Volume 2 of 2: Final Design Calculations

Siphon Draw Wash
Drainage Improvements Project

Contract FCD 2007C012

January 2009

Prepared for: **Flood Control District of Maricopa County**
2801 West Durango Street
Phoenix, AZ 85009

City of Mesa
20 E. Main Street
Mesa, AZ 85201

Prepared by: **Stanley Consultants**
1661 East Camelback Rd, Suite 400
Phoenix, AZ 85016

Contributions by: **AMEC Earth & Environmental**
1405 W Auto Drive
Tempe, AZ 85284

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Registered Professional Engineer (Civil)
CERTIFICATE NO. 34586
CHARLES JOY
Date Signed 4/15/09
ARIZONA, U.S.A.
Expires 3/31/09

APPENDICES

Appendix A:	Design Hydrology
Appendix B:	Siphon Draw Detention Basin
Appendix C:	Meridian Channel
Appendix D:	Siphon Draw Wash
Appendix E:	Project Outfall / Elliot Road Storm Drain Inlet
Appendix F:	Structural Design and Calculations
Appendix G:	Miscellaneous
Appendix H:	Meridian Channel Phase 2

SUMMARY OF PROJECT DESIGN DOCUMENTS

Volume 1 of 2: Draft Design Report

Volume 2 of 2: Design Calculations

Specifications, Bid Quantities & Engineers Construction Cost Estimate

Final Design Plans

Registered Professional Engineer (Civil)
CERTIFICATE NO.
34586
CHARLES
JOY
Date Signed 1/12/09
ARIZONA, U.S.A.
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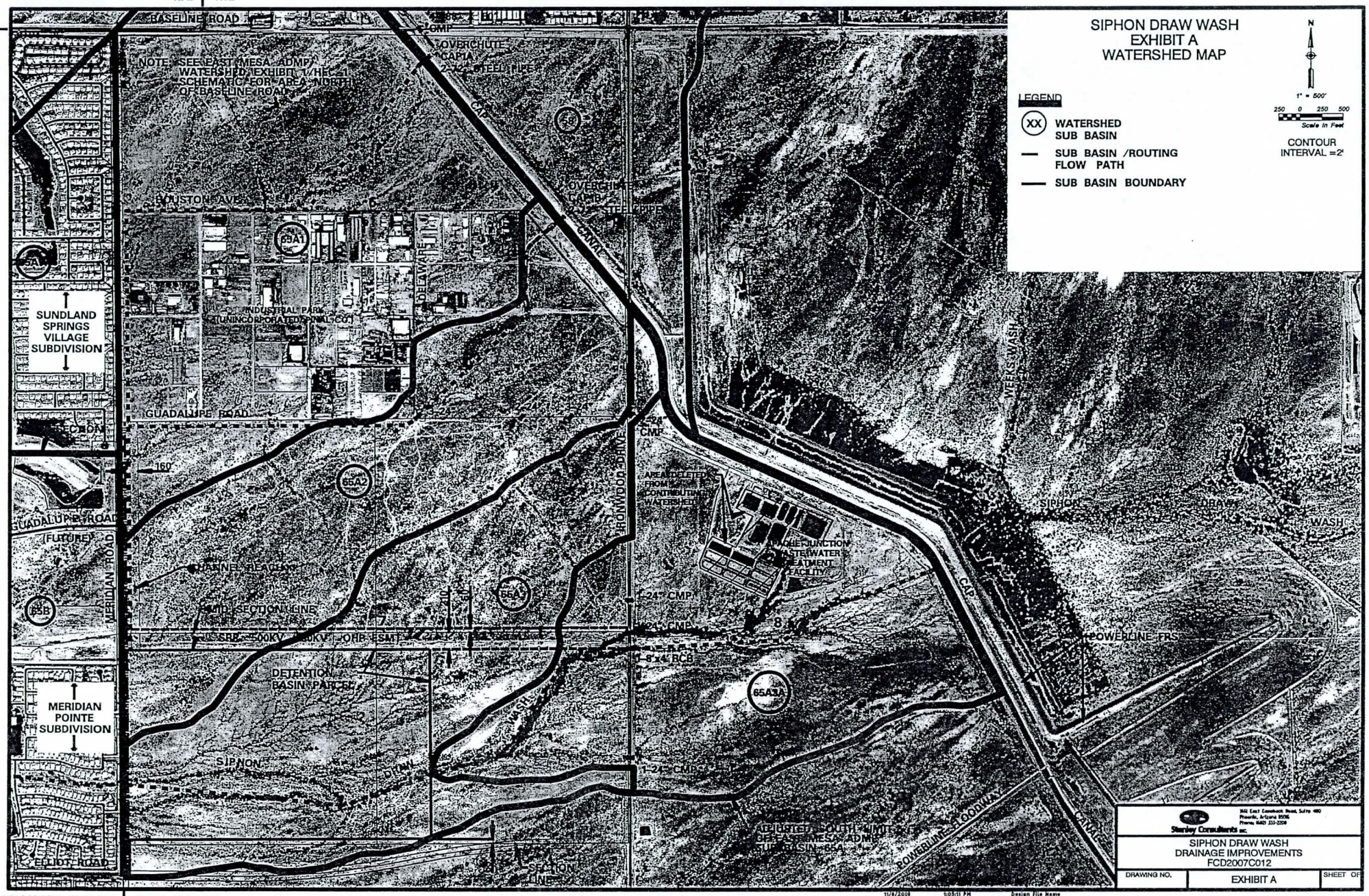
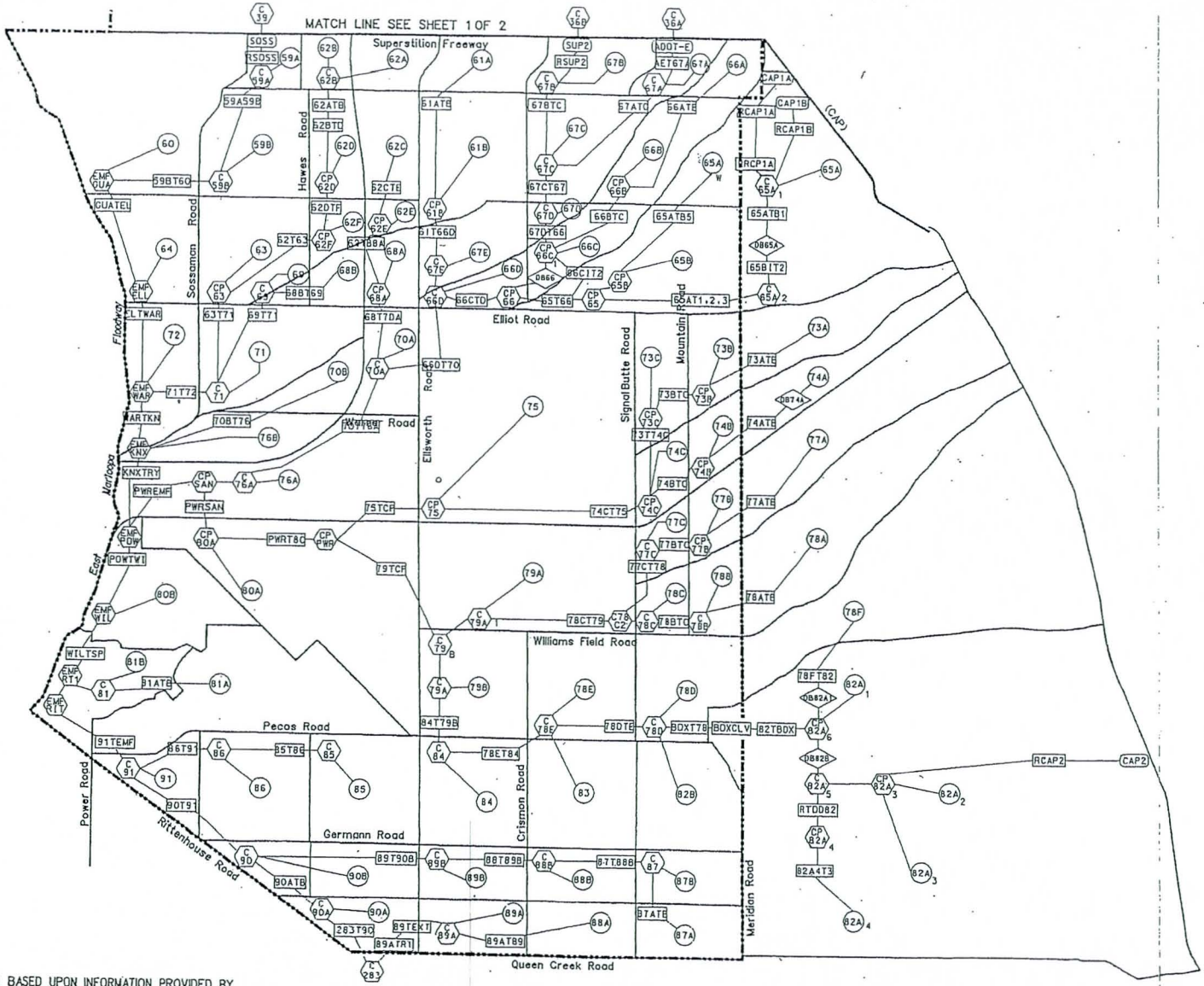
APPENDIX A

DESIGN HYDROLOGY

DESIGN HYDROLOGY

Exhibits


SIPHON DRAW WASH
EXHIBIT A
WATERSHED MAP
LEGEND
XX WATERSHED SUB BASIN
SUB BASIN /ROUTING FLOW PATH
SUB BASIN BOUNDARY
1" = 500'
250 0 250 500
Scale In Feet
CONTOUR INTERVAL =2'
N
R7E
R8E
T1N
T1S
BASELINE ROAD
NOTE: SEE EAST MESA ADMP WATERSHED EXHIBIT 1 HEC-1 SCHEMATIC FOR AREA NORTH OF BASELINE ROAD
OVERCHUTE CAP 1A
2-24" STEEL PIPE
OVERCHUTE CAP 1B
CAP
HOUSTON AVE
69A1
INDUSTRIAL PARK (UNINCORPORATED PINAL CO)
DELAWARE
SUNDLAND SPRINGS VILLAGE SUBDIVISION
GUADALUPE ROAD
160'
65A2
GUADALUPE ROAD (FUTURE)
MERIDIAN ROAD
CHANNEL REACH 1
65B
SECTION LINE
96A1
24" CMP
8'x4' RCB
DETENTION BASIN PARCEL
MERIDIAN POINTE SUBDIVISION
SIPHON
DRAW
WASH
IRONWOOD DRIVE
AREA DELETED FROM CONTRIBUTING WATERSHED
PINOLE JUNCTION WASTEWATER TREATMENT FACILITY
65A2A
WEEKS WASH
POWERLINE FRS
POWERLINE FLOODWAY
AREA LISTED SOUTH 1 MILE OF EAST MESA ADMP SUB BASIN 65A
ELLIOT ROAD
MARICOPA COUNTY
PINAL COUNTY
Stanley Consultants INC.
SIPHON DRAW WASH
DRAINAGE IMPROVEMENTS
FCD2007C012
DRAWING NO.
EXHIBIT A
SHEET OF



NOTE:
SCHEMATIC BASED UPON INFORMATION PROVIDED BY THE FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

East Mesa Area Drainage Master Plan

F.C.D. CONTRACT NO. 95-32

LEGEND

STUDY BOUNDARY	
SUB-BASIN BOUNDARY	
DIVERT HYDROGRAPH	DT TRW
SUB-BASIN RUNOFF	90A
ROUTE HYDROGRAPH	5ATTB
COMBINE HYDROGRAPH	CP 90A
OUTFLOW FROM STUDY AREA	CAP5
DETENTION BASIN	ADOT-W
CAP OVERCHUTE	5

N

2500 0' 2500 5000

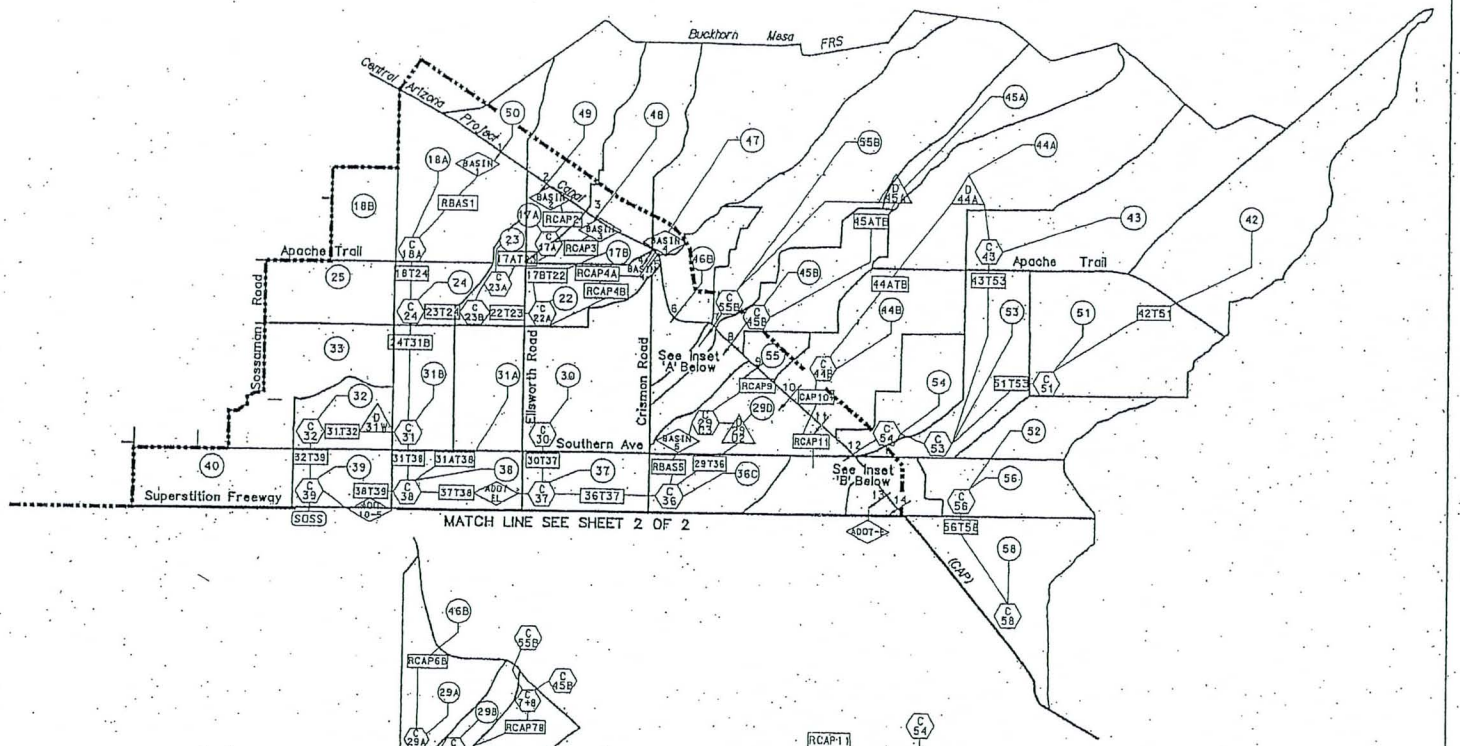
SCALE: 1" = 5000'

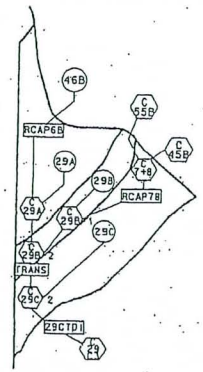
DIBBLE & ASSOCIATES CONSULTING ENGINEERS

Hoskin Engineering Consultants

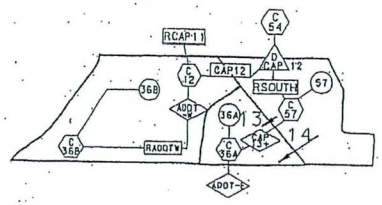
HEC-1 SCHEMATIC SOUTH OF SUPERSTITION FREEWAY

SHEET 2 OF 2





INSET 'A'



INSET 'B'

NOTE:
SCHEMATIC BASED UPON INFORMATION PROVIDED BY THE FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

East Mesa Area Drainage Master Plan

F.C.D. CONTRACT NO. 95-32

LEGEND

STUDY BOUNDARY	
SUB-BASIN BOUNDARY	
DIVERT HYDROGRAPH	DT TRW
SUB-BASIN RUNOFF	90A
ROUTE HYDROGRAPH	6AT7B
COMBINE HYDROGRAPH	CP 90A
OUTFLOW FROM STUDY AREA	CAP5
DETENTION BASIN	ADOT 9
CAP OVERCHUTE	5

N

2500 0' 2500 5000
SCALE: 1" = 5000'

DIBBLE & ASSOCIATES CONSULTING ENGINEERS

Hoskin Engineering Consultants

HEC-1 SCHEMATIC NORTH OF SUPERSTITION FREEWAY

SHEET 1 OF 2

DESIGN HYDROLOGY

HEC-1 Output
100-yr, 24-hr

```
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   29DEC08  TIME  14:11:11  *                    *          (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   Model:          Final Design Analysis
        3           ID                   Single Online Basin to Siphon Draw Wash & Meridian Channel
        4           ID
        5           ID   Project:        Siphon Draw Wash Drainage Improvements
        6           ID   Contract FCD:   2007C012
        7           ID   SCI Project No: 20539
        8           ID
        9           ID   Notes By:       Stanley Consultants, Inc. (SCI)
       10           ID   Revision Date:  November, 2008
       11           ID
       12           ID   Filename:       SDW_100.DAT
       13           ID   Storm Event:    100-Yr, 24 Hrs
       14           ID   Conditions:     Future Conditions
       15           ID
       16           ID   Comments:
       17           ID
       18           ID   This design model includes:
       19           ID
       20           ID      * A single basin online detention basin to both SDW
       21           ID        and the Meridian Channel.
       22           ID      * Reduces excavated volume of the basin by 5 acre-ft based upon
       23           ID        the assumption that 5 acre-ft of sediment would accumulate within
       24           ID        the basin before removal.
       25           ID      * Eliminates the Elliot Rd storm drain extension which previously was
       26           ID        to serve as the basin outlet.  Instead the basin was enlarged and now
       27           ID        discharges directly to SDW just upstream of Meridian Road and passes
       28           ID        through the Meridian Pointe subdivision.
       29           ID      * Utilizes the revised kn values per direction from FCDMC (utilizes
       30           ID        subbasins annotated with X as the first letter of the subbasin name
       31           ID      * Conservatively assumes some area within the drainage easement bypass
       32           ID        the basin completely and drains directly down SDW to the project
       33           ID        outfall. This area was not removed from the subbasin 65A3 area so
       34           ID        the area runoff is essentially accounted for twice.  This was assumed
       35           ID        because it is not know how runoff from the area south of the proposed
       36           ID        basin will be handled in the future.  The runoff (~30 cfs) has minimal
       37           ID        impact on the basin design.
       38           ID      * Routing of all flow from the CAP overchutes is assumed to be routed
       39           ID        to Meridian Channel north of the Guadalupe Road.  This is not the case
       40           ID        for existing conditions.  For existing conditions, some flow
       41           ID        (particularly from CAP2A) would likely not enter the proposed Meridian
       42           ID        Channel until just north of the proposed detention basin approximately
       43           ID      * Modifications to the diversion at DI65B where flow is split between
       44           ID        the Elliot Rd storm drain and the Elliot Detention Basin.  The changes
       45           ID        reflect the removal of an existing orifice plate over the 78" Elliot
       46           ID        Road storm drain inlet and the installation of a orifice plate (with
       47           ID        a 24" diameter orifice) over the 78" inlet to the Elliot Road Detention
       48           ID        basin.  While the upstream channel does not appear to have the capacity
       49           ID        to contain the magnitude of flow indicated for the 100-year event,
       50           ID        no changes will be made to the upstream channel as part of this
       51           ID        project.
       52           ID      * The low flow outlet data for the East Elliot Basin (RS65A SL record)
       53           ID        from the original hydrology model was changed to be reflect the actual
       54           ID        outlet design as shown in the design/as-built plans (an 18" low flow
       55           ID        outlet pipe at an invert elevation of 1426.5).  The SL record the low
1                                          HEC-1 INPUT                                          PAGE  2
```

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

  56          ID        flow outlet pipe area was therefore changed from 0.7854 sq ft
  57          ID        (for a 12" pipe) to 1.7663 sq ft (for an 18" pipe) and the outlet
  58          ID        pipe centerline elevation was changed from 1430.0 (which is
  59          ID        actually the inlet grate elevation) to 1427.3 (which is the pipe
  60          ID        invert of 1426.5 + 0.75 for the CL of an 18" pipe) per design plans.
  61          ID
  62          ID    Model Background:
  63          ID
  64          ID    This model was developed from the base hydrology model (SDW-BASE.DAT)
  65          ID    produced as part of this project and developed from previous hydrology
  66          ID    models from previous studies.  For this project SDW-BASE.DAT truncated
  67          ID    the previous hydrologic model S60EMAP1.DAT provided by the FCDMC.
  68          ID    Any hydrologic elements which do not contribute to runoff along
  69          ID    Elliot Road, just upstream of the SanTan Freeway Channel(routing
  70          ID    reach 66T70C) were removed
  71          ID
  72          ID    To run correctly, this model requires referencing a DSS file created
  73          ID    by the upstream hydrologic model ultimately developed from the
  74          ID    East Mesa ADMP.  For the 100-year, future conditions, this model is
  75          ID    N60EM.DAT (which produces N60EM.DSS).
  76          ID
  77          ID    This model is a revision of the pre-design submittal to address
  78          ID    comments from the FCDMC.  Revisions included:
  79          ID
  80          ID          *  changes to Kn values for the project subbasins
  81          ID          *  adjustment of land area assumed as water (proposed basin site)
  82          ID          *  the reclassification of the proposed basin site as open space
  83          ID             (as opposed to water as previously defined).
  84          ID
  85          ID    Subbasins with X are:  default Kn, with open space-undef. as land use.
  86          ID    Subbasins w/o a letter are:  ADMP Kn, with water as land use.
  87          ID
  88          ID    END SCI INTRODUCTORY COMMENTS
  89          ID
  90          ID    ************************************************************************
  91          ID
  92          ID    MODEL REVISED 9/12/02 TO CHANGE ZW CARD TO ZR CARD AT HYDROGRAPH CAP1B (CWR)
  93          ID
  94          ID    ID  Kirkham Michael:
  95          ID    Last Revised Date:  5/14/02
  96          ID    Filename:  WS4-SEM.DAT
  97          ID
  98          ID    Comments Dated 5/14/02 (CJ)
  99          ID
 100          ID    This model should be used for the Rittenhouse and Chandler Heights Basin
 101          ID    Design Project - 30% Design Analyses.
 102          ID
 103          ID    This model is one of several models that represent the EMF watershed.
 104          ID    This model covers the Southeast Mesa Area and should reference as a DSS
 105          ID    the watershed model for the Northeast Mesa Area (Filename WS2-NEM.DAT).
 106          ID
 107          ID    This model is necessary to determine the input hydrographs for the
 108          ID    Rittenhouse Basin Design HEC-RAS Unsteady State analysis.  To develop
 109          ID    the necessary input hydrographs the following models should be run in order.
 110          ID    Because the files utilize a TAPE21 file to export import hydrographs
1                                        HEC-1 INPUT                                        PAGE  3

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

 111          ID    between models, prior to running the FIRST model (WS1-NWM.DAT) any existing
 112          ID    TAPE21 file in the directory should be deleted.  The run procedure order is:
 113          ID
 114          ID         1)  WS1-NWM.DAT
 115          ID         2)  WS2-NEM.DAT
 116          ID         3)  WS3-QCSW.DAT
 117          ID         4)  WS4-SEM.DAT (referencing WS2-NEM.DSS for the DSS file)
 118          ID         5)  RT1-BASE.DAT
 119          ID
 120          ID    The necessary input hydrographs for the Rittenhouse Basin analysis
 121          ID    are determined in RT1-BASE.  In that output file, the hydrograph at
 122          ID    RWFLD1 should be exported and used as the input hydrograph at the
 123          ID    EMF Reach 4 Cross Section 17.082.  And the hydrograph at RITTEN should
 124          ID    be exported and used as the input hydrograph for the Rittenhouse Main
 125          ID    Channel at Cross Section 820.00
 126          ID
 127          ID
 128          ID    ************************************************************************
 129          ID    **** NOTE BY PRIMATECH ENGINEERS:                                   ****
 130          ID    **** DATE: 06/12/2001                                               ****
 131          ID    **** THE NEW FILE NAME IS: SEBTALT2.DAT                             ****
 132          ID    **** THE FILE WAS RENAMED AS <<RTBTALT2.DAT>> FOR THE EAST MARICOPA ****
 133          ID    **** FLOODWAY CAPACITY MITIGATION PROJECT, BY FLOOD CONTROL DISTRICT OF ****
 134          ID    **** MARICOPA COUNTY.                                               ****
 135          ID    **** THE FILE WAS RENAMED <<RTBTALT3.DAT>> AND UPDATED USING GREEN AND ****
 136          ID    **** AMPT FUTURE CONDITIONS FOR BASINS 258 TO 268.                  ****
 137          ID    ************************************************************************
 138          ID
 139          ID
 140          ID
 141          ID     THIS MODEL WAS ORIGINALLY MIDDOUT.DAT
 142          ID     IT HAS BEEN MODIFIED BY CPE (7/2000)
 143          ID     FOR ALTERNATIVE 2 FOR THE EAST MARICOPA FLOOWAY
 144          ID     CAPACITY MITIGATION AND MULTI-USE CORRIDOR STUDY
```

```
145          ID     TO ROUTE BOTH THE POWERLINE FLOOWAY
146          ID     AND THE SANTAN FREEWAY CHANNEL INTO THE RAY BASIN PRIOR THEIR OUTFALL
147          ID     INTO THE EMF
148          ID
149          ID    ***************************************************************
150          ID
151          ID          Model files changed by Collins/Pina Engineering
152          ID          to reflect multi-use design concepts (recreation
153          ID          and environment) proposed throughout the entire
154          ID          EMF Corridor.    July 2000
155          ID
156          ID
157          ID     VERSION 8.06  CPE 7/31/00
158          ID
159          ID  ***********************************************************************
160          ID
161          ID
162          ID  ***********************************************************************
163          ID   FILENAME: MIDDOUT.DAT
164          ID
165          ID   ALL CIP INFRASTRUCTURE IS IN PLACE, FUTURE CONDITIONS LANDUSE IS IN PLACE
1                                        HEC-1 INPUT                                          PAGE  4

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

166          ID   FLOW IS ROUTED UP ELLSWORTH ROAD IN A EARTH LINED CHANNEL
167          ID
168          ID  ***********************************************************************
169          ID   PRODUCED BY DIBBLE AND ASSOCIATES AND HOSKIN ENGINEERING CONSULTANTS.
170          ID   File Name: Final8.Dat
171          ID   Revised - Jan. 2000 by SZ (Wood/Patel) From Final7.dat - new Z-V & Sideweir
172          ID   Revised - Jan. 2000 by SZ (Wood/Patel) from Final6.dat - 60% review comments
173          ID   Revised - Dec. 1999 by SZ (Wood/Patel) from Final5.dat
174          ID   Revised - Dec. 1999 by SZ (Wood/Patel) from Final4.dat
175          ID   Revised - Nov. 1999 by SZ (Wood/Patel) from Final3.dat
176          ID   Revised - June 1999 by SZ (Wood/Patel) for Final Model from Opt1.dat.
177          ID   Revised - May 1999 by SZ (Wood/Patel) for Option 1, Based on Model SDIB.DAT
178          ID   REVISED - MAY, 1999 BY VAS TO INCORPORATE INCREASE OF SUBBASIN RETENTION AND
179          ID             REVISIONS TO THE REGIONAL DETENTION BASIN STORAGE
180          ID   REVISED - FEB, 1999 BY VALERIE SWICK, FCD OF MARICOPA COUNTY
181          ID   REVISED - MAY, 1998 BY D&A
182          ID
183          ID   REVISED BY VALERIE SWICK, FEB. 26, 1998
184          ID
185          ID   FLOWS FROM DETENTION BASIN LOCATED AT NE CORNER OF ELLIOT AND ELLSWORTH ROADS
186          ID   IS ROUTED TO THE SOUTHWEST BY SIPHON DRAW TO SUBBASIN 70A. FROM THERE THEY
187          ID   WILL BE ROUTED BY A CHANNEL TO THE EMF. FLOWS FROM SUBBASINS ADJACENT TO
188          ID   SANTAN FREEWAY ALIGNMENT WILL BE ROUTED SOUTH TO SUBBASIN 70A WHERE THEY WILL
189          ID   BE COMBINED WITH FLOW IN SIPHON DRAW.
190          ID
191          ID   EAST MESA AREA DRAINAGE MASTER PLAN
192          ID   AREA SOUTH OF SUPERSTITION (U.S. HWY 60)
193          ID   AUGUST 1997
194          ID   SOUTHEAST MESA HIGH RESOLUTION MODEL
195          ID
196          ID   ***********FUTURE CONDITION MODEL OF THE WATERSHED************************
197          ID
198          ID  ************ATTENTION*****************************************************
199          ID    SUBBASINS 75, 79A, 79B, 78E,  LANDUSES WERE NOT
200          ID    CHANGED BECAUSE IT WAS FELT THAT THEIR FUTURE CONDITIONS LANDUSES WOULD BE
201          ID    SIMILAR TO THE EXISTING CONDITIONS LANDUSES.
202          ID    RETENTION VOLUMES WILL ALSO NOT BE UTILIZED FOR SUBBASINS 75, 79A, 79B, 78E
203          ID    SOME QUEEN CREEK SUBBASINS WILL ALSO NOT HAVE RETENTION VOLUMES, EITHER
204          ID    BECAUSE THEY LIE IN PINAL COUNTY AND WE DONT KNOW PINAL COUNTIES PLANS OR
205          ID    THEY LIE IN THE SANTAN MOUNTAINS AND WON'T GET DEVELOPED
206          ID    WILLIAMS GATEWAY AIRPORT (SUBBASINS 80A, 80B, 81A, AND 81B) ARE MODELED AS
207          ID    FUTURE CONDITIONS AND HAVE RETENTION VOLUMES FOR THE 100YR 2HR STORM
208          ID  ***********************************************************************
209          ID   FILENAME:  SDIBB.DAT
210          ID
211          ID   THIS MODEL REPRESENTS THE FUTURE CONDITION OF THE WATERSHED.
212          ID   TOTAL DRAINAGE AREA IS APPROXIMATELY 213 SQ. MI.
213          ID   THIS MODEL USES A Kn VALUE OF 0.09 FOR DESERT LAND USE DUE TO SHEET FLOW
214          ID   CONDITIONS.
215          ID
216          ID   100-YEAR 24-HOUR FREQUENCY
217          ID   AREAL REDUCTIONS FROM FCD HYDROLOGY MANUAL
218          ID   THIS MODEL INCLUDES INFLOW FROM NORTH OF THE SUPERSTITION FREEWAY
219          ID   AND EAST OF THE CAP
220          ID
1                                        HEC-1 INPUT                                          PAGE  5

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

221          ID   DATA FROM THE QUEEN CREEK ADMS HAS BEEN ADDED TO CALCULATE FLOWS INTO THE
222          ID   EMF.   MUSKINGUM ROUTING NSTEPS WERE ADJUSTED TO BE WITHIN THE SUGGESTED
223          ID   RANGE.
224          ID
225          ID   METHODOLOGY
226          ID   THE US CORPS OF ENGINEERS FLOOD HYDROLOGY MODEL HEC-1 DATED SEP1990 VER 4.0
227          ID   SCS TYPE II RAINFALL DISTRIBUTION
228          ID   S-GRAPH HYDROGRAPH
229          ID   GREEN AND AMPT INFILTRATION EQUATION USED FOR CALCULATING LOSSES
230          ID   NORMAL DEPTH STORAGE CHANNEL ROUTING
231          ID   APPROXIMATE DIRECTION, LOCATION, AND LENGTH OF THE WASHES HAVE BEEN
```

```
232          ID   EVALUATED BASED ON FIELD INVESTIGATION, USGS MAPS, LANDIS AERIAL SURVEYS
233          ID   DATED 1994
234          ID   THE NOAA TECHNICAL MEMORANDUM NOAA ATLAS 2 DEPTH AREA RATIOS
235          ID
236          ID   ORIGINAL STUDY PERFORMED BY LISA C. YOUNG AND AFSHIN AHOURAIYAN, UPDATED BY
237          ID   DAVID DEGERNESS (OCT-DEC, 1996). REVIEWED BY VALERIE A. SWICK
238          ID   AND AMIR MOTAMEDI OF THE FLOOD CONTROL DISTRICT
239          ID   HYDROLOGY BRANCH ENGINEERING DIVISION, FLOOD CONTROL
240          ID   DISTRICT OF MARICOPA COUNTY, DECEMBER - JULY 1995.
241          ID
242          ID   ASSUMED VELOCITY OF 1 FT/SEC FOR SHEET FLOW, 2-3 FT/SEC FOR WASH/NATURAL
243          ID   CHANNEL, 3 FT/SEC FOR ROAD AND GRASS CHANNEL, 10FT/SEC FOR CONCRETE CHANNEL
244          ID
245          ID   VELOCITIES FOR ADMP IMPROVEMENT CHANNELS FROM DIBBLE AND ASSOCIATES
246          ID   SUGGESTED ALTERNATIVES (JULY 1, 1997)
247          ID
248          ID   ***********************************************************************
249          ID   **** THE FOLLOWING NOTE WAS ADDED BY PRIMATECH ENGINEERS ON 06-12-2001 ****
250          ID   ***********************************************************************
251          ID   NOTE: MUST USE NEBUILD.DSS AS THE DSS FILE TO IMPORT FLOWS ACROSS THE
252          ID         SUPERSTITION FREEWAY.
253          ID   ***********************************************************************
254          ID
255          ID
256          ID   NOTE: MUST USE NDIBF.DSS AS THE DSS FILE TO IMPORT FLOWS ACROSS THE
257          ID         SUPERSTITION FREEWAY.
258          ID
259          ID   DDM MCUHP2 SOUTH EAST MESA ADMP - SOUTH OF SUPERSTITION FREEWAY, FUTURE CONDI
             *DIAGRAM
260          IT       5  1APR97    0000    1000
261          IO       5
262          IN      15
263          JD    3.60    0.01
264          PC    .000    .002    .005    .008    .011    .014    .017    .020    .023    .026
265          PC    .029    .032    .035    .038    .041    .044    .048    .052    .056    .060
266          PC    .064    .068    .072    .076    .080    .085    .090    .095    .100    .105
267          PC    .110    .115    .120    .126    .133    .140    .147    .155    .163    .172
268          PC    .181    .191    .203    .218    .236    .257    .283    .387    .663    .707
269          PC    .735    .758    .776    .791    .804    .815    .825    .834    .842    .849
270          PC    .856    .863    .869    .875    .881    .887    .893    .898    .903    .908
271          PC    .913    .918    .922    .926    .930    .934    .938    .942    .946    .950
272          PC    .953    .956    .959    .962    .965    .968    .971    .974    .977    .980
273          PC    .983    .986    .989    .992    .995    .998   1.000
             *
1                                          HEC-1 INPUT                                          PAGE  6

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

274          JD    3.58     1.0
275          JD    3.49     5.0
276          JD    3.38    10.0
277          JD    3.24    30.0
278          JD    3.10    60.0
279          JD    3.05    90.0
280          JD    3.00   120.0
281          JD    2.97   150.0
             *

282          KK   X65A1   BASIN
283          KM    THE FOLLOWING PARAMETERS WERE PROVIDED FOR THIS BASIN
284          KM    L=      1.9  Lca=       1.4   S=   31.5  Kn= .040  LAG=  43.9
285          KM    PHOENIX VALLEY S-GRAPH WAS USED FOR THIS BASIN
286          BA   0.971
287          LG    0.20    0.25    5.00    0.35      50
288          UI      74      75     257     342     418     482     578     782     940     738
289          UI     619     516     429     363     253     151     127     104      74      55
290          UI      23      23      23      22      23      23       0       0       0       0
291          UI       0       0       0       0       0       0       0       0       0       0
292          UI       0       0       0       0       0       0       0       0       0       0
             *

293          KK   R65A1
294          KM   Retain first flush volume (equal to 80% of first ½" of runoff)
295          KM   from MDR areas only.
296          KM   First flush retention is not included for industrial areas at this time.
297          DT  FF65A1     9.9
298          DI       0   10000
299          DQ       0   10000
             *

300          KK   CAP1A
301          KM   INFLOW FROM EAST OF THE CAP ASSOCIATED WITH TWO 72" PIPE OVERCHUTES AT
302          KM   STATION 131+90 SALT-GILA AQUEDUCT REACH 2
303          KM   Overchute consists of two 72" pipes but level pool function
304          KM   at the CAP is disregarded for this location per the upper ADMP
305          KM   hydrology model.
306          KM   Basin area below represents half of the drainage area above CAP (1.93
307          BA   0.965
308          ZR  =QI A=CAP1A B=OVERCHUTE C=FLOW E=5MIN F=100YEAR
             *

309          KK  RCAP1A
310          KM   Route flow from CAP overchute (CAP1A) to confluence with CAP1B overchute
311          KM   at top of proposed Meridian Channel (~at Guadalupe Road).
312          KM   Hypothetical future condition earth channel.
```

```
 313          RS       4    FLOW      -1
 314          RC    .035    .035    .035    7250    .007
 315          RX       0       4       8      24      44      60      64      68
 316          RY     100      99      98      94      94      98      99     100
              *
1                                          HEC-1 INPUT                                                PAGE  7

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


 317          KK  CCAP1A
 318          KM   Combine routed (RCAP1A) and local hydrographs (65A1).
 319          HC       2   1.936
              *

 320          KK   X65A2   BASIN
 321          KM    THE FOLLOWING PARAMETERS WERE PROVIDED FOR THIS BASIN
 322          KM    L=      1.5  Lca=       .9   S=   42.8  Kn= .048  LAG=  37.5
 323          KM    PHOENIX VALLEY S-GRAPH WAS USED FOR THIS BASIN
 324          BA   0.544
 325          LG    0.24    0.25    4.60    0.40      42
 326          UI      48      80     193     252     308     378     527     590     439     367
 327          UI     296     234     161      88      79      50      41      16      15      15
 328          UI      15      15       0       0       0       0       0       0       0       0
 329          UI       0       0       0       0       0       0       0       0       0       0
 330          UI       0       0       0       0       0       0       0       0       0       0
              *

 331          KK   R65A2
 332          KM   Retain first flush volume (equal to 80% of first ½" of runoff)
 333          KM   from MDR areas only.
 334          DT  FF65A2     9.1
 335          DI       0   10000
 336          DQ       0   10000
              *

 337          KK   CAP1B
 338          KM   INFLOW FROM EAST OF THE CAP THROUGH 2 - 72" PIPE OVERCHUTES
 339          KM   STATION 158+00 SALT-GILA AQUEDUCT REACH 2
 340          KM   Overchute consists of two 72" pipes but level pool function
 341          KM   at the CAP is disregarded for this location per the upper ADMP
 342          KM   hydrology model.
 343          KM   Basin area below represents half of the drainage area above CAP (1.93)
 344          BA   0.965
 345          ZR  =QI  A=CAP1B  B=OVERCHUTE  C=FLOW  E=5MIN F=100YEAR
              *

 346          KK  RCAP1B
 347          KM   Route flow from CAP overchute (CAP1A) to confluence with CAP1B overchute
 348          KM   at top of proposed Meridian Channel (~at Guadalupe Road).
 349          KM   Hypothetical future condition earth channel.
 350          RS       4    FLOW      -1
 351          RC    .035    .035    .035    6750    .008
 352          RX       0       4       8      24      44      60      64      68
 353          RY     100      99      98      94      94      98      99     100
              *

 354          KK  CCAP1B
 355          KM   Combine routed (RCAP1B) and local hydrographs (65A2).
 356          HC       2   1.509
              *
1                                          HEC-1 INPUT                                                PAGE  8

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


 357          KK  C65A12
 358          KM   Combine routed (RCAP1A & RCAP1B) and local hydrographs (65A1 & 65A2)
 359          HC       2   3.445
              *

 360          KK  RMCHNL
 361          KM   Proposed Meridian Channel from Siphon Draw Basin to approximately Guadalupe R
 362          KM   Proposed concrete lined channel, 40' bottom, 2:1 sideslopes.
 363          RS       1    FLOW      -1
 364          RC    .016    .016    .016    3000    .002
 365          RX       0      10      20      36      76      92     102     112
 366          RY     100     100     100      92      92     100     100     100
              *

 367          KK   X65A3   BASIN
 368          KM    THE FOLLOWING PARAMETERS WERE PROVIDED FOR THIS BASIN
 369          KM    L=      2.1  Lca=      1.2   S=   27.9  Kn= .047  LAG=  50.4
 370          KM    PHOENIX VALLEY S-GRAPH WAS USED FOR THIS BASIN
 371          BA   1.207
 372          LG    0.23    0.25    4.60    0.41      40
 373          UI      80      82     206     331     408     468     541     633     828    1018
 374          UI     878     717     628     537     458     383     296     186     140     134
 375          UI      92      80      56      24      25      25      24      25      25      25
 376          UI       0       0       0       0       0       0       0       0       0       0
 377          UI       0       0       0       0       0       0       0       0       0       0
 378          ZW    A=X65A3 B=X65A3 C=FLOW  E=5MIN F=100YR
              *

 379          KK   R65A3
```

```
380          KM   Retain first flush volume (equal to 80% of first ½" of runoff)
381          KM   from MDR areas only.
382          DT  FF65A3    21.8
383          DI       0   10000
384          DQ       0   10000
             *

385          KK  SDWDBS
386          KM   Combine flow from Meridian Channel and Siphon Draw Wash (SDW)
387          HC       2  4.652
388          ZW    A=SDWDBS  B=COMBINED SDW N MERIDIAN   C=FLOW  E=5MIN  F=100YR
             *

389          KK      DB
390          KM      Single Inline Basin
391          KM      Level pool route at proposed Meridian on line basin. Outlet consists of
392          KM      2-6'x4' RCBC with a culvert invert at 1492 (basin bottom).
393          KM      The emergency spillway crest elevation is set at 1498.5.
394          RS       1    STOR       0
             *
             * Storage values from DTM report are shown in * SV below.  These values were
             * decreased by 5 acre-ft to account for the accumulation of sediment
             * in the detention basin and then used for the hydrologic analysis
             * SV     0       6      17      30     145     196     249     275     301
             *
1                                          HEC-1 INPUT                                          PAGE  9

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

395          SV       0       1      12      25     140     191     244     270     296
396          SQ       0      28      82     152     234     328     432     474     526
397          SE    1492    1493    1494    1495    1496    1497    1498  1498.5    1499
398          ZW    A=DB  B=SINGLE BASIN OUTLET  C=FLOW  E=5MIN  F=100YR
             *

399          KK  65A3BY
400          KM   Flow from subbasin X65A3 assumed to bypass basin.
401          KM   THIS IS A CONSERVATIVE APPROACH SINCE THIS AREA IS ALSO
402          KM   INCLUDED IN THE AREA FROM SUBBASIN 65A3.
403          KM   The hydrograph for X65A3 obtained from this model) and multiplied
404          KM   by the ratio of bypass area to the overall subbasin area (~12%).
405          KM
406          BA   0.144            0.12
407          LG    0.23    0.25    4.60    0.41      40
408          UI      80      82     206     331     408     468     541     633     828    1018
409          UI     878     717     628     537     458     383     296     186     140     134
410          UI      92      80      56      24      25      25      24      25      25      25
411          UI       0       0       0       0       0       0       0       0       0       0
412          UI       0       0       0       0       0       0       0       0       0       0
413          ZW    A=65A3BY B=X65A3BY C=FLOW  E=5MIN F=100YR
             *

414          KK  CP-MER
415          KM   Combine flow from Meridian basin and drainage area south of basin.
416          HC       2   4.652
417          ZW    A=CP-MER  B=FLOW AT MERIDIAN CULVER   C=FLOW  E=5MIN  F=100YR
             *

418          KK   RSDW1
419          KM   Siphon Draw Wash (SDW) Meridian Rd to Mountain Rd
420          KM
421          RS       3    FLOW      -1
422          RC    .055    .045    .055    2700    .005
423          RX     100     125     170     175     185     190     235     260
424          RY     100      98      96      94      94      96      98     100
             *

425          KK   RSDW2
426          KM   Siphon Draw Wash (SDW) Mountain Rd to Signal Butte
427          KM
428          RS      10    FLOW      -1
429          RC    .060    .050    .060    5800    .005
430          RX     100     200     340     345     355     360     500     600
431          RY     100      98      96      94      94      96      98     100
432          ZW    A=RSDW2 B=RSDW2 ROUTED FLOW FROM SDDB  C=FLOW  E=5MIN F=100YR
             *

433          KK    65AW
434          KM   BASIN 65AW
435          KM    THE FOLLOWING PARAMETERS WERE PROVIDED FOR THIS BASIN
436          KM    L=        .9  Lca=        .6   S=   54.7  Kn= .049  LAG=  26.1
437          KM    PHOENIX VALLEY S-GRAPH WAS USED FOR THIS BASIN
438          BA     .43
439          LG     .24     .25    5.30     .29   32.00
1                                          HEC-1 INPUT                                          PAGE 10

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

440          UI     56.    176.    295.    391.    603.    594.    432.    316.    210.    101.
441          UI     73.     43.     17.     17.     17.      0.      0.      0.      0.      0.
442          UI      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
             *

443          KK   R65AW
444          KM   RETAIN 100 YR 2 HR RUNOFF VOLUME
```

```
445          DT   D65AW      31
446          DI       0   10000
447          DQ       0   10000
             *

448          KK  65AT65
449          KM   ROUTE C65A TO BASIN 65B VIA A WASH,(THIS WASH IS NORTH OF SIPHON DRAW)
450          KM   THIS IS THE PART OF 65A WHICH IS WEST OF THE MERIDIAN RD ALIGNMENT
451          RS      11    FLOW      -1
452          RC    .045     .04    .045    9500    .007
453          RX       0     500    1000    1003    1053    1056    1511    2011
454          RY       4     3.5       3       0       0       2     2.5       3
455          ZW    A=65AT65 B=65AT65 IS 65AW ROUTED  C=FLOW  E=5MIN F=100YR
             *

456          KK     65B
457          KM   BASIN 65B
458          KM    THE FOLLOWING PARAMETERS WERE PROVIDED FOR THIS BASIN
459          KM    L=      2.0  Lca=      1.2   S=   37.5  Kn= .036  LAG=  36.6
460          KM    PHOENIX VALLEY S-GRAPH WAS USED FOR THIS BASIN
461          BA    1.37
462          LG     .18     .25    6.00     .24   53.00
463          UI    126.    218.    506.    669.    809.   1014.   1468.   1422.   1102.    901.
464          UI    720.    562.    337.    218.    182.    126.     71.     39.     39.     39.
465          UI     39.      0.      0.      0.      0.      0.      0.      0.      0.      0.
466          UI      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
             *

467          KK    R65B
468          KM   RETAIN 100 YR 2 HR RUNOFF VOLUME
469          DT    D65B     120
470          DI       0   10000
471          DQ       0   10000
472          ZW    A=R65B B= R65B IS routed 65B  C=FLOW  E=5MIN F=100YR
             *

473          KK   CP65B
474          KM   Combine flow from 65AW, 65B and RDSW2 (Siphon Draw Basin bypass flow)
475          HC       3   6.452
476          ZW    A=CP65B B= CP65B IS 65AW+65B+RDSW2  C=FLOW  E=5MIN F=100YR
             *

477          KK   DI65B
478          KM
479          KM        This diversion is modified to reflect proposed changes
480          KM        in the outfall conditions.  The orifice plate
481          KM        is removed from the 78" pipe inlet to the Elliot Road storm drain
482          KM        and an orifice plate is placed over the 78" Elliot Basin inlet pipe
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LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

483          KM        located within the lateral weir structure.  The flow split is based
484          KM        upon a rating curve that account for the channel capacity, the
485          KM        the weir inlet capacity, the 78" storm drain pipe inlet capacity
486          KM        and the capacity of a 24" orifice plate over the 78" pipe inlet
487          KM        to the Elliot Detention Basin (east)
488          KM
489          DT  DIRS65
490          DI       0     120     190     270     380     506     527     548
491          DQ       0       0      24      43      45      46      47      48
492          ZW    A=DI65B  B=SDW FLOW TO STORM DRAIN  C=FLOW  E=5MIN  F=100YR
             *

493          KK  65AT-3
494          KM   ROUTE FROM 104th ST TO E. BASIN OUTLET
495          RD    1500  0.0065   0.012            CIRC     7.0
             *

496          KK   DR65B
497          KM        RETURN DIVERT TO EAST DETENTION BASIN
498          DR  DIRS65
499          ZW    A=DR65B  B=SDW FLOW TO ELLIOT BASIN  C=FLOW  E=5MIN  F=100YR
             *

500          KK   RS65A
501          KM   ELLIOT BASIN, EAST
502          KM
503          KM   The low flow outlet data for the East Elliot Basin (SL record) was
504          KM   changed to be reflect the actual outlet design (an 18" pipe at an
505          KM   invert elevation of 1426.5).  The low flow outlet pipe area was
506          KM   changed from 0.7854 sq ft (for a 12" pipe) to 1.7663 sq ft (18" pipe)
507          KM   and the outlet centerline elevation was changed from 1430.0 (the inlet
508          KM   grate elevation) to 1427.3 (pipe invert of 1426.5 + 0.75 for the CL
509          KM   of an 18" pipe).
510          KM
511          RS       1    STOR       0
512          SV       0    5.40    9.30   13.90   18.80   24.00   29.50   35.30   41.40   48.00
513          SE  1429.0  1433.0  1434.0  1435.0  1436.0  1437.0  1438.0  1439.0  1440.0  1441.0
514          SL  1427.3  1.7663     .62      .5
515          SS  1439.0     200     2.5     1.5
516          ZW    A=RS65A  B=OUTFLOW FROM ELLIOT BASIN  C=FLOW  E=5MIN  F=100YR
             *

517          KK    CP65
```

```
 518          KM   COMBINE FLOWS FROM EAST ELLIOT BASIN AND ELLIOT STORM DRAIN
 519          KM   BEFORE COMBINING WITH FLOWS FROM THE BYPASS CRISMON CHANNEL
 520          HC       2
 521          ZW    A=CP65  B=SD FLOW DS OF ELLIOT BASIN  C=FLOW  E=5MIN  F=100YR
              *

 522          KK   65T66
 523          KM   ROUTE FROM E. BASIN OUTLET TO CRISMON ROAD.
 524          RD    1200  0.0065   0.012            CIRC     7.5
              *
1                                        HEC-1 INPUT                                          PAGE 12

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


 525          KK  ADOT-E
 526          KM   INFLOW FROM NORTH OF THE SUPERSTITION FREEWAY ENTERING 67A
 527          KM   FROM EAST ADOT DETENTION BASIN 4105.
 528          BA    0.01
 529          ZR  =QI A=ADOT EAST BASIN B=AT SUPERSTITION C=FLOW E=5MIN F=100YR
              *

 530          KK  AET67A
 531          KM    ROUTE SUPERSTITION FLOW THROUGH 67A TO BASELINE ROAD
 532          IN      15
 533          RS       6    FLOW      -1
 534          RC    .045    .040    .045    5500    .010
 535          RX       0     100     110     120     130     140     150     250
 536          RY       5       4       3       1       1       3       4       5
              *

 537          KK     67A
 538          KM   BASIN 67A
 539          KM    THE FOLLOWING PARAMETERS WERE PROVIDED FOR THIS BASIN
 540          KM    L=      1.0  Lca=       .7   S=   42.9  Kn= .042  LAG=  25.7
 541          KM    PHOENIX VALLEY S-GRAPH WAS USED FOR THIS BASIN
 542          BA     .30
 543          LG     .21     .25    4.70     .39   43.00
 544          UI     39.    126.    208.    277.    433.    400.    292.    213.    134.     67.
 545          UI     47.     25.     12.     12.     12.      0.      0.      0.      0.      0.
 546          UI      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
              *

 547          KK    R67A
 548          KM   RETAIN 100 YR 2 HR RUNOFF VOLUME
 549          DT    D67A      21
 550          DI       0   10000
 551          DQ       0   10000
              *

 552          KK    C67A
 553          KM    COMBINE FLOWS FROM ADOT-E AND SUBBASIN 67A
 554          HC       2
              *

 555          KK   67ATC
 556          KM   ROUTE 67A TO 67C VIA WASH CROSSING BASELINE
 557          RS       7    FLOW      -1
 558          RC    .055    .045    .055    6300   .0071
 559          RX       0     500     980    1003    1007    1031    1511    2011
 560          RY       4     3.5       3       0       0       3     3.5       4
              *

 561          KK    SUP2
 562          KM   INFLOW FROM NORTH OF SUPERSTITION FREEWAY, DISCHARGING INTO 67B
 563          BA    0.01
 564          ZR  =QI A=ADOT WEST BASIN B=AT SUPERSTITION C=FLOW E=5MIN F=100YR
              *
1                                        HEC-1 INPUT                                          PAGE 13

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


 565          KK   RSUP2
 566          KM   ROUTE SUP2 THROUGH SUBBASIN 67B
 567          IN      15
 568          RS       5    FLOW      -1
 569          RC    .045    .045    .045    4500   .0056
 570          RX       0     500    1000    1003    1007    1011    1511    2011
 571          RY       4     3.5       3       0       0       2     2.5       3
              *

 572          KK     67B
 573          KM   BASIN 67B
 574          KM    THE FOLLOWING PARAMETERS WERE PROVIDED FOR THIS BASIN
 575          KM    L=      1.2  Lca=       .9   S=   28.0  Kn= .034  LAG=  26.4
 576          KM    PHOENIX VALLEY S-GRAPH WAS USED FOR THIS BASIN
 577          BA     .53
 578          LG     .17     .25    4.90     .38   56.00
 579          UI     68.    210.    356.    470.    713.    741.    536.    395.    269.    131.
 580          UI     94.     59.     21.     21.     21.      0.      0.      0.      0.      0.
 581          UI      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
              *

 582          KK    R67B
```

```
583          KM   RETAIN 100 YR 2 HR RUNOFF VOLUME
584          DT    D67B      41
585          DI       0   10000
586          DQ       0   10000
             *

587          KK    C67B
588          KM   COMBINE FLOWS FROM SUP2 AND SUBBASIN 67B
589          HC       2
             *

590          KK   67BTC
591          KM   REACH CN-4, CN-5 plus culvert CNC-4.
592          KM   ROUTE FLOW IN THE CRISMON CHANNEL FROM BASELINE ROAD (C67B) TO
593          KM      GUADALUPE ROAD (C67C)
594          RS       2    FLOW      -1
595          RC    .025    .015    .025    5180   .0019
596          RX       0       8      16    24.4    36.4    44.8    52.8    60.8
597          RY     4.0     4.1     4.2       0       0     4.2     4.1     4.0
             *

598          KK     67C
599          KM   BASIN 67C
600          KM    THE FOLLOWING PARAMETERS WERE PROVIDED FOR THIS BASIN
601          KM    L=      1.2  Lca=       .7   S=   40.2  Kn= .049  LAG=  32.3
602          KM    PHOENIX VALLEY S-GRAPH WAS USED FOR THIS BASIN
603          BA     .93
604          LG     .25     .25    5.10     .32   31.00
605          UI     96.    213.    432.    557.    702.   1006.   1133.    842.    667.    518.
606          UI    365.    193.    157.     96.     59.     30.     30.     30.     30.      0.
607          UI      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
608          UI      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
             *
1                                          HEC-1 INPUT                                          PAGE 14

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

609          KK    R67C
610          KM   RETAIN 100 YR 2 HR RUNOFF VOLUME
611          DT    D67C      67
612          DI       0   10000
613          DQ       0   10000
             *

614          KK    C67C
615          KM   COMBINE SUBBASINS 67C AND 67A AND 67B
616          HC       3
             *

617          KK  67CT67
618          KM   REACH CN-3 plus culvert CNC-3
619          KM   ROUTE FLOW IN THE CRISMON CHANNEL FROM C67C (@ GUADALUPE ROAD & CRISMON ROAD)
620          KM    TO C67D (AT APPROX. 1/2 MILE SOUTH OF GUADALUPE ROAD).
             *       Sta. 39+00 to Guadalupe Rd.
621          RS       1    FLOW      -1
622          RC    .025    .015    .025    2420   .0018
623          RX       0       6      12      24      64      76      82      88
624          RY       4       3       2       0       0       2       3       4
             *

625          KK     67D
626          KM   BASIN 67D
627          KM    THE FOLLOWING PARAMETERS WERE PROVIDED FOR THIS BASIN
628          KM    L=       .6  Lca=       .4   S=   34.7  Kn= .050  LAG=  20.5
629          KM    PHOENIX VALLEY S-GRAPH WAS USED FOR THIS BASIN
630          BA     .13
631          LG     .25     .25    5.20     .30   30.00
632          UI     23.     87.    132.    216.    202.    137.     86.     38.     23.      9.
633          UI      6.      6.      0.      0.      0.      0.      0.      0.      0.      0.
634          UI      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
             *

635          KK    R67D
636          KM   RETAIN 100 YR 2 HR RUNOFF VOLUME
637          DT    D67D       9
638          DI       0   10000
639          DQ       0   10000
             *

640          KK    C67D
641          KM    COMBINE HYDROGRAPHS AT CP67D
642          HC       2
             *

643          KK  67DT66
644          KM   REACH CN-2 plus culvert CNC-2
645          KM   ROUTE FLOW IN THE CRISMON CHANNEL FROM APPROX. 1/2 MILE SOUTH
646          KM    OF GUADALUPE ROAD TO THE INFLOW SPILLWAY FOR THE ELLIOT DETENTION BASIN.
             *       Sta. 20+00 to Sta. 39+00
647          RS       1    FLOW      -1
648          RC    .032    .032    .032    1900  0.0035
1                                          HEC-1 INPUT                                          PAGE 15

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

```
649          RX       0       6      12      24      64      76      82      88
650          RY       4       3       2       0       0       2       3       4
             *

651          KK     66A
652          KM   BASIN 66A
653          KM    THE FOLLOWING PARAMETERS WERE PROVIDED FOR THIS BASIN
654          KM    L=       .7  Lca=       .3   S=   55.9  Kn= .047  LAG=  17.1
655          KM    PHOENIX VALLEY S-GRAPH WAS USED FOR THIS BASIN
656          BA     .26
657          LG     .24     .25    6.00     .22   35.00
658          UI     78.    256.    417.    576.    363.    205.     84.     39.     16.     16.
659          UI      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
660          UI      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
             *

661          KK    R66A
662          KM   RETAIN 100 YR 2 HR RUNOFF VOLUME
663          DT    D66A      21
664          DI       0   10000
665          DQ       0   10000
             *

666          KK   66ATB
667          KM   ROUTE S66A TO 66B VIA WASH CROSSING BASELINE
668          RS       7    FLOW      -1
669          RC    .045     .04    .045    7500   .0077
670          RX       0     500     980    1003    1007    1031    1511    2011
671          RY       4     3.5       3       0       0       3     3.5       4
             *

672          KK     66B
673          KM   BASIN 66B
674          KM    THE FOLLOWING PARAMETERS WERE PROVIDED FOR THIS BASIN
675          KM    L=      1.6  Lca=      1.0   S=   43.3  Kn= .050  LAG=  42.8
676          KM    PHOENIX VALLEY S-GRAPH WAS USED FOR THIS BASIN
677          BA     .67
678          LG     .25     .25    5.00     .33   30.00
679          UI     53.     56.    185.    248.    297.    352.    426.    590.    636.    496.
680          UI    419.    346.    286.    232.    152.     93.     86.     58.     53.     21.
681          UI     16.     16.     16.     16.     16.      0.      0.      0.      0.      0.
682          UI      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
             *

683          KK    R66B
684          KM   RETAIN 100 YR 2 HR RUNOFF VOLUME
685          DT    D66B      48
686          DI       0   10000
687          DQ       0   10000
             *
1                                        HEC-1 INPUT                                          PAGE 16

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

688          KK   CP66B
689          KM   COMBINE S66A AND S66B
690          HC       2
             *

691          KK   66BTC
692          KM   ROUTE 66B TO 66C VIA WASH
693          RS       7    FLOW      -1
694          RC    .045     .04    .045    6000   .0150
695          RX       0     500     995    1003    1007    1016    1511    2011
696          RY       4     3.5       3       0       0       3     3.5       4
             *

697          KK     66C
698          KM   BASIN 66C
699          KM    THE FOLLOWING PARAMETERS WERE PROVIDED FOR THIS BASIN
700          KM    L=      1.1  Lca=       .7   S=   46.5  Kn= .039  LAG=  24.3
701          KM    PHOENIX VALLEY S-GRAPH WAS USED FOR THIS BASIN
702          BA     .50
703          LG     .19     .25    5.40     .29   48.00
704          UI     69.    243.    385.    528.    817.    635.    463.    325.    159.    103.
705          UI     63.     21.     21.     21.      0.      0.      0.      0.      0.      0.
706          UI      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
             *

707          KK    R66C
708          KM   RETAIN 100 YR 2 HR RUNOFF VOLUME
709          DT    D66C      42
710          DI       0   10000
711          DQ       0   10000
             *

712          KK  CP66C1
713          KM   Split up hydrograph combination in order to separate flows.
714          KM   Combine Hydrographs 66BTC (from Sub. 66A)and R66C (from Sub. 66C)
715          HC       2
             *

716          KK  CP66C2
```

```
 717          KM   Combine Hydrograph CP66C1 (from Subbasins 66A, 66B and 66C)
 718          KM     plus hydrograph 67DT66 ( C67D )
 719          HC       2
              *

 720          KK    DI66
 721          KM    DIVERT FLOW TO DETENTION BASIN WA
 722          KM    By-pass Flow Reduced to 410 cfs from 458, SZ, 5-17-99
 723          DT    DB66
 724          DI       0     150     363   411.0   456.0     513     577     643     712    1000
 725          DQ       0       0       0    32.0     71.     122     179     239     302     590
              *
1                                          HEC-1 INPUT                                          PAGE 17

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

 726          KK  66C1T2
 727          KM    ROUTE FLOW FROM DIVERSION STRUCTURE TO ELLIOT CHANNEL at ELLIOT ROAD.
 728          KM    REACH CN-1 plus culvert CNC-1
 729          KM        A single pipe size and an overall slope are used to represent this
 730          KM        1,070 ft long reach which has pipe sizes of 78", 84" and 90", and
 731          KM        about 250' long sideweir and transition open channel.
 732          KM        RD card used for routing (Sta. 9+30 to Sta. 20+00)
 733          RD    1070  0.0130   0.012            CIRC       7
              *

 734          KK   CP66C
 735          KM   COMBINE FLOWS FROM ELLIOT CHANNEL AND CRISMON BYPASS CHANNEL
 736          HC       2
              *

 737          KK   66CTD
 738          KM   REACH ET-7
 739          KM   ROUTE FLOWS FROM INTERSECTION OF CRISMON AND ELLIOT CHANNELS
 740          KM   AT THE INTERSECTION OF ELLIOT ROAD and CRISMON ROAD TO THE ELLIOT BASIN
 741          KM   WA Bleed-off Outlet, WHICH IS ABOUT 390 ft WEST OF CRISMON ROAD.
 742          RD     500  0.0015   0.012            CIRC     9.5
              *

 743          KK    DR66
 744          KM         RETURN DIVERT TO DETENTION BASIN FROM DIVERSION STRUCTURE
 745          DR    DB66
              *

 746          KK  RS66D1
 747          KM   ELLIOT BASIN, WEST A
 748          KM   TWO PONDS OPERATING IN SERIES.
 749          KM        Bottom Elevation Lowered to 1415.0 ft from 1420, and 18" Bleed-off
 750          KM        Pipe Added from WA to Elliot Channel
              *       Since the bleed-off pipe length is short, no routing is provided.
              *       Existing SS = 1423   20   2.5   1.5, SZ, 5-18-99
 751          RS       1    STOR       0
 752          SV       0    1.60   10.00   25.50   34.70   44.20   54.10   64.40   75.10   86.00
 753          SE  1415.0    1417    1419    1421    1422    1423    1424    1425    1426    1427
 754          SL  1416.0  1.7672     .62      .5
 755          SS  1423.5      20     3.0     1.5
              *

 756          KK    B-WA
 757          KM        Bleed-off Flow from WA to Elliot Channel = 18" Pipe, SZ, 6-15-99
 758          KM        Divert Flow to WB by Weir Spillover (SS card on RS66D1)
 759          KM        RS66D1 is the total routed flow = SL + SS
 760          KM        This operation is designed to separate weir flow from pipe flow
 761          DT    D-WB
 762          DI       0       5      10      15   17.59   40.87   80.62  131.76  192.12  260.43
 763          DQ       0       0       0       0       0    21.2    60.0   110.2   169.7   237.2
              *
1                                          HEC-1 INPUT                                          PAGE 18

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

 764          KK    C-WA
 765          KM        Combine Bleed-off Flow from WA with Flow in Elliot Channel
 766          KM        Added by SZ, 5-17-99
 767          HC       2
              *

 768          KK   RC-WA
 769          KM        Route Flow from WA Outlet to WB Outlet in Elliot Channel
 770          KM        Added by SZ, 5-17-99
 771          KM        WA Bleed-off Outlet to WB Bleed-off Outlet.
 772          KM        RD card used for routing (Sta. 48+80 to Sta. 57+35)
 773          RD     855  0.0052   0.012            CIRC     9.5
              *

 774          KK   DR-WA
 775          KM        Return Diverted Flow (Spillway) to WB from WA, SZ 5-7-99
 776          DR    D-WB
              *

 777          KK  RS66D2
 778          KM   ELLIOT BASIN, WEST B
 779          KM   TWO PONDS OPERATING IN SERIES.
```

```
780          KM        Bottom Elevation Lowered to 1413.5 ft from 1414, and 36" Bleed-off
781          KM        Pipe Reduced to 18" from WB to Elliot Channel
782          KM        Since the bleed-off pipe length is short, no routing is provided.
783          KM        Existing SS = 1420.5   80   2.5   1.5, SZ, 5-18-99
784          RS       1    STOR       0
785          SV       0    4.40    8.80   14.50   21.00   28.00   35.30   42.90   50.90   59.20
786          SE  1412.0    1415    1416    1417    1418    1419    1420    1421    1422    1423
787          SL  1413.0  1.7672     .62      .5
788          SS  1422.6      50     2.5     1.5
             *

789          KK   CP66D
790          KM       COMBINE FLOWS FROM WEST ELLIOT BASIN AND ELLIOT CHANNEL
791          KM       AT THE OUTLET PIPE.
792          HC       2
             *

793          KK  66T66D
             * KM REACH ET-6
794          KM        ROUTE FROM DETENTION BASIN WB OUTLET TO ELLSWORTH RD
795          KM        2350 -> 3200,  SZ, 5-17-99
796          KM        First portion
797          KM        RD card used for routing (Sta. 36+44 to 48+80)
798          RD    1236  0.0052   0.012            CIRC     9.5
             *

799          KK  66-66D
800          KM   REACH ET-6
801          KM        ROUTE FROM DETENTION BASIN WB OUTLET TO ELLSWORTH RD
802          KM        2350 -> 3200,  SZ, 5-17-99
803          KM        Second portion
804          KM        RD card used for routing (Sta. 12+46 to Sta. 36+44)
```



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

805          RD    2398  0.0040   0.012            CIRC     9.5
             *

806          KK     66D
807          KM   BASIN 66D
808          KM    THE FOLLOWING PARAMETERS WERE PROVIDED FOR THIS BASIN
809          KM    L=       1.0  Lca=        .7   S=   28.6  Kn= .020  LAG=  13.2
810          KM    PHOENIX VALLEY S-GRAPH WAS USED FOR THIS BASIN
811          BA     .31
812          LG     .10     .17    6.80     .19   80.00
813          UI    162.    480.    845.    540.    232.     89.     24.      0.      0.      0.
814          UI      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
             *

815          KK    R66D
816          KM   RETENTION REDUCED BY 77% FROM 31 TO 7 AC-FT
817          KM   DUE TO DEVELOPMENT USING DETENTION BASIN
818          KM   The developer does not participate in the basin so the retention volume
819          KM   increased to 31 A-F
820          DT    D66D      31
821          DI       0   10000
822          DQ       0   10000
             *

823          KK     61A
824          KM   BASIN 61A
825          KM    THE FOLLOWING PARAMETERS WERE PROVIDED FOR THIS BASIN
826          KM    L=        .9  Lca=       .4   S=   36.8  Kn= .037  LAG=  19.1
827          KM    PHOENIX VALLEY S-GRAPH WAS USED FOR THIS BASIN
828          BA     .52
829          LG     .19     .25    4.20     .56   52.00
830          UI    117.    412.    628.   1037.    786.    517.    261.    132.     62.     28.
831          UI     28.      0.      0.      0.      0.      0.      0.      0.      0.      0.
832          UI      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
             *

833          KK    R61A
834          KM   RETAIN 100 YR 2 HR RUNOFF VOLUME
835          DT    D61A      42
836          DI       0   10000
837          DQ       0   10000
             *

838          KK   61ATB
839          KM   ROUTING 61A TO 61B VIA ELLSWORTH ROAD
840          RS       6    FLOW      -1
841          RC    .035    .024    .035    5280    .005
842          RX       0     500     750     752     802     852    1102    1602
843          RY       3       2     1.5     1.2     1.2     1.5       2       3
             *
```



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

844          KK     61B
845          KM   BASIN 61B
846          KM    THE FOLLOWING PARAMETERS WERE PROVIDED FOR THIS BASIN
847          KM    L=       1.4  Lca=        .7   S=   39.7  Kn= .047  LAG=  33.6
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848          KM    PHOENIX VALLEY S-GRAPH WAS USED FOR THIS BASIN
849          BA    1.09
850          LG     .24     .25    4.80     .37   35.00
851          UI    109.    223.    475.    615.    765.   1049.   1335.   1025.    822.    643.
852          UI    495.    288.    187.    143.    109.     36.     34.     34.     34.     34.
853          UI      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
854          UI      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
             *

855          KK    R61B
856          KM   RETAIN 100 YR 2 HR RUNOFF VOLUME
857          DT    D61B      81
858          DI       0   10000
859          DQ       0   10000
             *

860          KK   CP61B
861          KM   COMBINE FLOWS FROM S61A AND S61B
862          HC       2
             *

863          KK  61T66D
864          KM   ROUTE CP61B TO SUBBASIN 66D ALONG ELLSWORTH ROAD. ROUTING WILL BE
865          KM   THE SAME AS WAS GIVEN FOR SUBBASIN 61A
866          RS       6    FLOW      -1
867          RC    .035    .024    .035    5280    .008
868          RX       0     500     750     752     802     852    1102    1602
869          RY       3       2     1.5     1.2     1.2     1.5       2       3
             *

870          KK     67E
871          KM   BASIN 67E
872          KM    THE FOLLOWING PARAMETERS WERE PROVIDED FOR THIS BASIN
873          KM    L=      1.2  Lca=       .7   S=   32.3  Kn= .038  LAG=  26.9
874          KM    PHOENIX VALLEY S-GRAPH WAS USED FOR THIS BASIN
875          BA     .58
876          LG     .19     .25    5.40     .30   50.00
877          UI     73.    219.    378.    496.    732.    830.    597.    443.    315.    157.
878          UI    110.     73.     24.     22.     22.     22.      0.      0.      0.      0.
879          UI      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
             *

880          KK    R67E
881          KM   RETAIN 100 YR 2 HR RUNOFF VOLUME
882          KM   DUE TO DEVELOPMENT USING DETENTION BASIN
883          DT   D67E       50
884          DI       0   10000
885          DQ       0   10000
             *
1                                          HEC-1 INPUT                                          PAGE 21

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

886          KK    C67E
887          KM   COMBINE FLOWS FROM ELLSWORTH ROAD JUST NORTH OF ELLIOT ROAD
888          HC       2
             *

889          KK    C66D
890          KM   COMBINE ELLIOT CHANNEL FLOW WITH HYDROGRAPH C67E @ ELLIOT RD & ELLSWORTH RD.
891          HC       3
             *

892          KK  66T70A
893          KM        Pipe Routing, Reach ET-5
894          KM        SE corner curve of Elliot Rd. & Ellsworth Rd.
895          KM        RD card used for routing (Junction Structure to Sta. 12+46)
896          RD     500  0.0004   0.012            CIRC     9.5
             *

897          KK  66T70B
898          KM        Pipe Routing, Reach ET-5
899          KM        Elliot Rd. to Culvert along Ellsworth Rd. 2-102" pipe = 144" pipe
900          KM        RD card used for routing (Sta. 85+65 to Sta. 97+51)
901          RD    1186  0.0015   0.012            CIRC      12
             *

902          KK   CULVT
903          KM        Pipe Routing, Culvert
904          KM        2-102" pipe culvert crossing Ellsworth Rd.
905          KM        RD card used for routing
906          RD     300  0.0002   0.012            CIRC      12
             *

907          KK  66T70C
908          KM   REACH ET-4, ET-5( COMPRISED OF ET-5A AND ET-5B).
909          KM   ROUTE FROM ELLSWORTH Culvert TO SANTAN FREEWAY.
910          RS       2    FLOW      -1
911          RC    .032    .032    .032    2490   .0008
912          RX       0      10      20      56      76     112     120     130
913          RY     6.5     6.1     6.0       0       0     6.0     6.1     6.5
             *
914          ZZ
1
```

```
                 SCHEMATIC DIAGRAM OF STREAM NETWORK
INPUT
 LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

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

 282        X65A1
                .
                .
 297            .-------> FF65A1
 293        R65A1
                .
                .
 300            .      CAP1A
                .          V
                .          V
 309            .     RCAP1A
                .          .
                .          .
 317       CCAP1A...........
                .
                .
 320            .      X65A2
                .          .
                .          .
 334            .          .-------> FF65A2
 331            .      R65A2
                .          .
                .          .
 337            .          .      CAP1B
                .          .          V
                .          .          V
 346            .          .     RCAP1B
                .          .          .
                .          .          .
 354            .     CCAP1B...........
                .          .
                .          .
 357       C65A12...........
                V
                V
 360       RMCHNL
                .
                .
 367            .      X65A3
                .          .
                .          .
 382            .          .-------> FF65A3
 379            .      R65A3
                .          .
                .          .
 385       SDWDBS...........
                V
                V
 389           DB
                .
                .
 399            .     65A3BY
                .          .
                .          .
 414       CP-MER...........
                V
                V
 418        RSDW1
                V
                V
 425        RSDW2
                .
                .
 433            .       65AW
                .          .
                .          .
 445            .          .-------> D65AW
 443            .      R65AW
                .          V
                .          V
 448            .     65AT65
                .          .
                .          .
 456            .          .        65B
                .          .          .
                .          .          .
 469            .          .          .-------> D65B
 467            .          .       R65B
                .          .          .
                .          .          .
 473        CP65B........................
                .
                .
 489            .-------> DIRS65
 477        DI65B
                V
                V
 493       65AT-3
                .
```

```
                .
498             .          .<-------  DIRS65
496             .      DR65B
                .          V
                .          V
500             .      RS65A
                .          .
                .          .
517          CP65............
                V
                V
522         65T66
                .
                .
525             .     ADOT-E
                .          V
                .          V
530             .     AET67A
                .          .
                .          .
537             .          .        67A
                .          .         .
                .          .         .
549             .          .         .------->    D67A
547             .          .       R67A
                .          .         .
                .          .         .
552             .       C67A............
                .          V
                .          V
555             .      67ATC
                .          .
                .          .
561             .          .       SUP2
                .          .          V
                .          .          V
565             .          .      RSUP2
                .          .         .
                .          .         .
572             .          .         .         67B
                .          .         .          .
                .          .         .          .
584             .          .         .          .------->    D67B
582             .          .         .       R67B
                .          .         .          .
                .          .         .          .
587             .          .       C67B............
                .          .          V
                .          .          V
590             .          .      67BTC
                .          .         .
                .          .         .
598             .          .         .         67C
                .          .         .          .
                .          .         .          .
611             .          .         .          .------->    D67C
609             .          .         .       R67C
                .          .         .          .
                .          .         .          .
614             .       C67C........................
                .          V
                .          V
617             .     67CT67
                .          .
                .          .
625             .          .        67D
                .          .         .
                .          .         .
637             .          .         .------->    D67D
635             .          .       R67D
                .          .         .
                .          .         .
640             .       C67D............
                .          V
                .          V
643             .     67DT66
                .          .
                .          .
651             .          .        66A
                .          .         .
                .          .         .
663             .          .         .------->    D66A
661             .          .       R66A
                .          .          V
                .          .          V
666             .          .      66ATB
                .          .         .
                .          .         .
672             .          .         .         66B
                .          .         .          .
                .          .         .          .
685             .          .         .          .------->    D66B
683             .          .         .       R66B
                .          .         .          .
                .          .         .          .
```

```
688          .           .       CP66B............
             .           .           V
             .           .           V
691          .           .       66BTC
             .           .           .
             .           .           .
697          .           .           .         66C
             .           .           .           .
             .           .           .           .
709          .           .           .           .-------->    D66C
707          .           .           .       R66C
             .           .           .           .
             .           .           .           .
712          .           .      CP66C1............
             .           .           .
             .           .           .
716          .      CP66C2............
             .           .
             .           .
723          .           .-------->    DB66
720          .        DI66
             .           V
             .           V
726          .      66C1T2
             .           .
             .           .
734       CP66C............
             V
             V
737       66CTD
             .
             .
745          .           .<--------    DB66
743          .        DR66
             .           V
             .           V
746          .      RS66D1
             .           .
             .           .
761          .           .-------->    D-WB
756          .        B-WA
             .           .
             .           .
764        C-WA............
             V
             V
768       RC-WA
             .
             .
776          .           .<--------    D-WB
774          .       DR-WA
             .           V
             .           V
777          .      RS66D2
             .           .
             .           .
789       CP66D............
             V
             V
793      66T66D
             V
             V
799      66-66D
             .
             .
806          .         66D
             .           .
             .           .
820          .           .-------->    D66D
815          .        R66D
             .           .
             .           .
823          .           .         61A
             .           .           .
             .           .           .
835          .           .           .-------->    D61A
833          .           .       R61A
             .           .           V
             .           .           V
838          .           .      61ATB
             .           .           .
             .           .           .
844          .           .           .         61B
             .           .           .           .
             .           .           .           .
857          .           .           .           .-------->    D61B
855          .           .           .       R61B
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860          .           .      CP61B............
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             .           .           V
863          .           .      61T66D
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870          .          .          .        67E
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883          .          .          .          .-------->   D67E
880          .          .          .       R67E
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886          .          .       C67E...........
             .          .          .
             .          .          .
889       C66D......................
             V
             V
892      66T70A
             V
             V
897      66T70B
             V
             V
902       CULVT
             V
             V
907      66T70C

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION
1****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*             JUN   1998               *
*           VERSION 4.1                *
*                                      *
*  RUN DATE   29DEC08  TIME  14:11:11  *
*                                      *
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*                                   *
*    U.S. ARMY CORPS OF ENGINEERS   *
*    HYDROLOGIC ENGINEERING CENTER  *
*          609 SECOND STREET        *
*       DAVIS, CALIFORNIA 95616     *
*           (916) 756-1104          *
*                                   *
*************************************
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Model: Final Design Analysis
Single Online Basin to Siphon Draw Wash & Meridian Channel

Project: Siphon Draw Wash Drainage Improvements
Contract FCD: 2007C012
SCI Project No: 20539

Notes By: Stanley Consultants, Inc. (SCI)
Revision Date: November, 2008

Filename: SDW_100.DAT
Storm Event: 100-Yr, 24 Hrs
Conditions: Future Conditions

Comments:

This design model includes:

* A single basin online detention basin to both SDW and the Meridian Channel.
* Reduces excavated volume of the basin by 5 acre-ft based upon the assumption that 5 acre-ft of sediment would accumulate within the basin before removal.
* Eliminates the Elliot Rd storm drain extension which previously was to serve as the basin outlet. Instead the basin was enlarged and now discharges directly to SDW just upstream of Meridian Road and passes through the Meridian Pointe subdivision.
* Utilizes the revised kn values per direction from FCDMC (utilizes subbasins annotated with X as the first letter of the subbasin name
* Conservatively assumes some area within the drainage easement bypass the basin completely and drains directly down SDW to the project outfall. This area was not removed from the subbasin 65A3 area so the area runoff is essentially accounted for twice. This was assumed because it is not know how runoff from the area south of the proposed basin will be handled in the future. The runoff (~30 cfs) has minimal impact on the basin design.
* Routing of all flow from the CAP overchutes is assumed to be routed to Meridian Channel north of the Guadalupe Road. This is not the case for existing conditions. For existing conditions, some flow (particularly from CAP2A) would likely not enter the proposed Meridian Channel until just north of the proposed detention basin approximately
* Modifications to the diversion at DI65B where flow is split between the Elliot Rd storm drain and the Elliot Detention Basin. The changes reflect the removal of an existing orifice plate over the 78" Elliot Road storm drain inlet and the installation of a orifice plate (with a 24" diameter orifice) over the 78" inlet to the Elliot Road Detention basin. While the upstream channel does not appear to have the capacity to contain the magnitude of flow indicated for the 100-year event, no changes will be made to the upstream channel as part of this project.
* The low flow outlet data for the East Elliot Basin (RS65A SL record) from the original hydrology model was changed to be reflect the actual outlet design as shown in the design/as-built plans (an 18" low flow outlet pipe at an invert elevation of 1426.5). The SL record the low flow outlet pipe area was therefore changed from 0.7854 sq ft

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     (for a 12" pipe) to 1.7663 sq ft (for an 18" pipe) and the outlet
     pipe centerline elevation was changed from 1430.0 (which is
     actually the inlet grate elevation) to 1427.3 (which is the pipe
     invert of 1426.5 + 0.75 for the CL of an 18" pipe) per design plans.

Model Background:

This model was developed from the base hydrology model (SDW-BASE.DAT)
produced as part of this project and developed from previous hydrology
models from previous studies.  For this project SDW-BASE.DAT truncated
the previous hydrologic model S60EMAP1.DAT provided by the FCDMC.
Any hydrologic elements which do not contribute to runoff along
Elliot Road, just upstream of the SanTan Freeway Channel(routing
reach 66T70C) were removed

To run correctly, this model requires referencing a DSS file created
by the upstream hydrologic model ultimately developed from the
East Mesa ADMP.  For the 100-year, future conditions, this model is
N60EM.DAT (which produces N60EM.DSS).

This model is a revision of the pre-design submittal to address
comments from the FCDMC.  Revisions included:

      *  changes to Kn values for the project subbasins
      *  adjustment of land area assumed as water (proposed basin site)
      *  the reclassification of the proposed basin site as open space
         (as opposed to water as previously defined).

Subbasins with X are:  default Kn, with open space-undef. as land use.
Subbasins w/o a letter are:  ADMP Kn, with water as land use.

END SCI INTRODUCTORY COMMENTS

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

MODEL REVISED 9/12/02 TO CHANGE ZW CARD TO ZR CARD AT HYDROGRAPH CAP1B (CWR)

ID  Kirkham Michael:
Last Revised Date:  5/14/02
Filename:  WS4-SEM.DAT

Comments Dated 5/14/02 (CJ)

This model should be used for the Rittenhouse and Chandler Heights Basin
Design Project - 30% Design Analyses.

This model is one of several models that represent the EMF watershed.
This model covers the Southeast Mesa Area and should reference as a DSS
the watershed model for the Northeast Mesa Area (Filename WS2-NEM.DAT).

This model is necessary to determine the input hydrographs for the
Rittenhouse Basin Design HEC-RAS Unsteady State analysis.  To develop
the necessary input hydrographs the following models should be run in order.
Because the files utilize a TAPE21 file to export import hydrographs
between models, prior to running the FIRST model (WS1-NWM.DAT) any existing
TAPE21 file in the directory should be deleted.  The run procedure order is:

     1)  WS1-NWM.DAT
     2)  WS2-NEM.DAT
     3)  WS3-QCSW.DAT
     4)  WS4-SEM.DAT (referencing WS2-NEM.DSS for the DSS file)
     5)  RT1-BASE.DAT

The necessary input hydrographs for the Rittenhouse Basin analysis
are determined in RT1-BASE.  In that output file, the hydrograph at
RWFLD1 should be exported and used as the input hydrograph at the
EMF Reach 4 Cross Section 17.082.  And the hydrograph at RITTEN should
be exported and used as the input hydrograph for the Rittenhouse Main
Channel at Cross Section 820.00


*************************************************************************
**** NOTE BY PRIMATECH ENGINEERS:                                     ****
**** DATE: 06/12/2001                                                 ****
**** THE NEW FILE NAME IS: SEBTALT2.DAT                               ****
**** THE FILE WAS RENAMED AS <<RTBTALT2.DAT>> FOR THE EAST MARICOPA   ****
**** FLOODWAY CAPACITY MITIGATION PROJECT, BY FLOOD CONTROL DISTRICT OF ****
**** MARICOPA COUNTY.                                                 ****
**** THE FILE WAS RENAMED <<RTBTALT3.DAT>> AND UPDATED USING GREEN AND ****
**** AMPT FUTURE CONDITIONS FOR BASINS 258 TO 268.                    ****
*************************************************************************


 THIS MODEL WAS ORIGINALLY MIDDOUT.DAT
 IT HAS BEEN MODIFIED BY CPE (7/2000)
 FOR ALTERNATIVE 2 FOR THE EAST MARICOPA FLOOWAY
 CAPACITY MITIGATION AND MULTI-USE CORRIDOR STUDY
 TO ROUTE BOTH THE POWERLINE FLOOWAY
 AND THE SANTAN FREEWAY CHANNEL INTO THE RAY BASIN PRIOR THEIR OUTFALL
 INTO THE EMF

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

     Model files changed by Collins/Pina Engineering
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        to reflect multi-use design concepts (recreation
        and environment) proposed throughout the entire
        EMF Corridor.    July 2000

   VERSION 8.06  CPE 7/31/00

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

*****************************************************************************
 FILENAME: MIDDOUT.DAT

 ALL CIP INFRASTRUCTURE IS IN PLACE, FUTURE CONDITIONS LANDUSE IS IN PLACE
 FLOW IS ROUTED UP ELLSWORTH ROAD IN A EARTH LINED CHANNEL

*****************************************************************************
 PRODUCED BY DIBBLE AND ASSOCIATES AND HOSKIN ENGINEERING CONSULTANTS.
 File Name: Final8.Dat
 Revised - Jan. 2000 by SZ (Wood/Patel) From Final7.dat - new Z-V & Sideweir
 Revised - Jan. 2000 by SZ (Wood/Patel) from Final6.dat - 60% review comments
 Revised - Dec. 1999 by SZ (Wood/Patel) from Final5.dat
 Revised - Dec. 1999 by SZ (Wood/Patel) from Final4.dat
 Revised - Nov. 1999 by SZ (Wood/Patel) from Final3.dat
 Revised - June 1999 by SZ (Wood/Patel) for Final Model from Opt1.dat.
 Revised - May 1999 by SZ (Wood/Patel) for Option 1, Based on Model SDIB.DAT
 REVISED - MAY, 1999 BY VAS TO INCORPORATE INCREASE OF SUBBASIN RETENTION AND
           REVISIONS TO THE REGIONAL DETENTION BASIN STORAGE
 REVISED - FEB, 1999 BY VALERIE SWICK, FCD OF MARICOPA COUNTY
 REVISED - MAY, 1998 BY D&A

 REVISED BY VALERIE SWICK, FEB. 26, 1998

 FLOWS FROM DETENTION BASIN LOCATED AT NE CORNER OF ELLIOT AND ELLSWORTH ROADS
 IS ROUTED TO THE SOUTHWEST BY SIPHON DRAW TO SUBBASIN 70A. FROM THERE THEY
 WILL BE ROUTED BY A CHANNEL TO THE EMF. FLOWS FROM SUBBASINS ADJACENT TO
 SANTAN FREEWAY ALIGNMENT WILL BE ROUTED SOUTH TO SUBBASIN 70A WHERE THEY WILL
 BE COMBINED WITH FLOW IN SIPHON DRAW.

 EAST MESA AREA DRAINAGE MASTER PLAN
 AREA SOUTH OF SUPERSTITION (U.S. HWY 60)
 AUGUST 1997
 SOUTHEAST MESA HIGH RESOLUTION MODEL

 ***********FUTURE CONDITION MODEL OF THE WATERSHED************************

************ATTENTION*************************************************************
  SUBBASINS 75, 79A, 79B, 78E,  LANDUSES WERE NOT
  CHANGED BECAUSE IT WAS FELT THAT THEIR FUTURE CONDITIONS LANDUSES WOULD BE
  SIMILAR TO THE EXISTING CONDITIONS LANDUSES.
  RETENTION VOLUMES WILL ALSO NOT BE UTILIZED FOR SUBBASINS 75, 79A, 79B, 78E
  SOME QUEEN CREEK SUBBASINS WILL ALSO NOT HAVE RETENTION VOLUMES, EITHER
  BECAUSE THEY LIE IN PINAL COUNTY AND WE DONT KNOW PINAL COUNTIES PLANS OR
  THEY LIE IN THE SANTAN MOUNTAINS AND WON'T GET DEVELOPED
  WILLIAMS GATEWAY AIRPORT (SUBBASINS 80A, 80B, 81A, AND 81B) ARE MODELED AS
  FUTURE CONDITIONS AND HAVE RETENTION VOLUMES FOR THE 100YR 2HR STORM
*****************************************************************************
 FILENAME:  SDIBB.DAT

 THIS MODEL REPRESENTS THE FUTURE CONDITION OF THE WATERSHED.
 TOTAL DRAINAGE AREA IS APPROXIMATELY 213 SQ. MI.
 THIS MODEL USES A Kn VALUE OF 0.09 FOR DESERT LAND USE DUE TO SHEET FLOW
 CONDITIONS.

 100-YEAR 24-HOUR FREQUENCY
 AREAL REDUCTIONS FROM FCD HYDROLOGY MANUAL
 THIS MODEL INCLUDES INFLOW FROM NORTH OF THE SUPERSTITION FREEWAY
 AND EAST OF THE CAP

 DATA FROM THE QUEEN CREEK ADMS HAS BEEN ADDED TO CALCULATE FLOWS INTO THE
 EMF.   MUSKINGUM ROUTING NSTEPS WERE ADJUSTED TO BE WITHIN THE SUGGESTED
 RANGE.

 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

 ORIGINAL STUDY PERFORMED BY LISA C. YOUNG AND AFSHIN AHOURAIYAN, UPDATED BY
 DAVID DEGERNESS (OCT-DEC, 1996). REVIEWED BY VALERIE A. SWICK
 AND AMIR MOTAMEDI OF THE FLOOD CONTROL DISTRICT
 HYDROLOGY BRANCH ENGINEERING DIVISION, FLOOD CONTROL
 DISTRICT OF MARICOPA COUNTY, DECEMBER - JULY 1995.

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

 VELOCITIES FOR ADMP IMPROVEMENT CHANNELS FROM DIBBLE AND ASSOCIATES
 SUGGESTED ALTERNATIVES (JULY 1, 1997)
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                    ************************************************************************
                    **** THE FOLLOWING NOTE WAS ADDED BY PRIMATECH ENGINEERS ON 06-12-2001 ****
                    ************************************************************************
                    NOTE: MUST USE NEBUILD.DSS AS THE DSS FILE TO IMPORT FLOWS ACROSS THE
                          SUPERSTITION FREEWAY.
                    ************************************************************************


                    NOTE: MUST USE NDIBF.DSS AS THE DSS FILE TO IMPORT FLOWS ACROSS THE
                          SUPERSTITION FREEWAY.

                    DDM MCUHP2 SOUTH EAST MESA ADMP - SOUTH OF SUPERSTITION FREEWAY, FUTURE CONDI

261 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

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

264 PI            PRECIPITATION PATTERN
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274 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
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275 JD        INDEX STORM NO. 3
                STRM        3.49  PRECIPITATION DEPTH
                TRDA        5.00  TRANSPOSITION DRAINAGE AREA

  0 PI         PRECIPITATION PATTERN
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276 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
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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

277 JD        INDEX STORM NO. 5
                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
                .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
```

.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.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		

278 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
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.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		

279 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
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.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		

```
280 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
                   .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
                   .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
                   .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
                   .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
                   .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
                   .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
                   .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
                   .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
                   .00     .00     .00     .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

281 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:  Existing File Opened,  File: N60EM.DSS
                     Unit:  71;  DSS Version: 6-JG
       ----- Entering ZRRTSX for unit 71 -----
Pathname: /CAP1A/OVERCHUTE/FLOW//5MIN/100YEAR/
       Time Window set.  Interval:      5  Number of data values:        1
       Starting date and time:  Mar 31, 1997  2400  (  35519 1440)
       Ending   date and time:  Mar 31, 1997  2400  (  35519 1440)
       Input time offset:        0
       After ZRDINF, Record found: T
       Pathname: /CAP1A/OVERCHUTE/FLOW/31MAR1997/5MIN/100YEAR/
       Number of actual data:  288   Header length:   0
       Compression:   0  Quality:   0
-----DSS--- ZREAD Unit  71; Vers.    2:  /CAP1A/OVERCHUTE/FLOW/31MAR1997/5MIN/100YEAR/
     ----DSS---Debug:  Enter ZRRTSB;  Unit:  71
       NSTART:    1   NVALS:    1    JULS:   35519   ISTIME:  1440
       NLDATA:  288    JULSD:   35519
       JULS: 31MAR97         JULSD: 31MAR97
       Quality Read: F,  Quality Requested: F
       ---ZRRTSB Calculations:  NPOS:  288  NDATA:  288  NREAD:    1  ILIM:      1
     ----- Exiting ZRRTS, Number of data values:       1,  Status:  0
       Offset:         0,  Units: CFS      ,  Type:INST-VAL
       ----- Entering ZRRTSX for unit 71 -----
Pathname: /CAP1A/OVERCHUTE/FLOW//5MIN/100YEAR/
       Time Window set.  Interval:      5  Number of data values:      744
       Starting date and time:  Mar 31, 1997  2400  (  35519 1440)
       Ending   date and time:  Apr 3, 1997  1355  (  35522  835)
```

```
        Input time offset:      0
        After ZRDINF, Record found: T
        Pathname: /CAP1A/OVERCHUTE/FLOW/31MAR1997/5MIN/100YEAR/
        Number of actual data:  288  Header length:   0
        Compression:   0  Quality:   0
-----DSS--- ZREAD Unit  71; Vers.    2:  /CAP1A/OVERCHUTE/FLOW/31MAR1997/5MIN/100YEAR/
      ----DSS---Debug:  Enter ZRRTSB;  Unit:  71
        NSTART:    1   NVALS:  744    JULS:   35519  ISTIME:  1440
        NLDATA:  288   JULSD:   35519
        JULS: 31MAR97       JULSD: 31MAR97
        Quality Read: F,  Quality Requested: F
        ---ZRRTSB Calculations:  NPOS:  288  NDATA:  288  NREAD:    1  ILIM:    1
        After ZRDINF, Record found: T
        Pathname: /CAP1A/OVERCHUTE/FLOW/01APR1997/5MIN/100YEAR/
        Number of actual data:  288  Header length:   0
        Compression:   0  Quality:   0
-----DSS--- ZREAD Unit  71; Vers.    2:  /CAP1A/OVERCHUTE/FLOW/01APR1997/5MIN/100YEAR/
      ----DSS---Debug:  Enter ZRRTSB;  Unit:  71
        NSTART:    2   NVALS:  744    JULS:   35519  ISTIME:  1440
        NLDATA:  288   JULSD:   35520
        JULS: 31MAR97       JULSD: 01APR97
        Quality Read: F,  Quality Requested: F
        ---ZRRTSB Calculations:  NPOS:    1  NDATA:  288  NREAD:  288  ILIM:  289
        After ZRDINF, Record found: T
        Pathname: /CAP1A/OVERCHUTE/FLOW/02APR1997/5MIN/100YEAR/
        Number of actual data:  288  Header length:   0
        Compression:   0  Quality:   0
-----DSS--- ZREAD Unit  71; Vers.    2:  /CAP1A/OVERCHUTE/FLOW/02APR1997/5MIN/100YEAR/
      ----DSS---Debug:  Enter ZRRTSB;  Unit:  71
        NSTART:  290   NVALS:  744    JULS:   35519  ISTIME:  1440
        NLDATA:  288   JULSD:   35521
        JULS: 31MAR97       JULSD: 02APR97
        Quality Read: F,  Quality Requested: F
        ---ZRRTSB Calculations:  NPOS:    1  NDATA:  288  NREAD:  288  ILIM:  577
        After ZRDINF, Record found: T
        Pathname: /CAP1A/OVERCHUTE/FLOW/03APR1997/5MIN/100YEAR/
        Number of actual data:  288  Header length:   0
        Compression:   0  Quality:   0
-----DSS--- ZREAD Unit  71; Vers.    2:  /CAP1A/OVERCHUTE/FLOW/03APR1997/5MIN/100YEAR/
      ----DSS---Debug:  Enter ZRRTSB;  Unit:  71
        NSTART:  578   NVALS:  744    JULS:   35519  ISTIME:  1440
        NLDATA:  288   JULSD:   35522
        JULS: 31MAR97       JULSD: 03APR97
        Quality Read: F,  Quality Requested: F
        ---ZRRTSB Calculations:  NPOS:    1  NDATA:  288  NREAD:  167  ILIM:  744
      ----- Exiting ZRRTS, Number of data values:    744,  Status:  0
        Offset:       0,  Units: CFS     ,  Type:INST-VAL
        ----- Entering ZRRTSX for unit 71 -----
Pathname: /CAP1A/OVERCHUTE/FLOW//5MIN/100YEAR/
        Time Window set.  Interval:     5  Number of data values:      1
        Starting date and time:  Apr 3, 1997  1355  (  35522  835)
        Ending   date and time:  Apr 3, 1997  1355  (  35522  835)
        Input time offset:      0
        After ZRDINF, Record found: T
        Pathname: /CAP1A/OVERCHUTE/FLOW/03APR1997/5MIN/100YEAR/
        Number of actual data:  288  Header length:   0
        Compression:   0  Quality:   0
-----DSS--- ZREAD Unit  71; Vers.    2:  /CAP1A/OVERCHUTE/FLOW/03APR1997/5MIN/100YEAR/
      ----DSS---Debug:  Enter ZRRTSB;  Unit:  71
        NSTART:    1   NVALS:    1    JULS:   35522  ISTIME:   835
        NLDATA:  288   JULSD:   35522
        JULS: 03APR97       JULSD: 03APR97
        Quality Read: F,  Quality Requested: F
        ---ZRRTSB Calculations:  NPOS:  167  NDATA:  288  NREAD:    1  ILIM:    1
      ----- Exiting ZRRTS, Number of data values:      1,  Status:  0
        Offset:       0,  Units: CFS     ,  Type:INST-VAL
        ----- Entering ZRRTSX for unit 71 -----
Pathname: /CAP1A/OVERCHUTE/FLOW//5MIN/100YEAR/
        Time Window set.  Interval:     5  Number of data values:    744
        Starting date and time:  Apr 3, 1997  1355  (  35522  835)
        Ending   date and time:  Apr 6, 1997  0350  (  35525  230)
        Input time offset:      0
        After ZRDINF, Record found: T
        Pathname: /CAP1A/OVERCHUTE/FLOW/03APR1997/5MIN/100YEAR/
        Number of actual data:  288  Header length:   0
        Compression:   0  Quality:   0
-----DSS--- ZREAD Unit  71; Vers.    2:  /CAP1A/OVERCHUTE/FLOW/03APR1997/5MIN/100YEAR/
      ----DSS---Debug:  Enter ZRRTSB;  Unit:  71
        NSTART:    1   NVALS:  744    JULS:   35522  ISTIME:   835
        NLDATA:  288   JULSD:   35522
        JULS: 03APR97       JULSD: 03APR97
        Quality Read: F,  Quality Requested: F
        ---ZRRTSB Calculations:  NPOS:  167  NDATA:  288  NREAD:  122  ILIM:  122
        After ZRDINF, Record found: T
        Pathname: /CAP1A/OVERCHUTE/FLOW/04APR1997/5MIN/100YEAR/
        Number of actual data:  288  Header length:   0
        Compression:   0  Quality:   0
-----DSS--- ZREAD Unit  71; Vers.    2:  /CAP1A/OVERCHUTE/FLOW/04APR1997/5MIN/100YEAR/
      ----DSS---Debug:  Enter ZRRTSB;  Unit:  71
        NSTART:  123   NVALS:  744    JULS:   35522  ISTIME:   835
        NLDATA:  288   JULSD:   35523
        JULS: 03APR97       JULSD: 04APR97
        Quality Read: F,  Quality Requested: F
        ---ZRRTSB Calculations:  NPOS:    1  NDATA:  288  NREAD:  288  ILIM:  410
        After ZRDINF, Record found: F
```

```
        Pathname: /CAP1A/OVERCHUTE/FLOW/05APR1997/5MIN/100YEAR/
      ----DSS---Debug:  Enter ZRRTSB;  Unit:  71
        NSTART:  411   NVALS:  744    JULS:   35522  ISTIME:   835
        NLDATA:  288   JULSD:   35524
        JULS: 03APR97       JULSD: 05APR97
        Quality Read: F,  Quality Requested: F
        ---ZRRTSB Calculations:  NPOS:    1  NDATA:  288  NREAD:  288  ILIM:  698
-----DSS*** ZRRTS:  CAUTION - Data block not found in file.  Unit:  71
Pathname: /CAP1A/OVERCHUTE/FLOW/05APR1997/5MIN/100YEAR/
        After ZRDINF, Record found: F
        Pathname: /CAP1A/OVERCHUTE/FLOW/06APR1997/5MIN/100YEAR/
      ----DSS---Debug:  Enter ZRRTSB;  Unit:  71
        NSTART:  699   NVALS:  744    JULS:   35522  ISTIME:   835
        NLDATA:  288   JULSD:   35525
        JULS: 03APR97       JULSD: 06APR97
        Quality Read: F,  Quality Requested: F
        ---ZRRTSB Calculations:  NPOS:    1  NDATA:  288  NREAD:   46  ILIM:  744
      ----- Exiting ZRRTS, Number of data values:    744,  Status:  3
        Offset:       0,  Units: CFS     ,  Type:INST-VAL
        ----- Entering ZRRTSX for unit 71 -----
Pathname: /CAP1B/OVERCHUTE/FLOW//5MIN/100YEAR/
        Time Window set.  Interval:     5  Number of data values:      1
        Starting date and time:  Mar 31, 1997  2400  (  35519 1440)
        Ending   date and time:  Mar 31, 1997  2400  (  35519 1440)
        Input time offset:      0
        After ZRDINF, Record found: T
        Pathname: /CAP1B/OVERCHUTE/FLOW/31MAR1997/5MIN/100YEAR/
        Number of actual data:  288  Header length:   0
        Compression:   0  Quality:   0
-----DSS--- ZREAD Unit  71; Vers.    2:  /CAP1B/OVERCHUTE/FLOW/31MAR1997/5MIN/100YEAR/
      ----DSS---Debug:  Enter ZRRTSB;  Unit:  71
        NSTART:    1   NVALS:    1    JULS:   35519  ISTIME:  1440
        NLDATA:  288   JULSD:   35519
        JULS: 31MAR97       JULSD: 31MAR97
        Quality Read: F,  Quality Requested: F
        ---ZRRTSB Calculations:  NPOS:  288  NDATA:  288  NREAD:    1  ILIM:    1
      ----- Exiting ZRRTS, Number of data values:      1,  Status:  0
        Offset:       0,  Units: CFS     ,  Type:INST-VAL
        ----- Entering ZRRTSX for unit 71 -----
Pathname: /CAP1B/OVERCHUTE/FLOW//5MIN/100YEAR/
        Time Window set.  Interval:     5  Number of data values:    744
        Starting date and time:  Mar 31, 1997  2400  (  35519 1440)
        Ending   date and time:  Apr 3, 1997  1355  (  35522  835)
        Input time offset:      0
        After ZRDINF, Record found: T
        Pathname: /CAP1B/OVERCHUTE/FLOW/31MAR1997/5MIN/100YEAR/
        Number of actual data:  288  Header length:   0
        Compression:   0  Quality:   0
-----DSS--- ZREAD Unit  71; Vers.    2:  /CAP1B/OVERCHUTE/FLOW/31MAR1997/5MIN/100YEAR/
      ----DSS---Debug:  Enter ZRRTSB;  Unit:  71
        NSTART:    1   NVALS:  744    JULS:   35519  ISTIME:  1440
        NLDATA:  288   JULSD:   35519
        JULS: 31MAR97       JULSD: 31MAR97
        Quality Read: F,  Quality Requested: F
        ---ZRRTSB Calculations:  NPOS:  288  NDATA:  288  NREAD:    1  ILIM:    1
        After ZRDINF, Record found: T
        Pathname: /CAP1B/OVERCHUTE/FLOW/01APR1997/5MIN/100YEAR/
        Number of actual data:  288  Header length:   0
        Compression:   0  Quality:   0
-----DSS--- ZREAD Unit  71; Vers.    2:  /CAP1B/OVERCHUTE/FLOW/01APR1997/5MIN/100YEAR/
      ----DSS---Debug:  Enter ZRRTSB;  Unit:  71
        NSTART:    2   NVALS:  744    JULS:   35519  ISTIME:  1440
        NLDATA:  288   JULSD:   35520
        JULS: 31MAR97       JULSD: 01APR97
        Quality Read: F,  Quality Requested: F
        ---ZRRTSB Calculations:  NPOS:    1  NDATA:  288  NREAD:  288  ILIM:  289
        After ZRDINF, Record found: T
        Pathname: /CAP1B/OVERCHUTE/FLOW/02APR1997/5MIN/100YEAR/
        Number of actual data:  288  Header length:   0
        Compression:   0  Quality:   0
-----DSS--- ZREAD Unit  71; Vers.    2:  /CAP1B/OVERCHUTE/FLOW/02APR1997/5MIN/100YEAR/
      ----DSS---Debug:  Enter ZRRTSB;  Unit:  71
        NSTART:  290   NVALS:  744    JULS:   35519  ISTIME:  1440
        NLDATA:  288   JULSD:   35521
        JULS: 31MAR97       JULSD: 02APR97
        Quality Read: F,  Quality Requested: F
        ---ZRRTSB Calculations:  NPOS:    1  NDATA:  288  NREAD:  288  ILIM:  577
        After ZRDINF, Record found: T
        Pathname: /CAP1B/OVERCHUTE/FLOW/03APR1997/5MIN/100YEAR/
        Number of actual data:  288  Header length:   0
        Compression:   0  Quality:   0
-----DSS--- ZREAD Unit  71; Vers.    2:  /CAP1B/OVERCHUTE/FLOW/03APR1997/5MIN/100YEAR/
      ----DSS---Debug:  Enter ZRRTSB;  Unit:  71
        NSTART:  578   NVALS:  744    JULS:   35519  ISTIME:  1440
        NLDATA:  288   JULSD:   35522
        JULS: 31MAR97       JULSD: 03APR97
        Quality Read: F,  Quality Requested: F
        ---ZRRTSB Calculations:  NPOS:    1  NDATA:  288  NREAD:  167  ILIM:  744
      ----- Exiting ZRRTS, Number of data values:    744,  Status:  0
        Offset:       0,  Units: CFS     ,  Type:INST-VAL
        ----- Entering ZRRTSX for unit 71 -----
Pathname: /CAP1B/OVERCHUTE/FLOW//5MIN/100YEAR/
        Time Window set.  Interval:     5  Number of data values:      1
        Starting date and time:  Apr 3, 1997  1355  (  35522  835)
        Ending   date and time:  Apr 3, 1997  1355  (  35522  835)
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        Input time offset:      0
        After ZRDINF, Record found: T
        Pathname: /CAP1B/OVERCHUTE/FLOW/03APR1997/5MIN/100YEAR/
        Number of actual data:  288  Header length:   0
        Compression:   0  Quality:   0
-----DSS--- ZREAD Unit  71; Vers.    2:  /CAP1B/OVERCHUTE/FLOW/03APR1997/5MIN/100YEAR/
      ----DSS---Debug:  Enter ZRRTSB;  Unit:  71
        NSTART:    1   NVALS:    1    JULS:   35522  ISTIME:   835
        NLDATA:  288   JULSD:   35522
        JULS: 03APR97       JULSD: 03APR97
        Quality Read: F,  Quality Requested: F
        ---ZRRTSB Calculations:  NPOS:  167  NDATA:  288  NREAD:    1  ILIM:    1
      ----- Exiting ZRRTS, Number of data values:      1,  Status:  0
        Offset:       0,  Units: CFS     ,  Type:INST-VAL
        ----- Entering ZRRTSX for unit 71 -----
Pathname: /CAP1B/OVERCHUTE/FLOW//5MIN/100YEAR/
        Time Window set.  Interval:     5  Number of data values:    744
        Starting date and time:  Apr 3, 1997  1355  (  35522  835)
        Ending   date and time:  Apr 6, 1997  0350  (  35525  230)
        Input time offset:      0
        After ZRDINF, Record found: T
        Pathname: /CAP1B/OVERCHUTE/FLOW/03APR1997/5MIN/100YEAR/
        Number of actual data:  288  Header length:   0
        Compression:   0  Quality:   0
-----DSS--- ZREAD Unit  71; Vers.    2:  /CAP1B/OVERCHUTE/FLOW/03APR1997/5MIN/100YEAR/
      ----DSS---Debug:  Enter ZRRTSB;  Unit:  71
        NSTART:    1   NVALS:  744    JULS:   35522  ISTIME:   835
        NLDATA:  288   JULSD:   35522
        JULS: 03APR97       JULSD: 03APR97
        Quality Read: F,  Quality Requested: F
        ---ZRRTSB Calculations:  NPOS:  167  NDATA:  288  NREAD:  122  ILIM:  122
        After ZRDINF, Record found: T
        Pathname: /CAP1B/OVERCHUTE/FLOW/04APR1997/5MIN/100YEAR/
        Number of actual data:  288  Header length:   0
        Compression:   0  Quality:   0
-----DSS--- ZREAD Unit  71; Vers.    2:  /CAP1B/OVERCHUTE/FLOW/04APR1997/5MIN/100YEAR/
      ----DSS---Debug:  Enter ZRRTSB;  Unit:  71
        NSTART:  123   NVALS:  744    JULS:   35522  ISTIME:   835
        NLDATA:  288   JULSD:   35523
        JULS: 03APR97       JULSD: 04APR97
        Quality Read: F,  Quality Requested: F
        ---ZRRTSB Calculations:  NPOS:    1  NDATA:  288  NREAD:  288  ILIM:  410
        After ZRDINF, Record found: F
        Pathname: /CAP1B/OVERCHUTE/FLOW/05APR1997/5MIN/100YEAR/
      ----DSS---Debug:  Enter ZRRTSB;  Unit:  71
        NSTART:  411   NVALS:  744    JULS:   35522  ISTIME:   835
        NLDATA:  288   JULSD:   35524
        JULS: 03APR97       JULSD: 05APR97
        Quality Read: F,  Quality Requested: F
        ---ZRRTSB Calculations:  NPOS:    1  NDATA:  288  NREAD:  288  ILIM:  698
-----DSS*** ZRRTS:  CAUTION - Data block not found in file.  Unit:  71
Pathname: /CAP1B/OVERCHUTE/FLOW/05APR1997/5MIN/100YEAR/
        After ZRDINF, Record found: F
        Pathname: /CAP1B/OVERCHUTE/FLOW/06APR1997/5MIN/100YEAR/
      ----DSS---Debug:  Enter ZRRTSB;  Unit:  71
        NSTART:  699   NVALS:  744    JULS:   35522  ISTIME:   835
        NLDATA:  288   JULSD:   35525
        JULS: 03APR97       JULSD: 06APR97
        Quality Read: F,  Quality Requested: F
        ---ZRRTSB Calculations:  NPOS:    1  NDATA:  288  NREAD:   46  ILIM:  744
      ----- Exiting ZRRTS, Number of data values:    744,  Status:  3
        Offset:       0,  Units: CFS     ,  Type:INST-VAL
-----DSS---ZWRITE Unit  71; Vers.    3:  /X65A3/X65A3/FLOW/31MAR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    3:  /X65A3/X65A3/FLOW/01APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    3:  /X65A3/X65A3/FLOW/02APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    3:  /X65A3/X65A3/FLOW/03APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    3:  /X65A3/X65A3/FLOW/04APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    3:  /SDWDBS/COMBINED SDW N MERIDIAN/FLOW/31MAR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    3:  /SDWDBS/COMBINED SDW N MERIDIAN/FLOW/01APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    3:  /SDWDBS/COMBINED SDW N MERIDIAN/FLOW/02APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    3:  /SDWDBS/COMBINED SDW N MERIDIAN/FLOW/03APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    3:  /SDWDBS/COMBINED SDW N MERIDIAN/FLOW/04APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    3:  /DB/SINGLE BASIN OUTLET/FLOW/31MAR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    3:  /DB/SINGLE BASIN OUTLET/FLOW/01APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    3:  /DB/SINGLE BASIN OUTLET/FLOW/02APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    3:  /DB/SINGLE BASIN OUTLET/FLOW/03APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    3:  /DB/SINGLE BASIN OUTLET/FLOW/04APR1997/5MIN/100YR/

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-----DSS---ZWRITE Unit  71; Vers.    2:  /65A3BY/X65A3BY/FLOW/31MAR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    2:  /65A3BY/X65A3BY/FLOW/01APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    2:  /65A3BY/X65A3BY/FLOW/02APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    2:  /65A3BY/X65A3BY/FLOW/03APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    2:  /65A3BY/X65A3BY/FLOW/04APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    3:  /CP-MER/FLOW AT MERIDIAN CULVER/FLOW/31MAR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    3:  /CP-MER/FLOW AT MERIDIAN CULVER/FLOW/01APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    3:  /CP-MER/FLOW AT MERIDIAN CULVER/FLOW/02APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    3:  /CP-MER/FLOW AT MERIDIAN CULVER/FLOW/03APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    3:  /CP-MER/FLOW AT MERIDIAN CULVER/FLOW/04APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    3:  /RSDW2/RSDW2 ROUTED FLOW FROM SDDB/FLOW/31MAR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    3:  /RSDW2/RSDW2 ROUTED FLOW FROM SDDB/FLOW/01APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    3:  /RSDW2/RSDW2 ROUTED FLOW FROM SDDB/FLOW/02APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    3:  /RSDW2/RSDW2 ROUTED FLOW FROM SDDB/FLOW/03APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    3:  /RSDW2/RSDW2 ROUTED FLOW FROM SDDB/FLOW/04APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    3:  /65AT65/65AT65 IS 65AW ROUTED/FLOW/31MAR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    3:  /65AT65/65AT65 IS 65AW ROUTED/FLOW/01APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    3:  /65AT65/65AT65 IS 65AW ROUTED/FLOW/02APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    3:  /65AT65/65AT65 IS 65AW ROUTED/FLOW/03APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    3:  /65AT65/65AT65 IS 65AW ROUTED/FLOW/04APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    5:  /R65B/R65B IS ROUTED 65B/FLOW/31MAR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    5:  /R65B/R65B IS ROUTED 65B/FLOW/01APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    5:  /R65B/R65B IS ROUTED 65B/FLOW/02APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    5:  /R65B/R65B IS ROUTED 65B/FLOW/03APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    5:  /R65B/R65B IS ROUTED 65B/FLOW/04APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.   15:  /R65B/R65B IS ROUTED 65B/FLOW/31MAR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   15:  /R65B/R65B IS ROUTED 65B/FLOW/01APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   15:  /R65B/R65B IS ROUTED 65B/FLOW/02APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   15:  /R65B/R65B IS ROUTED 65B/FLOW/03APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   15:  /R65B/R65B IS ROUTED 65B/FLOW/04APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   16:  /R65B/R65B IS ROUTED 65B/FLOW/31MAR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   16:  /R65B/R65B IS ROUTED 65B/FLOW/01APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   16:  /R65B/R65B IS ROUTED 65B/FLOW/02APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   16:  /R65B/R65B IS ROUTED 65B/FLOW/03APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   16:  /R65B/R65B IS ROUTED 65B/FLOW/04APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   17:  /R65B/R65B IS ROUTED 65B/FLOW/31MAR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   17:  /R65B/R65B IS ROUTED 65B/FLOW/01APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   17:  /R65B/R65B IS ROUTED 65B/FLOW/02APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   17:  /R65B/R65B IS ROUTED 65B/FLOW/03APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   17:  /R65B/R65B IS ROUTED 65B/FLOW/04APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   18:  /R65B/R65B IS ROUTED 65B/FLOW/31MAR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   18:  /R65B/R65B IS ROUTED 65B/FLOW/01APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   18:  /R65B/R65B IS ROUTED 65B/FLOW/02APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   18:  /R65B/R65B IS ROUTED 65B/FLOW/03APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   18:  /R65B/R65B IS ROUTED 65B/FLOW/04APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   19:  /R65B/R65B IS ROUTED 65B/FLOW/31MAR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   19:  /R65B/R65B IS ROUTED 65B/FLOW/01APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   19:  /R65B/R65B IS ROUTED 65B/FLOW/02APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   19:  /R65B/R65B IS ROUTED 65B/FLOW/03APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   19:  /R65B/R65B IS ROUTED 65B/FLOW/04APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   20:  /R65B/R65B IS ROUTED 65B/FLOW/31MAR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   20:  /R65B/R65B IS ROUTED 65B/FLOW/01APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   20:  /R65B/R65B IS ROUTED 65B/FLOW/02APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   20:  /R65B/R65B IS ROUTED 65B/FLOW/03APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   20:  /R65B/R65B IS ROUTED 65B/FLOW/04APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   21:  /R65B/R65B IS ROUTED 65B/FLOW/31MAR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   21:  /R65B/R65B IS ROUTED 65B/FLOW/01APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   21:  /R65B/R65B IS ROUTED 65B/FLOW/02APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   21:  /R65B/R65B IS ROUTED 65B/FLOW/03APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   21:  /R65B/R65B IS ROUTED 65B/FLOW/04APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.    3:  /R65B/R65B IS ROUTED 65B/FLOW/31MAR1997/5MIN/??????????????????????????????????/
-----DSS---ZWRITE Unit  71; Vers.    3:  /R65B/R65B IS ROUTED 65B/FLOW/01APR1997/5MIN/??????????????????????????????????/
-----DSS---ZWRITE Unit  71; Vers.    3:  /R65B/R65B IS ROUTED 65B/FLOW/02APR1997/5MIN/??????????????????????????????????/
-----DSS---ZWRITE Unit  71; Vers.    3:  /R65B/R65B IS ROUTED 65B/FLOW/03APR1997/5MIN/??????????????????????????????????/
-----DSS---ZWRITE Unit  71; Vers.    3:  /R65B/R65B IS ROUTED 65B/FLOW/04APR1997/5MIN/??????????????????????????????????/
-----DSS---ZWRITE Unit  71; Vers.    6:  /R65B/R65B IS ROUTED 65B/FLOW/31MAR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    6:  /R65B/R65B IS ROUTED 65B/FLOW/01APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    6:  /R65B/R65B IS ROUTED 65B/FLOW/02APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    6:  /R65B/R65B IS ROUTED 65B/FLOW/03APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    6:  /R65B/R65B IS ROUTED 65B/FLOW/04APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    3:  /CP65B/CP65B IS 65AW+65B+RDSW2/FLOW/31MAR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    3:  /CP65B/CP65B IS 65AW+65B+RDSW2/FLOW/01APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    3:  /CP65B/CP65B IS 65AW+65B+RDSW2/FLOW/02APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    3:  /CP65B/CP65B IS 65AW+65B+RDSW2/FLOW/03APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    3:  /CP65B/CP65B IS 65AW+65B+RDSW2/FLOW/04APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    5:  /DI65B/SDW FLOW TO STORM DRAIN/FLOW/31MAR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    5:  /DI65B/SDW FLOW TO STORM DRAIN/FLOW/01APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    5:  /DI65B/SDW FLOW TO STORM DRAIN/FLOW/02APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    5:  /DI65B/SDW FLOW TO STORM DRAIN/FLOW/03APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    5:  /DI65B/SDW FLOW TO STORM DRAIN/FLOW/04APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.   15:  /DI65B/SDW FLOW TO STORM DRAIN/FLOW/31MAR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   15:  /DI65B/SDW FLOW TO STORM DRAIN/FLOW/01APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   15:  /DI65B/SDW FLOW TO STORM DRAIN/FLOW/02APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   15:  /DI65B/SDW FLOW TO STORM DRAIN/FLOW/03APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   15:  /DI65B/SDW FLOW TO STORM DRAIN/FLOW/04APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   16:  /DI65B/SDW FLOW TO STORM DRAIN/FLOW/31MAR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   16:  /DI65B/SDW FLOW TO STORM DRAIN/FLOW/01APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   16:  /DI65B/SDW FLOW TO STORM DRAIN/FLOW/02APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   16:  /DI65B/SDW FLOW TO STORM DRAIN/FLOW/03APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   16:  /DI65B/SDW FLOW TO STORM DRAIN/FLOW/04APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   17:  /DI65B/SDW FLOW TO STORM DRAIN/FLOW/31MAR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   17:  /DI65B/SDW FLOW TO STORM DRAIN/FLOW/01APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   17:  /DI65B/SDW FLOW TO STORM DRAIN/FLOW/02APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   17:  /DI65B/SDW FLOW TO STORM DRAIN/FLOW/03APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   17:  /DI65B/SDW FLOW TO STORM DRAIN/FLOW/04APR1997/5MIN//
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-----DSS---ZWRITE Unit  71; Vers.   18:  /DI65B/SDW FLOW TO STORM DRAIN/FLOW/31MAR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   18:  /DI65B/SDW FLOW TO STORM DRAIN/FLOW/01APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   18:  /DI65B/SDW FLOW TO STORM DRAIN/FLOW/02APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   18:  /DI65B/SDW FLOW TO STORM DRAIN/FLOW/03APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   18:  /DI65B/SDW FLOW TO STORM DRAIN/FLOW/04APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   19:  /DI65B/SDW FLOW TO STORM DRAIN/FLOW/31MAR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   19:  /DI65B/SDW FLOW TO STORM DRAIN/FLOW/01APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   19:  /DI65B/SDW FLOW TO STORM DRAIN/FLOW/02APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   19:  /DI65B/SDW FLOW TO STORM DRAIN/FLOW/03APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   19:  /DI65B/SDW FLOW TO STORM DRAIN/FLOW/04APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   20:  /DI65B/SDW FLOW TO STORM DRAIN/FLOW/31MAR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   20:  /DI65B/SDW FLOW TO STORM DRAIN/FLOW/01APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   20:  /DI65B/SDW FLOW TO STORM DRAIN/FLOW/02APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   20:  /DI65B/SDW FLOW TO STORM DRAIN/FLOW/03APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   20:  /DI65B/SDW FLOW TO STORM DRAIN/FLOW/04APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   21:  /DI65B/SDW FLOW TO STORM DRAIN/FLOW/31MAR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   21:  /DI65B/SDW FLOW TO STORM DRAIN/FLOW/01APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   21:  /DI65B/SDW FLOW TO STORM DRAIN/FLOW/02APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   21:  /DI65B/SDW FLOW TO STORM DRAIN/FLOW/03APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   21:  /DI65B/SDW FLOW TO STORM DRAIN/FLOW/04APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.    3:  /DI65B/SDW FLOW TO STORM DRAIN/FLOW/31MAR1997/5MIN/????????????????????????????/
-----DSS---ZWRITE Unit  71; Vers.    3:  /DI65B/SDW FLOW TO STORM DRAIN/FLOW/01APR1997/5MIN/????????????????????????????/
-----DSS---ZWRITE Unit  71; Vers.    3:  /DI65B/SDW FLOW TO STORM DRAIN/FLOW/02APR1997/5MIN/????????????????????????????/
-----DSS---ZWRITE Unit  71; Vers.    3:  /DI65B/SDW FLOW TO STORM DRAIN/FLOW/03APR1997/5MIN/????????????????????????????/
-----DSS---ZWRITE Unit  71; Vers.    3:  /DI65B/SDW FLOW TO STORM DRAIN/FLOW/04APR1997/5MIN/????????????????????????????/
-----DSS---ZWRITE Unit  71; Vers.    6:  /DI65B/SDW FLOW TO STORM DRAIN/FLOW/31MAR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    6:  /DI65B/SDW FLOW TO STORM DRAIN/FLOW/01APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    6:  /DI65B/SDW FLOW TO STORM DRAIN/FLOW/02APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    6:  /DI65B/SDW FLOW TO STORM DRAIN/FLOW/03APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    6:  /DI65B/SDW FLOW TO STORM DRAIN/FLOW/04APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    5:  /DR65B/SDW FLOW TO ELLIOT BASIN/FLOW/31MAR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    5:  /DR65B/SDW FLOW TO ELLIOT BASIN/FLOW/01APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    5:  /DR65B/SDW FLOW TO ELLIOT BASIN/FLOW/02APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    5:  /DR65B/SDW FLOW TO ELLIOT BASIN/FLOW/03APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    5:  /DR65B/SDW FLOW TO ELLIOT BASIN/FLOW/04APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.   15:  /DR65B/SDW FLOW TO ELLIOT BASIN/FLOW/31MAR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   15:  /DR65B/SDW FLOW TO ELLIOT BASIN/FLOW/01APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   15:  /DR65B/SDW FLOW TO ELLIOT BASIN/FLOW/02APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   15:  /DR65B/SDW FLOW TO ELLIOT BASIN/FLOW/03APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   15:  /DR65B/SDW FLOW TO ELLIOT BASIN/FLOW/04APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   16:  /DR65B/SDW FLOW TO ELLIOT BASIN/FLOW/31MAR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   16:  /DR65B/SDW FLOW TO ELLIOT BASIN/FLOW/01APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   16:  /DR65B/SDW FLOW TO ELLIOT BASIN/FLOW/02APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   16:  /DR65B/SDW FLOW TO ELLIOT BASIN/FLOW/03APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   16:  /DR65B/SDW FLOW TO ELLIOT BASIN/FLOW/04APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   17:  /DR65B/SDW FLOW TO ELLIOT BASIN/FLOW/31MAR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   17:  /DR65B/SDW FLOW TO ELLIOT BASIN/FLOW/01APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   17:  /DR65B/SDW FLOW TO ELLIOT BASIN/FLOW/02APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   17:  /DR65B/SDW FLOW TO ELLIOT BASIN/FLOW/03APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   17:  /DR65B/SDW FLOW TO ELLIOT BASIN/FLOW/04APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   18:  /DR65B/SDW FLOW TO ELLIOT BASIN/FLOW/31MAR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   18:  /DR65B/SDW FLOW TO ELLIOT BASIN/FLOW/01APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   18:  /DR65B/SDW FLOW TO ELLIOT BASIN/FLOW/02APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   18:  /DR65B/SDW FLOW TO ELLIOT BASIN/FLOW/03APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   18:  /DR65B/SDW FLOW TO ELLIOT BASIN/FLOW/04APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   19:  /DR65B/SDW FLOW TO ELLIOT BASIN/FLOW/31MAR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   19:  /DR65B/SDW FLOW TO ELLIOT BASIN/FLOW/01APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   19:  /DR65B/SDW FLOW TO ELLIOT BASIN/FLOW/02APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   19:  /DR65B/SDW FLOW TO ELLIOT BASIN/FLOW/03APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   19:  /DR65B/SDW FLOW TO ELLIOT BASIN/FLOW/04APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   20:  /DR65B/SDW FLOW TO ELLIOT BASIN/FLOW/31MAR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   20:  /DR65B/SDW FLOW TO ELLIOT BASIN/FLOW/01APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   20:  /DR65B/SDW FLOW TO ELLIOT BASIN/FLOW/02APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   20:  /DR65B/SDW FLOW TO ELLIOT BASIN/FLOW/03APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   20:  /DR65B/SDW FLOW TO ELLIOT BASIN/FLOW/04APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   21:  /DR65B/SDW FLOW TO ELLIOT BASIN/FLOW/31MAR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   21:  /DR65B/SDW FLOW TO ELLIOT BASIN/FLOW/01APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   21:  /DR65B/SDW FLOW TO ELLIOT BASIN/FLOW/02APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   21:  /DR65B/SDW FLOW TO ELLIOT BASIN/FLOW/03APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.   21:  /DR65B/SDW FLOW TO ELLIOT BASIN/FLOW/04APR1997/5MIN//
-----DSS---ZWRITE Unit  71; Vers.    3:  /DR65B/SDW FLOW TO ELLIOT BASIN/FLOW/31MAR1997/5MIN/????????????????????????????/
-----DSS---ZWRITE Unit  71; Vers.    3:  /DR65B/SDW FLOW TO ELLIOT BASIN/FLOW/01APR1997/5MIN/????????????????????????????/
-----DSS---ZWRITE Unit  71; Vers.    3:  /DR65B/SDW FLOW TO ELLIOT BASIN/FLOW/02APR1997/5MIN/????????????????????????????/
-----DSS---ZWRITE Unit  71; Vers.    3:  /DR65B/SDW FLOW TO ELLIOT BASIN/FLOW/03APR1997/5MIN/????????????????????????????/
-----DSS---ZWRITE Unit  71; Vers.    3:  /DR65B/SDW FLOW TO ELLIOT BASIN/FLOW/04APR1997/5MIN/????????????????????????????/
-----DSS---ZWRITE Unit  71; Vers.    6:  /DR65B/SDW FLOW TO ELLIOT BASIN/FLOW/31MAR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    6:  /DR65B/SDW FLOW TO ELLIOT BASIN/FLOW/01APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    6:  /DR65B/SDW FLOW TO ELLIOT BASIN/FLOW/02APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    6:  /DR65B/SDW FLOW TO ELLIOT BASIN/FLOW/03APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    6:  /DR65B/SDW FLOW TO ELLIOT BASIN/FLOW/04APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    3:  /RS65A/OUTFLOW FROM ELLIOT BASIN/FLOW/31MAR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    3:  /RS65A/OUTFLOW FROM ELLIOT BASIN/FLOW/01APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    3:  /RS65A/OUTFLOW FROM ELLIOT BASIN/FLOW/02APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    3:  /RS65A/OUTFLOW FROM ELLIOT BASIN/FLOW/03APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    3:  /RS65A/OUTFLOW FROM ELLIOT BASIN/FLOW/04APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    3:  /CP65/SD FLOW DS OF ELLIOT BASIN/FLOW/31MAR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    3:  /CP65/SD FLOW DS OF ELLIOT BASIN/FLOW/01APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    3:  /CP65/SD FLOW DS OF ELLIOT BASIN/FLOW/02APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    3:  /CP65/SD FLOW DS OF ELLIOT BASIN/FLOW/03APR1997/5MIN/100YR/
-----DSS---ZWRITE Unit  71; Vers.    3:  /CP65/SD FLOW DS OF ELLIOT BASIN/FLOW/04APR1997/5MIN/100YR/
        ----- Entering ZRRTSX for unit 71 -----
Pathname: /ADOT EAST BASIN/AT SUPERSTITION/FLOW//5MIN/100YR/
        Time Window set.  Interval:     5  Number of data values:      1
        Starting date and time:  Mar 31, 1997  2400  (  35519 1440)
        Ending   date and time:  Mar 31, 1997  2400  (  35519 1440)
```

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        Input time offset:      0
        After ZRDINF, Record found: T
        Pathname: /ADOT EAST BASIN/AT SUPERSTITION/FLOW/31MAR1997/5MIN/100YR/
        Number of actual data:  288  Header length:   0
        Compression:   0  Quality:   0
-----DSS--- ZREAD Unit  71; Vers.    1:  /ADOT EAST BASIN/AT SUPERSTITION/FLOW/31MAR1997/5MIN/100YR/
      ----DSS---Debug:  Enter ZRRTSB;  Unit:  71
        NSTART:    1   NVALS:    1    JULS:   35519  ISTIME:  1440
        NLDATA:  288   JULSD:   35519
        JULS: 31MAR97       JULSD: 31MAR97
        Quality Read: F,  Quality Requested: F
        ---ZRRTSB Calculations:  NPOS:  288  NDATA:  288  NREAD:    1  ILIM:    1
      ----- Exiting ZRRTS, Number of data values:      1,  Status:  0
        Offset:       0,  Units: CFS     ,  Type:INST-VAL
        ----- Entering ZRRTSX for unit 71 -----
Pathname: /ADOT EAST BASIN/AT SUPERSTITION/FLOW//5MIN/100YR/
        Time Window set.  Interval:     5  Number of data values:    744
        Starting date and time:  Mar 31, 1997  2400  (  35519 1440)
        Ending   date and time:  Apr 3, 1997  1355  (  35522  835)
        Input time offset:      0
        After ZRDINF, Record found: T
        Pathname: /ADOT EAST BASIN/AT SUPERSTITION/FLOW/31MAR1997/5MIN/100YR/
        Number of actual data:  288  Header length:   0
        Compression:   0  Quality:   0
-----DSS--- ZREAD Unit  71; Vers.    1:  /ADOT EAST BASIN/AT SUPERSTITION/FLOW/31MAR1997/5MIN/100YR/
      ----DSS---Debug:  Enter ZRRTSB;  Unit:  71
        NSTART:    1   NVALS:  744    JULS:   35519  ISTIME:  1440
        NLDATA:  288   JULSD:   35519
        JULS: 31MAR97       JULSD: 31MAR97
        Quality Read: F,  Quality Requested: F
        ---ZRRTSB Calculations:  NPOS:  288  NDATA:  288  NREAD:    1  ILIM:    1
        After ZRDINF, Record found: T
        Pathname: /ADOT EAST BASIN/AT SUPERSTITION/FLOW/01APR1997/5MIN/100YR/
        Number of actual data:  288  Header length:   0
        Compression:   0  Quality:   0
-----DSS--- ZREAD Unit  71; Vers.    1:  /ADOT EAST BASIN/AT SUPERSTITION/FLOW/01APR1997/5MIN/100YR/
      ----DSS---Debug:  Enter ZRRTSB;  Unit:  71
        NSTART:    2   NVALS:  744    JULS:   35519  ISTIME:  1440
        NLDATA:  288   JULSD:   35520
        JULS: 31MAR97       JULSD: 01APR97
        Quality Read: F,  Quality Requested: F
        ---ZRRTSB Calculations:  NPOS:    1  NDATA:  288  NREAD:  288  ILIM:  289
        After ZRDINF, Record found: T
        Pathname: /ADOT EAST BASIN/AT SUPERSTITION/FLOW/02APR1997/5MIN/100YR/
        Number of actual data:  288  Header length:   0
        Compression:   0  Quality:   0
-----DSS--- ZREAD Unit  71; Vers.    1:  /ADOT EAST BASIN/AT SUPERSTITION/FLOW/02APR1997/5MIN/100YR/
      ----DSS---Debug:  Enter ZRRTSB;  Unit:  71
        NSTART:  290   NVALS:  744    JULS:   35519  ISTIME:  1440
        NLDATA:  288   JULSD:   35521
        JULS: 31MAR97       JULSD: 02APR97
        Quality Read: F,  Quality Requested: F
        ---ZRRTSB Calculations:  NPOS:    1  NDATA:  288  NREAD:  288  ILIM:  577
        After ZRDINF, Record found: T
        Pathname: /ADOT EAST BASIN/AT SUPERSTITION/FLOW/03APR1997/5MIN/100YR/
        Number of actual data:  288  Header length:   0
        Compression:   0  Quality:   0
-----DSS--- ZREAD Unit  71; Vers.    1:  /ADOT EAST BASIN/AT SUPERSTITION/FLOW/03APR1997/5MIN/100YR/
      ----DSS---Debug:  Enter ZRRTSB;  Unit:  71
        NSTART:  578   NVALS:  744    JULS:   35519  ISTIME:  1440
        NLDATA:  288   JULSD:   35522
        JULS: 31MAR97       JULSD: 03APR97
        Quality Read: F,  Quality Requested: F
        ---ZRRTSB Calculations:  NPOS:    1  NDATA:  288  NREAD:  167  ILIM:  744
      ----- Exiting ZRRTS, Number of data values:    744,  Status:  0
        Offset:       0,  Units: CFS     ,  Type:INST-VAL
        ----- Entering ZRRTSX for unit 71 -----
Pathname: /ADOT EAST BASIN/AT SUPERSTITION/FLOW//5MIN/100YR/
        Time Window set.  Interval:     5  Number of data values:      1
        Starting date and time:  Apr 3, 1997  1355  (  35522  835)
        Ending   date and time:  Apr 3, 1997  1355  (  35522  835)
        Input time offset:      0
        After ZRDINF, Record found: T
        Pathname: /ADOT EAST BASIN/AT SUPERSTITION/FLOW/03APR1997/5MIN/100YR/
        Number of actual data:  288  Header length:   0
        Compression:   0  Quality:   0
-----DSS--- ZREAD Unit  71; Vers.    1:  /ADOT EAST BASIN/AT SUPERSTITION/FLOW/03APR1997/5MIN/100YR/
      ----DSS---Debug:  Enter ZRRTSB;  Unit:  71
        NSTART:    1   NVALS:    1    JULS:   35522  ISTIME:   835
        NLDATA:  288   JULSD:   35522
        JULS: 03APR97       JULSD: 03APR97
        Quality Read: F,  Quality Requested: F
        ---ZRRTSB Calculations:  NPOS:  167  NDATA:  288  NREAD:    1  ILIM:    1
      ----- Exiting ZRRTS, Number of data values:      1,  Status:  0
        Offset:       0,  Units: CFS     ,  Type:INST-VAL
        ----- Entering ZRRTSX for unit 71 -----
Pathname: /ADOT EAST BASIN/AT SUPERSTITION/FLOW//5MIN/100YR/
        Time Window set.  Interval:     5  Number of data values:    744
        Starting date and time:  Apr 3, 1997  1355  (  35522  835)
        Ending   date and time:  Apr 6, 1997  0350  (  35525  230)
        Input time offset:      0
        After ZRDINF, Record found: T
        Pathname: /ADOT EAST BASIN/AT SUPERSTITION/FLOW/03APR1997/5MIN/100YR/
        Number of actual data:  288  Header length:   0
        Compression:   0  Quality:   0
```

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-----DSS--- ZREAD Unit  71; Vers.    1:  /ADOT EAST BASIN/AT SUPERSTITION/FLOW/03APR1997/5MIN/100YR/
      ----DSS---Debug:  Enter ZRRTSB;  Unit:  71
        NSTART:    1   NVALS:  744    JULS:   35522  ISTIME:   835
        NLDATA:  288   JULSD:   35522
        JULS: 03APR97       JULSD: 03APR97
        Quality Read: F,  Quality Requested: F
        ---ZRRTSB Calculations:  NPOS:  167  NDATA:  288  NREAD:  122  ILIM:  122
        After ZRDINF, Record found: T
        Pathname: /ADOT EAST BASIN/AT SUPERSTITION/FLOW/04APR1997/5MIN/100YR/
        Number of actual data:  288  Header length:   0
        Compression:   0  Quality:   0
-----DSS--- ZREAD Unit  71; Vers.    1:  /ADOT EAST BASIN/AT SUPERSTITION/FLOW/04APR1997/5MIN/100YR/
      ----DSS---Debug:  Enter ZRRTSB;  Unit:  71
        NSTART:  123   NVALS:  744    JULS:   35522  ISTIME:   835
        NLDATA:  288   JULSD:   35523
        JULS: 03APR97       JULSD: 04APR97
        Quality Read: F,  Quality Requested: F
        ---ZRRTSB Calculations:  NPOS:    1  NDATA:  288  NREAD:  288  ILIM:  410
        After ZRDINF, Record found: F
        Pathname: /ADOT EAST BASIN/AT SUPERSTITION/FLOW/05APR1997/5MIN/100YR/
      ----DSS---Debug:  Enter ZRRTSB;  Unit:  71
        NSTART:  411   NVALS:  744    JULS:   35522  ISTIME:   835
        NLDATA:  288   JULSD:   35524
        JULS: 03APR97       JULSD: 05APR97
        Quality Read: F,  Quality Requested: F
        ---ZRRTSB Calculations:  NPOS:    1  NDATA:  288  NREAD:  288  ILIM:  698
-----DSS*** ZRRTS:  CAUTION - Data block not found in file.  Unit:  71
Pathname: /ADOT EAST BASIN/AT SUPERSTITION/FLOW/05APR1997/5MIN/100YR/
        After ZRDINF, Record found: F
        Pathname: /ADOT EAST BASIN/AT SUPERSTITION/FLOW/06APR1997/5MIN/100YR/
      ----DSS---Debug:  Enter ZRRTSB;  Unit:  71
        NSTART:  699   NVALS:  744    JULS:   35522  ISTIME:   835
        NLDATA:  288   JULSD:   35525
        JULS: 03APR97       JULSD: 06APR97
        Quality Read: F,  Quality Requested: F
        ---ZRRTSB Calculations:  NPOS:    1  NDATA:  288  NREAD:   46  ILIM:  744
      ----- Exiting ZRRTS, Number of data values:    744,  Status:  3
        Offset:       0,  Units: CFS     ,  Type:INST-VAL
        ----- Entering ZRRTSX for unit 71 -----
Pathname: /ADOT WEST BASIN/AT SUPERSTITION/FLOW//5MIN/100YR/
        Time Window set.  Interval:     5  Number of data values:      1
        Starting date and time:  Mar 31, 1997  2400  (  35519 1440)
        Ending   date and time:  Mar 31, 1997  2400  (  35519 1440)
        Input time offset:      0
        After ZRDINF, Record found: T
        Pathname: /ADOT WEST BASIN/AT SUPERSTITION/FLOW/31MAR1997/5MIN/100YR/
        Number of actual data:  288  Header length:   0
        Compression:   0  Quality:   0
-----DSS--- ZREAD Unit  71; Vers.    1:  /ADOT WEST BASIN/AT SUPERSTITION/FLOW/31MAR1997/5MIN/100YR/
      ----DSS---Debug:  Enter ZRRTSB;  Unit:  71
        NSTART:    1   NVALS:    1    JULS:   35519  ISTIME:  1440
        NLDATA:  288   JULSD:   35519
        JULS: 31MAR97       JULSD: 31MAR97
        Quality Read: F,  Quality Requested: F
        ---ZRRTSB Calculations:  NPOS:  288  NDATA:  288  NREAD:    1  ILIM:    1
      ----- Exiting ZRRTS, Number of data values:      1,  Status:  0
        Offset:       0,  Units: CFS     ,  Type:INST-VAL
        ----- Entering ZRRTSX for unit 71 -----
Pathname: /ADOT WEST BASIN/AT SUPERSTITION/FLOW//5MIN/100YR/
        Time Window set.  Interval:     5  Number of data values:    744
        Starting date and time:  Mar 31, 1997  2400  (  35519 1440)
        Ending   date and time:  Apr 3, 1997  1355  (  35522  835)
        Input time offset:      0
        After ZRDINF, Record found: T
        Pathname: /ADOT WEST BASIN/AT SUPERSTITION/FLOW/31MAR1997/5MIN/100YR/
        Number of actual data:  288  Header length:   0
        Compression:   0  Quality:   0
-----DSS--- ZREAD Unit  71; Vers.    1:  /ADOT WEST BASIN/AT SUPERSTITION/FLOW/31MAR1997/5MIN/100YR/
      ----DSS---Debug:  Enter ZRRTSB;  Unit:  71
        NSTART:    1   NVALS:  744    JULS:   35519  ISTIME:  1440
        NLDATA:  288   JULSD:   35519
        JULS: 31MAR97       JULSD: 31MAR97
        Quality Read: F,  Quality Requested: F
        ---ZRRTSB Calculations:  NPOS:  288  NDATA:  288  NREAD:    1  ILIM:    1
        After ZRDINF, Record found: T
        Pathname: /ADOT WEST BASIN/AT SUPERSTITION/FLOW/01APR1997/5MIN/100YR/
        Number of actual data:  288  Header length:   0
        Compression:   0  Quality:   0
-----DSS--- ZREAD Unit  71; Vers.    1:  /ADOT WEST BASIN/AT SUPERSTITION/FLOW/01APR1997/5MIN/100YR/
      ----DSS---Debug:  Enter ZRRTSB;  Unit:  71
        NSTART:    2   NVALS:  744    JULS:   35519  ISTIME:  1440
        NLDATA:  288   JULSD:   35520
        JULS: 31MAR97       JULSD: 01APR97
        Quality Read: F,  Quality Requested: F
        ---ZRRTSB Calculations:  NPOS:    1  NDATA:  288  NREAD:  288  ILIM:  289
        After ZRDINF, Record found: T
        Pathname: /ADOT WEST BASIN/AT SUPERSTITION/FLOW/02APR1997/5MIN/100YR/
        Number of actual data:  288  Header length:   0
        Compression:   0  Quality:   0
-----DSS--- ZREAD Unit  71; Vers.    1:  /ADOT WEST BASIN/AT SUPERSTITION/FLOW/02APR1997/5MIN/100YR/
      ----DSS---Debug:  Enter ZRRTSB;  Unit:  71
        NSTART:  290   NVALS:  744    JULS:   35519  ISTIME:  1440
        NLDATA:  288   JULSD:   35521
        JULS: 31MAR97       JULSD: 02APR97
        Quality Read: F,  Quality Requested: F
```

```
      ---ZRRTSB Calculations:  NPOS:    1  NDATA:  288  NREAD:  288  ILIM:  577
      After ZRDINF, Record found: T
      Pathname: /ADOT WEST BASIN/AT SUPERSTITION/FLOW/03APR1997/5MIN/100YR/
      Number of actual data:  288  Header length:   0
      Compression:   0  Quality:   0
-----DSS--- ZREAD Unit  71; Vers.    1:  /ADOT WEST BASIN/AT SUPERSTITION/FLOW/03APR1997/5MIN/100YR/
     ----DSS---Debug:  Enter ZRRTSB;  Unit:  71
      NSTART:  578   NVALS:  744    JULS:   35519  ISTIME:  1440
      NLDATA:  288   JULSD:   35522
      JULS: 31MAR97       JULSD: 03APR97
      Quality Read: F,  Quality Requested: F
      ---ZRRTSB Calculations:  NPOS:    1  NDATA:  288  NREAD:  167  ILIM:  744
     ----- Exiting ZRRTS, Number of data values:    744,  Status:  0
      Offset:       0,  Units: CFS     ,  Type:INST-VAL
      ----- Entering ZRRTSX for unit 71 -----
Pathname: /ADOT WEST BASIN/AT SUPERSTITION/FLOW//5MIN/100YR/
      Time Window set.  Interval:     5  Number of data values:      1
      Starting date and time:  Apr 3, 1997  1355  (  35522  835)
      Ending   date and time:  Apr 3, 1997  1355  (  35522  835)
      Input time offset:      0
      After ZRDINF, Record found: T
      Pathname: /ADOT WEST BASIN/AT SUPERSTITION/FLOW/03APR1997/5MIN/100YR/
      Number of actual data:  288  Header length:   0
      Compression:   0  Quality:   0
-----DSS--- ZREAD Unit  71; Vers.    1:  /ADOT WEST BASIN/AT SUPERSTITION/FLOW/03APR1997/5MIN/100YR/
     ----DSS---Debug:  Enter ZRRTSB;  Unit:  71
      NSTART:    1   NVALS:    1    JULS:   35522  ISTIME:   835
      NLDATA:  288   JULSD:   35522
      JULS: 03APR97       JULSD: 03APR97
      Quality Read: F,  Quality Requested: F
      ---ZRRTSB Calculations:  NPOS:  167  NDATA:  288  NREAD:    1  ILIM:    1
     ----- Exiting ZRRTS, Number of data values:      1,  Status:  0
      Offset:       0,  Units: CFS     ,  Type:INST-VAL
      ----- Entering ZRRTSX for unit 71 -----
Pathname: /ADOT WEST BASIN/AT SUPERSTITION/FLOW//5MIN/100YR/
      Time Window set.  Interval:     5  Number of data values:    744
      Starting date and time:  Apr 3, 1997  1355  (  35522  835)
      Ending   date and time:  Apr 6, 1997  0350  (  35525  230)
      Input time offset:      0
      After ZRDINF, Record found: T
      Pathname: /ADOT WEST BASIN/AT SUPERSTITION/FLOW/03APR1997/5MIN/100YR/
      Number of actual data:  288  Header length:   0
      Compression:   0  Quality:   0
-----DSS--- ZREAD Unit  71; Vers.    1:  /ADOT WEST BASIN/AT SUPERSTITION/FLOW/03APR1997/5MIN/100YR/
     ----DSS---Debug:  Enter ZRRTSB;  Unit:  71
      NSTART:    1   NVALS:  744    JULS:   35522  ISTIME:   835
      NLDATA:  288   JULSD:   35522
      JULS: 03APR97       JULSD: 03APR97
      Quality Read: F,  Quality Requested: F
      ---ZRRTSB Calculations:  NPOS:  167  NDATA:  288  NREAD:  122  ILIM:  122
      After ZRDINF, Record found: T
      Pathname: /ADOT WEST BASIN/AT SUPERSTITION/FLOW/04APR1997/5MIN/100YR/
      Number of actual data:  288  Header length:   0
      Compression:   0  Quality:   0
-----DSS--- ZREAD Unit  71; Vers.    1:  /ADOT WEST BASIN/AT SUPERSTITION/FLOW/04APR1997/5MIN/100YR/
     ----DSS---Debug:  Enter ZRRTSB;  Unit:  71
      NSTART:  123   NVALS:  744    JULS:   35522  ISTIME:   835
      NLDATA:  288   JULSD:   35523
      JULS: 03APR97       JULSD: 04APR97
      Quality Read: F,  Quality Requested: F
      ---ZRRTSB Calculations:  NPOS:    1  NDATA:  288  NREAD:  288  ILIM:  410
      After ZRDINF, Record found: F
      Pathname: /ADOT WEST BASIN/AT SUPERSTITION/FLOW/05APR1997/5MIN/100YR/
     ----DSS---Debug:  Enter ZRRTSB;  Unit:  71
      NSTART:  411   NVALS:  744    JULS:   35522  ISTIME:   835
      NLDATA:  288   JULSD:   35524
      JULS: 03APR97       JULSD: 05APR97
      Quality Read: F,  Quality Requested: F
      ---ZRRTSB Calculations:  NPOS:    1  NDATA:  288  NREAD:  288  ILIM:  698
-----DSS*** ZRRTS:  CAUTION - Data block not found in file.  Unit:  71
Pathname: /ADOT WEST BASIN/AT SUPERSTITION/FLOW/05APR1997/5MIN/100YR/
      After ZRDINF, Record found: F
      Pathname: /ADOT WEST BASIN/AT SUPERSTITION/FLOW/06APR1997/5MIN/100YR/
     ----DSS---Debug:  Enter ZRRTSB;  Unit:  71
      NSTART:  699   NVALS:  744    JULS:   35522  ISTIME:   835
      NLDATA:  288   JULSD:   35525
      JULS: 03APR97       JULSD: 06APR97
      Quality Read: F,  Quality Requested: F
      ---ZRRTSB Calculations:  NPOS:    1  NDATA:  288  NREAD:   46  ILIM:  744
     ----- Exiting ZRRTS, Number of data values:    744,  Status:  3
      Offset:       0,  Units: CFS     ,  Type:INST-VAL
1
                                        RUNOFF SUMMARY
                                   FLOW IN CUBIC FEET PER SECOND
                                 TIME IN HOURS,  AREA IN SQUARE MILES

                                 PEAK   TIME OF    AVERAGE FLOW FOR MAXIMUM PERIOD      BASIN     MAXIMUM     TIME OF
      OPERATION       STATION    FLOW    PEAK                                          AREA      STAGE     MAX STAGE
+                                                   6-HOUR     24-HOUR     72-HOUR

      HYDROGRAPH AT
+                      X65A1      943.   12.58        183.         59.         20.       .97

      DIVERSION TO
+                     FF65A1       22.    8.00         17.          5.          2.       .97
```

+	HYDROGRAPH AT	R65A1	943.	12.58	183.	54.	18.	.97
+	HYDROGRAPH AT	CAP1A	710.	12.67	132.	36.	12.	.96
+	ROUTED TO	RCAP1A	667.	12.92	132.	36.	12.	.96
+	2 COMBINED AT	CCAP1A	1358.	12.67	312.	89.	30.	1.94
+	HYDROGRAPH AT	X65A2	555.	12.50	94.	30.	10.	.54
+	DIVERSION TO	FF65A2	29.	11.17	13.	5.	2.	.54
+	HYDROGRAPH AT	R65A2	555.	12.50	92.	25.	8.	.54
+	HYDROGRAPH AT	CAP1B	710.	12.67	132.	36.	12.	.96
+	ROUTED TO	RCAP1B	675.	12.92	132.	36.	12.	.96
+	2 COMBINED AT	CCAP1B	942.	12.75	222.	61.	20.	1.51
+	2 COMBINED AT	C65A12	2266.	12.67	528.	149.	50.	3.44
+	ROUTED TO	RMCHNL	2249.	12.75	528.	149.	50.	3.44
+	HYDROGRAPH AT	X65A3	997.	12.67	203.	64.	21.	1.21
+	DIVERSION TO	FF65A3	105.	11.75	32.	11.	4.	1.21
+	HYDROGRAPH AT	R65A3	997.	12.67	194.	53.	18.	1.21
+	2 COMBINED AT	SDWDBS	3183.	12.67	712.	200.	67.	4.65
+	ROUTED TO	DB	461.	14.08	378.	198.	67.	4.65
+	HYDROGRAPH AT	65A3BY	120.	12.67	24.	8.	3.	.14
+	2 COMBINED AT	CP-MER	472.	14.00	391.	205.	69.	4.65
+	ROUTED TO	RSDW1	471.	14.25	390.	205.	69.	4.65
+	ROUTED TO	RSDW2	469.	14.92	389.	205.	69.	4.65
+	HYDROGRAPH AT	65AW	555.	12.25	70.	21.	7.	.43
+	DIVERSION TO	D65AW	555.	12.25	58.	16.	5.	.43
+	HYDROGRAPH AT	R65AW	187.	12.58	19.	6.	2.	.43
+	ROUTED TO	65AT65	58.	13.67	17.	6.	2.	.43
+	HYDROGRAPH AT	65B	1552.	12.42	271.	88.	29.	1.37
+	DIVERSION TO	D65B	1552.	12.42	218.	60.	20.	1.37
+	HYDROGRAPH AT	R65B	669.	12.83	89.	28.	9.	1.37
+	3 COMBINED AT	CP65B	569.	12.92	460.	232.	78.	6.45
+	DIVERSION TO	DIRS65	51.	12.92	46.	25.	8.	6.45
+	HYDROGRAPH AT	DI65B	519.	12.92	414.	207.	70.	6.45
	ROUTED TO							

+		65AT-3	511.	13.00	414.	207.	70.	6.45
+	HYDROGRAPH AT	DR65B	51.	12.92	46.	25.	8.	6.45
+	ROUTED TO	RS65A	26.	25.08	26.	23.	16.	6.45
+	2 COMBINED AT	CP65	523.	13.00	434.	229.	85.	6.45
+	ROUTED TO	65T66	515.	14.67	434.	229.	85.	6.45
+	HYDROGRAPH AT	ADOT-E	251.	14.50	182.	67.	22.	.01
+	ROUTED TO	AET67A	251.	14.75	182.	67.	22.	.01
+	HYDROGRAPH AT	67A	387.	12.25	52.	17.	6.	.30
+	DIVERSION TO	D67A	387.	12.25	38.	11.	4.	.30
+	HYDROGRAPH AT	R67A	229.	12.50	20.	6.	2.	.30
+	2 COMBINED AT	C67A	261.	14.75	190.	72.	24.	.31
+	ROUTED TO	67ATC	259.	15.08	190.	72.	24.	.31
+	HYDROGRAPH AT	SUP2	442.	13.00	384.	218.	73.	.01
+	ROUTED TO	RSUP2	397.	16.33	380.	218.	73.	.01
+	HYDROGRAPH AT	67B	714.	12.25	105.	35.	12.	.53
+	DIVERSION TO	D67B	714.	12.25	73.	21.	7.	.53
+	HYDROGRAPH AT	R67B	457.	12.50	46.	14.	5.	.53
+	2 COMBINED AT	C67B	495.	12.50	397.	232.	78.	.54
+	ROUTED TO	67BTC	414.	16.50	396.	232.	78.	.54
+	HYDROGRAPH AT	67C	1019.	12.42	146.	44.	15.	.93
+	DIVERSION TO	D67C	1019.	12.42	126.	34.	11.	.93
+	HYDROGRAPH AT	R67C	295.	12.83	34.	11.	4.	.93
+	3 COMBINED AT	C67C	678.	15.25	602.	313.	105.	1.78
+	ROUTED TO	67CT67	677.	15.33	601.	313.	105.	1.78
+	HYDROGRAPH AT	67D	183.	12.17	20.	6.	2.	.13
+	DIVERSION TO	D67D	183.	12.17	17.	5.	2.	.13
+	HYDROGRAPH AT	R67D	52.	12.50	5.	1.	0.	.13
+	2 COMBINED AT	C67D	680.	15.33	603.	314.	106.	1.91
+	ROUTED TO	67DT66	680.	15.42	603.	314.	106.	1.91
+	HYDROGRAPH AT	66A	446.	12.17	46.	14.	5.	.26
+	DIVERSION TO	D66A	446.	12.17	39.	11.	4.	.26
+	HYDROGRAPH AT	R66A	105.	12.42	11.	3.	1.	.26

+	ROUTED TO	66ATB	35.	13.17	10.	3.	1.	.26
+	HYDROGRAPH AT	66B	605.	12.58	104.	32.	11.	.67
+	DIVERSION TO	D66B	605.	12.58	90.	24.	8.	.67
+	HYDROGRAPH AT	R66B	168.	13.08	24.	7.	2.	.67
+	2 COMBINED AT	CP66B	196.	13.08	34.	11.	4.	.93
+	ROUTED TO	66BTC	169.	13.42	33.	11.	4.	.93
+	HYDROGRAPH AT	66C	707.	12.25	94.	30.	10.	.50
+	DIVERSION TO	D66C	707.	12.25	77.	21.	7.	.50
+	HYDROGRAPH AT	R66C	257.	12.58	29.	9.	3.	.50
+	2 COMBINED AT	CP66C1	232.	12.58	58.	19.	6.	1.43
+	2 COMBINED AT	CP66C2	720.	15.17	638.	331.	111.	3.34
+	DIVERSION TO	DB66	310.	15.17	234.	72.	24.	3.34
+	HYDROGRAPH AT	DI66	410.	14.83	403.	258.	87.	3.34
+	ROUTED TO	66C1T2	410.	14.92	403.	258.	87.	3.34
+	2 COMBINED AT	CP66C	914.	14.75	818.	478.	170.	9.79
+	ROUTED TO	66CTD	914.	14.75	818.	478.	170.	9.79
+	HYDROGRAPH AT	DR66	310.	15.17	234.	72.	24.	3.34
+	ROUTED TO	RS66D1	202.	18.00	152.	59.	24.	3.34
+	DIVERSION TO	D-WB	179.	18.00	130.	39.	13.	3.34
+	HYDROGRAPH AT	B-WA	23.	18.00	22.	19.	11.	3.34
+	2 COMBINED AT	C-WA	922.	14.83	826.	490.	179.	13.13
+	ROUTED TO	RC-WA	922.	14.83	826.	490.	179.	13.13
+	HYDROGRAPH AT	DR-WA	179.	18.00	130.	39.	13.	3.34
+	ROUTED TO	RS66D2	33.	22.67	29.	25.	13.	3.34
+	2 COMBINED AT	CP66D	922.	14.83	834.	507.	190.	13.13
+	ROUTED TO	66T66D	922.	14.83	834.	507.	190.	13.13
+	ROUTED TO	66-66D	922.	14.92	834.	507.	190.	13.13
+	HYDROGRAPH AT	66D	651.	12.08	75.	26.	9.	.31
+	DIVERSION TO	D66D	651.	12.08	55.	16.	5.	.31
+	HYDROGRAPH AT	R66D	350.	12.25	32.	10.	3.	.31
+	HYDROGRAPH AT	61A	794.	12.17	95.	31.	10.	.52
+	DIVERSION TO	D61A	794.	12.17	76.	21.	7.	.52

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          HYDROGRAPH AT
+                         R61A      333.   12.42        33.        10.        3.       .52
          ROUTED TO
+                        61ATB      104.   13.25        31.        10.        3.       .52
          HYDROGRAPH AT
+                          61B     1175.   12.42       176.        55.       18.      1.09
          DIVERSION TO
+                          D61B    1175.   12.42       151.        41.       14.      1.09
          HYDROGRAPH AT
+                         R61B      339.   12.83        45.        14.        5.      1.09
          2 COMBINED AT
+                        CP61B      330.   12.92        73.        23.        8.      1.61
          ROUTED TO
+                       61T66D      219.   13.67        71.        23.        8.      1.61
          HYDROGRAPH AT
+                          67E      771.   12.25       111.        36.       12.       .58
          DIVERSION TO
+                         D67E      771.   12.25        91.        25.        8.       .58
          HYDROGRAPH AT
+                         R67E      268.   12.67        34.        11.        4.       .58
          2 COMBINED AT
+                         C67E      249.   13.67        98.        33.       11.      2.19
          3 COMBINED AT
+                         C66D     1029.   14.58       906.       537.      200.     15.63
          ROUTED TO
+                       66T70A     1026.   14.58       905.       537.      200.     15.63
          ROUTED TO
+                       66T70B     1025.   14.58       905.       537.      200.     15.63
          ROUTED TO
+                        CULVT     1021.   14.58       903.       537.      200.     15.63
          ROUTED TO
+                       66T70C     1019.   14.83       903.       537.      200.     15.63
1
                          SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
                              (FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)
                                                                   INTERPOLATED TO
                                                                COMPUTATION INTERVAL
          ISTAQ    ELEMENT      DT       PEAK    TIME TO     VOLUME      DT       PEAK    TIME TO     VOLUME
                                                   PEAK                                     PEAK

                              (MIN)     (CFS)     (MIN)      (IN)     (MIN)     (CFS)     (MIN)       (IN)

          FOR STORM = 1  STORM AREA (SQ MI) =        .01
            65AT-3  MANE         1.21    772.65    771.39      1.28      5.00    697.17    770.00       1.28

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4400E+03 EXCESS= .0000E+00 OUTFLOW= .4400E+03 BASIN STORAGE= .1769E-03 PERCENT ERROR=    .0

          FOR STORM = 2  STORM AREA (SQ MI) =       1.00
            65AT-3  MANE         1.21    764.41    771.25      1.27      5.00    679.10    775.00       1.27

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4367E+03 EXCESS= .0000E+00 OUTFLOW= .4367E+03 BASIN STORAGE= .1733E-03 PERCENT ERROR=    .0

          FOR STORM = 3  STORM AREA (SQ MI) =       5.00
            65AT-3  MANE         1.27    609.11    776.08      1.23      5.00    583.36    775.00       1.23

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4221E+03 EXCESS= .0000E+00 OUTFLOW= .4221E+03 BASIN STORAGE= .1763E-03 PERCENT ERROR=    .0

          FOR STORM = 4  STORM AREA (SQ MI) =      10.00
            65AT-3  MANE         1.33    485.84    782.12      1.17      5.00    484.90    880.00       1.17

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4041E+03 EXCESS= .0000E+00 OUTFLOW= .4041E+03 BASIN STORAGE= .1731E-03 PERCENT ERROR=    .0

          FOR STORM = 5  STORM AREA (SQ MI) =      30.00
            65AT-3  MANE         1.35    454.49    896.47      1.11      5.00    454.43    895.00       1.11

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3814E+03 EXCESS= .0000E+00 OUTFLOW= .3814E+03 BASIN STORAGE= .1805E-03 PERCENT ERROR=    .0

          FOR STORM = 6  STORM AREA (SQ MI) =      60.00
            65AT-3  MANE         1.37    425.09    890.71      1.04      5.00    425.06    890.00       1.04
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CONTINUITY SUMMARY (AC-FT) - INFLOW= .3588E+03 EXCESS= .0000E+00 OUTFLOW= .3588E+03 BASIN STORAGE= .1771E-03 PERCENT ERROR=    .0

          FOR STORM = 7  STORM AREA (SQ MI) =      90.00
            65AT-3  MANE         1.38    417.50    891.18      1.02      5.00    417.46    890.00        1.02

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3506E+03 EXCESS= .0000E+00 OUTFLOW= .3506E+03 BASIN STORAGE= .1739E-03 PERCENT ERROR=    .0

          FOR STORM = 8  STORM AREA (SQ MI) =     120.00
            65AT-3  MANE         1.38    409.85    891.71       .99      5.00    409.79    890.00         .99

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3424E+03 EXCESS= .0000E+00 OUTFLOW= .3424E+03 BASIN STORAGE= .1778E-03 PERCENT ERROR=    .0

          FOR STORM = 9  STORM AREA (SQ MI) =     150.00
            65AT-3  MANE         1.38    405.24    892.35       .98      5.00    405.17    890.00         .98

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3374E+03 EXCESS= .0000E+00 OUTFLOW= .3374E+03 BASIN STORAGE= .1742E-03 PERCENT ERROR=    .0

          FOR STORM = 1  STORM AREA (SQ MI) =        .01
             65T66  MANE          .98    707.75    772.12      1.58      5.00    698.57    775.00        1.58

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5441E+03 EXCESS= .0000E+00 OUTFLOW= .5441E+03 BASIN STORAGE= .0000E+00 PERCENT ERROR=    .0

          FOR STORM = 2  STORM AREA (SQ MI) =       1.00
             65T66  MANE          .98    690.47    774.92      1.57      5.00    690.04    775.00        1.57

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5406E+03 EXCESS= .0000E+00 OUTFLOW= .5406E+03 BASIN STORAGE= .0000E+00 PERCENT ERROR=    .0

          FOR STORM = 3  STORM AREA (SQ MI) =       5.00
             65T66  MANE         1.01    588.10    776.87      1.53      5.00    562.59    780.00        1.53

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5253E+03 EXCESS= .0000E+00 OUTFLOW= .5253E+03 BASIN STORAGE= .0000E+00 PERCENT ERROR=    .0

          FOR STORM = 4  STORM AREA (SQ MI) =      10.00
             65T66  MANE         1.04    504.39    880.93      1.47      5.00    504.36    880.00        1.47

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5065E+03 EXCESS= .0000E+00 OUTFLOW= .5065E+03 BASIN STORAGE= .0000E+00 PERCENT ERROR=    .0

          FOR STORM = 5  STORM AREA (SQ MI) =      30.00
             65T66  MANE         1.06    474.15    900.10      1.40      5.00    474.15    900.00        1.40

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4827E+03 EXCESS= .0000E+00 OUTFLOW= .4827E+03 BASIN STORAGE= .0000E+00 PERCENT ERROR=    .0

          FOR STORM = 6  STORM AREA (SQ MI) =      60.00
             65T66  MANE         1.07    443.47    892.66      1.33      5.00    443.45    895.00        1.33

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4589E+03 EXCESS= .0000E+00 OUTFLOW= .4589E+03 BASIN STORAGE= .0000E+00 PERCENT ERROR=    .0

          FOR STORM = 7  STORM AREA (SQ MI) =      90.00
             65T66  MANE         1.08    435.74    894.63      1.31      5.00    435.73    895.00        1.31

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4504E+03 EXCESS= .0000E+00 OUTFLOW= .4504E+03 BASIN STORAGE= .0000E+00 PERCENT ERROR=    .0

          FOR STORM = 8  STORM AREA (SQ MI) =     120.00
             65T66  MANE         1.08    428.04    895.60      1.28      5.00    428.03    895.00        1.28

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4418E+03 EXCESS= .0000E+00 OUTFLOW= .4418E+03 BASIN STORAGE= .0000E+00 PERCENT ERROR=    .0

          FOR STORM = 9  STORM AREA (SQ MI) =     150.00
             65T66  MANE         1.08    423.41    895.33      1.27      5.00    423.40    895.00        1.27

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4367E+03 EXCESS= .0000E+00 OUTFLOW= .4367E+03 BASIN STORAGE= .0000E+00 PERCENT ERROR=    .0

          FOR STORM = 1  STORM AREA (SQ MI) =        .01
            66C1T2  MANE          .75    410.00    886.49      2.94      5.00    410.00    890.00        2.94

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5231E+03 EXCESS= .0000E+00 OUTFLOW= .5231E+03 BASIN STORAGE= .9382E-04 PERCENT ERROR=    .0
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FOR STORM = 2  STORM AREA (SQ MI) =        1.00
  66C1T2  MANE          .75    410.00    886.49      2.93      5.00    410.00    890.00        2.93

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5224E+03 EXCESS= .0000E+00 OUTFLOW= .5224E+03 BASIN STORAGE= .9382E-04 PERCENT ERROR=    .0

FOR STORM = 3  STORM AREA (SQ MI) =        5.00
  66C1T2  MANE          .75    410.00    891.72      2.91      5.00    410.00    895.00        2.91

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5186E+03 EXCESS= .0000E+00 OUTFLOW= .5186E+03 BASIN STORAGE= .9382E-04 PERCENT ERROR=    .0

FOR STORM = 4  STORM AREA (SQ MI) =       10.00
  66C1T2  MANE          .75    410.00    896.19      2.87      5.00    410.00    900.00        2.87

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5121E+03 EXCESS= .0000E+00 OUTFLOW= .5121E+03 BASIN STORAGE= .9382E-04 PERCENT ERROR=    .0

FOR STORM = 5  STORM AREA (SQ MI) =       30.00
  66C1T2  MANE          .75    409.96    916.36      2.82      5.00    409.95    915.00        2.82

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5020E+03 EXCESS= .0000E+00 OUTFLOW= .5020E+03 BASIN STORAGE= .9381E-04 PERCENT ERROR=    .0

FOR STORM = 6  STORM AREA (SQ MI) =       60.00
  66C1T2  MANE          .75    406.85    961.09      2.78      5.00    406.84    965.00        2.78

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4948E+03 EXCESS= .0000E+00 OUTFLOW= .4948E+03 BASIN STORAGE= .9375E-04 PERCENT ERROR=    .0

FOR STORM = 7  STORM AREA (SQ MI) =       90.00
  66C1T2  MANE          .75    406.11    930.06      2.76      5.00    406.11    930.00        2.76

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4924E+03 EXCESS= .0000E+00 OUTFLOW= .4924E+03 BASIN STORAGE= .9378E-04 PERCENT ERROR=    .0

FOR STORM = 8  STORM AREA (SQ MI) =      120.00
  66C1T2  MANE          .75    406.05    930.08      2.75      5.00    406.05    930.00        2.75

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4906E+03 EXCESS= .0000E+00 OUTFLOW= .4906E+03 BASIN STORAGE= .9377E-04 PERCENT ERROR=    .0

FOR STORM = 9  STORM AREA (SQ MI) =      150.00
  66C1T2  MANE          .75    406.02    930.08      2.75      5.00    406.02    930.00        2.75

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4895E+03 EXCESS= .0000E+00 OUTFLOW= .4895E+03 BASIN STORAGE= .9377E-04 PERCENT ERROR=    .0

FOR STORM = 1  STORM AREA (SQ MI) =        .01
    66CTD  MANE          .65   1071.15    774.78      2.04      5.00   1070.79    775.00        2.04

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1067E+04 EXCESS= .0000E+00 OUTFLOW= .1067E+04 BASIN STORAGE= .2189E-06 PERCENT ERROR=    .0

FOR STORM = 2  STORM AREA (SQ MI) =        1.00
    66CTD  MANE          .65   1057.23    775.23      2.04      5.00   1054.69    775.00        2.04

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1063E+04 EXCESS= .0000E+00 OUTFLOW= .1063E+04 BASIN STORAGE= .2189E-06 PERCENT ERROR=    .0

FOR STORM = 3  STORM AREA (SQ MI) =        5.00
    66CTD  MANE          .67    929.83    879.81      2.00      5.00    929.83    880.00        2.00

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1044E+04 EXCESS= .0000E+00 OUTFLOW= .1044E+04 BASIN STORAGE= .2189E-06 PERCENT ERROR=    .0

FOR STORM = 4  STORM AREA (SQ MI) =       10.00
    66CTD  MANE          .67    913.44    884.78      1.95      5.00    913.42    885.00        1.95

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1019E+04 EXCESS= .0000E+00 OUTFLOW= .1019E+04 BASIN STORAGE= .2189E-06 PERCENT ERROR=    .0

FOR STORM = 5  STORM AREA (SQ MI) =       30.00
    66CTD  MANE          .68    883.68    900.07      1.89      5.00    883.67    900.00        1.89

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9848E+03 EXCESS= .0000E+00 OUTFLOW= .9847E+03 BASIN STORAGE= .2217E-06 PERCENT ERROR=    .0

FOR STORM = 6  STORM AREA (SQ MI) =       60.00
    66CTD  MANE          .68    848.43    895.01      1.83      5.00    848.43    895.00        1.83
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CONTINUITY SUMMARY (AC-FT) - INFLOW= .9538E+03 EXCESS= .0000E+00 OUTFLOW= .9538E+03 BASIN STORAGE= .2189E-06 PERCENT ERROR=    .0

        FOR STORM = 7  STORM AREA (SQ MI) =      90.00
           66CTD  MANE          .69    840.65    896.66      1.81      5.00    840.62    895.00        1.81

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9428E+03 EXCESS= .0000E+00 OUTFLOW= .9428E+03 BASIN STORAGE= .2217E-06 PERCENT ERROR=    .0

        FOR STORM = 8  STORM AREA (SQ MI) =     120.00
           66CTD  MANE          .69    832.94    899.68      1.79      5.00    832.92    900.00        1.79

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9325E+03 EXCESS= .0000E+00 OUTFLOW= .9325E+03 BASIN STORAGE= .2189E-06 PERCENT ERROR=    .0

        FOR STORM = 9  STORM AREA (SQ MI) =     150.00
           66CTD  MANE          .69    828.30    899.96      1.77      5.00    828.30    900.00        1.77

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9263E+03 EXCESS= .0000E+00 OUTFLOW= .9263E+03 BASIN STORAGE= .2217E-06 PERCENT ERROR=    .0

        FOR STORM = 1  STORM AREA (SQ MI) =        .01
            RC-WA  MANE          .68   1064.65    775.84      1.62      5.00   1057.97    775.00        1.62

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1132E+04 EXCESS= .0000E+00 OUTFLOW= .1132E+04 BASIN STORAGE= .2363E-06 PERCENT ERROR=    .0

        FOR STORM = 2  STORM AREA (SQ MI) =       1.00
            RC-WA  MANE          .68   1047.75    775.69      1.61      5.00   1039.61    775.00        1.61

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1128E+04 EXCESS= .0000E+00 OUTFLOW= .1128E+04 BASIN STORAGE= .2363E-06 PERCENT ERROR=    .0

        FOR STORM = 3  STORM AREA (SQ MI) =       5.00
            RC-WA  MANE          .70    947.46    880.79      1.58      5.00    947.43    880.00        1.58

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1108E+04 EXCESS= .0000E+00 OUTFLOW= .1108E+04 BASIN STORAGE= .2363E-06 PERCENT ERROR=    .0

        FOR STORM = 4  STORM AREA (SQ MI) =      10.00
            RC-WA  MANE          .70    930.96    885.24      1.55      5.00    930.93    885.00        1.55

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1082E+04 EXCESS= .0000E+00 OUTFLOW= .1082E+04 BASIN STORAGE= .2363E-06 PERCENT ERROR=    .0

        FOR STORM = 5  STORM AREA (SQ MI) =      30.00
            RC-WA  MANE          .70    901.27    900.81      1.50      5.00    901.22    900.00        1.50

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1048E+04 EXCESS= .0000E+00 OUTFLOW= .1048E+04 BASIN STORAGE= .2387E-06 PERCENT ERROR=    .0

        FOR STORM = 6  STORM AREA (SQ MI) =      60.00
            RC-WA  MANE          .71    865.32    900.27      1.45      5.00    865.30    900.00        1.45

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1016E+04 EXCESS= .0000E+00 OUTFLOW= .1016E+04 BASIN STORAGE= .2363E-06 PERCENT ERROR=    .0

        FOR STORM = 7  STORM AREA (SQ MI) =      90.00
            RC-WA  MANE          .71    857.54    900.43      1.44      5.00    857.52    900.00        1.44

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1005E+04 EXCESS= .0000E+00 OUTFLOW= .1005E+04 BASIN STORAGE= .2387E-06 PERCENT ERROR=    .0

        FOR STORM = 8  STORM AREA (SQ MI) =     120.00
            RC-WA  MANE          .71    849.63    900.66      1.42      5.00    849.59    900.00        1.42

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9947E+03 EXCESS= .0000E+00 OUTFLOW= .9947E+03 BASIN STORAGE= .2363E-06 PERCENT ERROR=    .0

        FOR STORM = 9  STORM AREA (SQ MI) =     150.00
            RC-WA  MANE          .71    844.86    900.95      1.41      5.00    844.80    900.00        1.41

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9884E+03 EXCESS= .0000E+00 OUTFLOW= .9884E+03 BASIN STORAGE= .2363E-06 PERCENT ERROR=    .0

        FOR STORM = 1  STORM AREA (SQ MI) =        .01
          66T66D  MANE          .99   1048.73    776.66      1.74      5.00   1030.97    775.00        1.74

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1215E+04 EXCESS= .0000E+00 OUTFLOW= .1215E+04 BASIN STORAGE= .3924E-06 PERCENT ERROR=    .0
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FOR STORM = 2  STORM AREA (SQ MI) =        1.00
  66T66D  MANE          .99   1031.79    776.40      1.73      5.00   1013.06    780.00        1.73

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1210E+04 EXCESS= .0000E+00 OUTFLOW= .1210E+04 BASIN STORAGE= .3924E-06 PERCENT ERROR=    .0

FOR STORM = 3  STORM AREA (SQ MI) =        5.00
  66T66D  MANE         1.01    947.38    881.44      1.69      5.00    947.29    880.00        1.69

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1184E+04 EXCESS= .0000E+00 OUTFLOW= .1184E+04 BASIN STORAGE= .3822E-06 PERCENT ERROR=    .0

FOR STORM = 4  STORM AREA (SQ MI) =       10.00
  66T66D  MANE         1.01    930.84    886.53      1.65      5.00    930.78    885.00        1.65

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1152E+04 EXCESS= .0000E+00 OUTFLOW= .1152E+04 BASIN STORAGE= .3619E-06 PERCENT ERROR=    .0

FOR STORM = 5  STORM AREA (SQ MI) =       30.00
  66T66D  MANE         1.02    901.18    901.39      1.59      5.00    901.09    905.00        1.59

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1112E+04 EXCESS= .0000E+00 OUTFLOW= .1112E+04 BASIN STORAGE= .3687E-06 PERCENT ERROR=    .0

FOR STORM = 6  STORM AREA (SQ MI) =       60.00
  66T66D  MANE         1.03    865.26    901.48      1.53      5.00    865.21    900.00        1.53

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1072E+04 EXCESS= .0000E+00 OUTFLOW= .1072E+04 BASIN STORAGE= .3619E-06 PERCENT ERROR=    .0

FOR STORM = 7  STORM AREA (SQ MI) =       90.00
  66T66D  MANE         1.03    857.49    901.03      1.51      5.00    857.42    900.00        1.51

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1057E+04 EXCESS= .0000E+00 OUTFLOW= .1057E+04 BASIN STORAGE= .3619E-06 PERCENT ERROR=    .0

FOR STORM = 8  STORM AREA (SQ MI) =      120.00
  66T66D  MANE         1.03    849.56    901.66      1.49      5.00    849.49    905.00        1.49

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1043E+04 EXCESS= .0000E+00 OUTFLOW= .1043E+04 BASIN STORAGE= .3619E-06 PERCENT ERROR=    .0

FOR STORM = 9  STORM AREA (SQ MI) =      150.00
  66T66D  MANE         1.03    844.78    902.65      1.48      5.00    844.75    905.00        1.48

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1034E+04 EXCESS= .0000E+00 OUTFLOW= .1034E+04 BASIN STORAGE= .3653E-06 PERCENT ERROR=    .0

FOR STORM = 1  STORM AREA (SQ MI) =         .01
  66-66D  MANE         2.13   1028.95    779.17      1.74      5.00   1025.68    780.00        1.74

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1215E+04 EXCESS= .0000E+00 OUTFLOW= .1215E+04 BASIN STORAGE= .8663E-06 PERCENT ERROR=    .0

FOR STORM = 2  STORM AREA (SQ MI) =        1.00
  66-66D  MANE         2.14   1012.55    779.73      1.73      5.00   1011.67    780.00        1.73

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1210E+04 EXCESS= .0000E+00 OUTFLOW= .1210E+04 BASIN STORAGE= .8531E-06 PERCENT ERROR=    .0

FOR STORM = 3  STORM AREA (SQ MI) =        5.00
  66-66D  MANE         2.17    947.24    883.48      1.69      5.00    947.20    885.00        1.69

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1184E+04 EXCESS= .0000E+00 OUTFLOW= .1184E+04 BASIN STORAGE= .8400E-06 PERCENT ERROR=    .0

FOR STORM = 4  STORM AREA (SQ MI) =       10.00
  66-66D  MANE         2.18    930.66    888.75      1.65      5.00    930.57    890.00        1.65

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1152E+04 EXCESS= .0000E+00 OUTFLOW= .1152E+04 BASIN STORAGE= .7875E-06 PERCENT ERROR=    .0

FOR STORM = 5  STORM AREA (SQ MI) =       30.00
  66-66D  MANE         2.19    901.06    905.41      1.59      5.00    901.06    905.00        1.59

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1112E+04 EXCESS= .0000E+00 OUTFLOW= .1112E+04 BASIN STORAGE= .7941E-06 PERCENT ERROR=    .0

FOR STORM = 6  STORM AREA (SQ MI) =       60.00
  66-66D  MANE         2.21    865.15    903.87      1.53      5.00    865.08    905.00        1.53
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CONTINUITY SUMMARY (AC-FT) - INFLOW= .1072E+04 EXCESS= .0000E+00 OUTFLOW= .1072E+04 BASIN STORAGE= .7941E-06 PERCENT ERROR=    .0

          FOR STORM = 7  STORM AREA (SQ MI) =      90.00
            66-66D  MANE         2.21    857.37    903.26      1.51      5.00    857.35    905.00        1.51

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1057E+04 EXCESS= .0000E+00 OUTFLOW= .1057E+04 BASIN STORAGE= .7875E-06 PERCENT ERROR=    .0

          FOR STORM = 8  STORM AREA (SQ MI) =     120.00
            66-66D  MANE         2.22    849.49    904.93      1.49      5.00    849.49    905.00        1.49

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1043E+04 EXCESS= .0000E+00 OUTFLOW= .1043E+04 BASIN STORAGE= .7875E-06 PERCENT ERROR=    .0

          FOR STORM = 9  STORM AREA (SQ MI) =     150.00
            66-66D  MANE         2.22    844.70    905.92      1.48      5.00    844.69    905.00        1.48

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1034E+04 EXCESS= .0000E+00 OUTFLOW= .1034E+04 BASIN STORAGE= .8006E-06 PERCENT ERROR=    .0

          FOR STORM = 1  STORM AREA (SQ MI) =        .01
            66T70A  MANE         1.09   1191.09    820.28      1.57      5.00   1190.79    820.00        1.57

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1306E+04 EXCESS= .0000E+00 OUTFLOW= .1306E+04 BASIN STORAGE= .4598E-06 PERCENT ERROR=    .1

          FOR STORM = 2  STORM AREA (SQ MI) =       1.00
            66T70A  MANE         1.09   1171.11    824.16      1.56      5.00   1170.93    825.00        1.56

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1299E+04 EXCESS= .0000E+00 OUTFLOW= .1298E+04 BASIN STORAGE= .4598E-06 PERCENT ERROR=    .1

          FOR STORM = 3  STORM AREA (SQ MI) =       5.00
            66T70A  MANE         1.10   1106.19    844.90      1.52      5.00   1106.15    845.00        1.52

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1264E+04 EXCESS= .0000E+00 OUTFLOW= .1264E+04 BASIN STORAGE= .4433E-06 PERCENT ERROR=    .0

          FOR STORM = 4  STORM AREA (SQ MI) =      10.00
            66T70A  MANE         1.11   1055.23    865.24      1.47      5.00   1055.23    865.00        1.47

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1222E+04 EXCESS= .0000E+00 OUTFLOW= .1222E+04 BASIN STORAGE= .4160E-06 PERCENT ERROR=    .0

          FOR STORM = 5  STORM AREA (SQ MI) =      30.00
            66T70A  MANE         1.13    994.24    890.24      1.40      5.00    994.23    890.00        1.40

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1169E+04 EXCESS= .0000E+00 OUTFLOW= .1168E+04 BASIN STORAGE= .4160E-06 PERCENT ERROR=    .0

          FOR STORM = 6  STORM AREA (SQ MI) =      60.00
            66T70A  MANE         1.14    914.12    909.85      1.34      5.00    914.11    910.00        1.34

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1115E+04 EXCESS= .0000E+00 OUTFLOW= .1115E+04 BASIN STORAGE= .4214E-06 PERCENT ERROR=    .0

          FOR STORM = 7  STORM AREA (SQ MI) =      90.00
            66T70A  MANE         1.15    893.97    920.85      1.31      5.00    893.97    920.00        1.31

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1096E+04 EXCESS= .0000E+00 OUTFLOW= .1096E+04 BASIN STORAGE= .4160E-06 PERCENT ERROR=    .0

          FOR STORM = 8  STORM AREA (SQ MI) =     120.00
            66T70A  MANE         1.15    877.07    905.66      1.29      5.00    877.06    905.00        1.29

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1077E+04 EXCESS= .0000E+00 OUTFLOW= .1077E+04 BASIN STORAGE= .4214E-06 PERCENT ERROR=    .0

          FOR STORM = 9  STORM AREA (SQ MI) =     150.00
            66T70A  MANE         1.16    871.37    905.58      1.28      5.00    871.34    905.00        1.28

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1066E+04 EXCESS= .0000E+00 OUTFLOW= .1065E+04 BASIN STORAGE= .4269E-06 PERCENT ERROR=    .0

          FOR STORM = 1  STORM AREA (SQ MI) =        .01
            66T70B  MANE         1.47   1188.18    821.63      1.57      5.00   1187.56    820.00        1.57

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1305E+04 EXCESS= .0000E+00 OUTFLOW= .1305E+04 BASIN STORAGE= .6297E-06 PERCENT ERROR=    .0

          FOR STORM = 2  STORM AREA (SQ MI) =       1.00
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      66T70B  MANE          1.48   1169.88    824.37      1.56      5.00   1169.82    825.00        1.56

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1298E+04 EXCESS= .0000E+00 OUTFLOW= .1298E+04 BASIN STORAGE= .6297E-06 PERCENT ERROR=    .0

     FOR STORM = 3  STORM AREA (SQ MI) =        5.00
      66T70B  MANE          1.49   1105.75    844.18      1.52      5.00   1105.74    845.00        1.52

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1264E+04 EXCESS= .0000E+00 OUTFLOW= .1264E+04 BASIN STORAGE= .6037E-06 PERCENT ERROR=    .0

     FOR STORM = 4  STORM AREA (SQ MI) =       10.00
      66T70B  MANE          1.51   1054.83    865.66      1.47      5.00   1054.78    865.00        1.47

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1222E+04 EXCESS= .0000E+00 OUTFLOW= .1222E+04 BASIN STORAGE= .5712E-06 PERCENT ERROR=    .0

     FOR STORM = 5  STORM AREA (SQ MI) =       30.00
      66T70B  MANE          1.53    994.04    891.17      1.40      5.00    994.00    890.00        1.40

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1168E+04 EXCESS= .0000E+00 OUTFLOW= .1168E+04 BASIN STORAGE= .5712E-06 PERCENT ERROR=    .0

     FOR STORM = 6  STORM AREA (SQ MI) =       60.00
      66T70B  MANE          1.55    913.84    912.31      1.34      5.00    913.72    915.00        1.34

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1115E+04 EXCESS= .0000E+00 OUTFLOW= .1115E+04 BASIN STORAGE= .5712E-06 PERCENT ERROR=    .0

     FOR STORM = 7  STORM AREA (SQ MI) =       90.00
      66T70B  MANE          1.56    893.72    922.56      1.31      5.00    893.58    920.00        1.31

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1096E+04 EXCESS= .0000E+00 OUTFLOW= .1096E+04 BASIN STORAGE= .5712E-06 PERCENT ERROR=    .0

     FOR STORM = 8  STORM AREA (SQ MI) =      120.00
      66T70B  MANE          1.56    876.94    907.27      1.29      5.00    876.89    910.00        1.29

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1077E+04 EXCESS= .0000E+00 OUTFLOW= .1077E+04 BASIN STORAGE= .5712E-06 PERCENT ERROR=    .0

     FOR STORM = 9  STORM AREA (SQ MI) =      150.00
      66T70B  MANE          1.57    871.26    910.01      1.28      5.00    871.26    910.00        1.28

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1065E+04 EXCESS= .0000E+00 OUTFLOW= .1065E+04 BASIN STORAGE= .5842E-06 PERCENT ERROR=    .0

     FOR STORM = 1  STORM AREA (SQ MI) =        .01
         CULVT  MANE          .83   1179.62    820.14      1.56      5.00   1179.30    820.00        1.56

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1305E+04 EXCESS= .0000E+00 OUTFLOW= .1305E+04 BASIN STORAGE= .3612E-06 PERCENT ERROR=    .1

     FOR STORM = 2  STORM AREA (SQ MI) =        1.00
         CULVT  MANE          .84   1162.29    825.11      1.56      5.00   1162.23    825.00        1.56

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1298E+04 EXCESS= .0000E+00 OUTFLOW= .1297E+04 BASIN STORAGE= .3514E-06 PERCENT ERROR=    .1

     FOR STORM = 3  STORM AREA (SQ MI) =        5.00
         CULVT  MANE          .85   1099.73    845.37      1.51      5.00   1099.70    845.00        1.51

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1264E+04 EXCESS= .0000E+00 OUTFLOW= .1263E+04 BASIN STORAGE= .3448E-06 PERCENT ERROR=    .1

     FOR STORM = 4  STORM AREA (SQ MI) =       10.00
         CULVT  MANE          .85   1049.78    865.25      1.46      5.00   1049.73    865.00        1.46

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1222E+04 EXCESS= .0000E+00 OUTFLOW= .1221E+04 BASIN STORAGE= .3218E-06 PERCENT ERROR=    .0

     FOR STORM = 5  STORM AREA (SQ MI) =       30.00
         CULVT  MANE          .86    989.94    894.49      1.40      5.00    989.91    895.00        1.40

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1168E+04 EXCESS= .0000E+00 OUTFLOW= .1168E+04 BASIN STORAGE= .3251E-06 PERCENT ERROR=    .0

     FOR STORM = 6  STORM AREA (SQ MI) =       60.00
         CULVT  MANE          .88    910.53    914.76      1.34      5.00    910.51    915.00        1.34

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1115E+04 EXCESS= .0000E+00 OUTFLOW= .1115E+04 BASIN STORAGE= .3251E-06 PERCENT ERROR=    .0
```

```
          FOR STORM = 7  STORM AREA (SQ MI) =      90.00
             CULVT  MANE          .88    890.72    924.98      1.31      5.00    890.72    925.00        1.31

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1096E+04 EXCESS= .0000E+00 OUTFLOW= .1096E+04 BASIN STORAGE= .3251E-06 PERCENT ERROR=    .0

          FOR STORM = 8  STORM AREA (SQ MI) =     120.00
             CULVT  MANE          .89    873.30    909.84      1.29      5.00    873.30    910.00        1.29

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1077E+04 EXCESS= .0000E+00 OUTFLOW= .1076E+04 BASIN STORAGE= .3251E-06 PERCENT ERROR=    .0

          FOR STORM = 9  STORM AREA (SQ MI) =     150.00
             CULVT  MANE          .89    867.56    910.10      1.28      5.00    867.56    910.00        1.28

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1065E+04 EXCESS= .0000E+00 OUTFLOW= .1065E+04 BASIN STORAGE= .3284E-06 PERCENT ERROR=    .0


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


   -----DSS---ZCLOSE Unit:  71,   File: N60EM.DSS
             Pointer Utilization:   .31
             Number of Records:    170
             File Size:    309.0  Kbytes
             Percent Inactive:    .0
```

DESIGN HYDROLOGY

Miscellaneous

Detailed Output for RS65A outlet data

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

          **************
          *            *
506 KK    *     RS65A  *
          *            *
          **************

517 KO          OUTPUT CONTROL VARIABLES
                     IPRNT          1  PRINT CONTROL
                     IPLOT          0  PLOT CONTROL
                     QSCAL         0.  HYDROGRAPH PLOT SCALE

             HYDROGRAPH ROUTING DATA

518 RS          STORAGE ROUTING
                     NSTPS          1  NUMBER OF SUBREACHES
                      ITYP       STOR  TYPE OF INITIAL CONDITION
                    RSVRIC        .00  INITIAL CONDITION
                         X        .00 WORKING R AND D COEFFICIENT

519 SV            STORAGE        .0      5.4      9.3     13.9     18.8     24.0     29.5     35.3     41.4     48.0

520 SE          ELEVATION    1429.00  1433.00  1434.00  1435.00  1436.00  1437.00  1438.00  1439.00  1440.00  1441.00

521 SL          LOW-LEVEL OUTLET
                     ELEVL    1427.30  ELEVATION AT CENTER OF OUTLET
                     CAREA       1.77  CROSS-SECTIONAL AREA
                      COQL        .62  COEFFICIENT
                      EXPL        .50  EXPONENT OF HEAD

522 SS          SPILLWAY
                      CREL    1439.00  SPILLWAY CREST ELEVATION
                     SPWID     200.00  SPILLWAY WIDTH
                      COQW       2.50  WEIR COEFFICIENT
                      EXPW       1.50  EXPONENT OF HEAD
```

26cfs

```
                                   ***

                        COMPUTED OUTFLOW-ELEVATION DATA

   OUTFLOW        .00     12.30     13.28     14.43     15.80     17.45     19.49     22.08     25.45     30.04
 ELEVATION    1429.00   1429.26   1429.59   1430.00   1430.53   1431.25   1432.23   1433.62   1435.70   1439.00

   OUTFLOW      31.52     41.63     68.79    121.46    208.10    337.18    517.06    756.37   1063.48   1446.72
 ELEVATION    1439.02   1439.08   1439.18   1439.32   1439.50   1439.72   1439.98   1440.28   1440.62   1441.00

                        COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

   STORAGE        .00       .35       .79      1.35      2.07      3.03      4.36      5.40      7.81      9.30
   OUTFLOW      11.45     12.30     13.28     14.43     15.80     17.45     19.49     20.97     22.08     22.73
 ELEVATION    1429.00   1429.26   1429.59   1430.00   1430.53   1431.25   1432.23   1433.00   1433.62   1434.00

   STORAGE      13.90     17.32     18.80     24.00     29.50     35.30     35.42     35.79     36.40     37.26
   OUTFLOW      24.37     25.45     25.91     27.35     28.73     30.04     31.52     41.63     68.79    121.46
 ELEVATION    1435.00   1435.70   1436.00   1437.00   1438.00   1439.00   1439.02   1439.08   1439.18   1439.32

   STORAGE      38.36     39.70     41.28     41.40     43.25     45.50     48.00
   OUTFLOW     208.10    337.18    517.06    531.30    756.37   1063.48   1446.72
 ELEVATION    1439.50   1439.72   1439.98   1440.00   1440.28   1440.62   1441.00
```

$$El @ 26cfs = 1435.70 + (26-25.45)\frac{(1439-1435.7)}{(30.04-25.45)}$$

$$Elev_{26cfs} = 1436.07 \text{ ft}$$

Weir Crest @ 1439

MEMO

TO: Mike Lopez **DATE:** October 13, 2008

FROM: Charlie Joy

SUBJECT: Offsite Flow Assessment for Siphon Draw Detention Basin

---

Per our meeting with the FCDMC yesterday, it was requested that we try to provide ditches to contain and convey the 100-yr offsite drainage within the FCDMC easement as opposed to diverting flow overland.

Fill has been placed at the northeast corner of the site to direct drainage either to the west or south away from the known active fissure.

Normal depth/Manning's Equation is used to size the channels. A summary of the assessment is provided below and supporting documentation is attached.

Offsite Flow North of the Detention Basin

Rational method was used for hydrology north of the detention basin.

Reviewing the offsite topography, it was revealed that the SRP maintenance road within the SRP easement is incised and has the general configuration of a shallow 5:1 (H:V) trapezoidal channel 15' in width (bottom) and 1' in depth. With an average channel slope of ~0.9%, the road has an estimated capacity of ~100 cfs. It is therefore assumed that the road will intercept the first 100 cfs of the offsite drainage prior to the FCDMC easement.

It is assumed that the peak discharge from drainage area 65A2-23 (which is the combined areas of 65A2-2 and 65A2-3) will serve as the design Q for the North Channel. The peak discharge for 65A2-123 (which is the combined areas of 65A2-1, 65A2-2 and 65A2-3) is the concentration of all offsite flow to the north at the Meridian channel.

The channel results are for a trapezoidal channel: BW=10 ft, D=1 ft, 5:1 SS (H:V), n=0.025 and S=0.009 ft/ft.

Subbasin	Q (cfs)	Channel Q downstream[1] (cfs)	Trapezoidal Channel		
			Depth (ft)	Velocity (ft/s)	Top Width (ft)
65A2-3	38	0	Channel not necessary		
65A2-23	162	62	0.94	4.5	20
65A2-123	235	235	Flow concentrated at Meridian Channel		

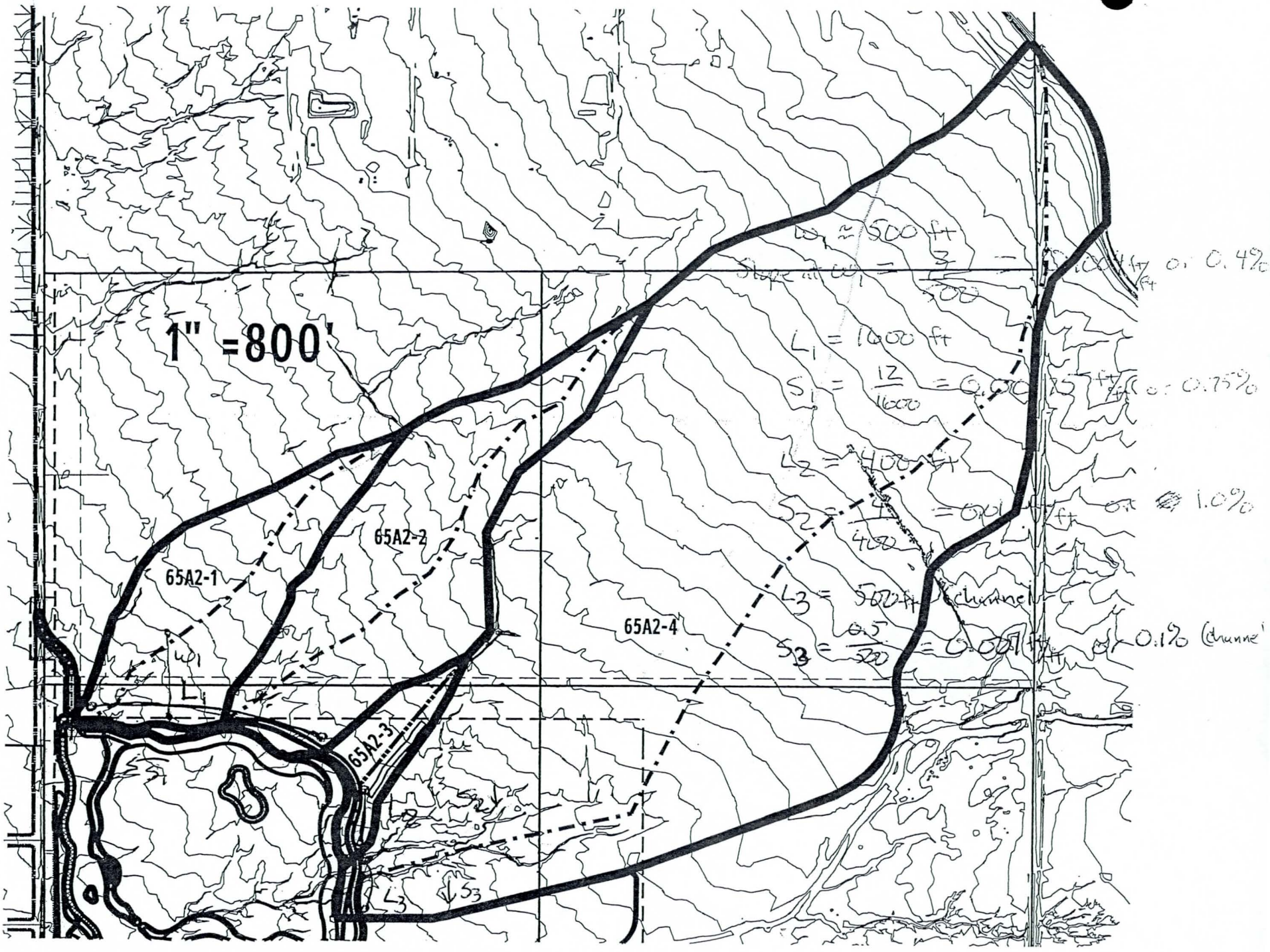
[1] *Flow is reduced by up to 100 cfs which is intercepted by SRP maintenance road.*
[2] *Subbasin 65A2-23 is the flow from the combined areas of 65A2-2 and 65A2-3.*
[3] *Subbasin 65A2-123 is the flow from the combined areas of 65A2-1, 65A2-2 and 65A2-3. Flow is not reduced by 100 cfs since flow from the maintenance road along with Subbasin 65A3-1 combine at the Meridian Channel.*

Offsite Flow Northeast and East of the Detention Basin

Because the 300 acre drainage area east of the basin far exceeds the typical maximum 150 acres used for the application of the rational method , the 100-yr discharge was based upon a percentage of the HEC-1 results for the subbasin tributary to Siphon Draw Wash per FCDMC recommendations. The total drainage area for Siphon Draw wash is ~773 acres (1.207 sq. mi) producing ~1000 cfs for the 100-year event. 300 acres is ~40% of 773 acres consequently 40% of 1000 cfs or 400 cfs is used to size the east channel.

The slope of the east channel is severely limited by the inverts of existing drainages north of Siphon Draw Wash. The estimated slope is approximately 0.001 ft/ft. Based upon that slope a 5:1 trapezoidal channels of the following dimensions is provided.

Q (cfs)	Depth (ft)	Bottom Width	Velocity (ft/s)	Top Width (ft)
400	3	30	3.2	60


1" =800'
65A2-1
65A2-2
65A2-3
65A2-4
$w_1 \approx 500$ ft
Slope at w_1 = 3/500 = 0.006 ft/ft or 0.4%
L_1 = 1600 ft
S_1 = 12/1600 = 0.0075 ft/ft or 0.75%
L_2 = 400 ft
S_2 = 4/400 = 0.01 ft/ft or 1.0%
L_3 = 500 ft (channel)
S_3 = 0.5/500 = 0.001 ft/ft or 0.1% (channel)

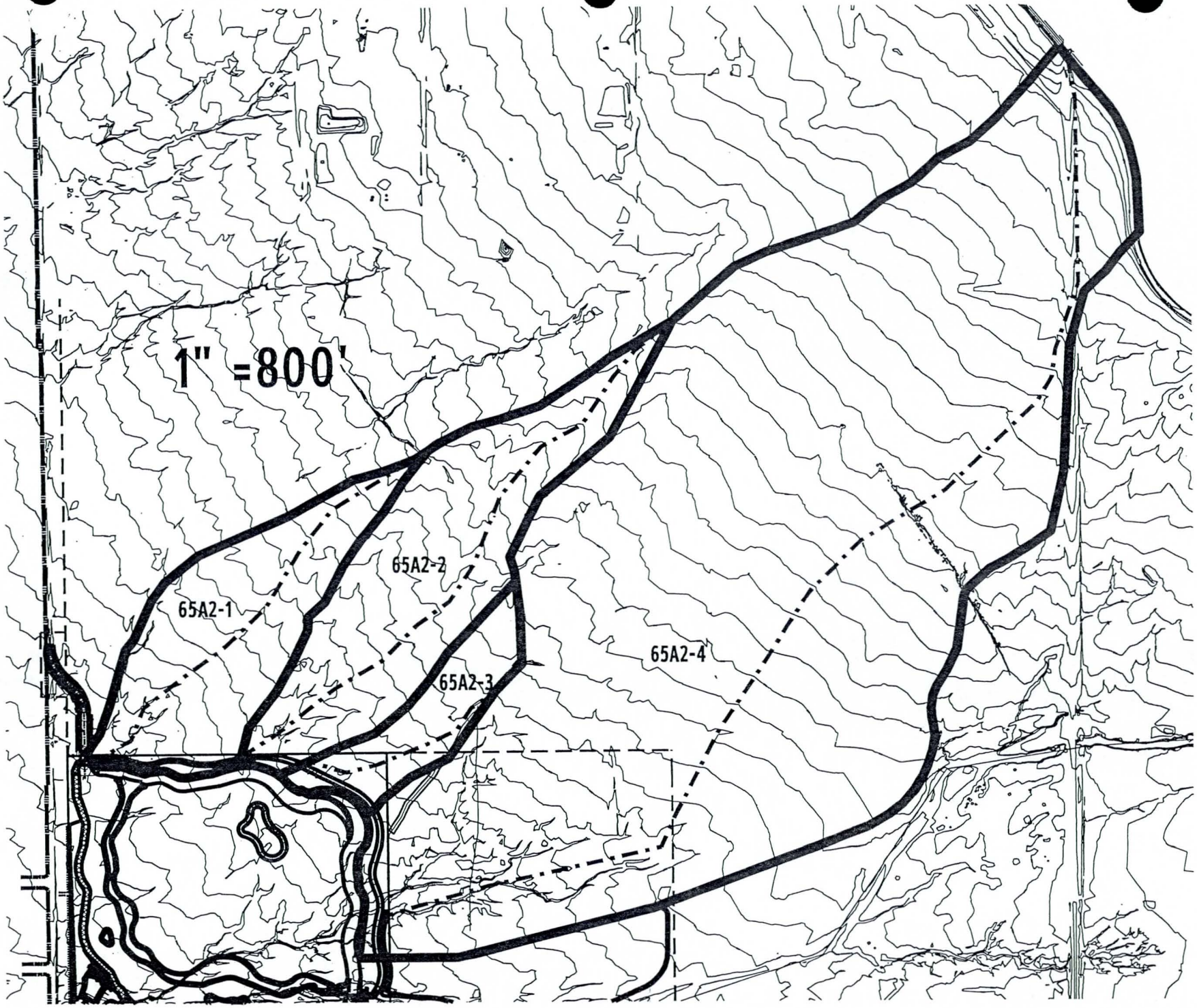
FCDMC Rational Method

Siphon Draw Wash Drainage Improvements Project - Offsite Drainage to Siphon Draw Detention Basin

Area	Total Area[A]		Elevation[A]		Length[A]		Slope	Slope	Drainage Roughness			
			Top	Bottom					Area	*m*	*b*	K_b [1]
	(sf)	(acres)	(ft)	(ft)	(ft)	(mi)	(ft/ft)	(ft/mi)	Type			
65A2-1	1,624,800	37.31	1528	1500	2900	0.549	0.010	50.98	B	-0.01375	0.08	0.0584
65A2-2	2,200,900	50.53	1544	1508	3900	0.739	0.009	48.74	B	-0.01375	0.08	0.0566
65A2-3	638,100	14.65	1524	1512	2050	0.388	0.006	30.91	B	-0.01375	0.08	0.0640
65A2-4	13,042,500	299.42	1570	1508	7640	1.447	0.008	42.85	B	-0.01375	0.08	0.0460
65A2-23	2,839,000	65.18	1544	1508	3900	0.739	0.009	48.74	B	-0.01375	0.08	0.0551
65A2-13	4,463,800	102.48	1544	1500	4830	0.915	0.009	48.10	B	-0.01375	0.08	0.0524

[A] Rough estimate based upon CADD files

[1] Table 3.1, Drainage Design Manual for Maricopa County - Hydrology, FCDMC, 1991


1" =800'
65A2-1
65A2-2
65A2-3
65A2-4

Stanley Consultants
Drainage Design Management System
SUB BASINS
Project Reference: 20539-REVISED

10/17/2008

ID	Sub Basin Data								Sub Basin Hydrology Summary					
	Area (acres)	Length (ft)	USGE	DSGE	Slope (ft/mi)	Kb	CustomTc (min)		2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
Major Basin ID: 01														
65A2-1	37.3	2,900	1,528.00	1,500.00	51.0	0.06	-	Q (cfs)	23	37	46	65	83	100
								C	0.40	0.40	0.40	0.44	0.48	0.50
								CA (ac)	14.92	14.92	14.92	16.42	17.91	18.66
								Tc (min)	29	24	22	20	19	18
								i (in/hr)	1.54	2.46	3.09	3.97	4.65	5.36
65A2-2	50.5	3,900	1,544.00	1,508.00	48.7	0.06	-	Q (cfs)	28	42	55	80	102	122
								C	0.40	0.40	0.40	0.44	0.48	0.50
								CA (ac)	20.21	20.21	20.21	22.23	24.25	25.27
								Tc (min)	35	30	27	24	23	22
								i (in/hr)	1.38	2.10	2.71	3.58	4.20	4.83
65A2-3	14.7	2,050	1,524.00	1,512.00	30.9	0.06	-	Q (cfs)	9	14	18	25	32	38
								C	0.40	0.40	0.40	0.44	0.48	0.50
								CA (ac)	5.86	5.86	5.86	6.45	7.03	7.33
								Tc (min)	30	25	23	21	20	19
								i (in/hr)	1.50	2.40	3.01	3.87	4.53	5.22
65A2-4	299.4	7,640	1,570.00	1,508.00	42.8	0.05	-	Q (cfs)	128	207	264	373	480	578
								C	0.40	0.40	0.40	0.44	0.48	0.50
								CA (ac)	119.77	119.77	119.77	131.74	143.72	149.71
								Tc (min)	50	42	38	35	33	31
								i (in/hr)	1.07	1.73	2.20	2.83	3.34	3.86
65A223	65.2	3,900	1,544.00	1,508.00	48.7	0.06	-	Q (cfs)	37	56	71	103	135	162
								C	0.40	0.40	0.40	0.44	0.48	0.50
								CA (ac)	26.07	26.07	26.07	28.68	31.29	32.59
								Tc (min)	34	29	27	24	22	21
								i (in/hr)	1.40	2.16	2.71	3.58	4.31	4.96
65A213	102.5	4,830	1,544.00	1,500.00	48.1	0.05	-	Q (cfs)	54	82	103	149	196	235
								C	0.40	0.40	0.40	0.44	0.48	0.50
								CA (ac)	40.99	40.99	40.99	45.09	49.19	51.24

SRP Road conveys all flow to West

Subbasins 65A2-2 plus 65A2-3

SRP Road conveys 100cfs to west

$Q_{100,offsite} = 162 - 100 = 62$ cfs

Subbasins 65A2-1 plus ~~65A2-2 plus~~ 65A2-3

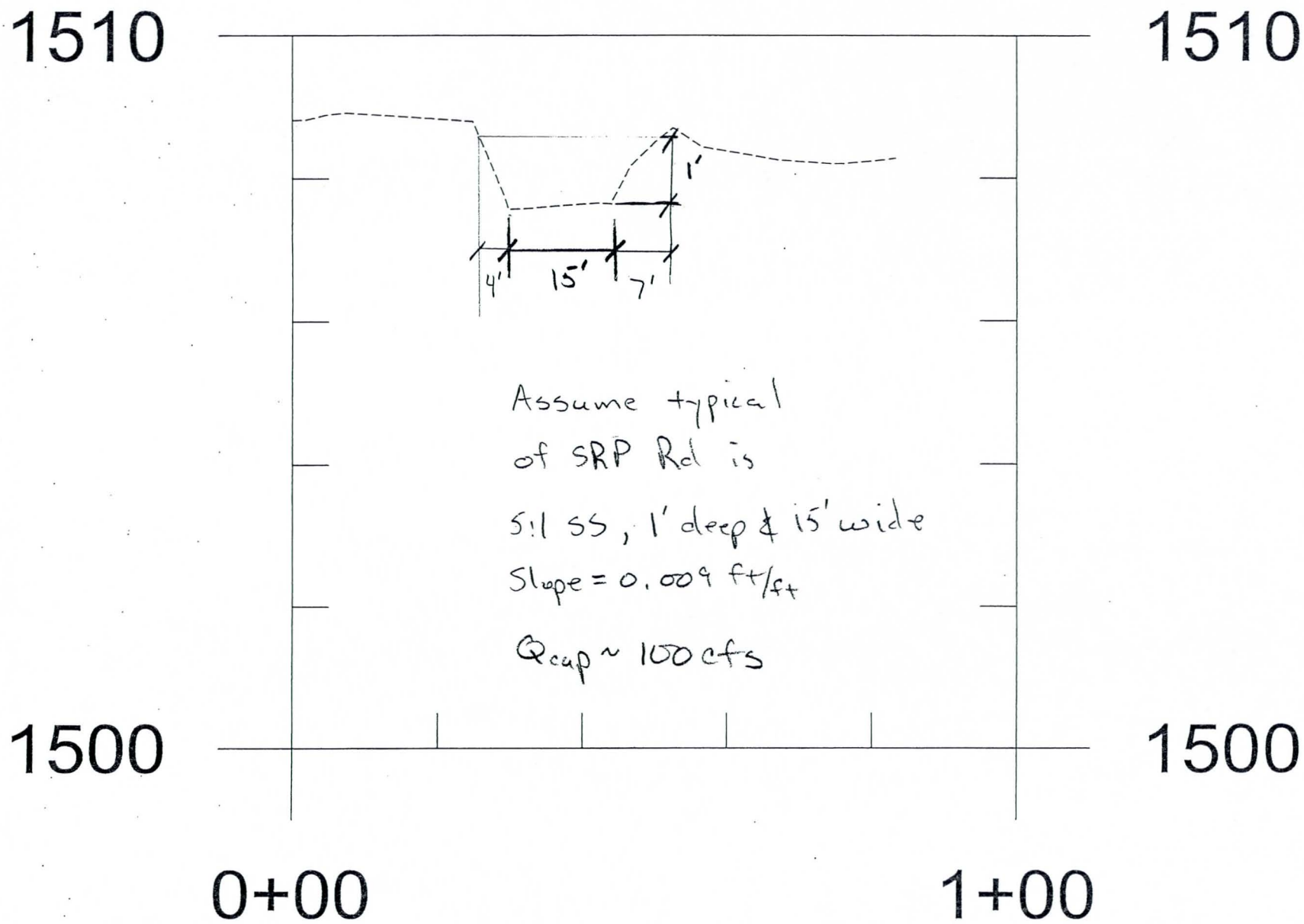
* Non default value

(stSubBasRat.rpt)

Stanley Consultants
Drainage Design Management System
SUB BASINS
Project Reference: 20539-REVISED

ID	Sub Basin Data								Sub Basin Hydrology Summary					
	Area (acres)	Length (ft)	USGE	DSGE	Slope (ft/mi)	Kb	CustomTc (min)		2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
Major Basin ID: 01														
								Tc (min)	38	33	30	27	25	24
								i (in/hr)	1.31	2.00	2.50	3.31	3.98	4.59

* Non default value


1510
1510
1'
4'
15'
7'
Assume typical
of SRP Rd is
5:1 SS, 1' deep & 15' wide
Slope = 0.009 ft/ft
Qcap ~ 100 cfs
1500
1500
0+00
1+00

Worksheet
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Existing SRP Road
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coefficient	0.025	
Channel Slope	0.009000	ft/ft
Depth	1.00	ft
Left Side Slope	5.00	H : V
Right Side Slope	5.00	H : V
Bottom Width	15.00	ft

Results		
Discharge	96.68	cfs
Flow Area	20.0	ft²
Wetted Perimeter	25.20	ft
Top Width	25.00	ft
Critical Depth	0.97	ft
Critical Slope	0.009987	ft/ft
Velocity	4.83	ft/s
Velocity Head	0.36	ft
Specific Energy	1.36	ft
Froude Number	0.95	
Flow Type	Subcritical	

Worksheet
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	East Trapezoidal Channel
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coefficient	0.025	
Channel Slope	0.001000	ft/ft
Depth	3.00	ft
Left Side Slope	5.00	H : V
Right Side Slope	5.00	H : V
Bottom Width	30.00	ft

Results		
Discharge	432.84	cfs
Flow Area	135.0	ft²
Wetted Perimeter	60.59	ft
Top Width	60.00	ft
Critical Depth	1.69	ft
Critical Slope	0.008251	ft/ft
Velocity	3.21	ft/s
Velocity Head	0.16	ft
Specific Energy	3.16	ft
Froude Number	0.38	
Flow Type	Subcritical	

APPENDIX B

SIPHON DRAW DETENTION BASIN

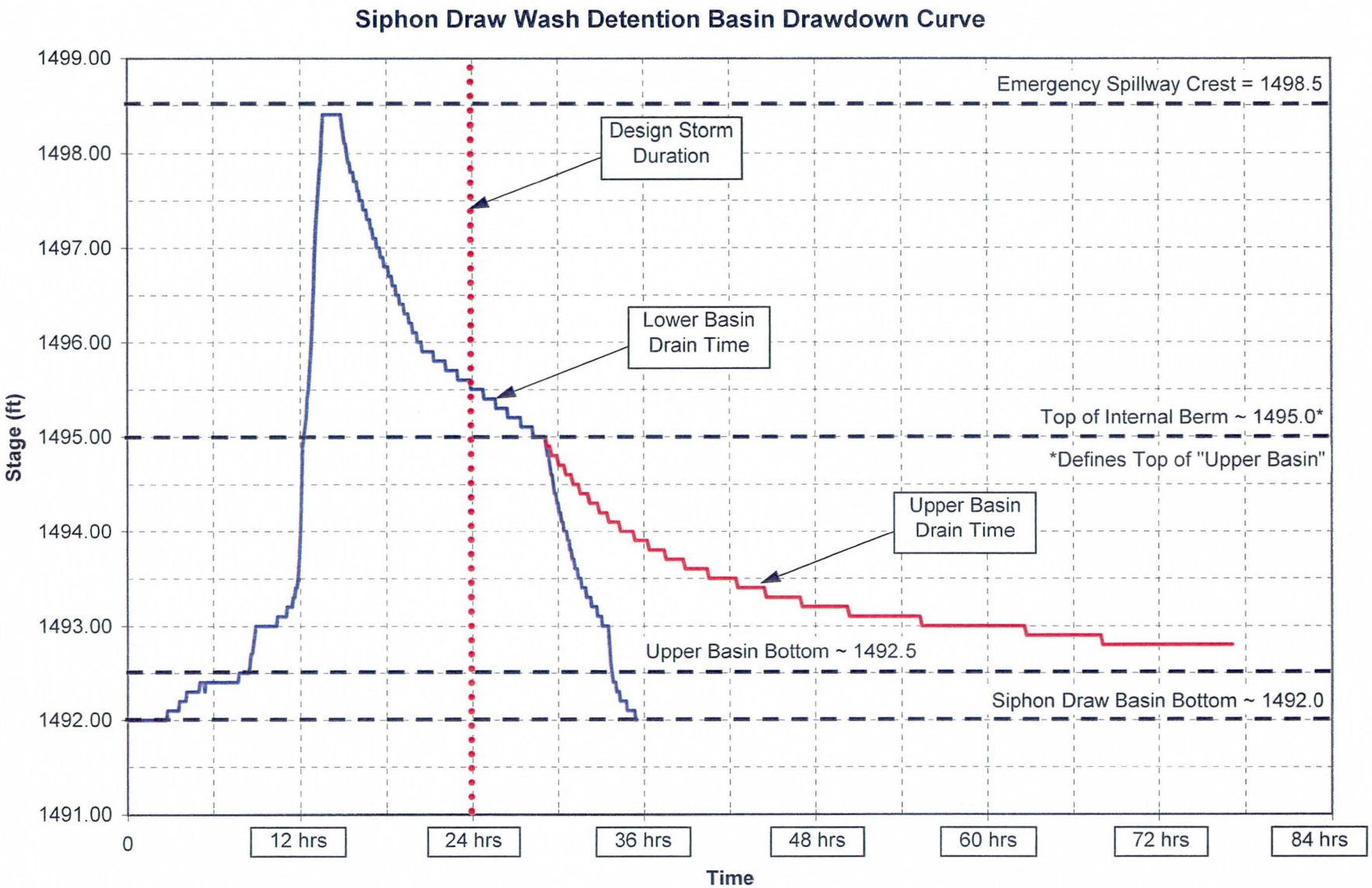
SIPHON DRAW DETENTION BASIN

Stage-Storage

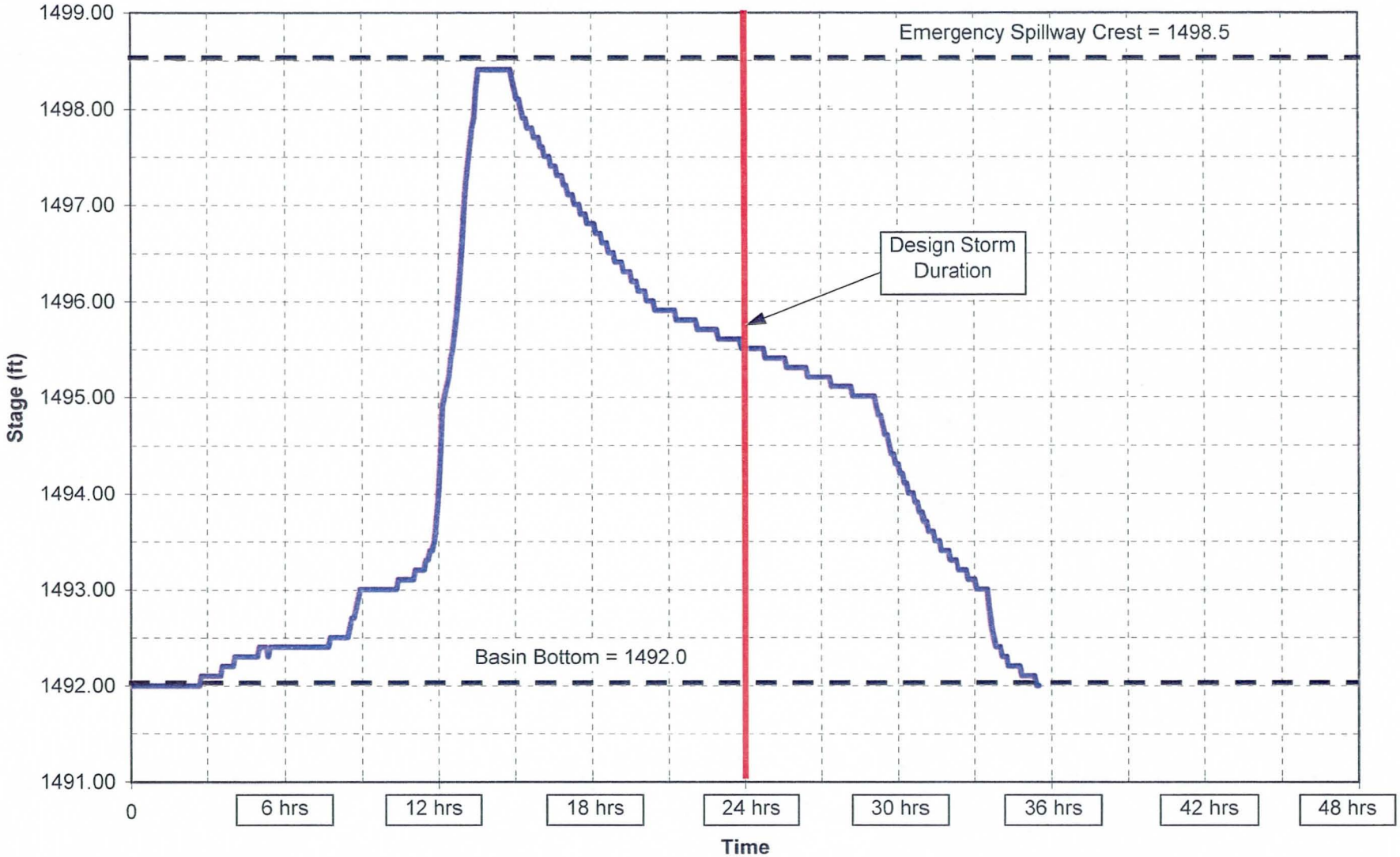
Elevation	Incremental Volume cu ft	Cumulative Volume cu ft	Acre-Feet	Surface Area sq ft	NO Berm Opening
1492.500	69161.25	69161.25	1.59	282962.38	
1493.000	194365.14	263526.38	6.05	497871.88	
1493.500	244801.70	508328.09	11.67	512741.20	
1494.000	253281.50	761609.58	17.48	527643.41	
1494.500	261738.47	1023348.05	23.49	542578.50	landscape berm elev
1495.000	270172.60	1293520.65	29.70	557546.47	
1495.500	3937710.95	5231231.60	120.09	2165466.18	
1496.000	1087418.69	6318650.29	145.06	2263954.51	
1496.500	1115125.09	7433775.38	170.66	2283902.06	
1497.000	1124041.60	8557816.98	196.46	2299241.32	
1497.500	1132835.29	9690652.27	222.47	2314601.17	
1498.000	1141622.29	10832274.56	248.67	2329985.63	
1498.500	1150400.40	11982674.95	275.08	2345391.60	
1499.000	1159171.30	13141846.26	301.70	2360822.68	
1499.500	1184273.39	14326119.65	328.88	2376275.50	
1500.000	1192006.48	15518126.13	356.25	2391753.51	

the stage-storage in this table is used for the HEC-1 model.* This table shows the storage available at various elevations if the landscape berm is "closed" meaning the flap gates are operation and do not allow any water into the basin area north & east of the berm. Being closed, water fills the lower basin until elevation 1495 is exceed at which point storage in the upper basin is available (hence the significant increase in storage between 1495 and 1495.5).

* Less 5 acre-ft to account for sedimentation of the basin


Siphon Draw Wash Detention Basin Drawdown Curve
Stage (ft)
1499.00
1498.00
1497.00
1496.00
1495.00
1494.00
1493.00
1492.00
1491.00
Emergency Spillway Crest = 1498.5
Design Storm Duration
Lower Basin Drain Time
Top of Internal Berm ~ 1495.0*
*Defines Top of "Upper Basin"
Upper Basin Drain Time
Upper Basin Bottom ~ 1492.5
Siphon Draw Basin Bottom ~ 1492.0
0
12 hrs
24 hrs
36 hrs
48 hrs
60 hrs
72 hrs
84 hrs
Time

Siphon Draw Wash Detention Basin Drawdown Curve (Lower Basin Only)



Siphon Draw Wash Detention Basin Stage/Storage & Time/Stage Curves

	Stage/Storage			Time/Stage			
	Detention Basin Inflow	Inflow Volume		Detention Basin	Cumulative Reduce	New Stored	New Basin Stage
Time (min)	Hydrographs (cfs)	Cum. (acre-ft)	Incremental (acre-ft)	Outflow (cfs)	Volume (acre-ft)	Volume (acre-ft)	(ft)
				459.96			**1498.40**
0	0	0	0	0	0	0	1492.00
5	0	0	0	0	0	0	1492.00
10	0	0	0	0	0	0	1492.00
15	0	0	0	0	0	0	1492.00
20	0	0	0	0	0	0	1492.00
25	0	0	0	0	0	0	1492.00
30	0	0	0	0	0	0	1492.00
35	0	0	0	0	0	0	1492.00
40	0	0	0	0	0	0	1492.00
45	0	0	0	0	0	0	1492.00
50	0	0	0	0	0	0	1492.00
55	0	0	0	0	0	0	1492.00
60	0	0	0	0	0	0	1492.00
65	0	0	0	0	0	0	1492.00
70	0	0	0	0	0	0	1492.00
75	0.1	0	0	0	0	0	1492.00
80	0.1	0	0	0	0	0	1492.00
85	0.1	0	0	0	0	0	1492.00
90	0.2	0	0	0	0	0	1492.00
95	0.2	0	0	0	0	0	1492.00
100	0.3	0	0	0	0	0	1492.00
105	0.3	0	0	0	0	0	1492.00
110	0.4	0	0	0	0	0	1492.00
115	0.5	0	0	0	0	0	1492.00
120	0.6	0	0	0	0	0	1492.00
125	0.8	0	0	0	0	0	1492.00
130	0.9	0	0	0	0	0	1492.00
135	1.1	0	0	0	0	0	1492.00
140	1.3	0	0	0	0	0	1492.00
145	1.4	0	0	0	0	0	1492.00
150	1.6	0	0	0	0	0	1492.00
155	1.9	0	0	0	0	0	1492.00
160	2.1	0	0	0	0	0	1492.00
165	2.3	0	0	0	0	0	1492.10
170	2.5	0	0	2	0	0	1492.10
175	2.7	0	0	2	0	0	1492.10
180	3	0	0	2	0	0	1492.10
185	3.2	0	0	2	0	0	1492.10
190	3.4	0	0	2	0	0	1492.10
195	3.6	0	0	2	0	0	1492.10
200	3.8	0	0	2	0	0	1492.10
205	3.9	0	0	2	0	0	1492.10
210	4.1	0	0	2	0	0	1492.10
215	4.3	0	0	2	0	0	1492.20
220	4.4	0	0	2	0	0	1492.20
225	4.5	0	0	2	0	0	1492.20
230	4.6	0	0	2	0	0	1492.20
235	4.7	0	0	2	0	0	1492.20
240	4.8	0	0	2	0	0	1492.20

Siphon Draw Wash Detention Basin Stage/Storage & Time/Stage Curves

	Stage/Storage			Time/Stage			
	Detention Basin Inflow	Inflow Volume		Detention Basin	Cumulative Reduce	New Stored	New Basin Stage
Time (min)	Hydrographs (cfs)	Cum. (acre-ft)	Incremental (acre-ft)	Outflow (cfs)	Volume (acre-ft)	Volume (acre-ft)	(ft)
245	4.9	1	0	2	0	0	1492.30
250	5	1	0	4	0	0	1492.30
255	5	1	0	4	0	0	1492.30
260	5.1	1	0	4	0	0	1492.30
265	5.2	1	0	4	0	0	1492.30
270	5.2	1	0	4	0	0	1492.30
275	5.2	1	0	4	0	0	1492.30
280	5.3	1	0	4	0	0	1492.30
285	5.3	1	0	4	0	0	1492.30
290	5.3	1	0	4	0	0	1492.30
295	5.4	1	0	4	0	0	1492.30
300	5.4	1	0	4	1	0	1492.40
305	5.4	1	0	6	1	0	1492.40
310	5.5	1	0	6	1	0	1492.40
315	5.5	1	0	6	1	0	1492.40
320	5.6	1	0	6	1	0	1492.30
325	5.6	1	0	4	1	0	1492.40
330	5.7	1	0	6	1	0	1492.40
335	5.7	1	0	6	1	0	1492.40
340	5.8	1	0	6	1	0	1492.40
345	5.8	1	0	6	1	0	1492.40
350	5.9	1	0	6	1	0	1492.40
355	6	1	0	6	1	0	1492.40
360	6.1	1	0	6	1	0	1492.40
365	6.1	1	0	6	1	0	1492.40
370	6.2	1	0	6	1	0	1492.40
375	6.3	2	0	6	1	0	1492.40
380	6.4	2	0	6	1	0	1492.40
385	6.4	2	0	6	1	0	1492.40
390	6.5	2	0	6	1	0	1492.40
395	6.6	2	0	6	1	0	1492.40
400	6.6	2	0	6	1	0	1492.40
405	6.7	2	0	6	1	0	1492.40
410	6.8	2	0	6	1	0	1492.40
415	6.8	2	0	6	1	0	1492.40
420	6.9	2	0	6	1	0	1492.40
425	6.9	2	0	6	2	0	1492.40
430	7	2	0	6	2	0	1492.40
435	7	2	0	6	2	0	1492.40
440	7.1	2	0	6	2	0	1492.40
445	7.1	2	0	6	2	0	1492.40
450	7.2	2	0	6	2	0	1492.40
455	7.3	2	0	6	2	0	1492.40
460	7.3	2	0	6	2	0	1492.40
465	7.4	2	0	6	2	1	1492.50
470	7.5	2	0	8	2	1	1492.50
475	7.5	2	0	8	2	1	1492.50
480	7.6	3	0	8	2	1	1492.50
485	7.7	3	0	8	2	1	1492.50
490	7.9	3	0	8	2	1	1492.50

Siphon Draw Wash Detention Basin Stage/Storage & Time/Stage Curves

	Stage/Storage			Time/Stage			
	Detention Basin Inflow	Inflow Volume		Detention Basin	Cumulative Reduce	New Stored	New Basin Stage
Time (min)	Hydrographs (cfs)	Cum. (acre-ft)	Incremental (acre-ft)	Outflow (cfs)	Volume (acre-ft)	Volume (acre-ft)	(ft)
495	9.2	3	0	8	2	1	1492.50
500	12.5	3	0	8	2	1	1492.50
505	16.3	3	0	8	2	1	1492.50
510	19.4	3	0	8	2	1	1492.60
515	22	3	0	10	2	1	1492.70
520	24.1	3	0	14	2	1	1492.70
525	26	3	0	14	3	1	1492.80
530	27.7	4	0	18	3	1	1492.90
535	29.2	4	0	22	3	1	1493.00
540	30.6	4	0	30	3	1	1493.00
545	31.9	4	0	30	3	1	1493.00
550	33.1	4	0	30	3	1	1493.00
555	34.1	5	0	30	4	1	1493.00
560	35.1	5	0	30	4	1	1493.00
565	36	5	0	30	4	1	1493.00
570	36.8	5	0	30	4	1	1493.00
575	37.6	6	0	30	4	1	1493.00
580	38.4	6	0	30	5	1	1493.00
585	39.2	6	0	30	5	1	1493.00
590	40.4	7	0	30	5	1	1493.00
595	41.8	7	0	30	5	2	1493.00
600	42.9	7	0	30	5	2	1493.00
605	44	7	0	30	6	2	1493.00
610	45	8	0	30	6	2	1493.00
615	46	8	0	30	6	2	1493.00
620	47	8	0	30	6	2	1493.00
625	48	9	0	30	7	2	1493.10
630	49.1	9	0	34	7	2	1493.10
635	50.2	9	0	34	7	2	1493.10
640	51.5	10	0	34	7	2	1493.10
645	52.9	10	0	34	7	3	1493.10
650	54.7	10	0	34	8	3	1493.10
655	56.6	11	0	34	8	3	1493.10
660	58.9	11	0	34	8	3	1493.10
665	61.5	12	0	34	8	3	1493.20
670	64.4	12	0	34	9	3	1493.20
675	67.8	12	0	34	9	4	1493.20
680	76.4	13	0	34	9	4	1493.20
685	89.8	14	1	34	9	4	1493.20
690	102	14	1	34	10	5	1493.30
695	113.7	15	1	38	10	5	1493.30
700	127.5	16	1	38	10	6	1493.40
705	151.5	17	1	44	10	6	1493.40
710	254.9	18	1	44	11	8	1493.50
715	440.1	21	2	48	11	10	1493.70
720	623	24	4	60	11	13	1494.00
725	864.4	29	5	84	12	17	1494.40
730	1177.1	36	7	102	12	24	1494.90
735	1517.8	46	9	138	13	32	1495.00
740	1873.9	57	12	152	14	43	1495.10

Siphon Draw Wash Detention Basin Stage/Storage & Time/Stage Curves

	Stage/Storage			Time/Stage			
	Detention Basin Inflow	Inflow Volume		Detention Basin	Cumulative Reduce	New Stored	New Basin Stage
Time (min)	Hydrographs (cfs)	Cum. (acre-ft)	Incremental (acre-ft)	Outflow (cfs)	Volume (acre-ft)	Volume (acre-ft)	(ft)
745	2255.7	72	14	160	15	56	1495.20
750	2660.1	88	17	160	16	72	1495.40
755	3010.3	108	20	176	18	90	1495.50
760	3183.4	129	21	184	19	110	1495.70
765	3169.5	151	22	202	20	131	1495.90
770	3028.7	173	21	218	22	151	1496.20
775	2855.2	193	20	244	23	170	1496.50
780	2643.3	212	19	272	25	187	1496.90
785	2392	229	17	310	27	202	1497.20
790	2129	245	16	340	29	215	1497.40
795	1864.4	258	14	360	32	227	1497.60
800	1617.6	270	12	380	34	236	1497.80
805	1408.8	281	10	400	37	244	1497.90
810	1225.9	290	9	410	40	250	1498.20
815	1071.6	298	8	442	43	255	1498.40
820	929.7	305	7	460	46	259	1498.40
825	809.7	311	6	460	49	262	1498.40
830	701.5	316	5	460	52	264	1498.40
835	613.7	320	5	460	55	265	1498.40
840	537.7	324	4	460	58	266	1498.40
845	468.4	328	3	460	62	266	1498.40
850	408.9	331	3	460	65	266	1498.40
855	357.6	333	3	460	68	266	1498.40
860	311.8	336	2	460	71	265	1498.40
865	275.9	338	2	460	74	264	1498.40
870	243.4	340	2	460	77	262	1498.40
875	220.8	341	2	460	81	261	1498.40
880	201.7	343	1	460	84	259	1498.40
885	185.9	344	1	460	87	257	1498.40
890	172.4	345	1	460	90	255	1498.40
895	162.3	346	1	460	93	253	1498.30
900	153.1	347	1	452	96	251	1498.20
905	144.3	348	1	442	99	249	1498.10
910	136.2	349	1	442	103	247	1498.10
915	128.8	350	1	442	106	245	1498.00
920	122.2	351	1	432	109	243	1497.90
925	116.5	352	1	410	111	241	1497.90
930	111.7	353	1	410	114	239	1497.80
935	107.5	354	1	400	117	237	1497.80
940	104.1	354	1	400	120	234	1497.80
945	101.2	355	1	400	123	232	1497.70
950	98.7	356	1	390	125	230	1497.70
955	96.4	356	1	390	128	228	1497.70
960	94.2	357	1	390	131	226	1497.60
965	92.1	358	1	380	133	224	1497.60
970	90.2	358	1	380	136	222	1497.50
975	88.6	359	1	370	139	220	1497.50
980	87.1	360	1	370	141	218	1497.50
985	85.8	360	1	370	144	217	1497.40
990	84.6	361	1	360	146	215	1497.40

Siphon Draw Wash Detention Basin Stage/Storage & Time/Stage Curves

	Stage/Storage			Time/Stage			
	Detention Basin Inflow	Inflow Volume		Detention Basin	Cumulative Reduce	New Stored	New Basin Stage
Time (min)	Hydrographs (cfs)	Cum. (acre-ft)	Incremental (acre-ft)	Outflow (cfs)	Volume (acre-ft)	Volume (acre-ft)	(ft)
995	83.5	361	1	360	149	213	1497.40
1000	82.6	362	1	360	151	211	1497.30
1005	81.6	362	1	350	154	209	1497.30
1010	80.6	363	1	350	156	207	1497.30
1015	79.6	364	1	350	158	205	1497.20
1020	78.5	364	1	340	161	203	1497.20
1025	77.4	365	1	340	163	202	1497.10
1030	76.2	365	1	340	165	200	1497.10
1035	74.8	366	1	340	168	198	1497.10
1040	73.3	366	1	340	170	196	1497.00
1045	72	367	1	328	172	194	1497.00
1050	70.8	367	0	328	175	193	1497.00
1055	69.8	368	0	328	177	191	1496.90
1060	68.8	368	0	310	179	189	1496.90
1065	68.1	369	0	310	181	187	1496.90
1070	67.4	369	0	310	183	186	1496.80
1075	66.8	370	0	300	185	184	1496.80
1080	66.1	370	0	300	188	182	1496.80
1085	65.5	370	0	300	190	181	1496.80
1090	64.7	371	0	300	192	179	1496.70
1095	63.9	371	0	290	194	178	1496.70
1100	63	372	0	290	196	176	1496.70
1105	62	372	0	290	198	174	1496.60
1110	60.9	373	0	282	200	173	1496.60
1115	59.6	373	0	282	202	171	1496.60
1120	58.6	373	0	282	204	170	1496.50
1125	57.9	374	0	272	205	168	1496.50
1130	57.1	374	0	272	207	167	1496.50
1135	56.4	375	0	272	209	165	1496.40
1140	55.8	375	0	262	211	164	1496.40
1145	55.3	375	0	262	213	163	1496.40
1150	54.8	376	0	262	215	161	1496.40
1155	54.4	376	0	262	216	160	1496.30
1160	54	377	0	254	218	158	1496.30
1165	53.7	377	0	254	220	157	1496.30
1170	53.4	377	0	254	222	156	1496.30
1175	53.1	378	0	254	224	154	1496.20
1180	52.9	378	0	244	225	153	1496.20
1185	52.7	378	0	244	227	151	1496.20
1190	52.5	379	0	244	229	150	1496.10
1195	52.2	379	0	244	230	149	1496.10
1200	51.9	379	0	244	232	148	1496.10
1205	51.5	380	0	244	234	146	1496.10
1210	51	380	0	244	235	145	1496.00
1215	50.5	381	0	236	237	144	1496.00
1220	49.8	381	0	236	239	142	1496.00
1225	49.1	381	0	236	240	141	1496.00
1230	48.1	382	0	236	242	140	1495.90
1235	47.1	382	0	218	243	138	1495.90
1240	46.1	382	0	218	245	137	1495.90

Siphon Draw Wash Detention Basin Stage/Storage & Time/Stage Curves

	Stage/Storage			Time/Stage			
	Detention Basin Inflow	Inflow Volume		Detention Basin	Cumulative Reduce	New Stored	New Basin Stage
Time (min)	Hydrographs (cfs)	Cum. (acre-ft)	Incremental (acre-ft)	Outflow (cfs)	Volume (acre-ft)	Volume (acre-ft)	(ft)
1245	45.1	383	0	218	246	136	1495.90
1250	44.3	383	0	218	248	135	1495.90
1255	43.5	383	0	218	249	134	1495.90
1260	42.9	383	0	218	251	133	1495.90
1265	42.3	384	0	218	252	131	1495.90
1270	41.8	384	0	218	254	130	1495.90
1275	41.4	384	0	218	255	129	1495.90
1280	41	385	0	218	257	128	1495.80
1285	40.7	385	0	210	258	126	1495.80
1290	40.4	385	0	210	260	125	1495.80
1295	40.2	385	0	210	261	124	1495.80
1300	40	386	0	210	263	123	1495.80
1305	39.8	386	0	210	264	122	1495.80
1310	39.7	386	0	210	266	121	1495.80
1315	39.5	387	0	210	267	119	1495.80
1320	39.4	387	0	210	268	118	1495.80
1325	39.2	387	0	210	270	117	1495.80
1330	39.1	387	0	210	271	116	1495.70
1335	39	388	0	202	273	115	1495.70
1340	38.9	388	0	202	274	114	1495.70
1345	38.8	388	0	202	276	113	1495.70
1350	38.7	388	0	202	277	111	1495.70
1355	38.6	389	0	202	278	110	1495.70
1360	38.5	389	0	202	280	109	1495.70
1365	38.5	389	0	202	281	108	1495.70
1370	38.4	389	0	202	283	107	1495.70
1375	38.3	390	0	202	284	106	1495.70
1380	38.3	390	0	202	285	105	1495.60
1385	38.2	390	0	192	287	104	1495.60
1390	38.2	391	0	192	288	102	1495.60
1395	38.1	391	0	192	289	101	1495.60
1400	38.1	391	0	192	291	100	1495.60
1405	38.1	391	0	192	292	99	1495.60
1410	38	392	0	192	293	98	1495.60
1415	38	392	0	192	295	97	1495.60
1420	38	392	0	192	296	96	1495.60
1425	38	392	0	192	297	95	1495.60
1430	37.9	393	0	192	299	94	1495.60
1435	37.8	393	0	192	300	93	1495.50
1440	37.7	393	0	184	301	92	1495.50
1445	37.3	393	0	184	302	91	1495.50
1450	36.9	394	0	184	304	90	1495.50
1455	36.1	394	0	184	305	89	1495.50
1460	35.1	394	0	184	306	88	1495.50
1465	33.7	394	0	184	308	87	1495.50
1470	32.1	395	0	184	309	86	1495.50
1475	30	395	0	184	310	85	1495.50
1480	27.8	395	0	184	311	84	1495.50
1485	25.3	395	0	184	313	83	1495.50
1490	22.6	395	0	184	314	81	1495.40

Siphon Draw Wash Detention Basin Stage/Storage & Time/Stage Curves

	Stage/Storage			Time/Stage			
	Detention Basin Inflow	Inflow Volume		Detention Basin	Cumulative Reduce	New Stored	New Basin Stage
Time (min)	Hydrographs (cfs)	Cum. (acre-ft)	Incremental (acre-ft)	Outflow (cfs)	Volume (acre-ft)	Volume (acre-ft)	(ft)
1495	20.1	395	0	176	315	80	1495.40
1500	17.8	396	0	176	316	79	1495.40
1505	15.7	396	0	176	318	78	1495.40
1510	13.9	396	0	176	319	77	1495.40
1515	12.3	396	0	176	320	76	1495.40
1520	10.9	396	0	176	321	75	1495.40
1525	9.8	396	0	176	322	74	1495.40
1530	8.8	396	0	176	324	73	1495.40
1535	8	396	0	176	325	71	1495.40
1540	7.3	396	0	176	326	70	1495.30
1545	6.7	396	0	168	327	69	1495.30
1550	6.1	396	0	168	328	68	1495.30
1555	5.7	396	0	168	330	67	1495.30
1560	5.3	396	0	168	331	66	1495.30
1565	4.9	396	0	168	332	65	1495.30
1570	4.5	397	0	168	333	64	1495.30
1575	4.2	397	0	168	334	62	1495.30
1580	3.9	397	0	168	335	61	1495.30
1585	3.6	397	0	168	336	60	1495.30
1590	3.4	397	0	168	338	59	1495.20
1595	3.2	397	0	160	339	58	1495.20
1600	2.9	397	0	160	340	57	1495.20
1605	2.7	397	0	160	341	56	1495.20
1610	2.5	397	0	160	342	55	1495.20
1615	2.3	397	0	160	343	54	1495.20
1620	2.2	397	0	160	344	52	1495.20
1625	2	397	0	160	345	51	1495.20
1630	1.8	397	0	160	346	50	1495.20
1635	1.7	397	0	160	348	49	1495.20
1640	1.5	397	0	160	349	48	1495.20
1645	1.4	397	0	160	350	47	1495.10
1650	1.3	397	0	160	351	46	1495.10
1655	1.2	397	0	160	352	45	1495.10
1660	1.1	397	0	160	353	44	1495.10
1665	1	397	0	160	354	43	1495.10
1670	0.9	397	0	160	355	42	1495.10
1675	0.8	397	0	160	356	40	1495.10
1680	0.7	397	0	160	357	39	1495.10
1685	0.6	397	0	160	359	38	1495.10
1690	0.5	397	0	160	360	37	1495.10
1695	0.5	397	0	160	361	36	1495.00
1700	0.4	397	0	152	362	35	1495.00
1705	0.4	397	0	152	363	34	1495.00
1710	0.3	397	0	152	364	33	1495.00
1715	0.3	397	0	152	365	32	1495.00
1720	0.3	397	0	152	366	31	1495.00
1725	0.2	397	0	152	367	30	1495.00
1730	0.2	397	0	152	368	29	1495.00
1735	0.2	397	0	152	369	28	1495.00
1740	0.2	397	0	152	370	27	1495.00

Siphon Draw Wash Detention Basin Stage/Storage & Time/Stage Curves

	Stage/Storage			Time/Stage			
	Detention Basin Inflow	Inflow Volume		Detention Basin	Cumulative Reduce	New Stored	New Basin Stage
Time (min)	Hydrographs (cfs)	Cum. (acre-ft)	Incremental (acre-ft)	Outflow (cfs)	Volume (acre-ft)	Volume (acre-ft)	(ft)
1745	0.1	397	0	152	371	26	1495.00
1750	0.1	397	0	152	372	25	1494.90
1755	0.1	397	0	138	373	24	1494.80
1760	0.1	397	0	130	374	23	1494.80
1765	0.1	397	0	130	375	22	1494.70
1770	0.1	397	0	124	376	21	1494.60
1775	0.1	397	0	116	377	20	1494.60
1780	0	397	0	116	378	19	1494.50
1785	0	397	0	110	378	18	1494.40
1790	0	397	0	102	379	18	1494.40
1795	0	397	0	102	380	17	1494.30
1800	0	397	0	96	381	16	1494.30
1805	0	397	0	96	381	16	1494.20
1810	0	397	0	90	382	15	1494.20
1815	0	397	0	90	382	14	1494.10
1820	0	397	0	90	383	14	1494.10
1825	0	397	0	90	384	13	1494.00
1830	0	397	0	84	384	13	1494.00
1835	0	397	0	84	385	12	1494.00
1840	0	397	0	84	385	11	1493.90
1845	0	397	0	71	386	11	1493.90
1850	0	397	0	71	386	10	1493.80
1855	0	397	0	66	387	10	1493.80
1860	0	397	0	66	387	9	1493.70
1865	0	397	0	60	388	9	1493.70
1870	0	397	0	60	388	9	1493.60
1875	0	397	0	54	389	8	1493.60
1880	0	397	0	54	389	8	1493.60
1885	0	397	0	54	389	8	1493.50
1890	0	397	0	48	390	7	1493.50
1895	0	397	0	48	390	7	1493.50
1900	0	397	0	48	390	6	1493.40
1905	0	397	0	44	391	6	1493.40
1910	0	397	0	44	391	6	1493.40
1915	0	397	0	44	391	6	1493.40
1920	0	397	0	44	392	5	1493.30
1925	0	397	0	38	392	5	1493.30
1930	0	397	0	38	392	5	1493.30
1935	0	397	0	38	392	4	1493.30
1940	0	397	0	38	393	4	1493.20
1945	0	397	0	34	393	4	1493.20
1950	0	397	0	34	393	4	1493.20
1955	0	397	0	34	393	3	1493.20
1960	0	397	0	34	394	3	1493.20
1965	0	397	0	34	394	3	1493.10
1970	0	397	0	34	394	3	1493.10
1975	0	397	0	34	394	3	1493.10
1980	0	397	0	34	395	2	1493.10
1985	0	397	0	34	395	2	1493.00
1990	0	397	0	30	395	2	1493.00

Siphon Draw Wash Detention Basin Stage/Storage & Time/Stage Curves

	Stage/Storage			Time/Stage			
	Detention Basin Inflow	Inflow Volume		Detention Basin	Cumulative Reduce	New Stored	New Basin Stage
Time (min)	Hydrographs (cfs)	Cum. (acre-ft)	Incremental (acre-ft)	Outflow (cfs)	Volume (acre-ft)	Volume (acre-ft)	(ft)
1995	0	397	0	30	395	2	1493.00
2000	0	397	0	30	395	1	1493.00
2005	0	397	0	30	396	1	1493.00
2010	0	397	0	30	396	1	1493.00
2015	0	397	0	30	396	1	1492.80
2020	0	397	0	18	396	1	1492.60
2025	0	397	0	10	396	1	1492.50
2030	0	397	0	8	396	0	1492.40
2035	0	397	0	6	396	0	1492.40
2040	0	397	0	6	396	0	1492.40
2045	0	397	0	6	396	0	1492.30
2050	0	397	0	4	397	0	1492.30
2055	0	397	0	4	397	0	1492.30
2060	0	397	0	4	397	0	1492.20
2065	0	397	0	2	397	0	1492.20
2070	0	397	0	2	397	0	1492.20
2075	0	397	0	2	397	0	1492.20
2080	0	397	0	2	397	0	1492.20
2085	0	397	0	2	397	0	1492.20
2090	0	397	0	2	397	0	1492.10
2095	0	397	0	2	397	0	1492.10
2100	0	397	0	2	397	0	1492.10
2105	0	397	0	2	397	0	1492.10
2110	0	397	0	2	397	0	1492.10
2115	0	397	0	2	397	0	1492.10
2120	0	397	0	2	397	0	1492.10
2125	0	397	0	2	397	0	1492.00
2130	0	397	0	0	397	0	1492.00

Siphon Draw Wash Detention Basin Storage

Elevation (ft)	Siphon Draw Detention Basin Stage-Volume (acre-ft)
1492.0	**0**
1492.2	*0*
1492.4	*0*
1492.6	*1*
1492.8	*1*
1493.0	**1**
1493.2	*3*
1493.4	*5*
1493.6	*8*
1493.8	*10*
1494.0	**12**
1494.2	*15*
1494.4	*17*
1494.6	*20*
1494.8	*22*
1495.0	**25**
1495.2	*48*
1495.4	*71*
1495.6	*94*
1495.8	*117*
1496.0	**140**
1496.2	*150*
1496.4	*160*
1496.6	*171*
1496.8	*181*
1497.0	**191**
1497.2	*202*
1497.4	*212*
1497.6	*223*
1497.8	*233*
1498.0	**244**
1498.2	*249*
1498.4	*254*
1498.5	**270**
1498.6	*286*
1498.8	*291*
1499.0	**296**
1499.2	*307*
1499.4	*318*
1499.6	*329*
1499.8	*340*
1500.0	**351**

BOLD text are values from digital terrain model

Red (in italics) are interpolated values

Elevation 1498.5 is the emergency spillway crest elevation

Rating Curve for Siphon Draw Wash Detention Basin Culvert Outlet

Elevation (ft)	Discharge From Detention Basin		
	Culvert (cfs)	Emergency Spillway (cfs)	Total (cfs)
1,492.00	0	0	0
1,492.17	2	0	2
1,492.26	4	0	4
1,492.35	6	0	6
1,492.42	8	0	8
1,492.49	10	0	10
1,492.55	12	0	12
1,492.61	14	0	14
1,492.67	16	0	16
1,492.72	18	0	18
1,492.77	20	0	20
1,492.82	22	0	22
1,492.87	24	0	24
1,492.92	26	0	26
1,492.97	28	0	28
1,493.01	30	0	30
1,493.06	32	0	32
1,493.10	34	0	34
1,493.14	36	0	36
1,493.19	38	0	38
1,493.23	40	0	40
1,493.27	42	0	42
1,493.31	44	0	44
1,493.35	46	0	46
1,493.39	48	0	48
1,493.42	50	0	50
1,493.46	52	0	52
1,493.50	54	0	54
1,493.54	56	0	56
1,493.57	58	0	58
1,493.61	60	0	60
1,493.64	62	0	62
1,493.68	64	0	64
1,493.71	66	0	66
1,493.75	68	0	68
1,493.78	70	0	70
1,493.82	72	0	72
1,493.85	74	0	74
1,493.88	76	0	76
1,493.92	78	0	78
1,493.95	80	0	80
1,493.98	82	0	82
1,494.01	84	0	84
1,494.05	86	0	86
1,494.08	88	0	88
1,494.11	90	0	90
1,494.14	92	0	92
1,494.17	94	0	94
1,494.20	96	0	96
1,494.23	98	0	98
1,494.26	100	0	100
1,494.29	102	0	102

Rating Curve for Siphon Draw Wash Detention Basin Culvert Outlet

Elevation (ft)	Discharge From Detention Basin		
	Culvert (cfs)	Emergency Spillway (cfs)	Total (cfs)
1,494.32	104	0	104
1,494.35	106	0	106
1,494.38	108	0	108
1,494.41	110	0	110
1,494.44	112	0	112
1,494.47	114	0	114
1,494.50	116	0	116
1,494.53	118	0	118
1,494.55	120	0	120
1,494.58	122	0	122
1,494.61	124	0	124
1,494.64	126	0	126
1,494.67	128	0	128
1,494.69	130	0	130
1,494.72	132	0	132
1,494.75	134	0	134
1,494.78	136	0	136
1,494.80	138	0	138
1,494.83	140	0	140
1,494.86	142	0	142
1,494.88	144	0	144
1,494.91	146	0	146
1,494.94	148	0	148
1,494.96	150	0	150
1,494.99	152	0	152
1,495.02	154	0	154
1,495.04	156	0	156
1,495.07	158	0	158
1,495.09	160	0	160
1,495.12	162	0	162
1,495.15	164	0	164
1,495.17	166	0	166
1,495.20	168	0	168
1,495.22	170	0	170
1,495.25	172	0	172
1,495.27	174	0	174
1,495.30	176	0	176
1,495.32	178	0	178
1,495.35	180	0	180
1,495.37	182	0	182
1,495.40	184	0	184
1,495.42	186	0	186
1,495.44	188	0	188
1,495.47	190	0	190
1,495.49	192	0	192
1,495.52	194	0	194
1,495.54	196	0	196
1,495.57	198	0	198
1,495.59	200	0	200
1,495.61	202	0	202
1,495.64	204	0	204
1,495.66	206	0	206

Rating Curve for Siphon Draw Wash Detention Basin Culvert Outlet

Elevation (ft)	Discharge From Detention Basin		
	Culvert (cfs)	Emergency Spillway (cfs)	Total (cfs)
1,495.69	208	0	208
1,495.71	210	0	210
1,495.73	212	0	212
1,495.76	214	0	214
1,495.78	216	0	216
1,495.80	218	0	218
1,495.83	220	0	220
1,495.85	222	0	222
1,495.87	224	0	224
1,495.89	226	0	226
1,495.92	228	0	228
1,495.94	230	0	230
1,495.96	232	0	232
1,495.99	234	0	234
1,496.01	236	0	236
1,496.03	238	0	238
1,496.05	240	0	240
1,496.08	242	0	242
1,496.10	244	0	244
1,496.12	246	0	246
1,496.14	248	0	248
1,496.17	250	0	250
1,496.19	252	0	252
1,496.21	254	0	254
1,496.23	256	0	256
1,496.25	258	0	258
1,496.28	260	0	260
1,496.30	262	0	262
1,496.32	264	0	264
1,496.34	266	0	266
1,496.36	268	0	268
1,496.39	270	0	270
1,496.41	272	0	272
1,496.43	274	0	274
1,496.45	276	0	276
1,496.47	278	0	278
1,496.49	280	0	280
1,496.51	282	0	282
1,496.54	284	0	284
1,496.56	286	0	286
1,496.58	288	0	288
1,496.60	290	0	290
1,496.62	292	0	292
1,496.64	294	0	294
1,496.66	296	0	296
1,496.68	298	0	298
1,496.70	300	0	300
1,496.73	302	0	302
1,496.75	304	0	304
1,496.77	306	0	306
1,496.79	308	0	308
1,496.81	310	0	310

Rating Curve for Siphon Draw Wash Detention Basin Culvert Outlet

Elevation (ft)	Discharge From Detention Basin		
	Culvert (cfs)	Emergency Spillway (cfs)	Total (cfs)
1,496.83	312	0	312
1,496.85	314	0	314
1,496.87	316	0	316
1,496.89	318	0	318
1,496.91	320	0	320
1,496.93	322	0	322
1,496.95	324	0	324
1,496.97	326	0	326
1,496.99	328	0	328
1,497.01	330	0	330
1,497.03	332	0	332
1,497.05	334	0	334
1,497.07	336	0	336
1,497.09	338	0	338
1,497.11	340	0	340
1,497.13	342	0	342
1,497.15	344	0	344
1,497.17	346	0	346
1,497.19	348	0	348
1,497.21	350	0	350
1,497.23	352	0	352
1,497.25	354	0	354
1,497.27	356	0	356
1,497.29	358	0	358
1,497.31	360	0	360
1,497.33	362	0	362
1,497.35	364	0	364
1,497.37	366	0	366
1,497.39	368	0	368
1,497.41	370	0	370
1,497.43	372	0	372
1,497.45	374	0	374
1,497.47	376	0	376
1,497.49	378	0	378
1,497.51	380	0	380
1,497.53	382	0	382
1,497.55	384	0	384
1,497.56	386	0	386
1,497.58	388	0	388
1,497.60	390	0	390
1,497.62	392	0	392
1,497.64	394	0	394
1,497.66	396	0	396
1,497.68	398	0	398
1,497.70	400	0	400
1,497.72	402	0	402
1,497.74	404	0	404
1,497.76	406	0	406
1,497.77	408	0	408
1,497.79	410	0	410
1,497.81	412	0	412
1,497.83	414	0	414

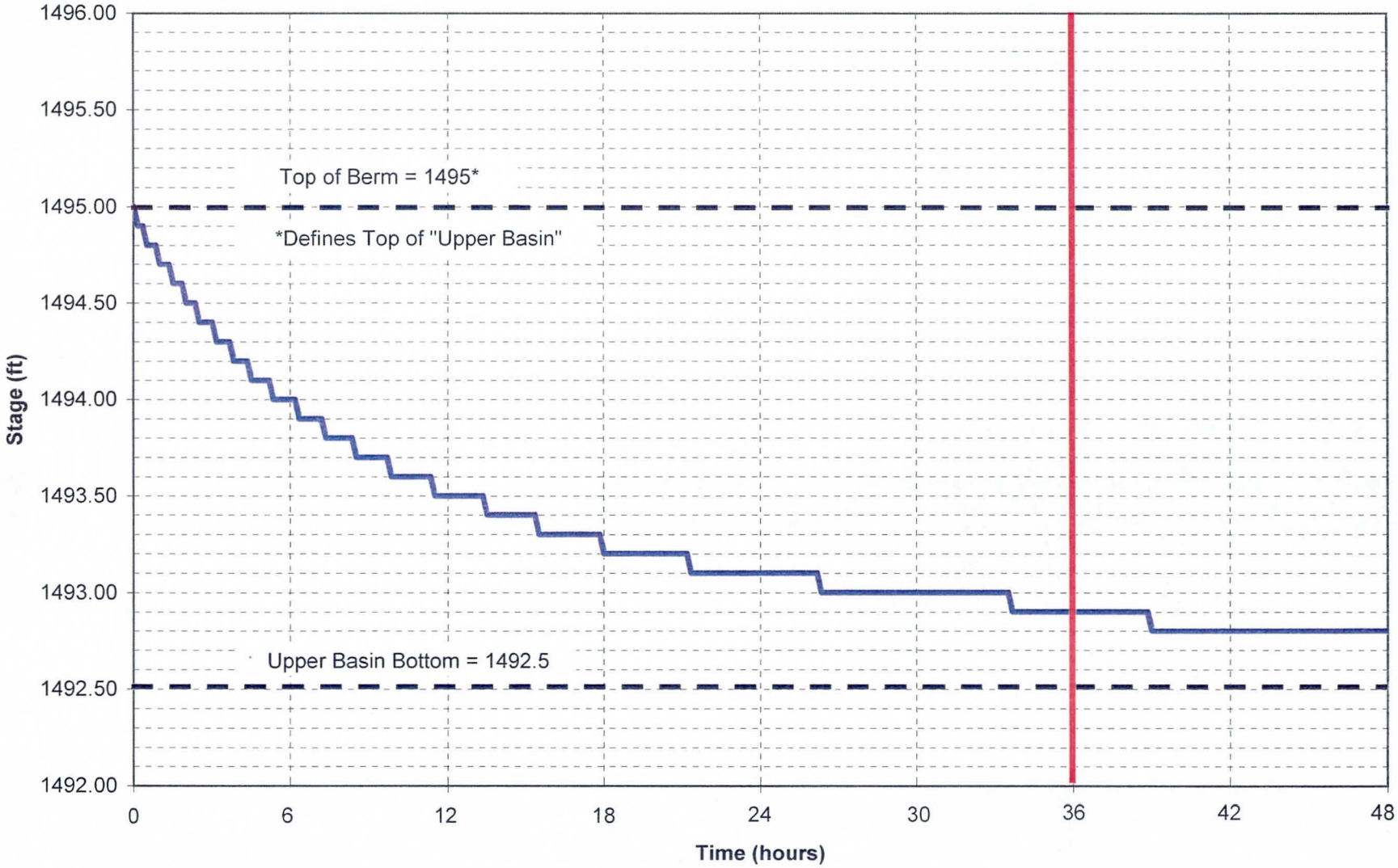
Rating Curve for Siphon Draw Wash Detention Basin Culvert Outlet

Elevation (ft)	Discharge From Detention Basin		
	Culvert (cfs)	Emergency Spillway (cfs)	Total (cfs)
1,497.85	416	0	416
1,497.87	418	0	418
1,497.89	420	0	420
1,497.91	422	0	422
1,497.92	424	0	424
1,497.94	426	0	426
1,497.96	428	0	428
1,497.98	430	0	430
1,498.00	432	0	432
1,498.02	434	0	434
1,498.04	436	0	436
1,498.05	438	0	438
1,498.07	440	0	440
1,498.09	442	0	442
1,498.11	444	0	444
1,498.13	446	0	446
1,498.15	448	0	448
1,498.17	450	0	450
1,498.20	452	0	452
1,498.22	454	0	454
1,498.25	456	0	456
1,498.28	458	0	458
1,498.31	460	0	460
1,498.33	462	0	462
1,498.36	464	0	464
1,498.39	466	0	466
1,498.41	468	0	468
1,498.44	470	0	470
1,498.47	472	0	472
1,498.50	474	0	474
1,498.52	476	0	476
1,498.55	478	0	478
1,498.57	479	1	480
1,498.59	481	1	482
1,498.62	482	2	484
1,498.64	484	2	486
1,498.66	485	3	488
1,498.68	487	3	490
1,498.70	488	4	492
1,498.72	490	4	494
1,498.74	491	5	496
1,498.76	492	6	498
1,498.78	494	6	500
1,498.80	495	7	502
1,498.82	496	8	504
1,498.83	497	9	506
1,498.85	499	9	508
1,498.87	500	10	510
1,498.89	501	11	512
1,498.90	502	12	514
1,498.92	503	13	516
1,498.94	505	13	518

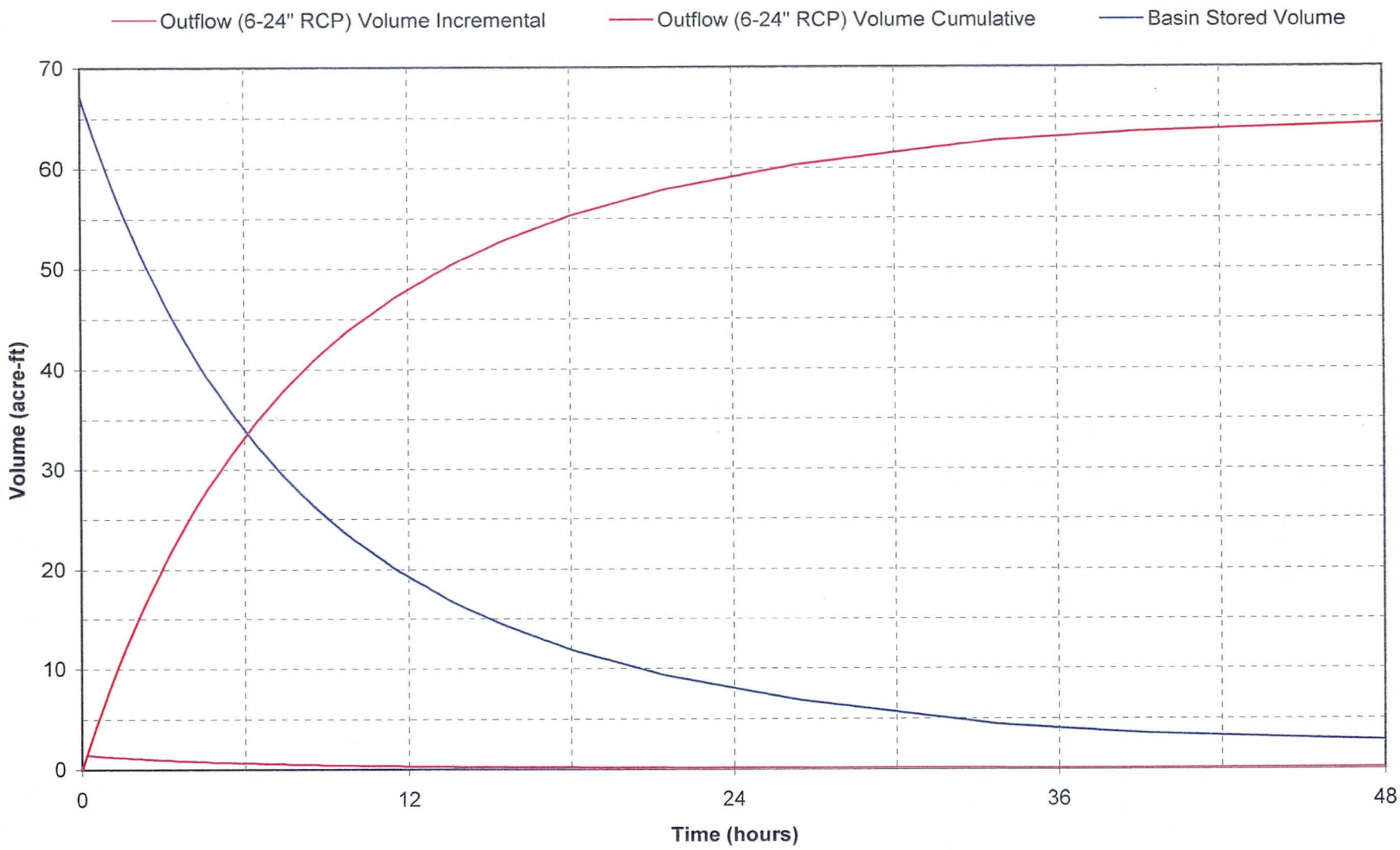
Rating Curve for Siphon Draw Wash Detention Basin Culvert Outlet

Elevation (ft)	Discharge From Detention Basin		
	Culvert (cfs)	Emergency Spillway (cfs)	Total (cfs)
1,498.95	506	14	520
1,498.97	507	15	522
1,498.99	508	16	524
1,499.00	509	17	526
1,499.02	510	18	528
1,499.03	511	19	530
1,499.05	512	20	532
1,499.07	513	21	534
1,499.08	514	22	536
1,499.10	515	23	538
1,499.11	516	24	540
1,499.12	517	25	542
1,499.14	518	26	544
1,499.15	519	27	546
1,499.17	520	28	548
1,499.18	521	29	550
1,499.20	522	30	552
1,499.21	523	31	554
1,499.22	523	32	556
1,499.24	524	34	558
1,499.25	525	35	560
1,499.26	526	36	562
1,499.28	527	37	564
1,499.29	528	38	566
1,499.30	529	39	568
1,499.32	530	40	570
1,499.33	530	42	572
1,499.34	531	43	574
1,499.36	532	44	576
1,499.37	533	45	578
1,499.38	534	46	580
1,499.39	534	48	582
1,499.41	535	49	584
1,499.42	536	50	586
1,499.43	537	51	588
1,499.44	537	52	590
1,499.45	538	54	592
1,499.47	539	55	594
1,499.48	540	56	596
1,499.49	540	58	598
1,499.50	541	59	600

Siphon Draw Wash Detention Basin Drawdown Curve (Upper Basin Only)



Siphon Draw Detention Basin Drain Time Volumes (Upper Basin Only)



Siphon Draw Detention Basin - Upper Basin Drain Time

Time		Time for Combined Curve[1]	Time/Stage				
			Detention Basin Outflow	Outflow (6-24" RCP) Volume		Basin Stored Volume	Basin Stage
				Incremental	Cumulative		
(min)	(hours)	(min)	(cfs)	(acre-ft)	(acre-ft)	(acre-ft)	(ft)
0	0.0	1745	100	0	0.0	67.0	1495.00
10	0.2	1755	100	1.38	1.4	65.6	1494.90
20	0.3	1765	95	1.34	2.7	64.3	1494.90
30	0.5	1775	95	1.31	4.0	63.0	1494.80
40	0.7	1785	89	1.27	5.3	61.7	1494.80
50	0.8	1795	89	1.23	6.5	60.5	1494.80
60	1.0	1805	89	1.23	7.7	59.3	1494.70
70	1.2	1815	83	1.18	8.9	58.1	1494.70
80	1.3	1825	83	1.14	10.1	56.9	1494.70
90	1.5	1835	83	1.14	11.2	55.8	1494.60
100	1.7	1845	77	1.10	12.3	54.7	1494.60
110	1.8	1855	77	1.06	13.4	53.6	1494.60
120	2.0	1865	77	1.06	14.4	52.6	1494.50
130	2.2	1875	71	1.02	15.5	51.5	1494.50
140	2.3	1885	71	0.98	16.4	50.6	1494.50
150	2.5	1895	71	0.98	17.4	49.6	1494.40
160	2.7	1905	65	0.94	18.4	48.6	1494.40
170	2.8	1915	65	0.90	19.2	47.8	1494.40
180	3.0	1925	65	0.90	20.1	46.9	1494.40
190	3.2	1935	65	0.90	21.0	46.0	1494.30
200	3.3	1945	59	0.85	21.9	45.1	1494.30
210	3.5	1955	59	0.81	22.7	44.3	1494.30
220	3.7	1965	59	0.81	23.5	43.5	1494.30
230	3.8	1975	59	0.81	24.3	42.7	1494.20
240	4.0	1985	54	0.78	25.1	41.9	1494.20
250	4.2	1995	54	0.74	25.9	41.1	1494.20
260	4.3	2005	54	0.74	26.6	40.4	1494.20
270	4.5	2015	54	0.74	27.3	39.7	1494.10
280	4.7	2025	48	0.70	28.0	39.0	1494.10
290	4.8	2035	48	0.66	28.7	38.3	1494.10
300	5.0	2045	48	0.66	29.4	37.6	1494.10
310	5.2	2055	48	0.66	30.0	37.0	1494.10
320	5.3	2065	48	0.66	30.7	36.3	1494.00
330	5.5	2075	43	0.63	31.3	35.7	1494.00
340	5.7	2085	43	0.59	31.9	35.1	1494.00
350	5.8	2095	43	0.59	32.5	34.5	1494.00
360	6.0	2105	43	0.59	33.1	33.9	1494.00
370	6.2	2115	43	0.59	33.7	33.3	1494.00
380	6.3	2125	43	0.59	34.3	32.7	1493.90
390	6.5	2135	38	0.56	34.8	32.2	1493.90
400	6.7	2145	38	0.52	35.4	31.6	1493.90
410	6.8	2155	38	0.52	35.9	31.1	1493.90
420	7.0	2165	38	0.52	36.4	30.6	1493.90
430	7.2	2175	38	0.52	36.9	30.1	1493.90

Siphon Draw Detention Basin - Upper Basin Drain Time

Time		Time for Combined Curve[1]	Time/Stage				
			Detention Basin Outflow	Outflow (6-24" RCP) Volume		Basin Stored Volume	Basin Stage
				Incremental	Cumulative		
(min)	(hours)	(min)	(cfs)	(acre-ft)	(acre-ft)	(acre-ft)	(ft)
440	7.3	2185	38	0.52	37.5	29.5	1493.80
450	7.5	2195	33	0.49	37.9	29.1	1493.80
460	7.7	2205	33	0.45	38.4	28.6	1493.80
470	7.8	2215	33	0.45	38.8	28.2	1493.80
480	8.0	2225	33	0.45	39.3	27.7	1493.80
490	8.2	2235	33	0.45	39.8	27.2	1493.80
500	8.3	2245	33	0.45	40.2	26.8	1493.80
510	8.5	2255	33	0.45	40.7	26.3	1493.70
520	8.7	2265	28	0.42	41.1	25.9	1493.70
530	8.8	2275	28	0.39	41.5	25.5	1493.70
540	9.0	2285	28	0.39	41.9	25.1	1493.70
550	9.2	2295	28	0.39	42.2	24.8	1493.70
560	9.3	2305	28	0.39	42.6	24.4	1493.70
570	9.5	2315	28	0.39	43.0	24.0	1493.70
580	9.7	2325	28	0.39	43.4	23.6	1493.70
590	9.8	2335	28	0.39	43.8	23.2	1493.60
600	10.0	2345	23	0.35	44.1	22.9	1493.60
610	10.2	2355	23	0.32	44.5	22.5	1493.60
620	10.3	2365	23	0.32	44.8	22.2	1493.60
630	10.5	2375	23	0.32	45.1	21.9	1493.60
640	10.7	2385	23	0.32	45.4	21.6	1493.60
650	10.8	2395	23	0.32	45.7	21.3	1493.60
660	11.0	2405	23	0.32	46.0	21.0	1493.60
670	11.2	2415	23	0.32	46.4	20.6	1493.60
680	11.3	2425	23	0.32	46.7	20.3	1493.60
690	11.5	2435	23	0.32	47.0	20.0	1493.50
700	11.7	2445	19	0.29	47.3	19.7	1493.50
710	11.8	2455	19	0.26	47.5	19.5	1493.50
720	12.0	2465	19	0.26	47.8	19.2	1493.50
730	12.2	2475	19	0.26	48.1	18.9	1493.50
740	12.3	2485	19	0.26	48.3	18.7	1493.50
750	12.5	2495	19	0.26	48.6	18.4	1493.50
760	12.7	2505	19	0.26	48.8	18.2	1493.50
770	12.8	2515	19	0.26	49.1	17.9	1493.50
780	13.0	2525	19	0.26	49.4	17.6	1493.50
790	13.2	2535	19	0.26	49.6	17.4	1493.50
800	13.3	2545	19	0.26	49.9	17.1	1493.50
810	13.5	2555	19	0.26	50.2	16.8	1493.40
820	13.7	2565	15	0.23	50.4	16.6	1493.40
830	13.8	2575	15	0.21	50.6	16.4	1493.40
840	14.0	2585	15	0.21	50.8	16.2	1493.40
850	14.2	2595	15	0.21	51.0	16.0	1493.40
860	14.3	2605	15	0.21	51.2	15.8	1493.40
870	14.5	2615	15	0.21	51.4	15.6	1493.40
880	14.7	2625	15	0.21	51.6	15.4	1493.40

Siphon Draw Detention Basin - Upper Basin Drain Time

Time		Time for Combined Curve[1]	Time/Stage				
			Detention Basin Outflow	Outflow (6-24" RCP) Volume		Basin Stored Volume	Basin Stage
				Incremental	Cumulative		
(min)	(hours)	(min)	(cfs)	(acre-ft)	(acre-ft)	(acre-ft)	(ft)
890	14.8	2635	15	0.21	51.8	15.2	1493.40
900	15.0	2645	15	0.21	52.0	15.0	1493.40
910	15.2	2655	15	0.21	52.3	14.7	1493.40
920	15.3	2665	15	0.21	52.5	14.5	1493.40
930	15.5	2675	15	0.21	52.7	14.3	1493.30
940	15.7	2685	12	0.19	52.9	14.1	1493.30
950	15.8	2695	12	0.17	53.0	14.0	1493.30
960	16.0	2705	12	0.17	53.2	13.8	1493.30
970	16.2	2715	12	0.17	53.3	13.7	1493.30
980	16.3	2725	12	0.17	53.5	13.5	1493.30
990	16.5	2735	12	0.17	53.7	13.3	1493.30
1000	16.7	2745	12	0.17	53.8	13.2	1493.30
1010	16.8	2755	12	0.17	54.0	13.0	1493.30
1020	17.0	2765	12	0.17	54.2	12.8	1493.30
1030	17.2	2775	12	0.17	54.3	12.7	1493.30
1040	17.3	2785	12	0.17	54.5	12.5	1493.30
1050	17.5	2795	12	0.17	54.7	12.3	1493.30
1060	17.7	2805	12	0.17	54.8	12.2	1493.30
1070	17.8	2815	12	0.17	55.0	12.0	1493.30
1080	18.0	2825	12	0.17	55.2	11.8	1493.20
1090	18.2	2835	9	0.14	55.3	11.7	1493.20
1100	18.3	2845	9	0.12	55.4	11.6	1493.20
1110	18.5	2855	9	0.12	55.6	11.4	1493.20
1120	18.7	2865	9	0.12	55.7	11.3	1493.20
1130	18.8	2875	9	0.12	55.8	11.2	1493.20
1140	19.0	2885	9	0.12	55.9	11.1	1493.20
1150	19.2	2895	9	0.12	56.1	10.9	1493.20
1160	19.3	2905	9	0.12	56.2	10.8	1493.20
1170	19.5	2915	9	0.12	56.3	10.7	1493.20
1180	19.7	2925	9	0.12	56.4	10.6	1493.20
1190	19.8	2935	9	0.12	56.5	10.5	1493.20
1200	20.0	2945	9	0.12	56.7	10.3	1493.20
1210	20.2	2955	9	0.12	56.8	10.2	1493.20
1220	20.3	2965	9	0.12	56.9	10.1	1493.20
1230	20.5	2975	9	0.12	57.0	10.0	1493.20
1240	20.7	2985	9	0.12	57.2	9.8	1493.20
1250	20.8	2995	9	0.12	57.3	9.7	1493.20
1260	21.0	3005	9	0.12	57.4	9.6	1493.20
1270	21.2	3015	9	0.12	57.5	9.5	1493.20
1280	21.3	3025	9	0.12	57.7	9.3	1493.10
1290	21.5	3035	6	0.10	57.8	9.2	1493.10
1300	21.7	3045	6	0.08	57.9	9.1	1493.10
1310	21.8	3055	6	0.08	57.9	9.1	1493.10
1320	22.0	3065	6	0.08	58.0	9.0	1493.10
1330	22.2	3075	6	0.08	58.1	8.9	1493.10

Siphon Draw Detention Basin - Upper Basin Drain Time

Time		Time for Combined Curve[1]	Time/Stage				
			Detention Basin Outflow	Outflow (6-24" RCP) Volume		Basin Stored Volume	Basin Stage
				Incremental	Cumulative		
(min)	(hours)	(min)	(cfs)	(acre-ft)	(acre-ft)	(acre-ft)	(ft)
1340	22.3	3085	6	0.08	58.2	8.8	1493.10
1350	22.5	3095	6	0.08	58.3	8.7	1493.10
1360	22.7	3105	6	0.08	58.3	8.7	1493.10
1370	22.8	3115	6	0.08	58.4	8.6	1493.10
1380	23.0	3125	6	0.08	58.5	8.5	1493.10
1390	23.2	3135	6	0.08	58.6	8.4	1493.10
1400	23.3	3145	6	0.08	58.7	8.3	1493.10
1410	23.5	3155	6	0.08	58.8	8.2	1493.10
1420	23.7	3165	6	0.08	58.8	8.2	1493.10
1430	23.8	3175	6	0.08	58.9	8.1	1493.10
1440	24.0	3185	6	0.08	59.0	8.0	1493.10
1450	24.2	3195	6	0.08	59.1	7.9	1493.10
1460	24.3	3205	6	0.08	59.2	7.8	1493.10
1470	24.5	3215	6	0.08	59.3	7.7	1493.10
1480	24.7	3225	6	0.08	59.3	7.7	1493.10
1490	24.8	3235	6	0.08	59.4	7.6	1493.10
1500	25.0	3245	6	0.08	59.5	7.5	1493.10
1510	25.2	3255	6	0.08	59.6	7.4	1493.10
1520	25.3	3265	6	0.08	59.7	7.3	1493.10
1530	25.5	3275	6	0.08	59.8	7.2	1493.10
1540	25.7	3285	6	0.08	59.8	7.2	1493.10
1550	25.8	3295	6	0.08	59.9	7.1	1493.10
1560	26.0	3305	6	0.08	60.0	7.0	1493.10
1570	26.2	3315	6	0.08	60.1	6.9	1493.10
1580	26.3	3325	6	0.08	60.2	6.8	1493.00
1590	26.5	3335	4	0.07	60.2	6.8	1493.00
1600	26.7	3345	4	0.06	60.3	6.7	1493.00
1610	26.8	3355	4	0.06	60.3	6.7	1493.00
1620	27.0	3365	4	0.06	60.4	6.6	1493.00
1630	27.2	3375	4	0.06	60.5	6.5	1493.00
1640	27.3	3385	4	0.06	60.5	6.5	1493.00
1650	27.5	3395	4	0.06	60.6	6.4	1493.00
1660	27.7	3405	4	0.06	60.6	6.4	1493.00
1670	27.8	3415	4	0.06	60.7	6.3	1493.00
1680	28.0	3425	4	0.06	60.7	6.3	1493.00
1690	28.2	3435	4	0.06	60.8	6.2	1493.00
1700	28.3	3445	4	0.06	60.8	6.2	1493.00
1710	28.5	3455	4	0.06	60.9	6.1	1493.00
1720	28.7	3465	4	0.06	61.0	6.0	1493.00
1730	28.8	3475	4	0.06	61.0	6.0	1493.00
1740	29.0	3485	4	0.06	61.1	5.9	1493.00
1750	29.2	3495	4	0.06	61.1	5.9	1493.00
1760	29.3	3505	4	0.06	61.2	5.8	1493.00
1770	29.5	3515	4	0.06	61.2	5.8	1493.00
1780	29.7	3525	4	0.06	61.3	5.7	1493.00

Siphon Draw Detention Basin - Upper Basin Drain Time

Time		Time for Combined Curve[1]	Time/Stage				
			Detention Basin Outflow	Outflow (6-24" RCP) Volume		Basin Stored Volume	Basin Stage
				Incremental	Cumulative		
(min)	(hours)	(min)	(cfs)	(acre-ft)	(acre-ft)	(acre-ft)	(ft)
1790	29.8	3535	4	0.06	61.3	5.7	1493.00
1800	30.0	3545	4	0.06	61.4	5.6	1493.00
1810	30.2	3555	4	0.06	61.4	5.6	1493.00
1820	30.3	3565	4	0.06	61.5	5.5	1493.00
1830	30.5	3575	4	0.06	61.6	5.4	1493.00
1840	30.7	3585	4	0.06	61.6	5.4	1493.00
1850	30.8	3595	4	0.06	61.7	5.3	1493.00
1860	31.0	3605	4	0.06	61.7	5.3	1493.00
1870	31.2	3615	4	0.06	61.8	5.2	1493.00
1880	31.3	3625	4	0.06	61.8	5.2	1493.00
1890	31.5	3635	4	0.06	61.9	5.1	1493.00
1900	31.7	3645	4	0.06	61.9	5.1	1493.00
1910	31.8	3655	4	0.06	62.0	5.0	1493.00
1920	32.0	3665	4	0.06	62.1	4.9	1493.00
1930	32.2	3675	4	0.06	62.1	4.9	1493.00
1940	32.3	3685	4	0.06	62.2	4.8	1493.00
1950	32.5	3695	4	0.06	62.2	4.8	1493.00
1960	32.7	3705	4	0.06	62.3	4.7	1493.00
1970	32.8	3715	4	0.06	62.3	4.7	1493.00
1980	33.0	3725	4	0.06	62.4	4.6	1493.00
1990	33.2	3735	4	0.06	62.4	4.6	1493.00
2000	33.3	3745	4	0.06	62.5	4.5	1493.00
2010	33.5	3755	4	0.06	62.5	4.5	1493.00
2020	33.7	3765	4	0.06	62.6	4.4	1492.90
2030	33.8	3775	2	0.04	62.6	4.4	1492.90
2040	34.0	3785	2	0.03	62.7	4.3	1492.90
2050	34.2	3795	2	0.03	62.7	4.3	1492.90
2060	34.3	3805	2	0.03	62.7	4.3	1492.90
2070	34.5	3815	2	0.03	62.8	4.2	1492.90
2080	34.7	3825	2	0.03	62.8	4.2	1492.90
2090	34.8	3835	2	0.03	62.8	4.2	1492.90
2100	35.0	3845	2	0.03	62.8	4.2	1492.90
2110	35.2	3855	2	0.03	62.9	4.1	1492.90
2120	35.3	3865	2	0.03	62.9	4.1	1492.90
2130	35.5	3875	2	0.03	62.9	4.1	1492.90
2140	35.7	3885	2	0.03	62.9	4.1	1492.90
2150	35.8	3895	2	0.03	63.0	4.0	1492.90
2160	**36.0**	3905	**2**	**0.03**	**63.0**	**4.0**	**1492.90**
2170	36.2	3915	2	0.03	63.0	4.0	1492.90
2180	36.3	3925	2	0.03	63.1	3.9	1492.90
2190	36.5	3935	2	0.03	63.1	3.9	1492.90
2200	36.7	3945	2	0.03	63.1	3.9	1492.90
2210	36.8	3955	2	0.03	63.1	3.9	1492.90
2220	37.0	3965	2	0.03	63.2	3.8	1492.90
2230	37.2	3975	2	0.03	63.2	3.8	1492.90

Siphon Draw Detention Basin - Upper Basin Drain Time

Time		Time for Combined Curve[1]	Time/Stage				
			Detention Basin Outflow	Outflow (6-24" RCP) Volume		Basin Stored Volume	Basin Stage
				Incremental	Cumulative		
(min)	(hours)	(min)	(cfs)	(acre-ft)	(acre-ft)	(acre-ft)	(ft)
2240	37.3	3985	2	0.03	63.2	3.8	1492.90
2250	37.5	3995	2	0.03	63.3	3.7	1492.90
2260	37.7	4005	2	0.03	63.3	3.7	1492.90
2270	37.8	4015	2	0.03	63.3	3.7	1492.90
2280	38.0	4025	2	0.03	63.3	3.7	1492.90
2290	38.2	4035	2	0.03	63.4	3.6	1492.90
2300	38.3	4045	2	0.03	63.4	3.6	1492.90
2310	38.5	4055	2	0.03	63.4	3.6	1492.90
2320	38.7	4065	2	0.03	63.4	3.6	1492.90
2330	38.8	4075	2	0.03	63.5	3.5	1492.90
2340	39.0	4085	2	0.03	63.5	3.5	1492.80
2350	39.2	4095	1	0.02	63.5	3.5	1492.80
2360	39.3	4105	1	0.01	63.5	3.5	1492.80
2370	39.5	4115	1	0.01	63.5	3.5	1492.80
2380	39.7	4125	1	0.01	63.6	3.4	1492.80
2390	39.8	4135	1	0.01	63.6	3.4	1492.80
2400	40.0	4145	1	0.01	63.6	3.4	1492.80
2410	40.2	4155	1	0.01	63.6	3.4	1492.80
2420	40.3	4165	1	0.01	63.6	3.4	1492.80
2430	40.5	4175	1	0.01	63.6	3.4	1492.80
2440	40.7	4185	1	0.01	63.6	3.4	1492.80
2450	40.8	4195	1	0.01	63.7	3.3	1492.80
2460	41.0	4205	1	0.01	63.7	3.3	1492.80
2470	41.2	4215	1	0.01	63.7	3.3	1492.80
2480	41.3	4225	1	0.01	63.7	3.3	1492.80
2490	41.5	4235	1	0.01	63.7	3.3	1492.80
2500	41.7	4245	1	0.01	63.7	3.3	1492.80
2510	41.8	4255	1	0.01	63.7	3.3	1492.80
2520	42.0	4265	1	0.01	63.8	3.2	1492.80
2530	42.2	4275	1	0.01	63.8	3.2	1492.80
2540	42.3	4285	1	0.01	63.8	3.2	1492.80
2550	42.5	4295	1	0.01	63.8	3.2	1492.80
2560	42.7	4305	1	0.01	63.8	3.2	1492.80
2570	42.8	4315	1	0.01	63.8	3.2	1492.80
2580	43.0	4325	1	0.01	63.8	3.2	1492.80
2590	43.2	4335	1	0.01	63.8	3.2	1492.80
2600	43.3	4345	1	0.01	63.9	3.1	1492.80
2610	43.5	4355	1	0.01	63.9	3.1	1492.80
2620	43.7	4365	1	0.01	63.9	3.1	1492.80
2630	43.8	4375	1	0.01	63.9	3.1	1492.80
2640	44.0	4385	1	0.01	63.9	3.1	1492.80
2650	44.2	4395	1	0.01	63.9	3.1	1492.80
2660	44.3	4405	1	0.01	63.9	3.1	1492.80
2670	44.5	4415	1	0.01	64.0	3.0	1492.80
2680	44.7	4425	1	0.01	64.0	3.0	1492.80

Siphon Draw Detention Basin - Upper Basin Drain Time

Time		Time for Combined Curve[1]	Time/Stage				
			Detention Basin Outflow	Outflow (6-24" RCP) Volume		Basin Stored Volume	Basin Stage
				Incremental	Cumulative		
(min)	(hours)	(min)	(cfs)	(acre-ft)	(acre-ft)	(acre-ft)	(ft)
2690	44.8	4435	1	0.01	64.0	3.0	1492.80
2700	45.0	4445	1	0.01	64.0	3.0	1492.80
2710	45.2	4455	1	0.01	64.0	3.0	1492.80
2720	45.3	4465	1	0.01	64.0	3.0	1492.80
2730	45.5	4475	1	0.01	64.0	3.0	1492.80
2740	45.7	4485	1	0.01	64.1	2.9	1492.80
2750	45.8	4495	1	0.01	64.1	2.9	1492.80
2760	46.0	4505	1	0.01	64.1	2.9	1492.80
2770	46.2	4515	1	0.01	64.1	2.9	1492.80
2780	46.3	4525	1	0.01	64.1	2.9	1492.80
2790	46.5	4535	1	0.01	64.1	2.9	1492.80
2800	46.7	4545	1	0.01	64.1	2.9	1492.80
2810	46.8	4555	1	0.01	64.2	2.8	1492.80
2820	47.0	4565	1	0.01	64.2	2.8	1492.80
2830	47.2	4575	1	0.01	64.2	2.8	1492.80
2840	47.3	4585	1	0.01	64.2	2.8	1492.80
2850	47.5	4595	1	0.01	64.2	2.8	1492.80
2860	47.7	4605	1	0.01	64.2	2.8	1492.80
2870	47.8	4615	1	0.01	64.2	2.8	1492.80
2880	**48.0**	4625	**1**	**0.01**	**64.2**	**2.8**	**1492.80**

1. Time for combined curve is based upon the time at which the lower basin starts to drop to below the top of internal berm elevation of 1495.

Siphon Draw Detention Basin - Upper Basin Stage-Storage

Elevation (ft)	Siphon Draw Detention Basin Stage-Volume (acre-ft)
1492.5	**0.0**
1492.6	*0.9*
1492.7	*1.8*
1492.8	*2.6*
1492.9	*3.5*
1493.0	**4.4**
1493.1	*6.9*
1493.2	*9.4*
1493.3	*11.9*
1493.4	*14.4*
1493.5	**16.9**
1493.6	*20.2*
1493.7	*23.4*
1493.8	*26.7*
1493.9	*29.9*
1494	**33.2**
1494.1	*36.5*
1494.2	*39.9*
1494.3	*43.2*
1494.4	*46.6*
1494.5	**49.9**
1494.6	*53.3*
1494.7	*56.6*
1494.8	*60.0*
1494.9	*63.3*
1495	**66.7**

Bold are values from digital terrain model

RED (in italics) are interpolated values

Elevation 1495 is the typical assumed top of berm elevation.

The upper basin storage volumes are included in the overall Siphon Draw Detention Basin storage volume.

Rating Curve for SDDB Upper Basin Outlet

Elevation (ft)	6-24" RCP Outlet Discharge (cfs)
1,492.55	0
1,493.02	5
1,493.22	10
1,493.37	15
1,493.50	20
1,493.62	25
1,493.73	30
1,493.83	35
1,493.93	40
1,494.03	45
1,494.12	50
1,494.21	55
1,494.30	60
1,494.38	65
1,494.47	70
1,494.55	75
1,494.63	80
1,494.72	85
1,494.81	90
1,494.89	95
1,494.98	100
1,495.08	105

Note: Data from CulvertMaster analysis.

SIPHON DRAW DETENTION BASIN

Basin Outlet Hydraulics

Culvert Designer/Analyzer Report
Siphon Draw Basin Outlet

Overtopping Analysis

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	2-6 x 4 ft Box	473.57 cfs	1,498.50 ft	12.19 ft/s
Weir	Roadway	0.00 cfs	1,498.50 ft	N/A
Total	----------	473.57 cfs	1,498.50 ft	N/A

Culvert Designer/Analyzer Report
Siphon Draw Basin Outlet

Component:Culvert-1

Culvert Summary					
Computed Headwater Elev	1,498.50	ft	Discharge	473.57	cfs
Inlet Control HW Elev.	1,498.50	ft	Tailwater Elevation	1,491.00	ft
Outlet Control HW Elev.	1,498.38	ft	Control Type	Inlet Control	
Headwater Depth/Height	1.63				

Grades					
Upstream Invert	1,492.00	ft	Downstream Invert	1,491.50	ft
Length	85.00	ft	Constructed Slope	0.005882	ft/ft

Hydraulic Profile					
Profile	S2		Depth, Downstream	3.24	ft
Slope Type	Steep		Normal Depth	3.13	ft
Flow Regime	Supercritical		Critical Depth	3.64	ft
Velocity Downstream	12.19	ft/s	Critical Slope	0.003937	ft/ft

Section					
Section Shape	Box		Mannings Coefficient	0.012	
Section Material	Concrete		Span	6.00	ft
Section Size	6 x 4 ft		Rise	4.00	ft
Number Sections	2				

Outlet Control Properties					
Outlet Control HW Elev.	1,498.38	ft	Upstream Velocity Head	1.82	ft
Ke	0.50		Entrance Loss	0.91	ft

Inlet Control Properties					
Inlet Control HW Elev.	1,498.50	ft	Flow Control	Submerged	
Inlet Type	45° non-offset wingwall flares		Area Full	48.0	ft^2
K	0.49700		HDS 5 Chart	12	
M	0.66700		HDS 5 Scale	1	
C	0.03390		Equation Form	2	
Y	0.80300				

Culvert Designer/Analyzer Report
Siphon Draw Basin Outlet

Component:Weir

Hydraulic Component(s): Roadway					
Discharge	0.00	cfs	Allowable HW Elevation	1,498.50	ft
Roadway Width	20.00	ft	Overtopping Coefficient	2.50	US
Low Point	1,498.50	ft	Headwater Elevation	N/A	ft
Discharge Coefficient (Cr)	2.50		Submergence Factor (Kt)	1.00	
Tailwater Elevation	1,491.00	ft			

Sta (ft)	Elev. (ft)
0.00	1,500.00
100.00	1,500.00
115.00	1,498.50
130.00	1,498.50
145.00	1,500.00
245.00	1,500.00

Rating Table Report
Siphon Draw Basin Outlet

Range Data:

	Minimum	Maximum	Increment	
Discharge	0.00	600.00	5.00	cfs

Discharge (cfs)	HW Elev. (ft)	TW Elev. (ft)	(1) Discharge	(W) Discharge
0.00	1,492.00	1,491.00	0.00	0.00
5.00	1,492.31	1,491.20	5.01	0.00
10.00	1,492.49	1,491.30	10.02	0.00
15.00	1,492.64	1,491.39	15.02	0.00
20.00	1,492.77	1,491.46	20.02	0.00
25.00	1,492.90	1,491.52	25.02	0.00
30.00	1,493.01	1,491.58	29.98	0.00
35.00	1,493.12	1,491.63	34.98	0.00
40.00	1,493.23	1,491.69	39.98	0.00
45.00	1,493.33	1,491.74	44.97	0.00
50.00	1,493.42	1,491.78	50.02	0.00
55.00	1,493.52	1,491.83	55.02	0.00
60.00	1,493.61	1,491.87	60.02	0.00
65.00	1,493.70	1,491.91	65.02	0.00
70.00	1,493.78	1,491.95	69.97	0.00
75.00	1,493.87	1,491.99	74.97	0.00
80.00	1,493.95	1,492.03	79.97	0.00
85.00	1,494.03	1,492.06	84.97	0.00
90.00	1,494.11	1,492.10	89.97	0.00
95.00	1,494.19	1,492.13	94.97	0.00
100.00	1,494.26	1,492.17	99.97	0.00
105.00	1,494.34	1,492.20	104.97	0.00
110.00	1,494.41	1,492.23	109.97	0.00
115.00	1,494.48	1,492.26	114.97	0.00
120.00	1,494.55	1,492.29	119.96	0.00
125.00	1,494.62	1,492.32	124.96	0.00
130.00	1,494.69	1,492.35	129.96	0.00
135.00	1,494.76	1,492.38	134.96	0.00
140.00	1,494.83	1,492.41	139.96	0.00
145.00	1,494.90	1,492.44	144.96	0.00
150.00	1,494.96	1,492.47	149.96	0.00
155.00	1,495.03	1,492.49	154.96	0.00
160.00	1,495.09	1,492.52	159.96	0.00
165.00	1,495.16	1,492.55	164.96	0.00
170.00	1,495.22	1,492.57	169.96	0.00
175.00	1,495.28	1,492.60	174.96	0.00
180.00	1,495.35	1,492.62	179.96	0.00
185.00	1,495.41	1,492.65	184.96	0.00
190.00	1,495.47	1,492.67	189.96	0.00
195.00	1,495.53	1,492.70	194.96	0.00
200.00	1,495.59	1,492.72	199.96	0.00
205.00	1,495.65	1,492.74	204.96	0.00
210.00	1,495.71	1,492.77	209.96	0.00
215.00	1,495.77	1,492.79	214.96	0.00
220.00	1,495.83	1,492.81	219.96	0.00
225.00	1,495.88	1,492.84	224.96	0.00
230.00	1,495.94	1,492.86	229.96	0.00
235.00	1,496.00	1,492.88	234.96	0.00

Rating Table Report
Siphon Draw Basin Outlet

Discharge (cfs)	HW Elev. (ft)	TW Elev. (ft)	(1) Discharge	W) Discharge
240.00	1,496.05	1,492.90	239.96	0.00
245.00	1,496.11	1,492.93	244.96	0.00
250.00	1,496.17	1,492.95	250.00	0.00
255.00	1,496.22	1,492.97	255.00	0.00
260.00	1,496.28	1,492.99	260.00	0.00
265.00	1,496.33	1,493.01	265.00	0.00
270.00	1,496.39	1,493.03	270.00	0.00
275.00	1,496.44	1,493.05	275.00	0.00
280.00	1,496.49	1,493.07	280.00	0.00
285.00	1,496.55	1,493.09	285.00	0.00
290.00	1,496.60	1,493.11	290.00	0.00
295.00	1,496.65	1,493.13	295.00	0.00
300.00	1,496.70	1,493.15	300.00	0.00
305.00	1,496.76	1,493.17	305.00	0.00
310.00	1,496.81	1,493.19	310.00	0.00
315.00	1,496.86	1,493.21	315.00	0.00
320.00	1,496.91	1,493.23	320.00	0.00
325.00	1,496.96	1,493.25	325.00	0.00
330.00	1,497.01	1,493.27	330.01	0.00
335.00	1,497.06	1,493.28	335.01	0.00
340.00	1,497.11	1,493.30	340.01	0.00
345.00	1,497.16	1,493.32	345.01	0.00
350.00	1,497.21	1,493.34	350.02	0.00
355.00	1,497.26	1,493.36	355.02	0.00
360.00	1,497.31	1,493.37	360.02	0.00
365.00	1,497.36	1,493.39	365.02	0.00
370.00	1,497.41	1,493.41	370.02	0.00
375.00	1,497.46	1,493.43	375.03	0.00
380.00	1,497.51	1,493.44	380.03	0.00
385.00	1,497.56	1,493.46	385.03	0.00
390.00	1,497.60	1,493.48	390.03	0.00
395.00	1,497.65	1,493.50	395.03	0.00
400.00	1,497.70	1,493.51	400.03	0.00
405.00	1,497.75	1,493.53	405.04	0.00
410.00	1,497.79	1,493.55	410.04	0.00
415.00	1,497.84	1,493.56	415.04	0.00
420.00	1,497.89	1,493.58	420.04	0.00
425.00	1,497.93	1,493.60	425.05	0.00
430.00	1,497.98	1,493.61	430.05	0.00
435.00	1,498.03	1,493.63	435.05	0.00
440.00	1,498.07	1,493.64	440.05	0.00
445.00	1,498.12	1,493.66	445.00	0.00
450.00	1,498.18	1,493.68	449.96	0.00
455.00	1,498.25	1,493.69	454.96	0.00
460.00	1,498.31	1,493.71	459.96	0.00
465.00	1,498.38	1,493.72	464.96	0.00
470.00	1,498.45	1,493.74	469.97	0.00
475.00	1,498.52	1,493.75	474.90	0.10
480.00	1,498.58	1,493.77	479.18	0.86
485.00	1,498.63	1,493.78	483.08	1.97
490.00	1,498.69	1,493.80	486.73	3.32
495.00	1,498.74	1,493.81	490.19	4.85
500.00	1,498.78	1,493.83	493.49	6.55

Rating Table Report
Siphon Draw Basin Outlet

Discharge (cfs)	HW Elev. (ft)	TW Elev. (ft)	(1) Discharge	(W) Discharge
505.00	1,498.83	1,493.84	496.65	8.39
510.00	1,498.87	1,493.86	499.66	10.34
515.00	1,498.92	1,493.87	502.60	12.43
520.00	1,498.96	1,493.89	505.41	14.61
525.00	1,499.00	1,493.90	508.11	16.89
530.00	1,499.04	1,493.92	510.74	19.26
535.00	1,499.08	1,493.93	513.29	21.71
540.00	1,499.11	1,493.95	515.76	24.24
545.00	1,499.15	1,493.96	518.13	26.81
550.00	1,499.19	1,493.97	520.46	29.47
555.00	1,499.22	1,493.99	522.73	32.20
560.00	1,499.26	1,494.00	524.93	34.99
565.00	1,499.29	1,494.02	527.09	37.84
570.00	1,499.32	1,494.03	529.19	40.74
575.00	1,499.35	1,494.05	531.24	43.69
580.00	1,499.38	1,494.06	533.24	46.68
585.00	1,499.42	1,494.07	535.19	49.73
590.00	1,499.45	1,494.09	537.11	52.81
595.00	1,499.47	1,494.10	538.98	55.94
600.00	1,499.50	1,494.11	540.81	59.10

Performance Curves Report
Siphon Draw Basin Outlet

Range Data:				
	Minimum	Maximum	Increment	
Discharge	0.00	550.00	5.00	cfs

Performance Curves Report
Siphon Draw Basin Outlet

Range Data:			
	Minimum	Maximum	Increment
Discharge	0.00	550.00	5.00 cfs

Rating Table Report
Siphon Draw Basin Outlet

Range Data:

	Minimum	Maximum	Increment	
Allowable HW E	1,492.00	1,499.00	0.50	ft

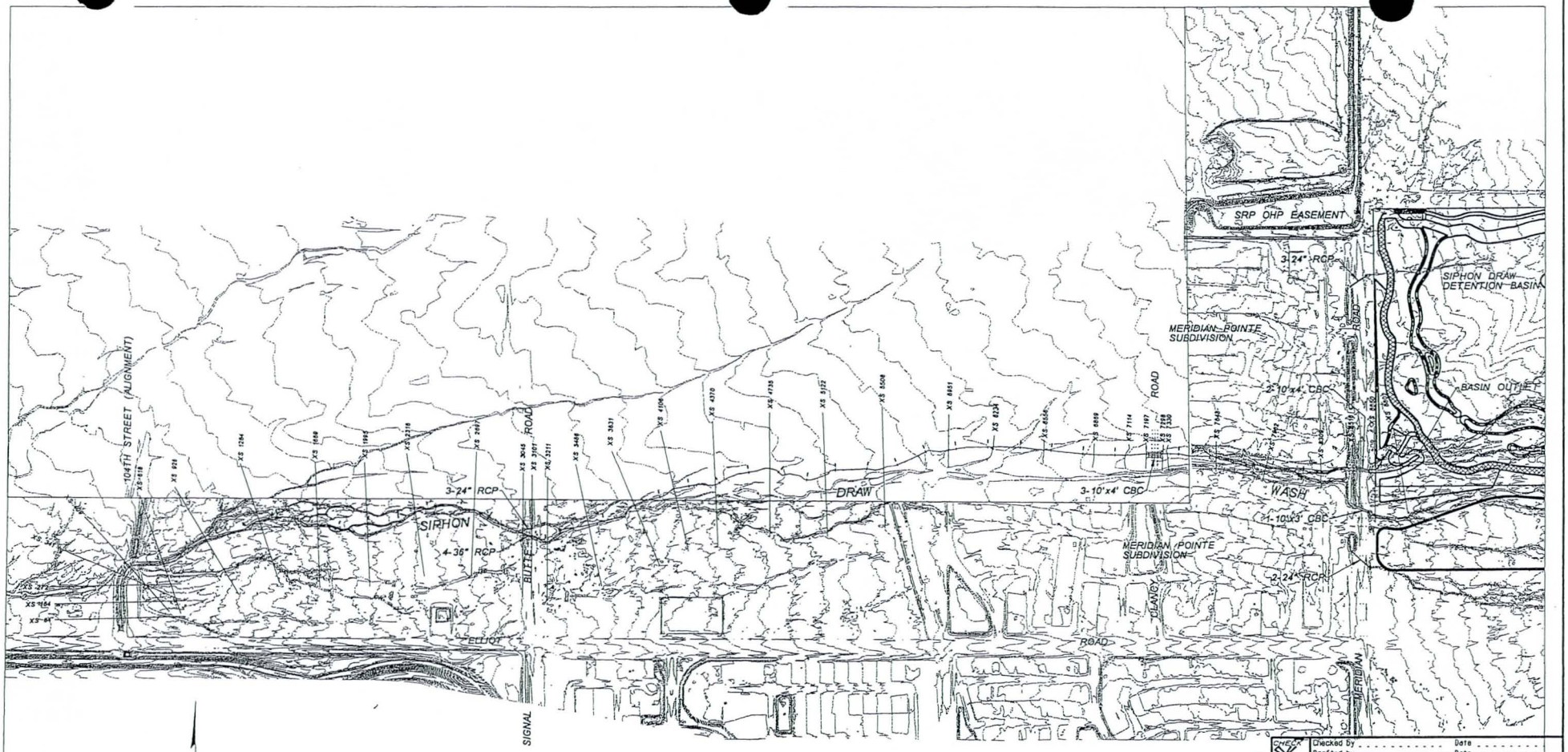
HW Elev. (ft)	Discharge (cfs)	(1) Discharge	(W) Discharge
1,492.00	0.00	0.00	0.00
1,492.50	10.40	10.40	0.00
1,493.00	29.40	29.40	0.00
1,493.50	54.01	54.01	0.00
1,494.00	83.16	83.16	0.00
1,494.50	116.22	116.22	0.00
1,495.00	152.78	152.78	0.00
1,495.50	192.52	192.52	0.00
1,496.00	235.22	235.22	0.00
1,496.50	280.67	280.67	0.00
1,497.00	328.72	328.72	0.00
1,497.50	379.25	379.25	0.00
1,498.00	432.12	432.12	0.00
1,498.50	473.57	473.57	0.00
1,499.00	525.13	508.18	16.95

HEC-1 Rating Curve for SDDB Outlet

Headwater Elevation (ft)	Discharge		
	Culvert (cfs)	Weir (cfs)	Total (cfs)
1492.0	0	0	0
1493.0	28	0	28
1494.0	82	0	82
1495.0	152	0	152
1496.0	234	0	234
1497.0	328	0	328
1498.0	432	0	432
1498.5	474	0	474
1499.0	509	17	526

SIPHON DRAW DETENTION BASIN

Outlet Channel



N

300 0 300 600

Scale in Feet

LEGEND

FLOW DIRECTION

XS 8309 SIPHON DRAW WEST HEC-RAS MODEL

CHECK & PRINT NO.		
	Checked by	Date
	Drafted by	Date
	Back Checked by	Date

NO.	REVISION	BY	DATE
3			
2			
1			

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
ENGINEERING DIVISION

SIPHON DRAW DRAINAGE IMPROVEMENTS PHASE 1
FCD PROJECT NO. 442-11-31
CONTRACT FCD 20090xxx

70%
NOT FOR CONSTRUCTION

	BY	DATE
DESIGNED	JLL	06/08
DRAWN	JLL	06/08
CHECKED	GSB	06/08

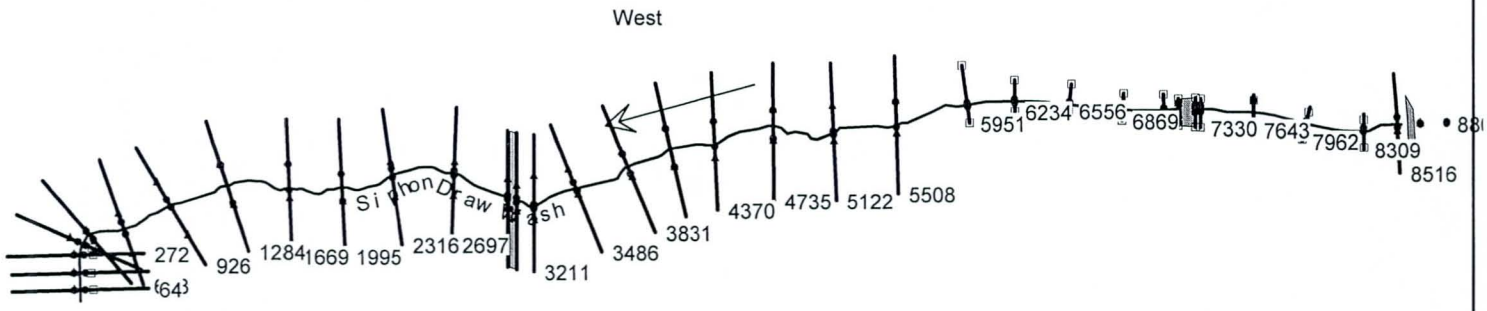
Stanley Consultants inc.

DRAWING NO.

SIPHON DRAW WASH - WEST
HEC-RAS ANALYSIS

SHEET OF

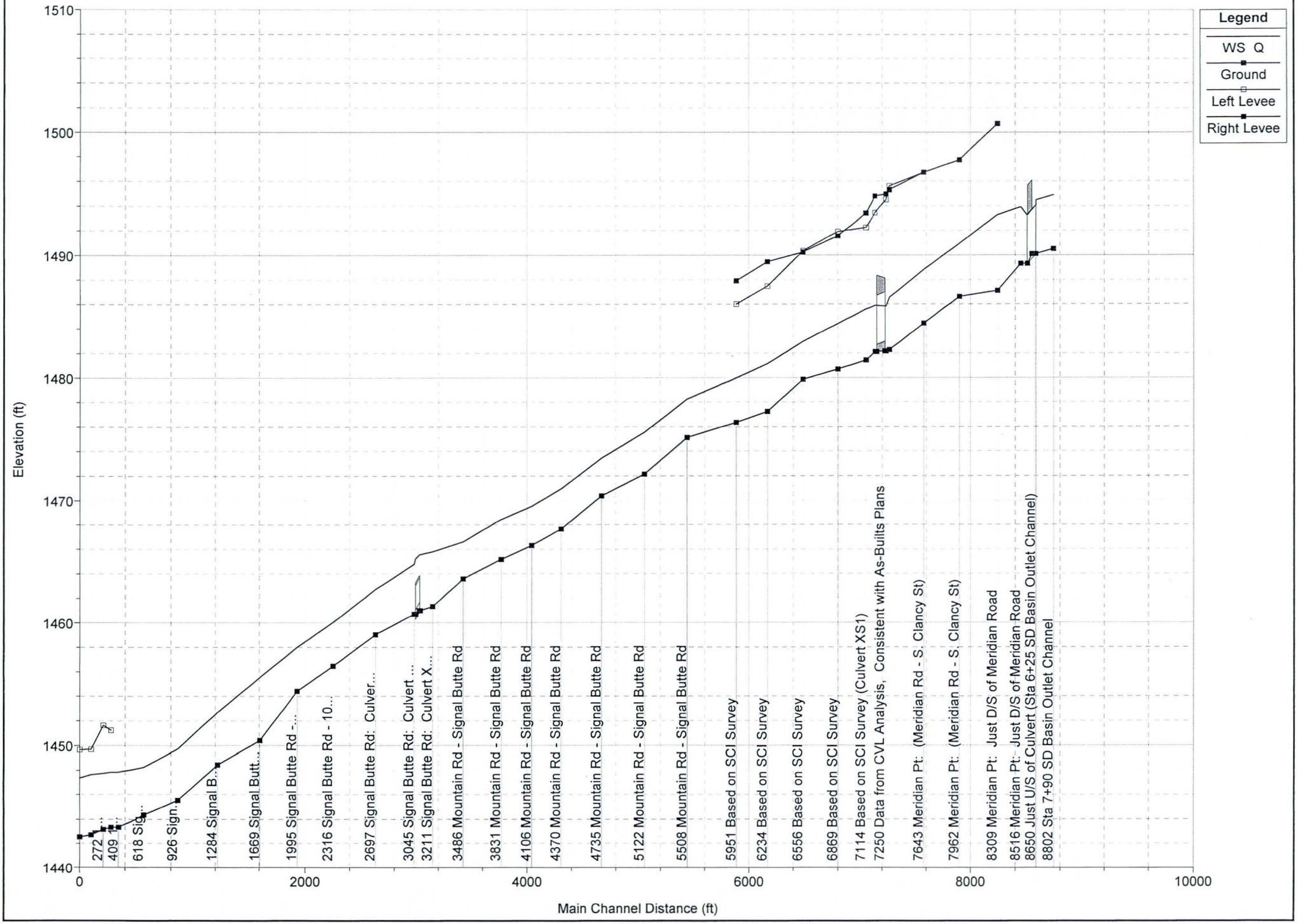
9/11/2008 q:\20539\07-Design\02-Compst\10-WR\JLL\SDW_WEST_HEC-RAS_Exhibit.dgn



9 of the 36 XS's are not Geo-Referenced (- Geo-Ref user entered XS - Geo-Ref interpolated XS - Non Geo-Ref user entered XS - Non Geo-Ref interpolated XS)

Siphon Draw Wash - West Plan F - Design 12/29/2008

Flow: Analysis Q



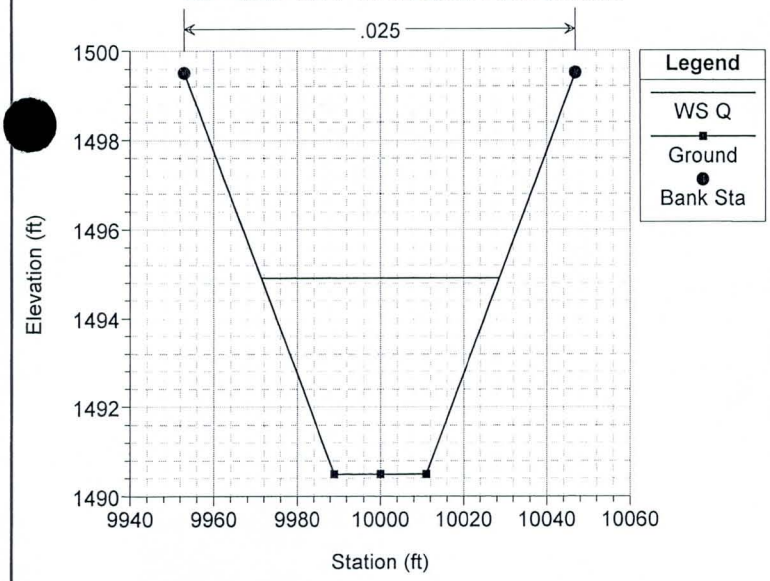
HEC-RAS Plan: Design River: Siphon Draw Wash Reach: West Profile: Q

Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
West	8802	500.00	1490.50	1494.92	1492.68	1495.04	0.000534	2.86	175.07	57.32	0.29
West	8650	500.00	1490.10	1494.48	1492.62	1494.90	0.001064	5.19	96.35	57.04	0.44
West	8579	Culvert									
[illegible]	8516	500.00	1489.30	1493.92	1491.87	1493.98	0.000960	2.04	270.15	517.53	0.20
[illegible]	8309	500.00	1487.10	1493.28	1491.76	1493.56	0.005710	4.80	140.28	94.32	0.44
West	7962	500.00	1486.62	1490.94	1490.27	1491.17	0.008344	3.92	139.09	113.92	0.52
West	7643	500.00	1484.45	1488.82	1487.79	1488.93	0.005811	2.71	184.36	138.83	0.41
West	7330	500.00	1482.29	1486.54	1485.68	1486.87	0.007370	4.84	133.80	116.09	0.52
West	7298	500.00	1482.17	1485.84	1485.47	1486.48	0.018232	6.46	77.49	65.01	0.79
West	7250	Culvert									
West	7197	500.00	1482.12	1485.89	1484.45	1486.05	0.002811	3.21	156.08	71.46	0.36
West	7114	500.00	1481.44	1485.59	1484.68	1485.79	0.003232	4.19	180.10	122.23	0.40
West	6869	500.00	1480.70	1484.41	1484.08	1484.73	0.006014	5.10	144.56	117.62	0.53
West	6556	500.00	1479.85	1482.97	1482.46	1483.13	0.004178	3.90	186.62	139.23	0.43
West	6234	500.00	1477.23	1481.14	1480.93	1481.41	0.006932	5.16	156.68	136.06	0.55
West	5951	500.00	1476.34	1479.97	1479.06	1480.08	0.003187	3.46	238.30	180.92	0.35
West	5508	500.00	1475.10	1478.23	1477.63	1478.32	0.005103	2.43	218.00	800.00	0.39
West	5122	500.00	1472.15	1475.53	1475.35	1475.70	0.009380	4.53	189.48	800.00	0.56
West	4735	500.00	1470.37	1473.45	1472.77	1473.53	0.003661	2.18	232.98	794.50	0.33
West	4370	500.00	1467.64	1470.96	1470.77	1471.10	0.015285	3.27	168.51	689.01	0.62
West	4106	500.00	1466.30	1469.52	1468.72	1469.57	0.002979	1.81	276.90	586.46	0.29
West	3831	500.00	1465.17	1468.44	1467.84	1468.54	0.004815	2.60	205.71	800.00	0.38
West	3486	500.00	1463.58	1466.60	1466.09	1466.71	0.006020	3.12	199.40	800.00	0.43
West	3211	500.00	1461.33	1465.79	1465.12	1465.84	0.001925	2.55	327.43	800.00	0.27
West	3101	500.00	1461.01	1465.55	1464.67	1465.62	0.002042	2.74	269.82	800.00	0.28
West	3073	Culvert									
West	3045	500.00	1460.71	1464.77	1464.36	1464.89	0.005257	3.75	213.16	800.00	0.43
West	2697	500.00	1459.04	1462.74	1462.46	1462.89	0.006309	3.96	203.65	800.00	0.47
West	2316	500.00	1456.46	1460.04	1459.76	1460.20	0.008473	3.72	185.14	800.00	0.52
West	1995	500.00	1454.42	1458.00	1457.43	1458.09	0.005184	2.45	208.14	800.00	0.39
[illegible]	1669	500.00	1450.41	1455.53	1455.22	1455.68	0.011446	3.13	171.61	757.40	0.55
[illegible]	1284	500.00	1448.45	1452.68	1451.92	1452.75	0.005360	2.17	231.01	541.51	0.38
West	926	500.00	1445.54	1449.73	1448.77	1450.10	0.010590	4.86	102.80	122.47	0.60
West	618	500.00	1444.36	1448.25	1446.82	1448.35	0.003244	2.73	215.71	491.80	0.33
West	409	500.00	1443.33	1447.86	1446.10	1448.02	0.000877	3.21	155.71	709.48	0.36
West	341	500.00	1443.34	1447.86	1445.82	1447.95	0.000489	2.66	265.30	461.70	0.27
West	272	500.00	1443.15	1447.76	1445.77	1447.91	0.000683	3.07	166.75	460.60	0.32
West	164	500.00	1442.71	1447.67	1445.54	1447.78	0.002187	2.72	184.97	435.49	0.29
West	64	500.00	1442.55	1447.38	1445.57	1447.52	0.003005	3.05	164.54	432.43	0.33

Siphon Draw Wash - West Plan: Plan F - Design 12/29/2008

Flow: Analysis Q

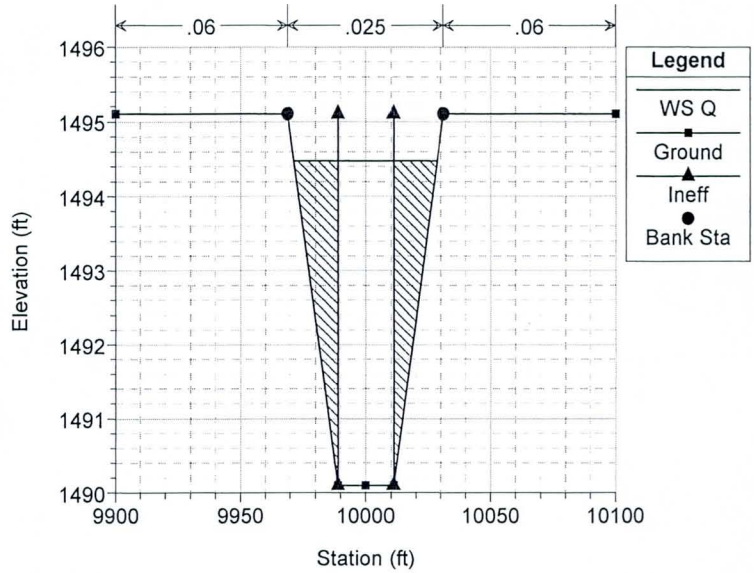
RS = 8802 Sta 7+90 SD Basin Outlet Channel



Siphon Draw Wash - West Plan: Plan F - Design 12/29/2008

Flow: Analysis Q

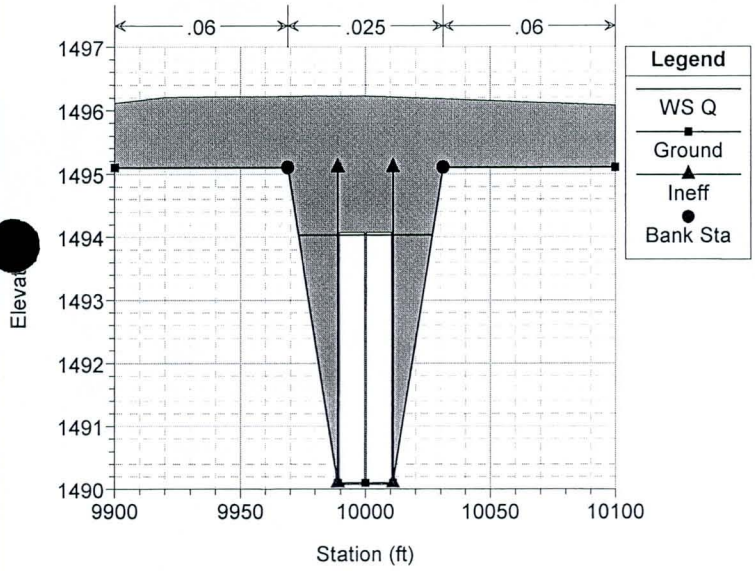
RS = 8650 Just U/S of Culvert (Sta 6+25 SD Basin Outlet Channel)



Siphon Draw Wash - West Plan: Plan F - Design 12/29/2008

Flow: Analysis Q

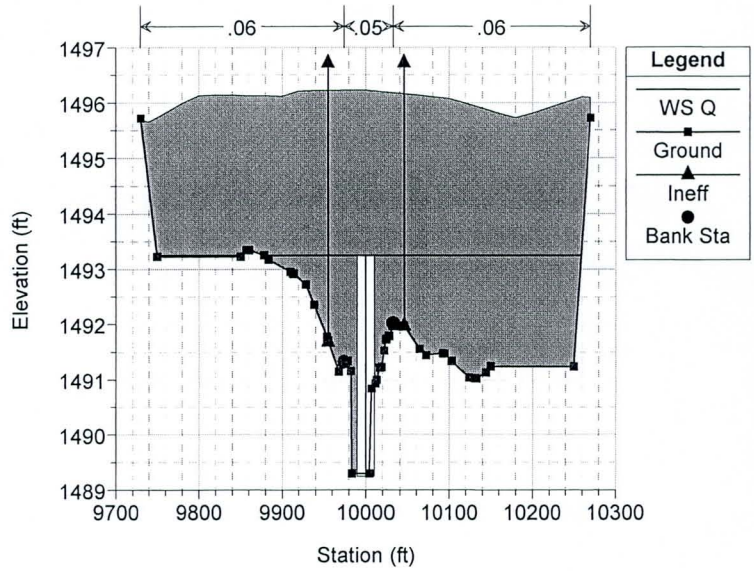
RS = 8579 Culv Meridian Road Culverts



Siphon Draw Wash - West Plan: Plan F - Design 12/29/2008

Flow: Analysis Q

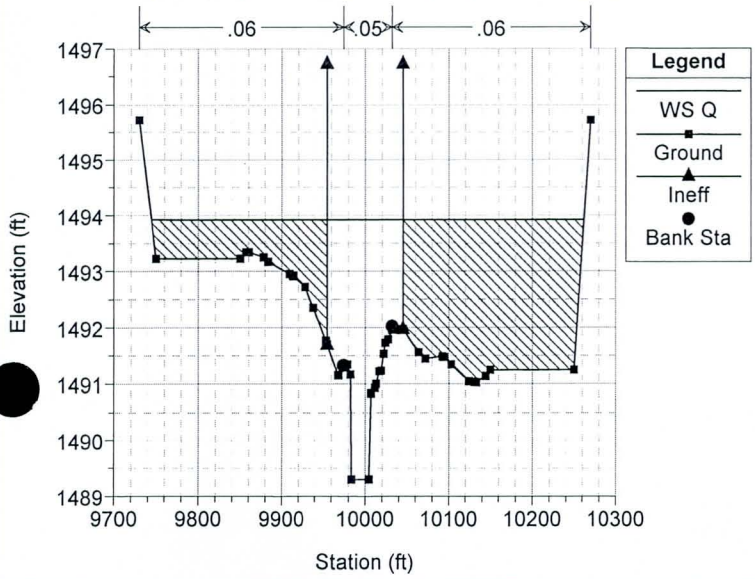
RS = 8579 Culv Meridian Road Culverts



Siphon Draw Wash - West Plan: Plan F - Design 12/29/2008

Flow: Analysis Q

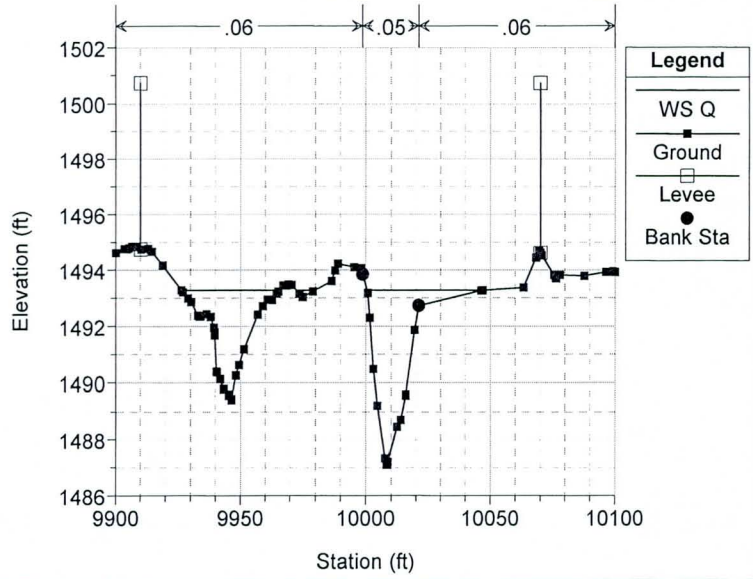
RS = 8516 Meridian Pt: Just D/S of Meridian Road



Siphon Draw Wash - West Plan: Plan F - Design 12/29/2008

Flow: Analysis Q

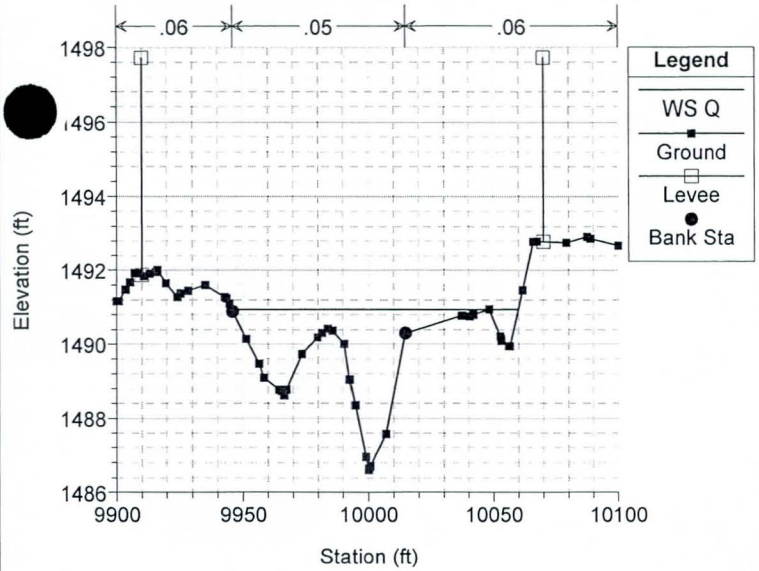
RS = 8309 Meridian Pt: Just D/S of Meridian Road



Siphon Draw Wash - West Plan: Plan F - Design 12/29/2008

Flow: Analysis Q

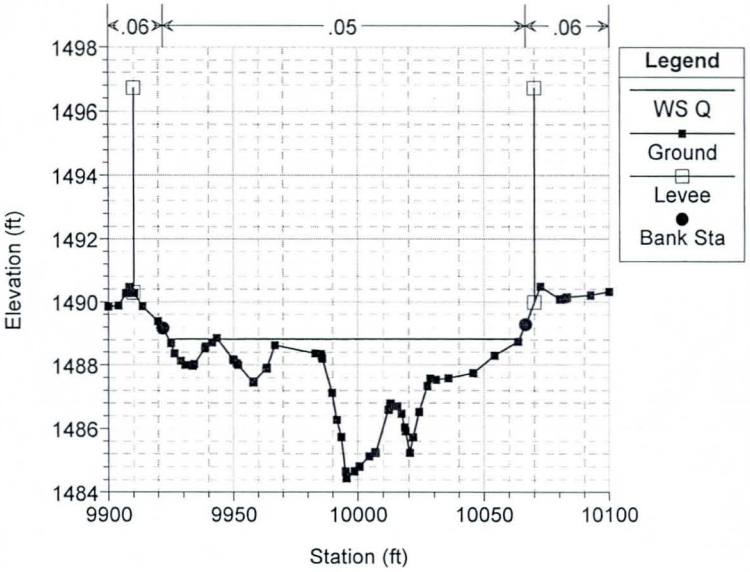
RS = 7962 Meridian Pt: (Meridian Rd - S. Clancy St)



Siphon Draw Wash - West Plan: Plan F - Design 12/29/2008

Flow: Analysis Q

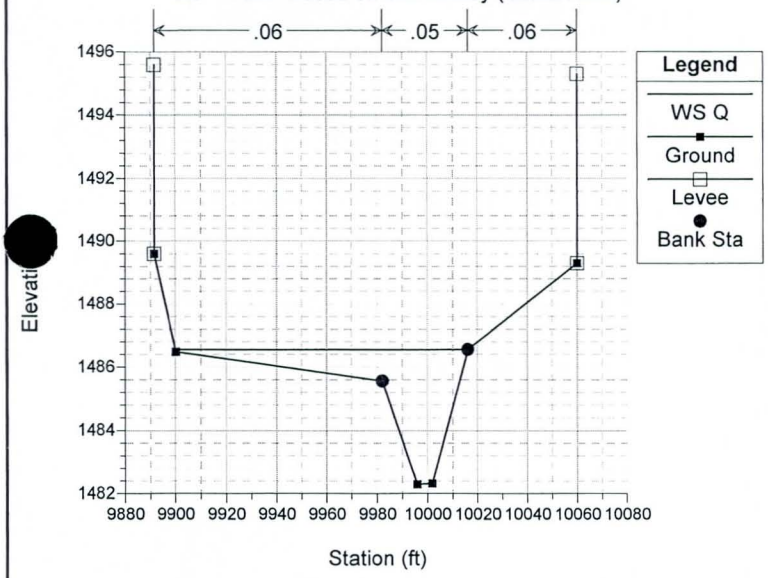
RS = 7643 Meridian Pt: (Meridian Rd - S. Clancy St)



Siphon Draw Wash - West Plan: Plan F - Design 12/29/2008

Flow: Analysis Q

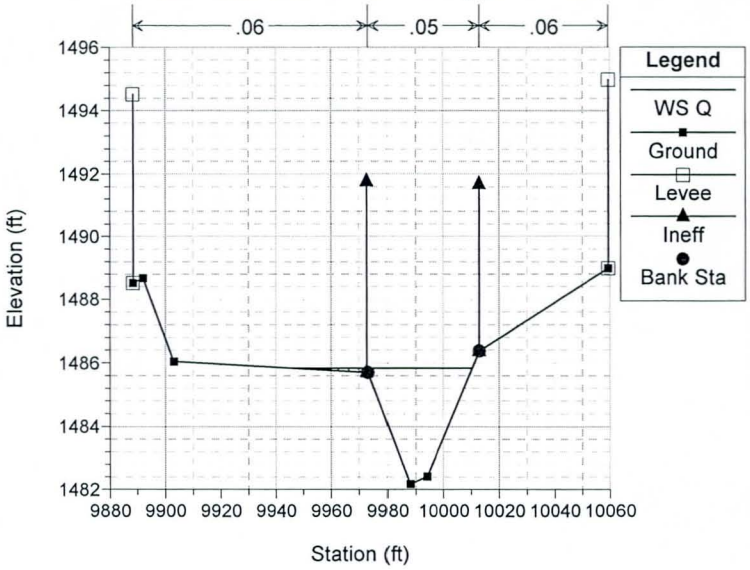
RS = 7330 Based on SCI Survey (Culvert XS4)



Siphon Draw Wash - West Plan: Plan F - Design 12/29/2008

Flow: Analysis Q

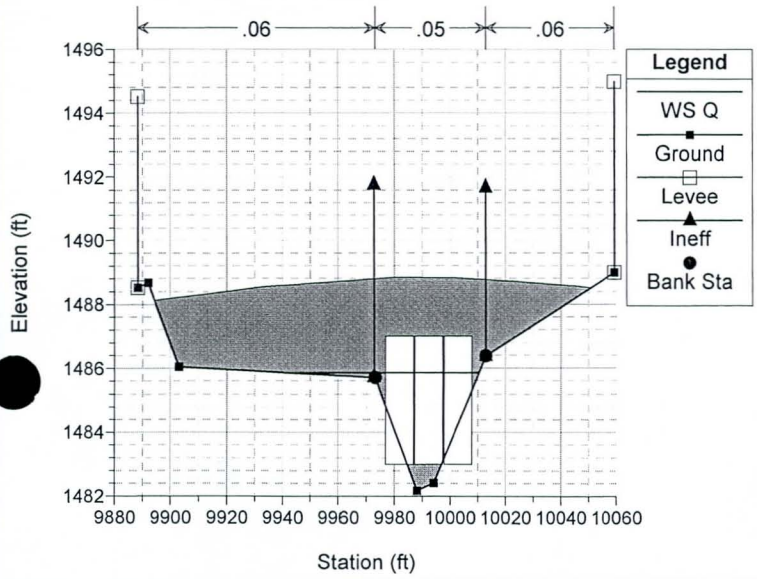
RS = 7298 Based on SCI Survey (Culvert XS3)



Siphon Draw Wash - West Plan: Plan F - Design 12/29/2008

Flow: Analysis Q

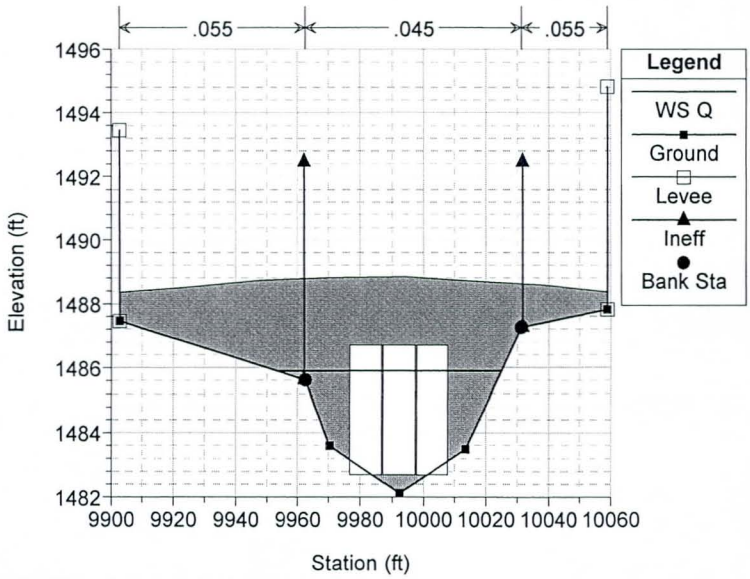
RS = 7250 Culv Data from CVL Analysis, Consistent with As-Builts Plans



Siphon Draw Wash - West Plan: Plan F - Design 12/29/2008

Flow: Analysis Q

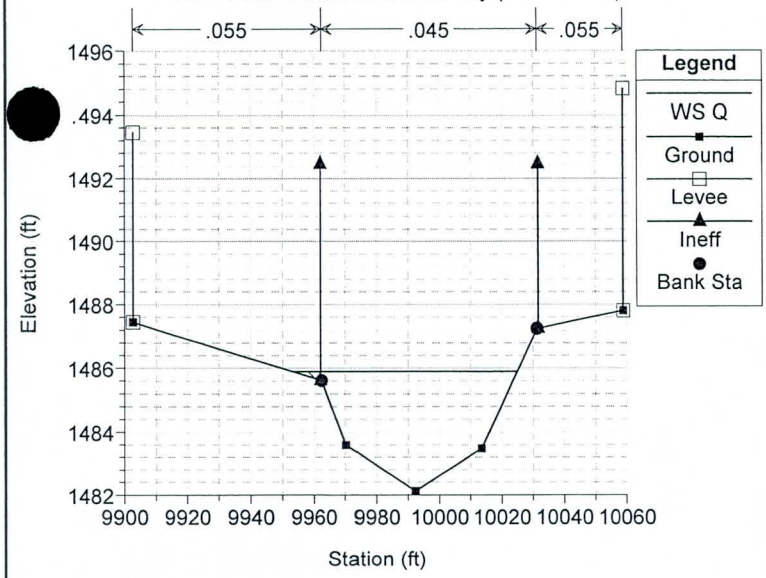
RS = 7250 Culv Data from CVL Analysis, Consistent with As-Builts Plans



Siphon Draw Wash - West Plan: Plan F - Design 12/29/2008

Flow: Analysis Q

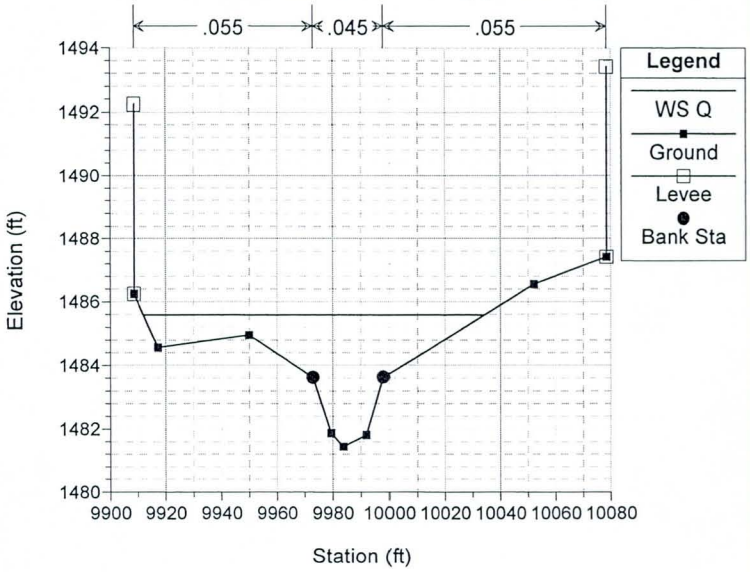
RS = 7197 Based on SCI Survey (Culvert XS2)



Siphon Draw Wash - West Plan: Plan F - Design 12/29/2008

Flow: Analysis Q

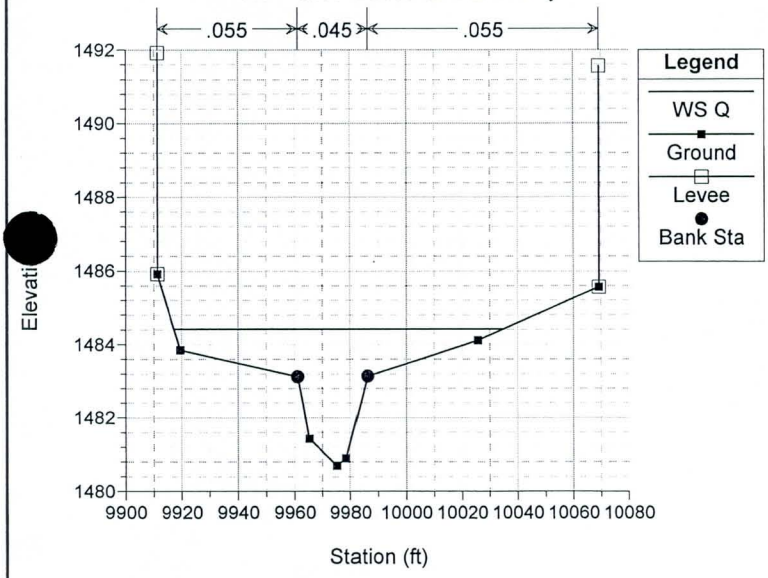
RS = 7114 Based on SCI Survey (Culvert XS1)



Siphon Draw Wash - West Plan: Plan F - Design 12/29/2008

Flow: Analysis Q

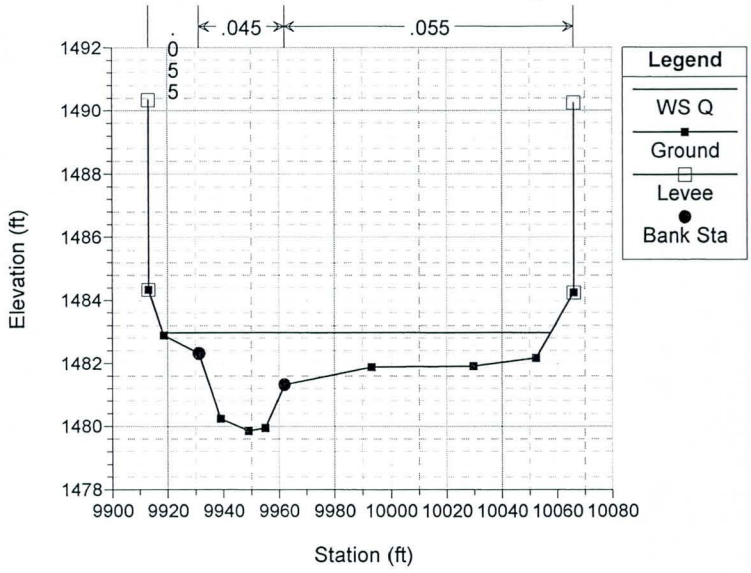
RS = 6869 Based on SCI Survey



Siphon Draw Wash - West Plan: Plan F - Design 12/29/2008

Flow: Analysis Q

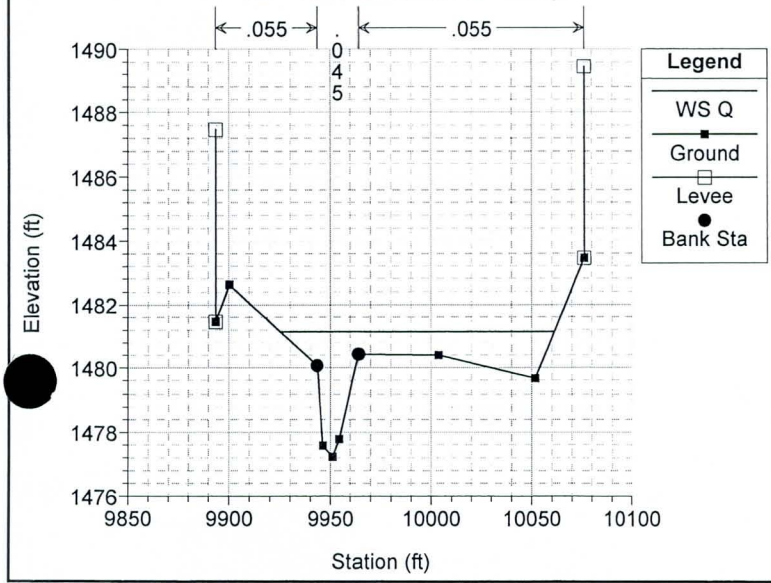
RS = 6556 Based on SCI Survey



Siphon Draw Wash - West Plan: Plan F - Design 12/29/2008

Flow: Analysis Q

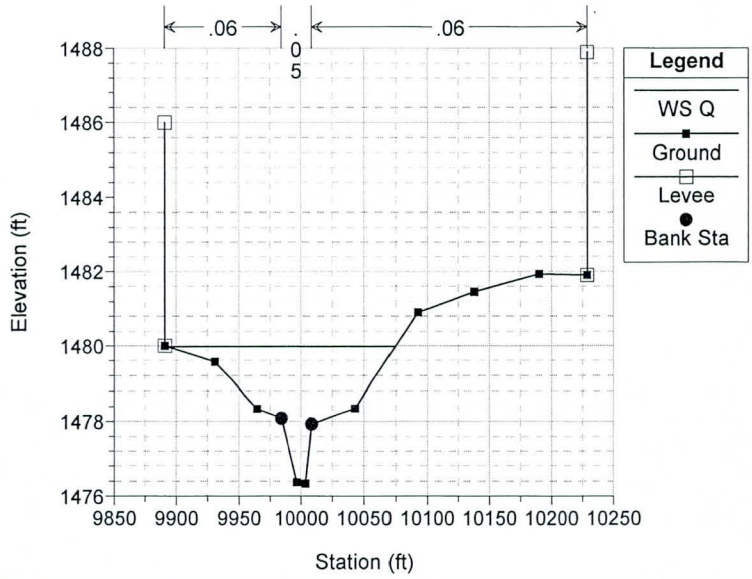
RS = 6234 Based on SCI Survey



Siphon Draw Wash - West Plan: Plan F - Design 12/29/2008

Flow: Analysis Q

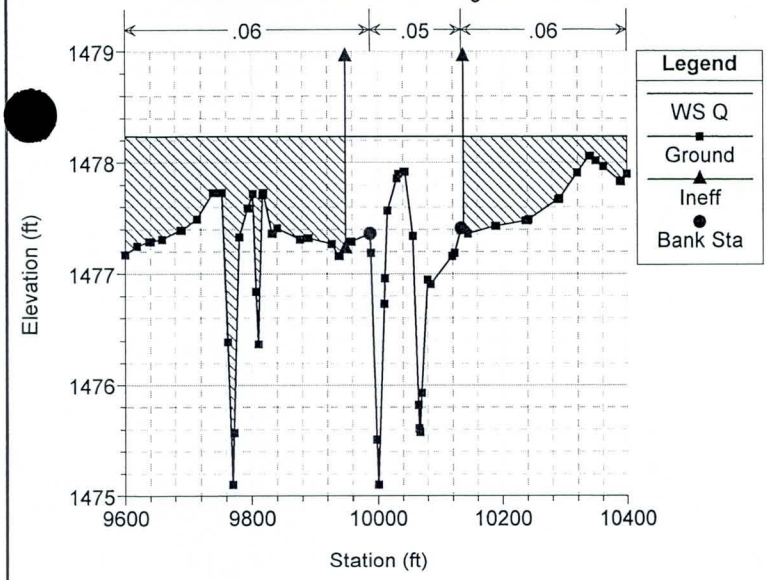
RS = 5951 Based on SCI Survey



Siphon Draw Wash - West Plan: Plan F - Design 12/29/2008

Flow: Analysis Q

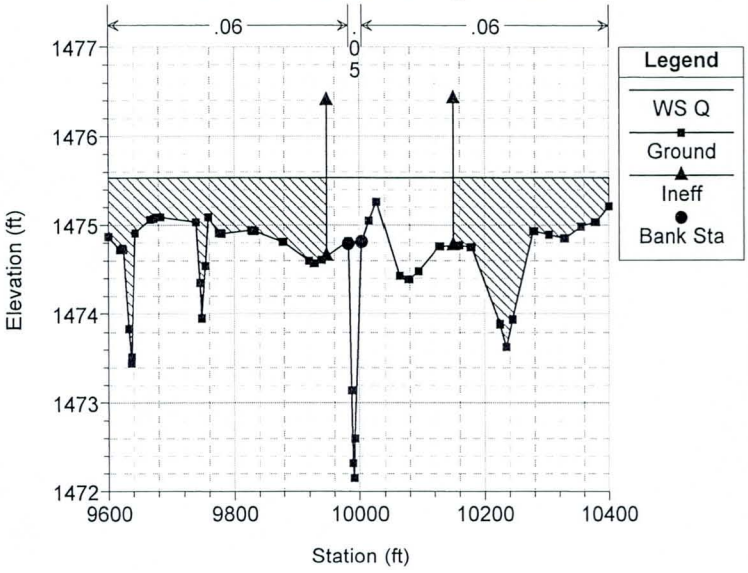
RS = 5508 Mountain Rd - Signal Butte Rd



Siphon Draw Wash - West Plan: Plan F - Design 12/29/2008

Flow: Analysis Q

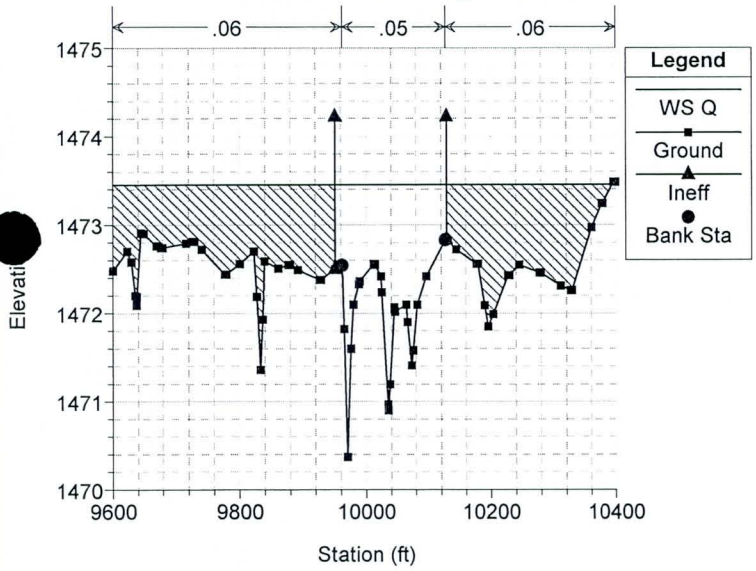
RS = 5122 Mountain Rd - Signal Butte Rd



Siphon Draw Wash - West Plan: Plan F - Design 12/29/2008

Flow: Analysis Q

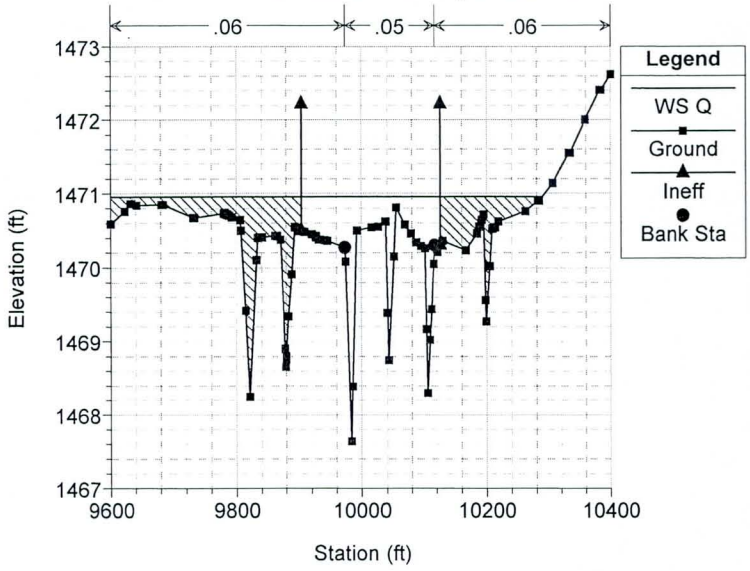
RS = 4735 Mountain Rd - Signal Butte Rd



Siphon Draw Wash - West Plan: Plan F - Design 12/29/2008

Flow: Analysis Q

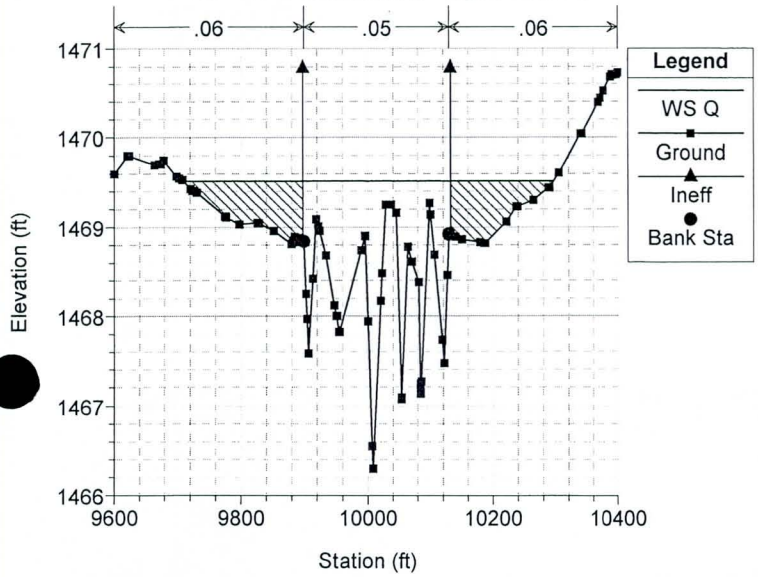
RS = 4370 Mountain Rd - Signal Butte Rd



Siphon Draw Wash - West Plan: Plan F - Design 12/29/2008

Flow: Analysis Q

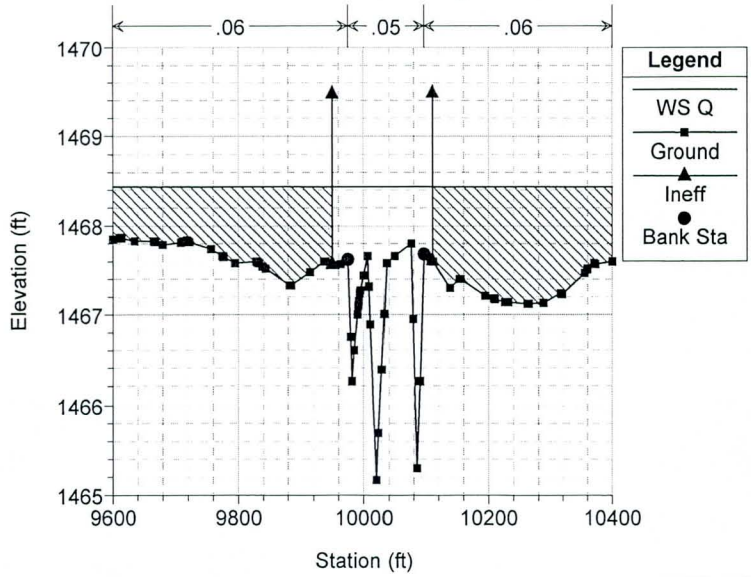
RS = 4106 Mountain Rd - Signal Butte Rd



Siphon Draw Wash - West Plan: Plan F - Design 12/29/2008

Flow: Analysis Q

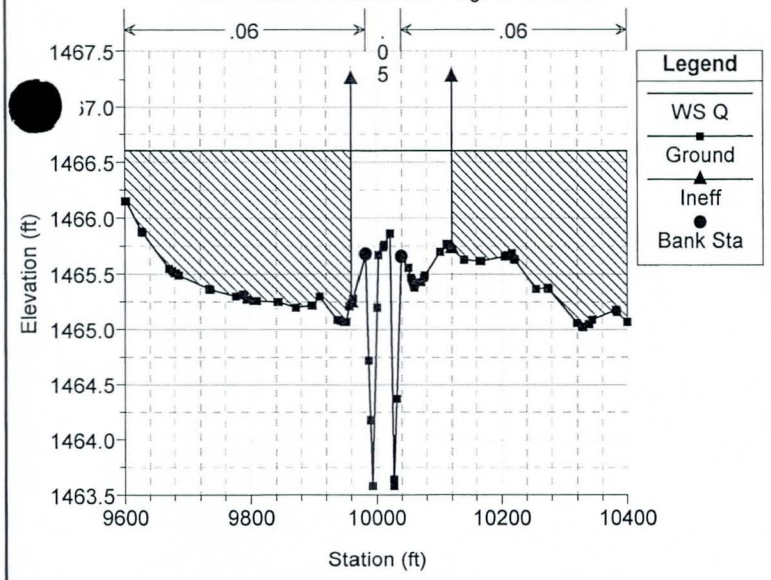
RS = 3831 Mountain Rd - Signal Butte Rd



Siphon Draw Wash - West Plan: Plan F - Design 12/29/2008

Flow: Analysis Q

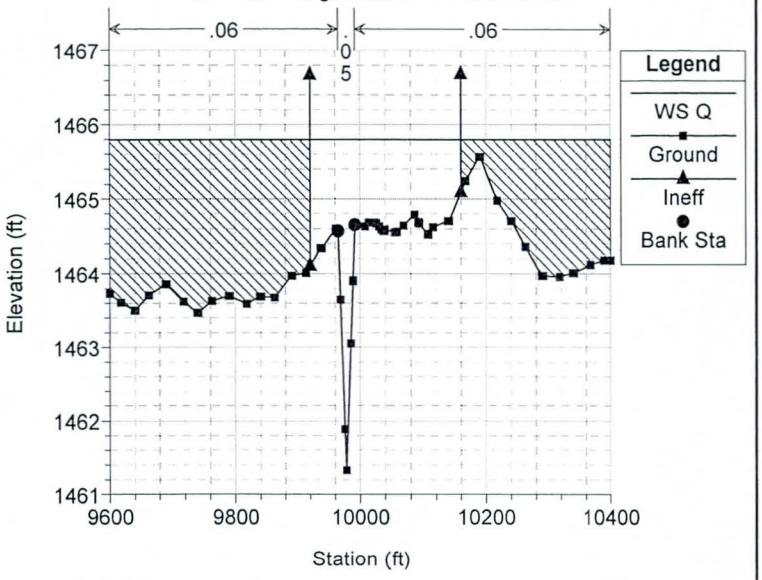
RS = 3486 Mountain Rd - Signal Butte Rd



Siphon Draw Wash - West Plan: Plan F - Design 12/29/2008

Flow: Analysis Q

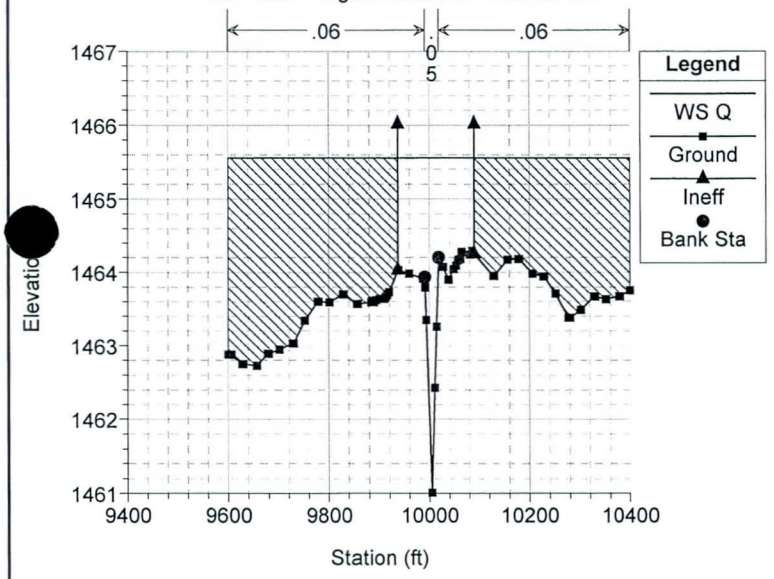
RS = 3211 Signal Butte Rd: Culvert XS4



Siphon Draw Wash - West Plan: Plan F - Design 12/29/2008

Flow: Analysis Q

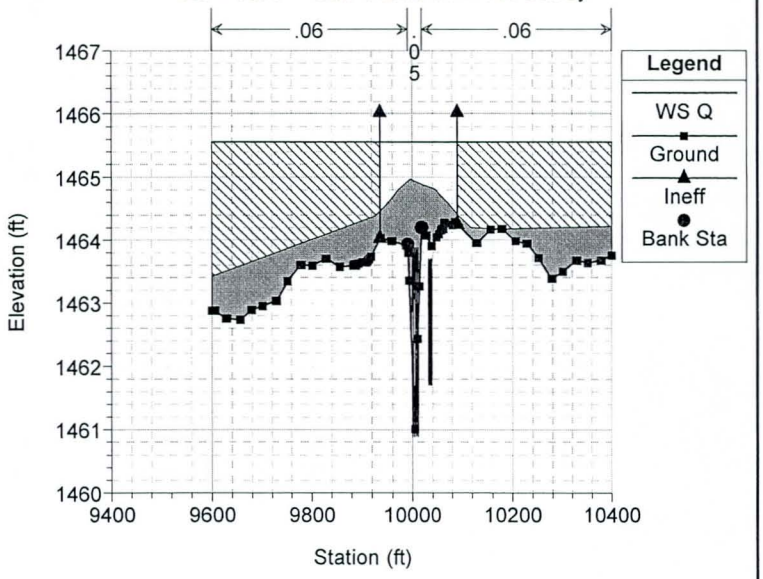
RS = 3101 Signal Butte Rd: Culvert XS3



Siphon Draw Wash - West Plan: Plan F - Design 12/29/2008

Flow: Analysis Q

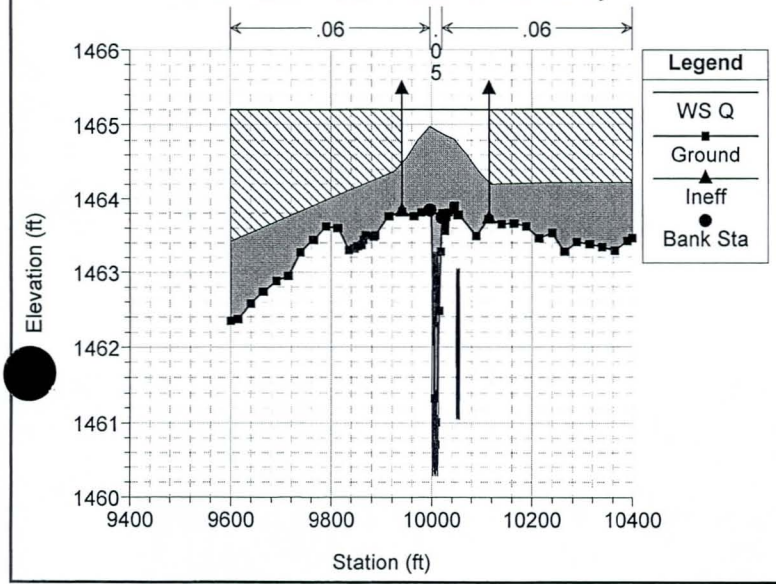
RS = 3073 Culv Profile from SCI Survey



Siphon Draw Wash - West Plan: Plan F - Design 12/29/2008

Flow: Analysis Q

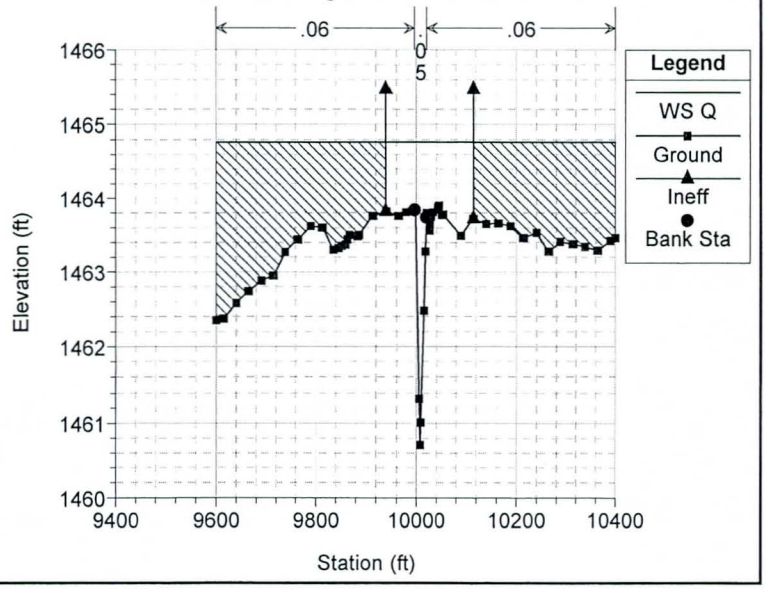
RS = 3073 Culv Profile from SCI Survey



Siphon Draw Wash - West Plan: Plan F - Design 12/29/2008

Flow: Analysis Q

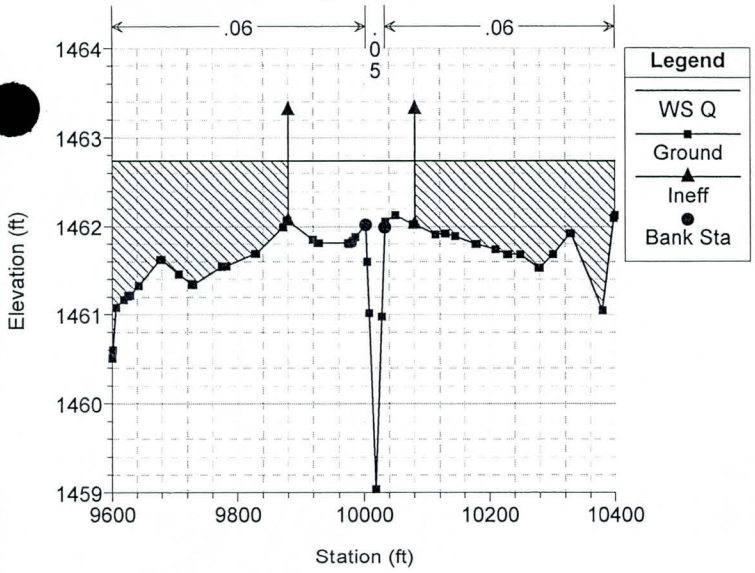
RS = 3045 Signal Butte Rd: Culvert XS2



Siphon Draw Wash - West Plan: Plan F - Design 12/29/2008

Flow: Analysis Q

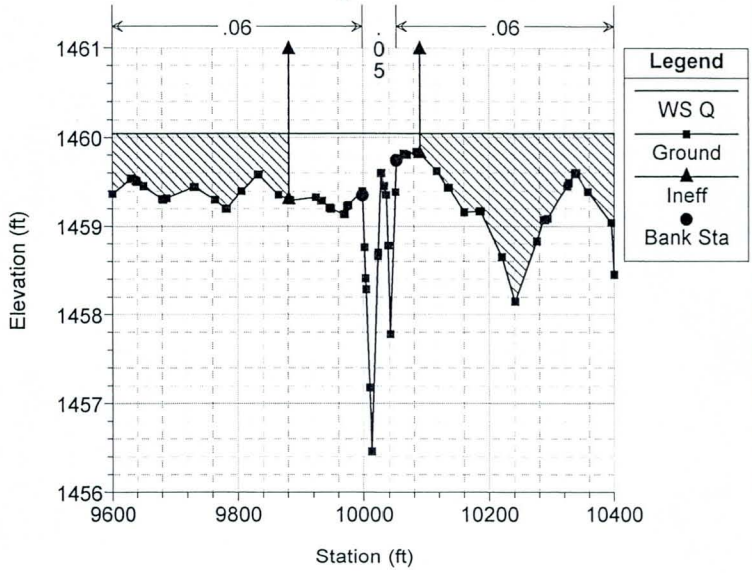
RS = 2697 Signal Butte Rd: Culvert XS1



Siphon Draw Wash - West Plan: Plan F - Design 12/29/2008

Flow: Analysis Q

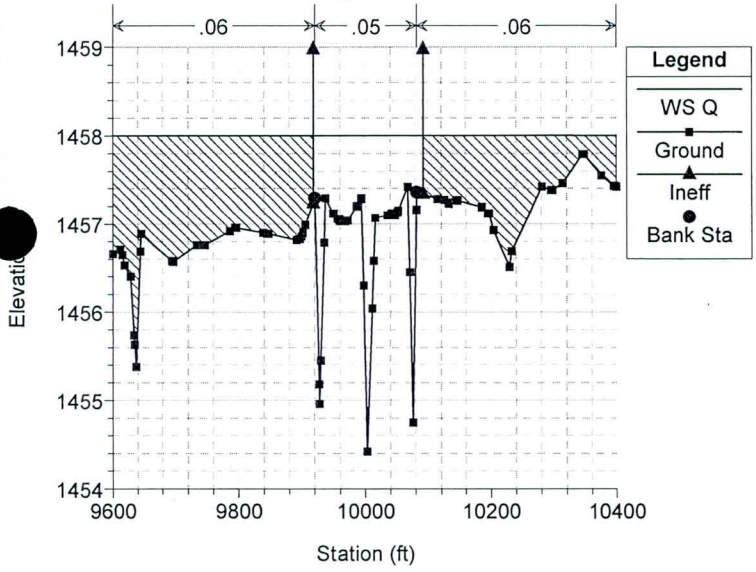
RS = 2316 Signal Butte Rd - 104th St



Siphon Draw Wash - West Plan: Plan F - Design 12/29/2008

Flow: Analysis Q

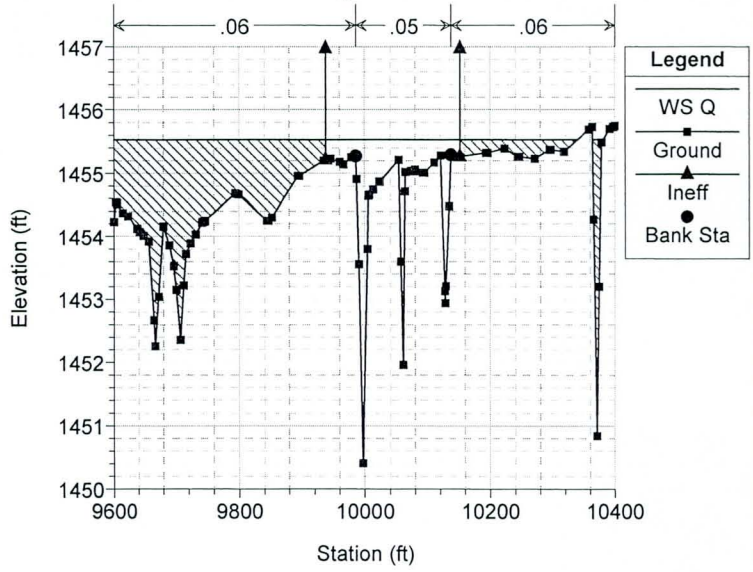
RS = 1995 Signal Butte Rd - 104th St



Siphon Draw Wash - West Plan: Plan F - Design 12/29/2008

Flow: Analysis Q

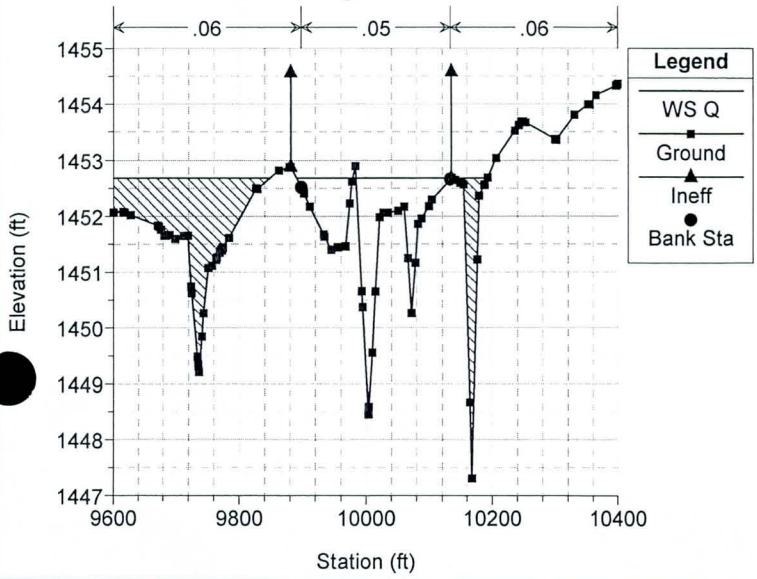
RS = 1669 Signal Butte Rd - 104th St



Siphon Draw Wash - West Plan: Plan F - Design 12/29/2008

Flow: Analysis Q

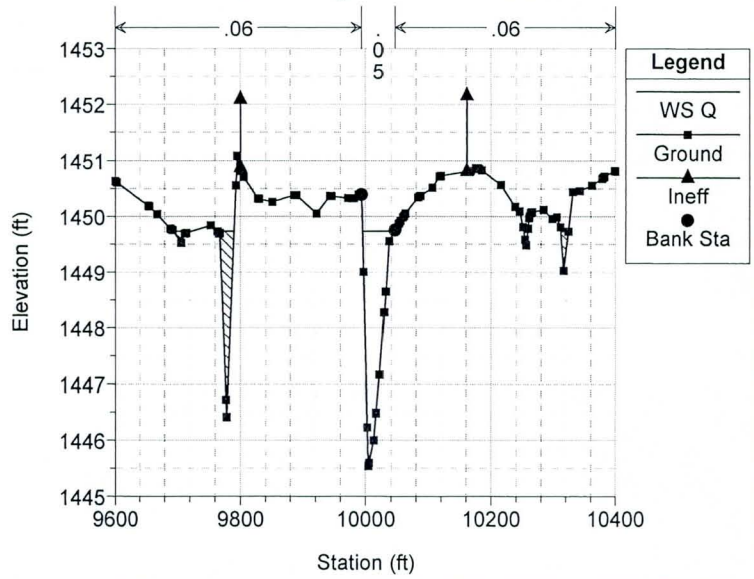
RS = 1284 Signal Butte Rd - 104th St



Siphon Draw Wash - West Plan: Plan F - Design 12/29/2008

Flow: Analysis Q

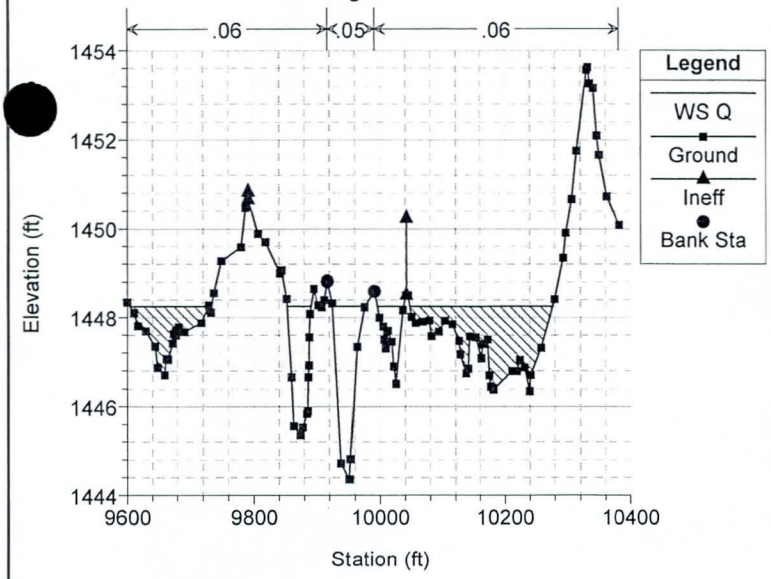
RS = 926 Signal Butte Rd - 104th St



Siphon Draw Wash - West Plan: Plan F - Design 12/29/2008

Flow: Analysis Q

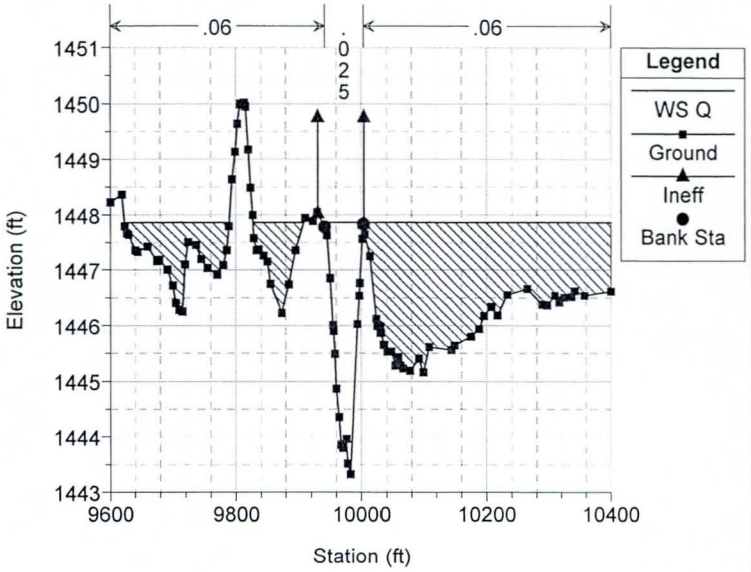
RS = 618 Signal Butte Rd - 104th St



Siphon Draw Wash - West Plan: Plan F - Design 12/29/2008

Flow: Analysis Q

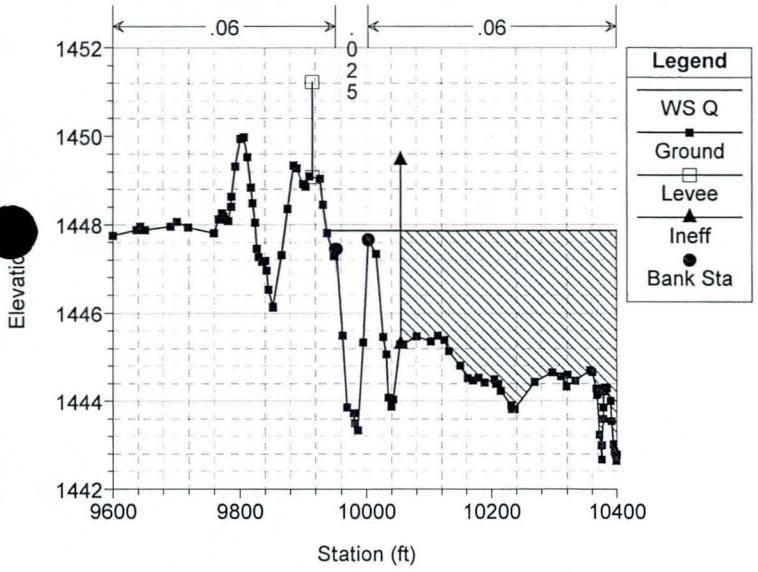
RS = 409 104th St Outfall Channel: (Concrete Lined Section)



Siphon Draw Wash - West Plan: Plan F - Design 12/29/2008

Flow: Analysis Q

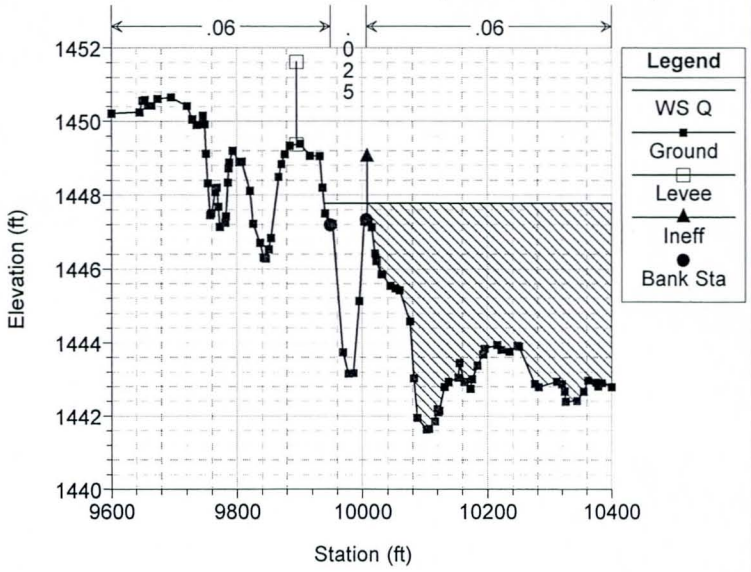
RS = 341 104th St Outfall Channel: (Concrete Lined Section)



Siphon Draw Wash - West Plan: Plan F - Design 12/29/2008

Flow: Analysis Q

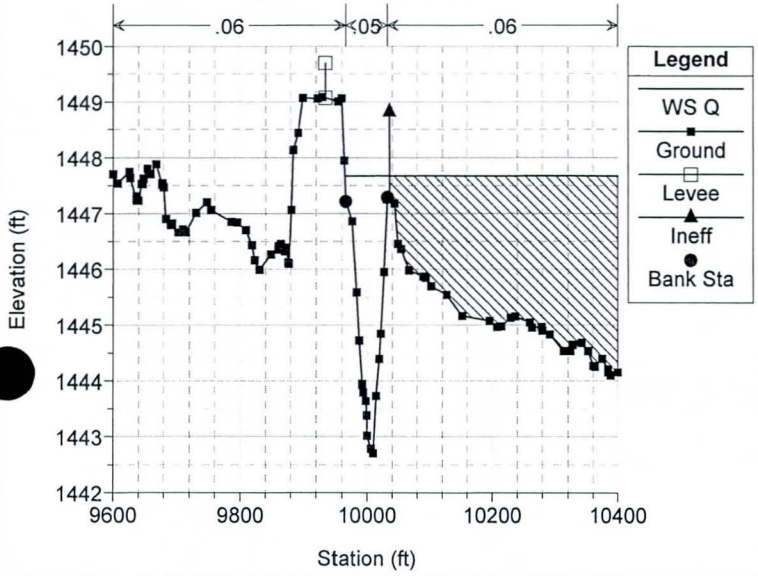
RS = 272 104th St Outfall Channel: (Concrete Lined Section)



Siphon Draw Wash - West Plan: Plan F - Design 12/29/2008

Flow: Analysis Q

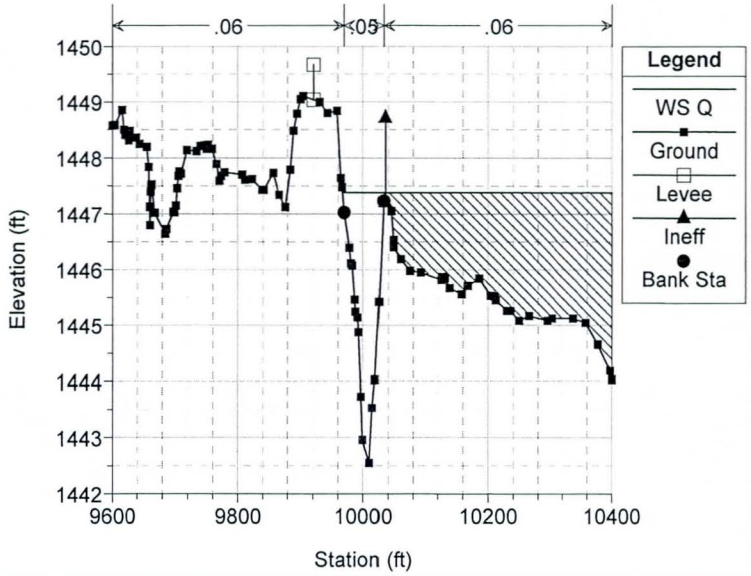
RS = 164 104th St Outfall Channel



Siphon Draw Wash - West Plan: Plan F - Design 12/29/2008

Flow: Analysis Q

RS = 64 104th St Outfall Channel



SIPHON DRAW DETENTION BASIN

Sediment Yield

Siphon Draw Geotechnical Data - Sieve Analyses from Test Borings

Boring Location	Sample Depth (ft)	USCS	Approximate D_{16} Sieve	D_{16} (mm)	D_{50} Sieve	D_{50} (mm)	D_{84} Sieve	D_{84} (mm)
BH-1	4.5 - 5.5	SC-SM	#200	0.075	#50	0.300	#10	2.00
BH-2	9.5 - 11.0	CL	#200	0.075	#200	0.075	#50	0.30
BH-3	4.5 - 6.0	CL	#200	0.075	#200	0.075	#30	0.60
BH-3	9.5 - 10.5	SC	#200	0.075	#100	0.150	#30	0.60
BH-4	14.5 - 15.5	SC	#200	0.075	#100	0.150	#10	2.00
BH-5	7.5 - 8.5	SC	#200	0.075	#100	0.150	#30	0.60
BH-6	4.5 - 6.0	CL	#200	0.075	#200	0.075	#100	0.150
BH-6	9.5 - 10.5	CL	#200	0.075	#200	0.075	#100	0.150
BH-7	14.5 - 15.5	SP-SC	#40	0.425	#16	1.180	#4	0.60
BH-8	4.5 - 6.0	CL	#200	0.075	#200	0.075	#200	0.08
BH-9	19.5 - 20.5	SC	#200	0.075	#200	0.075	#30	0.60
BH-10	7.5 - 8.5	SC	#200	0.075	#100	0.150	#16	1.18
BH-10	14.5 - 16.0	SC	#200	0.075	#200	0.075	#16	1.18
BH-11	9.5 - 10.5	CL	#200	0.075	#200	0.075	#200	0.08
BH-12	2.5 - 4.0	SM	#200	0.075	#40	0.425	#8	0.08
BH-12	14.5 - 15.5	SP-SC	#40	0.425	#16	1.180	#4	0.60
BH-13	19.5 - 20.5	SC	#200	0.075	#100	0.150	#4	0.60
BH-14	19.5 - 20.5	SC	#100	2.000	#16	1.180	#4	0.60
BH-15	4.5 - 6.0	CL	#200	0.075	#200	0.075	#200	0.08
BH-16	9.5 - 11.0	CL	#200	0.075	#200	0.075	#40	0.43
BH-17	4.5 - 5.5	CL	#200	0.075	#200	0.075	#100	0.150
BH-18	7.5 - 8.5	SC	#200	0.075	#50	0.300	#8	0.08
BH-19	19.5 - 20.5	SC	#200	0.075	#30	0.600	3/8"	0.08
BH-20	4.5 - 5.5	CL	#200	0.075	#200	0.075	#100	0.150
BH-21	19.5 - 21.0	SP-SM	#50	0.300	#10	2.000	#4	0.60
BH-22	0.0 - 4.5	CL	#200	0.075	#200	0.075	#30	0.60
BH-22	9.5 - 11.0	SC	#200	0.075	#30	0.600	#4	0.60
BH-23	0.0 - 4.5	SC	#200	0.075	#100	2.000	#10	2.00
BH-24	0.0 - 4.5	SC	#200	0.075	#50	0.300	3/8"	0.08
BH-24	9.5 - 11.0	CL	#200	0.075	#200	0.075	#40	0.43
BH-25	9.5 - 11.0	CL	#200	0.075	#200	0.075	#100	0.150
		Average:		**0.167**		**0.385**		**0.561**

Sieve	Size (mm)
4"	100
3"	75
2"	50
1 1/2"	37.5
1"	25
3/4"	19
1/2"	12.5
3/8"	9.5
#4	4.75
#8	2.36
#10	2
#16	1.18
#20	0.85
#30	0.6
#40	0.425
#50	0.3
#60	0.25
#70	0.212
#100	0.15
#140	0.106
#200	0.075
-	-
-	-
-	-
-	-
-	-
-	-
-	-
-	-
-	-
-	-
-	-

Reference: Siphon Draw Drainage Improvement Project Initial Geologic Hazard Assessment and Geotechnical Characterization Report, AMEC, July 16,2009

Siphon Draw Detention Basin Sediment Calculations (Bed Load)

Description	100-Year Sediment Yield Basin 65A1	
D_{84} =	0.561	mm
D_{50} =	0.385	mm
D_{16} =	0.167	mm
Gradation, $G = 1/2(D_{84.1}/D_{50} + D_{50}/D_{15.9})$ =	1.881	
Velocity, V_a =	7.98	ft/s
Depth, Y_h =	5.6	ft
Manning's n, n =	0.020	
Flow Area, A_w =	286	ft2
Width, $w = A_w/Y_h$ =	51.071	ft
Bed Discharge, $q_s = 0.0064[(n^{1.77}V_a^{4.32}G^{0.45})/(Y_h^{0.3}D_{50}^{0.61})]$ =	0.070	cfs/ft
Sediment Discharge, $Q_s = q_s w$ =	3.595	cfs
Peak Discharge, Q =	943	cfs
Volume of Flow, V_w =	118	ac-ft
Volume of Sediment, $V_s = V_w(Q_s/Q)$	0.450	ac-ft
Unit Weight of Sediment, $W = 125 - 7D_{50}^{0.21}$ =	123.3	lb/ft3
Bed Load = V_s =	**0.450**	**ac-ft**
Bed Load = $(43560V_s)W/2000$ =	**1208**	**tons**

Note: Methodology from FCDMC, 2008, DDMSW-River Mechanics: Quick Reference (draft) provided via email on 8/27/2008 by Dr. Zhao to Mr. Klenner and Mr. Lopez

Siphon Draw Detention Basin Sediment Calculations (Wash Load)

Description	Subbasin 65A1 100-Yr		Comments
α = 95 =	95		*Constant*
β = 0.56 =	0.56		*Constant*
K =	0.32		*Figure 2*
C&M Factor for the effects of canopy cover, C_I =	0.57		*Figure 3*
C&M Factor for effects of mulch and vegetation C_{II} =	0.65		*Figure 4*
C&M Factor for tillage & residual effects of land use, C_{III} =	0.25		*Figure 5*
Cover & Management Factor, $C = C_I C_{II} C_{III}$ =	0.10		*Equation A12*
Erosion Control Practice Factor, P =	1.00		*1.0 for wildland areas*
Volume of runoff, V =	118	acre-ft	*from calculation*
Peak flow rate, q_p =	943	cfs	
Slope length, λ =	1566	ft	*measured*
Percent slope, S =	0.61	%	*calculated*
exponent n, n=0.3 for S<3%, n=0.4 for S=4%, n=0.5 for S>5%, n =	0.30	n=	
Topographic Factor, $LS = (\lambda/72.6)^n(0.065 + 0.0454S + 0.0065S^2)$ =	0.24	LS	*Equation A11*
Wash Load or Watershed soil loss, $Y_{s(in\ tons)} = \alpha (Vq_p)^\beta KLSCP$ =	**463**	tons	*Equation A10*
Wash Load or Watershed soil loss (in acre-ft), $Y_s = (2000Y_{S(in\ tons)})/W/43560$ =	**0.172**	ac-ft	

Note: Methodology from draft Hydraulics Manual (Appendix A) provided by FCDMC but not yet published

Siphon Draw Detention Basin Sediment Calculations (Total YieldWash Load)

100-Year Event Sediment Yield for Representative Subbasin (65A1)

Description	100-Yr Subbasin 65A1	
Drainage Area, A_D =	0.93	sq mi
Sediment Delivery Ration, SDR = $-14.08(\log_{10}A_D) + 2.44(\log_{10}A_D^2) - 0.45(\mathrm{Log}_{10}A_D)^3 + 60.85$ =	61.3	%
Bed Load, V_s =	0.450	acre-ft
Wash Load, Y_s =	0.172	acre-ft
Total Sediment Yield = $SDR(Y_S) + V_S$ =	0.556	acre-ft
Total Sediment Yield per square mile = $(SDR\ (Y_S) + V_S) / A_D$ =	0.597	acre-ft / sq mi

100-Year Event Sediment Yield for Drainage Area

Description		
Subbasin 65A1 drainage area, A_{65A1} =	0.93	sq mi
Subbasin 65A2 drainage area, A_{65A2} =	0.53	sq mi
Subbasin 65A3 drainage area, A_{65A3} =	0.62	sq mi
Subbasin 65A3A drainage area, A_{65A3A} =	0.59	sq mi
Subbasin 52 drainage area, A_{52} =	0.43	sq mi
Subbasin 56 drainage area, A_{56} =	0.55	sq mi
Subbasin 58 drainage area, A_{58} =	0.94	sq mi
Total Drainage Area[1] = (65A3+65A2+65A3+65A3A+52+56+58) =	4.59	sq mi
Total Sediment Yield per square mile of drainage area[1] =	0.597	acre-ft / sq mi
Drainage area sediment yield for drainage area for 100-yr event, Y_{S100} =	2.74	acre-ft

1. *100-Yr event total sediment yield for Subbasin 65A1 is assumed to be representative of the entire drainage area*

Estimate of Total Storage to be Provided for the Accumulation of Sediment in the Detention Basin

Drainage area sediment yield for drainage area for 100-yr event, Y_{S100} =	2.74	acre-ft
Drainage area sediment yield for drainage area for 10-yr event[1], Y_{S10} =	2.74	acre-ft
Drainage area sediment yield for drainage area for 2-yr event[1], Y_{S2} =	2.74	acre-ft
Annual sediment yield[2] , $Y_{sm} = 0.055\ Y_{S100} + 0.245Y_{S10} + 0.45Y_{S2}$ =	2.06	acre-ft
Total additional storage volume to be provided for sediment[3] = $Y_{SM} + Y_{S100}$ =	4.80	acre-ft
Required additional detention storage volume for sediment[4] =	5.00	acre-ft

1. *For purposes of this project and with FCDMC approval, assumed 10-yr and 2-yr sediment yield is equal to the 100-yr.*
2. *Sediment and Erosion Design Guide, Albuquerque Metropoloitan Arroyo Flood Control Authority, November 1995*
3. *Initial requirements indicated by FCDMC.*
4. *FCDMC approved the provision of an additional 5 acre-ft of detention basin storage for sediment accumulation.*

Note: Methodology from draft Hydraulics Manual (Appendix A) provided by FCDMC but not yet published

Siphon Draw Drainage Improvement Project
Initial Geologic Hazard Assessment and Geotechnical Characterization Report
Contract FCD 2007C012
Maricopa County, Arizona

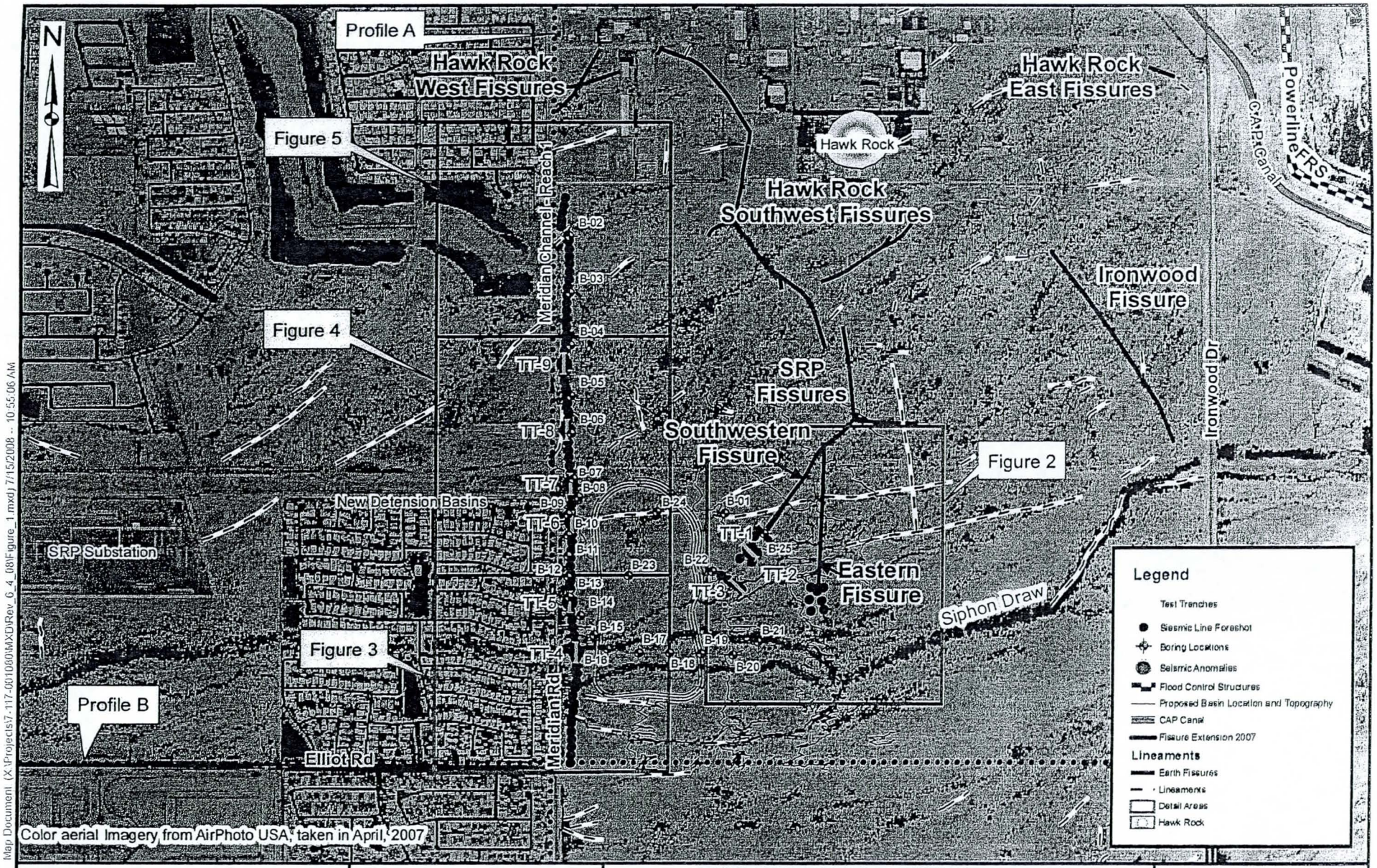
Submitted to:

Stanley Consultants, Inc.
Phoenix, Arizona

Submitted by:

AMEC Earth & Environmental, Inc.
Tempe, Arizona

July 16, 2008
AMEC Job No. 7-117-001080



Map Document (X:\Projects\7-117-001080\MXD\Rev_6_4_08\Figure_1.mxd) 7/15/2008 -- 10:55:06 AM

0 500 1,000 2,000 Feet

The map shown here has been created with all due and reasonable care and is strictly for use with AMEC Project Number: 7-117-001080. This map has not been certified by a licensed land surveyor, and any third party use of this map comes without warranties of any kind. AMEC assumes no liability, direct or indirect, whatsoever for any such third party or unintended use.

JOB NO.:	7-117-001080
DESIGN:	KCF
DRAWN:	PWB
DATE:	06/04/08
SCALE:	1" = 800'

INITIAL GEOTECHNICAL HAZARD ASSESSMENT AND
GEOTECHNICAL CHARACTERIZATION REPORT
SIPHON DRAW IMPROVEMENTS PROJECT
MARICOPA AND PINAL COUNTIES, ARIZONA
Contract FCD 2007C012.

Site Plan

FIGURE 1

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PROJECT:	Siphon Draw Retention Basin	**JOB NO:**	7-117-001080ph1
LOCATION:	Arizona	**WORK ORDER NO:**	1
SAMPLE SOURCE:	SEE BELOW	**DATE ASSIGNED:**	6/10/08

MECHANICAL SIEVE ANALYSIS
GROUP SYMBOL, USCS (ASTM D-2487)

				Silt or	SAND								GRAVEL									COBBLES	
				Clay	Fine			Medium			Coarse		Fine				Coarse						
Location & Depth	**USCS**	**LL**	**PI**	**#200**	**#100**	**#50**	**#40**	**#30**	**#16**	**#10**	**#8**	**#4**	**1/4"**	**3/8"**	**1/2"**	**3/4"**	**1"**	**1 1/4"**	**1 1/2"**	**2"**	**3"**	**6"**	**Lab #**

PERCENT PASSING BY WEIGHT

BH-1 @ 4.5-5.5'	SC-SM	25	5	25	35	51	58	64	75	84	87	95	97	98	100	100	100	100	100	100	100	100	2
BH-2 @ 9.5-11.0'	CL	34	11	54	74	83	86	89	93	95	95	98	99	100	100	100	100	100	100	100	100	100	9
BH-3 @ 4.5-6.0'	CL	27	8	59	70	76	79	82	87	91	92	98	99	100	100	100	100	100	100	100	100	100	13
BH-3 @ 9.5-10.5'	SC	78	53	39	51	63	71	79	92	95	96	99	99	99	100	100	100	100	100	100	100	100	15
BH-4 @ 14.5-15.5'	SC	45	24	43	54	62	66	71	80	86	89	95	96	99	100	100	100	100	100	100	100	100	22
BH-5 @ 7.5-8.5'	SC	38	19	43	55	65	72	81	92	96	97	99	99	99	100	100	100	100	100	100	100	100	26
BH-6 @ 4.5-6.0'	CL	36	17	74	82	89	91	93	96	97	98	99	100	100	100	100	100	100	100	100	100	100	31
BH-6 @ 9.5-10.5'	CL	42	23	65	81	89	91	94	97	98	99	100	100	100	100	100	100	100	100	100	100	100	33
BH-7 @ 14.5-15.5'	SP-SC	37	20	6.0	9	13	16	23	46	65	71	89	94	98	100	100	100	100	100	100	100	100	40
BH-8 @ 4.5-6.0'	CL	37	19	83	89	93	95	97	99	100	100	100	100	100	100	100	100	100	100	100	100	100	44

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PROJECT:	Siphon Draw Retention Basin	**JOB NO:**	7-117-001080ph1
LOCATION:	Arizona	**WORK ORDER NO:**	1
SAMPLE SOURCE:	SEE BELOW	**DATE ASSIGNED:**	6/10/08

MECHANICAL SIEVE ANALYSIS
GROUP SYMBOL, USCS (ASTM D-2487)

				Silt or	SAND								GRAVEL									COBBLES	
				Clay	Fine			Medium			Coarse		Fine				Coarse						
Location & Depth	**USCS**	**LL**	**PI**	**#200**	**#100**	**#50**	**#40**	**#30**	**#16**	**#10**	**#8**	**#4**	**1/4"**	**3/8"**	**1/2"**	**3/4"**	**1"**	**1 1/4"**	**1 1/2"**	**2"**	**3"**	**6"**	**Lab #**

PERCENT PASSING BY WEIGHT

BH-9 @ 19.5-20.5'	SC	49	25	49	63	71	75	79	87	93	94	98	100	100	100	100	100	100	100	100	100	100	55
BH-10 @ 7.5-8.5'	SC	50	31	33	47	63	70	76	86	92	94	99	100	100	100	100	100	100	100	100	100	100	58
BH-10 @ 14.5-16.0'	SC	65	41	43	57	66	71	76	84	91	93	98	100	100	100	100	100	100	100	100	100	100	60
BH-11 @ 9.5-10.5'	CL	44	24	97	99	99	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	64
BH-12 @ 2.5-4.0'	SM	22	3	29	36	43	48	54	65	75	78	91	95	98	100	100	100	100	100	100	100	100	67
BH-12 @ 14.5-15.5'	SP-SC	25	4	7.6	10	14	19	26	46	65	71	89	92	97	98	100	100	100	100	100	100	100	70
BH-13 @ 19.5-20.5'	SC	38	18	32	45	55	59	62	68	75	78	88	92	97	98	100	100	100	100	100	100	100	77
BH-14 @ 19.5-20.5'	SC	42	18	13	19	26	32	40	55	67	72	84	87	91	92	93	93	100	100	100	100	100	83
BH-15 @ 4.5-6.0'	CL	46	26	93	95	97	98	99	100	100	100	100	100	100	100	100	100	100	100	100	100	100	85
BH-16 @ 9.5-11.0'	CL	31	12	72	79	84	86	89	92	95	95	98	98	98	99	100	100	100	100	100	100	100	95

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PROJECT:	Siphon Draw Retention Basin	**JOB NO:**	7-117-001080ph1
LOCATION:	Arizona	**WORK ORDER NO:**	1
SAMPLE SOURCE:	SEE BELOW	**DATE ASSIGNED:**	6/10/08

MECHANICAL SIEVE ANALYSIS
GROUP SYMBOL, USCS (ASTM D-2487)

				Silt or	SAND								GRAVEL									COBBLES	
				Clay	Fine			Medium			Coarse		Fine				Coarse						
Location & Depth	**USCS**	**LL**	**PI**	**#200**	**#100**	**#50**	**#40**	**#30**	**#16**	**#10**	**#8**	**#4**	**1/4"**	**3/8"**	**1/2"**	**3/4"**	**1"**	**1 1/4"**	**1 1/2"**	**2"**	**3"**	**6"**	**Lab #**

PERCENT PASSING BY WEIGHT

BH-17 @ 4.5-5.5'	CL	45	26	76	86	93	95	97	99	100	100	100	100	100	100	100	100	100	100	100	100	100	100
BH-18 @ 7.5-8.5'	SC	53	33	36	44	50	54	59	70	78	81	94	97	99	100	100	100	100	100	100	100	100	107
BH-19 @ 19.5-20.5'	SC	34	15	17	23	31	36	43	55	63	65	75	79	85	88	95	100	100	100	100	100	100	115
BH-20 @ 4.5-5.5'	CL	46	26	69	82	91	94	95	97	98	99	100	100	100	100	100	100	100	100	100	100	100	117
BH-21 @ 19.5-21.0'	SP-SM	31	8	9.5	13	18	22	29	43	55	61	82	89	94	96	96	100	100	100	100	100	100	126
BH-22 @ 0.0-4.5'	CL	31	13	54	66	74	78	82	88	93	95	99	100	100	100	100	100	100	100	100	100	100	128
BH-22 @ 9.5-11.0'	SC	32	13	31	39	43	46	51	61	69	72	85	89	95	98	100	100	100	100	100	100	100	132
BH-23 @ 0.0-4.5'	SC	29	10	41	52	60	64	69	77	84	86	92	95	97	98	99	99	99	99	100	100	100	135
BH-24 @ 0.0-4.5'	SC	28	9	36	45	51	55	59	67	73	75	81	82	84	85	88	92	93	95	100	100	100	140
BH-24 @ 9.5-11.0'	CL	40	23	62	74	82	85	89	93	96	97	99	100	100	100	100	100	100	100	100	100	100	143
BH-25 @ 9.5-11.0'	CL	39	21	68	81	88	91	93	97	98	98	99	100	100	100	100	100	100	100	100	100	100	148

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i	initial
l	liquid
max	maximum
min	minimum
n	normal
p	plastic
R	radial
s	shrinkage, sleeve, or solids
sat	saturated
t	total
u	undrained
uc	unconfined compression
v	void (gas and water)
w	water
z	zero air voids

1. SOIL PARTICLE SIZE DISTRIBUTION

Soil is an aggregate of loose mineral and organic particles. *Rock*, on the other hand, exhibits strong and permanent cohesive forces between the mineral particles. From an engineering perspective, the distinction between soil and rock relates to the workability of materials. For example, one practical definition is that soil can be excavated with a backhoe while rock needs to be blasted. The distinction between soil and rock can also be made based on strength, density, and other quantifiable parameters. A geologist or soil scientist might be more interested in how a material has been formed than its workability, and thus might distinguish between soil and rock differently.

The primary mineral components of any soil are gravel, sand, silt, and clay. Organic material can also be present in surface samples. Gravel and sand are classified as coarse-grained soils, while inorganic silt and clay are classified as fine-grained soils. Particle size limits for defining gravel, sand, silt, and clay used in different classification schemes are given in Table 35.1.

The particle size distribution for a coarse soil is found from a sieve test. In a *sieve test*, the soil is passed through a set of sieves of consecutively smaller openings. The particle size distribution for the finer particles of a soil is determined from a *hydrometer test*. This test is based on Stokes' Law, which relates the speed of a particle falling out of suspension to its diameter and solid density. The results of both the sieve and hydrometer tests are graphed as a *particle size distribution*.

Table 35.2 *Sieve Sizes*

sieve size	opening size (mm)
4 in	100
3 in	75
2 in	50
$1\frac{1}{2}$ in	37.5
1 in	25
$\frac{3}{4}$ in	19
$\frac{1}{2}$ in	12.5
$\frac{3}{8}$ in	9.5
no. 4	4.75
no. 8	2.36
no. 10	2.00
no. 16	1.18
no. 20	0.850
no. 30	0.600
no. 40	0.425
no. 50	0.300
no. 60	0.250
no. 70	0.212
no. 100	0.150
no. 140	0.106
no. 200	0.075

specified in ASTM E-11, Table 1

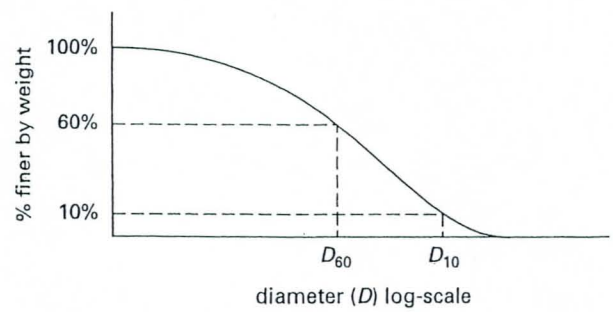

Figure 35.1 *Typical Particle Size Distribution*

Table 35.1 *Classification of Soil Particle Sizes*

		sizes (mm)			
system	date	gravel	sand	silt	clay
Bureau of Soils	1890	1–100	0.05–1	0.005–0.05	< 0.005
Atterberg	1905	2–100	0.2–2	0.002–0.2	< 0.002
MIT	1931	2–100	0.06–2	0.002–0.06	< 0.002
USDA	1938	2–100	0.05–2	0.002–0.05	< 0.002
Unified (or USCS)	1953	4.75–75	0.075–4.75	< 0.075	
ASTM	1967	4.75–75	0.075–4.75	< 0.075	
AASHTO	1970	2–75	0.075–2	0.002–0.075	0.001–0.002

Appendix A

Sediment Yield

The sediment yield consists of two parts and is defined as the sum of the wash load and the total bed material load delivered to a point of interest. The *wash load* is calculated with the MUSLE method, and the *total bed material load* is calculated with the Zeller-Fullerton equation (Zeller and Fullerton, 1983), which is based on the assumption that the reach is at an equilibrium condition. The sediment yield for a particular frequency (return period) = SDR*Wash+BedL where SDR is the sediment delivery ratio; Wash and BedL are, respectively, the wash load and total bed material load based on the MUSLE and the Zeller-Fullerton equation for a flood of a particular return period.

If the annual sediment yield is desired, it can be computed as SDR*Wash_P+BedL_P where SDR is the sediment delivery ratio, Wash_P is a probability-weighted average value for MUSLE over floods of different return periods, and BedL_P is a probability-weighted average value for the Zeller-Fullerton equation over floods of different return periods. The probability-weighted value over different return period floods can be computed as follows (Mussetter et. al., 1994):

$$Wash\_P = 0.015Wash\_P_{100} + 0.015Wash\_P_{50} + 0.04Wash\_P_{25} + 0.08Wash\_P_{10} + 0.2Wash\_P_5 + 0.4Wash\_P_2 \quad \text{(A1)}$$

$$BedL\_P = 0.015BedL\_P_{100} + 0.015BedL\_P_{50} + 0.04BedL\_P_{25} + 0.08BedL\_P_{10} + 0.2BedL\_P_5 + 0.4BedL\_P_2 \quad \text{(A2)}$$

where
Wash_P = annual eroded sediment which is considered wash load;
Wash_P_i = eroded sediment for i = 100-, 50-, 25-, 10-, 5-, and 2-year return periods (from MUSLE);
BedL_P = annual total bed material load; and
BedL_P_i = total bed material load for i = 100-, 50-, 25-, 10-, 5-, and 2-year return periods;

Sediment Delivery Ratio (SDR) for Wash Load

The USDA has published a handbook in which the SDR is related to drainage area (USDA, 1972). The SDR can be affected by a number of factors including sediment source, texture, nearness to the main stream, channel density, drainage area, slope, length, land use/land cover, and rainfall-runoff factors. The relationship established for sediment delivery ratio and drainage area is known as the SDR curve (red line in Figure 1). The dashed line is from USDA (1972) and can be used for general planning purposes or rough

estimation when no field data is available for the area of interest. The solid line is the FCDMC-recommended curve that considers sediment data in arid regions (Lane *et al.*, 1999). *The solid line may be used for studies in Maricopa County.* However, engineering judgment should be exercised. Table 1 shows the numerical values that were used to plot Figure 1, and Equation A3 is the regression equation used in the software to approximate the curve. The equation has the form

$$\mathrm{SDR} = -14.08(\log_{10} A_D) + 2.44(\log_{10} A_D)^2 - 0.45(\log_{10} A_D)^3 + 60.85 \qquad \text{(A3)}$$

where SDR is the sediment delivery ratio (percent), and A_D is the drainage area (square miles). The regression equation should only be used for drainage areas larger than 0.04 square miles and smaller than 500 square miles.

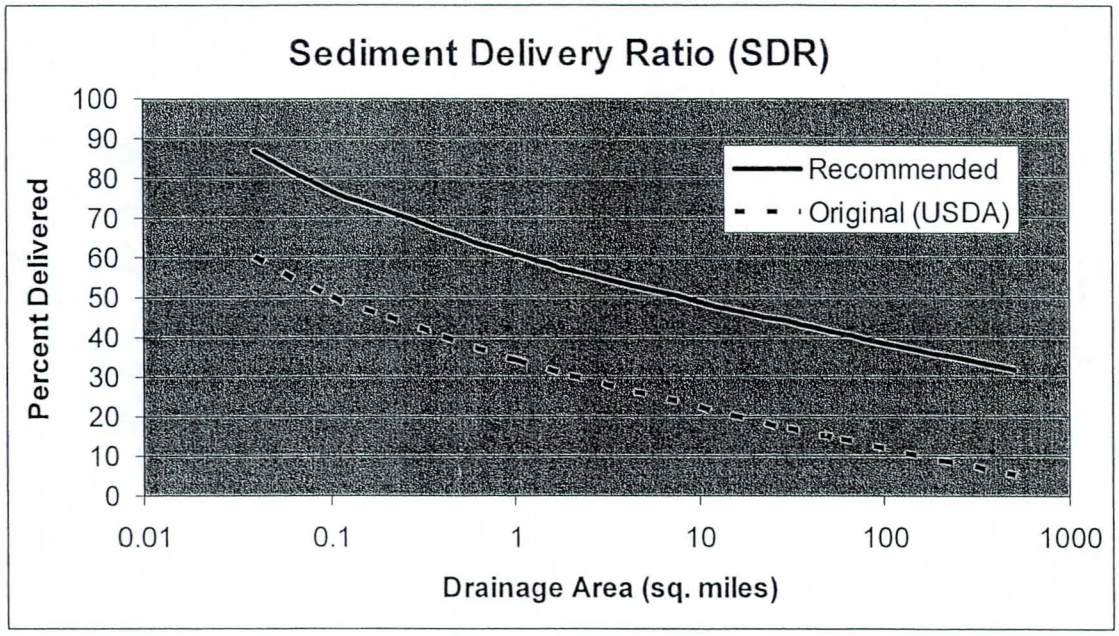

Figure 1: Relationship between drainage area and sediment delivery ratio

Drainage Area (square miles)	Original (USDA) (percent)	Recommended (percent)
0.04	60	87
0.1	50	77
0.2	45	72
0.4	40	67
1	34	61
2	30	57
15	20	47
30	17	44
57.53	14	41
200	8.5	35.5
500	5	32

Table 1: Tabular data for Figure 1

Total Bed Material Load

Since the reach is assumed to be in an equilibrium condition, the Zeller-Fullerton (Zeller and Fullerton, 1983) total bed material load equation can be used to estimate the total bed load. It has the form

$$q_s = 0.0064\left(\frac{n^{1.77}V_a^{4.32}G^{0.45}}{Y_h^{0.3}D_{50}^{0.61}}\right) \qquad \text{(A4)}$$

where
q_s = bed-material discharge in cfs per unit width (width can be defined as wetted cross-section area divided by flow depth where flow depth can be the Manning's equation-based normal depth or maximum flow depth from HEC-RAS);
n = Manning's roughness coefficient;
V_a = average velocity, (ft/s);
Y_h = hydraulic depth, (ft);
D_{50} = median diameter, also defined as the diameter where 50% is finer by weight (mm);
G = gradation coefficient, where

$$G = \frac{1}{2}\left(\frac{D_{84.1}}{D_{50}} + \frac{D_{50}}{D_{15.9}}\right) \qquad \text{(A5)}$$

and $D_{84.1}$, D_{50} and $D_{15.9}$ are sediment diameters based on a percent finer (by dry weight), (mm).

From the Zeller-Fullerton equation, the total bed material load is given as the peak bed load discharge of the storm in cfs per unit width (cfs/ft). This bed load discharge has to be converted to tons before it can be added to wash load (given in tons).

First, the bed load estimate must be multiplied by the width (width can be defined as wetted cross-section area divided by hydraulic depth) to obtain the result in cubic feet per second. Then, to obtain the total bed load volume for the total storm duration, the assumption that the sediment discharge hydrograph follows the same shape of the water flow hydrograph must be made. This assumption has the form

$$\frac{Q_S}{V_S} = \frac{Q}{V_W} \qquad \text{(A6)}$$

where
Q_S = the sediment discharge hydrograph ordinates, (cfs);
V_S = total volume of sediment under the sediment discharge hydrograph, (ft^3);
Q = the water flow discharge hydrograph ordinates, (cfs);
V_W = total volume of water under the water flow hydrograph, (ft^3).

Therefore,

$$V_S = V_W \left(\frac{Q_S}{Q} \right) \quad \text{(A7)}$$

which is the total bed load volume for the total storm duration.
With Equation A7, the sediment volume, V_S, can be found by using Q_S, peak Q, and V_W for the specified return periods (2-yr, 10-yr, etc.). Peak Q_S is equal to q_s multiplied by the width. Then, the annual bed material load (given in cubic feet) can be found by using Equation A2, which is the probability weighting equation.

Finally, to convert from cubic feet to tons, the specific weight of the bed load must be found. The specific weight can be determined with the equation (Vanoni, 2006)

$$W = 125 - 7D_{50}^{0.21} \quad \text{(A8)}$$

where
W = specific weight (lbs/ft^3);
D_{50} = median sediment size, also defined as the diameter where 50% is finer by weight (ft).

The specific weight, W, is then used to convert total bed load (for specified return period) in cubic feet to tons with the equation

$$\text{BedL\_P}_i \text{ (tons)} = W * \text{BedL\_P (ft}^3\text{) / 2000} \quad \text{(A9)}$$

where
i = 100-, 50-, 25-, 10-, 5-, and 2-year return periods.

Wash Load by Modified Universal Soil Loss Equation (MUSLE)

The MUSLE relationship is given by (SLA, 1985) to compute watershed soil loss in tons:

$$Y_s = \alpha (Vq_p)^{\beta} KLSCP \quad \text{(A10)}$$

where

Y_s = watershed soil loss from the storm of a particular return period in tons;
$\alpha = 95$;
$\beta = 0.56$;
K = the soil erodibility factor. Arcview shape file for NRCS soil and default tabulated values for K may be obtained from FCDMC; they can also be estimated from Figure 2; the FCDMC has developed preliminary values for K values for all soil types in Maricopa County based on the National Resource Conservation Service (NRCS; more discussions can be found in the following section;
C = the cover and management factor. Arcview shape files for land use from MAG may be used in conjunction with a land use table to automatically compute the C factor; the FCDMC has developed preliminary values for C values for all landuse types in Maricopa

County based on the Maricopa Association of Governments' (MAG) landuse and engineering judgment; more discussions can be found in the following section;

P = the erosion control practice factor (usually 1.0 for wildland areas). P values for erosion control methods in an agricultural field can be obtained from Wischmeier and Smith (1978);
V = runoff volume for the storm, (acre-feet);
q_p = peak flow rate for a storm event of a particular return period, (cfs);
LS = the topographic factor, defined as

$$LS = \left(\frac{\lambda}{72.6}\right)^n (0.065 + 0.0454S + 0.0065S^2) \qquad \text{(A11)}$$

where λ is slope length (in feet), S is the percent slope and n is an exponent depending upon slope. Slope length, λ is defined as the distance from the point of origin of overland flow to the point where either the slope gradient decreases enough such that deposition begins, or the runoff water enters a well-defined channel that may be part of a drainage network or a constructed channel. Percent slope, S, is the slope for the slope length. It is in percent, for example, 10 for 10%. It may be approximated by the average watershed slope (SLA, 1985). The MUSLE equation is best used for slope lengths of less than 400 ft and gradients of 3 to 8 percent.

The exponent n is given by
$n = 0.3$ for $S < 3$ percent;
$n = 0.4$ for $S = 4$ percent;
$n = 0.5$ for $S > 5$ percent.

The cover and management factor, C, can be divided into three distinct types of effects as follows: Type I - effects of canopy cover (C_I) as shown in Figure 3; Type II - effects of mulch or close-growing vegetation in direct contact with the soil surface (C_{II}) as shown in Figure 4; Type III – tillage and residual effects of the land use (C_{III}) as shown in Figure 5 (SLA, 1985). The cover and management factor, C, is defined as the product of these factors, and has the form

$$C = C_I C_{II} C_{III} \ . \qquad \text{(A12)}$$

The Flood Control District of Maricopa County has developed a table, from which the consultant may calculates the cover and management factor, C.

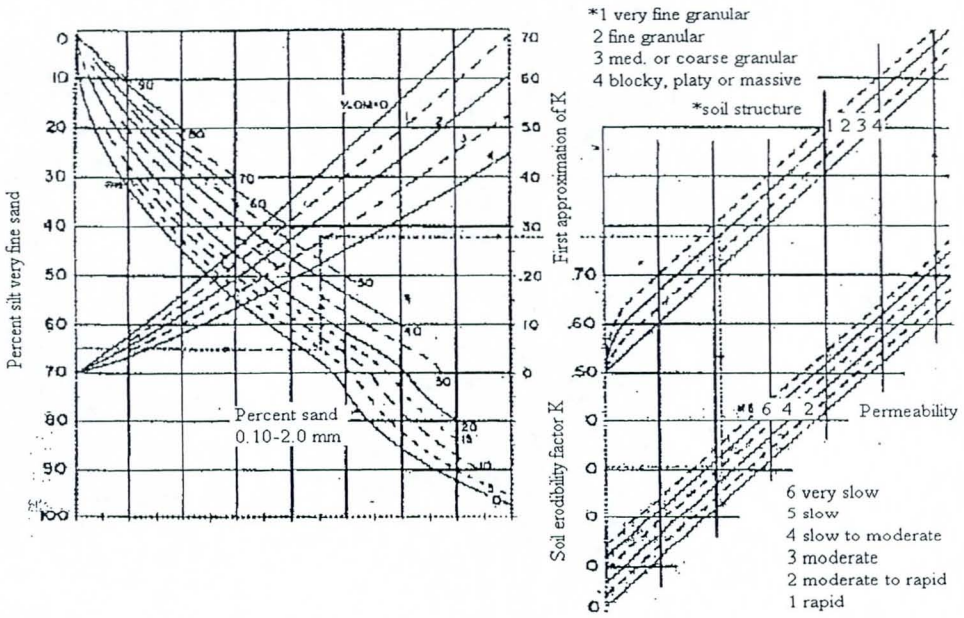

Figure 2: Soil erodibility nomograph used to determine factor K for specific topsoils or subsoil horizons. Solutions are in tons/acre (Wischmeier and Smith 1978)

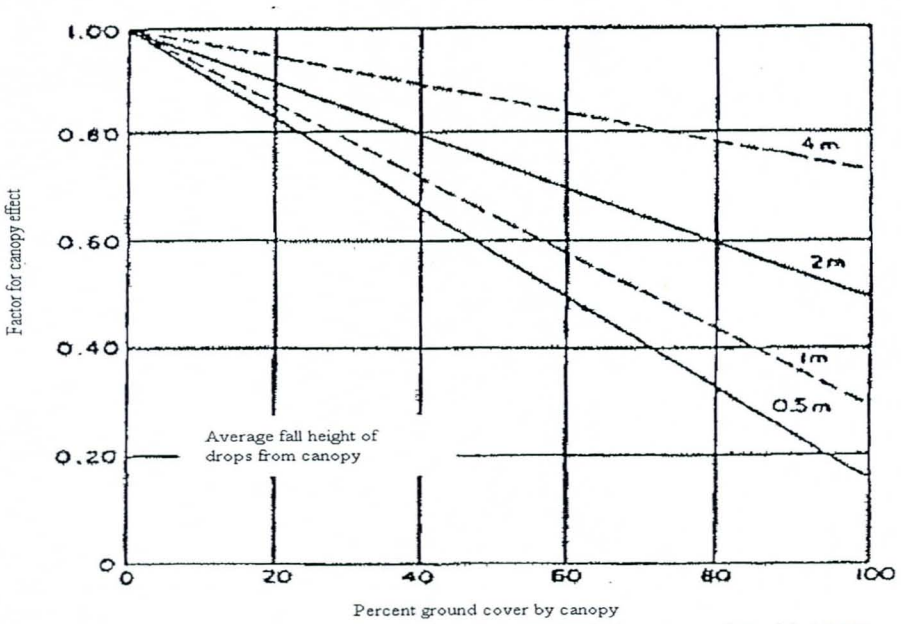

Figure 3: Influence of vegetal canopy on effective rainfall, C_l (Wischmeier and Smith 1978)

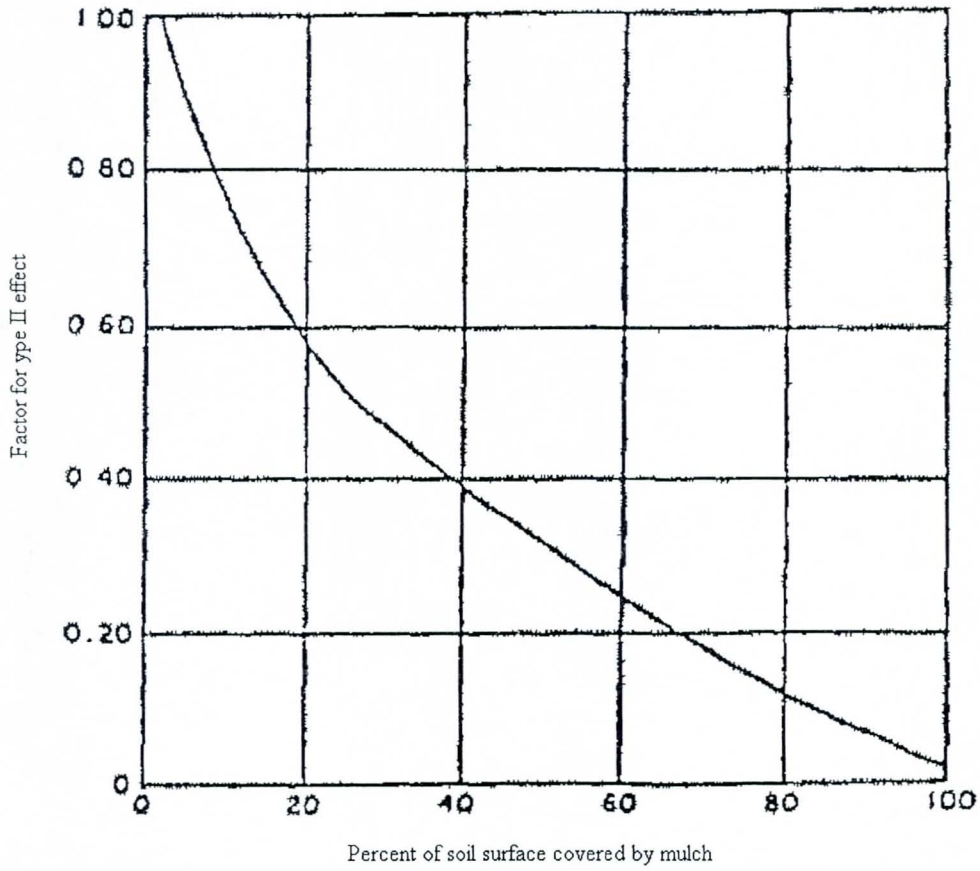

Figure 4: Effect of plant residues or close-growing stems at the soil surface, C_{II} (ADWR 1985)

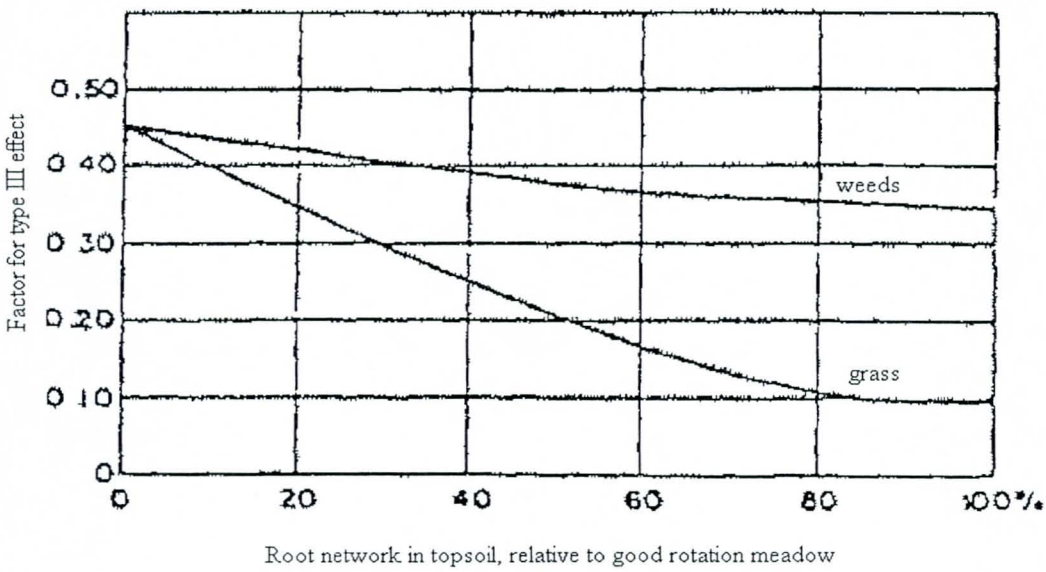

Figure 5: Type III effects on undisturbed land areas, C_{III} (ADWR 1985)

DAVE PEGERNEGS

SEDIMENT AND EROSION DESIGN GUIDE

Prepared for

Albuquerque Metropolitan Arroyo
Flood Control Authority
(AMAFCA)

Prepared by

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RCE Ref. No. 90-560

November, 1994

RCE RESOURCE CONSULTANTS & ENGINEERS, INC.
A Division of Ayres Associates

$$Y_{sm} = 0.055\ Y_{s_{100}} + 0.245\ Y_{s_{10}} + 0.45\ Y_{s_2} \quad ($$

Evaluation of the cumulative erosion or sedimentation occurring during a g event can be accomplished by discretizing the associated hydrograph, computing sediment yield associated with each discrete interval, and summing over the hydrogr The discretization process provides a series of constant discharges acting over short intervals, as illustrated in **Figure 4.7**. The discharge levels are selected so that the volume of the discretized hydrograph is approximately the same as the orig hydrograph. AMAFCA's AHYMO computer program (Anderson, 1994) may be use obtain sediment yield for a given event. The SEDIMENT TRANS function in AHYMO been developed to use Equation 3.39 with a computed hydrograph to obtain sedim yield.

When this process is completed for the range of return period events, Equation can be combined with the results of sediment transport analysis to estimate an ann sediment yield. A sediment continuity analysis is performed using the annual yields estimate the annual sedimentation or erosion rate. This value is then extrapolated provide a long-term estimate of sedimentation or erosion. For an urban area a 30-ye period has been recommended as a reasonable limit on this extrapolation.

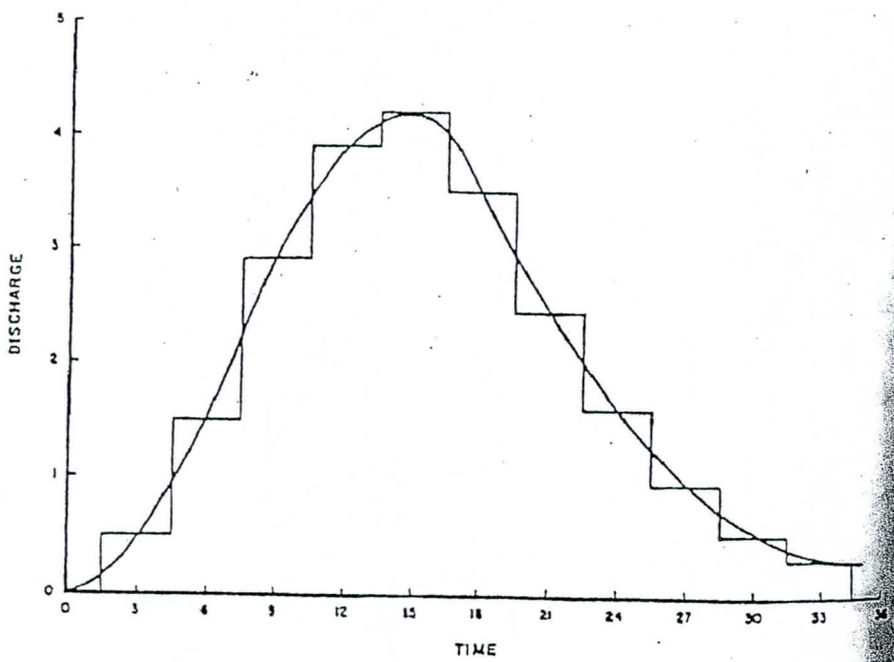


Figure 4.7. Definition sketch of hydrograph discretization process.

For reasons of practicality and to facilitate reproducibility, a single ratio for the 2-, 5- and 10-year recurrence intervals is provided that represents average conditions in Maricopa County. These values are listed in Table 6.1 and can be used for both local and general storms for drainage areas of any size, degree of development or other hydrologic and physiographic conditions.

Table 6.1
RATIOS TO 100-YEAR FLOOD HYDROGRAPHS
FOR THE 2-, 5- AND 10-YEAR RECURRENCE INTERVAL FLOODS

Recurrence Interval	Ratio %
2	10
5	25
10	35

This approach should be used when the results for the 2-, 5- and 10-year flood (peaks and volumes) using the methods, techniques and parameters in the preceding chapters are unreasonable. The reasonableness "test" applies to model results (peak discharges and runoff volumes) as well as to the HEC-1 input parameters, particularly for the unit hydrograph. This alternative method using the ratios from Table 6.1 does not preclude the use of another method or the use of different (site specific) ratios with prior approval from the Flood Control District, or local jurisdiction.

6.3 IMPLEMENTATION IN HEC-1

The ratio for the desired recurrence interval is coded into the 100-year HEC-1 model on field 3 of the subbasin area (BA) record for each subbasin. Alternatively, for a single storm analysis the ratio(s) can be coded into the 100-year HEC-1 model on the multiratio (JR) record. In addition to coding the ratio(s) on this record, the IRTIO variable in field 1 must be set to FLOW to ratio the runoff not the precipitation. The JR record cannot be used for a multiple storm analysis due to a conflict with the JD record used to define the index areas.

SIPHON DRAW DETENTION BASIN

Miscellaneous

Culvert Designer/Analyzer Report
Siphon Draw Basin Pipe Berm Outlet

Overtopping Analysis				
Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	6-24 inch Circular	126.95 cfs	1,495.55 ft	7.64 ft/s
Weir	Roadway (Constant Elevation)	0.00 cfs	1,495.55 ft	N/A
Total	----------	126.95 cfs	1,495.55 ft	N/A

Culvert Designer/Analyzer Report
Siphon Draw Basin Pipe Berm Outlet

Component:Culvert-1

Culvert Summary					
Computed Headwater Elev	1,495.55	ft	Discharge	126.95	cfs
Inlet Control HW Elev.	1,495.37	ft	Tailwater Elevation	1,492.50	ft
Outlet Control HW Elev.	1,495.55	ft	Control Type	Outlet Control	
Headwater Depth/Height	1.50				

Grades					
Upstream Invert	1,492.55	ft	Downstream Invert	1,492.50	ft
Length	50.00	ft	Constructed Slope	0.001000	ft/ft

Hydraulic Profile					
Profile	CompositeM2PressureProfile		Depth, Downstream	1.65	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	1.65	ft
Velocity Downstream	7.64	ft/s	Critical Slope	0.007390	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.012	
Section Material	Concrete		Span	2.00	ft
Section Size	24 inch		Rise	2.00	ft
Number Sections	6				

Outlet Control Properties					
Outlet Control HW Elev.	1,495.55	ft	Upstream Velocity Head	0.70	ft
Ke	0.20		Entrance Loss	0.14	ft

Inlet Control Properties					
Inlet Control HW Elev.	1,495.37	ft	Flow Control	Submerged	
Inlet Type	Groove end projecting		Area Full	18.8	ft^2
K	0.00450		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	3	
C	0.03170		Equation Form	1	
Y	0.69000				

Culvert Designer/Analyzer Report
Siphon Draw Basin Pipe Berm Outlet

Component:Weir

Hydraulic Component(s): Roadway (Constant Elevation)					
Discharge	0.00	cfs	Allowable HW Elevation	1,495.55	ft
Roadway Width	50.00	ft	Overtopping Coefficient	2.50	US
Length	20.00	ft	Crest Elevation	1,495.55	ft
Headwater Elevation	N/A	ft	Discharge Coefficient (Cr)	2.50	
Submergence Factor (Kt)	1.00				

Sta (ft)	Elev. (ft)
0.00	1,495.55
20.00	1,495.55

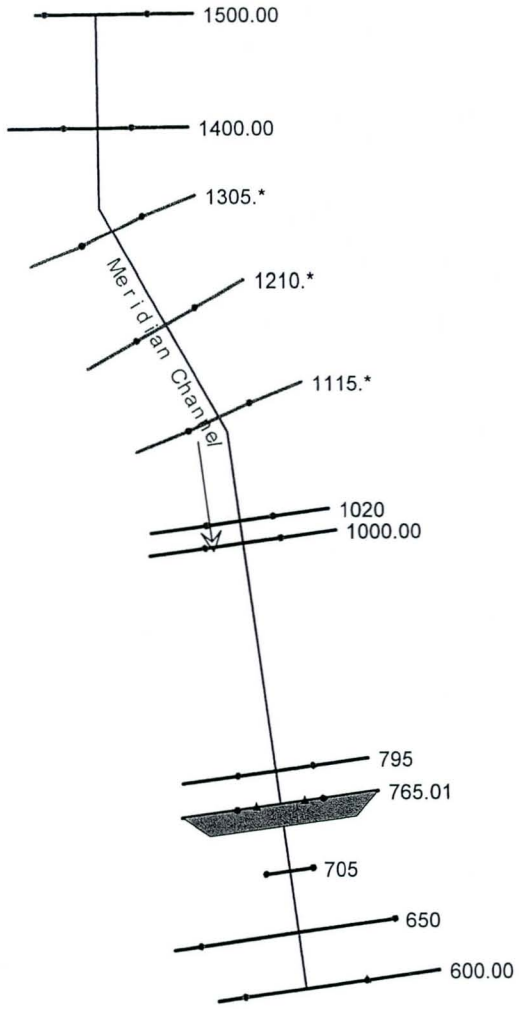
APPENDIX C

MERIDIAN CHANNEL PHASE 1

MERIDIAN CHANNEL – PHASE I

HEC-RAS Output

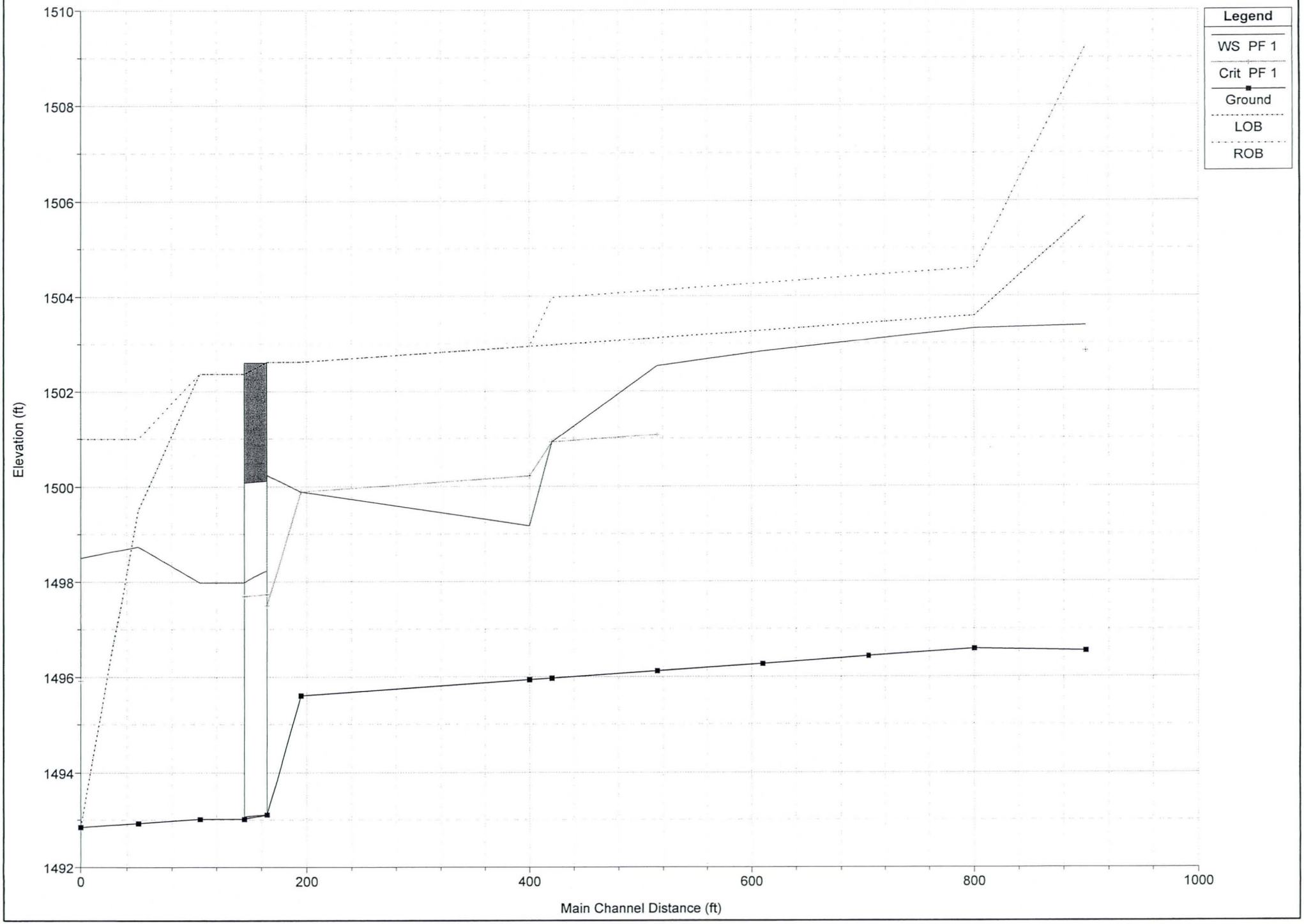
Phase 1



None of the XS's are Geo-Referenced (- Geo-Ref user entered XS Geo-Ref interpolated XS - Non Geo-Ref user entered XS - Non Geo-Ref interpolated XS)

Meridian Channel Phase 1 Plan: Meridian Channel Phase 1 12/8/2008

Flow: Pri , Q100



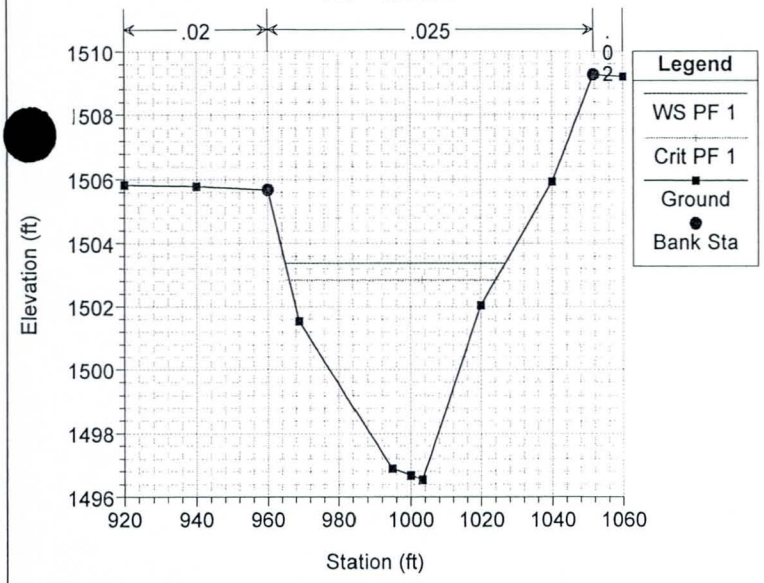
HEC-RAS Plan: Phase 1 River: Meridian Channel Reach: Phase 1 Profile: PF 1

Reach	River Sta	Q Total	Min Ch El	W.S. Elev	LOB Elev	ROB Elev	Max Chl Dpth	Vel Chnl	Froude # Chl	L. Freeboard	R. Freeboard
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft/s)		(ft)	(ft)
Phase 1	1500.00	2250.00	1496.54	1503.38	1505.68	1509.25	6.84	9.35	0.84	2.30	5.87
Phase 1	1400.00	2250.00	1496.58	1503.31	1503.58	1504.58	6.73	7.69	0.60	0.27	1.27
Phase 1	1305.*	2250.00	1496.43	1503.08	1503.43	1504.43	6.65	7.82	0.61	0.35	1.35
Phase 1	1210.*	2250.00	1496.27	1502.83	1503.27	1504.27	6.56	7.95	0.62	0.44	1.44
[illegible]	1115.*	2250.00	1496.12	1502.53	1503.12	1504.12	6.41	8.19	0.65	0.59	1.59
[illegible]	1020	2250.00	1495.97	1500.93	1502.97	1503.97	4.96	11.37	1.01	2.04	3.04
Phase 1	1000.00	2250.00	1495.94	1499.17	1502.94	1502.94	3.23	14.99	1.57	3.77	3.77
Phase 1	795	2250.00	1495.61	1499.89	1502.62	1502.62	4.28	10.83	1.00	2.73	2.73
Phase 1	765.01	2250.00	1493.11	1500.24	1502.62	1502.62	7.13	7.23	0.48	2.38	2.38
Phase 1	755	Culvert									
Phase 1	705	2250.00	1493.02	1497.98	1502.37	1502.37	4.96	10.62	0.84	4.39	4.39
Phase 1	650	2250.00	1492.93	1498.74	1499.50	1501.00	5.81	3.11	0.26	0.76	2.26
Phase 1	600.00	2250.00	1492.85	1498.50	1492.85	1501.00	5.65	4.73	0.38	-5.65	2.50

Meridian Channel Phase 1 Plan: Meridian Channel Phase 1 12/8/2008

Flow: Phase 1, Q100

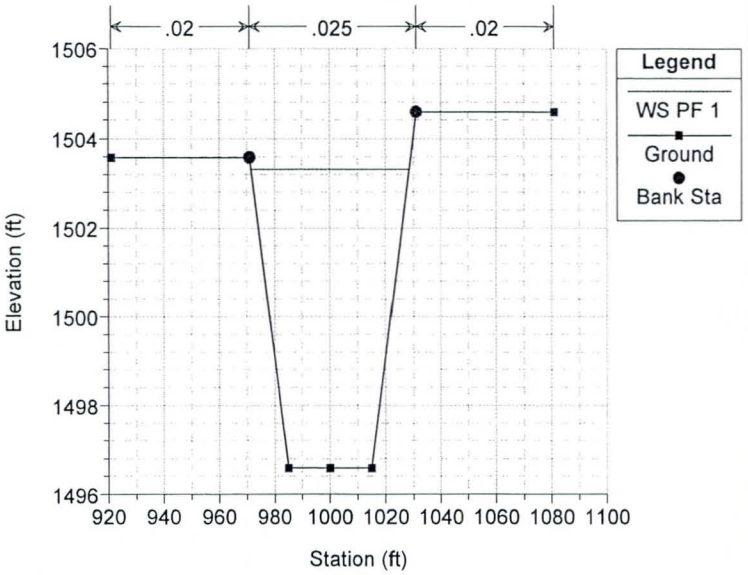
RS = 1500.00



Meridian Channel Phase 1 Plan: Meridian Channel Phase 1 12/8/2008

Flow: Phase 1, Q100

RS = 1400.00



Meridian Channel Phase 1 Plan: Meridian Channel Phase 1 12/8/2008

Flow: Phase 1, Q100

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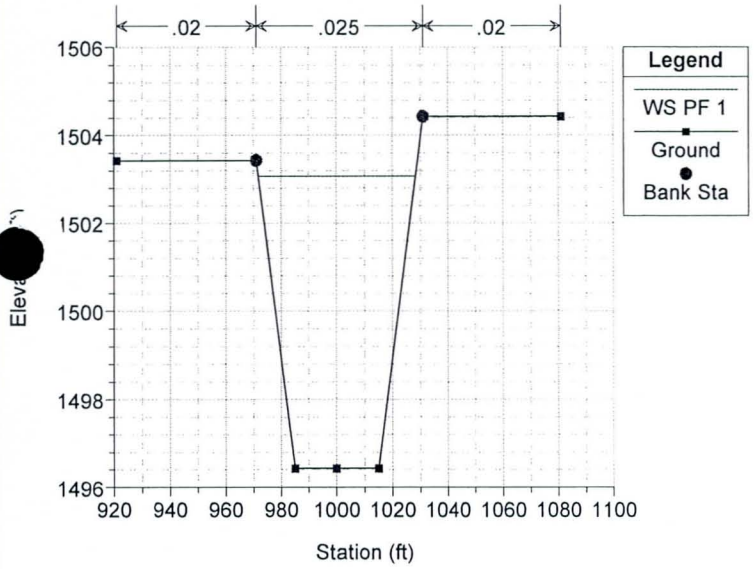

Meridian Channel Phase 1 Plan: Meridian Channel Phase 1 12/8/2008

Flow: Phase 1, Q100

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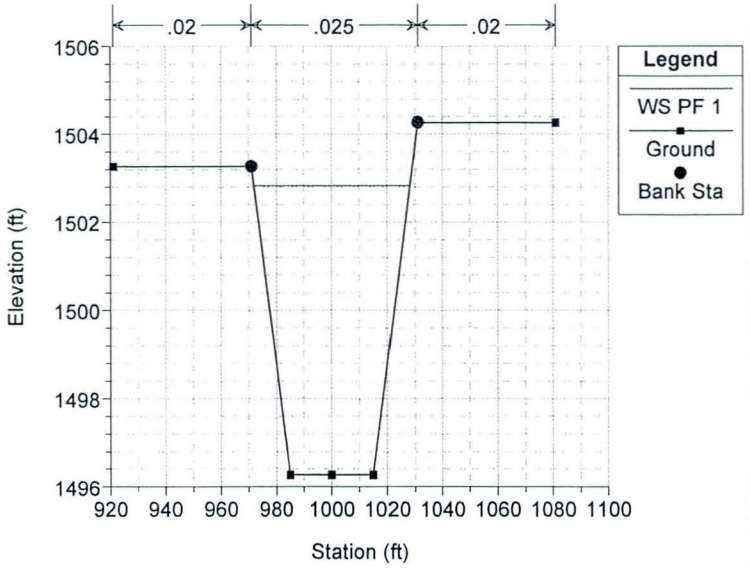
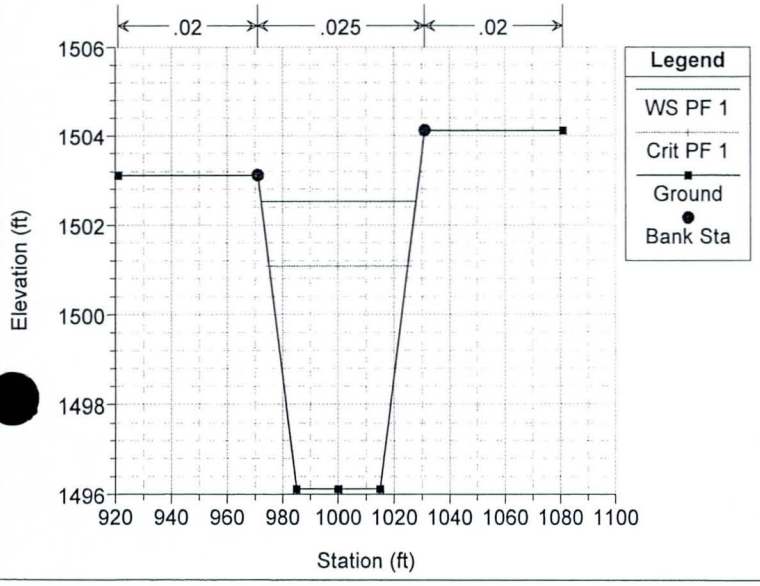


Meridian Channel Phase 1 Plan: Meridian Channel Phase 1 12/8/2008

Flow: Phase 1, Q100

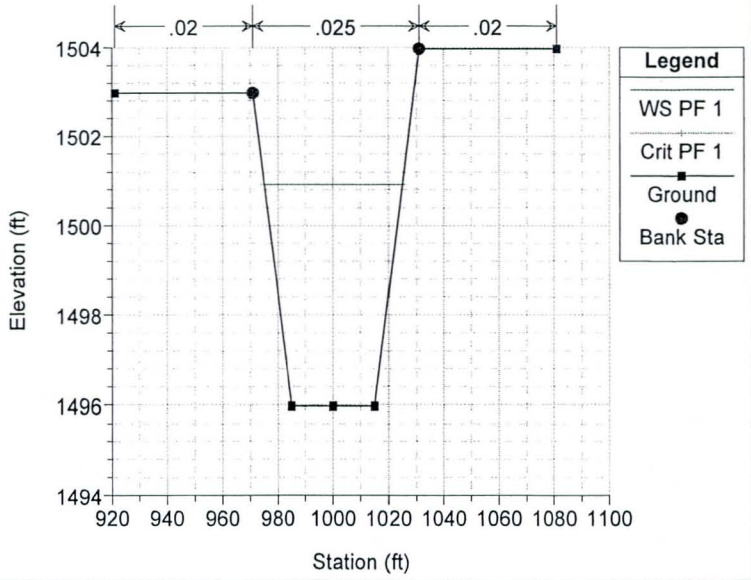
RS = 1115.*



Meridian Channel Phase 1 Plan: Meridian Channel Phase 1 12/8/2008

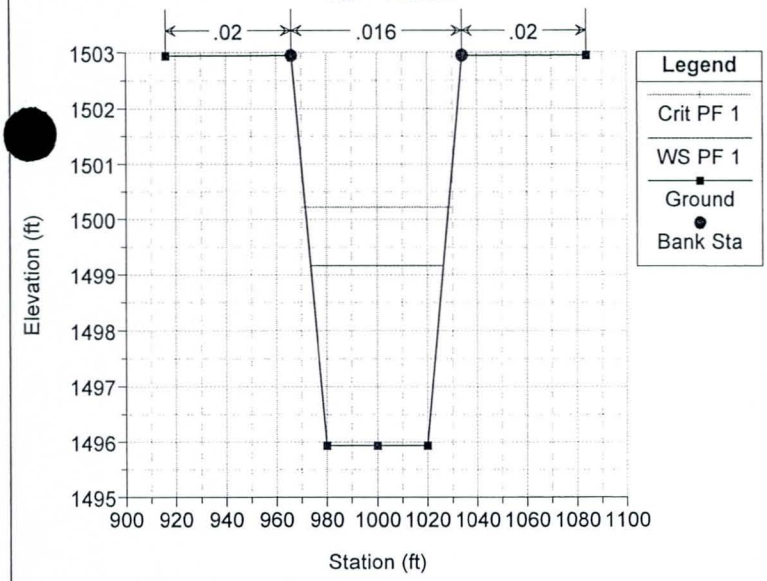
Flow: Phase 1, Q100

RS = 1020



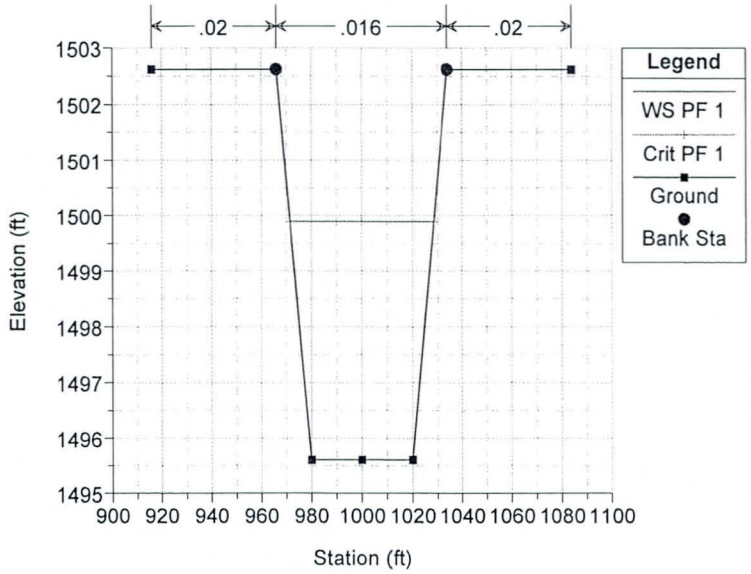
Meridian Channel Phase 1 Plan: Meridian Channel Phase 1 12/8/2008

Flow: Phase 1, Q100
RS = 1000.00



Meridian Channel Phase 1 Plan: Meridian Channel Phase 1 12/8/2008

Flow: Phase 1, Q100
RS = 795



Meridian Channel Phase 1 Plan: Meridian Channel Phase 1 12/8/2008

Flow: Phase 1, Q100
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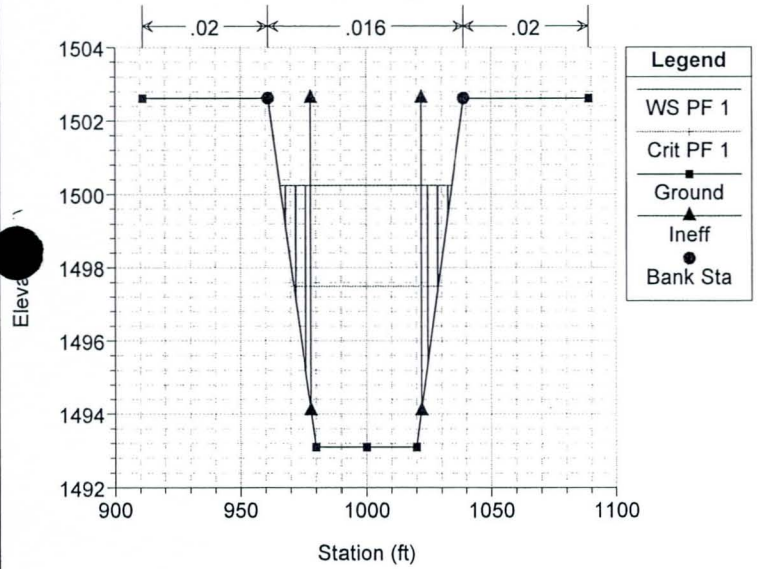
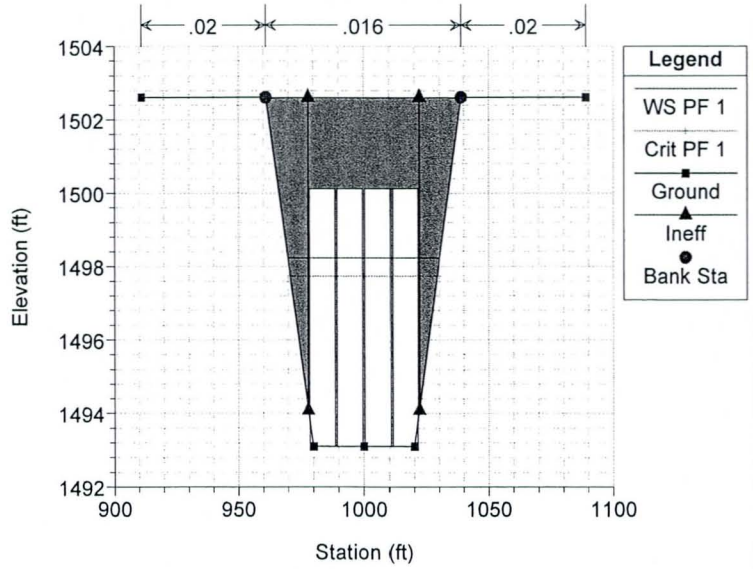


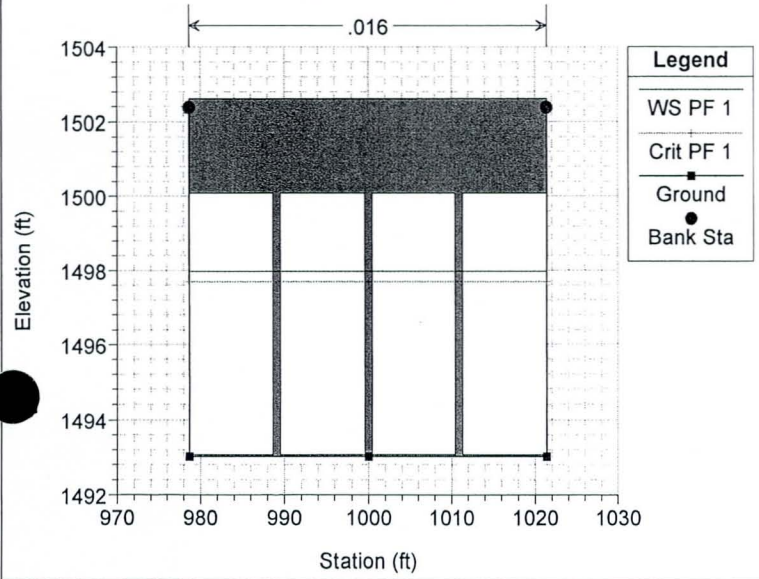
Meridian Channel Phase 1 Plan: Meridian Channel Phase 1 12/8/2008

Flow: Phase 1, Q100
RS = 755 Culv



Meridian Channel Phase 1 Plan: Meridian Channel Phase 1 12/8/2008

Flow: Phase 1, Q100
RS = 755 Culv



Meridian Channel Phase 1 Plan: Meridian Channel Phase 1 12/8/2008

Flow: Phase 1, Q100
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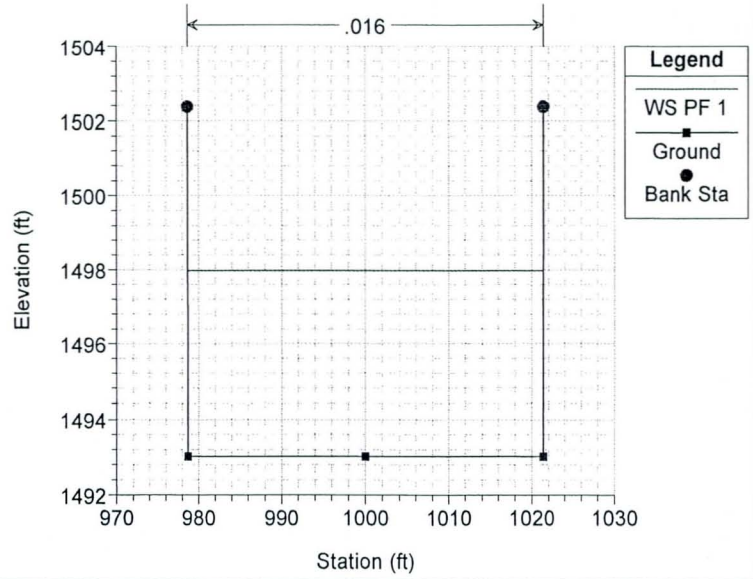
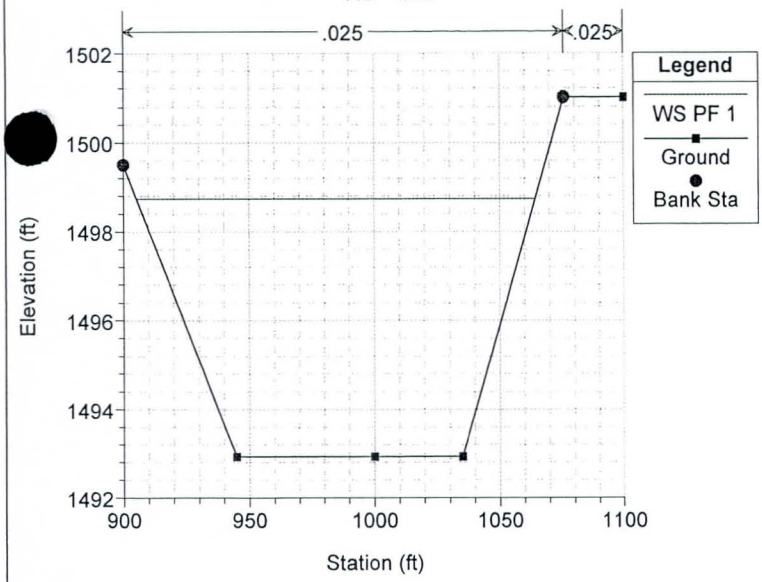
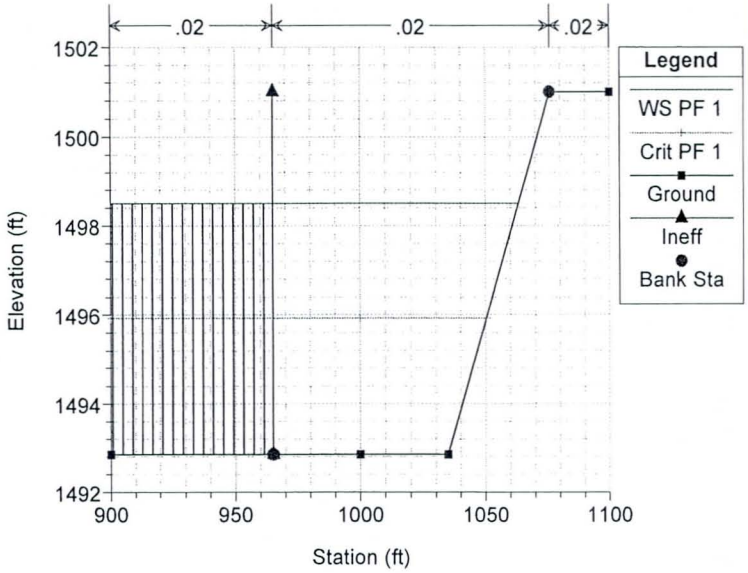


Flow: Phase 1, Q100
RS = 650



Meridian Channel Phase 1 Plan: Meridian Channel Phase 1 12/8/2008

Flow: Phase 1, Q100
RS = 600.00



MERIDIAN CHANNEL – PHASE I

Freeboard

Freeboard Calculations for Meridian Channel Phase 1

Cross Section	Q_{100} (cfs)	Min. Channel Elev. (ft)	Water Surface Elev. (ft)	Bank Station Elevation		Flow Depth (ft)	Channel Velocity (ft/s)	Froude Number	Freeboard						Comment	Resolution
									Required		Provided[1]		Meet FB?			
				Left (ft)	Right (ft)				Calc. (ft)	Min.	Left (ft)	Right (ft)	Left (ft)	Right (ft)		
1500	2250	1496.54	1503.38	1505.68	1509.25	6.84	9.35	0.84	2.0	2.0	2.3	5.9	yes	yes	Riprap channel	OK. Assumed it is not necessary to provide required FB in temporary channel. Riprap is also placed an additional 1' higher on west side.
1400	2250	1496.58	1503.31	1503.58	1504.58	6.73	7.69	0.60	1.9	1.9	0.3	1.3	no	no		
1305.*	2250	1496.43	1503.08	1503.43	1504.43	6.65	7.82	0.61	1.9	1.9	0.4	1.4	no	no		
1210.*	2250	1496.27	1502.83	1503.27	1504.27	6.56	7.95	0.62	1.9	1.9	0.4	1.4	no	no		
1115.*	2250	1496.12	1502.53	1503.12	1504.12	6.41	8.19	0.65	1.9	1.9	0.6	1.6	no	no		
1020	2250	1495.97	1500.93	1502.97	1503.97	4.96	11.37	1.01	1.7	2.0	2.0	3.0	yes	yes		
1000	2250	1495.94	1499.17	1502.94	1502.94	3.23	14.99	1.57	1.7	2.0	3.8	3.8	yes	yes		
795	2250	1495.61	1499.89	1502.62	1502.62	4.28	10.83	1.00	1.5	2.0	2.7	2.7	yes	yes	Top of 2.5' Drop	
765.01	2250	1493.11	1500.24	1502.62	1502.62	7.13	7.23	0.48	2.0	2.0	2.4	2.4	yes	yes	Bottom of 2.5' Drop	
755	Culvert														SRP Culvert	
705	2250	1493.02	1497.98	1502.37	1502.37	4.96	10.62	0.84	1.7	1.7	4.4	4.4	yes	yes	U-Channel	
650	2250	1492.93	1498.74	1499.50	1501.00	5.81	3.11	0.26							Cross sections within basin.	
600	2250	1492.85	1498.50	1492.85	1501.00	5.65	4.73	0.38								

MERIDIAN CHANNEL – PHASE I

Culvert Analyses

Culvert Designer/Analyzer Report
SRP Easement Maintenance Road Culvert (2250 cfs)

Analysis Component			
Storm Event	Design	Discharge	2,250.00 cfs

Peak Discharge Method: User-Specified			
Design Discharge	2,250.00 cfs	Check Discharge	2,250.00 cfs

Tailwater properties: Rectangular Channel

Tailwater conditions for Design Storm.			
Discharge	2,250.00 cfs	Bottom Elevation	1,493.08 ft
Depth	5.39 ft	Velocity	9.82 ft/s

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	4-10 x 7 ft Box	2,250.00 cfs	1,501.05 ft	10.44 ft/s
Weir	Not Considered	N/A	N/A	N/A

Culvert Designer/Analyzer Report
SRP Easement Maintenance Road Culvert (2250 cfs)

Component:Culvert-1

Culvert Summary					
Computed Headwater Elev	1,501.05	ft	Discharge	2,250.00	cfs
Inlet Control HW Elev.	1,500.26	ft	Tailwater Elevation	1,498.47	ft
Outlet Control HW Elev.	1,501.05	ft	Control Type	Outlet Control	
Headwater Depth/Height	1.13				

Grades					
Upstream Invert	1,493.12	ft	Downstream Invert	1,493.08	ft
Length	20.00	ft	Constructed Slope	0.002000	ft/ft

Hydraulic Profile					
Profile	M2		Depth, Downstream	5.39	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	4.62	ft
Velocity Downstream	10.44	ft/s	Critical Slope	0.005358	ft/ft

Section					
Section Shape	Box		Mannings Coefficient	0.016	
Section Material	Concrete		Span	10.00	ft
Section Size	10 x 7 ft		Rise	7.00	ft
Number Sections	4				

Outlet Control Properties					
Outlet Control HW Elev.	1,501.05	ft	Upstream Velocity Head	1.65	ft
Ke	0.50		Entrance Loss	0.82	ft

Inlet Control Properties					
Inlet Control HW Elev.	1,500.26	ft	Flow Control	Unsubmerged	
Inlet Type	33.7° wingwall flare, d=0.0830		Area Full	280.0	ft²
K	0.48600		HDS 5 Chart	9	
M	0.66700		HDS 5 Scale	2	
C	0.02490		Equation Form	2	
Y	0.83000				

Performance Curves Report
SRP Easement Maintenance Road Culvert (2250 cfs)

Range Data:				
	Minimum	Maximum	Increment	
Discharge	0.00	2,400.00	10.00	cfs

Culvert Designer/Analyzer Report
Guadalupe Road Culvert (2250 cfs)

Overtopping Analysis				
Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	4-10 x 7 ft Box	2,250.00 cfs	1,511.97 ft	11.51 ft/s
Weir	Not Considered	N/A	N/A	N/A

Culvert Designer/Analyzer Report
Guadalupe Road Culvert (2250 cfs)

Component:Culvert-1

Culvert Summary					
Computed Headwater Elev	1,511.97	ft	Discharge	2,250.00	cfs
Inlet Control HW Elev.	1,511.48	ft	Tailwater Elevation	1,508.72	ft
Outlet Control HW Elev.	1,511.97	ft	Control Type	Outlet Control	
Headwater Depth/Height	1.14				

Grades					
Upstream Invert	1,504.01	ft	Downstream Invert	1,503.83	ft
Length	118.00	ft	Constructed Slope	0.001525	ft/ft

Hydraulic Profile					
Profile	M2		Depth, Downstream	4.89	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	4.62	ft
Velocity Downstream	11.51	ft/s	Critical Slope	0.005358	ft/ft

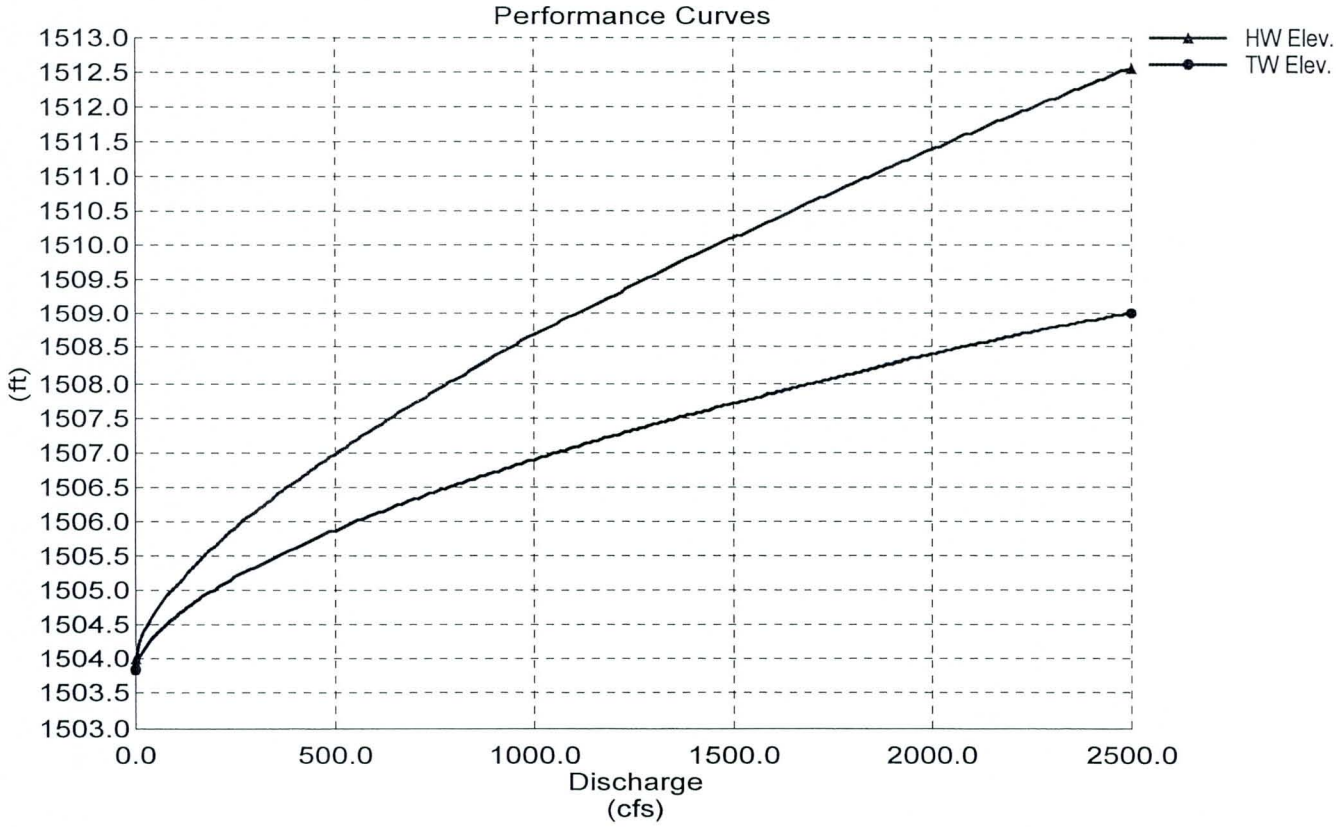
Section					
Section Shape	Box		Mannings Coefficient	0.016	
Section Material	Concrete		Span	10.00	ft
Section Size	10 x 7 ft		Rise	7.00	ft
Number Sections	4				

Outlet Control Properties					
Outlet Control HW Elev.	1,511.97	ft	Upstream Velocity Head	1.53	ft
Ke	0.50		Entrance Loss	0.77	ft

Inlet Control Properties					
Inlet Control HW Elev.	1,511.48	ft	Flow Control	Unsubmerged	
Inlet Type	30 to 75° wingwall flares		Area Full	280.0	ft²
K	0.02600		HDS 5 Chart	8	
M	1.00000		HDS 5 Scale	1	
C	0.03470		Equation Form	1	
Y	0.86000				

Performance Curves Report
Guadalupe Road Culvert (2250 cfs)

Range Data:				
	Minimum	Maximum	Increment	
Discharge	0.00	2,500.00	10.00	cfs



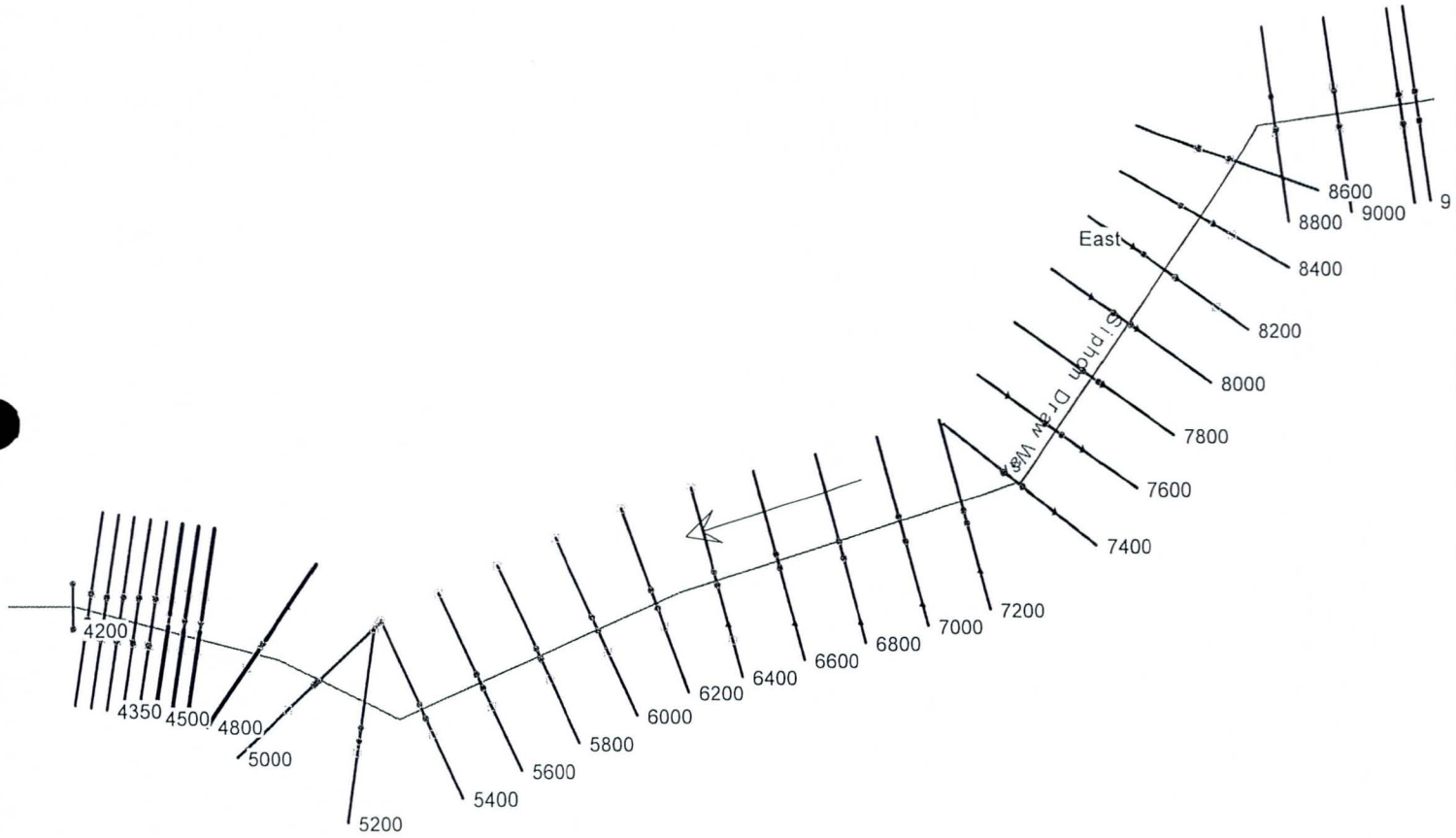
APPENDIX D

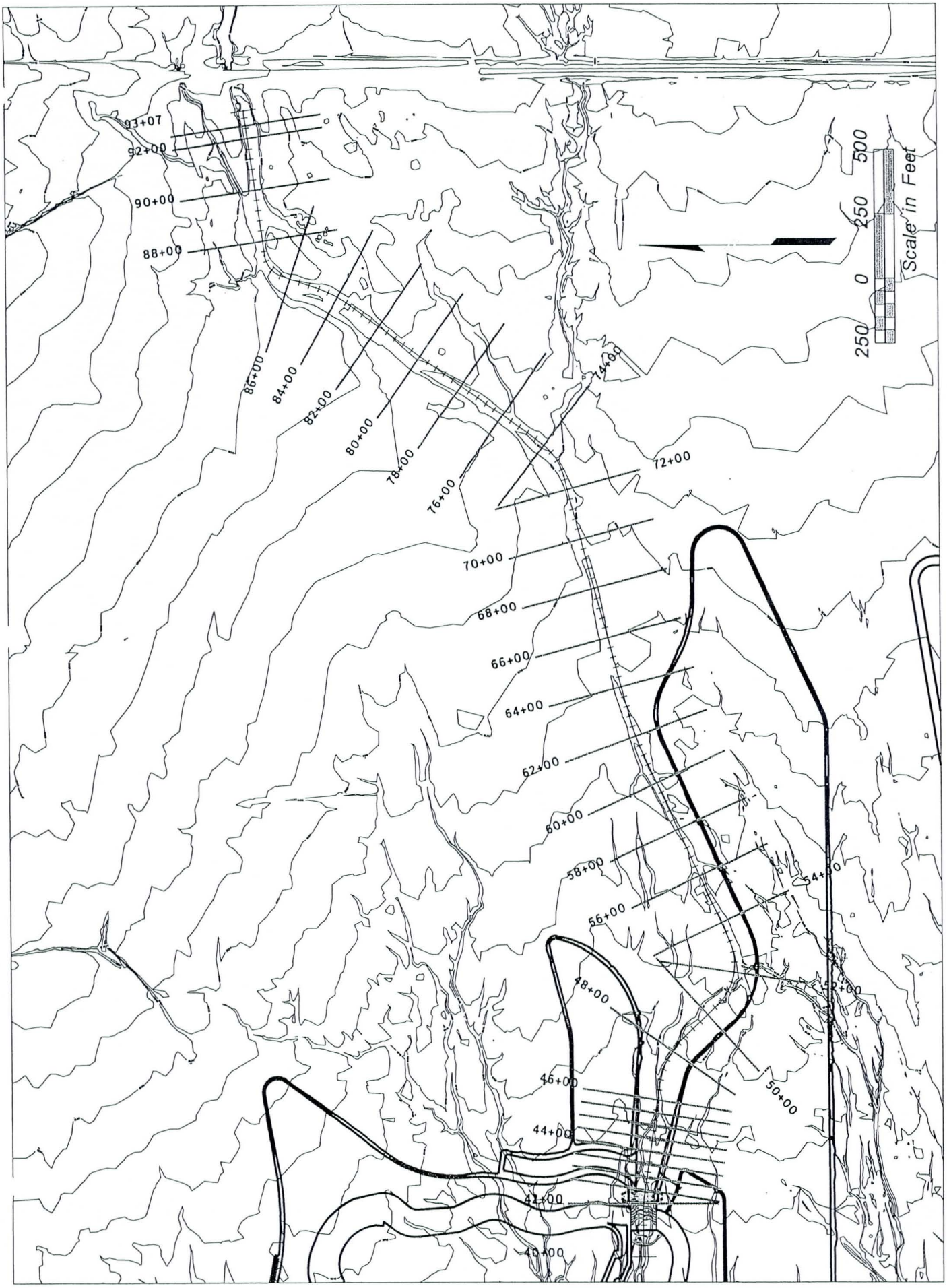
SIPHON DRAW WASH

SIPHON DRAW WASH

HEC-RAS Output

Siphon
Draw Wash
East

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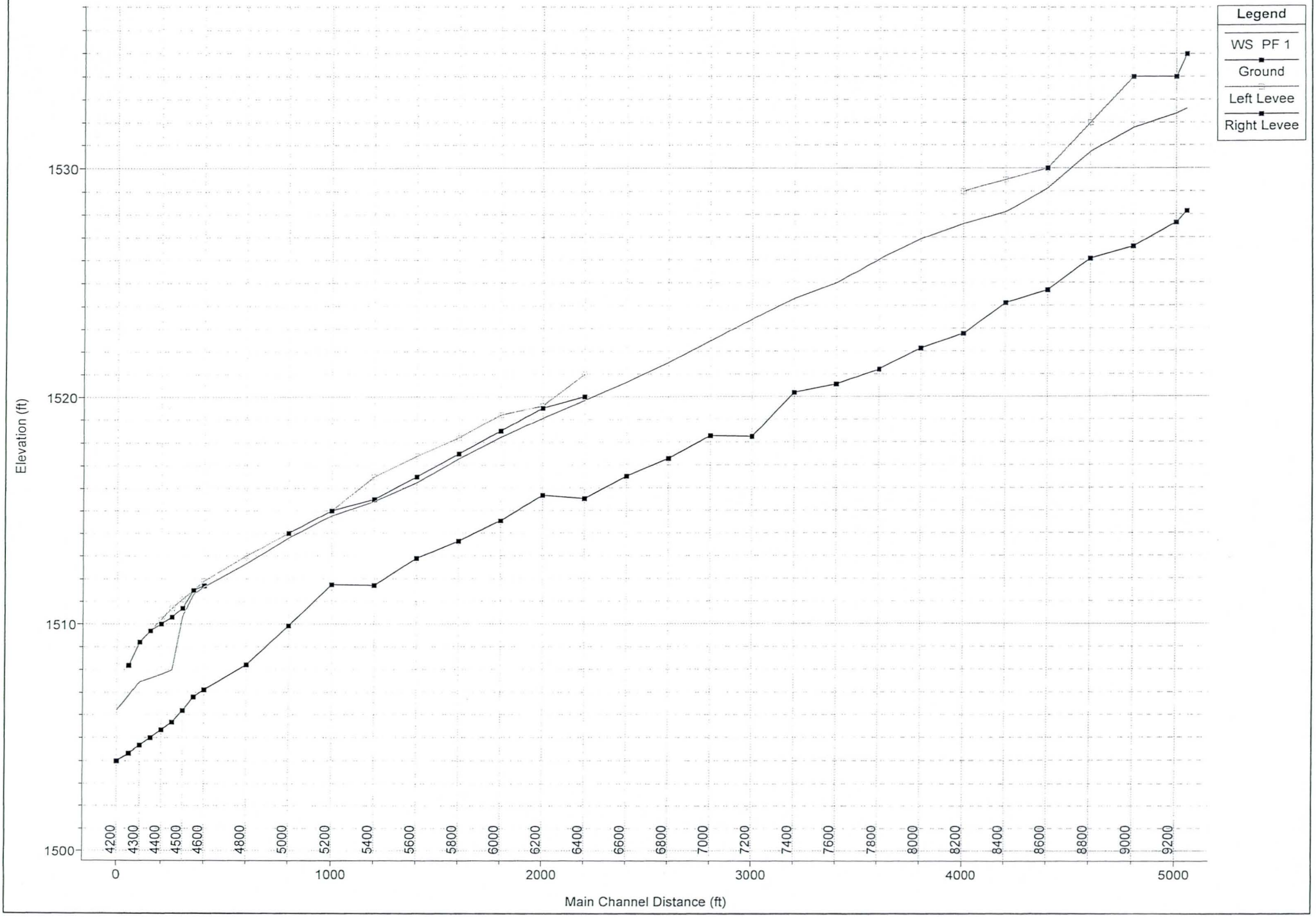
68+00
66+00
64+00
62+00
60+00
58+00
56+00
54+00
52+00
50+00
48+00
46+00
44+00
42+00
40+00
250
0
250
500
Scale in Feet

Siphon Draw Wash East of Basin Pla W-East Design Analysis 11/6/2008

Flow: 100-Yr [Discharge

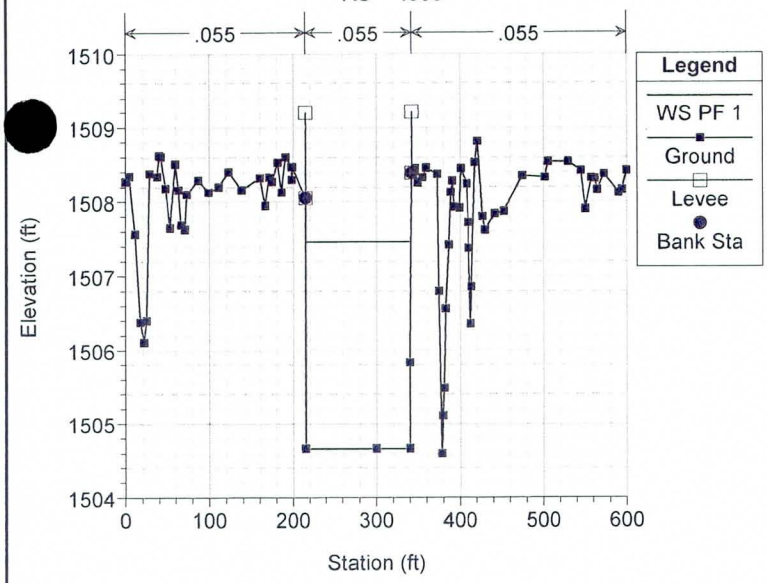


HEC-RAS Plan: SDW-East River: Siphon Draw Wash Reach: East Profile: PF 1

Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
East	9250	1000.00	1528.15	1532.62	1530.85	1532.88	0.004927	4.14	241.54	73.87	0.40
East	9200	1000.00	1527.65	1532.39	1530.50	1532.65	0.004327	4.06	246.47	70.13	0.38
East	9000	1000.00	1526.59	1531.77	1529.85	1531.92	0.002834	3.11	321.65	98.86	0.30
[illegible]	8800	1000.00	1526.05	1530.71	1529.42	1531.01	0.008157	4.39	227.94	93.25	0.49
[illegible]	8600	1000.00	1524.67	1529.13	1527.77	1529.41	0.007812	4.30	232.30	94.31	0.48
East	8400	1000.00	1524.12	1528.10	1526.56	1528.28	0.004110	3.37	296.96	143.71	0.36
East	8200	1000.00	1522.77	1527.59	1525.48	1527.69	0.002065	2.61	399.83	202.14	0.26
East	8000	1000.00	1522.13	1526.92	1525.45	1527.12	0.004066	3.86	308.61	388.00	0.37
East	7800	1000.00	1521.21	1526.02	1524.76	1526.24	0.004837	4.06	300.60	388.21	0.40
East	7600	1000.00	1520.56	1524.98	1523.68	1525.21	0.005418	4.20	286.91	309.38	0.42
East	7400	1000.00	1520.19	1524.31	1523.36	1524.38	0.002944	2.72	526.08	443.88	0.30
East	7200	1000.00	1518.24	1523.41	1523.15	1523.60	0.005504	4.29	395.03	434.81	0.42
East	7000	1000.00	1518.28	1522.45	1521.83	1522.58	0.004553	3.33	405.49	384.09	0.37
East	6800	1000.00	1517.29	1521.51	1521.13	1521.65	0.004707	3.75	422.92	481.59	0.39
East	6600	1000.00	1516.52	1520.64	1520.19	1520.74	0.004300	3.41	485.70	583.76	0.36
East	6400	1000.00	1515.53	1519.83	1519.37	1519.92	0.003939	3.17	495.07	485.00	0.35
East	6200	1000.00	1515.68	1519.05	1518.50	1519.14	0.003785	3.06	476.07	385.00	0.34
East	6000	1000.00	1514.55	1518.22	1517.44	1518.31	0.004474	3.19	461.37	385.00	0.36
East	5800	1000.00	1513.65	1517.28	1516.64	1517.37	0.004894	3.31	445.28	380.60	0.38
East	5600	1000.00	1512.89	1516.23	1515.69	1516.32	0.005635	2.95	439.98	385.00	0.39
East	5400	1000.00	1511.71	1515.41	1514.51	1515.47	0.003261	2.27	515.45	385.00	0.30
East	5200	1000.00	1511.74	1514.77	1514.15	1514.85	0.004770	2.75	464.51	385.00	0.36
East	5000	1000.00	1509.92	1513.79	1513.30	1513.89	0.006491	3.90	418.09	385.00	0.42
East	4800	1000.00	1508.21	1512.66	1511.98	1512.78	0.004686	3.72	377.77	385.00	0.38
East	4600	1000.00	1507.12	1511.65	1510.90	1511.80	0.004773	3.96	336.38	175.00	0.39
East	4550	1000.00	1506.80	1511.32	1510.74	1511.51	0.007271	4.21	298.79	175.00	0.46
East	4500	1000.00	1506.19	1510.34	1510.34	1510.95	0.015311	6.81	191.82	150.00	0.69
East	4450	1000.00	1505.68	1507.98	1506.82	1508.12	0.004231	3.00	333.46	144.99	0.35
East	4400	1000.00	1505.34	1507.79	1506.50	1507.92	0.003705	2.92	342.60	139.99	0.33
East	4350	1000.00	1505.00	1507.62	1506.20	1507.75	0.003184	2.83	353.88	135.00	0.31
[illegible]	4300	1000.00	1504.67	1507.46	1505.93	1507.59	0.003008	2.85	350.46	126.48	0.30
[illegible]	4250	1000.00	1504.34	1506.90	1506.10	1507.30	0.011302	5.08	196.92	80.13	0.57
East	4200	1000.00	1504.00	1506.21	1505.93	1506.84	0.007004	6.37	157.09	82.11	0.81

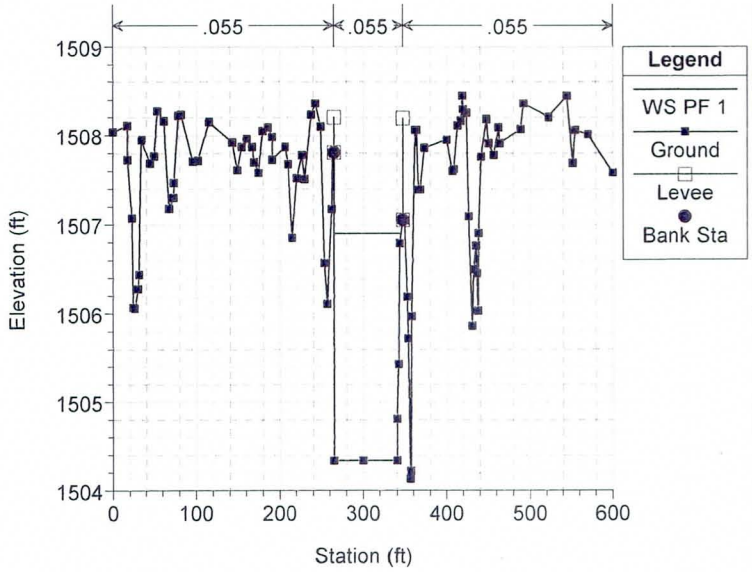
Siphon Draw Wash East of Basin Plan: SDW-East Design Analysis 11/6/2008

Flow: 100-Yr Design Discharge
RS = 4300



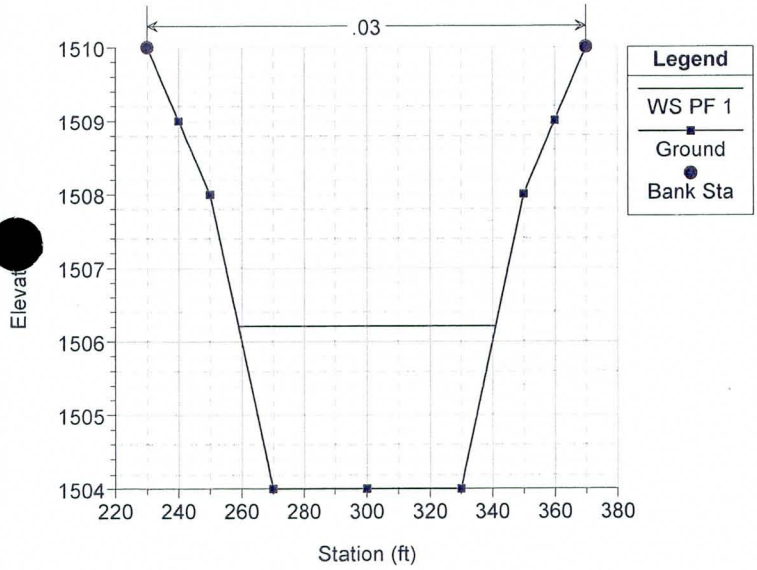
Siphon Draw Wash East of Basin Plan: SDW-East Design Analysis 11/6/2008

Flow: 100-Yr Design Discharge
RS = 4250



Siphon Draw Wash East of Basin Plan: SDW-East Design Analysis 11/6/2008

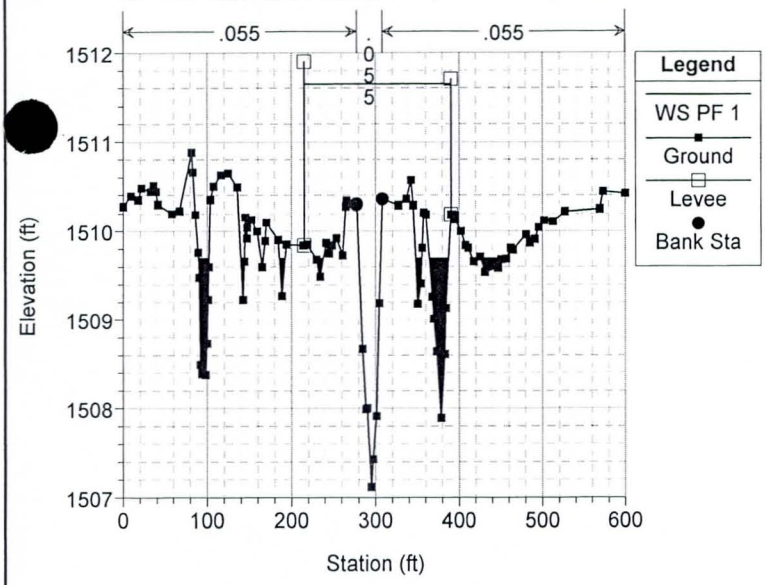
Flow: 100-Yr Design Discharge
RS = 4200 SDW Inlet to detention basin



Siphon Draw Wash East of Basin Plan: SDW-East Design Analysis 11/6/2008

Flow: 100-Yr Design Discharge

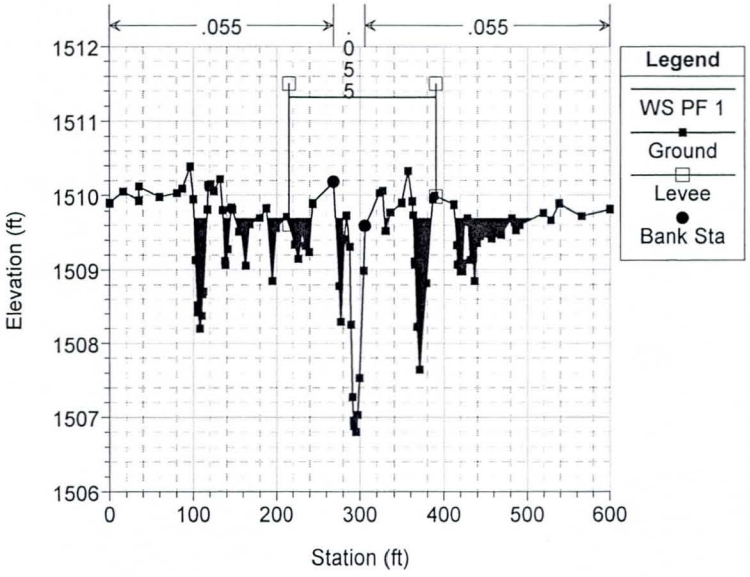
RS = 4600 D/S cutoff wall obstructs flow up to 1509.7 except in main chann



Siphon Draw Wash East of Basin Plan: SDW-East Design Analysis 11/6/2008

Flow: 100-Yr Design Discharge

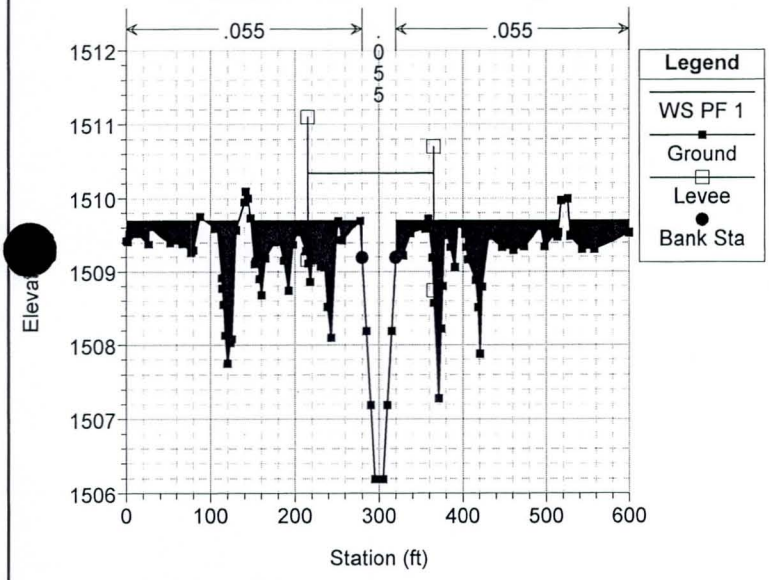
RS = 4550 D/S cutoff wall obstructs flow up to 1509.7 except in main chann



Siphon Draw Wash East of Basin Plan: SDW-East Design Analysis 11/6/2008

Flow: 100-Yr Design Discharge

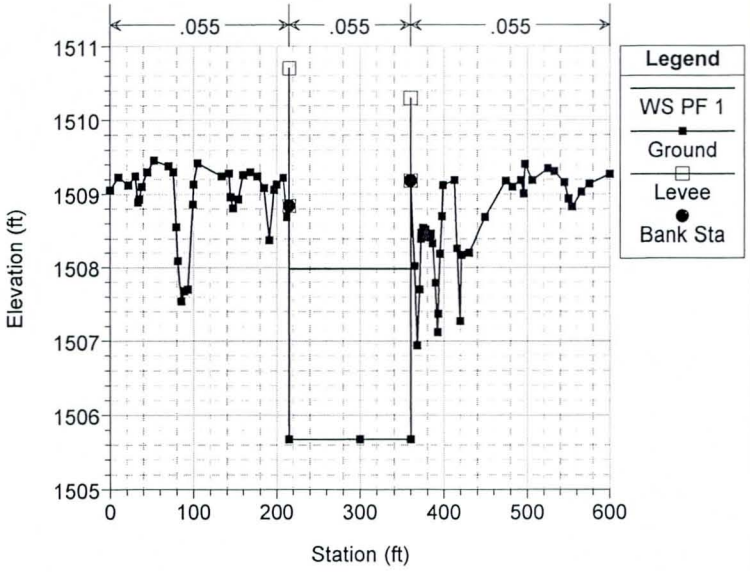
RS = 4500 Cutoff Wall across channel at 1509.7 except at main channel.



Siphon Draw Wash East of Basin Plan: SDW-East Design Analysis 11/6/2008

Flow: 100-Yr Design Discharge

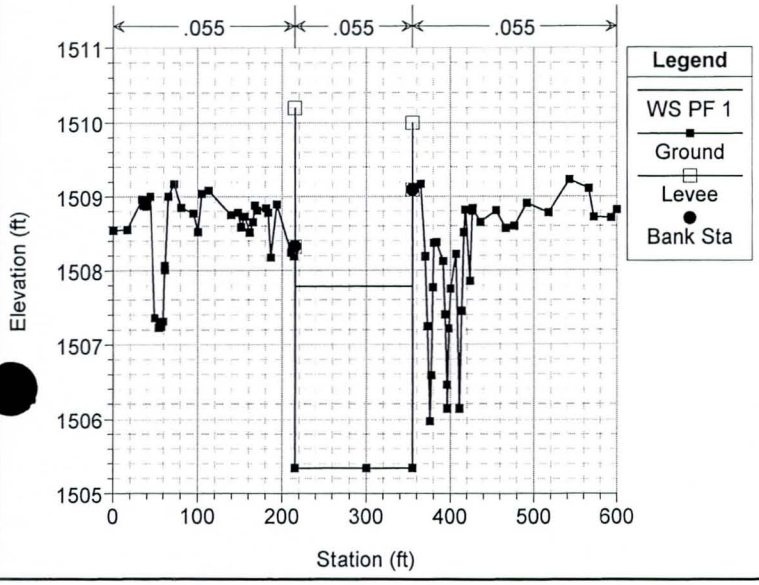
RS = 4450



Siphon Draw Wash East of Basin Plan: SDW-East Design Analysis 11/6/2008

Flow: 100-Yr Design Discharge

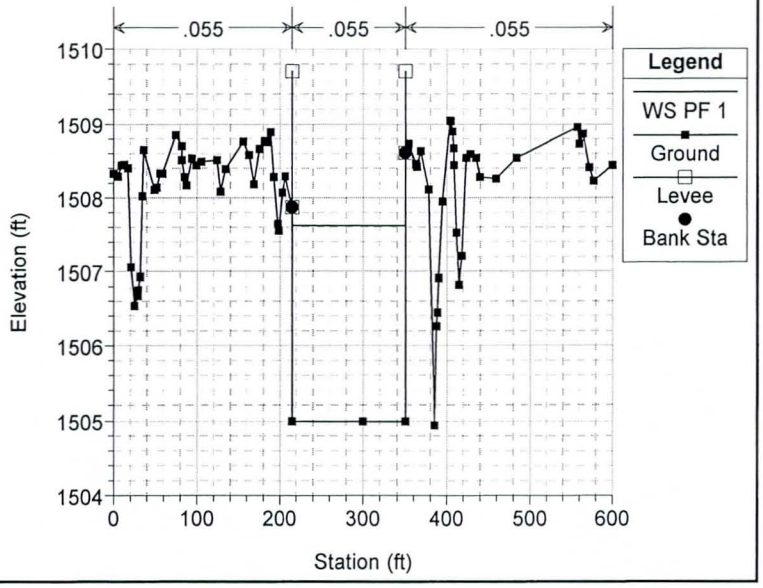
RS = 4400



Siphon Draw Wash East of Basin Plan: SDW-East Design Analysis 11/6/2008

Flow: 100-Yr Design Discharge

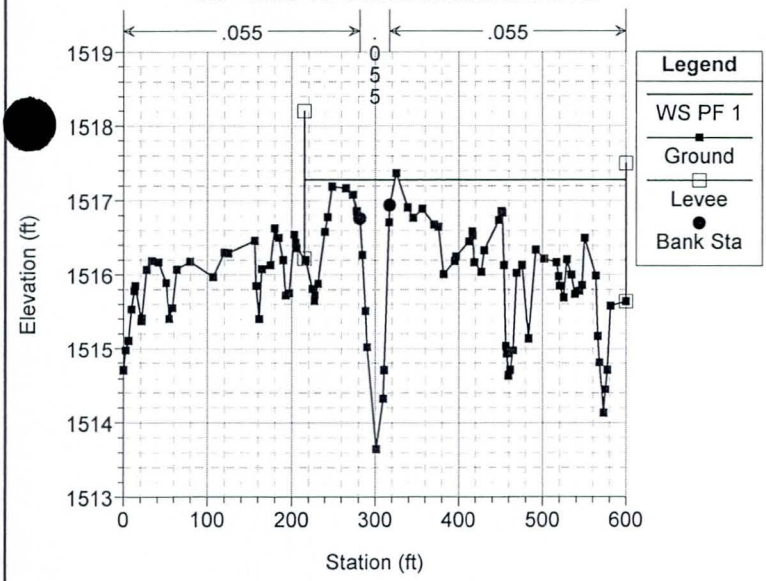
RS = 4350



Siphon Draw Wash East of Basin Plan: SDW-East Design Analysis 11/6/2008

Flow: 100-Yr Design Discharge

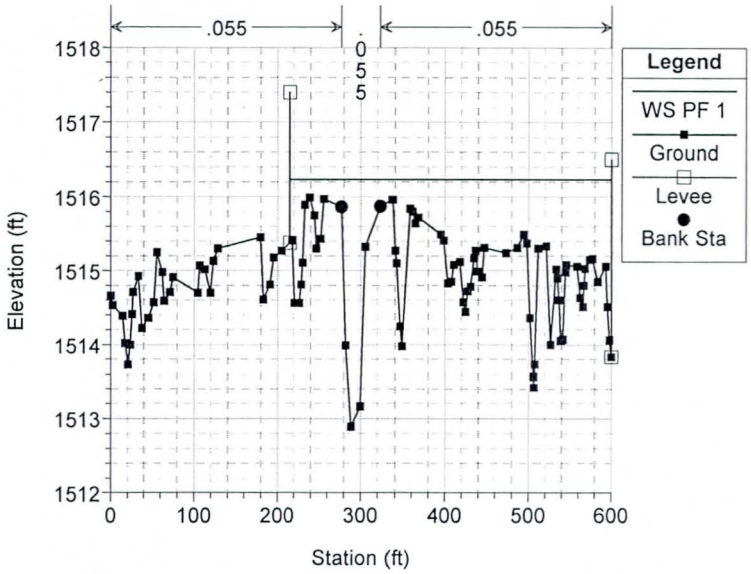
RS = 5800 ROB levee contains flow to XS



Siphon Draw Wash East of Basin Plan: SDW-East Design Analysis 11/6/2008

Flow: 100-Yr Design Discharge

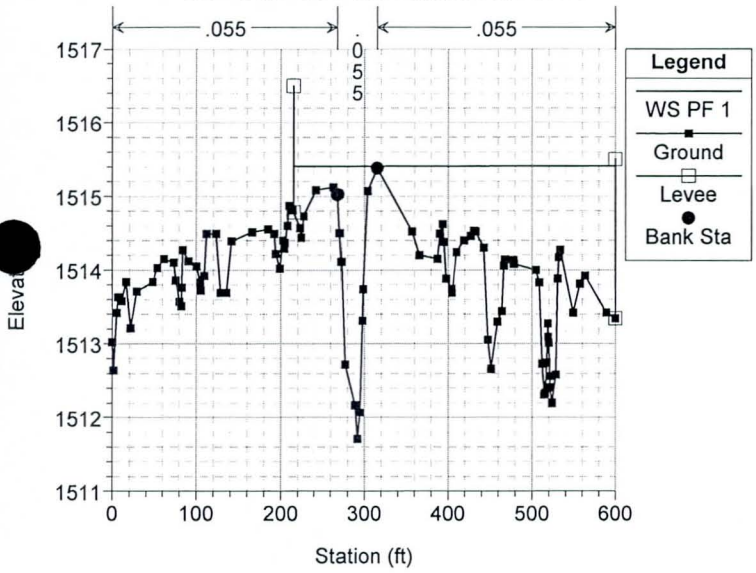
RS = 5600 ROB levee contains flow to XS



Siphon Draw Wash East of Basin Plan: SDW-East Design Analysis 11/6/2008

Flow: 100-Yr Design Discharge

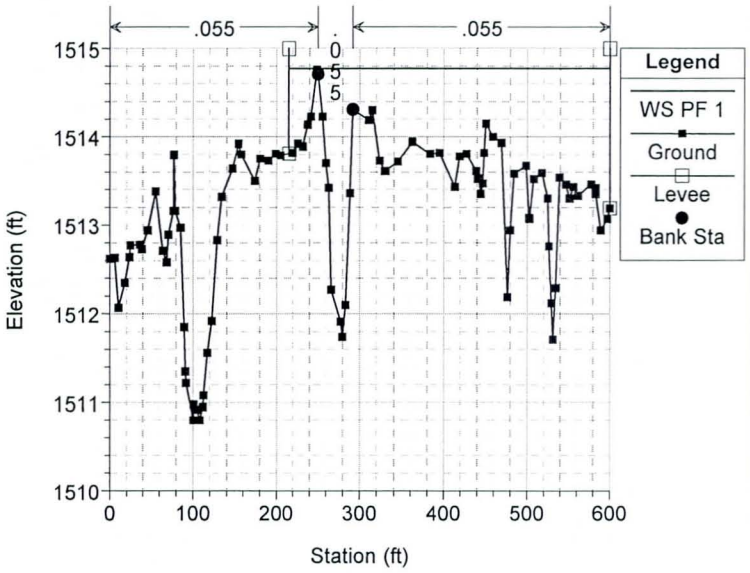
RS = 5400 ROB levee contains flow to XS



Siphon Draw Wash East of Basin Plan: SDW-East Design Analysis 11/6/2008

Flow: 100-Yr Design Discharge

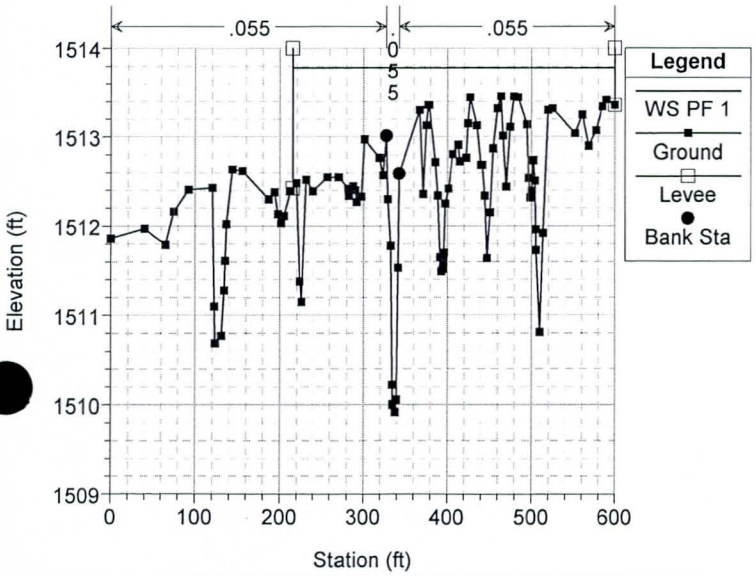
RS = 5200



Siphon Draw Wash East of Basin Plan: SDW-East Design Analysis 11/6/2008

Flow: 100-Yr Design Discharge

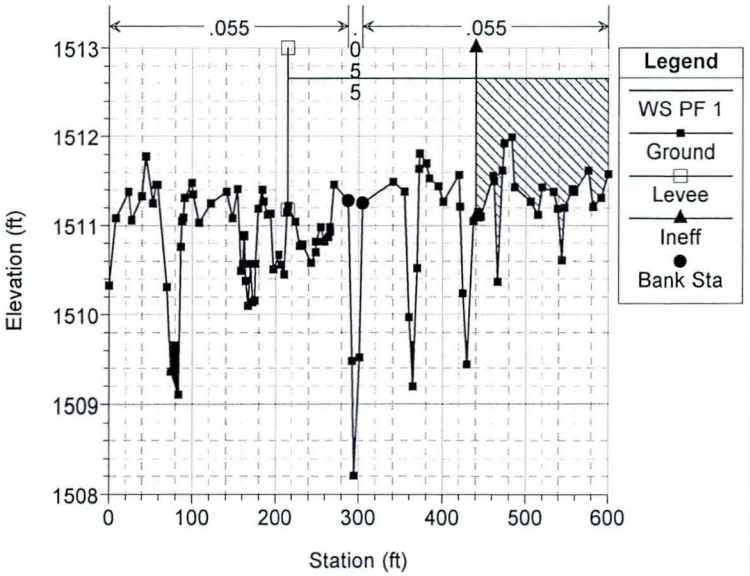
RS = 5000



Siphon Draw Wash East of Basin Plan: SDW-East Design Analysis 11/6/2008

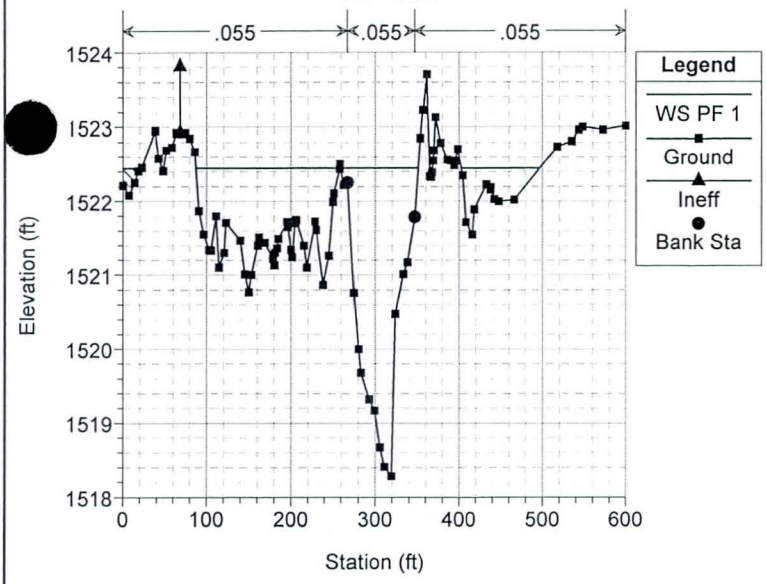
Flow: 100-Yr Design Discharge

RS = 4800 D/S cutoff wall obstructs flow up to 1509.7 except in main chann



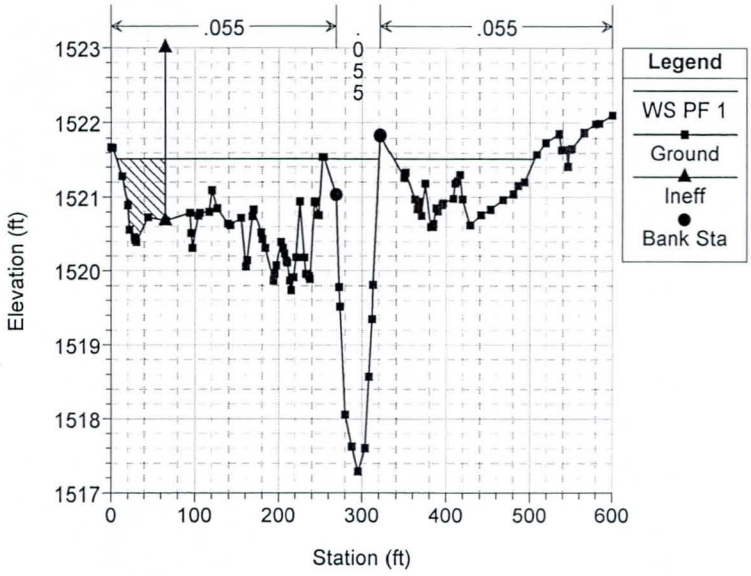
Siphon Draw Wash East of Basin Plan: SDW-East Design Analysis 11/6/2008

Flow: 100-Yr Design Discharge
RS = 7000



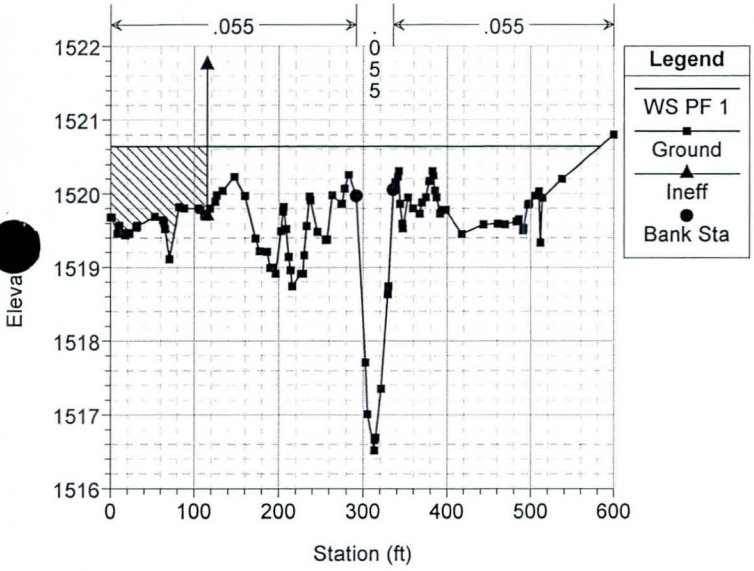
Siphon Draw Wash East of Basin Plan: SDW-East Design Analysis 11/6/2008

Flow: 100-Yr Design Discharge
RS = 6800



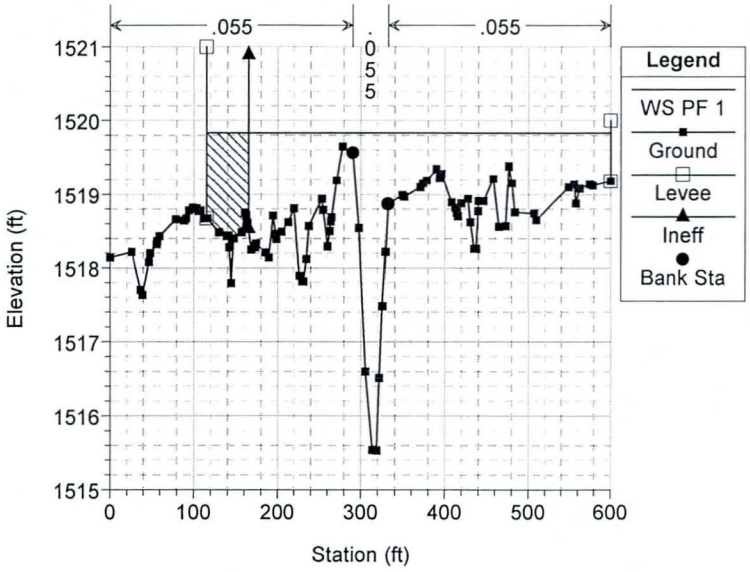
Siphon Draw Wash East of Basin Plan: SDW-East Design Analysis 11/6/2008

Flow: 100-Yr Design Discharge
RS = 6600



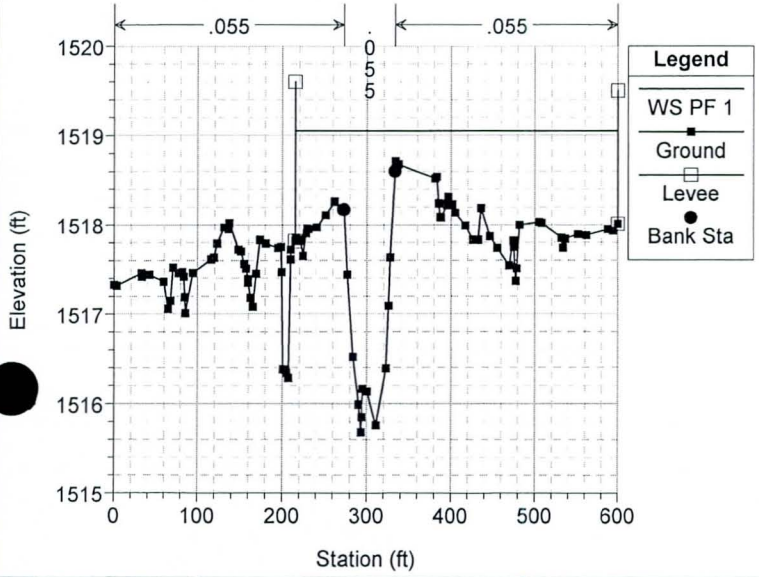
Siphon Draw Wash East of Basin Plan: SDW-East Design Analysis 11/6/2008

Flow: 100-Yr Design Discharge
RS = 6400 ROB levee contains flow to XS



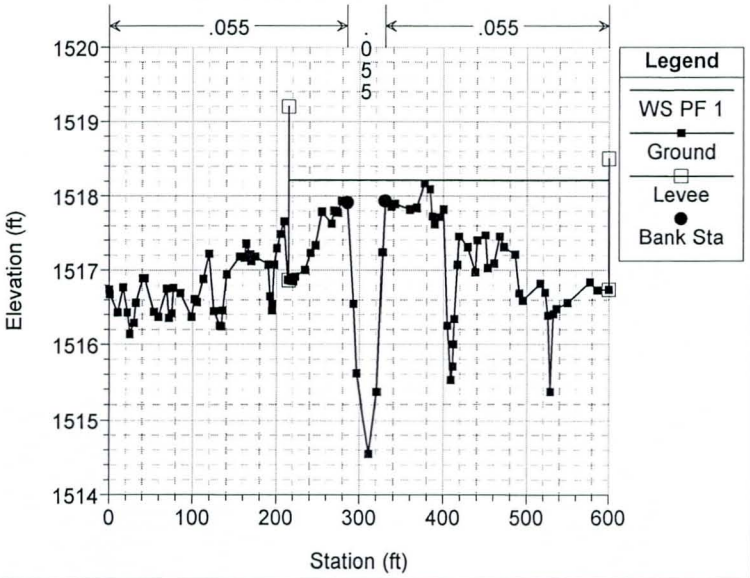
Siphon Draw Wash East of Basin Plan: SDW-East Design Analysis 11/6/2008

Flow: 100-Yr Design Discharge
RS = 6200 ROB levee contains flow to XS



Siphon Draw Wash East of Basin Plan: SDW-East Design Analysis 11/6/2008

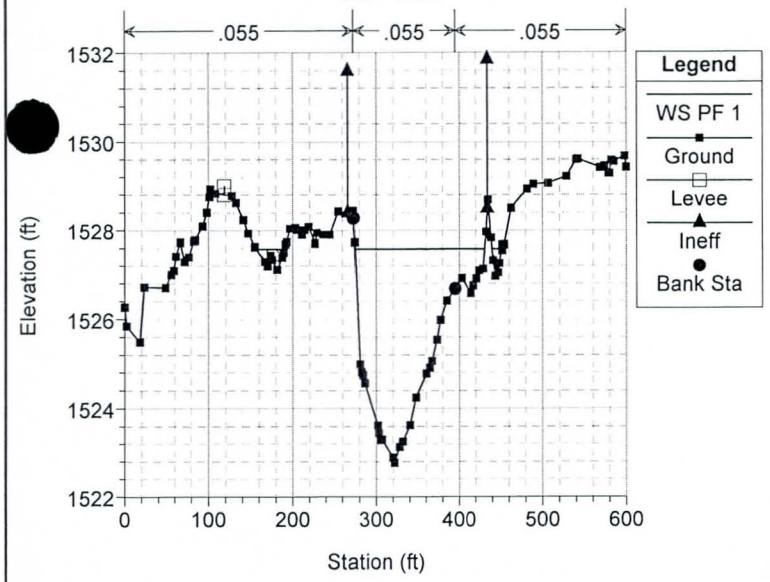
Flow: 100-Yr Design Discharge
RS = 6000 ROB levee contains flow to XS



Siphon Draw Wash East of Basin Plan: SDW-East Design Analysis 11/6/2008

Flow: 100-Yr Design Discharge

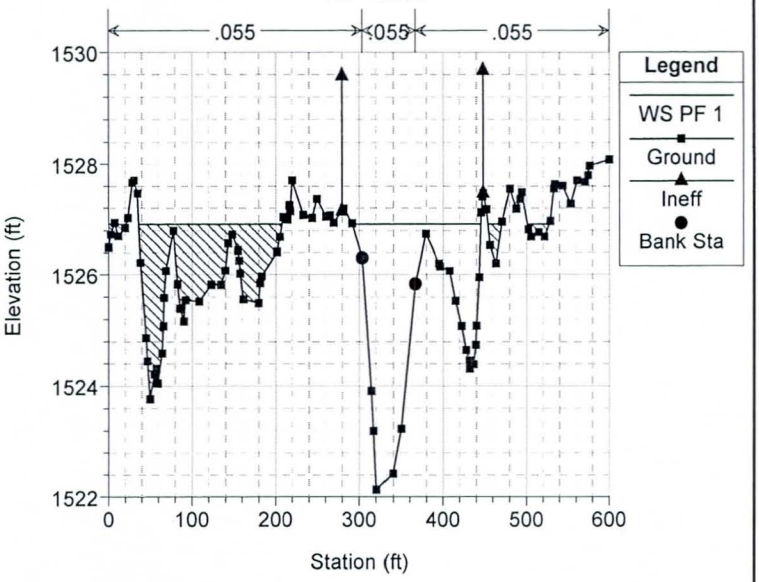
RS = 8200



Siphon Draw Wash East of Basin Plan: SDW-East Design Analysis 11/6/2008

Flow: 100-Yr Design Discharge

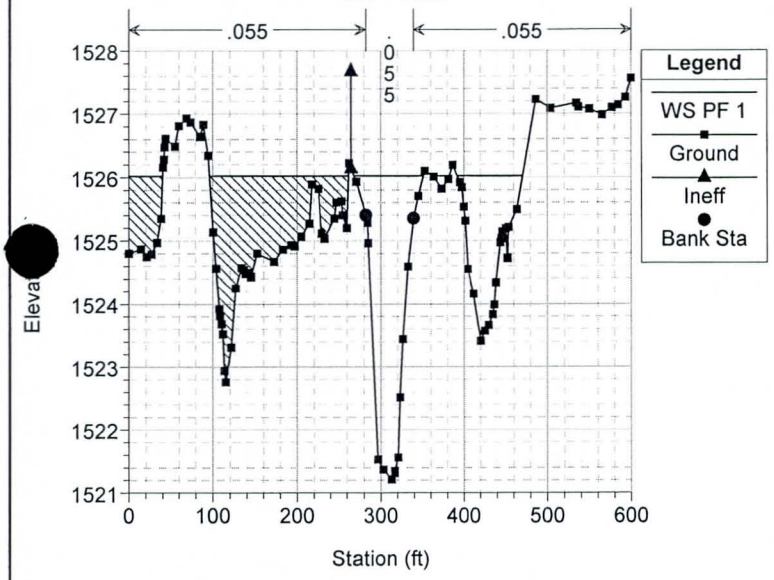
RS = 8000



Siphon Draw Wash East of Basin Plan: SDW-East Design Analysis 11/6/2008

Flow: 100-Yr Design Discharge

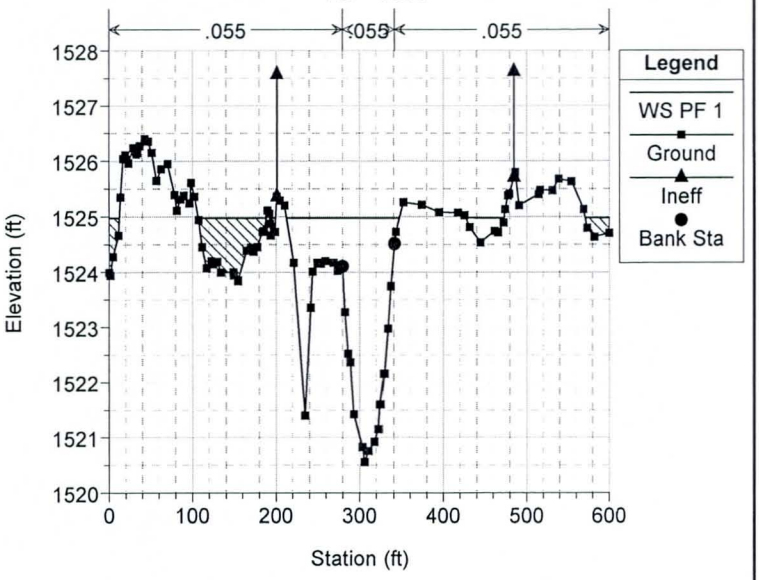
RS = 7800



Siphon Draw Wash East of Basin Plan: SDW-East Design Analysis 11/6/2008

Flow: 100-Yr Design Discharge

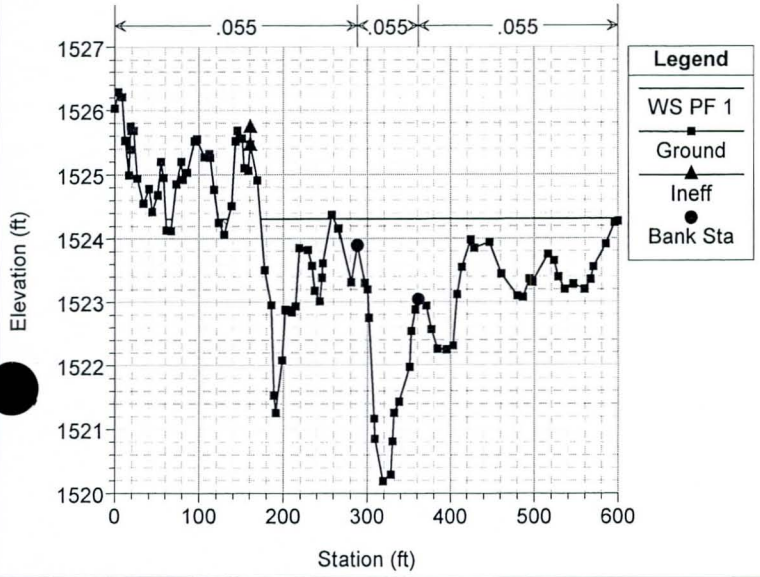
RS = 7600



Siphon Draw Wash East of Basin Plan: SDW-East Design Analysis 11/6/2008

Flow: 100-Yr Design Discharge

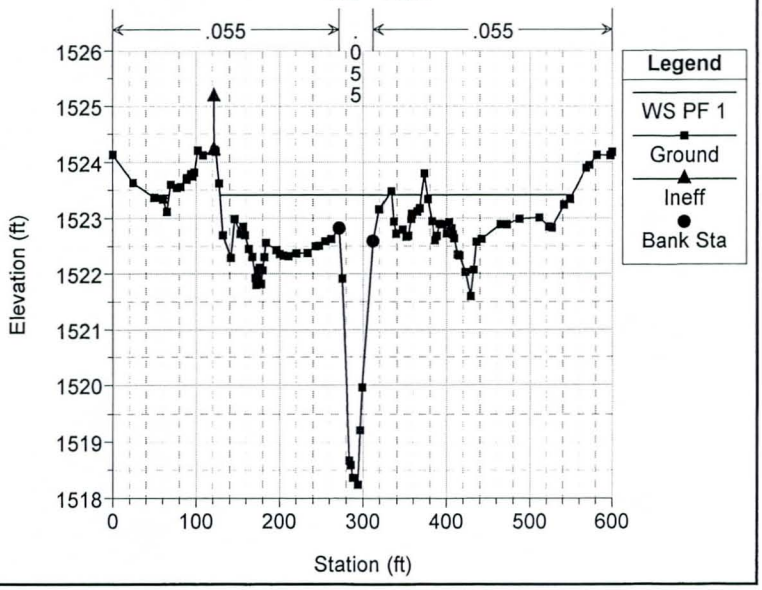
RS = 7400



Siphon Draw Wash East of Basin Plan: SDW-East Design Analysis 11/6/2008

Flow: 100-Yr Design Discharge

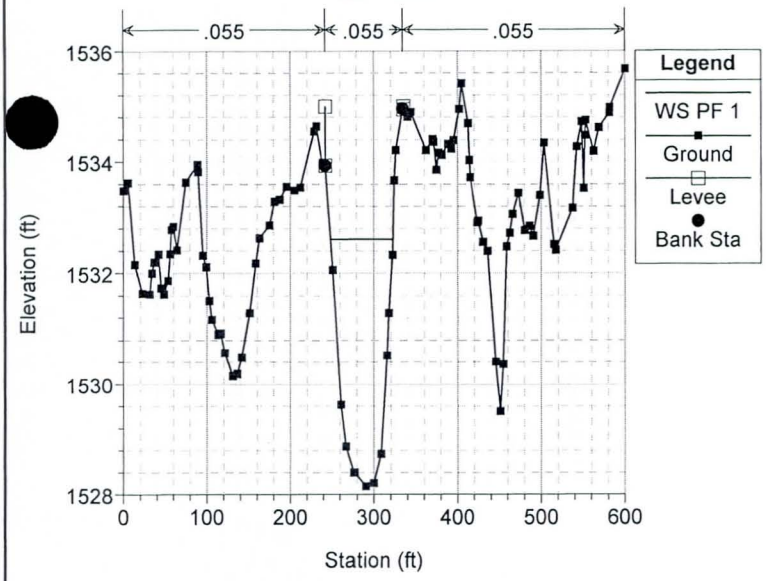
RS = 7200



Siphon Draw Wash East of Basin Plan: SDW-East Design Analysis 11/6/2008

Flow: 100-Yr Design Discharge

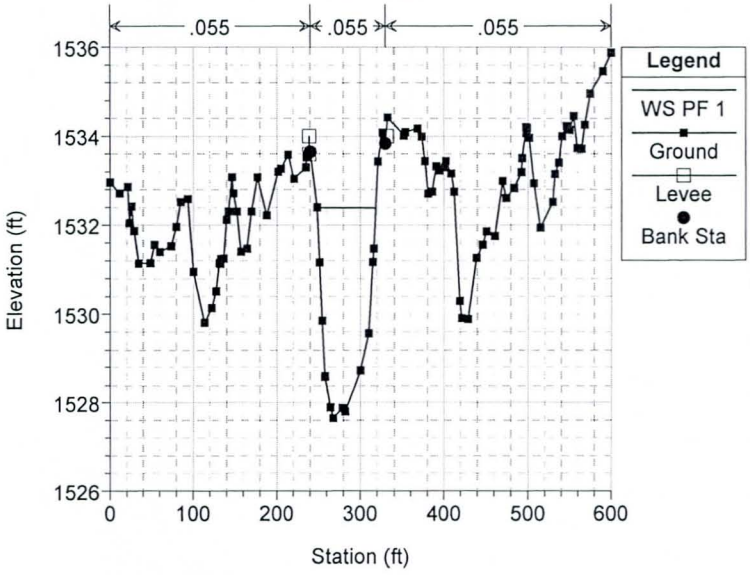
RS = 9250



Siphon Draw Wash East of Basin Plan: SDW-East Design Analysis 11/6/2008

Flow: 100-Yr Design Discharge

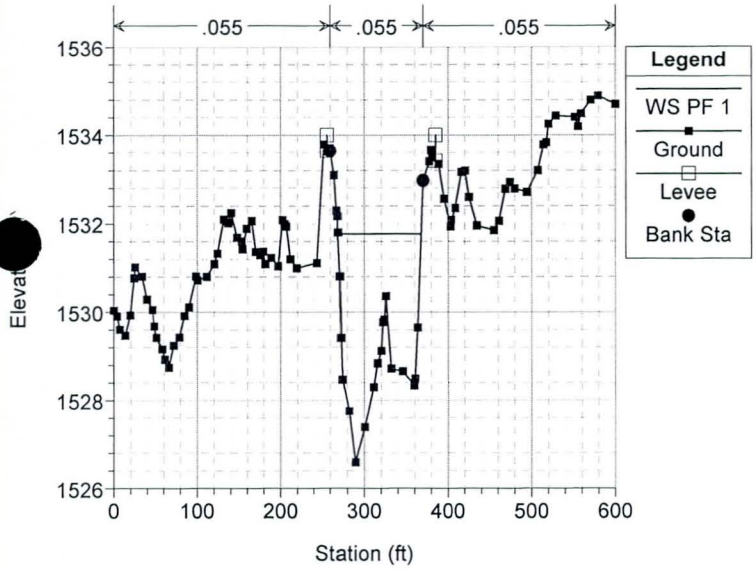
RS = 9200



Siphon Draw Wash East of Basin Plan: SDW-East Design Analysis 11/6/2008

Flow: 100-Yr Design Discharge

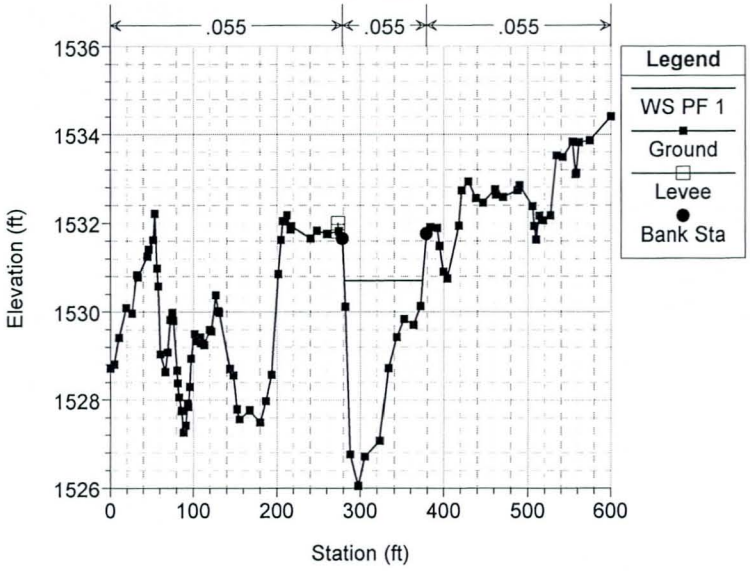
RS = 9000



Siphon Draw Wash East of Basin Plan: SDW-East Design Analysis 11/6/2008

Flow: 100-Yr Design Discharge

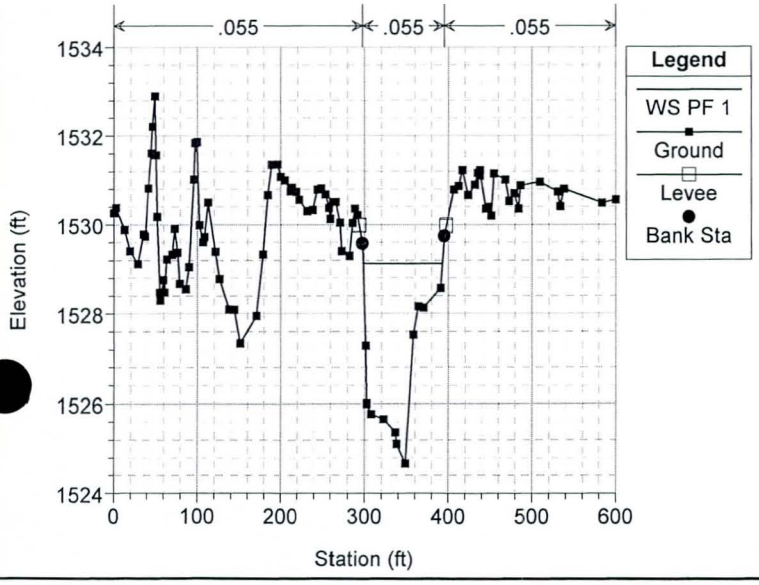
RS = 8800



Siphon Draw Wash East of Basin Plan: SDW-East Design Analysis 11/6/2008

Flow: 100-Yr Design Discharge

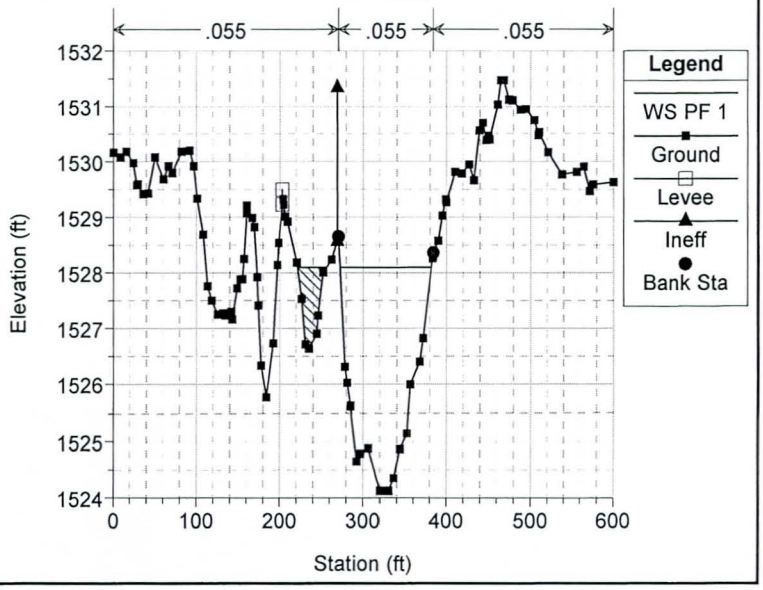
RS = 8600



Siphon Draw Wash East of Basin Plan: SDW-East Design Analysis 11/6/2008

Flow: 100-Yr Design Discharge

RS = 8400



SIPHON DRAW WASH

Spillway Hydraulics

MEMO

Phoenix, AZ

TO: Charlie Joy, P.E.

DATE: 11 September, 2008

FROM: Joe Lockett, P.E.

SUBJECT: Siphon Draw Wash – West, hydraulics
Siphon Draw Wash – East, discussion
Stepped drop structure design elements

This memo is intended to provide further description of the basis of design for several elements of the Siphon Draw Drainage Improvements Project. The elements described in this memo are,

1) the hydraulic model (HEC-RAS) of Siphon Draw Wash, from the proposed basin outlet west to 104th St. (herein referred to as, SDW-West),

2) the hydraulic model (HEC-RAS) of Siphon Draw Wash, from Ironwood Drive west to the proposed Siphon Draw Wash Basin (herein referred to as, SDW-East), and

3) the design of the various appurtenances associated with the stepped drop structure.

1) SDW-West covers the reach of SDW from the proposed basin outlet to the 104th Street alignment. This reach was modeled with HEC-RAS to investigate the ability of passing the design SDW Basin discharge (approximately 500 cfs) through the Meridian sub-division. The original design discharge for the SDW through Meridian subdivision was approximately 750 cfs. Both 500 and 750 cfs profiles were run in the current model.

Topographic coverage was obtained in part from the FCDMC and partially from Cooper aerial coverage for the project. Additionally, there were several cross-sections surveyed by SC within the Meridian Pointe sub-division. Adjustments were made to portions of this topo to equate it to the project datum of NAVD88. The cross-sections for the model were cut from this combined information.

As it exists today, SDW consists of several channels that flow within a wide corridor east of Meridian Road. A number of culverts at Meridian Road pass these flows to the west side of Meridian Road. The flows then combine via two manmade channels immediately west of and parallel to Meridian Road. The two channels drain to the main channel of SDW where the combined flow passes west through the Meridian Pointe subdivision.

Several HEC-RAS plans were made to investigate the effects of sedimentation in the culverts along SDW and the potential future extension of the 2-10'x4' CBC at Meridian Road. These runs were made for illustrative purposes only and do not necessarily include or represent the Siphon Draw Drainage Improvements.

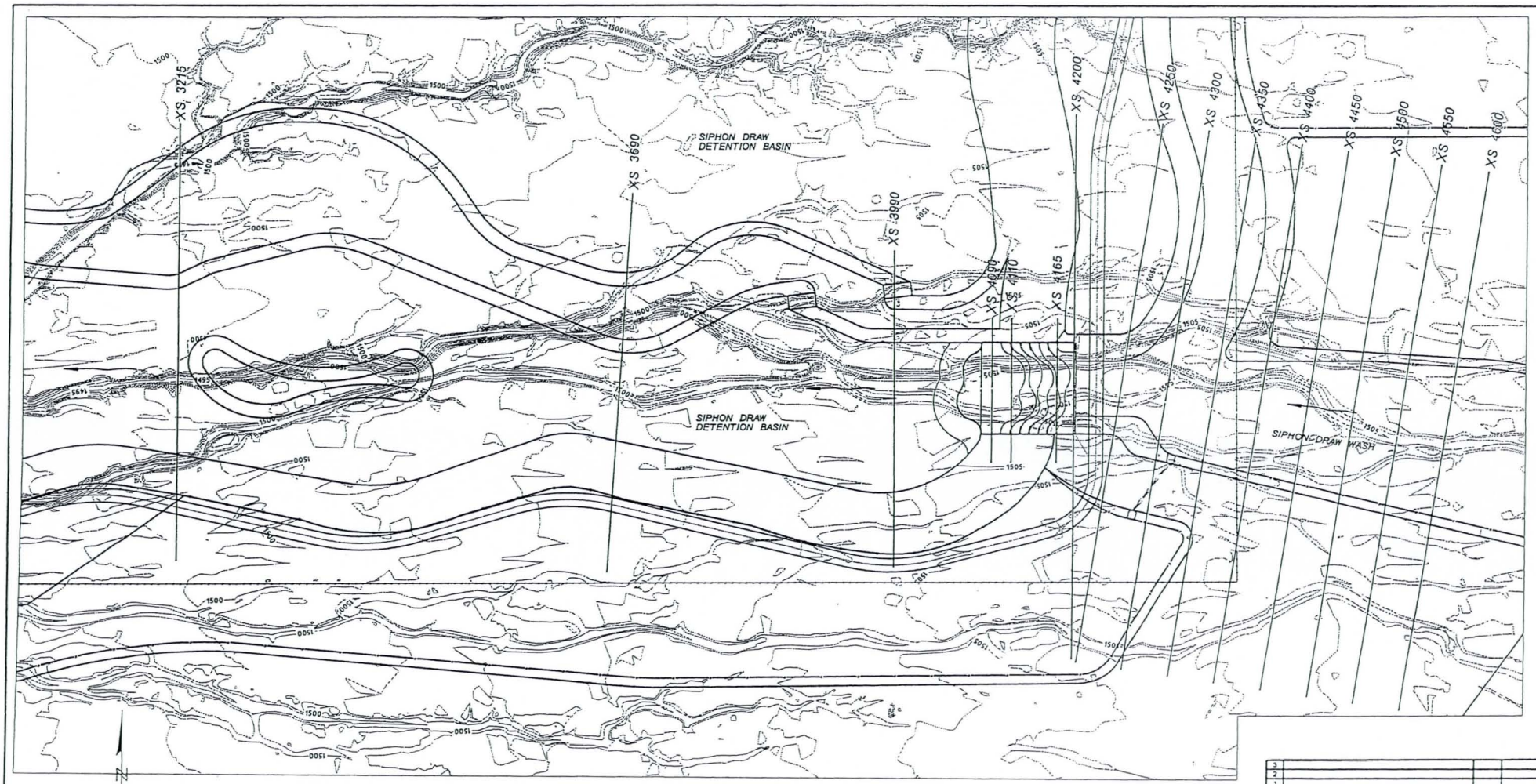
The last plan (Plan F in the provided model) represents the original HEC-RAS model with the reach extended east to include the Meridian Road crossing (2-10'x4' CBC) and the Siphon Draw Basin outlet channel, per the 70% Siphon Draw Drainage Improvements plans. Note that because of the nature of the improvements, the other culverts along Meridian Road are ignored in this analysis as their flows are largely cutoff.

2) SDW-East models the reach of SDW from Ironwood Drive to the proposed SDW Basin. SCI modeled the reach in two scenarios whereby a 400 ft corridor and a 150 ft corridor were maintained by adding fill to each side of SDW.

Through communication with the District, it was agreed to utilize the 150' corridor for SDW with approximately 2 feet of fill on either side of the wash. The design discharge used in this model was 1000 cfs. Documentation of this model is not provided as part of this submittal, but is briefly discussed here to illustrate that it was used as the basis of design for the Drop Structure HEC-RAS model (following).

3) The stepped drop structure was modeled in HEC-RAS (SDW Drop). This model includes the drop structure in to the proposed basin as well as several cross sections both up and downstream of the structure. Again, as in the SDW – East model, the design discharge is 1000 cfs. SCI, following discussions with the District, modeled the drop as a sloping chute to provide a conservative estimate of velocity conditions at the toe of the structure. With this, SCI designed an apron and sill to accommodate the hydraulic jump that would form at the base of the drop structure. Thus, if the drop structure is constructed as a stepped drop structure, rather than a chute, then the apron can be expected to be a conservative design. The various design elements that are a part of the stepped drop structure are included with this documentation. They include: a) the HEC-RAS model for the structure, b) the design for the bank protection upstream of the structure, c) the apron at the crest of the drop structure, d) the concrete apron length at the toe of the structure, e) the sill height at the toe of the structure, and f) the riprap apron downstream of the sill.

In addition to the hydraulics for the drop structure, the District has expressed a desire to maintain a token flow in the southernmost branch of Siphon Draw Wash. This flow would be allowed to pass from the re-aligned Siphon Draw Wash through the south fill prism via a culvert. A calculation has been provided for 2-18" HDPE pipes to convey approximately 20 cfs.



N

50 0 50 100

Scale in Feet

LEGEND

FLOW DIRECTION

XS 3690 SIPHON DRAW DROP STRUCTURE HEC-RAS MODEL CROSS SECTION

NO.	REVISION	BY	DATE
3			
2			
1			

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
ENGINEERING DIVISION

SIPHON DRAW DRAINAGE IMPROVEMENTS PHASE 1
FCD PROJECT NO. 442-11-31
CONTRACT FCD 2008C030

95%

NOT FOR CONSTRUCTION

	BY	DATE
DESIGNED	JLL	11/08
DRAWN	JLL	11/08
CHECKED	GSB	11/08

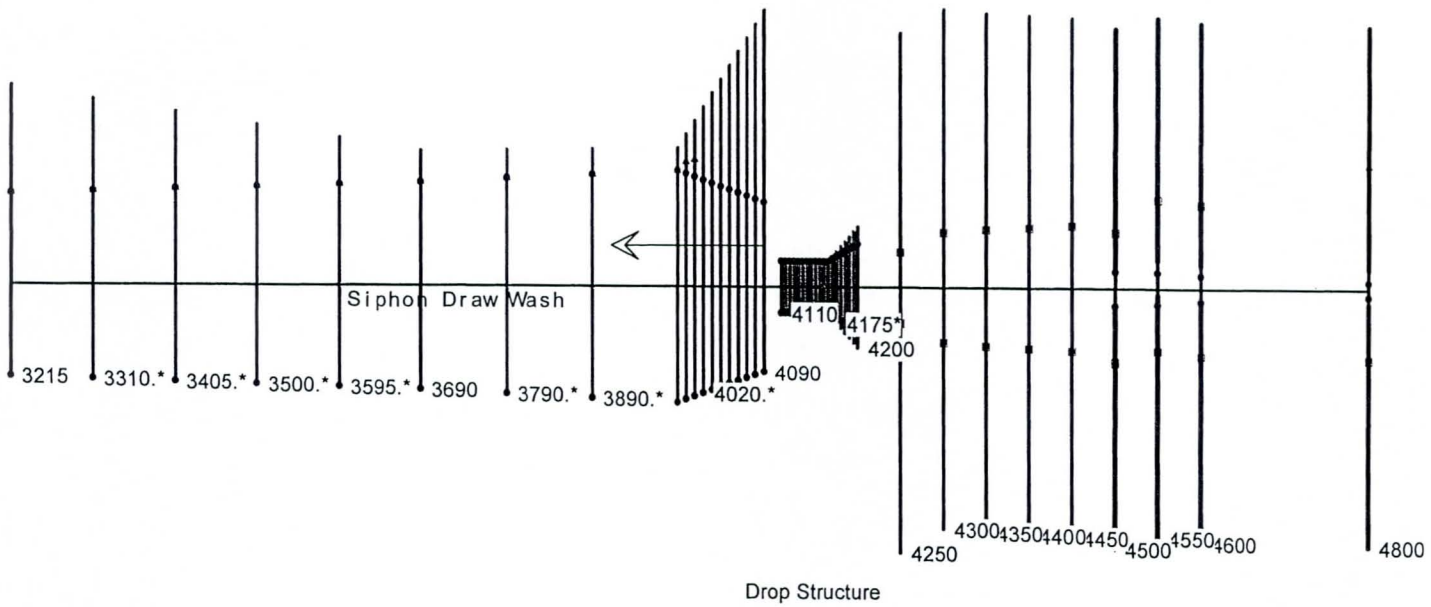
Stanley Consultants Inc.

DRAWING NO.

SIPHON DRAW WASH
STEPPED DROP HEC-RAS ANALYSIS

SHEET OF

Siphon Draw
Wash (East)
Drop Structure



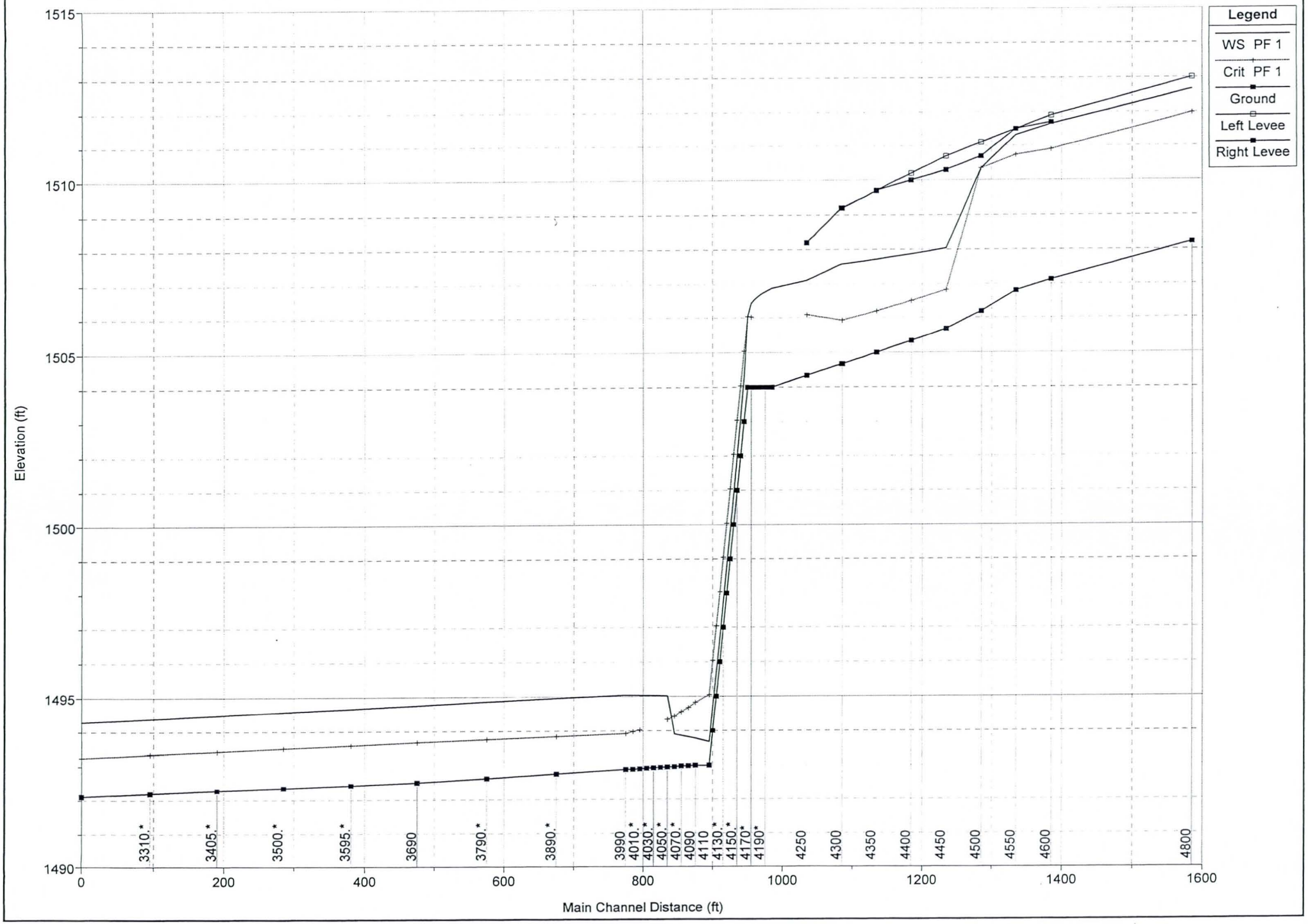
None of the XS's are Geo-Referenced (- Geo-Ref user entered XS - Geo-Ref interpolated XS - Non Geo-Ref user entered XS - Non Geo-Ref interpolated XS)

HEC-RAS Plan: Design River: Siphon Draw Wash Reach: Drop Structure Profile: PF 1

Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Drop Structure	4800	1000.00	1508.21	1512.66	1511.98	1512.78	0.004686	3.72	377.77	385.00	0.38
Drop Structure	4600	1000.00	1507.12	1511.65	1510.90	1511.80	0.004773	3.96	336.38	175.00	0.39
Drop Structure	4550	1000.00	1506.80	1511.32	1510.74	1511.51	0.007271	4.21	298.79	175.00	0.46
Drop Structure	4500	1000.00	1506.19	1510.34	1510.34	1510.95	0.015311	6.81	191.82	150.00	0.69
Drop Structure	4450	1000.00	1505.68	1508.04	1506.82	1508.17	0.003913	2.93	341.46	144.99	0.34
Drop Structure	4400	1000.00	1505.34	1507.86	1506.50	1507.98	0.003366	2.83	352.74	140.00	0.31
Drop Structure	4350	1000.00	1505.00	1507.71	1506.20	1507.83	0.002851	2.73	365.99	135.00	0.29
Drop Structure	4300	1000.00	1504.67	1507.57	1505.93	1507.69	0.002654	2.75	364.16	126.58	0.29
Drop Structure	4250	1000.00	1504.34	1507.10	1506.10	1507.45	0.008962	4.68	213.47	82.41	0.51
Drop Structure	4200	1000.00	1504.00	1506.88		1507.22	0.002783	4.68	213.85	88.75	0.53
Drop Structure	4195*	1000.00	1504.00	1506.83		1507.20	0.002123	4.91	203.68	84.21	0.56
Drop Structure	4190*	1000.00	1504.00	1506.77		1507.19	0.001983	5.16	193.68	79.80	0.58
Drop Structure	4185*	1000.00	1504.00	1506.71		1507.17	0.001842	5.45	183.56	75.49	0.62
Drop Structure	4180*	1000.00	1504.00	1506.64		1507.16	0.001706	5.77	173.20	71.30	0.65
Drop Structure	4175*	1000.00	1504.00	1506.55		1507.14	0.001585	6.16	162.29	67.28	0.70
Drop Structure	4170*	1000.00	1504.00	1506.43	1506.03	1507.12	0.001512	6.66	150.08	63.48	0.76
Drop Structure	4165	1000.00	1504.00	1506.04	1506.04	1507.08	0.002856	8.16	122.58	60.00	1.01
Drop Structure	4160.*	1000.00	1503.00	1504.29	1505.04	1506.89	0.012887	12.94	77.26	60.00	2.01
Drop Structure	4155.*	1000.00	1502.00	1503.09	1504.04	1506.71	0.022138	15.26	65.52	60.00	2.57
Drop Structure	4150.*	1000.00	1501.00	1501.98	1503.04	1506.49	0.031789	17.04	58.70	60.00	3.04
Drop Structure	4145.*	1000.00	1500.00	1500.90	1502.04	1506.22	0.041793	18.51	54.02	60.00	3.44
Drop Structure	4140.*	1000.00	1499.00	1499.84	1501.04	1505.91	0.051923	19.77	50.57	60.00	3.80
Drop Structure	4135.*	1000.00	1498.00	1498.80	1500.04	1505.56	0.062044	20.87	47.92	60.00	4.12
Drop Structure	4130.*	1000.00	1497.00	1497.76	1499.04	1505.16	0.071942	21.83	45.81	60.00	4.40
Drop Structure	4125.*	1000.00	1496.00	1496.74	1498.04	1504.72	0.081591	22.68	44.10	60.00	4.66
Drop Structure	4120.*	1000.00	1495.00	1495.71	1497.04	1504.24	0.090961	23.44	42.67	60.00	4.90
Drop Structure	4115.*	1000.00	1494.00	1494.69	1496.04	1503.71	0.099782	24.10	41.49	60.00	5.11
Drop Structure	4110	1000.00	1493.00	1493.68	1495.05	1503.15	0.108187	24.70	40.49	60.00	5.30
Drop Structure	4090	1000.00	1493.00	1493.78	1494.82	1499.32	0.165686	18.90	52.91	76.53	4.01
Drop Structure	4080.*	1000.00	1492.99	1493.81	1494.67	1497.51	0.100064	15.42	64.85	87.23	3.15
Drop Structure	4070.*	1000.00	1492.98	1493.86	1494.55	1496.38	0.061847	12.74	78.49	97.98	2.51
Drop Structure	4060.*	1000.00	1492.96	1493.90	1494.43	1495.66	0.039087	10.65	93.91	108.75	2.02
Drop Structure	4050.*	1000.00	1492.95	1495.02	1494.33	1495.27	0.002106	4.02	248.53	138.46	0.53
Drop Structure	4040.*	1000.00	1492.94	1495.03		1495.24	0.001721	3.69	270.70	147.33	0.48
Drop Structure	4030.*	1000.00	1492.93	1495.03		1495.21	0.001431	3.42	292.81	156.14	0.44
Drop Structure	4020.*	1000.00	1492.92	1495.04		1495.19	0.001207	3.18	314.95	164.91	0.40
Drop Structure	4010.*	1000.00	1492.90	1495.04	1494.03	1495.17	0.001013	2.95	339.02	173.78	0.37
Drop Structure	4000.*	1000.00	1492.89	1495.04	1493.97	1495.16	0.000874	2.77	361.38	193.46	0.35
Drop Structure	3990	1000.00	1492.88	1495.04	1493.92	1495.15	0.000760	2.61	383.84	204.11	0.32
Drop Structure	3890.*	1000.00	1492.76	1494.95	1493.84	1495.07	0.000811	2.71	369.57	196.04	0.34
Drop Structure	3790.*	1000.00	1492.63	1494.86	1493.76	1494.98	0.000867	2.81	355.43	187.98	0.35
Drop Structure	3690	1000.00	1492.51	1494.75	1493.68	1494.89	0.000969	2.97	336.91	179.64	0.37
Drop Structure	3595.*	1000.00	1492.43	1494.66	1493.59	1494.80	0.000972	2.97	336.90	185.13	0.37
Drop Structure	3500.*	1000.00	1492.35	1494.57	1493.51	1494.71	0.000977	2.97	336.75	187.53	0.37
Drop Structure	3405.*	1000.00	1492.27	1494.47	1493.42	1494.61	0.000983	2.97	336.37	182.27	0.37
Drop Structure	3310.*	1000.00	1492.19	1494.38	1493.35	1494.52	0.000991	2.98	335.78	181.42	0.37
Drop Structure	3215	1000.00	1492.11	1494.29	1493.25	1494.42	0.001000	2.99	334.96	181.52	0.37

SDW - Drop Structure Plan: Des 1:5 Ratio Sloping Drop 12/30/2008

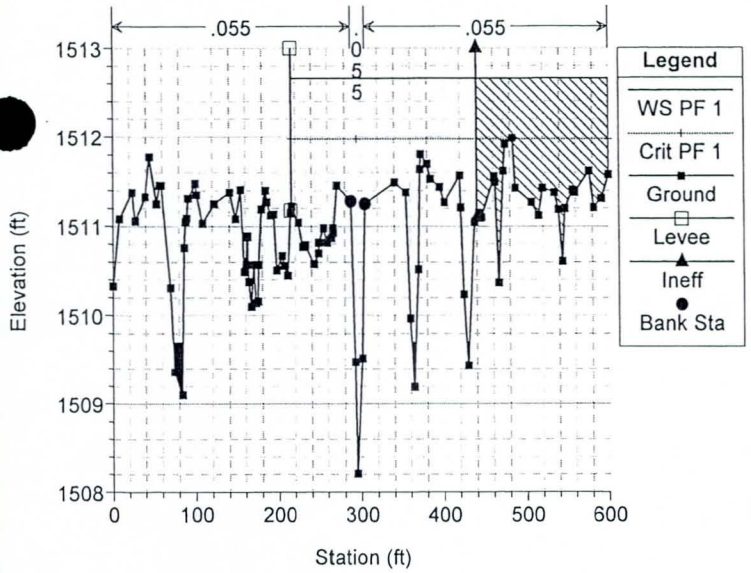
Flow: Desi 0yr, 24hr



SDW - Drop Structure Plan: Design: 1:5 Ratio Sloping Drop 12/30/2008

Flow: Design 100yr, 24hr

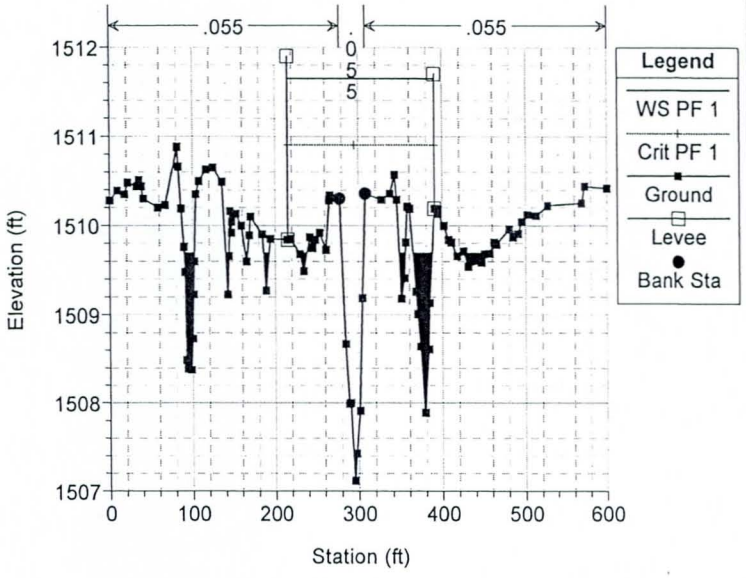
RS = 4800



SDW - Drop Structure Plan: Design: 1:5 Ratio Sloping Drop 12/30/2008

Flow: Design 100yr, 24hr

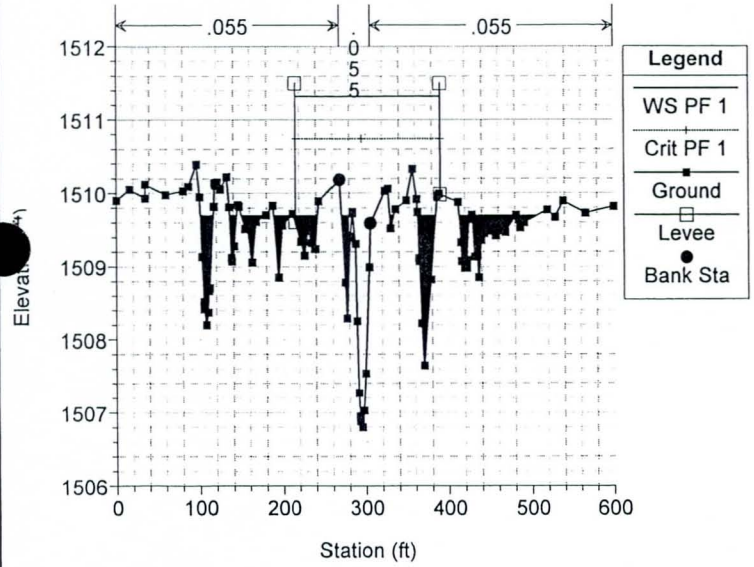
RS = 4600



SDW - Drop Structure Plan: Design: 1:5 Ratio Sloping Drop 12/30/2008

Flow: Design 100yr, 24hr

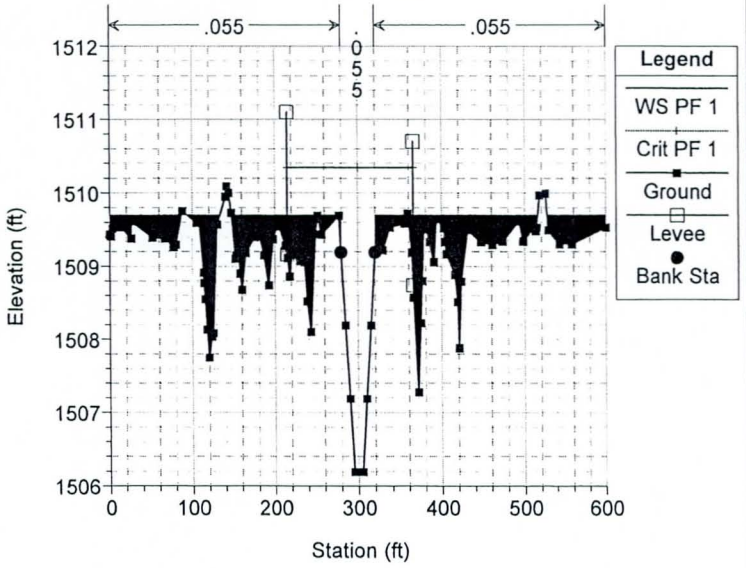
RS = 4550



SDW - Drop Structure Plan: Design: 1:5 Ratio Sloping Drop 12/30/2008

Flow: Design 100yr, 24hr

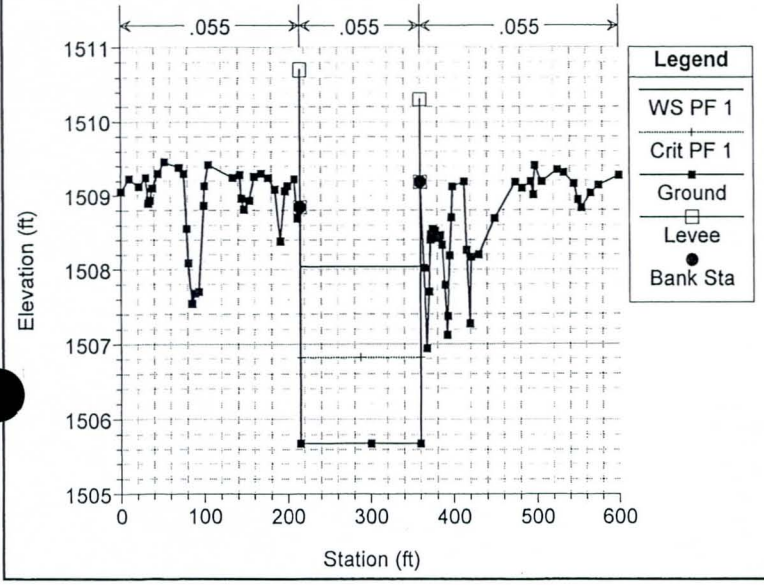
RS = 4500



SDW - Drop Structure Plan: Design: 1:5 Ratio Sloping Drop 12/30/2008

Flow: Design 100yr, 24hr

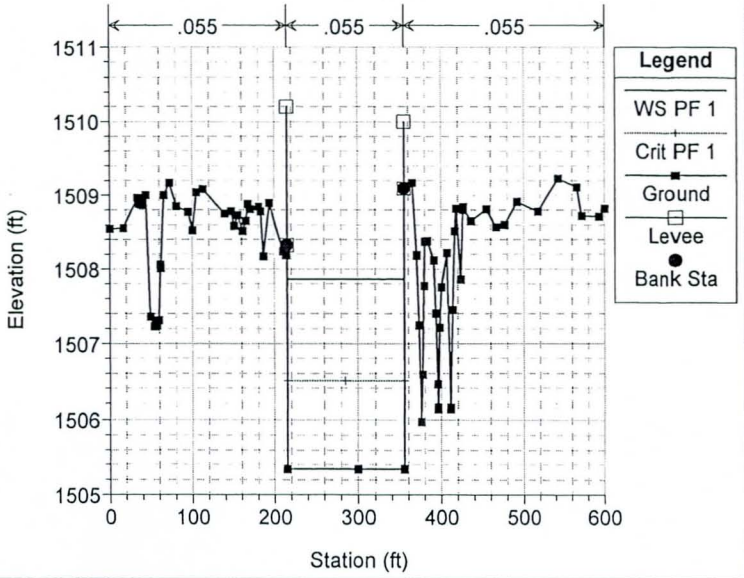
RS = 4450



SDW - Drop Structure Plan: Design: 1:5 Ratio Sloping Drop 12/30/2008

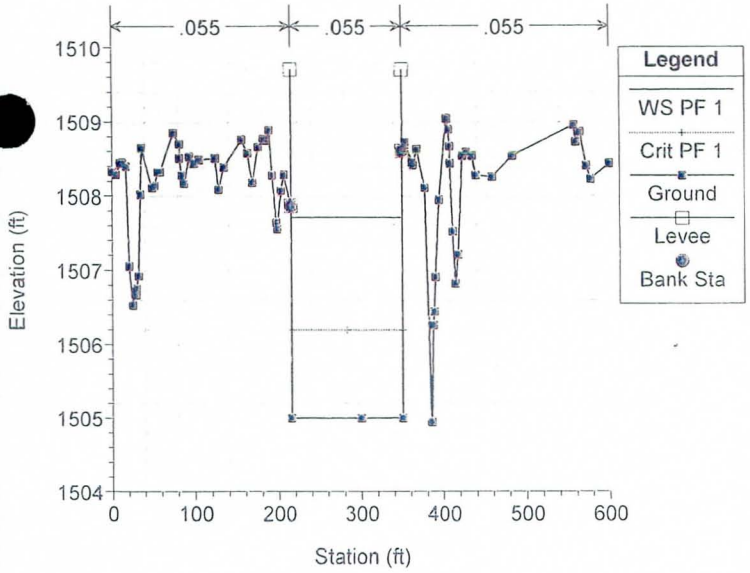
Flow: Design 100yr, 24hr

RS = 4400



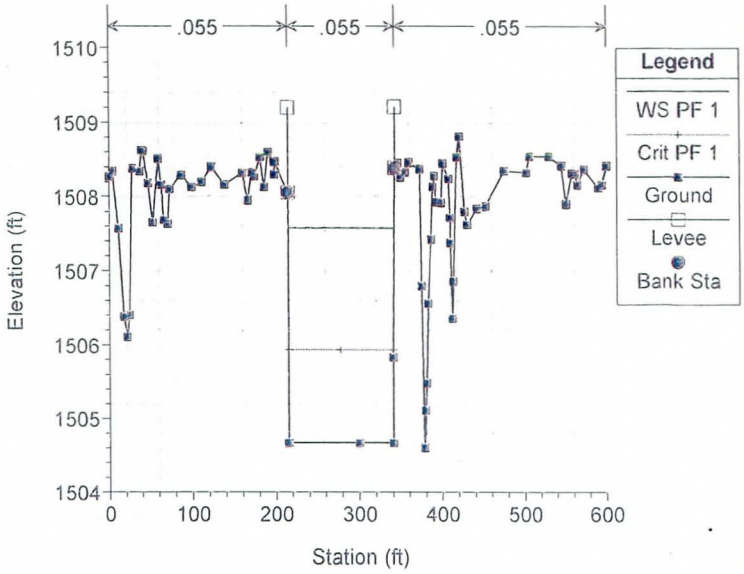
SDW - Drop Structure Plan: Design: 1:5 Ratio Sloping Drop 12/30/2008

Flow: Design 100yr, 24hr
RS = 4350



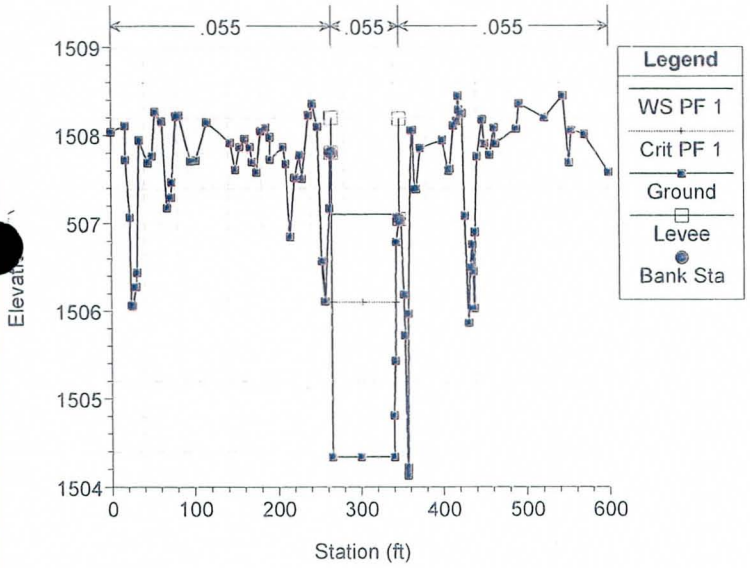
SDW - Drop Structure Plan: Design: 1:5 Ratio Sloping Drop 12/30/2008

Flow: Design 100yr, 24hr
RS = 4300



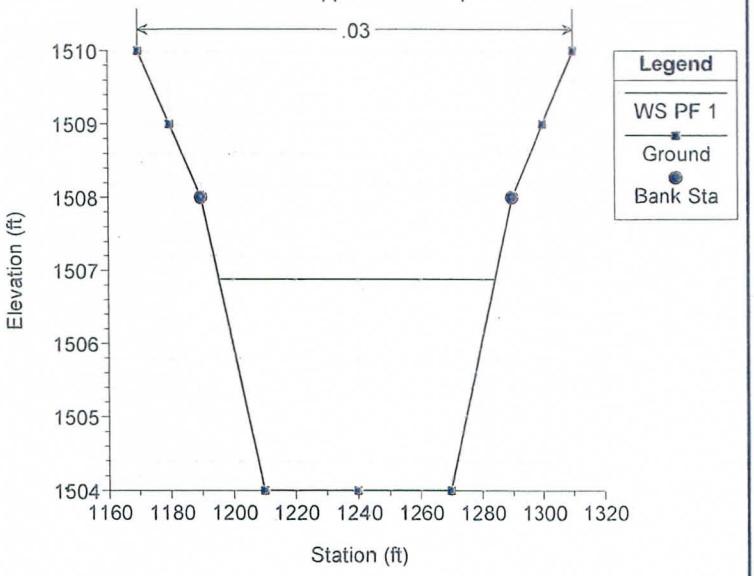
SDW - Drop Structure Plan: Design: 1:5 Ratio Sloping Drop 12/30/2008

Flow: Design 100yr, 24hr
RS = 4250



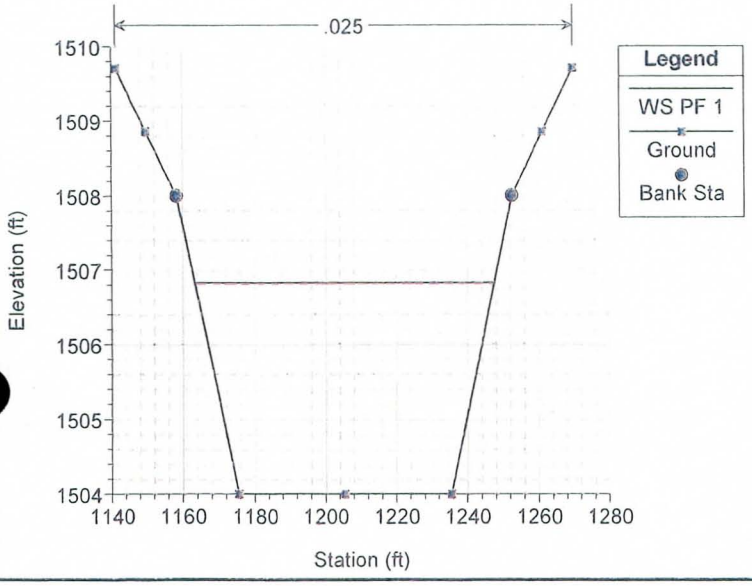
SDW - Drop Structure Plan: Design: 1:5 Ratio Sloping Drop 12/30/2008

Flow: Design 100yr, 24hr
RS = 4200 Approach to Drop Structure



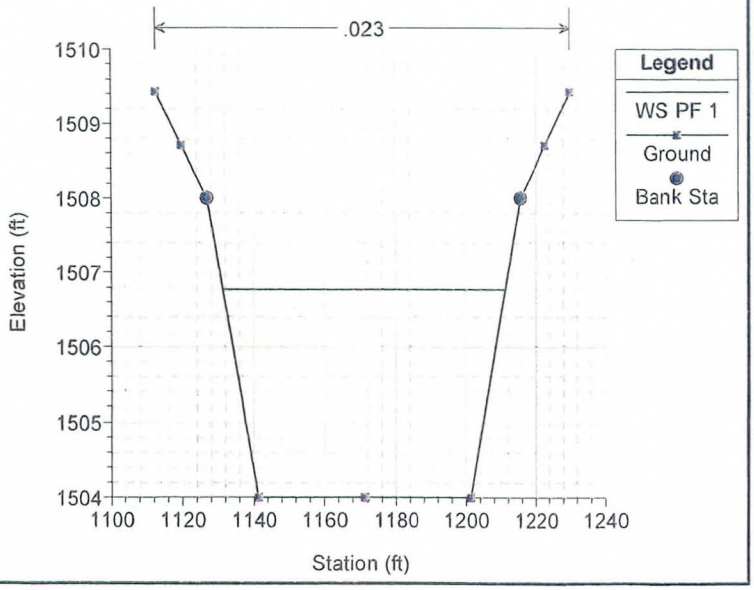
SDW - Drop Structure Plan: Design: 1:5 Ratio Sloping Drop 12/30/2008

Flow: Design 100yr, 24hr
RS = 4195*



SDW - Drop Structure Plan: Design: 1:5 Ratio Sloping Drop 12/30/2008

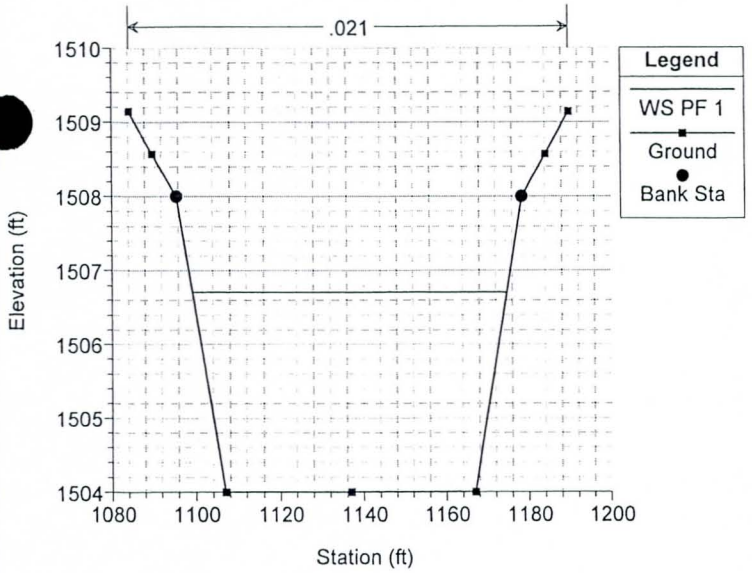
Flow: Design 100yr, 24hr
RS = 4190*



SDW - Drop Structure Plan: Design: 1:5 Ratio Sloping Drop 12/30/2008

Flow: Design 100yr, 24hr

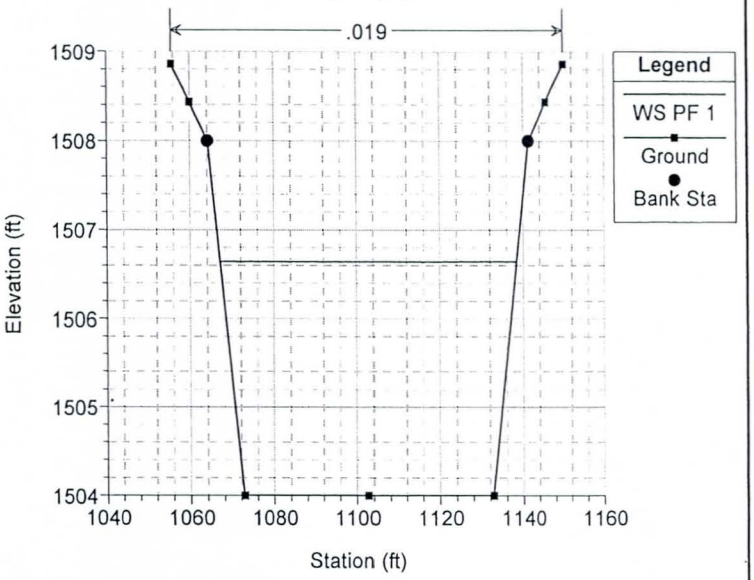
RS = 4185*



SDW - Drop Structure Plan: Design: 1:5 Ratio Sloping Drop 12/30/2008

Flow: Design 100yr, 24hr

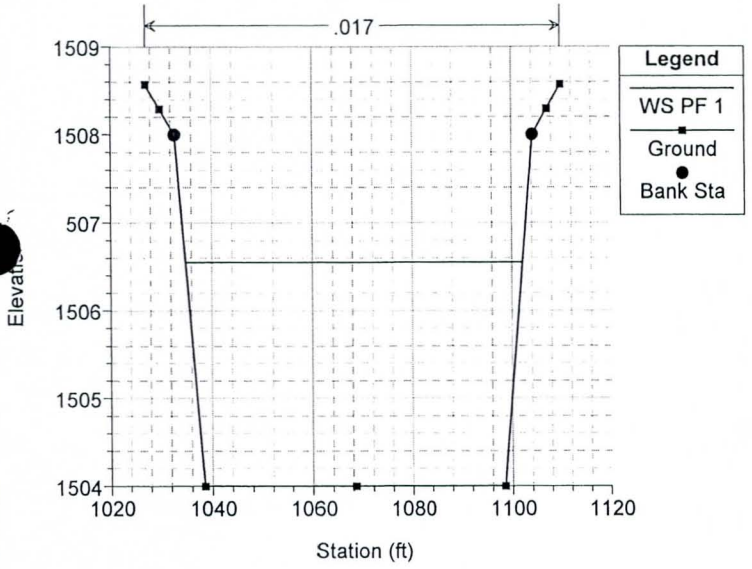
RS = 4180*



SDW - Drop Structure Plan: Design: 1:5 Ratio Sloping Drop 12/30/2008

Flow: Design 100yr, 24hr

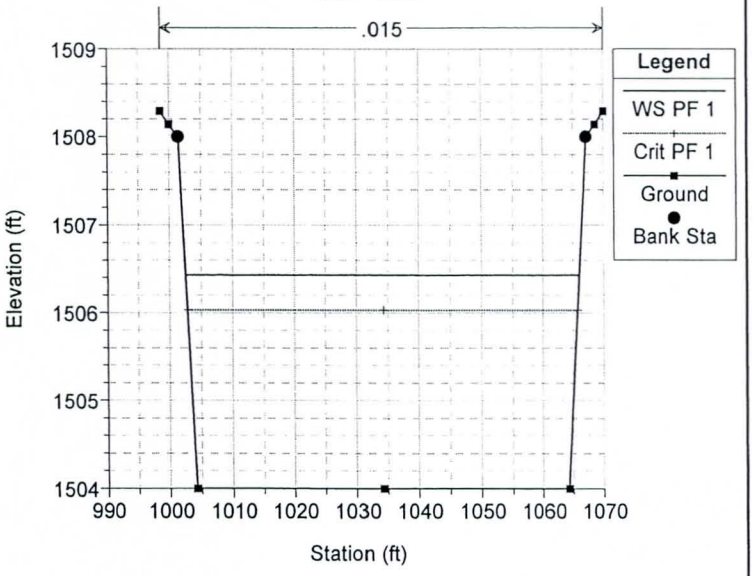
RS = 4175*



SDW - Drop Structure Plan: Design: 1:5 Ratio Sloping Drop 12/30/2008

Flow: Design 100yr, 24hr

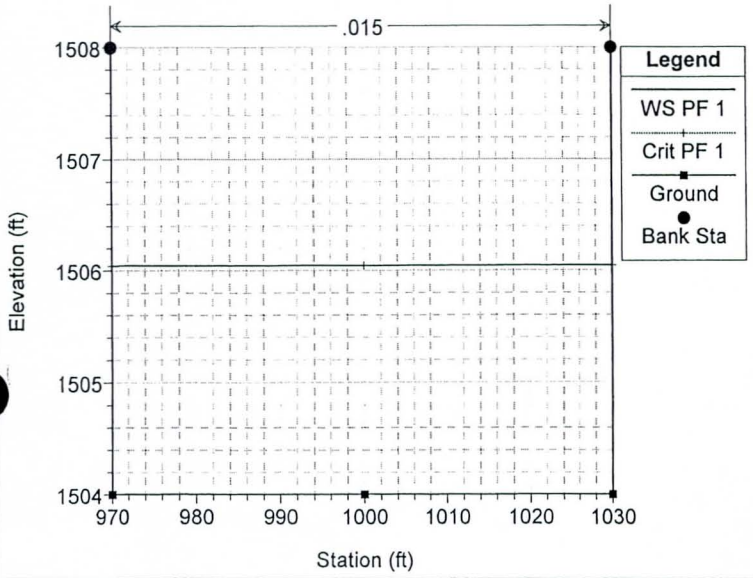
RS = 4170*



SDW - Drop Structure Plan: Design: 1:5 Ratio Sloping Drop 12/30/2008

Flow: Design 100yr, 24hr

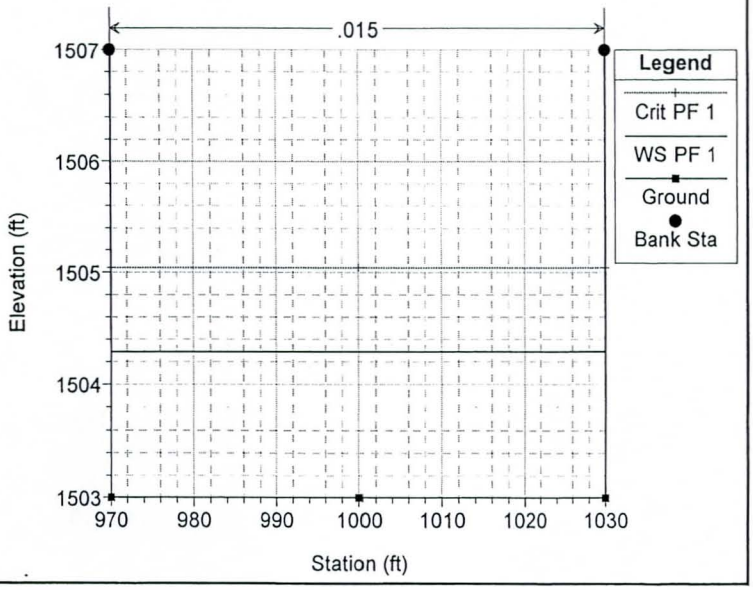
RS = 4165 Crest of Drop Structure



SDW - Drop Structure Plan: Design: 1:5 Ratio Sloping Drop 12/30/2008

Flow: Design 100yr, 24hr

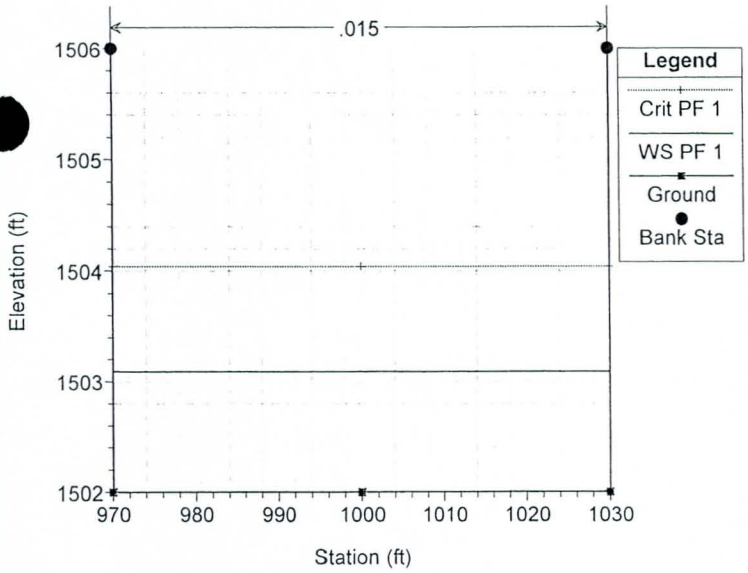
RS = 4160.*



SDW - Drop Structure Plan: Design: 1:5 Ratio Sloping Drop 12/30/2008

Flow: Design 100yr, 24hr

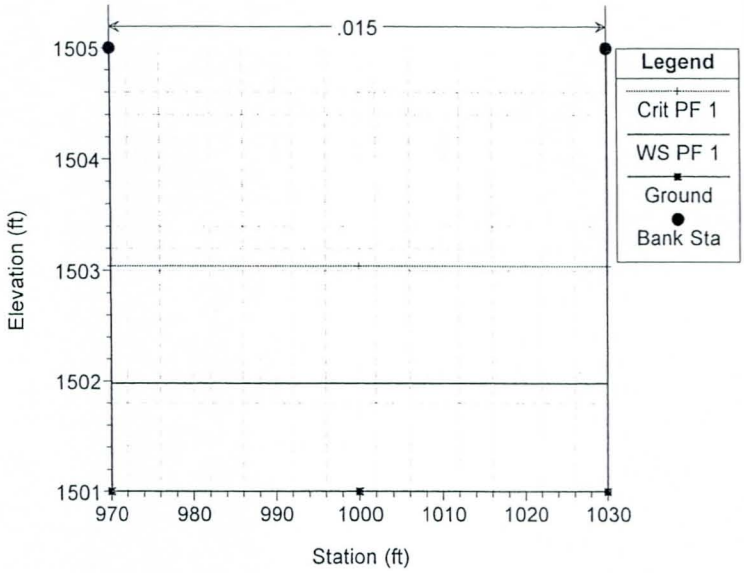
RS = 4155.*



SDW - Drop Structure Plan: Design: 1:5 Ratio Sloping Drop 12/30/2008

Flow: Design 100yr, 24hr

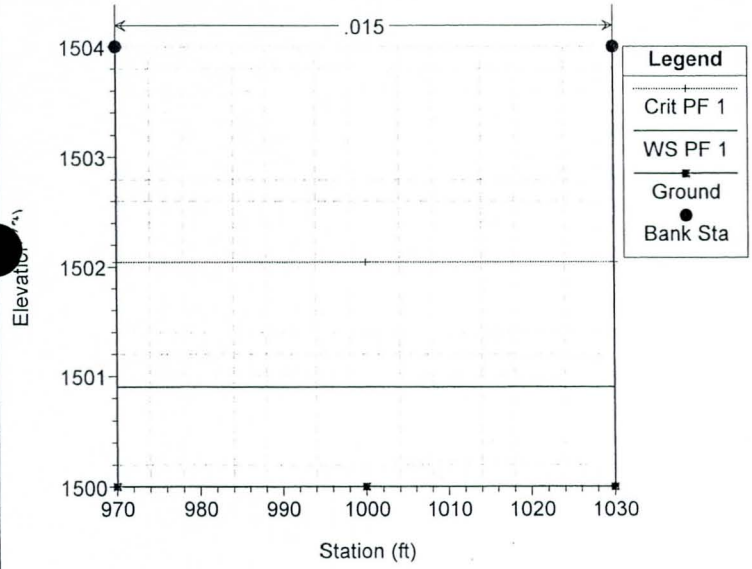
RS = 4150.*



SDW - Drop Structure Plan: Design: 1:5 Ratio Sloping Drop 12/30/2008

Flow: Design 100yr, 24hr

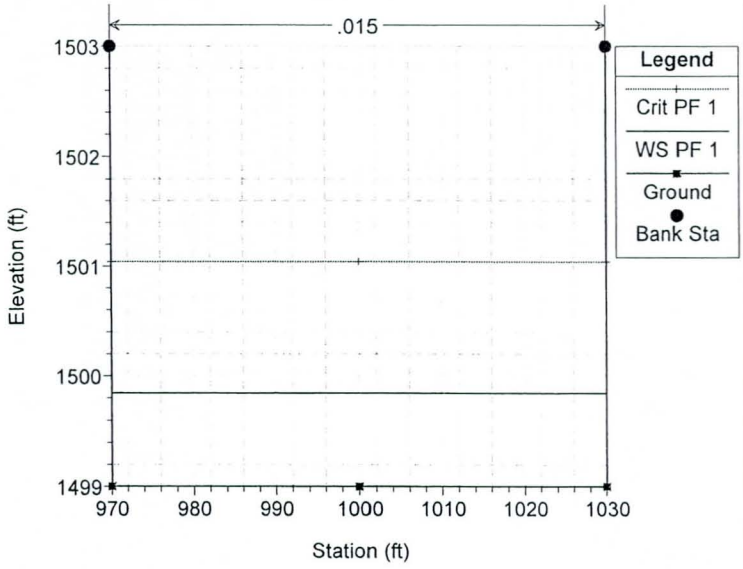
RS = 4145.*



SDW - Drop Structure Plan: Design: 1:5 Ratio Sloping Drop 12/30/2008

Flow: Design 100yr, 24hr

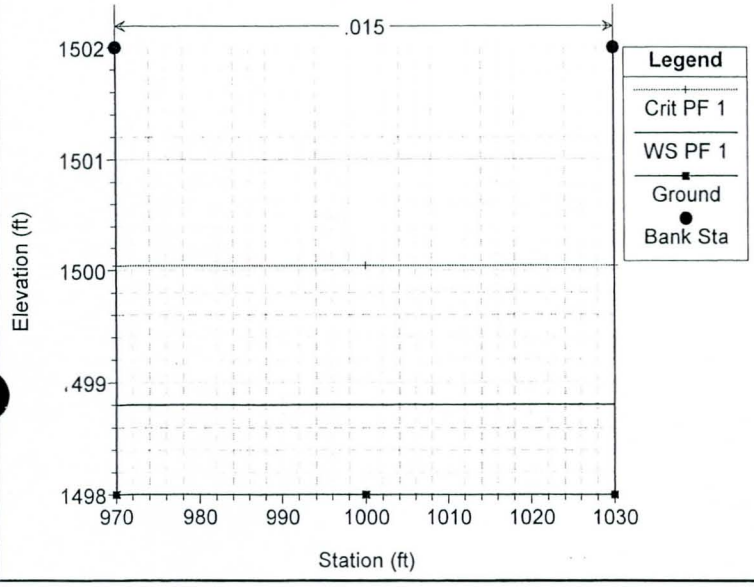
RS = 4140.*



SDW - Drop Structure Plan: Design: 1:5 Ratio Sloping Drop 12/30/2008

Flow: Design 100yr, 24hr

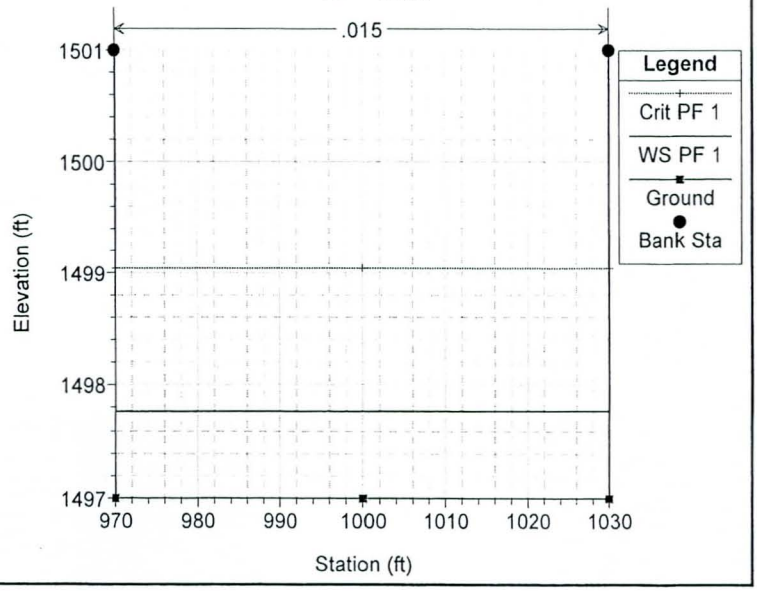
RS = 4135.*



SDW - Drop Structure Plan: Design: 1:5 Ratio Sloping Drop 12/30/2008

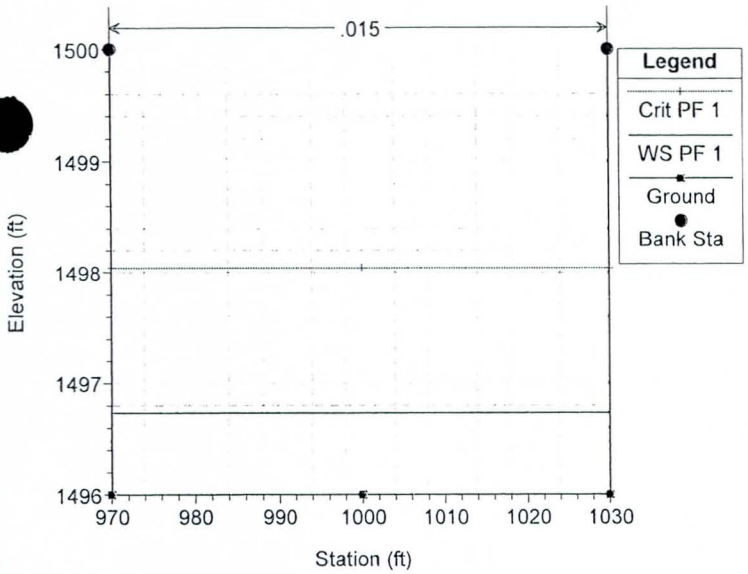
Flow: Design 100yr, 24hr

RS = 4130.*



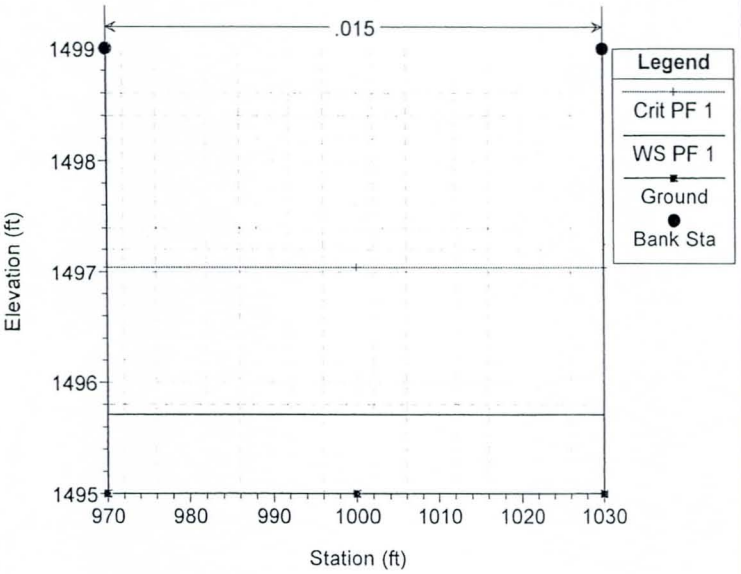
SDW - Drop Structure Plan: Design: 1:5 Ratio Sloping Drop 12/30/2008

Flow: Design 100yr, 24hr
RS = 4125.*



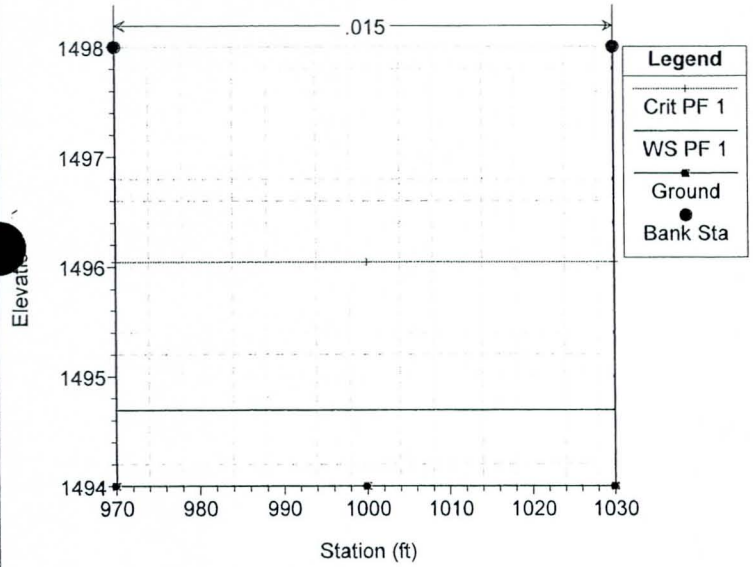
SDW - Drop Structure Plan: Design: 1:5 Ratio Sloping Drop 12/30/2008

Flow: Design 100yr, 24hr
RS = 4120.*



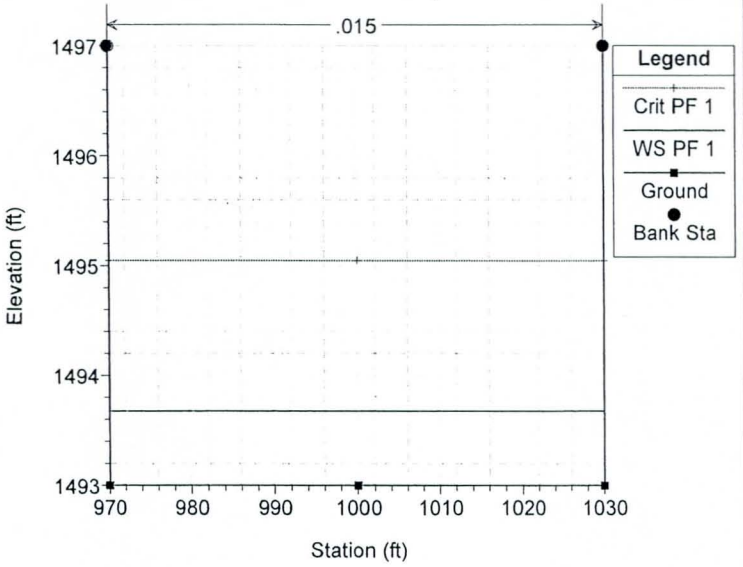
SDW - Drop Structure Plan: Design: 1:5 Ratio Sloping Drop 12/30/2008

Flow: Design 100yr, 24hr
RS = 4115.*



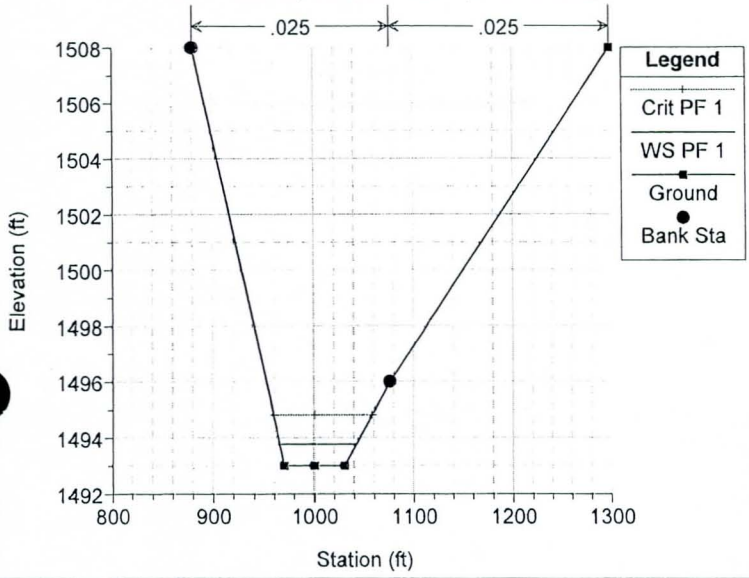
SDW - Drop Structure Plan: Design: 1:5 Ratio Sloping Drop 12/30/2008

Flow: Design 100yr, 24hr
RS = 4110 Toe of Drop Structure



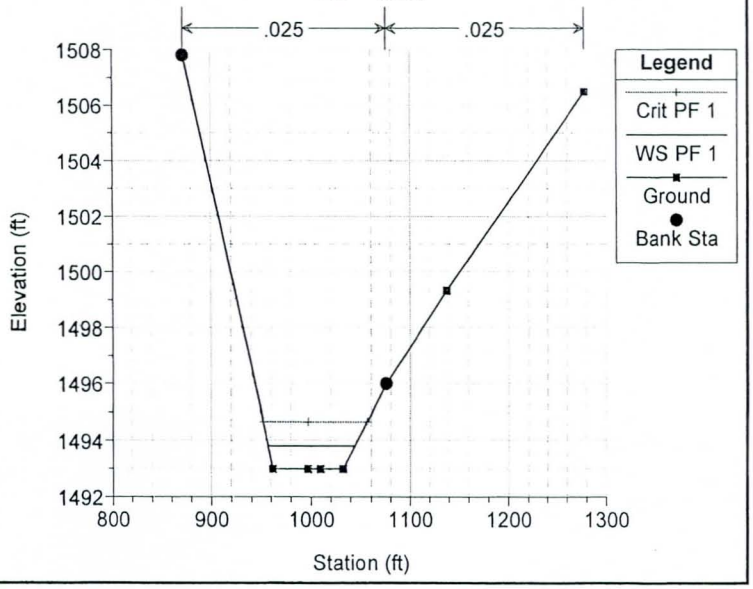
SDW - Drop Structure Plan: Design: 1:5 Ratio Sloping Drop 12/30/2008

Flow: Design 100yr, 24hr
RS = 4090 Siphon Draw Basin (Channel area)



SDW - Drop Structure Plan: Design: 1:5 Ratio Sloping Drop 12/30/2008

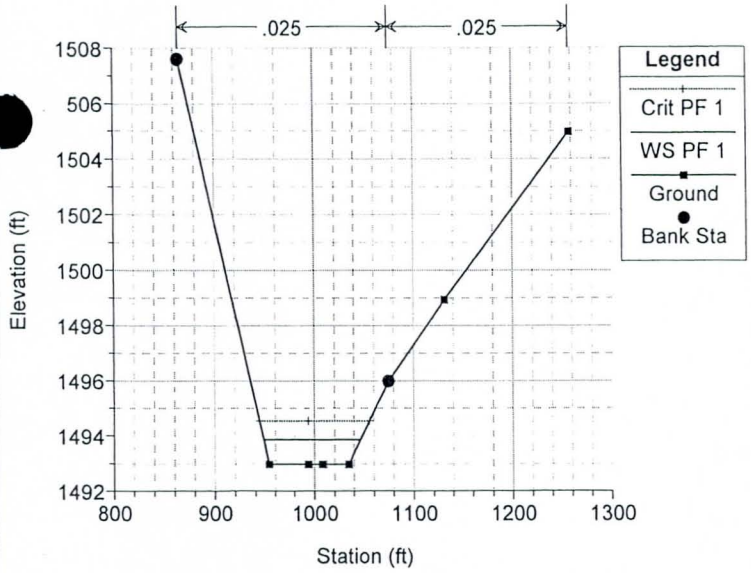
Flow: Design 100yr, 24hr
RS = 4080.*



SDW - Drop Structure Plan: Design: 1:5 Ratio Sloping Drop 12/30/2008

Flow: Design 100yr, 24hr

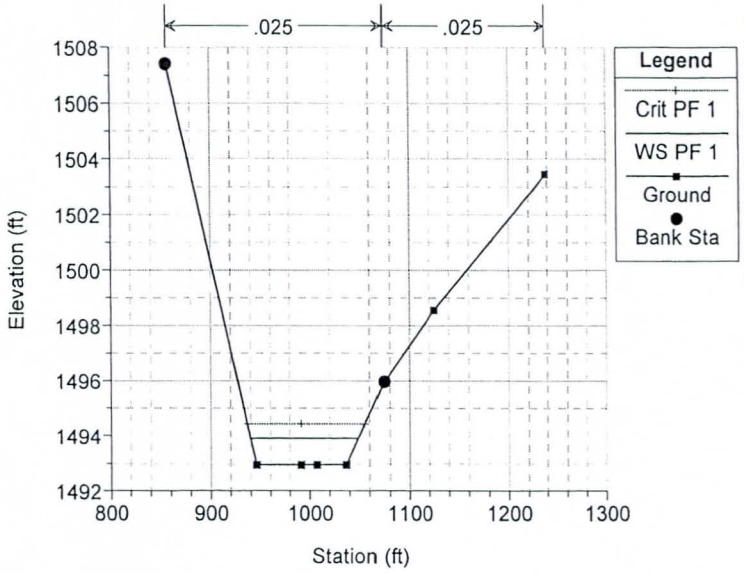
RS = 4070.*



SDW - Drop Structure Plan: Design: 1:5 Ratio Sloping Drop 12/30/2008

Flow: Design 100yr, 24hr

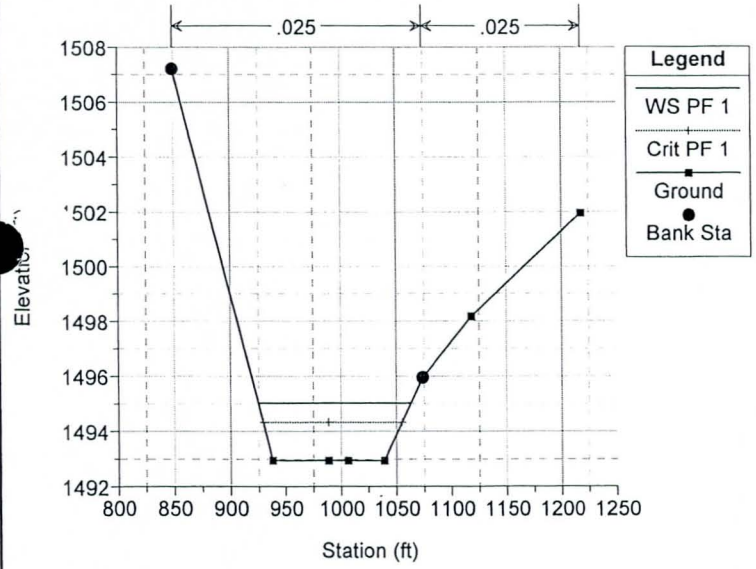
RS = 4060.*



SDW - Drop Structure Plan: Design: 1:5 Ratio Sloping Drop 12/30/2008

Flow: Design 100yr, 24hr

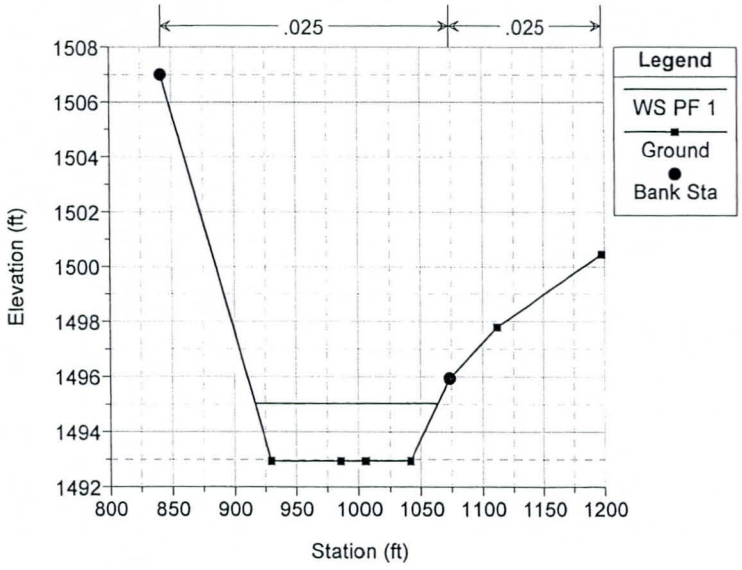
RS = 4050.*



SDW - Drop Structure Plan: Design: 1:5 Ratio Sloping Drop 12/30/2008

Flow: Design 100yr, 24hr

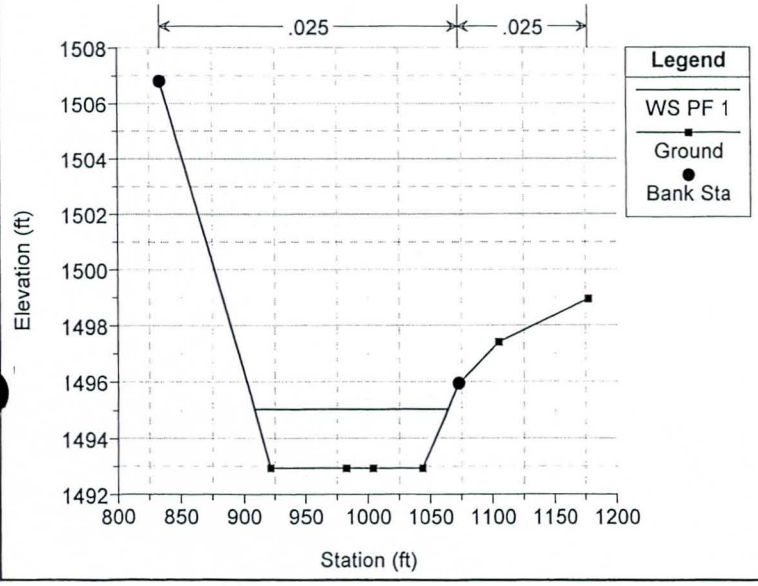
RS = 4040.*



SDW - Drop Structure Plan: Design: 1:5 Ratio Sloping Drop 12/30/2008

Flow: Design 100yr, 24hr

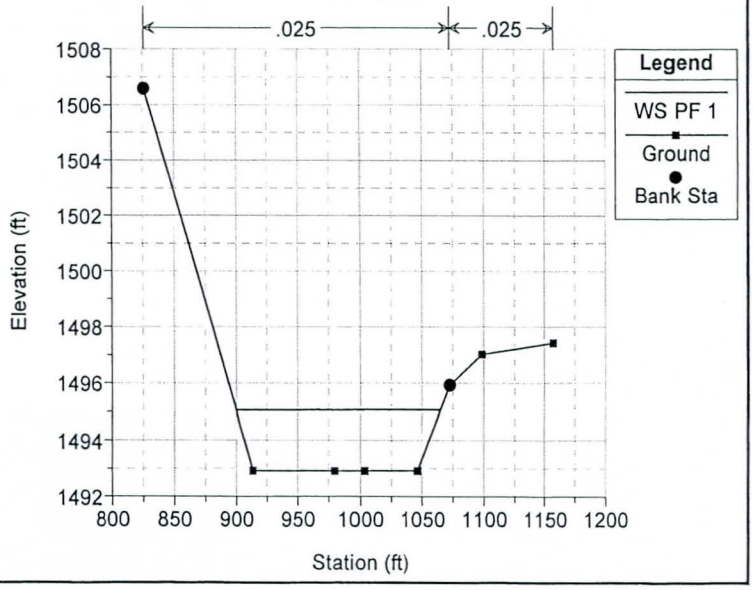
RS = 4030.*



SDW - Drop Structure Plan: Design: 1:5 Ratio Sloping Drop 12/30/2008

Flow: Design 100yr, 24hr

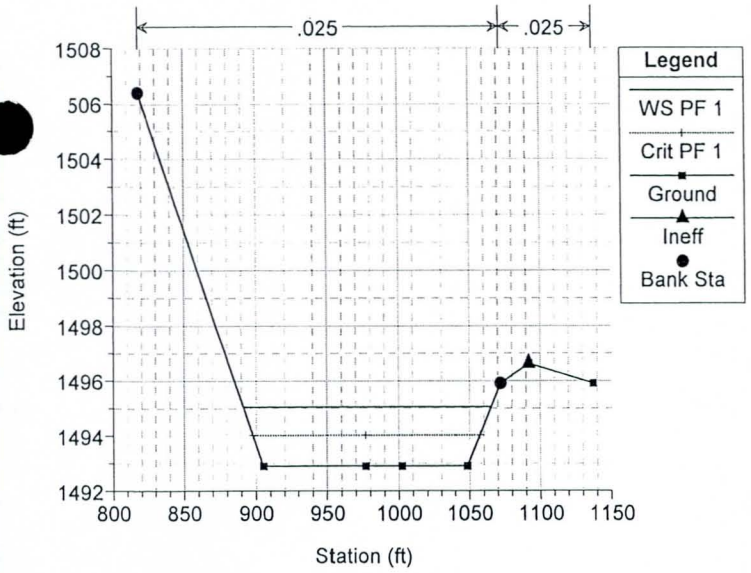
RS = 4020.*



SDW - Drop Structure Plan: Design: 1:5 Ratio Sloping Drop 12/30/2008

Flow: Design 100yr, 24hr

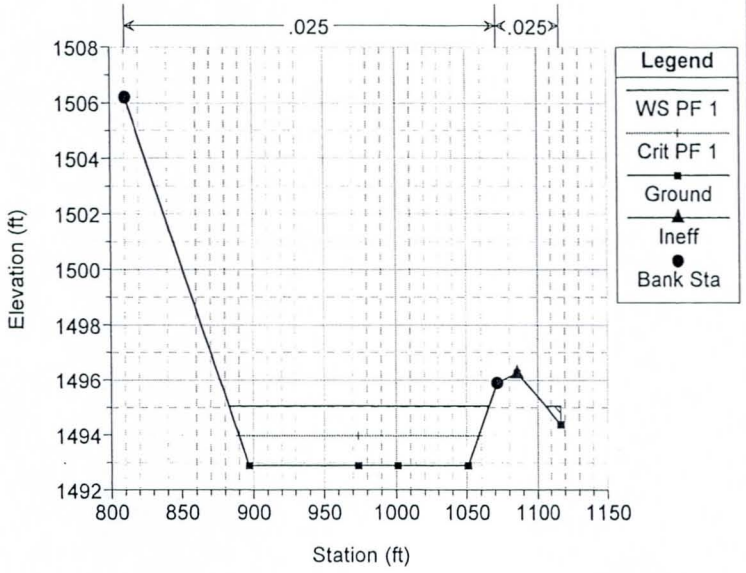
RS = 4010.*



SDW - Drop Structure Plan: Design: 1:5 Ratio Sloping Drop 12/30/2008

Flow: Design 100yr, 24hr

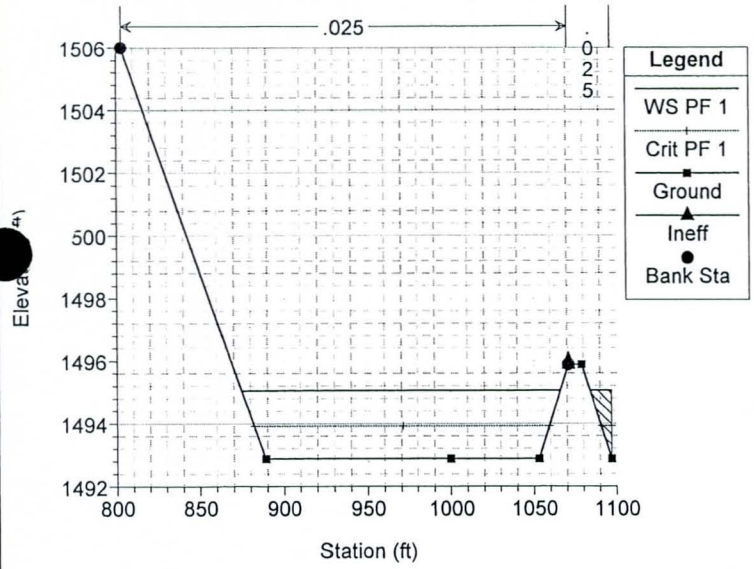
RS = 4000.*



SDW - Drop Structure Plan: Design: 1:5 Ratio Sloping Drop 12/30/2008

Flow: Design 100yr, 24hr

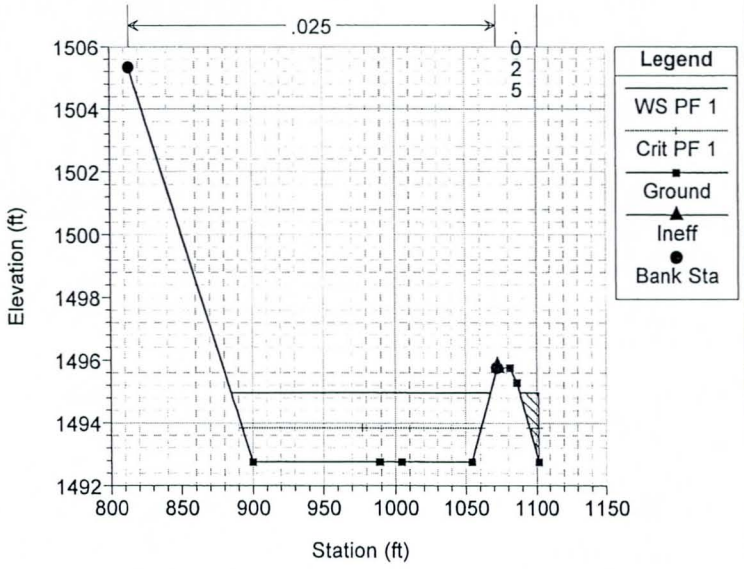
RS = 3990 Siphon Draw Basin (Channel area)



SDW - Drop Structure Plan: Design: 1:5 Ratio Sloping Drop 12/30/2008

Flow: Design 100yr, 24hr

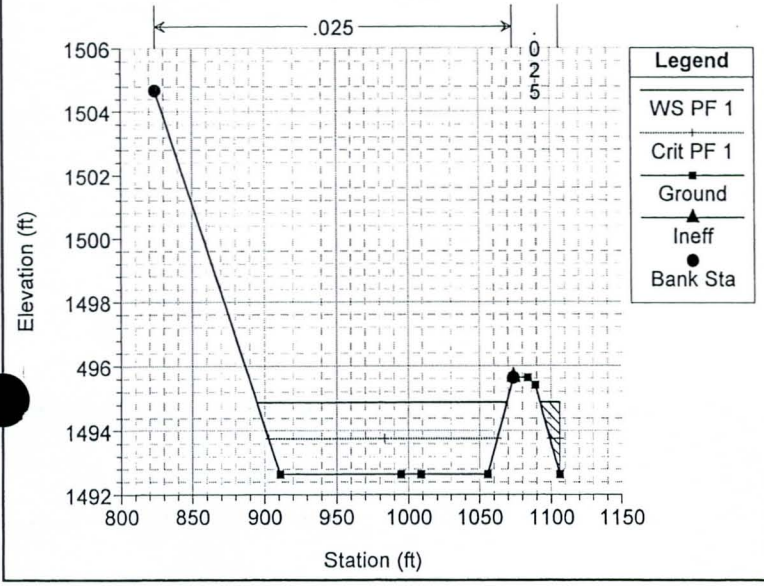
RS = 3890.*



SDW - Drop Structure Plan: Design: 1:5 Ratio Sloping Drop 12/30/2008

Flow: Design 100yr, 24hr

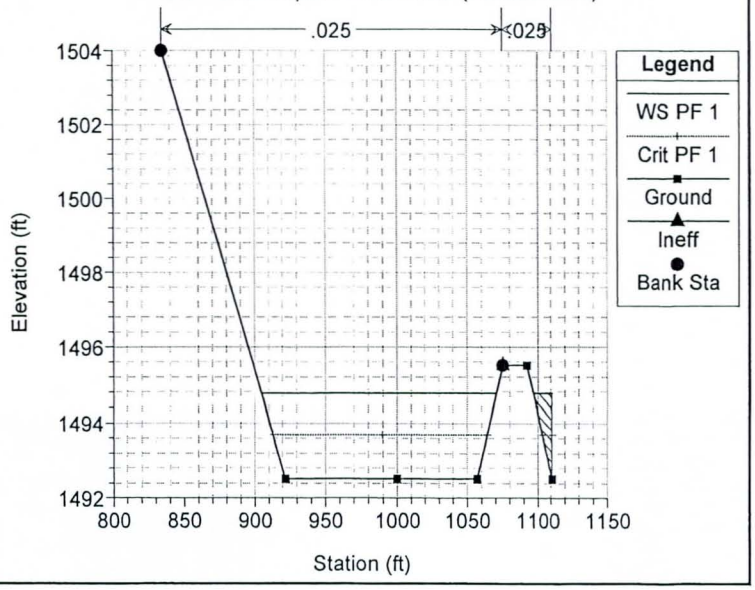
RS = 3790.*



SDW - Drop Structure Plan: Design: 1:5 Ratio Sloping Drop 12/30/2008

Flow: Design 100yr, 24hr

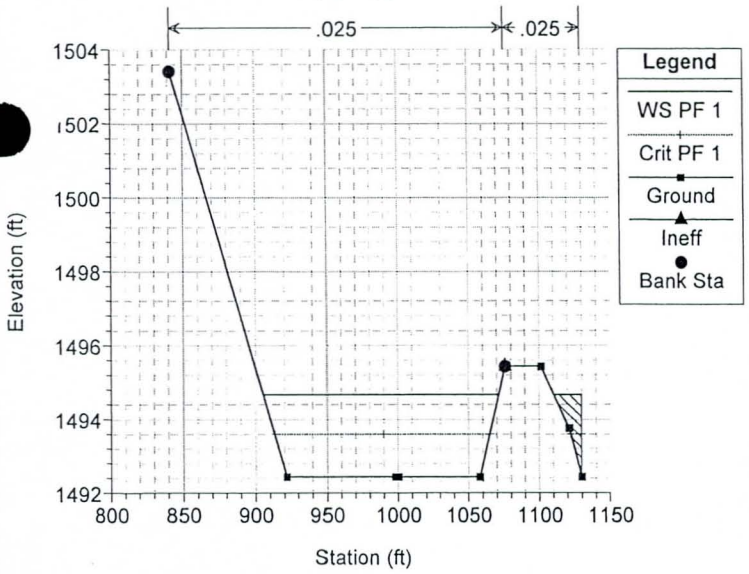
RS = 3690 Siphon Draw Basin (Channel area)



SDW - Drop Structure Plan: Design: 1:5 Ratio Sloping Drop 12/30/2008

Flow: Design 100yr, 24hr

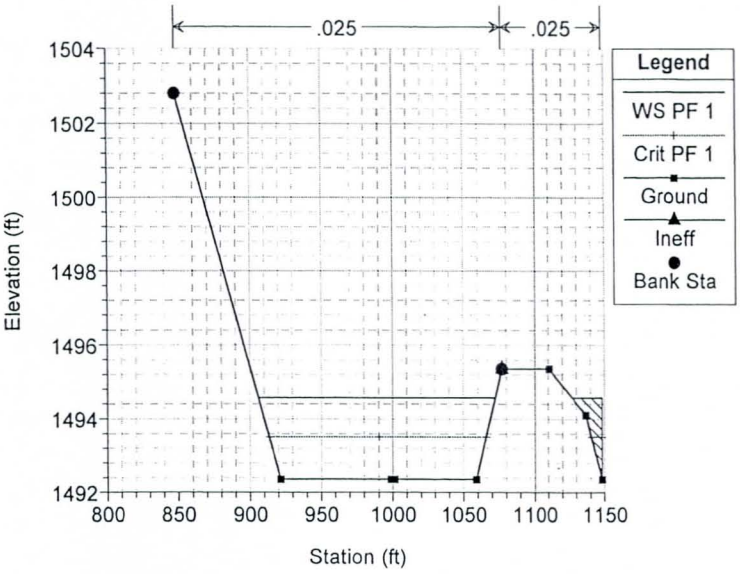
RS = 3595.*



SDW - Drop Structure Plan: Design: 1:5 Ratio Sloping Drop 12/30/2008

Flow: Design 100yr, 24hr

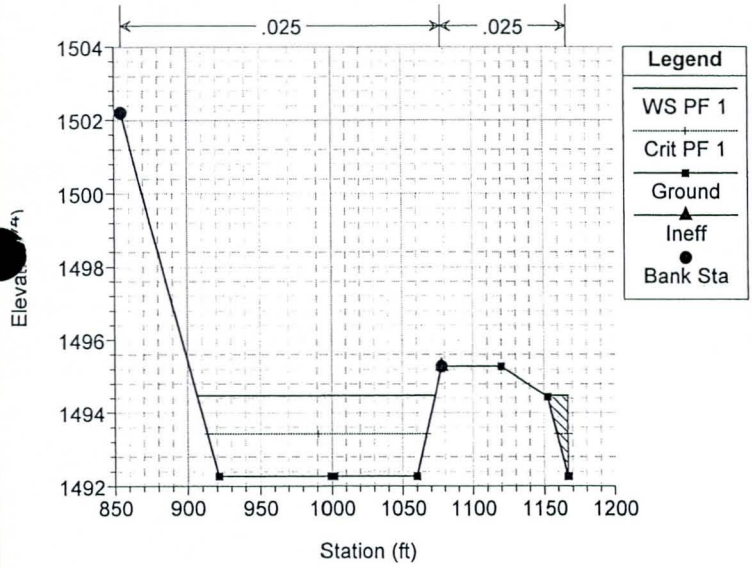
RS = 3500.*



SDW - Drop Structure Plan: Design: 1:5 Ratio Sloping Drop 12/30/2008

Flow: Design 100yr, 24hr

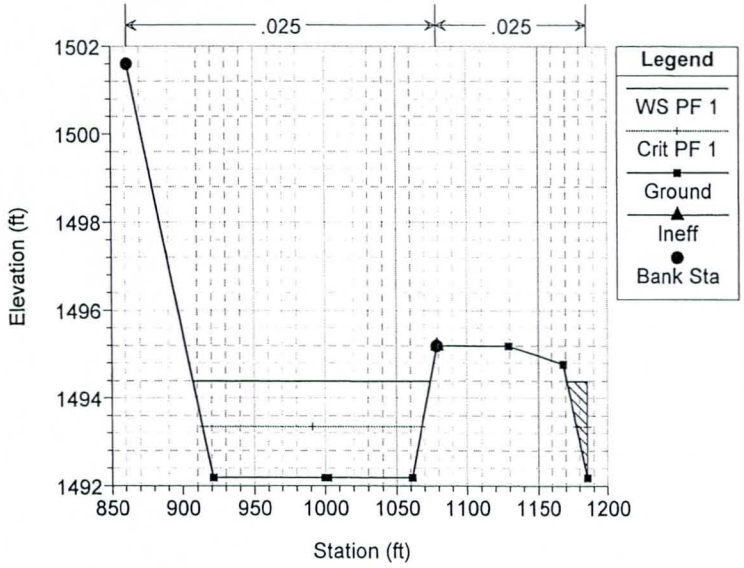
RS = 3405.*



SDW - Drop Structure Plan: Design: 1:5 Ratio Sloping Drop 12/30/2008

Flow: Design 100yr, 24hr

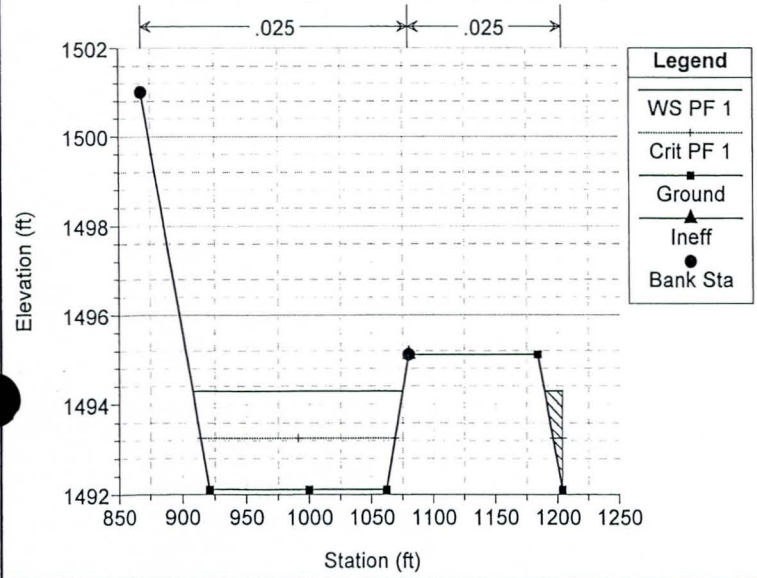
RS = 3310.*



SDW - Drop Structure Plan: Design: 1:5 Ratio Sloping Drop 12/30/2008

Flow: Design 100yr, 24hr

RS = 3215 Siphon Draw Basin (Channel area)



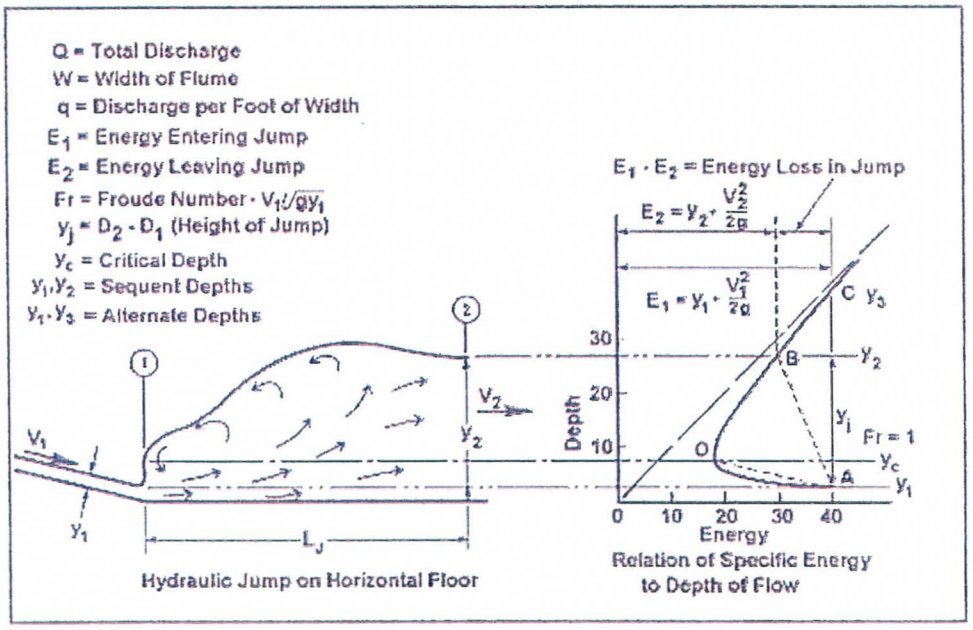
Reference: American Society of Civil Engineers (1995). *Hydraulic Design of Spillways*. American Society of Civil Engineers, U.S. Army Corps of Engineers. 1995.

The following equations are referenced and used for the design of the apron lengtl a horizontal apron floor, downstream of a sloping drop structure (see figure below)

$F_1 = V_1/(gD_1)^{1/2}$ $\qquad$ $D_2/D_1 = 1/2\ [(1+8F_1^2)^{1/2} - 1]$

Drop Structure Longitudinal Slope	D_1	V_1	D_2	Fr_1	L
H:V	ft	ft/s	ft		ft
5:1	0.69	24.1	**4.66**	5.11	13.6

Notes: 1. D_1 and V_1 are the depth and velocity, respectively, at the toe of the drop structure and are taken fr



Scour at Toe of Sloping Sill

References: 1. Arizona Department of Transportation, (1983). *Scour at Sill Structures.* State of Arizona. Report No. FHWA/AZ 83/184.

The ADOT equation for estimating scour for sloping sills is:

$$D_s / y_c = 4(y_c/d_m)^{0.2} - 3(d_{rr}/y_c)^{0.1}$$

$$d_s = D_s - y_n$$

Sill:

Variables:

q_0	Discharge per unit width of structure ($ft^3/s/ft$)
g	Gravitational acceleration (ft/s^2) (32.2)
d_s	Depth of scour below stream bed (ft)
D_s	Depth of scour below tailwater elevation (ft)
y_c	critical depth (ft)
y_n	Normal depth in downstream channel (ft) (Tailwater condition)
d_m	Size of material being scoured (ft)
d_{rr}	Size of riprap along sloping sill (ft)[2]

q_o =	16.7	$ft^3/s/ft$	
g =	32.2	ft/s^2	
$y_c = (q_o^2/g)^{1/3}$ =	2.1	ft	
y_n =	**0**	ft	
Without apron			
d_m =	**0.01**	ft	native material
d_{rr} =	**3**	ft	
D_s =	17.4	ft	
d_s =	17.4	ft	
With apron			
d_m =	**1**	ft	riprap on downstream apron
d_{rr} =	3	ft	
D_s =	3.1	ft	
d_s =	3.1	ft	

Note: 1. The preceeding ADOT equation for estimating scour assumes a 1 vertical to 4 horizontal (1V:4H) slope ratio.

2. The ADOT equation predicts scour based on sizes of riprap used on the foreslope as well as the downstream apron. In this case the foreslope is concrete steps. A large size of stone is therefore assumed to represent this foreslope condition.

3. This calculation is conservative, since the slope of the drop structure will be 1V:5H.

Reference: American Society of Civil Engineers (1995). *Hydraulic Design of Spillways*. American Society of Civil Engineers, U.S. Army Corps of Engineers. 1995.

The following equations are referenced and used for the design of the end sill at the terminus of a horizontal apron:

Choose the smaller of:

$$H_s = D_1/2 \quad \text{or} \quad H_s = D_2/12$$

Given: $D_1 = 0.69$ ft

$D_2 = 5.48$ ft

Calculation: $H_s = 0.345$ ft or

$H_s = 0.457$ ft

Design: Minimum sill height should be 0.35' - 0.46'

Design Sill Height = 0.5 ft

SIPHON DRAW WASH

Miscellaneous

Culvert Designer/Analyzer Report
Basin Bypass Flow on Siphon Draw Wash

Analysis Component			
Storm Event	Design	Discharge	20.00 cfs

Peak Discharge Method: User-Specified			
Design Discharge	20.00 cfs	Check Discharge	30.00 cfs

Tailwater properties: Triangular Channel

Tailwater conditions for Design Storm.			
Discharge	20.00 cfs	Bottom Elevation	1,504.50 ft
Depth	2.07 ft	Velocity	1.55 ft/s

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	2-24 inch Circular	20.01 cfs	1,506.93 ft	3.18 ft/s
Weir	Roadway (Constant Elevation)	0.00 cfs	1,506.93 ft	N/A
Total	----------	20.01 cfs	1,506.93 ft	N/A

Culvert Designer/Analyzer Report
Basin Bypass Flow on Siphon Draw Wash

Component:Culvert-1

Culvert Summary					
Computed Headwater Elev:	1,506.93	ft	Discharge	20.01	cfs
Inlet Control HW Elev.	1,506.57	ft	Tailwater Elevation	1,506.57	ft
Outlet Control HW Elev.	1,506.93	ft	Control Type	Outlet Control	
Headwater Depth/Height	1.11				

Grades					
Upstream Invert	1,504.70	ft	Downstream Invert	1,504.50	ft
Length	85.00	ft	Constructed Slope	0.002353	ft/ft

Hydraulic Profile					
Profile	PressureProfile		Depth, Downstream	2.07	ft
Slope Type	N/A		Normal Depth	1.50	ft
Flow Regime	N/A		Critical Depth	1.13	ft
Velocity Downstream	3.18	ft/s	Critical Slope	0.005201	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	2.00	ft
Section Size	24 inch		Rise	2.00	ft
Number Sections	2				

Outlet Control Properties					
Outlet Control HW Elev.	1,506.93	ft	Upstream Velocity Head	0.16	ft
Ke	0.20		Entrance Loss	0.03	ft

Inlet Control Properties					
Inlet Control HW Elev.	1,506.57	ft	Flow Control	Unsubmerged	
Inlet Type	Groove end w/headwall		Area Full	6.3	ft^2
K	0.00180		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	2	
C	0.02920		Equation Form	1	
Y	0.74000				

Culvert Designer/Analyzer Report
Basin Bypass Flow on Siphon Draw Wash

Component:Weir

Hydraulic Component(s): Roadway (Constant Elevation)					
Discharge	0.00	cfs	Allowable HW Elevation	1,506.93	ft
Roadway Width	200.00	ft	Overtopping Coefficient	2.90	US
Length	50.00	ft	Crest Elevation	1,507.00	ft
Headwater Elevation	N/A	ft	Discharge Coefficient (Cr)	2.90	
Submergence Factor (Kt)	1.00				

Sta (ft)	Elev. (ft)
0.00	1,507.00
50.00	1,507.00

APPENDIX E

PROJECT OUTFALL / ELLIOT ROAD STORM DRAIN INLET

ELLIOT ROAD
STORM DRAIN INLET

Hydraulics

Appendix E

This section provides the supporting documentation for the estimate of the flow split between flow entering the Elliot Road Storm Drain and flow entering the inlet to the Elliot Road Detention Basin hydrologically located in the HEC-1 model at DI65B. This new rating curve is necessary due to the changes made to the inlets which included the removal of the 24" orifice plate on the 78" inlet to the Elliot Road storm drain system and the installation of a 24" orifice plate over the inlet to the Elliot Road Detention Basin.

This new rating table/curve for the flow split is coded into the HEC-1 model at DI65B replacing the old flow split data developed previously by Wood Patel to determine the hydrologic impact of the changes on downstream flow conditions and the Elliot Road Detention Basin.

Rating Curve / Flow Split at Elliot Road Storm Drain Inlet and the Elliot Basin Inlet

Elevation (ft)	Channel Capacity (cfs)	Elliot Road Storm Drain Inlet Capacity (cfs)	Elliot Basin Lateral Weir Capacity[1] (cfs)	Elliot Basin 24" Orifice Capacity[2] (cfs)	HEC-1 Flow Split			Description
					Storm Drain[3] (cfs)	Basin[4] (cfs)	Total Flow (cfs)	
1435.5	0	0	0	0	0	0	0	Surveyed invert of 78" pipe inlet to Elliot Rd storm drain
1436.0	0	0	0	0	0	0	0	Approx invert of orifice
1436.5	0	0	0	0	0	0	0	
1437.0	0	0	0	0	0	0	0	Approx centroid of orifice
1437.5	0	0	0	0	0	0	0	
1438.0	0	0	0	0	0	0	0	
1438.5	0	0	0	0	0	0	0	
1439.0	0	0	0	0	0	0	0	
1439.5	0	0	0	0	0	0	0	
1440.0	0	0	0	0	0	0	0	
1440.5	0	0	0	0	0	0	0	
1441.0	0	0	0	0	0	0	0	1441.3 is maximum storm drain tailwater based on 500 cfs
1441.5	0	100	0	0	0	0	0	
1442.0	0	180	0	0	0	***0***	***0***	Approx channel invert adjacent to lateral weir
1442.5	10	240	0	0	10	***0***	***10***	
1443.0	30	280	0	0	30	***0***	***30***	
1443.5	70	320	0	0	70	***0***	***70***	
1444.0	120	360	0	0	120	***0***	***120***	Surveyed crest of lateral weir
1444.5	190	390	24	42	166	***24***	***190***	
1445.0	270	420	68	43	227	***43***	***270***	
1445.5	380	445	124	45	335	***45***	***380***	
1446.0	510	460	191	46	460	***46***	***506***	
1446.5	660	480	267	47	480	***47***	***527***	
1447.0	830	500	351	48	500	***48***	***548***	Approx top of bank and max WSEL before breakout

Values used for HEC-1 flow diversion at DI65B

[1] *Assumed $Q=CLH^{3/2}$ with C=2.6, L=26 ft*

[2] *Orifice on Elliot Basin inlet pipe will not see any water until flow overtops the lateral weir crest at 1444 at which point the orfice will essentially have several feet of headwater.*

[3] *Storm drain flow is limited by and cannot exceed the capacity of the inlet at a specific headwater elevation. When the combined total flow of the HEC-1 split is less than the channel capacity, flow will backup into the channel until elevation 1447 at which point flow will break out of the channel into the adjacent areas.*

[4] *Flow to the basin is limited both by the lateral weir capacity and the orifice capacity, whichever is less for the specific water surface elevation.*

Stanley Consultants INC.

Project No. _____ Page No. ___

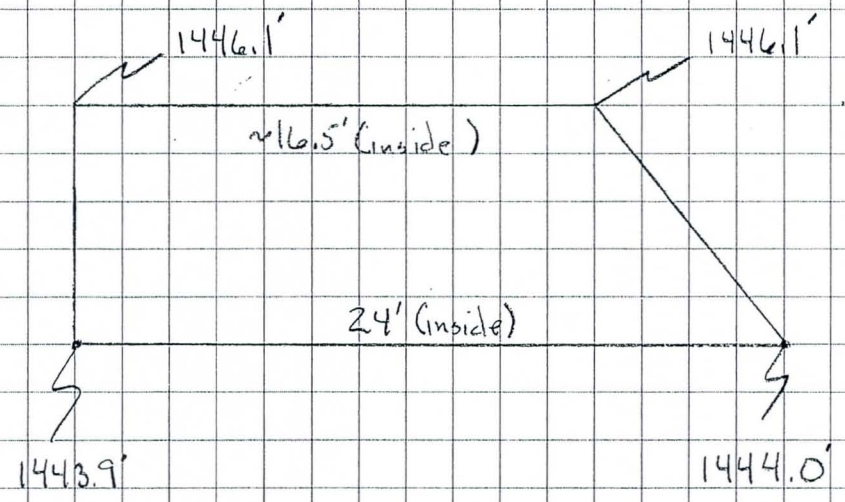
Subject: Summary of Survey & Elevation Data for Project Outfall Structures

Computed by _____ Date _____

Checked by _____ Date _____

Approved by _____ Date _____

Sheet No. ___ of ___

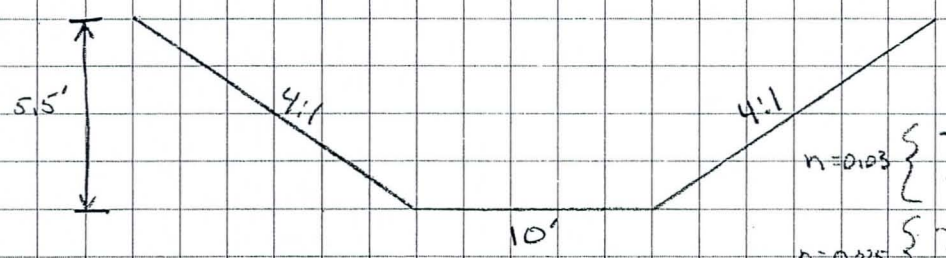


78" Pipe Inv = 1435.8'

Exist Ground ≈ 1442'
(adj to weir inlet)
Ex Grnd (Top) ≈ 1447

"As Builts"/Design Plans
Weir = 1439.6 (top = 1444.7)
Pipe Inv = 1434.5
Chnl Inv = 1439.6
Finish Grade (Top of Chnl) = 1445.1

Elliot Basin Inlet Weir

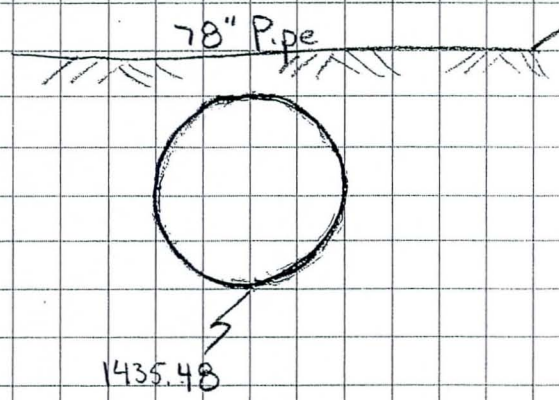


Q_{100} ~ 560 cfs

n = 0.03 { D ~ 4.2' (@ S = 0.003 ft/ft)
D ~ 4.6' (@ S = 0.002)

n = 0.025 { D ~ 3.9' (@ S = 0.003 design)
D ~ 4.3 (@ S = 0.002 measured)

Elliot Basin Inlet Channel



Assume Top of Grade ≈ 1447

$$\text{Pipe Slope} \approx \frac{\overset{\text{Survey}}{1435.48} - \overset{\text{As-Built}}{1431.39}}{\underset{\substack{\Delta x \text{ to } 45^\circ \text{ Bend} \\ \text{(survey}}}{125'}} = 0.033'/ft$$

Elliot Rd Storm Drain Inlet

SC 3004 R4 898

Worksheet
Worksheet for Circular Orifice

Project Description	
Worksheet	24" Orifice to Elliot Basin (East)
Type	Circular Orifice
Solve For	Discharge

Input Data		
Headwater Elevation	1,447.00	ft
Centroid Elevation	1,437.00	ft
Tailwater Elevation	1,435.80	ft
Discharge Coefficient	0.60	
Diameter	24.0	in

Results		
Discharge	47.82	cfs
Headwater Height Above Centroic	10.00	ft
Tailwater Height Above Centroid	-1.20	ft
Flow Area	3.1	ft²
Velocity	15.22	ft/s

Table
Rating Table for Circular Orifice

Project Description	
Worksheet	24" Orifice to Elliot Basin (East)
Type	Circular Orifice
Solve For	Discharge

Input Data	
Centroid Elevation	1,437.00 ft
Tailwater Elevation	1,435.80 ft
Discharge Coefficient	0.60
Diameter	24.0 in

Attribute	Minimum	Maximum	Increment
Headwater Elevation (ft)	1,435.80	1,447.00	0.10

Headwater Elevation (ft)	Discharge (cfs)	Velocity (ft/s)
1,435.80	N/A	N/A
1,435.90	N/A	N/A
1,436.00	N/A	N/A
1,436.10	N/A	N/A
1,436.20	N/A	N/A
1,436.30	N/A	N/A
1,436.40	N/A	N/A
1,436.50	N/A	N/A
1,436.60	N/A	N/A
1,436.70	N/A	N/A
1,436.80	N/A	N/A
1,436.90	N/A	N/A
1,437.00	N/A	N/A
1,437.10	4.78	1.52
1,437.20	6.76	2.15
1,437.30	8.28	2.64
1,437.40	9.56	3.04
1,437.50	10.69	3.40
1,437.60	11.71	3.73
1,437.70	12.65	4.03
1,437.80	13.52	4.30
1,437.90	14.34	4.57
1,438.00	15.12	4.81
1,438.10	15.86	5.05
1,438.20	16.56	5.27
1,438.30	17.24	5.49
1,438.40	17.89	5.69
1,438.50	18.52	5.89
1,438.60	19.13	6.09
1,438.70	19.71	6.28
1,438.80	20.29	6.46
1,438.90	20.84	6.63
1,439.00	21.38	6.81
1,439.10	21.91	6.97
1,439.20	22.43	7.14
1,439.30	22.93	7.30
1,439.40	23.42	7.46

Table
Rating Table for Circular Orifice

Headwater Elevation (ft)	Discharge (cfs)	Velocity (ft/s)
1,439.50	23.91	7.61
1,439.60	24.38	7.76
1,439.70	24.85	7.91
1,439.80	25.30	8.05
1,439.90	25.75	8.20
1,440.00	26.19	8.34
1,440.10	26.62	8.47
1,440.20	27.05	8.61
1,440.30	27.47	8.74
1,440.40	27.88	8.87
1,440.50	28.29	9.00
1,440.60	28.69	9.13
1,440.70	29.09	9.26
1,440.80	29.48	9.38
1,440.90	29.86	9.50
1,441.00	30.24	9.63
1,441.10	30.62	9.75
1,441.20	30.99	9.86
1,441.30	31.35	9.98
1,441.40	31.72	10.10
1,441.50	32.08	10.21
1,441.60	32.43	10.32
1,441.70	32.78	10.43
1,441.80	33.13	10.54
1,441.90	33.47	10.65
1,442.00	33.81	10.76
1,442.10	34.15	10.87
1,442.20	34.48	10.98
1,442.30	34.81	11.08
1,442.40	35.14	11.18
1,442.50	35.46	11.29
1,442.60	35.78	11.39
1,442.70	36.10	11.49
1,442.80	36.42	11.59
1,442.90	36.73	11.69
1,443.00	37.04	11.79
1,443.10	37.35	11.89
1,443.20	37.65	11.98
1,443.30	37.95	12.08
1,443.40	38.25	12.18
1,443.50	38.55	12.27
1,443.60	38.85	12.36
1,443.70	39.14	12.46
1,443.80	39.43	12.55
1,443.90	39.72	12.64
1,444.00	40.01	12.73
1,444.10	40.29	12.82
1,444.20	40.57	12.91
1,444.30	40.85	13.00
1,444.40	41.13	13.09
1,444.50	41.41	13.18
1,444.60	41.68	13.27
1,444.70	41.96	13.36

Table
Rating Table for Circular Orifice

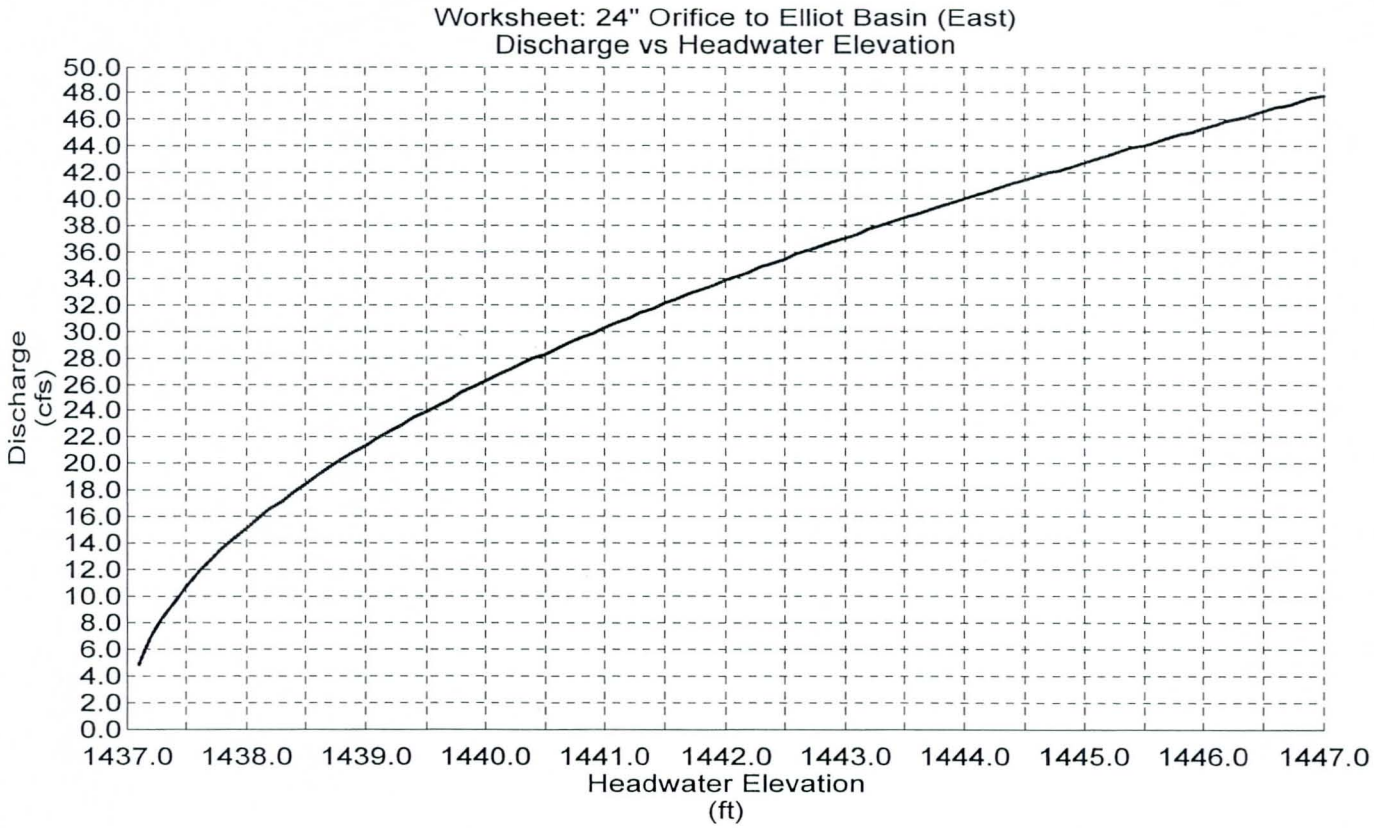
Headwater Elevation (ft)	Discharge (cfs)	Velocity (ft/s)
1,444.80	42.23	13.44
1,444.90	42.50	13.53
1,445.00	42.77	13.61
1,445.10	43.03	13.70
1,445.20	43.30	13.78
1,445.30	43.56	13.87
1,445.40	43.82	13.95
1,445.50	44.08	14.03
1,445.60	44.34	14.11
1,445.70	44.60	14.20
1,445.80	44.85	14.28
1,445.90	45.11	14.36
1,446.00	45.36	14.44
1,446.10	45.61	14.52
1,446.20	45.86	14.60
1,446.30	46.11	14.68
1,446.40	46.36	14.76
1,446.50	46.60	14.83
1,446.60	46.85	14.91
1,446.70	47.09	14.99
1,446.80	47.33	15.07
1,446.90	47.58	15.14
1,447.00	47.82	15.22

Curve
Plotted Curves for Circular Orifice

Project Description	
Worksheet	24" Orifice to Elliot Basin (East)
Type	Circular Orifice
Solve For	Discharge

Input Data	
Centroid Elevation	1,437.00 ft
Tailwater Elevation	1,435.80 ft
Discharge Coefficient	0.60
Diameter	24.0 in

Attribute	Minimum	Maximum	Increment
Headwater Elevation (ft)	1,435.80	1,447.00	0.10



Culvert Designer/Analyzer Report
Elliot Rd Inlet no overtopping

Overtopping Analysis

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-78 inch Circular	498.05 cfs	1,447.00 ft	23.17 ft/s
Weir	Broad Crested	0.00 cfs	1,447.00 ft	N/A
Total	----------	498.05 cfs	1,447.00 ft	N/A

Culvert Designer/Analyzer Report
Elliot Rd Inlet no overtopping

Component:Culvert-1

Culvert Summary					
Computed Headwater Elev	1,447.00	ft	Discharge	498.05	cfs
Inlet Control HW Elev.	1,447.00	ft	Tailwater Elevation	1,441.30	ft
Outlet Control HW Elev.	1,446.46	ft	Control Type	Inlet Control	
Headwater Depth/Height	1.77				

Grades					
Upstream Invert	1,435.48	ft	Downstream Invert	1,431.39	ft
Length	125.00	ft	Constructed Slope	0.032720	ft/ft

Hydraulic Profile					
Profile	PressureProfile		Depth, Downstream	4.01	ft
Slope Type	N/A		Normal Depth	3.19	ft
Flow Regime	N/A		Critical Depth	5.82	ft
Velocity Downstream	23.17	ft/s	Critical Slope	0.006803	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.012	
Section Material	Concrete		Span	6.50	ft
Section Size	78 inch		Rise	6.50	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	1,446.46	ft	Upstream Velocity Head	3.93	ft
Ke	0.20		Entrance Loss	0.70	ft

Inlet Control Properties					
Inlet Control HW Elev.	1,447.00	ft	Flow Control	Submerged	
Inlet Type	Groove end projecting		Area Full	33.2	ft^2
K	0.00450		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	3	
C	0.03170		Equation Form	1	
Y	0.69000				

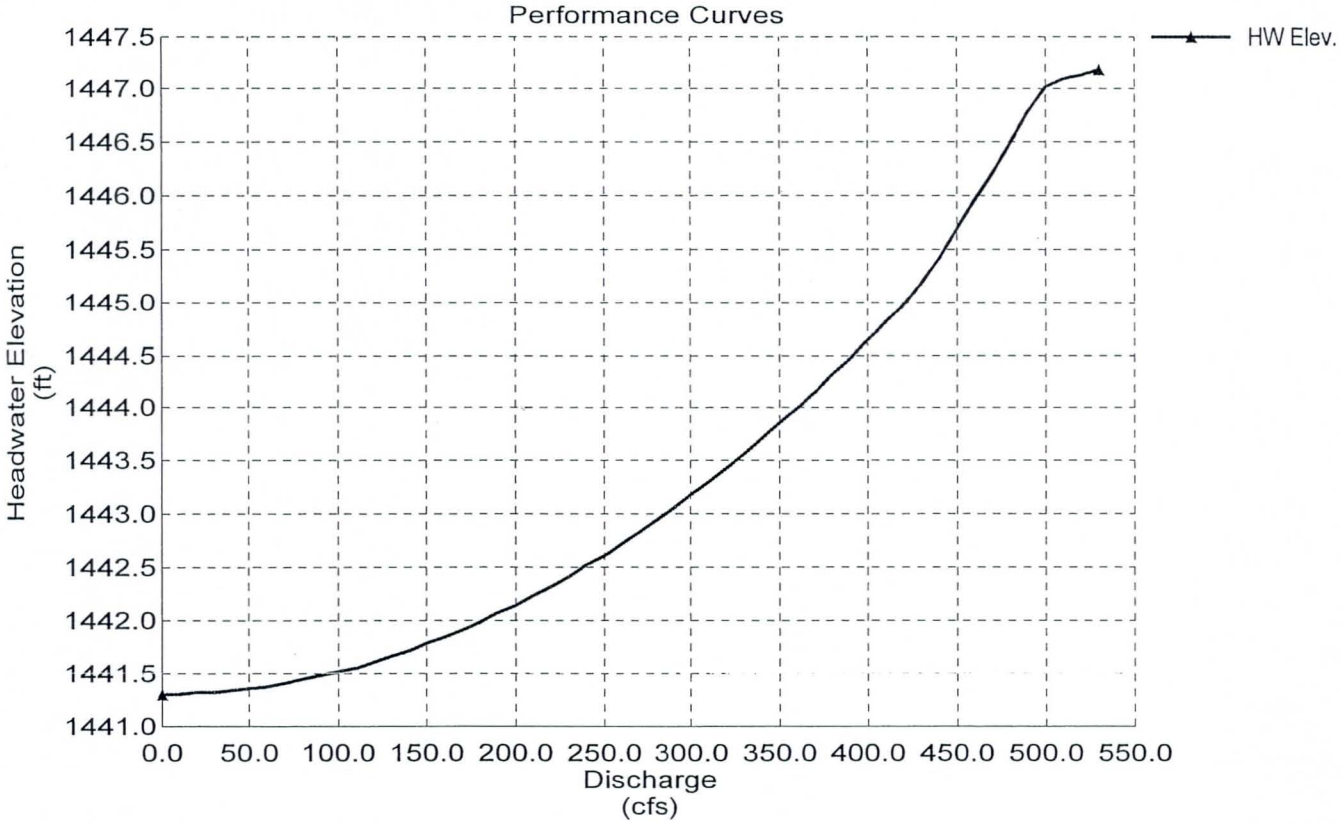
Culvert Designer/Analyzer Report
Elliot Rd Inlet no overtopping

Component:Weir

Hydraulic Component(s): Broad Crested					
Discharge	0.00	cfs	Allowable HW Elevation	1,447.00	ft
Weir Coefficient	3.33	US	Length	100.00	ft
Crest Elevation	1,447.00	ft	Headwater Elevation	N/A	ft

Performance Curves Report
Elliot Rd Inlet no overtopping

Range Data:			
	Minimum	Maximum	Increment
Discharge	0.00	530.00	10.00 cfs



Rating Table Report
Elliot Rd Inlet no overtopping

Range Data:

	Minimum	Maximum	Increment	
Discharge	0.00	580.00	10.00	cfs

Discharge (cfs)	HW Elev. (ft)
0.00	1,441.30
10.00	1,441.30
20.00	1,441.31
30.00	1,441.32
40.00	1,441.33
50.00	1,441.35
60.00	1,441.38
70.00	1,441.40
80.00	1,441.43
90.00	1,441.47
100.00	1,441.51
110.00	1,441.56
120.00	1,441.60
130.00	1,441.66
140.00	1,441.71
150.00	1,441.77
160.00	1,441.84
170.00	1,441.91
180.00	1,441.98
190.00	1,442.06
200.00	1,442.14
210.00	1,442.23
220.00	1,442.32
230.00	1,442.41
240.00	1,442.51
250.00	1,442.61
260.00	1,442.72
270.00	1,442.83
280.00	1,442.94
290.00	1,443.06
300.00	1,443.18
310.00	1,443.31
320.00	1,443.44
330.00	1,443.58
340.00	1,443.71
350.00	1,443.86
360.00	1,444.00
370.00	1,444.15
380.00	1,444.31
390.00	1,444.47
400.00	1,444.63
410.00	1,444.80
420.00	1,444.97
430.00	1,445.18
440.00	1,445.43
450.00	1,445.69
460.00	1,445.95
470.00	1,446.22

285 1443 (approx)

325 1443.5 (approx)

445 1445.5 (approx)

Rating Table Report
Elliot Rd Inlet no overtopping

Discharge (cfs)	HW Elev. (ft)
480.00	1,446.49
490.00	1,446.77
500.00	1,447.02
510.00	1,447.09
520.00	1,447.14
530.00	1,447.18
540.00	1,447.22
550.00	1,447.26
560.00	1,447.29
570.00	1,447.32
580.00	1,447.35

Top of Bank

Worksheet

Worksheet for Trapezoidal Channel

At Project Outfall (104th St)

Project Description	
Worksheet	Project Outfall Channel
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.003000	ft/ft
Left Side Slope	4.00	H : V
Right Side Slope	4.00	H : V
Bottom Width	10.00	ft
Discharge	580.00	cfs

Results		
Depth	4.25	ft
Flow Area	114.7	ft²
Wetted Perimeter	45.03	ft
Top Width	43.98	ft
Critical Depth	3.17	ft
Critical Slope	0.010662	ft/ft
Velocity	5.06	ft/s
Velocity Head	0.40	ft
Specific Energy	4.65	ft
Froude Number	0.55	
Flow Type	Subcritical	

Curve
Plotted Curves for Trapezoidal Channel

Project Description	
Worksheet	Project Outfall Channel
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.003000	ft/ft
Left Side Slope	4.00	H : V
Right Side Slope	4.00	H : V
Bottom Width	10.00	ft

Attribute	Minimum	Maximum	Increment
Discharge (cfs)	0.00	850.00	10.00

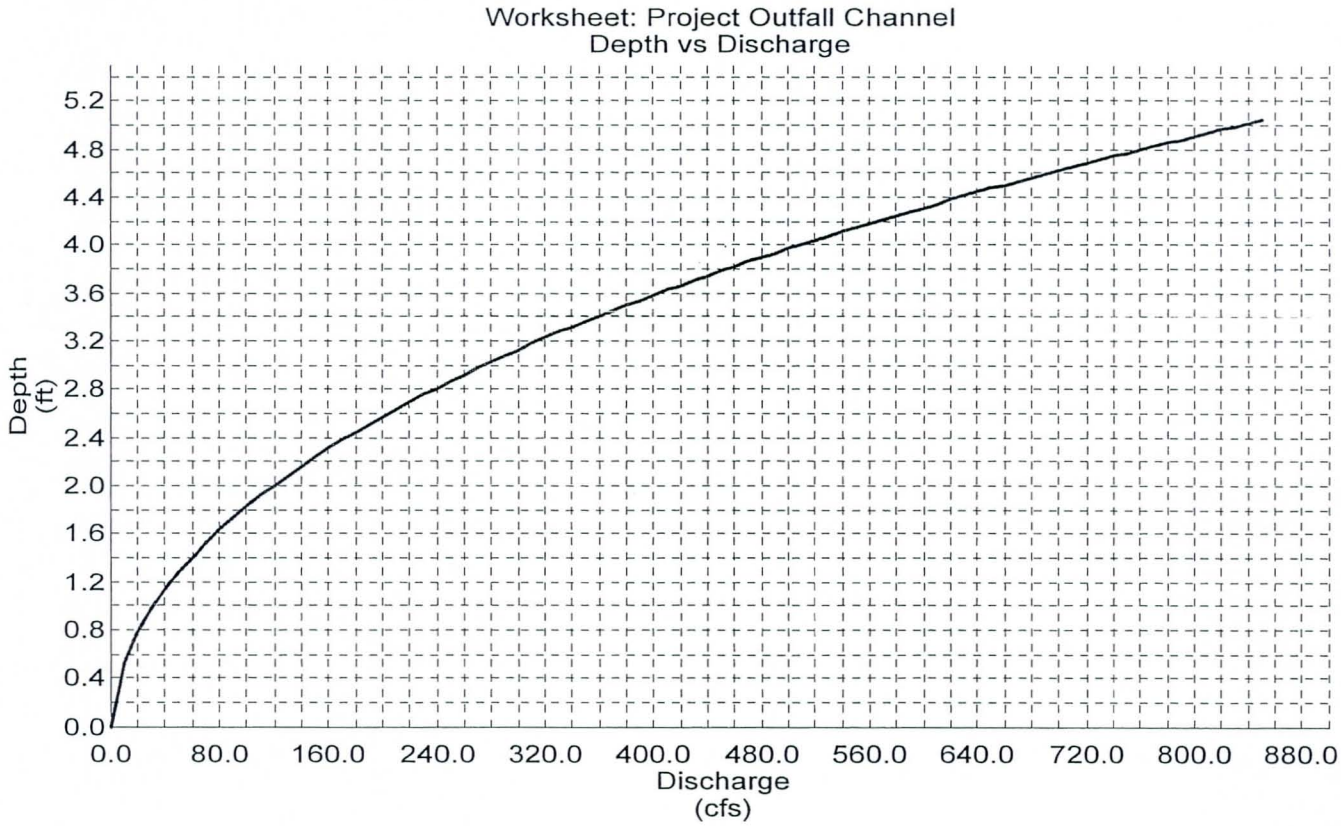


Table
Rating Table for Trapezoidal Channel

Project Description	
Worksheet	Project Outfall Channel
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.003000	ft/ft
Left Side Slope	4.00	H : V
Right Side Slope	4.00	H : V
Bottom Width	10.00	ft

Attribute	Minimum	Maximum	Increment
Discharge (cfs)	20.00	580.00	10.00

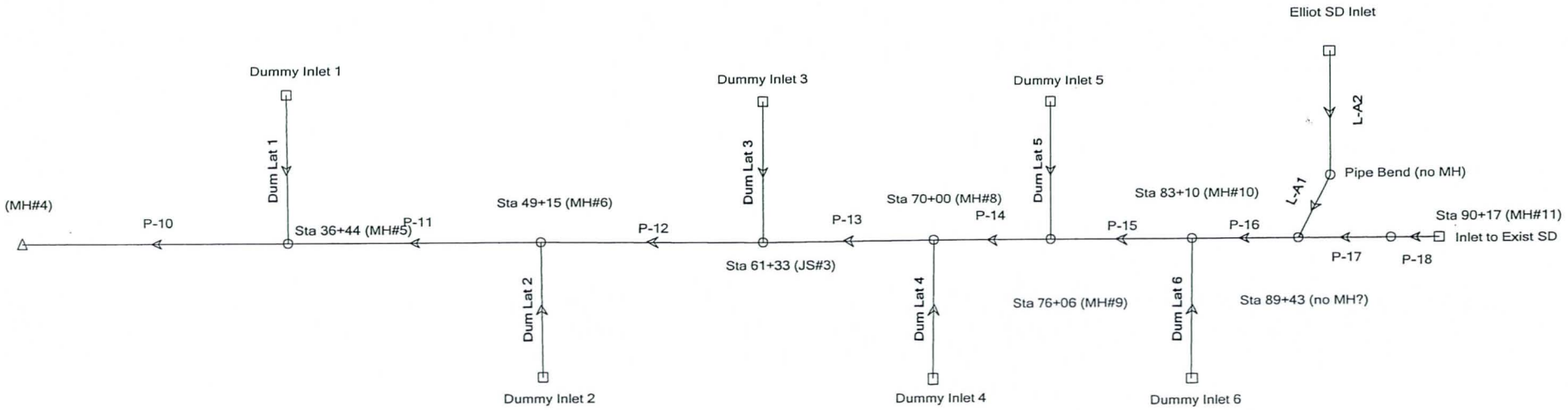
Approx channel invert at lateral weir is ~ 1442

Discharge (cfs)	Depth (ft)	Velocity (ft/s)	Flow Area (ft²)	Wetted Perimeter (ft)	Top Width (ft)	
20.00	0.77	1.97	10.1	16.39	16.20	
30.00	0.97	2.23	13.4	17.98	17.75	– 1443
40.00	1.13	2.43	16.4	19.33	19.05	
50.00	1.27	2.60	19.2	20.51	20.19	
60.00	1.40	2.74	21.9	21.57	21.22	
70.00	1.52	2.86	24.4	22.53	22.16	– 1443.5
80.00	1.63	2.97	26.9	23.43	23.03	
90.00	1.73	3.07	29.3	24.27	23.84	
100.00	1.83	3.17	31.6	25.05	24.60	
110.00	1.92	3.25	33.8	25.80	25.33	
120.00	2.00	3.33	36.0	26.51	26.01	– 1444
130.00	2.08	3.40	38.2	27.18	26.67	
140.00	2.16	3.47	40.3	27.82	27.29	
150.00	2.24	3.54	42.4	28.45	27.89	
160.00	2.31	3.60	44.4	29.04	28.47	
170.00	2.38	3.66	46.4	29.62	29.03	
180.00	2.45	3.72	48.4	30.18	29.57	
190.00	2.51	3.77	50.4	30.71	30.10	– 1444.5
200.00	2.58	3.82	52.3	31.24	30.61	
210.00	2.64	3.87	54.2	31.75	31.10	
220.00	2.70	3.92	56.1	32.24	31.58	
230.00	2.76	3.97	57.9	32.72	32.05	
240.00	2.81	4.02	59.8	33.19	32.50	
250.00	2.87	4.06	61.6	33.65	32.94	
260.00	2.92	4.10	63.4	34.10	33.38	
270.00	2.98	4.14	65.2	34.54	33.81	– 1445
280.00	3.03	4.18	66.9	34.97	34.22	
290.00	3.08	4.22	68.7	35.39	34.63	
300.00	3.13	4.26	70.4	35.80	35.03	
310.00	3.18	4.30	72.2	36.20	35.42	
320.00	3.23	4.33	73.9	36.60	35.80	
330.00	3.27	4.37	75.6	36.98	36.18	
340.00	3.32	4.40	77.2	37.36	36.55	
350.00	3.36	4.44	78.9	37.74	36.91	
360.00	3.41	4.47	80.6	38.11	37.27	

Table
Rating Table for Trapezoidal Channel

Discharge (cfs)	Depth (ft)	Velocity (ft/s)	Flow Area (ft²)	Wetted Perimeter (ft)	Top Width (ft)	
370.00	3.45	4.50	82.2	38.47	37.62	
380.00	3.50	4.53	83.8	38.83	37.97	- 1445.5
390.00	3.54	4.56	85.5	39.18	38.31	
400.00	3.58	4.59	87.1	39.52	38.64	
410.00	3.62	4.62	88.7	39.87	38.97	
420.00	3.66	4.65	90.3	40.20	39.30	
430.00	3.70	4.68	91.9	40.53	39.62	
440.00	3.74	4.71	93.4	40.86	39.94	
450.00	3.78	4.74	95.0	41.18	40.25	
460.00	3.82	4.76	96.6	41.50	40.56	
470.00	3.86	4.79	98.1	41.81	40.86	
480.00	3.90	4.82	99.7	42.12	41.16	
490.00	3.93	4.84	101.2	42.43	41.46	
500.00	3.97	4.87	102.7	42.73	41.75	
510.00	4.01	4.89	104.2	43.03	42.04	- 1446
520.00	4.04	4.92	105.7	43.32	42.33	
530.00	4.08	4.94	107.2	43.62	42.61	
540.00	4.11	4.97	108.7	43.90	42.89	
550.00	4.15	4.99	110.2	44.19	43.17	
560.00	4.18	5.01	111.7	44.47	43.44	
570.00	4.21	5.04	113.2	44.75	43.71	
580.00	4.25	5.06	114.7	45.03	43.98	
590.00	4.28	5.08	116.1	45.30	44.25	
600.00	4.31	5.10	117.6	45.57	44.51	
610.00	4.35	5.13	119.0	45.84	44.77	
620.00	4.38	5.15	120.5	46.11	45.03	
630.00	4.41	5.17	121.9	46.37	45.28	
640.00	4.44	5.19	123.3	46.63	45.53	
650.00	4.47	5.21	124.8	46.89	45.78	
660.00	4.50	5.23	126.2	47.14	46.03	- 1446.5
670.00	4.53	5.25	127.6	47.39	46.28	
680.00	4.57	5.27	129.0	47.65	46.52	
690.00	4.60	5.29	130.4	47.89	46.76	
700.00	4.63	5.31	131.8	48.14	47.00	
710.00	4.65	5.33	133.2	48.39	47.24	
720.00	4.68	5.35	134.6	48.63	47.47	
730.00	4.71	5.37	136.0	48.87	47.71	
740.00	4.74	5.39	137.4	49.11	47.94	
750.00	4.77	5.41	138.8	49.34	48.17	
760.00	4.80	5.42	140.1	49.58	48.40	
770.00	4.83	5.44	141.5	49.81	48.62	
780.00	4.86	5.46	142.9	50.04	48.84	
790.00	4.88	5.48	144.2	50.27	49.07	
800.00	4.91	5.50	145.6	50.50	49.29	
810.00	4.94	5.51	146.9	50.72	49.51	
820.00	4.97	5.53	148.3	50.95	49.72	
830.00	4.99	5.55	149.6	51.17	49.94	-1447 Top of Bank

Scenario: Base



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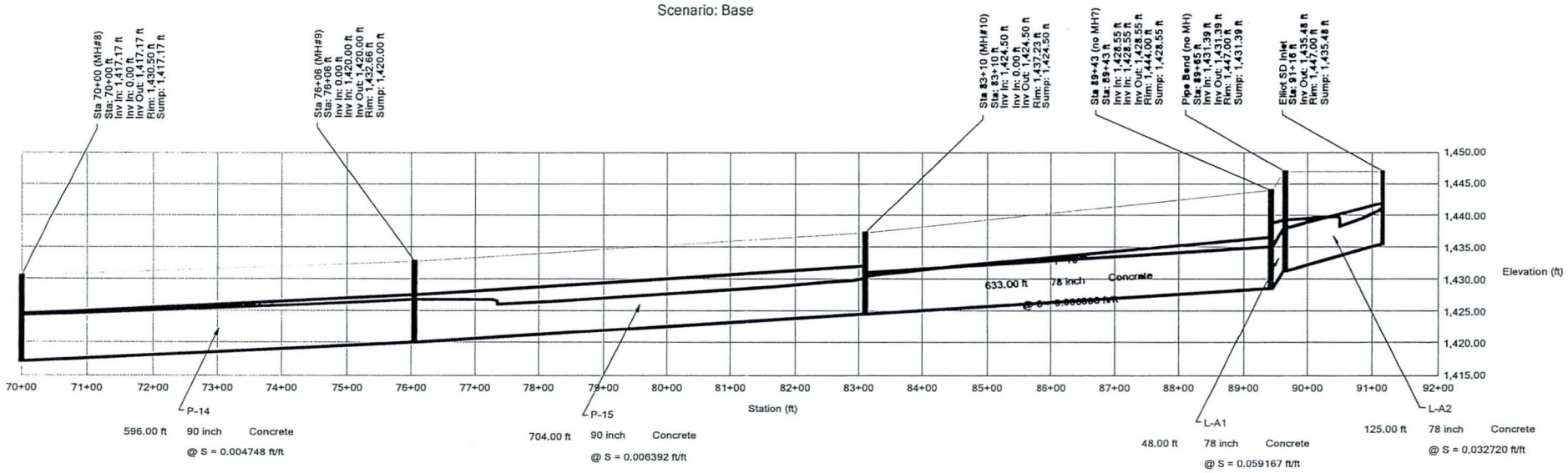
Scenario: Base

Profile: Elliot Rd SD & Project Outfall Main Line 70+00 to 89+43



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Pipe Report

Label	Downstream Node	Upstream Node	Length (ft)	Constructed Slope (ft/ft)	Section Size	Mannings n	Downstream Invert Elevation (ft)	Upstream Invert Elevation (ft)	Section Shape	Material	Hydraulic Grade Line Out (ft)	Hydraulic Grade Line In (ft)	Total Flow (cfs)
Dum Lat 3	Sta 61+33 (JS#3)	Dummy Inlet 3	712.00	0.000000	12 inch	0.010	0.00	0.00	Circula	PVC	1,422.90	7,221.63	410.00
Dum Lat 4	Sta 70+00 (MH#8)	Dummy Inlet 4	701.00	0.000000	12 inch	0.010	0.00	0.00	Circula	PVC	1,424.30	1,424.30	0.00
Dum Lat 2	Sta 49+15 (MH#6)	Dummy Inlet 2	681.00	0.000000	12 inch	0.010	0.00	0.00	Circula	PVC	1,415.55	1,415.55	0.00
Dum Lat 1	Sta 36+44 (MH#5)	Dummy Inlet 1	759.00	0.000000	12 inch	0.010	0.00	0.00	Circula	PVC	1,410.25	1,445.63	10.00
Dum Lat 6	Sta 83+10 (MH#10)	Dummy Inlet 6	709.00	0.000000	12 inch	0.010	0.00	0.00	Circula	PVC	1,430.29	1,430.29	0.00
Dum Lat 5	Sta 76+06 (MH#9)	Dummy Inlet 5	705.00	0.000000	12 inch	0.010	0.00	0.00	Circula	PVC	1,426.80	2,248.49	50.00
P-10	(MH#4)	Sta 36+44 (MH#5)	1,319.00	0.004003	114 inch	0.013	1,394.78	1,400.06	Circula	Concrete	1,404.28	1,410.25	970.00
P-11	Sta 36+44 (MH#5)	Sta 49+15 (MH#6)	1,271.00	0.005224	114 inch	0.013	1,400.06	1,406.70	Circula	Concrete	1,410.25	1,415.55	960.00
P-12	Sta 49+15 (MH#6)	Sta 61+33 (JS#3)	1,124.00	0.005605	114 inch	0.013	1,406.70	1,413.00	Circula	Concrete	1,415.55	1,420.55	960.00
P-13	Sta 61+33 (JS#3)	Sta 70+00 (MH#8)	858.00	0.004860	114 inch	0.013	1,413.00	1,417.17	Circula	Concrete	1,422.90	1,422.87	550.00
P-14	Sta 70+00 (MH#8)	Sta 76+06 (MH#9)	596.00	0.004748	90 inch	0.013	1,417.17	1,420.00	Circula	Concrete	1,424.30	1,426.80	550.00
P-15	Sta 76+06 (MH#9)	Sta 83+10 (MH#10)	704.00	0.006392	90 inch	0.013	1,420.00	1,424.50	Circula	Concrete	1,426.80	1,430.29	500.00
P-16	Sta 83+10 (MH#10)	Sta 89+43 (no MH?)	633.00	0.006398	78 inch	0.013	1,424.50	1,428.55	Circula	Concrete	1,430.32	1,436.37	500.00
L-A1	Sta 89+43 (no MH?)	Pipe Bend (no MH)	48.00	0.059167	78 inch	0.013	1,428.55	1,431.39	Circula	Concrete	1,438.84	1,439.28	500.00
P-17	Sta 89+43 (no MH?)	Sta 90+17 (MH#11)	74.00	0.006081	78 inch	0.013	1,428.55	1,429.00	Circula	Concrete	1,438.84	1,438.84	0.00
P-18	Sta 90+17 (MH#11)	Inlet to Exist SD	33.00	0.006061	78 inch	0.013	1,429.00	1,429.20	Circula	Concrete	1,438.84	1,438.84	0.00
L-A2	Pipe Bend (no MH)	Elliot SD Inlet	125.00	0.032720	78 inch	0.013	1,431.39	1,435.48	Circula	Concrete	1,439.28	1,441.30	500.00

APPENDIX F

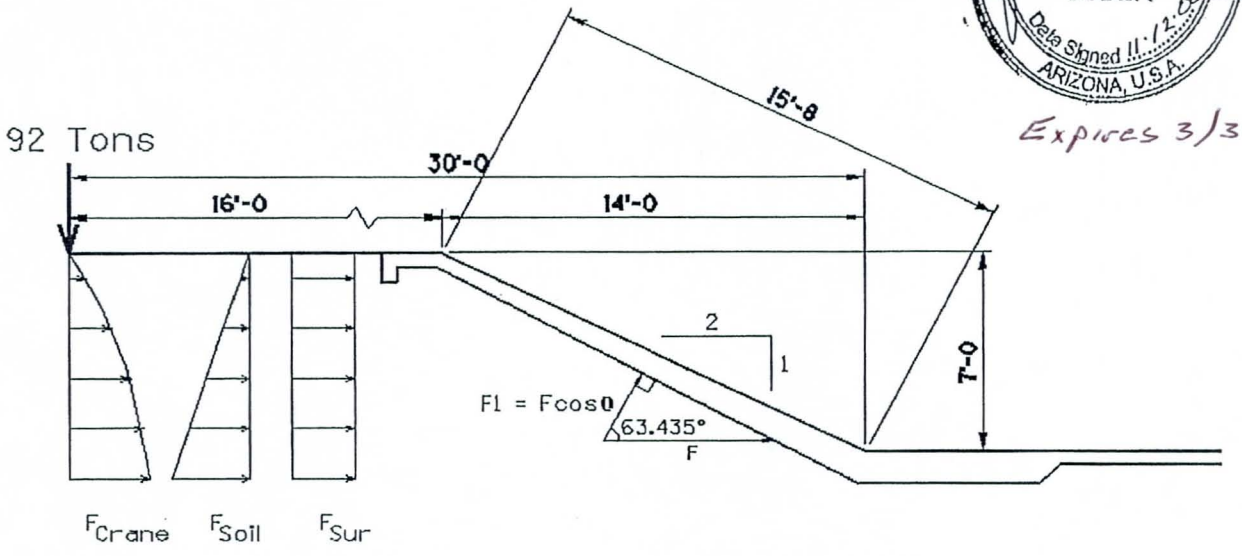
Structural Design and Calculations

NOTES: This design is based on a 92 ton crane outrigger load provided by the client. It also assumes that a barrier will prevent the outrigger load from being positioned any closer than 16' from the edge of the canal.

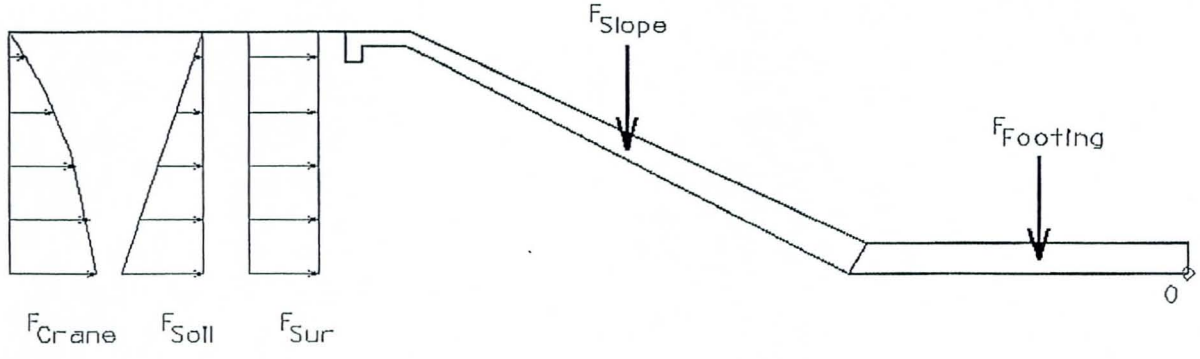
Registered Professional Engineer (Civil) CERTIFICATE NO. 40561 JAMES D. JODER Date Signed 11/12/08 ARIZONA, U.S.A.

Expires 3/31/2010

GEOMETRY:

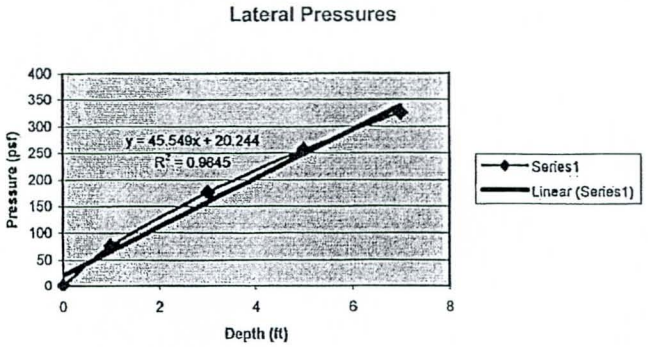


STABILITY: Overturning



Crane: See attached geotech loading chart.

Lateral Distance (ft)	Depth (ft)	Lateral Pressure (psf)
0	0	0
18	1	75
22	3	175
26	5	255
30	7	325



Best Fit Equation: Pressure = 45.549(depth)+20.244

Use linear distribution with max pressure of: 339 psf

Equivalent Fluid Pressure = 48.4 psf/ft

R_{CRANE} = 1187 lbs

Soil:

F_{SOIL} (EFP) = 35 psf/ft

R_{SOIL} = 858 lbs

Surcharge: The area adjacent to the canal is restricted with barriers, however, there is a chance that light truck traffic could occur simultaneously with crane loading. RetainPro inputs LL Surcharge as a vertical pressure (psf). Conservatively apply 1 ft of additional soil to approximate light truck loading. This may be reduced by the cosθ to account for the sloped canal lining.

Depth = 1 ft

Unit weight of soil = 110 pcf

Lateral load = 35 psf

R_{SUR} = 245 lbs

Slope Concrete DL:

Area = 15.560 sf

R_{SLOPE} = 2334.0 lbs

Distance to Centroid = 7.3 ft

Footing Concrete DL:

L = 6.000 ft

T = 1.167 ft

$R_{FOOTING}$ = 1050.3 lbs

STABILITY CHECK:

OVERTURNING:

Component	Force	Moment Arm	Moment
R_{CRANE}	1187 lbs	2.333 ft	2769 ft*lbs
R_{SOIL}	858 lbs	2.333 ft	2001 ft*lbs
R_{SUR}	245 lbs	3.500 ft	858 ft*lbs
			5628 ft*lbs

RESISTING:

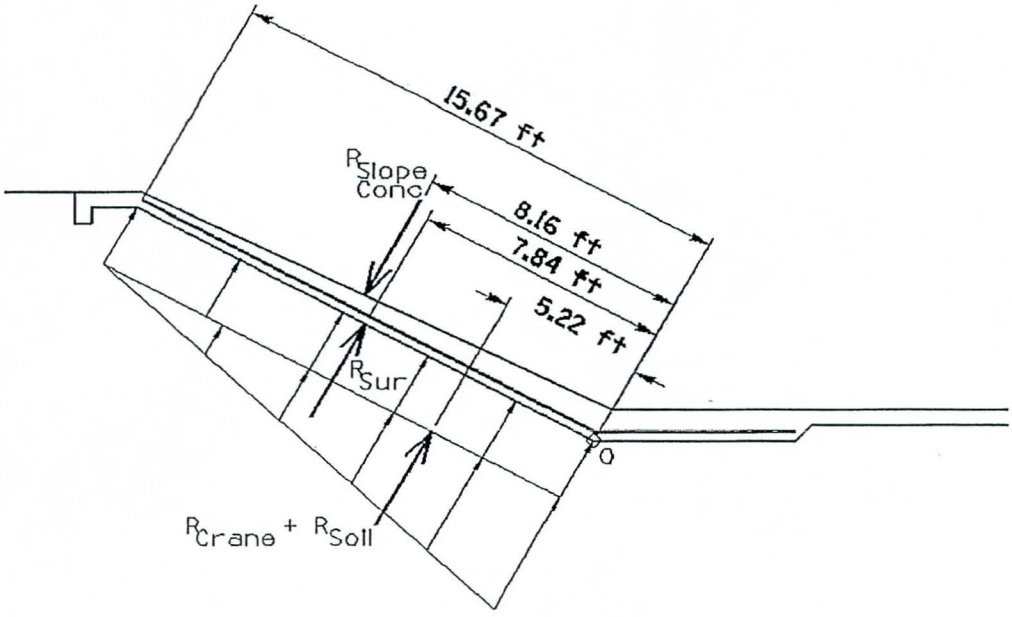
Slope Concrete DL:	2334 lbs	13.300 ft	31042 ft*lbs
Footing Concrete DL:	1050 lbs	3.000 ft	3151 ft*lbs
			34193 ft*lbs

Ratio = 6.0760 :1 **OK!**

SLIDING: By observation, the channel system is taken to be restrained against sliding due to the symmetry of the opposing channel slope.

REINFORCING: Break crane, soil, and surcharge forces into their component forces normal to the sloped channel. The component of the lateral force, F, acting normal to the face of the canal is F1, which equals Fcosθ.

θ =	63.435 °
cosθ =	0.447
sinθ =	0.894
Height of Model Wall =	15.670 ft (= length of slope)



Crane:

Equivalent Fluid Pressure (EFP) =	48.4 pcf
EFPcosθ =	21.7 psf/ft
R_{CRANE} =	2660 lbs

Soil:

EFP =	35 pcf
EFPcosθ =	15.7 pcf
R_{SOIL} =	1922 lbs

Surcharge:

F =	35
Fcosq =	15.7
R_{SUR} =	245 lbs

Slope Concrete DL

R_{SLOPE} =	2334 lbs
R_{SLOPE} sinθ =	2088 lbs
DL Reduction =	0.50
R_{SLOPE} sinθ (modified) =	1044 lbs

Summary of Moments at Base of Canal

Component	Force	Moment Arm	Moment
Crane	2660	5.22	13893
Soil	1922	5.22	10038
Surcharge	245	7.84	1922
Slope Concrete DL	1044	-8.16	-8519
			17333

Summary of Moments at Mid-Point of Canal

Component	Force	Moment Arm	Moment
Crane	665	2.61	1737
Soil	480	2.61	1255
Surcharge	123	3.92	480
Slope Concrete DL	497	-4.50	-2237
			1235

See attached reinforcing design spreadsheets.

Retain Pro 2007 , 24-Jul-2008, (c) 1989-2008
www.retainpro.com/support for latest release
Registration # : RP-1158435 RP2007-N

Cantilevered Retaining Wall Design

Code: AASHTO

Criteria

Retained Height	=	9.50 ft
Wall height above soil	=	0.00 ft
Slope Behind Wall	=	0.00 : 1
Height of Soil over Toe	=	0.00 in
Water height over heel	=	0.0 ft
Wind on Stem	=	0.0 psf

Vertical component of active lateral soil pressure options:
NOT USED for Soil Pressure.
NOT USED for Sliding Resistance.
NOT USED for Overturning Resistance.

Soil Data

Allow Soil Bearing	=	3,000.0 psf
Equivalent Fluid Pressure Method		
Heel Active Pressure	=	35.0 psf/ft
Toe Active Pressure	=	35.0 psf/ft
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe		0.00 pcf
Footing||Soil Friction	=	0.300
Soil height to ignore for passive pressure	=	0.00 in

Footing Dimensions & Strengths

Toe Width	=	7.50 ft
Heel Width	=	1.33
Total Footing Width	=	8.83
Footing Thickness	=	14.00 in
Key Width	=	18.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	2.67 ft

f'c = 3,000 psi Fy = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top = 2.00 in @ Btm.= 3.00 in

Surcharge Loads

Surcharge Over Heel = 220.0 psf
NOT Used To Resist Sliding & Overturning
Surcharge Over Toe = 0.0 psf
NOT Used for Sliding & Overturning

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	8.00 ft
...Height to Bottom	=	0.00 ft

Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type		Square Footing
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

Design Summary

Wall Stability Ratios

Overturning	=	1.92	OK

Slab Resists All Sliding !

Total Bearing Load	=	3,319 lbs	
...resultant ecc.	=	16.15 in	
Soil Pressure @ Toe	=	719 psf	OK
Soil Pressure @ Heel	=	32 psf	OK
Allowable	=	3,000 psf	

Soil Pressure Less Than Allowable

ACI Factored @ Toe	=	935 psf	
ACI Factored @ Heel	=	42 psf	
Footing Shear @ Toe	=	19.6 psi	OK
Footing Shear @ Heel	=	4.6 psi	OK
Allowable	=	82.2 psi	

Sliding Calcs Slab Resists All Sliding !

Lateral Sliding Force = 2,714.0 lbs

Load Factors

Building Code	AASHTO
Dead Load	1.300
Live Load	2.170
Earth, H	1.690
Wind, W	1.300
Seismic, E	1.000

Stem Construction

Top Stem

			Stem OK
Design Height Above Ftg	ft =		0.00
Wall Material Above "Ht"	=		Concrete
Thickness	=		12.00
Rebar Size	=		# 7
Rebar Spacing	=		12.00
Rebar Placed at	=		Edge
Design Data			
fb/FB + fa/Fa	=		0.569
Total Force @ Section	lbs =		3,793.0
Moment....Actual	ft-# =		13,790.6
Moment.....Allowable	=		24,225.8
Shear.....Actual	psi =		33.1
Shear.....Allowable	psi =		82.2
Wall Weight	=		150.0
Rebar Depth 'd'	in =		9.56
LAP SPLICE IF ABOVE	in =		21.39
LAP SPLICE IF BELOW	in =		
HOOK EMBED INTO FTG	in =		7.42
Masonry Data			
f'm	psi =		
Fs	psi =		
Solid Grouting	=		
Use Full Stresses	=		
Modular Ratio 'n'	=		
Short Term Factor	=		
Equiv. Solid Thick.	=		
Masonry Block Type	=		Medium Weight
Masonry Design Method	=		ASD
Concrete Data			
f'c	psi =		3,000.0
Fy	psi =		60,000.0

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Cantilevered Retaining Wall Design

Code: AASHTO

Footing Design Results

		Toe	Heel
Factored Pressure	=	935	42 psf
Mu' : Upward	=	19,188	3 ft-#
Mu' : Downward	=	6,398	109 ft-#
Mu: Design	=	12,789	106 ft-#
Actual 1-Way Shear	=	19.59	4.58 psi
Allow 1-Way Shear	=	82.16	82.16 psi
Toe Reinforcing	=	None Spec'd	
Heel Reinforcing	=	None Spec'd	
Key Reinforcing	=	None Spec'd	

Other Acceptable Sizes & Spacings

Toe: #4@ 6.50 in, #5@ 10.25 in, #6@ 14.50 in, #7@ 19.50 in, #8@ 25.75 in, #9@ 32
Heel: Not req'd, Mu < S * Fr
Key: Slab Resists Sliding - No Force on Key

Summary of Overturning & Resisting Forces & Moments

Item		.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	2,737.8	4.04	11,061.7
Toe Active Pressure	=	-23.8	0.39	-9.3
Surcharge Over Toe	=			
Adjacent Footing Load	=			
Added Lateral Load	=			
Load @ Stem Above Soil	=			
Total	=	2,714.0	O.T.M. =	11,052.5

Resisting/Overturning Ratio = 1.92

Vertical Loads used for Soil Pressure = 3,318.8 lbs

		.....RESISTING..... Force lbs	Distance ft	Moment ft-#
Soil Over Heel	=	348.0	8.67	3,015.8
Sloped Soil Over Heel	=			
Surcharge Over Heel	=			
Adjacent Footing Load	=			
Axial Dead Load on Stem	=		0.00	
Soil Over Toe	=			
Surcharge Over Toe	=			
Stem Weight(s)	=	1,425.0	8.00	11,400.0
Earth @ Stem Transitions	=			
Footing Weight	=	1,545.8	4.42	6,826.9
Key Weight	=		3.42	
Vert. Component	=			
Total	=	3,318.8 lbs	R.M.=	21,242.7

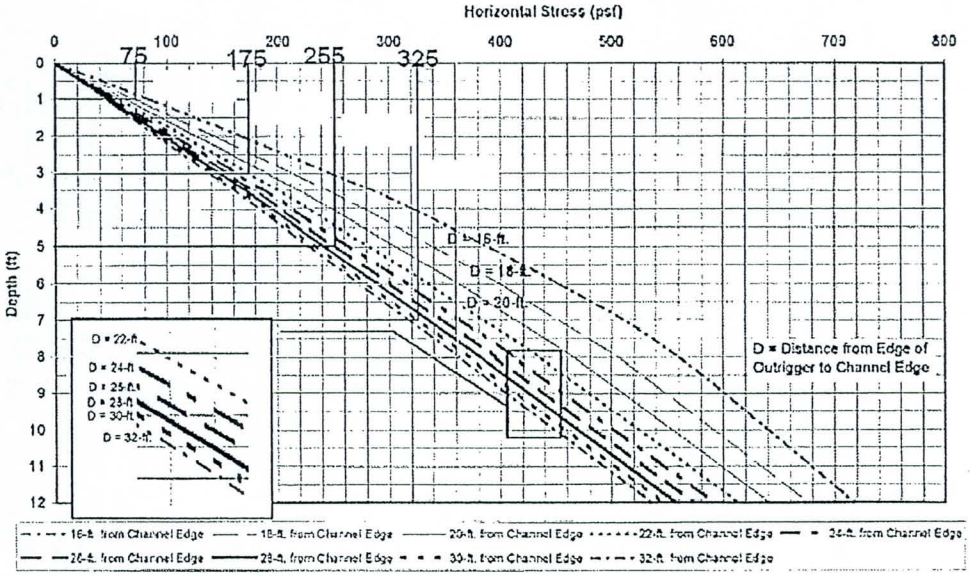
Vertical component of active pressure NOT used for soil pressure

DESIGNER NOTES:

anley Consultants INC.	Project No.:	20539	Calc'd by:	JDJ	Date: Aug-08
	Subject:	Merridian Channel	Checked by:	JDP	Date: Aug-08
		Crane Load at Canal			Sheet No.: 8/10

Q:\20539\07-Design\02-Comps\07-ST\Merridian_Channel\[Merridian_Channel.xls]Quantities

Siphon Draw Drainage Improvement Project
Lateral Earth Pressures - SRP Crane Loading
(Edge of outrigger 16 to 32 feet away from channel edge)



Note: For crane loading, design is based on Operating allowable stress levels.

Inputs:

f'_c (psi) =	3000	CL Top =	3	in		$f_{c\text{-allow}}$ (psi) =	1900
f_y (psi) =	60000	CL Bott =	3	in		$f_{s\text{-allow}}$ (psi) =	36000
width, b (in) =	12						
height, h (in) =	14						
d_{top} (in) =	10.69						
d_{bott} (in) =	10.69					E_{conc} (psi) =	3122019
						E_{steel} (psi) =	29000000
M_{bott} (k-ft) =	17.33	working loads					

AASHTO 2003 Manual for the Condition Evaluation of Bridges, 6.6.2.3 & 6.6.2.4

BAR_{bott} =	5	
A_s (in^2) =	0.31	
N_{bars} per b =	2	= #5 @ 6"
n =	9.3	
A_s (in^2) =	0.61	
ρ =	0.0048	
k =	0.257	
kd (in) =	2.7	

Flexural analysis of bottom bars:

M_{cap} (k-ft) =	17.99	OK, > 17.33
@ M_{load} f_c (psi) =	1292	OK, < 1900
@ M_{cap} f_c (psi) =	1340	OK, < 1900

Note: At midpoint of slope.
For crane loading, design is based on Operating allowable stress levels.

Inputs:

f'_c (psi) =	3000	CL Top =	3	in		$f_{c\text{-allow}}$ (psi) =	1900
f_y (psi) =	60000	CL Bott =	3	in		$f_{s\text{-allow}}$ (psi) =	36000

AASHTO 2003 Manual for the Condition Evaluation of Bridges, 6.6.2.3 & 6.6.2.4

width, b (in) =	12	
height, h (in) =	11	
d_{top} (in) =	7.69	
d_{bott} (in) =	7.69	
M_{bott} (k-ft) =	1.23	working loads
BAR_{bott} =	5	
A_s (in^2) =	0.31	
N_{bars} per b =	1	= #5 @ 12"
n =	9.3	
A_s (in^2) =	0.31	
ρ =	0.0033	
k =	0.220	
kd (in) =	1.7	

E_{conc} (psi) = 3122019
E_{steel} (psi) = 29000000

Flexural analysis of bottom bars:

M_{cap} (k-ft) =	6.56	OK, > 1.23
@ M_{load} f_c (psi) =	205	OK, < 1900
@ M_{cap} f_c (psi) =	1090	OK, < 1900

Memo

To	Michael Lopez, P.E. Stanley Consultants, Inc. 1661 East Camelback Road Suite 400 Phoenix, Arizona 85016	File no	7-117-001080
From	Brett A. Howey, P.E.	cc	
Tel	480-940-2320 ext. 116		
Date	November 12, 2008		

Subject Salt River Project Crane Surcharge - Meridian Channel Loading
Slope Stability Analysis
95 Percent Design Support Technical Memorandum
Siphon Draw Drainage Improvement Project
Maricopa County, Arizona

1.0 INTRODUCTION

This technical memorandum is submitted by AMEC Earth & Environmental, Inc. (AMEC) in support of the 95 percent design submittal for the Siphon Draw Drainage Improvement Project (Project). AMEC understands that the information presented herein will be incorporated into the overall 95 percent design package, which includes design plans, project specifications, special provisions, and construction cost estimates. This technical memorandum has been prepared for use by Stanley Consultants, Inc. (Stanley), the Flood Control District of Maricopa County (District) and its project partners, in support of the project design, Contract No. FCD 2007C012.

2.0 BACKGROUND

AMEC understands that the Meridian channel and channel concrete lining must be designed to withstand a surcharge load applied by a crane outrigger to allow periodic overhead electric line servicing by Salt River Project (SRP). The anticipated surcharge loading will be a maximum of 320 pounds per square inch (psi) on a 27-inch diameter outrigger pad.

The purpose of this technical memorandum is to document the calculated slope stability factor of safety for a typical channel cross-section inclusive of the surcharge applied by the SRP crane outrigger. Lateral earth pressures for varying distances from the channel edge were previously provided by AMEC (2008[1]) for channel concrete lining design. Additionally, SRP has requested an assessment of any impacts earth fissuring may have on this loading condition.

3.0 SLOPE STABILITY

A conventional static stability analysis of a typical channel side slope section was performed using the computer program SLOPE/W (Geo-Slope International, 2004). Loading conditions and the channel cross-section geometry was provided to AMEC by Mr. David Joder, P.E., with

[1] References are listed at the end of this report.

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Stanley. The outrigger pad closest to the slope was 15 feet from the edge. The comprehensive formulation of SLOPE/W makes it possible to easily analyze both simple and complex slope stability problems using a variety of methods to calculate the factor of safety (FOS). The FOS was computed using Bishop's method, which is conservative in comparison to solutions obtained by applying other limit equilibrium techniques.

The soil parameters utilized in the analysis were based on the results of lab testing completed by AMEC, published parameters and AMEC's experience with similar materials. The following soil strength input parameters were utilized for the native channel bank soils.

- Unit Weight – 95 pounds per cubic foot
- Internal Friction Angle – 30 degrees
- Cohesion – 200 pounds per square foot

The minimum FOS for the most critical failure surface was determined for static conditions using the programs search features. Results of the stability analysis for the detention basin slope are presented in Figure 1. The FOS value determined exceeds 1.5; therefore, considering the soil shear strength parameters selected, the SRP crane surcharge loading conditions are acceptable.

4.0 EARTH FISSURE IMPACTS

The project area is located in an area of known land subsidence and active earth fissuring. AMEC performed a site specific Geologic Hazard Assessment in support of this project. The purpose of the assessment portion of this investigation was to specifically address the impacts of subsidence and earth fissuring on project elements. This investigation included an additional search for earth fissures, characterization of known earth fissures and the delineation of subsidence and earth fissuring risk in the project area. Results of the investigation are documented in the AMEC report entitled, Geologic Hazard Assessment and Geotechnical Characterization Report, dated September 3, 2008 (AMEC, 2008).

No existing earth fissures were documented in the general vicinity of the Meridian channel intersection with the SRP overhead power line easement. Therefore, based on existing data it would not appear earth fissures would presently impact the safe set-up of an SRP crane at this location. However, earth fissures and associated earth fissure gully formation is a very dynamic geologic hazard process. AMEC recommends inspection of any crane set-up location by a qualified engineer prior to any mobilization activities to assess the presence of any earth fissures or any other unacceptable soil conditions that could impact the safe operation of a crane or other equipment.

Please do not hesitate to contact us if you have any questions concerning this technical memorandum.

Respectfully submitted,

AMEC Earth & Environmental, Inc.

Reviewed by:

Registered Professional Engineer (Civil) CERTIFICATE NO. 40209 BRETT A. HOWEY 11/12/08 Date Signed ARIZONA, U.S.A. Expires 12/31/09

Registered Professional Engineer (Civil) CERTIFICATE NO. 37284 DANIEL N. FRECHETTE 11·12·08 Date Signed ARIZONA, U.S.A. Expires 03/31/2011

Brett A. Howey, P.E.
Senior Geotechnical Engineer

Daniel N. Fréchette, Ph.D., P.E.
Geotechnical Engineer

c: Addressee (6)

G:\Engineering Department\2007 Projects\7-117-001080 Siphon Draw\95% Design Report Write-up\95% Design - SRP Crane Global Stability - Technical Memorandum.doc

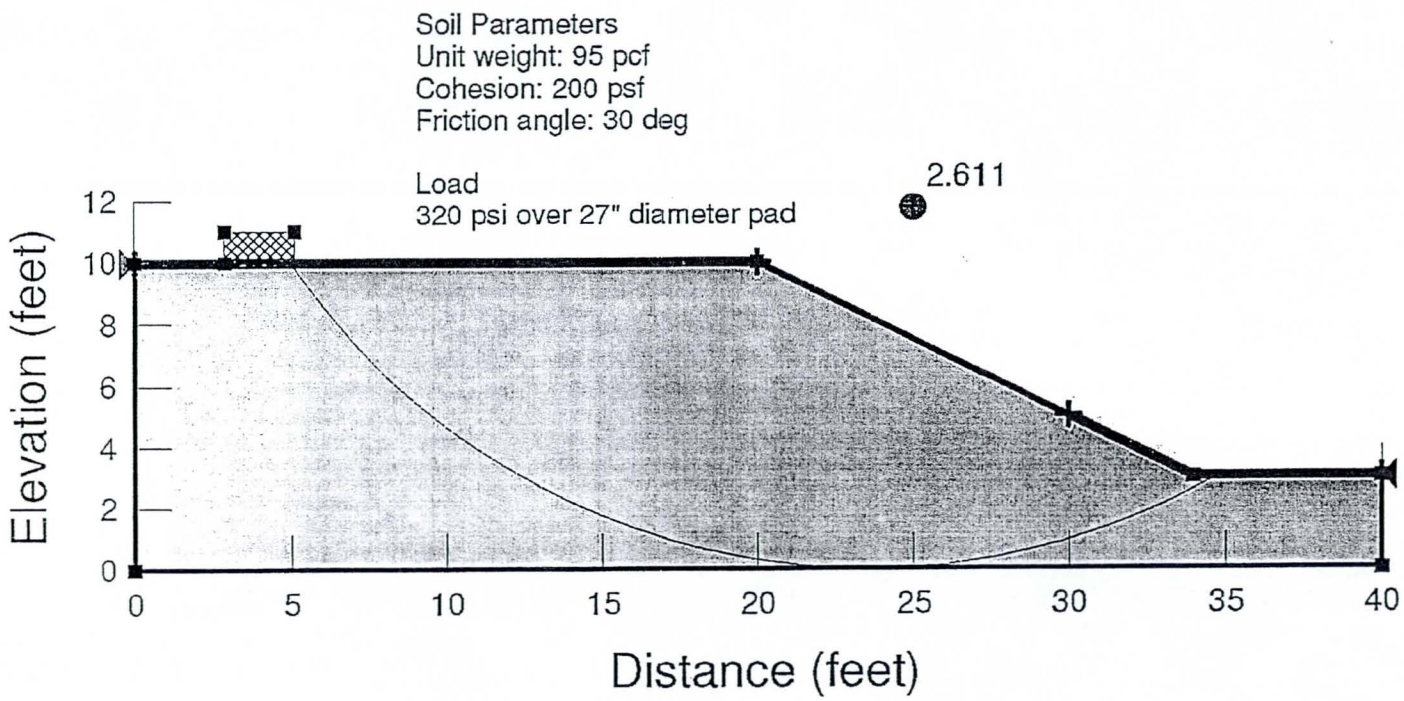
5.0 REFERENCES

AMEC Earth & Environmental Inc. (AMEC), 2008. Siphon Draw Drainage Improvement Project Geologic Hazard Assessment and Geotechnical Characterization Report, Maricopa County, Arizona. Prepared for the Flood Control District of Maricopa County on Behalf of Stanley Consultants, Inc, Contract FCD 2007C012, AMEC Job No. 7-117-001080, September 3.

GeoSlope International Ltd., 2004. Stability Modeling with Slope/W, An Engineering Methodology, First Edition, Revision 1, Calgary, Alberta, Canada.

FIGURE 1

Siphon Draw Retention Basin
Project # 7-117-001080
Equipment Load Model



APPENDIX G

Miscellaneous

MISCELLANEOUS

Offsite Drainage

MEMO

TO: Mike Lopez **DATE:** January 9, 2009

FROM: Charlie Joy

SUBJECT: SDW Phase 1 - Flow over the side of Meridian Channel

---

There are a number of ways that could be used for evaluating flow into the Meridian Channel. Attached are a couple of approaches.

One approach simply assumes that the flow through each incised inlet is the same as the capacity of the 1' deep, 10' bottom width, 10:1SS channel that flows into it. The channel capacity is estimated to be ~86 cfs using Manning's equation. With there being two inlets, it is assumed that 172 cfs flows into the channel through the incised inlets. The remaining 63 cfs (of the total 235 cfs for Q100) is assumed to drain into the channel uniformly over the channel bank with the capacity based upon the weir equation using a typical weir coefficient of 2.65. Assuming a 3" depth of sheet flow into the channel over the length of the concrete channel equates to 71 cfs, more than necessary. (the increase in channel capacity due to an additional 0.25' of flow depth in the channel is ignored)

Another approach is to apply the weir equation across the entire length of the concrete portion of the channel including the incised inlets. Since the inlets to the channel are basically the termination of a channel flowing unimpeded into another channel, to estimate the weir coefficient, a weir coefficient was selected that calculates the weir capacity of each inlet equivalent to the channel capacity (~86 cfs). A weir coefficient of 4.2 estimates the capacity of the incised inlets as 84 cfs and so is used for the weir calculations. Assuming flow elevations based upon a uniform sheet flow depth of ~0.1', the length of the channel will capture 235 cfs.

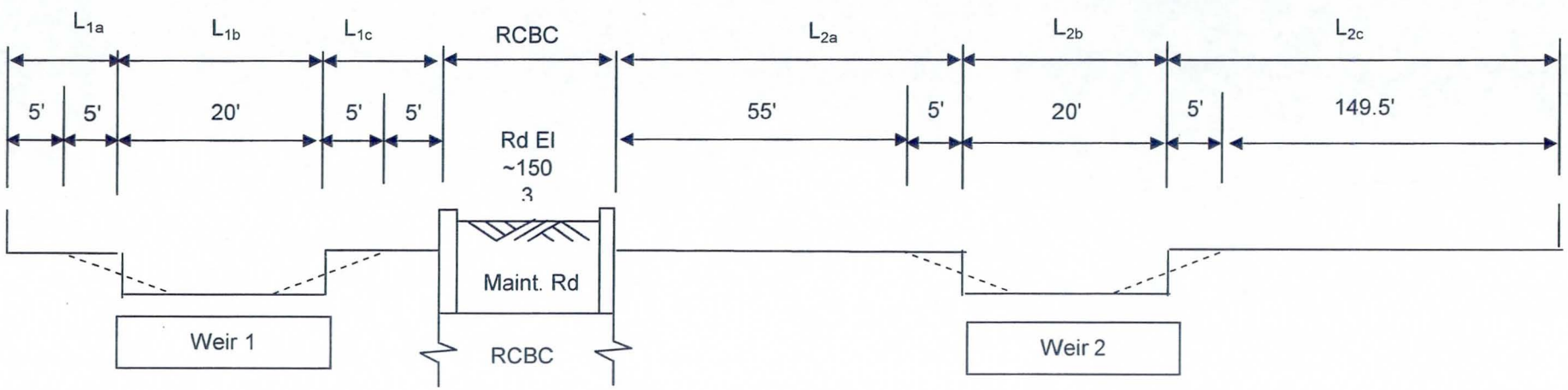
It should be noted that the maintenance road over the RCBC crests at ~1503 which is higher than the estimated height of the adjacent sheet flow areas.

Based upon these two approaches we can see that the inlet will handle the majority of the flow with any remaining flow into the channel being very shallow when spread out along the length of the channel.

Flow Over Side of Meridian Channel

Location	WSEL (ft)	Crest Elev[1] (ft)	C	L (ft)	H (ft)	Q[2] (cfs)
Typical Inlet	101	100	4.2	20	1	84
Weir 1a	1502.58	1502.48	4.2	10	0.1	1
Weir 1b	1502.58	1501.37	4.2	20	1.21	112
Weir 1c	1502.63	1502.53	4.2	10	0.1	1
Subtotal						114
Weir 2a	1502.71	1502.61	4.2	60	0.1	8
Weir 2b	1502.71	1501.65	4.2	20	1.06	92
Weir 2c	1502.92	1502.82	4.2	154.5	0.1	21
Subtotal						120
Total						235

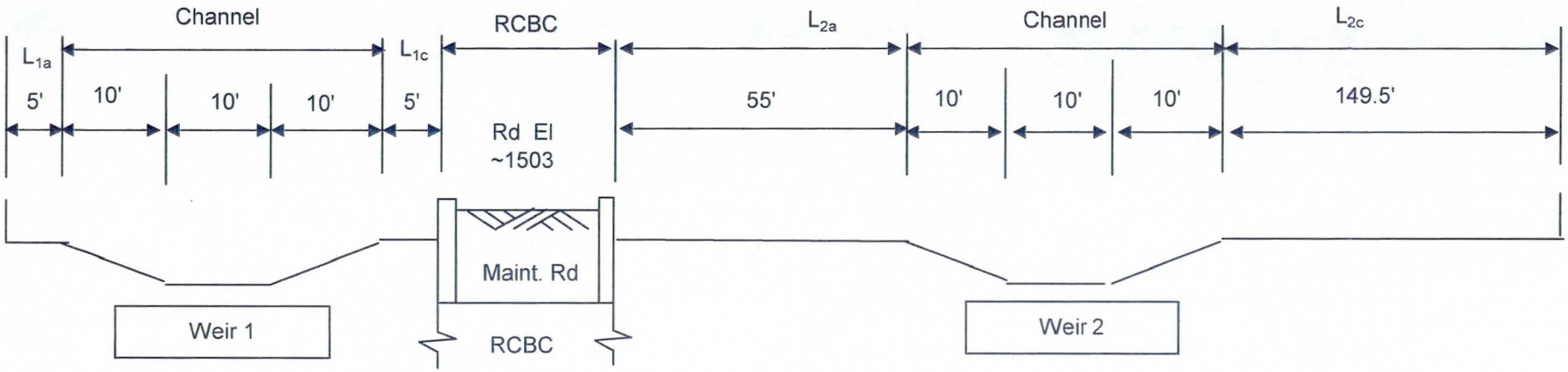
1. Average across length
2 $Q=CLH^{3/2}$



Flow Over Side of Meridian Channel

Location	WSEL (ft)	Crest Elev[1] (ft)	C	L (ft)	H (ft)	Q[2] (cfs)
Inlet Capacity[3]	-	-	-	-	-	86
Total Flow	-	-	-	-	-	235
Capcity of 2 Inlets	-	-	-	-	-	172
						63
Weir 1a	1502.73	1502.48	2.65	5	0.25	2
Weir 1c	1502.78	1502.53	2.65	5	0.25	2
Subtotal						3
Weir 2a	1502.86	1502.61	2.65	55	0.25	18
Weir 2c	1503.07	1502.82	2.65	149.5	0.25	50
Subtotal						68
Total						**71**

1. Average across length
2 $Q=CLH^{3/2}$
3. Based upon Manning's equation for a trapezoidal channel 1' deep, 10' bottom width & 10:1 SS



Worksheet
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	North Trapezoidal Channel
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coefficient	0.025	
Channel Slope	0.009000	ft/ft
Depth	1.00	ft
Left Side Slope	10.00	H : V
Right Side Slope	10.00	H : V
Bottom Width	10.00	ft

Results		
Discharge	85.87	cfs
Flow Area	20.0	ft²
Wetted Perimeter	30.10	ft
Top Width	30.00	ft
Critical Depth	0.96	ft
Critical Slope	0.010585	ft/ft
Velocity	4.29	ft/s
Velocity Head	0.29	ft
Specific Energy	1.29	ft
Froude Number	0.93	
Flow Type	Subcritical	

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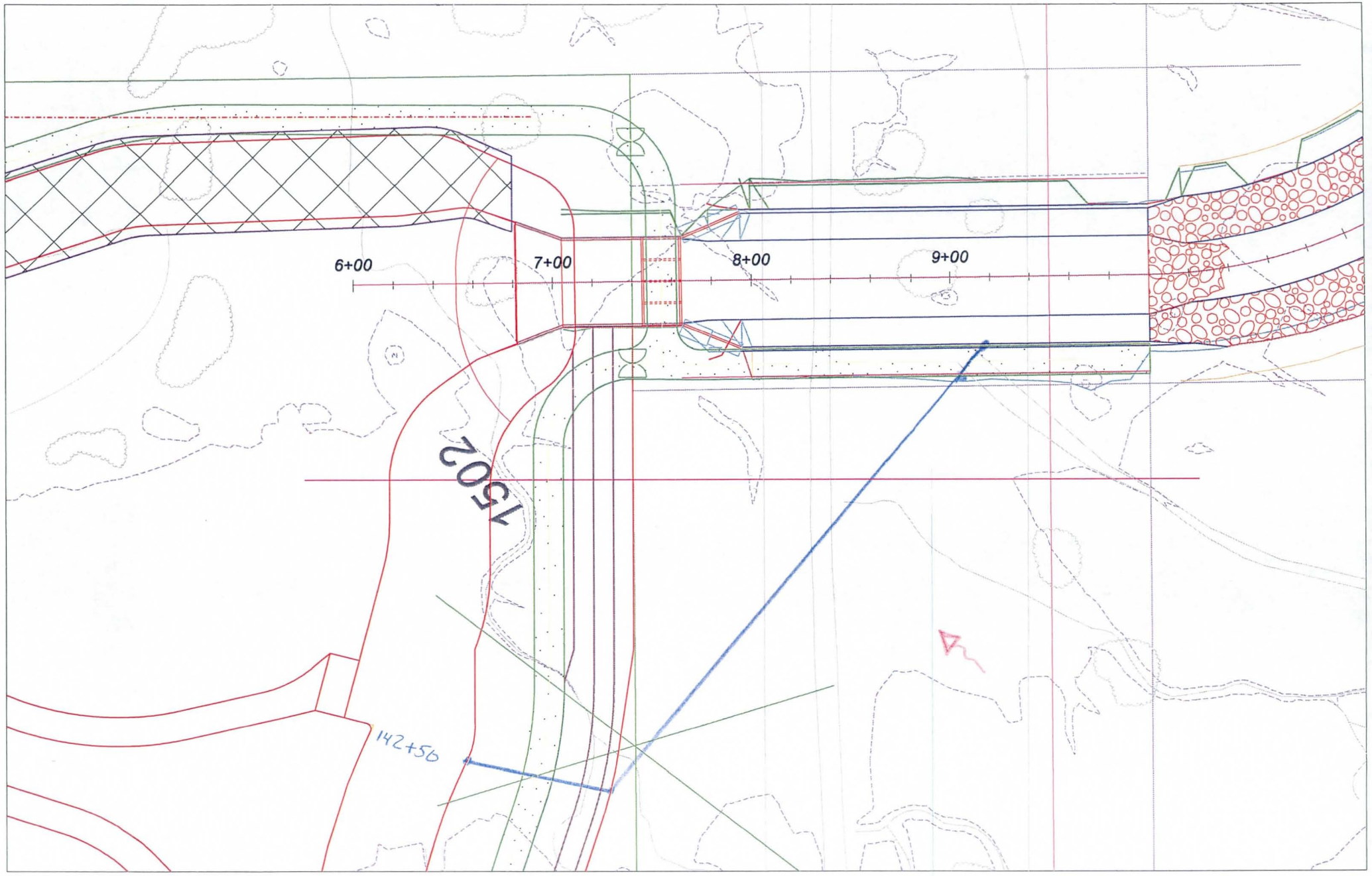
Stanley Consultants, Inc
37 Brookside Road Waterbury, CT 06708 USA +1-203-755-1666


6+00
7+00
8+00
9+00
1502
142+56

MISCELLANEOUS

Riprap

Summary of Loose Riprap Sizing Results
Siphon Draw Drainage Improvements Project

Description	Straight Reach				Curved Reach					Previous Method[1] (in)	Proposed Design Size (in)
	Bank Angle (degrees)	V_{ave} (ft/s)	Median Riprap Size, D_{50} Bank (in)	Median Riprap Size, D_{50} Bed (in)	Bend Angle (degrees)	Bank Angle (degrees)	V_{ave} (ft/s)	Median Riprap Size, D_{50} Bank (in)	Median Riprap Size, D_{50} Bed (in)		
Meridian Channel Phase 1	18.4	8.2	10	10	30	18.4	8.2	20	19	9	12
Meridian Channel Phase 2	18.4	8.5	11	11	30	18.4	8.5	21	20	9	12
MC - Downstream of Outlet[2]	-	-	-	-	-	-	-	-	-	10.7	12
North Offsite Drainage Channel[3]	11.3	4.5	3	3	25	11.3	4.5	N/A	N/A	3	3
East Offsite Drainage Channel[3]	11.3	3.5	2	2	25	11.3	3.5	N/A	N/A	2	9
SDW - East (Typical)	11.3	6.0	6	6	15	11.3	4.0	N/A	N/A	6	9
SDW - Approach to Drop Inlet	11.3	7.4	8	8	0	11.3	7.4	N/A	N/A	N/A	12
SDW - Downstream of Drop Inlet[4,6]	-	-	-	-	-	-	-	-	-	15	12
SDW - Downstream of Cutoff Wall	-	-	-	-	-	-	-	-	-	9	12
Basin Outlet Channel (typical)	14.0	5.0	4	4	25	14.0	5.0	N/A	N/A	4	12
Basin Outlet Channel (at outlet)[2]	-	-	-	-	-	-	-	-	-	10.4	12
Emergency Spillway[5]	-	-	-	-	-	-	-	-	-	-	12

Note:

1. *Methodolgy presented in Drainage Design Manual - Hydraulics, FCDMC, 2003 with the exception s as noted.*
2. *No FCDMC equations applied for sizing. Calculations based on HEC-14 Hydraulic Design of Energy Dissipators for Culverts and Channels, FHWA, July 2006*
3. *Proposed design sizes are rock sizes, not D_{50} sizes.*
4. *No FCDMC equations applied for sizing. Calculations based upon Scour at Sill Structures, ADOT, 1983.*
5. *Emergency spillway design is not based upon a specific design discharge.*
6. *Proposed design size is smaller than calculations because results are considered very conservative. Typically sizing applies to the actual sloping surface. In this application, it is applied to the riprap downstream of the drop structure which also includes a flat concrete apron.*

Sizing for Loose Riprap (Meridian Channel Phase 1)

For Straight Reaches

Channel Banks on Straight Reach

Average Velocity, V_a =	8.2	ft/s	(range from 7.7 - 8.2 ft/s)
Specific Weight of Stone, γ_s =	165.4	lb/ft³	(assumed as $2.6\gamma_w$)
Specific Weight of Water, γ_w =	62.4	lb/ft³	
Bank Angle, φ =	18.4	degrees	(3H:1V)
$D_{50} = (0.0191\ V_a^2/\cos\varphi)(\gamma_w/(\gamma_s-\gamma_w))$ =	0.82	ft	
	10	in	

Channel Bed on Straight Reach

Average Velocity, V_a =	8.2	ft/s	(range from 7.7 - 8.2 ft/s)
Specific Weight of Stone, γ_s =	165.4	lb/ft³	(assumed as $2.6\gamma_w$)
Specific Weight of Water, γ_w =	62.4	lb/ft³	
$D_{50} = (0.0191\ V_a^2)(\gamma_w/(\gamma_s-\gamma_w))$ =	0.78	ft	
	10	in	

[1] Velocity at upstream and downstream ends are approx 18 and 11 ft/s. Not considered representative of actual, or overall velocity.

For Curved Reaches

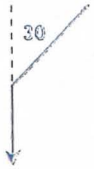
Channel Banks on Curved Reach

Outer bank protection of a curved reach of more than 30 degrees bend angle

Average Velocity, V_a =	8.2	ft/s	(range from 7.7 - 8.2 ft/s)
Specific Weight of Stone, γ_s =	165.4	lb/ft³	(assumed as $2.6\gamma_w$)
Specific Weight of Water, γ_w =	62.4	lb/ft³	
Bend Angle, φ =	30	degrees	(for reference, not used in calc)
Bank Angle, φ =	18.4	degrees	(3H:1V)
$D_{50} = (0.0372\ V_a^2/\cos\varphi)(\gamma_w/(\gamma_s-\gamma_w))$ =	1.60	ft	
	20	in	

Channel Bed on Curved Reach:

Channel bed protection near outer bank of a curved reach of more than 30 degrees bend angle



Average Velocity, V_a =	8.2	ft/s	(range from 7.7 - 8.2 ft/s)
Specific Weight of Stone, γ_s =	165.4	lb/ft³	(assumed as $2.6\gamma_w$)
Specific Weight of Water, γ_w =	62.4	lb/ft³	
Bend Angle, φ =	30	degrees	(for reference, not used in calc)
$D_{50} = 0.0372\ V_a^2(\gamma_w/(\gamma_s-\gamma_w))$ =	1.52	ft	
	19	in	

Reference: Drainage Design Manual, Hydraulics (DRAFT CHAPTER 11), FCDMC, 2007

Note: Methodology from draft Hydraulics Manual (Appendix B) provided by FCDMC but not yet published

Sizing for Loose Riprap (Meridian Channel Phase 2)

For Straight Reaches

Channel Banks on Straight Reach

Average Velocity, V_a =	8.5	ft/s	(generally 7.3 - 8.5 ft/s)[1]
Specific Weight of Stone, γ_s =	165.4	lb/ft³	(assumed as $2.6\gamma_w$)
Specific Weight of Water, γ_w =	62.4	lb/ft³	
Bank Angle, φ =	18.4	degrees	(3H:1V)
$D_{50} = (0.0191\ V_a^2/\cos\varphi)(\gamma_w/(\gamma_s-\gamma_w))$ =	0.88	ft	
	11	in	

Channel Bed on Straight Reach

Average Velocity, V_a =	8.5	ft/s	(generally 7.3 - 8.5 ft/s)[1]
Specific Weight of Stone, γ_s =	165.4	lb/ft³	(assumed as $2.6\gamma_w$)
Specific Weight of Water, γ_w =	62.4	lb/ft³	
$D_{50} = (0.0191\ V_a^2)(\gamma_w/(\gamma_s-\gamma_w))$ =	0.84	ft	
	11	in	

[1] Velocity at upstream and downstream ends are approx 18 and 11 ft/s. Not considered representative of actual, or overall velocity.

For Curved Reaches

Channel Banks on Curved Reach

Outer bank protection of a curved reach of more than 30 degrees bend angle

Average Velocity, V_a =	8.5	ft/s	(generally 7.3 - 8.5 ft/s)[1]
Specific Weight of Stone, γ_s =	165.4	lb/ft³	(assumed as $2.6\gamma_w$)
Specific Weight of Water, γ_w =	62.4	lb/ft³	
Bend Angle =	30	degrees	(for reference, not used in calc)
Bank Angle, φ =	18.4	degrees	(3H:1V)
$D_{50} = (0.0372\ V_a^2/\cos\varphi)(\gamma_w/(\gamma_s-\gamma_w))$ =	1.72	ft	
	21	in	

Channel Bed on Curved Reach:

Channel bed protection near outer bank of a curved reach of more than 30 degrees bend angle

Average Velocity, V_a =	8.5	ft/s	(generally 7.3 - 8.5 ft/s)[1]
Specific Weight of Stone, γ_s =	165.4	lb/ft³	(assumed as $2.6\gamma_w$)
Specific Weight of Water, γ_w =	62.4	lb/ft³	
Bend Angle, φ =	30	degrees	(for reference, not used in calc)
$D_{50} = 0.0372\ V_a^2(\gamma_w/(\gamma_s-\gamma_w))$ =	1.63	ft	
	20	in	

Reference: Drainage Design Manual, Hydraulics (DRAFT CHAPTER 11), FCDMC, 2007

Note: Methodology from draft Hydraulics Manual (Appendix B) provided by FCDMC but not yet published

Riprap Size D_{50} for Channel Lining

Channel Lining Riprap D50 (unadjusted):

Average depth of flow (ft), d_{avg} =	5	ft	*(~HEC-RAS results)*
Average channel velocity (ft/s), V_a =	9	ft/s	*(~HEC-RAS results)*

K_1, bank angle correction factor:

channel bank angle with horizontal, Θ =	18.4	deg	*(3H:1V)*
riprap angle of ripose, Φ =	41	deg	*{See Reference Table 6.14}*
$K_1 = [1-(\sin^2\Theta/\sin^2\Phi]^{1/2}$ =	0.877		

Channel Lining Riprap D_{50} (unadjusted):

$D_{50,unadj} = 0.001V_a^3/(d_{avg}^{1/2}K_1^{3/2})$ = 0.40 ft

Stability Correction Factors (SCF):

SCF for specific gravity of riprap, C_{sg}:

specific gravity of riprap, S_s =	2.65
SCF for specific gravity, $C_{sg} = 2.12/(S_s-1)^{3/2}$ =	1.00

SCF for channel condition, C_{sf}:

Uniform Flow: $1.0 < C_{sf} < 1.2$
- straight/mild curves (R_c/W_c<30), little/no design uncertainties
- little/no impact from wave action or debris,

Gradually Varying Flow: $1.3 < C_{sf} < 1.6$
- moderate bends (30>R_c/W_c>10),
- moderate impact from wave action or debris

Rapidly Varying Flow: $1.6 < C_{sf} < 2.0$
- sharp bends (10<R_c/W_c), significant design uncertainties
- turbulent, significant wave/debris impacts, bridge abutments

*R_c/W_c = curve radius/channel width

C_{sf} = 1.8

Channel Lining Riprap D_{50} (Adjusted):

$D_{50,adj} = (C_{sg})(C_{sf})(D_{50,unadj})$ =	0.71	ft	
$D_{50,adj}$ =	9	in	*(rounded up)*

Reference: Drainage Design Manual, Hydraulics, FCDMC, 2003

Riprap and Riprap Apron Sizing Downstream of Culverts
Meridian Channel Outlet to Siphon Draw Detention Basin

Urban Drainage and Flood Control District (UCFCD) Equations {Denver Colorado}

Description		Units	Comments
Type of culvert (circular or rectangular)	rectangular		
Q, design discharge	563	cfs	*2250 cfs/4 barrels*
D, culvert diameter (or rise)	7.0	ft	
B, culvert span (rectangular only))	10.0	ft	
TW, tailwater depth	5.0	ft	*HEC-RAS Results*
α, unit conversion constant: 1.0 (for US units)	1.0		
Riprap size D_{50} for circular culvert:			
$D_{50}=0.023D\ [Q/(\alpha D^{2.5})]\ [D/TW]^{1.2}$	n/a	ft	*{Equation D.1a}*
	n/a	in	
Riprap size D_{50} for rectangular culvert:			
$D_{50}=0.014D\ [Q/(\alpha BD^{1.5})]\ [D/TW]$	0.45	ft	*{Equation D.1b}*
	6	in	

Reference: HEC-14 Hydraulic Design of Energy Dissipators for Culverts and Channels, FHWA, July 2006

Berry & Perterka Equation

Description		Units	Comments
V, culvert exit velocity	10.6	ft/s	*HEC-RAS Results*
α, unit conversion constant: (0.0126 for US units)	0.0126		
Riprap size D_{50} for culvert			
$D_{50}=\alpha V^3$	1.42	ft	*{Equation D.2}*
	17	in	

Reference: HEC-14 Hydraulic Design of Energy Dissipators for Culverts and Channels, FHWA, July 2006

HEC-11 (Brown & Clyde) / HEC-14 (Searcy) Equation

Used in HEC-11 for sizing riprap protection for piers (Ref: pg D-1, HEC-14, 2006)

Description		Units	Comments
V, culvert exit velocity	10.6	ft/s	*HEC-RAS Results*
S, riprap specific gravity (2.65 for general value)	2.65		
g, accelerations due to gravity (32.2 ft/s^2)	32.2	ft/s^2	
Riprap size D_{50} for culvert			
$D_{50}= [0.692/(S-1)]\ (V^2/2g)$	0.73	ft	*{Equation D.3}*
	9	in	

Reference: HEC-14 Hydraulic Design of Energy Dissipators for Culverts and Channels, FHWA, July 2006

Riprap and Riprap Apron Sizing Downstream of Culverts
Meridian Channel Outlet to Siphon Draw Detention Basin

Bohan Equation

Two equations based on lab testing (Ref: pg D-2, HEC-14, 2006)

Description		Units	Comments
TW, tailwater depth	5.0	ft	*HEC-RAS Results*
D, culvert diameter (or rise)	7.0	ft	
TW/D, ratio of tailwater depth to culvert depth	0.7		
V_o, culvert exit velocity	10.6	ft/s	*HEC-RAS Results*
g, accelerations due to gravity (32.2 ft/s^2)	32.2	ft/s^2	
Fr_o, Froude number at outlet, $(V_o/(gD)^{0.5})$	0.71		
Riprap size D_{50} for culvert (TW/D<0.5)			
$D_{50}= D(0.25Fr_o)$	n/a	ft	*{Equation D.4a}*
	n/a	in	
Riprap size D_{50} for culvert (TW/D≥0.5)	0.19	ft	*{Equation D.4b}*
$D_{50}= D(0.25Fr_o-0.15)$	3	in	

Reference: HEC-14 Hydraulic Design of Energy Dissipators for Culverts and Channels, FHWA, July 2006

Fletcher & Grace Equation

Based on lab testing from Bohan and other sources (Ref: pg D-2, HEC-14, 2006)

Fletcher & Grace is recommended for circular culverts (Ref: pg 10-17, HEC-14, 2006)

Description		Units	Comments
Q, design discharge	563	cfs	*2250 cfs/4 barrels*
D, culvert diameter (or rise)[2]	7.0	ft	
TW, tailwater depth[1]	5.0	ft	*HEC-RAS Results*
α, unit conversion constant: 1.0 (for US units)	1.0		
Riprap size D_{50} for culvert (TW/D<0.5)			
$D_{50}= 0.02D\,[Q/(\alpha D^{2.5})]^{4/3}\,(D/TW)$	1.39	ft	*{Equation D.5}*
	17	in	

1. *TW for equation should be limited to 0.4D to 1.0D. If TW is uknown, use 0.4D.*
2. *When flow is supercritical in the culvert, diameter should be adjusted by:*

   D'=(D+yn)/2) where yn is normal (supercritical) depth in the culvert)

Note: Equation assumes specific gravity of riprap is 2.65

Reference: HEC-14 Hydraulic Design of Energy Dissipators for Culverts and Channels, FHWA, July 2006

Riprap and Riprap Apron Sizing Downstream of Culverts
Meridian Channel Outlet to Siphon Draw Detention Basin

Summary Table of Riprap Sizing Results

Method	D_{50} (in)	Comments
UDFCD *(Eqn D.1a & D.1b)*	6	
Berry & Perterka (Eqn. D.2)	17	
HEC-11 (Brown & Clyde) / HEC-14 (Searcy) (Eqn. D.3)	9	
Bohan (Eqn. D.4)	3	
Fletcher & Grace (Eqn. D.5)	17	
Average Riprap Size	10.4	
Average Riprap Size (discard high and low)	10.7	
Design Riprap	12	

Note: FHWA compared results of Eqn.s in 10 hypothetical situations involving 30-48" CMP pipes, discharges ranging from 40-150cfs and slope/tailwater changes resulting in 5 inlet control and 5 outlet control cases.

Based upon those specific scenarios evaluated:

Eqn. D.2 results in the highest values for the range of conditions evaluated.

Eqn.s D.2 & D.3 are not recommended because they do not consider tailwater effects.

Eqn. D.4 was also not further considered since it treats tailwater only as two separate conditions, min. and max.

Eqns. D.1 & D.5 are similar in apporach, based on lab data and would probably generate reasonable designs.

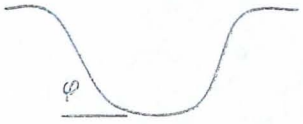
Eqn. D.1 produced the higher recommendation 3 times and the lower 7 times (less conservative)

Eqn. D.5 was included/utilized in Chapter 10 of the manual.

Sizing for Loose Riprap (North Channel for Offsite Drainage)

For Straight Reaches

Channel Banks on Straight Reach



Average Velocity, V_a =	4.5	ft/s	
Specific Weight of Stone, γ_s =	165.4	lb/ft³	(assumed as $2.6\gamma_w$)
Specific Weight of Water, γ_w =	62.4	lb/ft³	
Bank Angle, φ =	11.3	degrees	(5H:1V)
$D_{50} = (0.0191\ V_a^2/\cos\varphi)(\gamma_w/(\gamma_s-\gamma_w))$ =	0.24	ft	
	3	in	

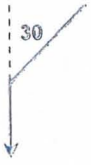
Channel Bed on Straight Reach

Average Velocity, V_a =	4.5	ft/s	
Specific Weight of Stone, γ_s =	165.4	lb/ft³	(assumed as $2.6\gamma_w$)
Specific Weight of Water, γ_w =	62.4	lb/ft³	
$D_{50} = (0.0191\ V_a^2)(\gamma_w/(\gamma_s-\gamma_w))$ =	0.23	ft	
	3	in	

For Curved Reaches

Channel Banks on Curved Reach

Outer bank protection of a curved reach of more than 30 degrees bend angle



Average Velocity, V_a =	4.5	ft/s	
Specific Weight of Stone, γ_s =	165.4	lb/ft³	(assumed as $2.6\gamma_w$)
Specific Weight of Water, γ_w =	62.4	lb/ft³	
Bend Angle, φ =	25	degrees	(for reference, not used in calc)
Bank Angle, φ =	11.3	degrees	(5H:1V)
$D_{50} = (0.0372\ V_a^2/\cos\varphi)(\gamma_w/(\gamma_s-\gamma_w))$ =	N/A	ft	
	N/A	in	

Channel Bed on Curved Reach:

Channel bed protection near outer bank of a curved reach of more than 30 degrees bend angle

Average Velocity, V_a =	4.5	ft/s	
Specific Weight of Stone, γ_s =	165.4	lb/ft³	(assumed as $2.6\gamma_w$)
Specific Weight of Water, γ_w =	62.4	lb/ft³	
Bend Angle, φ =	25	degrees	(for reference, not used in calc)
$D_{50} = 0.0372\ V_a^2(\gamma_w/(\gamma_s-\gamma_w))$ =	N/A	ft	
	N/A	in	

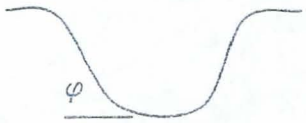
Reference: Drainage Design Manual, Hydraulics (DRAFT CHAPTER 11), FCDMC, 2007

Note: Methodology from draft Hydraulics Manual (Appendix B) provided by FCDMC but not yet published

Sizing for Loose Riprap (East Channel for Offsite Drainage)

For Straight Reaches

Channel Banks on Straight Reach



Average Velocity, V_a =	3.5	ft/s	
Specific Weight of Stone, γ_s =	165.4	lb/ft³	(assumed as 2.6γ_w)
Specific Weight of Water, γ_w =	62.4	lb/ft³	
Bank Angle, φ =	11.3	degrees	(5H:1V)
$D_{50} = (0.0191\ V_a^2/\cos\varphi)(\gamma_w/(\gamma_s-\gamma_w))$ =	0.14	ft	
	2	in	

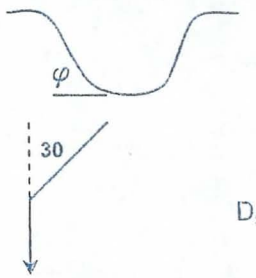
Channel Bed on Straight Reach

Average Velocity, V_a =	3.5	ft/s	
Specific Weight of Stone, γ_s =	165.4	lb/ft³	(assumed as 2.6γ_w)
Specific Weight of Water, γ_w =	62.4	lb/ft³	
$D_{50} = (0.0191\ V_a^2)(\gamma_w/(\gamma_s-\gamma_w))$ =	0.14	ft	
	2	in	

For Curved Reaches

Channel Banks on Curved Reach

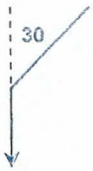
Outer bank protection of a curved reach of more than 30 degrees bend angle



Average Velocity, V_a =	3.5	ft/s	
Specific Weight of Stone, γ_s =	165.4	lb/ft³	(assumed as 2.6γ_w)
Specific Weight of Water, γ_w =	62.4	lb/ft³	
Bend Angle, φ =	25	degrees	(for reference, not used in calc)
Bank Angle, φ =	11.3	degrees	(5H:1V)
$D_{50} = (0.0372\ V_a^2/\cos\varphi)(\gamma_w/(\gamma_s-\gamma_w))$ =	N/A	ft	
	N/A	in	

Channel Bed on Curved Reach:

Channel bed protection near outer bank of a curved reach of more than 30 degrees bend angle



Average Velocity, V_a =	3.5	ft/s	
Specific Weight of Stone, γ_s =	165.4	lb/ft³	(assumed as 2.6γ_w)
Specific Weight of Water, γ_w =	62.4	lb/ft³	
Bend Angle, φ =	25	degrees	(for reference, not used in calc)
$D_{50} = 0.0372\ V_a^2(\gamma_w/(\gamma_s-\gamma_w))$ =	N/A	ft	
	N/A	in	

Reference: Drainage Design Manual, Hydraulics (DRAFT CHAPTER 11), FCDMC, 2007

Note: Methodology from draft Hydraulics Manual (Appendix B) provided by FCDMC but not yet published

Sizing for Loose Riprap (Siphon Draw Wash - Typical Channel)

For Straight Reaches

Channel Banks on Straight Reach

Average Velocity, V_a =	6	ft/s	(generally 3.0 - 6.0 ft/s)[1]
Specific Weight of Stone, γ_s =	165.4	lb/ft³	(assumed as $2.6\gamma_w$)
Specific Weight of Water, γ_w =	62.4	lb/ft³	
Bank Angle, φ =	11.3	degrees	(5H:1V)
$D_{50} = (0.0191\ V_a^2/\cos\varphi)(\gamma_w/(\gamma_s-\gamma_w))$ =	0.42	ft	
	6	in	

Channel Bed on Straight Reach

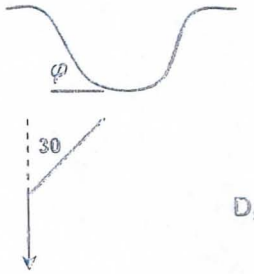
Average Velocity, V_a =	6	ft/s	(generally 3.0 - 6.0 ft/s)[1]
Specific Weight of Stone, γ_s =	165.4	lb/ft³	(assumed as $2.6\gamma_w$)
Specific Weight of Water, γ_w =	62.4	lb/ft³	
$D_{50} = (0.0191\ V_a^2)(\gamma_w/(\gamma_s-\gamma_w))$ =	0.42	ft	
	6	in	

[1] Velocity at downstream end at inlet to basin is approx 7.4 ft/s. Not considered representative of general channel velocity.

For Curved Reaches

Channel Banks on Curved Reach

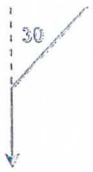
Outer bank protection of a curved reach of more than 30 degrees bend angle



Average Velocity, V_a =	4	ft/s	(at bends ~3.0-4.0 ft/s)[2]
Specific Weight of Stone, γ_s =	165.4	lb/ft³	(assumed as $2.6\gamma_w$)
Specific Weight of Water, γ_w =	62.4	lb/ft³	
Bend Angle, φ =	15	degrees	(for reference, not used in calc)
Bank Angle, φ =	11.3	degrees	(5H:1V)
$D_{50} = (0.0372\ V_a^2/\cos\varphi)(\gamma_w/(\gamma_s-\gamma_w))$ =	N/A	ft	
	N/A	in	

Channel Bed on Curved Reach:

Channel bed protection near outer bank of a curved reach of more than 30 degrees bend angle



Average Velocity, V_a =	4	ft/s	(at bends ~3.0-4.0 ft/s)[2]
Specific Weight of Stone, γ_s =	165.4	lb/ft³	(assumed as $2.6\gamma_w$)
Specific Weight of Water, γ_w =	62.4	lb/ft³	
Bend Angle, φ =	15	degrees	(for reference, not used in calc)
$D_{50} = 0.0372\ V_a^2(\gamma_w/(\gamma_s-\gamma_w))$ =	N/A	ft	
	N/A	in	

[2] Velocity in proximity of bends.

Reference: Drainage Design Manual, Hydraulics (DRAFT CHAPTER 11), FCDMC, 2007

Note: Methodology from draft Hydraulics Manual (Appendix B) provided by FCDMC but not yet published

Sizing for Loose Riprap (Siphon Draw Wash - Approach to Drop Inlet)

For Straight Reaches

Channel Banks on Straight Reach

Average Velocity, V_a =	7.4	ft/s	(just upstream of drop)[1]
Specific Weight of Stone, γ_s =	165.4	lb/ft³	(assumed as 2.6γ_w)
Specific Weight of Water, γ_w =	62.4	lb/ft³	
Bank Angle, φ =	11.3	degrees	(5H:1V)
$D_{50} = (0.0191\ V_a^2/\cos\varphi)(\gamma_w/(\gamma_s-\gamma_w))$ =	0.65	ft	
	8	in	

Channel Bed on Straight Reach

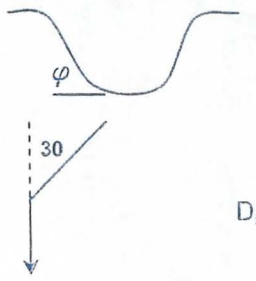
Average Velocity, V_a =	7.4	ft/s	(generally 3.0 - 6.0 ft/s)[1]
Specific Weight of Stone, γ_s =	165.4	lb/ft³	(assumed as 2.6γ_w)
Specific Weight of Water, γ_w =	62.4	lb/ft³	
$D_{50} = (0.0191\ V_a^2)(\gamma_w/(\gamma_s-\gamma_w))$ =	0.63	ft	
	8	in	

[1] Velocity at downstream end at inlet to basin is approx 7.4 ft/s. Not considered representative of general channel velocity.

For Curved Reaches

Channel Banks on Curved Reach

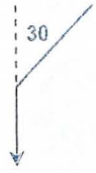
Outer bank protection of a curved reach of more than 30 degrees bend angle



Average Velocity, V_a =	7.4	ft/s	(at bends ~3.0-4.0 ft/s)[2]
Specific Weight of Stone, γ_s =	165.4	lb/ft³	(assumed as 2.6γ_w)
Specific Weight of Water, γ_w =	62.4	lb/ft³	
Bend Angle, φ =	0	degrees	(for reference, not used in calc)
Bank Angle, φ =	11.3	degrees	(5H:1V)
$D_{50} = (0.0372\ V_a^2/\cos\varphi)(\gamma_w/(\gamma_s-\gamma_w))$ =	N/A	ft	
	N/A	in	

Channel Bed on Curved Reach:

Channel bed protection near outer bank of a curved reach of more than 30 degrees bend angle



Average Velocity, V_a =	7.4	ft/s	(at bends ~3.0-4.0 ft/s)[2]
Specific Weight of Stone, γ_s =	165.4	lb/ft³	(assumed as 2.6γ_w)
Specific Weight of Water, γ_w =	62.4	lb/ft³	
Bend Angle, φ =	0	degrees	(for reference, not used in calc)
$D_{50} = 0.0372\ V_a^2(\gamma_w/(\gamma_s-\gamma_w))$ =	N/A	ft	
	N/A	in	

[2] Velocity in proximity of bends.

Reference: Drainage Design Manual, Hydraulics (DRAFT CHAPTER 11), FCDMC, 2007

Note: Methodology from draft Hydraulics Manual (Appendix B) provided by FCDMC but not yet published

Sizing for Loose Riprap

Siphon Draw Wash - Downstream of Drop Inlet

Sloped Drop Structure / Rock Chute

For a sloped drop structure or rock chute with a slope between 0.02 and 0.4

Discharge, Q =	1000	cfs
Width of flow, b =	60	ft
Unit discharge, q = Q/b =	16.7	cfs/ft
Structure/Channel Bed slope, S_o =	0.2	ft/ft

For $0.02 \leq S_o < 0.1$:

$D_{50} = 1.413\, q^{0.529}\, S_o^{0.794}$ = N/A ft

For $0.1 \leq S_o \leq 0.4$:

$D_{50} = 0.4623\, q^{0.529}\, S_o^{0.307}$ = 1.2 ft

D_{50} = 1.2 ft

15.0 in

Sizing for Loose Riprap

Siphon Draw Wash - Downstream of Cutoff Wall

Sloped Drop Structure / Rock Chute

For a sloped drop structure or rock chute with a slope between 0.02 and 0.4

Discharge, Q =	1000	cfs
Width of flow, b =	150	ft
Unit discharge, q = Q/b =	6.7	cfs/ft
Structure/Channel Bed slope, S_o =	0.2	ft/ft

For $0.02 \leq S_o < 0.1$:

$D_{50} = 1.413\, q^{0.529}\, S_o^{0.794}$ = N/A ft

For $0.1 \leq S_o \leq 0.4$:

$D_{50} = 0.4623\, q^{0.529}\, S_o^{0.307}$ = 0.8 ft

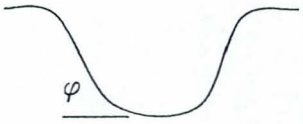
D_{50} = 0.8 ft

9.2 in

Sizing for Loose Riprap (Basin Outlet Channel)

For Straight Reaches

Channel Banks on Straight Reach



Average Velocity, V_a =	5	ft/s	(generally 2.5 - 5.0 ft/s)[1]
Specific Weight of Stone, γ_s =	165.4	lb/ft³	(assumed as $2.6\gamma_w$)
Specific Weight of Water, γ_w =	62.4	lb/ft³	
Bank Angle, φ =	14	degrees	(4H:1V)
$D_{50} = (0.0191\ V_a^2/\cos\varphi)(\gamma_w/(\gamma_s-\gamma_w))$ =	0.30	ft	
	4	in	

Channel Bed on Straight Reach

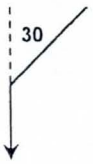
Average Velocity, V_a =	5	ft/s	(generally 2.5 - 5.0 ft/s)[1]
Specific Weight of Stone, γ_s =	165.4	lb/ft³	(assumed as $2.6\gamma_w$)
Specific Weight of Water, γ_w =	62.4	lb/ft³	
$D_{50} = (0.0191\ V_a^2)(\gamma_w/(\gamma_s-\gamma_w))$ =	0.29	ft	
	4	in	

[1] Velocity at downstream end is approx 6.5 ft/s. Not considered representative of actual, or overall velocity.

For Curved Reaches

Channel Banks on Curved Reach

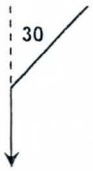
Outer bank protection of a curved reach of more than 30 degrees bend angle



Average Velocity, V_a =	5	ft/s	(generally 2.5 - 5.0 ft/s)[1]
Specific Weight of Stone, γ_s =	165.4	lb/ft³	(assumed as $2.6\gamma_w$)
Specific Weight of Water, γ_w =	62.4	lb/ft³	
Bend Angle, φ =	25	degrees	(for reference, not used in calc)
Bank Angle, φ =	14	degrees	(4H:1V)
$D_{50} = (0.0372\ V_a^2/\cos\varphi)(\gamma_w/(\gamma_s-\gamma_w))$ =	N/A	ft	
	N/A	in	

Channel Bed on Curved Reach:

Channel bed protection near outer bank of a curved reach of more than 30 degrees bend angle



Average Velocity, V_a =	5	ft/s	(generally 2.5 - 5.0 ft/s)[1]
Specific Weight of Stone, γ_s =	165.4	lb/ft³	(assumed as $2.6\gamma_w$)
Specific Weight of Water, γ_w =	62.4	lb/ft³	
Bend Angle, φ =	25	degrees	(for reference, not used in calc)
$D_{50} = 0.0372\ V_a^2(\gamma_w/(\gamma_s-\gamma_w))$ =	N/A	ft	
	N/A	in	

Reference: Drainage Design Manual, Hydraulics (DRAFT CHAPTER 11), FCDMC, 2007

Note: Methodology from draft Hydraulics Manual (Appendix B) provided by FCDMC but not yet published

Riprap and Riprap Apron Sizing Downstream of Culverts
Siphon Draw Detention Basin Outlet

Urban Drainage and Flood Control District (UCFCD) Equations {Denver Colorado}

Description		Units	Comments
Type of culvert (circular or rectangular)	rectangular		
Q, design discharge	225	cfs	*450 cfs/2 barrels*
D, culvert diameter (or rise)	4.0	ft	
B, culvert span (rectangular only))	6.0	ft	
TW, tailwater depth	2.5	ft	*CulvertMaster Results*
α, unit conversion constant: 1.0 (for US units)	1.0		
Riprap size D_{50} for circular culvert:			
$D_{50}=0.023D\ [Q/(\alpha D^{2.5})]\ [D/TW]^{1.2}$	n/a	ft	*{Equation D.1a}*
	n/a	in	
Riprap size D_{50} for rectangular culvert:			
$D_{50}=0.014D\ [Q/(\alpha BD^{1.5})]\ [D/TW]$	0.46	ft	*{Equation D.1b}*
	6	in	

Reference: HEC-14 Hydraulic Design of Energy Dissipators for Culverts and Channels, FHWA, July 2006

Berry & Perterka Equation

Description		Units	Comments
V, culvert exit velocity	9.5	ft/s	*CulvertMaster Results*
α, unit conversion constant: (0.0126 for US units)	0.0126		
Riprap size D_{50} for culvert			
$D_{50}=\alpha V^3$	1.14	ft	*{Equation D.2}*
	14	in	

Reference: HEC-14 Hydraulic Design of Energy Dissipators for Culverts and Channels, FHWA, July 2006

HEC-11 (Brown & Clyde) / HEC-14 (Searcy) Equation

Used in HEC-11 for sizing riprap protection for piers (Ref: pg D-1, HEC-14, 2006)

Description		Units	Comments
V, culvert exit velocity	9.5	ft/s	*CulvertMaster Results*
S, riprap specific gravity (2.65 for general value)	2.65		
g, accelerations due to gravity (32.2 ft/s^2)	32.2	ft/s^2	
Riprap size D_{50} for culvert			
$D_{50}= [0.692/(S-1)]\ (V^2/2g)$	0.59	ft	*{Equation D.3}*
	8	in	

Reference: HEC-14 Hydraulic Design of Energy Dissipators for Culverts and Channels, FHWA, July 2006

Riprap and Riprap Apron Sizing Downstream of Culverts
Siphon Draw Detention Basin Outlet

Bohan Equation

Two equations based on lab testing (Ref: pg D-2, HEC-14, 2006)

Description		Units	Comments
TW, tailwater depth	2.5	ft	*CulvertMaster Results*
D, culvert diameter (or rise)	4.0	ft	
TW/D, ratio of tailwater depth to culvert depth	0.6		
V_o, culvert exit velocity	9.5	ft/s	*CulvertMaster Results*
g, accelerations due to gravity (32.2 ft/s^2)	32.2	ft/s^2	
Fr_o, Froude number at outlet, $(V_o/(gD)^{0.5})$	0.84		
Riprap size D_{50} for culvert (TW/D<0.5)			
$D_{50}= D(0.25Fr_o)$	n/a	ft	*{Equation D.4a}*
	n/a	in	
Riprap size D_{50} for culvert (TW/D≥0.5)	0.24	ft	*{Equation D.4b}*
$D_{50}= D(0.25Fr_o-0.15)$	3	in	

Reference: HEC-14 Hydraulic Design of Energy Dissipators for Culverts and Channels, FHWA, July 2006

Fletcher & Grace Equation

Based on lab testing from Bohan and other sources (Ref: pg D-2, HEC-14, 2006)

Fletcher & Grace is recommended for circular culverts (Ref: pg 10-17, HEC-14, 2006)

Description		Units	Comments
Q, design discharge	225	cfs	*450 cfs/2 barrels*
D, culvert diameter (or rise)[2]	4.0	ft	
TW, tailwater depth[1]	2.5	ft	*CulvertMaster Results*
α, unit conversion constant: 1.0 (for US units)	1.0		
Riprap size D_{50} for culvert (TW/D<0.5)			
$D_{50}= 0.02D\,[Q/(\alpha D^{2.5})]^{4/3}\,(D/TW)$	1.72	ft	*{Equation D.5}*
	21	in	

1. *TW for equation should be limited to 0.4D to 1.0D. If TW is uknown, use 0.4D.*
2. *When flow is supercritical in the culvert, diameter should be adjusted by:*

   D'=(D+yn)/2) where yn is normal (supercritical) depth in the culvert)

Note: Equation assumes specific gravity of riprap is 2.65

Reference: HEC-14 Hydraulic Design of Energy Dissipators for Culverts and Channels, FHWA, July 2006

Riprap and Riprap Apron Sizing Downstream of Culverts
Siphon Draw Detention Basin Outlet

Summary Table of Riprap Sizing Results

Method	D_{50} (in)	Comments
UDFCD *(Eqn D.1a & D.1b)*	6	
Berry & Perterka (Eqn. D.2)	14	
HEC-11 (Brown & Clyde) / HEC-14 (Searcy) (Eqn. D.3)	8	
Bohan (Eqn. D.4)	3	
Fletcher & Grace (Eqn. D.5)	21	
Average Riprap Size	10.4	
Average Riprap Size (discard high and low)	9.3	
Design Riprap	12	

Note: FHWA compared results of Eqn.s in 10 hypothetical situations involving 30-48" CMP pipes, discharges ranging from 40-150cfs and slope/tailwater changes resulting in 5 inlet control and 5 outlet control cases.

Based upon those specific scenarios evaluated:

Eqn. D.2 results in the highest values for the range of conditions evaluated.

Eqn.s D.2 & D.3 are not recommended because they do not consider tailwater effects.

Eqn. D.4 was also not further considered since it treats tailwater only as two separate conditions, min. and max.

Eqns. D.1 & D.5 are similar in apporach, based on lab data and would probably generate reasonable designs.

Eqn. D.1 produced the higher recommendation 3 times and the lower 7 times (less conservative)

Eqn. D.5 was included/utilized in Chapter 10 of the manual.

Appendix B

Sizing for Loose Riprap

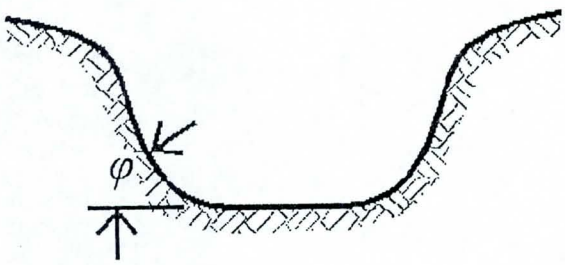
Channel Banks on Straight Reach

The loose riprap D_{50} for a straight channel reach bank protection is

$$D_{50} = \frac{0.0191 V_a^2}{\cos\varphi}\left(\frac{\gamma_w}{\gamma_s - \gamma_w}\right)$$

where

D_{50} is the median diameter (ft);
V_a = average velocity (ft/s);
γ_s= specific weight of stone, (lb/ft^3);
γ_w = specific weight of water, (lb/ft^3); and
φ = bank angle, (degrees);



Bank Angle

Channel Banks on Curved Reach

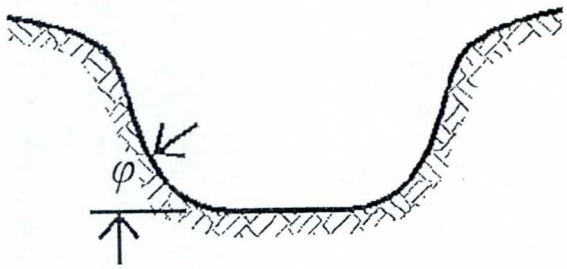
The loose riprap D_{50} for the outer bank of a curved reach of more than 30 degrees bend angle is

$$D_{50} = \frac{0.0372 V_a^2}{\cos\varphi}\left(\frac{\gamma_w}{\gamma_s - \gamma_w}\right)$$

where

D_{50} is the median diameter (ft);
V_a = average velocity (ft/s);
γ_s= specific weight of stone, (lb/ft^3);
γ_w = specific weight of water, (lb/ft^3); and

φ = bank angle, (degrees);



Bank Angle

Channel Bend Angle β > 30°

Channel Bed on Straight Reach

The loose riprap D_{50} for a straight channel reach bed protection is

$$D_{50} = 0.0191 V_a^2 \left(\frac{\gamma_w}{\gamma_s - \gamma_w} \right)$$

where

D_{50} is the median diameter (ft);
V_a = average velocity (ft/s);
γ_s= specific weight of stone, (lb/ft^3); and
γ_w = specific weight of water, (lb/ft^3)

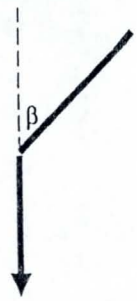
Channel Bed on Curved Reach

The loose riprap D_{50} for channel bed protection near outer bank of a curved reach of more than 30 degrees bend angle is

$$D_{50} = 0.0372 V_a^2 \left(\frac{\gamma_w}{\gamma_s - \gamma_w} \right)$$

where

D_{50} is the median diameter (ft);
V_a = average velocity (ft/s);
γ_s = specific weight of stone, (lb/ft^3); and
γ_w = specific weight of water, (lb/ft^3).



Channel Bend Angle β > 30°

Downstream of Grade Control

The loose riprap D_{50} for channel bed protection near outer bank of a curved reach of more than 30 degrees bend angle is

$$D_{50} = 0.0372 V_a^2 \left(\frac{\gamma_w}{\gamma_s - \gamma_w} \right)$$

where

D_{50} is the median diameter (ft);
V_a = average velocity (ft/s);
γ_s = specific weight of stone, (lb/ft^3); and
γ_w = specific weight of water, (lb/ft^3).

Below Stilling Basin

The loose riprap D_{50} for riprap below a stilling basin is

$$D_{50} = 0.0126V_a^2$$

where

D_{50} is the median diameter (ft);
V_a = average velocity (ft/s)

Spur Dike/Guide Bank/Abutment

The loose riprap D_{50} for spur dike, abutment, and guide bank is

$$D_{50} = 0.01V_a^{2.44}$$

where

D_{50} is the median diameter (ft);
V_a = average velocity (ft/s)

Sloped Drop Structure/Rock Chute

The loose riprap D_{50} for the sloped drop structure or rock chute with a slope between 0.02 and 0.1 is

$$D_{50} = 1.413q^{0.529}S_0^{0.794}$$

where

D_{50} is the median diameter (ft);
q = unit discharge (cfs/ft); and
S_0 = channel bed slope (ft/ft).

The loose riprap D_{50} for the sloped drop structure or rock chute with a slope between 0.1 and 0.4 is

$$D_{50} = 0.4623q^{0.529}S_0^{0.307}$$

where

D_{50} is the median diameter (ft);
q = unit discharge (cfs/ft); and
S_0 = channel bed slope (ft/ft).

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Riprap Size D_{50} for Channel Lining

Channel Lining Riprap D50 (unadjusted):

Average depth of flow (ft), d_{avg} =	5	ft	*(~HEC-RAS results)*
Average channel velocity (ft/s), V_a =	9	ft/s	*(~HEC-RAS results)*

K_1, bank angle correction factor:

channel bank angle with horizontal, Θ =	18.4	deg	*(3H:1V)*
riprap angle of ripose, Φ =	41	deg	*{See Reference Table 6.14}*
$K_1 = [1-(\sin^2\Theta/\sin^2\Phi]^{1/2}$ =	0.877		

Channel Lining Riprap D_{50} (unadjusted):

$D_{50,unadj} = 0.001V_a^3/(d_{avg}^{1/2}K_1^{3/2})$ = **0.40** **ft**

Stability Correction Factors (SCF):

SCF for specific gravity of riprap, C_{sg}:

specific gravity of riprap, S_s =	2.65	
SCF for specific gravity, $C_{sg} = 2.12/(S_s-1)^{3/2}$ =	**1.00**	

SCF for channel condition, C_{sf}:

Uniform Flow: $1.0 < C_{sf} < 1.2$

straight/mild curves (R_c/W_c<30), little/no design uncertainties

little/no impact from wave action or debris,

Gradually Varying Flow: $1.3 < C_{sf} < 1.6$

moderate bends (30>R_c/W_c>10),

moderate impact from wave action or debris

Rapidly Varying Flow: $1.6 < C_{sf} < 2.0$

sharp bends (10<R_c/W_c), significant design uncertainties

turbulent, signficant wave/debris impacts, bridge abutments

*R_c/W_c = curve radius/channel width

C_{sf} = **1.8**

Channel Lining Riprap D_{50} (Adjusted):

$D_{50,\ adj} = (C_{sg})(C_{sf})(D_{50,unadj})$ =	**0.71**	**ft**	
$D_{50,\ adj}$ =	**9**	**in**	*(rounded up)*

Reference: Drainage Design Manual, Hydraulics, FCDMC, 2003

Riprap Size D_{50} for Channel Lining

Channel Lining Riprap D50 (unadjusted):

Average depth of flow (ft), d_{avg} =	2	ft	*(~HEC-RAS results)*
Average channel velocity (ft/s), V_a =	8.2	ft/s	*(~HEC-RAS results)*

K_1, bank angle correction factor:

channel bank angle with horizontal, Θ =	11	deg	*(5H:1V)*
riprap angle of ripose, Φ =	41	deg	*{See Reference Table 6.14}*
$K_1 = [1-(\sin^2\Theta/\sin^2\Phi]^{1/2}$ =	0.957		

Channel Lining Riprap D_{50} (unadjusted):

$D_{50,unadj} = 0.001V_a^3/(d_{avg}^{1/2}K_1^{3/2})$ = **0.42 ft**

Stability Correction Factors (SCF):

SCF for specific gravity of riprap, C_{sg}:

specific gravity of riprap, S_s =	2.65
SCF for specific gravity, $C_{sg} = 2.12/(S_s-1)^{3/2}$ =	**1.00**

SCF for channel condition, C_{sf}:

Uniform Flow: $1.0 < C_{sf} < 1.2$

straight/mild curves (R_c/W_c<30), little/no design uncertainties

little/no impact from wave action or debris,

Gradually Varying Flow: $1.3 < C_{sf} < 1.6$

moderate bends (30>R_c/W_c>10),

moderate impact from wave action or debris

Rapidly Varying Flow: $1.6 < C_{sf} < 2.0$

sharp bends (10<R_c/W_c), significant design uncertainties

turbulent, signficant wave/debris impacts, bridge abutments

*R_c/W_c = curve radius/channel width

C_{sf} = **1.2**

Channel Lining Riprap D_{50} (Adjusted):

$D_{50,\ adj} = (C_{sg})(C_{sf})(D_{50,unadj})$ =	**0.50**	**ft**	
$D_{50,\ adj}$ =	**6**	**in**	*(rounded up)*

Reference: Drainage Design Manual, Hydraulics, FCDMC, 2003

Riprap Size D_{50} for Channel Lining

Channel Lining Riprap D50 (unadjusted):

Average depth of flow (ft), d_{avg} =	3	ft	*(~HEC-RAS results)*
Average channel velocity (ft/s), V_a =	4.5	ft/s	*(~HEC-RAS results)*

K_1, bank angle correction factor:

channel bank angle with horizontal, Θ =	11	deg	*(5H:1V)*
riprap angle of ripose, Φ =	40	deg	*{See Reference Table 6.14}*
$K_1 = [1-(\sin^2\Theta/\sin^2\Phi]^{1/2}$ =	0.955		

Channel Lining Riprap D_{50} (unadjusted):

$D_{50,unadj} = 0.001V_a^3/(d_{avg}^{1/2}K_1^{3/2})$ = **0.06** ft

Stability Correction Factors (SCF):

SCF for specific gravity of riprap, C_{sg}:

specific gravity of riprap, S_s =	2.65
SCF for specific gravity, $C_{sg} = 2.12/(S_s-1)^{3/2}$ =	**1.00**

SCF for channel condition, C_{sf}:

Uniform Flow: $1.0 < C_{sf} < 1.2$

straight/mild curves (R_c/W_c<30), little/no design uncertainties

little/no impact from wave action or debris,

Gradually Varying Flow: $1.3 < C_{sf} < 1.6$

moderate bends (30>R_c/W_c>10),

moderate impact from wave action or debris

Rapidly Varying Flow: $1.6 < C_{sf} < 2.0$

sharp bends (10<R_c/W_c), significant design uncertainties

turbulent, signficant wave/debris impacts, bridge abutments

*R_c/W_c = curve radius/channel width

C_{sf} = **1.2**

Channel Lining Riprap D_{50} (Adjusted):

$D_{50,\ adj} = (C_{sg})(C_{sf})(D_{50,unadj})$ =	**0.07**	ft	
$D_{50,\ adj}$ =	**1**	in	*(rounded up)*

Reference: Drainage Design Manual, Hydraulics, FCDMC, 2003

Riprap Size D_{50} for Channel Lining

Channel Lining Riprap D50 (unadjusted):

Average depth of flow (ft), d_{avg} =	3	ft	*(Flowmaster of typical section)*
Average channel velocity (ft/s), V_a =	5	ft/s	*(Flowmaster of typical section)*

K_1, bank angle correction factor:

channel bank angle with horizontal, Θ =	14	deg	*(4H:1V)*
riprap angle of ripose, Φ =	40	deg	*{See Reference Table 6.14}*
$K_1 = [1-(\sin^2\Theta/\sin^2\Phi]^{1/2}$ =	0.926		

Channel Lining Riprap D_{50} (unadjusted):

$D_{50,unadj} = 0.001V_a^3/(d_{avg}^{1/2}K_1^{3/2})$ = **0.08** ft

Stability Correction Factors (SCF):

SCF for specific gravity of riprap, C_{sg}:

specific gravity of riprap, S_s =	2.65
SCF for specific gravity, $C_{sg} = 2.12/(S_s-1)^{3/2}$ =	**1.00**

SCF for channel condition, C_{sf}:

Uniform Flow: $1.0 < C_{sf} < 1.2$

straight/mild curves (R_c/W_c<30), little/no design uncertainties

little/no impact from wave action or debris,

Gradually Varying Flow: $1.3 < C_{sf} < 1.6$

moderate bends (30>R_c/W_c>10),

moderate impact from wave action or debris

Rapidly Varying Flow: $1.6 < C_{sf} < 2.0$

sharp bends (10<R_c/W_c), significant design uncertainties

turbulent, signficant wave/debris impacts, bridge abutments

*R_c/W_c = curve radius/channel width

C_{sf} = **1.8**

Channel Lining Riprap D_{50} (Adjusted):

$D_{50,\ adj} = (C_{sg})(C_{sf})(D_{50,unadj})$ =	**0.15**	ft	
$D_{50,\ adj}$ =	**2**	in	*(rounded up)*

Reference: Drainage Design Manual, Hydraulics, FCDMC, 2003

Riprap and Riprap Apron Sizing Downstream of Culverts

Urban Drainage and Flood Control District (UCFCD) Equations {Denver Colorado}

Description		Units	Comments
Type of culvert (circular or rectangular)	rectangular		
Q, design discharge	225	cfs	*450 cfs/2 barrels*
D, culvert diameter (or rise)	4.0	ft	
B, culvert span (rectangular only))	6.0	ft	
TW, tailwater depth	2.5	ft	*CulvertMaster Results*
α, unit conversion constant: 1.0 (for US units)	1.0		
Riprap size D_{50} for circular culvert:			
$D_{50}=0.023D\ [Q/(\alpha D^{2.5})]\ [D/TW]^{1.2}$	n/a	ft	*{Equation D.1a}*
	n/a	in	
Riprap size D_{50} for rectangular culvert:			
$D_{50}=0.014D\ [Q/(\alpha BD^{1.5})]\ [D/TW]$	0.46	ft	*{Equation D.1b}*
	6	in	

Reference: HEC-14 Hydraulic Design of Energy Dissipators for Culverts and Channels, FHWA, July 2006

Berry & Perterka Equation

Description		Units	Comments
V, culvert exit velocity	9.5	ft/s	*CulvertMaster Results*
α, unit conversion constant: (0.0126 for US units)	0.0126		
Riprap size D_{50} for culvert			
$D_{50}=\alpha V^3$	1.14	ft	*{Equation D.2}*
	14	in	

Reference: HEC-14 Hydraulic Design of Energy Dissipators for Culverts and Channels, FHWA, July 2006

HEC-11 (Brown & Clyde) / HEC-14 (Searcy) Equation

Used in HEC-11 for sizing riprap protection for piers (Ref: pg D-1, HEC-14, 2006)

Description		Units	Comments
V, culvert exit velocity	9.5	ft/s	*CulvertMaster Results*
S, riprap specific gravity (2.65 for general value)	2.65		
g, accelerations due to gravity (32.2 ft/s^2)	32.2	ft/s^2	
Riprap size D_{50} for culvert			
$D_{50}= [0.692/(S-1)]\ (V^2/2g)$	0.59	ft	*{Equation D.3}*
	8	in	

Reference: HEC-14 Hydraulic Design of Energy Dissipators for Culverts and Channels, FHWA, July 2006

Riprap and Riprap Apron Sizing Downstream of Culverts

Bohan Equation

Two equations based on lab testing (Ref: pg D-2, HEC-14, 2006)

Description		Units	Comments
TW, tailwater depth	2.5	ft	*CulvertMaster Results*
D, culvert diameter (or rise)	4.0	ft	
TW/D, ratio of tailwater depth to culvert depth	0.6		
V_o, culvert exit velocity	9.5	ft/s	*CulvertMaster Results*
g, accelerations due to gravity (32.2 ft/s^2)	32.2	ft/s^2	
Fr_o, Froude number at outlet, $(V_o/(gD)^{0.5})$	0.84		
Riprap size D_{50} for culvert (TW/D<0.5)			
$D_{50}= D(0.25Fr_o)$	n/a	ft	*{Equation D.4a}*
	n/a	in	
Riprap size D_{50} for culvert (TW/D≥0.5)	0.24	ft	*{Equation D.4b}*
$D_{50}= D(0.25Fr_o-0.15)$	3	in	

Reference: HEC-14 Hydraulic Design of Energy Dissipators for Culverts and Channels, FHWA, July 2006

Fletcher & Grace Equation

Based on lab testing from Bohan and other sources (Ref: pg D-2, HEC-14, 2006)

Fletcher & Grace is recommended for circular culverts (Ref: pg 10-17, HEC-14, 2006)

Description		Units	Comments
Q, design discharge	225	cfs	*450 cfs/2 barrels*
D, culvert diameter (or rise)[2]	4.0	ft	
TW, tailwater depth[1]	2.5	ft	*CulvertMaster Results*
α, unit conversion constant: 1.0 (for US units)	1.0		
Riprap size D_{50} for culvert (TW/D<0.5)			
$D_{50}= 0.02D\,[Q/(\alpha D^{2.5})]^{4/3}\,(D/TW)$	1.72	ft	*{Equation D.5}*
	21	in	

1. TW for equation should be limited to 0.4D to 1.0D. If TW is uknown, use 0.4D.

2. When flow is supercritical in the culvert, diameter should be adjusted by:

D'=(D+yn)/2) where yn is normal (supercritical) depth in the culvert)

Note: Equation assumes specific gravity of riprap is 2.65

Reference: HEC-14 Hydraulic Design of Energy Dissipators for Culverts and Channels, FHWA, July 2006

Riprap and Riprap Apron Sizing Downstream of Culverts

Summary Table of Riprap Sizing Results

Method	D_{50} (in)	Comments
UDFCD *(Eqn D.1a & D.1b)*	6	
Berry & Perterka (Eqn. D.2)	14	
HEC-11 (Brown & Clyde) / HEC-14 (Searcy) (Eqn. D.3)	8	
Bohan (Eqn. D.4)	3	
Fletcher & Grace (Eqn. D.5)	21	
Average Riprap Size	10.4	
Average Riprap Size (discard high and low)	9.3	
Design Riprap	10	

Note: FHWA compared results of Eqn.s in 10 hypothetical situations involving 30-48" CMP pipes, discharges ranging from 40-150cfs and slope/tailwater changes resulting in 5 inlet control and 5 outlet control cases.

Based upon the scenarios evlauated:

Eqn. D.2 results in the highest values for the range of conditions evaluated.

Eqn.s D.2 & D.3 are not recommended because they do not consider tailwater effects.

Eqn. D.4 was also not further considered since it treats tailwater only as two separate conditions, min. and max.

Eqns. D.1 & D.5 are similar in apporach, based on lab data and would probably generate reasonable designs.

Eqn. D.1 produced the higher recommendation 3 times and the lower 7 times (less conservative)

Eqn. D.5 was included/utilized in Chapter 10 of the manual.

Stanley Consultants INC.

Computed by _____ Date _____
Checked by _____ Date _____
Approved by _____ Date _____

Project No. _____ Page No. 1/2
Subject Embankment Protection
Scour Depth - Siphon Draw
Wash and East Drainage
Sheet No. _____ of _____ Channel

Because the construction of the Siphon Draw Wash drop inlet provides downstream grade control and upstream grade control is provided by the Siphon Draw Wash grade control structure, AND because Siphon Draw Wash will be graded at a constant slope in between (generally Long term scour is not considered as part of potential scour estimates. Similarly, long term scour is not considered for the east drainage channel since the drop inlet also provides downstream grade control and the channel is very mildly graded (0.001 ft/ft) Only general scour will be considered for Siphon Draw Wash. While scour is not anticipated along the east channel, general scour will be considered for the design of embankment protection

SC 3020 R2 199

Stanley Consultants INC.

Project No. _____ Page No. 2/2

Subject Embankment Protection

Computed by _____ Date _____

Checked by _____ Date _____

Approved by _____ Date _____ Sheet No. _____ of _____

Level 1 Scour: $d_s = d_{gs} + \cancel{d_{LTS}} \rightarrow 0$ assumed

$$d_s = d_{gs} = 0.157 (Q|_{100})^{0.4}$$

$Q_{SDW,100,max} = 1000$ cfs (max)

$Q_{east\ chnl,100} = 400$ cfs (~40% of SDW flow)

East Channel

$$d_{gs} = 0.157(400)^{0.4} = \underline{1.7\ ft} \quad \text{use } 2.0\ ft$$

Siphon Draw Wash

$$d_{gs_{max}} = 0.157(1000)^{0.4} = 2.5\ ft \ (max)$$

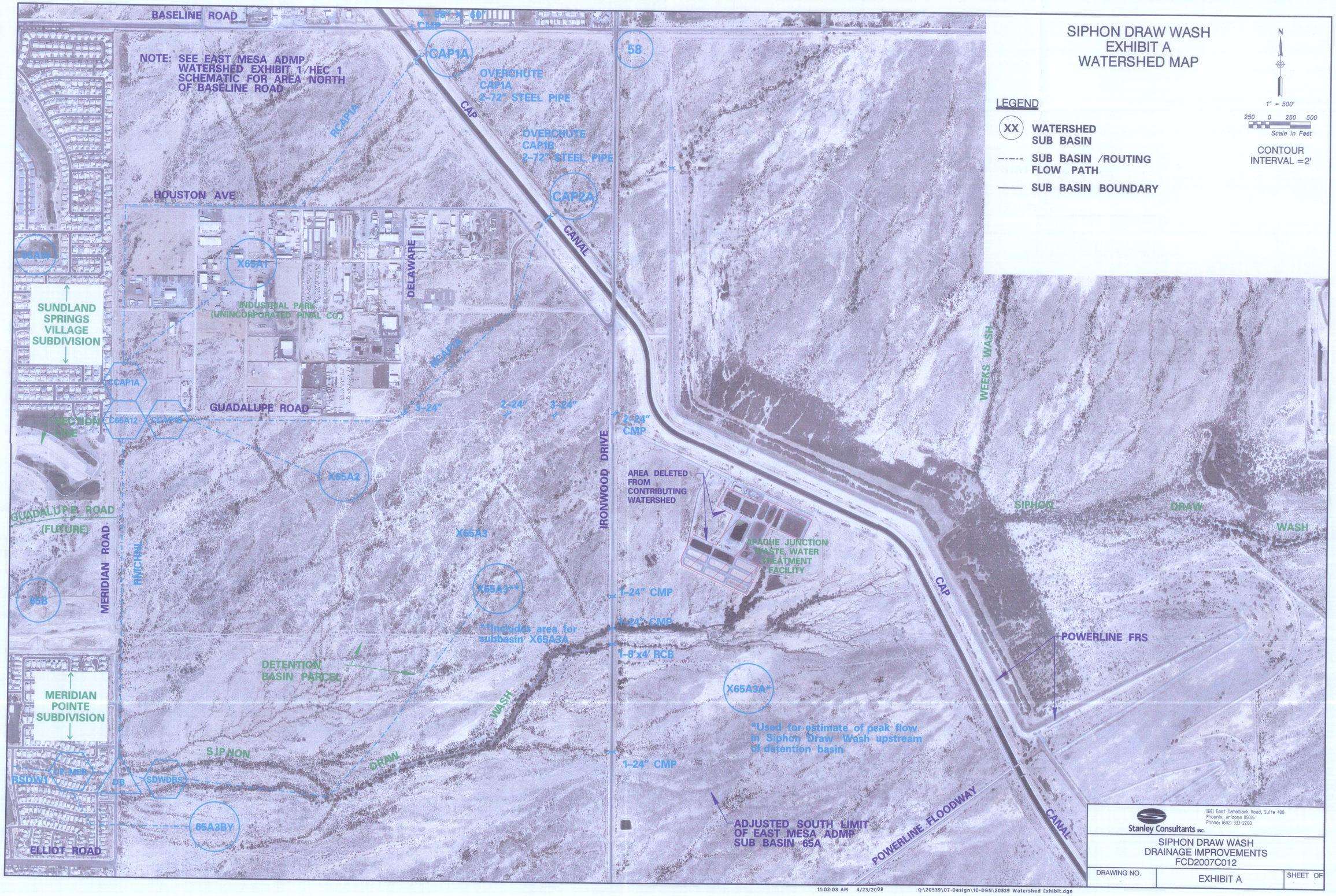
For each channel, protection will extend to the scour depth AND an apron of 4 ft along the toe of the embankment.

SC 3020 R2 199

APPENDIX H

Meridian Channel
Phase 2

SIPHON DRAW WASH
EXHIBIT A
WATERSHED MAP



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SIPHON DRAW WASH
DRAINAGE IMPROVEMENTS
FCD2007C012

DRAWING NO.	EXHIBIT A	SHEET OF

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