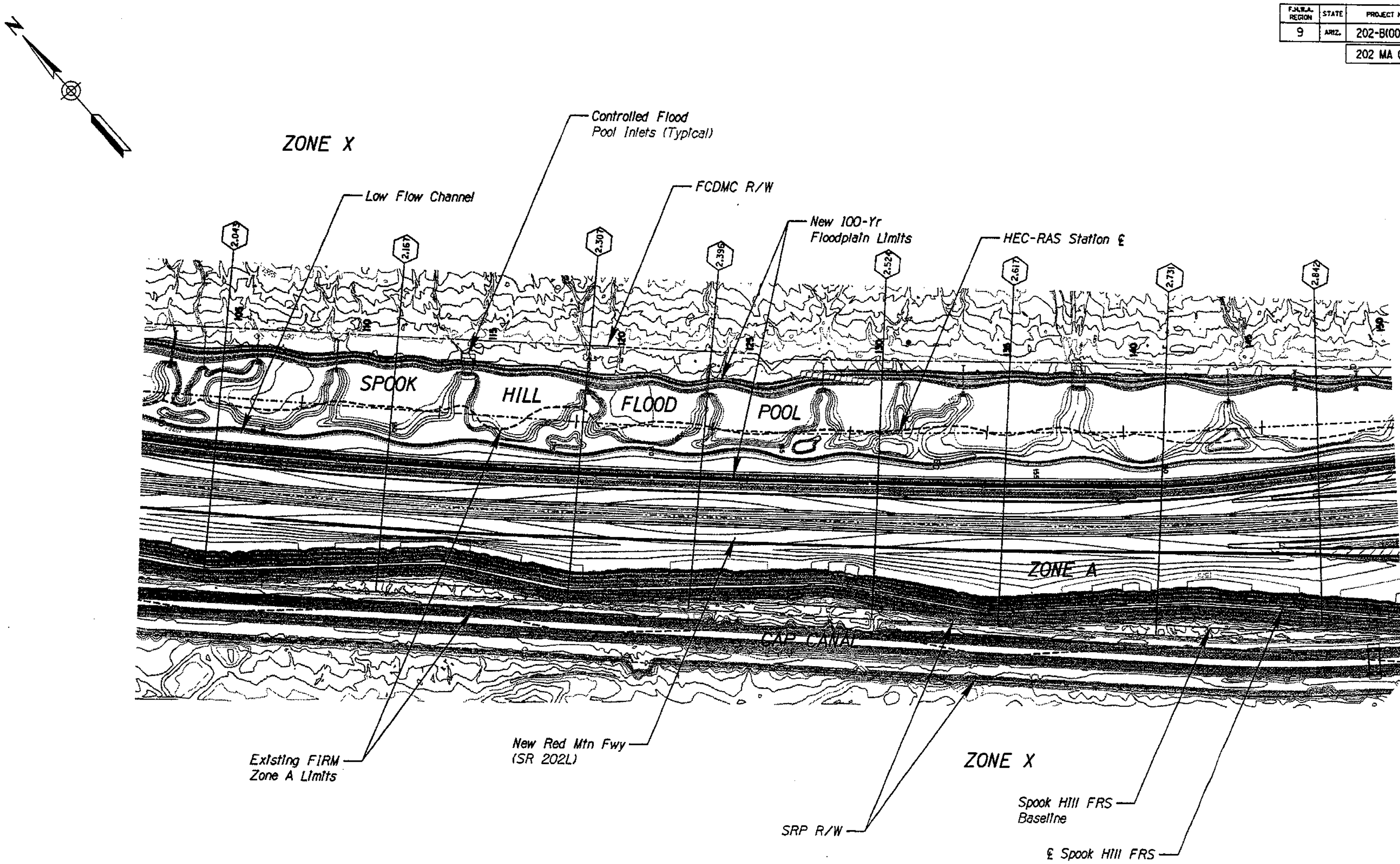
HEC-RAS CROSS SECTION EXHIBIT

PRELIMINARY
STAGE IV
95% Review
NOT FOR CONSTRUCTION OR RECORDING

ROUTE	LOCATION
202L	RED MTN FWY. POWER ROAD - UNIVERSITY DRIVE

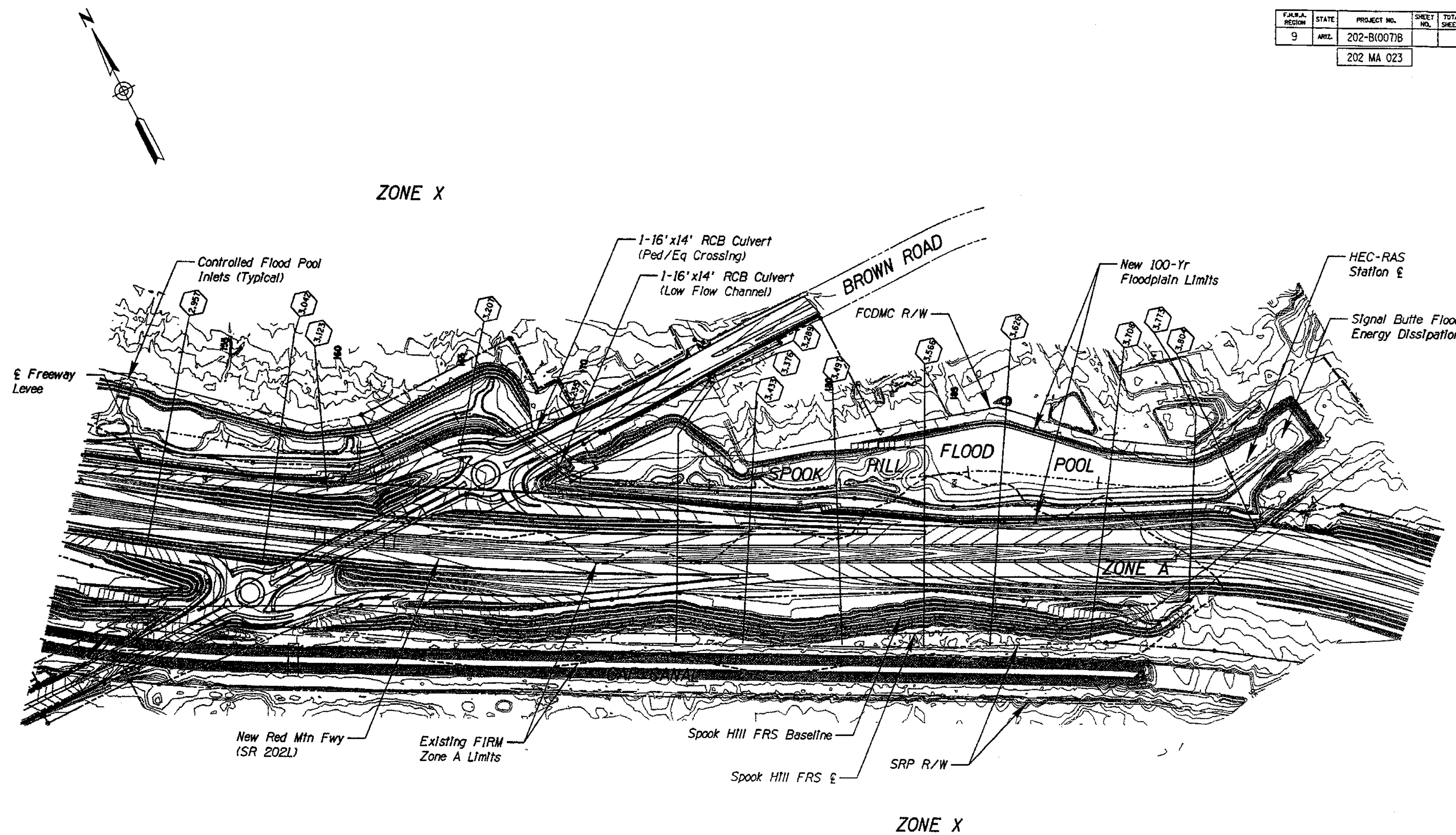
TRACS NO. H 5782 01C | 202-B(007)B | DWG NO. 2 OF 4

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	202-B(007)B			
		202 MA 023			

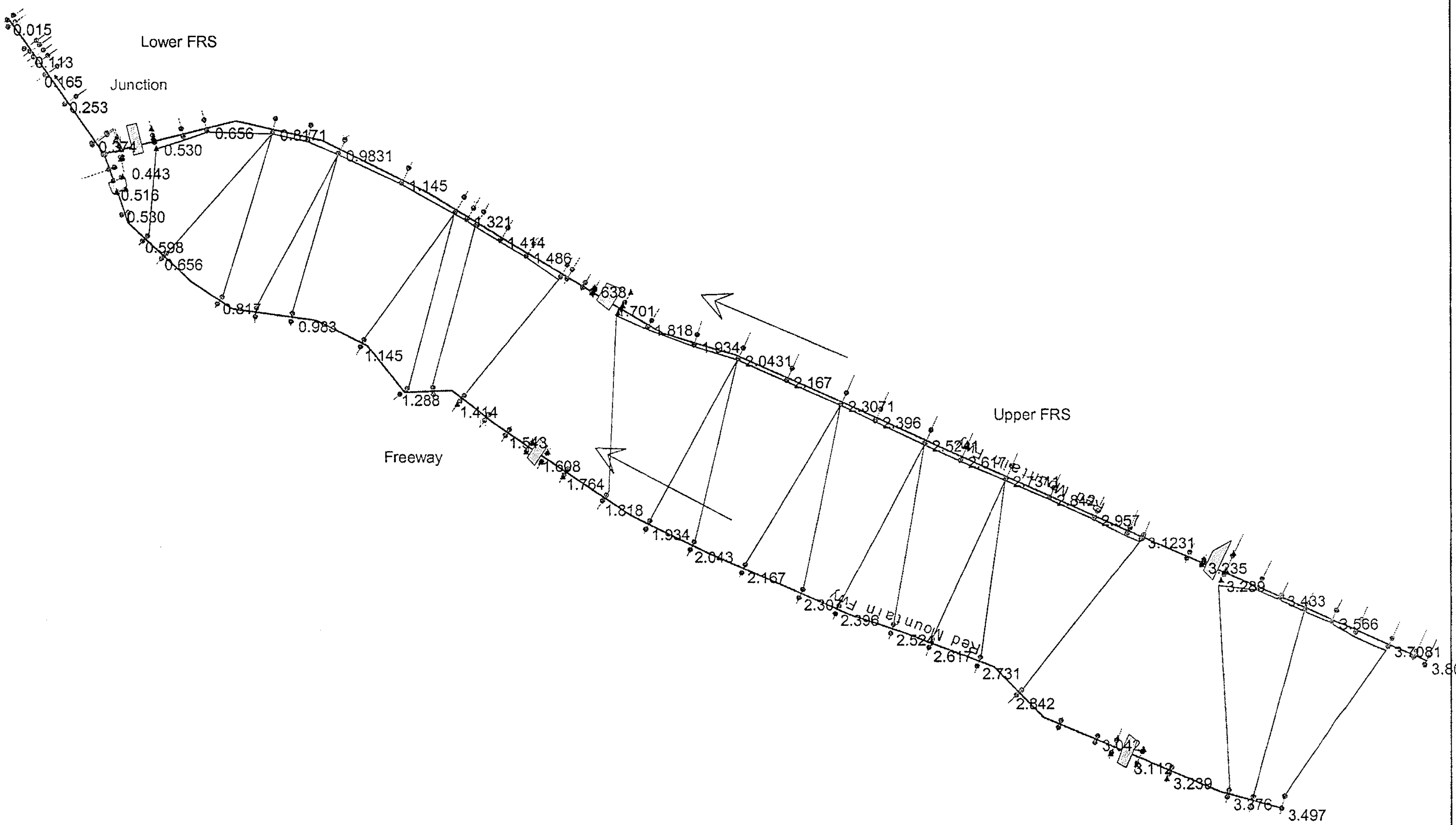


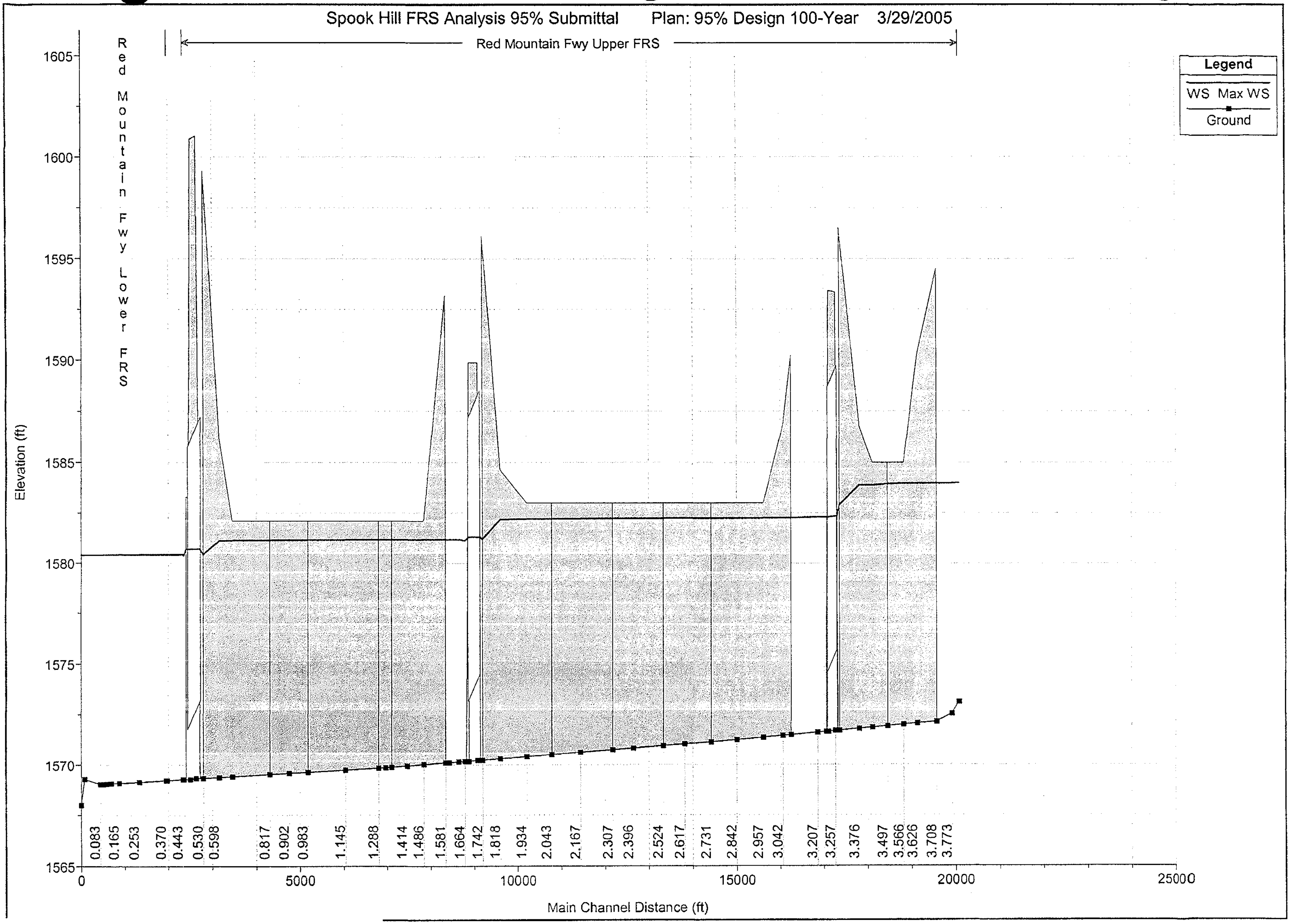
	NAME	DATE		
DESIGN		4/05	ARIZONA DEPARTMENT OF TRANSPORTATION INTERMODAL TRANSPORTATION DIVISION ROADWAY DESIGN SERVICES	PRELIMINARY STAGE IV 95% Review NOT FOR CONSTRUCTION OR RECORDING
DRAWN		4/05		
CHECKED		4/05		
Stanley Consultants inc.			HEC-RAS CROSS SECTION EXHIBIT	
ROUTE 202L	LOCATION RED MTN FWY, POWER ROAD - UNIVERSITY DRIVE			DWG NO.
TRACS NO. H 5782 01C			202-B(007)B	3 OF 4

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	202-B(007)B			
		202 MA 023			



	NAME	DATE		
DESIGN		4/05	ARIZONA DEPARTMENT OF TRANSPORTATION INTERMODAL TRANSPORTATION DIVISION ROADWAY DESIGN SERVICES	PRELIMINARY STAGE IV 95% Review NOT FOR CONSTRUCTION OR RECORDING
DRAWN		4/05		
CHECKED		4/05		
Stanley Consultants inc.			HEC-RAS CROSS SECTION EXHIBIT	
ROUTE 202L	LOCATION RED MTN FWY. POWER ROAD - UNIVERSITY DRIVE			DWG NO.
TRACS NO. H 5782 01C			202-B(007)B	4 OF 4


Lower FRS
Junction
Freeway
Upper FRS
0.015
0.113
0.165
0.253
0.374
0.530
0.656
0.8171
0.9831
1.145
1.321
1.414
1.486
1.638
1.701
1.818
1.934
2.0431
2.167
2.3071
2.396
2.5241
2.617
2.731
2.842
2.957
3.1231
3.235
3.289
3.433
3.566
3.7081
0.443
0.516
0.530
0.598
0.656
0.817
0.983
1.145
1.288
1.414
1.543
1.608
1.764
1.818
1.934
2.043
2.167
2.307
2.396
2.524
2.617
2.731
2.842
3.042
3.112
3.239
3.376
3.497

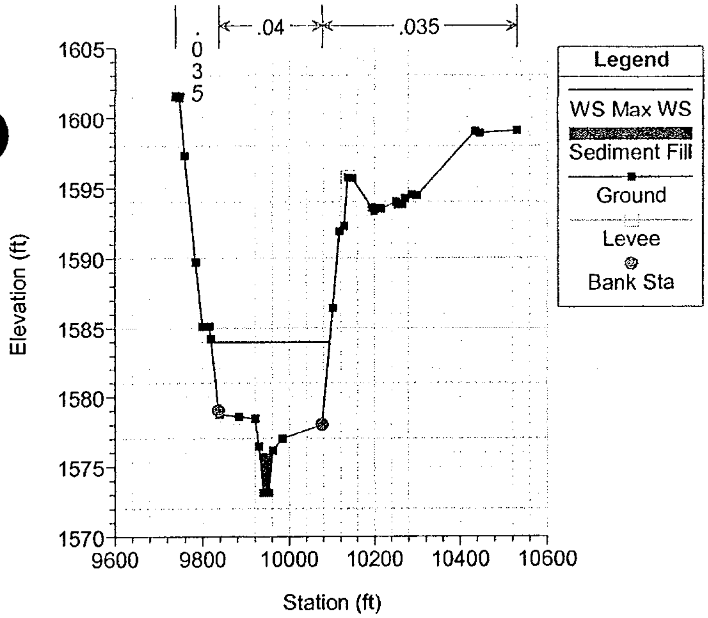

Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005
Red Mountain Fwy Upper FRS
Red Mountain Fwy Lower FRS
Legend
WS Max WS
Ground
Elevation (ft)
1605
1600
1595
1590
1585
1580
1575
1570
1565
0.083 0.165 0.253 0.370 0.443 0.530 0.598 0.817 0.902 0.983 1.145 1.288 1.414 1.486 1.581 1.664 1.742 1.818 1.934 2.043 2.167 2.307 2.396 2.524 2.617 2.731 2.842 2.957 3.042 3.207 3.257 3.376 3.497 3.566 3.626 3.708 3.773
0
5000
10000
15000
20000
25000
Main Channel Distance (ft)

EC-RAS Plan: 95% 100-Year Profile: Max WS

Reach	River Sta	Profile	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)	
ower FRS	0.000	Max WS	789.90	1575.95	1580.38	1576.66	1580.39	0.000056	0.75	1070.33	256.41	0.06
ower FRS	0.015	Max WS	790.02	1575.95	1580.39		1580.39	0.000051	0.71	1124.30	269.34	0.06
ower FRS	0.083	Max WS	782.61	1575.95	1580.40		1580.41	0.000018	0.42	1909.73	478.01	0.04
ower FRS	0.096	Max WS	781.19	1575.95	1580.40		1580.41	0.000029	0.55	1473.02	366.42	0.05
ow	0.113	Max WS	778.94	1575.95	1580.41		1580.41	0.000028	0.53	1481.06	348.98	0.04
owe	0.130	Max WS	776.96	1575.95	1580.41		1580.41	0.000022	0.47	1685.47	396.19	0.04
ower FRS	0.165	Max WS	773.21	1575.95	1580.41		1580.42	0.000017	0.41	1908.54	449.65	0.03
ower FRS	0.253	Max WS	764.06	1575.95	1580.42		1580.42	0.000017	0.42	1846.82	434.39	0.03
ower FRS	0.370	Max WS	752.58	1575.95	1580.43		1580.43	0.000013	0.36	2105.77	494.67	0.03
ower FRS	0.374	Max WS	752.69	1575.95	1580.43		1580.43	0.000013	0.36	2105.11	494.14	0.03
pper FRS	0.443	Max WS	807.95	1575.95	1580.43		1580.43	0.000018	0.43	1920.34	573.85	0.04
pper FRS	0.447	Max WS	752.91	1575.95	1580.35		1580.79	0.002880	5.35	140.71	425.11	0.45
pper FRS	0.487		Culvert									
pper FRS	0.530	Max WS	760.81	1575.95	1580.44		1580.87	0.002747	5.30	143.62	253.45	0.44
pper FRS	0.598	Max WS	762.25	1575.95	1581.11		1581.12	0.000037	0.68	1164.91	261.59	0.05
pper FRS	0.656	Max WS	761.19	1575.95	1581.12		1581.12	0.000020	0.50	1546.86	315.72	0.04
pper FRS	0.817	Max WS	758.67	1575.95	1581.13		1581.14	0.000014	0.41	1898.70	394.92	0.03
pper FRS	0.8171		Lat Struct									
pper FRS	0.902	Max WS	756.83	1575.95	1581.14		1581.14	0.000011	0.37	2069.61	414.97	0.03
pper FRS	0.983	Max WS	758.45	1575.95	1581.14		1581.15	0.000011	0.38	2042.01	411.49	0.03
pper FRS	0.9831		Lat Struct									
pper FRS	1.145	Max WS	741.51	1575.95	1581.15		1581.16	0.000009	0.34	2249.60	464.39	0.03
pper FRS	1.288	Max WS	752.84	1575.95	1581.16		1581.16	0.000008	0.31	2449.14	485.57	0.02
pper FRS	1.2881		Lat Struct									
pper FRS	1.321	Max WS	753.26	1575.95	1581.16		1581.16	0.000014	0.42	1833.49	373.96	0.03
pper FRS	1.346	Max WS	753.39	1575.95	1581.16		1581.16	0.000010	0.35	2166.27	436.36	0.03
pper FRS	1.3461		Lat Struct									
pper FRS	1.414	Max WS	748.92	1575.95	1581.17		1581.17	0.000011	0.37	2038.80	413.55	0.03
pper FRS	1.486	Max WS	758.89	1575.95	1581.17		1581.17	0.000012	0.38	2057.78	432.29	0.03
pper FRS	1.581	Max WS	759.59	1575.95	1581.17		1581.18	0.000014	0.42	1840.78	369.49	0.03
pper FRS	1.5811		Lat Struct									
pper FRS	1.596	Max WS	759.98	1575.95	1581.17		1581.18	0.000021	0.51	1519.72	308.36	0.04
pper FRS	1.638	Max WS	758.96	1575.95	1581.17		1581.19	0.000097	1.10	696.59	136.36	0.08
pper FRS	1.664	Max WS	699.95	1575.95	1581.11		1581.39	0.001458	4.24	165.19	136.84	0.33
pp	1.701		Culvert									
ppe	1.742	Max WS	802.30	1575.95	1581.18		1581.54	0.001833	4.79	167.39	274.71	0.37
pper FRS	1.818	Max WS	1166.56	1575.95	1582.16		1582.17	0.000048	0.87	1400.97	264.70	0.06
pper FRS	1.934	Max WS	1135.63	1575.95	1582.19		1582.19	0.000024	0.62	1875.47	321.69	0.04
pper FRS	2.043	Max WS	1107.85	1575.95	1582.20		1582.20	0.000019	0.54	2085.87	359.22	0.04
pper FRS	2.0431		Lat Struct									
pper FRS	2.167	Max WS	1078.07	1575.95	1582.21		1582.21	0.000015	0.49	2231.33	379.23	0.03
pper FRS	2.307	Max WS	1046.63	1575.95	1582.22		1582.22	0.000016	0.51	2103.71	361.75	0.04
pper FRS	2.3071		Lat Struct									
pper FRS	2.396	Max WS	1022.78	1575.95	1582.22		1582.23	0.000016	0.50	2099.67	359.70	0.04
pper FRS	2.524	Max WS	937.67	1575.95	1582.23		1582.23	0.000010	0.40	2401.02	404.41	0.03
pper FRS	2.5241		Lat Struct									
pper FRS	2.617	Max WS	888.77	1575.95	1582.23		1582.24	0.000009	0.38	2389.00	407.73	0.03
pper FRS	2.731	Max WS	815.64	1575.95	1582.24		1582.24	0.000008	0.35	2379.48	404.07	0.02
pper FRS	2.7311		Lat Struct									
pper FRS	2.842	Max WS	827.39	1575.95	1582.24		1582.24	0.000013	0.46	1859.21	324.31	0.03
pper FRS	2.957	Max WS	826.66	1575.95	1582.24		1582.25	0.000025	0.63	1360.86	245.51	0.04
pper FRS	3.042	Max WS	864.00	1575.95	1582.25		1582.26	0.000051	0.87	1018.43	187.90	0.06
pper FRS	3.123	Max WS	863.89	1575.95	1582.25		1582.27	0.000082	1.08	845.83	174.63	0.08
pper FRS	3.1231		Lat Struct									
pper FRS	3.207	Max WS	908.26	1575.95	1582.29		1582.30	0.000049	0.87	1084.96	197.59	0.06
pper FRS	3.235	Max WS	906.99	1575.95	1582.27		1582.63	0.001563	4.80	189.01	129.97	0.35
pper FRS	3.257		Culvert									
pper FRS	3.289	Max WS	1628.32	1575.95	1582.88		1583.76	0.003211	7.53	216.35	595.13	0.51
pper FRS	3.376	Max WS	1610.83	1575.95	1583.87		1583.88	0.000027	0.74	2222.71	313.23	0.05
pper FRS	3.433	Max WS	1593.97	1575.95	1583.87		1583.92	0.000183	1.98	885.72	160.32	0.12
pper FRS	3.497	Max WS	1576.41	1575.95	1583.94		1583.96	0.000053	1.04	1569.89	232.80	0.07
pper FRS	3.4971		Lat Struct									
pper FRS	3.566	Max WS	1557.27	1575.95	1583.96		1583.97	0.000020	0.65	2457.08	342.63	0.04
pper FRS	3.626	Max WS	1539.59	1575.95	1583.97		1583.97	0.000021	0.61	2563.43	397.16	0.04
ppe	3.708	Max WS	1511.05	1575.95	1583.97		1583.99	0.000047	0.93	1680.53	266.09	0.06
ppe	3.7081		Lat Struct									
pper FRS	3.773	Max WS	1503.20	1575.95	1583.98		1584.00	0.000077	1.19	1308.67	208.45	0.08
pper FRS	3.804	Max WS	1502.09	1575.95	1584.00		1584.01	0.000054	0.94	1631.51	274.49	0.07
pper FRS	3.805	Max WS	1502.13	1575.95	1584.00		1584.01	0.000054	0.94	1631.51	274.49	0.07

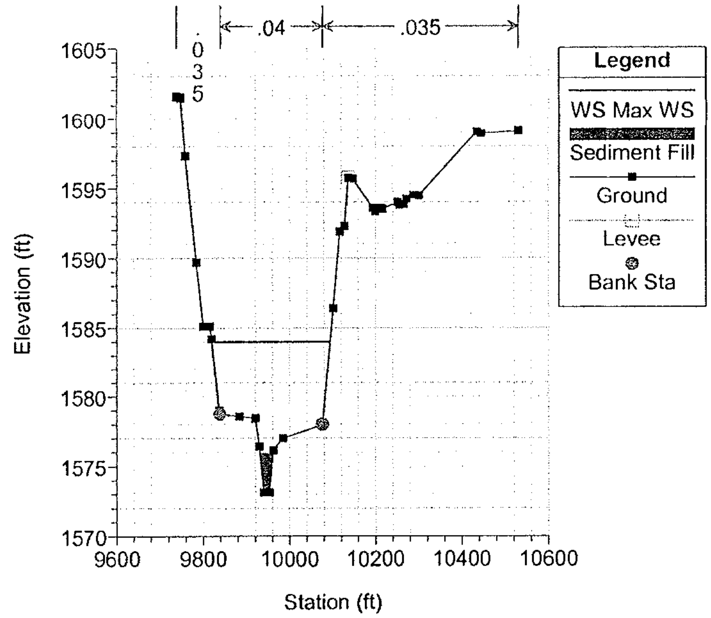
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 3.805



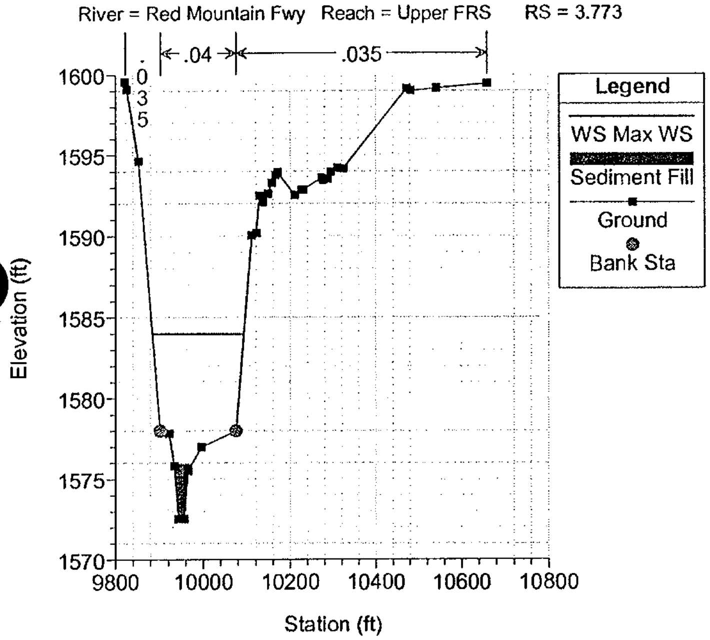
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 3.804



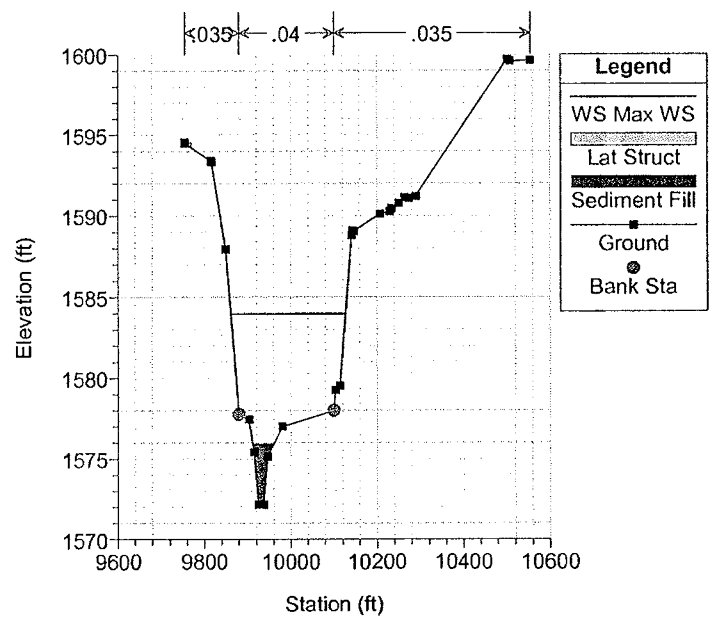
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 3.773



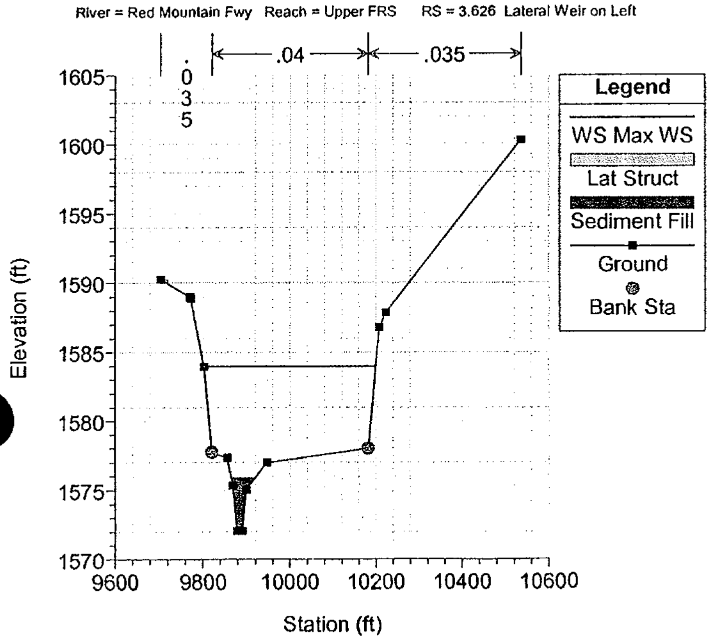
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 3.708 Lateral Weir on Left



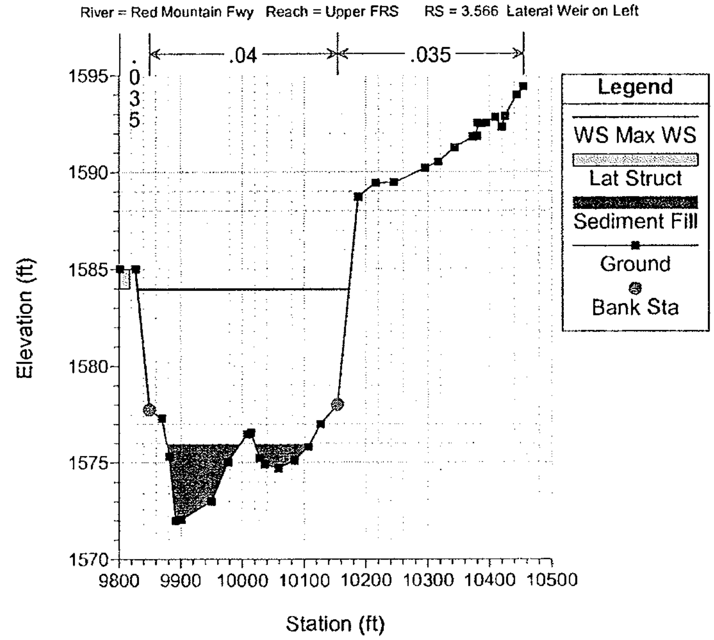
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 3.626 Lateral Weir on Left



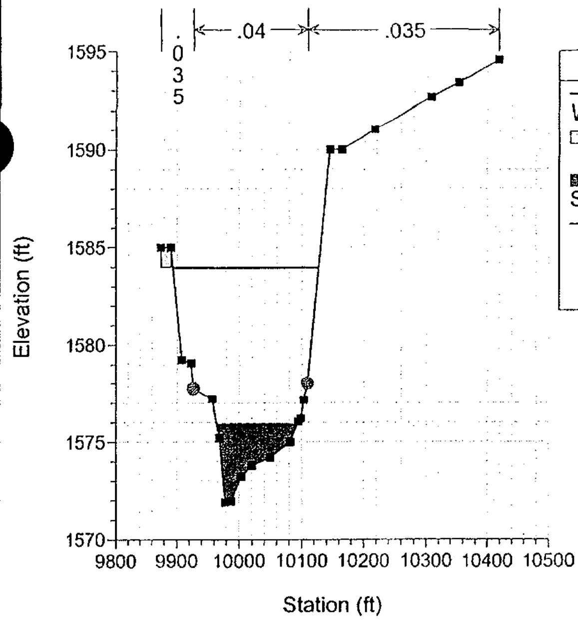
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 3.566 Lateral Weir on Left



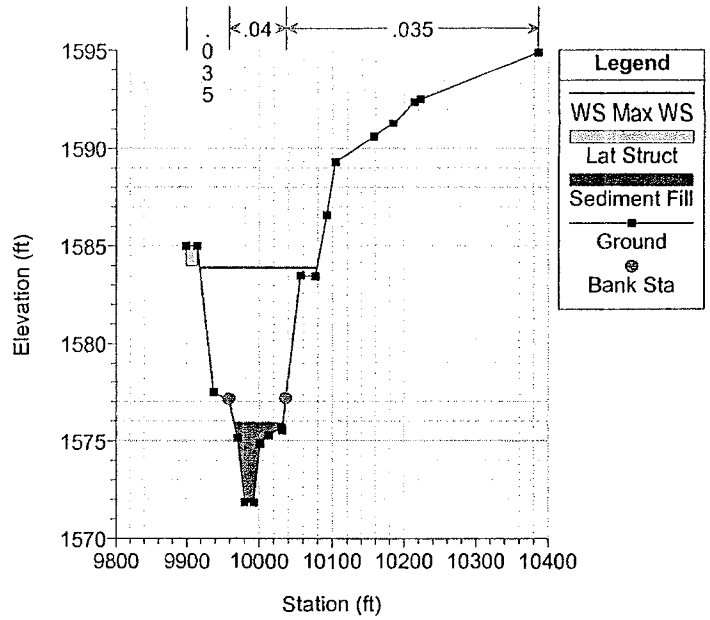
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 3.497 Lateral Weir on Left



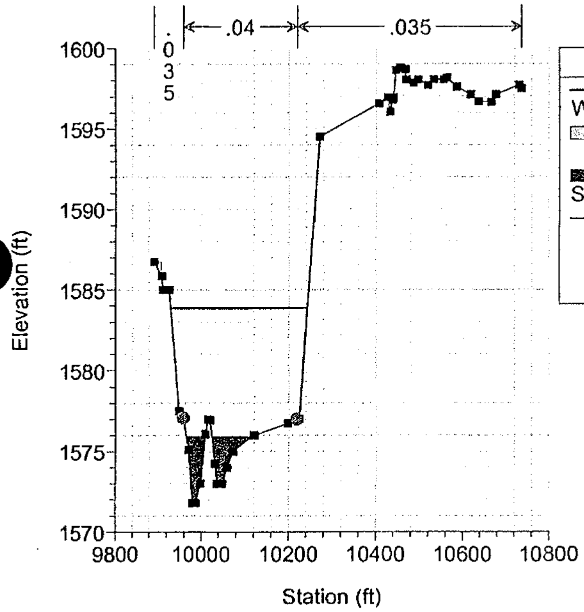
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 3.433 Lateral Weir on Left



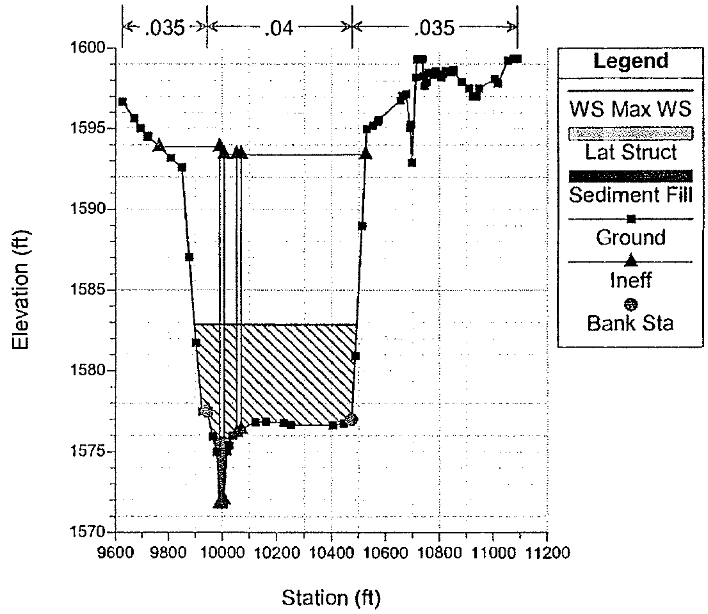
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 3.376 Lateral Weir on Left



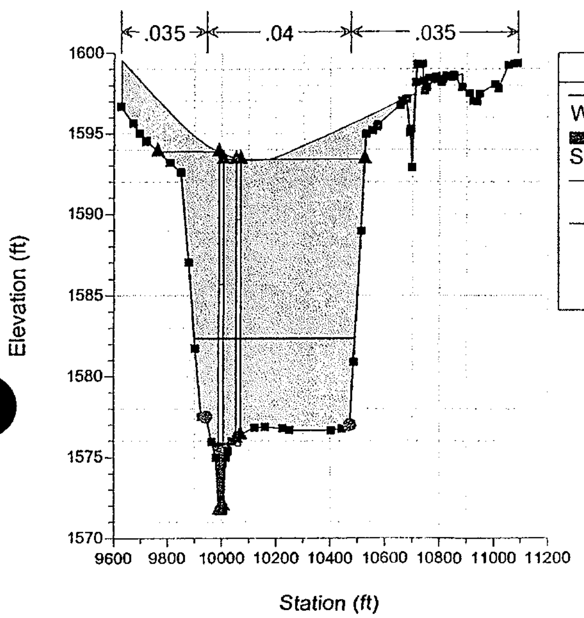
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 3.289 U/S Culvert Section Brown Road



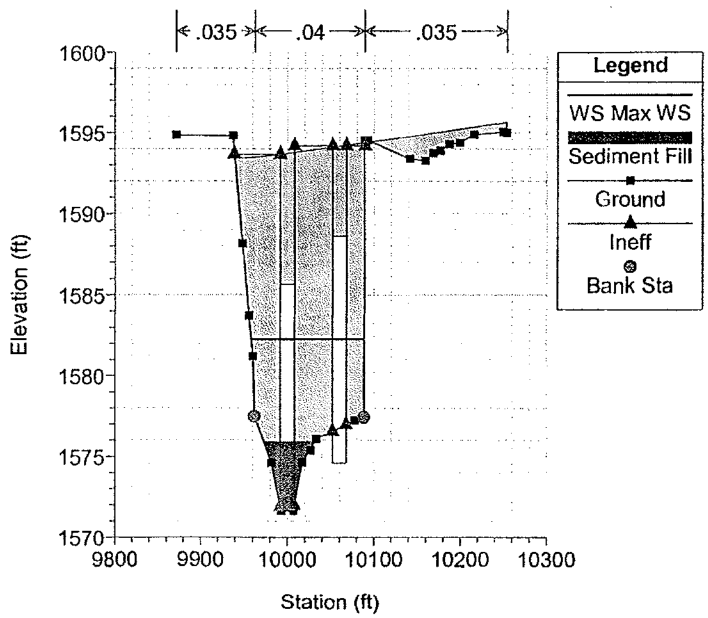
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 3.257 Culv Brown Road



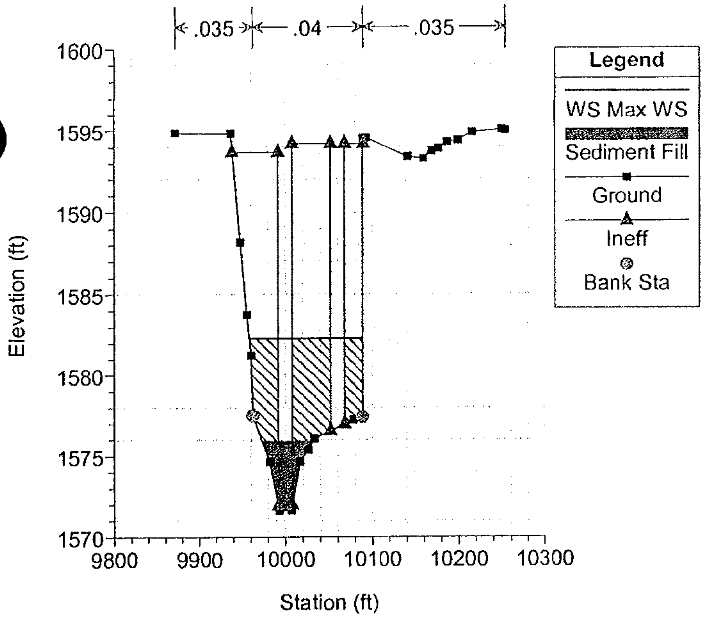
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 3.257 Culv Brown Road



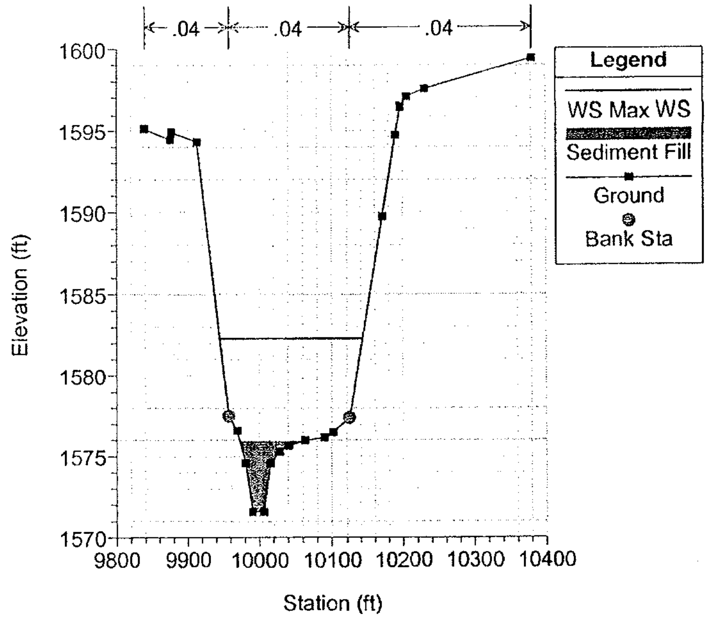
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 3.235 D/S Culvert Section Brown Road



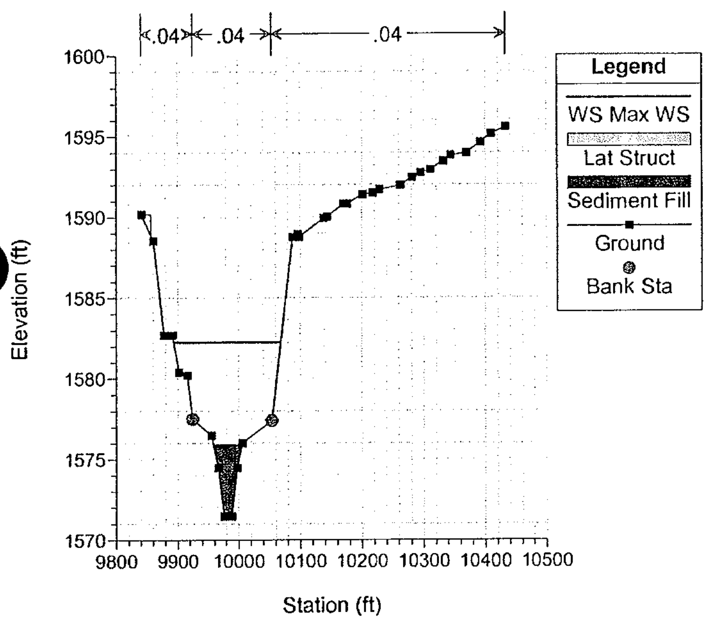
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 3.207



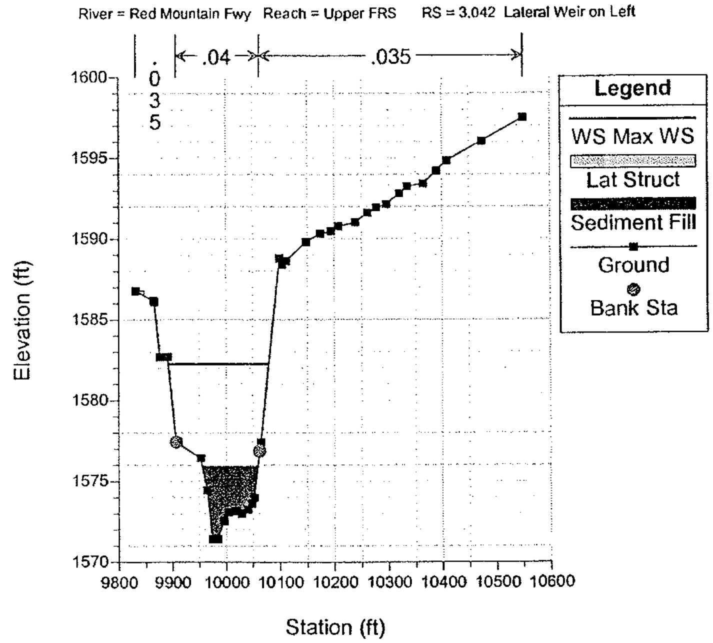
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 3.123 Lateral Weir on Left



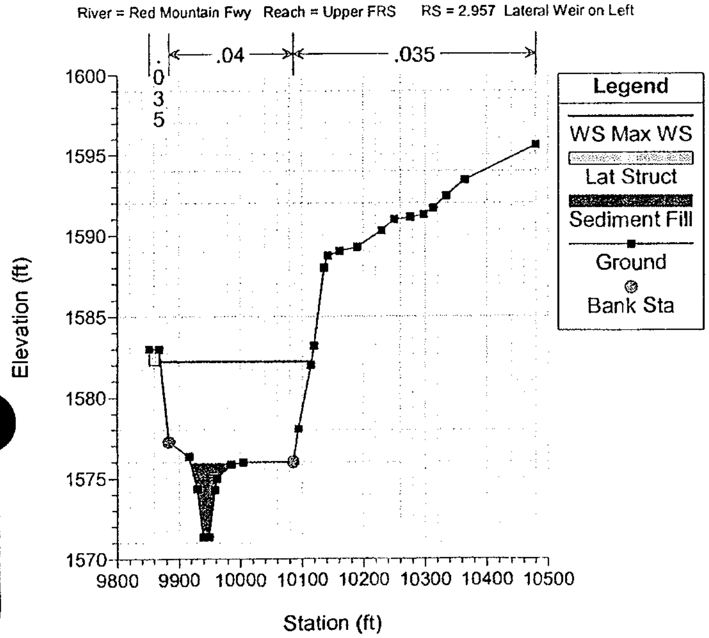
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 3.042 Lateral Weir on Left



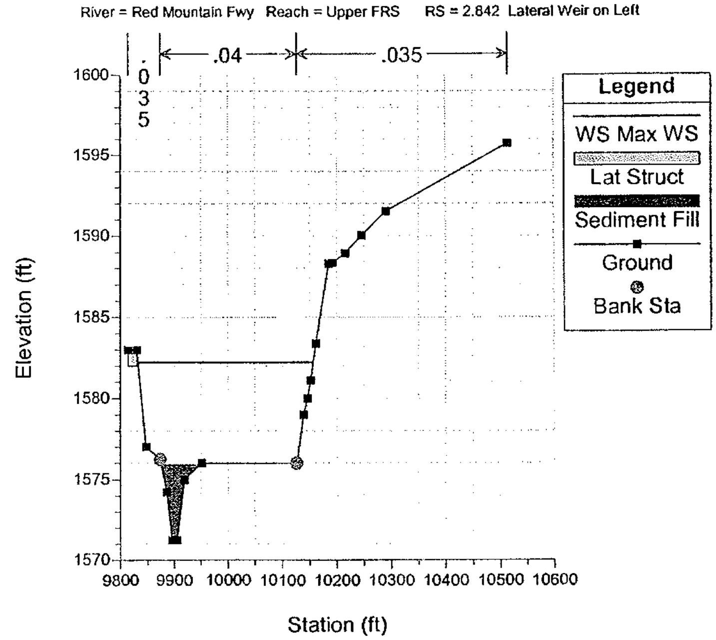
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 2.957 Lateral Weir on Left



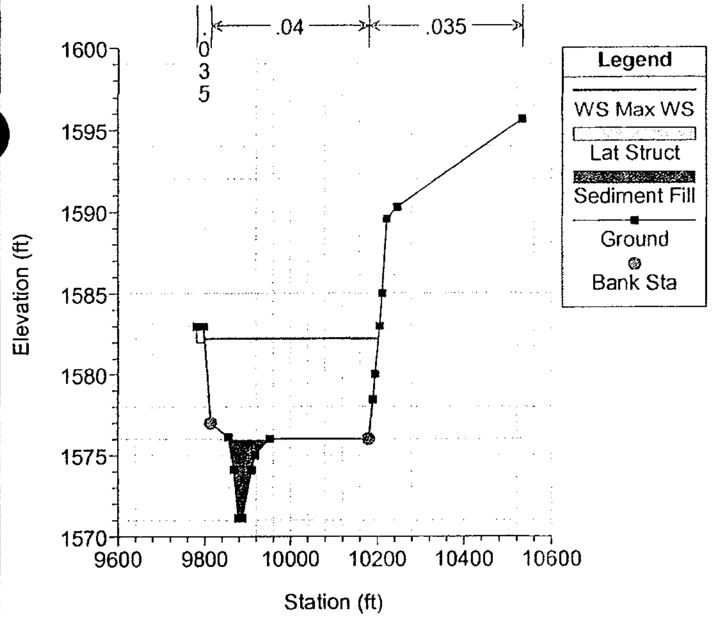
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 2.842 Lateral Weir on Left



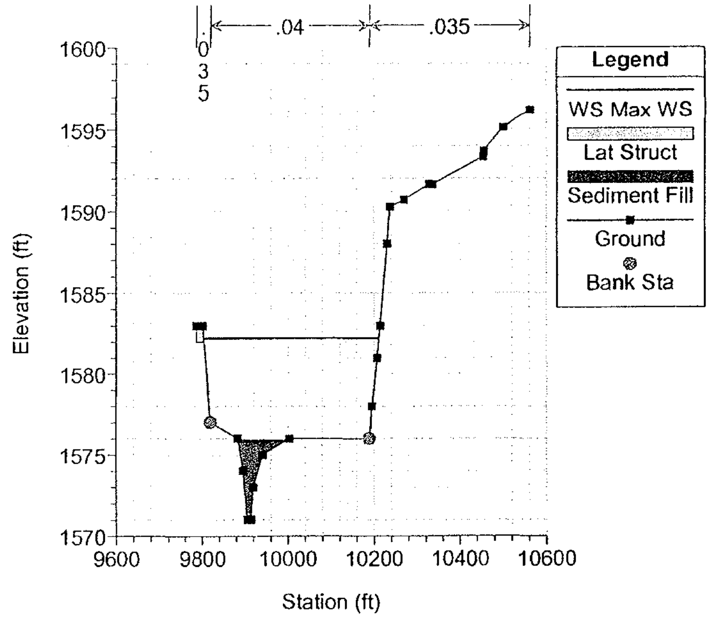
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 2.731 Lateral Weir on Left



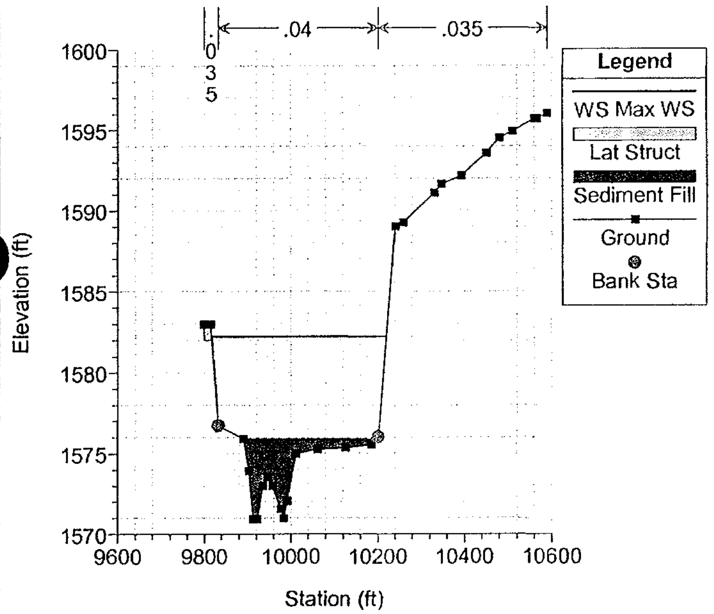
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 2.617 Lateral Weir on Left



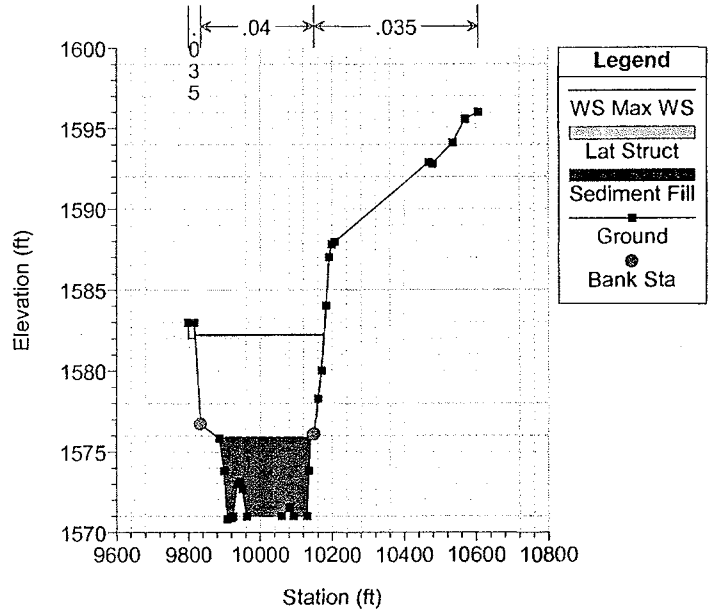
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 2.524 Lateral Weir on Left



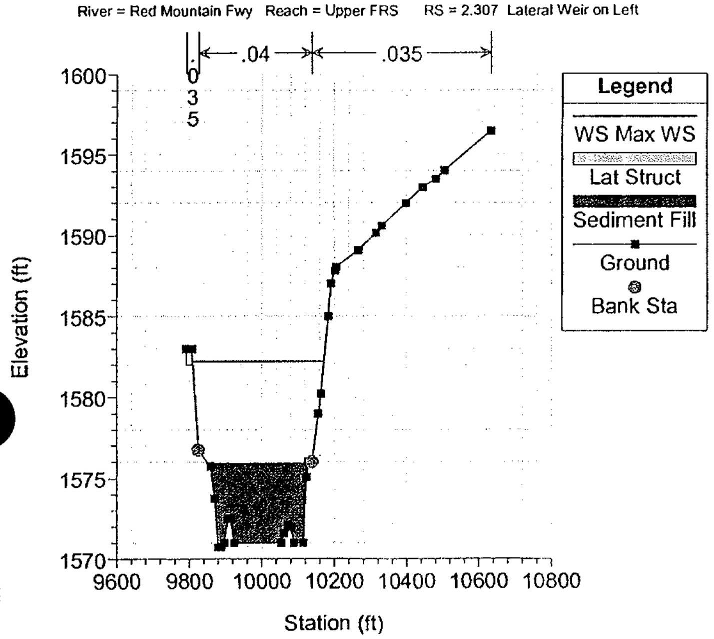
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 2.396 Lateral Weir on Left



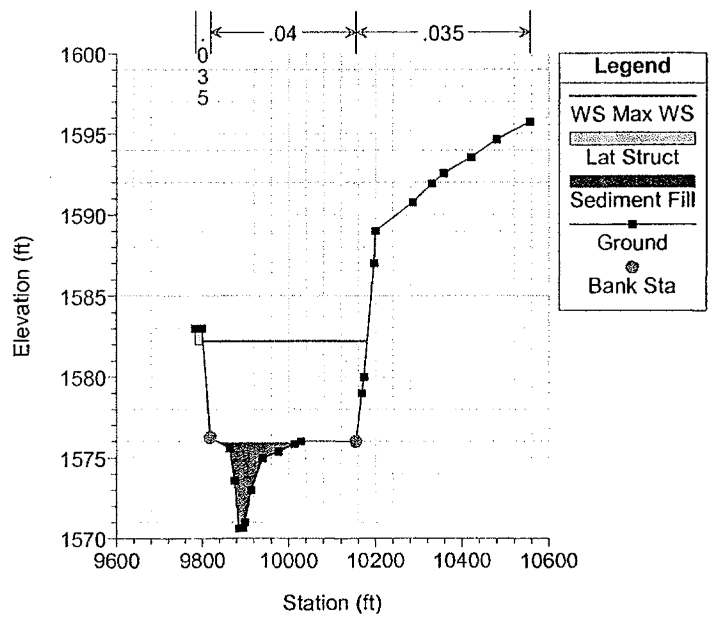
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 2.307 Lateral Weir on Left



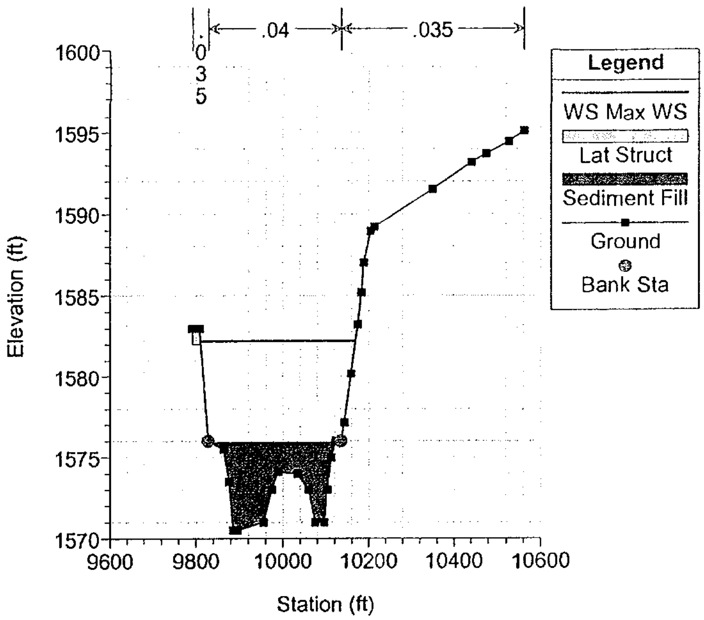
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 2.167 Lateral Weir on Left



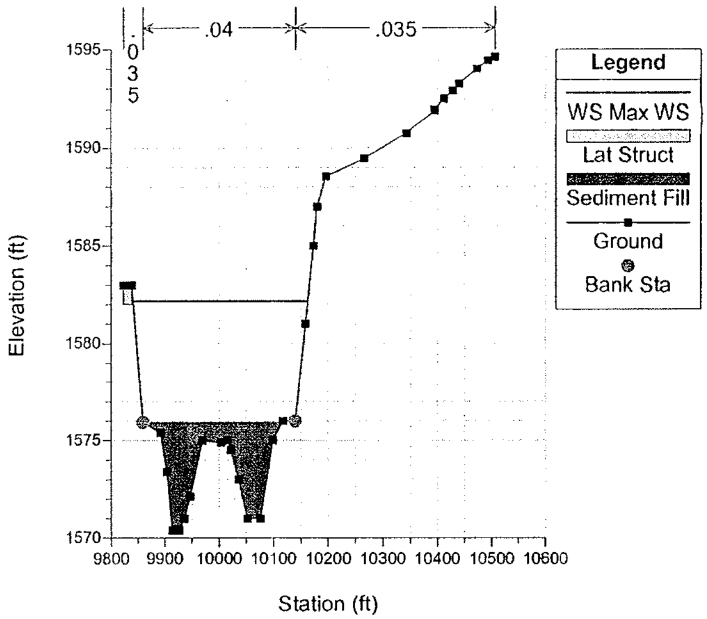
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 2.043 Lateral Weir on Left



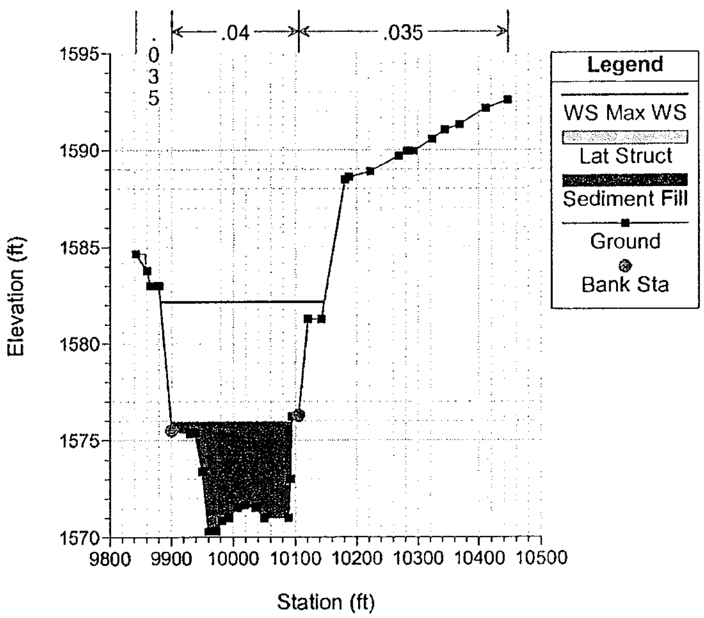
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 1.934 Lateral Weir on Left



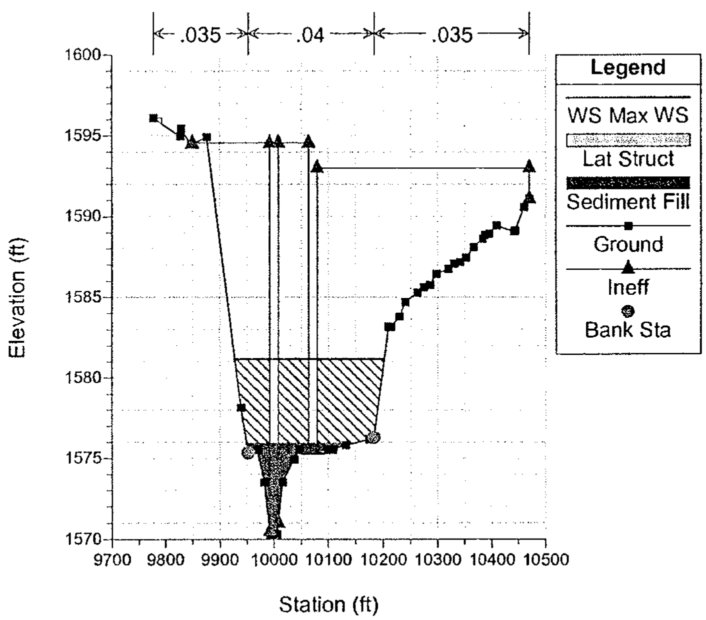
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 1.818 Lateral Weir on Left



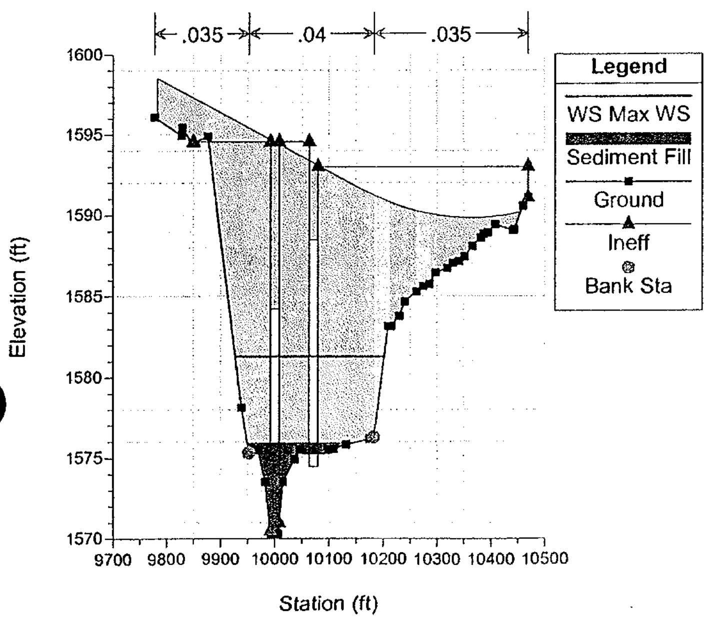
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 1.742 U/S Culvert Section McKellips Road



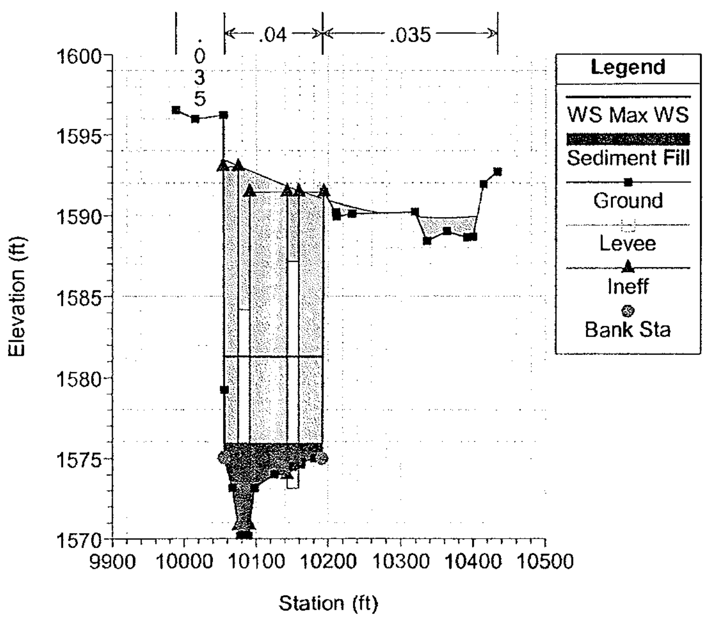
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 1.701 Culv McKellips Road



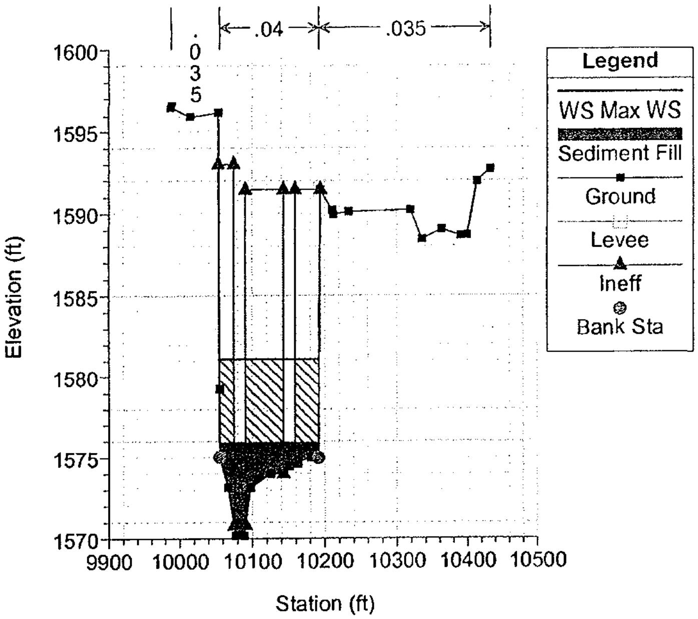
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 1.701 Culv McKellips Road



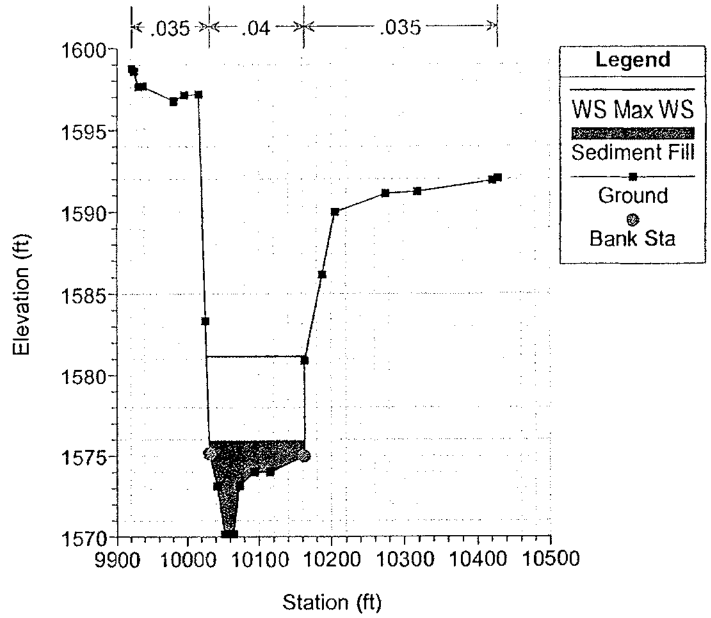
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 1.664 D/S Culvert Section McKellips Road



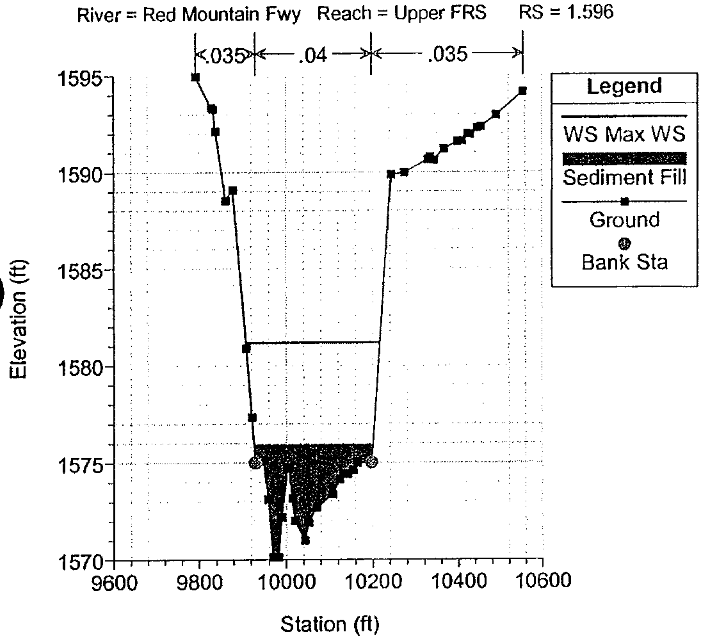
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 1.638



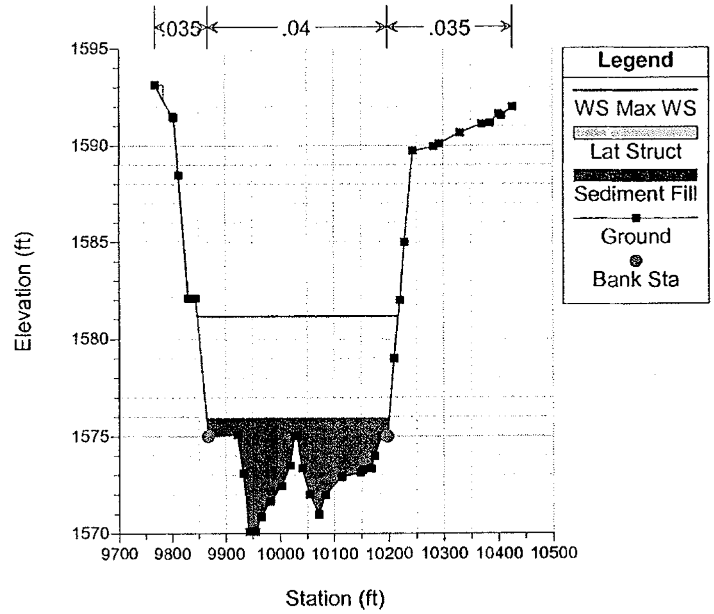
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 1.596



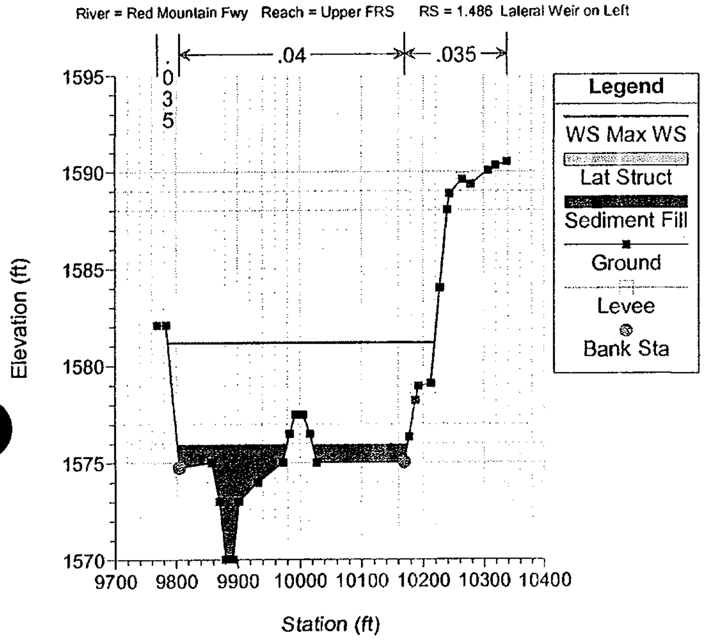
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 1.581 Lateral Weir on Left



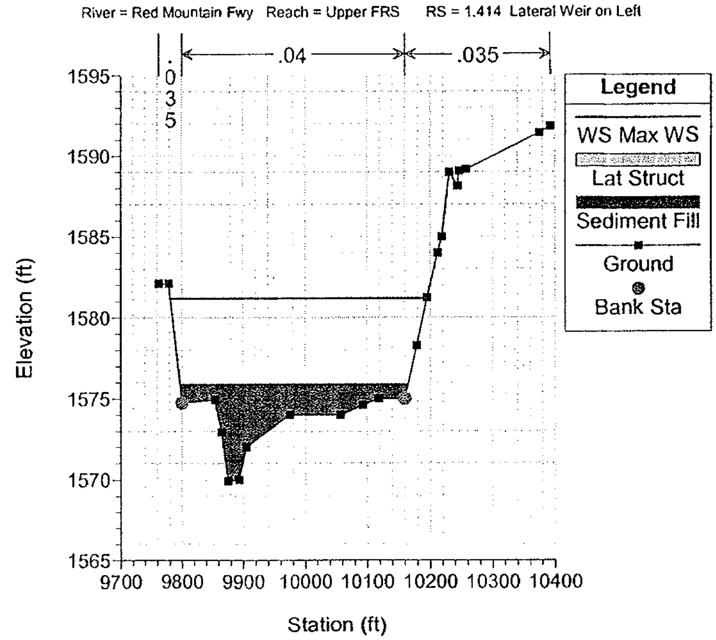
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 1.486 Lateral Weir on Left



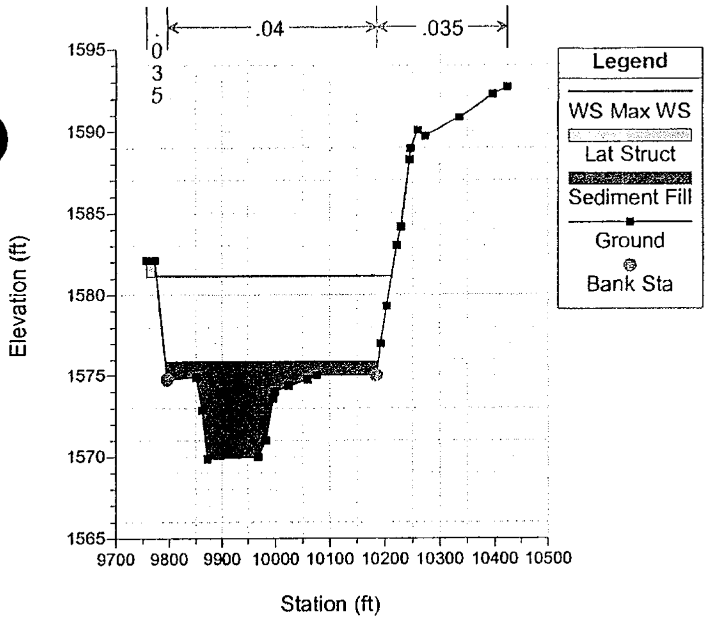
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 1.414 Lateral Weir on Left



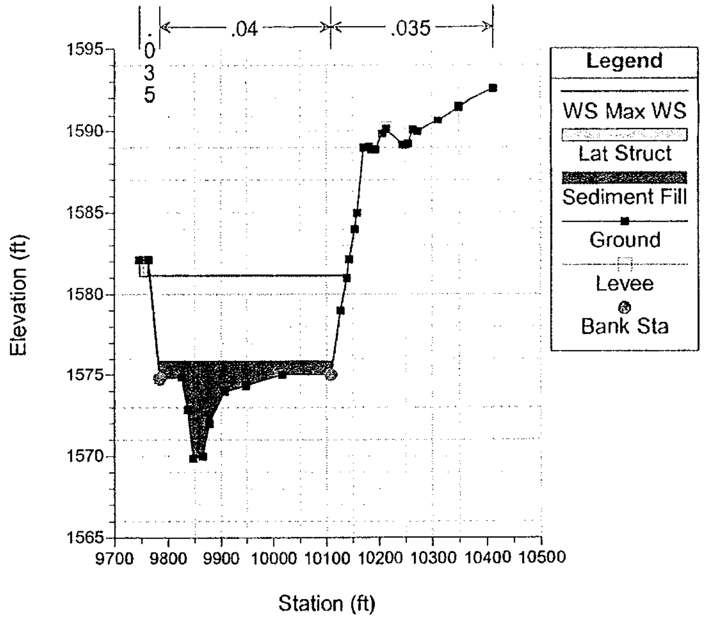
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 1.346 Lateral Weir on Left



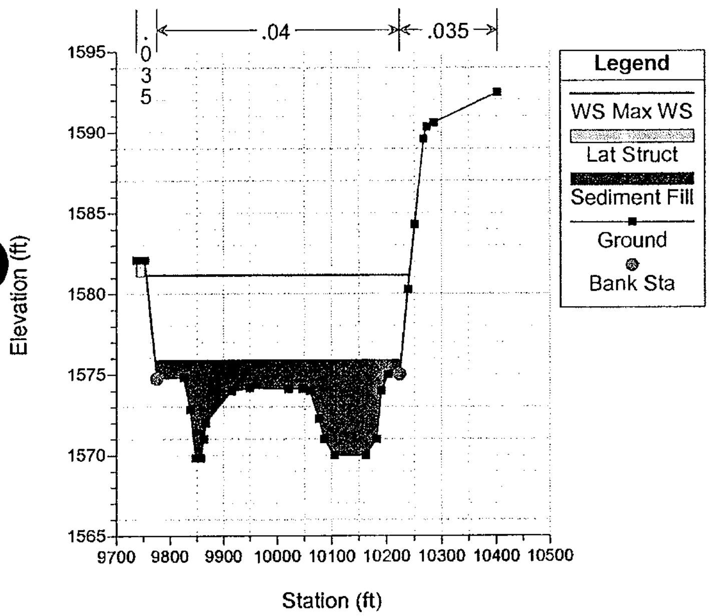
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 1.321 Lateral Weir on Left



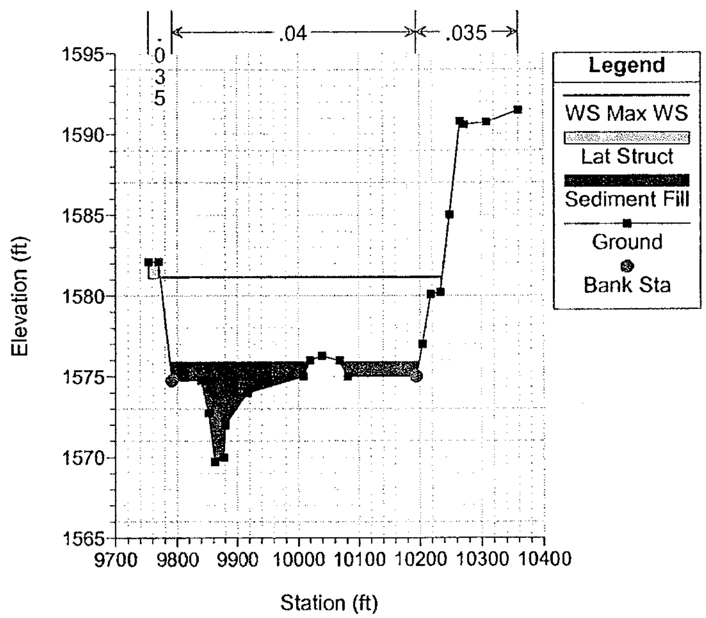
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 1.288 Lateral Weir on Left



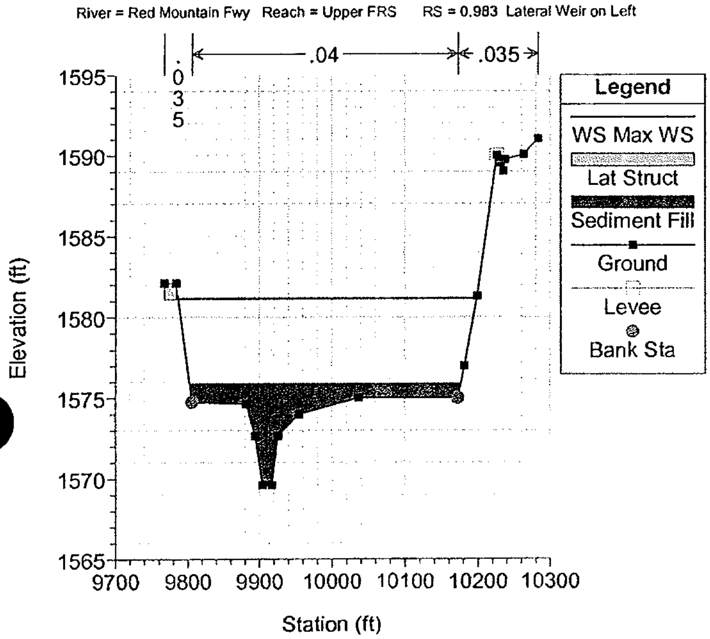
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 1.145 Lateral Weir on Left



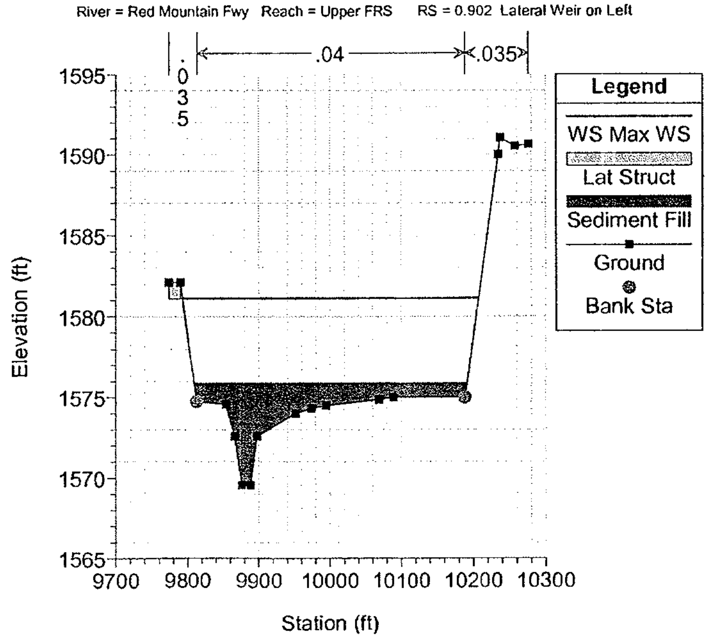
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 0.983 Lateral Weir on Left



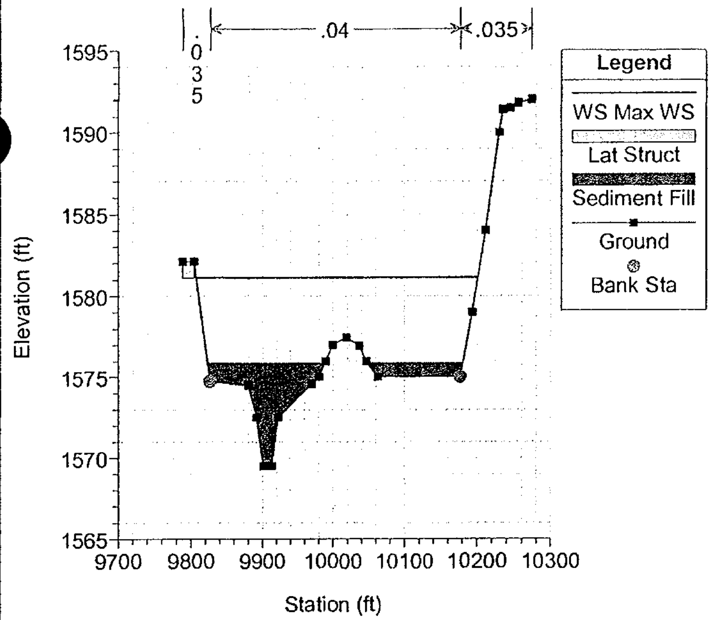
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 0.902 Lateral Weir on Left



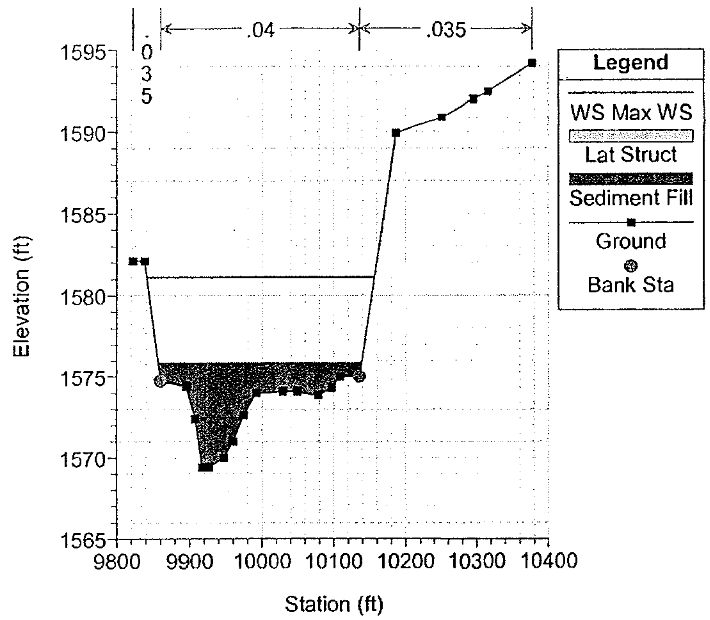
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 0.817 Lateral Weir on Left



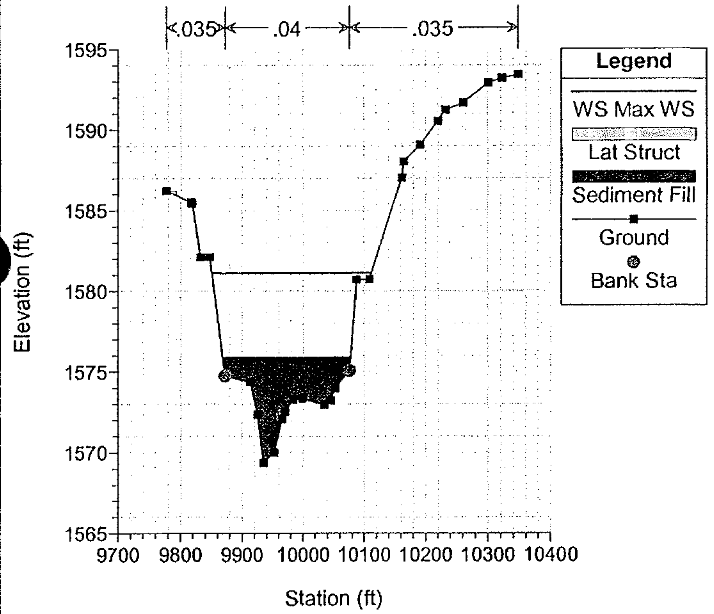
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 0.656 Lateral Weir on Left



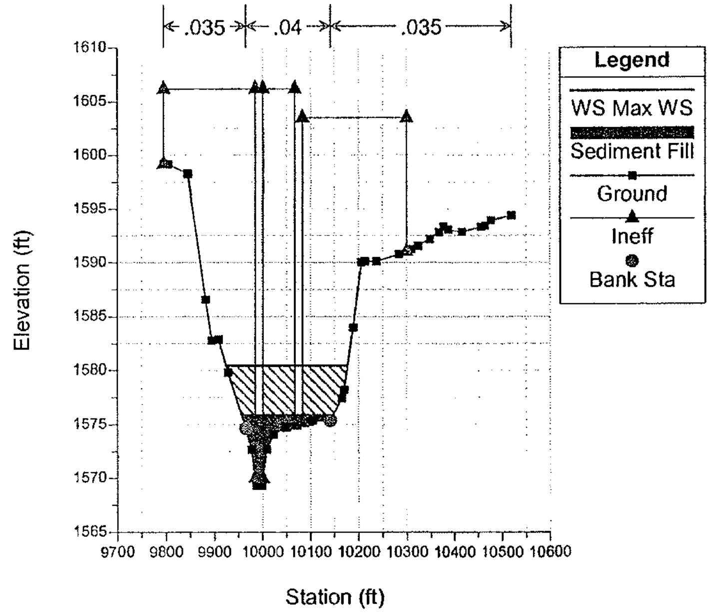
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 0.598 Lateral Weir on Left



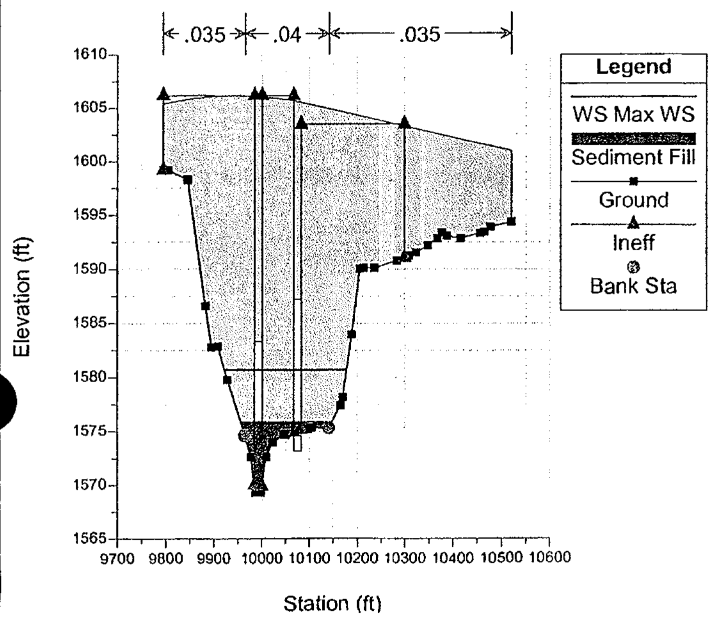
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 0.530 U/S Culvert Section McDowell Road



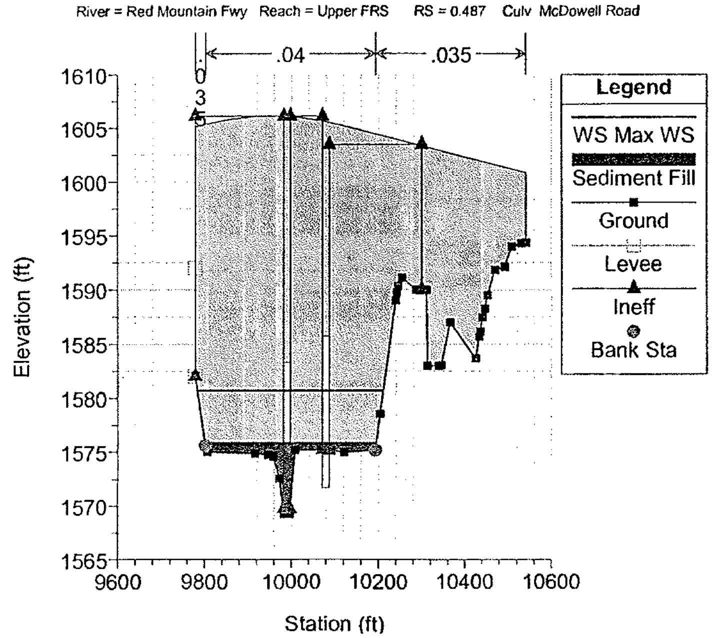
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005

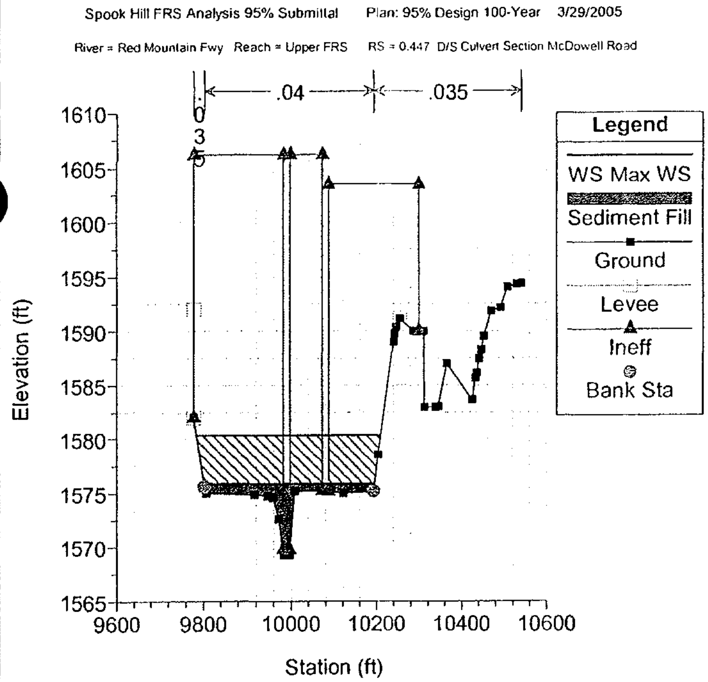
River = Red Mountain Fwy Reach = Upper FRS RS = 0.487 Culv McDowell Road

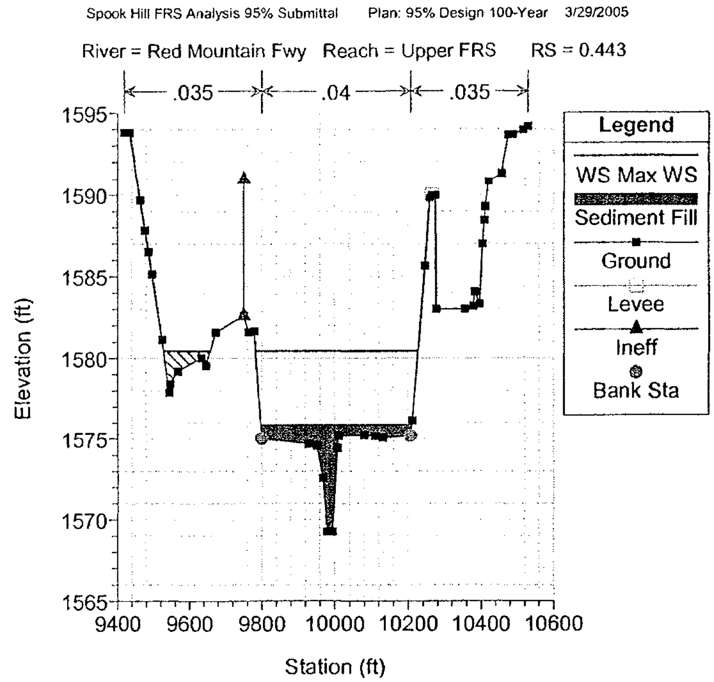


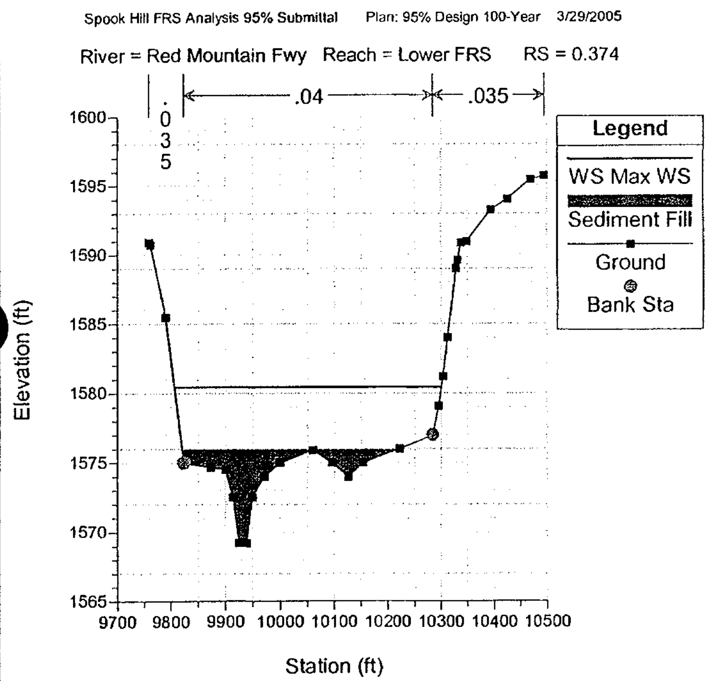
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005

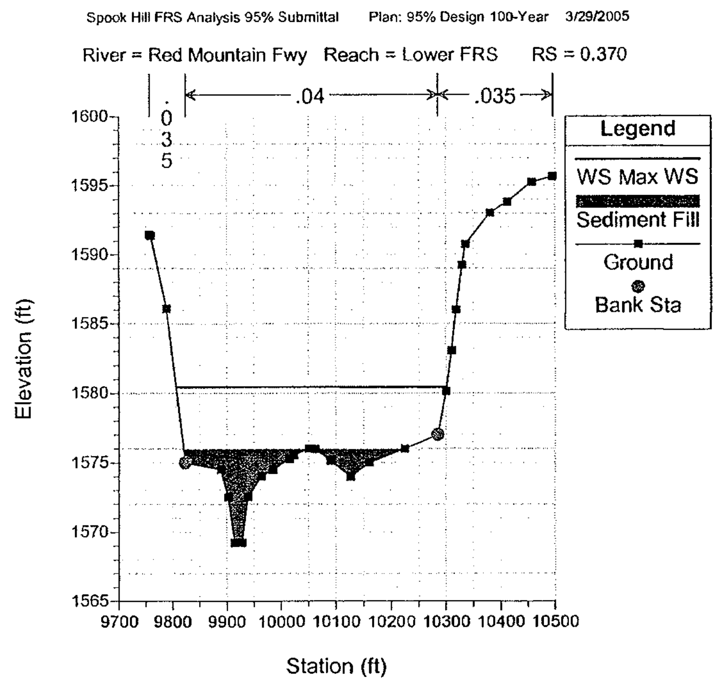
River = Red Mountain Fwy Reach = Upper FRS RS = 0.487 Culv McDowell Road

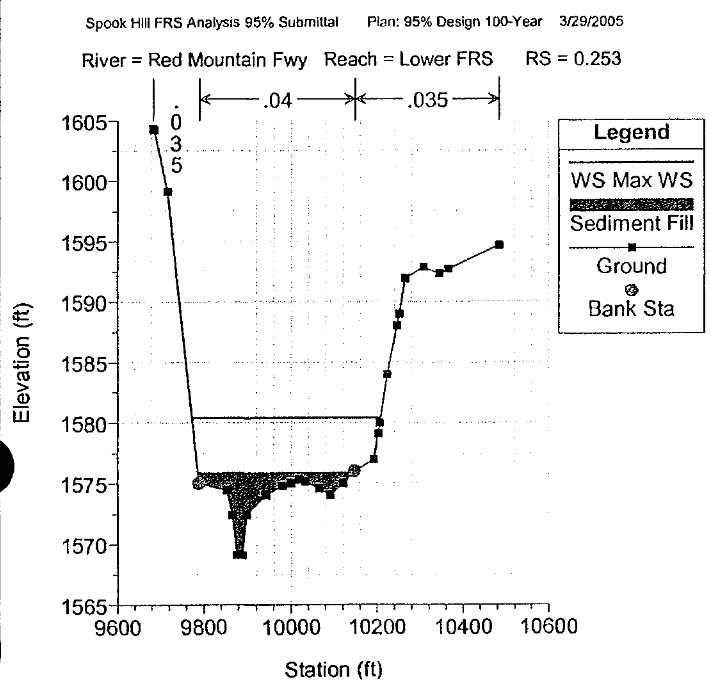


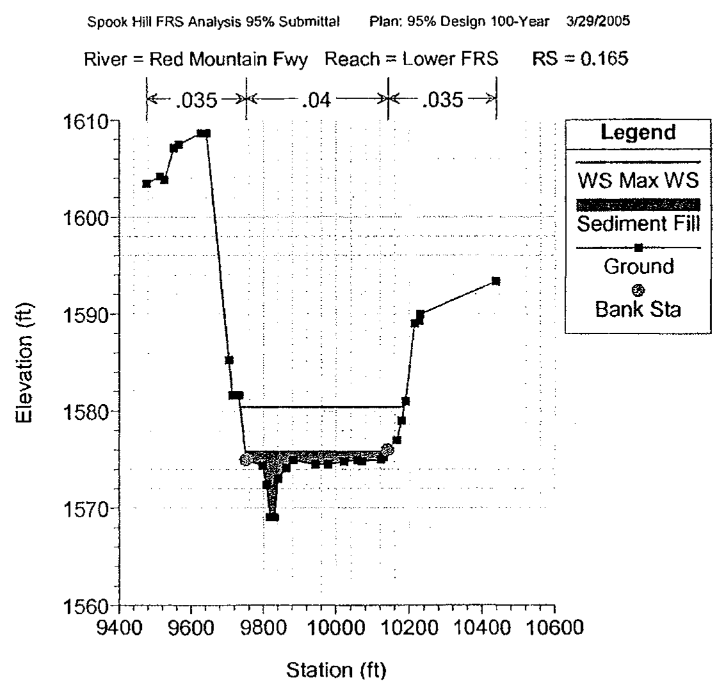

Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005
River = Red Mountain Fwy Reach = Upper FRS RS = 0.447 D/S Culvert Section McDowell Road
.04
.035
Legend
WS Max WS
Sediment Fill
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
Station (ft)

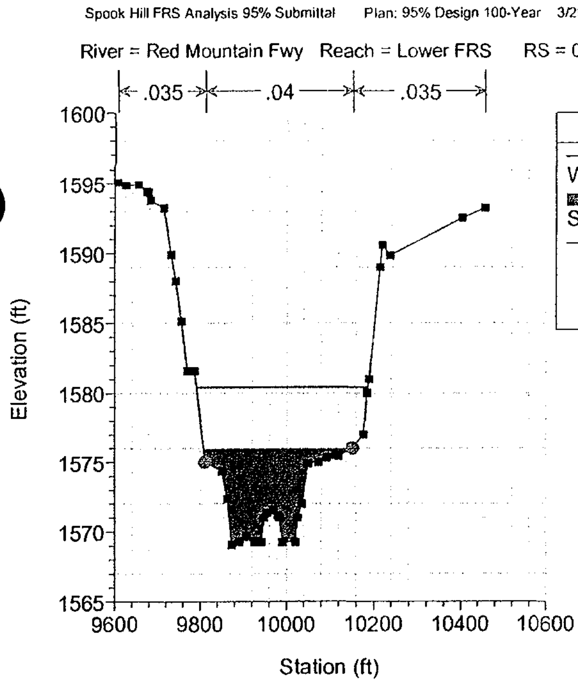

Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005
River = Red Mountain Fwy Reach = Upper FRS RS = 0.443
.035
.04
.035
Legend
WS Max WS
Sediment Fill
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
Station (ft)

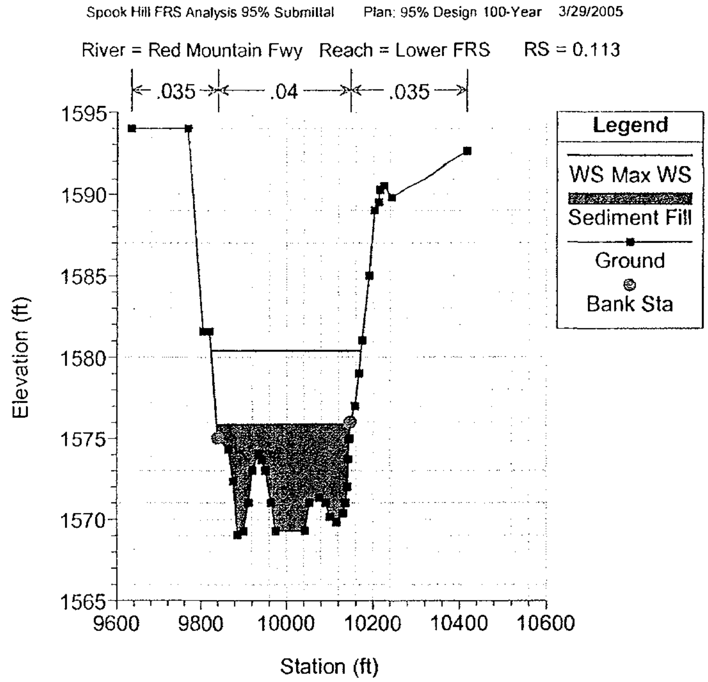

Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005
River = Red Mountain Fwy Reach = Lower FRS RS = 0.374
.04
.035
Legend
WS Max WS
Sediment Fill
Ground
Bank Sta
Elevation (ft)
Station (ft)

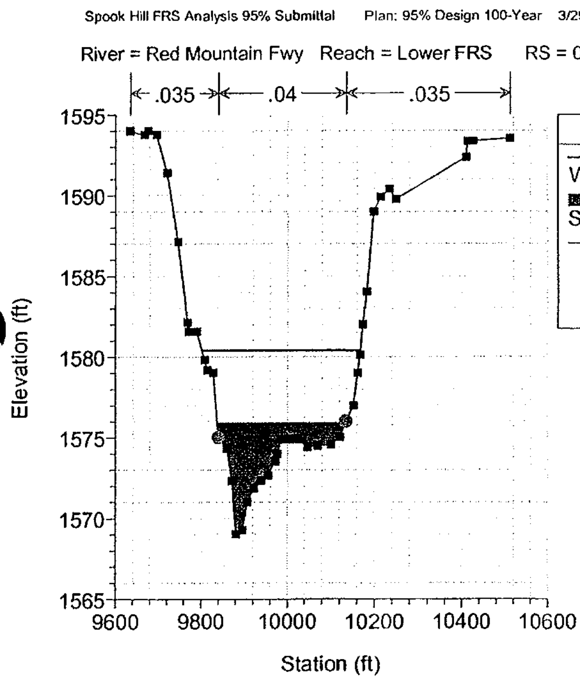

Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005
River = Red Mountain Fwy Reach = Lower FRS RS = 0.370
.04
.035
Legend
WS Max WS
Sediment Fill
Ground
Bank Sta
Elevation (ft)
Station (ft)

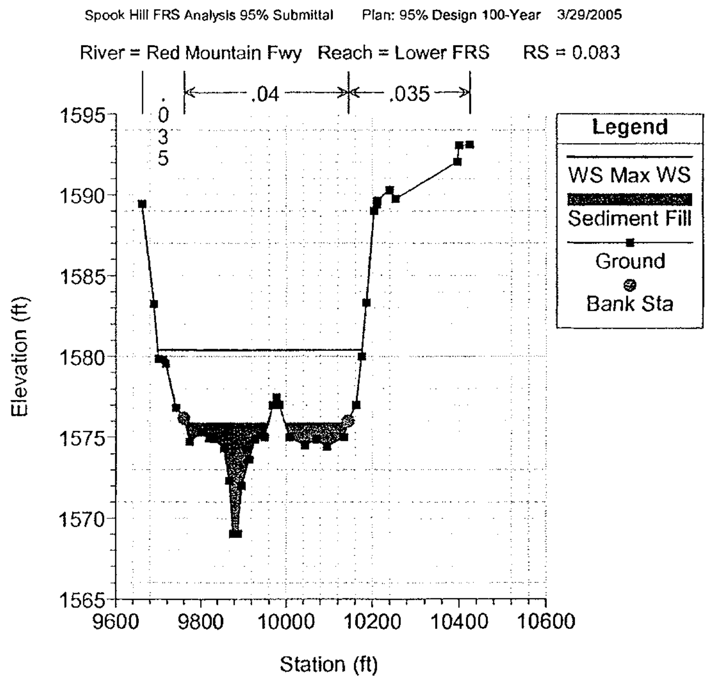

Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005
River = Red Mountain Fwy Reach = Lower FRS RS = 0.253
.04
.035
Legend
WS Max WS
Sediment Fill
Ground
Bank Sta
Elevation (ft)
Station (ft)

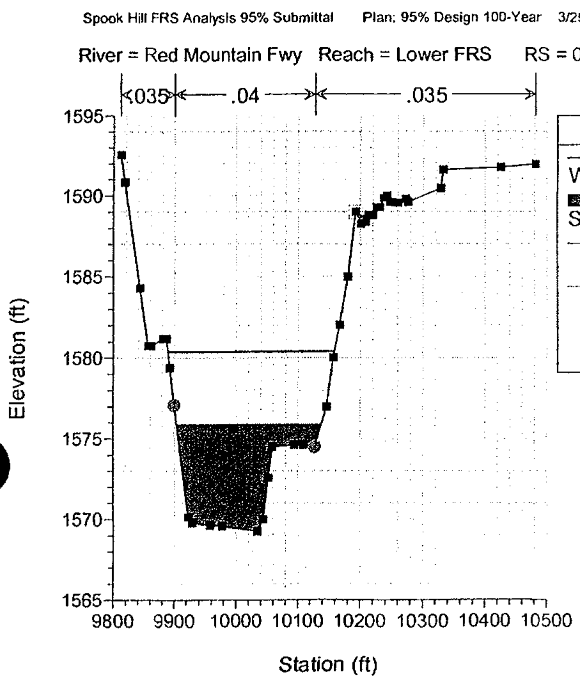

Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005
River = Red Mountain Fwy Reach = Lower FRS RS = 0.165
.035
.04
.035
Legend
WS Max WS
Sediment Fill
Ground
Bank Sta
Elevation (ft)
Station (ft)

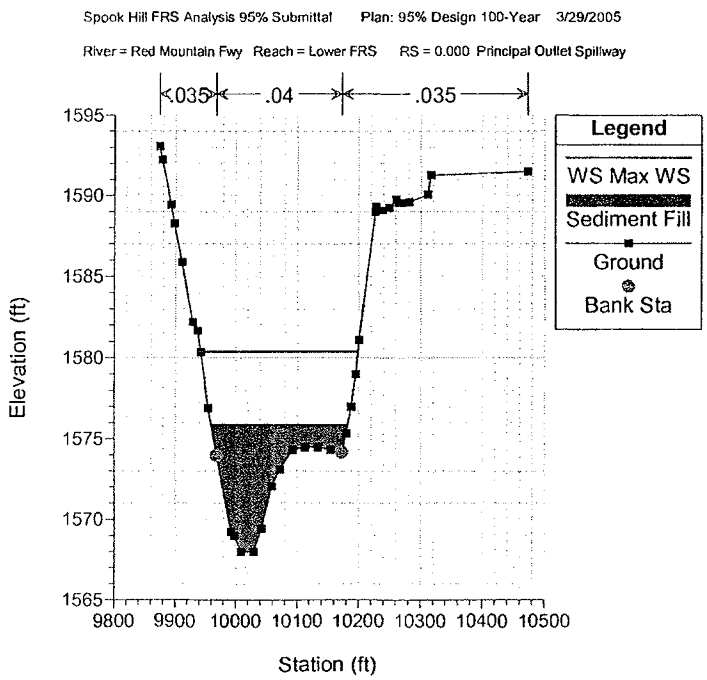

Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005
River = Red Mountain Fwy Reach = Lower FRS RS = 0.130
.035 .04 .035
Legend
WS Max WS
Sediment Fill
Ground
Bank Sta
Elevation (ft)
Station (ft)


Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005
River = Red Mountain Fwy Reach = Lower FRS RS = 0.113
.035 .04 .035
Legend
WS Max WS
Sediment Fill
Ground
Bank Sta
Elevation (ft)
Station (ft)


Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005
River = Red Mountain Fwy Reach = Lower FRS RS = 0.096
.035 .04 .035
Legend
WS Max WS
Sediment Fill
Ground
Bank Sta
Elevation (ft)
Station (ft)


Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005
River = Red Mountain Fwy Reach = Lower FRS RS = 0.083
.035 .04 .035
Legend
WS Max WS
Sediment Fill
Ground
Bank Sta
Elevation (ft)
Station (ft)

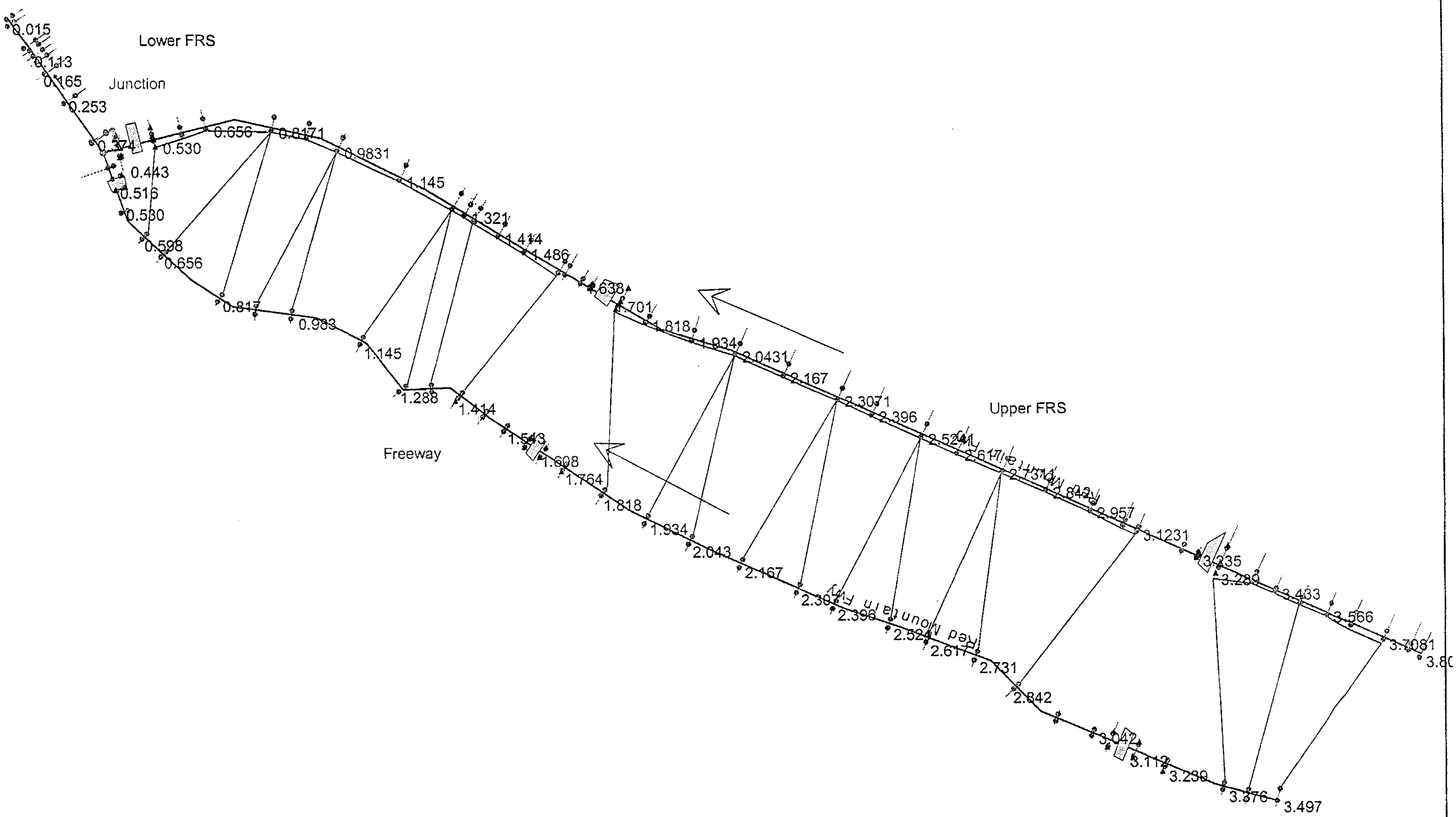

Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005
River = Red Mountain Fwy Reach = Lower FRS RS = 0.015
.035 .04 .035
Legend
WS Max WS
Sediment Fill
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)

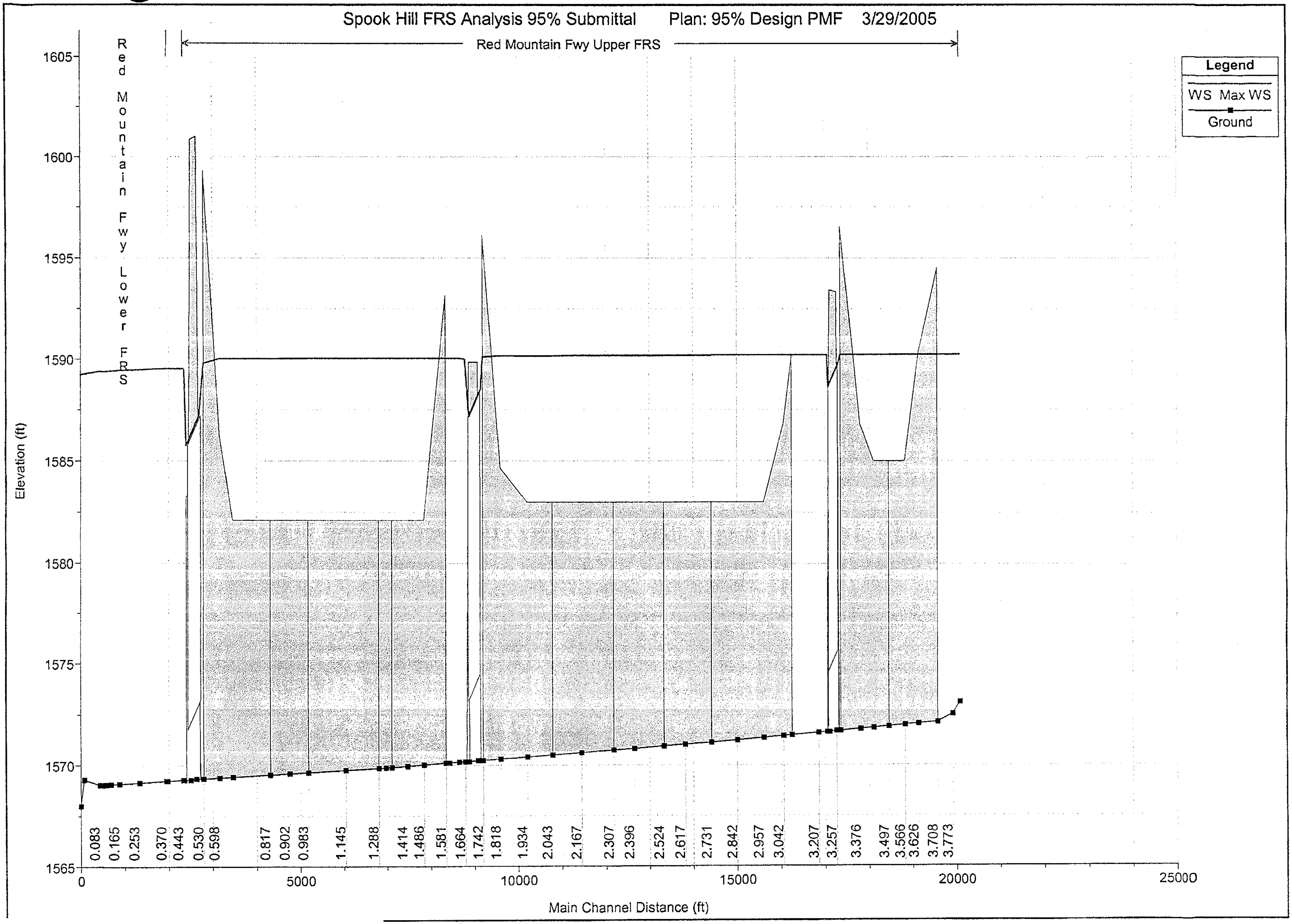

Spook Hill FRS Analysis 95% Submittal Plan: 95% Design 100-Year 3/29/2005
River = Red Mountain Fwy Reach = Lower FRS RS = 0.000 Principal Outlet Spillway
.035 .04 .035
Legend
WS Max WS
Sediment Fill
Ground
Bank Sta
Elevation (ft)
Station (ft)

APPENDIX C

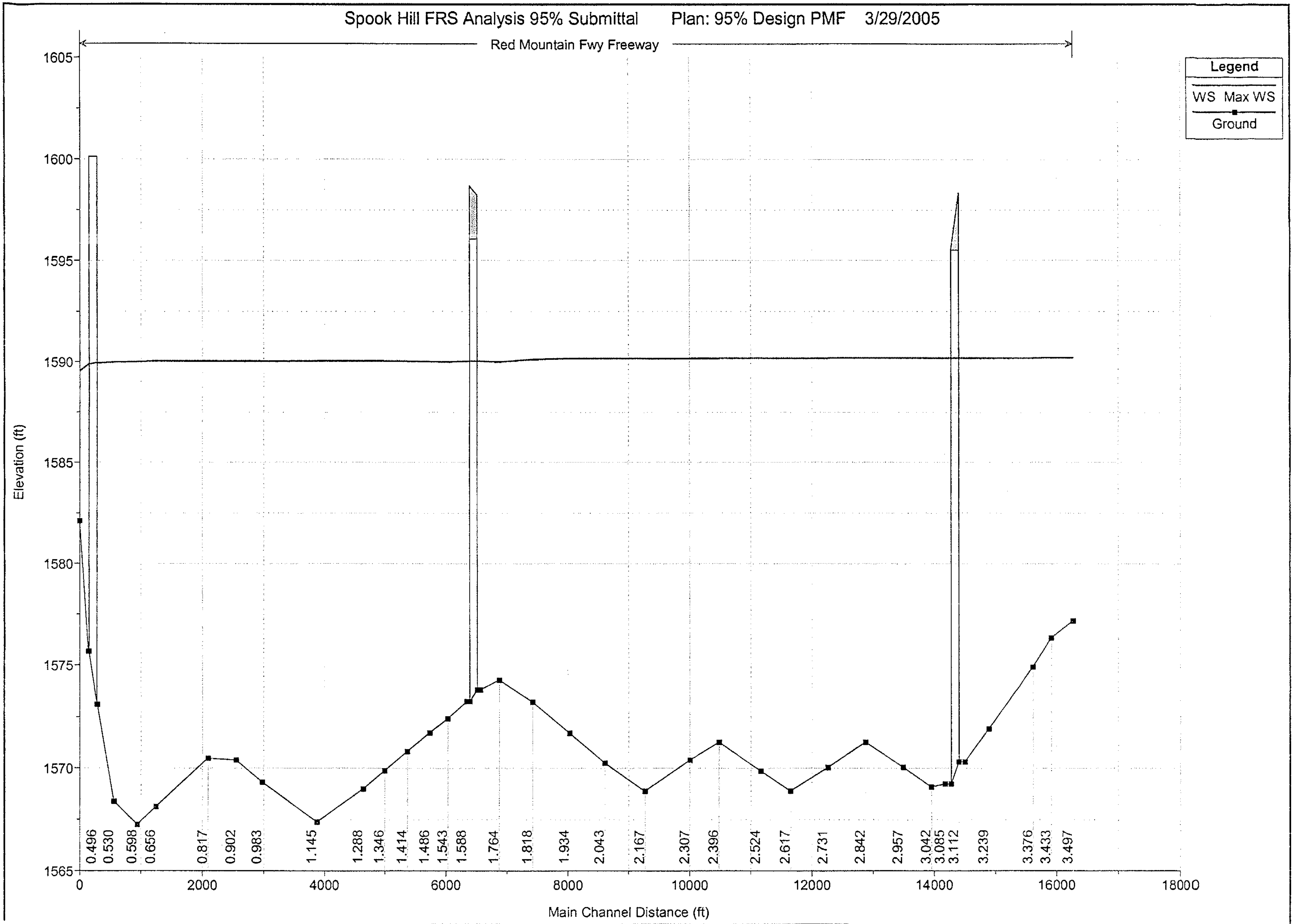
HEC-RAS UNSTEADY FLOW ANALYSES

PMF Analysis


Lower FRS
Junction
Upper FRS
Freeway
Red Mountain Fwy
0.015
0.113
0.165
0.253
0.374
0.530
0.656
0.8171
0.9831
1.145
1.321
1.414
1.486
1.638
1.701
1.818
1.934
2.0431
2.167
2.3071
2.396
2.5241
2.617
2.7311
2.842
2.957
3.1231
3.235
3.289
3.433
3.566
3.7081
0.443
0.516
0.530
0.598
0.656
0.817
0.983
1.145
1.288
1.414
1.543
1.608
1.764
1.818
1.934
2.043
2.167
2.307
2.396
2.524
2.617
2.731
2.842
3.042
3.112
3.239
3.376
3.497



Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005
Red Mountain Fwy Upper FRS
Red Mountain Fwy Lower FRS
Legend
WS Max WS
Ground
Elevation (ft)
1605
1600
1595
1590
1585
1580
1575
1570
1565
0.083 0.165 0.253 0.370 0.443 0.530 0.598 0.817 0.902 0.983 1.145 1.288 1.414 1.486 1.581 1.664 1.742 1.818 1.934 2.043 2.167 2.307 2.396 2.524 2.617 2.731 2.842 2.957 3.042 3.207 3.257 3.376 3.497 3.566 3.626 3.708 3.773
0
5000
10000
15000
20000
25000
Main Channel Distance (ft)



Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005
Red Mountain Fwy Freeway
Legend
WS Max WS
Ground
Elevation (ft)
1605
1600
1595
1590
1585
1580
1575
1570
1565
0.496
0.530
0.598
0.656
0.817
0.902
0.983
1.145
1.288
1.346
1.414
1.486
1.543
1.588
1.764
1.818
1.934
2.043
2.167
2.307
2.396
2.524
2.617
2.731
2.842
2.957
3.042
3.085
3.112
3.239
3.376
3.433
3.497
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
Main Channel Distance (ft)

EC-RAS Plan: 95% PMF Profile: Max WS

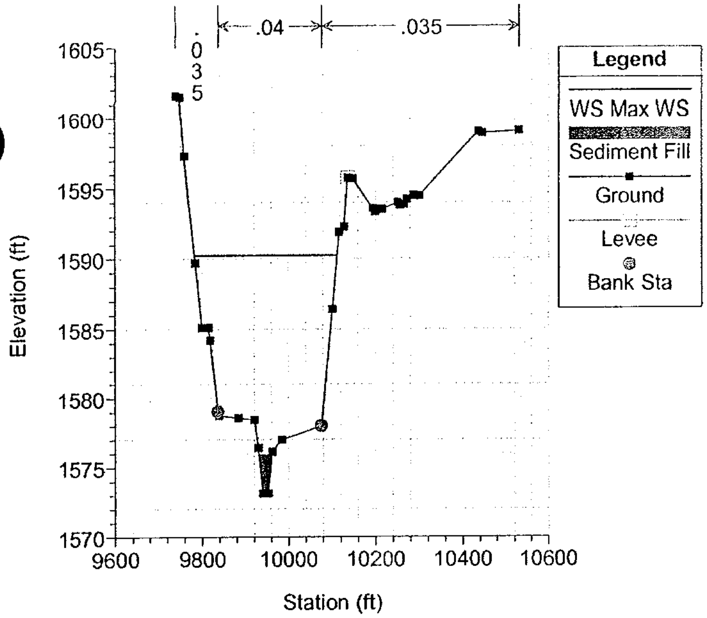
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
ower FRS	0.000	Max WS	11427.75	1575.95	1589.22	1580.08	1589.38	0.000251	3.30	3688.04	348.56	0.16
ower FRS	0.015	Max WS	11428.01	1575.95	1589.27		1589.40	0.000210	3.02	4121.51	401.78	0.15
ower FRS	0.083	Max WS	11365.41	1575.95	1589.39		1589.44	0.000076	1.82	6495.96	549.83	0.09
ower FRS	0.096	Max WS	11353.63	1575.95	1589.38		1589.45	0.000118	2.28	5289.89	471.13	0.11
ower FRS	0.113	Max WS	11339.00	1575.95	1589.38		1589.46	0.000128	2.37	5005.69	429.03	0.11
ower FRS	0.130	Max WS	11323.85	1575.95	1589.41		1589.47	0.000098	2.08	5680.51	481.12	0.10
ower FRS	0.165	Max WS	11291.96	1575.95	1589.44		1589.49	0.000077	1.85	6361.98	533.10	0.09
ower FRS	0.253	Max WS	11213.78	1575.95	1589.47		1589.52	0.000082	1.91	6101.04	508.38	0.09
ower FRS	0.370	Max WS	11108.76	1575.95	1589.53		1589.57	0.000062	1.66	6882.89	560.56	0.08
ower FRS	0.374	Max WS	11108.82	1575.95	1589.53		1589.57	0.000062	1.66	6884.45	562.49	0.08
reeway	0.450	Max WS	8942.07	1582.10	1589.53		1589.95	0.001460	5.98	1837.47	387.32	0.40
reeway	0.476	Max WS	8942.34	1575.67	1589.87		1590.03	0.000066	3.31	2941.81	235.64	0.16
reeway	0.496		Bridge									
reeway	0.516	Max WS	8942.51	1573.10	1589.93	1578.03	1590.03	0.000033	2.67	3653.07	266.22	0.12
reeway	0.530	Max WS	8942.87	1568.38	1589.97		1590.04	0.000017	2.24	4801.24	285.89	0.09
reeway	0.598	Max WS	8943.45	1567.26	1589.99		1590.04	0.000013	2.00	5868.15	380.32	0.08
reeway	0.656	Max WS	7077.96	1568.12	1590.03		1590.05	0.000007	1.40	6814.14	426.88	0.06
reeway	0.817	Max WS	7078.71	1570.48	1590.02		1590.06	0.000013	1.76	4800.11	329.59	0.07
reeway	0.902	Max WS	7955.14	1570.39	1590.03		1590.06	0.000011	1.64	5941.45	389.47	0.07
reeway	0.983	Max WS	7955.89	1569.31	1590.02		1590.07	0.000012	1.77	5264.60	331.72	0.07
reeway	1.145	Max WS	8466.53	1567.38	1590.04		1590.07	0.000007	1.47	7444.70	437.15	0.06
reeway	1.288	Max WS	8468.09	1568.99	1590.05		1590.08	0.000008	1.49	7174.38	450.02	0.06
reeway	1.346	Max WS	9991.83	1569.87	1590.04		1590.07	0.000012	1.71	7931.13	504.38	0.07
reeway	1.414	Max WS	9285.26	1570.81	1590.03		1590.09	0.000020	2.17	5526.97	574.41	0.09
reeway	1.486	Max WS	9287.17	1571.72	1590.01		1590.10	0.000035	2.71	4346.39	340.84	0.12
reeway	1.543	Max WS	9288.55	1572.41	1589.99		1590.12	0.000048	3.11	3668.26	311.85	0.14
reeway	1.588	Max WS	9289.69	1573.24	1590.03		1590.12	0.000032	2.47	4036.63	361.71	0.12
reeway	1.608		Bridge									
reeway	1.695	Max WS	9290.25	1573.79	1590.03	1579.70	1590.13	0.000036	2.56	3887.15	370.98	0.12
reeway	1.764	Max WS	9291.51	1574.26	1589.99		1590.15	0.000071	3.50	3174.03	427.18	0.17
reeway	1.818	Max WS	9354.52	1573.21	1590.11		1590.15	0.000022	2.05	6227.14	505.63	0.10
reeway	1.934	Max WS	4756.10	1571.70	1590.17		1590.19	0.000004	0.99	5879.67	403.24	0.04
reeway	2.043	Max WS	4757.89	1570.25	1590.18		1590.19	0.000003	0.90	6577.44	422.68	0.04
reeway	2.167	Max WS	5706.52	1568.88	1590.17		1590.19	0.000005	1.17	5867.42	361.73	0.05
reeway	2.307	Max WS	5708.85	1570.39	1590.17		1590.19	0.000005	1.11	6377.12	409.07	0.05
reeway	2.396	Max WS	4432.13	1571.26	1590.18		1590.19	0.000004	0.94	5730.44	386.46	0.04
reeway	2.524	Max WS	4433.96	1569.85	1590.19		1590.20	0.000003	0.89	6068.17	382.97	0.04
reeway	2.617	Max WS	4022.82	1568.89	1590.19		1590.20	0.000002	0.67	7595.23	452.76	0.03
reeway	2.731	Max WS	4024.08	1570.03	1590.19		1590.20	0.000002	0.73	6792.86	424.05	0.03
reeway	2.842	Max WS	3193.05	1571.26	1590.20		1590.20	0.000001	0.54	7910.87	514.29	0.02
reeway	2.957	Max WS	3194.13	1570.04	1590.20		1590.21	0.000003	0.83	4837.53	333.51	0.03
reeway	3.042	Max WS	3194.63	1569.09	1590.20		1590.21	0.000003	0.83	4675.60	291.90	0.03
reeway	3.085	Max WS	3194.89	1569.23	1590.20		1590.21	0.000001	0.49	7070.70	487.12	0.02
reeway	3.112		Bridge									
reeway	3.146	Max WS	3195.26	1570.31	1590.20	1574.25	1590.21	0.000001	0.52	6655.68	544.77	0.02
reeway	3.239	Max WS	3195.76	1571.91	1590.20		1590.21	0.000004	0.95	4287.05	431.80	0.04
reeway	3.376	Max WS	3196.47	1574.90	1590.20		1590.21	0.000006	1.03	3960.49	356.91	0.05
reeway	3.433	Max WS	736.62	1576.35	1590.22		1590.22	0.000000	0.20	4576.80	437.61	0.01
reeway	3.497	Max WS	0.00	1577.19	1590.22		1590.22	0.000000	0.00	3829.46	424.86	0.00
pper FRS	0.443	Max WS	2166.76	1575.95	1589.53		1589.53	0.000003	0.35	6360.22	794.62	0.02
pper FRS	0.447	Max WS	2166.86	1575.95	1589.45		1589.84	0.000568	5.02	431.84	462.74	0.24
pper FRS	0.487		Culvert									
pper FRS	0.530	Max WS	2166.86	1575.95	1589.79		1590.16	0.000522	4.89	442.91	333.28	0.23
pper FRS	0.598	Max WS	1375.23	1575.95	1590.02		1590.02	0.000003	0.37	4251.16	432.88	0.02
pper FRS	0.656	Max WS	2298.35	1575.95	1590.02		1590.02	0.000006	0.52	4642.19	368.89	0.02
pper FRS	0.817	Max WS	3833.52	1575.95	1590.01		1590.02	0.000010	0.70	5686.40	442.21	0.03
pper FRS	0.8171		Lat Struct									
pper FRS	0.902	Max WS	2543.88	1575.95	1590.03		1590.03	0.000004	0.43	6030.07	461.25	0.02
pper FRS	0.983	Max WS	2843.07	1575.95	1590.03		1590.03	0.000005	0.50	5982.27	492.77	0.02
pper FRS	0.9831		Lat Struct									
pper FRS	1.145	Max WS	1501.91	1575.95	1590.04		1590.04	0.000001	0.23	6647.59	510.32	0.01
pper FRS	1.288	Max WS	2122.51	1575.95	1590.03		1590.04	0.000002	0.31	7030.86	533.84	0.01
pper FRS	1.2881		Lat Struct									
pper FRS	1.321	Max WS	1179.02	1575.95	1590.04		1590.04	0.000001	0.23	5511.97	465.36	0.01
pper FRS	1.346	Max WS	559.65	1575.95	1590.04		1590.04	0.000000	0.09	6388.23	533.00	0.00
pper FRS	1.3461		Lat Struct									
pper FRS	1.414	Max WS	831.13	1575.95	1590.04		1590.04	0.000000	0.15	6112.29	540.09	0.01
pper FRS	1.486	Max WS	1020.60	1575.95	1590.04		1590.04	0.000001	0.18	6184.88	537.07	0.01
pper FRS	1.581	Max WS	1172.47	1575.95	1590.04		1590.04	0.000001	0.23	5470.46	479.82	0.01
pper FRS	1.5811		Lat Struct									
pper FRS	1.596	Max WS	1172.57	1575.95	1590.04		1590.04	0.000002	0.28	4550.63	425.80	0.01
pper FRS	1.638	Max WS	1172.76	1575.95	1590.03		1590.04	0.000007	0.59	2115.44	185.52	0.03
pper FRS	1.664	Max WS	1165.70	1575.95	1589.99		1590.09	0.000144	2.59	449.22	138.58	0.12

EC-RAS Plan: 95% PMF Profile: Max WS (Continued)

Reach	River Sta	Profile	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)	
pper FRS	1.701		Culvert									
pper FRS	1.742	Max WS	1165.70	1575.95	1590.10		1590.20	0.000140	2.58	452.64	560.75	0.12
pper FRS	1.818	Max WS	195.21	1575.95	1590.16		1590.16	0.000000	0.05	4057.68	462.28	0.00
pper	1.934	Max WS	4128.49	1575.95	1590.14		1590.16	0.000018	0.94	4791.83	482.73	0.04
ppe	2.043	Max WS	5129.26	1575.95	1590.15		1590.16	0.000023	1.05	5258.44	478.22	0.05
pper	2.0431		Lat Struct									
pper FRS	2.167	Max WS	1622.12	1575.95	1590.18		1590.18	0.000002	0.31	5513.50	473.75	0.01
pper FRS	2.307	Max WS	3428.80	1575.95	1590.17		1590.18	0.000010	0.69	5385.23	523.78	0.03
pper FRS	2.3071		Lat Struct									
pper FRS	2.396	Max WS	2978.45	1575.95	1590.18		1590.19	0.000008	0.60	5346.71	525.66	0.03
pper FRS	2.524	Max WS	3387.65	1575.95	1590.18		1590.19	0.000008	0.60	5879.04	497.80	0.03
pper FRS	2.5241		Lat Struct									
pper FRS	2.617	Max WS	2070.82	1575.95	1590.19		1590.19	0.000003	0.36	5869.43	450.72	0.02
pper FRS	2.731	Max WS	2073.70	1575.95	1590.19		1590.20	0.000003	0.37	5821.27	462.06	0.02
pper FRS	2.7311		Lat Struct									
pper FRS	2.842	Max WS	815.45	1575.95	1590.20		1590.20	0.000001	0.18	4782.74	436.13	0.01
pper FRS	2.957	Max WS	355.43	1575.95	1590.20		1590.20	0.000000	0.11	3633.08	373.79	0.01
pper FRS	3.042	Max WS	154.14	1575.95	1590.20		1590.20	0.000000	0.06	2970.58	335.86	0.00
pper FRS	3.123	Max WS	316.35	1575.95	1590.20		1590.20	0.000000	0.14	2590.21	308.54	0.01
pper FRS	3.1231		Lat Struct									
pper FRS	3.207	Max WS	317.42	1575.95	1590.20		1590.20	0.000000	0.12	2849.95	248.69	0.01
pper FRS	3.235	Max WS	317.61	1575.95	1590.20		1590.21	0.000011	0.72	442.61	143.96	0.03
pper FRS	3.257		Culvert									
pper FRS	3.289	Max WS	310.56	1575.95	1590.22		1590.23	0.000010	0.69	451.23	653.40	0.03
pper FRS	3.376	Max WS	944.48	1575.95	1590.22		1590.22	0.000001	0.22	4440.53	368.11	0.01
pper FRS	3.433	Max WS	1954.94	1575.95	1590.21		1590.23	0.000025	1.09	2115.95	242.24	0.05
pper FRS	3.497	Max WS	2595.01	1575.95	1590.22		1590.23	0.000017	0.88	3196.69	300.06	0.04
pper FRS	3.4971		Lat Struct									
pper FRS	3.566	Max WS	2588.81	1575.95	1590.23		1590.23	0.000007	0.57	4889.90	496.04	0.03
pper FRS	3.626	Max WS	3139.40	1575.95	1590.23		1590.23	0.000009	0.63	5358.53	577.13	0.03
pper FRS	3.708	Max WS	3015.42	1575.95	1590.23		1590.24	0.000021	0.94	3513.85	387.94	0.05
pper FRS	3.7081		Lat Struct									
pper FRS	3.773	Max WS	2918.37	1575.95	1590.23		1590.25	0.000030	1.14	2730.79	256.23	0.06
ppe	3.804	Max WS	2872.00	1575.95	1590.24		1590.25	0.000018	0.85	3552.55	330.11	0.04
ppe	3.805	Max WS	2872.00	1575.95	1590.24		1590.25	0.000018	0.85	3552.55	330.11	0.04

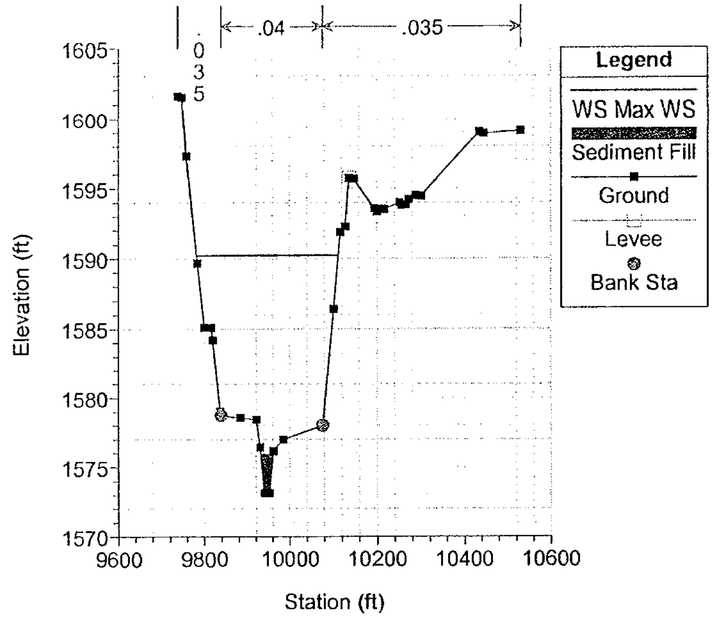
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 3.805



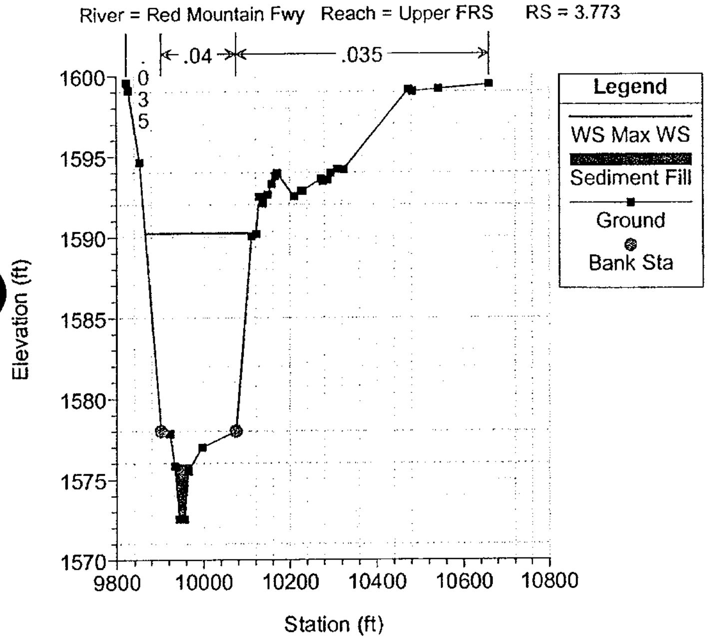
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 3.804



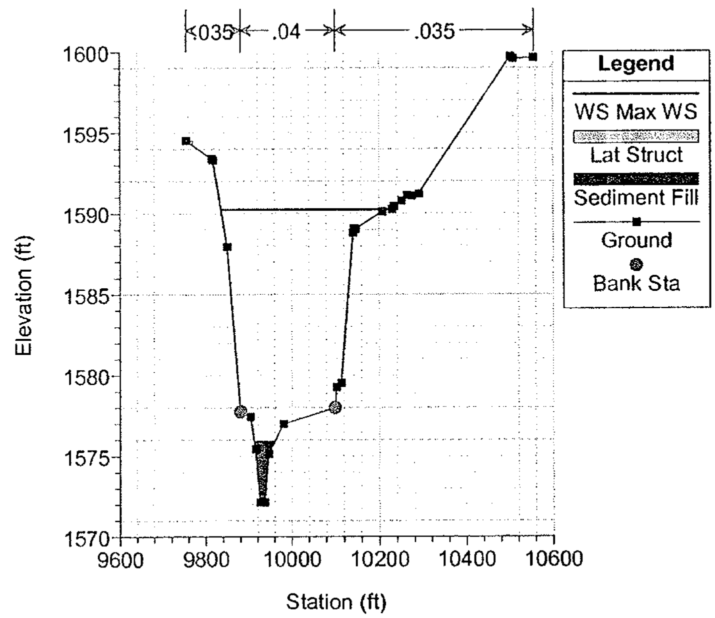
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 3.773



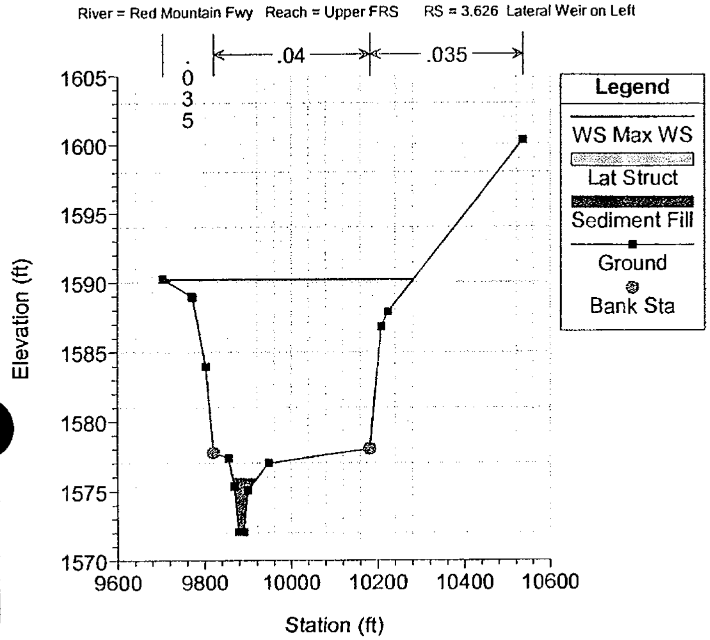
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 3.708 Lateral Weir on Left



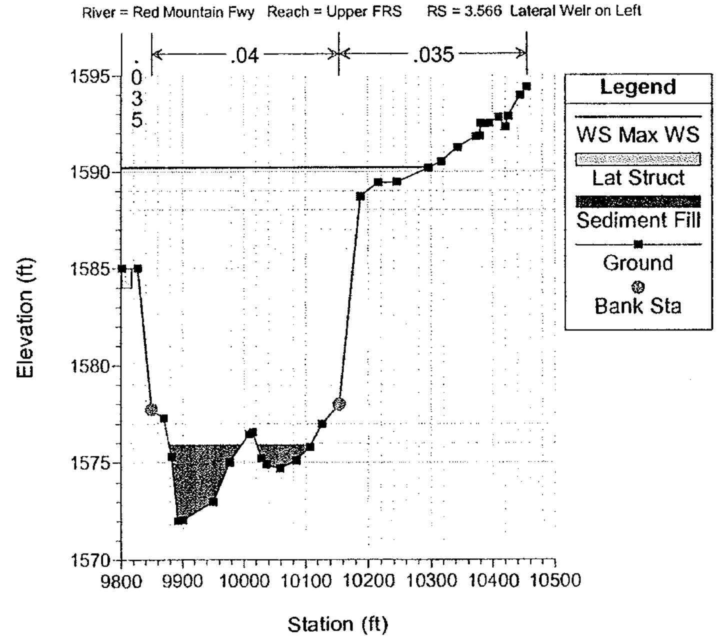
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005

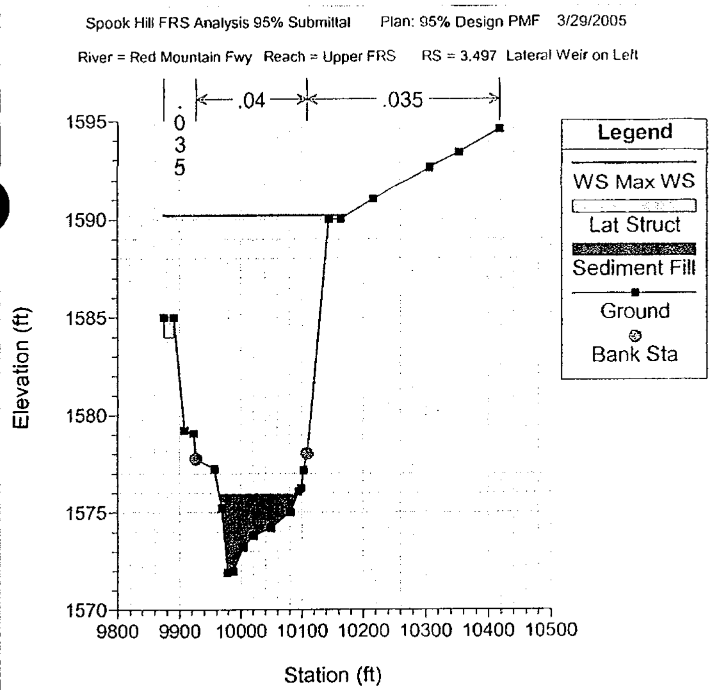
River = Red Mountain Fwy Reach = Upper FRS RS = 3.626 Lateral Weir on Left

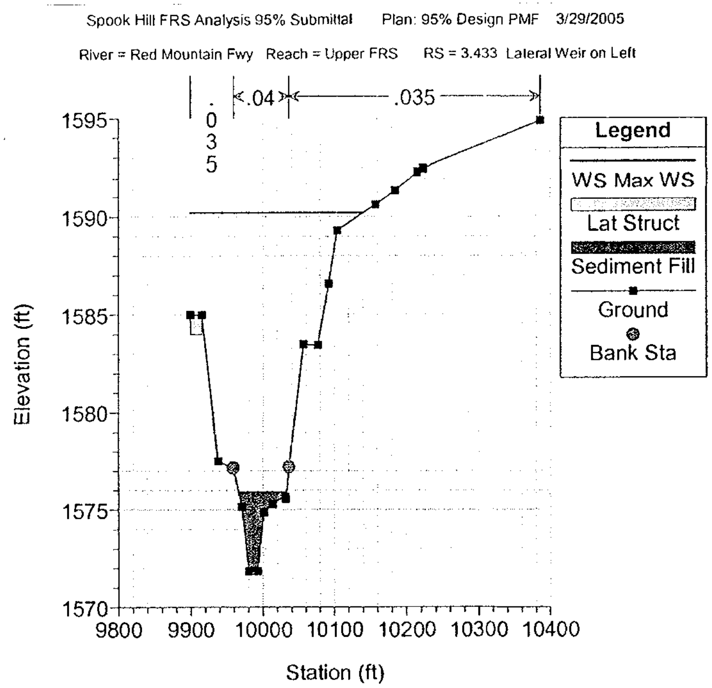


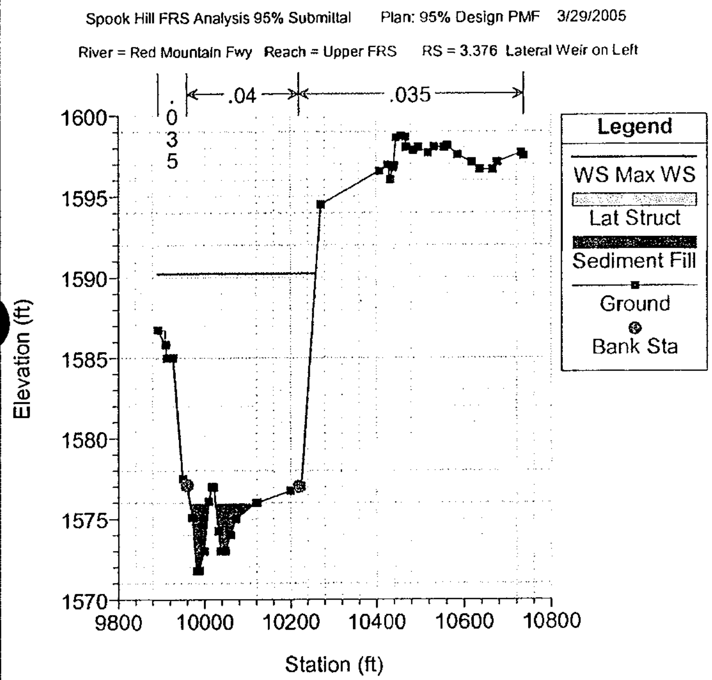
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005

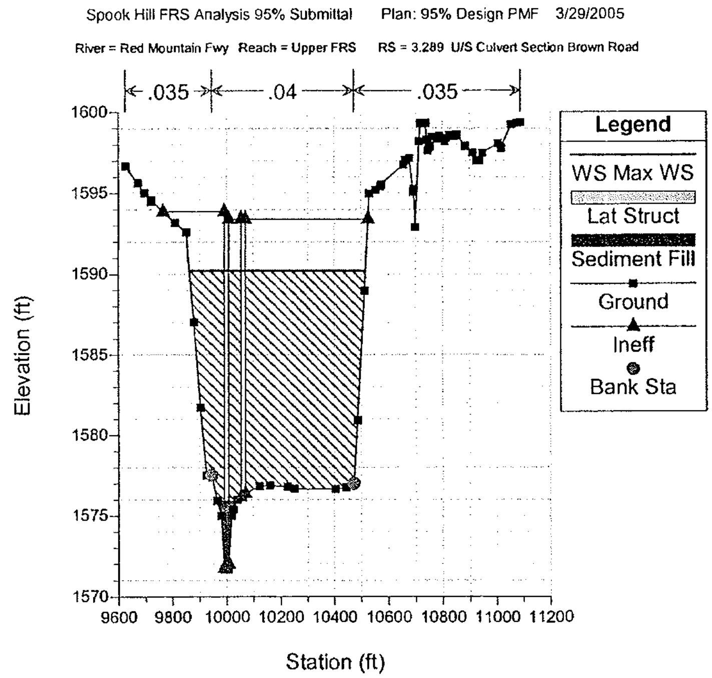
River = Red Mountain Fwy Reach = Upper FRS RS = 3.566 Lateral Weir on Left

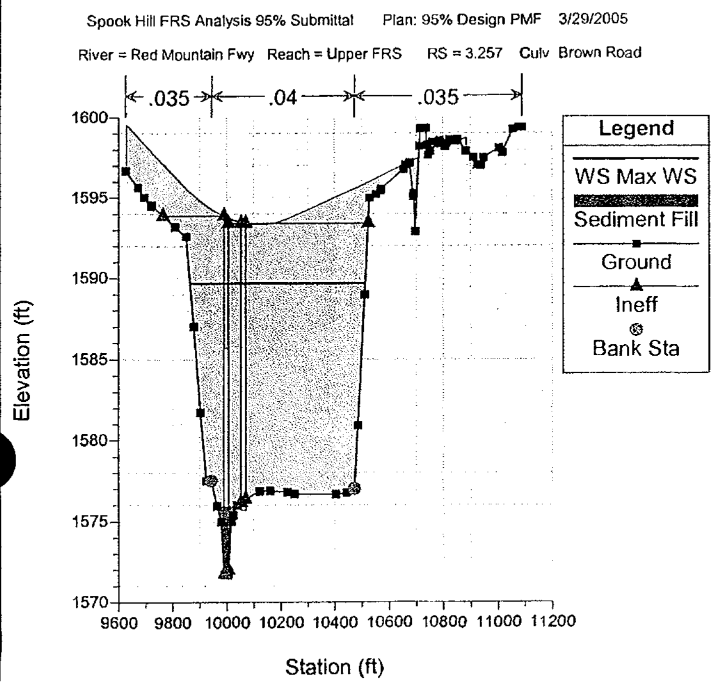


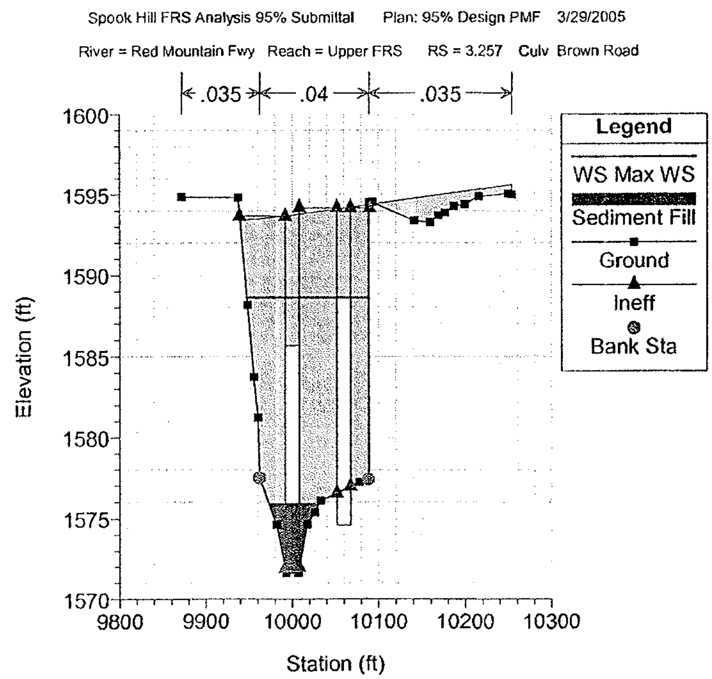

Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005
River = Red Mountain Fwy Reach = Upper FRS RS = 3.497 Lateral Weir on Left
.035
.04
.035
Legend
WS Max WS
Lat Struct
Sediment Fill
Ground
Bank Sta
Elevation (ft)
Station (ft)

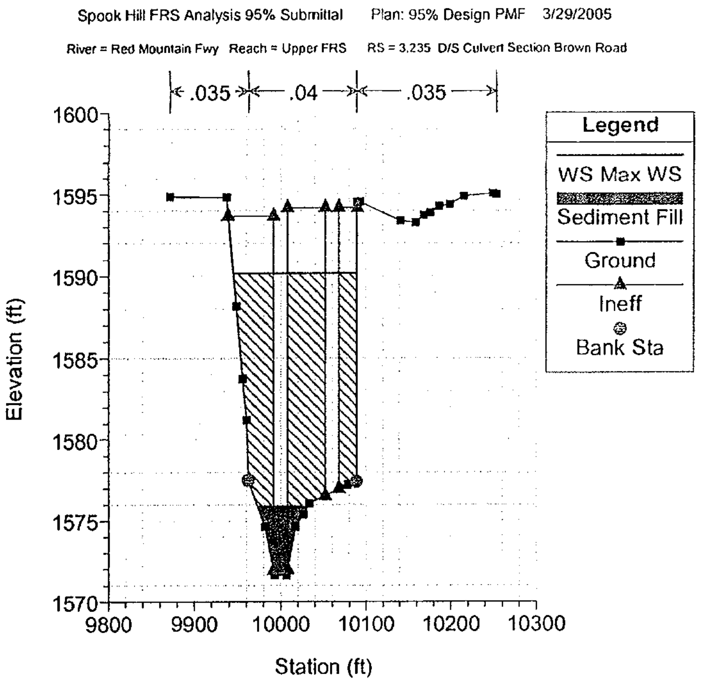

Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005
River = Red Mountain Fwy Reach = Upper FRS RS = 3.433 Lateral Weir on Left
.035
.04
.035
Legend
WS Max WS
Lat Struct
Sediment Fill
Ground
Bank Sta
Elevation (ft)
Station (ft)


Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005
River = Red Mountain Fwy Reach = Upper FRS RS = 3.376 Lateral Weir on Left
.035
.04
.035
Legend
WS Max WS
Lat Struct
Sediment Fill
Ground
Bank Sta
Elevation (ft)
Station (ft)

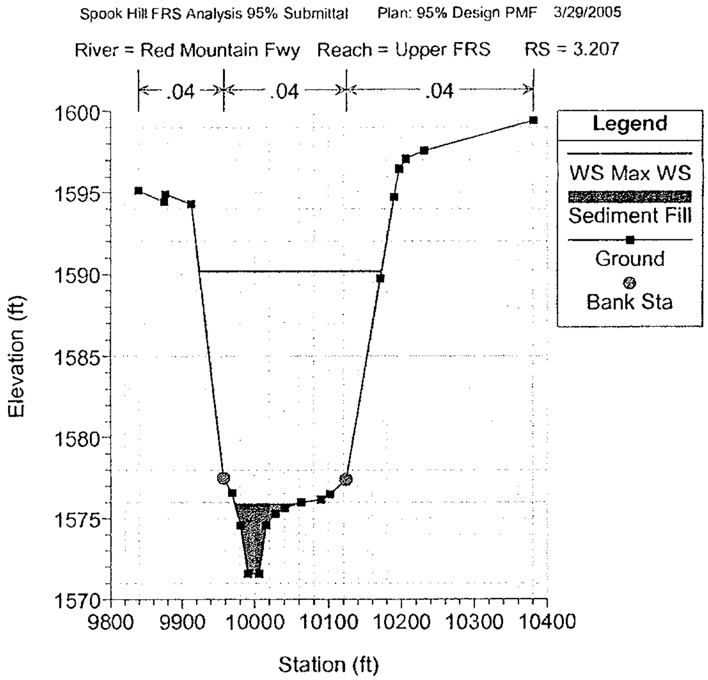

Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005
River = Red Mountain Fwy Reach = Upper FRS RS = 3.289 U/S Culvert Section Brown Road
.035
.04
.035
Legend
WS Max WS
Lat Struct
Sediment Fill
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)


Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005
River = Red Mountain Fwy Reach = Upper FRS RS = 3.257 Culv Brown Road
.035
.04
.035
Legend
WS Max WS
Sediment Fill
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

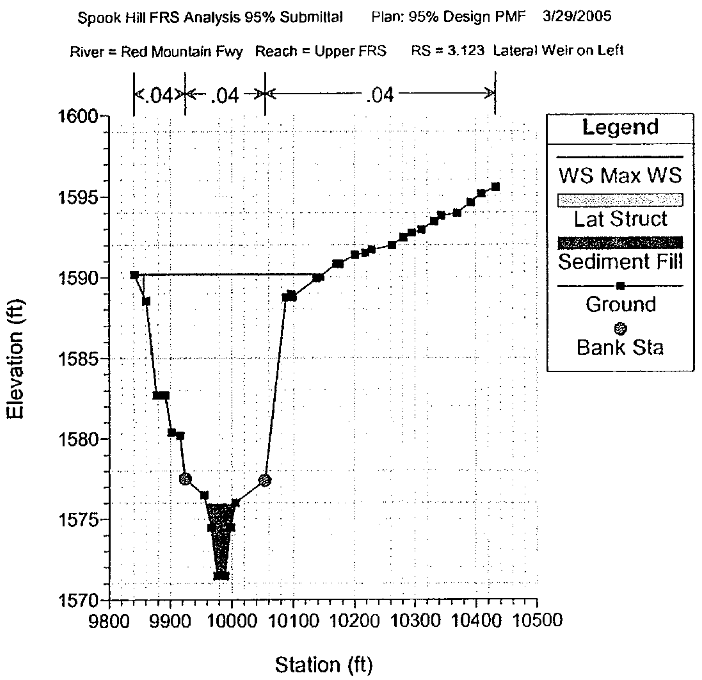

Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005
River = Red Mountain Fwy Reach = Upper FRS RS = 3.257 Culv Brown Road
.035
.04
.035
Legend
WS Max WS
Sediment Fill
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)



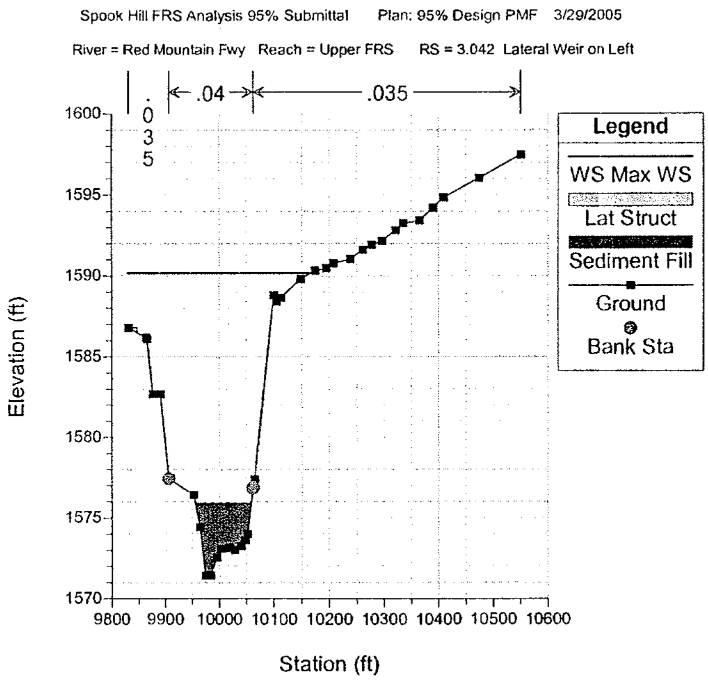
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005
River = Red Mountain Fwy Reach = Upper FRS RS = 3.235 D/S Culvert Section Brown Road
.035 .04 .035
Legend
WS Max WS
Sediment Fill
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)



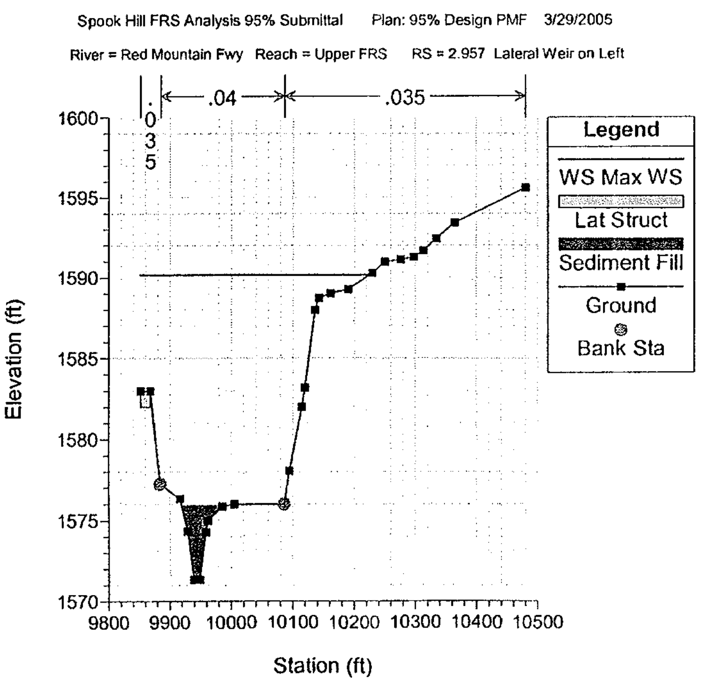
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005
River = Red Mountain Fwy Reach = Upper FRS RS = 3.207
.04 .04 .04
Legend
WS Max WS
Sediment Fill
Ground
Bank Sta
Elevation (ft)
Station (ft)



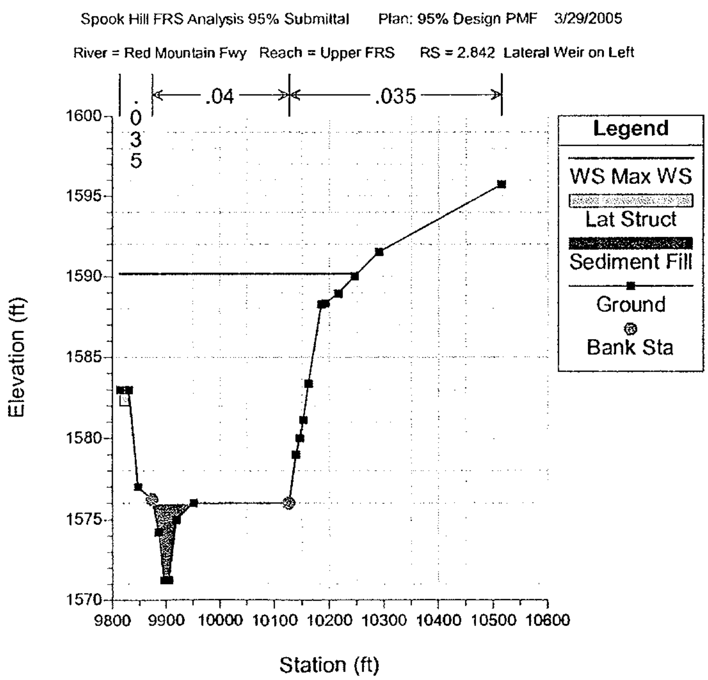
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005
River = Red Mountain Fwy Reach = Upper FRS RS = 3.123 Lateral Weir on Left
.04 .04 .04
Legend
WS Max WS
Lat Struct
Sediment Fill
Ground
Bank Sta
Elevation (ft)
Station (ft)



Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005
River = Red Mountain Fwy Reach = Upper FRS RS = 3.042 Lateral Weir on Left
.035 .04 .035
Legend
WS Max WS
Lat Struct
Sediment Fill
Ground
Bank Sta
Elevation (ft)
Station (ft)



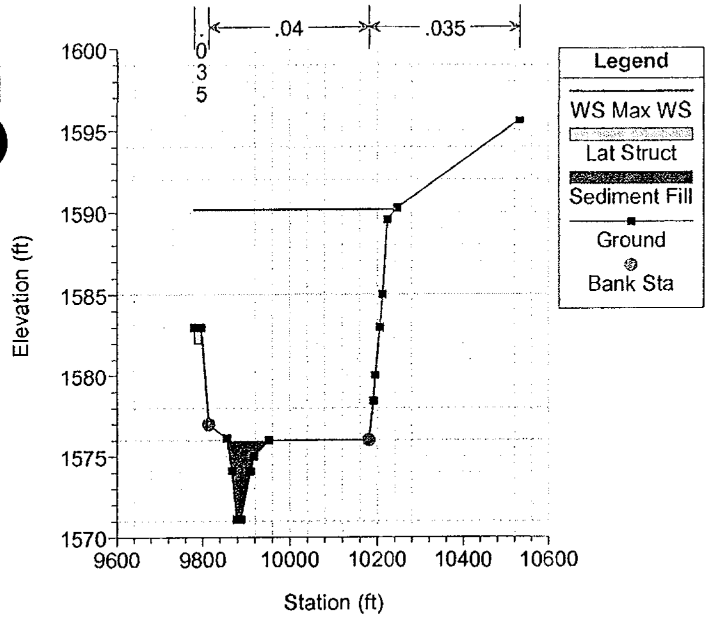
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005
River = Red Mountain Fwy Reach = Upper FRS RS = 2.957 Lateral Weir on Left
.035 .04 .035
Legend
WS Max WS
Lat Struct
Sediment Fill
Ground
Bank Sta
Elevation (ft)
Station (ft)



Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005
River = Red Mountain Fwy Reach = Upper FRS RS = 2.842 Lateral Weir on Left
.035 .04 .035
Legend
WS Max WS
Lat Struct
Sediment Fill
Ground
Bank Sta
Elevation (ft)
Station (ft)

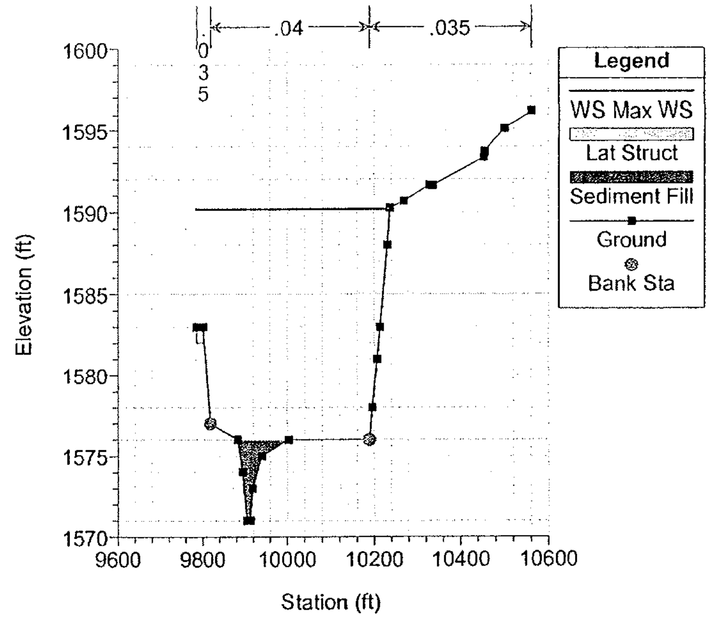
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 2.731 Lateral Weir on Left



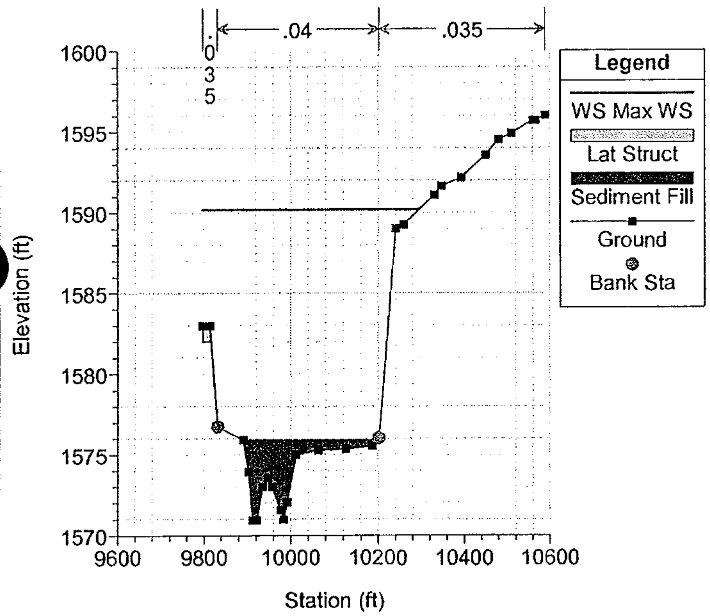
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 2.617 Lateral Weir on Left



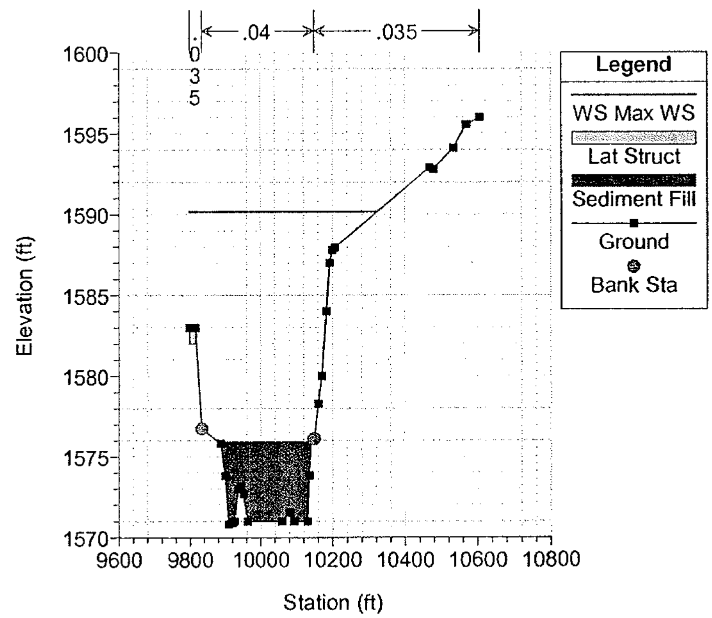
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 2.524 Lateral Weir on Left



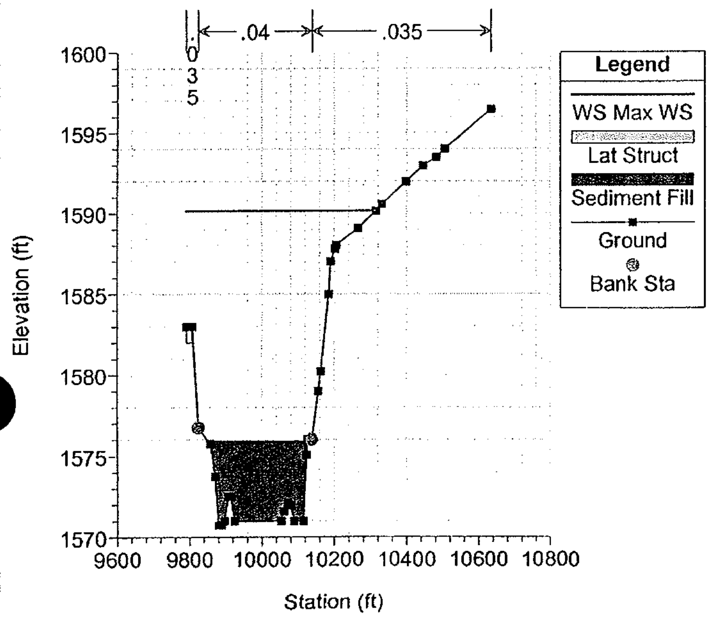
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 2.396 Lateral Weir on Left



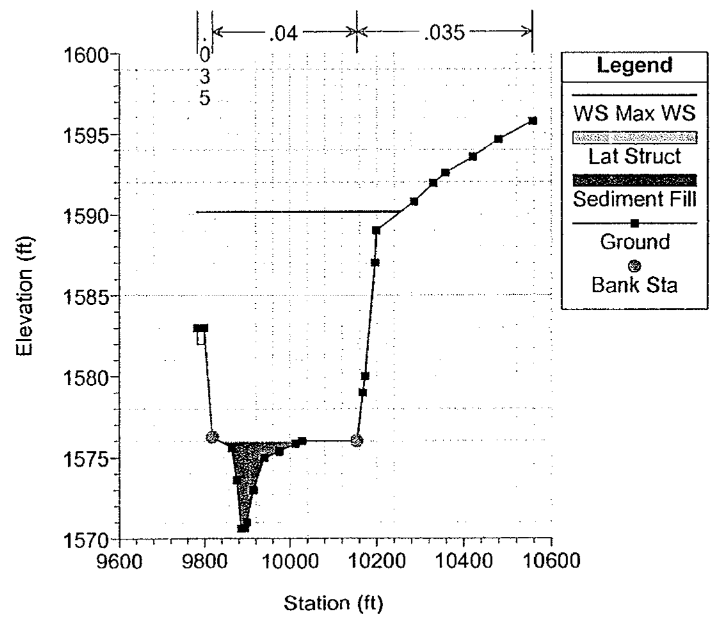
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 2.307 Lateral Weir on Left



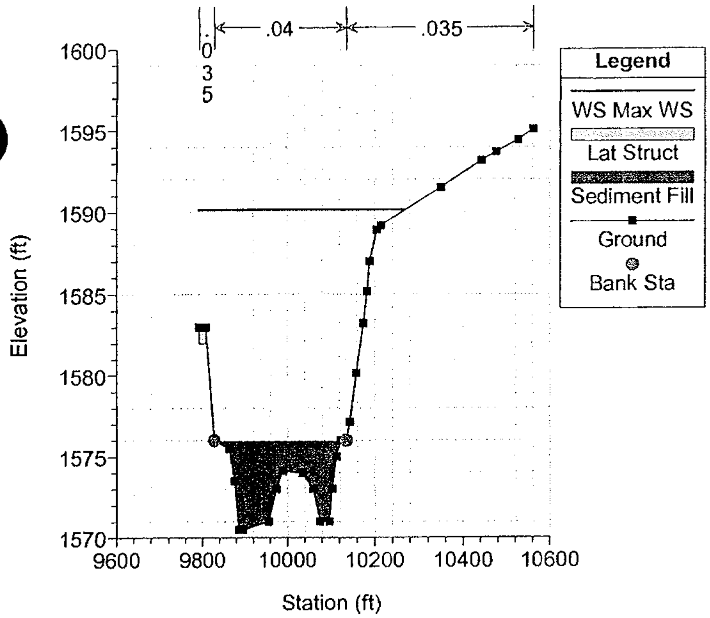
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 2.167 Lateral Weir on Left



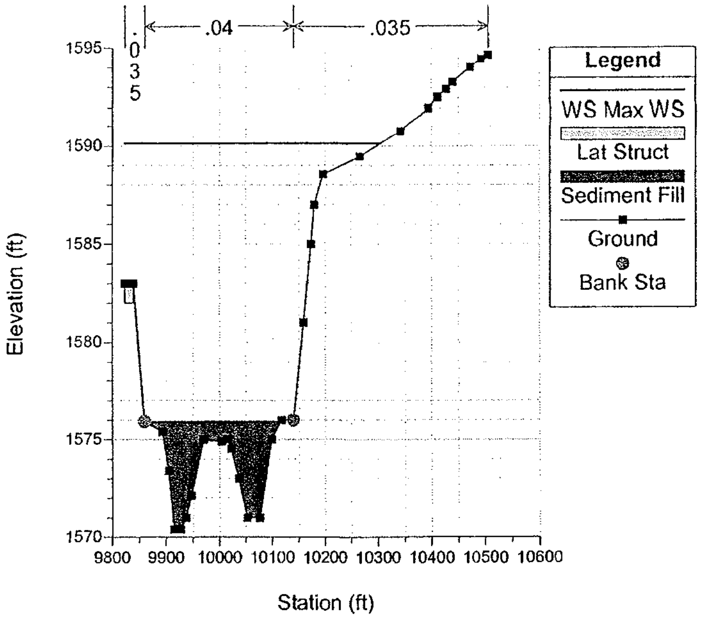
Spook Hill FRS Analysis 95% Submittal   Plan: 95% Design PMF   3/29/2005

River = Red Mountain Fwy   Reach = Upper FRS   RS = 2.043 Lateral Weir on Left



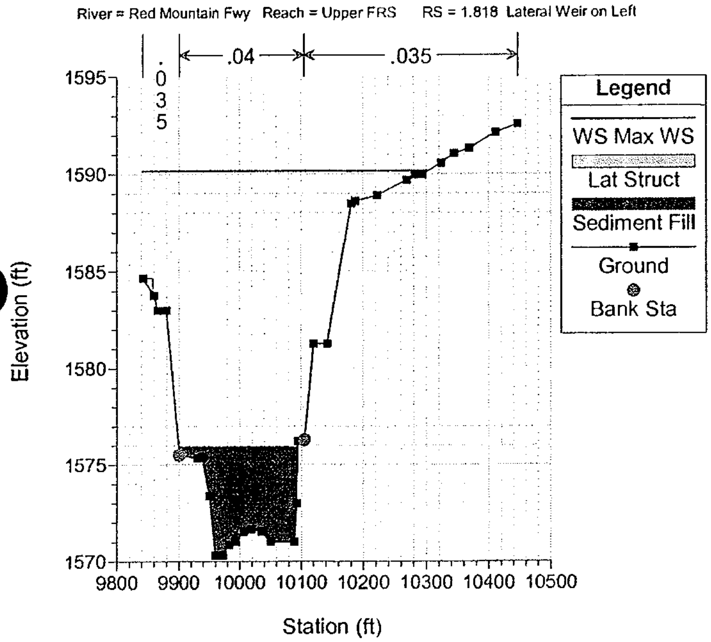
Spook Hill FRS Analysis 95% Submittal   Plan: 95% Design PMF   3/29/2005

River = Red Mountain Fwy   Reach = Upper FRS   RS = 1.934 Lateral Weir on Left



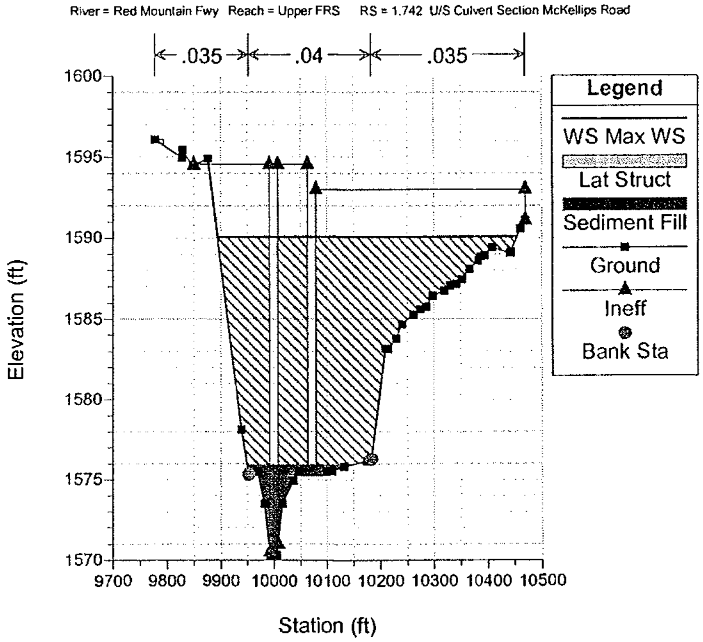
Spook Hill FRS Analysis 95% Submittal   Plan: 95% Design PMF   3/29/2005

River = Red Mountain Fwy   Reach = Upper FRS   RS = 1.818 Lateral Weir on Left



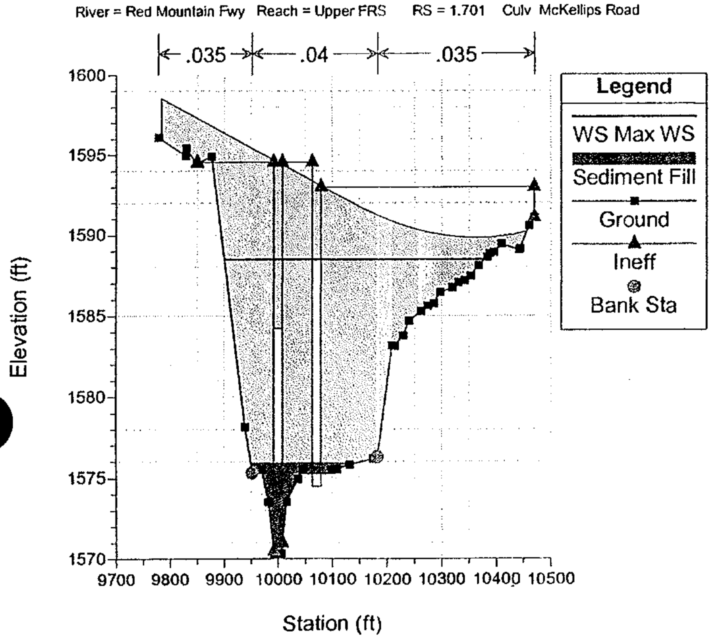
Spook Hill FRS Analysis 95% Submittal   Plan: 95% Design PMF   3/29/2005

River = Red Mountain Fwy   Reach = Upper FRS   RS = 1.742 U/S Culvert Section McKellips Road



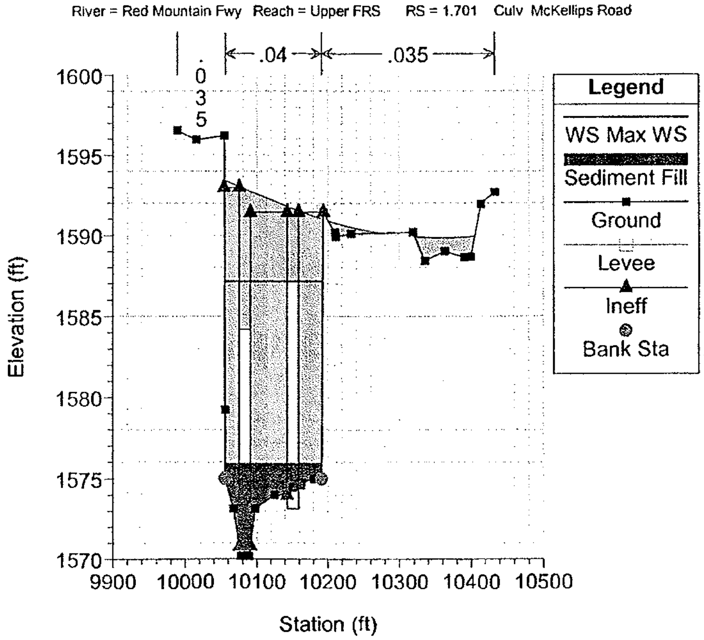
Spook Hill FRS Analysis 95% Submittal   Plan: 95% Design PMF   3/29/2005

River = Red Mountain Fwy   Reach = Upper FRS   RS = 1.701   Culv McKellips Road



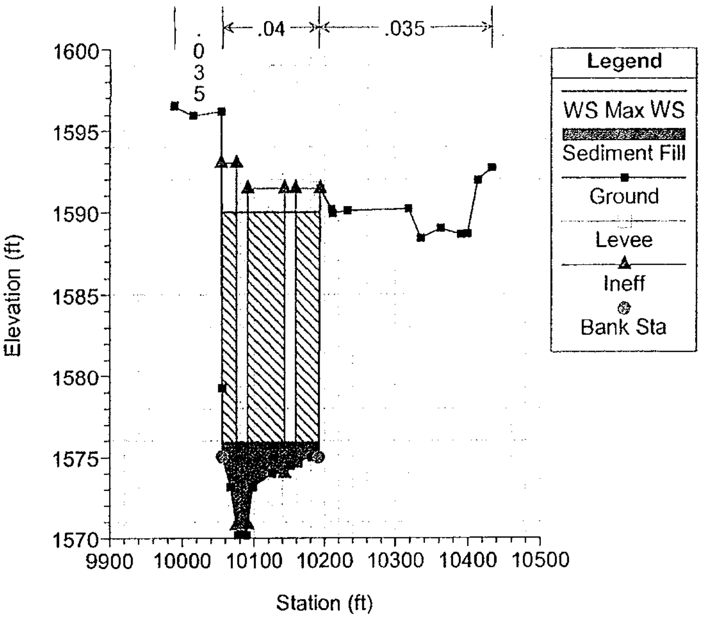
Spook Hill FRS Analysis 95% Submittal   Plan: 95% Design PMF   3/29/2005

River = Red Mountain Fwy   Reach = Upper FRS   RS = 1.701   Culv McKellips Road



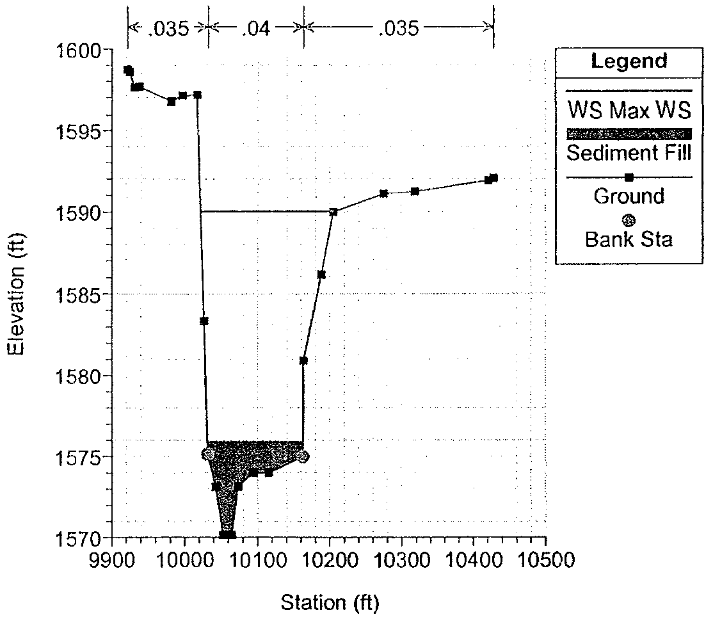
Spook Hill FRS Analysis 95% Submittal   Plan: 95% Design PMF   3/29/2005

River = Red Mountain Fwy   Reach = Upper FRS   RS = 1.664 D/S Culvert Section McKellips Road



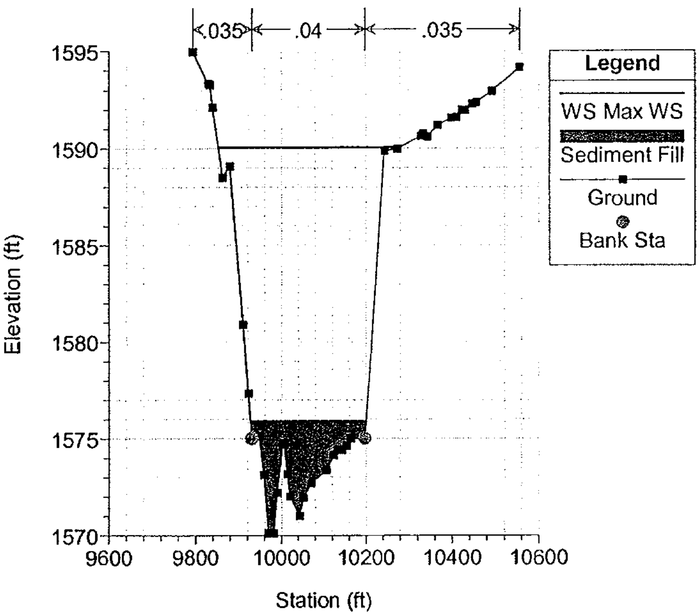
Spook Hill FRS Analysis 95% Submittal   Plan: 95% Design PMF   3/29/2005

River = Red Mountain Fwy   Reach = Upper FRS   RS = 1.638



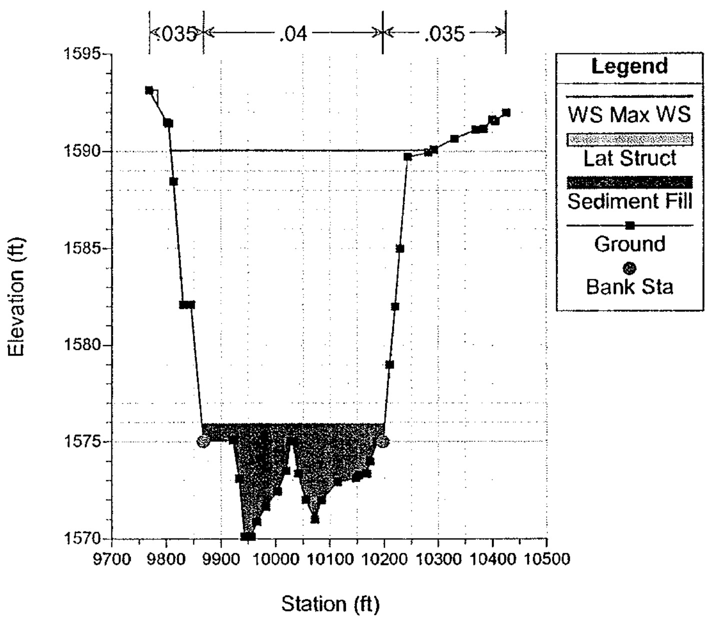
Spook Hill FRS Analysis 95% Submittal   Plan: 95% Design PMF   3/29/2005

River = Red Mountain Fwy   Reach = Upper FRS   RS = 1.596



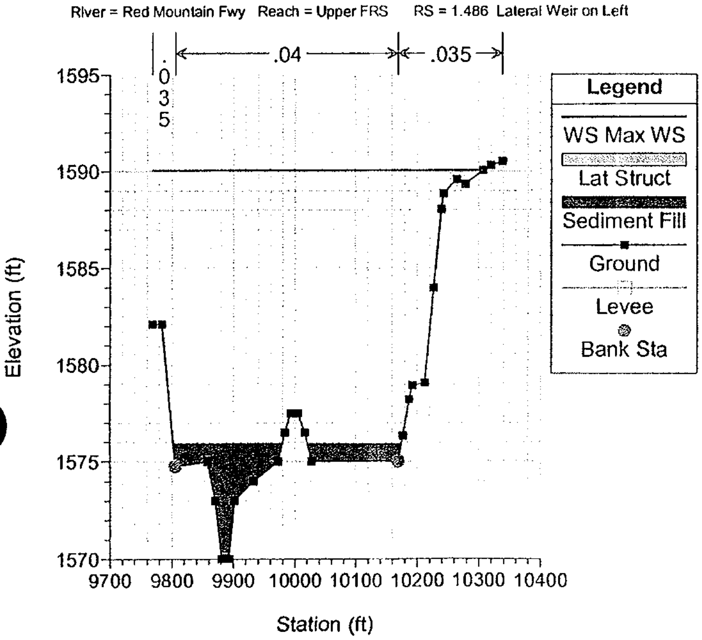
Spook Hill FRS Analysis 95% Submittal   Plan: 95% Design PMF   3/29/2005

River = Red Mountain Fwy   Reach = Upper FRS   RS = 1.581 Lateral Weir on Left



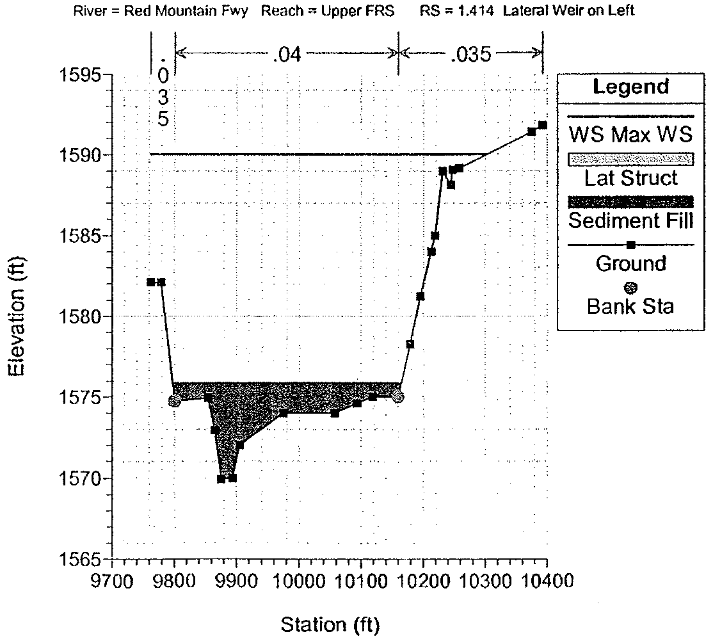
Spook Hill FRS Analysis 95% Submittal   Plan: 95% Design PMF   3/29/2005

River = Red Mountain Fwy   Reach = Upper FRS   RS = 1.486 Lateral Weir on Left



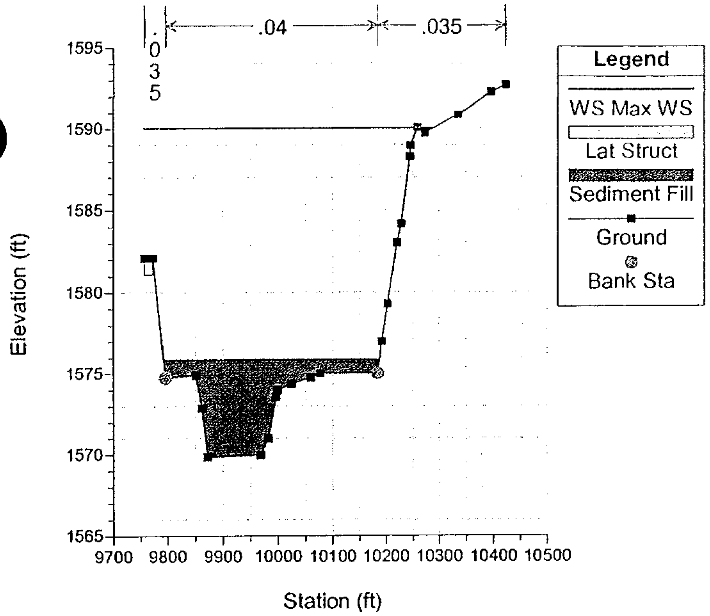
Spook Hill FRS Analysis 95% Submittal   Plan: 95% Design PMF   3/29/2005

River = Red Mountain Fwy   Reach = Upper FRS   RS = 1.414 Lateral Weir on Left



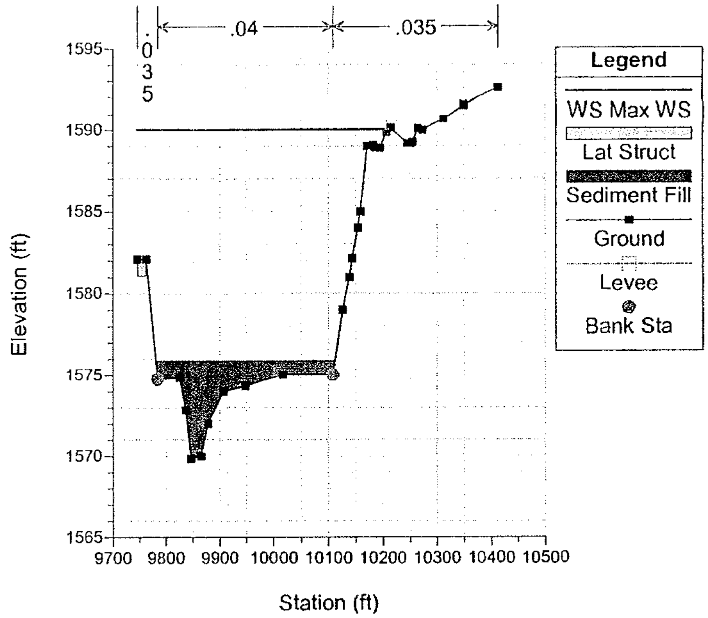
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 1.346 Lateral Weir on Left



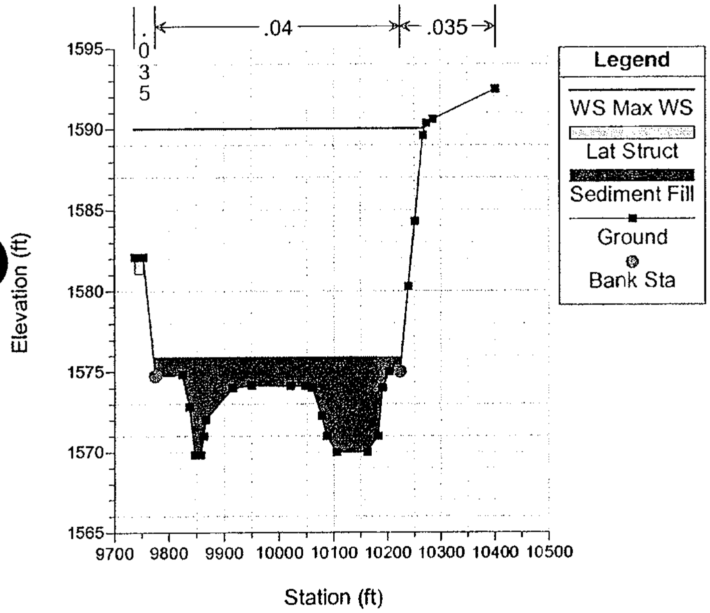
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 1.321 Lateral Weir on Left



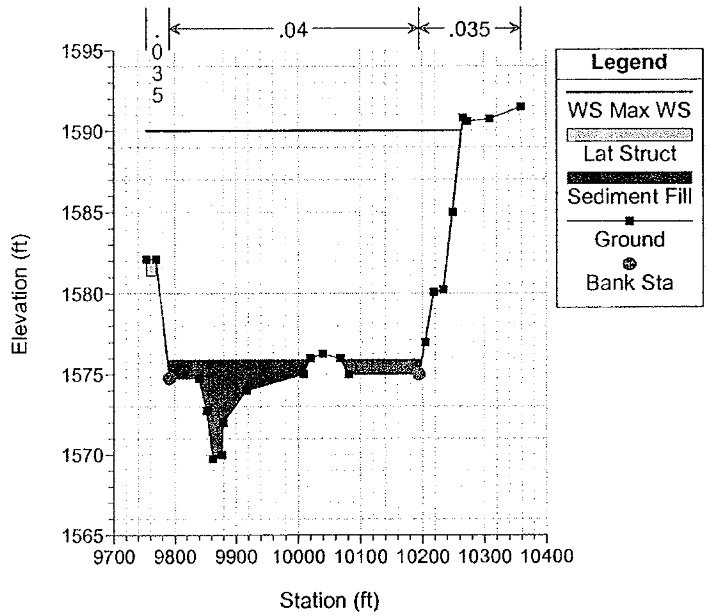
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 1.288 Lateral Weir on Left



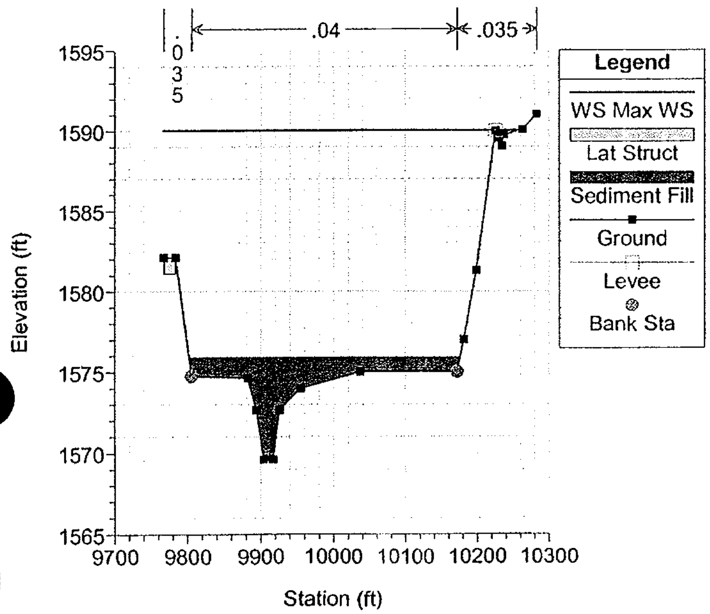
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 1.145 Lateral Weir on Left



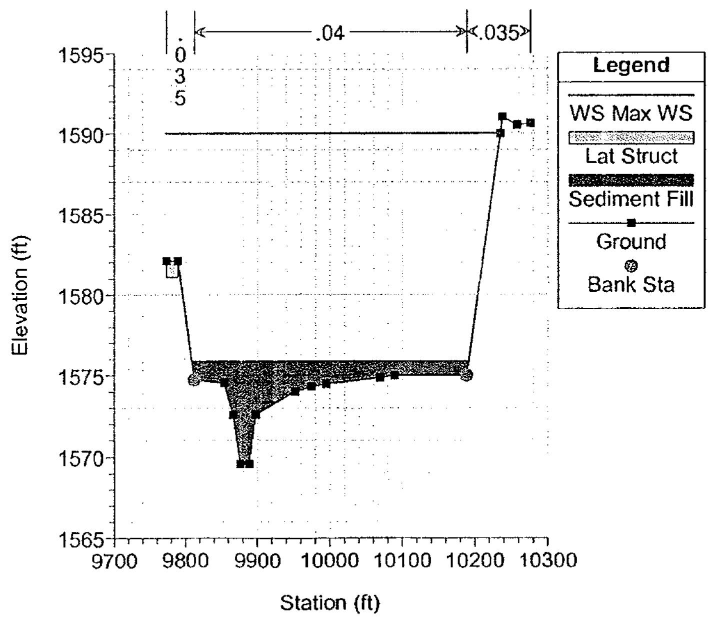
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 0.983 Lateral Weir on Left



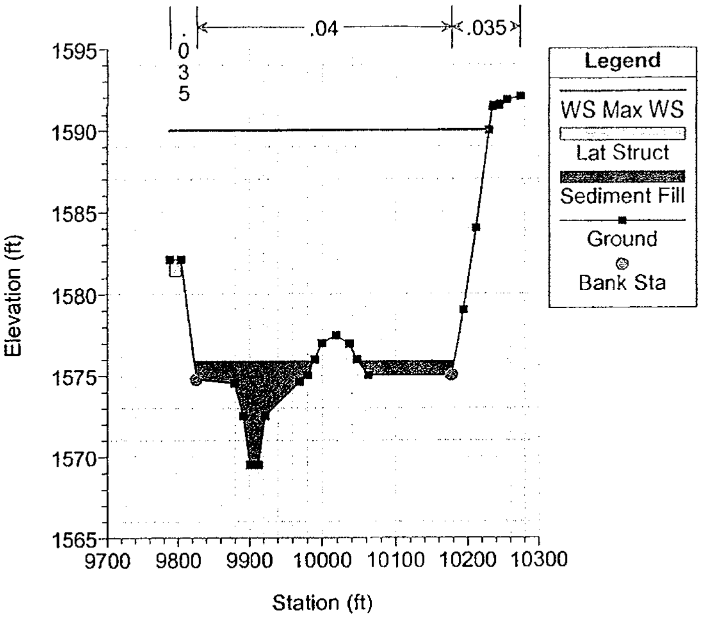
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 0.902 Lateral Weir on Left



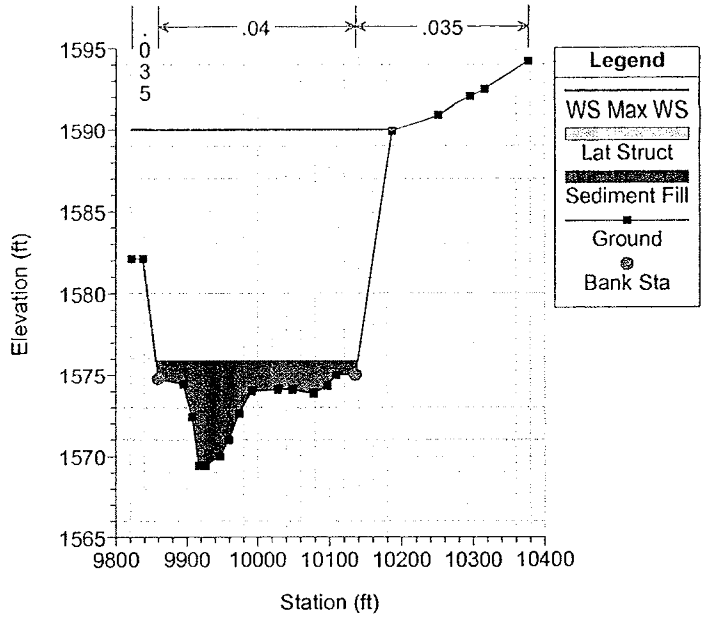
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 0.817 Lateral Weir on Left



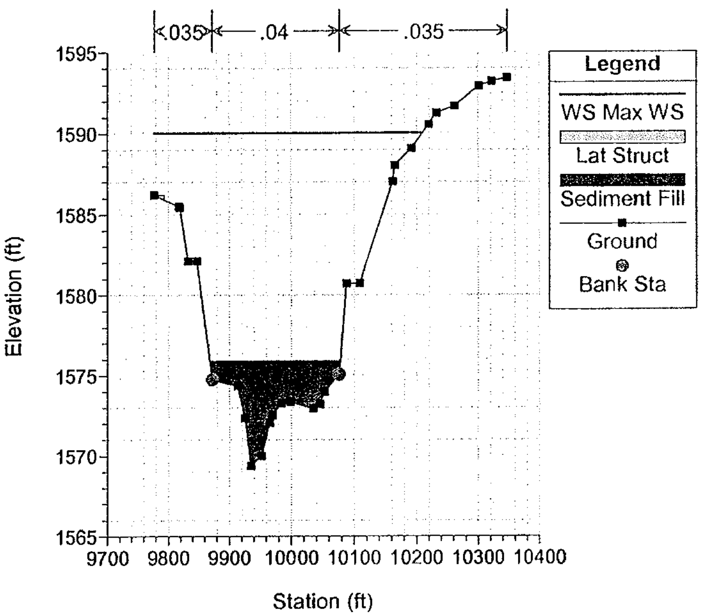
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 0.656 Lateral Weir on Left



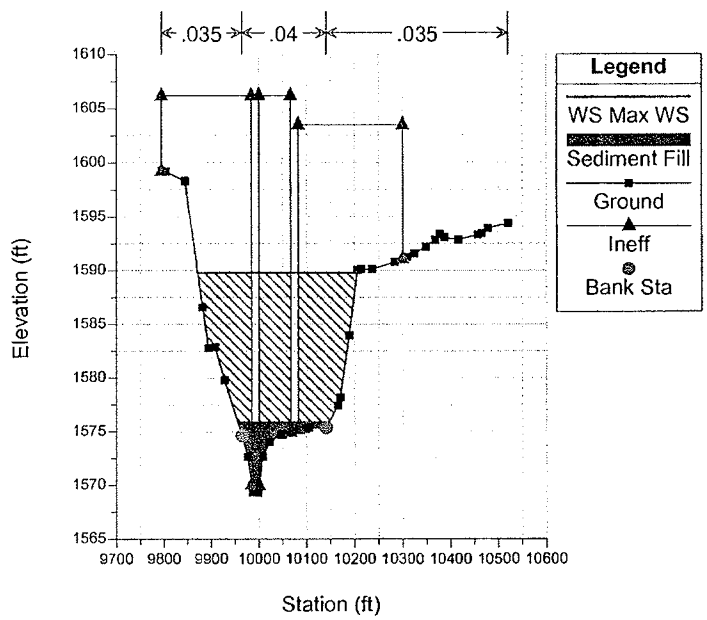
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 0.598 Lateral Weir on Left



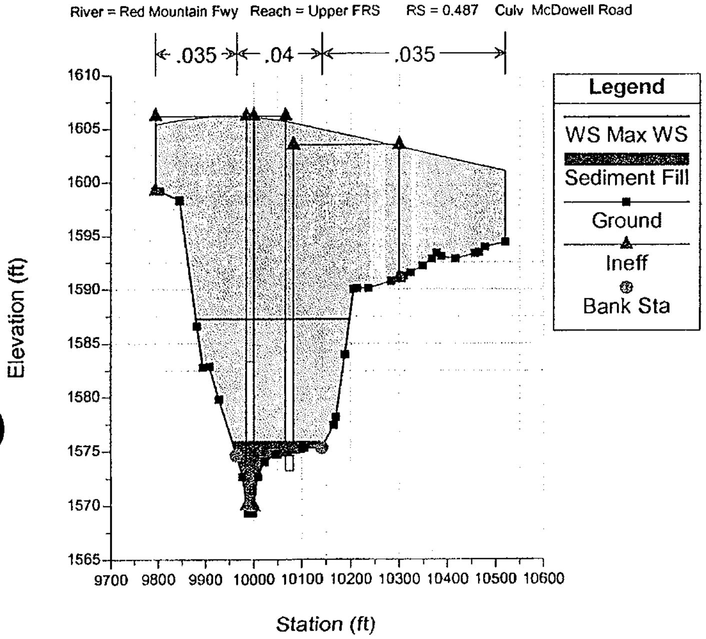
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 0.530 U/S Culvert Section McDowell Road



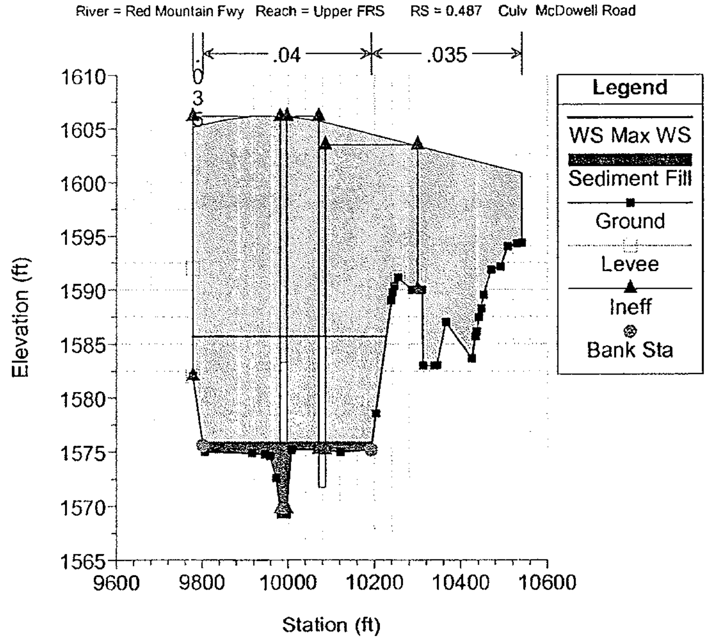
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 0.487 Culv McDowell Road



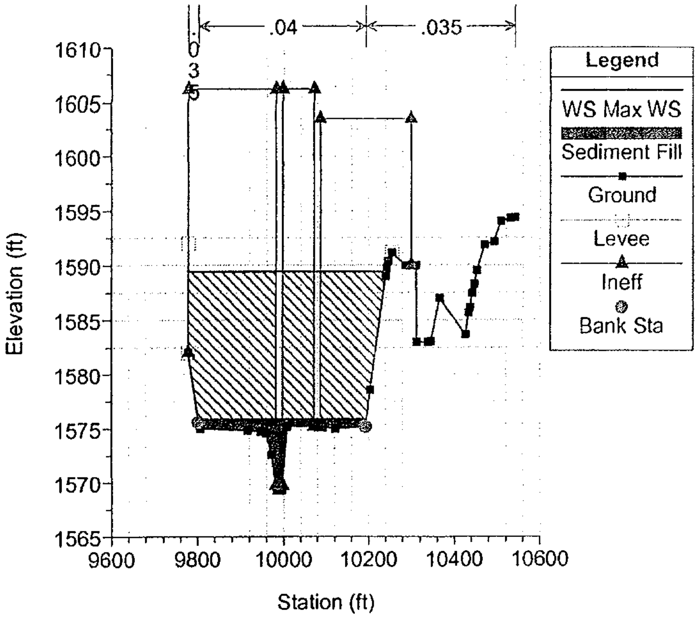
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 0.487 Culv McDowell Road



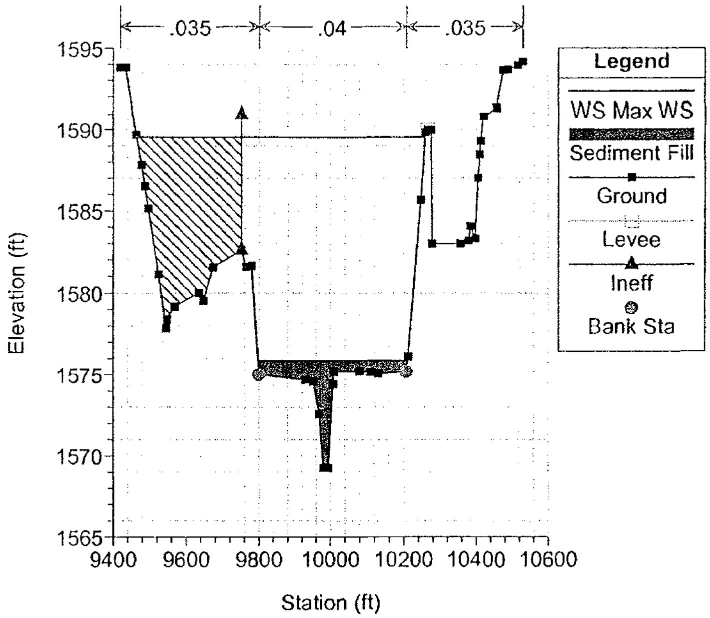
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 0.447 D/S Culvert Section McDowell Road



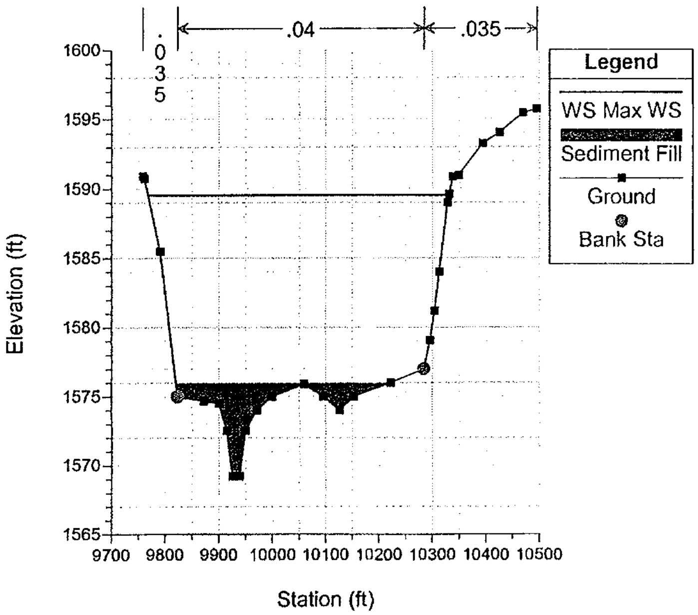
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005

River = Red Mountain Fwy Reach = Upper FRS RS = 0.443



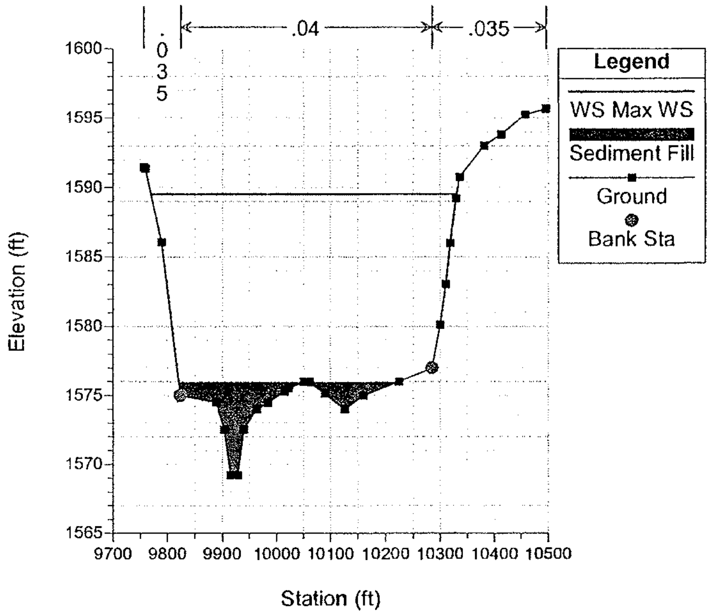
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005

River = Red Mountain Fwy Reach = Lower FRS RS = 0.374



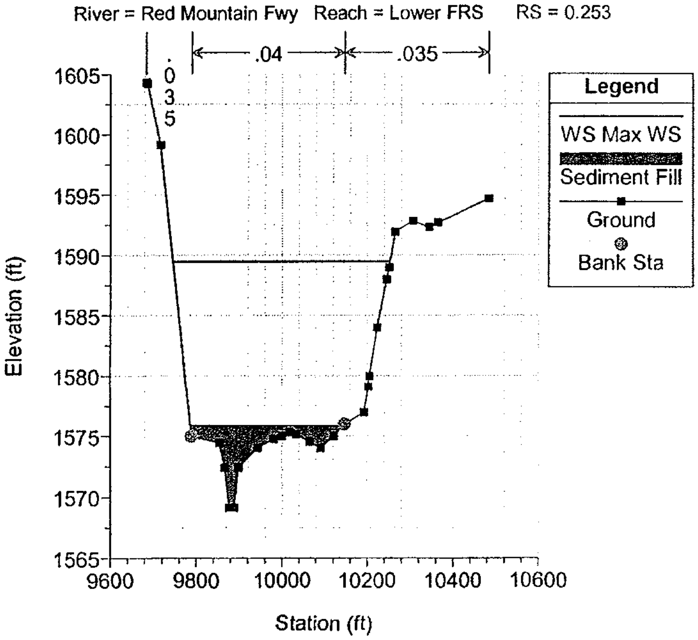
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005

River = Red Mountain Fwy Reach = Lower FRS RS = 0.370



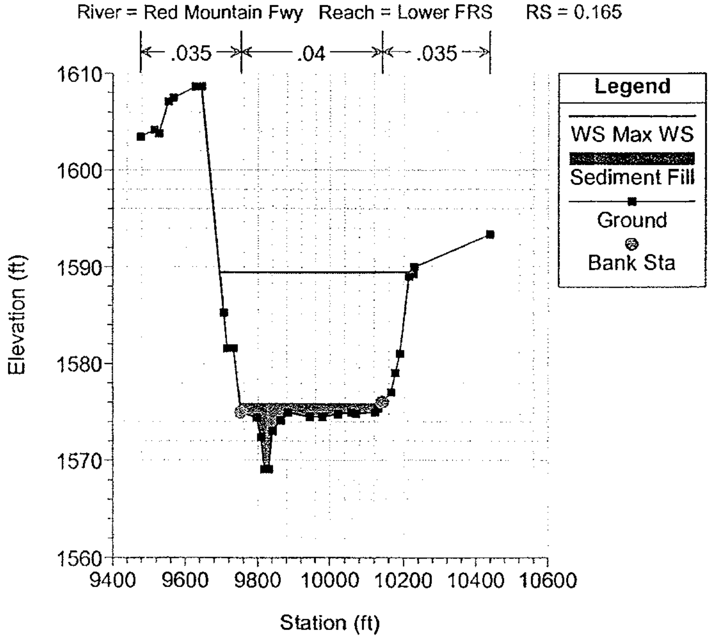
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005

River = Red Mountain Fwy Reach = Lower FRS RS = 0.253



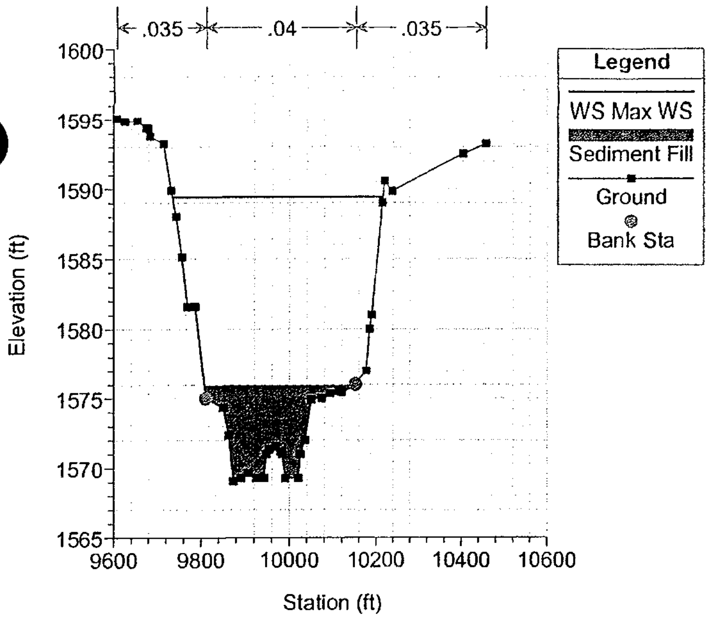
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005

River = Red Mountain Fwy Reach = Lower FRS RS = 0.165



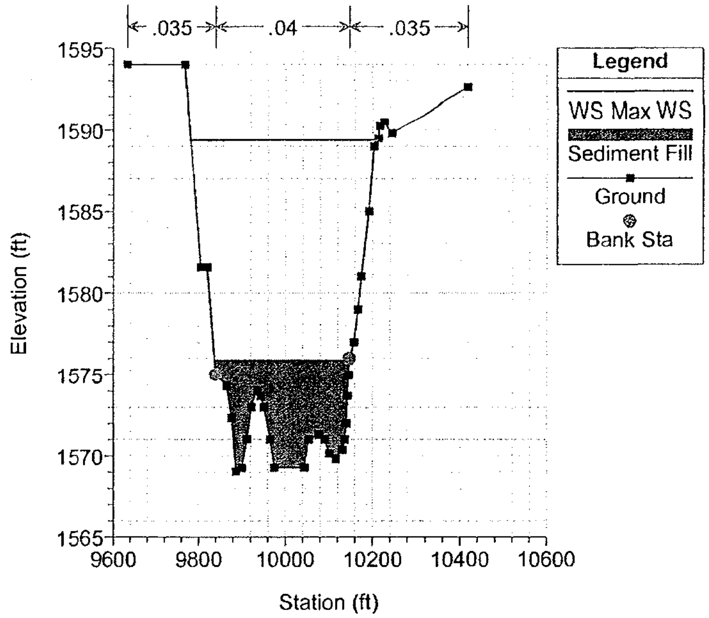
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005

River = Red Mountain Fwy Reach = Lower FRS RS = 0.130



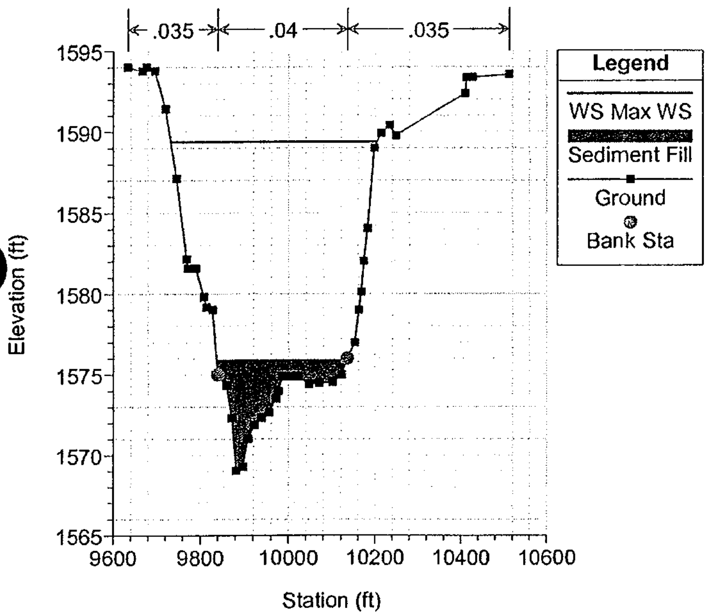
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005

River = Red Mountain Fwy Reach = Lower FRS RS = 0.113



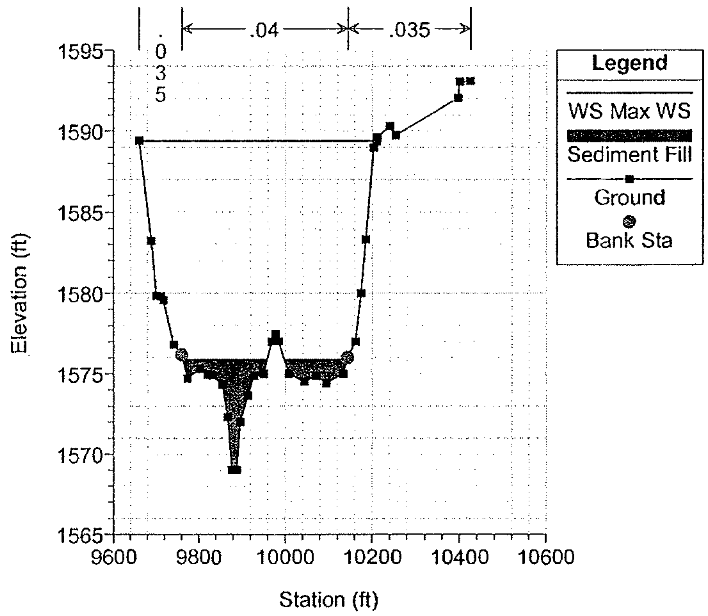
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005

River = Red Mountain Fwy Reach = Lower FRS RS = 0.096



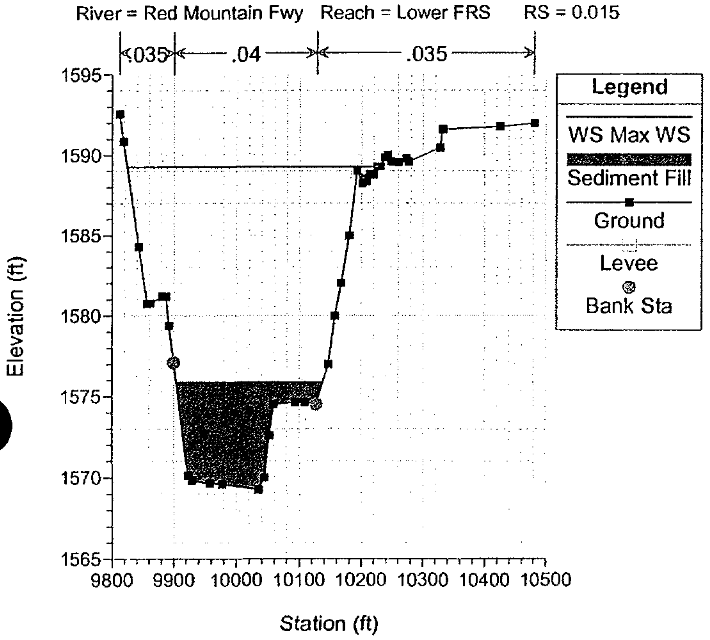
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005

River = Red Mountain Fwy Reach = Lower FRS RS = 0.083



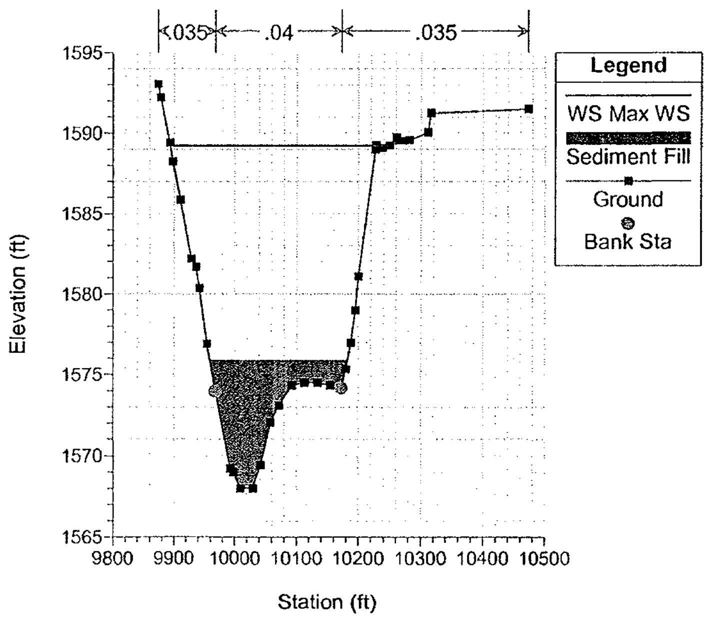
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005

River = Red Mountain Fwy Reach = Lower FRS RS = 0.015



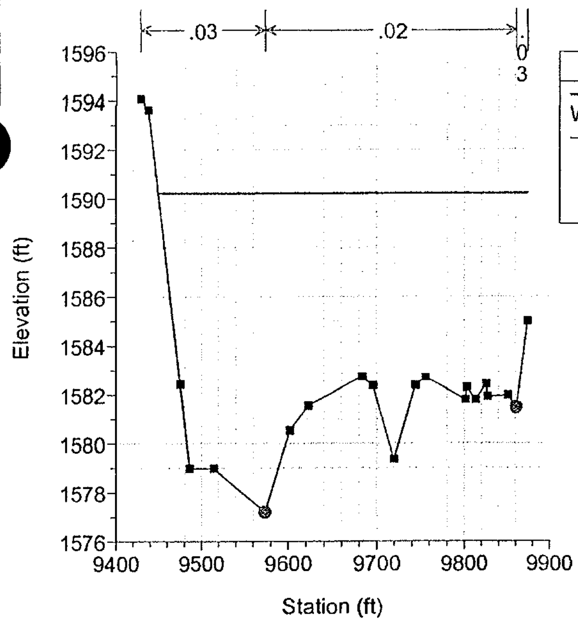
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005

River = Red Mountain Fwy Reach = Lower FRS RS = 0.000 Principal Outlet Spillway



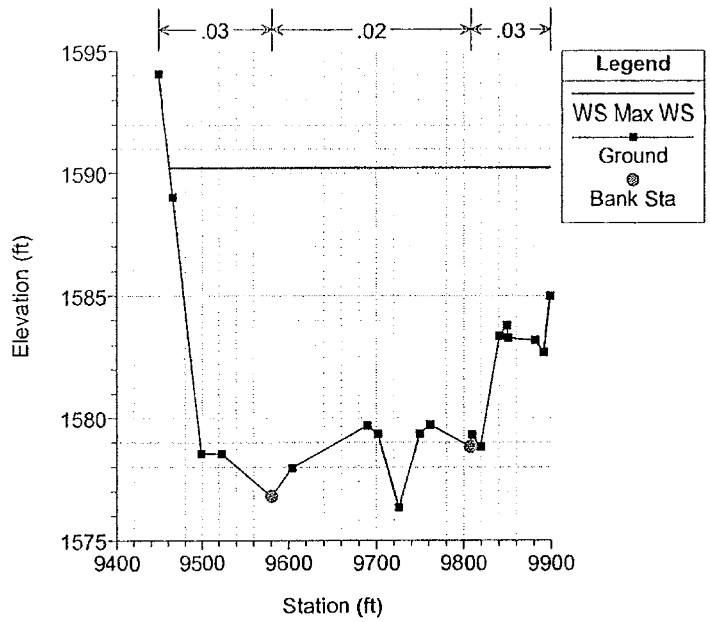
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005

River = Red Mountain Fwy Reach = Freeway RS = 3.497 Lateral Weir Tailwater Connection on Right



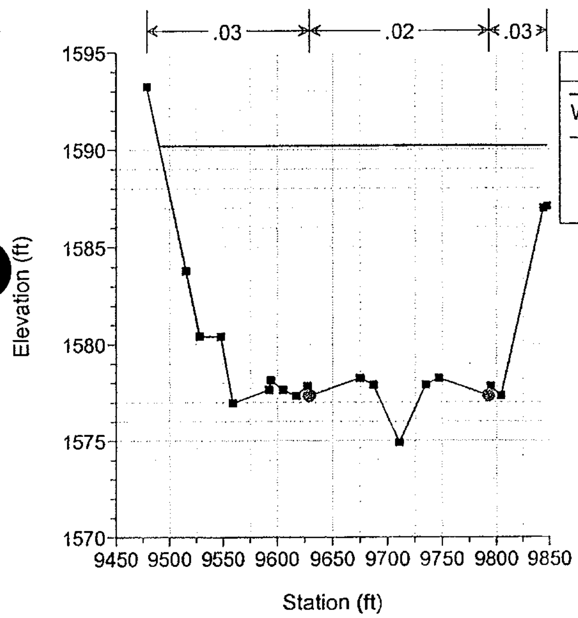
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005

River = Red Mountain Fwy Reach = Freeway RS = 3.433 Lateral Weir Tailwater Connection on Right



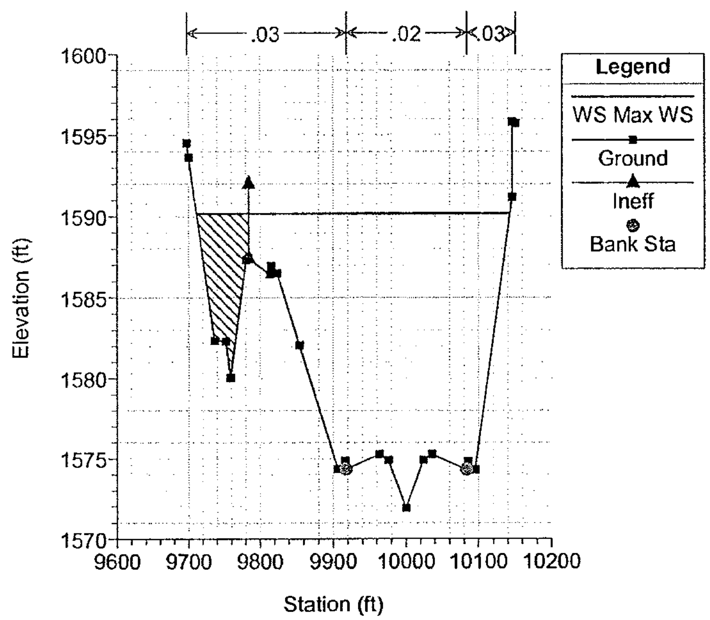
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005

River = Red Mountain Fwy Reach = Freeway RS = 3.376 Lateral Weir on Right



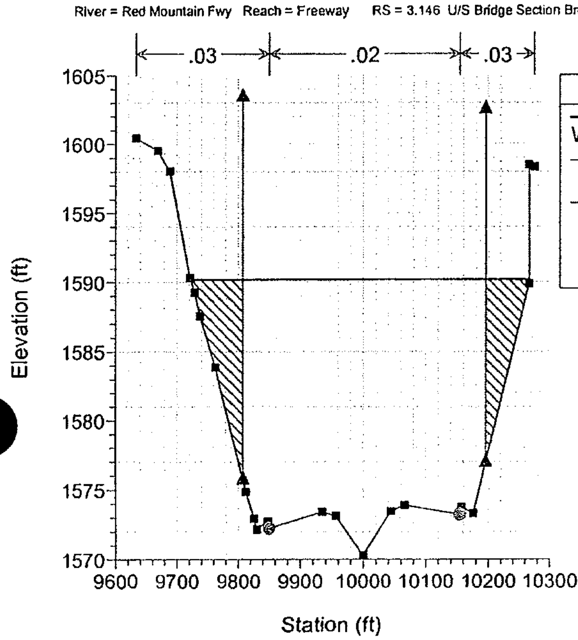
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005

River = Red Mountain Fwy Reach = Freeway RS = 3.239 Ineffective Flow is between On-Ramp and FRS



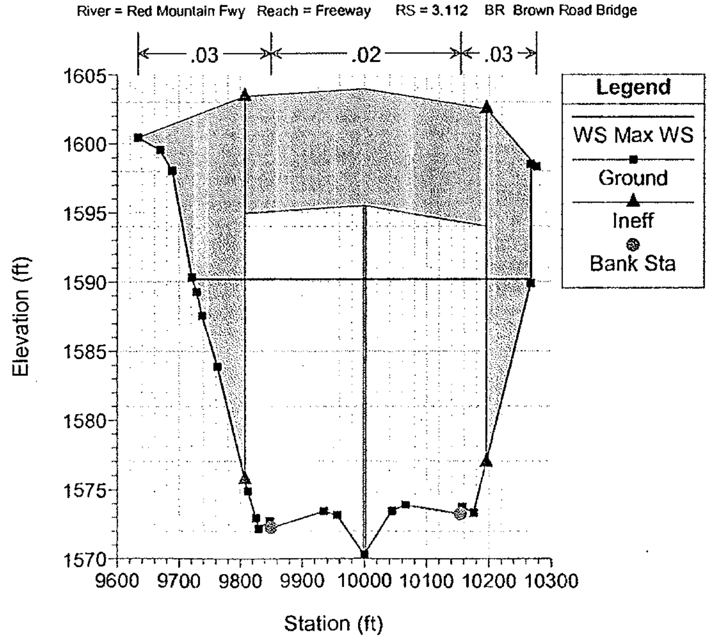
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005

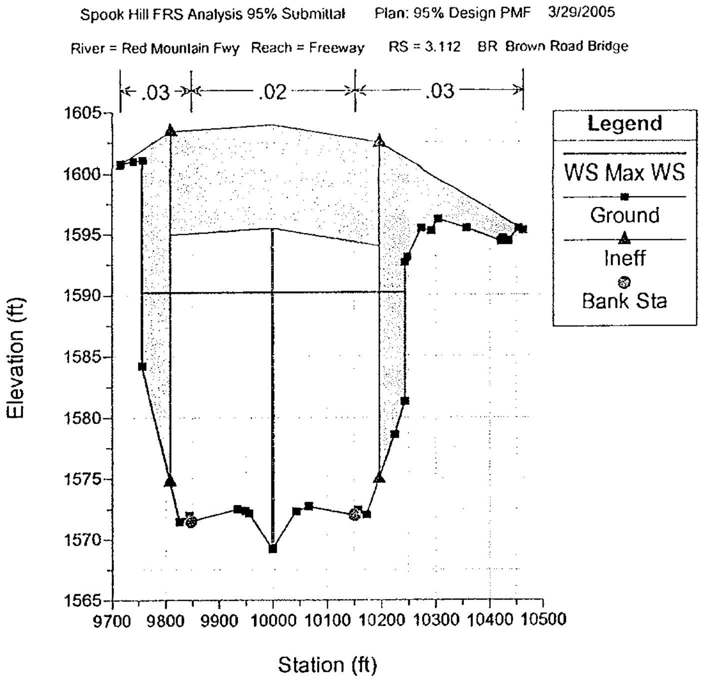
River = Red Mountain Fwy Reach = Freeway RS = 3.146 U/S Bridge Section Brown Road

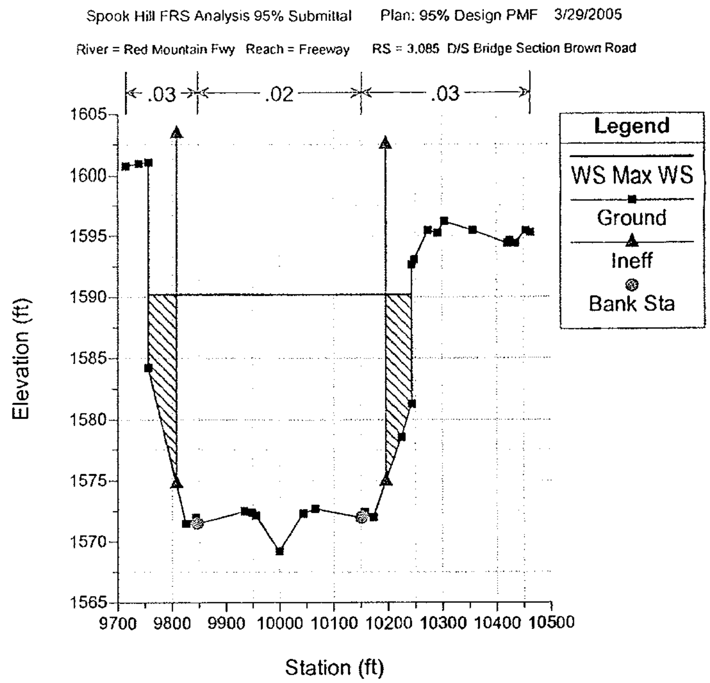


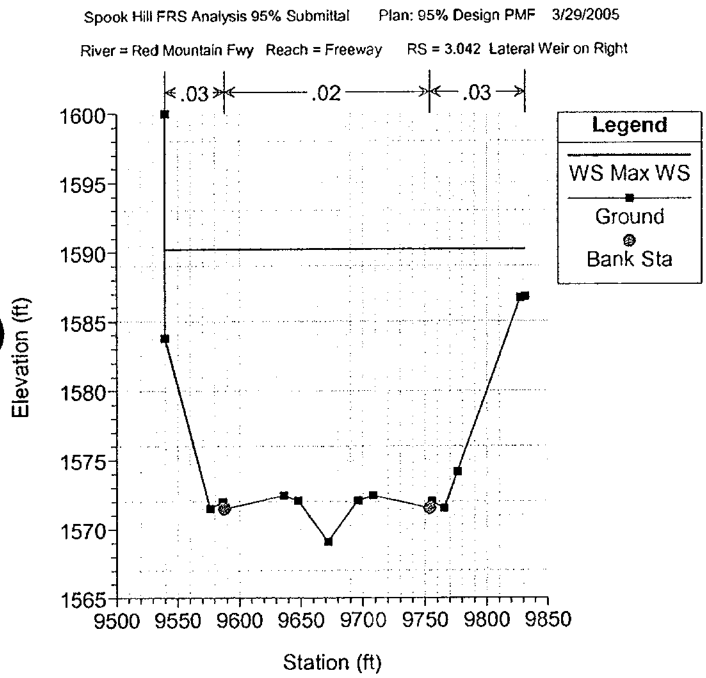
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005

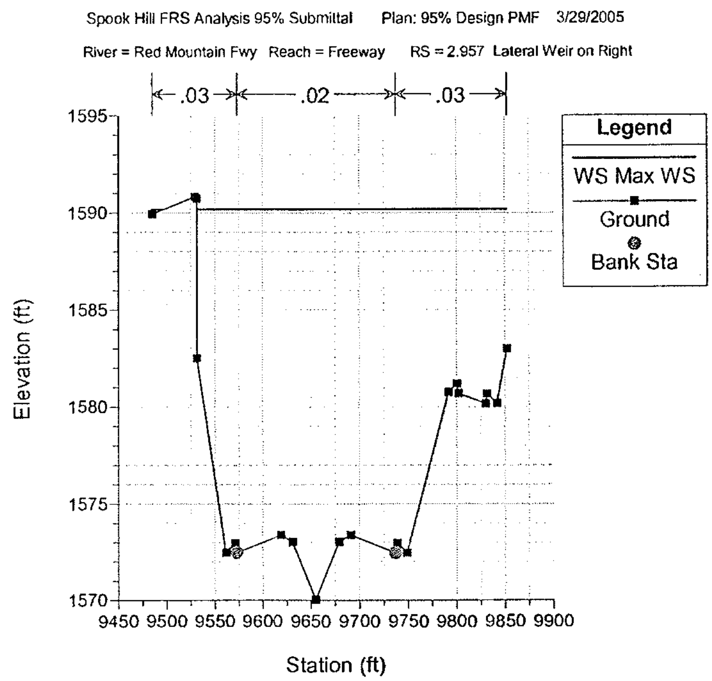
River = Red Mountain Fwy Reach = Freeway RS = 3.112 BR Brown Road Bridge

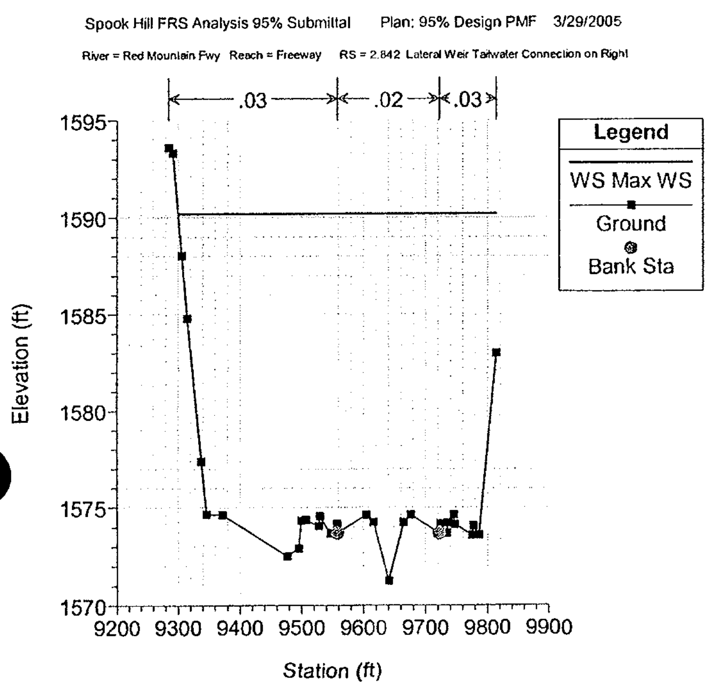


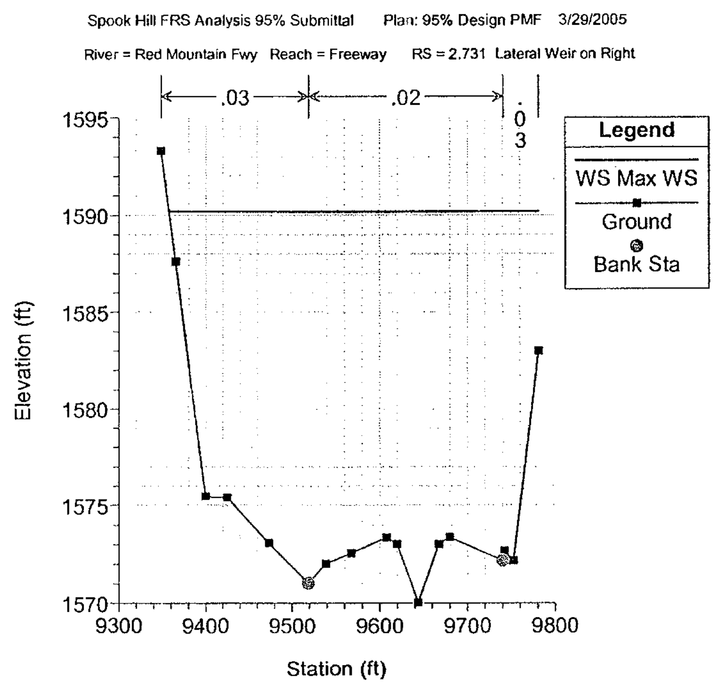

Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005
River = Red Mountain Fwy Reach = Freeway RS = 3.112 BR Brown Road Bridge
.03
.02
.03
Legend
WS Max WS
Ground
Ineff
Bank Sta
Elevation (ft)
1605
1600
1595
1590
1585
1580
1575
1570
1565
9700 9800 9900 10000 10100 10200 10300 10400 10500
Station (ft)

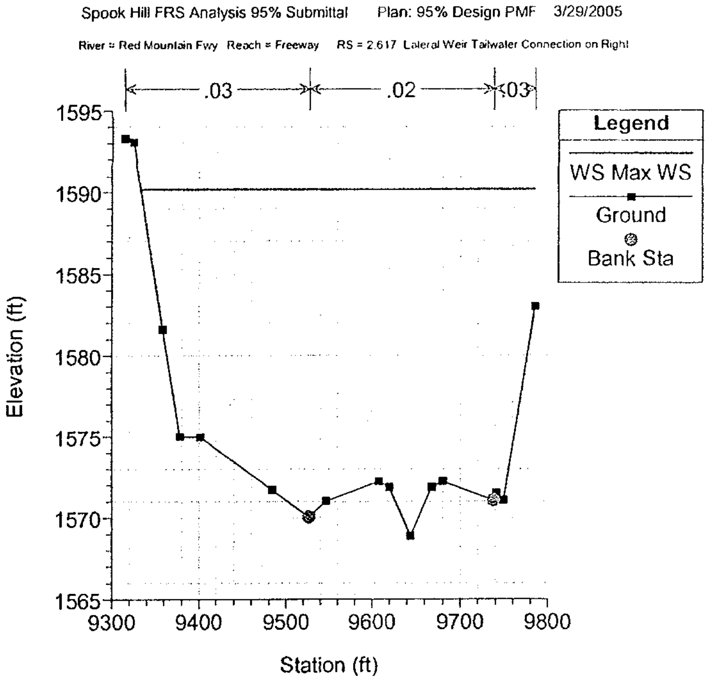

Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005
River = Red Mountain Fwy Reach = Freeway RS = 3.085 D/S Bridge Section Brown Road
.03
.02
.03
Legend
WS Max WS
Ground
Ineff
Bank Sta
Elevation (ft)
1605
1600
1595
1590
1585
1580
1575
1570
1565
9700 9800 9900 10000 10100 10200 10300 10400 10500
Station (ft)

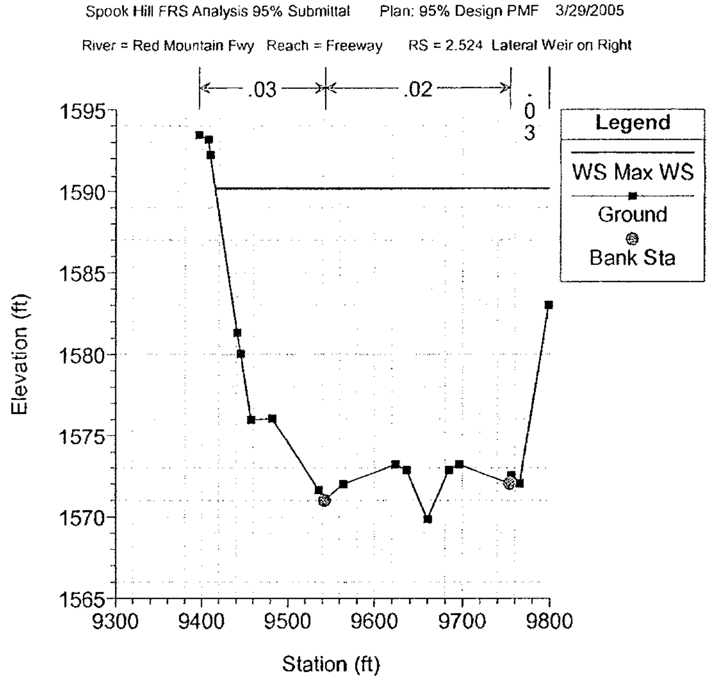

Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005
River = Red Mountain Fwy Reach = Freeway RS = 3.042 Lateral Weir on Right
.03
.02
.03
Legend
WS Max WS
Ground
Bank Sta
Elevation (ft)
1600
1595
1590
1585
1580
1575
1570
1565
9500 9550 9600 9650 9700 9750 9800 9850
Station (ft)

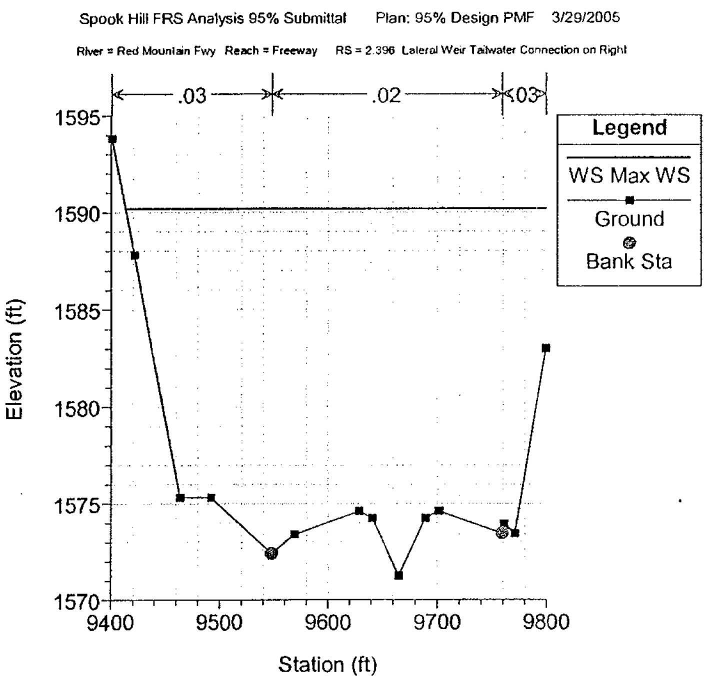

Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005
River = Red Mountain Fwy Reach = Freeway RS = 2.957 Lateral Weir on Right
.03
.02
.03
Legend
WS Max WS
Ground
Bank Sta
Elevation (ft)
1595
1590
1585
1580
1575
1570
9450 9500 9550 9600 9650 9700 9750 9800 9850 9900
Station (ft)

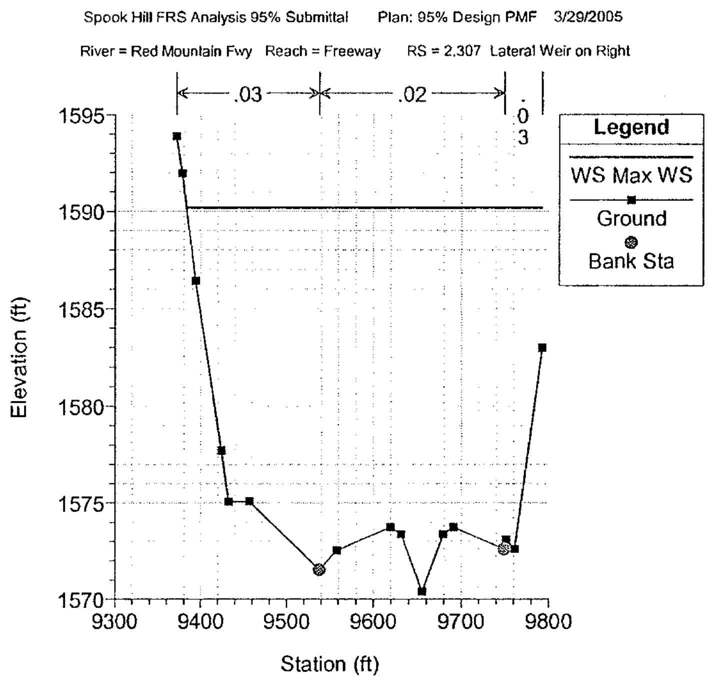

Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005
River = Red Mountain Fwy Reach = Freeway RS = 2.842 Lateral Weir Tailwater Connection on Right
.03
.02
.03
Legend
WS Max WS
Ground
Bank Sta
Elevation (ft)
1595
1590
1585
1580
1575
1570
9200 9300 9400 9500 9600 9700 9800 9900
Station (ft)

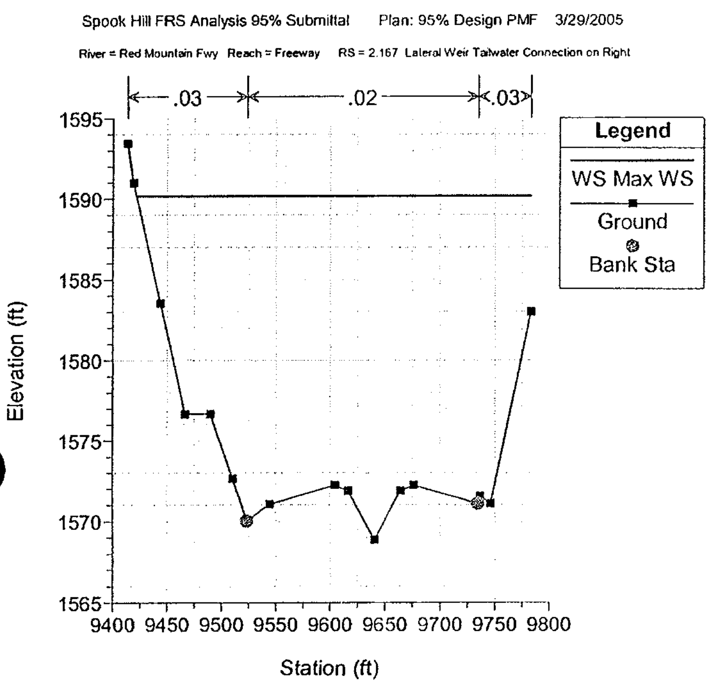

Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005
River = Red Mountain Fwy Reach = Freeway RS = 2.731 Lateral Weir on Right
.03
.02
.03
Legend
WS Max WS
Ground
Bank Sta
Elevation (ft)
1595
1590
1585
1580
1575
1570
9300 9400 9500 9600 9700 9800
Station (ft)

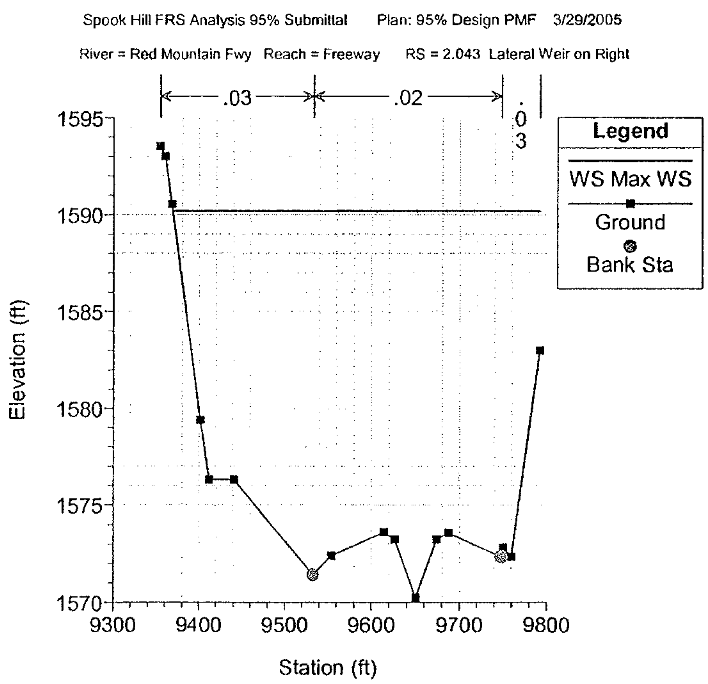

Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005
River = Red Mountain Fwy Reach = Freeway RS = 2.617 Lateral Weir Tailwater Connection on Right
.03
.02
.03
Legend
WS Max WS
Ground
Bank Sta
Elevation (ft)
1595
1590
1585
1580
1575
1570
1565
9300 9400 9500 9600 9700 9800
Station (ft)


Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005
River = Red Mountain Fwy Reach = Freeway RS = 2.524 Lateral Weir on Right
.03
.02
.03
Legend
WS Max WS
Ground
Bank Sta
Elevation (ft)
1595
1590
1585
1580
1575
1570
1565
9300 9400 9500 9600 9700 9800
Station (ft)


Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005
River = Red Mountain Fwy Reach = Freeway RS = 2.396 Lateral Weir Tailwater Connection on Right
.03
.02
.03
Legend
WS Max WS
Ground
Bank Sta
Elevation (ft)
1595
1590
1585
1580
1575
1570
9400 9500 9600 9700 9800
Station (ft)

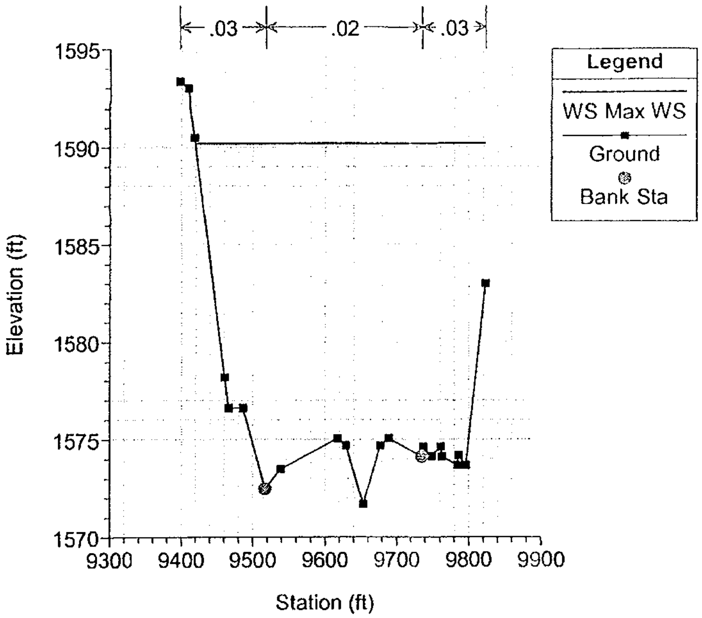

Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005
River = Red Mountain Fwy Reach = Freeway RS = 2.307 Lateral Weir on Right
.03
.02
.03
Legend
WS Max WS
Ground
Bank Sta
Elevation (ft)
1595
1590
1585
1580
1575
1570
9300 9400 9500 9600 9700 9800
Station (ft)


Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005
River = Red Mountain Fwy Reach = Freeway RS = 2.167 Lateral Weir Tailwater Connection on Right
.03
.02
.03
Legend
WS Max WS
Ground
Bank Sta
Elevation (ft)
1595
1590
1585
1580
1575
1570
1565
9400 9450 9500 9550 9600 9650 9700 9750 9800
Station (ft)


Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005
River = Red Mountain Fwy Reach = Freeway RS = 2.043 Lateral Weir on Right
.03
.02
.03
Legend
WS Max WS
Ground
Bank Sta
Elevation (ft)
1595
1590
1585
1580
1575
1570
9300 9400 9500 9600 9700 9800
Station (ft)

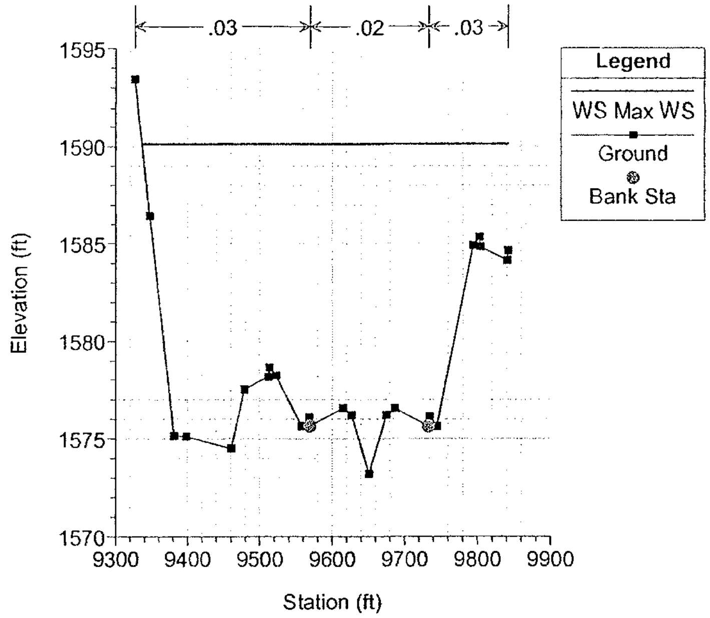
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005

River = Red Mountain Fwy Reach = Freeway RS = 1.934 Lateral Weir Tailwater Connection on Right



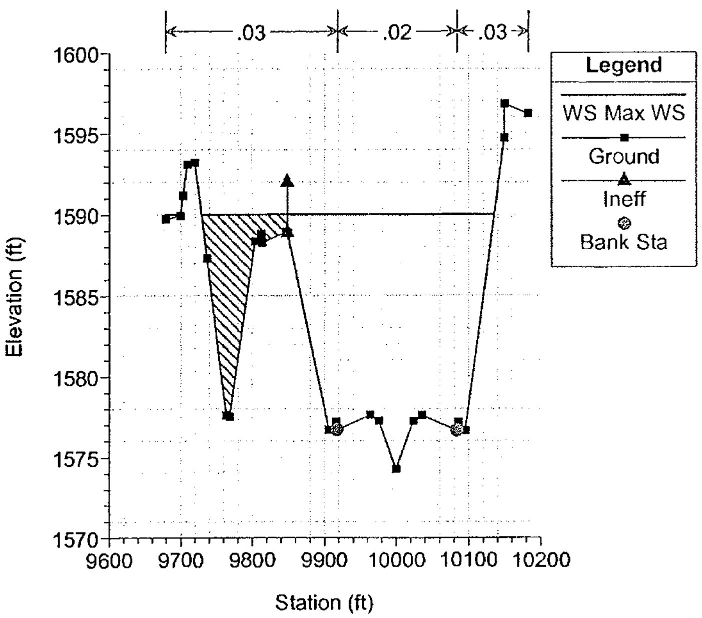
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005

River = Red Mountain Fwy Reach = Freeway RS = 1.818 Lateral Weir on Right



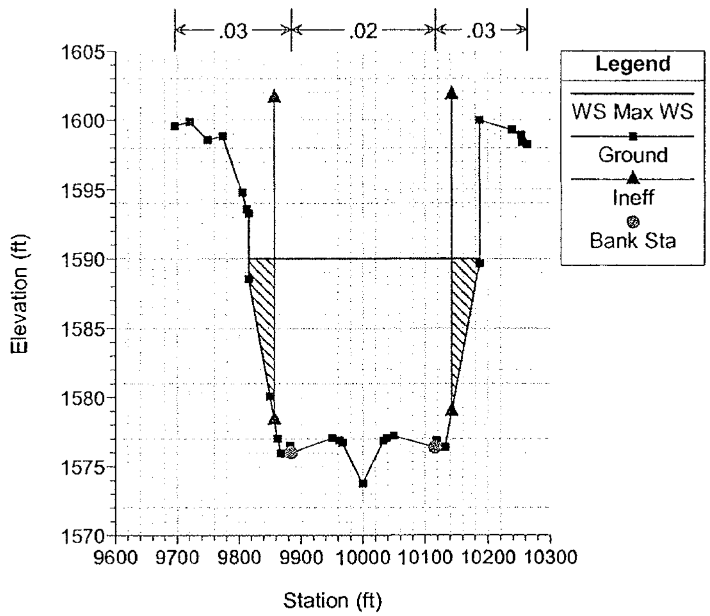
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005

River = Red Mountain Fwy Reach = Freeway RS = 1.764 Ineffective Flow is between On-Ramp and FRS



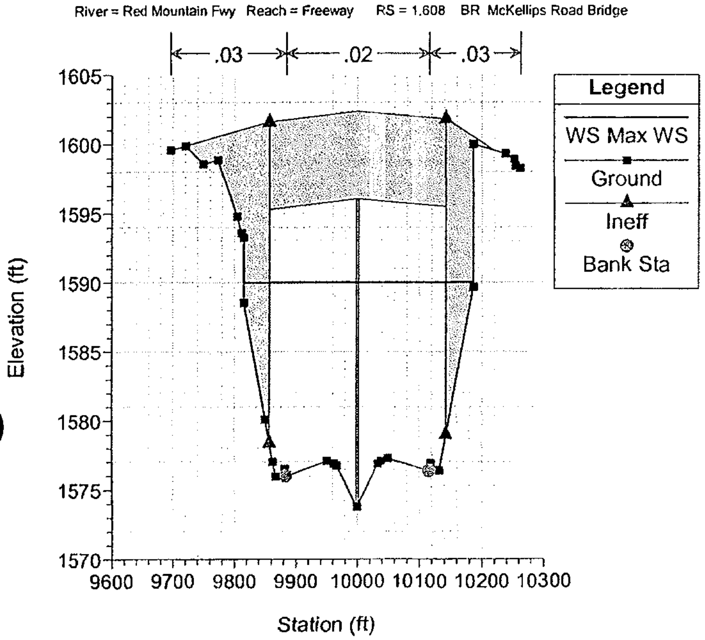
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005

River = Red Mountain Fwy Reach = Freeway RS = 1.695 U/S Bridge Section McKellips Road



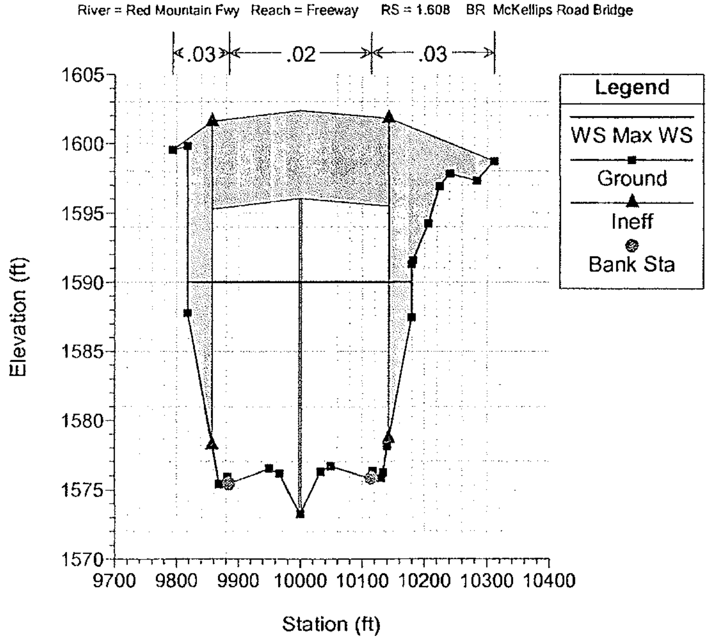
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005

River = Red Mountain Fwy Reach = Freeway RS = 1.608 BR McKellips Road Bridge



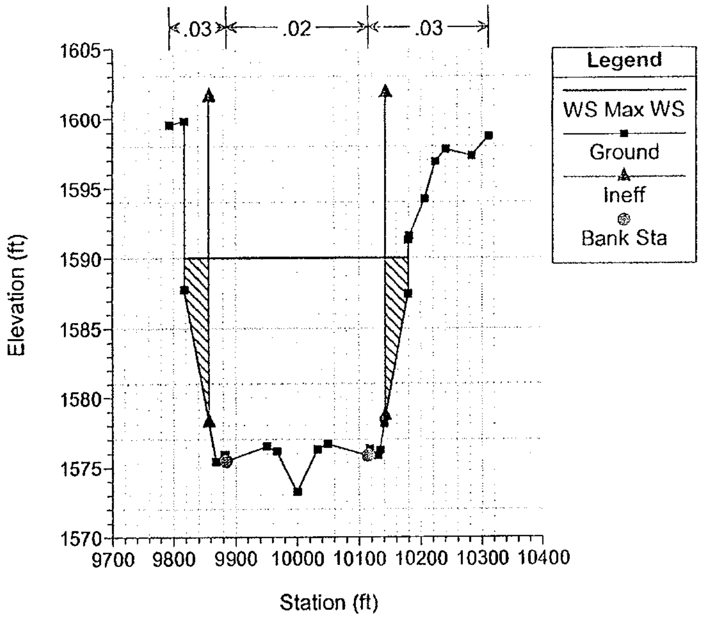
Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005

River = Red Mountain Fwy Reach = Freeway RS = 1.608 BR McKellips Road Bridge



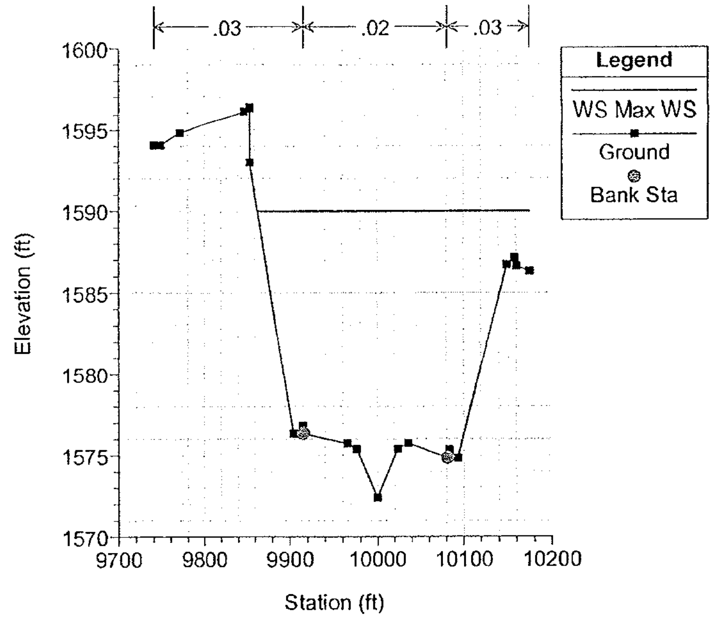
Spook Hill FRS Analysis 95% Submittal   Plan: 95% Design PMF   3/29/2005

River = Red Mountain Fwy   Reach = Freeway   RS = 1.588 D/S Bridge Section McKellips Road



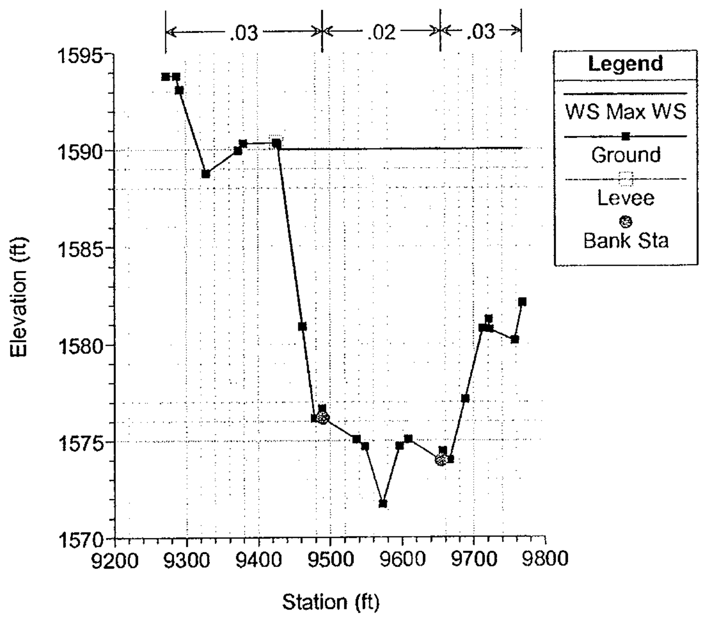
Spook Hill FRS Analysis 95% Submittal   Plan: 95% Design PMF   3/29/2005

River = Red Mountain Fwy   Reach = Freeway   RS = 1.543



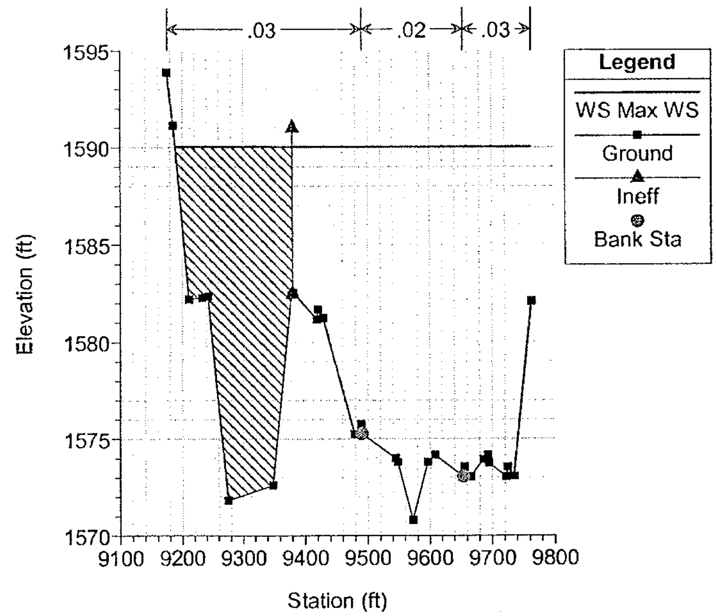
Spook Hill FRS Analysis 95% Submittal   Plan: 95% Design PMF   3/29/2005

River = Red Mountain Fwy   Reach = Freeway   RS = 1.486 Lateral Weir on Right



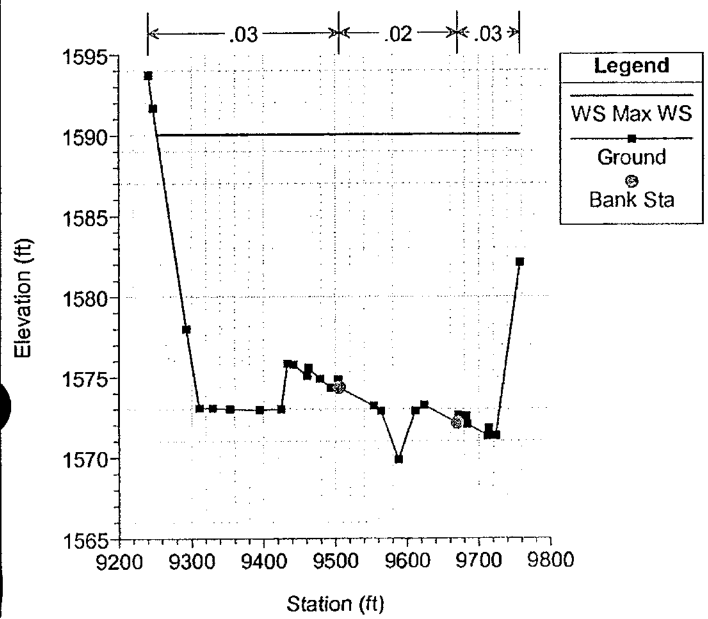
Spook Hill FRS Analysis 95% Submittal   Plan: 95% Design PMF   3/29/2005

River = Red Mountain Fwy   Reach = Freeway   RS = 1.414 Ineffective Flow is between Off-Ramp and FRS



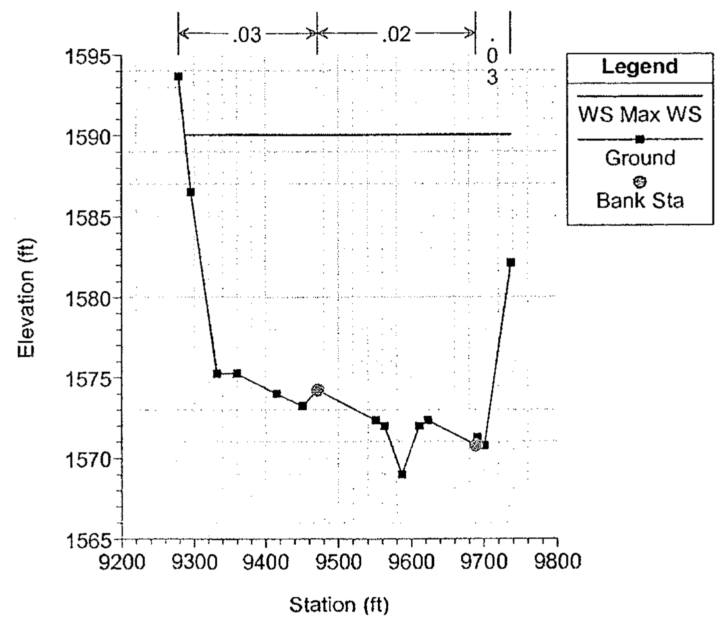
Spook Hill FRS Analysis 95% Submittal   Plan: 95% Design PMF   3/29/2005

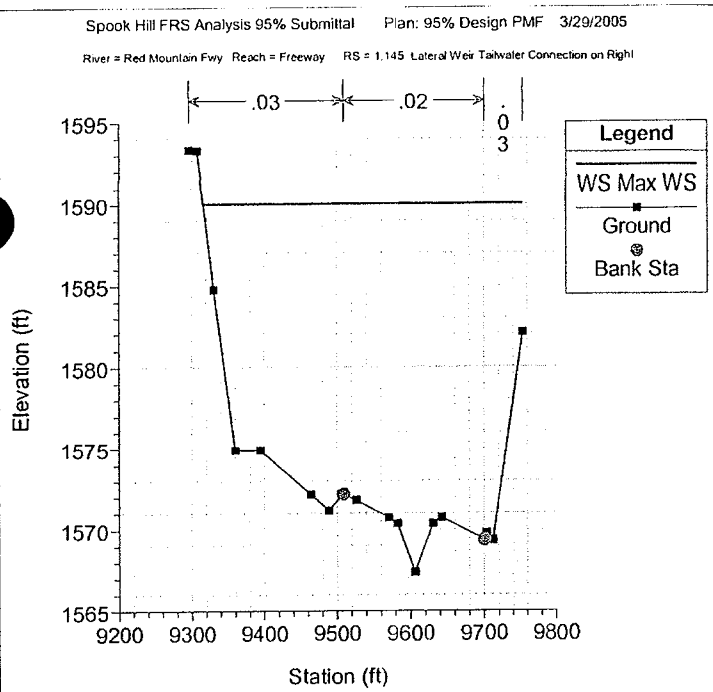
River = Red Mountain Fwy   Reach = Freeway   RS = 1.346 Lateral Weir Tailwater Connection on Right

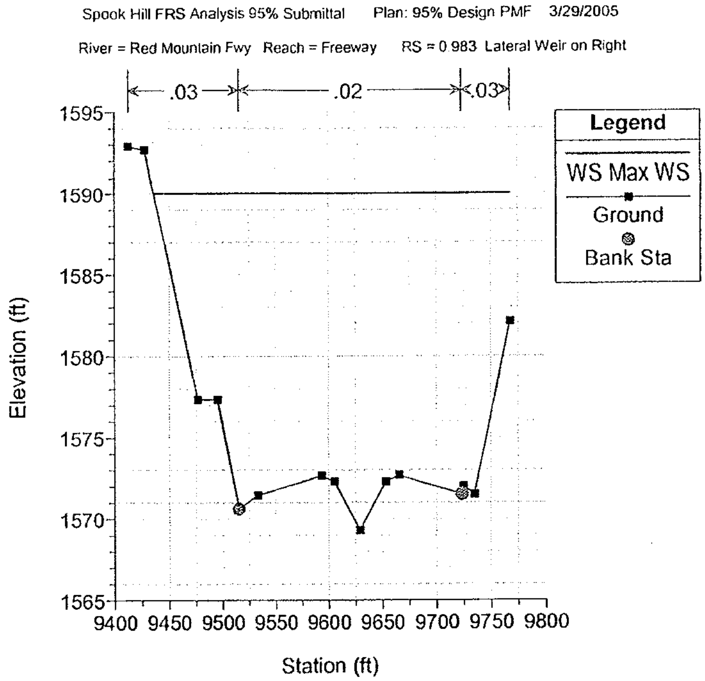


Spook Hill FRS Analysis 95% Submittal   Plan: 95% Design PMF   3/29/2005

River = Red Mountain Fwy   Reach = Freeway   RS = 1.288 Lateral Weir on Right




Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005
River = Red Mountain Fwy Reach = Freeway RS = 1.145 Lateral Weir Tailwater Connection on Right
.03
.02
.03
Legend
WS Max WS
Ground
Bank Sta
Elevation (ft)
Station (ft)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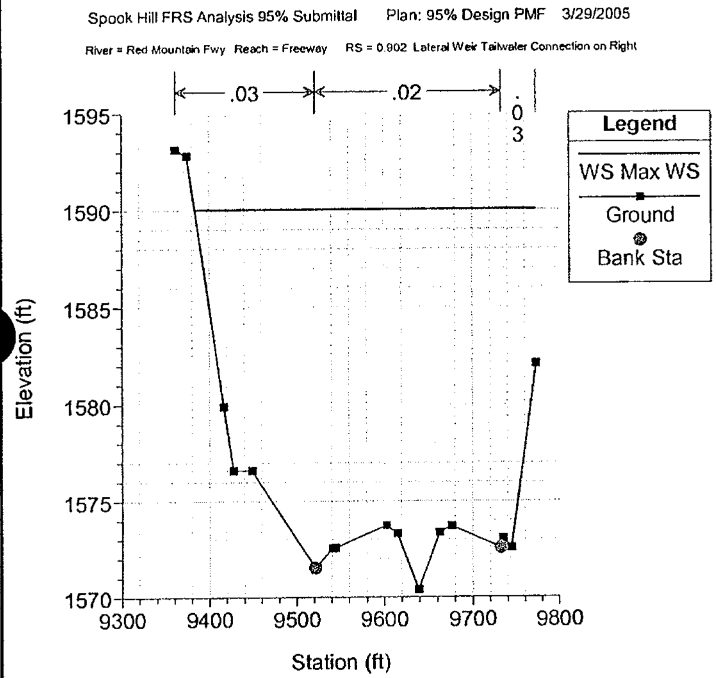
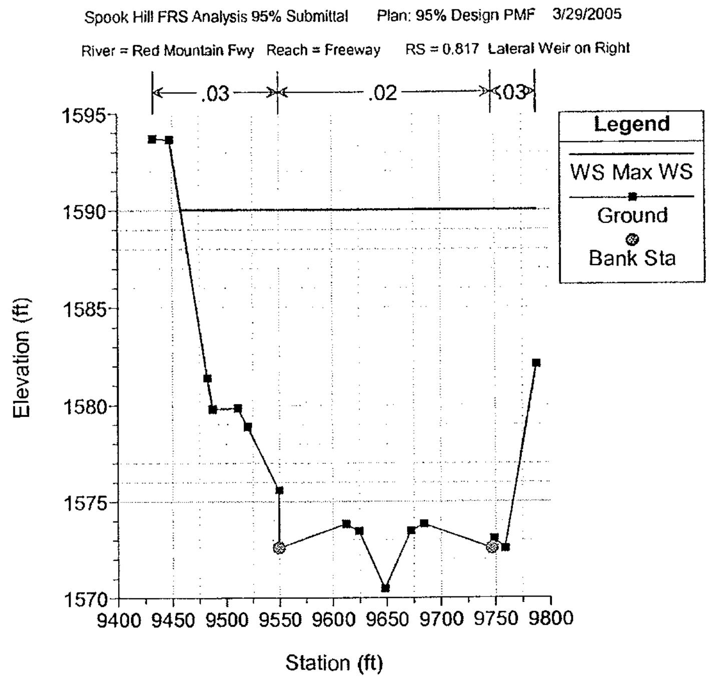
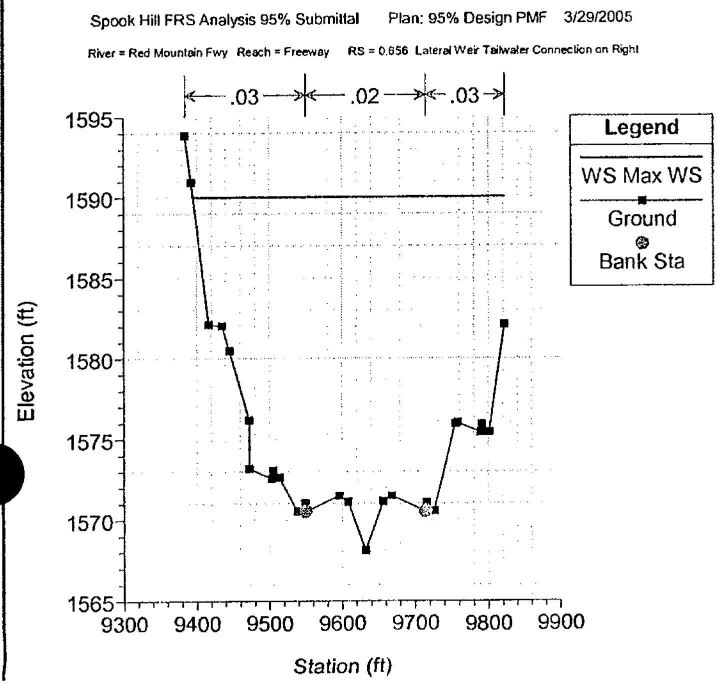
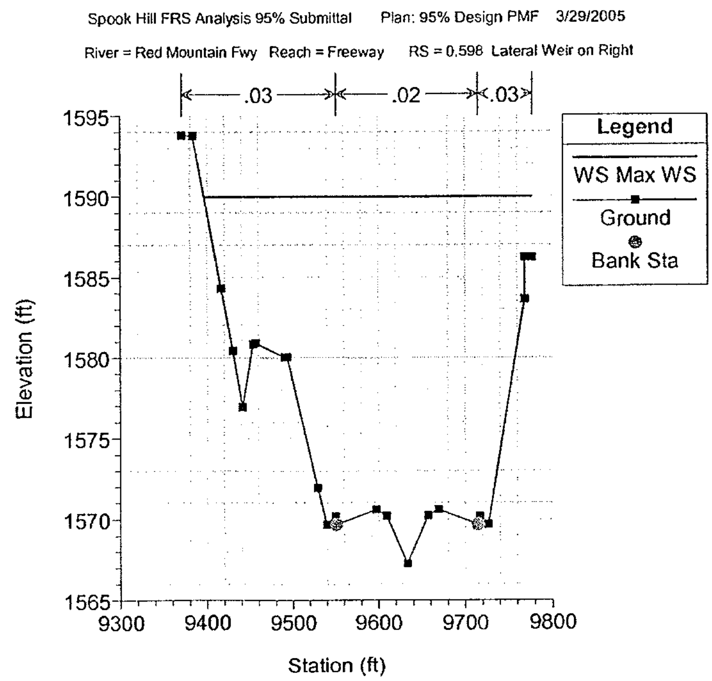
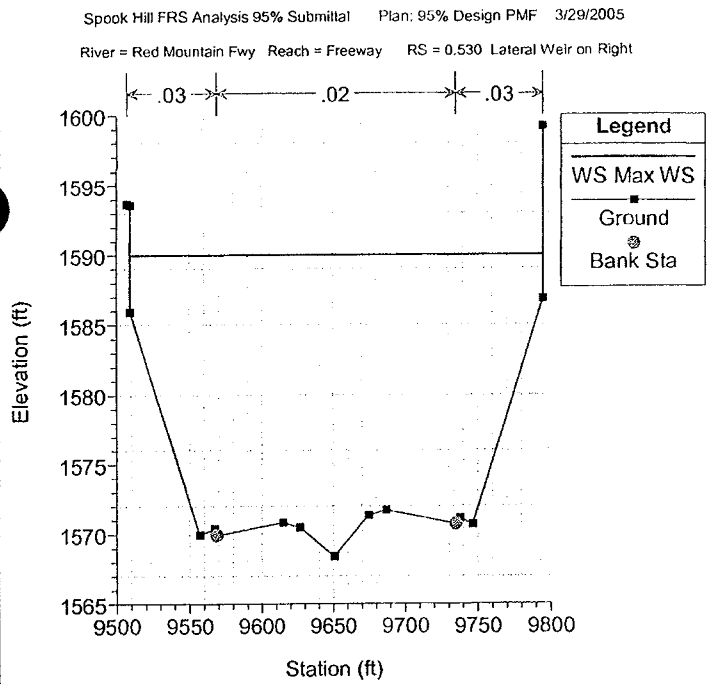
River = Red Mountain Fwy Reach = Freeway RS = 0.983 Lateral Weir on Right
.03
.02
.03
Legend
WS Max WS
Ground
Bank Sta
Elevation (ft)
Station (ft)

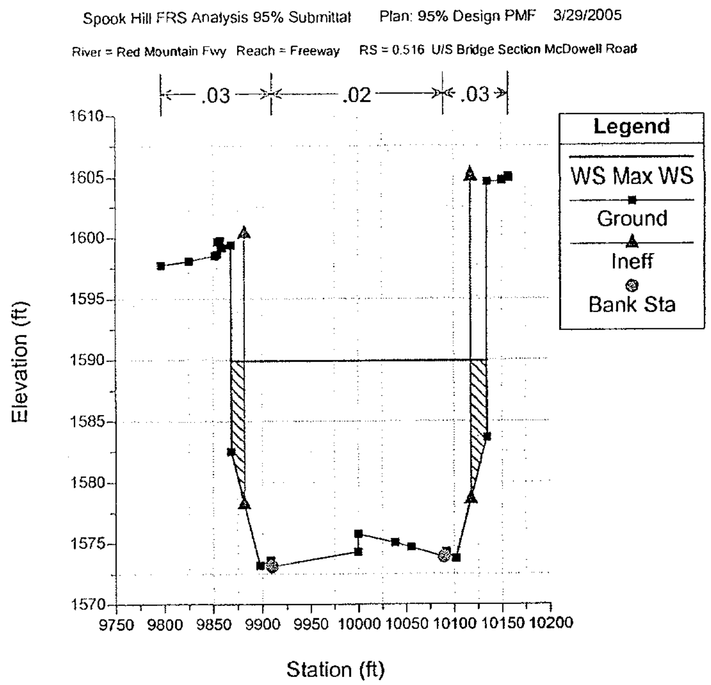

Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005
River = Red Mountain Fwy Reach = Freeway RS = 0.902 Lateral Weir Tailwater Connection on Right
.03
.02
.03
Legend
WS Max WS
Ground
Bank Sta
Elevation (ft)
Station (ft)

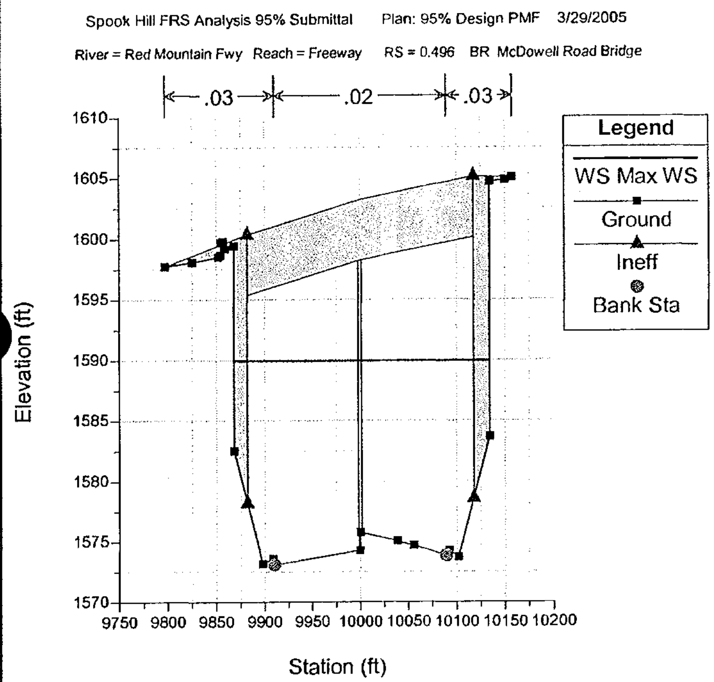

Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005
River = Red Mountain Fwy Reach = Freeway RS = 0.817 Lateral Weir on Right
.03
.02
.03
Legend
WS Max WS
Ground
Bank Sta
Elevation (ft)
Station (ft)

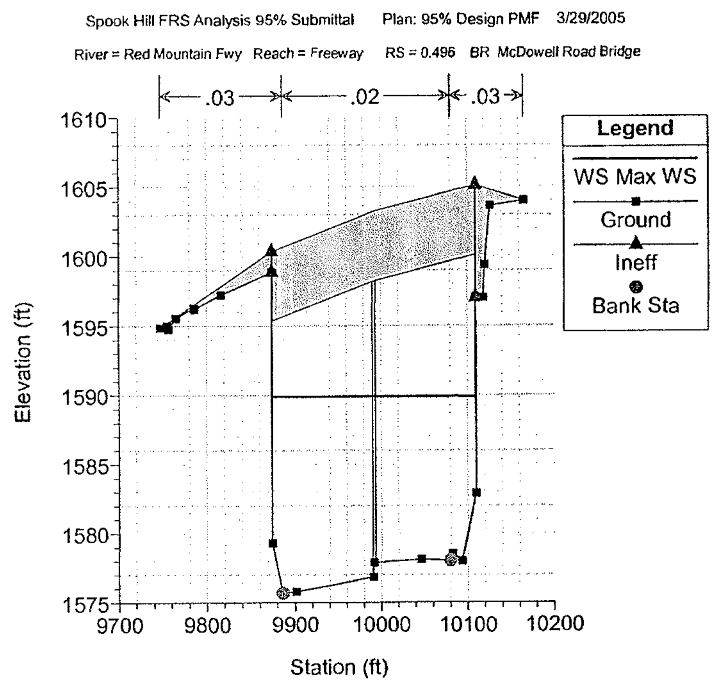

Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005
River = Red Mountain Fwy Reach = Freeway RS = 0.656 Lateral Weir Tailwater Connection on Right
.03
.02
.03
Legend
WS Max WS
Ground
Bank Sta
Elevation (ft)
Station (ft)

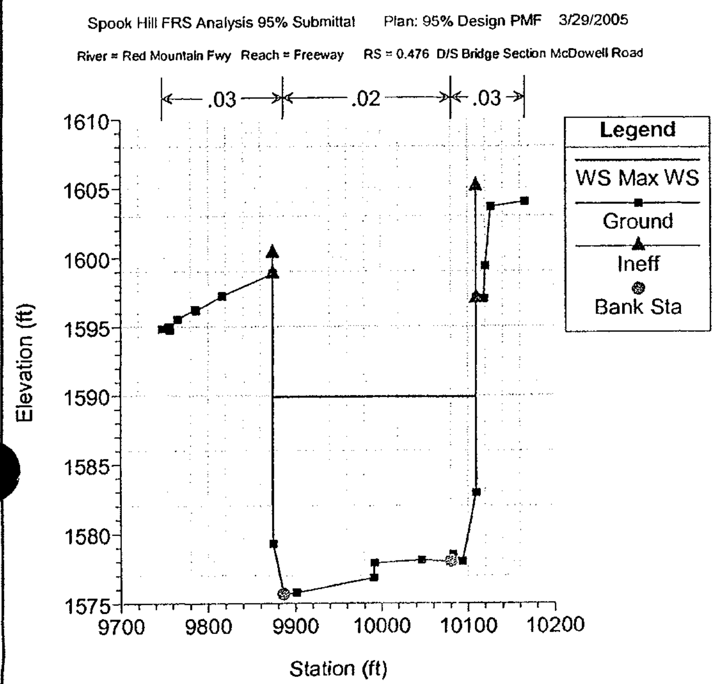

Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005
River = Red Mountain Fwy Reach = Freeway RS = 0.598 Lateral Weir on Right
.03
.02
.03
Legend
WS Max WS
Ground
Bank Sta
Elevation (ft)
Station (ft)

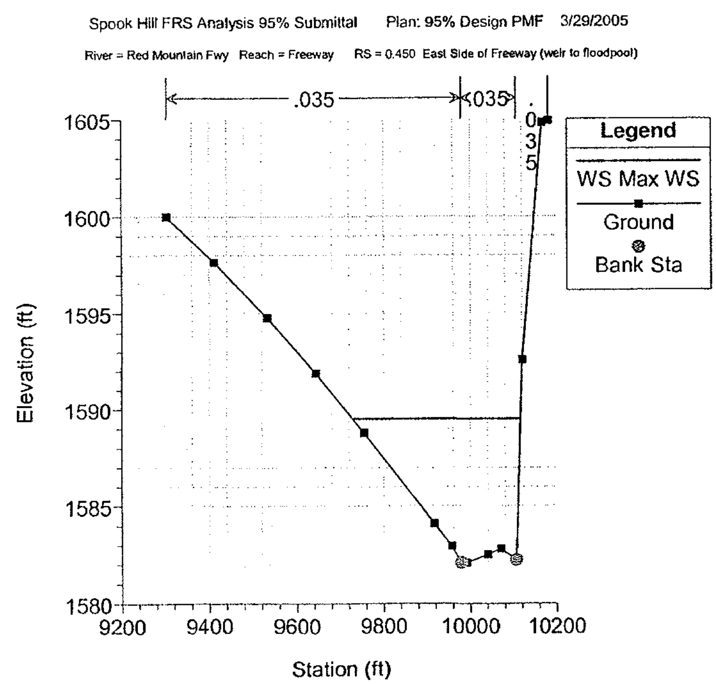

Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005
River = Red Mountain Fwy Reach = Freeway RS = 0.530 Lateral Weir on Right
.03
.02
.03
Legend
WS Max WS
Ground
Bank Sta
Elevation (ft)
Station (ft)


Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005
River = Red Mountain Fwy Reach = Freeway RS = 0.516 U/S Bridge Section McDowell Road
.03
.02
.03
Legend
WS Max WS
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)


Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005
River = Red Mountain Fwy Reach = Freeway RS = 0.496 BR McDowell Road Bridge
.03
.02
.03
Legend
WS Max WS
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)


Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005
River = Red Mountain Fwy Reach = Freeway RS = 0.496 BR McDowell Road Bridge
.03
.02
.03
Legend
WS Max WS
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)


Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005
River = Red Mountain Fwy Reach = Freeway RS = 0.476 D/S Bridge Section McDowell Road
.03
.02
.03
Legend
WS Max WS
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)


Spook Hill FRS Analysis 95% Submittal Plan: 95% Design PMF 3/29/2005
River = Red Mountain Fwy Reach = Freeway RS = 0.450 East Side of Freeway (weir to floodpool)
.035
.035
Legend
WS Max WS
Ground
Bank Sta
Elevation (ft)
Station (ft)

APPENDIX C

HEC-RAS UNSTEADY FLOW ANALYSES

Emergency Spillway Overtopping Analysis

Stanley Consultants INC.

Project No. 17000 Page No. 1

Subject FRS Return Frequency Capacity - Addressing Review Comment

Computed by C Joy Date 8/2/05
Checked by RSR Date 8/8/05
Approved by [signature] Date 8/9/05

Sheet No. ______ of ______

Emergency Spillway Overtopping

ES Crest = 1584.00

PMF precipitation = 12.76 inches (24 hour duration)
500 yr precip = 4.52 inches (24 hr)
100 yr precip = 3.81 inches (24 hr)

Summary:

A preliminary HEC-RAS unsteady flow analysis was performed using hydrographs obtain from HEC-1 models for various precipitation depths (the 100yr model was used and the precipitation values modified)

The results show the flow doesn't over top the ES at a rainfall value of 7". However, at 7.5" the water surface elevation in the flood pool exceeds 1584.00 at the low end of the flood pool. At 7.5", the flood pool contains an event that greatly exceeds the 500 yr event (500yr = 4.52"). (see attached reports from HEC-RAS analyses)

Conclusion:

FRS Capacity prior to overtopping the emergency spillway exceeds the 500-yr event.

HEC-RAS Plan: 100-7.5 Profile: Max WS

7.5" Rainfall Hydrographs 1/2

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)
Lower FRS	0.000	Max WS	1689.46	1575.95	1584.11	1577.10
Lower FRS	0.015	Max WS	1689.48	1575.95	1584.12	
Lower FRS	0.083	Max WS	1680.57	1575.95	1584.13	
Lower FRS	0.096	Max WS	1678.78	1575.95	1584.13	
Lower FRS	0.113	Max WS	1676.84	1575.95	1584.13	
Lower FRS	0.130	Max WS	1674.69	1575.95	1584.13	
Lower FRS	0.165	Max WS	1670.17	1575.95	1584.13	
Lower FRS	0.253	Max WS	1659.12	1575.95	1584.14	
Lower FRS	0.370	Max WS	1644.34	1575.95	1584.14	
Lower FRS	0.374	Max WS	1643.70	1575.95	1584.15	
Upper FRS	0.443	Max WS	941.15	1575.95	1584.15	
Upper FRS	0.447	Max WS	908.16	1575.95	1584.10	
Upper FRS	0.487		Culvert			
Upper FRS	0.530	Max WS	909.00	1575.95	1584.17	
Upper FRS	0.598	Max WS	907.45	1575.95	1584.33	
Upper FRS	0.656	Max WS	687.92	1575.95	1584.34	
Upper FRS	0.817	Max WS	336.77	1575.95	1584.34	
Upper FRS	0.8171		Lat Struct			
Upper FRS	0.902	Max WS	393.95	1575.95	1584.34	
Upper FRS	0.983	Max WS	461.30	1575.95	1584.34	
Upper FRS	0.9831		Lat Struct			
Upper FRS	1.145	Max WS	281.48	1575.95	1584.34	
Upper FRS	1.288	Max WS	261.52	1575.95	1584.34	
Upper FRS	1.2881		Lat Struct			
Upper FRS	1.321	Max WS	219.77	1575.95	1584.34	
Upper FRS	1.346	Max WS	192.12	1575.95	1584.34	
Upper FRS	1.3461		Lat Struct			
Upper FRS	1.414	Max WS	196.41	1575.95	1584.34	
Upper FRS	1.486	Max WS	188.70	1575.95	1584.34	
Upper FRS	1.581	Max WS	189.87	1575.95	1584.34	
Upper FRS	1.5811		Lat Struct			
Upper FRS	1.596	Max WS	189.63	1575.95	1584.34	
Upper FRS	1.638	Max WS	188.89	1575.95	1584.34	
Upper FRS	1.664	Max WS	188.46	1575.95	1584.34	
Upper FRS	1.701		Culvert			
Upper FRS	1.742	Max WS	188.37	1575.95	1584.35	
Upper FRS	1.818	Max WS	187.14	1575.95	1584.36	
Upper FRS	1.934	Max WS	337.15	1575.95	1584.36	
Upper FRS	2.043	Max WS	544.14	1575.95	1584.36	
Upper FRS	2.0431		Lat Struct			
Upper FRS	2.167	Max WS	463.05	1575.95	1584.36	
Upper FRS	2.307	Max WS	516.92	1575.95	1584.36	
Upper FRS	2.3071		Lat Struct			
Upper FRS	2.396	Max WS	529.80	1575.95	1584.36	
Upper FRS	2.524	Max WS	664.90	1575.95	1584.36	
Upper FRS	2.5241		Lat Struct			
Upper FRS	2.617	Max WS	707.47	1575.95	1584.36	
Upper FRS	2.731	Max WS	869.45	1575.95	1584.36	
Upper FRS	2.7311		Lat Struct			
Upper FRS	2.842	Max WS	1042.87	1575.95	1584.36	
Upper FRS	2.957	Max WS	1383.96	1575.95	1584.36	
Upper FRS	3.042	Max WS	1498.18	1575.95	1584.37	
Upper FRS	3.123	Max WS	1501.72	1575.95	1584.38	
Upper FRS	3.1231		Lat Struct			
Upper FRS	3.207	Max WS	1507.32	1575.95	1584.42	
Upper FRS	3.235	Max WS	1472.55	1575.95	1584.33	
Upper FRS	3.257		Culvert			
Upper FRS	3.289	Max WS	2612.20	1575.95	1585.50	
Upper FRS	3.376	Max WS	2470.81	1575.95	1586.50	
Upper FRS	3.433	Max WS	2876.72	1575.95	1586.47	
Upper FRS	3.497	Max WS	4548.49	1575.95	1586.47	

Exceeds Crest Elevation

Emergency Spillway Crest Elevation = 1584

7.5" Rainfall Hydrographs 4/2

HEC-RAS Plan: 100-7.5 Profile: Max WS (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.
			(cfs)	(ft)	(ft)	(ft)
Upper FRS	3.4971		Lat Struct			
Upper FRS	3.566	Max WS	6379.64	1575.95	1586.50	
Upper FRS	3.626	Max WS	6432.50	1575.95	1586.54	
Upper FRS	3.708	Max WS	6231.85	1575.95	1586.58	
Upper FRS	3.7081		Lat Struct			
Upper FRS	3.773	Max WS	6071.53	1575.95	1586.64	
Upper FRS	3.804	Max WS	5995.81	1575.95	1586.76	
Upper FRS	3.805	Max WS	5996.00	1575.95	1586.76	

HEC-RAS Plan: 100-7 Profile: Max WS

1 Rainfall ½ Hydrographs

Emergency Spillway Crest Elevation = 1584

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)
Lower FRS	0.000	Max WS	1484.26	1575.95	1582.86	1577.01
Lower FRS	0.015	Max WS	1485.91	1575.95	1582.86	
Lower FRS	0.083	Max WS	1266.49	1575.95	1582.88	
Lower FRS	0.096	Max WS	1225.46	1575.95	1582.88	
Lower FRS	0.113	Max WS	1174.36	1575.95	1582.88	Not
Lower FRS	0.130	Max WS	1121.45	1575.95	1582.88	Quite
Lower FRS	0.165	Max WS	1010.69	1575.95	1582.88	High
Lower FRS	0.253	Max WS	741.05	1575.95	1582.89	Enough
Lower FRS	0.370	Max WS	384.09	1575.95	1582.88	
Lower FRS	0.374	Max WS	385.09	1575.95	1582.88	
Upper FRS	0.443	Max WS	1082.48	1575.95	1582.88	
Upper FRS	0.447	Max WS	1215.86	1575.95	1582.75	
Upper FRS	0.487		Culvert			
Upper FRS	0.530	Max WS	1217.37	1575.95	1582.89	
Upper FRS	0.598	Max WS	1218.11	1575.95	1583.37	
Upper FRS	0.656	Max WS	1115.79	1575.95	1583.38	
Upper FRS	0.817	Max WS	162.48	1575.95	1583.39	
Upper FRS	0.8171		Lat Struct			
Upper FRS	0.902	Max WS	295.63	1575.95	1583.39	
Upper FRS	0.983	Max WS	425.17	1575.95	1583.39	
Upper FRS	0.9831		Lat Struct			
Upper FRS	1.145	Max WS	272.78	1575.95	1583.39	
Upper FRS	1.288	Max WS	263.42	1575.95	1583.39	
Upper FRS	1.2881		Lat Struct			
Upper FRS	1.321	Max WS	227.97	1575.95	1583.39	
Upper FRS	1.346	Max WS	203.70	1575.95	1583.39	
Upper FRS	1.3461		Lat Struct			
Upper FRS	1.414	Max WS	198.42	1575.95	1583.39	
Upper FRS	1.486	Max WS	195.73	1575.95	1583.39	
Upper FRS	1.581	Max WS	194.05	1575.95	1583.39	
Upper FRS	1.5811		Lat Struct			
Upper FRS	1.596	Max WS	193.81	1575.95	1583.39	
Upper FRS	1.638	Max WS	194.14	1575.95	1583.39	
Upper FRS	1.664	Max WS	192.59	1575.95	1583.39	
Upper FRS	1.701		Culvert			
Upper FRS	1.742	Max WS	192.59	1575.95	1583.39	
Upper FRS	1.818	Max WS	1414.46	1575.95	1583.50	
Upper FRS	1.934	Max WS	989.68	1575.95	1583.53	
Upper FRS	2.043	Max WS	1178.42	1575.95	1583.53	
Upper FRS	2.0431		Lat Struct			
Upper FRS	2.167	Max WS	1412.39	1575.95	1583.54	
Upper FRS	2.307	Max WS	1703.75	1575.95	1583.55	
Upper FRS	2.3071		Lat Struct			
Upper FRS	2.396	Max WS	1905.86	1575.95	1583.56	
Upper FRS	2.524	Max WS	1655.14	1575.95	1583.58	
Upper FRS	2.5241		Lat Struct			
Upper FRS	2.617	Max WS	1492.58	1575.95	1583.59	
Upper FRS	2.731	Max WS	1312.77	1575.95	1583.60	
Upper FRS	2.7311		Lat Struct			
Upper FRS	2.842	Max WS	2026.31	1575.95	1583.60	
Upper FRS	2.957	Max WS	2780.41	1575.95	1583.61	
Upper FRS	3.042	Max WS	2733.27	1575.95	1583.67	
Upper FRS	3.123	Max WS	2695.46	1575.95	1583.70	
Upper FRS	3.1231		Lat Struct			
Upper FRS	3.207	Max WS	2565.00	1575.95	1583.91	
Upper FRS	3.235	Max WS	2511.35	1575.95	1583.69	
Upper FRS	3.257		Culvert			
Upper FRS	3.289	Max WS	2537.02	1575.95	1585.41	
Upper FRS	3.376	Max WS	2446.76	1575.95	1586.40	
Upper FRS	3.433	Max WS	2787.32	1575.95	1586.37	
Upper FRS	3.497	Max WS	4318.32	1575.95	1586.38	

HEC-RAS Plan: 100-7 Profile: Max WS (Continued)

1" Rainfall 4/2
Hydrographs

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)
Upper FRS	3.4971		Lat Struct			
Upper FRS	3.566	Max WS	5998.74	1575.95	1586.41	
Upper FRS	3.626	Max WS	6044.64	1575.95	1586.45	
Upper FRS	3.708	Max WS	5872.55	1575.95	1586.48	
Upper FRS	3.7081		Lat Struct			
Upper FRS	3.773	Max WS	5735.32	1575.95	1586.54	
Upper FRS	3.804	Max WS	5669.84	1575.95	1586.65	
Upper FRS	3.805	Max WS	5669.93	1575.95	1586.65	

HEC-RAS Version 3.1.1 May 2003
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: FRS Emergency Spillway Overtopping
Project File : ESOvertopping.prj
Run Date and Time: 6/21/2005 1:04:12 PM

Project in English units

Project Description:
Spook Hill Floodwater Retarding Structure: Design Analysis (April 2005)
Prepared for: Arizona Department of Transportation

Red Mountain Freeway (202L) - Power Road to University Drive

Prepared by:
Stanley Consultants
2929 East Camelback Road, Suite 130
Phoenix, Arizona 85016

Emergency Spillway
Overtopping Analysis

This model addresses comments from the FCDMC regarding the point at which the FRS Emergency Spillway begins to overtop. Assessment is based upon hydrographs obtained from unrefined HEC-1 models using various rainfall depths.

The models presented in this project include:

* The final design models (100-yr & PMF) developed by Stanley Consultants that addresses review comments.
* Various models (all based on the 100-year HEC-RAS analyses) with new input hydrographs for various rainfall values. These models are for background information and should not be used as a basis for design.

****

PLAN DATA

Plan Title: 100-year 7.5 inches
Plan File : q:\17000\Active\07-Design\11-Water Res\Appendices\H&H Models for FCDMC\SCI\ES Overtopping\ESOvertopping.p05

Geometry Title: Final Design Geometry
Geometry File : q:\17000\Active\07-Design\11-Water Res\Appendices\H&H Models for FCDMC\SCI\ES Overtopping\ESOvertopping.g06

Flow Title :
Flow File :

Plan Description:
Spook Hill FRS
95% Design Analysis
Probable Maximum Flood Event

Plan Summary Information:

Number of:				
Cross Sections =	90	Mulitple Openings =	0
Culverts =	3	Inline Structures =	0
Bridges =	3	Lateral Structures =	12

Computational Information

Water surface calculation tolerance	=	0.01
Critical depth calculaton tolerance	=	0.01
Maximum number of interations	=	20
Maximum difference tolerance	=	0.3
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

Profile Output Table - Spillway Overtopping

Reach	River Sta	Profile		Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)
Lower FRS	0.000	Max WS		1689.46	1575.95	1584.11	1577.10
Lower FRS	0.015	Max WS		1689.48	1575.95	1584.12	
Lower FRS	0.083	Max WS		1680.57	1575.95	1584.13	
Lower FRS	0.096	Max WS		1678.78	1575.95	1584.13	
Lower FRS	0.113	Max WS		1676.84	1575.95	1584.13	
Lower FRS	0.130	Max WS		1674.69	1575.95	1584.13	
Lower FRS	0.165	Max WS		1670.17	1575.95	1584.13	
Lower FRS	0.253	Max WS		1659.12	1575.95	1584.14	
Lower FRS	0.370	Max WS		1644.34	1575.95	1584.14	
Lower FRS	0.374	Max WS		1643.70	1575.95	1584.15	
Freeway	0.450	Max WS		702.54	1582.10	1584.15	
Freeway	0.476	Max WS		702.98	1575.67	1584.34	

Freeway	0.496		Bridge			
Freeway	0.516	Max WS	703.16	1573.10	1584.34	1574.71
Freeway	0.530	Max WS	703.21	1568.38	1584.34	
Freeway	0.598	Max WS	703.07	1567.26	1584.34	
Freeway	0.656	Max WS	1268.94	1568.12	1584.34	
Freeway	0.817	Max WS	1269.20	1570.48	1584.34	
Freeway	0.902	Max WS	1139.67	1570.39	1584.34	
Freeway	0.983	Max WS	1140.89	1569.31	1584.34	
Freeway	1.145	Max WS	1335.38	1567.38	1584.34	
Freeway	1.288	Max WS	1335.93	1568.99	1584.34	
Freeway	1.346	Max WS	1404.81	1569.87	1584.34	
Freeway	1.414	Max WS	1403.98	1570.81	1584.34	
Freeway	1.486	Max WS	1404.25	1571.72	1584.34	
Freeway	1.543	Max WS	1400.58	1572.41	1584.34	
Freeway	1.588	Max WS	1404.54	1573.24	1584.34	
Freeway	1.608		Bridge			
Freeway	1.695	Max WS	1404.65	1573.79	1584.35	1577.29
Freeway	1.764	Max WS	1404.82	1574.26	1584.34	
Freeway	1.818	Max WS	1405.10	1573.21	1584.35	
Freeway	1.934	Max WS	1039.79	1571.70	1584.36	
Freeway	2.043	Max WS	1039.97	1570.25	1584.36	
Freeway	2.167	Max WS	1063.09	1568.88	1584.36	
Freeway	2.307	Max WS	1058.86	1570.39	1584.36	
Freeway	2.396	Max WS	894.37	1571.26	1584.36	
Freeway	2.524	Max WS	894.57	1569.85	1584.36	
Freeway	2.617	Max WS	678.54	1568.89	1584.36	
Freeway	2.731	Max WS	678.96	1570.03	1584.36	
Freeway	2.842	Max WS	37.40	1571.26	1584.36	
Freeway	2.957	Max WS	37.68	1570.04	1584.36	
Freeway	3.042	Max WS	37.81	1569.09	1584.36	
Freeway	3.085	Max WS	34.14	1569.23	1584.36	
Freeway	3.112		Bridge			
Freeway	3.146	Max WS	38.07	1570.31	1584.36	1571.14
Freeway	3.239	Max WS	38.27	1571.91	1584.36	
Freeway	3.376	Max WS	38.71	1574.90	1584.36	
Freeway	3.433	Max WS	23.15	1576.35	1584.36	
Freeway	3.497	Max WS	0.00	1577.19	1584.36	
Upper FRS	0.443	Max WS	941.15	1575.95	1584.15	
Upper FRS	0.447	Max WS	908.16	1575.95	1584.10	
Upper FRS	0.487		Culvert			
Upper FRS	0.530	Max WS	909.00	1575.95	1584.17	
Upper FRS	0.598	Max WS	907.45	1575.95	1584.33	
Upper FRS	0.656	Max WS	687.92	1575.95	1584.34	
Upper FRS	0.817	Max WS	336.77	1575.95	1584.34	
Upper FRS	0.8171		Lat Struct			
Upper FRS	0.902	Max WS	393.95	1575.95	1584.34	
Upper FRS	0.983	Max WS	461.30	1575.95	1584.34	
Upper FRS	0.9831		Lat Struct			
Upper FRS	1.145	Max WS	281.48	1575.95	1584.34	
Upper FRS	1.288	Max WS	261.52	1575.95	1584.34	
Upper FRS	1.2881		Lat Struct			
Upper FRS	1.321	Max WS	219.77	1575.95	1584.34	
Upper FRS	1.346	Max WS	192.12	1575.95	1584.34	
Upper FRS	1.3461		Lat Struct			
Upper FRS	1.414	Max WS	196.41	1575.95	1584.34	
Upper FRS	1.486	Max WS	188.70	1575.95	1584.34	
Upper FRS	1.581	Max WS	189.87	1575.95	1584.34	
Upper FRS	1.5811		Lat Struct			
Upper FRS	1.596	Max WS	189.63	1575.95	1584.34	

Upper FRS	1.638	Max WS	188.89	1575.95	1584.34	
Upper FRS	1.664	Max WS	188.46	1575.95	1584.34	
Upper FRS	1.701		Culvert			
Upper FRS	1.742	Max WS	188.37	1575.95	1584.35	
Upper FRS	1.818	Max WS	187.14	1575.95	1584.36	
Upper FRS	1.934	Max WS	337.15	1575.95	1584.36	
Upper FRS	2.043	Max WS	544.14	1575.95	1584.36	
Upper FRS	2.0431		Lat Struct			
Upper FRS	2.167	Max WS	463.05	1575.95	1584.36	
Upper FRS	2.307	Max WS	516.92	1575.95	1584.36	
Upper FRS	2.3071		Lat Struct			
Upper FRS	2.396	Max WS	529.80	1575.95	1584.36	
Upper FRS	2.524	Max WS	664.90	1575.95	1584.36	
Upper FRS	2.5241		Lat Struct			
Upper FRS	2.617	Max WS	707.47	1575.95	1584.36	
Upper FRS	2.731	Max WS	869.45	1575.95	1584.36	
Upper FRS	2.7311		Lat Struct			
Upper FRS	2.842	Max WS	1042.87	1575.95	1584.36	
Upper FRS	2.957	Max WS	1383.96	1575.95	1584.36	
Upper FRS	3.042	Max WS	1498.18	1575.95	1584.37	
Upper FRS	3.123	Max WS	1501.72	1575.95	1584.38	
Upper FRS	3.1231		Lat Struct			
Upper FRS	3.207	Max WS	1507.32	1575.95	1584.42	
Upper FRS	3.235	Max WS	1472.55	1575.95	1584.33	
Upper FRS	3.257		Culvert			
Upper FRS	3.289	Max WS	2612.20	1575.95	1585.50	
Upper FRS	3.376	Max WS	2470.81	1575.95	1586.50	
Upper FRS	3.433	Max WS	2876.72	1575.95	1586.47	
Upper FRS	3.497	Max WS	4548.49	1575.95	1586.47	
Upper FRS	3.4971		Lat Struct			
Upper FRS	3.566	Max WS	6379.64	1575.95	1586.50	
Upper FRS	3.626	Max WS	6432.50	1575.95	1586.54	
Upper FRS	3.708	Max WS	6231.85	1575.95	1586.58	
Upper FRS	3.7081		Lat Struct			
Upper FRS	3.773	Max WS	6071.53	1575.95	1586.64	
Upper FRS	3.804	Max WS	5995.81	1575.95	1586.76	
Upper FRS	3.805	Max WS	5996.00	1575.95	1586.76	

Flood Control District of Maricopa County
17000-FINAL - Red Mtn: CAP Overchute Hydrology - For Final Design
Rainfall Data

Primary Zone Number:	7	Latitude:	0.0	Elevation:	0
Short Duration Zone Number:	8	Longitude:	0.0		

	Point Values (in)						
Duration	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	500-Yr
5 MIN	0.28	0.40	0.47	0.57	0.65	0.73	0.92
10 MIN	0.42	0.60	0.72	0.88	1.00	1.12	1.41
15 MIN	0.52	0.75	0.90	1.12	1.28	1.44	1.82
30 MIN	0.68	1.01	1.22	1.51	1.73	1.96	2.47
1 HOUR	0.83	1.24	1.51	1.88	2.16	2.44	3.10
2 HOUR	0.92	1.36	1.65	2.04	2.35	2.65	3.35
3 HOUR	0.99	1.44	1.74	2.15	2.47	2.79	3.52
6 HOUR	1.10	1.59	1.92	2.36	2.71	3.05	3.84
12 HOUR	1.23	1.75	2.10	2.58	2.96	3.32	4.18
24 HOUR	1.35	1.91	2.29	2.80	3.20	3.60	4.52

APPENDIX C

HEC-RAS UNSTEADY FLOW ANALYSES

Spook Hill FRS Drawdown Time

Stanley Consultants INC.

Project No. 17000 Page No. 1
Subject Drawdown Time for Spook Hill FRS

Computed by CJoy Date 8/2/05
Checked by RSR Date 8/8/05
Approved by MPC Date 8/9/05

Sheet No. 1 of 4

Assuming only Infiltration

Given: Storage Volume = 448 acre-ft (this includes 241 acre-ft assumed to be sediment ∴ a conservative approach)

Elevation = 1577.50 at P.S. Crest
Elevation = 1568.10 at P.S. low flow outlet invert

∴ depth = 1577.50 − 1568.10 = 9.4 ft

Assume: Uniform infiltration rate over the duration of the drawdown time.

Infiltration rate assumed to be the vertical hydraulic conductivity assumed for the FRS embankment soils (5×10^{-4} cm/sec) (per AMEC Report pg 22)

$$9.4\,ft \left(\frac{1\,sec}{5\times10^{-4}\,cm}\right)\left(\frac{2.54\,cm}{in}\right)\left(\frac{12\,in}{ft}\right)\left(\frac{1\,min}{60\,sec}\right)\left(\frac{1\,hr}{60\,min}\right)\left(\frac{1\,day}{24\,hrs}\right) = 6.63\ days$$

6.63 days is less than the 10 days indicated by ADWR as being the maximum drawdown time.

Note that this does not account for flow being discharged from the 2'x2' low flow outlet in the principal spillway

SC 3004R4 898

Stanley Consultants INC.

Project No. ______ Page No. 2

Subject: Draw down time for Spook Hill FRS

Computed by: CJS Date: 8/8/05

Checked by: RSR Date: 8/8/05

Approved by: MR Date: 8/9/05

Sheet No. 2 of 4

Assuming only Discharge from Low Flow

Spread sheet calculations are included with this summary along with rating tables/curves for the principal spillway low flow outlet and the Spook Hill flood pool stage-storage calculations.

Based upon conservation assumptions that NO sediment occupies storage, the calculations indicate the basin would drain via the low flow outlet (alone) within 6 days.

Summary

If you consider the time it takes to drain the flood pool from the level of the principal outlet spillway crest elevations, it would appear than either infiltration or the low flow outlet alone are capable of draining the flood pool within 10 days. Combined they should drain the flood pool even quicker. However, because the Spook Hill FRS is on the downstream end of all the Buckhorn-Mesa watershed structures flow will continue to drain into the flood pool via the Signal Butte Floodway until those structures are completely drained. How long this might take is not known as such information is not readily available.

SC 3004R4 898

Table
Rating Table for Rectangular Orifice

Project Description	
Worksheet	Principal Spillway Low Flow Outlet
Type	Rectangular Orifice
Solve For	Discharge

Input Data		
Centroid Elevation	1,569.10	ft
Tailwater Elevation	1,568.10	ft
Discharge Coefficient	0.60	
Opening Width	2.00	ft
Opening Height	2.00	ft

Attribute	Minimum	Maximum	Increment
Headwater Elevation (ft)	1,569.10	1,577.50	0.40

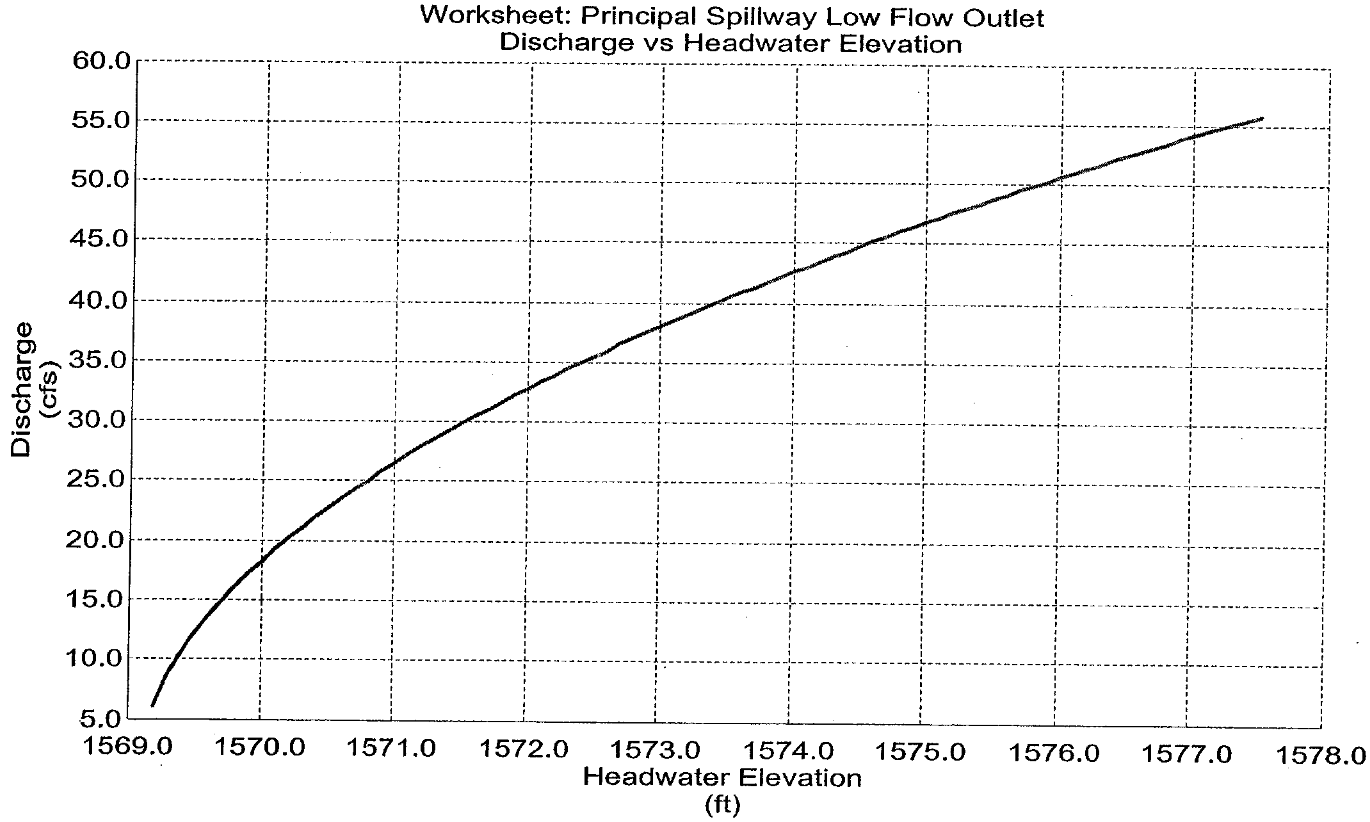
Headwater Elevation (ft)	Discharge (cfs)	Velocity (ft/s)
1,569.10	N/A	N/A
1,569.50	12.18	3.04
1,569.90	17.22	4.30
1,570.30	21.09	5.27
1,570.70	24.35	6.09
1,571.10	27.23	6.81
1,571.50	29.83	7.46
1,571.90	32.21	8.05
1,572.30	34.44	8.61
1,572.70	36.53	9.13
1,573.10	38.50	9.63
1,573.50	40.38	10.10
1,573.90	42.18	10.54
1,574.30	43.90	10.98
1,574.70	45.56	11.39
1,575.10	47.16	11.79
1,575.50	48.70	12.18
1,575.90	50.20	12.55
1,576.30	51.66	12.91
1,576.70	53.07	13.27
1,577.10	54.45	13.61
1,577.50	55.80	13.95

Curve
Plotted Curves for Rectangular Orifice

Project Description	
Worksheet	Principal Spillway Low Flow Outlet
Type	Rectangular Orifice
Solve For	Discharge

Input Data		
Centroid Elevation	1,569.10	ft
Tailwater Elevation	1,568.10	ft
Discharge Coefficient	0.60	
Opening Width	2.00	ft
Opening Height	2.00	ft

Attribute	Minimum	Maximum	Increment
Headwater Elevation (ft)	1,569.10	1,577.50	0.10



APPENDIX D

CATCH BASIN DESIGN

- Main Line & Ramp Catch Basin Summary
- Eastbound Main Line Catch Basin Calculations
- Westbound Main Line Catch Basin Calculations
- McDowell Road Ramps C & D Catch Basin Calculations
- McKellips Road Ramps A–D Catch Basins Calculations
- Brown Road Ramps A–D Catch Basin Calculations
- University Drive Ramps A & B Catch Basin Calculations
- Median Inlet Calculations Summary

APPENDIX D

CATCH BASIN DESIGN

Main Line & Ramp Catch Basin Summary

Red Mountain Freeway - Power Rd. to University Dr. - Roadway Catch Basin Summary

Stanley Consultants INC.

ADOT

Plan Ref. No.	Alignment	Station	Offset	Dir	Curb Type	EP Elev	Grate Elev	S_L (%)	S_X (ft/ft)	Area Unpaved (sf)	Area Paved (sf)	Area Unpaved (ac)	Area Paved (ac)	C	A	CA	Qb10yr (cfs)	Q10yr (cfs)	Qb50yr (cfs)	Q50yr (cfs)
Exst	ML EB	1052+18.00	79.50	Rt	F	1561.10	1560.85	2.9500%	0.0500	0	75717	0.000	1.738	0.950	1.738	1.651	1.4	8.4	-	-
101	ML EB	1061+06.00	79.50	Rt	F	1587.13	1586.88	2.4807%	0.0500	0	102788	0.000	2.360	0.950	2.360	2.242	0.0	9.5	-	-
104	ML EB	1078+20.00	79.50	Rt	F	1601.11	1600.86	1.0018%	0.0200	0	42100	0.000	0.966	0.950	0.966	0.918	0.0	3.9	-	-
107	ML EB	1085+50.00	79.50	Rt	C	1588.21	1588.07	2.4849%	0.0240	0	61019	0.000	1.401	0.950	1.401	1.331	0.4	6.0	-	-
110	ML EB	1092+50.00	79.50	Rt	B	1572.14	1571.89	1.3606%	0.0200	4483	47320	0.103	1.086	0.928	1.189	1.104	1.1	5.8	2.5	9.0
117	ML EB	1095+64.00	79.50	Rt	B	1569.49	1569.24	0.3280%	0.0200	18156	26219	0.417	0.602	0.848	1.019	0.864	0.5	4.1	1.8	6.8
118	ML EB	1096+63.75	79.50	Rt	B	1569.32	1569.07	0.0000%	0.0200	12345	16736	0.283	0.384	0.844	0.668	0.563	0.1	2.5	1.2	4.5
116	ML EB	1097+64.00	79.50	Rt	B	1569.49	1569.24	0.2836%	0.0200	21736	32319	0.499	0.742	0.849	1.241	1.054	0.1	4.5	0.4	6.6
122	ML EB	1101+50.00	79.50	Rt	B	1570.58	1570.33	0.2836%	0.0200	12377	39639	0.284	0.910	0.891	1.194	1.063	0.0	4.5	0.0	6.2
132	ML EB	1107+88.00	105.27	Rt	F	1571.88	1571.63	0.4436%	0.0200	0	15747	0.000	0.362	0.950	0.362	0.343	0.1	1.5	0.1	2.2
133	ML EB	1109+37.00	95.30	Rt	F	1572.49	1572.24	0.3283%	0.0200	0	11884	0.000	0.273	0.950	0.273	0.259	0.0	1.1	0.0	1.5
134	ML EB	1110+57.00	91.56	Rt	F	1572.80	1572.55	0.1440%	0.0200	0	15755	0.000	0.362	0.950	0.362	0.344	0.0	1.4	0.0	2.0
151	ML EB	1116+25.00	91.50	Rt	F	1572.26	1572.01	0.2500%	0.0200	0	39489	0.000	0.907	0.950	0.907	0.861	0.0	3.6	0.0	5.0
154	ML EB	1119+50.00	91.50	Rt	F	1571.45	1571.20	0.2500%	0.0200	0	45033	0.000	1.034	0.950	1.034	0.982	0.4	4.5	0.8	6.6
191	ML EB	1151+16.00	79.50	Rt	B	1575.35	1575.10	0.2500%	0.0200	26217	30857	0.602	0.708	0.835	1.310	1.094	0.0	4.6	0.0	6.4
194	ML EB	1155+00.00	79.50	Rt	B	1576.31	1576.06	0.2500%	0.0200	25050	23101	0.575	0.530	0.820	1.105	0.906	0.0	3.8	0.0	5.3
203	ML EB	1161+75.00	79.50	Rt	B	1576.12	1575.87	0.2500%	0.0200	26020	31313	0.597	0.719	0.837	1.316	1.101	0.0	4.6	0.0	6.5
206	ML EB	1165+50.00	79.50	Rt	B	1575.19	1574.94	0.2500%	0.0200	19318	31313	0.443	0.719	0.855	1.162	0.993	0.1	4.3	0.5	6.3
211	ML EB	1168+27.00	79.50	Rt	B	1574.49	1574.24	0.2500%	0.0200	6305	23129	0.145	0.531	0.896	0.676	0.606	0.6	3.1	1.5	5.0
215	ML EB	1170+15.00	104.48	Rt	F	1573.52	1573.27	0.0960%	0.0200	0	5966	0.000	0.137	0.950	0.137	0.130	0.1	0.7	0.2	1.0
216	ML EB	1170+70.00	100.44	Rt	F	1573.47	1573.22	0.1100%	0.0200	0	5951	0.000	0.137	0.950	0.137	0.130	0.1	0.6	0.2	1.0
217	ML EB	1171+28.00	96.60	Rt	F	1573.40	1573.15	0.1240%	0.0200	0	6047	0.000	0.139	0.950	0.139	0.132	0.1	0.6	0.2	1.0
218	ML EB	1172+10.00	93.27	Rt	F	1573.26	1573.01	0.1860%	0.0200	0	8241	0.000	0.189	0.950	0.189	0.180	0.1	0.8	0.2	1.3
219	ML EB	1173+00.00	91.50	Rt	F	1173.07	1172.82	0.2500%	0.0200	0	8808	0.000	0.202	0.950	0.202	0.192	0.1	1.0	0.3	1.5
229	ML EB	1178+60.00	91.50	Rt	F	1571.67	1571.42	0.2500%	0.0200	0	54466	0.000	1.250	0.950	1.250	1.188	0.0	5.1	0.1	7.1
235	ML EB	1180+75.00	91.50	Rt	F	1571.21	1570.96	0.1250%	0.0200	0	20947	0.000	0.481	0.950	0.481	0.457	0.9	2.8	1.7	4.4
233	ML EB	1182+00.00	91.50	Rt	F	1571.13	1570.88	0.0000%	0.0200	0	24392	0.000	0.560	0.950	0.560	0.532	0.9	3.2	2.3	5.4
236	ML EB	1183+25.00	91.50	Rt	F	1171.21	1170.96	0.1250%	0.0200	0	26831	0.000	0.616	0.950	0.616	0.585	0.5	3.0	1.2	4.6
240	ML EB	1186+00.00	91.50	Rt	F	1571.82	1571.57	0.2500%	0.0200	0	38953	0.000	0.894	0.950	0.894	0.850	0.4	4.0	0.8	5.8
242	ML EB	1190+00.00	91.50	Rt	F	1572.82	1572.57	0.2500%	0.0200	0	38904	0.000	0.893	0.950	0.893	0.848	0.0	3.6	0.0	5.0
251	ML EB	1198+00.00	91.50	Rt	F	1572.82	1572.57	0.2500%	0.0200	0	38904	0.000	0.893	0.950	0.893	0.848	0.0	3.6	0.0	5.0
254	ML EB	1202+00.00	91.50	Rt	F	1571.82	1571.57	0.2500%	0.0200	0	38904	0.000	0.893	0.950	0.893	0.848	0.4	4.0	0.8	5.8
260	ML EB	1204+75.00	91.50	Rt	F	1571.21	1570.96	0.1250%	0.0200	0	26794	0.000	0.615	0.950	0.615	0.584	0.5	3.0	1.2	4.6
258	ML EB	1206+00.00	91.50	Rt	F	1571.13	1570.88	0.0000%	0.0200	0	24392	0.000	0.560	0.950	0.560	0.532	0.6	2.9	1.5	4.6
261	ML EB	1207+25.00	91.50	Rt	F	1571.21	1570.96	0.1250%	0.0200	0	29029	0.000	0.666	0.950	0.666	0.633	0.0	2.7	0.1	3.8
265	ML EB	1210+21.00	94.03	Rt	F	1571.82	1571.57	0.2020%	0.0200	0	10558	0.000	0.242	0.950	0.242	0.230	0.0	1.0	0.1	1.4
266	ML EB	1211+25.00	96.93	Rt	F	1572.02	1571.77	0.1860%	0.0200	0	10472	0.000	0.240	0.950	0.240	0.228	0.0	1.0	0.1	1.4
267	ML EB	1212+25.00	100.39	Rt	F	1572.20	1571.95	0.1740%	0.0200	0	9750	0.000	0.224	0.950	0.224	0.213	0.0	0.9	0.1	1.3
268	ML EB	1213+15.00	104.07	Rt	F	1572.36	1572.11	0.1620%	0.0200	0	8624	0.000	0.198	0.950	0.198	0.188	0.0	0.8	0.1	1.2
269	ML EB	1213+92.00	107.64	Rt	F	1572.48	1572.23	0.1540%	0.0200	0	8497	0.000	0.195	0.950	0.195	0.185	0.1	0.8	0.2	1.2
274	ML EB	1216+53.00	79.50	Rt	B	1573.64	1573.39	0.1470%	0.0200	3436	12308	0.079	0.283	0.895	0.361	0.324	0.0	1.4	0.0	1.9

Red Mountain Freeway - Power Rd. to University Dr. - Roadway Catch Basin Summary

Stanley Consultants INC

ADOT

Plan Ref. No.	Alignment	Station	Offset	Dir	Curb Type	EP Elev	Grate Elev	$S_{L\,(\%)}$	S_X (ft/ft)	Area Unpaved (sf)	Area Paved (sf)	Area Unpaved (ac)	Area Paved (ac)	C	A	CA	Qb10yr (cfs)	Q10yr (cfs)	Qb50yr (cfs)	Q50yr (cfs)
290	ML EB	1222+50.00	79.50	Rt	B	1572.94	1572.69	0.2500%	0.0200	16717	37678	0.384	0.865	0.873	1.249	1.090	0.0	4.6	0.0	6.4
295	ML EB	1226+50.00	79.50	Rt	B	1571.94	1571.69	0.2500%	0.0200	16574	33491	0.380	0.769	0.867	1.149	0.997	0.1	4.3	0.5	6.3
300	ML EB	1228+21.00	79.50	Rt	B	1571.62	1571.37	0.1018%	0.0200	7960	14318	0.183	0.329	0.861	0.511	0.440	0.6	2.4	1.5	4.1
299	ML EB	1229+21.21	79.50	Rt	B	1571.56	1571.31	0.0000%	0.0200	8066	18729	0.185	0.430	0.875	0.615	0.538	0.2	2.4	1.0	4.2
301	ML EB	1230+46.00	79.50	Rt	B	1571.64	1571.39	0.1267%	0.0200	22755	15767	0.522	0.362	0.802	0.884	0.710	0.0	3.0	0.5	4.7
305	ML EB	1234+00.00	79.50	Rt	B	1572.70	1572.45	0.4100%	0.0200	41735	33491	0.958	0.769	0.811	1.727	1.401	0.0	5.9	0.5	8.7
309	ML EB	1238+00.00	79.50	Rt	B	1574.34	1574.09	0.4100%	0.0200	39136	35584	0.898	0.817	0.819	1.715	1.405	0.0	5.9	0.4	8.6
313	ML EB	1242+25.00	79.50	Rt	B	1576.08	1575.83	0.4100%	0.0200	21987	47648	0.505	1.094	0.871	1.599	1.392	0.0	5.9	0.0	8.2
320	ML EB	1249+50.00	105.65	Rt	F	1579.14	1578.89	0.9121%	0.0200	0	14884	0.000	0.342	0.950	0.342	0.325	0.2	1.6	0.7	2.6
321	ML EB	1250+90.00	95.87	Rt	F	1580.49	1580.24	0.9884%	0.0200	0	13426	0.000	0.308	0.950	0.308	0.293	0.4	1.7	1.3	3.0
322	ML EB	1252+25.00	91.50	Rt	F	1581.87	1581.62	1.0222%	0.0200	0	33134	0.000	0.761	0.950	0.761	0.723	1.0	4.1	2.2	6.5
336	ML EB	1255+66.00	91.50	Rt	F	1585.81	1585.56	1.2000%	0.0200	0	89992	0.000	2.066	0.950	2.066	1.963	0.0	8.3	0.0	11.5
343	ML EB	1266+10.00	91.50	Rt	F	1594.73	1594.48	0.5539%	0.0374	0	44331	0.000	1.018	0.950	1.018	0.967	0.6	4.6	1.1	6.8
345	ML EB	1269+50.00	91.50	Rt	F	1595.91	1595.66	0.5539%	0.0500	0	44848	0.000	1.030	0.950	1.030	0.978	0.0	4.1	0.0	5.7
348	ML EB	1279+50.00	91.50	Rt	F	1594.83	1594.58	1.0999%	0.0500	0	50993	0.000	1.171	0.950	1.171	1.112	0.0	4.7	0.0	6.5
351	ML EB	1284+90.00	91.5	Rt	F	1585.88	1585.63	2.2162%	0.0500	0	52316	0.000	1.201	0.950	1.201	1.141	0.5	5.3	1.1	7.7
387	ML EB	1291+71.00	97.63	Rt	F	1566.75	1566.50	2.9604%	0.0500	0	67658	0.000	1.553	0.950	1.553	1.476	0.6	6.8	1.2	9.9
368	ML EB	1301+30.00	67.5	Rt	B	1540.51	1540.26	2.7250%	0.0331	25862	51769	0.594	1.188	0.867	1.782	1.545	0.0	6.5	0.0	9.1
375	ML EB	1305+91.00	67.5	Rt	B	1531.29	1531.04	1.5890%	-0.0101	52390	32961	1.203	0.757	0.797	1.959	1.561	0.7	7.3	1.6	10.8
376	ML EB	1306+33.00	67.5	Rt	B	1530.89	1530.64	1.4856%	-0.0026	5031	3003	0.115	0.069	0.793	0.184	0.146	0.0	0.6	0.3	1.1
202L Mainline West Bound																				
100	ML WB	1060+67.00	4.00	Lt	Bridge	-	1588.84	2.7493%	0.0500	0	115449	0.000	2.650	0.950	2.650	2.518	0.0	10.6	-	-
102	ML WB	1074+58.00	4.00	Lt	Bridge	-	1607.38	0.2314%	0.0200	0	8099	0.000	0.186	0.950	0.186	0.177	0.0	0.7	-	-
113	ML WB	1096+41.00	79.50	Lt	B	1569.72	1569.47	0.3522%	0.0200	24008	44820	0.551	1.029	0.863	1.580	1.363	0.0	5.8	0.0	8.0
114	ML WB	1097+42.90	79.50	Lt	B	1569.54	1569.29	0.0000%	0.0200	11561	16987	0.265	0.390	0.849	0.655	0.556	0.0	2.4	0.5	3.8
119	ML WB	1098+45.00	79.50	Lt	B	1569.71	1569.46	0.2838%	0.0200	14586	25398	0.335	0.583	0.859	0.918	0.788	0.2	3.5	0.6	5.2
121	ML WB	1101+50.00	79.50	Lt	B	1570.58	1570.33	0.2838%	0.0200	11691	33575	0.268	0.771	0.885	1.039	0.920	0.0	3.9	0.0	5.4
c	ML WB	1108+00.00	105.81	Lt	B	-	-	0.4160%	0.0200	3196	8094	0.073	0.186	0.879	0.259	0.228	0.0	1.0	0.2	1.5
139	ML WB	1108+75.00	102.05	Lt	B	1572.19	1571.94	0.3780%	0.0200	3117	7828	0.072	0.180	0.879	0.251	0.221	0.0	1.0	0.2	1.5
c	ML WB	1109+50.00	98.78	Lt	B	-	-	0.3190%	0.0200	3019	7602	0.069	0.175	0.879	0.244	0.214	0.0	0.9	0.2	1.5
141	ML WB	1110+25.00	96.01	Lt	B	1572.66	1572.41	0.1726%	0.0200	8142	18877	0.187	0.433	0.875	0.620	0.543	0.0	2.3	0.0	3.2
150	ML WB	1116+25.00	91.50	Lt	B	1572.26	1572.01	0.2500%	0.0200	16683	38774	0.383	0.890	0.875	1.273	1.114	0.0	4.7	0.0	6.5
152	ML WB	1119+50.00	91.50	Lt	B	1571.45	1571.20	0.2500%	0.0200	13889	31038	0.319	0.713	0.873	1.031	0.900	0.7	4.5	1.6	6.9
156	ML WB	1124+00.00	91.50	Lt	B	1570.10	1569.85	0.2500%	0.0240	21233	42883	0.487	0.984	0.867	1.472	1.276	0.7	6.0	1.8	9.3
158	ML WB	1127+00.00	91.50	Lt	B	1569.46	1569.21	0.1000%	0.0240	14783	28471	0.339	0.654	0.865	0.993	0.858	0.3	3.9	1.3	6.4
159	ML WB	1128+00.00	91.50	Lt	B	1569.41	1569.16	0.0000%	0.0240	10727	18980	0.246	0.436	0.860	0.682	0.586	0.0	2.5	0.2	3.7
162	ML WB	1129+00.00	91.50	Lt	B	1569.46	1569.21	0.1000%	0.0240	7355	14236	0.169	0.327	0.865	0.496	0.429	0.1	1.9	0.3	2.9
163	ML WB	1130+50.00	91.50	Lt	B	1569.72	1569.47	0.2500%	0.0240	10785	20977	0.248	0.482	0.865	0.729	0.631	0.0	2.7	0.1	3.8
165	ML WB	1132+71.00	91.86	Lt	B	1570.27	1570.02	0.2092%	0.0240	2861	5845	0.066	0.134	0.868	0.200	0.173	0.0	0.7	0.1	1.1
c	ML WB	1133+32.00	93.02	Lt	B	-	-	0.1996%	0.0240	2761	5726	0.063	0.131	0.869	0.195	0.169	0.0	0.7	0.1	1.1
166	ML WB	1133+91.00	94.37	Lt	B	1570.51	1570.26	0.1900%	0.0240	2646	5612	0.061	0.129	0.870	0.190	0.165	0.0	0.7	0.1	1.0
c	ML WB	1134+48.00	95.88	Lt	B	-	-	0.1828%	0.0240	2590	5703	0.059	0.131	0.872	0.190	0.166	0.0	0.7	0.1	1.0

Red Mountain Freeway - Power Rd. to University Dr. - Roadway Catch Basin Summary

Stanley Consultants INC.

ADOT

Plan Ref. No.	Alignment	Station	Offset	Dir	Curb Type	EP Elev	Grate Elev	$S_{L\,(\%)}$	S_X (ft/ft)	Area Unpaved (sf)	Area Paved (sf)	Area Unpaved (ac)	Area Paved (ac)	C	A	CA	Qb10yr (cfs)	Q10yr (cfs)	Qb50yr (cfs)	Q50yr (cfs)
c	ML WB	1135+05.00	97.59	Lt	B	-	-	0.1732%	0.0240	2596	5805	0.060	0.133	0.873	0.193	0.168	0.0	0.7	0.0	1.0
168	ML WB	1135+62.00	99.50	Lt	B	1570.81	1570.56	0.1132%	0.0240	2098	4781	0.048	0.110	0.874	0.158	0.138	0.0	0.6	0.0	0.8
c	ML WB	1136+08.00	101.95	Lt	B	-	-	0.1108%	0.0240	2049	4794	0.047	0.110	0.875	0.157	0.137	0.0	0.6	0.0	0.8
c	ML WB	1136+53.00	104.62	Lt	B	-	-	0.1036%	0.0240	1786	4563	0.041	0.105	0.880	0.146	0.128	0.0	0.6	0.0	0.8
169	ML WB	1136+93.00	107.10	Lt	B	1570.96	1570.71	0.1012%	0.0240	1600	4051	0.037	0.093	0.879	0.130	0.114	0.0	0.5	0.1	0.8
177	ML WB	1138+92.00	79.50	Lt	B	1572.12	1571.87	0.2500%	0.0240	9307	33882	0.214	0.778	0.896	0.991	0.888	0.8	4.6	2.2	7.4
183	ML WB	1143+00.00	79.50	Lt	B	1573.14	1572.89	0.2500%	0.0240	21128	33217	0.485	0.763	0.853	1.248	1.064	0.7	5.2	1.9	8.1
185	ML WB	1147+00.00	79.50	Lt	B	1574.14	1573.89	0.2500%	0.0240	23780	27633	0.546	0.634	0.834	1.180	0.985	0.7	4.8	1.7	7.5
189	ML WB	1150+32.00	79.50	Lt	B	1575.14	1574.89	0.2500%	0.0200	24629	23631	0.565	0.542	0.822	1.108	0.911	0.6	4.5	1.4	6.8
192	ML WB	1153+15.00	79.50	Lt	B	1575.85	1575.60	0.2500%	0.0200	24564	30106	0.564	0.691	0.838	1.255	1.051	0.0	4.4	0.0	6.2
201	ML WB	1161+75.00	79.50	Lt	B	1576.12	1575.87	0.2500%	0.0200	26141	31313	0.600	0.719	0.836	1.319	1.103	0.0	4.7	0.0	6.5
205	ML WB	1165+50.00	79.50	Lt	B	1575.19	1574.94	0.2500%	0.0200	24086	31313	0.553	0.719	0.841	1.272	1.070	0.1	4.6	0.5	6.8
209	ML WB	1168+27.00	79.50	Lt	B	1574.49	1574.24	0.2500%	0.0200	12428	23130	0.285	0.531	0.863	0.816	0.704	0.7	3.7	1.7	5.9
221	ML WB	1170+24.00	79.50	Lt	B	1574.00	1573.75	0.2500%	0.0200	5164	16450	0.119	0.378	0.890	0.496	0.442	0.4	2.2	1.3	3.9
c	ML WB	1172+30.00	109.11	Lt	B	-	-	0.1320%	0.0200	1536	4114	0.035	0.094	0.882	0.130	0.114	0.0	0.5	0.1	0.7
c	ML WB	1172+66.00	107.06	Lt	B	-	-	0.1400%	0.0200	1546	4035	0.035	0.093	0.881	0.128	0.113	0.0	0.5	0.0	0.7
223	ML WB	1173+03.00	105.07	Lt	B	1572.79	1572.54	0.1460%	0.0200	1595	4072	0.037	0.093	0.880	0.130	0.114	0.0	0.5	0.0	0.7
c	ML WB	1173+41.00	103.15	Lt	B	-	-	0.1520%	0.0200	1642	4108	0.038	0.094	0.879	0.132	0.116	0.0	0.5	0.0	0.7
c	ML WB	1173+81.00	101.26	Lt	B	-	-	0.1600%	0.0200	1726	4248	0.040	0.098	0.878	0.137	0.120	0.0	0.5	0.0	0.7
224	ML WB	1174+24.00	99.40	Lt	B	1572.60	1572.35	0.1680%	0.0200	1847	4486	0.042	0.103	0.877	0.145	0.128	0.0	0.5	0.0	0.8
c	ML WB	1174+67.00	97.61	Lt	B	-	-	0.1740%	0.0200	1916	4612	0.044	0.106	0.877	0.150	0.131	0.0	0.6	0.0	0.8
c	ML WB	1175+17.00	95.91	Lt	B	-	-	0.1840%	0.0200	2025	4836	0.046	0.111	0.876	0.158	0.138	0.0	0.6	0.0	0.8
225	ML WB	1175+67.00	94.34	Lt	B	1572.35	1572.10	0.1900%	0.0200	2165	4956	0.050	0.114	0.874	0.163	0.143	0.0	0.6	0.0	0.9
c	ML WB	1176+18.00	92.67	Lt	B	-	-	0.2000%	0.0200	2279	4980	0.052	0.114	0.872	0.167	0.145	0.0	0.6	0.1	0.9
226	ML WB	1176+70.00	91.81	Lt	B	1572.14	1571.89	0.2100%	0.0200	2385	5011	0.055	0.115	0.869	0.170	0.148	0.0	0.6	0.1	0.9
227	ML WB	1178+60.00	91.50	Lt	B	1571.67	1571.42	0.2500%	0.0200	8838	18147	0.203	0.417	0.868	0.619	0.538	0.0	2.3	0.1	3.2
230	ML WB	1180+75.00	91.50	Lt	B	1571.21	1570.96	0.1250%	0.0200	10063	20497	0.231	0.471	0.868	0.702	0.609	0.6	3.1	1.0	4.6
231	ML WB	1182+00.00	91.50	Lt	B	1571.13	1570.88	0.0000%	0.0200	11852	23800	0.272	0.546	0.867	0.818	0.710	0.3	3.3	1.0	5.2
237	ML WB	1183+25.00	91.50	Lt	B	1571.21	1570.96	0.1250%	0.0200	12664	26180	0.291	0.601	0.868	0.892	0.774	0.0	3.3	0.0	4.6
238	ML WB	1186+00.00	91.50	Lt	B	1571.82	1571.57	0.2500%	0.0200	17450	38153	0.401	0.876	0.872	1.276	1.112	0.0	4.7	0.0	6.5
241	ML WB	1190+00.00	91.50	Lt	B	1572.82	1572.57	0.2500%	0.0200	16179	38200	0.371	0.877	0.876	1.248	1.093	0.0	4.6	0.0	6.4
250	ML WB	1198+00.00	91.50	Lt	B	1572.82	1572.57	0.2500%	0.0200	16029	38200	0.368	0.877	0.876	1.245	1.091	0.0	4.6	0.0	6.4
252	ML WB	1202+00.00	91.50	Lt	B	1571.82	1571.57	0.2500%	0.0200	17128	38200	0.393	0.877	0.873	1.270	1.108	0.1	4.7	0.5	7.0
255	ML WB	1204+75.00	91.50	Lt	B	1571.21	1570.96	0.1250%	0.0200	12484	26216	0.287	0.602	0.869	0.888	0.772	0.1	3.3	0.7	5.2
256	ML WB	1206+00.00	91.50	Lt	B	1571.13	1570.88	0.0000%	0.0200	11655	23800	0.268	0.546	0.868	0.814	0.706	0.4	3.4	1.4	5.5
262	ML WB	1207+25.00	91.50	Lt	B	1571.21	1570.96	0.1250%	0.0200	12680	26181	0.291	0.601	0.868	0.892	0.775	0.0	3.3	0.0	4.5
263	ML WB	1210+00.00	91.50	Lt	B	1571.82	1571.57	0.2500%	0.0200	4422	9631	0.102	0.221	0.871	0.323	0.281	0.0	1.2	0.1	1.7
275	ML WB	1211+01.00	92.29	Lt	B	1572.06	1571.81	0.2080%	0.0200	2278	5215	0.052	0.120	0.874	0.172	0.150	0.0	0.6	0.1	0.9
c	ML WB	1211+55.00	93.53	Lt	B	-	-	0.2000%	0.0200	2135	5190	0.049	0.119	0.877	0.168	0.147	0.0	0.6	0.1	0.9
276	ML WB	1212+08.00	94.98	Lt	B	1572.27	1572.02	0.1920%	0.0200	2069	5172	0.047	0.119	0.879	0.166	0.146	0.0	0.6	0.0	0.9
c	ML WB	1212+60.00	96.61	Lt	B	-	-	0.1840%	0.0200	1922	4853	0.044	0.111	0.879	0.156	0.137	0.0	0.6	0.0	0.8
c	ML WB	1213+08.00	98.31	Lt	B	-	-	0.1760%	0.0200	1768	4642	0.041	0.107	0.881	0.147	0.130	0.0	0.6	0.0	0.8

Red Mountain Freeway - Power Rd. to University Dr. - Roadway Catch Basin Summary

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ADOT

Plan Ref. No.	Alignment	Station	Offset	Dir	Curb Type	EP Elev	Grate Elev	$S_{L\,(\%)}$	S_X (ft/ft)	Area Unpaved (sf)	Area Paved (sf)	Area Unpaved (ac)	Area Paved (ac)	C	A	CA	Qb10yr (cfs)	Q10yr (cfs)	Qb50yr (cfs)	Q50yr (cfs)
277	ML WB	1213+53.00	100.83	Lt	B	1572.52	1572.27	0.1280%	0.0200	1540	4228	0.035	0.097	0.883	0.132	0.117	0.0	0.5	0.0	0.7
c	ML WB	1213+93.00	103.32	Lt	B	-	-	0.1220%	0.0200	1397	4001	0.032	0.092	0.885	0.124	0.110	0.0	0.5	0.0	0.7
c	ML WB	1214+30.00	105.74	Lt	B	-	-	0.1180%	0.0200	1370	3963	0.031	0.091	0.886	0.122	0.108	0.0	0.5	0.1	0.7
280	ML WB	1216+34.00	79.50	Lt	B	1573.61	1573.36	0.1660%	0.0200	2588	13823	0.059	0.317	0.911	0.377	0.343	0.0	1.4	0.0	2.0
288	ML WB	1222+50.00	79.50	Lt	B	1572.94	1572.69	0.2500%	0.0200	17161	37472	0.394	0.860	0.871	1.254	1.093	0.0	4.6	0.0	6.4
294	ML WB	1226+50.00	79.50	Lt	B	1571.94	1571.69	0.2500%	0.0200	24633	33309	0.565	0.765	0.844	1.330	1.122	0.0	4.7	0.0	6.6
296	ML WB	1228+21.00	79.50	Lt	B	1571.62	1571.37	0.1018%	0.0200	12067	14239	0.277	0.327	0.835	0.604	0.504	0.7	2.9	1.6	4.6
297	ML WB	1229+21.21	79.50	Lt	B	1571.56	1571.31	0.0000%	0.0200	16743	18736	0.384	0.430	0.832	0.814	0.678	0.3	3.2	1.5	5.5
302	ML WB	1230+46.00	79.50	Lt	B	1571.64	1571.39	0.1267%	0.0200	22921	16418	0.526	0.377	0.804	0.903	0.726	0.2	3.3	1.2	5.5
304	ML WB	1234+00.00	79.50	Lt	B	1572.70	1572.45	0.4100%	0.0200	16344	32175	0.375	0.739	0.866	1.114	0.964	0.9	5.0	2.5	8.1
308	ML WB	1238+00.00	79.50	Lt	B	1574.34	1574.09	0.4100%	0.0200	25003	33309	0.574	0.765	0.843	1.339	1.128	0.4	5.1	1.4	8.0
311	ML WB	1242+00.00	79.50	Lt	B	1575.98	1575.73	0.4100%	0.0200	27131	41647	0.623	0.956	0.851	1.579	1.344	0.1	5.7	0.5	8.4
324	ML WB	1247+00.00	79.50	Lt	B	1578.08	1577.83	0.5088%	0.0200	19575	51423	0.449	1.181	0.881	1.630	1.436	0.0	6.1	0.0	8.4
335	ML WB	1255+66.00	109.50	Lt	F	1585.45	1585.20	1.2960%	0.0200	0	17721	0.000	0.407	0.950	0.407	0.386	0.5	2.1	1.0	3.3
337	ML WB	1257+25.00	101.88	Lt	F	1587.51	1587.26	1.2920%	0.0200	0	13939	0.000	0.320	0.950	0.320	0.304	0.1	1.4	0.3	2.1
338	ML WB	1258+58.00	96.47	Lt	F	1589.20	1588.95	1.1568%	0.0200	0	11745	0.000	0.270	0.950	0.270	0.256	0.1	1.2	0.3	1.8
339	ML WB	1259+75.00	92.98	Lt	F	1590.58	1590.33	1.1192%	0.0200	0	36521	0.000	0.838	0.950	0.838	0.796	0.0	3.4	0.0	4.7
352	ML WB	1286+51.00	4	Lt	Bridge	-	1586.76	2.5434%	0.0500	0	22287	0.000	0.512	0.950	0.512	0.486	0.0	2.1	0.0	2.8
388	ML WB	1290+68.00	4	Lt	Bridge	-	1574.79	2.9564%	0.0500	0	41817	0.000	0.960	0.950	0.960	0.912	0.0	3.8	0.0	5.3
377	ML WB	1307+31.00	79.5	Lt	B	1527.74	1527.49	2.0896%	0.0200	34281	35687	0.787	0.819	0.828	1.606	1.329	0.0	5.6	0.0	7.8
McDowell Road Ramp C																				
389	McD RC	5+00.00	23.50	Lt	F	1591.90	1591.65	4.1000%	0.0200	0	29665	0.000	0.681	0.950	0.681	0.647	0.0	2.7	0.0	3.8
120	McD RC	8+90.00	13.90	Lt	F	1577.26	1577.01	2.8780%	0.0200	3896	16991	0.089	0.390	0.903	0.479	0.433	0.3	2.2	0.7	3.2
124	McD RC	11+80.00	5.50	Lt	B	1571.79	1571.54	1.0129%	0.0200	9296	10678	0.213	0.245	0.834	0.459	0.382	0.0	1.6	0.1	2.3
125	McD RC	12+77.00	5.50	Lt	B	1571.11	1570.86	0.3891%	0.0200	4415	2425	0.101	0.056	0.789	0.157	0.124	0.0	0.5	0.1	0.8
126	McD RC	13+37.49	5.50	Lt	B	1570.99	1570.74	0.0000%	0.0200	5530	8094	0.127	0.186	0.849	0.313	0.265	0.0	1.1	0.1	1.6
135	McD RC	13+98.00	5.50	Lt	B	1571.11	1570.86	0.3891%	0.0200	2313	6332	0.053	0.145	0.883	0.198	0.175	0.0	0.8	0.2	1.2
c	McD RC	14+50.00	5.50	Lt	B	-	-	0.4020%	0.0200	2967	7886	0.068	0.181	0.882	0.249	0.220	0.1	1.0	0.2	1.5
137	McD RC	15+18.00	5.50	Lt	B	1571.59	1571.34	0.4020%	0.0200	3291	8542	0.076	0.196	0.880	0.272	0.239	0.0	1.0	0.2	1.6
McDowell Road Ramp D																				
112	McD RD	4+20.00	11.50	Rt	F	1592.58	1592.33	3.1704%	0.0176	0	18671	0.000	0.429	0.950	0.429	0.407	0.0	1.7	0.0	2.4
123	McD RD	10+85.00	11.50	Lt	C	1572.68	1572.54	1.1748%	0.0204	0	22804	0.000	0.524	0.950	0.524	0.497	0.0	2.1	0.0	3.0
129	McD RD	12+82.00	11.50	Lt	F	1570.63	1570.38	0.4511%	0.0200	0	6454	0.000	0.148	0.950	0.148	0.141	0.0	0.6	0.1	0.9
130	McD RD	13+57.01	11.50	Rt	F	1570.46	1570.21	0.0000%	0.0200	0	4946	0.000	0.114	0.950	0.114	0.108	0.2	0.6	0.5	1.1
131	McD RD	14+33.00	11.50	Rt	F	1570.63	1570.38	0.4088%	0.0200	0	5171	0.000	0.119	0.950	0.119	0.113	0.2	0.7	0.6	1.2
128	McD RD	15+66.00	11.32	Rt	F	1571.18	1570.93	0.4088%	0.0200	0	18281	0.000	0.420	0.950	0.420	0.399	0.2	1.8	0.4	2.7
McKellips Road Ramp A																				
c	McK RA	7+25.00	8.66	Lt	B	-	-	0.2502%	0.0240	2609	6737	0.060	0.155	0.880	0.215	0.189	0.0	0.8	0.1	1.2
c	McK RA	7+83.00	9.81	Lt	B	-	-	0.2502%	0.0240	2545	6802	0.058	0.156	0.882	0.215	0.189	0.0	0.8	0.1	1.2
c	McK RA	8+40.00	10.95	Lt	B	-	-	0.2502%	0.0240	2456	5980	0.056	0.137	0.877	0.194	0.170	0.0	0.7	0.0	1.0
176	McK RA	8+95.00	11.50	Lt	B	1571.38	1571.13	0.2502%	0.0240	8922	6355	0.205	0.146	0.804	0.351	0.282	0.0	1.2	0.0	1.7
181	McK RA	11+00.00	11.50	Lt	B	1571.89	1571.64	0.2502%	0.0240	8261	6200	0.190	0.142	0.807	0.332	0.268	0.1	1.2	0.4	1.9

Red Mountain Freeway - Power Rd. to University Dr. - Roadway Catch Basin Summary

Stanley Consultants INC.

ADOT

Plan Ref. No.	Alignment	Station	Offset	Dir	Curb Type	EP Elev	Grate Elev	S_L (%)	S_X (ft/ft)	Area Unpaved (sf)	Area Paved (sf)	Area Unpaved (ac)	Area Paved (ac)	C	A	CA	Qb10yr (cfs)	Q10yr (cfs)	Qb50yr (cfs)	Q50yr (cfs)
182	McK RA	13+00.00	11.50	Lt	B	1573.39	1573.14	1.2464%	0.0240	9777	22518	0.224	0.517	0.874	0.741	0.648	0.0	2.8	0.2	4.0
188	McK RA	20+00.00	11.50	Lt	F	1588.14	1587.89	2.2426%	0.0200	0	20829	0.000	0.478	0.950	0.478	0.454	0.0	1.9	0.0	2.7
McKellips Road Ramp B																				
171	McK RB	7+21.00	11.50	Lt	C	1574.36	1574.22	0.4194%	0.0240	0	9583	0.000	0.220	0.950	0.220	0.209	0.0	0.9	0.0	1.2
179	McK RB	10+75.00	11.50	Lt	C	1576.48	1576.34	1.3002%	0.0350	0	26592	0.000	0.610	0.950	0.610	0.580	0.0	2.4	0.0	3.4
187	McK RB	17+20.00	23.50	Rt	C	1591.04	1590.90	2.4327%	0.0111	0	14884	0.000	0.342	0.950	0.342	0.325	0.0	1.4	0.0	1.9
McKellips Road Ramp C																				
204	McK RC	5+00.00	23.50	Lt	C	1588.05	1587.91	2.5482%	0.0200	0	27557	0.000	0.633	0.950	0.633	0.601	0.0	2.5	0.0	3.5
208	McK RC	10+00.00	7.50	Lt	B	1576.25	1576.00	2.2687%	0.0200	6558	19044	0.151	0.437	0.886	0.588	0.521	0.0	2.2	0.1	3.1
220	McK RC	12+00.00	5.50	Lt	B	1573.99	1573.74	0.5914%	0.0200	6893	5056	0.158	0.116	0.806	0.274	0.221	0.0	0.9	0.1	1.4
c	McK RC	13+40.00	5.50	Lt	B	-	-	0.3118%	0.0200	5298	3500	0.122	0.080	0.799	0.202	0.161	0.0	0.7	0.0	0.9
c	McK RC	13+92.00	5.50	Lt	B	-	-	0.3118%	0.0200	2076	7263	0.048	0.167	0.894	0.214	0.192	0.0	0.8	0.0	1.1
222	McK RC	14+48.00	5.50	Lt	B	1573.15	1572.90	0.3118%	0.0200	2289	6707	0.053	0.154	0.886	0.207	0.183	0.0	0.8	0.1	1.1
c	McK RC	15+03.00	5.50	Lt	B	-	-	0.3118%	0.0200	2310	6420	0.053	0.147	0.884	0.200	0.177	0.0	0.8	0.1	1.1
McKellips Road Ramp D																				
200	McK RD	10+00.00	11.50	Rt	F	1582.66	1582.41	1.9725%	0.0200	0	28455	0.000	0.653	0.950	0.653	0.621	0.0	2.6	0.0	3.6
207	McK RD	14+61.00	11.50	Rt	F	1575.02	1574.77	0.8562%	0.0200	0	15104	0.000	0.347	0.950	0.347	0.329	0.5	1.9	1.0	2.9
212	McK RD	17+40.00	11.50	Rt	F	1573.88	1573.63	0.2617%	0.0200	0	9170	0.000	0.211	0.950	0.211	0.200	0.3	1.1	0.7	1.9
213	McK RD	18+15.00	10.33	Rt	F	1573.71	1573.46	0.2218%	0.0200	0	9309	0.000	0.214	0.950	0.214	0.203	0.1	0.9	0.2	1.4
214	McK RD	18+75.00	9.14	Rt	F	1573.57	1573.32	0.2218%	0.0200	0	6944	0.000	0.159	0.950	0.159	0.151	0.0	0.7	0.1	1.0
Brown Road Ramp A																				
c	Brn RA	6+28.00	8.51	Lt	B	-	-	0.2796%	0.0200	2211	6507	0.051	0.149	0.887	0.200	0.177	0.0	0.8	0.1	1.1
278	Brn RA	6+85.00	9.65	Lt	B	1572.80	1572.55	0.2796%	0.0200	2178	6626	0.050	0.152	0.888	0.202	0.180	0.0	0.8	0.1	1.1
c	Brn RA	7+41.00	10.75	Lt	B	-	-	0.2796%	0.0200	2526	7051	0.058	0.162	0.884	0.220	0.194	0.0	0.8	0.0	1.1
279	Brn RA	8+06.00	11.50	Lt	B	1573.10	1572.85	0.2796%	0.0200	7410	6014	0.170	0.138	0.812	0.308	0.250	0.0	1.1	0.0	1.5
285	Brn RA	10+00.00	11.50	Lt	B	1273.88	1273.63	0.5938%	0.0200	10015	9455	0.230	0.217	0.821	0.447	0.367	0.0	1.5	0.0	2.2
287	Brn RA	13+05.00	11.50	Lt	B	1576.66	1576.41	1.2326%	0.0200	10003	15935	0.230	0.366	0.854	0.595	0.508	0.0	2.2	0.2	3.2
293	Brn RA	18+00.00	11.50	Lt	F	1583.21	1582.96	1.3269%	0.0200	0	38332	0.000	0.880	0.950	0.880	0.836	0.0	3.5	0.0	4.9
Brown Road Ramp B																				
270	Brn RB	8+21.00	5.50	Rt	F	1572.62	1572.37	0.2514%	0.0200	0	11202	0.000	0.257	0.950	0.257	0.244	0.1	1.1	0.1	1.6
271	Brn RB	9+15.00	5.50	Rt	F	1572.85	1572.60	0.2514%	0.0200	0	11626	0.000	0.267	0.950	0.267	0.254	0.0	1.1	0.1	1.5
272	Brn RB	10+00.00	5.50	Rt	F	1573.07	1572.82	0.2514%	0.0200	0	3936	0.000	0.090	0.950	0.090	0.086	0.0	0.4	0.0	0.5
273	Brn RB	11+47.00	11.50	Lt	C	1574.16	1574.02	1.2417%	0.0104	0	6578	0.000	0.151	0.950	0.151	0.143	0.0	0.6	0.0	0.9
286	Brn RB	13+50.00	11.50	Lt	F	1577.86	1577.61	2.6094%	0.0280	0	17108	0.000	0.393	0.950	0.393	0.373	0.2	1.8	0.4	2.5
291	Brn RB	17+34.00	27.55	Rt	C	1588.92	1588.78	2.9462%	0.0181	0	19764	0.000	0.454	0.950	0.454	0.431	0.0	1.8	0.0	2.5
292	Brn RB	19+59.00	16.00	Rt	A	1595.26	-	2.1010%	0.0200	0	7734	0.000	0.178	0.950	0.178	0.169	0.0	0.7	0.0	1.0
Brown Road Ramp C																				
310	Brn RC	1+92.00	16.00	Lt	A	1593.06	-	0.7726%	0.0200	0	13694	0.000	0.314	0.950	0.314	0.299	0.0	1.3	0.0	1.8
315	Brn RC	4+00.00	23.50	Lt	C	1590.88	1590.74	1.1817%	0.0200	0	16892	0.000	0.388	0.950	0.388	0.368	0.0	1.6	0.0	2.2
323	Brn RC	7+00.00	23.50	Lt	C	1587.06	1586.92	1.2800%	0.0200	0	13367	0.000	0.307	0.950	0.307	0.292	0.1	1.4	0.3	2.0
325	Brn RC	10+00.00	14.95	Lt	C	1583.40	1583.26	1.2800%	0.0200	2864	12330	0.066	0.283	0.903	0.349	0.315	0.1	1.4	0.3	2.1
328	Brn RC	12+00.00	6.50	Lt	C	1581.56	1581.42	0.5388%	0.0200	3905	6000	0.090	0.138	0.851	0.227	0.194	0.0	0.8	0.0	1.1

Red Mountain Freeway - Power Rd. to University Dr. - Roadway Catch Basin Summary

Stanley Consultants INC.

ADOT

Plan Ref. No.	Alignment	Station	Offset	Dir	Curb Type	EP Elev	Grate Elev	S_L (%)	S_X (ft/ft)	Area Unpaved (sf)	Area Paved (sf)	Area Unpaved (ac)	Area Paved (ac)	C	A	CA	Qb10yr (cfs)	Q10yr (cfs)	Qb50yr (cfs)	Q50yr (cfs)
329	Brn RC	13+09.02	5.50	Lt	C	1581.28	1581.14	0.0000%	0.0200	5172	5463	0.119	0.125	0.828	0.244	0.202	0.0	0.9	0.0	1.2
330	Brn RC	14+18.00	5.50	Lt	C	1581.58	1581.44	0.5385%	0.0200	2605	3409	0.060	0.078	0.842	0.138	0.116	0.0	0.5	0.1	0.8
331	Brn RC	15+33.00	5.50	Lt	C	1582.52	1582.38	1.1068%	0.0200	1566	9250	0.036	0.212	0.914	0.248	0.227	0.0	1.0	0.1	1.4
332	Brn RC	16+08.00	5.50	Lt	C	1583.41	1583.27	1.1908%	0.0200	1470	9569	0.034	0.220	0.917	0.253	0.232	0.0	1.0	0.1	1.4
333	Brn RC	16+88.00	5.50	Lt	C	1584.36	1584.22	1.1908%	0.0200	799	10439	0.018	0.240	0.932	0.258	0.241	0.0	1.0	0.0	1.4
									Brown Road Ramp D											
307	Brn RD	9+18.00	11.50	Rt	F	1588.61	1588.36	1.6579%	0.0150	0	29094	0.000	0.668	0.950	0.668	0.635	0.0	2.7	0.0	3.7
314	Brn RD	14+85.00	11.50	Lt	C	1579.36	1579.22	1.3212%	0.0150	0	18579	0.000	0.427	0.950	0.427	0.405	0.0	1.7	0.2	2.6
316	Brn RD	16+97.00	11.50	Rt	F	1577.39	1577.14	0.4812%	0.0200	0	6945	0.000	0.159	0.950	0.159	0.151	0.2	0.8	0.6	1.4
317	Brn RD	18+18.36	11.50	Rt	F	1577.10	1576.85	0.0000%	0.0200	0	7955	0.000	0.183	0.950	0.183	0.173	0.0	0.8	0.2	1.2
318	Brn RD	19+40.00	11.50	Rt	F	1577.39	1577.14	0.4816%	0.0200	0	3925	0.000	0.090	0.950	0.090	0.086	0.3	0.6	0.5	1.0
319	Brn RD	20+31.00	11.50	Rt	F	1577.98	1577.73	0.7193%	0.0200	0	17121	0.000	0.393	0.950	0.393	0.373	0.2	1.8	0.6	2.7
									University Drive Ramp A											
366	Uni RA	12+48.00	11.50	Rt	C	1551.37	1551.23	1.3858%	0.0100	0	14922	0.000	0.343	0.950	0.343	0.325	0.0	1.4	0.0	1.9
369	Uni RA	14+40.00	11.50	Lt	C	1549.42	1549.28	0.5183%	0.0200	8322	5951	0.191	0.137	0.804	0.328	0.264	0.0	1.1	0.0	1.5
372	Uni RA	15+54.65	11.50	Lt	C	1549.12	1548.98	0.0000%	0.0200	9207	7099	0.211	0.163	0.809	0.374	0.303	0.0	1.3	0.0	1.8
373	Uni RA	16+69.00	11.50	Lt	C	1549.42	1549.28	0.5163%	0.0200	6629	14340	0.152	0.329	0.871	0.481	0.419	0.0	1.8	0.0	2.5
									University Drive Ramp A											
357	Uni RB	8+51.00	5.50	Rt	B	1555.37	1555.12	3.3897%	0.0500	9002	26822	0.207	0.616	0.887	0.822	0.730	0.7	3.8	1.6	5.9
361	Uni RB	12+45.00	9.58	Rt	B	1546.35	1546.10	1.3754%	0.0500	26132	10072	0.600	0.231	0.770	0.831	0.640	0.1	2.8	0.6	4.3
362	Uni RB	13+49.00	13.74	Rt	B	1545.42	1545.17	0.7815%	0.0240	8227	3326	0.189	0.076	0.772	0.265	0.205	0.1	0.9	0.3	1.5
363	Uni RB	14+27.00	29.37	Rt	B	1544.11	1543.86	0.0000%	0.0045	0	3021	0.000	0.069	0.950	0.069	0.066	0.0	0.3	0.0	0.4
390	Uni RB	16+25.00	23.50	Lt	C	1544.38	1544.24	0.0000%	0.0450	0	13918	0.000	0.320	0.950	0.320	0.304	0.0	1.3	0.0	1.8
374	Uni RB	17+00.00	23.50	Lt	C	1544.93	1544.79	0.9654%	0.0450	0	21890	0.000	0.503	0.950	0.503	0.477	0.0	2.0	0.0	2.8
379	Uni RB	20+98.00	23.50	Rt	C	1549.72	1549.58	0.9654%	0.0045	0	9417	0.000	0.216	0.950	0.216	0.205	0.0	0.9	0.0	1.2

APPENDIX D

CATCH BASIN DESIGN

Eastbound Main Line Catch Basin Calculations

CB
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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

02-02-2005

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION -MLEB 1052+18 RT
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	2.950
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.050
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.050
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	8.400 - 10 yr
SPREAD-Ft.--T	=	7.861 - 18 max
Average Velocity-V-fps	=	5.944
FLOW in Gutter-CFS--Q	=	7.366
% Flow in Gutter-CFS	=	87.690
Velocity of Flow in Gutter-fps	=	6.514
Depth at Curb Line-Inches--d	=	4.014

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	3.072
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	64.091
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.136	1.143	3.998	5.141	3.259	61.20
10.000	0.263	2.210	3.555	5.765	2.635	68.63
15.000	0.381	3.202	3.122	6.324	2.076	75.29
20.000	0.490	4.116	2.702	6.818	1.582	81.17
25.000	0.589	4.950	2.295	7.245	1.155	86.25

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

02-02-2005

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML EB 106+06 RT CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	2.481
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.050
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.050
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	9.500 - 10yr
SPREAD-Ft.--T	=	8.434 - 18' max
Average Velocity-V-fps	=	5.769
FLOW in Gutter-CFS--Q	=	8.057
% Flow in Gutter-CFS	=	84.806
Velocity of Flow in Gutter-fps	=	6.395
Depth at Curb Line-Inches--d	=	4.359

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	3.041
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	63.701
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.137	1.300	4.302	5.602	3.898	58.97
10.000	0.265	2.514	3.825	6.339	3.161	66.73
15.000	0.383	3.641	3.360	7.000	2.500	73.69
20.000	0.493	4.679	2.906	7.585	1.915	79.[illegible]
25.000	0.592	5.626	2.468	8.094	1.406	85.[illegible]

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

09-09-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML EB 1078+20 RT CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.002
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	12.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	3.900 - 10yr
SPREAD-Ft.--T	=	10.812 - 18' max
Average Velocity-V-fps	=	2.908
FLOW in Gutter-CFS--Q	=	3.198
% Flow in Gutter-CFS	=	81.991
Velocity of Flow in Gutter-fps	=	3.392
Depth at Curb Line-Inches--d	=	3.513 - 6" max

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	2.016
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	36.280
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
10.000	0.440	1.717	1.470	3.187	0.713	81.73
15.000	0.617	2.407	1.116	3.523	0.377	90.33
20.000	0.764	2.978	0.766	3.744	0.156	95.99
25.000	0.878	3.424	0.450	3.874	0.026	99.33
30.000	0.957	3.734	0.166	3.900	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

09-09-2004

PROJECT NAME- TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML EB 1085+50 Rt CHECKER - [illegible] PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	2.485
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.024
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.024
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.021
Gutter Depression-Inches--	=	0.630
Manning's 'N	=	0.016
Flow-CFS--Q	=	6.000 - 10yr
SPREAD-Ft.--T	=	10.675 - 16' max
Average Velocity-V-fps	=	4.418
FLOW in Gutter-CFS--Q	=	3.012
% Flow in Gutter-CFS	=	50.197
Velocity of Flow in Gutter-fps	=	5.416
Depth at Curb Line-Inches--d	=	2.984 - 3" max

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	3.785
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	49.959
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.173	1.037	2.941	3.978	2.022	66.30
10.000	0.331	1.986	2.557	4.543	1.457	75.72
15.000	0.474	2.845	2.176	5.020	0.980	83.67
20.000	0.602	3.610	1.797	5.407	0.593	90.[illegible]
25.000	0.713	4.280	1.418	5.698	0.302	94.[illegible]
30.000	0.808	4.850	1.041	5.891	0.109	98.18

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

09-10-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML EB 1092+50 CHECKER - PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.361
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	5.800 ← 10yr
SPREAD-Ft.--T	=	12.157 - 16' max
Average Velocity-V-fps	=	3.570
FLOW in Gutter-CFS--Q	=	3.256
% Flow in Gutter-CFS	=	56.137
Velocity of Flow in Gutter-fps	=	4.704
Depth at Curb Line-Inches--d	=	4.328 - 6" max

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91 ←

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	5.124
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	29.731
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.282	1.636	3.021	4.657	1.143	80.30
10.000	0.522	3.027	2.325	5.352	0.448	92.28 ←
15.000	0.717	4.161	1.569	5.731	0.069	98.80
20.000	0.866	5.023	0.777	5.800	0.000	100.00
25.000	0.963	5.588	0.212	5.800	0.000	100.00
30.000	1.000	5.800	0.000	5.800	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

09-10-2004

PROJECT NAME- RM
TRACS NO.-
HIGHWAY NAME-
DESIGNER - RSR
LOCATION - MLEB 1092+50
CHECKER - NDV
PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.361
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	9.000 - 50yr
SPREAD-Ft.--T	=	14.674 - 22' max
Average Velocity-V-fps	=	3.913
FLOW in Gutter-CFS--Q	=	4.281
% Flow in Gutter-CFS	=	47.567
Velocity of Flow in Gutter-fps	=	5.233
Depth at Curb Line-Inches--d	=	4.932

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	5.766
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	38.523
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.221	1.993	4.114	6.107	2.893	67.86
10.000	0.418	3.760	3.471	7.232	1.768	80.35
15.000	0.588	5.296	2.809	8.105	0.895	90.06
20.000	0.732	6.591	2.109	8.700	0.300	96.[illegible]
25.000	0.848	7.633	1.341	8.973	0.027	99.[illegible]
30.000	0.934	8.404	0.596	9.000	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

09-10-2004

PROJECT NAME- RM
TRACS NO.-
HIGHWAY NAME-
DESIGNER - RSR
LOCATION - MLEB 1095+64
CHECKER - MTW
PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.328
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	4.100 - 10 yr
SPREAD-Ft.--T	=	14.219 - 16' max
Average Velocity-V-fps	=	1.890
FLOW in Gutter-CFS--Q	=	2.007
% Flow in Gutter-CFS	=	48.947
Velocity of Flow in Gutter-fps	=	2.523
Depth at Curb Line-Inches--d	=	4.823 - 6" max

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	5.651
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	17.842
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.447	1.832	1.753	3.585	0.515	87.43
10.000	0.772	3.166	0.900	4.066	0.034	99.18
15.000	0.963	3.950	0.150	4.100	0.000	100.00
20.000	1.000	4.100	0.000	4.100	0.000	100.00
25.000	1.000	4.100	0.000	4.100	0.000	100.00
30.000	1.000	4.100	0.000	4.100	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

09-10-2004

PROJECT NAME- RM   TRACS NO.-
HIGHWAY NAME-   DESIGNER - RSR
LOCATION - ML EB 1095+60   CHECKER -   PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.328
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	6.800 -50yr
SPREAD-Ft.--T	=	17.526 - 22' max
Average Velocity-V-fps	=	2.113
FLOW in Gutter-CFS--Q	=	2.738
% Flow in Gutter-CFS	=	40.268
Velocity of Flow in Gutter-fps	=	2.850
Depth at Curb Line-Inches--d	=	5.616

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.481
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	24.012
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.343	2.333	2.689	5.022	1.778	73.86
10.000	0.621	4.221	1.910	6.131	0.669	90.17
15.000	0.829	5.635	1.083	6.718	0.082	98.79
20.000	0.960	6.529	0.271	6.800	0.000	100.[illegible]
25.000	1.000	6.800	0.000	6.800	0.000	100.[illegible]
30.000	1.000	6.800	0.000	6.800	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

04-18-2005

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - MLEB 1096+63.75
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--IN SUMP

GUTTER FLOW HYDRAULICS

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.000

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Effective Perimeter--Ft.	=	7.354
Capture Ratio -- GRATE	=	0.500
Capture Ratio -- SLOTTED DRAIN	=	0.500
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	2.500 - 10yr

LENGTH	Q(Slot. Dn)	Q(Grate)	d(inches)	SPREAD,Ft.
5.000	1.275	1.225	3.397	8.321
10.000	1.797	0.704	2.482	4.507 ← 16' max
15.000	2.052	0.447	1.903	2.378
20.000	2.184	0.314	1.498	1.872

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

04-18-2005

PROJECT NAME- RM
TRACS NO.-
HIGHWAY NAME-
DESIGNER - RSR
LOCATION - MLEB 1096+63.75
CHECKER - NDV
PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--IN SUMP

GUTTER FLOW HYDRAULICS

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.000

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Effective Perimeter--Ft.	=	7.354
Capture Ratio -- GRATE	=	0.500
Capture Ratio -- SLOTTED DRAIN	=	0.500
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	4.500 ← 50yr

LENGTH	Q(Slot. Dn)	Q(Grate)	d(inches)	SPREAD,Ft.
5.000	1.718	2.782	5.466	16.940
10.000	2.966	1.534	3.862	10.260 ← 22' max
15.000	3.453	1.047	3.106	7.109
20.000	3.747	0.754	2.579	4.914

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

09-10-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML EB 1097+64 CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.284
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	4.500 - 10yr
SPREAD-Ft.--T	=	15.242 - 16' max
Average Velocity-V-fps	=	1.822
FLOW in Gutter-CFS--Q	=	2.067
% Flow in Gutter-CFS	=	45.937
Velocity of Flow in Gutter-fps	=	2.442
Depth at Curb Line-Inches--d	=	5.068 - 6" max

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	5.909
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	18.266
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.438	1.970	1.868	3.838	0.662	85.28
10.000	0.760	3.420	1.010	4.430	0.070	98.44
15.000	0.955	4.297	0.203	4.500	0.000	100.00
20.000	1.000	4.500	0.000	4.500	0.000	100.00
25.000	1.000	4.500	0.000	4.500	0.000	100.00
30.000	1.000	4.500	0.000	4.500	0.000	100.00

CB 116

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

09-10-2004

PROJECT NAME- RM   TRACS NO.-
HIGHWAY NAME-   DESIGNER - RSR
LOCATION - ML EB 1097+64   CHECKER - NDV   PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.284
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	6.600 - 50yr
SPREAD-Ft.--T	=	17.833 - 22' max
Average Velocity-V-fps	=	1.984
FLOW in Gutter-CFS--Q	=	2.614
% Flow in Gutter-CFS	=	39.601
Velocity of Flow in Gutter-fps	=	2.678
Depth at Curb Line-Inches--d	=	5.690

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.557
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	22.859
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.359	2.368	2.580	4.948	1.652	74.96
10.000	0.645	4.257	1.772	6.029	0.571	91.34
15.000	0.854	5.634	0.920	6.554	0.046	99.31
20.000	0.976	6.444	0.156	6.600	0.000	100.
25.000	1.000	6.600	0.000	6.600	0.000	100.
30.000	1.000	6.600	0.000	6.600	0.000	100.00

CB 122

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

09-10-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - MLEB 1101+50 RT CHECKER - NDF PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.284
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	4.500 - 10yr
SPREAD-Ft.--T	=	15.242 - 16' max
Average Velocity-V-fps	=	1.822
FLOW in Gutter-CFS--Q	=	2.067
% Flow in Gutter-CFS	=	45.937
Velocity of Flow in Gutter-fps	=	2.442
Depth at Curb Line-Inches--d	=	5.068 - 6" max

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	5.909
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	18.266
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.438	1.970	1.868	3.838	0.662	85.28
10.000	0.760	3.420	1.010	4.430	0.070	98.44
15.000	0.955	4.297	0.203	4.500	0.000	100.00
20.000	1.000	4.500	0.000	4.500	0.000	100.00
25.000	1.000	4.500	0.000	4.500	0.000	100.00
30.000	1.000	4.500	0.000	4.500	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

09-10-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - MLEB 110+50 Rt CHECKER - PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.284
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	6.200 - 50yr
SPREAD-Ft.--T	=	17.387 - 22' max
Average Velocity-V-fps	=	1.956
FLOW in Gutter-CFS--Q	=	2.516
% Flow in Gutter-CFS	=	40.577
Velocity of Flow in Gutter-fps	=	2.638
Depth at Curb Line-Inches--d	=	5.583

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.446
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	22.041
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.371	2.298	2.455	4.753	1.447	76.66
10.000	0.663	4.112	1.644	5.756	0.444	92.84
15.000	0.872	5.405	0.776	6.181	0.019	99.70
20.000	0.986	6.114	0.086	6.200	0.000	100.[illegible]
25.000	1.000	6.200	0.000	6.200	0.000	100.[illegible]
30.000	1.000	6.200	0.000	6.200	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

09-24-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - ML EB 1107+88 RT
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.444
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.500
SPREAD-Ft.--T	=	8.309 - 10' max
Average Velocity-V-fps	=	1.739
FLOW in Gutter-CFS--Q	=	1.378
% Flow in Gutter-CFS	=	91.874
Velocity of Flow in Gutter-fps	=	1.921
Depth at Curb Line-Inches--d	=	2.912

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	0.738
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	18.478
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.433	0.650	0.698	1.348	0.152	89.87
10.000	0.754	1.131	0.350	1.481	0.019	98.73
15.000	0.951	1.426	0.074	1.500	0.000	100.00
20.000	1.000	1.500	0.000	1.500	0.000	100.00
25.000	1.000	1.500	0.000	1.500	0.000	100.00
30.000	1.000	1.500	0.000	1.500	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

09-24-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML EB 1107+88 RT CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.444
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	2.200 -50 yr
SPREAD-Ft.--T	=	10.015 -16' max
Average Velocity-V-fps	=	1.872
FLOW in Gutter-CFS--Q	=	1.874
% Flow in Gutter-CFS	=	85.180
Velocity of Flow in Gutter-fps	=	2.152
Depth at Curb Line-Inches--d	=	3.321

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	0.957
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	22.130
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.369	0.813	1.019	1.832	0.368	83.25
10.000	0.661	1.455	0.628	2.082	0.118	94.65
15.000	0.870	1.914	0.279	2.193	0.007	99.68
20.000	0.985	2.167	0.033	2.200	0.000	100.0[illegible]
25.000	1.000	2.200	0.000	2.200	0.000	100.[illegible]
30.000	1.000	2.200	0.000	2.200	0.000	100.00

CB 133

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

09-24-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - ML EB 1109+37 RT
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - WDV
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.328
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.100 - 10yr
SPREAD-Ft.--T	=	7.653 - 10' max
Average Velocity-V-fps	=	1.452
FLOW in Gutter-CFS--Q	=	1.037
% Flow in Gutter-CFS	=	94.244
Velocity of Flow in Gutter-fps	=	1.575
Depth at Curb Line-Inches--d	=	2.755 - 6" max

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	1.291
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	14.721
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.526	0.579	0.462	1.041	0.059	94.63 ←
10.000	0.871	0.958	0.142	1.100	0.000	99.98
15.000	1.000	1.100	0.000	1.100	0.000	100.00
20.000	1.000	1.100	0.000	1.100	0.000	100.00
25.000	1.000	1.100	0.000	1.100	0.000	100.00
30.000	1.000	1.100	0.000	1.100	0.000	100.00

CB 133

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

09-24-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML EB 1109+37 RT CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.328
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.500 -50yr
SPREAD-Ft.--T	=	8.956 -10' max
Average Velocity-V-fps	=	1.540
FLOW in Gutter-CFS--Q	=	1.341
% Flow in Gutter-CFS	=	89.380
Velocity of Flow in Gutter-fps	=	1.728
Depth at Curb Line-Inches--d	=	3.067

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	1.291
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	17.004
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.466	0.699	0.662	1.361	0.139	90.73
10.000	0.797	1.196	0.292	1.488	0.012	99.23
15.000	0.979	1.468	0.032	1.500	0.000	100.00
20.000	1.000	1.500	0.000	1.500	0.000	100.[illegible]
25.000	1.000	1.500	0.000	1.500	0.000	100.[illegible]
30.000	1.000	1.500	0.000	1.500	0.000	100.00

CB 134

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

09-24-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML EB 1110+57 RT CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.144
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.500 - 10yr
SPREAD-Ft.--T	=	10.881 - 18' max
Average Velocity-V-fps	=	1.106
FLOW in Gutter-CFS--Q	=	1.225
% Flow in Gutter-CFS	=	81.687
Velocity of Flow in Gutter-fps	=	1.291
Depth at Curb Line-Inches--d	=	3.530 - 6" max

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	0.000
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	13.585
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.562	0.843	0.562	1.405	0.095	93.68
10.000	0.909	1.364	0.136	1.499	0.001	99.95
15.000	1.000	1.500	0.000	1.500	0.000	100.00
20.000	1.000	1.500	0.000	1.500	0.000	100.00
25.000	1.000	1.500	0.000	1.500	0.000	100.00
30.000	1.000	1.500	0.000	1.500	0.000	100.00

CB 134

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

09-24-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML EB 1110+57 RT CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.144
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	2.000 -50 yr
SPREAD-Ft.--T	=	12.379 -24' max
Average Velocity-V-fps	=	1.173
FLOW in Gutter-CFS--Q	=	1.519
% Flow in Gutter-CFS	=	75.944
Velocity of Flow in Gutter-fps	=	1.401
Depth at Curb Line-Inches--d	=	3.889

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	1.484
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	15.601
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.501	1.002	0.790	1.792	0.208	89.60
10.000	0.842	1.684	0.296	1.979	0.021	98.97
15.000	0.997	1.994	0.006	2.000	0.000	100.00
20.000	1.000	2.000	0.000	2.000	0.000	100.[illegible]
25.000	1.000	2.000	0.000	2.000	0.000	100.[illegible]
30.000	1.000	2.000	0.000	2.000	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-04-2004

PROJECT NAME- RM
TRACS NO.-
HIGHWAY NAME-
DESIGNER - RSR
LOCATION - MLEB 1116+25 R4
CHECKER - [illegible]
PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	12.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	3.600 - 10 yr
SPREAD-Ft.--T	=	14.165 - 18' max
Average Velocity-V-fps	=	1.652
FLOW in Gutter-CFS--Q	=	2.507
% Flow in Gutter-CFS	=	69.635
Velocity of Flow in Gutter-fps	=	2.014
Depth at Curb Line-Inches--d	=	4.318 - 6" max

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	2.091
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	24.036
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.343	1.234	1.479	2.714	0.886	75.38
10.000	0.620	2.233	1.000	3.233	0.367	89.80
15.000	0.828	2.981	0.534	3.515	0.085	97.65
20.000	0.960	3.455	0.145	3.600	0.000	99.99
25.000	1.000	3.600	0.000	3.600	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-04-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML ED 1116+25 RT CHECKER - MDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G = 0.250
Roadway Cross-Slope-Ft./Ft.--Sx = 0.020
Shoulder Width-Ft.-- = 12.000
Shoulder Slope-Ft./Ft.--Ss = 0.020
Gutter Width-Ft.--W = 4.500
Gutter Slope-Ft./Ft.--Sw = 0.037
Gutter Depression-Inches-- = 1.998
Manning's 'N = 0.016

Flow-CFS--Q = 5.000 -50yr
SPREAD-Ft.--T = 16.256 24'-max
Average Velocity-V-fps = 1.776

FLOW in Gutter-CFS--Q = 3.157
% Flow in Gutter-CFS = 63.142
Velocity of Flow in Gutter-fps = 2.204
Depth at Curb Line-Inches--d = 4.820

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft. = 3.350
Grate Width---Ft. = 2.000
Grate Area--Sq. Ft. = 5.590
Splash-Over Velocity--FPS = 7.350

Depth at INLET Curb Line-Inches--d = 1.370
Local Gutter Depression-Inches = 0.000

Length of opening: TOTAL Intercept--Ft. = 28.183
Capture Ratio -- SLOTTED DRAIN = 0.670
Capture Ratio -- GRATE = 0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.296	1.482	1.933	3.415	1.585	68.29
10.000	0.546	2.728	1.439	4.167	0.833	83.33
15.000	0.745	3.726	0.948	4.675	0.325	93.49
20.000	0.892	4.460	0.475	4.936	0.064	98.7
25.000	0.980	4.901	0.099	5.000	0.000	100.

CB 154

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

04-18-2005

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - MLEB 1119+50 RT CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--IN SUMP

GUTTER FLOW HYDRAULICS

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	12.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998

GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Effective Perimeter--Ft.	=	7.350
Capture Ratio -- GRATE	=	0.500
Capture Ratio -- SLOTTED DRAIN	=	0.500
Local Gutter Depression-Inches	=	0.000
Flow-CFS--Q	=	4.500 - 10yr

LENGTH	Q(Slot. Dn)	Q(Grate)	d(inches)	SPREAD,Ft.
5.000	1.595	2.905	5.569	19.379
10.000	2.558	1.942	4.405	14.530 ← 18' max
15.000	3.030	1.470	3.763	11.856
20.000	3.334	1.165	3.312	9.973

CS 154

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

04-18-2005

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - MLEB 1119+50 RT
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--IN SUMP

GUTTER FLOW HYDRAULICS

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	12.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998

GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Effective Perimeter--Ft.	=	7.350
Capture Ratio -- GRATE	=	0.500
Capture Ratio -- SLOTTED DRAIN	=	0.500
Local Gutter Depression-Inches	=	0.000
Flow-CFS--Q	=	6.600 ← 50 yr

LENGTH	Q(Slot. Dn)	Q(Grate)	d(inches)	SPREAD,Ft.
5.000	1.849	4.750	7.485	27.363
10.000	3.309	3.290	5.996	21.160 ← 24' max
15.000	4.352	2.247	4.791	16.138
20.000	4.797	1.802	4.220	13.760

CB 191

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

04-18-2005

PROJECT NAME- RM	TRACS NO.-		
HIGHWAY NAME-	DESIGNER - RSR		
LOCATION - EBML 1151+16 RT	CHECKER - NDV	PAGE	
Ver 3.40: December 1995			

SLOTTED DRAIN W/ GRATE--IN SUMP

GUTTER FLOW HYDRAULICS

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Effective Perimeter--Ft.	=	7.354
Capture Ratio -- GRATE	=	0.500
Capture Ratio -- SLOTTED DRAIN	=	0.500
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	4.600 - 10yr

LENGTH	Q(Slot. Dn)	Q(Grate)	d(inches)	SPREAD,Ft.
5.000	1.732	2.868	5.571	17.336
10.000	3.007	1.592	3.950	10.585 — 16' max
15.000	3.523	1.077	3.161	7.297
20.000	3.824	0.776	2.628	5.076

LD 191

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

04-18-2005

PROJECT NAME- RM | TRACS NO.-
HIGHWAY NAME- | DESIGNER - RSR
LOCATION - EBML 1151+16 RT | CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--IN SUMP

GUTTER FLOW HYDRAULICS

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Effective Perimeter--Ft.	=	7.354
Capture Ratio -- GRATE	=	0.500
Capture Ratio -- SLOTTED DRAIN	=	0.500
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	6.400 - 50yr

LENGTH	Q(Slot. Dn)	Q(Grate)	d(inches)	SPREAD,Ft.
5.000	1.942	4.458	7.260	24.374
10.000	3.480	2.919	5.630	17.583 ← 22' max
15.000	4.625	1.774	4.206	11.648
20.000	5.157	1.243	3.429	8.412

CB 194

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-06-2004

PROJECT NAME- RM		TRACS NO.-	
HIGHWAY NAME-		DESIGNER - RSR	
LOCATION - EB ML 1155+00 RT		CHECKER - NDV	PAGE

Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	3.800 -10yr
SPREAD-Ft.--T	=	14.582 -16' max
Average Velocity-V-fps	=	1.672
FLOW in Gutter-CFS--Q	=	1.818
% Flow in Gutter-CFS	=	47.842
Velocity of Flow in Gutter-fps	=	2.235
Depth at Curb Line-Inches--d	=	4.910

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	5.743
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	16.091
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.488	1.855	1.553	3.408	0.392	89.70
10.000	0.826	3.139	0.653	3.792	0.008	99.79
15.000	0.992	3.770	0.030	3.800	0.000	100.00
20.000	1.000	3.800	0.000	3.800	0.000	100.00

CO
194

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-06-2004

PROJECT NAME- RM
TRACS NO.-
HIGHWAY NAME-
DESIGNER - RSR
LOCATION - EB ML 1155+00 RT
CHECKER - NDV
PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	5.300 - 50yr
SPREAD-Ft.--T	=	16.734 - 22' max
Average Velocity-V-fps	=	1.798
FLOW in Gutter-CFS--Q	=	2.230
% Flow in Gutter-CFS	=	42.082
Velocity of Flow in Gutter-fps	=	2.421
Depth at Curb Line-Inches--d	=	5.426

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.284
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	19.565
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.412	2.184	2.120	4.304	0.996	81.20
10.000	0.724	3.838	1.267	5.105	0.195	96.32
15.000	0.927	4.914	0.386	5.300	0.000	100.00
20.000	1.000	5.300	0.000	5.300	0.000	100.00

C13
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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-06-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - ML EB 1161+75 Rt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	4.600 - 10yr
SPREAD-Ft.--T	=	15.788 - 16' max
Average Velocity-V-fps	=	1.743
FLOW in Gutter-CFS--Q	=	2.045
% Flow in Gutter-CFS	=	44.453
Velocity of Flow in Gutter-fps	=	2.340
Depth at Curb Line-Inches--d	=	5.199

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91 ✓

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.047
Local Gutter Depression-Inches	=	1.000 ✓
Length of opening: TOTAL Intercept--Ft.	=	18.005
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.443	2.039	1.868	3.907	0.693	84.94
10.000	0.768	3.531	0.995	4.526	0.074	98.38 ←
15.000	0.960	4.417	0.183	4.600	0.000	100.00
20.000	1.000	4.600	0.000	4.600	0.000	100.00

CD 203

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-06-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - ML EB 1161+75 RT
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	6.500 - 50yr
SPREAD-Ft.--T	=	18.181 - 22' max
Average Velocity-V-fps	=	1.883
FLOW in Gutter-CFS--Q	=	2.527
% Flow in Gutter-CFS	=	38.869
Velocity of Flow in Gutter-fps	=	2.543
Depth at Curb Line-Inches--d	=	5.773

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.643
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	22.040
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.371	2.409	2.511	4.921	1.579	75.71
10.000	0.663	4.311	1.679	5.989	0.511	92.15
15.000	0.872	5.667	0.806	6.472	0.028	99.58
20.000	0.986	6.410	0.090	6.500	0.000	100.[illegible]

LB
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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-07-2004

PROJECT NAME- RM   TRACS NO.-
HIGHWAY NAME-   DESIGNER - RSR
LOCATION - MLEB 1165+50 Rt   CHECKER - NDV   PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	4.300 -10yr
SPREAD-Ft.--T	=	15.353 -16' max
Average Velocity-V-fps	=	1.717
FLOW in Gutter-CFS--Q	=	1.962
% Flow in Gutter-CFS	=	45.623
Velocity of Flow in Gutter-fps	=	2.303
Depth at Curb Line-Inches--d	=	5.095

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	5.938
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	17.306
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.459	1.972	1.754	3.727	0.573	86.66
10.000	0.788	3.389	0.870	4.259	0.041	99.06
15.000	0.973	4.186	0.114	4.300	0.000	100.00
20.000	1.000	4.300	0.000	4.300	0.000	100.00

LB 206

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-07-2004

PROJECT NAME- RM
TRACS NO.-
HIGHWAY NAME-
DESIGNER - RSR
LOCATION - ML EB 1165+50 Rt
CHECKER - [illegible]
PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	6.300 - 50yr
SPREAD-Ft.--T	=	17.953 - 22' max
Average Velocity-V-fps	=	1.869
FLOW in Gutter-CFS--Q	=	2.479
% Flow in Gutter-CFS	=	39.346
Velocity of Flow in Gutter-fps	=	2.524
Depth at Curb Line-Inches--d	=	5.719

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.587
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	21.643
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.377	2.374	2.449	4.823	1.477	76.55
10.000	0.672	4.236	1.601	5.837	0.463	92.65
15.000	0.881	5.548	0.735	6.283	0.017	99.74
20.000	0.990	6.239	0.061	6.300	0.000	100.00

6B
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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-07-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - ML EB 1168+27 RT
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - BSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	3.100 -10 yr
SPREAD-Ft.--T	=	13.377 - 16' max
Average Velocity-V-fps	=	1.601
FLOW in Gutter-CFS--Q	=	1.602
% Flow in Gutter-CFS	=	51.690
Velocity of Flow in Gutter-fps	=	2.127
Depth at Curb Line-Inches--d	=	4.620

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	5.437
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	14.270
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.540	1.674	1.244	2.918	0.182	94.12
10.000	0.886	2.747	0.353	3.100	0.000	100.00
15.000	1.000	3.100	0.000	3.100	0.000	100.00
20.000	1.000	3.100	0.000	3.100	0.000	100.00

CB 211

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-07-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSP
LOCATION - ML EB 1168+27 Rt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	5.000 - 50yr
SPREAD-Ft.--T	=	16.339 - 22 max
Average Velocity-V-fps	=	1.775
FLOW in Gutter-CFS--Q	=	2.152
% Flow in Gutter-CFS	=	43.043
Velocity of Flow in Gutter-fps	=	2.388
Depth at Curb Line-Inches--d	=	5.331

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.185
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	18.908
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.425	2.123	2.014	4.138	0.862	82.75
10.000	0.742	3.710	1.153	4.863	0.137	97.26
15.000	0.941	4.707	0.293	5.000	0.000	100.00
20.000	1.000	5.000	0.000	5.000	0.000	100.00

CB 215

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-26-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - ML EB 1170+15 Rt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.096
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.700 -10 yr
SPREAD-Ft.--T	=	8.322 -10 max
Average Velocity-V-fps	=	0.809
FLOW in Gutter-CFS--Q	=	0.643
% Flow in Gutter-CFS	=	91.824
Velocity of Flow in Gutter-fps	=	0.894
Depth at Curb Line-Inches--d	=	2.915

GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.350
Splash-Over Velocity--FPS	=	7.350
Local Gutter Depression-Inches	=	0.000
Flow-CFS--Q	=	0.700
GUTTER FLOW at INLET-CFS--Q	=	0.643
Gutter Velocity at INLET-fps	=	0.894
Depth at INLET Curb Line-Inches--d	=	2.915
Frontal Flow Intercepted by GRATE--CFS	=	0.418
Lateral Flow Intercepted by GRATE--CFS	=	0.178
TOTAL Flow Intercepted by GRATE--CFS	=	0.596
% FLOW Intercepted	=	85.172
By-pass Flow--CFS	=	0.104

CD 315

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-26-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - MLEB 1170+15 R+ CHECKER - NDV PAGE
Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.096
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.000 - 50yr
SPREAD-Ft.--T	=	9.904 - 10 max
Average Velocity-V-fps	=	0.867
FLOW in Gutter-CFS--Q	=	0.856
% Flow in Gutter-CFS	=	85.595
Velocity of Flow in Gutter-fps	=	0.994
Depth at Curb Line-Inches--d	=	3.295

GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.350
Splash-Over Velocity--FPS	=	7.350
Local Gutter Depression-Inches	=	0.000
Flow-CFS--Q	=	1.000
GUTTER FLOW at INLET-CFS--Q	=	0.856
Gutter Velocity at INLET-fps	=	0.994
Depth at INLET Curb Line-Inches--d	=	3.295
Frontal Flow Intercepted by GRATE--CFS	=	0.530
Lateral Flow Intercepted by GRATE--CFS	=	0.269
TOTAL Flow Intercepted by GRATE--CFS	=	0.799
% FLOW Intercepted	=	79.893
By-pass Flow--CFS	=	0.201

CB 216

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-26-2004

PROJECT NAME-	RM	TRACS NO.-	
HIGHWAY NAME-		DESIGNER -	RSR
LOCATION -	MLEB 1170+70 Rt	CHECKER -	MOV
		PAGE	

Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.110
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.600 -10yr
SPREAD-Ft.--T	=	7.415 -10'max
Average Velocity-V-fps	=	0.831
FLOW in Gutter-CFS--Q	=	0.570
% Flow in Gutter-CFS	=	95.041
Velocity of Flow in Gutter-fps	=	0.895
Depth at Curb Line-Inches--d	=	2.698

GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.350
Splash-Over Velocity--FPS	=	7.350
Local Gutter Depression-Inches	=	0.000
Flow-CFS--Q	=	0.600
GUTTER FLOW at INLET-CFS--Q	=	0.570
Gutter Velocity at INLET-fps	=	0.895
Depth at INLET Curb Line-Inches--d	=	2.698
Frontal Flow Intercepted by GRATE--CFS	=	0.384
Lateral Flow Intercepted by GRATE--CFS	=	0.138
TOTAL Flow Intercepted by GRATE--CFS	=	0.522
% FLOW Intercepted	=	87.020
By-pass Flow--CFS	=	0.078 ←

CB 216

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-26-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - ML EB 1170+70 Rt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - MDC
PAGE

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.110
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.000 - 50yr
SPREAD-Ft.--T	=	9.590 - 10 max
Average Velocity-V-fps	=	0.916
FLOW in Gutter-CFS--Q	=	0.869
% Flow in Gutter-CFS	=	86.860
Velocity of Flow in Gutter-fps	=	1.043
Depth at Curb Line-Inches--d	=	3.219

GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.350
Splash-Over Velocity--FPS	=	7.350
Local Gutter Depression-Inches	=	0.000
Flow-CFS--Q	=	1.000
GUTTER FLOW at INLET-CFS--Q	=	0.869
Gutter Velocity at INLET-fps	=	1.043
Depth at INLET Curb Line-Inches--d	=	3.219
Frontal Flow Intercepted by GRATE--CFS	=	0.542
Lateral Flow Intercepted by GRATE--CFS	=	0.254
TOTAL Flow Intercepted by GRATE--CFS	=	0.796
% FLOW Intercepted	=	79.585
By-pass Flow--CFS	=	0.204

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

CB 217

10-26-2004

PROJECT NAME- RM	TRACS NO.-		
HIGHWAY NAME-	DESIGNER - RSR		
LOCATION - ML EB 1171+28 Rt	CHECKER - NDV	PAGE	

Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.124
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.600 - 10yr
SPREAD-Ft.--T	=	7.180 - 10' max
Average Velocity-V-fps	=	0.872
FLOW in Gutter-CFS--Q	=	0.575
% Flow in Gutter-CFS	=	95.793
Velocity of Flow in Gutter-fps	=	0.933
Depth at Curb Line-Inches--d	=	2.641

GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.350
Splash-Over Velocity--FPS	=	7.350
Local Gutter Depression-Inches	=	0.000
Flow-CFS--Q	=	0.600
GUTTER FLOW at INLET-CFS--Q	=	0.575
Gutter Velocity at INLET-fps	=	0.933
Depth at INLET Curb Line-Inches--d	=	2.641
Frontal Flow Intercepted by GRATE--CFS	=	0.391
Lateral Flow Intercepted by GRATE--CFS	=	0.130
TOTAL Flow Intercepted by GRATE--CFS	=	0.521
% FLOW Intercepted	=	86.898
By-pass Flow--CFS	=	0.079

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-26-2004

PROJECT NAME- RM
TRACS NO.-
HIGHWAY NAME-
DESIGNER - RSR
LOCATION - ML EB 1171+28 Rt
CHECKER - NDV
PAGE
Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.124
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.000 - 50yr
SPREAD-Ft.--T	=	9.318 - 10' max
Average Velocity-V-fps	=	0.961
FLOW in Gutter-CFS--Q	=	0.879
% Flow in Gutter-CFS	=	87.947
Velocity of Flow in Gutter-fps	=	1.088
Depth at Curb Line-Inches--d	=	3.154

GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.350
Splash-Over Velocity--FPS	=	7.350
Local Gutter Depression-Inches	=	0.000
Flow-CFS--Q	=	1.000
GUTTER FLOW at INLET-CFS--Q	=	0.879
Gutter Velocity at INLET-fps	=	1.088
Depth at INLET Curb Line-Inches--d	=	3.154
Frontal Flow Intercepted by GRATE--CFS	=	0.553
Lateral Flow Intercepted by GRATE--CFS	=	0.240
TOTAL Flow Intercepted by GRATE--CFS	=	0.794
% FLOW Intercepted	=	79.353
By-pass Flow--CFS	=	0.206

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-26-2004

PROJECT NAME- RM — TRACS NO.-
HIGHWAY NAME- — DESIGNER - RSP
LOCATION - ML EB 1172+10 Rt — CHECKER - NDV — PAGE
Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.186
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.800 - 10yr
SPREAD-Ft.--T	=	7.515 - 10' max
Average Velocity-V-fps	=	1.086
FLOW in Gutter-CFS--Q	=	0.758
% Flow in Gutter-CFS	=	94.711
Velocity of Flow in Gutter-fps	=	1.173
Depth at Curb Line-Inches--d	=	2.722

GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.350
Splash-Over Velocity--FPS	=	7.350
Local Gutter Depression-Inches	=	0.000
Flow-CFS--Q	=	0.800
GUTTER FLOW at INLET-CFS--Q	=	0.758
Gutter Velocity at INLET-fps	=	1.173
Depth at INLET Curb Line-Inches--d	=	2.722
Frontal Flow Intercepted by GRATE--CFS	=	0.508
Lateral Flow Intercepted by GRATE--CFS	=	0.152
TOTAL Flow Intercepted by GRATE--CFS	=	0.660
% FLOW Intercepted	=	82.515
By-pass Flow--CFS	=	0.140

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2.18

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-26-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION -ML EB 1172+10 Rt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER -
PAGE

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.186
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.300 - 50yr
SPREAD-Ft.--T	=	9.588 - 10' max
Average Velocity-V-fps	=	1.191
FLOW in Gutter-CFS--Q	=	1.129
% Flow in Gutter-CFS	=	86.864
Velocity of Flow in Gutter-fps	=	1.356
Depth at Curb Line-Inches--d	=	3.219

GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.350
Splash-Over Velocity--FPS	=	7.350
Local Gutter Depression-Inches	=	0.000
Flow-CFS--Q	=	1.300
GUTTER FLOW at INLET-CFS--Q	=	1.129
Gutter Velocity at INLET-fps	=	1.356
Depth at INLET Curb Line-Inches--d	=	3.219
Frontal Flow Intercepted by GRATE--CFS	=	0.705
Lateral Flow Intercepted by GRATE--CFS	=	0.260
TOTAL Flow Intercepted by GRATE--CFS	=	0.965
% FLOW Intercepted	=	74.204
By-pass Flow--CFS	=	0.335

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-26-2004

PROJECT NAME- RM   TRACS NO.-
HIGHWAY NAME-   DESIGNER - RSR
LOCATION -ML EB 1173+00 Rt   CHECKER - NDV   PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.000 - 10yr
SPREAD-Ft.--T	=	7.818 - 10'max
Average Velocity-V-fps	=	1.277
FLOW in Gutter-CFS--Q	=	0.937
% Flow in Gutter-CFS	=	93.667
Velocity of Flow in Gutter-fps	=	1.391
Depth at Curb Line-Inches--d	=	2.794

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	1.114
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	13.054
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.581	0.581	0.381	0.962	0.038	96.22
10.000	0.927	0.927	0.073	1.000	0.000	100.00
15.000	1.000	1.000	0.000	1.000	0.000	100.00
20.000	1.000	1.000	0.000	1.000	0.000	100.00
25.000	1.000	1.000	0.000	1.000	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-26-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - MLEB 1173+00 Rt CHECKER - UDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.500 50yr
SPREAD-Ft.--T	=	9.567 ~10 max
Average Velocity-V-fps	=	1.380
FLOW in Gutter-CFS--Q	=	1.304
% Flow in Gutter-CFS	=	86.952
Velocity of Flow in Gutter-fps	=	1.570
Depth at Curb Line-Inches--d	=	3.214

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	1.060
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	15.781
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.496	0.744	0.630	1.375	0.125	91.63
10.000	0.836	1.254	0.240	1.494	0.006	99.58
15.000	0.996	1.493	0.007	1.500	0.000	100.00
20.000	1.000	1.500	0.000	1.500	0.000	100.0[illegible]
25.000	1.000	1.500	0.000	1.500	0.000	100.[illegible]

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-26-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML EB 1178+60 Rt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	5.100 - 10 yr
SPREAD-Ft.--T	=	16.390 - 18' max
Average Velocity-V-fps	=	1.784
FLOW in Gutter-CFS--Q	=	3.201
% Flow in Gutter-CFS	=	62.759
Velocity of Flow in Gutter-fps	=	2.215
Depth at Curb Line-Inches--d	=	4.852

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	2.091
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	28.454
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.294	1.498	1.963	3.461	1.639	67.86
10.000	0.541	2.761	1.468	4.229	0.871	82.91
15.000	0.740	3.776	0.976	4.752	0.348	93.18
20.000	0.887	4.526	0.501	5.027	0.073	98.57
25.000	0.978	4.985	0.114	5.100	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-26-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML EB 1178+60 Rt CHECKER - [illegible] PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	7.100 - 50yr
SPREAD-Ft.--T	=	18.762 - 24' max
Average Velocity-V-fps	=	1.923
FLOW in Gutter-CFS--Q	=	4.015
% Flow in Gutter-CFS	=	56.551
Velocity of Flow in Gutter-fps	=	2.421
Depth at Curb Line-Inches--d	=	5.421

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	1.254
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	33.390
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.253	1.798	2.521	4.319	2.781	60.84
10.000	0.473	3.359	2.012	5.371	1.729	75.65
15.000	0.658	4.673	1.505	6.179	0.921	87.03
20.000	0.807	5.729	1.002	6.731	0.369	94.8[illegible]
25.000	0.917	6.509	0.514	7.023	0.077	98.[illegible]

CB 235

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-26-2004

PROJECT NAME- RM   TRACS NO.-
HIGHWAY NAME-   DESIGNER - RSR
LOCATION - ML EB 1180+75 Rt   CHECKER -   PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.125
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	2.800 - 10 yr
SPREAD-Ft.--T	=	14.748 - 18' max
Average Velocity-V-fps	=	1.193
FLOW in Gutter-CFS--Q	=	1.896
% Flow in Gutter-CFS	=	67.728
Velocity of Flow in Gutter-fps	=	1.462
Depth at Curb Line-Inches--d	=	4.458

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	1.526
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	17.676
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.450	1.261	1.106	2.367	0.433	84.52
10.000	0.777	2.176	0.539	2.715	0.085	96.97
15.000	0.967	2.706	0.094	2.800	0.000	100.00
20.000	1.000	2.800	0.000	2.800	0.000	100.00
25.000	1.000	2.800	0.000	2.800	0.000	100.00

LB 235

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-26-2004

PROJECT NAME- R/M TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML EB 1180+75 Rt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.125
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	4.400 - 50yr
SPREAD-Ft.--T	=	17.784 - 24' max
Average Velocity-V-fps	=	1.319
FLOW in Gutter-CFS--Q	=	2.595
% Flow in Gutter-CFS	=	58.981
Velocity of Flow in Gutter-fps	=	1.653
Depth at Curb Line-Inches--d	=	5.186

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	1.324
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	22.000
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.371	1.634	1.688	3.322	1.078	75.49
10.000	0.664	2.922	1.072	3.995	0.405	90.79
15.000	0.873	3.840	0.492	4.331	0.069	98.44
20.000	0.987	4.341	0.059	4.400	0.000	100.00
25.000	1.000	4.400	0.000	4.400	0.000	100.[illegible]

CB 233

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

04-18-2005

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - MLEB 1182+00 Rt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - BSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--IN SUMP

GUTTER FLOW HYDRAULICS

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998

GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Effective Perimeter--Ft.	=	7.350
Capture Ratio -- GRATE	=	0.500
Capture Ratio -- SLOTTED DRAIN	=	0.500
Local Gutter Depression-Inches	=	0.000
Flow-CFS--Q	=	3.200 ← 10yr

LENGTH	Q(Slot. Dn)	Q(Grate)	d(inches)	SPREAD,Ft.
5.000	1.271	1.928	4.386	14.450 ← 18' max
10.000	1.865	1.336	3.569	11.045
15.000	2.204	0.997	3.044	8.859
20.000	2.421	0.779	2.675	7.322
25.000	2.570	0.629	2.399	6.172

CB 233

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

04-18-2005

PROJECT NAME- RM | TRACS NO.-
HIGHWAY NAME- | DESIGNER - RSR
LOCATION - MLEB 1182+00 Rt | CHECKER - NDV | PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--IN SUMP

GUTTER FLOW HYDRAULICS

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998

GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Effective Perimeter--Ft.	=	7.350
Capture Ratio -- GRATE	=	0.500
Capture Ratio -- SLOTTED DRAIN	=	0.500
Local Gutter Depression-Inches	=	0.000
Flow-CFS--Q	=	5.400 ← 50yr

LENGTH	Q(Slot. Dn)	Q(Grate)	d(inches)	SPREAD, Ft.
5.000	1.712	3.687	6.420	22.925 ← 24' max
10.000	3.011	2.389	4.964	16.858
15.000	3.598	1.802	4.220	13.759
20.000	3.962	1.437	3.715	11.655
25.000	4.218	1.182	3.338	10.083

CB 236

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-11-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - ML EB 1183+25 Rt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.125
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	12.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	3.000 - 10yr
SPREAD-Ft.--T	=	15.182 - 18' max
Average Velocity-V-fps	=	1.211
FLOW in Gutter-CFS--Q	=	1.991
% Flow in Gutter-CFS	=	66.358
Velocity of Flow in Gutter-fps	=	1.490
Depth at Curb Line-Inches--d	=	4.562

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	1.681
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	18.277
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.437	1.312	1.184	2.497	0.503	83.22
10.000	0.760	2.279	0.608	2.887	0.113	96.25
15.000	0.955	2.864	0.135	2.999	0.001	99.97
20.000	1.000	3.000	0.000	3.000	0.000	100.00
25.000	1.000	3.000	0.000	3.000	0.000	100.00

CB 236

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-11-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - ML EB 1183+25 Rt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - [illegible]
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.125
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	12.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	4.600 -50yr
SPREAD-Ft.--T	=	18.108 -24' max
Average Velocity-V-fps	=	1.333
FLOW in Gutter-CFS--Q	=	2.675
% Flow in Gutter-CFS	=	58.155
Velocity of Flow in Gutter-fps	=	1.673
Depth at Curb Line-Inches--d	=	5.264

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	1.523
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	22.478
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.364	1.675	1.754	3.430	1.170	74.56
10.000	0.653	3.005	1.135	4.141	0.459	90.01
15.000	0.862	3.966	0.547	4.512	0.088	98.09
20.000	0.981	4.513	0.087	4.600	0.000	100.0[illegible]
25.000	1.000	4.600	0.000	4.600	0.000	100.[illegible]

CB 240

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-11-2004

PROJECT NAME- RM　　TRACS NO.-
HIGHWAY NAME-　　DESIGNER - RSR
LOCATION - ML EB 1186+00 Rt　　CHECKER - NDV　　PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	12.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	4.000 - 10yr
SPREAD-Ft.--T	=	14.811 - 18' max
Average Velocity-V-fps	=	1.691
FLOW in Gutter-CFS--Q	=	2.701
% Flow in Gutter-CFS	=	67.527
Velocity of Flow in Gutter-fps	=	2.074
Depth at Curb Line-Inches--d	=	4.473

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE:　ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	1.185
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	25.295
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.327	1.309	1.615	2.925	1.075	73.11
10.000	0.596	2.383	1.131	3.513	0.487	87.84
15.000	0.802	3.207	0.655	3.862	0.138	96.56
20.000	0.940	3.760	0.234	3.994	0.006	99.86
25.000	1.000	3.999	0.001	4.000	0.0[illegible]	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-11-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML EB 1186+00 Rt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	12.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	5.800 - 50yr
SPREAD-Ft.--T	=	17.280 - 24' max
Average Velocity-V-fps	=	1.837
FLOW in Gutter-CFS--Q	=	3.498
% Flow in Gutter-CFS	=	60.302
Velocity of Flow in Gutter-fps	=	2.294
Depth at Curb Line-Inches--d	=	5.065

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	1.114
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	30.282
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.277	1.609	2.167	3.776	2.024	65.10
10.000	0.514	2.981	1.667	4.648	1.152	80.14
15.000	0.708	4.106	1.169	5.276	0.524	90.96
20.000	0.857	4.970	0.680	5.650	0.150	97.4[illegible]
25.000	0.957	5.550	0.244	5.793	0.007	99.[illegible]

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-11-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - ML EB 1190+00 Rt
Ver 3.40: December 1995

TRACS NO. -
DESIGNER - RSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	12.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	3.600 - 10 yr
SPREAD-Ft.--T	=	14.165 - 18' max
Average Velocity-V-fps	=	1.652
FLOW in Gutter-CFS--Q	=	2.507
% Flow in Gutter-CFS	=	69.635
Velocity of Flow in Gutter-fps	=	2.014
Depth at Curb Line-Inches--d	=	4.318

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	1.552
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	24.036
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.343	1.234	1.479	2.714	0.886	75.38
10.000	0.620	2.233	1.000	3.233	0.367	89.80
15.000	0.828	2.981	0.534	3.515	0.085	97.65
20.000	0.960	3.455	0.145	3.600	0.000	99.99
25.000	1.000	3.600	0.000	3.600	0.000	100.00

CB 242

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-11-2004

PROJECT NAME- RM		TRACS NO.-	
HIGHWAY NAME-		DESIGNER - RSR	
LOCATION - ML EB 1190+00 Rt		CHECKER - JDV	PAGE

Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	12.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	5.000 - 50yr
SPREAD-Ft.--T	=	16.256 - 24' max
Average Velocity-V-fps	=	1.776
FLOW in Gutter-CFS--Q	=	3.157
% Flow in Gutter-CFS	=	63.142
Velocity of Flow in Gutter-fps	=	2.204
Depth at Curb Line-Inches--d	=	4.820

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	1.185
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	28.183
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.296	1.482	1.933	3.415	1.585	68.29
10.000	0.546	2.728	1.439	4.167	0.833	83.33
15.000	0.745	3.726	0.948	4.675	0.325	93.49
20.000	0.892	4.460	0.475	4.936	0.064	98.71
25.000	0.980	4.901	0.099	5.000	0.000	100.0[illegible]

CB 251

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-11-2004

PROJECT NAME- RM　　TRACS NO.-
HIGHWAY NAME-　　DESIGNER - RSR
LOCATION - ML EB 1198+00 Rt　　CHECKER - [illegible]　　PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	12.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	3.600 - 10yr
SPREAD-Ft.--T	=	14.165 - 18 max
Average Velocity-V-fps	=	1.652
FLOW in Gutter-CFS--Q	=	2.507
% Flow in Gutter-CFS	=	69.635
Velocity of Flow in Gutter-fps	=	2.014
Depth at Curb Line-Inches--d	=	4.318

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	1.185
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	24.036
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.343	1.234	1.479	2.714	0.886	75.38
10.000	0.620	2.233	1.000	3.233	0.367	89.80
15.000	0.828	2.981	0.534	3.515	0.085	97.65
20.000	0.960	3.455	0.145	3.600	0.000	99.99
25.000	1.000	3.600	0.000	3.600	0.000	100.00

CB
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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-11-2004

PROJECT NAME- RM | TRACS NO.-
HIGHWAY NAME- | DESIGNER - RSR
LOCATION - ML EB 1198+00 Rt | CHECKER - NDW | PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	12.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016

Flow-CFS--Q	=	5.000 - 50yr
SPREAD-Ft.--T	=	16.256 - 24' max
Average Velocity-V-fps	=	1.776

FLOW in Gutter-CFS--Q	=	3.157
% Flow in Gutter-CFS	=	63.142
Velocity of Flow in Gutter-fps	=	2.204
Depth at Curb Line-Inches--d	=	4.820

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350

Depth at INLET Curb Line-Inches--d	=	1.185
Local Gutter Depression-Inches	=	0.000

Length of opening: TOTAL Intercept--Ft.	=	28.183
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.296	1.482	1.933	3.415	1.585	68.29
10.000	0.546	2.728	1.439	4.167	0.833	83.33
15.000	0.745	3.726	0.948	4.675	0.325	93.49
20.000	0.892	4.460	0.475	4.936	0.064	98.71
25.000	0.980	4.901	0.099	5.000	0.000	100.

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-11-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - ML EB 1202+00 Rt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	12.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	4.000 - 10 yr
SPREAD-Ft.--T	=	14.811 - 18' max
Average Velocity-V-fps	=	1.691
FLOW in Gutter-CFS--Q	=	2.701
% Flow in Gutter-CFS	=	67.527
Velocity of Flow in Gutter-fps	=	2.074
Depth at Curb Line-Inches--d	=	4.473

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	1.370
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	25.295
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.327	1.309	1.615	2.925	1.075	73.11
10.000	0.596	2.383	1.131	3.513	0.487	87.84
15.000	0.802	3.207	0.655	3.862	0.138	96.56
20.000	0.940	3.760	0.234	3.994	0.006	99.86
25.000	1.000	3.999	0.001	4.000	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-11-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - ML EB 1202+00 Rt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - AJDV
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G = 0.250
Roadway Cross-Slope-Ft./Ft.--Sx = 0.020
Shoulder Width-Ft.-- = 12.000
Shoulder Slope-Ft./Ft.--Ss = 0.020
Gutter Width-Ft.--W = 4.500
Gutter Slope-Ft./Ft.--Sw = 0.037
Gutter Depression-Inches-- = 1.998
Manning's 'N = 0.016

Flow-CFS--Q = 5.800 - 50yr
SPREAD-Ft.--T = 17.280 - 24' max
Average Velocity-V-fps = 1.837

FLOW in Gutter-CFS--Q = 3.498
% Flow in Gutter-CFS = 60.302
Velocity of Flow in Gutter-fps = 2.294
Depth at Curb Line-Inches--d = 5.065

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft. = 3.350
Grate Width---Ft. = 2.000
Grate Area--Sq. Ft. = 5.590
Splash-Over Velocity--FPS = 7.350

Depth at INLET Curb Line-Inches--d = 0.235
Local Gutter Depression-Inches = 0.000

Length of opening: TOTAL Intercept--Ft. = 30.282
Capture Ratio -- SLOTTED DRAIN = 0.670
Capture Ratio -- GRATE = 0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.277	1.609	2.167	3.776	2.024	65.10
10.000	0.514	2.981	1.667	4.648	1.152	80.14
15.000	0.708	4.106	1.169	5.276	0.524	90.96
20.000	0.857	4.970	0.680	5.650	0.150	97.4[illegible]
25.000	0.957	5.550	0.244	5.793	0.007	99.[illegible]

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-12-2004

PROJECT NAME- RM | TRACS NO.-
HIGHWAY NAME- | DESIGNER - RSR
LOCATION - ML EB 1204+75 Rt | CHECKER - NDV | PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.125
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	12.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	3.000
SPREAD-Ft.--T	=	15.182
Average Velocity-V-fps	=	1.211
FLOW in Gutter-CFS--Q	=	1.991
% Flow in Gutter-CFS	=	66.358
Velocity of Flow in Gutter-fps	=	1.490
Depth at Curb Line-Inches--d	=	4.562

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	5.296
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	14.392
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.536	1.609	1.165	2.774	0.226	92.46
10.000	0.882	2.646	0.348	2.994	0.006	99.79
15.000	1.000	3.000	0.000	3.000	0.000	100.00
20.000	1.000	3.000	0.000	3.000	0.000	100.00
25.000	1.000	3.000	0.000	3.000	0.000	100.00

CB 260

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-12-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML EB 1204+75 Rt CHECKER - MDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.125
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	12.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	4.600
SPREAD-Ft.--T	=	18.108
Average Velocity-V-fps	=	1.333
FLOW in Gutter-CFS--Q	=	2.675
% Flow in Gutter-CFS	=	58.155
Velocity of Flow in Gutter-fps	=	1.673
Depth at Curb Line-Inches--d	=	5.264

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	6.043
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	18.024
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.443	2.037	1.859	3.896	0.704	84.69
10.000	0.767	3.528	0.938	4.467	0.133	97.10
15.000	0.960	4.415	0.185	4.600	0.000	100.00
20.000	1.000	4.600	0.000	4.600	0.000	100.00
25.000	1.000	4.600	0.000	4.600	0.000	100.[illegible]

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

04-18-2005

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION -ML EB 1206+00 Rt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - ASR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--IN SUMP

GUTTER FLOW HYDRAULICS

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998

GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Effective Perimeter--Ft.	=	7.350
Capture Ratio -- GRATE	=	0.500
Capture Ratio -- SLOTTED DRAIN	=	0.500
Local Gutter Depression-Inches	=	0.000
Flow-CFS--Q	=	2.900 — 10 yr

LENGTH	Q(Slot. Dn)	Q(Grate)	d(inches)	SPREAD,Ft.
5.000	1.162	1.737	4.133	13.396 ← 18' max
10.000	1.704	1.197	3.360	10.177
15.000	2.012	0.889	2.865	8.112
20.000	2.209	0.692	2.517	6.661
25.000	2.344	0.556	2.256	5.576

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

04-18-2005

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - MLEB 1206+00 Rt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--IN SUMP

GUTTER FLOW HYDRAULICS

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998

GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Effective Perimeter--Ft.	=	7.350
Capture Ratio -- GRATE	=	0.500
Capture Ratio -- SLOTTED DRAIN	=	0.500
Local Gutter Depression-Inches	=	0.000
Flow-CFS--Q	=	4.600 ← 50 yr

LENGTH	Q(Slot. Dn)	Q(Grate)	d(inches)	SPREAD,Ft.
5.000	1.608	2.991	5.666	19.784 ← 24' max
10.000	2.611	1.989	4.466	14.782
15.000	3.093	1.507	3.816	12.073
20.000	3.404	1.195	3.358	10.165
25.000	3.620	0.979	3.015	8.737

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-03-2004

PROJECT NAME- RM | TRACS NO.-
HIGHWAY NAME- | DESIGNER - RSR
LOCATION - MLEB 1207+25 Rt | CHECKER - NOV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.125
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	2.700 - 10yr
SPREAD-Ft.--T	=	14.524 · 18' max
Average Velocity-V-fps	=	1.183
FLOW in Gutter-CFS--Q	=	1.848
% Flow in Gutter-CFS	=	68.454
Velocity of Flow in Gutter-fps	=	1.448
Depth at Curb Line-Inches--d	=	4.404

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	1.115
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	17.367
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.457	1.235	1.066	2.300	0.400	85.20
10.000	0.786	2.123	0.504	2.627	0.073	97.31
15.000	0.972	2.625	0.075	2.700	0.000	100.00
20.000	1.000	2.700	0.000	2.700	0.000	100.00
25.000	1.000	2.700	0.000	2.700	0.000	100.00

CB 261

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-03-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - MLEB 1207+25 Rt CHECKER - [illegible] PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.125
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	3.800 - 50yr
SPREAD-Ft.--T	=	16.748 - 24' max
Average Velocity-V-fps	=	1.276
FLOW in Gutter-CFS--Q	=	2.347
% Flow in Gutter-CFS	=	61.753
Velocity of Flow in Gutter-fps	=	1.589
Depth at Curb Line-Inches--d	=	4.937

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	1.217
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	20.494
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.396	1.503	1.481	2.984	0.816	78.52
10.000	0.700	2.661	0.879	3.540	0.260	93.15
15.000	0.906	3.445	0.329	3.773	0.027	99.30
20.000	0.999	3.795	0.005	3.800	0.000	100.0[illegible]
25.000	1.000	3.800	0.000	3.800	0.000	100.[illegible]

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-03-2004

PROJECT NAME- RM
TRACS NO.-
HIGHWAY NAME-
DESIGNER - RSR
LOCATION - EB ML 1210+21 Rt
CHECKER - NDV
PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.202
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.000 - 10 yr
SPREAD-Ft.--T	=	8.258 - 10 max
Average Velocity-V-fps	=	1.171
FLOW in Gutter-CFS--Q	=	0.921
% Flow in Gutter-CFS	=	92.065
Velocity of Flow in Gutter-fps	=	1.291
Depth at Curb Line-Inches--d	=	2.900

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	1.500
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	12.302
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.609	0.609	0.358	0.967	0.033	96.72
10.000	0.951	0.951	0.049	1.000	0.000	100.00
15.000	1.000	1.000	0.000	1.000	0.000	100.00
20.000	1.000	1.000	0.000	1.000	0.000	100.00
25.000	1.000	1.000	0.000	1.000	0.000	100.00

CD 265

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-03-2004

PROJECT NAME- RM	TRACS NO.-
HIGHWAY NAME-	DESIGNER - RSR
LOCATION - EB ML 1210+21 Rt	CHECKER - NDV PAGE

Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.202
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.400 - 50 yr
SPREAD-Ft.--T	=	9.739 - 10 max
Average Velocity-V-fps	=	1.249
FLOW in Gutter-CFS--Q	=	1.208
% Flow in Gutter-CFS	=	86.258
Velocity of Flow in Gutter-fps	=	1.427
Depth at Curb Line-Inches--d	=	3.255

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	1.615
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	14.410
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.536	0.750	0.556	1.306	0.094	93.30
10.000	0.881	1.234	0.165	1.399	0.001	99.91
15.000	1.000	1.400	0.000	1.400	0.000	100.00
20.000	1.000	1.400	0.000	1.400	0.000	100.0
25.000	1.000	1.400	0.000	1.400	0.000	100.0

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-03-2004

PROJECT NAME- RM   TRACS NO.-
HIGHWAY NAME-   DESIGNER - RSR
LOCATION - ML EB 1211+25 Rt   CHECKER - NDV   PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.186
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.000 - 10yr
SPREAD-Ft.--T	=	8.432 - 10' max
Average Velocity-V-fps	=	1.132
FLOW in Gutter-CFS--Q	=	0.914
% Flow in Gutter-CFS	=	91.409
Velocity of Flow in Gutter-fps	=	1.255
Depth at Curb Line-Inches--d	=	2.942

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	1.470
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	12.024
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.620	0.620	0.349	0.969	0.031	96.91
10.000	0.960	0.960	0.040	1.000	0.000	100.00
15.000	1.000	1.000	0.000	1.000	0.000	100.00
20.000	1.000	1.000	0.000	1.000	0.000	100.00
25.000	1.000	1.000	0.000	1.000	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-03-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML EB 1211+25 Rt CHECKER - PAGE
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.186
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.400 - 50yr
SPREAD-Ft.--T	=	9.931 -10' max
Average Velocity-V-fps	=	1.209
FLOW in Gutter-CFS--Q	=	1.197
% Flow in Gutter-CFS	=	85.487
Velocity of Flow in Gutter-fps	=	1.386
Depth at Curb Line-Inches--d	=	3.302

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	0.656
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	14.089
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.546	0.764	0.546	1.310	0.090	93.59
10.000	0.892	1.249	0.150	1.399	0.001	99.94
15.000	1.000	1.400	0.000	1.400	0.000	100.00
20.000	1.000	1.400	0.000	1.400	0.000	100.0[illegible]
25.000	1.000	1.400	0.000	1.400	0.000	100.[illegible]

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-03-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - ML ER 1212+25 Rt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.174
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.900 - 10yr
SPREAD-Ft.--T	=	8.130 - 10' max
Average Velocity-V-fps	=	1.080
FLOW in Gutter-CFS--Q	=	0.833
% Flow in Gutter-CFS	=	92.541
Velocity of Flow in Gutter-fps	=	1.188
Depth at Curb Line-Inches--d	=	2.869

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	1.314
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	11.239
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.653	0.588	0.293	0.881	0.019	97.92
10.000	0.981	0.883	0.017	0.900	0.000	100.00
15.000	1.000	0.900	0.000	0.900	0.000	100.00
20.000	1.000	0.900	0.000	0.900	0.000	100.00
25.000	1.000	0.900	0.000	0.900	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-03-2004

PROJECT NAME- RM   TRACS NO.-
HIGHWAY NAME-   DESIGNER - RSR
LOCATION - MLEB 1212+25 Rt   CHECKER - [illegible]   PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.174
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.300 - 50yr
SPREAD-Ft.--T	=	9.742 - 10' max
Average Velocity-V-fps	=	1.160
FLOW in Gutter-CFS--Q	=	1.121
% Flow in Gutter-CFS	=	86.249
Velocity of Flow in Gutter-fps	=	1.325
Depth at Curb Line-Inches--d	=	3.256

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	1.443
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	13.357
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.570	0.741	0.490	1.231	0.069	94.67
10.000	0.917	1.192	0.108	1.300	0.000	99.99
15.000	1.000	1.300	0.000	1.300	0.000	100.00
20.000	1.000	1.300	0.000	1.300	0.000	100.0[illegible]
25.000	1.000	1.300	0.000	1.300	0.000	100.0[illegible]

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-03-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - MLEB 12\13+15 Rt CHECKER - [illegible] PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.162
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.800 - 10 yr
SPREAD-Ft.--T	=	7.793 - 10' max
Average Velocity-V-fps	=	1.026
FLOW in Gutter-CFS--Q	=	0.750
% Flow in Gutter-CFS	=	93.756
Velocity of Flow in Gutter-fps	=	1.118
Depth at Curb Line-Inches--d	=	2.788

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	0.254
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	10.433
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.691	0.553	0.239	0.791	0.009	98.92
10.000	0.997	0.797	0.003	0.800	0.000	100.00
15.000	1.000	0.800	0.000	0.800	0.000	100.00
20.000	1.000	0.800	0.000	0.800	0.000	100.00
25.000	1.000	0.800	0.000	0.800	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-03-2004

PROJECT NAME- RM TRACS NO.-
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LOCATION - ML EB 1213+15 Rt CHECKER - [illegible] PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.162
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.200 -50yr
SPREAD-Ft.--T	=	9.538 -10' max
Average Velocity-V-fps	=	1.109
FLOW in Gutter-CFS--Q	=	1.045
% Flow in Gutter-CFS	=	87.065
Velocity of Flow in Gutter-fps	=	1.262
Depth at Curb Line-Inches--d	=	3.207

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	0.329
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	12.611
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.597	0.716	0.432	1.149	0.051	95.73
10.000	0.941	1.130	0.070	1.200	0.000	100.00
15.000	1.000	1.200	0.000	1.200	0.000	100.00
20.000	1.000	1.200	0.000	1.200	0.000	100.0[illegible]
25.000	1.000	1.200	0.000	1.200	0.000	100.0[illegible]

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-03-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION -MLEB 12,13,92 RT
Ver 3.40: December 1995

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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.154
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.800 - 10 yr
SPREAD-Ft.--T	=	7.896 - 10 max
Average Velocity-V-fps	=	1.006
FLOW in Gutter-CFS--Q	=	0.747
% Flow in Gutter-CFS	=	93.390
Velocity of Flow in Gutter-fps	=	1.098
Depth at Curb Line-Inches--d	=	2.813

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	1.103
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	10.287
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.698	0.559	0.233	0.792	0.008	98.97
10.000	0.998	0.799	0.001	0.800	0.000	100.00
15.000	1.000	0.800	0.000	0.800	0.000	100.00
20.000	1.000	0.800	0.000	0.800	0.000	100.00
25.000	1.000	0.800	0.000	0.800	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-03-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - R3R
LOCATION - ML EB 1213+92 Rt CHECKER - MDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.154
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.200 - 50yr
SPREAD-Ft.--T	=	9.654 - 10' max
Average Velocity-V-fps	=	1.087
FLOW in Gutter-CFS--Q	=	1.039
% Flow in Gutter-CFS	=	86.600
Velocity of Flow in Gutter-fps	=	1.239
Depth at Curb Line-Inches--d	=	3.235

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	1.103
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	12.438
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.604	0.724	0.426	1.151	0.049	95.88
10.000	0.947	1.136	0.064	1.200	0.000	100.00
15.000	1.000	1.200	0.000	1.200	0.000	100.00
20.000	1.000	1.200	0.000	1.200	0.000	100.0
25.000	1.000	1.200	0.000	1.200	0.000	100.0

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-12-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION -ML EB 1216+53 Rt
Ver 3.40: December 1995

TRACS NO.-
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.147
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.400 -10 yr
SPREAD-Ft.--T	=	10.583 -16' max
Average Velocity-V-fps	=	1.105
FLOW in Gutter-CFS--Q	=	0.879
% Flow in Gutter-CFS	=	62.800
Velocity of Flow in Gutter-fps	=	1.433
Depth at Curb Line-Inches--d	=	3.950

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	4.712
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	7.975
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.831	1.163	0.237	1.400	0.000	100.00
10.000	1.000	1.400	0.000	1.400	0.000	100.00
15.000	1.000	1.400	0.000	1.400	0.000	100.00
20.000	1.000	1.400	0.000	1.400	0.000	100.00
25.000	1.000	1.400	0.000	1.400	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-12-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - ML EB 1216+53 Rt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSK
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.147
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.900 -50yr
SPREAD-Ft.--T	=	12.137 -10' max
Average Velocity-V-fps	=	1.173
FLOW in Gutter-CFS--Q	=	1.068
% Flow in Gutter-CFS	=	56.197
Velocity of Flow in Gutter-fps	=	1.545
Depth at Curb Line-Inches--d	=	4.323

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	5.119
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	9.538
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.737	1.401	0.495	1.896	0.004	99.80
10.000	1.000	1.900	0.000	1.900	0.000	100.00
15.000	1.000	1.900	0.000	1.900	0.000	100.00
20.000	1.000	1.900	0.000	1.900	0.000	100.0[illegible]
25.000	1.000	1.900	0.000	1.900	0.000	100.0[illegible]

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-11-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - ML EB 1222+50 Rt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	4.600 10yr
SPREAD-Ft.--T	=	15.788 16 max
Average Velocity-V-fps	=	1.743
FLOW in Gutter-CFS--Q	=	2.045
% Flow in Gutter-CFS	=	44.453
Velocity of Flow in Gutter-fps	=	2.340
Depth at Curb Line-Inches--d	=	5.199

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.047
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	18.005
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.443	2.039	1.868	3.907	0.693	84.94
10.000	0.768	3.531	0.995	4.526	0.074	98.38
15.000	0.960	4.417	0.183	4.600	0.000	100.00
20.000	1.000	4.600	0.000	4.600	0.000	100.00
25.000	1.000	4.600	0.000	4.600	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-11-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML EB 1222+50 Rt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	6.400 - 50yr
SPREAD-Ft.--T	=	18.068 - 22' max
Average Velocity-V-fps	=	1.876
FLOW in Gutter-CFS--Q	=	2.503
% Flow in Gutter-CFS	=	39.105
Velocity of Flow in Gutter-fps	=	2.534
Depth at Curb Line-Inches--d	=	5.746

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.615
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	21.842
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.374	2.392	2.480	4.872	1.528	76.13
10.000	0.668	4.274	1.640	5.913	0.487	92.40
15.000	0.876	5.608	0.770	6.378	0.022	99.66
20.000	0.988	6.325	0.075	6.400	0.000	100.0
25.000	1.000	6.400	0.000	6.400	0.000	100.0

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-11-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION -ML EB 1226+50 Rt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - ADW
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	4.300 - 10yr
SPREAD-Ft.--T	=	15.353 - 16' max
Average Velocity-V-fps	=	1.717
FLOW in Gutter-CFS--Q	=	1.962
% Flow in Gutter-CFS	=	45.623
Velocity of Flow in Gutter-fps	=	2.303
Depth at Curb Line-Inches--d	=	5.095

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	5.938
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	17.306
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.459	1.972	1.754	3.727	0.573	86.66
10.000	0.788	3.389	0.870	4.259	0.041	99.06
15.000	0.973	4.186	0.114	4.300	0.000	100.00
20.000	1.000	4.300	0.000	4.300	0.000	100.00
25.000	1.000	4.300	0.000	4.300	0.000	100.00

CB 295

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-11-2004

PROJECT NAME- RM   TRACS NO. -
HIGHWAY NAME-   DESIGNER - RSR
LOCATION - ML EB 1226+50 Rt   CHECKER - NDV   PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	6.300 - 50 yr
SPREAD-Ft.--T	=	17.953 - 22' max
Average Velocity-V-fps	=	1.869
FLOW in Gutter-CFS--Q	=	2.479
% Flow in Gutter-CFS	=	39.346
Velocity of Flow in Gutter-fps	=	2.524
Depth at Curb Line-Inches--d	=	5.719

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91 ✓

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.587
Local Gutter Depression-Inches	=	1.000 ✓
Length of opening: TOTAL Intercept--Ft.	=	21.643
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.377	2.374	2.449	4.823	1.477	76.55
10.000	0.672	4.236	1.601	5.837	0.463	92.65
15.000	0.881	5.548	0.735	6.283	0.017	99.74
20.000	0.990	6.239	0.061	6.300	0.000	100.0[illegible]
25.000	1.000	6.300	0.000	6.300	0.000	100.0[illegible]

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-12-2004

PROJECT NAME- RM
TRACS NO.-
HIGHWAY NAME-
DESIGNER - RSR
LOCATION - ML EB 1228+21 Rt
CHECKER - MDK
PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.102
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	2.400 - 10 yr
SPREAD-Ft.--T	=	14.518 - 16' max
Average Velocity-V-fps	=	1.065
FLOW in Gutter-CFS--Q	=	1.153
% Flow in Gutter-CFS	=	48.026
Velocity of Flow in Gutter-fps	=	1.423
Depth at Curb Line-Inches--d	=	4.894

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	5.727
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	10.114
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.707	1.697	0.673	2.370	0.030	98.74
10.000	1.000	2.399	0.001	2.400	0.000	100.00
15.000	1.000	2.400	0.000	2.400	0.000	100.00
20.000	1.000	2.400	0.000	2.400	0.000	100.00
25.000	1.000	2.400	0.000	2.400	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-12-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION -MLEB 1228+21 Rt CHECKER - MDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.102
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	4.100 -50yr
SPREAD-Ft.--T	=	18.096 -22' max
Average Velocity-V-fps	=	1.198
FLOW in Gutter-CFS--Q	=	1.601
% Flow in Gutter-CFS	=	39.046
Velocity of Flow in Gutter-fps	=	1.618
Depth at Curb Line-Inches--d	=	5.753

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.622
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	13.845
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.554	2.270	1.441	3.710	0.390	90.50
10.000	0.900	3.691	0.406	4.098	0.002	99.95
15.000	1.000	4.100	0.000	4.100	0.000	100.00
20.000	1.000	4.100	0.000	4.100	0.000	100.0
25.000	1.000	4.100	0.000	4.100	0.000	100.0

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

04-18-2005

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - ML EB 1229+21.21 Rt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--IN SUMP

GUTTER FLOW HYDRAULICS

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Effective Perimeter--Ft.	=	7.354
Capture Ratio -- GRATE	=	0.500
Capture Ratio -- SLOTTED DRAIN	=	0.500
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	2.400 - 10 yr

LENGTH	Q(Slot. Dn)	Q(Grate)	d(inches)	SPREAD,Ft.
5.000	1.236	1.165	3.306	7.900 ← 16' max
10.000	1.738	0.664	2.404	4.143
15.000	1.979	0.419	1.833	2.280
20.000	2.101	0.299	1.434	1.784
25.000	2.307	0.093	1.233	1.533

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

04-18-2005

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - MLEB 1229+21.21 Rt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--IN SUMP

GUTTER FLOW HYDRAULICS

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Effective Perimeter--Ft.	=	7.354
Capture Ratio -- GRATE	=	0.500
Capture Ratio -- SLOTTED DRAIN	=	0.500
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	4.200 ← 50yr

LENGTH	Q(Slot. Dn)	Q(Grate)	d(inches)	SPREAD,Ft.
5.000	1.677	2.522	5.164	15.640 ← 22' max
10.000	2.797	1.404	3.676	9.440
15.000	3.250	0.949	2.944	6.391
20.000	3.522	0.678	2.435	4.269
25.000	3.695	0.507	2.056	2.692

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-12-2004

PROJECT NAME- RM
TRACS NO.-
HIGHWAY NAME-
DESIGNER - RSR
LOCATION - ML EB 1230+46
CHECKER - [illegible]
PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.127
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	3.000 - 10 yr
SPREAD-Ft.--T	=	15.225 - 16' max
Average Velocity-V-fps	=	1.217
FLOW in Gutter-CFS--Q	=	1.379
% Flow in Gutter-CFS	=	45.978
Velocity of Flow in Gutter-fps	=	1.631
Depth at Curb Line-Inches--d	=	5.064

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	5.906
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	12.092
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.617	1.852	1.020	2.871	0.129	95.71
10.000	0.957	2.872	0.128	3.000	0.000	100.00
15.000	1.000	3.000	0.000	3.000	0.000	100.00
20.000	1.000	3.000	0.000	3.000	0.000	100.00
25.000	1.000	3.000	0.000	3.000	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-12-2004

PROJECT NAME- RM　　　　TRACS NO.-
HIGHWAY NAME-　　　　DESIGNER - RSP
LOCATION - ML EB 1230+46　　　　CHECKER - [illegible]　　　　PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.127
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	4.700 -50yr
SPREAD-Ft.--T	=	18.296 -22' max
Average Velocity-V-fps	=	1.345
FLOW in Gutter-CFS--Q	=	1.816
% Flow in Gutter-CFS	=	38.634
Velocity of Flow in Gutter-fps	=	1.817
Depth at Curb Line-Inches--d	=	5.801

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE:　ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.672
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	15.726
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.498	2.340	1.728	4.068	0.632	86.55
10.000	0.838	3.937	0.727	4.665	0.035	99.25
15.000	0.996	4.681	0.019	4.700	0.000	100.00
20.000	1.000	4.700	0.000	4.700	0.000	100.0[illegible]
25.000	1.000	4.700	0.000	4.700	0.000	100.0[illegible]

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-12-2004

PROJECT NAME- RM   TRACS NO.-
HIGHWAY NAME-   DESIGNER - RSR
LOCATION - ML EB 1234+00 Rt   CHECKER - NDP   PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.410
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	5.900 -10yr
SPREAD-Ft.--T	=	15.799 -16' max
Average Velocity-V-fps	=	2.232
FLOW in Gutter-CFS--Q	=	2.621
% Flow in Gutter-CFS	=	44.430
Velocity of Flow in Gutter-fps	=	2.998
Depth at Curb Line-Inches--d	=	5.202

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.049
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	23.194
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.354	2.089	2.484	4.573	1.327	77.51
10.000	0.638	3.763	1.718	5.480	0.420	92.89
15.000	0.846	4.993	0.886	5.879	0.021	99.64
20.000	0.972	5.734	0.166	5.900	0.000	100.00
25.000	1.000	5.900	0.000	5.900	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-12-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - MLEB 1234+00 Rt CHECKER - [illegible] PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.410
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	8.700 - 50yr
SPREAD-Ft.--T	=	18.508 - 22' max
Average Velocity-V-fps	=	2.435
FLOW in Gutter-CFS--Q	=	3.324
% Flow in Gutter-CFS	=	38.205
Velocity of Flow in Gutter-fps	=	3.292
Depth at Curb Line-Inches--d	=	5.852

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.724
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	29.103
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.288	2.503	3.316	5.819	2.881	66.89
10.000	0.531	4.622	2.588	7.210	1.490	82.88
15.000	0.729	6.338	1.836	8.174	0.526	93.96
20.000	0.877	7.626	1.025	8.651	0.049	99.4
25.000	0.971	8.444	0.256	8.700	0.000	100.0

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-12-2004

PROJECT NAME- RM   TRACS NO.-
HIGHWAY NAME-   DESIGNER - RSR
LOCATION - ML EB 1238+00 Rt   CHECKER - MDV   PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.410
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	5.900 -10yr
SPREAD-Ft.--T	=	15.799 -16' max
Average Velocity-V-fps	=	2.232
FLOW in Gutter-CFS--Q	=	2.621
% Flow in Gutter-CFS	=	44.430
Velocity of Flow in Gutter-fps	=	2.998
Depth at Curb Line-Inches--d	=	5.202

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.049
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	23.194
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.354	2.089	2.484	4.573	1.327	77.51
10.000	0.638	3.763	1.718	5.480	0.420	92.89
15.000	0.846	4.993	0.886	5.879	0.021	99.64
20.000	0.972	5.734	0.166	5.900	0.000	100.00
25.000	1.000	5.900	0.000	5.900	0.000	100.00

CB 309

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-12-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML EB 1238+00 Rt CHECKER - NOV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.410
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	8.600 -50 yr
SPREAD-Ft.--T	=	18.422 -22' max
Average Velocity-V-fps	=	2.429
FLOW in Gutter-CFS--Q	=	3.300
% Flow in Gutter-CFS	=	38.378
Velocity of Flow in Gutter-fps	=	3.283
Depth at Curb Line-Inches--d	=	5.831

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.703
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	28.908
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.290	2.490	3.289	5.779	2.821	67.20
10.000	0.534	4.595	2.560	7.155	1.445	83.20
15.000	0.732	6.296	1.806	8.102	0.498	94.21
20.000	0.880	7.567	0.992	8.559	0.041	99.5
25.000	0.973	8.365	0.235	8.600	0.000	100.0

CB 313

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-12-2004

PROJECT NAME- RM	TRACS NO.-
HIGHWAY NAME-	DESIGNER - RSR
LOCATION - ML EB 1242+25 Rt	CHECKER - NDV	PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.410
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	5.900 - 10yr
SPREAD-Ft.--T	=	15.799 - 16' max
Average Velocity-V-fps	=	2.232
FLOW in Gutter-CFS--Q	=	2.621
% Flow in Gutter-CFS	=	44.430
Velocity of Flow in Gutter-fps	=	2.998
Depth at Curb Line-Inches--d	=	5.202

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.049
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	23.194
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.354	2.089	2.484	4.573	1.327	77.51
10.000	0.638	3.763	1.718	5.480	0.420	92.89
15.000	0.846	4.993	0.886	5.879	0.021	99.64
20.000	0.972	5.734	0.166	5.900	0.000	100.00
25.000	1.000	5.900	0.000	5.900	0.000	100.00

CB 313

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-12-2004

PROJECT NAME- RM		TRACS NO.-	
HIGHWAY NAME-		DESIGNER - RSR	
LOCATION - ML EB 1242+25 Rt		CHECKER - WDV	PAGE
Ver 3.40: December 1995			

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.410
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	8.200 - 50yr
SPREAD-Ft.--T	=	18.071 - 22' max
Average Velocity-V-fps	=	2.403
FLOW in Gutter-CFS--Q	=	3.206
% Flow in Gutter-CFS	=	39.098
Velocity of Flow in Gutter-fps	=	3.245
Depth at Curb Line-Inches--d	=	5.747

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.616
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	28.118
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.297	2.436	3.179	5.615	2.585	68.47
10.000	0.547	4.483	2.447	6.929	1.271	84.50
15.000	0.746	6.121	1.686	7.807	0.393	95.21
20.000	0.893	7.324	0.859	8.182	0.018	99.7[illegible]
25.000	0.981	8.043	0.157	8.200	0.000	100.0[illegible]

CB 320

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-11-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - ML EB 1249+50 Rt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.912
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	12.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.600 -10yr
SPREAD-Ft.--T	=	7.115 -10' max
Average Velocity-V-fps	=	2.359
FLOW in Gutter-CFS--Q	=	1.536
% Flow in Gutter-CFS	=	95.995
Velocity of Flow in Gutter-fps	=	2.518
Depth at Curb Line-Inches--d	=	2.626

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	0.853
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	23.295
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.353	0.564	0.838	1.402	0.198	87.61
10.000	0.636	1.017	0.529	1.546	0.054	96.65
15.000	0.844	1.351	0.248	1.599	0.001	99.91
20.000	0.970	1.553	0.047	1.600	0.000	100.00
25.000	1.000	1.600	0.000	1.600	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-11-2004

PROJECT NAME- RM   TRACS NO.-
HIGHWAY NAME-   DESIGNER - RSR
LOCATION - MLED 1249+50 Rt   CHECKER - NDV   PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.912
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	12.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	2.600 - 50 yr
SPREAD-Ft.--T	=	9.130 - 10' max
Average Velocity-V-fps	=	2.585
FLOW in Gutter-CFS--Q	=	2.307
% Flow in Gutter-CFS	=	88.717
Velocity of Flow in Gutter-fps	=	2.915
Depth at Curb Line-Inches--d	=	3.109

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	0.848
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	29.165
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.287	0.747	1.300	2.047	0.553	78.73
10.000	0.530	1.379	0.953	2.332	0.268	89.67
15.000	0.727	1.891	0.617	2.509	0.091	96.48
20.000	0.876	2.276	0.318	2.594	0.006	99.7[illegible]
25.000	0.970	2.522	0.078	2.600	0.000	100.0[illegible]

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-11-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - ML EB 1250+90 Rt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - A/DL
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.988
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	12.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.700 -10yr
SPREAD-Ft.--T	=	7.194 -10 max
Average Velocity-V-fps	=	2.465
FLOW in Gutter-CFS--Q	=	1.628
% Flow in Gutter-CFS	=	95.750
Velocity of Flow in Gutter-fps	=	2.638
Depth at Curb Line-Inches--d	=	2.645

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	1.173
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	24.496
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.337	0.573	0.898	1.471	0.229	86.55
10.000	0.611	1.039	0.588	1.627	0.073	95.69
15.000	0.818	1.391	0.305	1.696	0.004	99.76
20.000	0.953	1.620	0.080	1.700	0.000	100.00
25.000	1.000	1.700	0.000	1.700	0.000	100.00

CB 321

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-11-2004

PROJECT NAME- RM	TRACS NO.-		
HIGHWAY NAME-	DESIGNER - RSR		
LOCATION - ML EB 1250+90 Rt	CHECKER - VDV	PAGE	

Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.988
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	12.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	3.000 - 50yr
SPREAD-Ft.--T	=	9.595 - 10 max
Average Velocity-V-fps	=	2.745
FLOW in Gutter-CFS--Q	=	2.606
% Flow in Gutter-CFS	=	86.865
Velocity of Flow in Gutter-fps	=	3.128
Depth at Curb Line-Inches--d	=	3.221

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	0.840
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	31.899
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.264	0.793	1.480	2.273	0.727	75.77
10.000	0.492	1.476	1.132	2.608	0.392	86.94
15.000	0.681	2.044	0.788	2.832	0.168	94.40
20.000	0.831	2.492	0.475	2.967	0.033	98.9[illegible]
25.000	0.936	2.809	0.190	3.000	0.000	99.[illegible]

LB 322

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-11-2004

PROJECT NAME- RM   TRACS NO.-
HIGHWAY NAME-   DESIGNER - RSR
LOCATION - MLEB 1252+25 Rt   CHECKER - UDV   PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.022
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	12.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	4.100 - 10yr
SPREAD-Ft.--T	=	11.011 < 18' max.
Average Velocity-V-fps	=	2.961
FLOW in Gutter-CFS--Q	=	3.329
% Flow in Gutter-CFS	=	81.203
Velocity of Flow in Gutter-fps	=	3.466
Depth at Curb Line-Inches--d	=	3.561

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	0.000
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	37.364
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.228	0.934	1.901	2.835	1.265	69.14
10.000	0.429	1.760	1.546	3.306	0.794	80.62
15.000	0.603	2.472	1.191	3.664	0.436	89.36
20.000	0.748	3.068	0.839	3.907	0.193	95.30
25.000	0.863	3.540	0.516	4.056	0.044	98.92

CB 322

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-11-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - MLEB 1252+25 Rt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - [illegible]
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.022
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	12.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	6.500 - 50yr
SPREAD-Ft.--T	=	13.496 - 24' max
Average Velocity-V-fps	=	3.261
FLOW in Gutter-CFS--Q	=	4.675
% Flow in Gutter-CFS	=	71.919
Velocity of Flow in Gutter-fps	=	3.947
Depth at Curb Line-Inches--d	=	4.157

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	1.746
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	46.662
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.185	1.200	2.660	3.860	2.640	59.38
10.000	0.352	2.289	2.294	4.583	1.917	70.51
15.000	0.502	3.266	1.928	5.194	1.306	79.91
20.000	0.635	4.127	1.561	5.688	0.812	87.5[illegible]
25.000	0.749	4.867	1.194	6.061	0.439	93.2[illegible]

CB 336

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-10-2004

PROJECT NAME- RM	TRACS NO.-		
HIGHWAY NAME-	DESIGNER - RSR		
LOCATION - ML EB 1255+66 Rt	CHECKER -	PAGE	

Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.200
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	12.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	8.300 - 10yr
SPREAD-Ft.--T	=	14.475 - 18' max
Average Velocity-V-fps	=	3.660
FLOW in Gutter-CFS--Q	=	5.695
% Flow in Gutter-CFS	=	68.612
Velocity of Flow in Gutter-fps	=	4.476
Depth at Curb Line-Inches--d	=	4.392

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	1.347
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	54.832
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.158	1.312	3.217	4.530	3.770	54.58
10.000	0.304	2.523	2.853	5.377	2.923	64.78
15.000	0.437	3.631	2.490	6.121	2.179	73.74
20.000	0.558	4.632	2.126	6.758	1.542	81.43
25.000	0.666	5.525	1.762	7.287	1.013	87.80

CB 336

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-10-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML EB 1255+66 Rt CHECKER - [illegible] PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G = 1.200
Roadway Cross-Slope-Ft./Ft.--Sx = 0.020
Shoulder Width-Ft.-- = 12.000
Shoulder Slope-Ft./Ft.--Ss = 0.020
Gutter Width-Ft.--W = 4.500
Gutter Slope-Ft./Ft.--Sw = 0.037
Gutter Depression-Inches-- = 1.998
Manning's 'N = 0.016

Flow-CFS--Q = 11.500 - 50yr
SPREAD-Ft.--T = 16.586 - 24' max
Average Velocity-V-fps = 3.934

FLOW in Gutter-CFS--Q = 7.154
% Flow in Gutter-CFS = 62.204
Velocity of Flow in Gutter-fps = 4.892
Depth at Curb Line-Inches--d = 4.899

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft. = 3.354
Grate Width---Ft. = 2.000
Grate Area--Sq. Ft. = 5.171
Splash-Over Velocity--FPS = 7.354

Depth at INLET Curb Line-Inches--d = 3.033
Local Gutter Depression-Inches = 0.000

Length of opening: TOTAL Intercept--Ft. = 64.215
Capture Ratio -- SLOTTED DRAIN = 0.670
Capture Ratio -- GRATE = 0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.136	1.561	4.005	5.566	5.934	48.40
10.000	0.263	3.021	3.630	6.651	4.849	57.83
15.000	0.381	4.376	3.257	7.633	3.867	66.37
20.000	0.489	5.625	2.884	8.509	2.991	73.9[illegible]
25.000	0.588	6.767	2.512	9.278	2.222	80.6[illegible]

LB 343

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

04-18-2005

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - MLEB 1266+10 Rt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--IN SUMP

GUTTER FLOW HYDRAULICS

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.037
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.037
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998

GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Effective Perimeter--Ft.	=	7.350
Capture Ratio -- GRATE	=	0.500
Capture Ratio -- SLOTTED DRAIN	=	0.500
Local Gutter Depression-Inches	=	0.000
Flow-CFS--Q	=	4.600 - 10 yr/18' max

LENGTH	Q(Slot. Dn)	Q(Grate)	d(inches)	SPREAD,Ft.
5.000	1.608	2.991	5.666	12.761
10.000	2.611	1.989	4.466	10.058
15.000	3.093	1.507	3.816	8.594
20.000	3.404	1.195	3.358	7.562
25.000	3.620	0.979	3.015	6.790

* Use 100' of slotted drain to drain edge sump and avoid conflict with FRS.

CB 343

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

04-18-2005

PROJECT NAME- RM | TRACS NO.-
HIGHWAY NAME- | DESIGNER - RSR
LOCATION - MLEB 1266+10 Rt | CHECKER - NDV | PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--IN SUMP

GUTTER FLOW HYDRAULICS

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.037
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.037
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998

GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Effective Perimeter--Ft.	=	7.350
Capture Ratio -- GRATE	=	0.500
Capture Ratio -- SLOTTED DRAIN	=	0.500
Local Gutter Depression-Inches	=	0.000
Flow-CFS--Q	=	6.800 - 50 yr/24' Max

LENGTH	Q(Slot. Dn)	Q(Grate)	d(inches)	SPREAD,Ft.
5.000	1.870	4.929	7.656	17.244
10.000	3.355	3.444	6.163	13.880
15.000	4.478	2.322	4.883	10.998
20.000	4.936	1.863	4.301	9.688
25.000	5.256	1.542	3.865	8.706

CP 345

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-10-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - MLEB 1269+50 Rt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSP
CHECKER - VDV
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.554
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.050
Shoulder Width-Ft.--	=	12.000
Shoulder Slope-Ft./Ft.--Ss	=	0.050
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	4.100 - 10 yr
SPREAD-Ft.--T	=	8.180 - 18 max
Average Velocity-V-fps	=	2.660
FLOW in Gutter-CFS--Q	=	3.529
% Flow in Gutter-CFS	=	86.076
Velocity of Flow in Gutter-fps	=	2.934
Depth at Curb Line-Inches--d	=	4.206

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	2.924
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	28.618
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.292	1.198	1.826	3.024	1.076	73.75
10.000	0.539	2.209	1.317	3.526	0.574	86.00
15.000	0.737	3.023	0.848	3.871	0.229	94.41
20.000	0.885	3.627	0.435	4.062	0.038	99.08
25.000	0.976	4.001	0.099	4.100	0.000	100.00

CB 345

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-10-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML EB 1269+50 Rt CHECKER - NBV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.554
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.050
Shoulder Width-Ft.--	=	12.000
Shoulder Slope-Ft./Ft.--Ss	=	0.050
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	5.700 -50yr
SPREAD-Ft.--T	=	9.150 -24' max
Average Velocity-V-fps	=	2.906
FLOW in Gutter-CFS--Q	=	4.635
% Flow in Gutter-CFS	=	81.320
Velocity of Flow in Gutter-fps	=	3.262
Depth at Curb Line-Inches--d	=	4.788

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	1.023
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	32.555
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.259	1.478	2.416	3.894	1.806	68.32
10.000	0.483	2.756	1.846	4.601	1.099	80.73
15.000	0.671	3.825	1.309	5.133	0.567	90.06
20.000	0.820	4.674	0.816	5.490	0.210	96.3[illegible]
25.000	0.928	5.289	0.387	5.676	0.024	99.5[illegible]

CB 348

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

03-14-2005

PROJECT NAME- RM	TRACS NO.-		
HIGHWAY NAME-	DESIGNER - RSR		
LOCATION - ML EB 1279+50	CHECKER -	PAGE	

Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.100
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.050
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.050
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	4.700 -10yr
SPREAD-Ft.--T	=	7.636 - 18' max
Average Velocity-V-fps	=	3.545
FLOW in Gutter-CFS--Q	=	4.175
% Flow in Gutter-CFS	=	88.833
Velocity of Flow in Gutter-fps	=	3.865
Depth at Curb Line-Inches--d	=	3.879

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	2.260
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	37.441
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.227	1.069	2.217	3.286	1.414	69.92
10.000	0.428	2.013	1.768	3.781	0.919	80.45
15.000	0.602	2.830	1.341	4.171	0.529	88.73
20.000	0.747	3.512	0.942	4.453	0.247	94.75
25.000	0.862	4.053	0.582	4.635	0.065	98.62
30.000	0.945	4.444	0.255	4.699	0.001	99.98

CB 348

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

03-14-2005

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - MLEB 1279+50
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - [illegible]
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.100
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.050
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.050
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	6.500 - 50yr
SPREAD-Ft.--T	=	8.512 - 24' max
Average Velocity-V-fps	=	3.869
FLOW in Gutter-CFS--Q	=	5.487 - 50yr
% Flow in Gutter-CFS	=	84.419 - 24
Velocity of Flow in Gutter-fps	=	4.296
Depth at Curb Line-Inches--d	=	4.405

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	1.285
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	42.523
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.202	1.310	2.890	4.200	2.300	64.62
10.000	0.383	2.488	2.389	4.877	1.623	75.03
15.000	0.543	3.529	1.907	5.437	1.063	83.64
20.000	0.681	4.429	1.450	5.879	0.621	90.4[illegible]
25.000	0.797	5.182	1.022	6.204	0.296	95.4[illegible]
30.000	0.889	5.780	0.633	6.413	0.087	98.66

CB 351

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

03-14-2005

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - MLEB 1284+90 Rt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	2.216
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.050
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.050
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	5.300 -10 yr
SPREAD-Ft.--T	=	7.080 -10 max
Average Velocity-V-fps	=	4.726
FLOW in Gutter-CFS--Q	=	4.857
% Flow in Gutter-CFS	=	91.645
Velocity of Flow in Gutter-fps	=	5.086
Depth at Curb Line-Inches--d	=	3.546

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	1.892
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	48.868
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.177	0.936	2.673	3.608	1.692	68.08
10.000	0.338	1.790	2.270	4.060	1.240	76.60
15.000	0.483	2.561	1.881	4.442	0.858	83.81
20.000	0.612	3.245	1.509	4.754	0.546	89.71
25.000	0.725	3.841	1.156	4.997	0.303	94.27
30.000	0.820	4.344	0.830	5.175	0.125	97.63

CB 351

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

03-14-2005

PROJECT NAME- Em	TRACS NO.-		
HIGHWAY NAME-	DESIGNER - RSR		
LOCATION - mLEB 1284+90 Rt	CHECKER - ADV	PAGE	

Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	2.216
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.050
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.050
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	7.700 - 50yr
SPREAD-Ft.--T	=	8.009 - 10' max
Average Velocity-V-fps	=	5.231
FLOW in Gutter-CFS--Q	=	6.694
% Flow in Gutter-CFS	=	86.939
Velocity of Flow in Gutter-fps	=	5.750
Depth at Curb Line-Inches--d	=	4.104

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	1.845
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	56.624
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.153	1.180	3.599	4.780	2.920	62.07
10.000	0.295	2.273	3.143	5.416	2.284	70.34
15.000	0.425	3.275	2.700	5.975	1.725	77.60
20.000	0.544	4.185	2.272	6.457	1.243	83.8[illegible]
25.000	0.650	5.002	1.860	6.861	0.839	89.1[illegible]
30.000	0.743	5.720	1.466	7.187	0.513	93.34

CB 387

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

03-14-2005

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION -MLEB 1291+71 Rt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - MDV
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	2.960
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.050
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.050
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	6.800 -10 yr
SPREAD-Ft.--T	=	7.326 -10 max
Average Velocity-V-fps	=	5.620
FLOW in Gutter-CFS--Q	=	6.148
% Flow in Gutter-CFS	=	90.407
Velocity of Flow in Gutter-fps	=	6.084
Depth at Curb Line-Inches--d	=	3.693

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	2.260
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	59.034
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.147	1.001	3.388	4.389	2.411	64.55
10.000	0.284	1.931	2.975	4.906	1.894	72.14
15.000	0.410	2.788	2.573	5.361	1.439	78.84
20.000	0.525	3.571	2.184	5.754	1.046	84.62
25.000	0.629	4.277	1.809	6.086	0.714	89.50
30.000	0.721	4.904	1.450	6.355	0.445	93.45

LB
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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

03-14-2005

PROJECT NAME-	RM	TRACS NO.-	
HIGHWAY NAME-		DESIGNER -	RSR
LOCATION	-ML EB 129+71 Rt	CHECKER -	NDV	PAGE

Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	2.960
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.050
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.050
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	9.900 -50yr
SPREAD-Ft.--T	=	8.301 -10' max
Average Velocity-V-fps	=	6.222
FLOW in Gutter-CFS--Q	=	8.462
% Flow in Gutter-CFS	=	85.470
Velocity of Flow in Gutter-fps	=	6.880
Depth at Curb Line-Inches--d	=	4.279

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	2.260
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	68.435
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.128	1.264	4.545	5.808	4.092	58.67
10.000	0.247	2.450	4.077	6.528	3.372	65.94
15.000	0.359	3.558	3.621	7.179	2.721	72.51
20.000	0.463	4.586	3.175	7.761	2.139	78.4[illegible]
25.000	0.559	5.532	2.742	8.275	1.625	83.5[illegible]
30.000	0.646	6.395	2.323	8.719	1.181	88.07

CB 368

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

12-09-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML EB 1301+30 Rt CHECKER - PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	2.725
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.033
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.033
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	5.800 -10 yr
SPREAD-Ft.--T	=	7.788 - 16' max
Average Velocity-V-fps	=	5.226
FLOW in Gutter-CFS--Q	=	4.127
% Flow in Gutter-CFS	=	71.152
Velocity of Flow in Gutter-fps	=	6.379
Depth at Curb Line-Inches--d	=	4.110

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	4.817
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	32.817
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.257	1.493	3.585	5.077	0.723	87.54
10.000	0.480	2.785	2.744	5.529	0.271	95.33
15.000	0.667	3.868	1.885	5.753	0.047	99.19
20.000	0.816	4.732	1.068	5.800	0.000	100.00
25.000	0.924	5.362	0.438	5.800	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

12-09-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - ML EB 1301+30 Rt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - [illegible]
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	2.725
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.033
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.033
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	8.000-50yr
SPREAD-Ft.--T	=	8.942-22 in max
Average Velocity-V-fps	=	5.597
FLOW in Gutter-CFS--Q	=	5.167
% Flow in Gutter-CFS	=	64.592
Velocity of Flow in Gutter-fps	=	6.960
Depth at Curb Line-Inches--d	=	4.569

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	5.315
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	38.923
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.219	1.754	4.637	6.391	1.609	79.88
10.000	0.414	3.312	3.807	7.120	0.880	89.00
15.000	0.584	4.669	2.965	7.633	0.367	95.42
20.000	0.727	5.816	2.103	7.918	0.082	98.9
25.000	0.843	6.743	1.255	7.997	0.003	99.9

CB 375

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

12-09-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - ML EB 1305+91 Rt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - [illegible]
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.589
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	7.300 - 10 yr
SPREAD-Ft.--T	=	12.990 - 16' max
Average Velocity-V-fps	=	3.980
FLOW in Gutter-CFS--Q	=	3.872
% Flow in Gutter-CFS	=	53.035
Velocity of Flow in Gutter-fps	=	5.275
Depth at Curb Line-Inches--d	=	4.528

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	5.338
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	35.205
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.241	1.759	3.674	5.433	1.867	74.43
10.000	0.452	3.300	3.013	6.313	0.987	86.48
15.000	0.632	4.613	2.319	6.932	0.368	94.95
20.000	0.779	5.689	1.561	7.250	0.050	99.32
25.000	0.892	6.514	0.786	7.300	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

12-09-2004

PROJECT NAME- R/M TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML EB 1305+91 Rt CHECKER - [illegible] PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.589
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	10.800 - 50yr
SPREAD-Ft.--T	=	15.330 - 22' max
Average Velocity-V-fps	=	4.325
FLOW in Gutter-CFS--Q	=	4.935
% Flow in Gutter-CFS	=	45.693
Velocity of Flow in Gutter-fps	=	5.800
Depth at Curb Line-Inches--d	=	5.089

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	5.931
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	44.347
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.194	2.092	4.775	6.867	3.933	63.59
10.000	0.369	3.982	4.150	8.131	2.669	75.29
15.000	0.524	5.663	3.512	9.175	1.625	84.95
20.000	0.660	7.130	2.840	9.970	0.830	92.3[illegible]
25.000	0.775	8.373	2.157	10.531	0.269	97.5[illegible]

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

12-09-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - ML EB 1306+33 Rt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.486
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.003
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.003
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.600 - 10yr
SPREAD-Ft.--T	=	4.870 - 16 max
Average Velocity-V-fps	=	2.585
FLOW in Gutter-CFS--Q	=	0.598
% Flow in Gutter-CFS	=	99.616
Velocity of Flow in Gutter-fps	=	2.659
Depth at Curb Line-Inches--d	=	2.084

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	2.428
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	9.707
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.728	0.437	0.163	0.600	0.000	100.00
10.000	1.000	0.600	0.000	0.600	0.000	100.00
15.000	1.000	0.600	0.000	0.600	0.000	100.00
20.000	1.000	0.600	0.000	0.600	0.000	100.00
25.000	1.000	0.600	0.000	0.600	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

12-09-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - MLEB 1306+33 Rt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.486
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.003
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.003
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.100 - 50yr
SPREAD-Ft.--T	=	15.854 - 22' - ex
Average Velocity-V-fps	=	2.083
FLOW in Gutter-CFS--Q	=	0.889
% Flow in Gutter-CFS	=	80.815
Velocity of Flow in Gutter-fps	=	3.001
Depth at Curb Line-Inches--d	=	2.427

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	3.048
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	12.523
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.600	0.660	0.440	1.100	0.000	100.00
10.000	0.944	1.038	0.062	1.100	0.000	100.00
15.000	1.000	1.100	0.000	1.100	0.000	100.00
20.000	1.000	1.100	0.000	1.100	0.000	100.00
25.000	1.000	1.100	0.000	1.100	0.000	100.0

APPENDIX D

CATCH BASIN DESIGN

Westbound Main Line Catch Basin Calculations

LB
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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

03-23-2005

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML WB 1060+67 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	2.749
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.050
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.050
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.050
Gutter Depression-Inches--	=	2.700
Manning's 'N	=	0.016
Flow-CFS--Q	=	10.600 - 10yr
SPREAD-Ft.--T	=	8.152 - 18' max
Average Velocity-V-fps	=	6.381
FLOW in Gutter-CFS--Q	=	9.355
% Flow in Gutter-CFS	=	88.251
Velocity of Flow in Gutter-fps	=	7.045
Depth at Curb Line-Inches--d	=	4.891

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	3.327
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	59.240
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.147	1.556	5.168	6.723	3.877	63.43
10.000	0.283	3.001	4.610	7.611	2.989	71.80
15.000	0.409	4.333	4.006	8.338	2.262	78.66
20.000	0.524	5.550	3.415	8.964	1.636	84.57
25.000	0.627	6.648	2.840	9.488	1.112	89.51

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

03-23-2005

PROJECT NAME- RM
TRACS NO.-
HIGHWAY NAME-
DESIGNER - RSR
LOCATION - ML WB 1074+58 Lt
CHECKER - NDV
PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.231
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.020
Gutter Depression-Inches--	=	1.080
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.700 - 10yr
SPREAD-Ft.--T	=	8.297 - 18' max
Average Velocity-V-fps	=	1.017
FLOW in Gutter-CFS--Q	=	0.613
% Flow in Gutter-CFS	=	87.572
Velocity of Flow in Gutter-fps	=	1.126
Depth at Curb Line-Inches--d	=	1.991

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	0.864
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	15.604
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.501	0.351	0.282	0.633	0.067	90.39
10.000	0.842	0.589	0.106	0.695	0.005	99.27
15.000	0.997	0.698	0.002	0.700	0.000	100.00
20.000	1.000	0.700	0.000	0.700	0.000	100.0[illegible]
25.000	1.000	0.700	0.000	0.700	0.000	100.0[illegible]

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

09-27-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - ML WB 1096+41
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - MDV
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.352
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	5.800 - 10yr
SPREAD-Ft.--T	=	16.187 - 16'
Average Velocity-V-fps	=	2.096
FLOW in Gutter-CFS--Q	=	2.519
% Flow in Gutter-CFS	=	43.430
Velocity of Flow in Gutter-fps	=	2.819
Depth at Curb Line-Inches--d	=	5.295

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.146
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	22.220
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.368	2.134	2.396	4.531	1.269	78.12
10.000	0.659	3.823	1.609	5.432	0.368	93.65
15.000	0.868	5.033	0.756	5.789	0.011	99.81
20.000	0.984	5.708	0.092	5.800	0.000	100.00
25.000	1.000	5.800	0.000	5.800	0.000	100.00
30.000	1.000	5.800	0.000	5.800	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

09-27-2004

PROJECT NAME- RM
TRACS NO.-
HIGHWAY NAME-
DESIGNER - RSR
LOCATION - ML WB 1096+41
CHECKER - NDV
PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.352
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	8.000 - 50yr
SPREAD-Ft.--T	=	18.449 - 22' max
Average Velocity-V-fps	=	2.253
FLOW in Gutter-CFS--Q	=	3.066
% Flow in Gutter-CFS	=	38.323
Velocity of Flow in Gutter-fps	=	3.045
Depth at Curb Line-Inches--d	=	5.838

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.709
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	26.810
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.310	2.483	3.064	5.546	2.454	69.33
10.000	0.568	4.547	2.310	6.857	1.143	85.71
15.000	0.771	6.171	1.521	7.692	0.308	96.16
20.000	0.915	7.321	0.674	7.995	0.005	99.9[illegible]
25.000	0.992	7.937	0.063	8.000	0.000	100.0[illegible]
30.000	1.000	8.000	0.000	8.000	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

04-20-2005

PROJECT NAME- RM
TRACS NO.-
HIGHWAY NAME-
DESIGNER - RSR
LOCATION - MLWB 1097+42.90
CHECKER - NDV
PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--IN SUMP

GUTTER FLOW HYDRAULICS

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Effective Perimeter--Ft.	=	7.354
Capture Ratio -- GRATE	=	0.500
Capture Ratio -- SLOTTED DRAIN	=	0.500
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	2.400 - 10yr

LENGTH	Q(Slot. Dn)	Q(Grate)	d(inches)	SPREAD,Ft.
5.000	1.236	1.165	3.306	7.900 ← 16' max
10.000	1.738	0.664	2.404	4.143
15.000	1.979	0.419	1.833	2.280
20.000	2.101	0.299	1.434	1.784

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

04-20-2005

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - MLWB 1097+42.90 CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--IN SUMP

GUTTER FLOW HYDRAULICS

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Effective Perimeter--Ft.	=	7.354
Capture Ratio -- GRATE	=	0.500
Capture Ratio -- SLOTTED DRAIN	=	0.500
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	3.800 - 50yr

LENGTH	Q(Slot. Dn)	Q(Grate)	d(inches)	SPREAD,Ft.
5.000	1.619	2.181	4.741	13.880 ← 22' max
10.000	2.567	1.234	3.416	8.356
15.000	2.975	0.824	2.718	5.451
20.000	3.215	0.583	2.232	3.426

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

03-23-2005

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML WB 1098+45 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.284
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	3.500 - 10yr
SPREAD-Ft.--T	=	13.711 - 18' max
Average Velocity-V-fps	=	1.727
FLOW in Gutter-CFS--Q	=	1.770
% Flow in Gutter-CFS	=	50.570
Velocity of Flow in Gutter-fps	=	2.299
Depth at Curb Line-Inches--d	=	4.701

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	5.522
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	15.754
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.497	1.740	1.461	3.201	0.299	91.45
10.000	0.837	2.929	0.568	3.497	0.003	99.92
15.000	0.996	3.485	0.015	3.500	0.000	100.00
20.000	1.000	3.500	0.000	3.500	0.000	100.00
25.000	1.000	3.500	0.000	3.500	0.000	100.00

CB 119

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

03-23-2005

PROJECT NAME- RM　　TRACS NO.-
HIGHWAY NAME-　　DESIGNER - RSP
LOCATION - ML WB 1098+45 Lt　　CHECKER - NDW　　PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.284
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	5.200 - 50 yr
SPREAD-Ft.--T	=	16.178 - 22' max
Average Velocity-V-fps	=	1.881
FLOW in Gutter-CFS--Q	=	2.259
% Flow in Gutter-CFS	=	43.448
Velocity of Flow in Gutter-fps	=	2.529
Depth at Curb Line-Inches--d	=	5.293

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.145
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	19.888
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.406	2.112	2.122	4.235	0.965	81.43
10.000	0.716	3.722	1.288	5.009	0.191	96.34
15.000	0.920	4.784	0.416	5.200	0.000	100.00
20.000	1.000	5.200	0.000	5.200	0.000	100.0
25.000	1.000	5.200	0.000	5.200	0.000	100.0

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

03-23-2005

PROJECT NAME- RM   TRACS NO.-
HIGHWAY NAME-   DESIGNER - RSR
LOCATION - ML WB 110+50 Lt   CHECKER - NDV   PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.284
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	3.900 - 10yr
SPREAD-Ft.--T	=	14.354 - 16' max
Average Velocity-V-fps	=	1.767
FLOW in Gutter-CFS--Q	=	1.893
% Flow in Gutter-CFS	=	48.531
Velocity of Flow in Gutter-fps	=	2.360
Depth at Curb Line-Inches--d	=	4.855

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	5.685
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	16.792
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.471	1.836	1.631	3.467	0.433	88.90
10.000	0.804	3.135	0.750	3.885	0.015	99.62
15.000	0.982	3.831	0.069	3.900	0.000	100.00
20.000	1.000	3.900	0.000	3.900	0.000	100.00
25.000	1.000	3.900	0.000	3.900	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

03-23-2005

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - ML WB 1101+50 Lt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.284
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	5.400 -50yr
SPREAD-Ft.--T	=	16.431 - 22' max
Average Velocity-V-fps	=	1.897
FLOW in Gutter-CFS--Q	=	2.312
% Flow in Gutter-CFS	=	42.818
Velocity of Flow in Gutter-fps	=	2.552
Depth at Curb Line-Inches--d	=	5.353

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.208
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	20.333
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.398	2.151	2.191	4.342	1.058	80.42
10.000	0.704	3.803	1.362	5.166	0.234	95.66
15.000	0.910	4.915	0.484	5.399	0.001	99.98
20.000	0.999	5.397	0.003	5.400	0.000	100.0
25.000	1.000	5.400	0.000	5.400	0.000	100.0

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

09-23-2004

PROJECT NAME- RM		TRACS NO.-	
HIGHWAY NAME-		DESIGNER - RSR	
LOCATION - ML WB 1108+00 LT		CHECKER - NDV	PAGE

Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.416
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	7.500
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.000 - 10 yr
SPREAD-Ft.--T	=	6.873 - 8' max
Average Velocity-V-fps	=	1.615
FLOW in Gutter-CFS--Q	=	0.830
% Flow in Gutter-CFS	=	82.968
Velocity of Flow in Gutter-fps	=	1.938
Depth at Curb Line-Inches--d	=	3.059

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	1.000
GUTTER FLOW at INLET-CFS--Q	=	0.949
Gutter Velocity at INLET-fps	=	2.099
Depth at INLET Curb Line-Inches--d	=	3.676
Frontal Flow Intercepted by GRATE--CFS	=	0.903
Lateral Flow Intercepted by GRATE--CFS	=	0.062
TOTAL Flow Intercepted by GRATE--CFS	=	0.965
% FLOW Intercepted	=	96.543
By-pass Flow--CFS	=	0.035 ←

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

09-23-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML WB 1108+00 LT CHECKER - NDV PAGE
Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.416
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	7.500
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.500 - 50yr
SPREAD-Ft.--T	=	8.528 - 8' max
Average Velocity-V-fps	=	1.716
FLOW in Gutter-CFS--Q	=	1.100
% Flow in Gutter-CFS	=	73.319
Velocity of Flow in Gutter-fps	=	2.153
Depth at Curb Line-Inches--d	=	3.457

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	1.500
GUTTER FLOW at INLET-CFS--Q	=	1.286
Gutter Velocity at INLET-fps	=	2.331
Depth at INLET Curb Line-Inches--d	=	4.154
Frontal Flow Intercepted by GRATE--CFS	=	1.197
Lateral Flow Intercepted by GRATE--CFS	=	0.141
TOTAL Flow Intercepted by GRATE--CFS	=	1.338
% FLOW Intercepted	=	89.178
By-pass Flow--CFS	=	0.162

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

09-23-2004

PROJECT NAME- RM   TRACS NO.-
HIGHWAY NAME-   DESIGNER - RSR
LOCATION - ML WB 1108+75 Lt   CHECKER - NDK   PAGE
Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.378
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	7.500
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.000 - 10yr
SPREAD-Ft.--T	=	7.060 - 8' max
Average Velocity-V-fps	=	1.550
FLOW in Gutter-CFS--Q	=	0.818
% Flow in Gutter-CFS	=	81.842
Velocity of Flow in Gutter-fps	=	1.871
Depth at Curb Line-Inches--d	=	3.104 - 6" max

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	1.000
GUTTER FLOW at INLET-CFS--Q	=	0.940
Gutter Velocity at INLET-fps	=	2.026
Depth at INLET Curb Line-Inches--d	=	3.732
Frontal Flow Intercepted by GRATE--CFS	=	0.892
Lateral Flow Intercepted by GRATE--CFS	=	0.069
TOTAL Flow Intercepted by GRATE--CFS	=	0.961
% FLOW Intercepted	=	96.103
By-pass Flow--CFS	=	0.039

• 80 LF Slotted Drain

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

09-23-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - ML WB 1108+75 Lt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.378
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	7.500
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.500 - 50yr
SPREAD-Ft.--T	=	8.735 - 8' max
Average Velocity-V-fps	=	1.649
FLOW in Gutter-CFS--Q	=	1.083
% Flow in Gutter-CFS	=	72.174
Velocity of Flow in Gutter-fps	=	2.077
Depth at Curb Line-Inches--d	=	3.506

spread @ upstream end of slotted drain Ok.

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	1.500
GUTTER FLOW at INLET-CFS--Q	=	1.267
Gutter Velocity at INLET-fps	=	2.248
Depth at INLET Curb Line-Inches--d	=	4.211
Frontal Flow Intercepted by GRATE--CFS	=	1.177
Lateral Flow Intercepted by GRATE--CFS	=	0.151
TOTAL Flow Intercepted by GRATE--CFS	=	1.328
% FLOW Intercepted	=	88.539
By-pass Flow--CFS	=	0.172

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

09-23-2004

PROJECT NAME-	RM	TRACS NO.-	
HIGHWAY NAME-		DESIGNER -	RSR
LOCATION -	ML WB 1109+50 Lt	CHECKER -	NDV	PAGE

Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.319
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	7.500
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.900 - 10 yr
SPREAD-Ft.--T	=	6.979 - 8' max
Average Velocity-V-fps	=	1.420
FLOW in Gutter-CFS--Q	=	0.741
% Flow in Gutter-CFS	=	82.328
Velocity of Flow in Gutter-fps	=	1.710
Depth at Curb Line-Inches--d	=	3.085 - 6" max

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000 ✓
Flow-CFS--Q	=	0.900
GUTTER FLOW at INLET-CFS--Q	=	0.850
Gutter Velocity at INLET-fps	=	1.851
Depth at INLET Curb Line-Inches--d	=	3.708
Frontal Flow Intercepted by GRATE--CFS	=	0.807
Lateral Flow Intercepted by GRATE--CFS	=	0.063
TOTAL Flow Intercepted by GRATE--CFS	=	0.871
% FLOW Intercepted	=	96.732
By-pass Flow--CFS	=	0.029 ←

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

09-23-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML WB 1109+50 LT CHECKER - NDV PAGE
Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.319
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	7.500
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.500 - 50yr
SPREAD-Ft.--T	=	9.107 - 8' max
Average Velocity-V-fps	=	1.537
FLOW in Gutter-CFS--Q	=	1.052
% Flow in Gutter-CFS	=	70.162
Velocity of Flow in Gutter-fps	=	1.950
Depth at Curb Line-Inches--d	=	3.596

Spread @ upstream end of slotted drain OK.

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	1.500
GUTTER FLOW at INLET-CFS--Q	=	1.234
Gutter Velocity at INLET-fps	=	2.109
Depth at INLET Curb Line-Inches--d	=	4.314
Frontal Flow Intercepted by GRATE--CFS	=	1.141
Lateral Flow Intercepted by GRATE--CFS	=	0.171
TOTAL Flow Intercepted by GRATE--CFS	=	1.312
% FLOW Intercepted	=	87.465
By-pass Flow--CFS	=	0.188

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

09-23-2004

PROJECT NAME- RM   TRACS NO.-
HIGHWAY NAME-   DESIGNER - RSR
LOCATION -ML WB 1110+25 LT   CHECKER - NDr   PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.238
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	2.300 - 10yr
SPREAD-Ft.--T	=	11.874 - 16' max
Average Velocity-V-fps	=	1.477
FLOW in Gutter-CFS--Q	=	1.317
% Flow in Gutter-CFS	=	57.257
Velocity of Flow in Gutter-fps	=	1.942
Depth at Curb Line-Inches--d	=	4.260 - 6" max

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	5.051
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	11.843
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.627	1.443	0.824	2.267	0.033	98.57
10.000	0.965	2.219	0.081	2.300	0.000	100.00
15.000	1.000	2.300	0.000	2.300	0.000	100.00
20.000	1.000	2.300	0.000	2.300	0.000	100.00
25.000	1.000	2.300	0.000	2.300	0.000	100.00
30.000	1.000	2.300	0.000	2.300	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

09-23-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML WB 1110+25 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.238
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	3.200 - 50yr
SPREAD-Ft.--T	=	13.701 - 22' max
Average Velocity-V-fps	=	1.581
FLOW in Gutter-CFS--Q	=	1.619
% Flow in Gutter-CFS	=	50.605
Velocity of Flow in Gutter-fps	=	2.105
Depth at Curb Line-Inches--d	=	4.698

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	5.520
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	14.388
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.536	1.716	1.277	2.993	0.207	93.54
10.000	0.882	2.823	0.377	3.200	0.000	100.00
15.000	1.000	3.200	0.000	3.200	0.000	100.00
20.000	1.000	3.200	0.000	3.200	0.000	100.[illegible]
25.000	1.000	3.200	0.000	3.200	0.000	100.[illegible]
30.000	1.000	3.200	0.000	3.200	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-04-2004

PROJECT NAME- RM　　　　TRACS NO.-
HIGHWAY NAME-　　　　DESIGNER - RSR
LOCATION - ML WB 1116+25 LT　　　　CHECKER - NDV　　　　PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	4.700 - 10yr
SPREAD-Ft.--T	=	15.929 - 16' max
Average Velocity-V-fps	=	1.751
FLOW in Gutter-CFS--Q	=	2.072
% Flow in Gutter-CFS	=	44.085
Velocity of Flow in Gutter-fps	=	2.352
Depth at Curb Line-Inches--d	=	5.233 - 6" max

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.082
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	18.234
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.438	2.060	1.905	3.966	0.734	84.38
10.000	0.761	3.576	1.036	4.612	0.088	98.13
15.000	0.956	4.491	0.209	4.700	0.000	100.00
20.000	1.000	4.700	0.000	4.700	0.000	100.00
25.000	1.000	4.700	0.000	4.700	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-04-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION -ML WB 1116+25 LT CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	6.500 · 50 yr
SPREAD-Ft.--T	=	18.181 · 22' max
Average Velocity-V-fps	=	1.883
FLOW in Gutter-CFS--Q	=	2.527
% Flow in Gutter-CFS	=	38.869
Velocity of Flow in Gutter-fps	=	2.543
Depth at Curb Line-Inches--d	=	5.773

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.643
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	22.040
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.371	2.409	2.511	4.921	1.579	75.71
10.000	0.663	4.311	1.679	5.989	0.511	92.15
15.000	0.872	5.667	0.806	6.472	0.028	99.58
20.000	0.986	6.410	0.090	6.500	0.000	100.0
25.000	1.000	6.500	0.000	6.500	0.000	100.0

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-04-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML WB 1119+50 LT CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	4.500 -10yr
SPREAD-Ft.--T	=	15.645 -16' max
Average Velocity-V-fps	=	1.734
FLOW in Gutter-CFS--Q	=	2.017
% Flow in Gutter-CFS	=	44.831
Velocity of Flow in Gutter-fps	=	2.328
Depth at Curb Line-Inches--d	=	5.165 -6" max

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.011
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	17.774
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.448	2.017	1.831	3.848	0.652	85.50
10.000	0.774	3.484	0.954	4.438	0.062	98.63
15.000	0.965	4.341	0.159	4.500	0.000	100.00
20.000	1.000	4.500	0.000	4.500	0.000	100.00
25.000	1.000	4.500	0.000	4.500	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-04-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - BSR
LOCATION - ML WB 1119+50 LT CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	6.900
SPREAD-Ft.--T	=	18.624
Average Velocity-V-fps	=	1.908
FLOW in Gutter-CFS--Q	=	2.620
% Flow in Gutter-CFS	=	37.973
Velocity of Flow in Gutter-fps	=	2.580
Depth at Curb Line-Inches--d	=	5.880

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.753
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	22.819
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.359	2.479	2.634	5.113	1.787	74.10
10.000	0.646	4.456	1.812	6.268	0.632	90.84
15.000	0.855	5.896	0.945	6.841	0.059	99.14
20.000	0.977	6.740	0.160	6.900	0.000	100.0
25.000	1.000	6.900	0.000	6.900	0.000	100.0

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-04-2004

PROJECT NAME- RM
TRACS NO.-
HIGHWAY NAME-
DESIGNER - RSR
LOCATION - MLWB 1124+00 LT
CHECKER - NDV
PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.024
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.024
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	6.000 - 10 yr
SPREAD-Ft.--T	=	15.741 - 16' max
Average Velocity-V-fps	=	1.931
FLOW in Gutter-CFS--Q	=	2.570
% Flow in Gutter-CFS	=	42.839
Velocity of Flow in Gutter-fps	=	2.561
Depth at Curb Line-Inches--d	=	5.823 - 6" max

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.676
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	20.154
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.401	2.409	2.404	4.812	1.188	80.21
10.000	0.709	4.253	1.468	5.721	0.279	95.36
15.000	0.914	5.485	0.514	5.998	0.002	99.97
20.000	1.000	5.999	0.001	6.000	0.000	100.00
25.000	1.000	6.000	0.000	6.000	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-04-2004

PROJECT NAME- RM TRACS NO. -
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML WB 1124+00 LT CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.024
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.024
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	9.300 - 50yr
SPREAD-Ft.--T	=	18.751 - 22' max
Average Velocity-V-fps	=	2.136
FLOW in Gutter-CFS--Q	=	3.379
% Flow in Gutter-CFS	=	36.329
Velocity of Flow in Gutter-fps	=	2.853
Depth at Curb Line-Inches--d	=	6.690

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	7.568
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	25.783
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.322	2.991	3.424	6.415	2.885	68.97
10.000	0.587	5.456	2.511	7.967	1.333	85.67
15.000	0.792	7.363	1.582	8.945	0.355	96.19
20.000	0.932	8.669	0.625	9.294	0.006	99.9
25.000	0.998	9.283	0.017	9.300	0.000	100.0

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-04-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - ML WB 1127+00 LT
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - UDV
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.100
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.024
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.024
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	3.900 -10 yr
SPREAD-Ft.--T	=	15.917 -16' max
Average Velocity-V-fps	=	1.229
FLOW in Gutter-CFS--Q	=	1.654
% Flow in Gutter-CFS	=	42.408
Velocity of Flow in Gutter-fps	=	1.630
Depth at Curb Line-Inches--d	=	5.874 -6" max

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.728
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	12.827
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.589	2.297	1.326	3.623	0.277	92.89
10.000	0.934	3.644	0.256	3.900	0.000	100.00
15.000	1.000	3.900	0.000	3.900	0.000	100.00
20.000	1.000	3.900	0.000	3.900	0.000	100.00
25.000	1.000	3.900	0.000	3.900	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-04-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML WB 1127+00 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.100
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.024
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.024
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	6.400 -50yr
SPREAD-Ft.--T	=	19.386 -22' max
Average Velocity-V-fps	=	1.378
FLOW in Gutter-CFS--Q	=	2.252
% Flow in Gutter-CFS	=	35.187
Velocity of Flow in Gutter-fps	=	1.842
Depth at Curb Line-Inches--d	=	6.873

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	7.755
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	16.936
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.467	2.991	2.303	5.294	1.106	82.72
10.000	0.800	5.117	1.122	6.239	0.161	97.48
15.000	0.980	6.271	0.129	6.400	0.000	100.00
20.000	1.000	6.400	0.000	6.400	0.000	100.0
25.000	1.000	6.400	0.000	6.400	0.000	100.0

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

04-20-2005

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - MLWB 1128+00 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--IN SUMP

GUTTER FLOW HYDRAULICS

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.024
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.024
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Effective Perimeter--Ft.	=	7.354
Capture Ratio -- GRATE	=	0.500
Capture Ratio -- SLOTTED DRAIN	=	0.500
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	2.500 - 10yr

LENGTH	Q(Slot. Dn)	Q(Grate)	d(inches)	SPREAD,Ft.
5.000	1.277	1.224	3.400	7.326 ← 10' max
10.000	1.799	0.703	2.484	4.144
15.000	2.053	0.446	1.904	2.368
20.000	2.184	0.314	1.498	1.863

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

04-20-2005

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER -
LOCATION - ML WB 1128+00 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--IN SUMP

GUTTER FLOW HYDRAULICS

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.024
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.024
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Effective Perimeter--Ft.	=	7.354
Capture Ratio -- GRATE	=	0.500
Capture Ratio -- SLOTTED DRAIN	=	0.500
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	3.700 - 50yr

LENGTH	Q(Slot. Dn)	Q(Grate)	d(inches)	SPREAD,Ft.
5.000	1.604	2.096	4.633	11.607 ← 22' max
10.000	2.509	1.192	3.349	7.149
15.000	2.906	0.793	2.661	4.759
20.000	3.138	0.560	2.180	3.092

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML WB 1129+00 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.100
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.024
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.024
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.900 - 10 yr
SPREAD-Ft.--T	=	11.825 - 16' max
Average Velocity-V-fps	=	1.048
FLOW in Gutter-CFS--Q	=	1.048
% Flow in Gutter-CFS	=	55.172
Velocity of Flow in Gutter-fps	=	1.363
Depth at Curb Line-Inches--d	=	4.696

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	5.494
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	8.518
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.796	1.513	0.385	1.898	0.002	99.92
10.000	1.000	1.900	0.000	1.900	0.000	100.00
15.000	1.000	1.900	0.000	1.900	0.000	100.00
20.000	1.000	1.900	0.000	1.900	0.000	100.00
25.000	1.000	1.900	0.000	1.900	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - ML WB 1129+00 Lt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.100
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.024
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.024
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	2.900 - 50 yr
SPREAD-Ft.--T	=	14.109 - 22' max
Average Velocity-V-fps	=	1.149
FLOW in Gutter-CFS--Q	=	1.373
% Flow in Gutter-CFS	=	47.330
Velocity of Flow in Gutter-fps	=	1.515
Depth at Curb Line-Inches--d	=	5.353

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.187
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	10.842
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.671	1.947	0.880	2.827	0.073	97.474
10.000	0.990	2.871	0.029	2.900	0.000	100.00
15.000	1.000	2.900	0.000	2.900	0.000	100.00
20.000	1.000	2.900	0.000	2.900	0.000	100.0
25.000	1.000	2.900	0.000	2.900	0.000	100.

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2004

PROJECT NAME- RM
TRACS NO.-
HIGHWAY NAME-
DESIGNER - BSR
LOCATION - MLWB 1130+50 Lt
CHECKER - NDV
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Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.024
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.024
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	2.700 - 10 yr
SPREAD-Ft.--T	=	11.297 - 16' max
Average Velocity-V-fps	=	1.621
FLOW in Gutter-CFS--Q	=	1.547
% Flow in Gutter-CFS	=	57.300
Velocity of Flow in Gutter-fps	=	2.099
Depth at Curb Line-Inches--d	=	4.544

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	5.332
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	12.789
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.590	1.594	1.030	2.624	0.076	97.194
10.000	0.936	2.526	0.174	2.700	0.000	100.00
15.000	1.000	2.700	0.000	2.700	0.000	100.00
20.000	1.000	2.700	0.000	2.700	0.000	100.00
25.000	1.000	2.700	0.000	2.700	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML WB 1130+50 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.024
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.024
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	3.800 -50yr
SPREAD-Ft.--T	=	13.055 -22'max
Average Velocity-V-fps	=	1.744
FLOW in Gutter-CFS--Q	=	1.926
% Flow in Gutter-CFS	=	50.696
Velocity of Flow in Gutter-fps	=	2.286
Depth at Curb Line-Inches--d	=	5.050

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	5.869
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	15.543
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.503	1.910	1.554	3.465	0.335	91.18
10.000	0.844	3.206	0.590	3.796	0.004	99.89
15.000	0.998	3.791	0.009	3.800	0.000	100.00
20.000	1.000	3.800	0.000	3.800	0.000	100.0[illegible]
25.000	1.000	3.800	0.000	3.800	0.000	100.0[illegible]

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2004

PROJECT NAME- RM	TRACS NO.-		
HIGHWAY NAME-	DESIGNER - RSR		
LOCATION - ML WB 1132+71 Lt	CHECKER - NDV	PAGE	

Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.209
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.024
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.024
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.700 - 10yr
SPREAD-Ft.--T	=	6.199 - 8' max
Average Velocity-V-fps	=	1.176
FLOW in Gutter-CFS--Q	=	0.596
% Flow in Gutter-CFS	=	85.098
Velocity of Flow in Gutter-fps	=	1.381
Depth at Curb Line-Inches--d	=	3.075

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.700
GUTTER FLOW at INLET-CFS--Q	=	0.671
Gutter Velocity at INLET-fps	=	1.487
Depth at INLET Curb Line-Inches--d	=	3.671
Frontal Flow Intercepted by GRATE--CFS	=	0.639
Lateral Flow Intercepted by GRATE--CFS	=	0.048
TOTAL Flow Intercepted by GRATE--CFS	=	0.687
% FLOW Intercepted	=	98.084
By-pass Flow--CFS	=	0.013

• 65 LF slotted drain

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION -ML WB 1132+71 Lt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.209
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.024
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.024
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.100 - 50yr
SPREAD-Ft.--T	=	7.820 - 8' max
Average Velocity-V-fps	=	1.267
FLOW in Gutter-CFS--Q	=	0.824
% Flow in Gutter-CFS	=	74.925
Velocity of Flow in Gutter-fps	=	1.559
Depth at Curb Line-Inches--d	=	3.542

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	1.100
GUTTER FLOW at INLET-CFS--Q	=	0.951
Gutter Velocity at INLET-fps	=	1.678
Depth at INLET Curb Line-Inches--d	=	4.226
Frontal Flow Intercepted by GRATE--CFS	=	0.883
Lateral Flow Intercepted by GRATE--CFS	=	0.135
TOTAL Flow Intercepted by GRATE--CFS	=	1.017
% FLOW Intercepted	=	92.496
By-pass Flow--CFS	=	0.083

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2004

PROJECT NAME- RM	TRACS NO.-		
HIGHWAY NAME-	DESIGNER - RSR		
LOCATION - ML WB 1133+32 Lt	CHECKER - NDV	PAGE	

Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.200
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.024
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.024
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.700 - 10 yr
SPREAD-Ft.--T	=	6.279 - 8' max
Average Velocity-V-fps	=	1.152
FLOW in Gutter-CFS--Q	=	0.592
% Flow in Gutter-CFS	=	84.590
Velocity of Flow in Gutter-fps	=	1.358
Depth at Curb Line-Inches--d	=	3.098

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.700
GUTTER FLOW at INLET-CFS--Q	=	0.668
Gutter Velocity at INLET-fps	=	1.462
Depth at INLET Curb Line-Inches--d	=	3.699
Frontal Flow Intercepted by GRATE--CFS	=	0.635
Lateral Flow Intercepted by GRATE--CFS	=	0.051
TOTAL Flow Intercepted by GRATE--CFS	=	0.686
% FLOW Intercepted	=	97.970
By-pass Flow--CFS	=	0.014

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2004

PROJECT NAME- RM | TRACS NO.-
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LOCATION - ML WB 1133+32 Lt | CHECKER - NDV | PAGE
Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.200
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.024
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.024
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.100 - 50yr
SPREAD-Ft.--T	=	7.909 - 8 max
Average Velocity-V-fps	=	1.243
FLOW in Gutter-CFS--Q	=	0.818
% Flow in Gutter-CFS	=	74.390
Velocity of Flow in Gutter-fps	=	1.533
Depth at Curb Line-Inches--d	=	3.568

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	1.100
GUTTER FLOW at INLET-CFS--Q	=	0.945
Gutter Velocity at INLET-fps	=	1.649
Depth at INLET Curb Line-Inches--d	=	4.256
Frontal Flow Intercepted by GRATE--CFS	=	0.876
Lateral Flow Intercepted by GRATE--CFS	=	0.139
TOTAL Flow Intercepted by GRATE--CFS	=	1.015
% FLOW Intercepted	=	92.303
By-pass Flow--CFS	=	0.085

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2004

PROJECT NAME- RM | TRACS NO.-
HIGHWAY NAME- | DESIGNER - RSR
LOCATION - ML WB 1133+91 Lt | CHECKER - NDV | PAGE
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GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.190
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.024
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.024
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.700 - 10yr
SPREAD-Ft.--T	=	6.363 - 8' max
Average Velocity-V-fps	=	1.129
FLOW in Gutter-CFS--Q	=	0.588
% Flow in Gutter-CFS	=	84.053
Velocity of Flow in Gutter-fps	=	1.334
Depth at Curb Line-Inches--d	=	3.123

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.700
GUTTER FLOW at INLET-CFS--Q	=	0.665
Gutter Velocity at INLET-fps	=	1.436
Depth at INLET Curb Line-Inches--d	=	3.729
Frontal Flow Intercepted by GRATE--CFS	=	0.631
Lateral Flow Intercepted by GRATE--CFS	=	0.054
TOTAL Flow Intercepted by GRATE--CFS	=	0.685
% FLOW Intercepted	=	97.848
By-pass Flow--CFS	=	0.015

· 115 LF slotted Drain

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2004

PROJECT NAME- RM	TRACS NO.-		
HIGHWAY NAME-	DESIGNER - RSR		
LOCATION - ML WB 1133+91 Lt	CHECKER - NDV	PAGE	

Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.190
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.024
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.024
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.000 - 50yr
SPREAD-Ft.--T	=	7.641 - 8' max
Average Velocity-V-fps	=	1.198
FLOW in Gutter-CFS--Q	=	0.760
% Flow in Gutter-CFS	=	76.000
Velocity of Flow in Gutter-fps	=	1.468
Depth at Curb Line-Inches--d	=	3.491

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	1.000
GUTTER FLOW at INLET-CFS--Q	=	0.876
Gutter Velocity at INLET-fps	=	1.579
Depth at INLET Curb Line-Inches--d	=	4.166
Frontal Flow Intercepted by GRATE--CFS	=	0.815
Lateral Flow Intercepted by GRATE--CFS	=	0.121
TOTAL Flow Intercepted by GRATE--CFS	=	0.936
% FLOW Intercepted	=	93.592
By-pass Flow--CFS	=	0.064

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2004

PROJECT NAME- RM | TRACS NO.-
HIGHWAY NAME- | DESIGNER - RSR
LOCATION - ML WB 1134+48 Lt | CHECKER - NDV | PAGE
Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.183
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.024
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.024
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.700 - 10 yr
SPREAD-Ft.--T	=	6.429 - 8' max
Average Velocity-V-fps	=	1.110
FLOW in Gutter-CFS--Q	=	0.585
% Flow in Gutter-CFS	=	83.630
Velocity of Flow in Gutter-fps	=	1.315
Depth at Curb Line-Inches--d	=	3.142

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.700
GUTTER FLOW at INLET-CFS--Q	=	0.663
Gutter Velocity at INLET-fps	=	1.416
Depth at INLET Curb Line-Inches--d	=	3.752
Frontal Flow Intercepted by GRATE--CFS	=	0.628
Lateral Flow Intercepted by GRATE--CFS	=	0.056
TOTAL Flow Intercepted by GRATE--CFS	=	0.684
% FLOW Intercepted	=	97.752
By-pass Flow--CFS	=	0.016

(C)

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML WB 1134+48 Lt CHECKER - UDV PAGE
Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.183
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.024
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.024
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.000 - 50yr
SPREAD-Ft.--T	=	7.714 - 8' max
Average Velocity-V-fps	=	1.179
FLOW in Gutter-CFS--Q	=	0.756
% Flow in Gutter-CFS	=	75.560
Velocity of Flow in Gutter-fps	=	1.447
Depth at Curb Line-Inches--d	=	3.512

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	1.000
GUTTER FLOW at INLET-CFS--Q	=	0.871
Gutter Velocity at INLET-fps	=	1.557
Depth at INLET Curb Line-Inches--d	=	4.191
Frontal Flow Intercepted by GRATE--CFS	=	0.810
Lateral Flow Intercepted by GRATE--CFS	=	0.125
TOTAL Flow Intercepted by GRATE--CFS	=	0.935
% FLOW Intercepted	=	93.484
By-pass Flow--CFS	=	0.065

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2004

PROJECT NAME- RM	TRACS NO.-		
HIGHWAY NAME-	DESIGNER - RSR		
LOCATION - ML WB 1135+05	CHECKER - NDV	PAGE	

Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.173
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.024
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.024
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.700 - 10yr
SPREAD-Ft.--T	=	6.523 - 8' max
Average Velocity-V-fps	=	1.085
FLOW in Gutter-CFS--Q	=	0.581
% Flow in Gutter-CFS	=	83.036
Velocity of Flow in Gutter-fps	=	1.290
Depth at Curb Line-Inches--d	=	3.169

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.700
GUTTER FLOW at INLET-CFS--Q	=	0.660
Gutter Velocity at INLET-fps	=	1.389
Depth at INLET Curb Line-Inches--d	=	3.785
Frontal Flow Intercepted by GRATE--CFS	=	0.624
Lateral Flow Intercepted by GRATE--CFS	=	0.059
TOTAL Flow Intercepted by GRATE--CFS	=	0.683
% FLOW Intercepted	=	97.616
By-pass Flow--CFS	=	0.017

C

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML WB 1135+05 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.173
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.024
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.024
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.000 - 50 yr
SPREAD-Ft.--T	=	7.816 - 8' max
Average Velocity-V-fps	=	1.153
FLOW in Gutter-CFS--Q	=	0.749
% Flow in Gutter-CFS	=	74.945
Velocity of Flow in Gutter-fps	=	1.418
Depth at Curb Line-Inches--d	=	3.541

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	1.000
GUTTER FLOW at INLET-CFS--Q	=	0.865
Gutter Velocity at INLET-fps	=	1.527
Depth at INLET Curb Line-Inches--d	=	4.225
Frontal Flow Intercepted by GRATE--CFS	=	0.803
Lateral Flow Intercepted by GRATE--CFS	=	0.130
TOTAL Flow Intercepted by GRATE--CFS	=	0.933
% FLOW Intercepted	=	93.283
By-pass Flow--CFS	=	0.067

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML WB 1135+62 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.113
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.024
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.024
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.600 - 10 yr
SPREAD-Ft.--T	=	6.727 - 8' max
Average Velocity-V-fps	=	0.886
FLOW in Gutter-CFS--Q	=	0.490
% Flow in Gutter-CFS	=	81.737
Velocity of Flow in Gutter-fps	=	1.059
Depth at Curb Line-Inches--d	=	3.227

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.600
GUTTER FLOW at INLET-CFS--Q	=	0.559
Gutter Velocity at INLET-fps	=	1.141
Depth at INLET Curb Line-Inches--d	=	3.856
Frontal Flow Intercepted by GRATE--CFS	=	0.527
Lateral Flow Intercepted by GRATE--CFS	=	0.060
TOTAL Flow Intercepted by GRATE--CFS	=	0.587
% FLOW Intercepted	=	97.853
By-pass Flow--CFS	=	0.013

.95LF Slotted Drain

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - MLWB 1135+62 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G =	0.113
Roadway Cross-Slope-Ft./Ft.--Sx =	0.024
Shoulder Width-Ft.-- =	8.000
Shoulder Slope-Ft./Ft.--Ss =	0.024
Gutter Width-Ft.--W =	2.500
Gutter Slope-Ft./Ft.--Sw =	0.067
Gutter Depression-Inches-- =	2.010
Manning's 'N =	0.016
Flow-CFS--Q =	0.800 - 50yr
SPREAD-Ft.--T =	7.779 - 8'max
Average Velocity-V-fps =	0.930
FLOW in Gutter-CFS--Q =	0.602
% Flow in Gutter-CFS =	75.220
Velocity of Flow in Gutter-fps =	1.144
Depth at Curb Line-Inches--d =	3.530

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft. =	3.354
Grate Width---Ft. =	2.000
Grate Area--Sq. Ft. =	5.171
Capture Ratio -- GRATE =	0.500
Effective Perimeter--Ft. =	7.354
Splash-Over Velocity--FPS =	7.354
Local Gutter Depression-Inches =	1.000
Flow-CFS--Q =	0.800
GUTTER FLOW at INLET-CFS--Q =	0.694
Gutter Velocity at INLET-fps =	1.231
Depth at INLET Curb Line-Inches--d =	4.211
Frontal Flow Intercepted by GRATE--CFS =	0.644
Lateral Flow Intercepted by GRATE--CFS =	0.116
TOTAL Flow Intercepted by GRATE--CFS =	0.760
% FLOW Intercepted =	94.956
By-pass Flow--CFS =	0.040

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2004

PROJECT NAME- Rm
TRACS NO.-
HIGHWAY NAME-
DESIGNER - RSR
LOCATION -ML WB 1136+08 Lt
CHECKER - UDV
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Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.111
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.024
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.024
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.600 - 10yr
SPREAD-Ft.--T	=	6.765 - 8' max
Average Velocity-V-fps	=	0.878
FLOW in Gutter-CFS--Q	=	0.489
% Flow in Gutter-CFS	=	81.498
Velocity of Flow in Gutter-fps	=	1.051
Depth at Curb Line-Inches--d	=	3.238

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.600
GUTTER FLOW at INLET-CFS--Q	=	0.557
Gutter Velocity at INLET-fps	=	1.131
Depth at INLET Curb Line-Inches--d	=	3.868
Frontal Flow Intercepted by GRATE--CFS	=	0.525
Lateral Flow Intercepted by GRATE--CFS	=	0.061
TOTAL Flow Intercepted by GRATE--CFS	=	0.587
% FLOW Intercepted	=	97.764
By-pass Flow--CFS	=	0.013

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - ML WB 1136+08 Lt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.111
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.024
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.024
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.800 - 50yr
SPREAD-Ft.--T	=	7.820 - 8' max
Average Velocity-V-fps	=	0.922
FLOW in Gutter-CFS--Q	=	0.600
% Flow in Gutter-CFS	=	74.976
Velocity of Flow in Gutter-fps	=	1.135
Depth at Curb Line-Inches--d	=	3.542

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.800
GUTTER FLOW at INLET-CFS--Q	=	0.692
Gutter Velocity at INLET-fps	=	1.221
Depth at INLET Curb Line-Inches--d	=	4.224
Frontal Flow Intercepted by GRATE--CFS	=	0.642
Lateral Flow Intercepted by GRATE--CFS	=	0.117
TOTAL Flow Intercepted by GRATE--CFS	=	0.759
% FLOW Intercepted	=	94.897
By-pass Flow--CFS	=	0.041

(C)

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION -ML WB 1136+53 Lt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
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GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.104
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.024
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.024
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.600 -10yr
SPREAD-Ft.--T	=	6.884 - 8' max
Average Velocity-V-fps	=	0.853
FLOW in Gutter-CFS--Q	=	0.484
% Flow in Gutter-CFS	=	80.745
Velocity of Flow in Gutter-fps	=	1.025
Depth at Curb Line-Inches--d	=	3.273

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.600
GUTTER FLOW at INLET-CFS--Q	=	0.553
Gutter Velocity at INLET-fps	=	1.104
Depth at INLET Curb Line-Inches--d	=	3.909
Frontal Flow Intercepted by GRATE--CFS	=	0.520
Lateral Flow Intercepted by GRATE--CFS	=	0.065
TOTAL Flow Intercepted by GRATE--CFS	=	0.586
% FLOW Intercepted	=	97.621
By-pass Flow--CFS	=	0.014

(c)

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2004

PROJECT NAME- RM	TRACS NO.-		
HIGHWAY NAME-	DESIGNER - RSR		
LOCATION - ML WB 1136+53 Lt	CHECKER - NDV	PAGE	

Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.104
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.024
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.024
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.800 - 50yr
SPREAD-Ft.--T	=	7.948 - 8' max
Average Velocity-V-fps	=	0.896
FLOW in Gutter-CFS--Q	=	0.594
% Flow in Gutter-CFS	=	74.210
Velocity of Flow in Gutter-fps	=	1.107
Depth at Curb Line-Inches--d	=	3.579

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.800
GUTTER FLOW at INLET-CFS--Q	=	0.685
Gutter Velocity at INLET-fps	=	1.191
Depth at INLET Curb Line-Inches--d	=	4.267
Frontal Flow Intercepted by GRATE--CFS	=	0.635
Lateral Flow Intercepted by GRATE--CFS	=	0.123
TOTAL Flow Intercepted by GRATE--CFS	=	0.758
% FLOW Intercepted	=	94.716
By-pass Flow--CFS	=	0.042

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2004

PROJECT NAME- RM | TRACS NO.-
HIGHWAY NAME- | DESIGNER - RSR
LOCATION - ML WB 1136+93 Lt | CHECKER - NDV | PAGE
Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.101
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.024
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.024
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.500 - 10yr
SPREAD-Ft.--T	=	6.289 - 8' max
Average Velocity-V-fps	=	0.821
FLOW in Gutter-CFS--Q	=	0.423
% Flow in Gutter-CFS	=	84.521
Velocity of Flow in Gutter-fps	=	0.968
Depth at Curb Line-Inches--d	=	3.101

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.500
GUTTER FLOW at INLET-CFS--Q	=	0.477
Gutter Velocity at INLET-fps	=	1.042
Depth at INLET Curb Line-Inches--d	=	3.703
Frontal Flow Intercepted by GRATE--CFS	=	0.453
Lateral Flow Intercepted by GRATE--CFS	=	0.040
TOTAL Flow Intercepted by GRATE--CFS	=	0.494
% FLOW Intercepted	=	98.760
By-pass Flow--CFS	=	0.006

155 LF Slotted drain

CB 169

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2004

PROJECT NAME- RM   TRACS NO.-
HIGHWAY NAME- ML WB 1136+93 Lt   DESIGNER - RSR
LOCATION -   CHECKER - NDV   PAGE
Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.101
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.024
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.024
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.800 - 50yr
SPREAD-Ft.--T	=	7.993 - 8' max
Average Velocity-V-fps	=	0.888
FLOW in Gutter-CFS--Q	=	0.592
% Flow in Gutter-CFS	=	73.943
Velocity of Flow in Gutter-fps	=	1.098
Depth at Curb Line-Inches--d	=	3.592

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.800
GUTTER FLOW at INLET-CFS--Q	=	0.683
Gutter Velocity at INLET-fps	=	1.180
Depth at INLET Curb Line-Inches--d	=	4.282
Frontal Flow Intercepted by GRATE--CFS	=	0.632
Lateral Flow Intercepted by GRATE--CFS	=	0.125
TOTAL Flow Intercepted by GRATE--CFS	=	0.757
% FLOW Intercepted	=	94.655
By-pass Flow--CFS	=	0.043

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-04-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - ML WB 1138+92 Lt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.024
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.024
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	4.600 -10yr
SPREAD-Ft.--T	=	14.128 - 16' max
Average Velocity-V-fps	=	1.819
FLOW in Gutter-CFS--Q	=	2.175
% Flow in Gutter-CFS	=	47.274
Velocity of Flow in Gutter-fps	=	2.397
Depth at Curb Line-Inches--d	=	5.359 - 6" max

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.193
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	17.332
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.458	2.107	1.870	3.977	0.623	86.47
10.000	0.787	3.622	0.929	4.551	0.049	98.94
15.000	0.973	4.476	0.124	4.600	0.000	100.00
20.000	1.000	4.600	0.000	4.600	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-04-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML WB 1139+92 LT CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.024
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.024
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	7.400 - 50yr
SPREAD-Ft.--T	=	17.124 - 22'max
Average Velocity-V-fps	=	2.026
FLOW in Gutter-CFS--Q	=	2.931
% Flow in Gutter-CFS	=	39.602
Velocity of Flow in Gutter-fps	=	2.697
Depth at Curb Line-Inches--d	=	6.222

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	7.087
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	22.685
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.361	2.673	2.863	5.536	1.864	74.81
10.000	0.649	4.801	1.935	6.736	0.664	91.02
15.000	0.857	6.345	0.990	7.336	0.064	99.13
20.000	0.979	7.241	0.159	7.400	0.000	100.0[illegible]

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-04-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML WB 1143+00 LT CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.024
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.024
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	5.200 - 10yr
SPREAD-Ft.--T	=	14.854 - 16' max
Average Velocity-V-fps	=	1.869
FLOW in Gutter-CFS--Q	=	2.349
% Flow in Gutter-CFS	=	45.181
Velocity of Flow in Gutter-fps	=	2.471
Depth at Curb Line-Inches--d	=	5.568 - 6" max

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.411
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	18.583
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.431	2.242	2.117	4.359	0.841	83.83 ←
10.000	0.751	3.905	1.170	5.075	0.125	97.60
15.000	0.948	4.931	0.269	5.200	0.000	100.00
20.000	1.000	5.200	0.000	5.200	0.000	100.00

CB 183

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-04-2004

PROJECT NAME- RM   TRACS NO.-
HIGHWAY NAME-   DESIGNER - RSR
LOCATION - ML WB 1143+00 LT   CHECKER - NDV   PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.024
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.024
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	8.100
SPREAD-Ft.--T	=	17.752
Average Velocity-V-fps	=	2.069
FLOW in Gutter-CFS--Q	=	3.100
% Flow in Gutter-CFS	=	38.277
Velocity of Flow in Gutter-fps	=	2.757
Depth at Curb Line-Inches--d	=	6.402

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	7.273
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	23.866
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.345	2.795	3.077	5.871	2.229	72.49
10.000	0.624	5.052	2.159	7.211	0.889	89.03
15.000	0.832	6.737	1.218	7.955	0.145	98.21
20.000	0.962	7.794	0.306	8.100	0.000	100.00

CB 185

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-04-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - ML WB 1147+00 Lt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.024
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.024
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	4.800 - 10 yr
SPREAD-Ft.--T	=	14.376 - 11' max
Average Velocity-V-fps	=	1.836
FLOW in Gutter-CFS--Q	=	2.234
% Flow in Gutter-CFS	=	46.538
Velocity of Flow in Gutter-fps	=	2.423
Depth at Curb Line-Inches--d	=	5.430 - 6" max

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.267
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	17.757
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.449	2.153	1.963	4.117	0.683	85.76
10.000	0.775	3.719	1.011	4.730	0.070	98.54
15.000	0.965	4.632	0.168	4.800	0.000	100.00
20.000	1.000	4.800	0.000	4.800	0.000	100.00

CB 185

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-04-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML WB 1147+00 Lt CHECKER - UDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.024
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.024
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	7.500 -50yr
SPREAD-Ft.--T	=	17.216 -22' max
Average Velocity-V-fps	=	2.032
FLOW in Gutter-CFS--Q	=	2.955
% Flow in Gutter-CFS	=	39.403
Velocity of Flow in Gutter-fps	=	2.705
Depth at Curb Line-Inches--d	=	6.248

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	7.114
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	22.857
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.359	2.691	2.894	5.585	1.915	74.46
10.000	0.645	4.838	1.973	6.810	0.690	90.80
15.000	0.854	6.403	1.023	7.426	0.074	99.02
20.000	0.976	7.322	0.178	7.500	0.000	100.0[illegible]

CB 189

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-04-2004

PROJECT NAME- RM　　TRACS NO.-
HIGHWAY NAME-　　DESIGNER - RSR
LOCATION - ML WB 115+32　　CHECKER - NDV　　PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	4.500 - 10 yr
SPREAD-Ft.--T	=	15.645 - 16' max
Average Velocity-V-fps	=	1.734
FLOW in Gutter-CFS--Q	=	2.017
% Flow in Gutter-CFS	=	44.831
Velocity of Flow in Gutter-fps	=	2.328
Depth at Curb Line-Inches--d	=	5.165 - 6" max

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.011
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	17.774
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.448	2.017	1.831	3.848	0.652	85.50
10.000	0.774	3.484	0.954	4.438	0.062	98.63
15.000	0.965	4.341	0.159	4.500	0.000	100.00
20.000	1.000	4.500	0.000	4.500	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-04-2004

PROJECT NAME- RM | TRACS NO.-
HIGHWAY NAME- | DESIGNER - RSR
LOCATION -ML WB 1150+32 | CHECKER - NDV | PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	6.800 -10yr
SPREAD-Ft.--T	=	18.515 -22' max
Average Velocity-V-fps	=	1.902
FLOW in Gutter-CFS--Q	=	2.597
% Flow in Gutter-CFS	=	38.191
Velocity of Flow in Gutter-fps	=	2.571
Depth at Curb Line-Inches--d	=	5.854

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.726
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	22.626
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.362	2.462	2.603	5.065	1.735	74.49
10.000	0.650	4.420	1.780	6.201	0.599	91.18
15.000	0.859	5.840	0.910	6.750	0.050	99.27
20.000	0.979	6.659	0.141	6.800	0.000	100.0[illegible]

CB 192

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-04-2004

PROJECT NAME- RM | TRACS NO.-
HIGHWAY NAME- | DESIGNER - RSR
LOCATION - ML WB 1153+15 LT | CHECKER - NDV | PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	4.400 -10 yr
SPREAD-Ft.--T	=	15.500 -16' max
Average Velocity-V-fps	=	1.726
FLOW in Gutter-CFS--Q	=	1.990
% Flow in Gutter-CFS	=	45.221
Velocity of Flow in Gutter-fps	=	2.315
Depth at Curb Line-Inches--d	=	5.130 -6" max

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	5.975
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	17.541
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.453	1.995	1.793	3.788	0.612	86.08
10.000	0.781	3.437	0.912	4.350	0.050	98.86
15.000	0.969	4.264	0.136	4.400	0.000	100.00
20.000	1.000	4.400	0.000	4.400	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-04-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML WB 1153+15 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	6.200 - 50yr
SPREAD-Ft.--T	=	17.837 - 22' max
Average Velocity-V-fps	=	1.863
FLOW in Gutter-CFS--Q	=	2.455
% Flow in Gutter-CFS	=	39.592
Velocity of Flow in Gutter-fps	=	2.515
Depth at Curb Line-Inches--d	=	5.691

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.558
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	21.442
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.380	2.356	2.417	4.773	1.427	76.98
10.000	0.677	4.198	1.584	5.782	0.418	93.26
15.000	0.885	5.488	0.700	6.188	0.012	99.80
20.000	0.992	6.152	0.048	6.200	0.000	100.00

CB 201

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-08-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - ML WB 1161+75 Lt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	4.700
SPREAD-Ft.--T	=	15.929
Average Velocity-V-fps	=	1.751
FLOW in Gutter-CFS--Q	=	2.072
% Flow in Gutter-CFS	=	44.085
Velocity of Flow in Gutter-fps	=	2.352
Depth at Curb Line-Inches--d	=	5.233

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.082
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	18.234
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.438	2.060	1.905	3.966	0.734	84.38
10.000	0.761	3.576	1.036	4.612	0.088	98.13
15.000	0.956	4.491	0.209	4.700	0.000	100.00
20.000	1.000	4.700	0.000	4.700	0.000	100.00

CB 201

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-08-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - MLWB 1161+75 Lt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	6.500
SPREAD-Ft.--T	=	18.181
Average Velocity-V-fps	=	1.883
FLOW in Gutter-CFS--Q	=	2.527
% Flow in Gutter-CFS	=	38.869
Velocity of Flow in Gutter-fps	=	2.543
Depth at Curb Line-Inches--d	=	5.773

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.643
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	22.040
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.371	2.409	2.511	4.921	1.579	75.71
10.000	0.663	4.311	1.679	5.989	0.511	92.15
15.000	0.872	5.667	0.806	6.472	0.028	99.58
20.000	0.986	6.410	0.090	6.500	0.000	100.0[illegible]

CB 205

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-08-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML WB 1165+50 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	4.600 - 10yr
SPREAD-Ft.--T	=	15.788 - 16' max
Average Velocity-V-fps	=	1.743
FLOW in Gutter-CFS--Q	=	2.045
% Flow in Gutter-CFS	=	44.453
Velocity of Flow in Gutter-fps	=	2.340
Depth at Curb Line-Inches--d	=	5.199

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.047
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	18.005
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.443	2.039	1.868	3.907	0.693	84.94
10.000	0.768	3.531	0.995	4.526	0.074	98.38
15.000	0.960	4.417	0.183	4.600	0.000	100.00
20.000	1.000	4.600	0.000	4.600	0.000	100.00

CB 205

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-08-2004

PROJECT NAME- RM   TRACS NO.-
HIGHWAY NAME-   DESIGNER - RSR
LOCATION - ML WB 1165+50 Lt   CHECKER - NDV   PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	6.800 - 50yr
SPREAD-Ft.--T	=	18.515 - 22' max
Average Velocity-V-fps	=	1.902
FLOW in Gutter-CFS--Q	=	2.597
% Flow in Gutter-CFS	=	38.191
Velocity of Flow in Gutter-fps	=	2.571
Depth at Curb Line-Inches--d	=	5.854

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.726
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	22.626
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.362	2.462	2.603	5.065	1.735	74.49
10.000	0.650	4.420	1.780	6.201	0.599	91.18
15.000	0.859	5.840	0.910	6.750	0.050	99.27
20.000	0.979	6.659	0.141	6.800	0.000	100.0

CB 209

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-08-2004

PROJECT NAME- RM
TRACS NO.-
HIGHWAY NAME-
DESIGNER - RSR
LOCATION - ML WB 1168+27 Lt
CHECKER - NDV
PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	3.700 - 10yr
SPREAD-Ft.--T	=	14.419 - 16' max
Average Velocity-V-fps	=	1.662
FLOW in Gutter-CFS--Q	=	1.788
% Flow in Gutter-CFS	=	48.332
Velocity of Flow in Gutter-fps	=	2.221
Depth at Curb Line-Inches--d	=	4.871

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	5.702
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	15.840
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.495	1.831	1.511	3.342	0.358	90.32
10.000	0.834	3.086	0.609	3.695	0.005	99.86
15.000	0.995	3.681	0.019	3.700	0.000	100.00
20.000	1.000	3.700	0.000	3.700	0.000	100.00

CB 209

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-08-2004

PROJECT NAME- RM	TRACS NO.-
HIGHWAY NAME-	DESIGNER - RSR
LOCATION - ML WB 1168+27 Lt	CHECKER - NDV PAGE

Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	5.900 - 50yr
SPREAD-Ft.--T	=	17.482 - 22' max
Average Velocity-V-fps	=	1.842
FLOW in Gutter-CFS--Q	=	2.382
% Flow in Gutter-CFS	=	40.365
Velocity of Flow in Gutter-fps	=	2.485
Depth at Curb Line-Inches--d	=	5.606

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.470
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	20.831
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.390	2.300	2.321	4.621	1.279	78.32
10.000	0.692	4.082	1.482	5.564	0.336	94.31
15.000	0.899	5.304	0.592	5.895	0.005	99.92
20.000	0.997	5.882	0.018	5.900	0.000	100.0

CB 221

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-08-2004

PROJECT NAME- RM	TRACS NO.-		
HIGHWAY NAME-	DESIGNER - RSR		
LOCATION -ML WB 1170+24 Lt	CHECKER - NDV	PAGE	

Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	2.200 - 10yr
SPREAD-Ft.--T	=	11.516 - 16' max
Average Velocity-V-fps	=	1.493
FLOW in Gutter-CFS--Q	=	1.292
% Flow in Gutter-CFS	=	58.722
Velocity of Flow in Gutter-fps	=	1.957
Depth at Curb Line-Inches--d	=	4.174

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	4.957
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	11.660
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.635	1.397	0.780	2.177	0.023	98.95
10.000	0.970	2.134	0.066	2.200	0.000	100.00
15.000	1.000	2.200	0.000	2.200	0.000	100.00
20.000	1.000	2.200	0.000	2.200	0.000	100.00

CB 221

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-08-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION -ML WB 1170+24 Lt CHECKER - UDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	3.900 - 50yr
SPREAD-Ft.--T	=	14.741 - 22' max
Average Velocity-V-fps	=	1.681
FLOW in Gutter-CFS--Q	=	1.847
% Flow in Gutter-CFS	=	47.369
Velocity of Flow in Gutter-fps	=	2.249
Depth at Curb Line-Inches--d	=	4.948

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	5.784
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	16.339
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.482	1.879	1.573	3.453	0.447	88.53
10.000	0.818	3.191	0.697	3.888	0.012	99.69
15.000	0.989	3.857	0.043	3.900	0.000	100.00
20.000	1.000	3.900	0.000	3.900	0.000	100.0[illegible]

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION -ML WB 1172+30 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.132
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.500 - 10yr
SPREAD-Ft.--T	=	6.418 - 8' max
Average Velocity-V-fps	=	0.895
FLOW in Gutter-CFS--Q	=	0.429
% Flow in Gutter-CFS	=	85.793
Velocity of Flow in Gutter-fps	=	1.058
Depth at Curb Line-Inches--d	=	2.950

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.500
GUTTER FLOW at INLET-CFS--Q	=	0.485
Gutter Velocity at INLET-fps	=	1.145
Depth at INLET Curb Line-Inches--d	=	3.538
Frontal Flow Intercepted by GRATE--CFS	=	0.465
Lateral Flow Intercepted by GRATE--CFS	=	0.031
TOTAL Flow Intercepted by GRATE--CFS	=	0.495
% FLOW Intercepted	=	99.081
By-pass Flow--CFS	=	0.005

(c)

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML WB 1172+30 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.132
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.700 - 50 yr
SPREAD-Ft.--T	=	7.738 8' max
Average Velocity-V-fps	=	0.939
FLOW in Gutter-CFS--Q	=	0.545
% Flow in Gutter-CFS	=	77.815
Velocity of Flow in Gutter-fps	=	1.156
Depth at Curb Line-Inches--d	=	3.267

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.700
GUTTER FLOW at INLET-CFS--Q	=	0.632
Gutter Velocity at INLET-fps	=	1.252
Depth at INLET Curb Line-Inches--d	=	3.929
Frontal Flow Intercepted by GRATE--CFS	=	0.594
Lateral Flow Intercepted by GRATE--CFS	=	0.081
TOTAL Flow Intercepted by GRATE--CFS	=	0.675
% FLOW Intercepted	=	96.481
By-pass Flow--CFS	=	0.025

(c)

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-22-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - ML WB 1172+66 Lt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.140
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.500 - 10yr
SPREAD-Ft.--T	=	6.307 - 8' max
Average Velocity-V-fps	=	0.918
FLOW in Gutter-CFS--Q	=	0.432
% Flow in Gutter-CFS	=	86.453
Velocity of Flow in Gutter-fps	=	1.081
Depth at Curb Line-Inches--d	=	2.924

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.500
GUTTER FLOW at INLET-CFS--Q	=	0.487
Gutter Velocity at INLET-fps	=	1.170
Depth at INLET Curb Line-Inches--d	=	3.503
Frontal Flow Intercepted by GRATE--CFS	=	0.468
Lateral Flow Intercepted by GRATE--CFS	=	0.028
TOTAL Flow Intercepted by GRATE--CFS	=	0.496
% FLOW Intercepted	=	99.165
By-pass Flow--CFS	=	0.004

(c)

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-22-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION -ML WB 1172+66 Lt CHECKER - UDV PAGE
Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.140
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.700 - 50yr
SPREAD-Ft.--T	=	7.618 - 8' max
Average Velocity-V-fps	=	0.963
FLOW in Gutter-CFS--Q	=	0.550
% Flow in Gutter-CFS	=	78.520
Velocity of Flow in Gutter-fps	=	1.181
Depth at Curb Line-Inches--d	=	3.238

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.700
GUTTER FLOW at INLET-CFS--Q	=	0.637
Gutter Velocity at INLET-fps	=	1.279
Depth at INLET Curb Line-Inches--d	=	3.895
Frontal Flow Intercepted by GRATE--CFS	=	0.600
Lateral Flow Intercepted by GRATE--CFS	=	0.077
TOTAL Flow Intercepted by GRATE--CFS	=	0.677
% FLOW Intercepted	=	96.664
By-pass Flow--CFS	=	0.023

CB 223

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-22-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML WB 1173+03 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.146
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.500 -10yr
SPREAD-Ft.--T	=	6.228 -8' max
Average Velocity-V-fps	=	0.935
FLOW in Gutter-CFS--Q	=	0.435
% Flow in Gutter-CFS	=	86.919
Velocity of Flow in Gutter-fps	=	1.098
Depth at Curb Line-Inches--d	=	2.905

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.500
GUTTER FLOW at INLET-CFS--Q	=	0.488
Gutter Velocity at INLET-fps	=	1.188
Depth at INLET Curb Line-Inches--d	=	3.479
Frontal Flow Intercepted by GRATE--CFS	=	0.470
Lateral Flow Intercepted by GRATE--CFS	=	0.027
TOTAL Flow Intercepted by GRATE--CFS	=	0.496
% FLOW Intercepted	=	99.222
By-pass Flow--CFS	=	0.004

.110 cf slotted Drain

CB 223

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-22-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML WB 1173+03 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.146
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.700 - 50yr
SPREAD-Ft.--T	=	7.533 - 8' max
Average Velocity-V-fps	=	0.980
FLOW in Gutter-CFS--Q	=	0.553
% Flow in Gutter-CFS	=	79.022
Velocity of Flow in Gutter-fps	=	1.200
Depth at Curb Line-Inches--d	=	3.218

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.700
GUTTER FLOW at INLET-CFS--Q	=	0.640
Gutter Velocity at INLET-fps	=	1.299
Depth at INLET Curb Line-Inches--d	=	3.870
Frontal Flow Intercepted by GRATE--CFS	=	0.603
Lateral Flow Intercepted by GRATE--CFS	=	0.074
TOTAL Flow Intercepted by GRATE--CFS	=	0.678
% FLOW Intercepted	=	96.795
By-pass Flow--CFS	=	0.022

(c)

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-22-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - ML WB 1173+41 Lt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - R&R
CHECKER - NDV
PAGE

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.152
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.500 - 10yr
SPREAD-Ft.--T	=	6.152 - 8' max
Average Velocity-V-fps	=	0.952
FLOW in Gutter-CFS--Q	=	0.437
% Flow in Gutter-CFS	=	87.363
Velocity of Flow in Gutter-fps	=	1.114
Depth at Curb Line-Inches--d	=	2.886

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.500
GUTTER FLOW at INLET-CFS--Q	=	0.490
Gutter Velocity at INLET-fps	=	1.205
Depth at INLET Curb Line-Inches--d	=	3.455
Frontal Flow Intercepted by GRATE--CFS	=	0.471
Lateral Flow Intercepted by GRATE--CFS	=	0.025
TOTAL Flow Intercepted by GRATE--CFS	=	0.496
% FLOW Intercepted	=	99.275
By-pass Flow--CFS	=	0.004

(c)

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-22-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - ML WB 1173+41 Lt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.152
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.700 - 50yr
SPREAD-Ft.--T	=	7.452 - 8' max
Average Velocity-V-fps	=	0.997
FLOW in Gutter-CFS--Q	=	0.557
% Flow in Gutter-CFS	=	79.503
Velocity of Flow in Gutter-fps	=	1.218
Depth at Curb Line-Inches--d	=	3.198

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.700
GUTTER FLOW at INLET-CFS--Q	=	0.643
Gutter Velocity at INLET-fps	=	1.319
Depth at INLET Curb Line-Inches--d	=	3.847
Frontal Flow Intercepted by GRATE--CFS	=	0.607
Lateral Flow Intercepted by GRATE--CFS	=	0.071
TOTAL Flow Intercepted by GRATE--CFS	=	0.678
% FLOW Intercepted	=	96.920
By-pass Flow--CFS	=	0.022

C

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-22-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - ML WB 1173+81 Lt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.160
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.500 - 10yr
SPREAD-Ft.--T	=	6.056 - 8 max
Average Velocity-V-fps	=	0.973
FLOW in Gutter-CFS--Q	=	0.440
% Flow in Gutter-CFS	=	87.923
Velocity of Flow in Gutter-fps	=	1.135
Depth at Curb Line-Inches--d	=	2.863

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.500
GUTTER FLOW at INLET-CFS--Q	=	0.491
Gutter Velocity at INLET-fps	=	1.228
Depth at INLET Curb Line-Inches--d	=	3.425
Frontal Flow Intercepted by GRATE--CFS	=	0.474
Lateral Flow Intercepted by GRATE--CFS	=	0.023
TOTAL Flow Intercepted by GRATE--CFS	=	0.497
% FLOW Intercepted	=	99.339
By-pass Flow--CFS	=	0.003

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-22-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML WB 1173+81 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.160
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.700 - 50yr
SPREAD-Ft.--T	=	7.349 - 8' max
Average Velocity-V-fps	=	1.019
FLOW in Gutter-CFS--Q	=	0.561
% Flow in Gutter-CFS	=	80.114
Velocity of Flow in Gutter-fps	=	1.241
Depth at Curb Line-Inches--d	=	3.174

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.700
GUTTER FLOW at INLET-CFS--Q	=	0.647
Gutter Velocity at INLET-fps	=	1.344
Depth at INLET Curb Line-Inches--d	=	3.817
Frontal Flow Intercepted by GRATE--CFS	=	0.612
Lateral Flow Intercepted by GRATE--CFS	=	0.068
TOTAL Flow Intercepted by GRATE--CFS	=	0.680
% FLOW Intercepted	=	97.080
By-pass Flow--CFS	=	0.020

CB 224

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-22-2004

PROJECT NAME- RM		TRACS NO.-	
HIGHWAY NAME-		DESIGNER - RSR	
LOCATION - ML WB	1174+24 Lt	CHECKER - NDV	PAGE

Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.168
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.500 - 10yr
SPREAD-Ft.--T	=	5.965 - 8' max
Average Velocity-V-fps	=	0.995
FLOW in Gutter-CFS--Q	=	0.442
% Flow in Gutter-CFS	=	88.449
Velocity of Flow in Gutter-fps	=	1.156
Depth at Curb Line-Inches--d	=	2.842

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.500
GUTTER FLOW at INLET-CFS--Q	=	0.492
Gutter Velocity at INLET-fps	=	1.249
Depth at INLET Curb Line-Inches--d	=	3.396
Frontal Flow Intercepted by GRATE--CFS	=	0.475
Lateral Flow Intercepted by GRATE--CFS	=	0.022
TOTAL Flow Intercepted by GRATE--CFS	=	0.497
% FLOW Intercepted	=	99.357
By-pass Flow--CFS	=	0.003

.85 LF Slotted Drain

CB 224

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-22-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML WB 1179+24 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.168
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.800 - 50yr
SPREAD-Ft.--T	=	7.791 - 8' max
Average Velocity-V-fps	=	1.061
FLOW in Gutter-CFS--Q	=	0.620
% Flow in Gutter-CFS	=	77.504
Velocity of Flow in Gutter-fps	=	1.308
Depth at Curb Line-Inches--d	=	3.280

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.800
GUTTER FLOW at INLET-CFS--Q	=	0.721
Gutter Velocity at INLET-fps	=	1.417
Depth at INLET Curb Line-Inches--d	=	3.946
Frontal Flow Intercepted by GRATE--CFS	=	0.677
Lateral Flow Intercepted by GRATE--CFS	=	0.089
TOTAL Flow Intercepted by GRATE--CFS	=	0.766
% FLOW Intercepted	=	95.745
By-pass Flow--CFS	=	0.034

(c)

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-22-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML WB 1174+67 Lt CHECKER - ADV PAGE
Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.174
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.600 - 10yr
SPREAD-Ft.--T	=	6.582 - 8' max
Average Velocity-V-fps	=	1.034
FLOW in Gutter-CFS--Q	=	0.508
% Flow in Gutter-CFS	=	84.712
Velocity of Flow in Gutter-fps	=	1.229
Depth at Curb Line-Inches--d	=	2.990

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.600
GUTTER FLOW at INLET-CFS--Q	=	0.578
Gutter Velocity at INLET-fps	=	1.331
Depth at INLET Curb Line-Inches--d	=	3.589
Frontal Flow Intercepted by GRATE--CFS	=	0.552
Lateral Flow Intercepted by GRATE--CFS	=	0.039
TOTAL Flow Intercepted by GRATE--CFS	=	0.592
% FLOW Intercepted	=	98.611
By-pass Flow--CFS	=	0.008

(C)

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-22-2004

PROJECT NAME- RM
TRACS NO.-
HIGHWAY NAME-
DESIGNER - RSR
LOCATION - ML WB 1174+67 Lt
CHECKER - NDV
PAGE
Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.174
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.800 - 50yr
SPREAD-Ft.--T	=	7.719 - 8' max
Average Velocity-V-fps	=	1.077
FLOW in Gutter-CFS--Q	=	0.623
% Flow in Gutter-CFS	=	77.925
Velocity of Flow in Gutter-fps	=	1.325
Depth at Curb Line-Inches--d	=	3.263

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.800
GUTTER FLOW at INLET-CFS--Q	=	0.723
Gutter Velocity at INLET-fps	=	1.435
Depth at INLET Curb Line-Inches--d	=	3.924
Frontal Flow Intercepted by GRATE--CFS	=	0.680
Lateral Flow Intercepted by GRATE--CFS	=	0.087
TOTAL Flow Intercepted by GRATE--CFS	=	0.767
% FLOW Intercepted	=	95.825
By-pass Flow--CFS	=	0.033

(c)

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-22-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION -MLWB 1175+17 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.184
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.600 -10yr
SPREAD-Ft.--T	=	6.476 -8' max
Average Velocity-V-fps	=	1.060
FLOW in Gutter-CFS--Q	=	0.512
% Flow in Gutter-CFS	=	85.350
Velocity of Flow in Gutter-fps	=	1.255
Depth at Curb Line-Inches--d	=	2.964

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.600
GUTTER FLOW at INLET-CFS--Q	=	0.580
Gutter Velocity at INLET-fps	=	1.358
Depth at INLET Curb Line-Inches--d	=	3.557
Frontal Flow Intercepted by GRATE--CFS	=	0.556
Lateral Flow Intercepted by GRATE--CFS	=	0.037
TOTAL Flow Intercepted by GRATE--CFS	=	0.592
% FLOW Intercepted	=	98.723
By-pass Flow--CFS	=	0.008

(c)

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-22-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION -ML WB 1175+17 Lt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.184
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.800 - 50yr
SPREAD-Ft.--T	=	7.605 - 8' max
Average Velocity-V-fps	=	1.103
FLOW in Gutter-CFS--Q	=	0.629
% Flow in Gutter-CFS	=	78.594
Velocity of Flow in Gutter-fps	=	1.353
Depth at Curb Line-Inches--d	=	3.235

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.800
GUTTER FLOW at INLET-CFS--Q	=	0.729
Gutter Velocity at INLET-fps	=	1.466
Depth at INLET Curb Line-Inches--d	=	3.891
Frontal Flow Intercepted by GRATE--CFS	=	0.686
Lateral Flow Intercepted by GRATE--CFS	=	0.082
TOTAL Flow Intercepted by GRATE--CFS	=	0.768
% FLOW Intercepted	=	96.033
By-pass Flow--CFS	=	0.032

CB 225

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-22-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - ML WB 175+67 LT
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.190
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.600 -10yr
SPREAD-Ft.--T	=	6.415 - 8' max
Average Velocity-V-fps	=	1.075
FLOW in Gutter-CFS--Q	=	0.514
% Flow in Gutter-CFS	=	85.715
Velocity of Flow in Gutter-fps	=	1.270
Depth at Curb Line-Inches--d	=	2.950

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.600
GUTTER FLOW at INLET-CFS--Q	=	0.582
Gutter Velocity at INLET-fps	=	1.374
Depth at INLET Curb Line-Inches--d	=	3.538
Frontal Flow Intercepted by GRATE--CFS	=	0.558
Lateral Flow Intercepted by GRATE--CFS	=	0.035
TOTAL Flow Intercepted by GRATE--CFS	=	0.593
% FLOW Intercepted	=	98.785
By-pass Flow--CFS	=	0.007

.100LF Slotted drain

CB 225

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-22-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML WB 1175+67 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.190
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.900 - 50yr
SPREAD-Ft.--T	=	8.023 - 8' max
Average Velocity-V-fps	=	1.138
FLOW in Gutter-CFS--Q	=	0.685
% Flow in Gutter-CFS	=	76.154
Velocity of Flow in Gutter-fps	=	1.412
Depth at Curb Line-Inches--d	=	3.336

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.900
GUTTER FLOW at INLET-CFS--Q	=	0.799
Gutter Velocity at INLET-fps	=	1.529
Depth at INLET Curb Line-Inches--d	=	4.012
Frontal Flow Intercepted by GRATE--CFS	=	0.748
Lateral Flow Intercepted by GRATE--CFS	=	0.104
TOTAL Flow Intercepted by GRATE--CFS	=	0.851
% FLOW Intercepted	=	94.599
By-pass Flow--CFS	=	0.049

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-22-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML WB 1176+18 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.200
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.600 - 10yr
SPREAD-Ft.--T	=	6.318 - 8' max
Average Velocity-V-fps	=	1.099
FLOW in Gutter-CFS--Q	=	0.518
% Flow in Gutter-CFS	=	86.293
Velocity of Flow in Gutter-fps	=	1.294
Depth at Curb Line-Inches--d	=	2.926

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.600
GUTTER FLOW at INLET-CFS--Q	=	0.584
Gutter Velocity at INLET-fps	=	1.400
Depth at INLET Curb Line-Inches--d	=	3.508
Frontal Flow Intercepted by GRATE--CFS	=	0.561
Lateral Flow Intercepted by GRATE--CFS	=	0.033
TOTAL Flow Intercepted by GRATE--CFS	=	0.593
% FLOW Intercepted	=	98.882
By-pass Flow--CFS	=	0.007

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-22-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION -ML WB 1176+18 Lt CHECKER - ADV PAGE
Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.200
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.900 - 50yr
SPREAD-Ft.--T	=	7.917 - 8' max
Average Velocity-V-fps	=	1.163
FLOW in Gutter-CFS--Q	=	0.691
% Flow in Gutter-CFS	=	76.770
Velocity of Flow in Gutter-fps	=	1.439
Depth at Curb Line-Inches--d	=	3.310

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.900
GUTTER FLOW at INLET-CFS--Q	=	0.804
Gutter Velocity at INLET-fps	=	1.558
Depth at INLET Curb Line-Inches--d	=	3.982
Frontal Flow Intercepted by GRATE--CFS	=	0.754
Lateral Flow Intercepted by GRATE--CFS	=	0.099
TOTAL Flow Intercepted by GRATE--CFS	=	0.853
% FLOW Intercepted	=	94.809
By-pass Flow--CFS	=	0.047

CB 226

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-22-2004

PROJECT NAME- RM	TRACS NO.-		
HIGHWAY NAME-	DESIGNER - RSR		
LOCATION - ML WB 1176+70 Lt	CHECKER - NDV	PAGE	

Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.210
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.600 - 10yr
SPREAD-Ft.--T	=	6.226 - 8 max
Average Velocity-V-fps	=	1.123
FLOW in Gutter-CFS--Q	=	0.521
% Flow in Gutter-CFS	=	86.838
Velocity of Flow in Gutter-fps	=	1.317
Depth at Curb Line-Inches--d	=	2.904

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.600
GUTTER FLOW at INLET-CFS--Q	=	0.586
Gutter Velocity at INLET-fps	=	1.425
Depth at INLET Curb Line-Inches--d	=	3.479
Frontal Flow Intercepted by GRATE--CFS	=	0.563
Lateral Flow Intercepted by GRATE--CFS	=	0.030
TOTAL Flow Intercepted by GRATE--CFS	=	0.594
% FLOW Intercepted	=	98.969
By-pass Flow--CFS	=	0.006

.55 LF Slotted drain

CB 226

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-22-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML WB 1176+70 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.210
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.900 -50yr
SPREAD-Ft.--T	=	7.816 -8'max
Average Velocity-V-fps	=	1.188
FLOW in Gutter-CFS--Q	=	0.696
% Flow in Gutter-CFS	=	77.355
Velocity of Flow in Gutter-fps	=	1.465
Depth at Curb Line-Inches--d	=	3.286

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.900
GUTTER FLOW at INLET-CFS--Q	=	0.809
Gutter Velocity at INLET-fps	=	1.587
Depth at INLET Curb Line-Inches--d	=	3.953
Frontal Flow Intercepted by GRATE--CFS	=	0.760
Lateral Flow Intercepted by GRATE--CFS	=	0.095
TOTAL Flow Intercepted by GRATE--CFS	=	0.855
% FLOW Intercepted	=	95.011
By-pass Flow--CFS	=	0.045

CB
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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-22-2004

PROJECT NAME- RM	TRACS NO.-		
HIGHWAY NAME-	DESIGNER - RSR		
LOCATION - ML WB 1178+60 Lt	CHECKER - NDV	PAGE	

Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	2.300 - 2yr
SPREAD-Ft.--T	=	11.746 - 16' max
Average Velocity-V-fps	=	1.507
FLOW in Gutter-CFS--Q	=	1.329
% Flow in Gutter-CFS	=	57.773
Velocity of Flow in Gutter-fps	=	1.978
Depth at Curb Line-Inches--d	=	4.229

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	2.300
GUTTER FLOW at INLET-CFS--Q	=	1.557
Gutter Velocity at INLET-fps	=	2.128
Depth at INLET Curb Line-Inches--d	=	5.017
Frontal Flow Intercepted by GRATE--CFS	=	1.407
Lateral Flow Intercepted by GRATE--CFS	=	0.333
TOTAL Flow Intercepted by GRATE--CFS	=	1.740
% FLOW Intercepted	=	75.665
By-pass Flow--CFS	=	0.560

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-22-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML WB 1178+60 Lt CHECKER - MDV PAGE
Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	3.200 - 50yr
SPREAD-Ft.--T	=	13.559 - 22 max
Average Velocity-V-fps	=	1.612
FLOW in Gutter-CFS--Q	=	1.634
% Flow in Gutter-CFS	=	51.074
Velocity of Flow in Gutter-fps	=	2.144
Depth at Curb Line-Inches--d	=	4.664

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	3.200
GUTTER FLOW at INLET-CFS--Q	=	1.903
Gutter Velocity at INLET-fps	=	2.295
Depth at INLET Curb Line-Inches--d	=	5.484
Frontal Flow Intercepted by GRATE--CFS	=	1.699
Lateral Flow Intercepted by GRATE--CFS	=	0.457
TOTAL Flow Intercepted by GRATE--CFS	=	2.156
% FLOW Intercepted	=	67.362
By-pass Flow--CFS	=	1.044

CB
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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-22-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - MLWB 1180+75 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.125
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	3.100 — 10 yr
SPREAD-Ft.--T	=	15.477 - 16' max
Average Velocity-V-fps	=	1.219
FLOW in Gutter-CFS--Q	=	1.404
% Flow in Gutter-CFS	=	45.284
Velocity of Flow in Gutter-fps	=	1.636
Depth at Curb Line-Inches--d	=	5.124

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	8.494
Depth at INLET Curb Line-Inches--d	=	5.969
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	12.291
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.670

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.609	1.889	1.117	3.006	0.094	96.97
10.000	0.951	2.949	0.151	3.100	0.000	100.00
15.000	1.000	3.100	0.000	3.100	0.000	100.00
20.000	1.000	3.100	0.000	3.100	0.000	100.00
25.000	1.000	3.100	0.000	3.100	0.000	100.00

CB 230

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-22-2004

PROJECT NAME- RM
TRACS NO.-
HIGHWAY NAME-
DESIGNER - RSR
LOCATION - MLWB 1180+75 Lt
CHECKER - NDV
PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.125
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	4.600 - 50yr
SPREAD-Ft.--T	=	18.187 - 22' max
Average Velocity-V-fps	=	1.332
FLOW in Gutter-CFS--Q	=	1.787
% Flow in Gutter-CFS	=	38.857
Velocity of Flow in Gutter-fps	=	1.799
Depth at Curb Line-Inches--d	=	5.775

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	8.494
Depth at INLET Curb Line-Inches--d	=	6.645
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	15.485
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.670

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.504	2.320	1.865	4.185	0.415	90.99
10.000	0.846	3.890	0.695	4.584	0.016	99.66
15.000	0.998	4.591	0.009	4.600	0.000	100.00
20.000	1.000	4.600	0.000	4.600	0.000	100.0[illegible]
25.000	1.000	4.600	0.000	4.600	0.000	100.0[illegible]

CB 231

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

04-20-2005

PROJECT NAME- RM
TRACS NO.-
HIGHWAY NAME-
DESIGNER - RSR
LOCATION - ML WB 1182+00 Lt
CHECKER - NDV
PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--IN SUMP

GUTTER FLOW HYDRAULICS

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Effective Perimeter--Ft.	=	7.354
Capture Ratio -- GRATE	=	0.500
Capture Ratio -- SLOTTED DRAIN	=	0.500
Local Gutter Depression-Inches	=	1.000 ✓
Flow-CFS--Q	=	3.300 - 10yr

LENGTH	Q(Slot. Dn)	Q(Grate)	d(inches)	SPREAD,Ft.
5.000	1.539	1.761	4.187	11.570 ← 16' max
10.000	2.276	1.026	3.076	6.940
15.000	2.627	0.672	2.422	4.218
20.000	2.830	0.471	1.969	2.449

CB 231

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

04-20-2005

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML WB 1182+00 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--IN SUMP

GUTTER FLOW HYDRAULICS

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Effective Perimeter--Ft.	=	7.354
Capture Ratio -- GRATE	=	0.500
Capture Ratio -- SLOTTED DRAIN	=	0.500
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	5.200 - 50yr

LENGTH	Q(Slot. Dn)	Q(Grate)	d(inches)	SPREAD,Ft.
5.000	1.808	3.392	6.157	19.780 ← 22' max
10.000	3.179	2.020	4.534	13.018
15.000	3.927	1.272	3.474	8.601
20.000	4.272	0.928	2.907	6.236

CB 237

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-08-2004

PROJECT NAME- PM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML WB 1183+25 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.125
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	3.300 - 10yr
SPREAD-Ft.--T	=	15.882 - 18' max
Average Velocity-V-fps	=	1.236
FLOW in Gutter-CFS--Q	=	1.459
% Flow in Gutter-CFS	=	44.206
Velocity of Flow in Gutter-fps	=	1.661
Depth at Curb Line-Inches--d	=	5.222

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.071
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	12.751
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.592	1.953	1.153	3.106	0.194	94.13
10.000	0.937	3.091	0.209	3.300	0.000	100.00
15.000	1.000	3.300	0.000	3.300	0.000	100.00
20.000	1.000	3.300	0.000	3.300	0.000	100.00

CB 237

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-08-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - BSR
LOCATION - ML WB 1183+25 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.125
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	4.600 -50yr
SPREAD-Ft.--T	=	18.187 - 22' max
Average Velocity-V-fps	=	1.332
FLOW in Gutter-CFS--Q	=	1.787
% Flow in Gutter-CFS	=	38.857
Velocity of Flow in Gutter-fps	=	1.799
Depth at Curb Line-Inches--d	=	5.775

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.645
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	15.485
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.504	2.320	1.687	4.007	0.593	87.11
10.000	0.846	3.890	0.683	4.573	0.027	99.41
15.000	0.998	4.591	0.009	4.600	0.000	100.00
20.000	1.000	4.600	0.000	4.600	0.000	100.0

CB 238

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-08-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML WB 1186+00 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	4.700 -10 yr
SPREAD-Ft.--T	=	15.929 -16 way
Average Velocity-V-fps	=	1.751
FLOW in Gutter-CFS--Q	=	2.072
% Flow in Gutter-CFS	=	44.085
Velocity of Flow in Gutter-fps	=	2.352
Depth at Curb Line-Inches--d	=	5.233

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.082
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	18.234
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.438	2.060	1.905	3.966	0.734	84.38
10.000	0.761	3.576	1.036	4.612	0.088	98.13
15.000	0.956	4.491	0.209	4.700	0.000	100.00
20.000	1.000	4.700	0.000	4.700	0.000	100.00

CD 238

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-08-2004

PROJECT NAME- RM   TRACS NO.-
HIGHWAY NAME-   DESIGNER - RSR
LOCATION - ML WB 1186+00 Lt   CHECKER - NDV   PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	6.500 - 50yr
SPREAD-Ft.--T	=	18.181 <22max
Average Velocity-V-fps	=	1.883
FLOW in Gutter-CFS--Q	=	2.527
% Flow in Gutter-CFS	=	38.869
Velocity of Flow in Gutter-fps	=	2.543
Depth at Curb Line-Inches--d	=	5.773

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.643
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	22.040
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.371	2.409	2.511	4.921	1.579	75.71
10.000	0.663	4.311	1.679	5.989	0.511	92.15
15.000	0.872	5.667	0.806	6.472	0.028	99.58
20.000	0.986	6.410	0.090	6.500	0.000	100.0

CB 241

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-08-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - WB ML 1190+00 Lt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	4.600 - 10 yr
SPREAD-Ft.--T	=	15.788 - 16' max
Average Velocity-V-fps	=	1.743
FLOW in Gutter-CFS--Q	=	2.045
% Flow in Gutter-CFS	=	44.453
Velocity of Flow in Gutter-fps	=	2.340
Depth at Curb Line-Inches--d	=	5.199

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.047
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	18.005
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.443	2.039	1.868	3.907	0.693	84.94
10.000	0.768	3.531	0.995	4.526	0.074	98.38
15.000	0.960	4.417	0.183	4.600	0.000	100.00
20.000	1.000	4.600	0.000	4.600	0.000	100.00

CB
241

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-08-2004

PROJECT NAME- RM   TRACS NO.-
HIGHWAY NAME-   DESIGNER - RSR
LOCATION -WB ML 1190+00 Lt   CHECKER - NDV   PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	6.400 -50yr
SPREAD-Ft.--T	=	18.068 -22' max
Average Velocity-V-fps	=	1.876
FLOW in Gutter-CFS--Q	=	2.503
% Flow in Gutter-CFS	=	39.105
Velocity of Flow in Gutter-fps	=	2.534
Depth at Curb Line-Inches--d	=	5.746

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.615
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	21.842
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.374	2.392	2.480	4.872	1.528	76.13
10.000	0.668	4.274	1.640	5.913	0.487	92.40
15.000	0.876	5.608	0.770	6.378	0.022	99.66
20.000	0.988	6.325	0.075	6.400	0.000	100.0

CB 250

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-11-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML WB 1198+00 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	4.600 -10yr
SPREAD-Ft.--T	=	15.788 - 10' max
Average Velocity-V-fps	=	1.743
FLOW in Gutter-CFS--Q	=	2.045
% Flow in Gutter-CFS	=	44.453
Velocity of Flow in Gutter-fps	=	2.340
Depth at Curb Line-Inches--d	=	5.199

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.047
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	18.005
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.443	2.039	1.868	3.907	0.693	84.94
10.000	0.768	3.531	0.995	4.526	0.074	98.38
15.000	0.960	4.417	0.183	4.600	0.000	100.00
20.000	1.000	4.600	0.000	4.600	0.000	100.00
25.000	1.000	4.600	0.000	4.600	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

CB 250

10-11-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - ML WB 1198+00 Lt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	6.400 - 50 yr
SPREAD-Ft.--T	=	18.068 - 22' max
Average Velocity-V-fps	=	1.876
FLOW in Gutter-CFS--Q	=	2.503
% Flow in Gutter-CFS	=	39.105
Velocity of Flow in Gutter-fps	=	2.534
Depth at Curb Line-Inches--d	=	5.746

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.615
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	21.842
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.374	2.392	2.480	4.872	1.528	76.13
10.000	0.668	4.274	1.640	5.913	0.487	92.40
15.000	0.876	5.608	0.770	6.378	0.022	99.66
20.000	0.988	6.325	0.075	6.400	0.000	100.0[illegible]
25.000	1.000	6.400	0.000	6.400	0.000	100.0[illegible]

CB 252

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-11-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - ML WB 1202+00 Lt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	4.700 - 10yr
SPREAD-Ft.--T	=	15.929 - 16' max
Average Velocity-V-fps	=	1.751
FLOW in Gutter-CFS--Q	=	2.072
% Flow in Gutter-CFS	=	44.085
Velocity of Flow in Gutter-fps	=	2.352
Depth at Curb Line-Inches--d	=	5.233

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.082
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	18.234
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.438	2.060	1.905	3.966	0.734	84.38
10.000	0.761	3.576	1.036	4.612	0.088	98.13
15.000	0.956	4.491	0.209	4.700	0.000	100.00
20.000	1.000	4.700	0.000	4.700	0.000	100.00
25.000	1.000	4.700	0.000	4.700	0.000	100.00

CB 252

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-11-2004

PROJECT NAME- BM　　　　TRACS NO.-
HIGHWAY NAME-　　　　DESIGNER - RSR
LOCATION - ML WB 1202+00 Lt　　　　CHECKER - NDV　　　　PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	7.000 - 50yr
SPREAD-Ft.--T	=	18.732 - 22' max
Average Velocity-V-fps	=	1.915
FLOW in Gutter-CFS--Q	=	2.643
% Flow in Gutter-CFS	=	37.760
Velocity of Flow in Gutter-fps	=	2.589
Depth at Curb Line-Inches--d	=	5.906

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.780
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	23.010
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.357	2.496	2.663	5.160	1.840	73.71
10.000	0.642	4.492	1.843	6.335	0.665	90.50
15.000	0.850	5.952	0.979	6.931	0.069	99.01
20.000	0.974	6.820	0.180	7.000	0.000	100.00
25.000	1.000	7.000	0.000	7.000	0.000	100.00

CB 255

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-11-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - ML WB 1204+75 Lt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.125
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	3.300 - 10yr
SPREAD-Ft.--T	=	15.882 - 16' max
Average Velocity-V-fps	=	1.236
FLOW in Gutter-CFS--Q	=	1.459
% Flow in Gutter-CFS	=	44.206
Velocity of Flow in Gutter-fps	=	1.661
Depth at Curb Line-Inches--d	=	5.222

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.071
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	12.751
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.592	1.953	1.153	3.106	0.194	94.13
10.000	0.937	3.091	0.209	3.300	0.000	100.00
15.000	1.000	3.300	0.000	3.300	0.000	100.00
20.000	1.000	3.300	0.000	3.300	0.000	100.00
25.000	1.000	3.300	0.000	3.300	0.000	100.00

CB
255

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-11-2004

PROJECT NAME- RM
TRACS NO.-
HIGHWAY NAME-
DESIGNER - RSR
LOCATION - ML WB 1204+75 Lt
CHECKER - NDV
PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.125
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	5.200 -50yr
SPREAD-Ft.--T	=	19.107 22'max
Average Velocity-V-fps	=	1.369
FLOW in Gutter-CFS--Q	=	1.926
% Flow in Gutter-CFS	=	37.039
Velocity of Flow in Gutter-fps	=	1.852
Depth at Curb Line-Inches--d	=	5.996

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.872
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	16.627
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.475	2.469	1.908	4.377	0.823	84.17
10.000	0.809	4.207	0.907	5.114	0.086	98.35
15.000	0.985	5.121	0.079	5.200	0.000	100.00
20.000	1.000	5.200	0.000	5.200	0.000	100.0[illegible]
25.000	1.000	5.200	0.000	5.200	0.000	100.[illegible]

CB 256

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

04-20-2005

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - MLWB 1206+00 Lt CHECKER - ADV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--IN SUMP

GUTTER FLOW HYDRAULICS

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Effective Perimeter--Ft.	=	7.354
Capture Ratio -- GRATE	=	0.500
Capture Ratio -- SLOTTED DRAIN	=	0.500
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	3.400 - 10yr

LENGTH	Q(Slot. Dn)	Q(Grate)	d(inches)	SPREAD,Ft.
5.000	1.555	1.843	4.300	12.040 ← 16' max
10.000	2.335	1.067	3.145	7.230
15.000	2.697	0.702	2.483	4.471
20.000	2.909	0.493	2.023	2.556

CB 256

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

04-20-2005

PROJECT NAME- RM   TRACS NO.-
HIGHWAY NAME-   DESIGNER - BSR
LOCATION - ML WB 1206+00 Lt   CHECKER - NDV   PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--IN SUMP

GUTTER FLOW HYDRAULICS

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Effective Perimeter--Ft.	=	7.354
Capture Ratio -- GRATE	=	0.500
Capture Ratio -- SLOTTED DRAIN	=	0.500
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	5.500 - 50yr

LENGTH	Q(Slot. Dn)	Q(Grate)	d(inches)	SPREAD,Ft.
5.000	1.843	3.657	6.441	20.962 - 22' max
10.000	3.259	2.240	4.816	14.192
15.000	4.129	1.371	3.626	9.233
20.000	4.495	1.005	3.041	6.796

CB 262

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-04-2004

PROJECT NAME- RM   TRACS NO.-
HIGHWAY NAME-   DESIGNER - RSR
LOCATION - MLWB 1207+25 Lt   CHECKER - NDV   PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.125
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	3.300 - 10 yr
SPREAD-Ft.--T	=	15.882 - 16' max
Average Velocity-V-fps	=	1.236
FLOW in Gutter-CFS--Q	=	1.459
% Flow in Gutter-CFS	=	44.206
Velocity of Flow in Gutter-fps	=	1.661
Depth at Curb Line-Inches--d	=	5.222

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.070
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	12.752
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.592	1.953	1.153	3.106	0.194	94.13
10.000	0.937	3.091	0.209	3.300	0.000	100.00
15.000	1.000	3.300	0.000	3.300	0.000	100.00
20.000	1.000	3.300	0.000	3.300	0.000	100.00
25.000	1.000	3.300	0.000	3.300	0.000	100.00

CB 262

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-04-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML WB 1207+25 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.125
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	4.500 - 50yr
SPREAD-Ft.--T	=	18.026 - 22' max
Average Velocity-V-fps	=	1.325
FLOW in Gutter-CFS--Q	=	1.764
% Flow in Gutter-CFS	=	39.192
Velocity of Flow in Gutter-fps	=	1.789
Depth at Curb Line-Inches--d	=	5.736

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.605
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	15.288
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.510	2.294	1.649	3.943	0.557	87.62
10.000	0.852	3.834	0.645	4.479	0.021	99.53
15.000	0.999	4.496	0.004	4.500	0.000	100.00
20.000	1.000	4.500	0.000	4.500	0.000	100.0
25.000	1.000	4.500	0.000	4.500	0.000	100.0

LB
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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-04-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - ML WB 1210+00 Lt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.200 - 10yr
SPREAD-Ft.--T	=	8.661 · 16' max
Average Velocity-V-fps	=	1.338
FLOW in Gutter-CFS--Q	=	0.871
% Flow in Gutter-CFS	=	72.550
Velocity of Flow in Gutter-fps	=	1.683
Depth at Curb Line-Inches--d	=	3.489

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	4.191
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	8.220
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.815	0.978	0.222	1.200	0.000	100.00
10.000	1.000	1.200	0.000	1.200	0.000	100.00
15.000	1.000	1.200	0.000	1.200	0.000	100.00
20.000	1.000	1.200	0.000	1.200	0.000	100.00
25.000	1.000	1.200	0.000	1.200	0.000	100.00

CB 263

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-04-2004

PROJECT NAME- RM		TRACS NO.-	
HIGHWAY NAME-		DESIGNER - RSR	
LOCATION - ML WB 1210+00 Lt		CHECKER - NDV	PAGE

Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.700 - 50yr
SPREAD-Ft.--T	=	10.241 - 22' hwy
Average Velocity-V-fps	=	1.422
FLOW in Gutter-CFS--Q	=	1.095
% Flow in Gutter-CFS	=	64.428
Velocity of Flow in Gutter-fps	=	1.836
Depth at Curb Line-Inches--d	=	3.868

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	4.621
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	10.031
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.711	1.209	0.490	1.699	0.001	99.93
10.000	1.000	1.700	0.000	1.700	0.000	100.00
15.000	1.000	1.700	0.000	1.700	0.000	100.00
20.000	1.000	1.700	0.000	1.700	0.000	100.[illegible]
25.000	1.000	1.700	0.000	1.700	0.000	100.[illegible]

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-04-2004

PROJECT NAME- RM	TRACS NO.-		
HIGHWAY NAME-	DESIGNER - RSR		
LOCATION - MLWB 1211+01 Lt	CHECKER - NDV	PAGE	

Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.208
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.600 - 10yr
SPREAD-Ft.--T	=	6.244 - 8' max
Average Velocity-V-fps	=	1.118
FLOW in Gutter-CFS--Q	=	0.520
% Flow in Gutter-CFS	=	86.732
Velocity of Flow in Gutter-fps	=	1.312
Depth at Curb Line-Inches--d	=	2.908

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.600
GUTTER FLOW at INLET-CFS--Q	=	0.586
Gutter Velocity at INLET-fps	=	1.420
Depth at INLET Curb Line-Inches--d	=	3.485
Frontal Flow Intercepted by GRATE--CFS	=	0.563
Lateral Flow Intercepted by GRATE--CFS	=	0.031
TOTAL Flow Intercepted by GRATE--CFS	=	0.594
% FLOW Intercepted	=	98.952
By-pass Flow--CFS	=	0.006

• 55 LF Slotted Drain

CB 275

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-04-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML UB 1211+01 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.208
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.900 - 50yr
SPREAD-Ft.--T	=	7.836 - 8 max
Average Velocity-V-fps	=	1.183
FLOW in Gutter-CFS--Q	=	0.695
% Flow in Gutter-CFS	=	77.240
Velocity of Flow in Gutter-fps	=	1.460
Depth at Curb Line-Inches--d	=	3.291

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.900
GUTTER FLOW at INLET-CFS--Q	=	0.808
Gutter Velocity at INLET-fps	=	1.581
Depth at INLET Curb Line-Inches--d	=	3.959
Frontal Flow Intercepted by GRATE--CFS	=	0.759
Lateral Flow Intercepted by GRATE--CFS	=	0.096
TOTAL Flow Intercepted by GRATE--CFS	=	0.855
% FLOW Intercepted	=	94.971
By-pass Flow--CFS	=	0.045

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-04-2004

PROJECT NAME- RM		TRACS NO.-	
HIGHWAY NAME-		DESIGNER -	RSR
LOCATION - McFB 121+55 Lt		CHECKER -	NDV	PAGE

Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.200
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.900 - 50yr
SPREAD-Ft.--T	=	7.917 - 8 max
Average Velocity-V-fps	=	1.163
FLOW in Gutter-CFS--Q	=	0.691
% Flow in Gutter-CFS	=	76.770
Velocity of Flow in Gutter-fps	=	1.439
Depth at Curb Line-Inches--d	=	3.310

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.900
GUTTER FLOW at INLET-CFS--Q	=	0.804
Gutter Velocity at INLET-fps	=	1.558
Depth at INLET Curb Line-Inches--d	=	3.982
Frontal Flow Intercepted by GRATE--CFS	=	0.754
Lateral Flow Intercepted by GRATE--CFS	=	0.099
TOTAL Flow Intercepted by GRATE--CFS	=	0.853
% FLOW Intercepted	=	94.809
By-pass Flow--CFS	=	0.047

(c)

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-04-2004

PROJECT NAME- RM   TRACS NO.-
HIGHWAY NAME-   DESIGNER - RSR
LOCATION - ML WB 1211+55 Lt   CHECKER - NDV   PAGE
Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.200
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.600 - 10yr
SPREAD-Ft.--T	=	6.318 - 8max
Average Velocity-V-fps	=	1.099
FLOW in Gutter-CFS--Q	=	0.518
% Flow in Gutter-CFS	=	86.293
Velocity of Flow in Gutter-fps	=	1.294
Depth at Curb Line-Inches--d	=	2.926

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.600
GUTTER FLOW at INLET-CFS--Q	=	0.584
Gutter Velocity at INLET-fps	=	1.400
Depth at INLET Curb Line-Inches--d	=	3.508
Frontal Flow Intercepted by GRATE--CFS	=	0.561
Lateral Flow Intercepted by GRATE--CFS	=	0.033
TOTAL Flow Intercepted by GRATE--CFS	=	0.593
% FLOW Intercepted	=	98.882
By-pass Flow--CFS	=	0.007

(GB 276)

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-04-2004

PROJECT NAME-	RM	TRACS NO.-	
HIGHWAY NAME-		DESIGNER -	RSR
LOCATION -	ML WB 1212+08 Lt	CHECKER -	NDV PAGE

Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.192
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.900 - 50yr
SPREAD-Ft.--T	=	8.001 - 8' max
Average Velocity-V-fps	=	1.143
FLOW in Gutter-CFS--Q	=	0.687
% Flow in Gutter-CFS	=	76.280
Velocity of Flow in Gutter-fps	=	1.417
Depth at Curb Line-Inches--d	=	3.330

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.900
GUTTER FLOW at INLET-CFS--Q	=	0.800
Gutter Velocity at INLET-fps	=	1.535
Depth at INLET Curb Line-Inches--d	=	4.006
Frontal Flow Intercepted by GRATE--CFS	=	0.749
Lateral Flow Intercepted by GRATE--CFS	=	0.103
TOTAL Flow Intercepted by GRATE--CFS	=	0.852
% FLOW Intercepted	=	94.642
By-pass Flow--CFS	=	0.048

· 100 LF Slotted drain

CB 276

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-04-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - MI WB 1212+08 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.192
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.600 -10yr
SPREAD-Ft.--T	=	6.395 -8' max
Average Velocity-V-fps	=	1.080
FLOW in Gutter-CFS--Q	=	0.515
% Flow in Gutter-CFS	=	85.833
Velocity of Flow in Gutter-fps	=	1.274
Depth at Curb Line-Inches--d	=	2.945

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.600
GUTTER FLOW at INLET-CFS--Q	=	0.582
Gutter Velocity at INLET-fps	=	1.379
Depth at INLET Curb Line-Inches--d	=	3.532
Frontal Flow Intercepted by GRATE--CFS	=	0.558
Lateral Flow Intercepted by GRATE--CFS	=	0.035
TOTAL Flow Intercepted by GRATE--CFS	=	0.593
% FLOW Intercepted	=	98.805
By-pass Flow--CFS	=	0.007

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-04-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - ML WB 1212+60 Lt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.184
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.800 - 50yr
SPREAD-Ft.--T	=	7.605 - 8' max
Average Velocity-V-fps	=	1.103
FLOW in Gutter-CFS--Q	=	0.629
% Flow in Gutter-CFS	=	78.594
Velocity of Flow in Gutter-fps	=	1.353
Depth at Curb Line-Inches--d	=	3.235

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.800
GUTTER FLOW at INLET-CFS--Q	=	0.729
Gutter Velocity at INLET-fps	=	1.466
Depth at INLET Curb Line-Inches--d	=	3.891
Frontal Flow Intercepted by GRATE--CFS	=	0.686
Lateral Flow Intercepted by GRATE--CFS	=	0.082
TOTAL Flow Intercepted by GRATE--CFS	=	0.768
% FLOW Intercepted	=	96.033
By-pass Flow--CFS	=	0.032

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-04-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - MLWB 1212+60 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.184
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.600 - 10yr
SPREAD-Ft.--T	=	6.476 - 8' max
Average Velocity-V-fps	=	1.060
FLOW in Gutter-CFS--Q	=	0.512
% Flow in Gutter-CFS	=	85.350
Velocity of Flow in Gutter-fps	=	1.255
Depth at Curb Line-Inches--d	=	2.964

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.600
GUTTER FLOW at INLET-CFS--Q	=	0.580
Gutter Velocity at INLET-fps	=	1.358
Depth at INLET Curb Line-Inches--d	=	3.557
Frontal Flow Intercepted by GRATE--CFS	=	0.556
Lateral Flow Intercepted by GRATE--CFS	=	0.037
TOTAL Flow Intercepted by GRATE--CFS	=	0.592
% FLOW Intercepted	=	98.723
By-pass Flow--CFS	=	0.008

(c)

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-04-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - ML WB 1213+08 Lt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.176
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.800 -50 yr
SPREAD-Ft.--T	=	7.696 = 8' max
Average Velocity-V-fps	=	1.082
FLOW in Gutter-CFS--Q	=	0.624
% Flow in Gutter-CFS	=	78.062
Velocity of Flow in Gutter-fps	=	1.331
Depth at Curb Line-Inches--d	=	3.257

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.800
GUTTER FLOW at INLET-CFS--Q	=	0.724
Gutter Velocity at INLET-fps	=	1.442
Depth at INLET Curb Line-Inches--d	=	3.917
Frontal Flow Intercepted by GRATE--CFS	=	0.681
Lateral Flow Intercepted by GRATE--CFS	=	0.086
TOTAL Flow Intercepted by GRATE--CFS	=	0.767
% FLOW Intercepted	=	95.868
By-pass Flow--CFS	=	0.033

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-04-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML WB 1213+08 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.176
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.600 - 10yr
SPREAD-Ft.--T	=	6.560 8 max
Average Velocity-V-fps	=	1.039
FLOW in Gutter-CFS--Q	=	0.509
% Flow in Gutter-CFS	=	84.843
Velocity of Flow in Gutter-fps	=	1.234
Depth at Curb Line-Inches--d	=	2.985

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.600
GUTTER FLOW at INLET-CFS--Q	=	0.578
Gutter Velocity at INLET-fps	=	1.336
Depth at INLET Curb Line-Inches--d	=	3.583
Frontal Flow Intercepted by GRATE--CFS	=	0.553
Lateral Flow Intercepted by GRATE--CFS	=	0.039
TOTAL Flow Intercepted by GRATE--CFS	=	0.592
% FLOW Intercepted	=	98.634
By-pass Flow--CFS	=	0.008

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-04-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML WB 1213+53 Lt CHECKER - NPV PAGE
Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.128
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.700 - 50 yr
SPREAD-Ft.--T	=	7.801 - 9' max
Average Velocity-V-fps	=	0.927
FLOW in Gutter-CFS--Q	=	0.542
% Flow in Gutter-CFS	=	77.446
Velocity of Flow in Gutter-fps	=	1.143
Depth at Curb Line-Inches--d	=	3.282

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.700
GUTTER FLOW at INLET-CFS--Q	=	0.630
Gutter Velocity at INLET-fps	=	1.237
Depth at INLET Curb Line-Inches--d	=	3.947
Frontal Flow Intercepted by GRATE--CFS	=	0.591
Lateral Flow Intercepted by GRATE--CFS	=	0.083
TOTAL Flow Intercepted by GRATE--CFS	=	0.675
% FLOW Intercepted	=	96.386
By-pass Flow--CFS	=	0.025

• 115 LF Slotted Drain

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-04-2004

PROJECT NAME- RM   TRACS NO.-
HIGHWAY NAME-   DESIGNER - RSR
LOCATION - MLWB 1213+53 Lt   CHECKER - NPV   PAGE
Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.128
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.500 · 10yr
SPREAD-Ft.--T	=	6.477 ~ 8' max
Average Velocity-V-fps	=	0.883
FLOW in Gutter-CFS--Q	=	0.427
% Flow in Gutter-CFS	=	85.445
Velocity of Flow in Gutter-fps	=	1.047
Depth at Curb Line-Inches--d	=	2.964

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.500
GUTTER FLOW at INLET-CFS--Q	=	0.484
Gutter Velocity at INLET-fps	=	1.132
Depth at INLET Curb Line-Inches--d	=	3.556
Frontal Flow Intercepted by GRATE--CFS	=	0.463
Lateral Flow Intercepted by GRATE--CFS	=	0.032
TOTAL Flow Intercepted by GRATE--CFS	=	0.495
% FLOW Intercepted	=	99.036
By-pass Flow--CFS	=	0.005

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-04-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - MLWB 1213+93 Lt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.122
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.700 - 50 yr
SPREAD-Ft.--T	=	7.899 - 8' max
Average Velocity-V-fps	=	0.908
FLOW in Gutter-CFS--Q	=	0.538
% Flow in Gutter-CFS	=	76.870
Velocity of Flow in Gutter-fps	=	1.123
Depth at Curb Line-Inches--d	=	3.306

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.700
GUTTER FLOW at INLET-CFS--Q	=	0.626
Gutter Velocity at INLET-fps	=	1.216
Depth at INLET Curb Line-Inches--d	=	3.977
Frontal Flow Intercepted by GRATE--CFS	=	0.587
Lateral Flow Intercepted by GRATE--CFS	=	0.087
TOTAL Flow Intercepted by GRATE--CFS	=	0.674
% FLOW Intercepted	=	96.287
By-pass Flow--CFS	=	0.026

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-04-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RGR
LOCATION - ML WB 1213+93 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.122
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.500 - 10 yr
SPREAD-Ft.--T	=	6.564 - 8' max
Average Velocity-V-fps	=	0.865
FLOW in Gutter-CFS--Q	=	0.424
% Flow in Gutter-CFS	=	84.822
Velocity of Flow in Gutter-fps	=	1.028
Depth at Curb Line-Inches--d	=	2.985

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.500
GUTTER FLOW at INLET-CFS--Q	=	0.482
Gutter Velocity at INLET-fps	=	1.113
Depth at INLET Curb Line-Inches--d	=	3.584
Frontal Flow Intercepted by GRATE--CFS	=	0.461
Lateral Flow Intercepted by GRATE--CFS	=	0.034
TOTAL Flow Intercepted by GRATE--CFS	=	0.495
% FLOW Intercepted	=	98.963
By-pass Flow--CFS	=	0.005

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-04-2004

PROJECT NAME- RM	TRACS NO.-		
HIGHWAY NAME-	DESIGNER - RSR		
LOCATION - ML WB 1214+30 Lt	CHECKER - NDV	PAGE	

Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.118
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.700 - 50yr
SPREAD-Ft.--T	=	7.968 - 8' max
Average Velocity-V-fps	=	0.895
FLOW in Gutter-CFS--Q	=	0.535
% Flow in Gutter-CFS	=	76.470
Velocity of Flow in Gutter-fps	=	1.109
Depth at Curb Line-Inches--d	=	3.322

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.700
GUTTER FLOW at INLET-CFS--Q	=	0.623
Gutter Velocity at INLET-fps	=	1.201
Depth at INLET Curb Line-Inches--d	=	3.996
Frontal Flow Intercepted by GRATE--CFS	=	0.584
Lateral Flow Intercepted by GRATE--CFS	=	0.089
TOTAL Flow Intercepted by GRATE--CFS	=	0.673
% FLOW Intercepted	=	96.189
By-pass Flow--CFS	=	0.027

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-04-2004

PROJECT NAME- RM   TRACS NO.-
HIGHWAY NAME-   DESIGNER - RSR
LOCATION - ML WB 1214+30 Lt   CHECKER - NDV   PAGE
Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.118
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.500 - 10yr
SPREAD-Ft.--T	=	6.628 - 8' max
Average Velocity-V-fps	=	0.853
FLOW in Gutter-CFS--Q	=	0.422
% Flow in Gutter-CFS	=	84.439
Velocity of Flow in Gutter-fps	=	1.015
Depth at Curb Line-Inches--d	=	3.001

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.500
GUTTER FLOW at INLET-CFS--Q	=	0.480
Gutter Velocity at INLET-fps	=	1.099
Depth at INLET Curb Line-Inches--d	=	3.603
Frontal Flow Intercepted by GRATE--CFS	=	0.459
Lateral Flow Intercepted by GRATE--CFS	=	0.036
TOTAL Flow Intercepted by GRATE--CFS	=	0.495
% FLOW Intercepted	=	98.911
By-pass Flow--CFS	=	0.005

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-12-2004

PROJECT NAME- RM   TRACS NO.-
HIGHWAY NAME-   DESIGNER - RSR
LOCATION - ML WB 1216+34 Lt   CHECKER - NDV   PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.166
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.400 - 10 yr
SPREAD-Ft.--T	=	10.290 - 16' max
Average Velocity-V-fps	=	1.161
FLOW in Gutter-CFS--Q	=	0.898
% Flow in Gutter-CFS	=	64.170
Velocity of Flow in Gutter-fps	=	1.500
Depth at Curb Line-Inches--d	=	3.880

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	4.634
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	8.191
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.817	1.143	0.257	1.400	0.000	100.00
10.000	1.000	1.400	0.000	1.400	0.000	100.00
15.000	1.000	1.400	0.000	1.400	0.000	100.00
20.000	1.000	1.400	0.000	1.400	0.000	100.00
25.000	1.000	1.400	0.000	1.400	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-12-2004

PROJECT NAME- R/M
TRACS NO.-
HIGHWAY NAME-
DESIGNER - RSR
LOCATION - ML WB 1216+34 Lt
CHECKER - NDV
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Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.166
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	2.000 - 50yr
SPREAD-Ft.--T	=	12.087 - 22' max
Average Velocity-V-fps	=	1.244
FLOW in Gutter-CFS--Q	=	1.128
% Flow in Gutter-CFS	=	56.394
Velocity of Flow in Gutter-fps	=	1.638
Depth at Curb Line-Inches--d	=	4.311

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	5.106
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	10.091
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.708	1.416	0.576	1.992	0.008	99.62
10.000	1.000	2.000	0.000	2.000	0.000	100.00
15.000	1.000	2.000	0.000	2.000	0.000	100.00
20.000	1.000	2.000	0.000	2.000	0.000	100.00
25.000	1.000	2.000	0.000	2.000	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-11-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML WB 1222+50 Lt CHECKER - NbV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	4.600 - 10yr
SPREAD-Ft.--T	=	15.788 - 16 max
Average Velocity-V-fps	=	1.743
FLOW in Gutter-CFS--Q	=	2.045
% Flow in Gutter-CFS	=	44.453
Velocity of Flow in Gutter-fps	=	2.340
Depth at Curb Line-Inches--d	=	5.199

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.047
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	18.005
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.443	2.039	1.868	3.907	0.693	84.94
10.000	0.768	3.531	0.995	4.526	0.074	98.38
15.000	0.960	4.417	0.183	4.600	0.000	100.00
20.000	1.000	4.600	0.000	4.600	0.000	100.00
25.000	1.000	4.600	0.000	4.600	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-11-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML WB 1222+50 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	6.400 · 50yr
SPREAD-Ft.--T	=	18.068 - 22' max
Average Velocity-V-fps	=	1.876
FLOW in Gutter-CFS--Q	=	2.503
% Flow in Gutter-CFS	=	39.105
Velocity of Flow in Gutter-fps	=	2.534
Depth at Curb Line-Inches--d	=	5.746

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.615
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	21.842
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.374	2.392	2.480	4.872	1.528	76.13
10.000	0.668	4.274	1.640	5.913	0.487	92.40
15.000	0.876	5.608	0.770	6.378	0.022	99.66
20.000	0.988	6.325	0.075	6.400	0.000	100.0
25.000	1.000	6.400	0.000	6.400	0.000	100.0

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-12-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML WB 1226+50 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	4.700 -10yr
SPREAD-Ft.--T	=	15.929 -16' max
Average Velocity-V-fps	=	1.751
FLOW in Gutter-CFS--Q	=	2.072
% Flow in Gutter-CFS	=	44.085
Velocity of Flow in Gutter-fps	=	2.352
Depth at Curb Line-Inches--d	=	5.233

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.082
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	18.234
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.438	2.060	1.905	3.966	0.734	84.38
10.000	0.761	3.576	1.036	4.612	0.088	98.13
15.000	0.956	4.491	0.209	4.700	0.000	100.00
20.000	1.000	4.700	0.000	4.700	0.000	100.00
25.000	1.000	4.700	0.000	4.700	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-12-2004

PROJECT NAME- RM   TRACS NO.-
HIGHWAY NAME-   DESIGNER - RSR
LOCATION - ML WB 1226+50 Lt   CHECKER - NDV   PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	6.600 - 50yr
SPREAD-Ft.--T	=	18.294 - 22' max
Average Velocity-V-fps	=	1.889
FLOW in Gutter-CFS--Q	=	2.550
% Flow in Gutter-CFS	=	38.638
Velocity of Flow in Gutter-fps	=	2.553
Depth at Curb Line-Inches--d	=	5.800

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.671
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	22.237
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.368	2.427	2.542	4.969	1.631	75.29
10.000	0.659	4.348	1.716	6.064	0.536	91.88
15.000	0.867	5.725	0.841	6.566	0.034	99.48
20.000	0.984	6.494	0.106	6.600	0.000	100.0[illegible]
25.000	1.000	6.600	0.000	6.600	0.000	100.0[illegible]

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-12-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML WB 1228+21 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.102
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	2.900 - 10yr
SPREAD-Ft.--T	=	15.709 - 16 max
Average Velocity-V-fps	=	1.109
FLOW in Gutter-CFS--Q	=	1.295
% Flow in Gutter-CFS	=	44.661
Velocity of Flow in Gutter-fps	=	1.489
Depth at Curb Line-Inches--d	=	5.180

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.027
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	11.306
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.650	1.886	0.916	2.803	0.097	96.64
10.000	0.979	2.840	0.060	2.900	0.000	100.00
15.000	1.000	2.900	0.000	2.900	0.000	100.00
20.000	1.000	2.900	0.000	2.900	0.000	100.00
25.000	1.000	2.900	0.000	2.900	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-12-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML WB 1228+21 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G = 0.102
Roadway Cross-Slope-Ft./Ft.--Sx = 0.020
Shoulder Width-Ft.-- = 10.000
Shoulder Slope-Ft./Ft.--Ss = 0.020
Gutter Width-Ft.--W = 2.500
Gutter Slope-Ft./Ft.--Sw = 0.067
Gutter Depression-Inches-- = 2.010
Manning's 'N = 0.016

Flow-CFS--Q = 4.600 - 50yr
SPREAD-Ft.--T = 18.955 - 22' max
Average Velocity-V-fps = 1.230

FLOW in Gutter-CFS--Q = 1.717
% Flow in Gutter-CFS = 37.329
Velocity of Flow in Gutter-fps = 1.664
Depth at Curb Line-Inches--d = 5.959

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft. = 3.354
Grate Width---Ft. = 2.000
Grate Area--Sq. Ft. = 5.171
Splash-Over Velocity--FPS = 7.354

Depth at INLET Curb Line-Inches--d = 6.835
Local Gutter Depression-Inches = 1.000

Length of opening: TOTAL Intercept--Ft. = 14.802
Capture Ratio -- SLOTTED DRAIN = 0.670
Capture Ratio -- GRATE = 0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.524	2.409	1.638	4.048	0.552	87.99
10.000	0.868	3.994	0.589	4.583	0.017	99.63
15.000	1.000	4.600	0.000	4.600	0.000	100.00
20.000	1.000	4.600	0.000	4.600	0.000	100.0
25.000	1.000	4.600	0.000	4.600	0.000	100.0

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

04-22-2005

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - ML WB 1229+21.27 Lt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
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SLOTTED DRAIN W/ GRATE--IN SUMP

GUTTER FLOW HYDRAULICS

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Effective Perimeter--Ft.	=	7.354
Capture Ratio -- GRATE	=	0.500
Capture Ratio -- SLOTTED DRAIN	=	0.500
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	3.300 - 10 yr

LENGTH	Q(Slot. Dn)	Q(Grate)	d(inches)	SPREAD,Ft.
5.000	1.539	1.761	4.187	11.570 ← 16' max
10.000	2.276	1.026	3.076	6.940
15.000	2.627	0.672	2.422	4.218
20.000	2.830	0.471	1.969	2.449
25.000	2.949	0.351	1.629	2.026

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

04-22-2005

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML WB 1229 +21.21 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--IN SUMP

GUTTER FLOW HYDRAULICS

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Effective Perimeter--Ft.	=	7.354
Capture Ratio -- GRATE	=	0.500
Capture Ratio -- SLOTTED DRAIN	=	0.500
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	5.500 - 50 yr

LENGTH	Q(Slot. Dn)	Q(Grate)	d(inches)	SPREAD,Ft.
5.000	1.843	3.657	6.441	20.962 - 22' max
10.000	3.259	2.240	4.816	14.192
15.000	4.129	1.371	3.626	9.233
20.000	4.495	1.005	3.041	6.796
25.000	4.737	0.765	2.606	4.985

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-12-2004

PROJECT NAME- RM
TRACS NO.-
HIGHWAY NAME-
DESIGNER - RSR
LOCATION - ML WB 1230+46
CHECKER - NDV
PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.127
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	3.300 -10yr
SPREAD-Ft.--T	=	15.838 -16' max
Average Velocity-V-fps	=	1.243
FLOW in Gutter-CFS--Q	=	1.463
% Flow in Gutter-CFS	=	44.321
Velocity of Flow in Gutter-fps	=	1.669
Depth at Curb Line-Inches--d	=	5.211

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.060
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	12.789
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.590	1.948	1.157	3.105	0.195	94.10
10.000	0.936	3.087	0.213	3.300	0.000	100.00
15.000	1.000	3.300	0.000	3.300	0.000	100.00
20.000	1.000	3.300	0.000	3.300	0.000	100.00
25.000	1.000	3.300	0.000	3.300	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-12-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - ML WB 1230+46
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.127
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	5.500 - 50yr
SPREAD-Ft.--T	=	19.488 - 22'max
Average Velocity-V-fps	=	1.394
FLOW in Gutter-CFS--Q	=	1.998
% Flow in Gutter-CFS	=	36.330
Velocity of Flow in Gutter-fps	=	1.887
Depth at Curb Line-Inches--d	=	6.087

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.966
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	17.227
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.460	2.533	2.017	4.550	0.950	82.72
10.000	0.791	4.348	1.022	5.370	0.130	97.64
15.000	0.975	5.362	0.138	5.500	0.000	100.00
20.000	1.000	5.500	0.000	5.500	0.000	100.[illegible]
25.000	1.000	5.500	0.000	5.500	0.000	100.[illegible]

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-12-2004

PROJECT NAME- RM   TRACS NO.-
HIGHWAY NAME-   DESIGNER - RSR
LOCATION - ML WB 1234+00 Lt   CHECKER - NDV   PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.410
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	5.000 - 10yr
SPREAD-Ft.--T	=	14.748 - 16' max
Average Velocity-V-fps	=	2.153
FLOW in Gutter-CFS--Q	=	2.367
% Flow in Gutter-CFS	=	47.349
Velocity of Flow in Gutter-fps	=	2.881
Depth at Curb Line-Inches--d	=	4.950

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	5.785
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	21.042
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.386	1.932	2.172	4.104	0.896	82.08
10.000	0.687	3.434	1.380	4.813	0.187	96.27
15.000	0.894	4.471	0.528	4.999	0.001	99.99
20.000	0.996	4.978	0.022	5.000	0.000	100.00
25.000	1.000	5.000	0.000	5.000	0.000	100.00

CB 304

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-12-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML WB 1234+00 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.410
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	8.100 - 50yr
SPREAD-Ft.--T	=	17.982 - 22' max
Average Velocity-V-fps	=	2.396
FLOW in Gutter-CFS--Q	=	3.182
% Flow in Gutter-CFS	=	39.285
Velocity of Flow in Gutter-fps	=	3.236
Depth at Curb Line-Inches--d	=	5.726

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.594
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	27.918
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.299	2.422	3.151	5.573	2.527	68.80
10.000	0.550	4.454	2.418	6.872	1.228	84.84
15.000	0.750	6.077	1.655	7.732	0.368	95.45
20.000	0.897	7.262	0.824	8.086	0.014	99.8
25.000	0.983	7.961	0.139	8.100	0.000	100.0

CB 308

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-12-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - MLWD 1238+00 Lt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.410
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	5.100 - 10 yr
SPREAD-Ft.--T	=	14.871 - 16 max
Average Velocity-V-fps	=	2.163
FLOW in Gutter-CFS--Q	=	2.397
% Flow in Gutter-CFS	=	46.991
Velocity of Flow in Gutter-fps	=	2.895
Depth at Curb Line-Inches--d	=	4.979

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	5.816
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	21.289
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.382	1.950	2.209	4.159	0.941	81.54
10.000	0.681	3.472	1.419	4.891	0.209	95.91
15.000	0.889	4.532	0.567	5.099	0.001	99.97
20.000	0.994	5.067	0.033	5.100	0.000	100.00
25.000	1.000	5.100	0.000	5.100	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-12-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML WB 1238+00 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.410
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	8.000 - 50yr
SPREAD-Ft.--T	=	17.892 - 22'max
Average Velocity-V-fps	=	2.389
FLOW in Gutter-CFS--Q	=	3.158
% Flow in Gutter-CFS	=	39.476
Velocity of Flow in Gutter-fps	=	3.226
Depth at Curb Line-Inches--d	=	5.704

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.571
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	27.717
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.301	2.408	3.123	5.531	2.469	69.13
10.000	0.553	4.425	2.389	6.814	1.186	85.17
15.000	0.754	6.032	1.624	7.656	0.344	95.69
20.000	0.900	7.199	0.790	7.989	0.011	99.8
25.000	0.985	7.878	0.122	8.000	0.000	100.0

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-12-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - ML WB 1242+00 Lt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.410
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	5.700 -10yr
SPREAD-Ft.--T	=	15.575 - 16' max
Average Velocity-V-fps	=	2.216
FLOW in Gutter-CFS--Q	=	2.566
% Flow in Gutter-CFS	=	45.025
Velocity of Flow in Gutter-fps	=	2.973
Depth at Curb Line-Inches--d	=	5.148

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	5.993
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	22.729
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.361	2.055	2.417	4.473	1.227	78.47
10.000	0.648	3.692	1.646	5.338	0.362	93.66
15.000	0.857	4.882	0.806	5.688	0.012	99.79
20.000	0.978	5.574	0.126	5.700	0.000	100.00
25.000	1.000	5.700	0.000	5.700	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-12-2004

PROJECT NAME- RM	TRACS NO.-
HIGHWAY NAME-	DESIGNER - RSR
LOCATION - ML WB 1242+00 Lt	CHECKER - NDV PAGE

Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.410
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	8.400 - 50 yr
SPREAD-Ft.--T	=	18.248 - 22' max
Average Velocity-V-fps	=	2.416
FLOW in Gutter-CFS--Q	=	3.253
% Flow in Gutter-CFS	=	38.732
Velocity of Flow in Gutter-fps	=	3.264
Depth at Curb Line-Inches--d	=	5.790

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.660
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	28.515
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.293	2.463	3.234	5.697	2.703	67.82
10.000	0.540	4.539	2.504	7.043	1.357	83.84
15.000	0.739	6.209	1.747	7.956	0.444	94.71
20.000	0.886	7.446	0.926	8.372	0.028	99.6
25.000	0.977	8.206	0.194	8.400	0.000	100.0

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-12-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - ML WB 1247+00 Lt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.509
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	6.100 - 10 yr
SPREAD-Ft.--T	=	15.318 - 16' max
Average Velocity-V-fps	=	2.447
FLOW in Gutter-CFS--Q	=	2.789
% Flow in Gutter-CFS	=	45.726
Velocity of Flow in Gutter-fps	=	3.280
Depth at Curb Line-Inches--d	=	5.086

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	5.929
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	24.783
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.333	2.034	2.635	4.669	1.431	76.54
10.000	0.605	3.693	1.896	5.589	0.511	91.63
15.000	0.812	4.955	1.095	6.050	0.050	99.18
20.000	0.948	5.784	0.316	6.100	0.000	100.00
25.000	1.000	6.100	0.000	6.100	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-12-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - ML WB 1247+00 Lt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.509
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	8.400 - 50yr
SPREAD-Ft.--T	=	17.468 - 22' max
Average Velocity-V-fps	=	2.626
FLOW in Gutter-CFS--Q	=	3.393
% Flow in Gutter-CFS	=	40.399
Velocity of Flow in Gutter-fps	=	3.543
Depth at Curb Line-Inches--d	=	5.602

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	6.466
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	29.895
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.281	2.358	3.330	5.688	2.712	67.71
10.000	0.520	4.364	2.623	6.988	1.412	83.19
15.000	0.715	6.003	1.891	7.894	0.506	93.98
20.000	0.863	7.252	1.097	8.349	0.051	99.4[illegible]
25.000	0.962	8.077	0.323	8.400	0.000	100.[illegible]

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-10-2004

PROJECT NAME- RM
TRACS NO.-
HIGHWAY NAME-
DESIGNER - RSR
LOCATION - MLWD 1255+66 Lt
CHECKER - NDV
PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.296
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	12.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	2.100 - 10 yr
SPREAD-Ft.--T	=	7.493 - 10' max
Average Velocity-V-fps	=	2.863
FLOW in Gutter-CFS--Q	=	1.990
% Flow in Gutter-CFS	=	94.785
Velocity of Flow in Gutter-fps	=	3.091
Depth at Curb Line-Inches--d	=	2.716

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	1.455
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	29.115
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.288	0.604	1.136	1.740	0.360	82.84
10.000	0.531	1.115	0.818	1.933	0.167	92.04
15.000	0.728	1.530	0.530	2.060	0.040	98.09
20.000	0.876	1.840	0.259	2.099	0.001	99.96
25.000	0.970	2.038	0.062	2.100	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-10-2004

PROJECT NAME- RM | TRACS NO.-
HIGHWAY NAME- | DESIGNER - BSR
LOCATION - ML WB 1255+66 Lt | CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.296
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	12.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	3.300 - 50 yr
SPREAD-Ft.--T	=	9.412 - 10' max.
Average Velocity-V-fps	=	3.119
FLOW in Gutter-CFS--Q	=	2.891
% Flow in Gutter-CFS	=	87.597
Velocity of Flow in Gutter-fps	=	3.540
Depth at Curb Line-Inches--d	=	3.177

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	1.595
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	35.936
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.236	0.780	1.659	2.439	0.861	73.90
10.000	0.444	1.465	1.322	2.788	0.512	84.47
15.000	0.622	2.052	0.987	3.040	0.260	92.11
20.000	0.769	2.536	0.670	3.207	0.093	97.1[illegible]
25.000	0.883	2.912	0.379	3.291	0.009	99.7[illegible]

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-10-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - ML WB 1257+25 Lt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.292
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	12.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	2.500 - 10yr
SPREAD-Ft.--T	=	8.210 - 10' max
Average Velocity-V-fps	=	2.955
FLOW in Gutter-CFS--Q	=	2.306
% Flow in Gutter-CFS	=	92.245
Velocity of Flow in Gutter-fps	=	3.255
Depth at Curb Line-Inches--d	=	2.888

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	0.752
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	31.525
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.267	0.668	1.321	1.989	0.511	79.54
10.000	0.497	1.242	0.993	2.236	0.264	89.42
15.000	0.687	1.718	0.682	2.401	0.099	96.02
20.000	0.837	2.091	0.397	2.489	0.011	99.55
25.000	0.941	2.353	0.147	2.500	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-10-2004

PROJECT NAME- PVM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - MLWB 1257+25 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.292
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	12.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	3.600 - 50yr
SPREAD-Ft.--T	=	9.818 - 10 max
Average Velocity-V-fps	=	3.169
FLOW in Gutter-CFS--Q	=	3.095
% Flow in Gutter-CFS	=	85.970
Velocity of Flow in Gutter-fps	=	3.627
Depth at Curb Line-Inches--d	=	3.274

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	1.011
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	37.417
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.228	0.819	1.775	2.595	1.005	72.07
10.000	0.429	1.543	1.436	2.979	0.621	82.76
15.000	0.602	2.168	1.098	3.266	0.334	90.73
20.000	0.748	2.691	0.766	3.457	0.143	96.[illegible]
25.000	0.863	3.106	0.470	3.576	0.024	99.[illegible]

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

03-23-2005

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML WB 1258+58 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.157
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.200 - 10 yr
SPREAD-Ft.--T	=	5.623 r 10 max
Average Velocity-V-fps	=	2.457
FLOW in Gutter-CFS--Q	=	1.192
% Flow in Gutter-CFS	=	99.368
Velocity of Flow in Gutter-fps	=	2.506
Depth at Curb Line-Inches--d	=	2.268

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	3.071
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	21.962
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.372	0.446	0.658	1.104	0.096	92.03
10.000	0.665	0.798	0.390	1.188	0.012	99.01
15.000	0.874	1.048	0.152	1.200	0.000	100.00
20.000	0.987	1.184	0.016	1.200	0.000	100.00
25.000	1.000	1.200	0.000	1.200	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

03-23-2005

PROJECT NAME- RM   TRACS NO.-
HIGHWAY NAME-   DESIGNER - RSR
LOCATION - ML WB 1258+58 Lt   CHECKER - NDV   PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.157
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.800 -50yr
SPREAD-Ft.--T	=	7.111 -8' max
Average Velocity-V-fps	=	2.656
FLOW in Gutter-CFS--Q	=	1.728
% Flow in Gutter-CFS	=	96.007
Velocity of Flow in Gutter-fps	=	2.835
Depth at Curb Line-Inches--d	=	2.625

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	0.445
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	26.285
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.316	0.569	0.971	1.540	0.260	85.53
10.000	0.578	1.040	0.663	1.702	0.098	94.57
15.000	0.782	1.407	0.382	1.789	0.011	99.40
20.000	0.924	1.663	0.137	1.800	0.000	100.
25.000	0.996	1.792	0.008	1.800	0.000	100.0

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-10-2004

PROJECT NAME- RM   TRACS NO.-
HIGHWAY NAME-   DESIGNER - RSR
LOCATION - ML WB 1259+75 Lt   CHECKER - NDV   PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.119
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	12.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	3.400 -10yr
SPREAD-Ft.--T	=	9.886 -10' max
Average Velocity-V-fps	=	2.958
FLOW in Gutter-CFS--Q	=	2.914
% Flow in Gutter-CFS	=	85.696
Velocity of Flow in Gutter-fps	=	3.390
Depth at Curb Line-Inches--d	=	3.291

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	1.746
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	35.018
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.242	0.823	1.664	2.488	0.912	73.17
10.000	0.454	1.544	1.320	2.863	0.537	84.22
15.000	0.635	2.157	0.976	3.133	0.267	92.16
20.000	0.782	2.659	0.648	3.307	0.093	97.27
25.000	0.895	3.043	0.350	3.393	0.007	99.79

CD 339

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-10-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - ML WB 1259+75 Lt CHECKER - ADV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.119
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	12.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	4.700 - 50yr
SPREAD-Ft.--T	=	11.474 - 16' max
Average Velocity-V-fps	=	3.157
FLOW in Gutter-CFS--Q	=	3.731
% Flow in Gutter-CFS	=	79.387
Velocity of Flow in Gutter-fps	=	3.723
Depth at Curb Line-Inches--d	=	3.672

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	1.450
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	40.885
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.209	0.984	2.131	3.114	1.586	66.26
10.000	0.396	1.863	1.778	3.641	1.059	77.47
15.000	0.561	2.636	1.425	4.060	0.640	86.39
20.000	0.702	3.297	1.072	4.369	0.331	92.9[illegible]
25.000	0.818	3.843	0.725	4.568	0.132	97.1[illegible]

CB 352

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

12-09-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION -MLWD 1286+51 L+ CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	2.543
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.050
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.050
Gutter Width-Ft.--W	=	2.000
Gutter Slope-Ft./Ft.--Sw	=	0.050
Gutter Depression-Inches--	=	1.200
Manning's 'N	=	0.016
Flow-CFS--Q	=	2.100 - 10yr
SPREAD-Ft.--T	=	4.507 - 10' max
Average Velocity-V-fps	=	4.134
FLOW in Gutter-CFS--Q	=	1.661
% Flow in Gutter-CFS	=	79.075
Velocity of Flow in Gutter-fps	=	4.734
Depth at Curb Line-Inches--d	=	2.704

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	1.490
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	29.321
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.286	0.600	1.311	1.911	0.189	91.02
10.000	0.528	1.109	0.922	2.031	0.069	96.71
15.000	0.725	1.522	0.567	2.089	0.011	99.46
20.000	0.873	1.833	0.267	2.100	0.000	100.00
25.000	0.968	2.033	0.067	2.100	0.000	100.00

CB 352

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

12-09-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - ML UB 1286+51 Lt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	2.543
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.050
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.050
Gutter Width-Ft.--W	=	2.000
Gutter Slope-Ft./Ft.--Sw	=	0.050
Gutter Depression-Inches--	=	1.200
Manning's 'N	=	0.016
Flow-CFS--Q	=	2.800
SPREAD-Ft.--T	=	5.021 - 10' max
Average Velocity-V-fps	=	4.443
FLOW in Gutter-CFS--Q	=	2.078
% Flow in Gutter-CFS	=	74.206
Velocity of Flow in Gutter-fps	=	5.167
Depth at Curb Line-Inches--d	=	3.013

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	0.743
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	33.087
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.255	0.715	1.715	2.430	0.370	86.79
10.000	0.477	1.335	1.286	2.621	0.179	93.60
15.000	0.663	1.856	0.884	2.739	0.061	97.84
20.000	0.812	2.273	0.520	2.792	0.008	99.7[illegible]
25.000	0.921	2.578	0.222	2.800	0.000	100.[illegible]

CB 388

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

03-23-2005

PROJECT NAME- RM
TRACS NO.-
HIGHWAY NAME-
DESIGNER - RSR
LOCATION - MLWB 1290+68 Lt
CHECKER - NDV
PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	2.956
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.050
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.050
Gutter Width-Ft.--W	=	2.000
Gutter Slope-Ft./Ft.--Sw	=	0.050
Gutter Depression-Inches--	=	1.200
Manning's 'N	=	0.016
Flow-CFS--Q	=	3.800 - 10yr
SPREAD-Ft.--T	=	5.474 - 10' max
Average Velocity-V-fps	=	5.073
FLOW in Gutter-CFS--Q	=	2.670
% Flow in Gutter-CFS	=	70.265
Velocity of Flow in Gutter-fps	=	5.969
Depth at Curb Line-Inches--d	=	3.284

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	0.345
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	39.351
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.217	0.825	2.297	3.122	0.678	82.16
10.000	0.410	1.558	1.837	3.396	0.404	89.36
15.000	0.578	2.198	1.398	3.596	0.204	94.63
20.000	0.721	2.741	0.984	3.725	0.075	98.02
25.000	0.837	3.182	0.606	3.787	0.013	99.67

CB
388

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

03-23-2005

PROJECT NAME- RM	TRACS NO.-		
HIGHWAY NAME-	DESIGNER - RSR		
LOCATION - ML WB 1290+68 Lt	CHECKER - NDV	PAGE	

Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	2.956
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.050
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.050
Gutter Width-Ft.--W	=	2.000
Gutter Slope-Ft./Ft.--Sw	=	0.050
Gutter Depression-Inches--	=	1.200
Manning's 'N	=	0.016
Flow-CFS--Q	=	5.300 - 50yr
SPREAD-Ft.--T	=	6.201 - 10' max
Average Velocity-V-fps	=	5.514
FLOW in Gutter-CFS--Q	=	3.424
% Flow in Gutter-CFS	=	64.602
Velocity of Flow in Gutter-fps	=	6.583
Depth at Curb Line-Inches--d	=	3.721

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	1.662
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	45.253
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.190	1.007	3.043	4.050	1.250	76.42
10.000	0.362	1.919	2.536	4.455	0.845	84.06
15.000	0.516	2.733	2.047	4.779	0.521	90.17
20.000	0.650	3.445	1.577	5.022	0.278	94.[illegible]
25.000	0.765	4.053	1.132	5.186	0.114	97.8[illegible]

CB
377

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

12-09-2004

PROJECT NAME- RM	TRACS NO.-
HIGHWAY NAME-	DESIGNER - RSR
LOCATION - ML WB 1307+31 Lt	CHECKER - NDV	PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	2.090
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	5.600 - 10 yr
SPREAD-Ft.--T	=	10.875 - 16' max
Average Velocity-V-fps	=	4.212
FLOW in Gutter-CFS--Q	=	3.444
% Flow in Gutter-CFS	=	61.499
Velocity of Flow in Gutter-fps	=	5.483
Depth at Curb Line-Inches--d	=	4.020

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	4.789
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	31.962
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.264	1.477	3.196	4.674	0.926	83.46
10.000	0.491	2.750	2.497	5.247	0.353	93.69
15.000	0.680	3.810	1.736	5.546	0.054	99.04
20.000	0.830	4.645	0.954	5.600	0.000	100.00
25.000	0.936	5.240	0.360	5.600	0.000	100.00

CB 377

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

12-09-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - MC WB 1307+31 Lt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	2.090
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	7.800 - 50yr
SPREAD-Ft.--T	=	12.599 - 22' max
Average Velocity-V-fps	=	4.498
FLOW in Gutter-CFS--Q	=	4.248
% Flow in Gutter-CFS	=	54.457
Velocity of Flow in Gutter-fps	=	5.946
Depth at Curb Line-Inches--d	=	4.434

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	5.238
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	38.828
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.220	1.714	4.045	5.759	2.041	73.84
10.000	0.415	3.236	3.407	6.644	1.156	85.18
15.000	0.585	4.561	2.728	7.289	0.511	93.45
20.000	0.728	5.680	1.999	7.679	0.121	98.4[illegible]
25.000	0.844	6.584	1.211	7.794	0.006	99.9[illegible]

APPENDIX D

CATCH BASIN DESIGN

McDowell Road Ramps C & D Catch Basin Calculations

CB 389

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

03-07-2005

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - MCD Ramp C 5400 Lt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	4.100
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	2.700 - 10yr
SPREAD-Ft.--T	=	6.257 - 8' max
Average Velocity-V-fps	=	4.790
FLOW in Gutter-CFS--Q	=	2.653
% Flow in Gutter-CFS	=	98.257
Velocity of Flow in Gutter-fps	=	4.980
Depth at Curb Line-Inches--d	=	2.420

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	0.000
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	45.268
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.190	0.513	1.664	2.177	0.523	80.64
10.000	0.362	0.977	1.382	2.359	0.341	87.37
15.000	0.515	1.392	1.115	2.507	0.193	92.85
20.000	0.650	1.755	0.861	2.615	0.085	96.86
25.000	0.765	2.064	0.615	2.679	0.021	99.22

CB 389

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

03-07-2005

PROJECT NAME- Pm
HIGHWAY NAME-
LOCATION - MeD Ramp C 5+00
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	4.100
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	3.800 -50yr
SPREAD-Ft.--T	=	7.562 -8' only
Average Velocity-V-fps	=	5.108
FLOW in Gutter-CFS--Q	=	3.594
% Flow in Gutter-CFS	=	94.566
Velocity of Flow in Gutter-fps	=	5.527
Depth at Curb Line-Inches--d	=	2.733

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	1.411
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	52.798
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.164	0.623	2.195	2.818	0.982	74.17
10.000	0.315	1.196	1.898	3.094	0.706	81.43
15.000	0.452	1.718	1.603	3.320	0.480	87.38
20.000	0.576	2.187	1.311	3.498	0.302	92.06
25.000	0.685	2.602	1.040	3.643	0.157	95.86

LB 120

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

03-07-2005

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - MoD Ramp C 8+90 LT
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	2.878
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	2.200 - 10yr
SPREAD-Ft.--T	=	6.156 - 8' max
Average Velocity-V-fps	=	3.992
FLOW in Gutter-CFS--Q	=	2.166
% Flow in Gutter-CFS	=	98.470
Velocity of Flow in Gutter-fps	=	4.137
Depth at Curb Line-Inches--d	=	2.395

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	1.789
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	37.331
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.228	0.502	1.328	1.830	0.370	83.17
10.000	0.430	0.945	1.047	1.992	0.208	90.56
15.000	0.603	1.328	0.787	2.115	0.085	96.13
20.000	0.749	1.647	0.535	2.183	0.017	99.21
25.000	0.864	1.900	0.299	2.200	0.000	99.99

CB 120

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

03-07-2005

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - McD Ramp C 8+90 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	2.878
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	3.200 -50yr
SPREAD-Ft.--T	=	7.582 - 8' max
Average Velocity-V-fps	=	4.284
FLOW in Gutter-CFS--Q	=	3.024
% Flow in Gutter-CFS	=	94.486
Velocity of Flow in Gutter-fps	=	4.637
Depth at Curb Line-Inches--d	=	2.738

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	1.137
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	44.184
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.194	0.622	1.818	2.440	0.760	76.24
10.000	0.370	1.184	1.515	2.699	0.501	84.33
15.000	0.526	1.683	1.215	2.898	0.302	90.57
20.000	0.662	2.119	0.933	3.052	0.148	95.37
25.000	0.777	2.487	0.667	3.154	0.046	98.57

CB
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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

03-07-2005

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - PSR
LOCATION - McD Ramp C 114802+ CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.013
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.600 - 10 yr
SPREAD-Ft.--T	=	6.969 - 8' max
Average Velocity-V-fps	=	2.529
FLOW in Gutter-CFS--Q	=	1.318
% Flow in Gutter-CFS	=	82.386
Velocity of Flow in Gutter-fps	=	3.045
Depth at Curb Line-Inches--d	=	3.083

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	3.705
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	13.427
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.568	0.908	0.692	1.600	0.000	99.99
10.000	0.914	1.463	0.137	1.600	0.000	100.00
15.000	1.000	1.600	0.000	1.600	0.000	100.00
20.000	1.000	1.600	0.000	1.600	0.000	100.00
25.000	1.000	1.600	0.000	1.600	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

03-07-2005

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - McD Ramp C 11+80 Lt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSZ
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.013
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	2.300 - 50yr
SPREAD-Ft.--T	=	8.452 - 8' max
Average Velocity-V-fps	=	2.670
FLOW in Gutter-CFS--Q	=	1.696
% Flow in Gutter-CFS	=	73.743
Velocity of Flow in Gutter-fps	=	3.345
Depth at Curb Line-Inches--d	=	3.439

Spread @ upstream end of slotted drain OK✓

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	4.132
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	16.326
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.482	1.109	1.170	2.279	0.021	99.09
10.000	0.819	1.883	0.417	2.300	0.000	100.00
15.000	0.989	2.275	0.025	2.300	0.000	100.00
20.000	1.000	2.300	0.000	2.300	0.000	100.00
25.000	1.000	2.300	0.000	2.300	0.000	100.00

CB
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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

09-24-2004

PROJECT NAME- RM
TRACS NO.-
HIGHWAY NAME-
DESIGNER - RSR
LOCATION - McD Ramp C 12+77
CHECKER - NDV
PAGE
Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.389
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	5.500
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.500 - 10 yr
SPREAD-Ft.--T	=	4.458 - 8' max
Average Velocity-V-fps	=	1.447
FLOW in Gutter-CFS--Q	=	0.481
% Flow in Gutter-CFS	=	96.152
Velocity of Flow in Gutter-fps	=	1.565
Depth at Curb Line-Inches--d	=	2.480 - 6" max

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.500
GUTTER FLOW at INLET-CFS--Q	=	0.500
Gutter Velocity at INLET-fps	=	1.700
Depth at INLET Curb Line-Inches--d	=	2.915
Frontal Flow Intercepted by GRATE--CFS	=	0.495
Lateral Flow Intercepted by GRATE--CFS	=	0.004
TOTAL Flow Intercepted by GRATE--CFS	=	0.500
% FLOW Intercepted	=	99.909
By-pass Flow--CFS	=	0.000

CB
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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

09-24-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - McD Ramp C 12+77 CHECKER - NDV PAGE
Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.389
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	5.500
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.800 - 50yr
SPREAD-Ft.--T	=	6.148 - 8' max
Average Velocity-V-fps	=	1.524
FLOW in Gutter-CFS--Q	=	0.698
% Flow in Gutter-CFS	=	87.297
Velocity of Flow in Gutter-fps	=	1.783
Depth at Curb Line-Inches--d	=	2.886

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.800
GUTTER FLOW at INLET-CFS--Q	=	0.783
Gutter Velocity at INLET-fps	=	1.928
Depth at INLET Curb Line-Inches--d	=	3.455
Frontal Flow Intercepted by GRATE--CFS	=	0.754
Lateral Flow Intercepted by GRATE--CFS	=	0.034
TOTAL Flow Intercepted by GRATE--CFS	=	0.788
% FLOW Intercepted	=	98.554
By-pass Flow--CFS	=	0.012

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

04-22-2005

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION -McD Ramp C 13+37.49
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--IN SUMP

GUTTER FLOW HYDRAULICS

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Effective Perimeter--Ft.	=	7.354
Capture Ratio -- GRATE	=	0.500
Capture Ratio -- SLOTTED DRAIN	=	0.500
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	1.100 -10yr

LENGTH	Q(Slot. Dn)	Q(Grate)	d(inches)	SPREAD,Ft.
5.000	0.669	0.430	1.861	2.315 ← 8' max
10.000	1.000	0.100	1.355	1.685
15.000	1.031	0.069	0.834	1.038
20.000	1.047	0.053	0.530	0.660
25.000	1.058	0.042	0.327	0.407

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

04-22-2005

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION -McD Ramp C 13+37.49
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--IN SUMP

GUTTER FLOW HYDRAULICS

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Effective Perimeter--Ft.	=	7.354
Capture Ratio -- GRATE	=	0.500
Capture Ratio -- SLOTTED DRAIN	=	0.500
Local Gutter Depression-Inches	=	1.000 ✓
Flow-CFS--Q	=	1.640 - 50 yr

LENGTH	Q(Slot. Dn)	Q(Grate)	d(inches)	SPREAD,Ft.
5.000	0.915	0.723	2.525	4.646 ← 8' max
10.000	1.254	0.386	1.739	2.162
15.000	1.537	0.103	1.394	1.734
20.000	1.562	0.078	0.997	1.240
25.000	1.577	0.063	0.732	0.911

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

09-24-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - M.D Ramp C 13+98
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.389
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	5.500
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.800 - 10 yr
SPREAD-Ft.--T	=	6.148 - 8' max
Average Velocity-V-fps	=	1.524
FLOW in Gutter-CFS--Q	=	0.698
% Flow in Gutter-CFS	=	87.297
Velocity of Flow in Gutter-fps	=	1.783
Depth at Curb Line-Inches--d	=	2.886 - 6" max

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.800
GUTTER FLOW at INLET-CFS--Q	=	0.783
Gutter Velocity at INLET-fps	=	1.928
Depth at INLET Curb Line-Inches--d	=	3.455
Frontal Flow Intercepted by GRATE--CFS	=	0.754
Lateral Flow Intercepted by GRATE--CFS	=	0.034
TOTAL Flow Intercepted by GRATE--CFS	=	0.788
% FLOW Intercepted	=	98.554
By-pass Flow--CFS	=	0.012

.55 LF slotted drain

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

09-24-2004

PROJECT NAME- RM	TRACS NO.-		
HIGHWAY NAME-	DESIGNER - RGR		
LOCATION - M.D Ramp C 13+98	CHECKER - NDV	PAGE	

Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.389
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	5.500
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.200 - 50 yr
SPREAD-Ft.--T	=	7.731 - 8' max
Average Velocity-V-fps	=	1.612
FLOW in Gutter-CFS--Q	=	0.934
% Flow in Gutter-CFS	=	77.851
Velocity of Flow in Gutter-fps	=	1.984
Depth at Curb Line-Inches--d	=	3.266

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	1.200
GUTTER FLOW at INLET-CFS--Q	=	1.085
Gutter Velocity at INLET-fps	=	2.149
Depth at INLET Curb Line-Inches--d	=	3.929
Frontal Flow Intercepted by GRATE--CFS	=	1.020
Lateral Flow Intercepted by GRATE--CFS	=	0.101
TOTAL Flow Intercepted by GRATE--CFS	=	1.120
% FLOW Intercepted	=	93.359
By-pass Flow--CFS	=	0.080

C

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

09-24-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - McD Ramp C 14+50
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.402
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	5.500
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.000 ← 10yr
SPREAD-Ft.--T	=	6.938 - 8' max
Average Velocity-V-fps	=	1.592
FLOW in Gutter-CFS--Q	=	0.826
% Flow in Gutter-CFS	=	82.573
Velocity of Flow in Gutter-fps	=	1.915
Depth at Curb Line-Inches--d	=	3.075 - 6"

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	1.000
GUTTER FLOW at INLET-CFS--Q	=	0.946
Gutter Velocity at INLET-fps	=	2.073
Depth at INLET Curb Line-Inches--d	=	3.696
Frontal Flow Intercepted by GRATE--CFS	=	0.899
Lateral Flow Intercepted by GRATE--CFS	=	0.065
TOTAL Flow Intercepted by GRATE--CFS	=	0.964
% FLOW Intercepted	=	96.390
By-pass Flow--CFS	=	0.036 ←

(C)

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

09-24-2004

PROJECT NAME- RM	TRACS NO.-		
HIGHWAY NAME-	DESIGNER - RSR		
LOCATION - McD Ramp C 19+50	CHECKER - NDV	PAGE	

Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.402
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	5.500
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.500 ← 50yr
SPREAD-Ft.--T	=	8.601
Average Velocity-V-fps	=	1.692
FLOW in Gutter-CFS--Q	=	1.094
% Flow in Gutter-CFS	=	72.915
Velocity of Flow in Gutter-fps	=	2.126
Depth at Curb Line-Inches--d	=	3.474

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	1.500
GUTTER FLOW at INLET-CFS--Q	=	1.279
Gutter Velocity at INLET-fps	=	2.301
Depth at INLET Curb Line-Inches--d	=	4.174
Frontal Flow Intercepted by GRATE--CFS	=	1.190
Lateral Flow Intercepted by GRATE--CFS	=	0.144
TOTAL Flow Intercepted by GRATE--CFS	=	1.334
% FLOW Intercepted	=	88.949
By-pass Flow--CFS	=	0.166 ←

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

09-24-2004

PROJECT NAME- RM	TRACS NO.-		
HIGHWAY NAME-	DESIGNER - RSR		
LOCATION - McD Ramp C 15+18	CHECKER - NDV	PAGE	
Ver 3.40: December 1995			

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.402
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	5.500
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.100 ← 10yr
SPREAD-Ft.--T	=	7.314 8' max
Average Velocity-V-fps	=	1.613
FLOW in Gutter-CFS--Q	=	0.884
% Flow in Gutter-CFS	=	80.320
Velocity of Flow in Gutter-fps	=	1.963
Depth at Curb Line-Inches--d	=	3.165 - 6" max

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000 ✓
Flow-CFS--Q	=	1.100
GUTTER FLOW at INLET-CFS--Q	=	1.019
Gutter Velocity at INLET-fps	=	2.126
Depth at INLET Curb Line-Inches--d	=	3.807
Frontal Flow Intercepted by GRATE--CFS	=	0.964
Lateral Flow Intercepted by GRATE--CFS	=	0.081
TOTAL Flow Intercepted by GRATE--CFS	=	1.045
% FLOW Intercepted	=	94.989
By-pass Flow--CFS	=	0.055 ←

• 80 LF slotted drain

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

09-24-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - McD Ramp C 15+18
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.402
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	5.500
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.600 - 50yr
SPREAD-Ft.--T	=	8.881 8' max
Average Velocity-V-fps	=	1.710 Spread @ upstream end of Slotted Drain OK ✓
FLOW in Gutter-CFS--Q	=	1.142
% Flow in Gutter-CFS	=	71.377
Velocity of Flow in Gutter-fps	=	2.161
Depth at Curb Line-Inches--d	=	3.541

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	1.600
GUTTER FLOW at INLET-CFS--Q	=	1.338
Gutter Velocity at INLET-fps	=	2.338
Depth at INLET Curb Line-Inches--d	=	4.251
Frontal Flow Intercepted by GRATE--CFS	=	1.240
Lateral Flow Intercepted by GRATE--CFS	=	0.159
TOTAL Flow Intercepted by GRATE--CFS	=	1.399
% FLOW Intercepted	=	87.456
By-pass Flow--CFS	=	0.201 ←

CB 112

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

04-22-2005

PROJECT NAME- RM
TRACS NO.-
HIGHWAY NAME-
DESIGNER - RSR
LOCATION - McD Ramp D 4+20 Lt
CHECKER - NDV
PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	2.242
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.018
Shoulder Width-Ft.--	=	5.500
Shoulder Slope-Ft./Ft.--Ss	=	0.018
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.700 -10 yr
SPREAD-Ft.--T	=	5.812 -10' max
Average Velocity-V-fps	=	3.425
FLOW in Gutter-CFS--Q	=	1.687
% Flow in Gutter-CFS	=	99.211
Velocity of Flow in Gutter-fps	=	3.507
Depth at Curb Line-Inches--d	=	2.281

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	0.576
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	31.027
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.271	0.461	1.016	1.477	0.223	86.89
10.000	0.504	0.856	0.753	1.610	0.090	94.68
15.000	0.695	1.182	0.500	1.683	0.017	98.98
20.000	0.845	1.436	0.264	1.700	0.000	99.99

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

04-22-2005

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER -
LOCATION -McD Ramp D 4+20 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	2.242
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.018
Shoulder Width-Ft.--	=	5.500
Shoulder Slope-Ft./Ft.--Ss	=	0.018
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	2.400 -50 yr
SPREAD-Ft.--T	=	7.199 -10' max
Average Velocity-V-fps	=	3.643
FLOW in Gutter-CFS--Q	=	2.308
% Flow in Gutter-CFS	=	96.170
Velocity of Flow in Gutter-fps	=	3.891
Depth at Curb Line-Inches--d	=	2.581

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	1.137
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	36.204
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.235	0.563	1.381	1.945	0.455	81.02
10.000	0.441	1.059	1.083	2.141	0.259	89.23
15.000	0.618	1.484	0.804	2.288	0.112	95.32
20.000	0.765	1.835	0.540	2.375	0.025	98.97←

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

09-24-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - McD Ramp D 10+85 Lt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.175
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	5.500
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	2.100 -10yr
SPREAD-Ft.--T	=	7.632 -10' max
Average Velocity-V-fps	=	2.755
FLOW in Gutter-CFS--Q	=	1.978
% Flow in Gutter-CFS	=	94.211
Velocity of Flow in Gutter-fps	=	2.988
Depth at Curb Line-Inches--d	=	2.765 -6" max

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	1.909
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	28.305
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.295	0.620	1.120	1.739	0.361	82.83
10.000	0.544	1.142	0.796	1.938	0.162	92.27
15.000	0.743	1.560	0.504	2.064	0.036	98.30
20.000	0.890	1.869	0.231	2.100	0.000	99.98

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

09-24-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - McD Ramp D 10+85 LT
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.175
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	5.500
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	3.000 - 50yr
SPREAD-Ft.--T	=	9.122 · 16' max
Average Velocity-V-fps	=	2.951
FLOW in Gutter-CFS--Q	=	2.658
% Flow in Gutter-CFS	=	88.586
Velocity of Flow in Gutter-fps	=	3.327
Depth at Curb Line-Inches--d	=	3.129

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	1.220
Local Gutter Depression-Inches	=	0.000 ✓
Length of opening: TOTAL Intercept--Ft.	=	33.401
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.253	0.759	1.516	2.276	0.724	75.86
10.000	0.473	1.419	1.177	2.595	0.405	86.52
15.000	0.658	1.974	0.841	2.815	0.185	93.84
20.000	0.807	2.420	0.535	2.955	0.045	98.50 ←

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

09-24-2004

PROJECT NAME- RM	TRACS NO.-		
HIGHWAY NAME-	DESIGNER - RSR		
LOCATION - McD Ramp D 12+82	CHECKER - NDV	PAGE	

Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.451
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	5.500
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.600 - 10yr
SPREAD-Ft.--T	=	4.877 - 10' max
Average Velocity-V-fps	=	1.464
FLOW in Gutter-CFS--Q	=	0.600
% Flow in Gutter-CFS	=	99.963
Velocity of Flow in Gutter-fps	=	1.468
Depth at Curb Line-Inches--d	=	2.088 - 6" max

GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.350
Splash-Over Velocity--FPS	=	7.350
Local Gutter Depression-Inches	=	0.000
Flow-CFS--Q	=	0.600
GUTTER FLOW at INLET-CFS--Q	=	0.600
Gutter Velocity at INLET-fps	=	1.468
Depth at INLET Curb Line-Inches--d	=	2.088
Frontal Flow Intercepted by GRATE--CFS	=	0.463
Lateral Flow Intercepted by GRATE--CFS	=	0.061
TOTAL Flow Intercepted by GRATE--CFS	=	0.524
% FLOW Intercepted	=	87.264
By-pass Flow--CFS	=	0.076

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

09-24-2004

PROJECT NAME-	RM	TRACS NO.-	
HIGHWAY NAME-		DESIGNER -	RSR
LOCATION	-McD Ramp D 12+82	CHECKER -	NDV PAGE

Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.451
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	5.500
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.900 - 50yr
SPREAD-Ft.--T	=	6.275 - 10' max
Average Velocity-V-fps	=	1.590
FLOW in Gutter-CFS--Q	=	0.884
% Flow in Gutter-CFS	=	98.218
Velocity of Flow in Gutter-fps	=	1.654
Depth at Curb Line-Inches--d	=	2.424

GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.350
Splash-Over Velocity--FPS	=	7.350
Local Gutter Depression-Inches	=	0.000
Flow-CFS--Q	=	0.900
GUTTER FLOW at INLET-CFS--Q	=	0.884
Gutter Velocity at INLET-fps	=	1.654
Depth at INLET Curb Line-Inches--d	=	2.424
Frontal Flow Intercepted by GRATE--CFS	=	0.628
Lateral Flow Intercepted by GRATE--CFS	=	0.103
TOTAL Flow Intercepted by GRATE--CFS	=	0.731
% FLOW Intercepted	=	81.229
By-pass Flow--CFS	=	0.169

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

04-22-2005

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - McD Ramp D 13+57.01 CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--IN SUMP

GUTTER FLOW HYDRAULICS

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998

GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Effective Perimeter--Ft.	=	7.350
Capture Ratio -- GRATE	=	0.500
Capture Ratio -- SLOTTED DRAIN	=	0.500
Local Gutter Depression-Inches	=	0.000
Flow-CFS--Q	=	0.600 - 10 yr

LENGTH	Q(Slot. Dn)	Q(Grate)	d(inches)	SPREAD,Ft.
5.000	0.302	0.297	1.681	3.787 ← 10' max
10.000	0.427	0.173	1.337	3.010
15.000	0.489	0.111	1.116	2.513
20.000	0.524	0.078	0.964	2.172

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

04-22-2005

PROJECT NAME- RM | TRACS NO.-
HIGHWAY NAME- | DESIGNER - RSR
LOCATION - McD Ramp D 13+57.01 | CHECKER - NDV | PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--IN SUMP

GUTTER FLOW HYDRAULICS

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998

GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Effective Perimeter--Ft.	=	7.350
Capture Ratio -- GRATE	=	0.500
Capture Ratio -- SLOTTED DRAIN	=	0.500
Local Gutter Depression-Inches	=	0.000
Flow-CFS--Q	=	1.100 - 50yr

LENGTH	Q(Slot. Dn)	Q(Grate)	d(inches)	SPREAD,Ft.
5.000	0.498	0.603	2.349	5.961 ← 16' max
10.000	0.717	0.383	1.887	4.251
15.000	0.836	0.264	1.595	3.593
20.000	0.909	0.191	1.392	3.136

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

09-24-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - McD Ramp D 14+33 RT CHECKER - NDV PAGE
Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.409
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	5.500
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.700 - 10 yr
SPREAD-Ft.--T	=	5.559 - 10' max
Average Velocity-V-fps	=	1.455
FLOW in Gutter-CFS--Q	=	0.696
% Flow in Gutter-CFS	=	99.491
Velocity of Flow in Gutter-fps	=	1.482
Depth at Curb Line-Inches--d	=	2.252

GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.350
Splash-Over Velocity--FPS	=	7.350
Local Gutter Depression-Inches	=	0.000
Flow-CFS--Q	=	0.700
GUTTER FLOW at INLET-CFS--Q	=	0.696
Gutter Velocity at INLET-fps	=	1.482
Depth at INLET Curb Line-Inches--d	=	2.252
Frontal Flow Intercepted by GRATE--CFS	=	0.515
Lateral Flow Intercepted by GRATE--CFS	=	0.080
TOTAL Flow Intercepted by GRATE--CFS	=	0.595
% FLOW Intercepted	=	84.995
By-pass Flow--CFS	=	0.105

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

09-24-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - McD Ramp D 14+33. RT
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER -
PAGE

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.409
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	5.500
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.200 - 50yr
SPREAD-Ft.--T	=	7.562 - 16' max
Average Velocity-V-fps	=	1.613
FLOW in Gutter-CFS--Q	=	1.135
% Flow in Gutter-CFS	=	94.554
Velocity of Flow in Gutter-fps	=	1.745
Depth at Curb Line-Inches--d	=	2.733

GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.350
Splash-Over Velocity--FPS	=	7.350
Local Gutter Depression-Inches	=	0.000
Flow-CFS--Q	=	1.200
GUTTER FLOW at INLET-CFS--Q	=	1.135
Gutter Velocity at INLET-fps	=	1.745
Depth at INLET Curb Line-Inches--d	=	2.733
Frontal Flow Intercepted by GRATE--CFS	=	0.760
Lateral Flow Intercepted by GRATE--CFS	=	0.153
TOTAL Flow Intercepted by GRATE--CFS	=	0.912
% FLOW Intercepted	=	76.014
By-pass Flow--CFS	=	0.288

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

09-24-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - McD Ramp D 15+66 Rt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.409
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	11.300
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.800 - 10yr
SPREAD-Ft.--T	=	9.279 · 10' max
Average Velocity-V-fps	=	1.742
FLOW in Gutter-CFS--Q	=	1.586
% Flow in Gutter-CFS	=	88.103
Velocity of Flow in Gutter-fps	=	1.971
Depth at Curb Line-Inches--d	=	3.145 - 6" max

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	0.702
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	19.679
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.410	0.738	0.831	1.569	0.231	87.15
10.000	0.721	1.298	0.449	1.747	0.053	97.08
15.000	0.925	1.664	0.136	1.800	0.000	99.99
20.000	1.000	1.800	0.000	1.800	0.000	100.00
25.000	1.000	1.800	0.000	1.800	0.000	100.00
30.000	1.000	1.800	0.000	1.800	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

09-24-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - McD Ramp D 15+66 RT CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.409
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	11.300
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	2.700 - 50yr
SPREAD-Ft.--T	=	11.215 - 16' max
Average Velocity-V-fps	=	1.888
FLOW in Gutter-CFS--Q	=	2.171
% Flow in Gutter-CFS	=	80.400
Velocity of Flow in Gutter-fps	=	2.217
Depth at Curb Line-Inches--d	=	3.610

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	1.218
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	23.873
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.345	0.931	1.213	2.144	0.556	79.41
10.000	0.624	1.684	0.803	2.487	0.213	92.09
15.000	0.832	2.245	0.415	2.660	0.040	98.54
20.000	0.962	2.598	0.102	2.700	0.000	100.00
25.000	1.000	2.700	0.000	2.700	0.000	100.00
30.000	1.000	2.700	0.000	2.700	0.000	100.00

APPENDIX D

CATCH BASIN DESIGN

McKellips Road Ramps A–D Catch Basins Calculations

C

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-13-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - McK Ramp A 7+25 Lt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.024
Shoulder Width-Ft.--	=	2.000
Shoulder Slope-Ft./Ft.--Ss	=	0.024
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.800 -10yr
SPREAD-Ft.--T	=	6.349 - 8' max
Average Velocity-V-fps	=	1.294
FLOW in Gutter-CFS--Q	=	0.673
% Flow in Gutter-CFS	=	84.142
Velocity of Flow in Gutter-fps	=	1.529
Depth at Curb Line-Inches--d	=	3.119

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.800
GUTTER FLOW at INLET-CFS--Q	=	0.761
Gutter Velocity at INLET-fps	=	1.646
Depth at INLET Curb Line-Inches--d	=	3.724
Frontal Flow Intercepted by GRATE--CFS	=	0.722
Lateral Flow Intercepted by GRATE--CFS	=	0.057
TOTAL Flow Intercepted by GRATE--CFS	=	0.779
% FLOW Intercepted	=	97.434
By-pass Flow--CFS	=	0.021

c

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-13-2004

PROJECT NAME- RM	TRACS NO.-
HIGHWAY NAME-	DESIGNER - RSR
LOCATION - McK Ramp A 7+25 Lt	CHECKER - NDV PAGE

Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.024
Shoulder Width-Ft.--	=	2.000
Shoulder Slope-Ft./Ft.--Ss	=	0.024
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.200 - 50yr
SPREAD-Ft.--T	=	7.810 - 8' max
Average Velocity-V-fps	=	1.385
FLOW in Gutter-CFS--Q	=	0.900
% Flow in Gutter-CFS	=	74.981
Velocity of Flow in Gutter-fps	=	1.704
Depth at Curb Line-Inches--d	=	3.539

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	1.200
GUTTER FLOW at INLET-CFS--Q	=	1.038
Gutter Velocity at INLET-fps	=	1.834
Depth at INLET Curb Line-Inches--d	=	4.223
Frontal Flow Intercepted by GRATE--CFS	=	0.964
Lateral Flow Intercepted by GRATE--CFS	=	0.137
TOTAL Flow Intercepted by GRATE--CFS	=	1.101
% FLOW Intercepted	=	91.761
By-pass Flow--CFS	=	0.099

c

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-13-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION -Mck Ramp A 7+83 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.024
Shoulder Width-Ft.--	=	2.000
Shoulder Slope-Ft./Ft.--Ss	=	0.024
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.800 - 10 yr
SPREAD-Ft.--T	=	6.349 - 8' max
Average Velocity-V-fps	=	1.294
FLOW in Gutter-CFS--Q	=	0.673
% Flow in Gutter-CFS	=	84.142
Velocity of Flow in Gutter-fps	=	1.529
Depth at Curb Line-Inches--d	=	3.119

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.800
GUTTER FLOW at INLET-CFS--Q	=	0.761
Gutter Velocity at INLET-fps	=	1.646
Depth at INLET Curb Line-Inches--d	=	3.724
Frontal Flow Intercepted by GRATE--CFS	=	0.722
Lateral Flow Intercepted by GRATE--CFS	=	0.057
TOTAL Flow Intercepted by GRATE--CFS	=	0.779
% FLOW Intercepted	=	97.434
By-pass Flow--CFS	=	0.021

(c)

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-13-2004

PROJECT NAME- RM	TRACS NO.-
HIGHWAY NAME-	DESIGNER - RSR
LOCATION -Mck Ramp A 7+83 Lt	CHECKER - NDV PAGE

Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.024
Shoulder Width-Ft.--	=	2.000
Shoulder Slope-Ft./Ft.--Ss	=	0.024
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.200 - 50yr
SPREAD-Ft.--T	=	7.810 - 8' max
Average Velocity-V-fps	=	1.385
FLOW in Gutter-CFS--Q	=	0.900
% Flow in Gutter-CFS	=	74.981
Velocity of Flow in Gutter-fps	=	1.704
Depth at Curb Line-Inches--d	=	3.539

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000 ✓
Flow-CFS--Q	=	1.200
GUTTER FLOW at INLET-CFS--Q	=	1.038
Gutter Velocity at INLET-fps	=	1.834
Depth at INLET Curb Line-Inches--d	=	4.223
Frontal Flow Intercepted by GRATE--CFS	=	0.964
Lateral Flow Intercepted by GRATE--CFS	=	0.137
TOTAL Flow Intercepted by GRATE--CFS	=	1.101
% FLOW Intercepted	=	91.761
By-pass Flow--CFS	=	0.099

(c)

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-13-2004

PROJECT NAME- RM		TRACS NO.-	
HIGHWAY NAME-		DESIGNER - RSR	
LOCATION - Mck Ramp A 8+40 Lt		CHECKER - NDV	PAGE

Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.024
Shoulder Width-Ft.--	=	2.000
Shoulder Slope-Ft./Ft.--Ss	=	0.024
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.700 -10yr
SPREAD-Ft.--T	=	5.898 - 8' max
Average Velocity-V-fps	=	1.268
FLOW in Gutter-CFS--Q	=	0.609
% Flow in Gutter-CFS	=	86.998
Velocity of Flow in Gutter-fps	=	1.474
Depth at Curb Line-Inches--d	=	2.989

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.700
GUTTER FLOW at INLET-CFS--Q	=	0.680
Gutter Velocity at INLET-fps	=	1.586
Depth at INLET Curb Line-Inches--d	=	3.563
Frontal Flow Intercepted by GRATE--CFS	=	0.651
Lateral Flow Intercepted by GRATE--CFS	=	0.039
TOTAL Flow Intercepted by GRATE--CFS	=	0.689
% FLOW Intercepted	=	98.492
By-pass Flow--CFS	=	0.011

(c)

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-13-2004

PROJECT NAME- RM	TRACS NO.-		
HIGHWAY NAME-	DESIGNER - RSR		
LOCATION - M.k Ramp A 8+40 Lt	CHECKER - NDV	PAGE	

Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.024
Shoulder Width-Ft.--	=	2.000
Shoulder Slope-Ft./Ft.--Ss	=	0.024
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.000 - 50yr
SPREAD-Ft.--T	=	7.133 - 8' max
Average Velocity-V-fps	=	1.342
FLOW in Gutter-CFS--Q	=	0.791
% Flow in Gutter-CFS	=	79.129
Velocity of Flow in Gutter-fps	=	1.624
Depth at Curb Line-Inches--d	=	3.344

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	1.000
GUTTER FLOW at INLET-CFS--Q	=	0.907
Gutter Velocity at INLET-fps	=	1.748
Depth at INLET Curb Line-Inches--d	=	3.995
Frontal Flow Intercepted by GRATE--CFS	=	0.850
Lateral Flow Intercepted by GRATE--CFS	=	0.097
TOTAL Flow Intercepted by GRATE--CFS	=	0.947
% FLOW Intercepted	=	94.697
By-pass Flow--CFS	=	0.053

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-13-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - Mck Ramp A 8+95 Lt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.024
Shoulder Width-Ft.--	=	2.000
Shoulder Slope-Ft./Ft.--Ss	=	0.024
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.200 - 10yr
SPREAD-Ft.--T	=	7.810 - 8' max
Average Velocity-V-fps	=	1.385
FLOW in Gutter-CFS--Q	=	0.900
% Flow in Gutter-CFS	=	74.981
Velocity of Flow in Gutter-fps	=	1.704
Depth at Curb Line-Inches--d	=	3.539

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	4.223
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	8.122
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.821	0.985	0.215	1.200	0.000	100.00
10.000	1.000	1.200	0.000	1.200	0.000	100.00
15.000	1.000	1.200	0.000	1.200	0.000	100.00

CB 176

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-13-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - Mck Ramp A 8+95 Lt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.024
Shoulder Width-Ft.--	=	2.000
Shoulder Slope-Ft./Ft.--Ss	=	0.024
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.700 - 50yr
SPREAD-Ft.--T	=	9.204 - 14' max
Average Velocity-V-fps	=	1.477
FLOW in Gutter-CFS--Q	=	1.141
% Flow in Gutter-CFS	=	67.130
Velocity of Flow in Gutter-fps	=	1.866
Depth at Curb Line-Inches--d	=	3.941

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	4.675
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	9.844
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.721	1.226	0.474	1.699	0.001	99.95
10.000	1.000	1.700	0.000	1.700	0.000	100.00
15.000	1.000	1.700	0.000	1.700	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-13-2004

PROJECT NAME- RM
TRACS NO.-
HIGHWAY NAME-
DESIGNER - RSR
LOCATION - Mck Ramp A 11+00 Lt
CHECKER - NPV
PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.024
Shoulder Width-Ft.--	=	2.000
Shoulder Slope-Ft./Ft.--Ss	=	0.024
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.200 - 10yr
SPREAD-Ft.--T	=	7.810 - 8' max
Average Velocity-V-fps	=	1.385
FLOW in Gutter-CFS--Q	=	0.900
% Flow in Gutter-CFS	=	74.981
Velocity of Flow in Gutter-fps	=	1.704
Depth at Curb Line-Inches--d	=	3.539

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	4.223
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	8.122
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.821	0.985	0.215	1.200	0.000	100.00
10.000	1.000	1.200	0.000	1.200	0.000	100.00
15.000	1.000	1.200	0.000	1.200	0.000	100.00
20.000	1.000	1.200	0.000	1.200	0.000	100.00
25.000	1.000	1.200	0.000	1.200	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-13-2004

PROJECT NAME- RM
TRACS NO.-
HIGHWAY NAME-
DESIGNER - RSR
LOCATION - Mck Ramp A 11+00 Lt
CHECKER - NDV
PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.250
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.024
Shoulder Width-Ft.--	=	2.000
Shoulder Slope-Ft./Ft.--Ss	=	0.024
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.900 - 50yr
SPREAD-Ft.--T	=	9.679 - 14' max
Average Velocity-V-fps	=	1.510
FLOW in Gutter-CFS--Q	=	1.229
% Flow in Gutter-CFS	=	64.689
Velocity of Flow in Gutter-fps	=	1.920
Depth at Curb Line-Inches--d	=	4.078

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	4.826
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	10.480
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.689	1.309	0.587	1.896	0.004	99.78
10.000	0.996	1.893	0.007	1.900	0.000	100.00
15.000	1.000	1.900	0.000	1.900	0.000	100.00
20.000	1.000	1.900	0.000	1.900	0.000	100.00
25.000	1.000	1.900	0.000	1.900	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-13-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - Mck Ramp A 13+00 Lt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.246
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.024
Shoulder Width-Ft.--	=	2.000
Shoulder Slope-Ft./Ft.--Ss	=	0.024
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	2.800 - 10yr
SPREAD-Ft.--T	=	7.980 - 8' max
Average Velocity-V-fps	=	3.116
FLOW in Gutter-CFS--Q	=	2.071
% Flow in Gutter-CFS	=	73.969
Velocity of Flow in Gutter-fps	=	3.848
Depth at Curb Line-Inches--d	=	3.588

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	4.279
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	18.871
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.425	1.191	1.542	2.733	0.067	97.60
10.000	0.743	2.080	0.720	2.800	0.000	100.00
15.000	0.942	2.638	0.162	2.800	0.000	100.00
20.000	1.000	2.800	0.000	2.800	0.000	100.00
25.000	1.000	2.800	0.000	2.800	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-13-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - Mck Ramp A 13+00Lt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.246
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.024
Shoulder Width-Ft.--	=	2.000
Shoulder Slope-Ft./Ft.--Ss	=	0.024
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	4.000 - 50yr
SPREAD-Ft.--T	=	9.427 - 14' max
Average Velocity-V-fps	=	3.331
FLOW in Gutter-CFS--Q	=	2.639
% Flow in Gutter-CFS	=	65.966
Velocity of Flow in Gutter-fps	=	4.222
Depth at Curb Line-Inches--d	=	4.005

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	4.746
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	22.999
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.357	1.427	2.217	3.644	0.356	91.11
10.000	0.642	2.568	1.394	3.962	0.038	99.04
15.000	0.851	3.402	0.598	4.000	0.000	100.00
20.000	0.974	3.898	0.102	4.000	0.000	100.00
25.000	1.000	4.000	0.000	4.000	0.000	100.00

CB
188

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-05-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - Mck Ramp A 20+00 LT CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	2.243
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	4.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.900 -10yr
SPREAD-Ft.--T	=	6.077 -10' max
Average Velocity-V-fps	=	3.509
FLOW in Gutter-CFS--Q	=	1.874
% Flow in Gutter-CFS	=	98.627
Velocity of Flow in Gutter-fps	=	3.628
Depth at Curb Line-Inches--d	=	2.377 -6" max

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	0.000
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	32.556
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.259	0.493	1.125	1.617	0.283	85.12
10.000	0.483	0.918	0.848	1.767	0.133	93.00
15.000	0.671	1.275	0.589	1.864	0.036	98.11
20.000	0.820	1.558	0.340	1.898	0.002	99.90

CB 188

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-05-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - Mck Ramp A 20+00 Lt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	2.243
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	4.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	2.700 -50 yr
SPREAD-Ft.--T	=	7.402 -16' max
Average Velocity-V-fps	=	3.750
FLOW in Gutter-CFS--Q	=	2.567
% Flow in Gutter-CFS	=	95.085
Velocity of Flow in Gutter-fps	=	4.038
Depth at Curb Line-Inches--d	=	2.695

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	1.252
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	38.110
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.224	0.604	1.525	2.129	0.571	78.86
10.000	0.422	1.139	1.220	2.359	0.341	87.37
15.000	0.594	1.603	0.925	2.527	0.173	93.61
20.000	0.738	1.992	0.653	2.646	0.054	97.99

CB 171

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-14-2004

PROJECT NAME- RM	TRACS NO.-		
HIGHWAY NAME-	DESIGNER - RSR		
LOCATION - Nch Ramp B 7+21 Lt	CHECKER - NDV	PAGE	

Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.419
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.024
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.024
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.021
Gutter Depression-Inches--	=	0.630
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.900 - 10 yr
SPREAD-Ft.--T	=	7.358 - 8' max
Average Velocity-V-fps	=	1.406
FLOW in Gutter-CFS--Q	=	0.594
% Flow in Gutter-CFS	=	65.951
Velocity of Flow in Gutter-fps	=	1.662
Depth at Curb Line-Inches--d	=	2.029

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	2.735
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	12.133
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.616	0.554	0.339	0.893	0.007	99.22
10.000	0.956	0.861	0.039	0.900	0.000	100.00
15.000	1.000	0.900	0.000	0.900	0.000	100.00
20.000	1.000	0.900	0.000	0.900	0.000	100.00
25.000	1.000	0.900	0.000	0.900	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-14-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - McK Ramp B 7+21 Lt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.419
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.024
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.024
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.021
Gutter Depression-Inches--	=	0.630
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.200 - 50yr
SPREAD-Ft.--T	=	8.179 - 8' max
Average Velocity-V-fps	=	1.512
FLOW in Gutter-CFS--Q	=	0.735
% Flow in Gutter-CFS	=	61.268
Velocity of Flow in Gutter-fps	=	1.809
Depth at Curb Line-Inches--d	=	2.266

Spread @ upstream end of slotted drain ok ✓

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	3.003
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	14.013
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.548	0.658	0.505	1.163	0.037	96.93
10.000	0.895	1.074	0.126	1.200	0.000	100.00
15.000	1.000	1.200	0.000	1.200	0.000	100.00
20.000	1.000	1.200	0.000	1.200	0.000	100.00
25.000	1.000	1.200	0.000	1.200	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-14-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - Mck Ramp B 10+75
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.300
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.035
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.035
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.021
Gutter Depression-Inches--	=	0.630
Manning's 'N	=	0.016
Flow-CFS--Q	=	2.400 - 10yr
SPREAD-Ft.--T	=	6.988 - 8' max
Average Velocity-V-fps	=	2.960
FLOW in Gutter-CFS--Q	=	1.580
% Flow in Gutter-CFS	=	65.853
Velocity of Flow in Gutter-fps	=	3.448
Depth at Curb Line-Inches--d	=	2.515

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	3.227
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	25.330
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.327	0.784	1.324	2.108	0.292	87.85
10.000	0.595	1.428	0.883	2.311	0.089	96.28
15.000	0.801	1.922	0.470	2.393	0.007	99.69
20.000	0.940	2.255	0.145	2.400	0.000	100.00 ←
25.000	1.000	2.399	0.001	2.400	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

CB 179

10-14-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - McK Ramp B 10+75 CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.300
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.035
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.035
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.021
Gutter Depression-Inches--	=	0.630
Manning's 'N	=	0.016
Flow-CFS--Q	=	3.400 - 50yr
SPREAD-Ft.--T	=	7.896 - 8' max
Average Velocity-V-fps	=	3.246
FLOW in Gutter-CFS--Q	=	2.061
% Flow in Gutter-CFS	=	60.609
Velocity of Flow in Gutter-fps	=	3.832
Depth at Curb Line-Inches--d	=	2.896

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	3.641
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	29.785
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.282	0.958	1.804	2.762	0.638	81.23
10.000	0.521	1.772	1.332	3.104	0.296	91.28
15.000	0.717	2.436	0.876	3.313	0.087	97.43
20.000	0.865	2.942	0.452	3.394	0.006	99.82
25.000	0.963	3.274	0.126	3.400	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

CB 187

10-20-2004

PROJECT NAME- RM
TRACS NO.-
HIGHWAY NAME-
DESIGNER - RSR
LOCATION - Mck Ramp B 17+20 Rt
CHECKER - NDV
PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	2.433
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.011
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.011
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.021
Gutter Depression-Inches--	=	0.630
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.400 - 10yr
SPREAD-Ft.--T	=	9.535 - 10'
Average Velocity-V-fps	=	2.614
FLOW in Gutter-CFS--Q	=	0.852
% Flow in Gutter-CFS	=	60.830
Velocity of Flow in Gutter-fps	=	3.265
Depth at Curb Line-Inches--d	=	1.567

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	2.297
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	25.170
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.329	0.460	0.861	1.321	0.079	94.35
10.000	0.598	0.837	0.556	1.393	0.007	99.53
15.000	0.804	1.126	0.274	1.400	0.000	100.00
20.000	0.942	1.319	0.081	1.400	0.000	100.00
25.000	1.000	1.400	0.000	1.400	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-20-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - McK Ramp B 17+20 Rt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	2.433
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.011
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.011
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.021
Gutter Depression-Inches--	=	0.630
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.900 - 50yr
SPREAD-Ft.--T	=	10.799 - 16' max
Average Velocity-V-fps	=	2.801
FLOW in Gutter-CFS--Q	=	1.048
% Flow in Gutter-CFS	=	55.168
Velocity of Flow in Gutter-fps	=	3.542
Depth at Curb Line-Inches--d	=	1.735

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	2.504
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	29.954
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.280	0.532	1.122	1.655	0.245	87.09
10.000	0.519	0.985	0.843	1.829	0.071	96.24
15.000	0.714	1.356	0.539	1.895	0.005	99.74 ←
20.000	0.862	1.638	0.262	1.900	0.000	100.00
25.000	0.961	1.826	0.074	1.900	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-20-2004

PROJECT NAME- RM
TRACS NO.-
HIGHWAY NAME-
DESIGNER - RSR
LOCATION - Mck Ramp C 5+00 Lt
CHECKER - NDV
PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	2.548
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.021
Gutter Depression-Inches--	=	0.630
Manning's 'N	=	0.016
Flow-CFS--Q	=	2.500 - 10yr
SPREAD-Ft.--T	=	8.500 8' max
Average Velocity-V-fps	=	3.446
FLOW in Gutter-CFS--Q	=	1.521
% Flow in Gutter-CFS	=	60.847
Velocity of Flow in Gutter-fps	=	4.161
Depth at Curb Line-Inches--d	=	2.070

– checked spread @ upstream end of Slotted Drain ok

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	2.808
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	32.986
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.256	0.640	1.478	2.118	0.382	84.72
10.000	0.478	1.195	1.141	2.336	0.164	93.45
15.000	0.664	1.661	0.800	2.461	0.039	98.42
20.000	0.813	2.033	0.465	2.498	0.002	99.93
25.000	0.922	2.305	0.195	2.500	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-20-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - Nth Ramp L 5+00 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	2.548
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.021
Gutter Depression-Inches--	=	0.630
Manning's 'N	=	0.016
Flow-CFS--Q	=	3.500 - 50yr
SPREAD-Ft.--T	=	9.650 14' max
Average Velocity-V-fps	=	3.746
FLOW in Gutter-CFS--Q	=	1.938
% Flow in Gutter-CFS	=	55.360
Velocity of Flow in Gutter-fps	=	4.579
Depth at Curb Line-Inches--d	=	2.346

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	3.117
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	39.330
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.217	0.760	1.927	2.686	0.814	76.75
10.000	0.410	1.436	1.589	3.025	0.475	86.44
15.000	0.579	2.026	1.250	3.276	0.224	93.60
20.000	0.722	2.526	0.907	3.432	0.068	98.06
25.000	0.838	2.931	0.562	3.494	0.006	99.82

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-20-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - Mek Ramp C 10+00 L+
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.710
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.021
Gutter Depression-Inches--	=	0.630
Manning's 'N	=	0.016
Flow-CFS--Q	=	2.200 · 10 yr
SPREAD-Ft.--T	=	8.733 · 8' max
Average Velocity-V-fps	=	2.873
FLOW in Gutter-CFS--Q	=	1.312
% Flow in Gutter-CFS	=	59.656
Velocity of Flow in Gutter-fps	=	3.479
Depth at Curb Line-Inches--d	=	2.126

- checked spread @ upstream end of slotted drain, ok ✓

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91 ✓

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	2.871
Local Gutter Depression-Inches	=	1.000 ✓
Length of opening: TOTAL Intercept--Ft.	=	27.935
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.299	0.657	1.239	1.896	0.304	86.18
10.000	0.550	1.209	0.891	2.100	0.100	95.47
15.000	0.750	1.650	0.540	2.190	0.010	99.53
20.000	0.896	1.972	0.228	2.200	0.000	100.00
25.000	0.983	2.162	0.038	2.200	0.000	100.00

CB 208

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-20-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - McK Ramp C 10+00 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.710
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.021
Gutter Depression-Inches--	=	0.630
Manning's 'N	=	0.016
Flow-CFS--Q	=	3.100 - 50yr
SPREAD-Ft.--T	=	9.938 · 14' max
Average Velocity-V-fps	=	3.129
FLOW in Gutter-CFS--Q	=	1.678
% Flow in Gutter-CFS	=	54.123
Velocity of Flow in Gutter-fps	=	3.835
Depth at Curb Line-Inches--d	=	2.415

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91.

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	3.194
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	33.430
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.253	0.784	1.638	2.422	0.678	78.14
10.000	0.473	1.465	1.291	2.756	0.344	88.89
15.000	0.658	2.039	0.940	2.979	0.121	96.09
20.000	0.806	2.500	0.585	3.084	0.016	99.49
25.000	0.916	2.840	0.260	3.100	0.000	100.00

CB 220

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-20-2004

PROJECT NAME- RM
TRACS NO.-
HIGHWAY NAME-
DESIGNER - RSR
LOCATION - Mck Ramp C 12+00 Lt
CHECKER - NDV
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Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.591
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.900 - 10 yr
SPREAD-Ft.--T	=	5.809 - 8' max
Average Velocity-V-fps	=	1.858
FLOW in Gutter-CFS--Q	=	0.803
% Flow in Gutter-CFS	=	89.274
Velocity of Flow in Gutter-fps	=	2.144
Depth at Curb Line-Inches--d	=	2.804

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	3.349
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	8.778
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.781	0.703	0.197	0.900	0.000	100.00
10.000	1.000	0.900	0.000	0.900	0.000	100.00
15.000	1.000	0.900	0.000	0.900	0.000	100.00
20.000	1.000	0.900	0.000	0.900	0.000	100.00
25.000	1.000	0.900	0.000	0.900	0.000	100.00

CB 220

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-20-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - McK Ramp C 12+00 Lt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.591
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.400 - 50yr
SPREAD-Ft.--T	=	7.507 - 8' max
Average Velocity-V-fps	=	1.970
FLOW in Gutter-CFS--Q	=	1.108
% Flow in Gutter-CFS	=	79.172
Velocity of Flow in Gutter-fps	=	2.411
Depth at Curb Line-Inches--d	=	3.212

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	3.864
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	10.957
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.666	0.933	0.467	1.400	0.000	100.00
10.000	0.988	1.383	0.017	1.400	0.000	100.00
15.000	1.000	1.400	0.000	1.400	0.000	100.00
20.000	1.000	1.400	0.000	1.400	0.000	100.00
25.000	1.000	1.400	0.000	1.400	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-20-2004

PROJECT NAME- RM
TRACS NO.-
HIGHWAY NAME-
DESIGNER - RSR
LOCATION - Mch Ramp C 13+40 Lt
CHECKER - NDV
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Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.312
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.700 -10yr
SPREAD-Ft.--T	=	6.063 -8' max
Average Velocity-V-fps	=	1.361
FLOW in Gutter-CFS--Q	=	0.615
% Flow in Gutter-CFS	=	87.797
Velocity of Flow in Gutter-fps	=	1.586
Depth at Curb Line-Inches--d	=	2.865

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	3.429
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	6.541
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.926	0.648	0.052	0.700	0.000	100.00
10.000	1.000	0.700	0.000	0.700	0.000	100.00
15.000	1.000	0.700	0.000	0.700	0.000	100.00
20.000	1.000	0.700	0.000	0.700	0.000	100.00
25.000	1.000	0.700	0.000	0.700	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-20-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - McK Ramp C 13+40 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.312
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.900 - 50 yr
SPREAD-Ft.--T	=	7.023 - 8' max
Average Velocity-V-fps	=	1.406
FLOW in Gutter-CFS--Q	=	0.739
% Flow in Gutter-CFS	=	82.063
Velocity of Flow in Gutter-fps	=	1.696
Depth at Curb Line-Inches--d	=	3.096

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	3.721
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	7.415
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.867	0.781	0.119	0.900	0.000	100.00
10.000	1.000	0.900	0.000	0.900	0.000	100.00
15.000	1.000	0.900	0.000	0.900	0.000	100.00
20.000	1.000	0.900	0.000	0.900	0.000	100.00
25.000	1.000	0.900	0.000	0.900	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-20-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - McK Ramp C 13+92 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.312
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.800 -10yr
SPREAD-Ft.--T	=	6.567 8' max
Average Velocity-V-fps	=	1.384
FLOW in Gutter-CFS--Q	=	0.678
% Flow in Gutter-CFS	=	84.803
Velocity of Flow in Gutter-fps	=	1.644
Depth at Curb Line-Inches--d	=	2.986

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.800
GUTTER FLOW at INLET-CFS--Q	=	0.771
Gutter Velocity at INLET-fps	=	1.779
Depth at INLET Curb Line-Inches--d	=	3.585
Frontal Flow Intercepted by GRATE--CFS	=	0.737
Lateral Flow Intercepted by GRATE--CFS	=	0.047
TOTAL Flow Intercepted by GRATE--CFS	=	0.784
% FLOW Intercepted	=	97.939
By-pass Flow--CFS	=	0.016

C

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-20-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - McK Ramp C 13+92 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.312
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.100 - 5 yr
SPREAD-Ft.--T	=	7.829 - 8' max
Average Velocity-V-fps	=	1.448
FLOW in Gutter-CFS--Q	=	0.850
% Flow in Gutter-CFS	=	77.282
Velocity of Flow in Gutter-fps	=	1.787
Depth at Curb Line-Inches--d	=	3.289

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	1.100
GUTTER FLOW at INLET-CFS--Q	=	0.988
Gutter Velocity at INLET-fps	=	1.935
Depth at INLET Curb Line-Inches--d	=	3.957
Frontal Flow Intercepted by GRATE--CFS	=	0.928
Lateral Flow Intercepted by GRATE--CFS	=	0.103
TOTAL Flow Intercepted by GRATE--CFS	=	1.031
% FLOW Intercepted	=	93.684
By-pass Flow--CFS	=	0.069

CB 222

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2004

PROJECT NAME- RM	TRACS NO.-		
HIGHWAY NAME-	DESIGNER -	RSR	
LOCATION - McK Ramp L 14+48 Lt	CHECKER -	NDV	PAGE

Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.312
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.800 - 10yr
SPREAD-Ft.--T	=	6.567 - 8' max
Average Velocity-V-fps	=	1.384
FLOW in Gutter-CFS--Q	=	0.678
% Flow in Gutter-CFS	=	84.803
Velocity of Flow in Gutter-fps	=	1.644
Depth at Curb Line-Inches--d	=	2.986

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.800
GUTTER FLOW at INLET-CFS--Q	=	0.771
Gutter Velocity at INLET-fps	=	1.779
Depth at INLET Curb Line-Inches--d	=	3.585
Frontal Flow Intercepted by GRATE--CFS	=	0.737
Lateral Flow Intercepted by GRATE--CFS	=	0.047
TOTAL Flow Intercepted by GRATE--CFS	=	0.784
% FLOW Intercepted	=	97.939
By-pass Flow--CFS	=	0.016

• 110 LF slotted drain

CB 222

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - McK Bump C 14+48 Lt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.312
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.100 ~50yr
SPREAD-Ft.--T	=	7.829 ~8' max
Average Velocity-V-fps	=	1.448
FLOW in Gutter-CFS--Q	=	0.850
% Flow in Gutter-CFS	=	77.282
Velocity of Flow in Gutter-fps	=	1.787
Depth at Curb Line-Inches--d	=	3.289

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	1.100
GUTTER FLOW at INLET-CFS--Q	=	0.988
Gutter Velocity at INLET-fps	=	1.935
Depth at INLET Curb Line-Inches--d	=	3.957
Frontal Flow Intercepted by GRATE--CFS	=	0.928
Lateral Flow Intercepted by GRATE--CFS	=	0.103
TOTAL Flow Intercepted by GRATE--CFS	=	1.031
% FLOW Intercepted	=	93.684
By-pass Flow--CFS	=	0.069

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION -McK Ramp C 15+03 Lt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.312
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.800 - 10yr
SPREAD-Ft.--T	=	6.567 - 8' max
Average Velocity-V-fps	=	1.384
FLOW in Gutter-CFS--Q	=	0.678
% Flow in Gutter-CFS	=	84.803
Velocity of Flow in Gutter-fps	=	1.644
Depth at Curb Line-Inches--d	=	2.986

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.800
GUTTER FLOW at INLET-CFS--Q	=	0.771
Gutter Velocity at INLET-fps	=	1.779
Depth at INLET Curb Line-Inches--d	=	3.585
Frontal Flow Intercepted by GRATE--CFS	=	0.737
Lateral Flow Intercepted by GRATE--CFS	=	0.047
TOTAL Flow Intercepted by GRATE--CFS	=	0.784
% FLOW Intercepted	=	97.939
By-pass Flow--CFS	=	0.016

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2004

PROJECT NAME- RM   TRACS NO.-
HIGHWAY NAME-   DESIGNER - RSR
LOCATION - McK Ramp C 15+03 Lt   CHECKER - NDV   PAGE
Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.312
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.100 - 50yr
SPREAD-Ft.--T	=	7.829 - 8max
Average Velocity-V-fps	=	1.448
FLOW in Gutter-CFS--Q	=	0.850
% Flow in Gutter-CFS	=	77.282
Velocity of Flow in Gutter-fps	=	1.787
Depth at Curb Line-Inches--d	=	3.289

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	1.100
GUTTER FLOW at INLET-CFS--Q	=	0.988
Gutter Velocity at INLET-fps	=	1.935
Depth at INLET Curb Line-Inches--d	=	3.957
Frontal Flow Intercepted by GRATE--CFS	=	0.928
Lateral Flow Intercepted by GRATE--CFS	=	0.103
TOTAL Flow Intercepted by GRATE--CFS	=	1.031
% FLOW Intercepted	=	93.684
By-pass Flow--CFS	=	0.069 ←

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-26-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - Mck Ramp D 10+00 Rt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.972
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	2.600 - 10yr
SPREAD-Ft.--T	=	7.507 - 10' max
Average Velocity-V-fps	=	3.534
FLOW in Gutter-CFS--Q	=	2.463
% Flow in Gutter-CFS	=	94.738
Velocity of Flow in Gutter-fps	=	3.817
Depth at Curb Line-Inches--d	=	2.720

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	1.762
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	36.129
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.235	0.611	1.451	2.062	0.538	79.32
10.000	0.442	1.149	1.142	2.291	0.309	88.11
15.000	0.619	1.610	0.845	2.456	0.144	94.44
20.000	0.766	1.991	0.572	2.564	0.036	98.60
25.000	0.880	2.288	0.311	2.599	0.001	99.95

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-26-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - McK Ramp D 10+00 Rt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.972
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	3.600 - 50yr
SPREAD-Ft.--T	=	8.865 - 16' max
Average Velocity-V-fps	=	3.758
FLOW in Gutter-CFS--Q	=	3.231
% Flow in Gutter-CFS	=	89.762
Velocity of Flow in Gutter-fps	=	4.211
Depth at Curb Line-Inches--d	=	3.046

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	1.240
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	42.014
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.204	0.734	1.886	2.621	0.979	72.79
10.000	0.387	1.393	1.566	2.959	0.641	82.20
15.000	0.548	1.974	1.247	3.221	0.379	89.47
20.000	0.688	2.475	0.932	3.408	0.192	94.66
25.000	0.804	2.893	0.648	3.541	0.059	98.36

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-26-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - McK Ramp D 19+61 Rt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.856
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.900 - 10 yr
SPREAD-Ft.--T	=	7.926 - 10 max
Average Velocity-V-fps	=	2.374
FLOW in Gutter-CFS--Q	=	1.772
% Flow in Gutter-CFS	=	93.284
Velocity of Flow in Gutter-fps	=	2.595
Depth at Curb Line-Inches--d	=	2.820

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	0.937
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	24.757
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.334	0.634	0.976	1.610	0.290	84.76
10.000	0.606	1.151	0.642	1.793	0.107	94.36
15.000	0.813	1.544	0.346	1.891	0.009	99.50
20.000	0.949	1.802	0.098	1.900	0.000	100.00
25.000	1.000	1.900	0.000	1.900	0.000	100.00

CB 207

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-26-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - Mk Ramp D 14+61 Rt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.856
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	2.900 - 50yr
SPREAD-Ft.--T	=	9.769 - 18' max
Average Velocity-V-fps	=	2.574
FLOW in Gutter-CFS--Q	=	2.499
% Flow in Gutter-CFS	=	86.165
Velocity of Flow in Gutter-fps	=	2.944
Depth at Curb Line-Inches--d	=	3.263

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	0.937
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	30.184
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.278	0.807	1.412	2.219	0.681	76.52
10.000	0.515	1.495	1.057	2.552	0.348	87.98
15.000	0.710	2.058	0.707	2.765	0.135	95.33
20.000	0.859	2.490	0.393	2.883	0.017	99.41
25.000	0.958	2.778	0.122	2.900	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-26-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION -McK Ramp D 17+40 Rt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.262
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.100 - 10 yr
SPREAD-Ft.--T	=	8.116 - 10' max
Average Velocity-V-fps	=	1.324
FLOW in Gutter-CFS--Q	=	1.019
% Flow in Gutter-CFS	=	92.593
Velocity of Flow in Gutter-fps	=	1.455
Depth at Curb Line-Inches--d	=	2.866

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	1.018
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	13.818
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.554	0.610	0.437	1.047	0.053	95.21
10.000	0.901	0.991	0.109	1.100	0.000	99.99
15.000	1.000	1.100	0.000	1.100	0.000	100.00
20.000	1.000	1.100	0.000	1.100	0.000	100.00
25.000	1.000	1.100	0.000	1.100	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

CB 212

10-26-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - Mck Ramp D 17+40 Rt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.262
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.900 - 50yr
SPREAD-Ft.--T	=	10.576 - 16' max
Average Velocity-V-fps	=	1.472
FLOW in Gutter-CFS--Q	=	1.576
% Flow in Gutter-CFS	=	82.928
Velocity of Flow in Gutter-fps	=	1.710
Depth at Curb Line-Inches--d	=	3.456

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	1.219
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	17.881
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.446	0.847	0.820	1.668	0.232	87.77
10.000	0.771	1.465	0.394	1.859	0.041	97.85
15.000	0.963	1.829	0.071	1.900	0.000	100.00
20.000	1.000	1.900	0.000	1.900	0.000	100.00
25.000	1.000	1.900	0.000	1.900	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-26-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - Mich Ramp D 18+15 Rt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.222
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.900 - 10 yr
SPREAD-Ft.--T	=	7.634 - 10' max
Average Velocity-V-fps	=	1.192
FLOW in Gutter-CFS--Q	=	0.849
% Flow in Gutter-CFS	=	94.308
Velocity of Flow in Gutter-fps	=	1.292
Depth at Curb Line-Inches--d	=	2.750

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	2.750
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	12.027
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.620	0.558	0.320	0.878	0.022	97.52
10.000	0.959	0.863	0.037	0.900	0.000	100.00
15.000	1.000	0.900	0.000	0.900	0.000	100.00
20.000	1.000	0.900	0.000	0.900	0.000	100.00
25.000	1.000	0.900	0.000	0.900	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-26-2004

PROJECT NAME- RM　　TRACS NO.-
HIGHWAY NAME-　　DESIGNER - RSR
LOCATION - Mck Ramp D 18+15 Rt　　CHECKER - NDV　　PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.222
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.400 - 50yr
SPREAD-Ft.--T	=	9.525 - 10' max
Average Velocity-V-fps	=	1.297
FLOW in Gutter-CFS--Q	=	1.220
% Flow in Gutter-CFS	=	87.119
Velocity of Flow in Gutter-fps	=	1.475
Depth at Curb Line-Inches--d	=	3.204

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	0.835
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	14.782
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.524	0.734	0.567	1.302	0.098	92.97
10.000	0.869	1.216	0.182	1.398	0.002	99.86
15.000	1.000	1.400	0.000	1.400	0.000	100.00
20.000	1.000	1.400	0.000	1.400	0.000	100.00
25.000	1.000	1.400	0.000	1.400	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-26-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - McK Ramp D 18+75 Rt CHECKER - NDV PAGE
Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.222
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.700 - 10 yr
SPREAD-Ft.--T	=	6.658 - 10' max
Average Velocity-V-fps	=	1.137
FLOW in Gutter-CFS--Q	=	0.681
% Flow in Gutter-CFS	=	97.293
Velocity of Flow in Gutter-fps	=	1.197
Depth at Curb Line-Inches--d	=	2.516

GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.350
Splash-Over Velocity--FPS	=	7.350
Local Gutter Depression-Inches	=	0.000
Flow-CFS--Q	=	0.700
GUTTER FLOW at INLET-CFS--Q	=	0.681
Gutter Velocity at INLET-fps	=	1.197
Depth at INLET Curb Line-Inches--d	=	2.516
Frontal Flow Intercepted by GRATE--CFS	=	0.475
Lateral Flow Intercepted by GRATE--CFS	=	0.117
TOTAL Flow Intercepted by GRATE--CFS	=	0.592
% FLOW Intercepted	=	84.507
By-pass Flow--CFS	=	0.108

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-26-2004

PROJECT NAME- RM	TRACS NO.-		
HIGHWAY NAME-	DESIGNER - RSR		
LOCATION -McK Ramp D 18+75 Rt	CHECKER - NDV	PAGE	
Ver 3.40: December 1995			

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.222
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.000 -50yr
SPREAD-Ft.--T	=	8.064 -10-yr
Average Velocity-V-fps	=	1.216
FLOW in Gutter-CFS--Q	=	0.928
% Flow in Gutter-CFS	=	92.784
Velocity of Flow in Gutter-fps	=	1.334
Depth at Curb Line-Inches--d	=	2.853

GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.350
Splash-Over Velocity--FPS	=	7.350
Local Gutter Depression-Inches	=	0.000
Flow-CFS--Q	=	1.000
GUTTER FLOW at INLET-CFS--Q	=	0.928
Gutter Velocity at INLET-fps	=	1.334
Depth at INLET Curb Line-Inches--d	=	2.853
Frontal Flow Intercepted by GRATE--CFS	=	0.609
Lateral Flow Intercepted by GRATE--CFS	=	0.179
TOTAL Flow Intercepted by GRATE--CFS	=	0.788
% FLOW Intercepted	=	78.798
By-pass Flow--CFS	=	0.212

APPENDIX D

CATCH BASIN DESIGN

Brown Road Ramps A–D Catch Basin Calculations

(c)

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-04-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - Brn Ramp A 6+28 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.280
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.800 -10 yr
SPREAD-Ft.--T	=	6.777 - 8' max
Average Velocity-V-fps	=	1.320
FLOW in Gutter-CFS--Q	=	0.668
% Flow in Gutter-CFS	=	83.544
Velocity of Flow in Gutter-fps	=	1.579
Depth at Curb Line-Inches--d	=	3.036

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.800
GUTTER FLOW at INLET-CFS--Q	=	0.763
Gutter Velocity at INLET-fps	=	1.710
Depth at INLET Curb Line-Inches--d	=	3.647
Frontal Flow Intercepted by GRATE--CFS	=	0.727
Lateral Flow Intercepted by GRATE--CFS	=	0.053
TOTAL Flow Intercepted by GRATE--CFS	=	0.780
% FLOW Intercepted	=	97.546
By-pass Flow--CFS	=	0.020

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-04-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - Ben Ramp A 6+28 Lt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - UDV
PAGE

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.280
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.100 - 50yr
SPREAD-Ft.--T	=	8.054 - 8' max - ok
Average Velocity-V-fps	=	1.383
FLOW in Gutter-CFS--Q	=	0.836
% Flow in Gutter-CFS	=	75.974
Velocity of Flow in Gutter-fps	=	1.716
Depth at Curb Line-Inches--d	=	3.343

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	1.100
GUTTER FLOW at INLET-CFS--Q	=	0.974
Gutter Velocity at INLET-fps	=	1.858
Depth at INLET Curb Line-Inches--d	=	4.021
Frontal Flow Intercepted by GRATE--CFS	=	0.912
Lateral Flow Intercepted by GRATE--CFS	=	0.113
TOTAL Flow Intercepted by GRATE--CFS	=	1.024
% FLOW Intercepted	=	93.117
By-pass Flow--CFS	=	0.076

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-04-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - Brn Ramp A 6+85 Lt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.280
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.800 - 10yr
SPREAD-Ft.--T	=	6.777 - 8' max
Average Velocity-V-fps	=	1.320
FLOW in Gutter-CFS--Q	=	0.668
% Flow in Gutter-CFS	=	83.544
Velocity of Flow in Gutter-fps	=	1.579
Depth at Curb Line-Inches--d	=	3.036

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.800
GUTTER FLOW at INLET-CFS--Q	=	0.763
Gutter Velocity at INLET-fps	=	1.710
Depth at INLET Curb Line-Inches--d	=	3.647
Frontal Flow Intercepted by GRATE--CFS	=	0.727
Lateral Flow Intercepted by GRATE--CFS	=	0.053
TOTAL Flow Intercepted by GRATE--CFS	=	0.780
% FLOW Intercepted	=	97.546
By-pass Flow--CFS	=	0.020

· 60 LF Slotted drain

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-04-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - Brn Ramp A 6+85 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.280
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.100 - 50yr
SPREAD-Ft.--T	=	8.054 - 8' max ok
Average Velocity-V-fps	=	1.383
FLOW in Gutter-CFS--Q	=	0.836
% Flow in Gutter-CFS	=	75.974
Velocity of Flow in Gutter-fps	=	1.716
Depth at Curb Line-Inches--d	=	3.343

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	1.100
GUTTER FLOW at INLET-CFS--Q	=	0.974
Gutter Velocity at INLET-fps	=	1.858
Depth at INLET Curb Line-Inches--d	=	4.021
Frontal Flow Intercepted by GRATE--CFS	=	0.912
Lateral Flow Intercepted by GRATE--CFS	=	0.113
TOTAL Flow Intercepted by GRATE--CFS	=	1.024
% FLOW Intercepted	=	93.117
By-pass Flow--CFS	=	0.076

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

03-24-2005

PROJECT NAME- Rm TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - Bcn Ramp A 7+41 CHECKER - NDV PAGE
Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.280
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.800
SPREAD-Ft.--T	=	6.777
Average Velocity-V-fps	=	1.320
FLOW in Gutter-CFS--Q	=	0.668
% Flow in Gutter-CFS	=	83.544
Velocity of Flow in Gutter-fps	=	1.579
Depth at Curb Line-Inches--d	=	3.036

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.800
GUTTER FLOW at INLET-CFS--Q	=	0.763
Gutter Velocity at INLET-fps	=	1.710
Depth at INLET Curb Line-Inches--d	=	3.647
Frontal Flow Intercepted by GRATE--CFS	=	0.727
Lateral Flow Intercepted by GRATE--CFS	=	0.053
TOTAL Flow Intercepted by GRATE--CFS	=	0.780
% FLOW Intercepted	=	97.546
By-pass Flow--CFS	=	0.020

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

03-24-2005

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - Brn Ramp A 7+41
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - BSR
CHECKER - NDV
PAGE

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.280
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.100
SPREAD-Ft.--T	=	8.054
Average Velocity-V-fps	=	1.383
FLOW in Gutter-CFS--Q	=	0.836
% Flow in Gutter-CFS	=	75.974
Velocity of Flow in Gutter-fps	=	1.716
Depth at Curb Line-Inches--d	=	3.343

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.354
Splash-Over Velocity--FPS	=	7.354
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	1.100
GUTTER FLOW at INLET-CFS--Q	=	0.974
Gutter Velocity at INLET-fps	=	1.858
Depth at INLET Curb Line-Inches--d	=	4.021
Frontal Flow Intercepted by GRATE--CFS	=	0.912
Lateral Flow Intercepted by GRATE--CFS	=	0.113
TOTAL Flow Intercepted by GRATE--CFS	=	1.024
% FLOW Intercepted	=	93.117
By-pass Flow--CFS	=	0.076

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-03-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - Brn Ramp A 8+06 Lt CHECKER - UDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.280
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.060 - 10yr
SPREAD-Ft.--T	=	7.901 - 8' max
Average Velocity-V-fps	=	1.375
FLOW in Gutter-CFS--Q	=	0.815
% Flow in Gutter-CFS	=	76.863
Velocity of Flow in Gutter-fps	=	1.700
Depth at Curb Line-Inches--d	=	3.306

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	3.977
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	7.877
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.837	0.887	0.173	1.060	0.000	100.00
10.000	1.000	1.060	0.000	1.060	0.000	100.00
15.000	1.000	1.060	0.000	1.060	0.000	100.00
20.000	1.000	1.060	0.000	1.060	0.000	100.00
25.000	1.000	1.060	0.000	1.060	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-03-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - Brn Ramp A 8+06 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.280
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.500 - 50yr
SPREAD-Ft.--T	=	9.402 - 14 max
Average Velocity-V-fps	=	1.455
FLOW in Gutter-CFS--Q	=	1.029
% Flow in Gutter-CFS	=	68.614
Velocity of Flow in Gutter-fps	=	1.856
Depth at Curb Line-Inches--d	=	3.666

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	4.394
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	9.568
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.736	1.104	0.396	1.500	0.000	99.99
10.000	1.000	1.500	0.000	1.500	0.000	100.00
15.000	1.000	1.500	0.000	1.500	0.000	100.00
20.000	1.000	1.500	0.000	1.500	0.000	100.00
25.000	1.000	1.500	0.000	1.500	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-03-2004

PROJECT NAME- RM　　TRACS NO.-
HIGHWAY NAME-　　DESIGNER - RSR
LOCATION - Brn Ramp A 10+00 Lt　　CHECKER - NDV　　PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.594
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.500 -10yr
SPREAD-Ft.--T	=	7.781 -8max
Average Velocity-V-fps	=	1.994
FLOW in Gutter-CFS--Q	=	1.164
% Flow in Gutter-CFS	=	77.591
Velocity of Flow in Gutter-fps	=	2.458
Depth at Curb Line-Inches--d	=	3.278

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	3.942
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	11.382
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.647	0.971	0.529	1.500	0.000	99.99
10.000	0.978	1.466	0.034	1.500	0.000	100.00
15.000	1.000	1.500	0.000	1.500	0.000	100.00
20.000	1.000	1.500	0.000	1.500	0.000	100.00
25.000	1.000	1.500	0.000	1.500	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-03-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - Brn Ramp A 10+00 L+ CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.594
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	2.200 - 50yr'
SPREAD-Ft.--T	=	9.430 - 14' max
Average Velocity-V-fps	=	2.123
FLOW in Gutter-CFS--Q	=	1.506
% Flow in Gutter-CFS	=	68.464
Velocity of Flow in Gutter-fps	=	2.710
Depth at Curb Line-Inches--d	=	3.673

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	4.402
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	14.099
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.545	1.200	0.980	2.180	0.020	99.09
10.000	0.892	1.962	0.238	2.200	0.000	100.00
15.000	1.000	2.200	0.000	2.200	0.000	100.00
20.000	1.000	2.200	0.000	2.200	0.000	100.00
25.000	1.000	2.200	0.000	2.200	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-03-2004

PROJECT NAME- RM | TRACS NO.-
HIGHWAY NAME- | DESIGNER - RSR
LOCATION - Bin Ramp A 13+05 Lt | CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.233
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	2.200 -10yr
SPREAD-Ft.--T	=	7.855 -8' max
Average Velocity-V-fps	=	2.880
FLOW in Gutter-CFS--Q	=	1.698
% Flow in Gutter-CFS	=	77.164
Velocity of Flow in Gutter-fps	=	3.558
Depth at Curb Line-Inches--d	=	3.295

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	3.963
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	16.680
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.473	1.042	1.146	2.188	0.012	99.44
10.000	0.807	1.776	0.424	2.200	0.000	100.00
15.000	0.984	2.165	0.035	2.200	0.000	100.00
20.000	1.000	2.200	0.000	2.200	0.000	100.00
25.000	1.000	2.200	0.000	2.200	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-03-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - Brn Ramp A 13+05 Lt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.233
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	3.200 - 50 yr
SPREAD-Ft.--T	=	9.474 - 14' max
Average Velocity-V-fps	=	3.064
FLOW in Gutter-CFS--Q	=	2.184
% Flow in Gutter-CFS	=	68.241
Velocity of Flow in Gutter-fps	=	3.913
Depth at Curb Line-Inches--d	=	3.684

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	4.414
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	20.575
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.394	1.261	1.780	3.042	0.158	95.05
10.000	0.698	2.234	0.961	3.196	0.004	99.87
15.000	0.905	2.895	0.305	3.200	0.000	100.00
20.000	0.998	3.195	0.005	3.200	0.000	100.00
25.000	1.000	3.200	0.000	3.200	0.000	100.00

CB 293

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-03-2004

PROJECT NAME- RM
TRACS NO.-
HIGHWAY NAME-
DESIGNER - RSP
LOCATION - Bin Ramp A 18+00 Lt
CHECKER - NDV
PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G = 1.327
Roadway Cross-Slope-Ft./Ft.--Sx = 0.020
Shoulder Width-Ft.-- = 10.000
Shoulder Slope-Ft./Ft.--Ss = 0.020
Gutter Width-Ft.--W = 4.500
Gutter Slope-Ft./Ft.--Sw = 0.037
Gutter Depression-Inches-- = 1.998
Manning's 'N = 0.016

Flow-CFS--Q = 3.500 -10yr
SPREAD-Ft.--T = 9.626 -10' max
Average Velocity-V-fps = 3.185

FLOW in Gutter-CFS--Q = 3.036
% Flow in Gutter-CFS = 86.739
Velocity of Flow in Gutter-fps = 3.631
Depth at Curb Line-Inches--d = 3.228

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft. = 3.350
Grate Width---Ft. = 2.000
Grate Area--Sq. Ft. = 5.590
Splash-Over Velocity--FPS = 7.350

Depth at INLET Curb Line-Inches--d = 1.646
Local Gutter Depression-Inches = 0.000

Length of opening: TOTAL Intercept--Ft. = 37.190
Capture Ratio -- SLOTTED DRAIN = 0.670
Capture Ratio -- GRATE = 0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.229	0.801	1.743	2.544	0.956	72.70
10.000	0.431	1.508	1.406	2.915	0.585	83.27
15.000	0.605	2.118	1.070	3.189	0.311	91.10
20.000	0.751	2.627	0.744	3.371	0.129	96.32
25.000	0.866	3.030	0.450	3.480	0.020	99.44

CB 293

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-03-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - Bin Ramp A 18+00 Lt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.327
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	4.900 - 50yr
SPREAD-Ft.--T	=	11.252 - 16' max
Average Velocity-V-fps	=	3.407
FLOW in Gutter-CFS--Q	=	3.932
% Flow in Gutter-CFS	=	80.255
Velocity of Flow in Gutter-fps	=	4.003
Depth at Curb Line-Inches--d	=	3.618

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	1.557
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	43.672
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.197	0.963	2.249	3.212	1.688	65.55
10.000	0.374	1.832	1.903	3.735	1.165	76.22
15.000	0.531	2.603	1.558	4.160	0.740	84.90
20.000	0.668	3.273	1.212	4.485	0.415	91.52
25.000	0.783	3.838	0.870	4.708	0.192	96.09 ←

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-03-2004

PROJECT NAME- RM   TRACS NO.-
HIGHWAY NAME-   DESIGNER - RSR
LOCATION - Brn Ramp B 8+21 Rt   CHECKER - NDV   PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.251
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.100 - 10yr
SPREAD-Ft.--T	=	8.199 - 10' max
Average Velocity-V-fps	=	1.303
FLOW in Gutter-CFS--Q	=	1.015
% Flow in Gutter-CFS	=	92.284
Velocity of Flow in Gutter-fps	=	1.435
Depth at Curb Line-Inches--d	=	2.886

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	0.610
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	13.664
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.560	0.616	0.433	1.048	0.052	95.32
10.000	0.906	0.997	0.103	1.100	0.000	100.00
15.000	1.000	1.100	0.000	1.100	0.000	100.00
20.000	1.000	1.100	0.000	1.100	0.000	100.00
25.000	1.000	1.100	0.000	1.100	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-03-2004

PROJECT NAME- RM　　TRACS NO.-
HIGHWAY NAME-　　DESIGNER - RSR
LOCATION - Brn Ramp B 8+21 Rt　　CHECKER - NDV　　PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.251
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.600 - 50yr
SPREAD-Ft.--T	=	9.851 - 10' max
Average Velocity-V-fps	=	1.400
FLOW in Gutter-CFS--Q	=	1.373
% Flow in Gutter-CFS	=	85.808
Velocity of Flow in Gutter-fps	=	1.603
Depth at Curb Line-Inches--d	=	3.282

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	0.000
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	16.296
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.483	0.773	0.678	1.451	0.149	90.68
10.000	0.819	1.311	0.277	1.588	0.012	99.28
15.000	0.989	1.583	0.017	1.600	0.000	100.00
20.000	1.000	1.600	0.000	1.600	0.000	100.00
25.000	1.000	1.600	0.000	1.600	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-02-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - Brn Ramp B 9+15 Rt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.251
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.100 -10yr
SPREAD-Ft.--T	=	8.199 - 10 max
Average Velocity-V-fps	=	1.303
FLOW in Gutter-CFS--Q	=	1.015
% Flow in Gutter-CFS	=	92.284
Velocity of Flow in Gutter-fps	=	1.435
Depth at Curb Line-Inches--d	=	2.886

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	3.351
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	13.664
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.560	0.616	0.433	1.048	0.052	95.32
10.000	0.906	0.997	0.103	1.100	0.000	100.00
15.000	1.000	1.100	0.000	1.100	0.000	100.00
20.000	1.000	1.100	0.000	1.100	0.000	100.00
25.000	1.000	1.100	0.000	1.100	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-02-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - Brn Ramp B 9+15 Rt
Ver 3.40: December 1995

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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.251
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.500 - 50yr
SPREAD-Ft.--T	=	9.554 - 10' max
Average Velocity-V-fps	=	1.383
FLOW in Gutter-CFS--Q	=	1.305
% Flow in Gutter-CFS	=	87.003
Velocity of Flow in Gutter-fps	=	1.573
Depth at Curb Line-Inches--d	=	3.211

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	1.203
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	15.805
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.496	0.744	0.631	1.374	0.126	91.61
10.000	0.835	1.253	0.241	1.494	0.006	99.58
15.000	0.995	1.493	0.007	1.500	0.000	100.00
20.000	1.000	1.500	0.000	1.500	0.000	100.00
25.000	1.000	1.500	0.000	1.500	0.000	100.00

CB 272

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-02-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - Brn Ramp B 10+00 Rt CHECKER - NDV PAGE
Ver 3.40: December 1995

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.251
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.400 - 10yr
SPREAD-Ft.--T	=	4.516 - 10'max
Average Velocity-V-fps	=	1.064
FLOW in Gutter-CFS--Q	=	0.400
% Flow in Gutter-CFS	=	100.000
Velocity of Flow in Gutter-fps	=	1.064
Depth at Curb Line-Inches--d	=	2.002

GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.350
Splash-Over Velocity--FPS	=	7.350
Local Gutter Depression-Inches	=	0.000
Flow-CFS--Q	=	0.400
GUTTER FLOW at INLET-CFS--Q	=	0.400
Gutter Velocity at INLET-fps	=	1.064
Depth at INLET Curb Line-Inches--d	=	2.002
Frontal Flow Intercepted by GRATE--CFS	=	0.316
Lateral Flow Intercepted by GRATE--CFS	=	0.050
TOTAL Flow Intercepted by GRATE--CFS	=	0.366
% FLOW Intercepted	=	91.489
By-pass Flow--CFS	=	0.034

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-02-2004

PROJECT NAME- RM	TRACS NO.-		
HIGHWAY NAME-	DESIGNER - RSR		
LOCATION - Brn Ramp B 10+00 Rt	CHECKER - NDV	PAGE	
Ver 3.40: December 1995			

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.251	
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020	
Shoulder Width-Ft.--	=	10.000	
Shoulder Slope-Ft./Ft.--Ss	=	0.020	
Gutter Width-Ft.--W	=	4.500	
Gutter Slope-Ft./Ft.--Sw	=	0.037	
Gutter Depression-Inches--	=	1.998	
Manning's 'N	=	0.016	
Flow-CFS--Q	=	0.500	-50yr
SPREAD-Ft.--T	=	5.241	-10' max
Average Velocity-V-fps	=	1.119	
FLOW in Gutter-CFS--Q	=	0.499	
% Flow in Gutter-CFS	=	99.789	
Velocity of Flow in Gutter-fps	=	1.131	
Depth at Curb Line-Inches--d	=	2.176	

GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.350
Splash-Over Velocity--FPS	=	7.350
Local Gutter Depression-Inches	=	0.000
Flow-CFS--Q	=	0.500
GUTTER FLOW at INLET-CFS--Q	=	0.499
Gutter Velocity at INLET-fps	=	1.131
Depth at INLET Curb Line-Inches--d	=	2.176
Frontal Flow Intercepted by GRATE--CFS	=	0.376
Lateral Flow Intercepted by GRATE--CFS	=	0.069
TOTAL Flow Intercepted by GRATE--CFS	=	0.445
% FLOW Intercepted	=	88.998
By-pass Flow--CFS	=	0.055

CB 273

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-02-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - Brn Ramp B 11+47 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.242
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.010
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.010
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.021
Gutter Depression-Inches--	=	0.630
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.600 -10yr
SPREAD-Ft.--T	=	7.974 -10' max
Average Velocity-V-fps	=	1.649
FLOW in Gutter-CFS--Q	=	0.420
% Flow in Gutter-CFS	=	69.967
Velocity of Flow in Gutter-fps	=	2.019
Depth at Curb Line-Inches--d	=	1.313

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	1.968
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	13.591
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.562	0.337	0.263	0.600	0.000	100.00
10.000	0.909	0.545	0.055	0.600	0.000	100.00
15.000	1.000	0.600	0.000	0.600	0.000	100.00
20.000	1.000	0.600	0.000	0.600	0.000	100.00
25.000	1.000	0.600	0.000	0.600	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-02-2004

PROJECT NAME- RM　　TRACS NO.-
HIGHWAY NAME-　　DESIGNER - RSR
LOCATION - Brn Ramp B 11+47 Lt　　CHECKER - NDV　　PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.242
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.010
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.010
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.021
Gutter Depression-Inches--	=	0.630
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.900 - 50yr
SPREAD-Ft.--T	=	9.476 - 10 max
Average Velocity-V-fps	=	1.800
FLOW in Gutter-CFS--Q	=	0.556
% Flow in Gutter-CFS	=	61.807
Velocity of Flow in Gutter-fps	=	2.252
Depth at Curb Line-Inches--d	=	1.501

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	2.223
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	16.907
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.468	0.421	0.469	0.890	0.010	98.93
10.000	0.800	0.720	0.180	0.900	0.000	100.00
15.000	0.980	0.882	0.018	0.900	0.000	100.00
20.000	1.000	0.900	0.000	0.900	0.000	100.00
25.000	1.000	0.900	0.000	0.900	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-02-2004

PROJECT NAME- RM   TRACS NO.-
HIGHWAY NAME-   DESIGNER - RSR
LOCATION -Ben Ramp B 13+50 Lt   CHECKER - NDV   PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	2.609
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.028
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.028
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.800 - 10 yr
SPREAD-Ft.--T	=	5.304 - 10' max
Average Velocity-V-fps	=	3.712
FLOW in Gutter-CFS--Q	=	1.792
% Flow in Gutter-CFS	=	99.550
Velocity of Flow in Gutter-fps	=	3.765
Depth at Curb Line-Inches--d	=	2.268

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	1.107
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	33.201
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.255	0.458	1.094	1.553	0.247	86.25
10.000	0.475	0.856	0.833	1.688	0.112	93.80
15.000	0.661	1.190	0.581	1.771	0.029	98.41
20.000	0.810	1.458	0.341	1.799	0.001	99.93
25.000	0.919	1.655	0.145	1.800	0.000	100.00

CB 286

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-02-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - Brn Ramp B 13+50 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	2.609
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.028
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.028
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	2.500 - 50yr
SPREAD-Ft.--T	=	6.176 - 10' max
Average Velocity-V-fps	=	3.999
FLOW in Gutter-CFS--Q	=	2.442
% Flow in Gutter-CFS	=	97.696
Velocity of Flow in Gutter-fps	=	4.169
Depth at Curb Line-Inches--d	=	2.561

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	0.883
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	38.216
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.223	0.558	1.462	2.019	0.481	80.77
10.000	0.421	1.052	1.163	2.215	0.285	88.59
15.000	0.592	1.481	0.884	2.365	0.135	94.60
20.000	0.737	1.841	0.621	2.462	0.038	98.48
25.000	0.852	2.130	0.367	2.498	0.002	99.91

CB
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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-02-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - BSR
LOCATION - Bsn Ramp B 17+34 RT CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	2.946
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.018
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.018
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.021
Gutter Depression-Inches--	=	0.630
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.800 - 10yr
SPREAD-Ft.--T	=	7.714 - 8' max
Average Velocity-V-fps	=	3.290
FLOW in Gutter-CFS--Q	=	1.188
% Flow in Gutter-CFS	=	66.014
Velocity of Flow in Gutter-fps	=	3.944
Depth at Curb Line-Inches--d	=	1.761

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	2.462
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	29.110
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.288	0.518	1.136	1.653	0.147	91.86
10.000	0.531	0.956	0.809	1.765	0.035	98.07
15.000	0.728	1.311	0.487	1.799	0.001	99.92
20.000	0.876	1.578	0.222	1.800	0.000	100.00
25.000	0.971	1.747	0.053	1.800	0.000	100.00

CB 291

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-02-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - Brn Ramp B 17+34 Rt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	2.946
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.018
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.018
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.021
Gutter Depression-Inches--	=	0.630
Manning's 'N	=	0.016
Flow-CFS--Q	=	2.500 - 50yr
SPREAD-Ft.--T	=	8.750 - 14max
Average Velocity-V-fps	=	3.565
FLOW in Gutter-CFS--Q	=	1.508
% Flow in Gutter-CFS	=	60.331
Velocity of Flow in Gutter-fps	=	4.333
Depth at Curb Line-Inches--d	=	1.986

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	2.726
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	34.584
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.245	0.613	1.503	2.116	0.384	84.63
10.000	0.459	1.147	1.182	2.330	0.170	93.20
15.000	0.641	1.602	0.853	2.455	0.045	98.21
20.000	0.789	1.972	0.525	2.497	0.003	99.88
25.000	0.901	2.252	0.248	2.500	0.000	100.00

CB 292

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

03-24-2005

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - Btn Ramp B 19+59 Rt CHECKER - NDV PAGE
Ver 3.40: December 1995

CURB OPENING INLET -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	2.101
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.000
Gutter Slope-Ft./Ft.--Sw	=	0.020
Gutter Depression-Inches--	=	0.480
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.700 - 10yr
SPREAD-Ft.--T	=	5.486 - 8' max
Average Velocity-V-fps	=	2.326
FLOW in Gutter-CFS--Q	=	0.491
% Flow in Gutter-CFS	=	70.162
Velocity of Flow in Gutter-fps	=	2.737
Depth at Curb Line-Inches--d	=	1.317

CURB OPENING--ADOT STD. C-15.20

Flow-CFS--Q	=	0.700
Gutter Velocity at INLET-fps	=	3.166
GUTTER FLOW at INLET-CFS--Q	=	0.650
Depth at INLET Curb Line-Inches--d	=	1.971
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	13.280
Capture Ratio -- CURB OPENING	=	0.800

LENGTH	Efficiency	Q(Captured)	Q(By-Pass)
3.083	0.378	0.265	0.435
6.583	0.708	0.496	0.204
9.583	0.900	0.630	0.070
13.583	1.000	0.700	0.000
20.583	1.000	0.700	0.000

. 11.5' Wing

CB 292

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

03-24-2005

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - Brn Ramp B 19+59 Rt CHECKER - NDV PAGE
Ver 3.40: December 1995

CURB OPENING INLET -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	2.101
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.000
Gutter Slope-Ft./Ft.--Sw	=	0.020
Gutter Depression-Inches--	=	0.480
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.000 - .50 yr
SPREAD-Ft.--T	=	6.272 ← 8 max
Average Velocity-V-fps	=	2.542
FLOW in Gutter-CFS--Q	=	0.641
% Flow in Gutter-CFS	=	64.097
Velocity of Flow in Gutter-fps	=	3.040
Depth at Curb Line-Inches--d	=	1.505

CURB OPENING--ADOT STD. C-15.20

Flow-CFS--Q	=	1.000
Gutter Velocity at INLET-fps	=	3.493
GUTTER FLOW at INLET-CFS--Q	=	0.855
Depth at INLET Curb Line-Inches--d	=	2.209
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	15.926
Capture Ratio -- CURB OPENING	=	0.800

LENGTH	Efficiency	Q(Captured)	Q(By-Pass)
3.083	0.321	0.321	0.679
6.583	0.617	0.617	0.383
9.583	0.809	0.809	0.191
13.583	0.968	0.968	0.032 ←
20.583	1.000	1.000	0.000

CB 310

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

03-24-2005

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - Bm Ramp C 1+92 Lt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
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CURB OPENING INLET -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.773
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.000
Gutter Slope-Ft./Ft.--Sw	=	0.020
Gutter Depression-Inches--	=	0.480
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.300 - 10yr
SPREAD-Ft.--T	=	8.348 - 8' max
Average Velocity-V-fps	=	1.866 spread @ upstream end of wing ok ✓
FLOW in Gutter-CFS--Q	=	0.674
% Flow in Gutter-CFS	=	51.833
Velocity of Flow in Gutter-fps	=	2.293
Depth at Curb Line-Inches--d	=	2.003

CURB OPENING--ADOT STD. C-15.20

Flow-CFS--Q	=	1.300
Gutter Velocity at INLET-fps	=	2.586
GUTTER FLOW at INLET-CFS--Q	=	0.883
Depth at INLET Curb Line-Inches--d	=	2.788
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	14.339
Capture Ratio -- CURB OPENING	=	0.800

LENGTH	Efficiency	Q(Captured)	Q(By-Pass)
3.083	0.353	0.459	0.841
6.583	0.669	0.870	0.430
9.583	0.863	1.122	0.178
13.583	0.995	1.293	0.007
20.583	1.000	1.300	0.000

19.5' Wing

CB 310

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

03-24-2005

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - Bry Ramp C H92 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

CURB OPENING INLET -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.773
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.000
Gutter Slope-Ft./Ft.--Sw	=	0.020
Gutter Depression-Inches--	=	0.480
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.800 - 50yr
SPREAD-Ft.--T	=	9.431 - 8 max
Average Velocity-V-fps	=	2.024 spread @ upstream end of wing ok
FLOW in Gutter-CFS--Q	=	0.847
% Flow in Gutter-CFS	=	47.041
Velocity of Flow in Gutter-fps	=	2.511
Depth at Curb Line-Inches--d	=	2.263

CURB OPENING--ADOT STD. C-15.20

Flow-CFS--Q	=	1.800
Gutter Velocity at INLET-fps	=	2.806
GUTTER FLOW at INLET-CFS--Q	=	1.092
Depth at INLET Curb Line-Inches--d	=	3.075
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	17.087
Capture Ratio -- CURB OPENING	=	0.800

LENGTH	Efficiency	Q(Captured)	Q(By-Pass)
3.083	0.301	0.542	1.258
6.583	0.583	1.050	0.750
9.583	0.773	1.391	0.409
13.583	0.942	1.696	0.104
20.583	1.000	1.800	0.000

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-11-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - Brn Ramp C 4+00 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.182
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.021
Gutter Depression-Inches--	=	0.630
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.600 - 10yr
SPREAD-Ft.--T	=	8.303 - 8' max - o/k
Average Velocity-V-fps	=	2.311
FLOW in Gutter-CFS--Q	=	0.990
% Flow in Gutter-CFS	=	61.885
Velocity of Flow in Gutter-fps	=	2.783
Depth at Curb Line-Inches--d	=	2.023

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	2.754
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	21.584
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.378	0.604	0.868	1.472	0.128	92.02
10.000	0.674	1.078	0.508	1.586	0.014	99.15
15.000	0.882	1.411	0.189	1.600	0.000	100.00
20.000	0.991	1.585	0.015	1.600	0.000	100.00
25.000	1.000	1.600	0.000	1.600	0.000	100.00

CB 315

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-11-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - Brn Ramp C 4400 Lt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.182
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.021
Gutter Depression-Inches--	=	0.630
Manning's 'N	=	0.016
Flow-CFS--Q	=	2.200 - 50yr
SPREAD-Ft.--T	=	9.363 - 14' max
Average Velocity-V-fps	=	2.501
FLOW in Gutter-CFS--Q	=	1.246
% Flow in Gutter-CFS	=	56.642
Velocity of Flow in Gutter-fps	=	3.049
Depth at Curb Line-Inches--d	=	2.277

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	3.041
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	25.485
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.325	0.715	1.161	1.876	0.324	85.29
10.000	0.592	1.303	0.801	2.104	0.096	95.63
15.000	0.798	1.755	0.439	2.194	0.006	99.72
20.000	0.937	2.061	0.139	2.200	0.000	100.00
25.000	0.999	2.198	0.002	2.200	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-11-2004

PROJECT NAME- RM | TRACS NO.-
HIGHWAY NAME- | DESIGNER - RSR
LOCATION - Brn Ramp C 7+00 Lt | CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.280
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.021
Gutter Depression-Inches--	=	0.630
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.400 - 10yr
SPREAD-Ft.--T	=	7.776 - 8' max
Average Velocity-V-fps	=	2.303
FLOW in Gutter-CFS--Q	=	0.908
% Flow in Gutter-CFS	=	64.822
Velocity of Flow in Gutter-fps	=	2.755
Depth at Curb Line-Inches--d	=	1.896

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	2.608
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	20.554
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.395	0.552	0.771	1.323	0.077	94.50
10.000	0.699	0.978	0.418	1.396	0.004	99.72
15.000	0.905	1.267	0.133	1.400	0.000	100.00
20.000	0.999	1.398	0.002	1.400	0.000	100.00
25.000	1.000	1.400	0.000	1.400	0.000	100.00

CB 323

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-11-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - Bm Ramp C 7400 Lt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RGR
CHECKER - NDV
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.280
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.021
Gutter Depression-Inches--	=	0.630
Manning's 'N	=	0.016
Flow-CFS--Q	=	2.000 - 50yr
SPREAD-Ft.--T	=	8.897 - 11' max
Average Velocity-V-fps	=	2.517
FLOW in Gutter-CFS--Q	=	1.177
% Flow in Gutter-CFS	=	58.843
Velocity of Flow in Gutter-fps	=	3.053
Depth at Curb Line-Inches--d	=	2.165

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	2.916
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	24.731
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.334	0.668	1.083	1.751	0.249	87.57
10.000	0.606	1.213	0.726	1.939	0.061	96.95
15.000	0.813	1.627	0.371	1.998	0.002	99.90
20.000	0.949	1.898	0.102	2.000	0.000	100.00
25.000	1.000	2.000	0.000	2.000	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-11-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - Brn Ramp C 10+00 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.280
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.021
Gutter Depression-Inches--	=	0.630
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.400 - 10yr
SPREAD-Ft.--T	=	7.776 - 8' max
Average Velocity-V-fps	=	2.303
FLOW in Gutter-CFS--Q	=	0.908
% Flow in Gutter-CFS	=	64.822
Velocity of Flow in Gutter-fps	=	2.755
Depth at Curb Line-Inches--d	=	1.896

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	2.608
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	20.554
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.395	0.552	0.771	1.323	0.077	94.50
10.000	0.699	0.978	0.418	1.396	0.004	99.72
15.000	0.905	1.267	0.133	1.400	0.000	100.00
20.000	0.999	1.398	0.002	1.400	0.000	100.00
25.000	1.000	1.400	0.000	1.400	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-11-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - Brn Ramp ⊄ 10+00 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.280
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.021
Gutter Depression-Inches--	=	0.630
Manning's 'N	=	0.016
Flow-CFS--Q	=	2.100 - 50yr
SPREAD-Ft.--T	=	9.062 - 14' max
Average Velocity-V-fps	=	2.547
FLOW in Gutter-CFS--Q	=	1.219
% Flow in Gutter-CFS	=	58.044
Velocity of Flow in Gutter-fps	=	3.096
Depth at Curb Line-Inches--d	=	2.205

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	2.960
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	25.370
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.326	0.685	1.131	1.816	0.284	86.49
10.000	0.594	1.248	0.774	2.022	0.078	96.28
15.000	0.800	1.680	0.416	2.096	0.004	99.82
20.000	0.939	1.972	0.128	2.100	0.000	100.00
25.000	1.000	2.099	0.001	2.100	0.000	100.00

CB 328

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-11-2004

PROJECT NAME- Rm — TRACS NO.-
HIGHWAY NAME- — DESIGNER - RSR
LOCATION - Brn Ramp C 12+00 Lt — CHECKER - NDV — PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.539
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.021
Gutter Depression-Inches--	=	0.630
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.800 - 10 yr
SPREAD-Ft.--T	=	7.412 - 8' max
Average Velocity-V-fps	=	1.448
FLOW in Gutter-CFS--Q	=	0.536
% Flow in Gutter-CFS	=	66.998
Velocity of Flow in Gutter-fps	=	1.722
Depth at Curb Line-Inches--d	=	1.809

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	2.505
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	12.387
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.606	0.484	0.312	0.797	0.003	99.58
10.000	0.948	0.759	0.041	0.800	0.000	100.00
15.000	1.000	0.800	0.000	0.800	0.000	100.00
20.000	1.000	0.800	0.000	0.800	0.000	100.00
25.000	1.000	0.800	0.000	0.800	0.000	100.00

CB 328

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-11-2004

PROJECT NAME- RM
TRACS NO.-
HIGHWAY NAME-
DESIGNER - RSR
LOCATION - Brn Ramp C 12+00 Lt
CHECKER - NDV
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Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.539
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.021
Gutter Depression-Inches--	=	0.630
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.100 - 50yr
SPREAD-Ft.--T	=	8.359 - 8 max. Ok.
Average Velocity-V-fps	=	1.567
FLOW in Gutter-CFS--Q	=	0.677
% Flow in Gutter-CFS	=	61.584
Velocity of Flow in Gutter-fps	=	1.889
Depth at Curb Line-Inches--d	=	2.036

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	2.769
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	14.596
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.530	0.583	0.488	1.071	0.029	97.364
10.000	0.875	0.963	0.137	1.100	0.000	100.00
15.000	1.000	1.100	0.000	1.100	0.000	100.00
20.000	1.000	1.100	0.000	1.100	0.000	100.00
25.000	1.000	1.100	0.000	1.100	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

04-22-2005

PROJECT NAME- RM
TRACS NO.-
HIGHWAY NAME-
DESIGNER - RSR
LOCATION - Brn Ramp C 13+09.02 Lt
CHECKER - NDV
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Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--IN SUMP

GUTTER FLOW HYDRAULICS

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Effective Perimeter--Ft.	=	7.354
Capture Ratio -- GRATE	=	0.500
Capture Ratio -- SLOTTED DRAIN	=	0.500
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.900 -10 yr

LENGTH	Q(Slot. Dn)	Q(Grate)	d(inches)	SPREAD,Ft.
5.000	0.583	0.345	1.609	2.001 ← 8' max
10.000	0.818	0.082	1.060	1.318
15.000	0.844	0.056	0.605	0.752
20.000	0.857	0.043	0.339	0.421

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

04-22-2005

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - Brn Ramp C 13+09.02 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--IN SUMP

GUTTER FLOW HYDRAULICS

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Effective Perimeter--Ft.	=	7.354
Capture Ratio -- GRATE	=	0.500
Capture Ratio -- SLOTTED DRAIN	=	0.500
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	1.300 - 50yr

LENGTH	Q(Slot. Dn)	Q(Grate)	d(inches)	SPREAD,Ft.
5.000	0.764	0.535	2.123	2.973 ← 8' max
10.000	1.045	0.297	1.426	1.774
15.000	1.218	0.082	1.050	1.307
20.000	1.238	0.062	0.711	0.884

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-10-2004

PROJECT NAME- RM
TRACS NO.-
HIGHWAY NAME-
DESIGNER - RSR
LOCATION - Brn Ramp C 14+18 Lt
CHECKER - NOV
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Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.539
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.021
Gutter Depression-Inches--	=	0.630
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.500 - 10 yr
SPREAD-Ft.--T	=	6.204 - 8 max
Average Velocity-V-fps	=	1.289
FLOW in Gutter-CFS--Q	=	0.376
% Flow in Gutter-CFS	=	75.127
Velocity of Flow in Gutter-fps	=	1.498
Depth at Curb Line-Inches--d	=	1.519

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	2.148
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	9.807
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.723	0.361	0.139	0.500	0.000	100.00
10.000	1.000	0.500	0.000	0.500	0.000	100.00
15.000	1.000	0.500	0.000	0.500	0.000	100.00
20.000	1.000	0.500	0.000	0.500	0.000	100.00
25.000	1.000	0.500	0.000	0.500	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-10-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - Brn Ramp C 14+18 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.539
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.021
Gutter Depression-Inches--	=	0.630
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.800 -50yr
SPREAD-Ft.--T	=	7.412 - 8' max
Average Velocity-V-fps	=	1.448
FLOW in Gutter-CFS--Q	=	0.536
% Flow in Gutter-CFS	=	66.993
Velocity of Flow in Gutter-fps	=	1.722
Depth at Curb Line-Inches--d	=	1.809

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	2.505
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	12.386
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.606	0.485	0.312	0.797	0.003	99.58
10.000	0.948	0.759	0.041	0.800	0.000	100.00
15.000	1.000	0.800	0.000	0.800	0.000	100.00
20.000	1.000	0.800	0.000	0.800	0.000	100.00
25.000	1.000	0.800	0.000	0.800	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-10-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - Brn Ramp C 15+33 Lt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.107
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.021
Gutter Depression-Inches--	=	0.630
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.000 - 10yr
SPREAD-Ft.--T	=	7.038 - 8 max
Average Velocity-V-fps	=	2.006
FLOW in Gutter-CFS--Q	=	0.694
% Flow in Gutter-CFS	=	69.360
Velocity of Flow in Gutter-fps	=	2.371
Depth at Curb Line-Inches--d	=	1.719

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	2.397
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	16.686
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.473	0.473	0.511	0.985	0.015	98.46
10.000	0.807	0.807	0.193	1.000	0.000	100.00
15.000	0.984	0.984	0.016	1.000	0.000	100.00
20.000	1.000	1.000	0.000	1.000	0.000	100.00
25.000	1.000	1.000	0.000	1.000	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-10-2004

PROJECT NAME- RM
TRACS NO.-
HIGHWAY NAME-
DESIGNER - RSR
LOCATION - Bra Ramp C 15+33 Lt
CHECKER - NDV
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Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.107
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.021
Gutter Depression-Inches--	=	0.630
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.400 - 50yr
SPREAD-Ft.--T	=	7.993 - 8' max
Average Velocity-V-fps	=	2.181
FLOW in Gutter-CFS--Q	=	0.890
% Flow in Gutter-CFS	=	63.586
Velocity of Flow in Gutter-fps	=	2.616
Depth at Curb Line-Inches--d	=	1.948

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	2.668
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	19.814
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.408	0.571	0.750	1.320	0.080	94.30
10.000	0.718	1.005	0.392	1.397	0.003	99.75
15.000	0.922	1.290	0.110	1.400	0.000	100.00
20.000	1.000	1.400	0.000	1.400	0.000	100.00
25.000	1.000	1.400	0.000	1.400	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-10-2004

PROJECT NAME- RM
TRACS NO.-
HIGHWAY NAME-
DESIGNER - RSR
LOCATION - Bra Ramp L 16+08 Lt
CHECKER - NDV
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Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.191
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.021
Gutter Depression-Inches--	=	0.630
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.000 - 10yr
SPREAD-Ft.--T	=	6.941 - 8' max
Average Velocity-V-fps	=	2.062
FLOW in Gutter-CFS--Q	=	0.700
% Flow in Gutter-CFS	=	69.993
Velocity of Flow in Gutter-fps	=	2.433
Depth at Curb Line-Inches--d	=	1.696

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	2.369
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	17.004
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.466	0.466	0.519	0.985	0.015	98.50
10.000	0.797	0.797	0.203	1.000	0.000	100.00
15.000	0.979	0.979	0.021	1.000	0.000	100.00
20.000	1.000	1.000	0.000	1.000	0.000	100.00
25.000	1.000	1.000	0.000	1.000	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-10-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - Brn Ramp C 16+08 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.191
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.021
Gutter Depression-Inches--	=	0.630
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.400 - 50yr
SPREAD-Ft.--T	=	7.883 - 8max
Average Velocity-V-fps	=	2.242
FLOW in Gutter-CFS--Q	=	0.899
% Flow in Gutter-CFS	=	64.207
Velocity of Flow in Gutter-fps	=	2.685
Depth at Curb Line-Inches--d	=	1.922

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	2.637
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	20.183
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.401	0.561	0.760	1.322	0.078	94.40
10.000	0.708	0.991	0.405	1.396	0.004	99.74
15.000	0.913	1.279	0.121	1.400	0.000	100.00
20.000	1.000	1.400	0.000	1.400	0.000	100.00
25.000	1.000	1.400	0.000	1.400	0.000	100.00

CB 333

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-10-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - Brn Ramp C 16+88 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.191
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.021
Gutter Depression-Inches--	=	0.630
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.000 10yr
SPREAD-Ft.--T	=	6.941 8max
Average Velocity-V-fps	=	2.062
FLOW in Gutter-CFS--Q	=	0.700
% Flow in Gutter-CFS	=	69.993
Velocity of Flow in Gutter-fps	=	2.433
Depth at Curb Line-Inches--d	=	1.696

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	2.369
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	17.004
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.466	0.466	0.519	0.985	0.015	98.50
10.000	0.797	0.797	0.203	1.000	0.000	100.00
15.000	0.979	0.979	0.021	1.000	0.000	100.00
20.000	1.000	1.000	0.000	1.000	0.000	100.00
25.000	1.000	1.000	0.000	1.000	0.000	100.00

CB 333

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-10-2004

PROJECT NAME- RM | TRACS NO.-
HIGHWAY NAME- | DESIGNER - RSR
LOCATION - Brn Ramp C 16+88 Lt | CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.191
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.021
Gutter Depression-Inches--	=	0.630
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.400 - 50yr
SPREAD-Ft.--T	=	7.883 - 8' max
Average Velocity-V-fps	=	2.242
FLOW in Gutter-CFS--Q	=	0.899
% Flow in Gutter-CFS	=	64.207
Velocity of Flow in Gutter-fps	=	2.685
Depth at Curb Line-Inches--d	=	1.922

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	2.637
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	20.183
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.401	0.561	0.760	1.322	0.078	94.40
10.000	0.708	0.991	0.405	1.396	0.004	99.74
15.000	0.913	1.279	0.121	1.400	0.000	100.00
20.000	1.000	1.400	0.000	1.400	0.000	100.00
25.000	1.000	1.400	0.000	1.400	0.000	100.00

CB 307

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-09-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - Brn Ramp D 9+18 Rt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.658
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.015
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.015
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	2.700-10yr
SPREAD-Ft.--T	=	9.063 -10' max
Average Velocity-V-fps	=	3.219
FLOW in Gutter-CFS--Q	=	2.465
% Flow in Gutter-CFS	=	91.287
Velocity of Flow in Gutter-fps	=	3.611
Depth at Curb Line-Inches--d	=	2.819

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	1.261
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	35.448
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.239	0.646	1.458	2.104	0.596	77.93
10.000	0.449	1.213	1.149	2.362	0.338	87.48
15.000	0.629	1.697	0.842	2.539	0.161	94.04
20.000	0.776	2.095	0.565	2.659	0.041	98.49
25.000	0.889	2.401	0.298	2.699	0.001	99.95

CB 307

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-09-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - Brn Ramp D 9+18 Rt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.658
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.015
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.015
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	3.700 - 50 yr
SPREAD-Ft.--T	=	10.770 - 14' max
Average Velocity-V-fps	=	3.386
FLOW in Gutter-CFS--Q	=	3.150
% Flow in Gutter-CFS	=	85.143
Velocity of Flow in Gutter-fps	=	3.949
Depth at Curb Line-Inches--d	=	3.127

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	1.261
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	41.428
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.207	0.765	1.862	2.626	1.074	70.98
10.000	0.392	1.450	1.554	3.004	0.696	81.19
15.000	0.555	2.053	1.241	3.294	0.406	89.02
20.000	0.695	2.571	0.926	3.496	0.204	94.50
25.000	0.811	3.000	0.636	3.636	0.064	98.27

LB 314

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-09-2004

PROJECT NAME- RM
TRACS NO.-
HIGHWAY NAME-
DESIGNER - RSR
LOCATION - Bsn Ramp D 14+85 Lt
CHECKER - A/DV
PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.321
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.015
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.015
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.021
Gutter Depression-Inches--	=	0.630
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.700 - 10yr
SPREAD-Ft.--T	=	9.790 - 10' max
Average Velocity-V-fps	=	2.305
FLOW in Gutter-CFS--Q	=	0.967
% Flow in Gutter-CFS	=	56.867
Velocity of Flow in Gutter-fps	=	2.852
Depth at Curb Line-Inches--d	=	1.942

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	2.702
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	23.664
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.348	0.591	0.928	1.519	0.181	89.35
10.000	0.628	1.067	0.603	1.670	0.030	98.25
15.000	0.836	1.421	0.279	1.700	0.000	100.00
20.000	0.965	1.641	0.059	1.700	0.000	100.00
25.000	1.000	1.700	0.000	1.700	0.000	100.00

CB 314

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-09-2004

PROJECT NAME- RM	TRACS NO.-		
HIGHWAY NAME-	DESIGNER - RSR		
LOCATION - Brn Ramp D 14+85Lt	CHECKER - NDV	PAGE	

Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.321
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.015
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.015
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.021
Gutter Depression-Inches--	=	0.630
Manning's 'N	=	0.016
Flow-CFS--Q	=	2.600 - 50yr
SPREAD-Ft.--T	=	11.545 - 14' max
Average Velocity-V-fps	=	2.553
FLOW in Gutter-CFS--Q	=	1.297
% Flow in Gutter-CFS	=	49.869
Velocity of Flow in Gutter-fps	=	3.203
Depth at Curb Line-Inches--d	=	2.258

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	3.059
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	29.940
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.280	0.729	1.319	2.047	0.553	78.75
10.000	0.519	1.349	1.010	2.359	0.241	90.72
15.000	0.714	1.856	0.689	2.545	0.055	97.87
20.000	0.863	2.243	0.356	2.599	0.001	99.95
25.000	0.961	2.499	0.101	2.600	0.000	100.00

CB 316

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-09-2004

PROJECT NAME- Rm
HIGHWAY NAME-
LOCATION - Brn Ramp D 16+97 RT
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.481
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.800 - 10yr
SPREAD-Ft.--T	=	5.741 - 10' max
Average Velocity-V-fps	=	1.595
FLOW in Gutter-CFS--Q	=	0.794
% Flow in Gutter-CFS	=	99.258
Velocity of Flow in Gutter-fps	=	1.633
Depth at Curb Line-Inches--d	=	2.296

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	0.407
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	14.242
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.541	0.433	0.350	0.782	0.018	97.78
10.000	0.887	0.710	0.090	0.800	0.000	100.00
15.000	1.000	0.800	0.000	0.800	0.000	100.00
20.000	1.000	0.800	0.000	0.800	0.000	100.00
25.000	1.000	0.800	0.000	0.800	0.000	100.00

CB 316

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-09-2004

PROJECT NAME- RM
TRACS NO.-
HIGHWAY NAME-
DESIGNER - RSP
LOCATION - Brn Ramp D 16+97 Rt
CHECKER - NDV
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Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.481
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.400 - 50yr
SPREAD-Ft.--T	=	7.855 - 14' max
Average Velocity-V-fps	=	1.774
FLOW in Gutter-CFS--Q	=	1.310
% Flow in Gutter-CFS	=	93.536
Velocity of Flow in Gutter-fps	=	1.936
Depth at Curb Line-Inches--d	=	2.803

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	1.015
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	18.307
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.437	0.612	0.658	1.270	0.130	90.70 ←
10.000	0.759	1.062	0.325	1.387	0.013	99.08
15.000	0.954	1.336	0.064	1.400	0.000	100.00
20.000	1.000	1.400	0.000	1.400	0.000	100.00
25.000	1.000	1.400	0.000	1.400	0.000	100.00

CB 317

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

04-22-2005

PROJECT NAME- RM | TRACS NO.-
HIGHWAY NAME- | DESIGNER - RSR
LOCATION - Brn Ramp D 18+18.36 Rt | CHECKER - NDV | PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--IN SUMP

GUTTER FLOW HYDRAULICS

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998

GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Effective Perimeter--Ft.	=	7.350
Capture Ratio -- GRATE	=	0.500
Capture Ratio -- SLOTTED DRAIN	=	0.500
Local Gutter Depression-Inches	=	0.000
Flow-CFS--Q	=	0.800 - 10yr

LENGTH	Q(Slot. Dn)	Q(Grate)	d(inches)	SPREAD,Ft.
5.000	0.382	0.419	1.969	4.436 ← 10' max
10.000	0.546	0.255	1.573	3.542
15.000	0.631	0.169	1.322	2.978
20.000	0.683	0.119	1.150	2.591

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

04-22-2005

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - Brn Ramp D 18+18.36 Rt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
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SLOTTED DRAIN W/ GRATE--IN SUMP

GUTTER FLOW HYDRAULICS

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998

GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Effective Perimeter--Ft.	=	7.350
Capture Ratio -- GRATE	=	0.500
Capture Ratio -- SLOTTED DRAIN	=	0.500
Local Gutter Depression-Inches	=	0.000
Flow-CFS--Q	=	1.200 ~ 50 yr

LENGTH	Q(Slot. Dn)	Q(Grate)	d(inches)	SPREAD,Ft.
5.000	0.536	0.665	2.467	6.453 ← 10' max
10.000	0.774	0.427	1.985	4.471
15.000	0.903	0.296	1.680	3.783
20.000	0.983	0.217	1.467	3.304

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-11-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - Brn Ramp D 19+40 Rt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.482
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.600 - 10yr
SPREAD-Ft.--T	=	4.771 - 10' max
Average Velocity-V-fps	=	1.501
FLOW in Gutter-CFS--Q	=	0.600
% Flow in Gutter-CFS	=	99.985
Velocity of Flow in Gutter-fps	=	1.503
Depth at Curb Line-Inches--d	=	2.063

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	0.311
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	12.599
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.598	0.359	0.239	0.597	0.003	99.50
10.000	0.942	0.565	0.035	0.600	0.000	100.00
15.000	1.000	0.600	0.000	0.600	0.000	100.00
20.000	1.000	0.600	0.000	0.600	0.000	100.00
25.000	1.000	0.600	0.000	0.600	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-11-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - Brn Ramp D 19+40 Rt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.482
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.000 - 50yr
SPREAD-Ft.--T	=	6.543 - 10' max
Average Velocity-V-fps	=	1.666
FLOW in Gutter-CFS--Q	=	0.976
% Flow in Gutter-CFS	=	97.590
Velocity of Flow in Gutter-fps	=	1.747
Depth at Curb Line-Inches--d	=	2.488

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	0.731
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	15.718
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.498	0.498	0.453	0.951	0.049	95.13
10.000	0.838	0.838	0.162	1.000	0.000	99.97
15.000	0.996	0.996	0.004	1.000	0.000	100.00
20.000	1.000	1.000	0.000	1.000	0.000	100.00
25.000	1.000	1.000	0.000	1.000	0.000	100.00

CB 319

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-11-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - Ben Ramp D 20+31 Rt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.719
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.800 - 10yr
SPREAD-Ft.--T	=	8.062 < 10' max
Average Velocity-V-fps	=	2.190
FLOW in Gutter-CFS--Q	=	1.670
% Flow in Gutter-CFS	=	92.791
Velocity of Flow in Gutter-fps	=	2.403
Depth at Curb Line-Inches--d	=	2.853

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	0.718
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	23.001
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.357	0.642	0.904	1.546	0.254	85.91
10.000	0.642	1.155	0.565	1.720	0.080	95.56
15.000	0.851	1.531	0.266	1.797	0.003	99.83
20.000	0.974	1.754	0.046	1.800	0.000	100.00
25.000	1.000	1.800	0.000	1.800	0.000	100.00

CB 319

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

11-11-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - Brn Ramp D 20+31 Rt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.719
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	4.500
Gutter Slope-Ft./Ft.--Sw	=	0.037
Gutter Depression-Inches--	=	1.998
Manning's 'N	=	0.016
Flow-CFS--Q	=	2.700 - 50yr
SPREAD-Ft.--T	=	9.842 - 10' max
Average Velocity-V-fps	=	2.367
FLOW in Gutter-CFS--Q	=	2.319
% Flow in Gutter-CFS	=	85.873
Velocity of Flow in Gutter-fps	=	2.711
Depth at Curb Line-Inches--d	=	3.280

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	7.350
Depth at INLET Curb Line-Inches--d	=	0.141
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	27.824
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.300	0.810	1.300	2.110	0.590	78.16
10.000	0.551	1.489	0.936	2.425	0.275	89.82
15.000	0.752	2.030	0.581	2.612	0.088	96.73
20.000	0.898	2.425	0.272	2.697	0.003	99.87
25.000	0.984	2.656	0.044	2.700	0.000	100.00

APPENDIX D

CATCH BASIN DESIGN

University Drive Ramps A & B Catch Basin Calculations

CB 366

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

12-09-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - Uni Ramp A 12+48 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.386
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.010
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.010
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.021
Gutter Depression-Inches--	=	0.630
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.400 10yr
SPREAD-Ft.--T	=	11.373 - 8' max Checked Spread @ upstream end of slotted Drain Ok.
Average Velocity-V-fps	=	2.055
FLOW in Gutter-CFS--Q	=	0.754
% Flow in Gutter-CFS	=	53.865
Velocity of Flow in Gutter-fps	=	2.623
Depth at Curb Line-Inches--d	=	1.695

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	2.470
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	22.415
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.365	0.511	0.774	1.285	0.115	91.80
10.000	0.655	0.917	0.475	1.392	0.008	99.41
15.000	0.863	1.209	0.191	1.400	0.000	100.00
20.000	0.982	1.375	0.025	1.400	0.000	100.00
25.000	1.000	1.400	0.000	1.400	0.000	100.00

CB 366

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

12-09-2004

PROJECT NAME- RM　　　TRACS NO.-
HIGHWAY NAME-　　　DESIGNER - RSR
LOCATION - Uni Ramp A 12+48 Lt　　　CHECKER - NDV　　　PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.386
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.010
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.010
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.021
Gutter Depression-Inches--	=	0.630
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.900 - 50yr
SPREAD-Ft.--T	=	12.866 - 14' max
Average Velocity-V-fps	=	2.204
FLOW in Gutter-CFS--Q	=	0.922
% Flow in Gutter-CFS	=	48.546
Velocity of Flow in Gutter-fps	=	2.840
Depth at Curb Line-Inches--d	=	1.874

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	2.680
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	26.862
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.310	0.589	1.000	1.588	0.312	83.59
10.000	0.567	1.078	0.732	1.810	0.090	95.28
15.000	0.770	1.464	0.432	1.896	0.004	99.77
20.000	0.914	1.737	0.163	1.900	0.000	100.00
25.000	0.992	1.884	0.016	1.900	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

12-09-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - Uni Ramp A 14+40 Lt CHECKER - NDY PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.518
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.100 - 10yr
SPREAD-Ft.--T	=	6.815 - 8' max
Average Velocity-V-fps	=	1.799
FLOW in Gutter-CFS--Q	=	0.916
% Flow in Gutter-CFS	=	83.315
Velocity of Flow in Gutter-fps	=	2.156
Depth at Curb Line-Inches--d	=	3.046

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	3.659
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	9.348
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.748	0.823	0.277	1.100	0.000	100.00
10.000	1.000	1.100	0.000	1.100	0.000	100.00
15.000	1.000	1.100	0.000	1.100	0.000	100.00
20.000	1.000	1.100	0.000	1.100	0.000	100.00
25.000	1.000	1.100	0.000	1.100	0.000	100.00

CB 369

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

12-09-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - Uni Ramp A 14+90 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.518
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.500 - 50yr
SPREAD-Ft.--T	=	8.063 - 14' max
Average Velocity-V-fps	=	1.882
FLOW in Gutter-CFS--Q	=	1.139
% Flow in Gutter-CFS	=	75.960
Velocity of Flow in Gutter-fps	=	2.337
Depth at Curb Line-Inches--d	=	3.345

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	4.023
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	11.021
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.663	0.995	0.505	1.500	0.000	99.994
10.000	0.986	1.479	0.021	1.500	0.000	100.00
15.000	1.000	1.500	0.000	1.500	0.000	100.00
20.000	1.000	1.500	0.000	1.500	0.000	100.00
25.000	1.000	1.500	0.000	1.500	0.000	100.00

CIS 372

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

04-22-2005

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - Uni Ramp A 15+54.65 Lt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--IN SUMP

GUTTER FLOW HYDRAULICS

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Effective Perimeter--Ft.	=	7.354
Capture Ratio -- GRATE	=	0.500
Capture Ratio -- SLOTTED DRAIN	=	0.500
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	1.300 - 10 yr

LENGTH	Q(Slot. Dn)	Q(Grate)	d(inches)	SPREAD,Ft.
5.000	0.764	0.535	2.123	2.973 ← 8' max
10.000	1.045	0.297	1.426	1.774
15.000	1.218	0.082	1.050	1.307
20.000	1.238	0.062	0.711	0.884
25.000	1.250	0.050	0.484	0.601

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

04-22-2005

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - Uni Ramp A 15+54.65 Lt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--IN SUMP

GUTTER FLOW HYDRAULICS

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Effective Perimeter--Ft.	=	7.354
Capture Ratio -- GRATE	=	0.500
Capture Ratio -- SLOTTED DRAIN	=	0.500
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	1.800 - 50 yr

LENGTH	Q(Slot. Dn)	Q(Grate)	d(inches)	SPREAD,Ft.
5.000	0.984	0.814	2.700	5.375 ← 8' max
10.000	1.360	0.441	1.891	2.352
15.000	1.576	0.299	1.434	1.784
20.000	1.714	0.086	1.125	1.399
25.000	1.730	0.070	0.843	1.049

CB 373

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

12-09-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION -Dri Ramp A 16+69 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.516
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.800-10yr
SPREAD-Ft.--T	=	8.849-8 max Checked spread
Average Velocity-V-fps	=	1.936 @ upstream end of slotted drain ok.
FLOW in Gutter-CFS--Q	=	1.288
% Flow in Gutter-CFS	=	71.552
Velocity of Flow in Gutter-fps	=	2.445
Depth at Curb Line-Inches--d	=	3.534

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	4.243
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	12.190
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.613	1.104	0.693	1.797	0.003	99.85
10.000	0.955	1.718	0.082	1.800	0.000	100.00
15.000	1.000	1.800	0.000	1.800	0.000	100.00
20.000	1.000	1.800	0.000	1.800	0.000	100.00
25.000	1.000	1.800	0.000	1.800	0.000	100.00

CB 373

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

12-09-2004

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - Uni Ramp A 16+69 Lt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.516
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	2.500 50 yr
SPREAD-Ft.--T	=	10.352 - 14' max
Average Velocity-V-fps	=	2.052
FLOW in Gutter-CFS--Q	=	1.598
% Flow in Gutter-CFS	=	63.905
Velocity of Flow in Gutter-fps	=	2.654
Depth at Curb Line-Inches--d	=	3.894

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	4.650
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	14.715
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.526	1.316	1.127	2.443	0.057	97.71
10.000	0.871	2.178	0.322	2.500	0.000	100.00
15.000	1.000	2.500	0.000	2.500	0.000	100.00
20.000	1.000	2.500	0.000	2.500	0.000	100.00
25.000	1.000	2.500	0.000	2.500	0.000	100.00

CB 357

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

04-22-2005

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - Uni Ramp B 8+51 Rt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	3.191
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.050
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.050
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	3.800 -10 yr
SPREAD-Ft.--T	=	5.089 -8' max
Average Velocity-V-fps	=	5.423
FLOW in Gutter-CFS--Q	=	3.263
% Flow in Gutter-CFS	=	85.878
Velocity of Flow in Gutter-fps	=	6.122
Depth at Curb Line-Inches--d	=	3.564

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	4.154
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	27.022
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.308	1.171	2.502	3.673	0.127	96.65 ←
10.000	0.565	2.146	1.638	3.784	0.016	99.58
15.000	0.767	2.916	0.884	3.800	0.000	100.00
20.000	0.912	3.464	0.336	3.800	0.000	100.00
25.000	0.991	3.764	0.036	3.800	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

04-22-2005

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION -Uni Ramp B 8+51 Rt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	3.191
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.050
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.050
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	5.900 -50 yr
SPREAD-Ft.--T	=	6.101 - 8' max
Average Velocity-V-fps	=	5.998
FLOW in Gutter-CFS--Q	=	4.607
% Flow in Gutter-CFS	=	78.092
Velocity of Flow in Gutter-fps	=	6.987
Depth at Curb Line-Inches--d	=	4.170

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	4.826
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	33.293
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.254	1.498	3.815	5.313	0.587	90.05
10.000	0.474	2.798	2.879	5.677	0.223	96.22
15.000	0.660	3.892	1.965	5.858	0.042	99.28
20.000	0.808	4.770	1.130	5.900	0.000	100.00
25.000	0.918	5.417	0.483	5.900	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

04-22-2005

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION -Uni Ramp B 12+45
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RGR
CHECKER - NDV
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.487
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.050
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.050
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	2.800 - 10 yr
SPREAD-Ft.--T	=	5.254 - 8' max
Average Velocity-V-fps	=	3.767
FLOW in Gutter-CFS--Q	=	2.368
% Flow in Gutter-CFS	=	84.577
Velocity of Flow in Gutter-fps	=	4.277
Depth at Curb Line-Inches--d	=	3.663

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	4.265
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	18.971
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.423	1.186	1.569	2.755	0.045	98.39 ←
10.000	0.740	2.073	0.727	2.800	0.000	100.00
15.000	0.940	2.632	0.168	2.800	0.000	100.00
20.000	1.000	2.800	0.000	2.800	0.000	100.00
25.000	1.000	2.800	0.000	2.800	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

04-22-2005

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - Uni Ramp B 12+45 CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.487
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.050
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.050
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	4.300 - 50yr
SPREAD-Ft.--T	=	6.265 - 8' max
Average Velocity-V-fps	=	4.157
FLOW in Gutter-CFS--Q	=	3.306
% Flow in Gutter-CFS	=	76.890
Velocity of Flow in Gutter-fps	=	4.862
Depth at Curb Line-Inches--d	=	4.269

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	4.933
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	23.278
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.353	1.518	2.497	4.014	0.286	93.35
10.000	0.636	2.735	1.526	4.260	0.040	99.08
15.000	0.844	3.631	0.669	4.300	0.000	100.00
20.000	0.971	4.174	0.126	4.300	0.000	100.00
25.000	1.000	4.300	0.000	4.300	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

03-14-2005

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - Uni Ramp B 13+49 Rt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.781
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.024
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.024
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.900 - 10 yr
SPREAD-Ft.--T	=	4.877 - 8' max
Average Velocity-V-fps	=	2.144
FLOW in Gutter-CFS--Q	=	0.838
% Flow in Gutter-CFS	=	93.109
Velocity of Flow in Gutter-fps	=	2.381
Depth at Curb Line-Inches--d	=	2.694

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	3.187
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	9.501
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.739	0.665	0.235	0.900	0.000	100.00
10.000	1.000	0.900	0.000	0.900	0.000	100.00
15.000	1.000	0.900	0.000	0.900	0.000	100.00
20.000	1.000	0.900	0.000	0.900	0.000	100.00
25.000	1.000	0.900	0.000	0.900	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

03-14-2005

PROJECT NAME- RM　　TRACS NO.-
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LOCATION - Uni Ramp B 13+49 Rt　　CHECKER - NDV　　PAGE
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.781
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.024
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.024
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.500 - 50 yr
SPREAD-Ft.--T	=	6.551 - 6 max
Average Velocity-V-fps	=	2.310
FLOW in Gutter-CFS--Q	=	1.242
% Flow in Gutter-CFS	=	82.808
Velocity of Flow in Gutter-fps	=	2.745
Depth at Curb Line-Inches--d	=	3.177

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	3.795
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	12.098
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.617	0.926	0.574	1.500	0.000	100.00
10.000	0.957	1.436	0.064	1.500	0.000	100.00
15.000	1.000	1.500	0.000	1.500	0.000	100.00
20.000	1.000	1.500	0.000	1.500	0.000	100.00
25.000	1.000	1.500	0.000	1.500	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

04-25-2005

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - Uni Ramp 14127 Rt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
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SLOTTED DRAIN W/ GRATE--IN SUMP

GUTTER FLOW HYDRAULICS

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.004
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.004
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Effective Perimeter--Ft.	=	7.354
Capture Ratio -- GRATE	=	0.500
Capture Ratio -- SLOTTED DRAIN	=	0.500
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.300 - 10yr

LENGTH	Q(Slot. Dn)	Q(Grate)	d(inches)	SPREAD,Ft.
5.000	0.250	0.050	0.483	0.601 ← 8' max
10.000	0.273	0.027	-0.010	-0.012
15.000	0.281	0.019	-0.229	-0.284
20.000	0.286	0.014	-0.356	-0.443
25.000	0.288	0.012	-0.442	-0.550

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

04-25-2005

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - Uni Ramp 14+27 Rt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
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SLOTTED DRAIN W/ GRATE--IN SUMP

GUTTER FLOW HYDRAULICS

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.004
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.004
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.010

GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Effective Perimeter--Ft.	=	7.354
Capture Ratio -- GRATE	=	0.500
Capture Ratio -- SLOTTED DRAIN	=	0.500
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.400 - 50yr

LENGTH	Q(Slot. Dn)	Q(Grate)	d(inches)	SPREAD,Ft.
5.000	0.333	0.067	0.797	0.991 ← 8' max
10.000	0.364	0.036	0.200	0.248
15.000	0.375	0.025	-0.065	-0.081
20.000	0.381	0.019	-0.220	-0.274
25.000	0.385	0.015	-0.324	-0.403

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

04-25-2005

PROJECT NAME- RM TRACS NO.-
HIGHWAY NAME- DESIGNER - RSR
LOCATION - Uni Ramp B 17+00 Rt CHECKER - NDV PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.919
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.045
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.045
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.021
Gutter Depression-Inches--	=	0.630
Manning's 'N	=	0.016
Flow-CFS--Q	=	2.000 – 10 yr
SPREAD-Ft.--T	=	6.130
Average Velocity-V-fps	=	2.596
FLOW in Gutter-CFS--Q	=	1.405
% Flow in Gutter-CFS	=	70.258
Velocity of Flow in Gutter-fps	=	2.964
Depth at Curb Line-Inches--d	=	2.590

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	3.275
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	20.536
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.395	0.790	1.052	1.842	0.158	92.11
10.000	0.699	1.398	0.577	1.975	0.025	98.77
15.000	0.906	1.811	0.189	2.000	0.000	100.00
20.000	0.999	1.997	0.003	2.000	0.000	100.00
25.000	1.000	2.000	0.000	2.000	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

04-25-2005

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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.919
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.045
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.045
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.021
Gutter Depression-Inches--	=	0.630
Manning's 'N	=	0.016
Flow-CFS--Q	=	2.800 - 50 yr
SPREAD-Ft.--T	=	6.859
Average Velocity-V-fps	=	2.847
FLOW in Gutter-CFS--Q	=	1.831
% Flow in Gutter-CFS	=	65.402
Velocity of Flow in Gutter-fps	=	3.294
Depth at Curb Line-Inches--d	=	2.984

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	3.701
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	23.805
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.346	0.968	1.465	2.434	0.366	86.91
10.000	0.625	1.750	0.936	2.686	0.114	95.92
15.000	0.833	2.333	0.458	2.790	0.010	99.65 ←
20.000	0.963	2.697	0.103	2.800	0.000	100.00
25.000	1.000	2.800	0.000	2.800	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

12-13-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION -Uni Ramp B 20+98 Rt
Ver 3.40: December 1995

TRACS NO.-
DESIGNER - RSR
CHECKER - NDV
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.965
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.004
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.004
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.021
Gutter Depression-Inches--	=	0.630
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.900 - 10 yr
SPREAD-Ft.--T	=	16.537
Average Velocity-V-fps	=	1.350
FLOW in Gutter-CFS--Q	=	0.417
% Flow in Gutter-CFS	=	46.282
Velocity of Flow in Gutter-fps	=	1.863
Depth at Curb Line-Inches--d	=	1.388

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	2.203
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	17.152
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.462	0.416	0.463	0.879	0.021	97.63
10.000	0.793	0.714	0.186	0.900	0.000	100.00
15.000	0.976	0.879	0.021	0.900	0.000	100.00
20.000	1.000	0.900	0.000	0.900	0.000	100.00
25.000	1.000	0.900	0.000	0.900	0.000	100.00

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

12-13-2004

PROJECT NAME- RM
HIGHWAY NAME-
LOCATION - Uni Ramp B 20+98 Rt
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TRACS NO.-
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.965
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.004
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.004
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.021
Gutter Depression-Inches--	=	0.630
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.200 - 50yr
SPREAD-Ft.--T	=	18.687
Average Velocity-V-fps	=	1.433
FLOW in Gutter-CFS--Q	=	0.493
% Flow in Gutter-CFS	=	41.072
Velocity of Flow in Gutter-fps	=	1.990
Depth at Curb Line-Inches--d	=	1.504

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	7.354
Depth at INLET Curb Line-Inches--d	=	2.348
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	20.775
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.391	0.469	0.611	1.080	0.120	89.98
10.000	0.693	0.832	0.365	1.197	0.003	99.72
15.000	0.900	1.080	0.120	1.200	0.000	100.00
20.000	0.997	1.197	0.003	1.200	0.000	100.00
25.000	1.000	1.200	0.000	1.200	0.000	100.00

APPENDIX D

CATCH BASIN DESIGN

Median Inlet Calculations Summary

Red Mountain Freeway - Power Road to University Drive

Stanley Consultants INC

ADOT

Median Catch Basin Design ADOT Standard C-15.80
Parameters:
I (in/hr)= 5.86
Effective Perimeter (ft)= 7
Effective Area (ft^2)= 2.05

Inlet Station	CB ID	Area Unpaved (ac)	Area Paved (ac)	Weighted C	Q 50yr (cfs)	Q Each Inlet (cfs)	Depth Weir ft	Depth Orifice (ft)	Available Depth (ft)	Comments
202L Med Sta 1054+40 4' Lt	Exst	0.431	1.028	0.876	7.5	7.5	0.50	0.46	0.55	
202L Med Sta 1078+20 10' Rt	103	0.231	0.606	0.881	4.3	4.3	0.35	0.15	1.32	
202L Med Sta 1081+90 10' Rt	105	0.257	0.592	0.874	4.3	4.3	0.35	0.16	1.35	
202L Med Sta 1085+50 10' Rt	106	0.244	0.576	0.876	4.2	4.2	0.34	0.15	1.35	
202L Med Sta 1089+57 10' Rt	108	0.247	0.740	0.887	5.1	5.1	0.39	0.22	2.00	
202L Med Sta 1089+34 104' Rt	109	3.359	0.000	0.700	13.8	6.9	0.48	0.39	1.58	Double
202L Med Sta 1097+42.90 0' Rt	115	1.622	0.464	0.756	9.2	9.2	0.58	0.70	2.09	
202L Med Sta 1105+40 0' Rt	127	0.873	0.249	0.755	5.0	5.0	0.38	0.20	3.20	
McD Ramp D Sta 13+57.01 22.5' Rt	142	2.988	0.000	0.700	12.3	6.1	0.44	0.31	0.88	Double
202L Med Sta 1119+50 0' Rt	153	0.940	0.269	0.756	5.4	5.4	0.40	0.24	3.20	
202L Med Sta 1118+75 117' Rt	155	4.032	0.000	0.700	16.5	8.3	0.54	0.56	1.26	Double
202L Med Sta 1124+00 0' Rt	157	0.579	0.166	0.756	3.3	3.3	0.29	0.09	3.17	
202L Med Sta 1128+00 0' Rt	160	0.836	0.240	0.756	4.8	4.8	0.37	0.19	3.17	
202L Med Sta 1128+00 117' Rt	161	6.423	0.000	0.700	26.3	13.2	0.73	1.43	2.08	Double
202L Med Sta 1130+50 0' Rt	164	0.438	0.126	0.756	2.5	2.5	0.24	0.05	3.16	
202L Med Sta 1133+94 0' Rt	167	0.644	0.185	0.756	3.7	3.7	0.31	0.11	3.17	
202L Med Sta 1137+13 92' Rt	170	1.724	0.000	0.700	7.1	7.1	0.48	0.41	0.50	
202L Med Sta 1138+92 0' Rt	178	0.525	0.151	0.756	3.0	3.0	0.27	0.07	3.17	
Mck Ramp B Sta 10+90 41' Rt	180	4.333	0.342	0.718	19.7	19.7	0.96	3.19	7.58	
202L Med Sta 1143+00 0' Rt	184	0.514	0.148	0.756	2.9	2.9	0.27	0.07	1.74	
202L Med Sta 1147+00 0' Rt	186	0.429	0.124	0.756	2.4	2.4	0.24	0.05	1.74	
202L Med Sta 1150+34 0' Rt	190	0.255	0.073	0.756	1.5	1.5	0.17	0.02	1.73	
202L Med Sta 1154+42 215' Lt	193	0.386	0.000	0.700	1.6	1.6	0.18	0.02	7.02	
202L Med Sta 1153+70 200' Rt	195	0.436	0.000	0.700	1.8	1.8	0.19	0.03	1.06	
202L Med Sta 1156+00 0' Rt	196	0.356	0.102	0.756	2.0	2.0	0.21	0.03	3.20	
202L Med Sta 1161+75 0' Rt	202	0.482	0.138	0.756	2.7	2.7	0.26	0.06	3.20	
202L Med Sta 1168+27 0' Rt	210	0.838	0.239	0.755	4.8	4.8	0.37	0.19	3.20	
202L Med Sta 1178+60 0' Rt	228	1.328	0.379	0.756	7.6	7.6	0.51	0.47	3.20	
202L Med Sta 1182+00 0' Rt	232	0.951	0.272	0.756	5.4	5.4	0.41	0.24	3.20	
202L Med Sta 1182+00 117' Rt	234	6.293	0.000	0.700	25.8	12.9	0.72	1.37	2.16	Double
202L Med Sta 1186+00 0' Rt	239	1.028	0.588	0.294	2.8	2.8	0.26	0.06	1.74	
202L Med Sta 1190+00 117' Rt	243	1.777	0.000	0.700	7.3	3.6	0.31	0.11	1.08	Double
202L Med Sta 1202+00 0' Rt	253	1.028	0.588	0.791	7.5	7.5	0.50	0.46	3.20	
202L Med Sta 1206+00 0' Rt	257	1.028	0.588	0.791	7.5	7.5	0.50	0.46	3.20	
202L Med Sta 1206+00 117' Rt	259	6.928	0.000	0.700	28.4	14.2	0.77	1.66	1.73	Double
202L Med Sta 1210+00 0' Rt	264	1.028	0.588	0.791	7.5	7.5	0.50	0.46	3.20	

Red Mountain Freeway - Power Road to University Drive

Stanley Consultants INC.

ADOT

Median Catch Basin Design ADOT Standard C-15.80

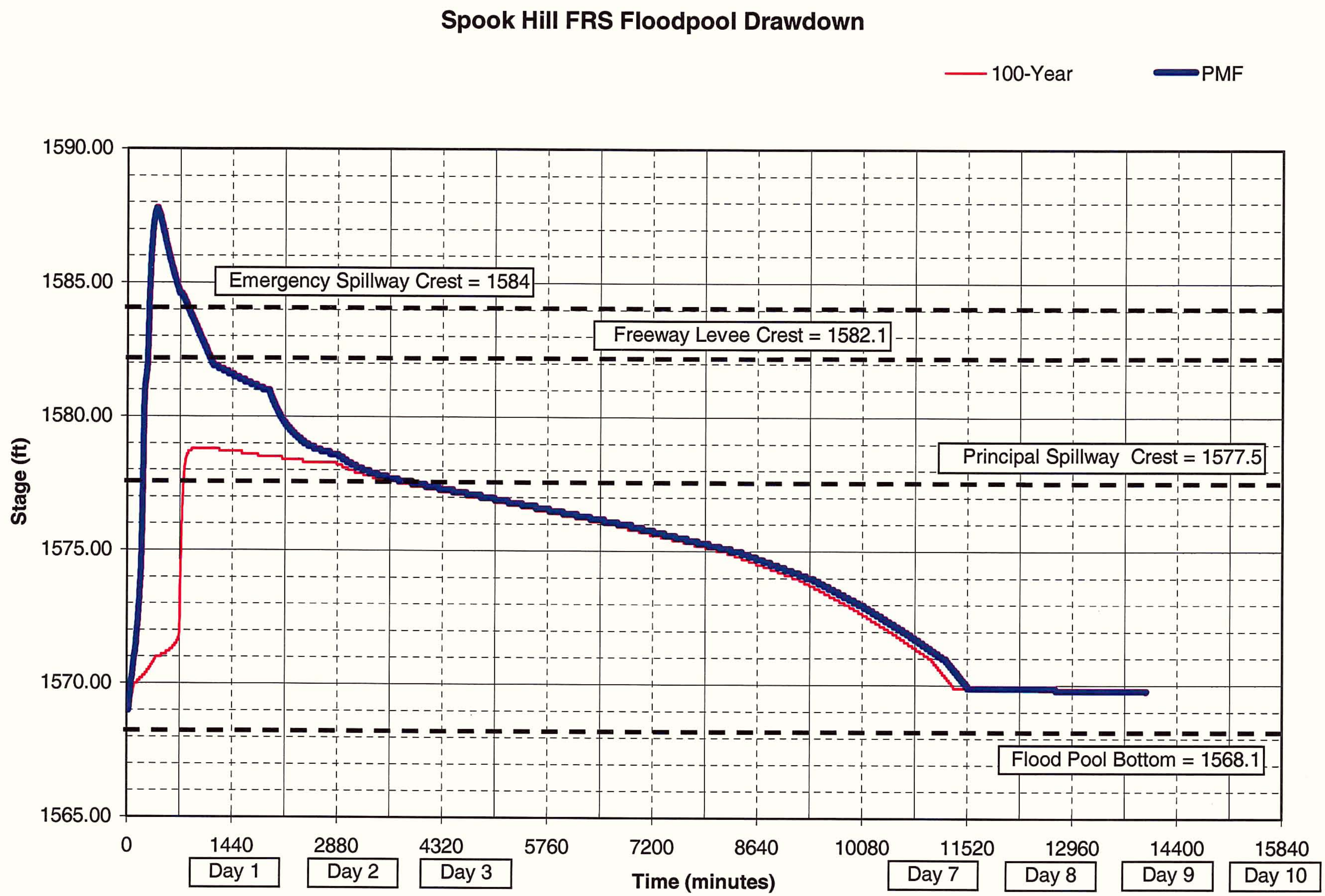
Parameters:

I (in/hr)= 5.86

Effective Perimeter (ft)= 7

Effective Area (ft^2)= 2.05

Inlet Station	CB ID	Area Unpaved (ac)	Area Paved (ac)	Weighted C	Q 50yr (cfs)	Q Each Inlet (cfs)	Depth Weir ft	Depth Orifice (ft)	Available Depth (ft)	Comments
202L Med Sta 1210+21 119.54' Rt	281	8.114	3.001	0.767	50.0	16.7	0.86	2.29	2.47	Triple
202L Med Sta 1231+89 219' Rt	284	0.744	0.000	0.700	3.1	3.1	0.28	0.08	0.31	
202L Med Sta 1222+50 0' Rt	289	0.579	0.166	0.756	3.3	3.3	0.29	0.09	1.74	
202L Med Sta 1229+21.21 0' Rt	298	1.057	0.303	0.756	6.0	6.0	0.43	0.30	3.20	
3rn Ramp A Sta 24+20 71' Rt	303	0.791	0.000	0.700	3.2	3.2	0.29	0.09	6.93	
202L Med Sta 1234+75 0' Rt	306	1.018	0.292	0.756	5.8	5.8	0.42	0.28	3.20	
202L Med Sta 1242+00 0' Rt	312	0.765	0.219	0.756	4.4	4.4	0.35	0.16	3.20	
202L Med Sta 1247+95 0' Rt	326	0.670	0.191	0.755	3.8	3.8	0.32	0.12	3.20	
3rn Ramp D Sta 20+31 37' Rt	327	9.670	0.000	0.700	39.7	13.2	0.74	1.44	1.65	Triple
202L Med Sta 1253+16 0' Rt	334	0.697	0.199	0.756	4.0	4.0	0.33	0.13	3.18	
202L Med Sta 1258+58 0' Rt	340	0.633	0.181	0.756	3.6	3.6	0.31	0.11	3.20	
202L Med Sta 1263+50 0' Rt	341	0.377	0.591	0.853	4.8	4.8	0.38	0.19	3.11	
202L Med Sta 1266+98 8' Lt	342	0.162	0.479	0.887	3.3	3.3	0.29	0.09	1.01	
202L Med Sta 1269+50 8' Lt	344	0.193	0.571	0.887	4.0	4.0	0.33	0.13	0.95	
202L Med Sta 1272+50 8' Lt	346	0.166	0.494	0.887	3.4	3.4	0.30	0.10	0.95	
202L Med Sta 1279+50 4' Rt	347	0.284	0.842	0.887	5.9	5.9	0.43	0.28	1.03	
202L Med Sta 1282+00 4' Rt	349	0.161	0.477	0.887	3.3	3.3	0.29	0.09	1.00	
202L Med Sta 1283+75 4' Rt	350	0.145	0.431	0.887	3.0	3.0	0.27	0.07	1.00	
202L Med Sta 1290+95 155' Rt	353	0.815	0.000	0.700	3.3	3.3	0.29	0.09	N/A	Orifice plate
CAP UP Sta 58+50 18.75' Rt	355	0.000	0.987	0.950	5.5	5.5	0.41	0.25	N/A	Orifice plate
202L Med Sta 1293+70 8' Rt	356	0.055	0.242	0.904	1.6	1.6	0.18	0.02	1.20	
202L Med Sta 1296+62 8' Rt	358	0.093	0.293	0.890	2.0	2.0	0.21	0.03	1.20	
202L Med Sta 1298+30 92' Rt	360	0.221	0.000	0.700	0.9	0.9	0.12	0.01	1.03	
Uni Ramp B Sta 14+27 29.37' Rt	364	0.662	0.000	0.700	2.7	2.7	0.26	0.06	0.44	
Uni Ramp A Sta 12+48 24' Lt	365	0.413	0.000	0.700	1.7	1.7	0.19	0.02	0.46	
202L Med Sta 1300+00 8' Rt	367	0.217	0.437	0.867	3.3	3.3	0.29	0.09	1.20	
202L Med Sta 1302+85 85.09' Lt	370	0.412	0.000	0.700	1.7	1.7	0.19	0.02	0.42	
202L Med Sta 1302+85 8' Rt	371	0.183	0.383	0.869	2.9	2.9	0.27	0.07	0.90	
202L Med Sta 1307+31 8' Lt	378	0.289	0.662	0.874	4.9	4.9	0.38	0.20	1.12	
202L Med Sta 1292+95 135' Lt	385	1.761	0.242	0.730	8.6	8.6	0.55	0.60	4.14	
202L Med Sta 1292+25 8' Rt	386	0.072	0.319	0.904	2.1	2.1	0.21	0.04	0.96	
'6th St Sta 13+84.69 226.8' Lt	384	0.000	0.641	0.950	3.6	3.6	0.31	0.10	0.31	
202L Med Sta 1173+00 117' Rt	395	6.054	0.653	0.724	28.5	9.5	0.59	0.74	1.00	Triple


Spook Hill FRS Floodpool Drawdown
100-Year
PMF
1590.00
1585.00
1580.00
1575.00
1570.00
1565.00
Stage (ft)
Emergency Spillway Crest = 1584
Freeway Levee Crest = 1582.1
Principal Spillway Crest = 1577.5
Flood Pool Bottom = 1568.1
0
1440
2880
4320
5760
7200
8640
10080
11520
12960
14400
15840
Day 1
Day 2
Day 3
Day 7
Day 8
Day 9
Day 10
Time (minutes)

PMF FRS Stage/Storage and Time/Stage Curves

Time (min)	Stage/Storage: Sum of Inflow: Hydrographs (cfs)	3.805 (cfs)	3.804 (cfs)	3.042 (cfs)	2.396 (cfs)	1.486 (cfs)	0.370 (cfs)	Inflow Volume Cum. (acre-ft)	Time/Stage: Basin Spillway Outflow (cfs)	Cumulative Reduce Volume (acre-ft)	New Stored Volume (acre-ft)	New Basin Stage (Sed ~1574.8) (ft)
									7211			**1587.80**
0	1	1	0	0	0	0	0	0	0	0	0	1569.00
60	90	7	13	6	6	56	2	3	17	0	3	1570.00
120	398	170	34	57	26	105	6	18	27	2	16	1571.30
122	419	189	34	58	26	106	6	19	27	2	17	1571.40
124	436	201	35	60	27	107	6	20	27	2	18	1571.40
126	448	208	35	62	28	109	6	21	27	2	19	1571.50
128	459	213	36	65	28	111	6	23	27	2	21	1571.50
130	469	216	37	67	29	114	6	24	27	2	22	1571.60
140	536	228	44	81	34	142	7	31	27	3	28	1571.90
160	841	265	74	117	53	325	7	49	32	3	46	1572.60
180	1317	360	131	176	86	557	7	79	39	4	74	1573.50
360	11960	2872	714	5796	1761	808	9	4268	6067	431	3837	1587.20
720	707	277	0	4	46	0	380	5778	2246	2769	3009	1584.70
1080	172	157	0	0	0	0	15	5982	1523	3621	2361	1582.60
1440	166	157	0	0	0	0	9	6066	1346	4327	1739	1581.60
1800	158	157	0	0	0	0	1	6145	1159	4954	1191	1581.10
2160	158	157	0	0	0	0	1	6223	584	5424	799	1579.80
2520	158	157	0	0	0	0	1	6302	298	5639	663	1578.90
2880	0	0	0	0	0	0	0	6380	217	5764	616	1578.60
3240	0	0	0	0	0	0	0	6380	113	5848	532	1578.00
3600	0	0	0	0	0	0	0	6380	67	5892	488	1577.70
3960	0	0	0	0	0	0	0	6380	56	5922	458	1577.50
4320	0	0	0	0	0	0	0	6380	55	5950	430	1577.30
4680	0	0	0	0	0	0	0	6380	54	5977	403	1577.10
5040	0	0	0	0	0	0	0	6380	54	6004	376	1577.00
5400	0	0	0	0	0	0	0	6380	50	6028	351	1576.80
5760	0	0	0	0	0	0	0	6380	50	6053	327	1576.60
6120	0	0	0	0	0	0	0	6380	50	6078	302	1576.40
6480	0	0	0	0	0	0	0	6380	50	6103	277	1576.20
6840	0	0	0	0	0	0	0	6380	50	6128	252	1576.00
7200	0	0	0	0	0	0	0	6380	47	6151	229	1575.80
7560	0	0	0	0	0	0	0	6380	47	6175	205	1575.50
7920	0	0	0	0	0	0	0	6380	47	6198	182	1575.30
8280	0	0	0	0	0	0	0	6380	47	6221	159	1575.00
8640	0	0	0	0	0	0	0	6380	42	6243	137	1574.70
9000	0	0	0	0	0	0	0	6380	42	6264	116	1574.40
9360	0	0	0	0	0	0	0	6380	42	6285	95	1574.00
9720	0	0	0	0	0	0	0	6380	39	6304	76	1573.50
10080	0	0	0	0	0	0	0	6380	39	6324	56	1573.00
10440	0	0	0	0	0	0	0	6380	32	6340	40	1572.40
10800	0	0	0	0	0	0	0	6380	27	6355	25	1571.70
11160	0	0	0	0	0	0	0	6380	27	6368	12	1571.10
11520	0	0	0	0	0	0	0	6380	17	6378	2	1570.00
11880	0	0	0	0	0	0	0	6380	0	6378	2	1569.90
13680	0	0	0	0	0	0	0	6380	0	6378	2	1569.80

*Most time increments not shown. Various calculations chosen across entire time range for demonstration purposes.

100-Year FRS Stage/Storage and Time/Stage Curves

	Stage/Storage										Time/Stage			
	Sum of Inflow									Inflow Volume Cum. (acre-ft)	Basin Spillway Outflow (cfs)	Cumulative Reduce Volume (acre-ft)	New Stored Volume (acre-ft)	New Basin Stage (ft)
Time (min)	Hydros (cfs)	3.805 (cfs)	3.804 (cfs)	2.731 (cfs)	2.396 (cfs)	1.818 (cfs)	1.145 (cfs)	0.447 (cfs)	0.370 (cfs)					
											271			**1578.80**
0	1	1	0	0	0	0	0	0	0	0	0	0	0	1569.00
240	32	8	3	4	4	1	2	7	3	8	17	3	5	1570.30
480	48	13	4	5	7	1	2	12	4	21	27	10	11	1571.10
540	54	14	5	6	7	1	3	14	4	25	27	12	13	1571.20
680	92	24	6	8	10	2	4	32	6	38	27	18	21	1571.50
682	94	24	6	8	11	2	4	33	6	39	27	18	21	1571.60
684	96	25	6	8	11	2	4	34	6	39	27	18	21	1571.60
686	96	25	6	8	11	2	4	34	6	39	27	18	21	1571.60
688	98	26	6	8	11	2	4	35	6	39	27	18	22	1571.60
690	100	26	6	9	11	2	4	36	6	40	27	18	22	1571.60
692	103	27	6	9	12	2	4	37	6	40	27	18	22	1571.60
694	104	27	6	9	12	2	4	38	6	40	27	18	22	1571.60
696	106	28	6	9	12	2	4	39	6	41	27	18	22	1571.60
698	107	28	6	9	12	2	4	40	6	41	27	18	23	1571.60
700	112	29	6	9	13	2	4	43	6	41	27	18	23	1571.60
720	1660	777	9	11	23	2	449	380	9	50	27	19	31	1572.00
1080	261	134	29	19	15	7	9	15	33	772	271	126	646	1578.80
1440	220	129	22	13	11	5	6	9	25	888	244	254	634	1578.70
1800	165	121	12	6	6	2	2	1	15	975	196	366	609	1578.50
2160	160	120	10	6	6	2	2	1	13	1056	196	463	592	1578.40
2520	155	120	9	5	5	2	2	1	11	1134	175	558	576	1578.30
2880	0	0	0	0	0	0	0	0	0	1208	155	644	564	1578.20
3240	0	0	0	0	0	0	0	0	0	1208	90	703	505	1577.90
3600	0	0	0	0	0	0	0	0	0	1208	56	738	470	1577.60
3960	0	0	0	0	0	0	0	0	0	1208	56	765	443	1577.40
4320	0	0	0	0	0	0	0	0	0	1208	55	793	415	1577.20
4680	0	0	0	0	0	0	0	0	0	1208	54	820	388	1577.00
5040	0	0	0	0	0	0	0	0	0	1208	50	846	363	1576.80
5400	0	0	0	0	0	0	0	0	0	1208	50	870	338	1576.70
5760	0	0	0	0	0	0	0	0	0	1208	50	895	313	1576.50
6120	0	0	0	0	0	0	0	0	0	1208	50	920	288	1576.30
6480	0	0	0	0	0	0	0	0	0	1208	50	945	263	1576.10
6840	0	0	0	0	0	0	0	0	0	1208	47	969	239	1575.90
7920	0	0	0	0	0	0	0	0	0	1208	47	1039	169	1575.20
8280	0	0	0	0	0	0	0	0	0	1208	42	1062	146	1574.90
8640	0	0	0	0	0	0	0	0	0	1208	42	1083	125	1574.50
9000	0	0	0	0	0	0	0	0	0	1208	42	1104	105	1574.20
9360	0	0	0	0	0	0	0	0	0	1208	39	1124	84	1573.70
9720	0	0	0	0	0	0	0	0	0	1208	39	1143	65	1573.20
10080	0	0	0	0	0	0	0	0	0	1208	32	1161	47	1572.70
10440	0	0	0	0	0	0	0	0	0	1208	32	1177	31	1572.00
10800	0	0	0	0	0	0	0	0	0	1208	27	1190	18	1571.40
11160	0	0	0	0	0	0	0	0	0	1208	17	1202	6	1570.50
11520	0	0	0	0	0	0	0	0	0	1208	0	1206	2	1569.90
11880	0	0	0	0	0	0	0	0	0	1208	0	1206	2	1569.90
13680	0	0	0	0	0	0	0	0	0	1208	0	1206	2	1569.80

*Most time increments not shown. Various calculations chosen across entire time range for demonstration purposes.

Summary of FRS and Freeway Detention Storage

Elevation (ft)	Total Stage-Volume for Combined FRS & Freeway (acre-ft)
1569	0
1570	2
1571	9
1572	29
1573	55
1574	92
1575	149
1576	247
1577	376
1578	519
1579	669
1580	822
1581	980
1582	2171
1582.1	***2202***
1582.2	***2232***
1583	2474
1584	2785
1585	3101
1586	3423
1587	3749
1588	4080
1589	4416
1590	4766

RED are interpolated values
BOLD is sediment level elevation
BOLD ITALICS is lateral weir elevation (and 0.1ft above)

Principal Outlet and Emergency Spillway Rating Curve

Elevation NAVD88 (ft)	2x2 (cfs)	ES & PS (cfs)	Total FRS Discharge (cfs)
1569	0.1	0	0.1
1570	17	0	17
1571	27	0	27
1572	32	0	32
1573	39	0	39
1574	42	0	42
1575	47	0	47
1576	50	0	50
1577.0	54	0	54
1577.5	56	0	56
1578.0	56	57	113
1578.5	56	161	217
1579.0	56	296	352
1579.5	56	456	512
1580.0	56	637	693
1580.5	56	838	894
1581.0	56	1056	1112
1581.5	56	1290	1346
1582.0	56	1425	1481
1582.5	56	1460	1516
1583.0	56	1495	1551
1583.5	56	1530	1586
1584.0	56	1574	1630
1584.5	56	2087	2143
1585.0	56	2600	2656
1585.5	56	3112	3168
1586.0	56	3624	3680
1586.5	56	4589	4645
1587.0	56	5553	5609
1587.5	56	6697	6753
1588.0	56	7842	7898
1588.5	56	9311	9367
1589.0	56	10777	10833
1589.5	56	12243	12299
1590.0	56	13710	13766
1590.5	56	15351	15407
1591.0	56	16993	17049

Notes:
1. Rating curve differs from HEC-RAS. HEC-RAS ignored discharge thru the 2x2 opening in the P.S. For purposes of drawdown it was necessary to account for the discharge.
2. Stage storage was also modified to remove 241 acre-ft of sediment so that the drawdown analysis could be performed (else the sed elevation would have prevented discharge below the P.S. crest).

Table
Rating Table for Rectangular Orifice

Project Description	
Worksheet	Principal Spillway Low Flow Outlet
Type	Rectangular Orifice
Solve For	Discharge

Input Data		
Centroid Elevation	1,569.10	ft
Tailwater Elevation	1,568.10	ft
Discharge Coefficient	0.60	
Opening Width	2.00	ft
Opening Height	2.00	ft

Attribute	Minimum	Maximum	Increment
Headwater Elevation (ft)	1,569.10	1,577.50	0.40

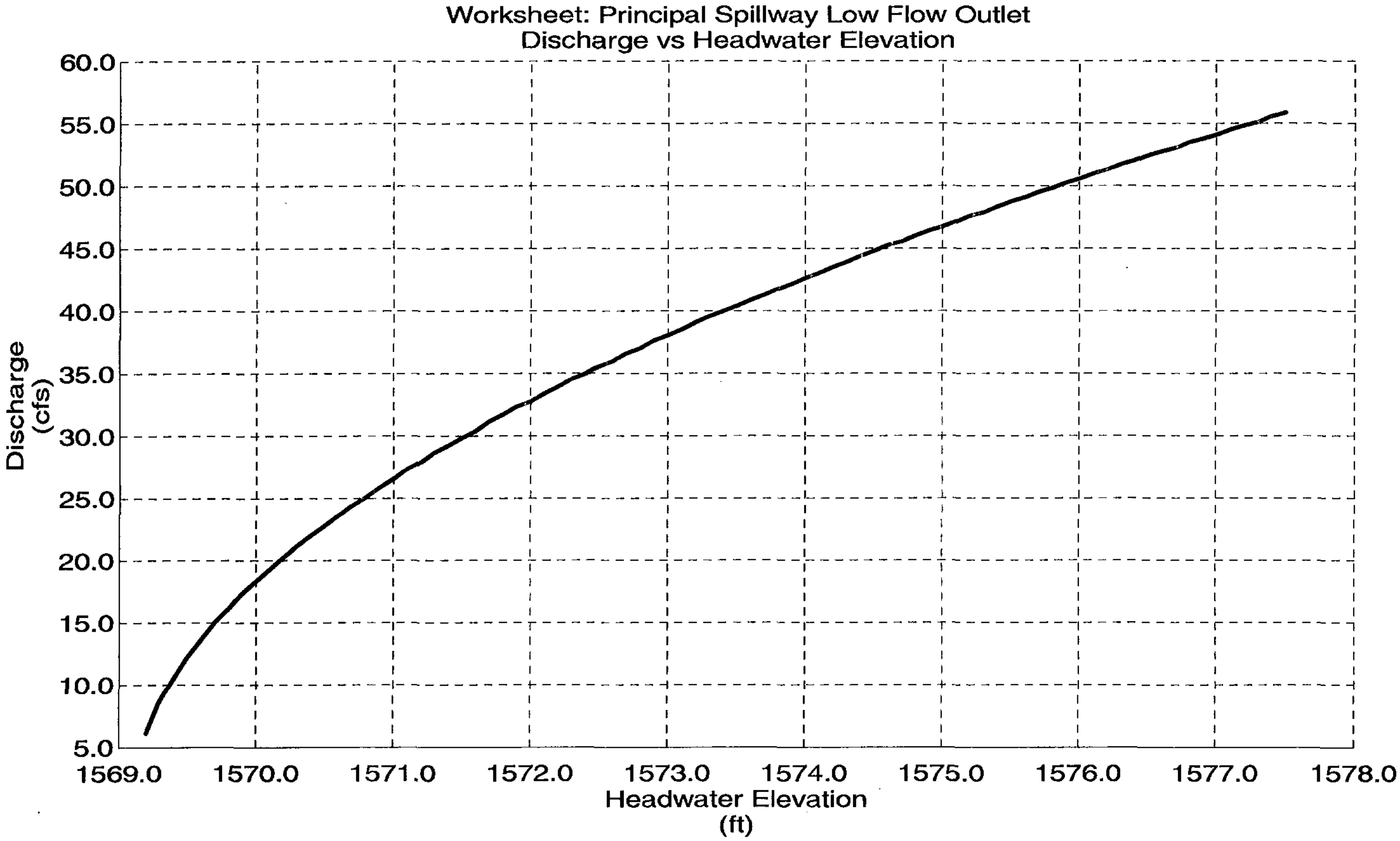
Headwater Elevation (ft)	Discharge (cfs)	Velocity (ft/s)
1,569.10	N/A	N/A
1,569.50	12.18	3.04
1,569.90	17.22	4.30
1,570.30	21.09	5.27
1,570.70	24.35	6.09
1,571.10	27.23	6.81
1,571.50	29.83	7.46
1,571.90	32.21	8.05
1,572.30	34.44	8.61
1,572.70	36.53	9.13
1,573.10	38.50	9.63
1,573.50	40.38	10.10
1,573.90	42.18	10.54
1,574.30	43.90	10.98
1,574.70	45.56	11.39
1,575.10	47.16	11.79
1,575.50	48.70	12.18
1,575.90	50.20	12.55
1,576.30	51.66	12.91
1,576.70	53.07	13.27
1,577.10	54.45	13.61
1,577.50	55.80	13.95

Curve
Plotted Curves for Rectangular Orifice

Project Description	
Worksheet	Principal Spillway Low Flow Outlet
Type	Rectangular Orifice
Solve For	Discharge

Input Data		
Centroid Elevation	1,569.10	ft
Tailwater Elevation	1,568.10	ft
Discharge Coefficient	0.60	
Opening Width	2.00	ft
Opening Height	2.00	ft

Attribute	Minimum	Maximum	Increment
Headwater Elevation (ft)	1,569.10	1,577.50	0.10



Red Mountain Freeway – Power Road to University Drive

Addendum to:

FINAL DRAINAGE REPORT – VOLUME 1 & VOLUME 2
RED MOUNTAIN FREEWAY (SR 202L)
Power Road to University Drive
ADOT Contract No. 04-15
SCI Project No. 17000
April 2005

Prepared for: **Arizona Department of Transportation**
205 S. 17th Ave.
Phoenix, AZ

Prepared by: **Stanley Consultants**
2929 E. Camelback Rd., Suite 130
Phoenix, AZ 85016

With Subconsultants:
J2 Engineering & Environmental Design

The following is a listing of revisions and replacements to the Final Drainage Report:

VOLUME 1

TABLE OF CONTENTS:

Remove TABLE OF CONTENTS sheets i through vii (sealed 4-26-05) and replace with new TABLE OF CONTENTS sheets i through vii (sealed 8-18-05)

Final Drainage Report Body:

Remove Final Drainage Report page 1 of 71 through page 71 of 71 and replace with new page 1 of 74 through page 74 of 74.

APPENDIX B
PRINCIPAL SPILLWAY OUTLET
Structural Calculations:

Remove all sheets in the Structural Calculations section of Appendix B and replace with new sheets.

Replace sheet *(on light blue colored paper)* titled:

APPENDIX C
HEC-RAS UNSTEADY FLOW ANALYSES

- 100-Year Analysis
- PMF Analysis
- Pump Station Storm Drain
- Emergency Spillway Overtopping Analysis
- Spook Hill FRS Drawdown Time

With new sheet *(on light blue colored paper)* titled:

APPENDIX C
HEC-RAS UNSTEADY FLOW ANALYSES

- **100-Year Analysis**
- **PMF Analysis**
- **Pump Station Storm Drain**
- **Emergency Spillway Overtopping Analysis**
- **Spook Hill FRS Drawdown Time**

Add the following sections to Appendix C:

APPENDIX C
HEC-RAS UNSTEADY FLOW ANALYSES
Emergency Spillway Overtopping Analysis
(10 sheets)

APPENDIX C
HEC-RAS UNSTEADY FLOW ANALYSES
Spook Hill FRS Drawdown Time
(4 sheets)

VOLUME 2

Replace sheet *(on light blue colored paper)* titled:

APPENDIX F

STORM DRAIN DESIGN

- North End Storm Drain
- Middle Storm Drain
- Pump Station Storm Drain
- South End Storm Drain
- South Trunk Storm Drain
- Pump Station Outlet Culvert Hydraulics
- ADOT/FCDMC Storm Water Quality Correspondence

With new sheet *(on light blue colored paper)* titled:

APPENDIX F

STORM DRAIN DESIGN

- **North End Storm Drain**
- **Middle Storm Drain**
- **Pump Station Storm Drain**
- **South End Storm Drain**
- **South Trunk Storm Drain**
- **McDowell Road Storm Drain**
- **McKellips Road Storm Drain**
- **Brown Road Storm Drain**
- **Pump Station Outlet Culvert Hydraulics**
- **ADOT/FCDMC Storm Water Quality Correspondence**

Add the following sections to Appendix F:

APPENDIX F
STORM DRAIN DESIGN
McDowell Road Storm Drain
(3 sheets)

APPENDIX F
STORM DRAIN DESIGN
McKellips Road Storm Drain
(4 sheets)

APPENDIX F
STORM DRAIN DESIGN
Brown Road Storm Drain
(4 sheets)

Replace all 3 sheets of:

APPENDIX H
McKELLIPS ROAD
PUMP STATION ANALYSIS
Pump Station & RCB Vault Stage-Storage

With new 3 sheets.

Replace all 4 sheets of:

APPENDIX H
McKELLIPS ROAD
PUMP STATION ANALYSIS
Freeway Drainage System 50-Year Hydrograph
(Pump Station Design Inflow Hydrograph)

With new 4 sheets.

Replace 1 sheet of:

APPENDIX H
McKELLIPS ROAD
PUMP STATION ANALYSIS
Summary of Pump Curves

With new sheet.

Replace all (23) sheets in:

APPENDIX H
McKELLIPS ROAD
PUMP STATION ANALYSIS
Main Storm Water Pump

With new 23 sheets.

Replace all (11) sheets in:

APPENDIX H
McKELLIPS ROAD
PUMP STATION ANALYSIS
Submersible Pump

With new 11 sheets.

Replace 1 sheet of:

APPENDIX I
LIFT STATION CALCULATIONS
Signal Butte Lift Station

With new sheet.

Replace all (44) sheets in:

APPENDIX I
LIFT STATION CALCULATIONS
CAP & FRS Equipment Underpass Lift Stations

With new 44 sheets.

Replace sheets of:

APPENDIX J
DRAINAGE DESIGN PLANS

With new 38 sheets

VOLUME 2

Section B (tabbed) (Prepared by J2 Engineering and Environmental Design

Replace all (14) sheets in:

Appendix A: Hydrologic Analysis
Rational Method Calculations
Drainage area map

With new 14 sheets.

Replace all (3) sheets in:

Appendix C: Collector Channel Hydraulic Calculations
Baffle Chute Spillway

With new 3 sheets

Replace all (24) sheets in:

Appendix C: Collector Channel Hydraulic Calculations
Impact Basin Energy Dissipaters

With new 24 sheets.

Joe Rumann - FCDX

From: Joy, Charles [JoyCharles@stanleygroup.com]
Sent: Tuesday, June 07, 2005 6:20 PM
To: Joe Rumann - FCDX

Joe,

Just quickly the info I have then I'll try to get J2's input.

For Las Sendas Channel:

From the 30% Report Technical Appendix B, the hydrology file DHEC24.DAT hard copy output has a peak discharge of 1507 cfs for the routing hydrograph R415 which is identified as the Las Sendas Channel.

The note next to the peak discharge says "to be conservative, assume 1600 cfs"....it's my handwriting. To be conservative a value of 1600 cfs was used as the design Q for the 30% HEC-RAS analysis of the Las Sendas Channel. J2 used the 1507 cfs from the model rather than the 1600 cfs.

For Table 1:

Most of the Qs from Table 4 of the 30% DMJM report seem to correspond directly to values in J2's Table 1 with the exception of a few areas were J2 revised the areas/hydrology. So the most inlet locations don't appear to have changed maybe a few added.

From 30%, few of the inlet values were derived from the HEC-1 model so most don't have a correlation to any HEC-1 subbasins (a few of the larger inflows do). Most were determined using the Rational Method but the actual method used was the most conservative of the HEC-1, Rational Method, Area Ratio or Culvert Ratio Methods (you'd really have to read the 30% report for an explanation of all methods).

Hope that helps some. I'll get with Chris and see if J2 can't provide any better information.

Charlie

Charles Joy, P.E., CFM
Sr. Water Resources Engineer

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Phoenix, AZ 85016
(602) 912-6500
(602) 912-6577 (fax)
JoyCharles@stanleygroup.com

MEMO

TO: Joe Rumann - FCDMC
2801 W Durango St
Phoenix, AZ

DATE: June 2, 2005

FROM: Charlie Joy

SUBJECT: H&H models for Red Mtn/Spook Hill FRS Submittal
SCI Proj. No. 17000

Joe,

Included are the HEC-1 and HEC-RAS that Stanley Consultants used in the analysis of the Spook Hill FRS. The models/files are listed below along with a brief summary of the use and origin. If I can be of any assistance, or if there are any questions, please give me a call at 602-912-6555.

Thanks,
Charlie

HYDROLOGY MODELS

CAP Overchute:

DDMSW files that were used to revise Subbasin 50 of the East Mesa ADMP. Subbasin 50 is the uppermost basin of a particular routing reach in the East Mesa ADMP hydrology. **(SCI)**

SCFINAL5.DAT – 50-yr existing conditions HEC-1 hydrology of Subbasin 50 revised to account for the proposed freeway extension. Used to size the ADOT northeast channel and a freeway culvert. **(SCI)**

SCFINAL1.DAT – 100-yr existing conditions HEC-1 hydrology of a portion of the East Mesa ADMP hydrology that includes Subbasin 50 with a revised Subbasin 50 to account for the proposed freeway extension. Used to size a new ADOT detention basin at the CAP Overchute. **(SCI)**

SC-UPDEX.DAT – An "updated" 100-yr existing conditions HEC-1 hydrology of the East Mesa ADMP hydrology. "Updated" does not refer to updating hydrologic parameters for the freeway (see report for discussion of need to revise existing conditions model for comparison to proposed conditions). Compared to SCFINAL1.DAT for pre vs. post project impact. **(SCI)**

Spook Hill Watershed

100YR.DAT & PMF.DAT – Spook Hill watershed models for the 100-yr and PMF events. Used to obtain input hydrographs for the HEC-RAS unsteady flow analysis of the Spook Hill FRS flood pool. **(DMJM+Harris)**

HYDRAULIC MODELS

Northeast Channel **NE_Channel.PRJ** – Steady flow HEC-RAS analysis of the ADOT northeast channel for the 50-yr design condition.

Spook Hill Floodway **Thomas.PRJ** – Steady flow HEC-RAS analysis of the Spook Hill Floodway from the Spook Hill FRS Principal Outlet Spillway to the beginning of the natural wash area upstream of Bush Highway. A number of plans of various scenarios are included including existing conditions for various discharges (design Q, bank full, overtopping, proposed, proposed plus offsite). Used at 30% for assessment of the Floodway capacity and to determine available excess capacity. **(DMJM+Harris)**

Spook Hill FRS 30% **RM06_30.PRJ** – The 30% HEC-RAS unsteady flow design models for the Spook Hill FRS as provided by DMJM+Harris. Includes existing conditions, proposed conditions with and without sediment for the 100-year and PMF events. **(DMJM+Harris)**

Spook Hill FRS Final **SHFRS100.PRJ** – Unsteady flow HEC-RAS models submitted as final design models for the 100-year and PMF events of the Spook Hill FRS. Included in the project are plans to assess higher n values than used for the project design. **(SCI)**

SOFTWARE EXECUTABLES

HEC-1 V4.1 **HEC1.EXE** – HEC-1 Version 4.1 is used for all HEC-1 analyses.

HEC-RAS V3.1.1 **RAS.EXE** – HEC-RAS Version 3.1.1 should be used for the Spook Hill FRS Unsteady Flow Analyses. It is not know if other provided models utilized Version 3.1.1 or Version 3.1.2. With the exception of the FRS unsteady flow analyses, either 3.1.1 or 3.1.2 should be suitable.

J2 FILES

The J2 files names appear to be self explanatory. There are HEC-RAS files for the Las Sendas Channel and the 86th Street Channel. The HEC-1 model appears to be the 100-yr existing conditions model from DMJM+Harris probably used for some of the offsite flows.