Technical Data Notebook
Casandro Wash LOMR Project
Being within Township 7 N, Range 5 W
Gila and Salt River Meridian (G&SRM)
FCDMC Contract No. C-69-96-026-5
CPE Job No. 3660.2

Prepared for
Flood Control District of Maricopa County
2801 West Durango St.
Phoenix, Arizona 85009

Prepared by
Collins/Pina Consulting Engineers, Inc.
630 East 9th Street
Tucson, AZ 85705

September 1996

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Before this it should have Introduction, Area studied Community Rating Summary

1.0 General Documentation & Correspondence

1.0 Summary

Much of the Town of Wickenburg, located in Maricopa County, Arizona, currently lies in the Federal Emergency Management Agency (FEMA) 100 year floodplain due to the potential flooding of Casandro Wash. To mitigate this hazard, Maricopa County has built a dam and detention basin upstream of the main flood potential area and an outfall storm sewer system designed to convey flow safely through downtown Wickenburg to Sols Wash, the principal drainageway in the area and a major tributary of the Hassayampa River (see Figure 1.1). The flood control improvements will affect properties within Sections 11 and 12 of T.7N., R.5W. G&SRM in downtown Wickenburg, Arizona.

1.1 Site Location

Figure 1.1 shows the location of the study. It involves the watershed of the Casandro Wash located within the corporate limits of the Town of Wickenburg, Arizona.

1.2 Analysis

Post project flow rates were calculated using the United States Army Corp of Engineers, September 1990 version of the Flood Hydrograph Package HEC-1 according to the guidelines detailed in the Drainage Design Manual for Maricopa County, Arizona, Volume I, Hydrology (Flood Control District of Maricopa County, 1995). The following options were used:

- Maricopa County 6-hour Storm Distribution: 1.8.
- Point Precipitation Depth from NOAA Atlas 2, Volume 8: Arizona.
- An Area Reduction Factor of .983, from the Drainage Design Manual for Maricopa County, Arizona, Volume I, Hydrology (FCDMC Manual).
- Infiltration loss rate estimation with the Green Ampt, HEC-1, option.
- Hydrograph Development with the Clark Unit Hydrograph according to FCDMC Manual.
- Reservoir and channel routing using the Normal Depth Modified Puls option in HEC-1.

1.3 Results

The dam and outfall system significantly decrease the 100 year flow of Casandro Wash as it flows through the Town of Wickenburg, from 1500 to 281 cubic feet per second (cfs) at the Atchison Topeka and Santa Fe (AT&SF) RR Crossing, effectively maintaining flows within the public right-of-way and storm drainage conveyance facilities.

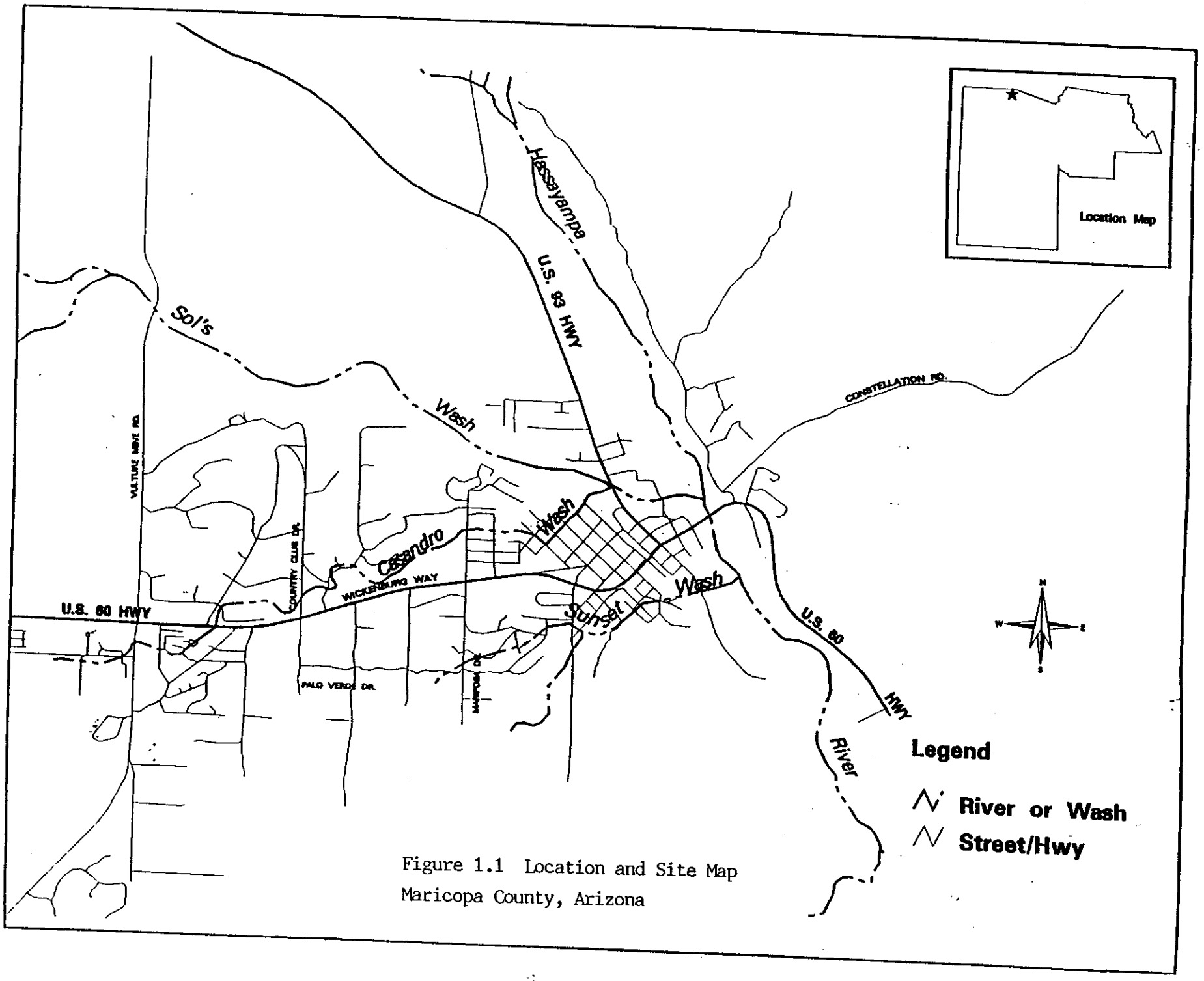


Figure 1.1 Location and Site Map
Maricopa County, Arizona

~~2.0 Introduction~~ Mapping & Survey Information

2.1 Purpose

The purpose of this study is to demonstrate the impact of the Casandro Wash Dam and Outfall Stormdrain Project on the existing Flood Insurance Rate Map (FIRM) in order to apply to FEMA for a Letter of Map Revision (LOMR) that changes the delineation of the 100 year floodplain in the Town of Wickenburg. The study involves accurately modeling the effect of the dam and outfall conveyance system on the hydrology of the watershed and on the hydraulic operation of Casandro Wash.

2.2 Scope

This study encompasses the hydrologic analysis of the 1.6 square mile (1024 acre) watershed of Casandro Wash. The hydrologic analyses involve modeling the system pre- and post-improvement construction from the headwaters of Casandro Wash to its confluence with Sols Wash. The hydraulic analysis involves modeling the improved drainage system from the outlet of the dam through the town of Wickenburg to the stormdrain outlet at Sols Wash, and defining the limits of the new 100-year floodplain.

Hydrology Analysis

3.0 Study Parameters

3.1 Available Mapping and Information Sources

No stream gauge data or rain gauge data is available from any location within the Casandro Wash catchment.

Watershed delineation was accomplished using the 1" = 200', 2 foot interval contour mapping prepared for the Flood Control District of Maricopa County and used in the Floodplain Delineation Study, Wickenburg Area Drainage Master Study (ADMS). This data was provided by Maricopa County on CD ROM. All areas, lengths, and slopes were prepared digitally using AutoCADD software.

Cross sections and hydraulic data were taken from the 1" = 40', 1 foot interval contour mapping, from areal photos taken 6/18/93, of Casandro Wash provided by the Flood Control District of Maricopa County,

The approved Construction Plans of the Casandro Wash Dam and the Casandro Wash Outfall were used in the preparation of rating curves and flow characteristics of drainage improvements.

The following studies were used for reference in the HEC-1 modeling procedure and general organization of this study: 1) Wickenburg Area Drainage Master Study, Watershed Hydrology Report, Black and Veatch, May 1991. 2) Design Concept Report for the Casandro Wash Outfall, Flood Control District of Maricopa County, July 1994. 3) Casandro Wash Dam Final Design Report for the Flood Control District of Maricopa County, CH2M Hill, February 1995. Each of these three studies include hydrologic models of Casandro Wash. However, the focus of each was such that a comprehensive pre- and post-dam development flood analysis was not completed. Hence, a new study was necessary.

Land surveying was conducted to provide additional information about the location of drainage features in and around Wickenburg and to field verify the mapping provided for this project.

3.2 General Hydrologic Setting

Casandro Wash is an ephemeral stream draining a 1.6 square mile watershed. The wash begins in the arid mountainous region near Vulture Peak and flows in a northeasterly direction to Sols Wash in the Town of Wickenburg. Soils in the watershed are generally sandy loam to loamy sand with some clay content and rock outcrops (SCS, 1986).

3.2.1 Pre-development Conditions

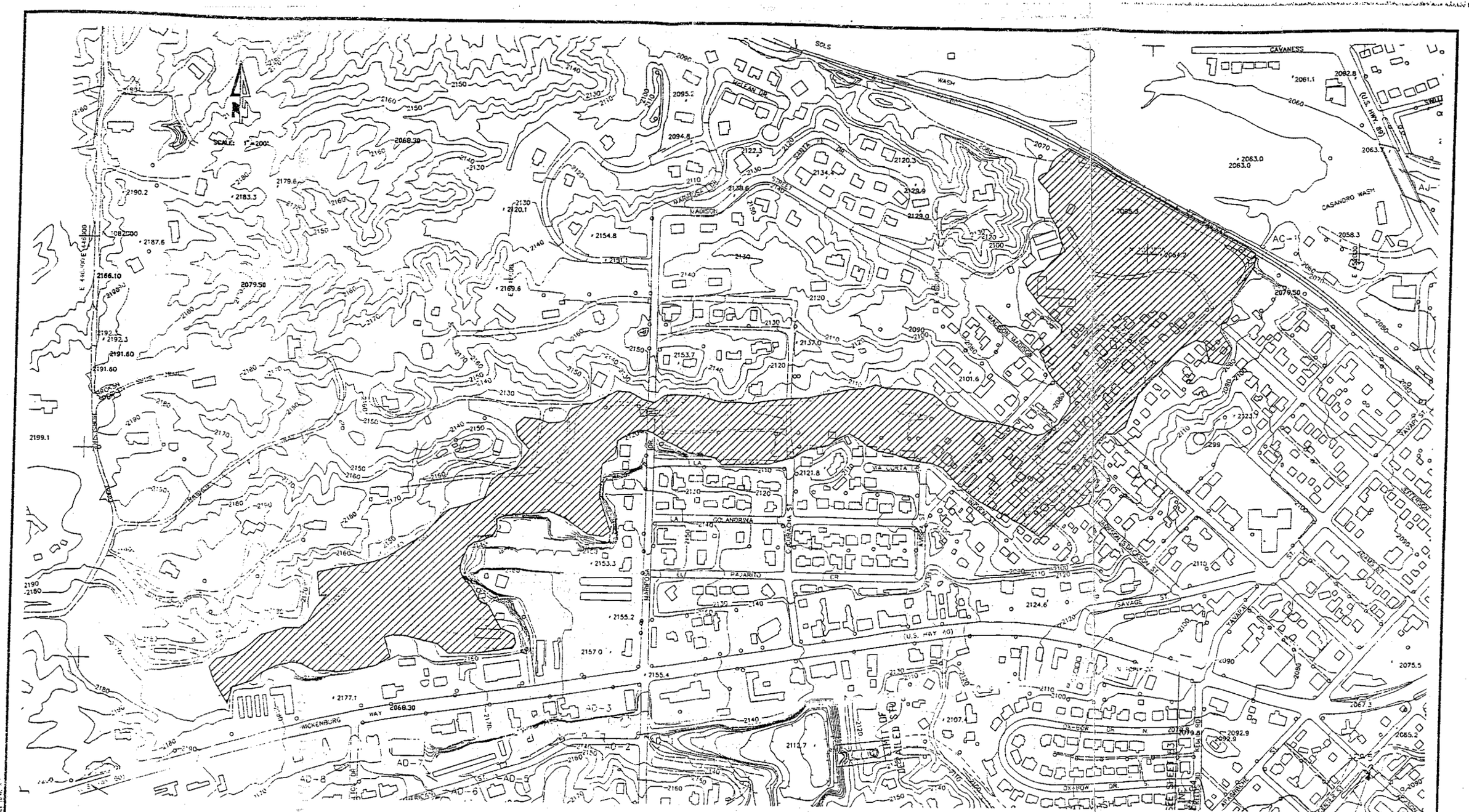
Casandro Wash upstream of the I-60 crossing consists of two well defined natural channels with slopes of 2 to 3 percent. These channels cross under Interstate 60 west of Wickenburg, through reinforced concrete box culverts (RCBC) of standard Arizona Department Of Transportation (ADOT) design, and confluence shortly downstream of the crossing. Casandro wash flows through the western part of Wickenburg in a poorly defined, steeply banked natural channel with slopes of 2 to 3 percent. It intersects dip sections of Mariposa and Cucaracha Streets. Although both intersections contain 4 36" x 22" corrugated metal arch pipe culverts designed to convey nuisance amounts of water underneath the streets during low flow events. The wash terminates just upstream of the intersection of Navajo and Jackson Streets. It is conveyed underneath Navajo Street with a dual 10' x 5' CBC . Historically, the wash then flows into Jackson Street and through Mohave Street to the Southern Pacific Railroad crossing where a 8' x 10' RCBC with a 200 cfs capacity with 4 ft headwater, limits its flow to Sols Wash and creates localized flooding hazard (see Fig. 3.1).

3.2.2 Post-development Conditions

Due to the history of floods and property damage in this moderate to high density residential area, the ADMS, completed in 1991 for the Maricopa County Flood Control District, recommended the construction of a detention dam and outfall storm drain conveyance system in Wickenburg. The dam, built roughly 2500 ft downstream of the I-60 diversion and just upstream of Mariposa Dr. was designed to severely limit the flow from the upper part of Casandro watershed into Wickenburg. The outfall stormdrain, which conveys flow directly downstream of the Navajo Street CBC to the natural channel of Sols Wash, was designed to carry the majority of the dam overflow and locally generated flow, eliminating most streetflow and flooding along its alignment.

3.3 Land Use

The upper watershed of Casandro Wash upstream of the I-60 crossing is predominately low density residential and range land, encompassing new development along Vulture Mine Rd and I-60. The denser part of the town of Wickenburg, downstream of Mariposa Drive, is a mixture of commercial and medium to high density residential.



LEGEND

100-YEAR FLOODPLAIN DELINEATION

NO.	DATE	REVISION	BY	CH.	APPR.

Collins-Piña Consulting Engineers Inc.
630 East 9th Street - Tucson, Arizona 85705 - (520) 623-7980
FAX - (520) 884-5275

FEMA FIRM LOMR
FIG. 3.1 PRE-DEVELOPMENT CONDITIONS
CASANDRO WASH
100-YEAR FLOODPLAIN DELINEATION

job no.	3660.2
date	6/96
design	MCH
draft	SAK
chk'd	RAGP
scale	1" = 200'
sheet	1 of 1

Hydraulic Analysis

4.0 Hydrological Analysis

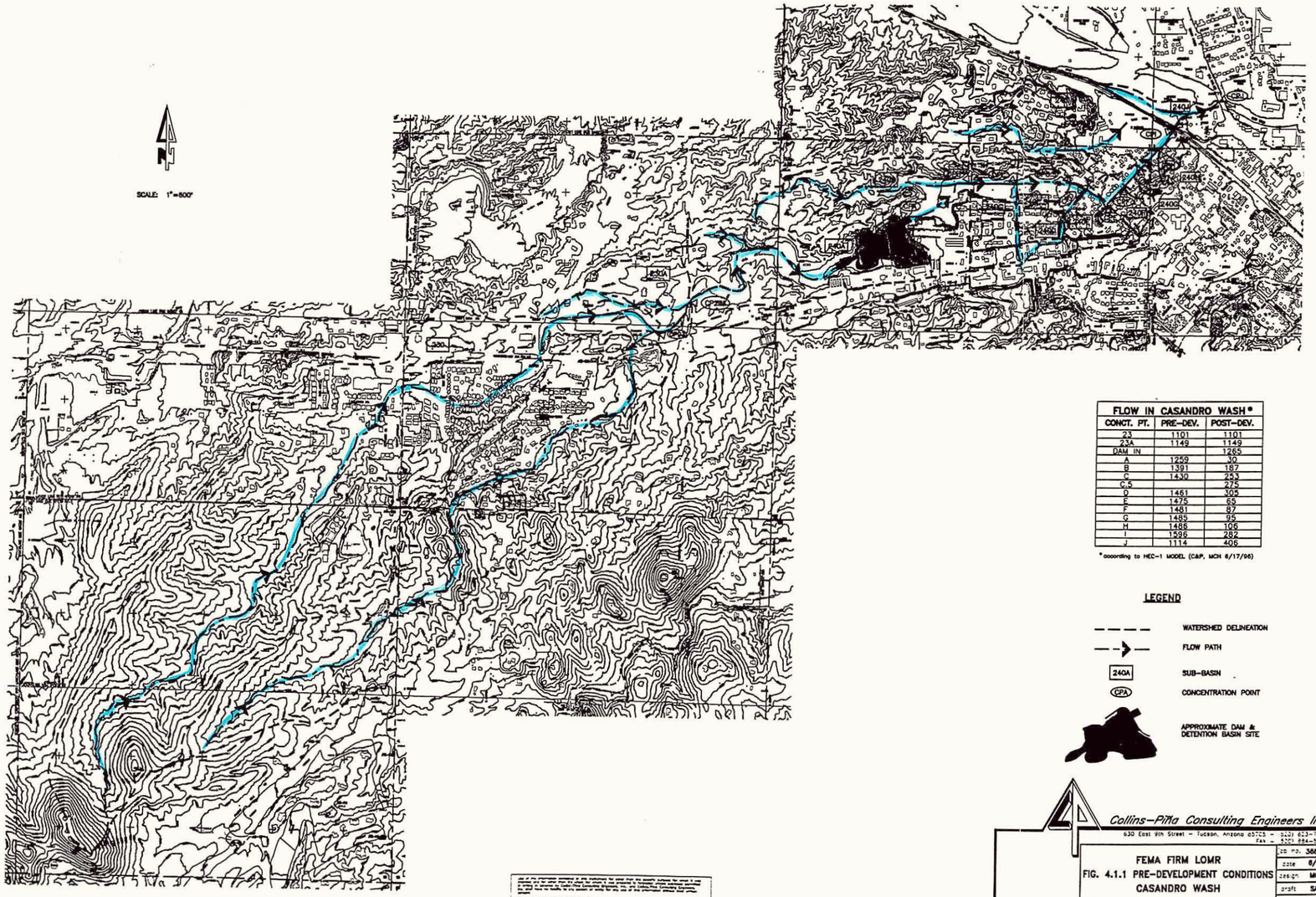
Hydrological analyses for the Casandro Wash Dam and its impact on the flood hazard in the Town of Wickenburg were completed using the United States Army Corp of Engineers, September 1990 version of HEC-1. The analyses used the 6-hour local Maricopa County storm distribution, the Green-Ampt Loss Rate function and the Clark Unit Hydrograph to estimate precipitation, runoff and streamflow response in the Casandro Wash during the design 100-year storm event. All parameter estimation, methods, and assumptions were based on the FCDMC Manual. The HEC-1 generated output files are included in Appendix A for both pre- and post-development. A detailed description of parameter estimation and hydrological calculations as well as all pertinent figures and tables from FCDMC Manual are contained within Appendix C.

To demonstrate the full impact of the dam on the Town of Wickenburg, pre- and post-dam development conditions were modeled with HEC-1. Pre-development conditions ignore the construction of the dam and outfall conveyance. Post-development conditions include the dam and detention basin and the outfall storm sewer conveyance system as it flows from Navajo Street to Sols Wash.

4.1 Conceptualization of Watershed

To model the hydrology, the Casandro Wash watershed was divided into twelve sub-basins. Flow was routed through each downstream basin cumulatively. Figures 4.1.1 and 4.1.2 show the watershed map and its subbasins for pre- and post-development conditions. All parameters were estimated on a sub-basin scale, with areally weighted land use and soil data.

All areas, watercourse lengths, channel reach lengths and slopes were measured digitally from the 1" = 100' 2-ft contour interval exhibits provided by the Flood Control District of Maricopa County, Wickenburg ADMS. The areas and watercourse lengths data are presented in Table 4.1.



FLOW IN CASANDRO WASH*		
CONCT. PT.	PRE-DEV.	POST-DEV.
23	1101	1101
23A	1149	1149
DAM IN		1265
A	1259	30
B	1391	187
C	1430	253
C.5		275
D	1461	305
E	1475	69
F	1481	87
G	1485	95
H	1466	106
I	1596	282
J	1114	406

*according to HEC-1 MODEL (C&P, MCH 6/17/96)

LEGEND

- WATERSHED DELINEATION
- FLOW PATH
- 240A — SUB-BASIN
- CP1 — CONCENTRATION POINT
- APPROXIMATE DAM & DETENTION BASIN SITE

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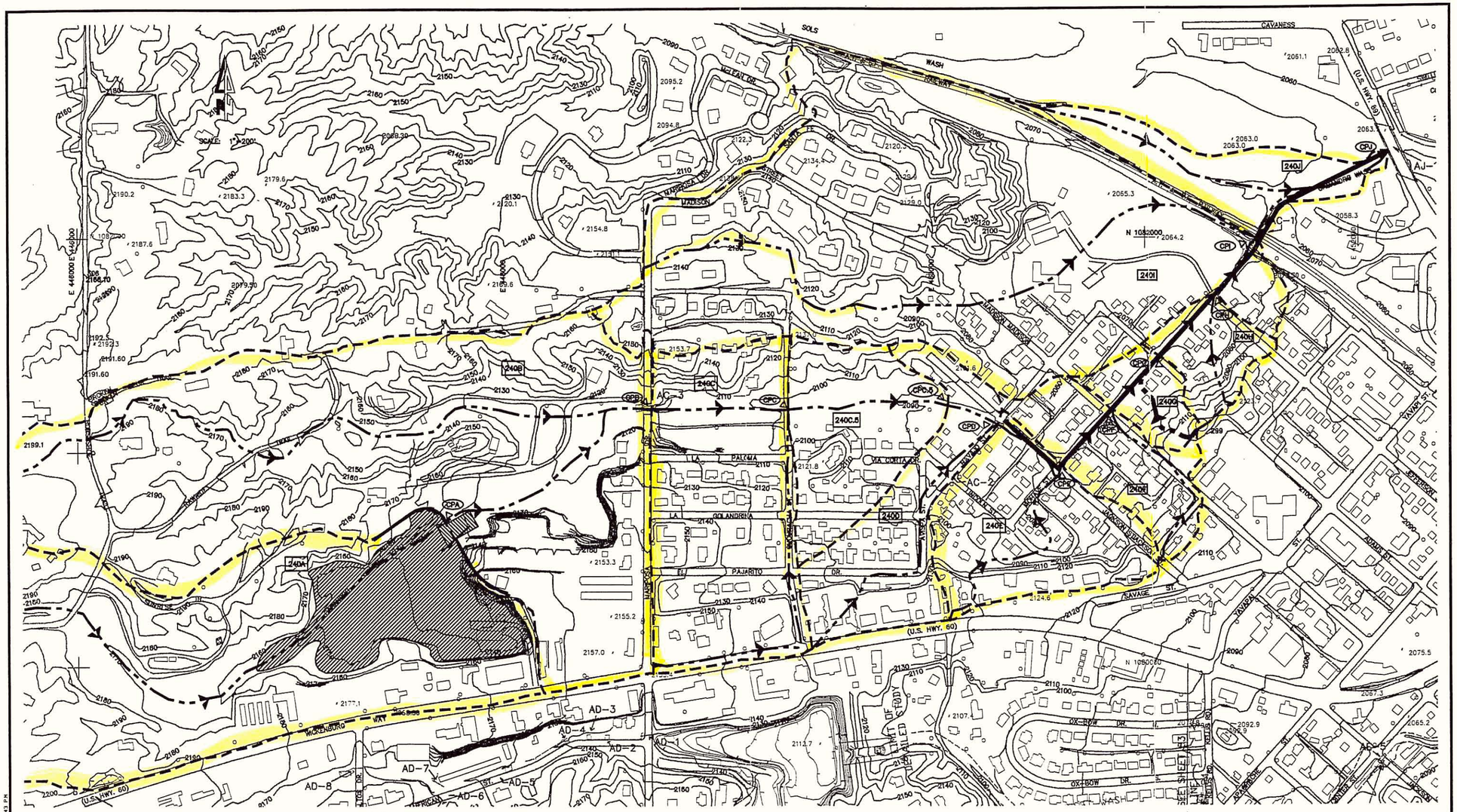
job no.	3660.2
date	6/96
design	MCH
draft	SAK
check	RAGP
scale	1"=500'
sheet	1 of 2

FEMA FIRM LOMR
FIG. 4.1.1 PRE-DEVELOPMENT CONDITIONS
CASANDRO WASH
HEC-1 WATERSHED DELINEATION
SUBBASIN ALIGNMENT

NO.	DATE	REVISION	BY:	CK.	APPR.

CASANDRO/SAK2/REDFA1.SAK, 1 : 1, 5/20/1996, at 4:24 PM



LEGEND

- WATERSHED DELINEATION
- FLOW PATH
- OUTFALL CONVEYANCE SYSTEM
- 240A — SUB-BASIN
- CPA — CONCENTRATION POINT
- APPROXIMATE DAM & DETENTION BASIN SITE

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NO.	DATE	REVISION	BY:	CH.	APPR.

FEMA FIRM LOMR
FIG. 4.1.2 POST DEVELOPMENT CONDITIONS
CASANDRO WASH
HEC-1 WATERSHED DELINEATION
SUBBASIN ALIGNMENT

job no.	3680.2
date	6/98
design	MCH
draft	SAK
chk'd	RAGP
scale	1"=200'
sheet	2 of 2

Sub-basin	Area (mi^2)	Lc (ft)	RL (ft) prior CP
230	0.6845	13434.810	
235	0.3861	10998.900	
230A	0.0430	1744.280	698.7
240a	0.1228	2534.000	1720
240b	0.1090	3693.000	1291
240c	0.0361	1813.750	641.28
240c.5	0.0188	1162	888
240d	0.0180	1514.900	888
240e	0.0214	1149.800	392.7
240f	0.0127	926.400	347.1
240g	0.0054	573.300	335.9
240h	0.0068	552.500	384.9
240i	0.1051	3286.200	332.03
240j	0.0125	1435.600	781.6
Total	1.582		8701.210

Table 4.1: Watercourse lengths, subbasin areas and and reach lengths.

4.2 Precipitation

The 6-hour precipitation depths were obtained from the isopluvial maps for Maricopa County, based on NOAA Atlas 2, Volume VII (Miller, et al, 1973), Figures 2.1 - 2.14 in the FCDMC Manual. Depths were areally adjusted for the 1.60 square mile watershed by a factor of .983, according to Table 2.2 in the FCDMC Manual. The Maricopa County Pattern 1.8 was used as the rainfall pattern distribution, according to Figure 2.17 in the FCDMC Manual, developed from statistics found in the NOAA Atlas for the Western States, Arizona. The adjusted rainfall and depths for the 5 storms of interest (2, 10, 25,50, and 100) are represented in Table 4.2.

Ret. Period	Unadjusted	Adjusted
2	1.4	1.37
10	2.2	2.16
25	2.7	2.65
50	3.2	3.15
100	3.4	3.34

Table 4.2: Precipitation depths for storms of interest.

4.3 Losses

To estimate all parameters for surface and infiltration loss, the procedures followed FCDMC Manual guidance. Areally weighted land use and soil classifications were determined for each subbasin. The land use delineation was determined from two sources, assuming fully developed conditions under existing zoning. The General Plan of the Town of Wickenburg was used for watershed areas upstream of the dam, and the Land Use Exhibit of the Casandro Wash Watershed Below the Proposed Dam, provided by Maricopa County, was used for the watershed surrounding and downstream of the dam. The soil classification delineation was determined according to the USDA, SCS Soil Survey of Aquila-Carefree Area, Parts of Maricopa and Pinal Counties, AZ (SCS, 1986). These delineations were correlated with the subbasin delineation and measured with a planimeter to determine soil classification and land use percentages for each subbasin, see soils exhibit in Appendix C, p.

The initial abstraction (IA) parameters were obtained from Table 4.2a in the FCDMC Manual for each land use and areally weighted for each subbasin. IA parameters range from 0.25-0.29 inch.

Infiltration loss rates were computed with the Green Ampt infiltration option in HEC-1. The hydraulic conductivity at natural saturation (XKSAT) for each soil type contained within the study was obtained from Appendix A, Aquila-Carefree Loss Rate Parameters, in the FCDMC Manual and averaged according to Eq. 4.4 in the FCDMC Manual for each subbasin. The areally averaged XKSAT values were then used to determine the parameters describing the soil moisture deficit (DTHETA) and the average capillary suction in the wetted zone (PSIF), according to Figure 4.3 in the FCDMC Manual and assuming normal conditions. Final XKSAT values were adjusted to account for areally weighted vegetative cover using Fig 4.4 in the FCDMC Manual.

The percentages of directly connected impervious surface (RTIMP) of each subbasin were computed from Table 4.2a in the FCDMC Manual and land use percentages. RTIMP parameters were adjusted to account for bedrock outcropping according to the SCS report. Adjusted RTIMP parameters range from 18 to 38 percent.

All adjusted parameters used for the Green-Ampt Infiltration loss equation in HEC-1 are represented in Table 4.3.

Sub-basin	Area (mi^2)	IA (in)	Dtheta	PSIF (in)	XKSAT (in/hr)	RTIMP (%)
230	0.6845	0.26	0.25	5.1	0.33	30
235	0.3861	0.24	0.25	6.2	0.21	30
230-A	0.0430	0.28	0.21	6.4	0.19	30
240-A	0.1228	0.29	0.21	6.4	0.19	20
240-B	0.1090	0.29	0.21	6.4	0.19	18
240-C	0.0361	0.23	0.21	6.4	0.19	38
240-C.5	0.0188	0.23	0.21	6.4	0.19	36
240-D	0.0180	0.23	0.21	6.4	0.19	35
240-E	0.0214	0.23	0.21	6.4	0.19	38
240-F	0.0127	0.25	0.21	6.4	0.19	30
240-G	0.0054	0.25	0.21	6.4	0.19	30
240-H	0.0068	0.25	0.21	6.4	0.19	30
240-I	0.1051	0.25	0.21	6.4	0.19	30
240-J	0.0125	0.25	0.21	6.4	0.19	30

Table 4.3: Green and Ampt Infiltration Parameters used in HEC-1 Model.

4.4 Hydrograph Method

The Clark Synthetic unit hydrograph was used to estimate the stream response to excess rainfall in each subbasin, as suggested by FCDMC Manual for watersheds of this size.

The slope for each subbasin was adjusted according to Figure 5.4 in the FCDMC Manual. The roughness coefficient (Kb) was obtained from Table 5.1 in the FCDMC Manual using m and b parameters weighted according to residential, desert, developed or park land uses in each subbasin.

The time of concentration (Tc) and storage coefficient (R) parameters were calculated using the computer program MCUHP1 as provided with the FCDMC Manual. This code iteratively computes the Tc and intensity (I) using Eq. 5.5 in the FCDMC Manual for each subbasin within a study area when provided all abstraction, infiltration and subbasin area and flow path data. It then computes R by Eq 5.6 in the FCDMC Manual.

The subbasin data and Clark Unit Hydrograph parameters used in HEC-1 are represented in Table 4.4.

Sub-basin	Area (mi^2)	Lc (mi)	Slope (ft/mi)	Kb	T (hr)	R (hr)
230	0.6845	2.544	130.5	0.043	0.558	0.502
235	0.3861	2.083	105.6	0.053	0.592	0.636
230-A	0.0430	0.33	102.9	0.06	0.225	0.175
240-A	0.1228	0.48	203.5	0.053	0.208	0.119
240-B	0.1090	0.7	151	0.054	0.283	0.24
240-C	0.0361	0.343	165.9	0.057	0.192	0.166
240-C.5	0.0188	0.22	168	0.062	0.162	0.14
240-D	0.0180	0.287	179	0.062	0.183	0.206
240-E	0.0214	0.218	227	0.062	0.146	0.118
240-F	0.0127	0.175	311	0.067	0.133	0.119
240-G	0.0054	0.109	464	0.073	0.104	0.105
240-H	0.0068	0.104	580	0.07	0.096	0.073
240-I	0.1051	0.622	165	0.055	0.258	0.203
240-J	0.0125	0.272	69.9	0.068	0.246	0.34

Table 4.4: Clark Unit Hydrograph Parameters used in HEC-1 Model.

4.5 Channel Routing

Eleven channel reaches were modeled. Routing parameters were based on typical average cross sections of Casandro Wash or the appropriate street flow cross section, obtained from the 1" = 200' 2 foot interval contour maps between corresponding concentration points. The normal-depth Modified Puls storage routing option was used, according to the guidelines in the FCDMC Manual.

The Manning's coefficients (n) were calculated from field observation, soil data and two sources. For the natural channel of Casandro Wash between the dam site and Navajo street, a constant value (0.028) was calculated using the methods described in "Estimated Manning's Roughness Coefficients for Stream Channels and Flood Plains in Maricopa County, Arizona" prepared by the U.S. Geological Survey, Water Resources Division. For the section of Casandro Wash that flows in the street, an "n" value (0.022) was obtained from FCDMC Drainage Design Manual, Volume II, Hydraulics, Table 5.11 (see Appendix C). The same aforementioned table was also used to obtain a constant n value (0.040) for all overbank flow.

4.6 Detention Basin and Stormdrain Routing

To model the newly constructed Casandro Wash Dam and detention basin in the town of Wickenburg, the approved constructions plans provided by Maricopa County and CH2M-Hill were used. A rating curve for the dam and detention basin was created using the elevation-volume average method, estimated by planimetering 2-foot contour interval mapping of the grading plan and dam alignment, adjusted to account for the 2 acre-feet of sediment storage during the 100-year event (see Figure 4.6.1). An outflow rating curve was created for the dam's low flow orifice structure discharge, determined with the orifice equation, in combination with the emergency spillway discharge, using the verified rating curve found in the Casandro Wash Dam Final Design Report (CH2M Hill, 1995) determined with the procedures outlined in the "Design of Small Dams" by the U.S. Bureau of Reclamation (1987) and "Hydraulic Design of the Spillways," by the U.S. Army Corp of Engineers (1990) (see Figure 4.6.2). These rating curves were entered into the post-development HEC-1 model as a reservoir routing reach at the location of the dam.

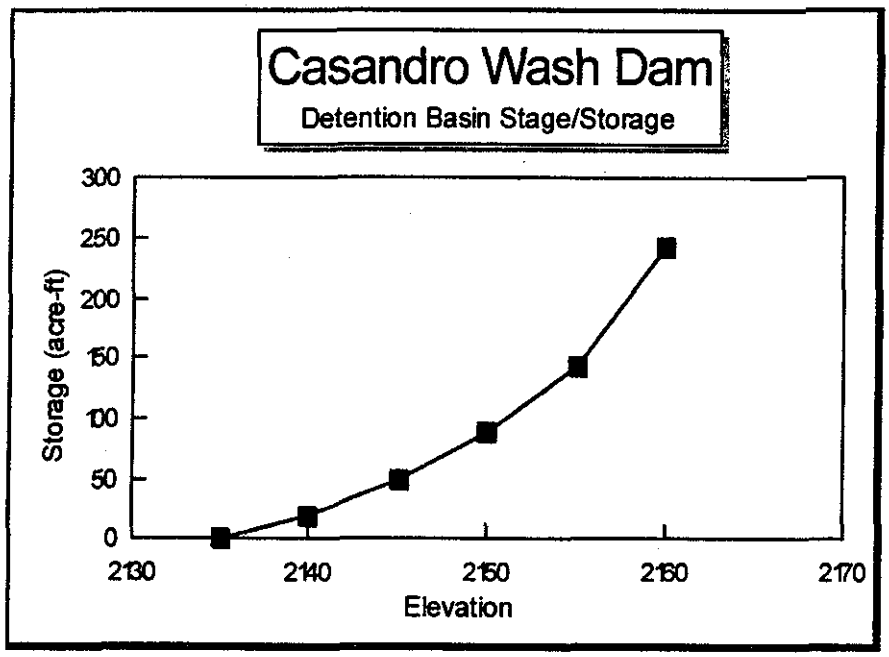


Figure 4.6:1: Rating Curve Computed for Detention basin Storage

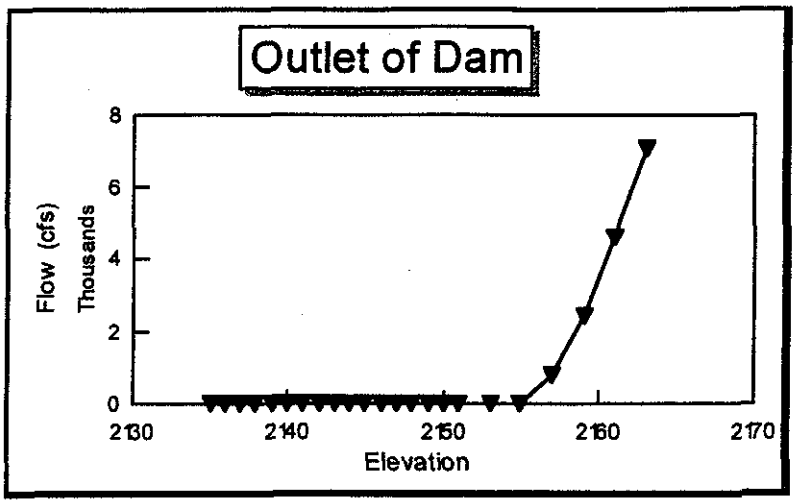


Figure 4.6.2: Outlet flow from low flow orifice and spillway on Casandro Wash Dam.

To model the outfall stormsewer that was built from Navajo Street to Sols Wash, the approved construction plans provided by Maricopa County were used. The flow was estimated by calculating the hydraulic gradient in the dual 48" RCP pipe system and assuming outlet control and full 100 year flow elevation in Sols Wash and 6 ft of available head at the catch basin inlet. As the system was designed, the sewer will collect all flow from Casandro Wash until a maximum of 274 cubic feet per second is reached. At this point, all flow greater than 274 cfs will overflow the catch basin into Jackson and Mohave Streets and through the historic route to Sols Wash. This was entered into the post-development HEC-1 model as a simple diversion at the point of the outfall catch basin.

4.7 Remaining Hydraulic Structures

The dual 5' x 6' box culvert's diverting the western flow and the single 5' x 6' box culvert conveying the eastern flow underneath Interstate 60 upstream of the dam were neglected in the hydrology model due to their insignificant effect on the flow of Casandro Wash through the Town of Wickenburg below the dam.

The four 36" x 22" CMPA underneath Mariposa and Cucaracha Streets were neglected in the hydrology model.

The dual 10' x 5' CBC underneath Navajo Street leading to the catch basin for the storm

sewer was modeled using a detention storage volume-flow relationship computed with the following procedure. The elevation\flow rating curve for the dual culvert was calculated with the Dodson and Associates, Box Culvert Analysis Computer Program, which uses Federal Highway Administration methods. From preliminary results of the hydraulic modeling, it was determined that the water surface elevation at the outlet during the peak of the design storm would be 1.82 ft above the outlet invert, creating an outlet controlled flow regime in the culvert. The elevation/storage and elevation/flow rating curves were entered into both pre- and post-development HEC-1 models with the reservoir routing option (see Appendix C).

The RCBC underneath the AT & SF railroad was modeled using a detention volume-flow relationship computed with a procedure parallel to that used with the Navajo Street culvert. The depressed area upstream of the crossing was planimetered using the railroad tracks as the northeast boundary. The elevation/flow rating curve was determined with the Box Culvert Analysis Computer Program assuming outlet control with 100 year flow elevation in Sols Wash. The culvert storage flow relationship was entered into both pre- and post-development HEC-1 models with the reservoir routing method (see Appendix C).

4.8 Results

The results of the HEC-1 modeling procedure demonstrate that the dam and outfall structure will significantly decrease the 100 year flow through the Town of Wickenburg, from 1606 cfs to 278 cfs at the railroad crossing. The pre- and post-development flows for each concentration point are shown in Table 4.8.1.

Flow results of HEC-1 Model (cfs)		
Conc Pt	Pre-dev	Post-dev
23	1101	1101
23A	1149	1149
Dam In		1265
A	1259	30
B	1391	187
C	1430	253
D	1461	305
E	1475	63
F	1481	86
G	1485	94
H	1486	105
I	1596	281
J	1114	406

Table 4.8.1: Flow results, Casandro wash.

Estimated 100-year peak flows in Casandro Wash resulting from this modeling procedure are lower than the estimates made in the previous hydrologic studies (see Table 4.8.2 and Appendix C for comparison of the various models, parameters, and results). In 1995, Maricopa County published an addendum to its FCDMC Manual which suggested that directly connected percent impervious parameters that were lower than those used in the previous three studies for most land uses. This was the only significant difference between the various models. Notably, the Casandro Wash Dam Final Design Report for the Flood Control District of Maricopa County (CH2M Hill, February 1995) contains an estimated outflow from the dam of 118 cfs, where this study's estimated outflow is 30 cfs. The dam and outfall structures were designed for larger flows.

Post development flows were then entered into the HEC-2 hydraulic model of Casandro Wash downstream of the dam to determine the resulting water surface elevation of the 100-year flood.

Erosion/Sediment transport: Not covered by the project scope.

5.0 Hydraulic Analysis

To estimate the post-project 100-year flood surface elevation of Casandro Wash through the town of Wickenburg, a hydraulic analysis was completed downstream of the dam to the AT&SF Pacific Railroad crossing. Cross sections were derived from the 1993 Maricopa County DOT map. Field surveys of bottom channel elevations and hydraulic structures were conducted to confirm the digital MCDOT mapping.

The analysis was completed using the May 1991 version of U.S. Army Corp of Engineers HEC-2 Water Surface Profiles model. The starting water surface elevation was determined at the inlet of the box culvert underneath the railroad crossing assuming the 100-year FEMA FIRM elevation in Sols Wash at the outlet. Casandro Wash was modeled from this crossing to the inlet of the storm drain at the intersection of Navajo and Jackson Streets as street flow through town according to the map. The wash was then separately modeled from the inlet of the box culvert at the Navajo and Jackson intersection upstrem to Casandro Wash Dam.

Without an original FEMA (pre-project) HEC 2 run, an alternate method was used to evaluate post-project hydraulic effects. The 100 year HEC 2 water surface elevations (WSEL) and streambed elevations, revised with new verified topographic survey, were graphically plotted by river mile oon Figure 5.1:1 along with the FIS FLOOD PROFILES from panels 37P and 38P. Figure 5.1:1 enables graphic comparison of pre- and post-project WSELs..

All flows used in the hydraulic model of Casandro Wash were obtained from the 100-year post-development results of the HEC-1 modeling procedure computed at corresponding locations. Subcritical flow was assumed and all calculations were computed in the upstream direction.

5.1 Parameter Estimation

The method used to obtain the Manning's coefficients is detailed in the Hydrologic Analyses Section 4.5. A coefficient of 0.022 was used for the street flow through town. A coefficient of 0.028 was used for the wash in the natural channel and a coefficient of 0.040 was used for all overbank flow, as described in FCDMC Hydraulic Drainage Design Manual, Table 5.11.

The "n" values for overbank flow are at the lower range of values used in the pre-project FIS. Values for the channel differ slightly from the FIS reflecting crossing upgrades, other observed changes in the natural channel, and due to compliance with MCFCD Hydraulic Drainage Design Manaual. Please see Section 4.5 Channel Routing for more detailed explaination of "n" value estimates used for this study.

The remaining parameters, namely the contraction and expansion coefficients, were estimated according to the methods outlined in the HEC-2 User's Manual with data collected by field

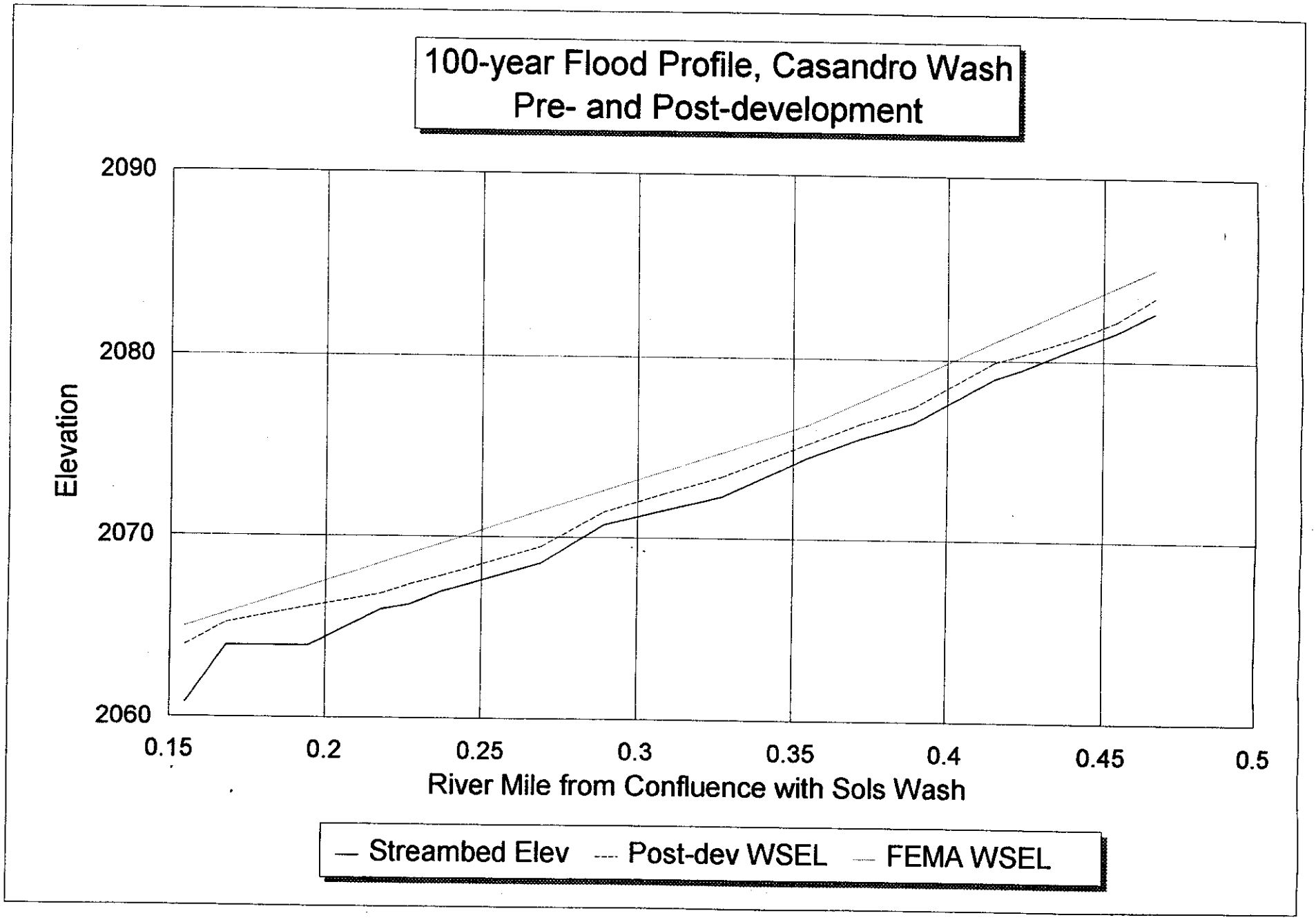


Figure 5.1.1: Navajo Street to RR Crossing, 100-yr Flood and Revised Streambed Profile

and map observation.

All channel cross sections and bank locations were obtained from the Maricopa County DOT 1" = 40' mapping. Because the inundated area was beyond the limit of DOT's mapping at the AT&SF Railroad crossing, the WADMS 1" = 200' scale maps were used for further information. Field survey data were used for confirmation and clarification. Road elevations and culvert specifications were obtained from the appropriate As-Built street plans provided by Yost and Gardner Engineers and confirmed with field survey.

5.2 Modeling Procedure

5.2.1 Natural Channel Profile

Casandro Wash was divided into two separate hydraulic models due to the difficulty in modeling the added hydraulic effects of the box culvert and storm sewer diversion at the intersection of Jackson and Navajo Streets with HEC-2.

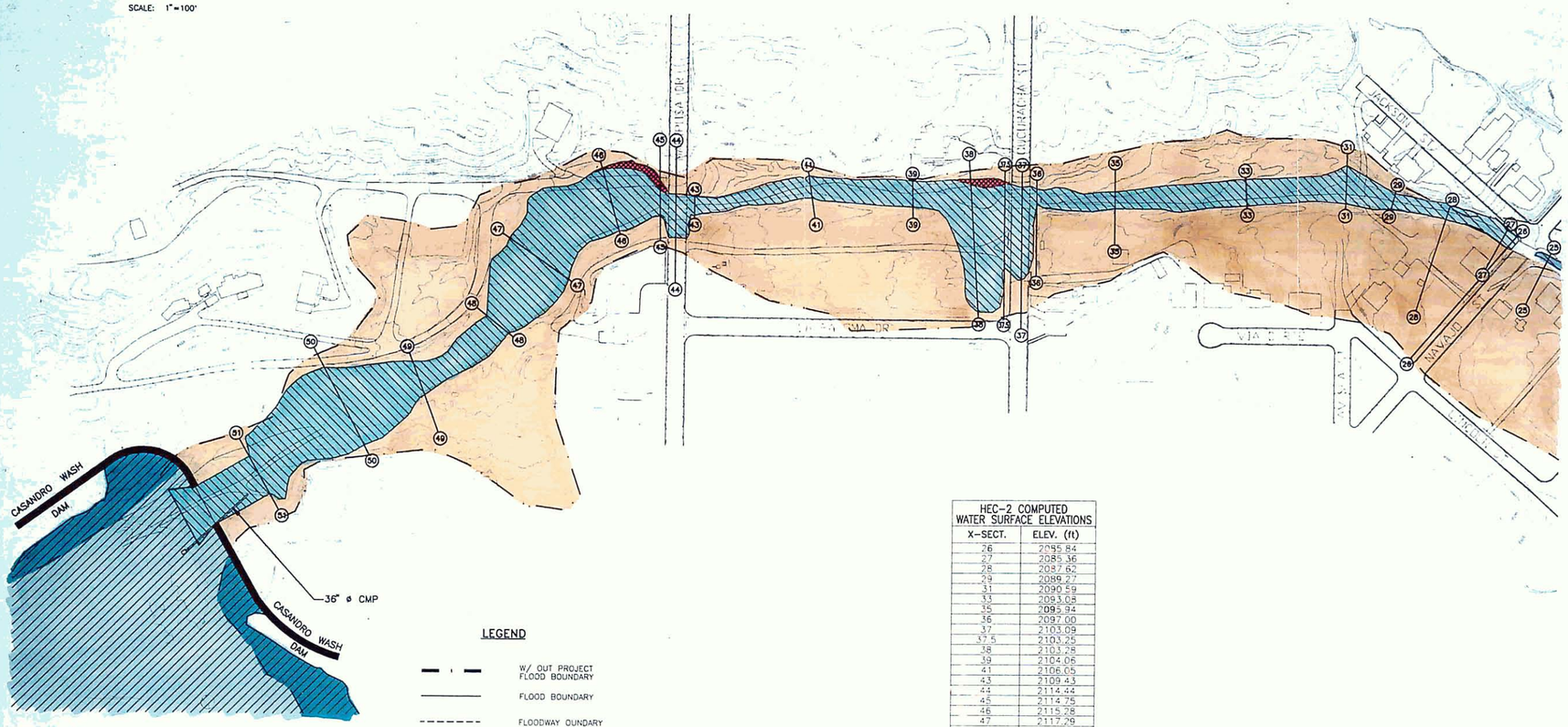
The first HEC-2 model calculated the water surface elevation of Casandro Wash beginning at the inlet of the railroad crossing upstream to the outlet of the CBC underneath Navajo Street. The water surface elevation (WSEL) upstream of the railroad culvert computed by the reservoir routing routine in the 100-year post-development HEC-1 model was used as the starting WSEL (see Section 4.7 and Appendix C).

The cross sections in the first model describe the unpaved Mohave and Jackson Streets as the main conveyance of flow with the short-cut through the northwest corner of the intersection of the two streets (see Figure 5.2 and Appendix C).

The second HEC-2 model calculated the water surface elevation of Casandro Wash beginning at the inlet of the CBC underneath Navajo Street to the outlet of the spillway at Casandro Wash Dam. The WSEL at the inlet of the CBC computed by the reservoir routing routine in the 100-year post-development HEC-1 model was used as the initial WSEL (see Section 4.7).
Cross sections in the second model describe the natural channel of Casandro Wash as the main conveyance of flow. As in the hydrologic model, the low flow culverts underneath Mariposa and Cucaracha were neglected in the hydraulic model. The culverts, designed to carry nuisance low flow events underneath the streets, are currently clogged with sediment and debris and make a negligible impact on the water surface elevation of the 100-year floodplain. The streets, which are above the surrounding natural ground, are modeled with simple weir flow, with cross sections describing the center line of the streets and the natural ground channel directly upstream and downstream of both streets (see Figure 5.2).

5.2.2 Floodway Encroachment Analysis

SCALE: 1"=100'



LEGEND

- W/ OUT PROJECT FLOOD BOUNDARY
- FLOOD BOUNDARY
- FLOODWAY OUNDARY
- WITH PROJECT FLOODWAY
- WITH PROJECT FLOODPLAIN
- WITH PROJECT FLOOD-PRONE AREAS (AO)
- 49 — 49 HEC-2 CROSS-SECTION LOCATION
- APPROXIMATE DAM & DETENTION BASIN SITE

HEC-2 COMPUTED WATER SURFACE ELEVATIONS	
X-SECT.	ELEV. (ft)
26	2085.84
27	2085.36
28	2087.62
29	2089.27
31	2090.59
33	2093.08
35	2095.94
36	2097.00
37	2103.09
37.5	2103.25
38	2103.28
39	2104.06
41	2106.05
43	2109.43
44	2114.44
45	2114.75
46	2115.28
47	2117.29
48	2119.30
49	2122.85
50	2126.10
51	2130.48

ACCORDING TO HEC-2 MODEL
(CAP, MCH 7-15-96)

NO.	DATE	REVISION	BY:	CH.	APPR.

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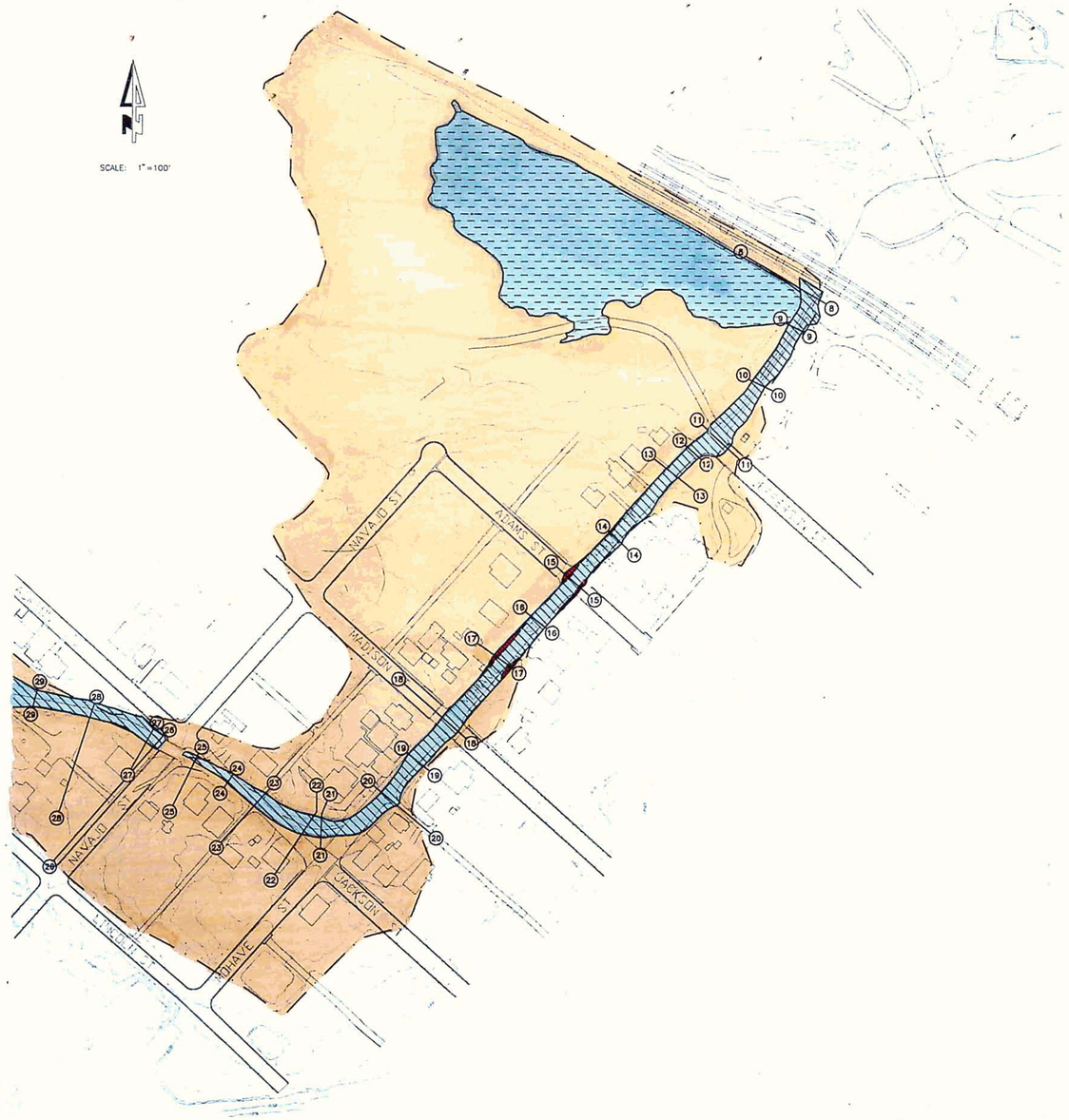
FAX - (520) 884-5278

FEMA FIRM LOMR
FIG. 5.2a WITH PROJECT FLOODPLAIN
CASANDRO WASH
HEC-2 CROSS SECTIONS AND
COMPUTED WATER SURFACE ELEVATIONS

job no.	3660.2
date	9/96
design	MCH
draft	SAK
chk'd	RAGP
scale	1"=100'
sheet	3 of 4



HEC-2 COMPUTED WATER SURFACE ELEVATIONS	
X-SECT.	ELEV. (ft)
8	2064.36
9	2065.23
10	2066.13
11	2066.85
12	2067.40
13	2067.87
14	2069.48
15	2071.39
16	2072.41
17	2073.38
18	2075.25
19	2076.40
20	2077.36
21	2079.91
22	2080.32
23	2081.30
24	2082.21
25	2083.52

ACCORDING TO HEC-2 MODEL (CAP, MCH 7-15-96)

LEGEND

- W/ OUT PROJECT FLOOD BOUNDARY
- FLOOD BOUNDARY
- FLOODWAY OUNDARY
- WITH PROJECT FLOODWAY
- WITH PROJECT FLOODPLAIN
- WITH PROJECT FLOOD-PRONE AREAS (AO)
- 49 — 49 HEC-2 CROSS-SECTION LOCATION
- APPROXIMATE DAM & DETENTION BASIN SITE

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NO.	DATE	REVISION	BY:	CH.	APPR.

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FEMA FIRM LOMR
FIG. 5.2b WITH PROJECT FLOODPLAIN
CASANDRO WASH
HEC-2 CROSS SECTIONS AND
COMPUTED WATER SURFACE ELEVATIONS

job no.	3660.2
date	9/96
design	MCH
draft	SAK
chk'd	RAGP
scale	1"=100'
sheet	4 of 4

The results of the above natural channel profile were used to establish the maximum limits of encroachment using the following criteria: the water surface elevation could not increase above 1 ft over natural conditions, the channel velocity could not increase to the point where damaging erosion would occur, and the top width of the floodway could not vary excessively. The floodway analysis was initially estimated using HEC-2 method 4 and completed for presentation with HEC-2 method 1.

5.3 Results

The water surface elevations of the 100-year flow through Casandro Wash, as simulated by HEC-2, were reduced in response to contrustion of the dam and storm sewer. The majority of the flow is conveyed in the natural channel of Casandro Wash or in the right of way of Jackson and Mohave Streets. One hundred percent of the commercial and residential development in Casandro Wash previously inside the FIRM floodplain is now outside of the boundary.

X-Section	WSEL	X-Section	WSEL
8	2064.00	26	2085.84
9	2065.23	27	2086.36
10	2066.13	28	2087.62
11	2066.85	29	2089.27
12	2067.40	31	2090.59
13	2067.88	33	2093.49
14	2069.48	35	2096.55
15	2071.39	36	2097.22
16	2072.41	37	2013.29
17	2073.38	37.5	2103.32
18	2075.25	38	2103.33
19	2076.40	39	2104.05
20	2077.36	41	2106.07
21	2079.91	43	2109.43
22	2080.32	44	2114.44
23	2081.30	45	2114.75
24	2082.21	46	2115.28
25	2083.52	47	2117.30
		48	2119.42
		49	2122.95
		50	2126.14
		51	2130.63

Table 5.3.1: Water surface elevations computed by HEC-2. (see Figure 5.2 for x-sect locations)

The HEC-2 computed post-development water surface elevations for all cross sections are shown in Table 5.3.1 and Figure 5.2.

Three pre-development regions of both nuisance and severe flooding; (1) upstream of the weir flow over Mariposa, (2) upstream of the weir flow over Cucaracha Streets, and (3) upstream of the culvert underneath the AT&SF Railroad crossing, continue to be (post-development) areas of ponding on a smaller scale, (see Figures 3.1 and 5.3.1). Although the flows over the streets and through the culverts are greatly reduced by the dam and outfall construction, the topography of the associated surrounding land is flat. Consequently, the post-construction floodplain does include some development (one non-permanent barn) in these areas. However, because the simulated flood is under 1 ft in depth in most places, existing bottom floor elevations of all buildings should be adequate to obtain removal from the FIRM.

The encroachment analysis demonstrates that the flow in the three areas of ponding could be confined to the channel without significantly affecting its velocity or depth. See Table 5.3.2 for the comparison of natural profile and encroachment WSEL's and velocitiesApart from these three areas of ponding, the post-development flows are confined to the natural channel upstream of Navajo Street and confined to the street right-of-way from Navajo Street to the railroad crossing. The floodway encroachment analysis does not change the depth or lateral extent of flow in any of the already confined stretches.

X-Section	Nat WSEL	Enc WSEL	Delt WSEL	Nat VCH	Enc VCH	Delt VCH
8	2064	2064.36	0.36	1.72	2.57	0.85
9	2065.23	2065.23	0	5.2	5.52	0.32
10	2066.13	2066.14	0.01	4.51	4.49	-0.02
11	2066.85	2066.85	0	3.8	3.8	0
12	2067.4	2067.4	0	4.56	4.55	-0.01
13	2067.88	2067.88	0	4.7	4.67	-0.03
14	2069.48	2069.48	0	4.78	4.79	0.01
15	2071.39	2071.39	0	3.99	4.22	0.23
16	2072.41	2072.41	0	4.43	4.44	0.01
17	2073.38	2073.38	0	4.8	4.9	0.1
18	2075.25	2075.25	0	3.76	3.76	0
19	2076.4	2076.4	0	4.76	4.76	0
20	2077.36	2077.36	0	5.76	5.76	0
21	2079.91	2079.91	0	6.76	6.76	0
22	2080.32	2080.32	0	7.76	7.76	0
23	2081.3	2081.3	0	3.35	3.36	0.01
24	2082.21	2082.21	0	3.46	3.46	0
25	2083.52	2083.52	0	3.82	3.84	0.02
26	2085.84	2085.84	0	6.52	6.52	0
27	2086.36	2086.36	0	4.56	4.56	0
28	2087.62	2087.62	0	7.06	7.06	0
29	2089.27	2089.31	0.04	6.56	6.92	0.36
31	2090.59	2090.65	0.06	4.66	4.28	-0.38
33	2093.49	2093.5	0.01	5.15	5.2	0.05
35	2096.55	2096.55	0	6.27	6.25	-0.02
36	2097.22	2097.22	0	3.79	3.81	0.02
37	2103.29	2103.95	0.66	4.23	5.35	1.12
37.5	2103.32	2104	0.68	1.29	1.35	0.06
38	2103.33	2104.05	0.72	0.86	2.86	2
39	2104.05	2104.05	0	5.13	5.15	0.02
41	2106.06	2106.06	0	4.57	4.55	-0.02
43	2109.43	2109.43	0	5.61	5.59	-0.02
44	2114.44	2114.44	0	4.26	4.3	0.04
45	2114.75	2114.75	0	0.66	0.66	0
46	2115.28	2115.27	-0.01	3.65	3.67	0.02
47	2117.3	2117.3	0	0.74	0.73	-0.01
48	2119.42	2119.42	0	2.78	2.81	0.03
49	2122.95	2122.95	0	2.48	2.44	-0.04
50	2126.14	2126.14	0	1.61	1.64	0.03
51	2130.63	2130.63	0	3.05	3.04	-0.01

Table 5.3.2: Comparison of natural profile and encroachment water surface profiles (WSEL) and velocities (VCH).

6.0. Reference Materials:

References

Black & Veatch and CVL, 1992, *Wickenburg Are Drainage Master Study*, Watershed Hydrology Report, Volume I, 27p plus appendices.

CH2M Hill, 1995, *Casandro Wash Dam Final Design Report for The Flood Control District of Maricopa County*, 40p plus appendices.

Flood Control District of Maricopa County, 1994, *Design Concept Report for Casandro Wash Outfall*, 19p plus appendices.

Flood Control District of Maricopa County, 1992, *Drainage Design Manual for Maricopa County, Arizona, Volume I Hydrology*, 86p plus appendices.

Flood Control District of Maricopa County, 1991, *Drainage Design Manual for Maricopa County, Arizona, Volume II Hydraulics*, 420p.

U.S. Army Corps of Engineers, 1990, *HEC-1 Flood Hydrograph Package, User's Manual*, Hydrologic Engineering Center, Davis California, 32p plus appendices.

Thomsen, B.W. and H.W. Hjalmarson, 1991, *Estimated Manning's Roughness Coefficients for Stream Channels and Flood Plains in Maricopa County, Arizona*, U.S. Geological Survey, Prepared for the Flood Control District of Maricopa County, 129p.

U.S. Army Corps of Engineers, 1990, *HEC-2 Flood Water Surface Profiles, User's Manual*, Hydrologic Engineering Center, Davis California, 47p plus appendices.

Appendix A: HEC-1 Output Files, pre- and post-development.

```
1****************************************                    ****************************************
*                                      *                    *                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                    *   U.S. ARMY CORPS OF ENGINEERS       *
*          SEPTEMBER 1990              *                    *   HYDROLOGIC ENGINEERING CENTER      *
*           VERSION 4.0                *                    *        609 SECOND STREET             *
*                                      *                    *      DAVIS, CALIFORNIA 95616         *
* RUN DATE  08/14/1996  TIME  08:30:07 *                    *          (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   CASANDRO WASH,  CLOMR 3660.2
  2           ID   POST OUTFALL AND DAM DEVELOPMENT
  3           ID   COLLINS PINA, MCH 6-1-96
  4           ID   6 HOUR, 100 YEAR STORM EVENT
              *DIAGRAM
  5           IT       5                    200
  6           IO       5
              *

  7           KK  CS230
  8           KM   SUB-BASIN 230
  9           KM   6-HOUR RAINFALL, PATTERN NO. 1.80 WAS USED TO FIND TC & R FOR THIS BASIN
 10           KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF .980
 11           BA    .684
 12           IN      15
 13           KM   RAINFALL DEPTH OF 3.40 WAS SPACIALLY REDUCED AS SHOWN BY THE PB RECORD
 14           PB   3.343
 15           KM   THE FOLLOWING PC RECORD USED A 6-HOUR STORM WITH A PATTERN No. OF 1.80
 16           PC    .000    .009    .016    .025    .034    .042    .051    .059    .067    .076
 17           PC    .087    .100    .120    .158    .245    .437    .721    .851    .906    .940
 18           PC    .952    .965    .977    .989   1.000
 19           LG    .260    .250     5.1    .330  30.000
```

```
 20          UC    .558    .502
 21          UA       0       5      16      30      65      77      84      90      94      97
 22          UA     100
             *

 23          KK  CS235
 24          KM   SUB-BASIN 235
 25          BA    .386
 26          LG    .240    .210   6.400    .210  30.000
 27          UC    .592    .636
 28          UA       0       5      16      30      65      77      84      90      94      97
 29          UA     100
             *

 30          KK  CAC23
 31          KM   COMBINE 230 AND 235 AT 23
 32          HC       2
             *

 33          KK  CAC230-A
 34          KM   ROUTE COMBINED HYDROGRAPH TO COUNTRY CLUB DRIVE
 35          RS       1    FLOW      -1
 36          RC    .040    .028    .040     699   .0258
 37          RX     0.0     140     160     240     280     290     360     560
 38          RY       8       4       2       0       0       2       6       8
             *

 39          KK  CS230A
 40          KM   SUB-BASIN 230A
 41          BA    .043
 42          LG    .280    .210   6.400    .190      30
 43          UC    .225    .175
 44          UA       0       5      16      30      65      77      84      90      94      97
```



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

 45          UA     100
             *

 46          KK  CAC2
 47          KM   COMBINE 230, 235 AND 230.A
 48          HC       2
             *

 49          KK   ROUTE
 50          KM   ROUTE COMBINED HYDROGRAPH TO PROPOSED DAM LOCATION
 51          RS       1    FLOW      -1
 52          RC    .040    .028    .040    1720   .0319
 53          RX   463.5   467.5   477.5   487.5   512.5   522.5   532.5   536.5
 54          RY    16.5    12.5    12.5    10.0    10.0    12.5    12.5    16.5
             *

 55          KK  CS240A
 56          KM   SUB-BASIN 240A
 57          BA    .123
 58          LG    .290    .210   6.400    .190    20.0
 59          UC    .208    .119
 60          UA       0       5      16      30      65      77      84      90      94      97
 61          UA     100
```

```
                *

 62             KK  DAMIN
 63             KM   ADD 240A TO UPSTREAM FLOW AT DAM LOCATION
 64             HC       2
                *

 65             KK  CPA                                                                                  KK
 66             KM    Route Hydrograph Through Dam.
 67             KM
 68             RS       1    STOR       2
 69             SA    2.05    2.49    5.80    6.77    9.06   10.20   10.96   11.34   11.61   11.88
 70             SA   12.09   12.31   12.81   13.31   13.81
 71             SE    2135    2137    2140    2144    2150    2153    2155    2156    2157    2158
 72             SE    2159    2160    2161    2162    2163
 73             SQ       0     9.5    13.5    19.1    23.3    28.6    30.9     295     823    1539
 74             SQ    2423    3450    4577    5773    7015
                *

 75             KK  RCPA-B
 76             KM   ROUTE FROM DAM SITE TO MARIPOSA DR
 77             RS       1    FLOW      -1
 78             RC    .040    .028    .040  1291.1   .0190
 79             RX     0.0    80.0   160.0   230.0   330.0   425.6   475.6   480.6
 80             RY    13.5     6.3     2.9     0.3     0.1    3.80     8.1       9
                *
1                                          HEC-1 INPUT                                                PAGE  3

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


 81             KK  CS240B
 82             KM   SUB-BASIN 240B
 83             BA    .109
 84             LG    .290    .210   6.400    .190      18
 85             UC    .283    .240
 86             UA       0       5      16      30      65      77      84      90      94      97
 87             UA     100
                *

 88             KK  CPB
 89             KM   ADD 240B TO UPSTREAM FLOW
 90             HC       2
                *

 91             KK  RCPB-C
 92             KM   ROUTE FROM MARIPOSA DR TO CUCURACHA ST
 93             RS       1    FLOW      -1
 94             RC    .040    .028    .040     641   .0190
 95             RX     0.0      30      60      80     283   320.4     330     340
 96             RY    12.1     7.7     3.4       0     0.7     3.8     5.8      10
                *

 97             KK  CS240C
 98             KM   SUB-BASIN 240C
 99             BA    .036
100             LG    .230    .210   6.400    .190      38
101             UC    .192    .166
102             UA       0       5      16      30      65      77      84      90      94      97
103             UA     100
```

```
                *

 104            KK  CPC
 105            KM   CUCURACHA ST
 106            HC       2
                *

 107            KK  C-D                                                                    K
 108            KM   ROUTE FROM CUCURACHA ST TO CULVERT CONCENTRATION POINT
 109            RS       1    FLOW      -1
 110            RC    .040    .028    .040     888   0.012
 111            RX     0.0      10      30      80     130   316.9   327.5     430
 112            RY     7.0     5.4     1.8     0.8       0     1.8     2.5     2.9
                *

 113            KK  CS240C.5
 114            KM   SUB-BASIN 240C.5
 115            BA   .0188
 116            LG     .23    .210   6.400    .190      36
 117            UC    .162    .140
 118            UA       0       5      16      30      65      77      84      90      94
 119            UA     100
                *
```



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


 120            KK  CUL
 121            KM    CULVERT FLOW
 122            HC       2
                *

 123            KK   C.5-CUL
 124            KM   ROUTE FROM CULVERT CONCENTRATION POINT TO CULVERT
 125            RS       1    FLOW      -1
 126            RC    .040    .028    .040     120   0.012
 127            RX     0.0      10      30      80     130   316.9   327.5     430
 128            RY     7.0     5.4     1.8     0.8       0     1.8     2.5     2.9
                *

 129            KK  CULVERT
 130            KM   DIVERT FLOW UNDERNEATH NAVAJO STREET THROUGH 2 BARREL 10X5 RCBC CULVERT
 131            SA       0       0       0    .028    .095    .106    .380
 132            SQ       0       0       0      20     180     320     600
 133            SE  2082.4  2083.0  2084.0    2085  2085.5    2086    2087
                *

 134            KK  CS240D
 135            KM   SUB-BASIN 240D
 136            BA    .018
 137            LG    .230    .210   6.400    .190      36
 138            UC    .183    .206
 139            UA       0       5      16      30      65      77      84      90      94      97
 140            UA     100
                *

 141            KK  CPD
 142            KM   NAVAJO AND JACKSON ST'S
 143            HC       2
```

```
                *

 144            KK  DIVERT
 145            KM   DIVERT PIPE FLOW OF 294 CFS, REST OF Q CONTINUES DOWNSTREAM
 146            DT   DIV-D
 147            DI       0     100     200     300     400     500     800
 148            DQ       0     100     200     274     274     274     274
                *

 149            KK  RCPD-E
 150            KM   ROUTE FROM NAVAJO AND JACKSON ST'S TO MOHAVE AND JACKSON ST'S
 151            RS       1    FLOW      -1
 152            RC    .040     .02    .040     393   0.010
 153            RX     0.0      80     130     170     180     230     280     320
 154            RY       0     2.0     2.2     1.4     1.5     1.8     2.5     2.5
                *
1                                          HEC-1 INPUT                                          PAGE  5

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


 155            KK  CS240E
 156            KM   SUB-BASIN 240E
 157            BA    .021
 158            LG    .230    .210   6.400    .190      38
 159            UC    .146    .118
 160            UA       0       5      16      30      65      77      84      90      94      97
 161            UA     100
                *

 162            KK  CPE
 163            KM   MOHAVE AND JACKSON ST'S
 164            HC       2
                *

 165            KK  RCPE-F
 166            KM   ROUTE FROM MOHAVE AND JACKSON ST'S TO MOHAVE AND MADISON ST'S
 167            RS       1    FLOW      -1
 168            RC    .040     .02    .040     347   0.023
 169            RX     0.0      70     100     150   192.6   292.6   342.6   384.4
 170            RY     2.8     1.5     1.1       0      .1     0.9     2.6     5.1
                *

 171            KK  CS240F
 172            KM   SUB-BASIN 240F
 173            BA    .013
 174            LG    .250    .210   6.400    .190      30
 175            UC    .133    .119
 176            UA       0       5      16      30      65      77      84      90      94      97
 177            UA     100
                *

 178            KK  CPF
 179            KM   MOHAVE AND MADISON ST'S
 180            HC       2
                *

 181            KK  RCPF-G
 182            KM   ROUTE FROM MOHAVE AND MADISON ST'S TO MOHAVE AND ADAMS ST'S
 183            RS       1    FLOW      -1
```

```
184          RC    .040     .02    .040     336   0.015
185          RX     0.0      30      50      70      80    90.5   110.5   202.8
186          RY     5.0       3       3       0       1       3     8.2    12.7
             *

187          KK  CS240G
188          KM   SUB-BASIN 240G
189          BA    .005
190          LG    .250    .210   6.400    .190      30
191          UC    .104    .105
192          UA       0       5      16      30      65      77      84      90      94      97
193          UA     100
             *
```



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

194          KK  CPG
195          KM   MOHAVE AND ADAMS ST'S
196          HC       2
             *

197          KK  RCPG-H
198          KM   ROUTE FROM MOHAVE AND ADAMS ST'S TO MOHAVE AND JEFFERSON ST'S
199          RS       1    FLOW      -1
200          RC    .040     .02    .040     385   0.010
201          RX     0.0      80     130     280     380     530     540     550
202          RY     3.5     2.5     1.7       0     0.1     1.4     3.5     5.5
             *

203          KK  CS240H
204          KM   SUB-BASIN 240H
205          BA    .007
206          LG    .250    .210   6.400    .190      30
207          UC    .096    .073
208          UA       0       5      16      30      65      77      84      90      94      97
209          UA     100
             *

210          KK  CPH
211          KM   MOHAVE AND JEFFERSON ST'S
212          HC       2
             *

213          KK  RCPH-I
214          KM   ROUTE FROM MOHAVE AND JEFFERSON ST'S TO ATSF RAILROAD
215          RS       1    FLOW      -1
216          RC    .040     .02    .040     332   0.009
217          RX     0.0      30     130     180     910    1080    1106    1116
218          RY     0.8     0.0     0.0       0       0     0.0     0.0     5.2
             *

219          KK  CS240I
220          KM   SUB-BASIN 240I
221          BA    .105
222          LG    .250    .210   6.400    .190      30
223          UC    .258    .203
224          UA       0       5      16      30      65      77      84      90      94      97
225          UA     100
```

```
                    *
 226                KK  CPI
 227                KM   ATSF RAILROAD
 228                HC       2
                    *
1                                          HEC-1 INPUT                                          PAGE  7

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


 229                KK  DAC242 DETENTION STORAGE ROUTING UNDER AT&SF RR
 230                KM         DETENTION AREA BEHIND RR EMBANKMENT (8 x 10 RCB)
 231                KM         CULVERT INVERT 2061.4 FROM M-H STRUCTURE SURVEY 1990
 232                KM         WEIR CREST (LOW PT ALONG RR TRACKS) 2069
 233                RS       1    ELEV  2061.4
 234                SA   0.001    0.01    0.12    13.1    15.4    17.7    20.0
 235                SQ   0.001     0.0      60     380     550     700     800
 236                SE  2061.4    2062    2063    2068    2069    2070    2071
                    *

 237                KK  RCPI-J
 238                KM   ROUTE FROM ATSF RAILROAD TO SOLS WASH
 239                RS       1    FLOW      -1
 240                RC    .040    .028    .040     782   0.012
 241                RX     0.0     130     210     310     360     760     770     780
 242                RY     5.0     4.0     2.0       0       0     2.0       4     6.0
 243                KO       2
                    *

 244                KK  CS240J
 245                KM   SUB-BASIN 240J
 246                BA    .012
 247                LG    .250    .210   6.400    .190      30
 248                UC    .246    .340
 249                UA       0       5      16      30      65      77      84      90      94      97
 250                UA     100
                    *

 251                KK   STORM
 252                KM   RETRIEVE DIVERSION FROM STORM DRAIN OUTFALL
 253                DR   DIV-D
                    *

 254                KK  SOLS
 255                KM   SOLS WASH OUTLET
 256                HC       3
 257                ZZ
1
              SCHEMATIC DIAGRAM OF STREAM NETWORK
INPUT
 LINE       (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

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

    7       CS230
                .
                .
   23           .      CS235
                .          .
```

```
                .
                .          .
 30      CAC23 ............
                V
                V
 33      CAC230
                .
                .
 39             .      CS230A
                .          .
                .          .
 46      CAC2  ............
                V
                V
 49      ROUTE
                .
                .
 55             .      CS240A
                .          .
                .          .
 62      DAMIN ............
                V
                V
 65      CPA
                V
                V
 75      RCPA-B
                .
                .
 81             .      CS240B
                .          .
                .          .
 88      CPB   ............
                V
                V
 91      RCPB-C
                .
                .
 97             .      CS240C
                .          .
                .          .
104      CPC   ............
                V
                V
107      C-D
                .
                .
113             .      CS240C
                .          .
                .          .
120      CUL   ............
                V
                V
123      C.5-C
                .
                .
134             .      CS240D
                .          .
                .          .
141      CPD   ............
                .
```

```
                .
                .
146             .-------->   DIV-D
144       DIVERT
               V
               V
149       RCPD-E
               .
               .
155            .      CS240E
               .           .
               .           .
162       CPE   ............
               V
               V
165       RCPE-F
               .
               .
171            .      CS240F
               .           .
               .           .
178       CPF   ............
               V
               V
181       RCPF-G
               .
               .
187            .      CS240G
               .           .
               .           .
194       CPG   ............
               V
               V
197       RCPG-H
               .
               .
203            .      CS240H
               .           .
               .           .
210       CPH   ............
               V
               V
213       RCPH-I
               .
               .
219            .      CS240I
               .           .
               .           .
226       CPI   ............
               V
               V
229       DAC242
               V
               V
237       RCPI-J
               .
               .
244            .      CS240J
               .           .
               .           .
253            .           .          .<-------   DIV-D
```

```
  251          .          .       STORM
               .          .          .
               .          .          .
  254      SOLS  ......................

 (***) RUNOFF ALSO COMPUTED AT THIS LOCATION
1****************************************
 *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
 *            SEPTEMBER 1990            *
 *             VERSION 4.0              *
 *                                      *
 *  RUN DATE  08/14/1996  TIME  08:30:07 *
 *                                      *
 ****************************************
```

```
****************************************
*                                      *
*    U.S. ARMY CORPS OF ENGINEERS      *
*    HYDROLOGIC ENGINEERING CENTER     *
*          609 SECOND STREET           *
*       DAVIS, CALIFORNIA 95616        *
*           (916) 756-1104             *
*                                      *
****************************************
```

```
                        CASANDRO WASH,  CLOMR 3660.2
                        POST OUTFALL AND DAM DEVELOPMENT
                        COLLINS PINA, MCH 6-1-96
                        6 HOUR, 100 YEAR STORM EVENT

  6 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      1    0  STARTING DATE
                      ITIME       0000  STARTING TIME
                         NQ        200  NUMBER OF HYDROGRAPH ORDINATES
                     NDDATE      1    0  ENDING DATE
                     NDTIME       1635  ENDING TIME
                     ICENT          19  CENTURY MARK

                 COMPUTATION INTERVAL     .08 HOURS
                      TOTAL TIME BASE   16.58 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


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


          **************
          *            *
 237 KK   *    RCPI-J  *
          *            *
```

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

243 KO          OUTPUT CONTROL VARIABLES
                      IPRNT          2  PRINT CONTROL
                      IPLOT          0  PLOT CONTROL
                      QSCAL         0.  HYDROGRAPH PLOT SCALE

              HYDROGRAPH ROUTING DATA

239 RS          STORAGE ROUTING
                      NSTPS          1  NUMBER OF SUBREACHES
                       ITYP       FLOW  TYPE OF INITIAL CONDITION
                     RSVRIC      -1.00  INITIAL CONDITION
                          X        .00 WORKING R AND D COEFFICIENT

240 RC          NORMAL DEPTH CHANNEL
                        ANL       .040  LEFT OVERBANK N-VALUE
                       ANCH       .028  MAIN CHANNEL N-VALUE
                        ANR       .040  RIGHT OVERBANK N-VALUE
                      RLNTH       782.  REACH LENGTH
                        SEL      .0120  ENERGY SLOPE
                      ELMAX         .0  MAX. ELEV. FOR STORAGE/OUTFLOW CALCULATION

                                   CROSS-SECTION DATA
                         --- LEFT OVERBANK --- + ------ MAIN CHANNEL ------- + --- RIGHT OVERBANK ---
242 RY        ELEVATION     5.00      4.00      2.00       .00       .00      2.00      4.00      6.00
241 RX        DISTANCE       .00    130.00    210.00    310.00    360.00    760.00    770.00    780.00

                                                  ***

                                   COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

          STORAGE       .00       .51      1.46      2.86      4.71      7.01      9.76     12.87     16.08     19.37
          OUTFLOW       .00     59.86    254.16    629.08   1227.31   2087.97   3247.47   4974.53   7154.06   9653.23
        ELEVATION       .00       .32       .63       .95      1.26      1.58      1.89      2.21      2.53      2.84

          STORAGE     22.75     26.20     29.73     33.36     37.19     41.26     45.57     49.97     54.38     58.79
          OUTFLOW  12460.63  15567.54  18967.25  22632.05  26568.15  30828.69  35436.14  40468.09  45806.46  51441.32
        ELEVATION      3.16      3.47      3.79      4.11      4.42      4.74      5.05      5.37      5.68      6.00

*** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN      629. TO    51441.
                THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK INFLOWS.
                THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER REACH.)

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

                                   HYDROGRAPH AT STATION   RCPI-J

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

DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	*	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	*	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1		0000	1	0.	.0	.0	*	1		0535	68	58.	.5	.3	*	1		1110	135	0.	.0	.0
1		0005	2	0.	.0	.0	*	1		0540	69	37.	.3	.2	*	1		1115	136	0.	.0	.0
1		0010	3	0.	.0	.0	*	1		0545	70	18.	.1	.1	*	1		1120	137	0.	.0	.0
1		0015	4	1.	.0	.0	*	1		0550	71	11.	.1	.1	*	1		1125	138	0.	.0	.0
1		0020	5	2.	.0	.0	*	1		0555	72	7.	.1	.0	*	1		1130	139	0.	.0	.0
1		0025	6	2.	.0	.0	*	1		0600	73	6.	.0	.0	*	1		1135	140	0.	.0	.0
1		0030	7	2.	.0	.0	*	1		0605	74	5.	.0	.0	*	1		1140	141	0.	.0	.0

1	0035	8	3.	.0	.0	*	1	0610	75	4.	.0	.0	*	1	1145	142	0.	.0	.0
1	0040	9	3.	.0	.0	*	1	0615	76	4.	.0	.0	*	1	1150	143	0.	.0	.0
1	0045	10	3.	.0	.0	*	1	0620	77	3.	.0	.0	*	1	1155	144	0.	.0	.0
1	0050	11	3.	.0	.0	*	1	0625	78	2.	.0	.0	*	1	1200	145	0.	.0	.0
1	0055	12	3.	.0	.0	*	1	0630	79	1.	.0	.0	*	1	1205	146	0.	.0	.0
1	0100	13	3.	.0	.0	*	1	0635	80	1.	.0	.0	*	1	1210	147	0.	.0	.0
1	0105	14	3.	.0	.0	*	1	0640	81	0.	.0	.0	*	1	1215	148	0.	.0	.0
1	0110	15	4.	.0	.0	*	1	0645	82	0.	.0	.0	*	1	1220	149	0.	.0	.0
1	0115	16	3.	.0	.0	*	1	0650	83	0.	.0	.0	*	1	1225	150	0.	.0	.0
1	0120	17	3.	.0	.0	*	1	0655	84	0.	.0	.0	*	1	1230	151	0.	.0	.0
1	0125	18	3.	.0	.0	*	1	0700	85	0.	.0	.0	*	1	1235	152	0.	.0	.0
1	0130	19	3.	.0	.0	*	1	0705	86	0.	.0	.0	*	1	1240	153	0.	.0	.0
1	0135	20	3.	.0	.0	*	1	0710	87	0.	.0	.0	*	1	1245	154	0.	.0	.0
1	0140	21	3.	.0	.0	*	1	0715	88	0.	.0	.0	*	1	1250	155	0.	.0	.0
1	0145	22	3.	.0	.0	*	1	0720	89	0.	.0	.0	*	1	1255	156	0.	.0	.0
1	0150	23	3.	.0	.0	*	1	0725	90	0.	.0	.0	*	1	1300	157	0.	.0	.0
1	0155	24	3.	.0	.0	*	1	0730	91	0.	.0	.0	*	1	1305	158	0.	.0	.0
1	0200	25	3.	.0	.0	*	1	0735	92	0.	.0	.0	*	1	1310	159	0.	.0	.0
1	0205	26	3.	.0	.0	*	1	0740	93	0.	.0	.0	*	1	1315	160	0.	.0	.0
1	0210	27	3.	.0	.0	*	1	0745	94	0.	.0	.0	*	1	1320	161	0.	.0	.0
1	0215	28	3.	.0	.0	*	1	0750	95	0.	.0	.0	*	1	1325	162	0.	.0	.0
1	0220	29	3.	.0	.0	*	1	0755	96	0.	.0	.0	*	1	1330	163	0.	.0	.0
1	0225	30	4.	.0	.0	*	1	0800	97	0.	.0	.0	*	1	1335	164	0.	.0	.0
1	0230	31	4.	.0	.0	*	1	0805	98	0.	.0	.0	*	1	1340	165	0.	.0	.0
1	0235	32	4.	.0	.0	*	1	0810	99	0.	.0	.0	*	1	1345	166	0.	.0	.0
1	0240	33	4.	.0	.0	*	1	0815	100	0.	.0	.0	*	1	1350	167	0.	.0	.0
1	0245	34	4.	.0	.0	*	1	0820	101	0.	.0	.0	*	1	1355	168	0.	.0	.0
1	0250	35	5.	.0	.0	*	1	0825	102	0.	.0	.0	*	1	1400	169	0.	.0	.0
1	0255	36	5.	.0	.0	*	1	0830	103	0.	.0	.0	*	1	1405	170	0.	.0	.0
1	0300	37	6.	.0	.0	*	1	0835	104	0.	.0	.0	*	1	1410	171	0.	.0	.0
1	0305	38	6.	.1	.0	*	1	0840	105	0.	.0	.0	*	1	1415	172	0.	.0	.0
1	0310	39	7.	.1	.0	*	1	0845	106	0.	.0	.0	*	1	1420	173	0.	.0	.0
1	0315	40	9.	.1	.0	*	1	0850	107	0.	.0	.0	*	1	1425	174	0.	.0	.0
1	0320	41	11.	.1	.1	*	1	0855	108	0.	.0	.0	*	1	1430	175	0.	.0	.0
1	0325	42	15.	.1	.1	*	1	0900	109	0.	.0	.0	*	1	1435	176	0.	.0	.0
1	0330	43	22.	.2	.1	*	1	0905	110	0.	.0	.0	*	1	1440	177	0.	.0	.0
1	0335	44	33.	.3	.2	*	1	0910	111	0.	.0	.0	*	1	1445	178	0.	.0	.0
1	0340	45	46.	.4	.2	*	1	0915	112	0.	.0	.0	*	1	1450	179	0.	.0	.0
1	0345	46	56.	.5	.3	*	1	0920	113	0.	.0	.0	*	1	1455	180	0.	.0	.0
1	0350	47	65.	.5	.3	*	1	0925	114	0.	.0	.0	*	1	1500	181	0.	.0	.0
1	0355	48	75.	.6	.3	*	1	0930	115	0.	.0	.0	*	1	1505	182	0.	.0	.0
1	0400	49	87.	.6	.4	*	1	0935	116	0.	.0	.0	*	1	1510	183	0.	.0	.0
1	0405	50	100.	.7	.4	*	1	0940	117	0.	.0	.0	*	1	1515	184	0.	.0	.0
1	0410	51	115.	.8	.4	*	1	0945	118	0.	.0	.0	*	1	1520	185	0.	.0	.0
1	0415	52	128.	.8	.4	*	1	0950	119	0.	.0	.0	*	1	1525	186	0.	.0	.0
1	0420	53	138.	.9	.4	*	1	0955	120	0.	.0	.0	*	1	1530	187	0.	.0	.0
1	0425	54	144.	.9	.5	*	1	1000	121	0.	.0	.0	*	1	1535	188	0.	.0	.0
1	0430	55	146.	.9	.5	*	1	1005	122	0.	.0	.0	*	1	1540	189	0.	.0	.0
1	0435	56	145.	.9	.5	*	1	1010	123	0.	.0	.0	*	1	1545	190	0.	.0	.0
1	0440	57	140.	.9	.4	*	1	1015	124	0.	.0	.0	*	1	1550	191	0.	.0	.0
1	0445	58	134.	.9	.4	*	1	1020	125	0.	.0	.0	*	1	1555	192	0.	.0	.0
1	0450	59	127.	.8	.4	*	1	1025	126	0.	.0	.0	*	1	1600	193	0.	.0	.0
1	0455	60	119.	.8	.4	*	1	1030	127	0.	.0	.0	*	1	1605	194	0.	.0	.0
1	0500	61	111.	.8	.4	*	1	1035	128	0.	.0	.0	*	1	1610	195	0.	.0	.0
1	0505	62	103.	.7	.4	*	1	1040	129	0.	.0	.0	*	1	1615	196	0.	.0	.0
1	0510	63	95.	.7	.4	*	1	1045	130	0.	.0	.0	*	1	1620	197	0.	.0	.0
1	0515	64	88.	.6	.4	*	1	1050	131	0.	.0	.0	*	1	1625	198	0.	.0	.0
1	0520	65	81.	.6	.3	*	1	1055	132	0.	.0	.0	*	1	1630	199	0.	.0	.0
1	0525	66	74.	.6	.3	*	1	1100	133	0.	.0	.0	*	1	1635	200	0.	.0	.0
1	0530	67	68.	.5	.3	*	1	1105	134	0.	.0	.0	*						

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

  PEAK FLOW     TIME                              MAXIMUM AVERAGE FLOW
                                          6-HR       24-HR       72-HR     16.58-HR
+   (CFS)       (HR)
                                 (CFS)
+     146.      4.50                      38.         14.         14.         14.
                              (INCHES)    .226        .227        .227        .227
                              (AC-FT)     19.         19.         19.         19.

 PEAK STORAGE   TIME                              MAXIMUM AVERAGE STORAGE
                                          6-HR       24-HR       72-HR     16.58-HR
+  (AC-FT)      (HR)
       1.       4.50                       0.          0.          0.          0.

  PEAK STAGE    TIME                              MAXIMUM AVERAGE STAGE
                                          6-HR       24-HR       72-HR     16.58-HR
+   (FEET)      (HR)
      .46       4.50                      .15         .05         .05         .05

                              CUMULATIVE AREA =    1.57 SQ MI

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
+                        CS230      714.   4.33        145.        53.         53.       .68

        HYDROGRAPH AT
+                        CS235      386.   4.33         90.        33.         33.       .39

        2 COMBINED AT
+                        CAC23     1100.   4.33        235.        86.         86.      1.07

        ROUTED TO
+                        CAC230    1101.   4.33        235.        86.         86.      1.07
+                                                                                        1.59       4.33

        HYDROGRAPH AT
+                        CS230A      77.   4.08         10.         4.          4.       .04

        2 COMBINED AT
+                        CAC2      1149.   4.33        245.        90.         90.      1.11

        ROUTED TO
+                         ROUTE    1150.   4.33        245.        90.         90.      1.11
+                                                                                       12.35       4.33

        HYDROGRAPH AT
+                        CS240A      236.   4.00         27.        10.         10.       .12

        2 COMBINED AT
+                        DAMIN     1265.   4.25        272.        99.         99.      1.24
```

	ROUTED TO								
+		CPA	30.	6.92	29.	23.	23.	1.24	
+									2153.97	6.92
	ROUTED TO								
+		RCPA-B	30.	7.00	29.	23.	23.	1.24	
+									.16	7.00
	HYDROGRAPH AT								
+		CS240B	172.	4.08	24.	9.	9.	.11	
	2 COMBINED AT								
+		CPB	187.	4.08	49.	31.	31.	1.35	
	ROUTED TO								
+		RCPB-C	187.	4.08	49.	31.	31.	1.35	
+									.00	4.08
	HYDROGRAPH AT								
+		CS240C	67.	4.00	9.	3.	3.	.04	
	2 COMBINED AT								
+		CPC	253.	4.08	57.	35.	35.	1.38	
	ROUTED TO								
+		C-D	246.	4.17	57.	35.	35.	1.38	
+									.89	4.17
	HYDROGRAPH AT								
+		CS240C	37.	4.00	5.	2.	2.	.02	
	2 COMBINED AT								
+		CUL	275.	4.08	61.	36.	36.	1.40	
	ROUTED TO								
+		C.5-C	275.	4.17	61.	36.	36.	1.40	
+									.93	4.17
	ROUTED TO								
+		CULVER	275.	4.17	61.	36.	36.	1.40	
+									2085.84	4.17
	HYDROGRAPH AT								
+		CS240D	31.	4.08	4.	2.	2.	.02	
	2 COMBINED AT								
+		CPD	305.	4.08	65.	38.	38.	1.42	
	DIVERSION TO								
+		DIV-D	274.	4.08	64.	37.	37.	1.42	
	HYDROGRAPH AT								
+		DIVERT	31.	4.08	2.	1.	1.	1.42	
	ROUTED TO								
+		RCPD-E	30.	4.17	2.	1.	1.	1.42	
+									.84	4.17
	HYDROGRAPH AT								

```
+                    CS240E     43.   4.00      5.      2.      2.     .02
     2 COMBINED AT
+                    CPE        63.   4.08      7.      3.      3.    1.44
     ROUTED TO
+                    RCPE-F     62.   4.08      7.      3.      3.    1.44
+                                                                     .30      4.08
     HYDROGRAPH AT
+                    CS240F     26.   4.00      3.      1.      1.     .01
     2 COMBINED AT
+                    CPF        86.   4.08     10.      4.      4.    1.45
     ROUTED TO
+                    RCPF-G     85.   4.08     10.      4.      4.    1.45
+                                                                    1.18      4.08
     HYDROGRAPH AT
+                    CS240G     10.   4.00      1.      0.      0.     .00
     2 COMBINED AT
+                    CPG        94.   4.08     11.      4.      4.    1.46
     ROUTED TO
+                    RCPG-H     93.   4.08     11.      4.      4.    1.46
+                                                                     .31      4.08
     HYDROGRAPH AT
+                    CS240H     15.   4.00      2.      1.      1.     .01
     2 COMBINED AT
+                    CPH       105.   4.08     13.      5.      5.    1.46
     ROUTED TO
+                    RCPH-I    102.   4.17     13.      5.      5.    1.46
+                                                                     .03      4.17
     HYDROGRAPH AT
+                    CS240I    182.   4.08     25.      9.      9.     .10
     2 COMBINED AT
+                    CPI       281.   4.08     38.     14.     14.    1.57
     ROUTED TO
+                    DAC242    147.   4.42     38.     14.     14.    1.57
+                                                                 2064.36      4.42
     ROUTED TO
+                    RCPI-J    146.   4.50     38.     14.     14.    1.57
+                                                                     .46      4.50
     HYDROGRAPH AT
+                    CS240J     17.   4.08      3.      1.      1.     .01
     HYDROGRAPH AT
+                    STORM     274.   4.08     64.     37.     37.     .00
     3 COMBINED AT
```

+	SOLS	406.	4.17	103.	52.	52.	1.58

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

```
1****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*            SEPTEMBER 1990            *
*             VERSION 4.0              *
*                                      *
* RUN DATE  07/15/1996  TIME  15:10:04 *
*                                      *
****************************************
```

```
****************************************
*                                      *
*   U.S. ARMY CORPS OF ENGINEERS       *
*   HYDROLOGIC ENGINEERING CENTER      *
*         609 SECOND STREET            *
*      DAVIS, CALIFORNIA 95616         *
*          (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


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

  1           ID   CASANDRO WASH, CLOMR  3660.2
  2           ID   PRE OUTFALL AND DAM DEVELOPMENT
  3           ID   COLLINS PINA, MCH 6-1-96
  4           ID   6 HOUR, 100 YEAR STORM EVENT
              *DIAGRAM
  5           IT       5                    200
  6           IO       5
              *

  7           KK  CS230
  8           KM   SUB-BASIN 230
  9           KM   6-HOUR RAINFALL, PATTERN NO. 1.80 WAS USED TO FIND TC & R FOR THIS BASIN
 10           KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF .980
 11           BA    .684
 12           IN      15
 13           KM   RAINFALL DEPTH OF 3.40 WAS SPACIALLY REDUCED AS SHOWN BY THE PB RECORD
 14           PB   3.343
 15           KM   THE FOLLOWING PC RECORD USED A 6-HOUR STORM WITH A PATTERN No. OF 1.80
 16           KM   THE FOLLOWING PC RECORD USED A 6-HOUR STORM WITH A PATTERN No. OF 1.80
 17           PC    .000    .009    .016    .025    .034    .042    .051    .059    .067    .076
 18           PC    .087    .100    .120    .158    .245    .437    .721    .851    .906    .940
 19           PC    .952    .965    .977    .989   1.000
```

```
 20          LG    .260    .250     5.1    .330  30.000
 21          UC    .558    .502
 22          UA       0       5      16      30      65      77      84      90      94      97
 23          UA     100
             *

 24          KK  CS235
 25          KM   SUB-BASIN 235
 26          BA    .386
 27          LG    .240    .210   6.400    .210  30.000
 28          UC    .592    .636
 29          UA       0       5      16      30      65      77      84      90      94      97
 30          UA     100
             *

 31          KK  CAC2
 32          KM   COMBINE 230 AND 235 AT BEGINNING OF 230A
 33          HC       2
             *

 34          KK  CAC230-A
 35          KM   ROUTE COMBINED HYDROGRAPH TO COUNTRY CLUB DRIVE
 36          RS       1    FLOW      -1
 37          RC    .045     .03    .045     699   .0258
 38          RX     0.0     140     160     240     280     290     360     560
 39          RY       8       4       2       0       0       2       6       8
             *
```



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

 40          KK  CS230A
 41          KM   SUB-BASIN 230A
 42          BA    .043
 43          LG    .280    .210   6.400    .190      30
 44          UC    .225    .175
 45          UA       0       5      16      30      65      77      84      90      94      97
 46          UA     100
             *

 47          KK  CAC2
 48          KM   COMBINE 230, 235 AND 230.A
 49          HC       2
             *

 50          KK   ROUTE
 51          KM   ROUTE COMBINED HYDROGRAPH TO CPA
 52          RS       1    FLOW      -1
 53          RC    .045     .03    .045    2020   .0319
 54          RX   463.5   467.5   477.5   487.5   512.5   522.5   532.5   536.5
 55          RY    16.5    12.5    12.5    10.0    10.0    12.5    12.5    16.5
             *

 56          KK  CS240A
 57          KM   SUB-BASIN 240A
 58          BA    .123
 59          LG    .290    .210   6.400    .190    20.0
 60          UC    .208    .119
 61          UA       0       5      16      30      65      77      84      90      94      97
```

```
 62          UA     100
             *

 63          KK  CPA
 64          KM   ADD 240A TO UPSTREAM FLOW AT CPA
 65          HC       2
             *

 66          KK  RCPA-B
 67          KM   ROUTE FROM DAM SITE TO MARIPOSA DR
 68          RS       1    FLOW      -1
 69          RC    .045     .03    .045  1291.1   .0190
 70          RX     0.0    80.0   160.0   230.0   330.0   425.6   475.6   480.6
 71          RY    13.5     6.3     2.9     0.3     0.1    3.80     8.1       9
             *

 72          KK  CS240B
 73          KM   SUB-BASIN 240B
 74          BA    .109
 75          LG    .290    .210   6.400    .190      18
 76          UC    .283    .240
 77          UA       0       5      16      30      65      77      84      90      94      97
 78          UA     100
             *
1                                          HEC-1 INPUT                                          PAGE  3

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


 79          KK  CPB
 80          KM   ADD 240B TO UPSTREAM FLOW
 81          HC       2
             *

 82          KK  RCPB-C
 83          KM   ROUTE FROM MARIPOSA DR TO CUCURACHA ST
 84          RS       1    FLOW      -1
 85          RC    .045     .03    .045     641   .0190
 86          RX     0.0      30      60      80     283   320.4     330     340
 87          RY    12.1     7.7     3.4       0     0.7     3.8     5.8      10
             *

 88          KK  CS240C
 89          KM   SUB-BASIN 240C
 90          BA    .036
 91          LG    .230    .210   6.400    .190      38
 92          UC    .192    .166
 93          UA       0       5      16      30      65      77      84      90      94      97
 94          UA     100
             *

 95          KK  CPC
 96          KM   CUCURACHA ST
 97          HC       2
             *

 98          KK   C-D                                                                          KK
 99          KM   ROUTE FROM CUCURACHA ST TO NAVAJO AND JACKSON ST'S
100          RS       1    FLOW      -1
101          RC    .045     .03    .045    1008   0.012
```

```
 102          RX     0.0      10      30      80     130   316.9   327.5     430
 103          RY     7.0     5.4     1.8     0.8       0     1.8     2.5     2.9
              *

 104          KK  CS240D
 105          KM   SUB-BASIN 240D
 106          BA    .037
 107          LG    .230    .210   6.400    .190      36
 108          UC    .175    .130
 109          UA       0       5      16      30      65      77      84      90      94      97
 110          UA     100
              *

 111          KK  CPD
 112          KM   NAVAJO AND JACKSON ST'S
 113          HC       2
              *
1                                          HEC-1 INPUT                                          PAGE  4

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


 114          KK  CULVERT
 115          KM   DIVERT FLOW UNDERNEATH NAVAJO STREET THROUGH 2 BARREL 10X5 RCBC CULVERT
 116          SA       0       0       0    .028    .095    .106    .380
 117          SQ       0       0       0      20     180     320     600
 118          SE  2082.4  2083.0  2084.0    2085  2085.5    2086    2087
              *

 119          KK  RCPD-E
 120          KM   ROUTE FROM NAVAJO AND JACKSON ST'S TO MOHAVE AND JACKSON ST'S
 121          RS       1    FLOW      -1
 122          RC    .045     .03    .045     393   0.010
 123          RX     0.0      80     130     170     180     230     280     320
 124          RY       0     2.0     2.2     1.4     1.5     1.8     2.5     2.5
              *

 125          KK  CS240E
 126          KM   SUB-BASIN 240E
 127          BA    .021
 128          LG    .230    .210   6.400    .190      38
 129          UC    .146    .118
 130          UA       0       5      16      30      65      77      84      90      94      97
 131          UA     100
              *

 132          KK  CPE
 133          KM   MOHAVE AND JACKSON ST'S
 134          HC       2
              *

 135          KK  RCPE-F
 136          KM   ROUTE FROM MOHAVE AND JACKSON ST'S TO MOHAVE AND MADISON ST'S
 137          RS       1    FLOW      -1
 138          RC    .045     .03    .045     347   0.023
 139          RX     0.0      70     100     150   192.6   292.6   342.6   384.4
 140          RY     2.8     1.5     1.1       0      .1     0.9     2.6     5.1
              *

 141          KK  CS240F
```

```
142          KM   SUB-BASIN 240F
143          BA    .013
144          LG    .250    .210   6.400    .190      30
145          UC    .133    .119
146          UA       0       5      16      30      65      77      84      90      94      97
147          UA     100
             *

148          KK  CPF
149          KM   MOHAVE AND MADISON ST'S
150          HC       2
             *
```



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

151          KK  RCPF-G
152          KM   ROUTE FROM MOHAVE AND MADISON ST'S TO MOHAVE AND ADAMS ST'S
153          RS       1    FLOW      -1
154          RC    .045     .03    .045     336   0.015
155          RX     0.0      30      50      70      80    90.5   110.5   202.8
156          RY     5.0       3       3       0       1       3     8.2    12.7
             *

157          KK  CS240G
158          KM   SUB-BASIN 240G
159          BA    .005
160          LG    .250    .210   6.400    .190      30
161          UC    .104    .105
162          UA       0       5      16      30      65      77      84      90      94      97
163          UA     100
             *

164          KK  CPG
165          KM   MOHAVE AND ADAMS ST'S
166          HC       2
             *

167          KK  RCPG-H
168          KM   ROUTE FROM MOHAVE AND ADAMS ST'S TO MOHAVE AND JEFFERSON ST'S
169          RS       1    FLOW      -1
170          RC    .045     .03    .045     385   0.010
171          RX     0.0      80     130     280     380     530     540     550
172          RY     3.5     2.5     1.7       0     0.1     1.4     3.5     5.5
             *

173          KK  CS240H
174          KM   SUB-BASIN 240H
175          BA    .007
176          LG    .250    .210   6.400    .190      30
177          UC    .096    .073
178          UA       0       5      16      30      65      77      84      90      94      97
179          UA     100
             *

180          KK  CPH
181          KM   MOHAVE AND JEFFERSON ST'S
182          HC       2
             *
```

```
183          KK  RCPH-I
184          KM   ROUTE FROM MOHAVE AND JEFFERSON ST'S TO ATSF RAILROAD
185          RS       1    FLOW      -1
186          RC    .045     .03    .045     332   0.009
187          RX     0.0      30     130     180     910    1080    1116    1116
188          RY     0.8     0.0     0.0       0       0     0.0     0.0     5.2
             *
1                                          HEC-1 INPUT                                                    PAGE  6

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


189          KK  CS240I
190          KM   SUB-BASIN 240I
191          BA    .105
192          LG    .250    .210   6.400    .190      30
193          UC    .258    .203
194          UA       0       5      16      30      65      77      84      90      94      97
195          UA     100
             *

196          KK  CPI
197          KM   ATSF RAILROAD
198          HC       2
             *

199          KK  DAC242 DETENTION STORAGE ROUTING UNDER AT&SF RR
200          KM         DETENTION AREA BEHIND RR EMBANKMENT (8 x 10 RCB)
201          KM         CULVERT INVERT 2061.4 FROM M-H STRUCTURE SURVEY 1990
202          KM         WEIR CREST (LOW PT ALONG RR TRACKS) 2069
203          KM         (TAKEN DIRECTLY FROM WADMS (1991)
204          RS       1    ELEV  2061.4
205          SA   0.001     0.2     6.6    13.1    15.4    17.7    20.0
206          SQ   0.001     130     300     510     610    1260    4630
207          SE  2061.4    2064    2066    2068    2069    2070    2071
             *

208          KK  RCPI-J
209          KM   ROUTE FROM ATSF RAILROAD TO SOLS WASH
210          RS       1    FLOW      -1
211          RC    .045     .03    .045     782   0.012
212          RX     0.0     130     210     310     360     760     770     780
213          RY     5.0     4.0     2.0       0       0     2.0       4     6.0
             *

214          KK  CS240J
215          KM   SUB-BASIN 240J
216          BA    .012
217          LG    .250    .210   6.400    .190      30
218          UC    .246    .340
219          UA       0       5      16      30      65      77      84      90      94      97
220          UA     100
             *

221          KK  SOLS
222          KM   SOLS WASH OUTLET
223          HC       2
224          ZZ
1
```

SCHEMATIC DIAGRAM OF STREAM NETWORK

```
INPUT
 LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

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

   7       CS230
                .
                .
  24            .      CS235
                .           .
                .           .
  31       CAC2  ............
                V
                V
  34       CAC230
                .
                .
  40            .      CS230A
                .           .
                .           .
  47       CAC2  ............
                V
                V
  50        ROUTE
                .
                .
  56            .      CS240A
                .           .
                .           .
  63       CPA   ............
                V
                V
  66       RCPA-B
                .
                .
  72            .      CS240B
                .           .
                .           .
  79       CPB   ............
                V
                V
  82       RCPB-C
                .
                .
  88            .      CS240C
                .           .
                .           .
  95       CPC   ............
                V
                V
  98        C-D
                .
                .
 104            .      CS240D
                .           .
                .           .
 111       CPD   ............
                V
                V
```

```
*            SEPTEMBER 1990            *                                    *   HYDROLOGIC ENGINEERING CENTER    *
*             VERSION 4.0              *                                    *         609 SECOND STREET          *
*                                      *                                    *      DAVIS, CALIFORNIA 95616       *
*  RUN DATE  07/15/1996  TIME  15:10:04 *                                    *          (916) 756-1104            *
*                                      *                                    *                                    *
****************************************                                    ****************************************
```

```
                        CASANDRO WASH, CLOMR  3660.2
                        PRE OUTFALL AND DAM DEVELOPMENT
                        COLLINS PINA, MCH 6-1-96
                        6 HOUR, 100 YEAR STORM EVENT

  6 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     1    0  STARTING DATE
                      ITIME       0000  STARTING TIME
                         NQ        200  NUMBER OF HYDROGRAPH ORDINATES
                     NDDATE     1    0  ENDING DATE
                     NDTIME       1635  ENDING TIME
                      ICENT         19  CENTURY MARK

                 COMPUTATION INTERVAL     .08 HOURS
                      TOTAL TIME BASE   16.58 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

WARNING --- ROUTED OUTFLOW (    655.) IS GREATER THAN MAXIMUM OUTFLOW (    600.) IN STORAGE-OUTFLOW TABLE

WARNING --- ROUTED OUTFLOW (    911.) IS GREATER THAN MAXIMUM OUTFLOW (    600.) IN STORAGE-OUTFLOW TABLE

WARNING --- ROUTED OUTFLOW (   1154.) IS GREATER THAN MAXIMUM OUTFLOW (    600.) IN STORAGE-OUTFLOW TABLE

WARNING --- ROUTED OUTFLOW (   1327.) IS GREATER THAN MAXIMUM OUTFLOW (    600.) IN STORAGE-OUTFLOW TABLE

WARNING --- ROUTED OUTFLOW (   1424.) IS GREATER THAN MAXIMUM OUTFLOW (    600.) IN STORAGE-OUTFLOW TABLE

WARNING --- ROUTED OUTFLOW (   1462.) IS GREATER THAN MAXIMUM OUTFLOW (    600.) IN STORAGE-OUTFLOW TABLE

WARNING --- ROUTED OUTFLOW (   1431.) IS GREATER THAN MAXIMUM OUTFLOW (    600.) IN STORAGE-OUTFLOW TABLE

WARNING --- ROUTED OUTFLOW (   1353.) IS GREATER THAN MAXIMUM OUTFLOW (    600.) IN STORAGE-OUTFLOW TABLE

WARNING --- ROUTED OUTFLOW (   1250.) IS GREATER THAN MAXIMUM OUTFLOW (    600.) IN STORAGE-OUTFLOW TABLE
```

```
 119      RCPD-E
                .
                .
 125            .      CS240E
                .           .
                .           .
 132      CPE   ............
                V
                V
 135      RCPE-F
                .
                .
 141            .      CS240F
                .           .
                .           .
 148      CPF   ............
                V
                V
 151      RCPF-G
                .
                .
 157            .      CS240G
                .           .
                .           .
 164      CPG   ............
                V
                V
 167      RCPG-H
                .
                .
 173            .      CS240H
                .           .
                .           .
 180      CPH   ............
                V
                V
 183      RCPH-I
                .
                .
 189            .      CS240I
                .           .
                .           .
 196      CPI   ............
                V
                V
 199      DAC242
                V
                V
 208      RCPI-J
                .
                .
 214            .      CS240J
                .           .
                .           .
 221      SOLS  ............

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION
1****************************************                    ****************************************
 *                                      *                    *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                    *   U.S. ARMY CORPS OF ENGINEERS       *
```

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WARNING --- ROUTED OUTFLOW (   1131.) IS GREATER THAN MAXIMUM OUTFLOW (    600.) IN STORAGE-OUTFLOW TABLE

WARNING --- ROUTED OUTFLOW (   1005.) IS GREATER THAN MAXIMUM OUTFLOW (    600.) IN STORAGE-OUTFLOW TABLE

WARNING --- ROUTED OUTFLOW (    886.) IS GREATER THAN MAXIMUM OUTFLOW (    600.) IN STORAGE-OUTFLOW TABLE

WARNING --- ROUTED OUTFLOW (    780.) IS GREATER THAN MAXIMUM OUTFLOW (    600.) IN STORAGE-OUTFLOW TABLE

WARNING --- ROUTED OUTFLOW (    689.) IS GREATER THAN MAXIMUM OUTFLOW (    600.) IN STORAGE-OUTFLOW TABLE

WARNING --- ROUTED OUTFLOW (    603.) IS GREATER THAN MAXIMUM OUTFLOW (    600.) IN STORAGE-OUTFLOW TABLE

WARNING --- ROUTED OUTFLOW (   1095.) IS GREATER THAN MAXIMUM OUTFLOW (    865.) IN STORAGE-OUTFLOW TABLE

WARNING --- ROUTED OUTFLOW (   1291.) IS GREATER THAN MAXIMUM OUTFLOW (    865.) IN STORAGE-OUTFLOW TABLE

WARNING --- ROUTED OUTFLOW (   1404.) IS GREATER THAN MAXIMUM OUTFLOW (    865.) IN STORAGE-OUTFLOW TABLE

WARNING --- ROUTED OUTFLOW (   1456.) IS GREATER THAN MAXIMUM OUTFLOW (    865.) IN STORAGE-OUTFLOW TABLE

WARNING --- ROUTED OUTFLOW (   1443.) IS GREATER THAN MAXIMUM OUTFLOW (    865.) IN STORAGE-OUTFLOW TABLE

WARNING --- ROUTED OUTFLOW (   1375.) IS GREATER THAN MAXIMUM OUTFLOW (    865.) IN STORAGE-OUTFLOW TABLE

WARNING --- ROUTED OUTFLOW (   1276.) IS GREATER THAN MAXIMUM OUTFLOW (    865.) IN STORAGE-OUTFLOW TABLE

WARNING --- ROUTED OUTFLOW (   1160.) IS GREATER THAN MAXIMUM OUTFLOW (    865.) IN STORAGE-OUTFLOW TABLE

WARNING --- ROUTED OUTFLOW (   1036.) IS GREATER THAN MAXIMUM OUTFLOW (    865.) IN STORAGE-OUTFLOW TABLE

WARNING --- ROUTED OUTFLOW (    914.) IS GREATER THAN MAXIMUM OUTFLOW (    865.) IN STORAGE-OUTFLOW TABLE
1
```

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

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	CS230	714.	4.33	145.	53.	53.	.68		
+	HYDROGRAPH AT	CS235	386.	4.33	90.	33.	33.	.39		
+	2 COMBINED AT	CAC2	1100.	4.33	235.	86.	86.	1.07		
+	ROUTED TO	CAC230	1101.	4.33	235.	86.	86.	1.07		
+									1.65	4.33
+	HYDROGRAPH AT	CS230A	77.	4.08	10.	4.	4.	.04		
+	2 COMBINED AT	CAC2	1149.	4.33	245.	90.	90.	1.11		
	ROUTED TO									

```
+                    ROUTE      1148.   4.33      245.      90.      90.     1.11
+                                                                                   12.43      4.33

     HYDROGRAPH AT
+                    CS240A      236.   4.00       27.      10.      10.      .12

     2 COMBINED AT
+                    CPA        1259.   4.33      272.      99.      99.     1.24

     ROUTED TO
+                    RCPA-B     1260.   4.33      271.      99.      99.     1.24
+                                                                                    1.52      4.33

     HYDROGRAPH AT
+                    CS240B      172.   4.08       24.       9.       9.      .11

     2 COMBINED AT
+                    CPB        1391.   4.33      295.     108.     108.     1.35

     ROUTED TO
+                    RCPB-C     1392.   4.33      295.     108.     108.     1.35
+                                                                                     .01      4.33

     HYDROGRAPH AT
+                    CS240C       67.   4.00        9.       3.       3.      .04

     2 COMBINED AT
+                    CPC        1430.   4.33      304.     111.     111.     1.38

     ROUTED TO
+                    C-D        1426.   4.33      304.     111.     111.     1.38
+                                                                                    1.82      4.33

     HYDROGRAPH AT
+                    CS240D       73.   4.00        9.       3.       3.      .04

     2 COMBINED AT
+                    CPD        1461.   4.33      313.     115.     115.     1.42

     ROUTED TO
+                    CULVER     1462.   4.33      313.     115.     115.     1.42
+                                                                                 2090.08      4.33

     ROUTED TO
+                    RCPD-E     1456.   4.33      313.     115.     115.     1.42
+                                                                                    2.89      4.33

     HYDROGRAPH AT
+                    CS240E       43.   4.00        5.       2.       2.      .02

     2 COMBINED AT
+                    CPE        1475.   4.33      318.     117.     117.     1.44

     ROUTED TO
+                    RCPE-F     1469.   4.33      318.     117.     117.     1.44
+                                                                                    1.41      4.33

     HYDROGRAPH AT
+                    CS240F       26.   4.00        3.       1.       1.      .01
```

	2 COMBINED AT								
+		CPF	1481.	4.33	321.	118.	118.	1.45	
	ROUTED TO								
+		RCPF-G	1481.	4.33	321.	118.	118.	1.45	
+									4.15 4.33
	HYDROGRAPH AT								
+		CS240G	10.	4.00	1.	0.	0.	.00	
	2 COMBINED AT								
+		CPG	1485.	4.33	322.	118.	118.	1.46	
	ROUTED TO								
+		RCPG-H	1481.	4.33	322.	118.	118.	1.46	
+									1.41 4.33
	HYDROGRAPH AT								
+		CS240H	15.	4.00	2.	1.	1.	.01	
	2 COMBINED AT								
+		CPH	1486.	4.33	324.	119.	119.	1.46	
	ROUTED TO								
+		RCPH-I	1488.	4.42	324.	119.	119.	1.46	
+									.48 4.42
	HYDROGRAPH AT								
+		CS240I	182.	4.08	25.	9.	9.	.10	
	2 COMBINED AT								
+		CPI	1596.	4.33	349.	128.	128.	1.57	
	ROUTED TO								
+		DAC242	1110.	4.75	349.	128.	128.	1.57	
+									2069.77 4.75
	ROUTED TO								
+		RCPI-J	1109.	4.83	349.	128.	128.	1.57	
+									1.24 4.83
	HYDROGRAPH AT								
+		CS240J	17.	4.08	3.	1.	1.	.01	
	2 COMBINED AT								
+		SOLS	1114.	4.83	351.	129.	129.	1.58	

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

Appendix B: HEC-2 Output Files, post-development.

```
1*****************************************
 *  HEC-2 WATER SURFACE PROFILES          *
 *                                        *
 *  Version   4.6.2;  May 1991            *
 *                                        *
 *  RUN DATE    05SEP96    TIME   11:16:07 *
 *****************************************
```

```
*************************************
*  U.S. ARMY CORPS OF ENGINEERS     *
*  HYDROLOGIC ENGINEERING CENTER    *
*  609 SECOND STREET, SUITE D       *
*  DAVIS, CALIFORNIA 95616-4687     *
*          (916) 756-1104           *
*************************************
```

```
X     X  XXXXXXX   XXXXX             XXXXX
X     X  X       X     X           X     X
X     X  X       X                       X
XXXXXXX  XXXX    X         XXXXX    XXXXX
X     X  X       X                 X
X     X  X       X     X           X
X     X  XXXXXXX   XXXXX            XXXXXXX
```

1

05SEP96 11:16:07 PAGE 1

THIS RUN EXECUTED 05SEP96 11:16:07

```
*************************************
 HEC-2 WATER SURFACE PROFILES

 Version   4.6.2;  May 1991
*************************************
```

T1 CASANDRO WASH
T2 CLOMR STUDY (FUTURE CONDITIONS) FROM NAVAJO ST TO RAILROAD CROSSING
T3 FILE NAME: NAV-RR.DAT

J1	ICHECK	INQ	NINV	IDIR	STRT	METRIC	HVINS	Q	WSEL	FQ
	0.0	2	0.0	0.0	0	0.0	00	000.0	2064.36	0.0

J2	NPROF	IPLOT	PRFVS	XSECV	XSECH	FN	ALLDC	IBW	CHNIM	ITRACE
	1	0.0	-1	0.0	0.0	0.0	0.0			

J3 VARIABLE CODES FOR SUMMARY PRINTOUT

150	38	39	11

NC	0.040	0.040	0.022	0.1	0.3					
QT	1	280								
X1	8	7	135	197.5	55					
GR	2065	0	2064	135	2062	177.5	2060.8	185	2062	192.5
GR	2064	197.5	2066	202.5						

QT	1	102								
X1	9	5	12	37.6	70	70	70			
GR	2066	0	2066	12	2064	16	2064	26.4	2066	37.6
X1	10	5	23	43	145	150	140			
GR	2067.5	16	2066	23	2064.0	36	2066	43	2068	55
QT	1	91								
X1	11	8	15	66	120	120	120			
GR	2068	0	2067	15	2066	25	2066.1	40	2067	66
GR	2068	86	2069	113	2070	120				
X1	12	5	9	51	52	55	50			
GR	2068	9	2067	15	2066.3	32	2067	40	2068	51

X1	13	7	10	40	53	53	53			
GR	2068.5	0	2068	10	2067	15	2067.2	25	2067	35
GR	2068	40	2069	80						
X1	14	8	15	45	170	170	170			
GR	2071	13	2070	15	2069	19	2068.6	25	2068.6	35
GR	2069	43	2070	45	2071	51				
QT	1	82								
X1	15	5	26	62	103	105	105			
GR	2072	0	2071	26	2070.7	46	2071	62	2072	87
X1	16	7	20	56	102	100	100			
GR	2074	0	2073	20	2072	24	2071.5	40	2072	51
GR	2073	56	2074	59						
X1	17	8	52	75	100	100	100			
GR	2075.4	0	2075	25	2074	42	2073	52	2072.3	65
GR	2073	75	2074	80	2076	85				
QT	1	59								
X1	18	8	80	137	146	146	146			
GR	2077	0	2076.4	41	2076	80	2075	96	2074.5	111
GR	2075	126	2076	137	2077	155				
X1	19	8	15	55	90	90	90			
GR	2079	0	2078	15	2076	22	2075.6	35	2076	44
GR	2077	50	2078	55	2080	60				

```
X1      20       9       1      60      90      90      90
GR    2080       0    2078       1  2077.2      19    2077      30  2076.5      41
GR    2077      50    2078      60    2079     101    2080     141

X1      21       7      14      51     155     120     140
GR    2082       0    2082       7    2080      14    2079      32    2080      51
GR    2080     110    2080     130

QT       1      30
X1      22      10      18      52      25      45      45
GR    2082       0  2082.2      10    2082      13    2081      18    2080      20
GR  2079.5      35    2080      44    2081      52    2082      89    2082     145
```



```
X1      23       7      22      65      93      95      93
GR    2083       0    2082      22    2081      37 2080.74      45    2081      55
GR    2082      65  2082.4     185

X1      24       8      28      66      70      68      68
GR    2084       0    2084      25    2083      28    2082      31  2081.6      41
GR    2082      51    2083      66    2084      78

X1      25       8       0      45      65      70      65
GR    2085       0    2084       2    2083      10  2082.7      14    2083      18
GR    2084      28    2085      45  2084.3     100
```



```
SECNO    DEPTH    CWSEL    CRIWS    WSELK    EG       HV       HL       OLOSS    L-BANK ELEV
Q        QLOB     QCH      QROB     ALOB     ACH      AROB     VOL      TWA      R-BANK ELEV
TIME     VLOB     VCH      VROB     XNL      XNCH     XNR      WTN      ELMIN    SSTA
SLOPE    XLOBL    XLCH     XLOBR    ITRIAL   IDC      ICONT    CORAR    TOPWID   ENDST

*PROF 1
0

CCHV=     .100 CEHV=     .300
*SECNO 8.000
    8.000     3.56  2064.36      .00  2064.36  2064.46      .10      .00      .00  2064.00
    280.0      2.7    277.2       .0      8.8    109.0       .2       .0       .0  2064.00
      .00      .31     2.54      .29     .040     .022     .040     .000  2060.80    86.39
  .000684      55.       0.       0.        0        0        0      .00   112.01   198.40

*SECNO 9.000
```

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

9.000	1.23	2065.23	2065.23	.00	2065.70	.47	.07	.11	2066.00
102.0	.0	102.0	.0	.0	18.5	.0	.1	.1	2066.00
.00	.00	5.52	.00	.000	.022	.000	.000	2064.00	13.55
.007477	70.	70.	70.	20	22	0	.00	19.73	33.27

*SECNO 10.000

10.000	2.13	2066.13	.00	.00	2066.45	.32	.73	.02	2066.00
102.0	.0	102.0	.0	.0	22.6	.1	.2	.2	2066.00
.01	.02	4.51	.02	.040	.022	.040	.000	2064.00	22.38
.003882	145.	140.	150.	2	0	0	.00	21.41	43.79

*SECNO 11.000

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = .64

11.000	.85	2066.85	.00	.00	2067.08	.23	.62	.01	2067.00
91.0	.0	91.0	.0	.0	23.9	.0	.2	.3	2067.00
.02	.00	3.81	.00	.000	.022	.000	.000	2066.00	16.47
.007501	120.	120.	120.	2	0	0	.00	45.27	61.75

*SECNO 12.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

12.000	1.10	2067.40	2067.40	.00	2067.72	.32	.40	.03	2068.00
91.0	.0	91.0	.0	.0	20.0	.0	.3	.3	2068.00
.02	.00	4.56	.00	.000	.022	.000	.000	2066.30	12.63
.008465	52.	50.	55.	20	11	0	.00	31.73	44.35

1

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 13.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

13.000	.87	2067.87	2067.87	.00	2068.22	.34	.45	.01	2068.00
91.0	.0	91.0	.0	.0	19.3	.0	.3	.3	2068.00
.03	.00	4.71	.00	.000	.022	.000	.000	2067.00	10.63
.008335	53.	53.	53.	1	15	0	.00	28.75	39.37

*SECNO 14.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

14.000	.88	2069.48	2069.48	.00	2069.84	.36	1.39	.00	2070.00
91.0	.0	91.0	.0	.0	19.0	.0	.4	.5	2070.00

```
      .04       .00      4.79       .00      .000      .022      .000      .000   2068.60     17.08
   .008059      170.      170.      170.         3         5         0       .00     26.88     43.96


*SECNO 15.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
    15.000       .69   2071.39   2071.39       .00   2071.63       .24       .85       .01   2071.00
      82.0       2.2      77.7       2.1       1.9      19.3       1.9        .4        .6   2071.00
       .04      1.12      4.02      1.12      .040      .022      .040      .000   2070.70     15.93
   .008107      103.      105.      105.        20        15         0       .00     55.75     71.68


*SECNO 16.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
    16.000       .91   2072.41   2072.41       .00   2072.71       .31       .83       .02   2073.00
      82.0        .0      82.0        .0        .0      18.5        .0        .5        .7   2073.00
       .05       .00      4.44       .00      .000      .022      .000      .000   2071.50     22.38
   .008554      102.      100.      100.         2        11         0       .00     30.65     53.03


*SECNO 17.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
    17.000      1.08   2073.38   2073.38       .00   2073.74       .35       .81       .01   2073.00
      82.0        .8      80.8        .4        .7      16.8        .4        .5        .7   2073.00
       .06      1.08      4.80      1.07      .040      .022      .040      .000   2072.30     48.18
   .007683      100.      100.      100.         2        11         0       .00     28.73     76.91


1
   05SEP96      11:16:07                                                                          PAGE    6


    SECNO      DEPTH      CWSEL      CRIWS      WSELK      EG         HV         HL         OLOSS      L-BANK ELEV
    Q          QLOB       QCH        QROB       ALOB       ACH        AROB       VOL        TWA        R-BANK ELEV
    TIME       VLOB       VCH        VROB       XNL        XNCH       XNR        WTN        ELMIN      SSTA
    SLOPE      XLOBL      XLCH       XLOBR      ITRIAL     IDC        ICONT      CORAR      TOPWID     ENDST


*SECNO 18.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
    18.000       .75   2075.25   2075.25       .00   2075.47       .22      1.23       .01   2076.00
      59.0        .0      59.0        .0        .0      15.7        .0        .6        .8   2076.00
       .07       .00      3.76       .00      .000      .022      .000      .000   2074.50     92.07
   .009643      146.      146.      146.         6        19         0       .00     36.62    128.70


*SECNO 19.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
    19.000       .80   2076.40   2076.40       .00   2076.68       .28       .84       .02   2078.00
      59.0        .0      59.0        .0        .0      14.0        .0        .6        .9   2078.00
       .07       .00      4.23       .00      .000      .022      .000      .000   2075.60     20.60
   .008935       90.       90.       90.         3         8         0       .00     25.80     46.40
```

```
*SECNO 20.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
   20.000      .86   2077.36   2077.36      .00   2077.57      .21      .84      .01   2078.00
     59.0       .0      59.0       .0       .0      15.9       .0       .6      1.0   2078.00
      .08      .00      3.72      .00     .000      .022     .000     .000  2076.50     15.47
  .009736      90.       90.      90.        3         8        0      .00    38.10     53.57


*SECNO 21.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
   21.000      .91   2079.91   2079.91      .00   2080.14      .23     1.34      .01   2080.00
     59.0       .0      59.0       .0       .0      15.3       .0       .7      1.1   2080.00
      .09      .00      3.87      .00     .000      .022     .000     .000  2079.00     15.66
  .009420     155.      140.     120.        3         8        0      .00    33.59     49.25


*SECNO 22.000
   22.000      .82   2080.32      .00       .00   2080.39      .07      .23      .02   2081.00
     30.0       .0      30.0       .0       .0      14.3       .0       .7      1.1   2081.00
      .10      .00      2.10      .00     .000      .022     .000     .000  2079.50     19.35
  .002308      25.       45.      45.        2         0        0      .00    27.23     46.58


1
   05SEP96      11:16:07                                                                  PAGE    7


   SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        OLOSS     L-BANK ELEV
   Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA       R-BANK ELEV
   TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WTN       ELMIN     SSTA
   SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWID    ENDST


*SECNO 23.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
   23.000      .56   2081.30   2081.30      .00   2081.48      .17      .39      .03   2082.00
     30.0       .0      30.0       .0       .0       8.9       .0       .7      1.2   2082.00
      .10      .00      3.35      .00     .000      .022     .000     .000  2080.74     32.45
  .010016      93.       93.      95.       20        16        0      .00    25.58     58.03


*SECNO 24.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
   24.000      .61   2082.21   2082.21      .00   2082.40      .19      .69      .00   2083.00
     30.0       .0      30.0       .0       .0       8.7       .0       .7      1.2   2083.00
      .11      .00      3.46      .00     .000      .022     .000     .000  2081.60     30.36
  .010138      70.       68.      68.        3         8        0      .00    23.84     54.20


*SECNO 25.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
   25.000      .82   2083.52   2083.52      .00   2083.75      .23      .63      .01   2085.00
     30.0       .0      30.0       .0       .0       7.8       .0       .7      1.2   2085.00
```

.11	.00	3.82	.00	.000	.022	.000	.000	2082.70	5.81
.009324	65.	65.	70.	20	11	0	.00	17.42	23.23

1

THIS RUN EXECUTED 05SEP96 11:16:08

****
HEC-2 WATER SURFACE PROFILES

Version 4.6.2; May 1991
****

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

NAME: NAV-RR.DAT

SUMMARY PRINTOUT

	SECNO	XLCH	HL
	8.000	.00	.00
*	9.000	70.00	.07
	10.000	140.00	.73
*	11.000	120.00	.62
*	12.000	50.00	.40
*	13.000	53.00	.45
*	14.000	170.00	1.39
*	15.000	105.00	.85
*	16.000	100.00	.83
*	17.000	100.00	.81
*	18.000	146.00	1.23
*	19.000	90.00	.84
*	20.000	90.00	.84
*	21.000	140.00	1.34
	22.000	45.00	.23
*	23.000	93.00	.39

*	24.000	68.00	.69

1

	SECNO	XLCH	HL
*	25.000	65.00	.63

1

NAME: NAV-RR.DAT

SUMMARY PRINTOUT TABLE 150

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
	8.000	.00	.00	.00	2060.80	280.00	2064.36	.00	2064.46	6.84	2.54	117.92	107.04
*	9.000	70.00	.00	.00	2064.00	102.00	2065.23	2065.23	2065.70	74.77	5.52	18.48	11.80
	10.000	140.00	.00	.00	2064.00	102.00	2066.13	.00	2066.45	38.82	4.51	22.73	16.37
*	11.000	120.00	.00	.00	2066.00	91.00	2066.85	.00	2067.08	75.01	3.81	23.86	10.51
*	12.000	50.00	.00	.00	2066.30	91.00	2067.40	2067.40	2067.72	84.65	4.56	19.97	9.89
*	13.000	53.00	.00	.00	2067.00	91.00	2067.87	2067.87	2068.22	83.35	4.71	19.31	9.97
*	14.000	170.00	.00	.00	2068.60	91.00	2069.48	2069.48	2069.84	80.59	4.79	19.00	10.14
*	15.000	105.00	.00	.00	2070.70	82.00	2071.39	2071.39	2071.63	81.07	4.02	23.16	9.11
*	16.000	100.00	.00	.00	2071.50	82.00	2072.41	2072.41	2072.71	85.54	4.44	18.45	8.87
*	17.000	100.00	.00	.00	2072.30	82.00	2073.38	2073.38	2073.74	76.83	4.80	17.93	9.35
*	18.000	146.00	.00	.00	2074.50	59.00	2075.25	2075.25	2075.47	96.43	3.76	15.67	6.01
*	19.000	90.00	.00	.00	2075.60	59.00	2076.40	2076.40	2076.68	89.35	4.23	13.96	6.24
*	20.000	90.00	.00	.00	2076.50	59.00	2077.36	2077.36	2077.57	97.36	3.72	15.88	5.98
*	21.000	140.00	.00	.00	2079.00	59.00	2079.91	2079.91	2080.14	94.20	3.87	15.25	6.08
	22.000	45.00	.00	.00	2079.50	30.00	2080.32	.00	2080.39	23.08	2.10	14.27	6.25
*	23.000	93.00	.00	.00	2080.74	30.00	2081.30	2081.30	2081.48	100.16	3.35	8.95	3.00
*	24.000	68.00	.00	.00	2081.60	30.00	2082.21	2082.21	2082.40	101.38	3.46	8.67	2.98
*	25.000	65.00	.00	.00	2082.70	30.00	2083.52	2083.52	2083.75	93.24	3.82	7.85	3.11

1

NAME: NAV-RR.DAT

SUMMARY PRINTOUT TABLE 150

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
	8.000	280.00	2064.36	.00	.00	.00	112.01	.00
*	9.000	102.00	2065.23	.00	.87	.00	19.73	70.00
	10.000	102.00	2066.13	.00	.91	.00	21.41	140.00
*	11.000	91.00	2066.85	.00	.72	.00	45.27	120.00
*	12.000	91.00	2067.40	.00	.54	.00	31.73	50.00
*	13.000	91.00	2067.87	.00	.48	.00	28.75	53.00
*	14.000	91.00	2069.48	.00	1.61	.00	26.88	170.00
*	15.000	82.00	2071.39	.00	1.91	.00	55.75	105.00
*	16.000	82.00	2072.41	.00	1.02	.00	30.65	100.00
*	17.000	82.00	2073.38	.00	.98	.00	28.73	100.00
*	18.000	59.00	2075.25	.00	1.86	.00	36.62	146.00
*	19.000	59.00	2076.40	.00	1.15	.00	25.80	90.00
*	20.000	59.00	2077.36	.00	.96	.00	38.10	90.00
*	21.000	59.00	2079.91	.00	2.55	.00	33.59	140.00
	22.000	30.00	2080.32	.00	.41	.00	27.23	45.00
*	23.000	30.00	2081.30	.00	.98	.00	25.58	93.00
*	24.000	30.00	2082.21	.00	.91	.00	23.84	68.00
*	25.000	30.00	2083.52	.00	1.31	.00	17.42	65.00

1

SUMMARY OF ERRORS AND SPECIAL NOTES

```
CAUTION SECNO=     9.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=     9.000  PROFILE=  1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=     9.000  PROFILE=  1  20 TRIALS ATTEMPTED TO BALANCE WSEL

WARNING SECNO=    11.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

CAUTION SECNO=    12.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
```

```
CAUTION SECNO=     12.000  PROFILE=  1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=     12.000  PROFILE=  1  20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION SECNO=     13.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=     13.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY

CAUTION SECNO=     14.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=     14.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY

CAUTION SECNO=     15.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=     15.000  PROFILE=  1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=     15.000  PROFILE=  1  20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION SECNO=     16.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=     16.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY

CAUTION SECNO=     17.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=     17.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY

CAUTION SECNO=     18.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=     18.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY

CAUTION SECNO=     19.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=     19.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY

CAUTION SECNO=     20.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=     20.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY

CAUTION SECNO=     21.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=     21.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY

CAUTION SECNO=     23.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=     23.000  PROFILE=  1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=     23.000  PROFILE=  1  20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION SECNO=     24.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=     24.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY

CAUTION SECNO=     25.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=     25.000  PROFILE=  1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=     25.000  PROFILE=  1  20 TRIALS ATTEMPTED TO BALANCE WSEL
```

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1*****************************************
 *  HEC-2 WATER SURFACE PROFILES          *
 *                                        *
 *  Version   4.6.2;  May 1991            *
 *                                        *
 *  RUN DATE    11SEP96    TIME   08:30:46 *
 *****************************************
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*************************************
*  U.S. ARMY CORPS OF ENGINEERS
*  HYDROLOGIC ENGINEERING CENTER
*  609 SECOND STREET, SUITE D
*  DAVIS, CALIFORNIA 95616-4687
*          (916) 756-1104
*************************************
```

```
X     X  XXXXXXX   XXXXX             XXXXX
X     X  X        X     X           X     X
X     X  X        X                       X
XXXXXXX  XXXX     X         XXXXX   XXXXX
X     X  X        X                 X
X     X  X        X     X           X
X     X  XXXXXXX   XXXXX            XXXXXXX
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1
   11SEP96      08:30:46                                                                    PAGE    1
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                                                                THIS RUN EXECUTED 11SEP96    08:30:46
*************************************
 HEC-2 WATER SURFACE PROFILES

 Version   4.6.2;  May 1991
*************************************
```

```
T1 CASANDRO WASH
T2 CLOMR STUDY (FUTURE CONDITIONS)  FROM DAM SITE TO NAVAJO STREET
T3 FILE NAME: DAM-NAV.DAT

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ

     0.0        2       0.0       0.0        0        0.0       00       0.0    2085.84     0.0

J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE

      1       0.0        -1       0.0       0.0       0.0       0.0

J3  VARIABLE CODES FOR SUMMARY PRINTOUT

    150        38        39        11


NC    0.040     0.040     0.028       0.1       0.3
QT        1       275


X1       26         8        26        50
GR     2088         0      2088        25      2088        26      2084        27   2083.63        35
GR     2084        47      2088        50      2087        57
```

X1	27	8	0	32	28	38	32			
GR	2087	00	2084.5	1	2084	6	2083.8	18	2085	23
GR	2085.3	31	2088	31.25	2088	32				
X1	28	7	5	32	100	105	105			
GR	2090	0	2088	5	2086	10	2085.5	15	2086	23
GR	2086.3	30	2087.93	32						
QT	1	253								
X1	29	6	8	33	100	100	100			
GR	2090	0	2088	8	2087.7	20	2088	33	2089	38
GR	2090	39								

1

X1	31	9	85	186	85	65	75			
GR	2092	16	2091	85	2090	105	2089.5	135	2090	160
GR	2091	186	2091	287	2092	311	2092	357		
X1	33	7	65	124	210	190	200			
GR	2094	48	2094	55	2093	65	2092	75	2092	104
GR	2093	124	2094	125						
X1	35	9	43	130	250	252	252			
GR	2098	43	2097	67	2096	85	2095	95	2093.5	113
GR	2095	115	2096	120	2098	130	2098	200		
QT	1	187								
X1	36	9	30	74	120	110	110			
GR	2100	30	2098	33	2096	37	2094.6	47	2096	65
GR	2098	69	2100	74	2100	84	2100	169		
X1	37	9	30	205	150	151	151			
GR	2106	0	2104	20	2103	30	2102.5	46	2102.7	106
GR	2102.9	172	2103	205	2103.4	240	2104	268		
X1	37.5	9	24	75	23	23	23			
GR	2106	0	2104	14	2102	24	2101	28	2100.5	48
GR	2101	68	2102	75	2104	254	2106	280		
X1	38	14	98	128	75	70	65			
GR	2108	0	2106	24	2105	40	2104	51	2103	55
GR	2102.2	65	2102	98	2101.5	108	2102	128	2102	298
GR	2103	305	2104	310	2106	315	2107	320		
X1	39	7	15	60	105	235	105			

GR	2106	12	2104	15	2103	29	2103	52	2104	60
GR	2105	66	2105	83						
X1	41	13	220	260	185	205	205			
GR	2110	0	2108	4	2107	16	2107	125	2108	180
GR	2108	205	2106	220	2105	230	2104.5	245	2105	255
GR	2106	260	2108	272	2110	280				

X1	43	6	2	46	220	232	220			
GR	2112	0	2110	2	2108	5	2108	17	2110	46
GR	2112	49								
X1	44	12	51	157	60	60	60			
GR	2120	0	2118	16	2116	35	2115	51	2114	78
GR	2113.5	96	2114	134	2115	157	2116	181	2117	197
GR	2118	213	2120	243						
X1	45	10	60	190	25	25	25			
GR	2120	0	2118	15	2116	40	2114	60	2112	90
GR	2111	95	2111	115	2112	120	2114	190	2120	200
X1	46	11	42	186	112	96	100			
GR	2117	35	2116	42	2115	60	2115	104	2114.6	110
GR	2115	122	2115	129	2114.5	174	2115	182	2116	186
GR	2117	195								
QT	1	30								
X1	47	4	0	164	140	100	220			
GR	2118	0	2117	8	2117	144	2118	164		
X1	48	5	240	328	158	165	155			
GR	2120	233	2120	240	2119	283	2119	310	2120	328
X1	49	7	414	510	135	210	180			
GR	2125	408	2124	411	2123	414	2122.5	448	2123	510
GR	2124	543	2125	576						
X1	50	8	71	278	156	156	157			
GR	2130	61	2129	65	2127	71	2126	80	2126	255
GR	2127	278	2128	283	2130	288				
X1	51	7	105	170	195	212	215			
GR	2132	100	2131	105	2130	107	2130	113	2131	170
GR	2131	214	2132	255						

```
SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        OLOSS     L-BANK ELEV
Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA       R-BANK ELEV
TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WTN       ELMIN     SSTA
SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWID    ENDST


*PROF 1
0

CCHV=     .100 CEHV=     .300
*SECNO 26.000
   26.000      2.21   2085.84       .00   2085.84   2086.50       .66       .00       .00   2088.00
    275.0        .0     275.0        .0        .0      42.2        .0        .0        .0   2088.00
      .00       .00      6.52       .00      .000      .028      .000      .000   2083.63     26.54
  .007190        0.        0.        0.         0         0         0       .00     21.84     48.38


*SECNO 27.000

3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =  1.47

   27.000      2.56   2086.36       .00       .00   2086.68       .32       .15       .03   2087.00
    275.0        .0     275.0        .0        .0      60.3        .0        .0        .0   2088.00
      .00       .00      4.56       .00      .000      .028      .000      .000   2083.80       .26
  .003336       28.       32.       38.         3         0         0       .00     30.84     31.10


*SECNO 28.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
   28.000      2.12   2087.62   2087.62       .00   2088.39       .77       .57       .14   2088.00
    275.0        .0     275.0        .0        .0      39.0        .0        .2        .1   2087.93
      .01       .00      7.06       .00      .000      .028      .000      .000   2085.50      5.95
  .010582      100.      105.      105.        20        15         0       .00     25.67     31.62


*SECNO 29.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
   29.000      1.57   2089.27   2089.27       .00   2089.90       .62      1.01       .01   2088.00
    253.0       8.5     232.9      11.6       3.2      35.5       3.9        .3        .2   2088.00
      .01      2.63      6.56      2.99      .040      .028      .040      .000   2087.70      2.92
  .009559      100.      100.      100.         5        15         0       .00     35.35     38.27


*SECNO 31.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
```



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SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        OLOSS     L-BANK ELEV
Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA       R-BANK ELEV
```

TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST
31.000	1.09	2090.59	2090.59	.00	2090.93	.34	.84	.03	2091.00
253.0	.0	253.0	.0	.0	54.2	.0	.3	.3	2091.00
.01	.00	4.66	.00	.000	.028	.000	.000	2089.50	93.19
.013450	85.	75.	65.	10	19	0	.00	82.16	175.35

*SECNO 33.000

33.000	1.08	2093.08	2093.08	.00	2093.49	.41	2.54	.02	2093.00
253.0	.0	253.0	.0	.0	49.2	.0	.6	.6	2093.00
.03	.04	5.15	.04	.040	.028	.040	.000	2092.00	64.12
.012005	210.	200.	190.	6	5	0	.00	59.96	124.09

*SECNO 35.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

35.000	2.44	2095.94	2095.94	.00	2096.55	.61	2.96	.06	2098.00
253.0	.0	253.0	.0	.0	40.3	.0	.8	.9	2098.00
.04	.00	6.27	.00	.000	.028	.000	.000	2093.50	85.63
.011463	250.	252.	252.	3	20	0	.00	34.06	119.69

*SECNO 36.000

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 1.46

36.000	2.39	2096.99	.00	.00	2097.22	.22	.63	.04	2100.00
187.0	.0	187.0	.0	.0	49.3	.0	.9	.9	2100.00
.04	.00	3.79	.00	.000	.028	.000	.000	2094.60	35.02
.002942	120.	110.	110.	2	0	0	.00	31.96	66.98

*SECNO 37.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

37.000	.59	2103.09	2103.09	.00	2103.25	.16	.87	.01	2103.00
187.0	.0	186.8	.2	.0	57.8	.3	1.1	1.3	2103.00
.06	.05	3.23	.58	.040	.028	.040	.000	2102.50	29.15
.016277	150.	151.	151.	20	14	0	.00	183.31	212.46

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 37.500

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 8.98

37.500	2.75	2103.25	.00	.00	2103.28	.02	.02	.01	2102.00
187.0	1.5	158.4	27.1	3.9	119.4	70.2	1.2	1.4	2102.00
.06	.38	1.33	.39	.040	.028	.040	.000	2100.50	17.74
.000202	23.	23.	23.	2	0	0	.00	169.38	187.12

*SECNO 38.000

38.000	1.78	2103.28	.00	.00	2103.29	.01	.01	.00	2102.00
187.0	23.0	41.0	123.0	46.0	46.0	223.8	1.6	1.7	2102.00
.09	.50	.89	.55	.040	.028	.040	.000	2101.50	53.87
.000159	75.	65.	70.	2	0	0	.00	252.55	306.42

*SECNO 39.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

39.000	1.06	2104.06	2104.06	.00	2104.46	.41	.08	.12	2104.00
187.0	.0	187.0	.0	.0	36.6	.0	2.4	2.4	2104.00
.10	.04	5.11	.04	.040	.028	.040	.000	2103.00	14.91
.012251	105.	105.	235.	20	11	0	.00	45.43	60.35

*SECNO 41.000

41.000	1.55	2106.05	.00	.00	2106.38	.33	1.91	.01	2106.00
187.0	.0	187.0	.0	.0	40.8	.0	2.5	2.6	2106.00
.11	.03	4.58	.03	.040	.028	.040	.000	2104.50	219.61
.007299	185.	205.	205.	4	0	0	.00	40.70	260.31

*SECNO 43.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

43.000	1.43	2109.43	2109.43	.00	2109.91	.49	2.03	.05	2110.00
187.0	.0	187.0	.0	.0	33.4	.0	2.7	2.8	2110.00
.13	.00	5.61	.00	.000	.028	.000	.000	2108.00	2.86
.012028	220.	220.	232.	20	11	0	.00	34.80	37.67

1

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 44.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

44.000	.94	2114.44	2114.44	.00	2114.73	.28	.78	.02	2115.00
187.0	.0	187.0	.0	.0	43.8	.0	2.8	2.8	2115.00
.13	.00	4.27	.00	.000	.028	.000	.000	2113.50	66.02
.014061	60.	60.	60.	20	14	0	.00	78.18	144.20

```
*SECNO 45.000

3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO = 16.01

    45.000      3.75   2114.75       .00       .00   2114.76       .01       .00       .03   2114.00
     187.0        .4     186.5        .1       2.8     282.9        .5       2.9       2.9   2114.00
       .14       .14       .66       .13      .040      .028      .040      .000   2111.00     52.47
   .000055       25.       25.       25.         2         0         0       .00    138.79    191.26


*SECNO 46.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
    46.000       .78   2115.28   2115.28       .00   2115.48       .21       .02       .06   2116.00
     187.0        .0     187.0        .0        .0      51.2        .0       3.3       3.2   2116.00
       .15       .00      3.65       .00      .000      .028      .000      .000   2114.50     55.05
   .016041      112.      100.       96.        20        21         0       .00    128.05    183.10


*SECNO 47.000

3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =   .63

    47.000       .29   2117.29       .00       .00   2117.30       .01      1.80       .02   2118.00
      30.0        .0      30.0        .0        .0      40.6        .0       3.5       3.9   2118.00
       .23       .00       .74       .00      .000      .028      .000      .000   2117.00      5.68
   .001051      140.      220.      100.         5         0         0       .00    144.11    149.80


*SECNO 48.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
1
   11SEP96      08:30:46                                                                          PAGE    8


    SECNO      DEPTH      CWSEL      CRIWS      WSELK      EG         HV         HL         OLOSS      L-BANK ELEV
    Q          QLOB       QCH        QROB       ALOB       ACH        AROB       VOL        TWA        R-BANK ELEV
    TIME       VLOB       VCH        VROB       XNL        XNCH       XNR        WTN        ELMIN      SSTA
    SLOPE      XLOBL      XLCH       XLOBR      ITRIAL     IDC        ICONT      CORAR      TOPWID     ENDST


3720 CRITICAL DEPTH ASSUMED
    48.000       .30   2119.30   2119.30       .00   2119.42       .12       .43       .03   2120.00
      30.0        .0      30.0        .0        .0      10.8        .0       3.6       4.2   2120.00
       .25       .00      2.78       .00      .000      .028      .000      .000   2119.00    270.15
   .018545      158.      155.      165.        20         8         0       .00     45.23    315.38


*SECNO 49.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3720 CRITICAL DEPTH ASSUMED
    49.000       .35   2122.85   2122.85       .00   2122.95       .10      3.62       .00   2123.00
      30.0        .0      30.0        .0        .0      12.1        .0       3.6       4.5   2123.00
       .27       .00      2.48       .00      .000      .028      .000      .000   2122.50    423.86
   .021893      135.      180.      210.        20        11         0       .00     68.16    492.02


*SECNO 50.000
```

50.000	.10	2126.10	.00	.00	2126.14	.04	3.18	.01	2127.00
30.0	.0	30.0	.0	.0	18.6	.0	3.7	4.9	2127.00
.29	.00	1.61	.00	.000	.028	.000	.000	2126.00	79.05
.018849	156.	157.	156.	5	0	0	.00	178.37	257.42

*SECNO 51.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

51.000	.48	2130.48	2130.48	.00	2130.63	.14	3.93	.03	2131.00
30.0	.0	30.0	.0	.0	9.8	.0	3.8	5.4	2131.00
.31	.00	3.05	.00	.000	.028	.000	.000	2130.00	106.03
.017705	195.	215.	212.	3	26	0	.00	34.61	140.64

1

THIS RUN EXECUTED 11SEP96 08:30:48

****
HEC-2 WATER SURFACE PROFILES

Version 4.6.2; May 1991
****

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

NAME: DAM-NAV.DAT

SUMMARY PRINTOUT

	SECNO	XLCH	HL
	26.000	.00	.00
*	27.000	32.00	.15
*	28.000	105.00	.57
*	29.000	100.00	1.01
*	31.000	75.00	.84
	33.000	200.00	2.54
*	35.000	252.00	2.96
*	36.000	110.00	.63
*	37.000	151.00	.87
*	37.500	23.00	.02
	38.000	65.00	.01

*	39.000	105.00	.08
	41.000	205.00	1.91
*	43.000	220.00	2.03
*	44.000	60.00	.78
*	45.000	25.00	.00
*	46.000	100.00	.02

1

	SECNO	XLCH	HL
*	47.000	220.00	1.80
*	48.000	155.00	.43
*	49.000	180.00	3.62
	50.000	157.00	3.18
*	51.000	215.00	3.93

1

NAME: DAM-NAV.DAT

SUMMARY PRINTOUT TABLE 150

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
	26.000	.00	.00	.00	2083.63	275.00	2085.84	.00	2086.50	71.90	6.52	42.20	32.43
*	27.000	32.00	.00	.00	2083.80	275.00	2086.36	.00	2086.68	33.36	4.56	60.31	47.61
*	28.000	105.00	.00	.00	2085.50	275.00	2087.62	2087.62	2088.39	105.82	7.06	38.96	26.73
*	29.000	100.00	.00	.00	2087.70	253.00	2089.27	2089.27	2089.90	95.59	6.56	42.64	25.88
*	31.000	75.00	.00	.00	2089.50	253.00	2090.59	2090.59	2090.93	134.50	4.66	54.23	21.82
	33.000	200.00	.00	.00	2092.00	253.00	2093.08	2093.08	2093.49	120.05	5.15	49.21	23.09
*	35.000	252.00	.00	.00	2093.50	253.00	2095.94	2095.94	2096.55	114.63	6.27	40.33	23.63
*	36.000	110.00	.00	.00	2094.60	187.00	2096.99	.00	2097.22	29.42	3.79	49.29	34.48
*	37.000	151.00	.00	.00	2102.50	187.00	2103.09	2103.09	2103.25	162.77	3.23	58.12	14.66
*	37.500	23.00	.00	.00	2100.50	187.00	2103.25	.00	2103.28	2.02	1.33	193.53	131.56

	38.000	65.00	.00	.00	2101.50	187.00	2103.28	.00	2103.29	1.59	.89	315.86	148.09
*	39.000	105.00	.00	.00	2103.00	187.00	2104.06	2104.06	2104.46	122.51	5.11	36.61	16.89
	41.000	205.00	.00	.00	2104.50	187.00	2106.05	.00	2106.38	72.99	4.58	40.83	21.89
*	43.000	220.00	.00	.00	2108.00	187.00	2109.43	2109.43	2109.91	120.28	5.61	33.36	17.05
*	44.000	60.00	.00	.00	2113.50	187.00	2114.44	2114.44	2114.73	140.61	4.27	43.76	15.77
*	45.000	25.00	.00	.00	2111.00	187.00	2114.75	.00	2114.76	.55	.66	286.22	252.40
*	46.000	100.00	.00	.00	2114.50	187.00	2115.28	2115.28	2115.48	160.41	3.65	51.25	14.76
*	47.000	220.00	.00	.00	2117.00	30.00	2117.29	.00	2117.30	10.51	.74	40.59	9.25
*	48.000	155.00	.00	.00	2119.00	30.00	2119.30	2119.30	2119.42	185.45	2.78	10.79	2.20
*	49.000	180.00	.00	.00	2122.50	30.00	2122.85	2122.85	2122.95	218.93	2.48	12.10	2.03
	50.000	157.00	.00	.00	2126.00	30.00	2126.10	.00	2126.14	188.49	1.61	18.59	2.19
*	51.000	215.00	.00	.00	2130.00	30.00	2130.48	2130.48	2130.63	177.05	3.05	9.84	2.25

1

NAME: DAM-NAV.DAT

SUMMARY PRINTOUT TABLE 150

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
	26.000	275.00	2085.84	.00	.00	.00	21.84	.00
*	27.000	275.00	2086.36	.00	.52	.00	30.84	32.00
*	28.000	275.00	2087.62	.00	1.26	.00	25.67	105.00
*	29.000	253.00	2089.27	.00	1.65	.00	35.35	100.00
*	31.000	253.00	2090.59	.00	1.32	.00	82.16	75.00
	33.000	253.00	2093.08	.00	2.49	.00	59.96	200.00
*	35.000	253.00	2095.94	.00	2.86	.00	34.06	252.00
*	36.000	187.00	2096.99	.00	1.06	.00	31.96	110.00
*	37.000	187.00	2103.09	.00	6.09	.00	183.31	151.00
*	37.500	187.00	2103.25	.00	.17	.00	169.38	23.00
	38.000	187.00	2103.28	.00	.03	.00	252.55	65.00
*	39.000	187.00	2104.06	.00	.77	.00	45.43	105.00
	41.000	187.00	2106.05	.00	1.99	.00	40.70	205.00

*	43.000	187.00	2109.43	.00	3.37	.00	34.80	220.00
*	44.000	187.00	2114.44	.00	5.02	.00	78.18	60.00
*	45.000	187.00	2114.75	.00	.31	.00	138.79	25.00
*	46.000	187.00	2115.28	.00	.52	.00	128.05	100.00
*	47.000	30.00	2117.29	.00	2.01	.00	144.11	220.00
*	48.000	30.00	2119.30	.00	2.01	.00	45.23	155.00
*	49.000	30.00	2122.85	.00	3.56	.00	68.16	180.00
	50.000	30.00	2126.10	.00	3.25	.00	178.37	157.00
*	51.000	30.00	2130.48	.00	4.38	.00	34.61	215.00

1

SUMMARY OF ERRORS AND SPECIAL NOTES

```
WARNING SECNO=    27.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

CAUTION SECNO=    28.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=    28.000  PROFILE=  1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=    28.000  PROFILE=  1  20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION SECNO=    29.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=    29.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY

CAUTION SECNO=    31.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=    31.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY

CAUTION SECNO=    35.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=    35.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY

WARNING SECNO=    36.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

CAUTION SECNO=    37.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=    37.000  PROFILE=  1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=    37.000  PROFILE=  1  20 TRIALS ATTEMPTED TO BALANCE WSEL

WARNING SECNO=    37.500  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

CAUTION SECNO=    39.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=    39.000  PROFILE=  1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=    39.000  PROFILE=  1  20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION SECNO=    43.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=    43.000  PROFILE=  1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=    43.000  PROFILE=  1  20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION SECNO=    44.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
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CAUTION SECNO=     44.000  PROFILE=  1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=     44.000  PROFILE=  1  20 TRIALS ATTEMPTED TO BALANCE WSEL

WARNING SECNO=     45.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

CAUTION SECNO=     46.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=     46.000  PROFILE=  1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=     46.000  PROFILE=  1  20 TRIALS ATTEMPTED TO BALANCE WSEL

WARNING SECNO=     47.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

CAUTION SECNO=     48.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=     48.000  PROFILE=  1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=     48.000  PROFILE=  1  20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION SECNO=     49.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=     49.000  PROFILE=  1  20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION SECNO=     51.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
1
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CAUTION SECNO=     51.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY
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Appendix C: Hydrologic and Hydraulic Calculations.

Local flow for each sub-basin.

CP #	DIS1	DIS2	CH2	WAMD	MCHP	MCHD
230	950	950	1078	751	714	714
235	493	493	532	469	386	386
230A						77
240A	209	209	275		236	236
240B	188	188			172	172
240C	69	69			67	67
240D	97	97		(594*)	73	73
240E	52	52			43	43
240F	25	25			26	26
240G	25	25			10	10
240H	25	25			15	15
240I	204	204			182	182
240J					17	17

Kb values

CP #	DIS 1&2	CH2	WAMD	MCH P&D
230	NR	0.038	0.03	0.0430
235	NR	0.044	0.03	0.0530
230A				0.06
240A	0.052	0.051		0.0530
240B	0.051			0.0540
240C	0.04			0.0570
240D	0.04		(0.03*)	0.0620
240E	0.034			0.0620
240F	0.034			0.0620
240G	0.043			0.0670
240H	0.043			0.0730
240I	0.033			0.0700
240J				0.0680

Regional Flow at each concentration pt

CP #	DIS1	DIS2	CH2	WAMD	MCHP	MCHD
Confluence	1396	1396	1552	1074	1149	1149
damin	1576	1576	1769	811	1261	1265
damout	0	0	118		1261	30
240B	188	188	(118*)		1394	187
240C	246	246			1432	253
240D	317	317			1464	305
240E	350	69			1480	63
240F	370	86			1488	85
240G	390	106			1491	94
240H	404	125			1493	105
240I	587	328			1606	281
240j						406
FINAL	587	328	118	811	1124	475

Initial Abstraction Values

CP #	DIS 1&2	CH2	WAMD	MCH P&D
230	0.14	0.1	0.14	0.26
235	0.14	0.1	0.14	0.24
230A				0.28
240A	0.34	0.1		0.29
240B	0.32			0.29
240C	0.18			0.23
240D	0.16		(0.14*)	0.23
240E	0.11			0.23
240F	0.1			0.25
240G	0.15			0.25
240H	0.15			0.25
240I	0.14			0.25
240J				0.25

COMPARISON OF HEC-1 DAM MODELS: MARICOPA COUNTY PREOUTFALL (DIS1), MARICOPA COUNTY POST OUTFALL (DIS2),CH2M-HILL'S DAM CONSTRUCTION (CH2), WICKENBURG AREA DRAINAGE MASTER STUDY (WADM), CURRENT STUDY PREDEVELOPED (MCHP), CURRENT STUDY POST DEVELOPMENT (MCHD)

Percent Impervious

CP #	DIS 1&2	CH2	WAMD	MCH P&D
230	6.7	35	6.7	30
235	10.1	36	10.1	30
240A				30
240A	45	21		20
240B	39			18
240C	52			38
240D	52			35
240E	54		(8.0*)	38
240F	45			30
240G	45			30
240H	45			30
240I	45			30
240J				30

Wetting Front Suction

CP #	DIS 1&2	CH2	WAMD	MCH P&D
230	6.96	5.2	4.02	5.1
235	6.96	6.2	3.72	6.2
230A				6.4
240A	6.96	6.4		6.4
240B	6.96			6.2
240C	6.96			6.4
240D	6.96			6.4
240E	6.96		(3.77*)	6.4
240F	6.96			6.4
240G	6.96			6.4
240H	6.96			6.4
240I	6.96			6.4
240J				6.4

DTHETA

CP #	DIS 1&2	CH2	WAMD	MCH P&D
230	0.21	0.25	0.34	0.25
235	0.34	0.23	0.31	0.25
230A				0.21
240A	0.21	0.21		0.21
240B	0.21			0.21
240C	0.21			0.21
240D	0.21			0.21
240E	0.21		(.32*)	0.21
240F	0.21			0.21
240G	0.21			0.21
240H	0.21			0.21
240I	0.21			0.21
240j				0.21

XKSAT

CP #	DIS 1&2	CH2	WAMD	MCH P&D
230	0.13	0.24	0.35	0.33
235	0.13	0.15	0.29	0.21
230A				0.19
240A	0.13	0.14		0.19
240B	0.13			0.19
240C	0.13			0.19
240D	0.13			0.19
240E	0.13		(.30*)	0.19
240F	0.13			0.19
240G	0.13			0.19
240H	0.13			0.19
240I	0.13			0.19
240J				0.19

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Project Casandro Wash CLOMR

Job No. 3060.2 Sht. 1 of
Calc. MCH Chk. B'chk.
Date 6-13-96 Date Date

Precipitation

From MCFCD Hydrology Manual

Isopluvial maps fig 2.1-2.13

112°47' - 42
33° 57'

Year	Duration	Map value (1/10 inch)	Linearly Adjusted (Fig. 2.14)
2	6	13.5	1.4
5	6	18.5	1.8
10	6	22.6	2.2
25	6	26.4	2.75
50	6	32.0	3.2
100	6	33.3	3.4

- Depth Area Reduction
  For 1.60 mile² watershed
  from table 2.2 DDM
  1 mile² = 0.987 } linearly interpolate
  5 mile² = 0.96 }

  1.6 mile² = .98 reduction factor

- Rain Pattern [illegible] Figure 2.17 DDM
  1.6 mile² ≈ 2
  Pattern = 1.80 [illegible]

- Used [illegible] to determine Distribution of Rainfall
  [illegible] 6 hour storm which is [illegible] Table 7.4 DDM

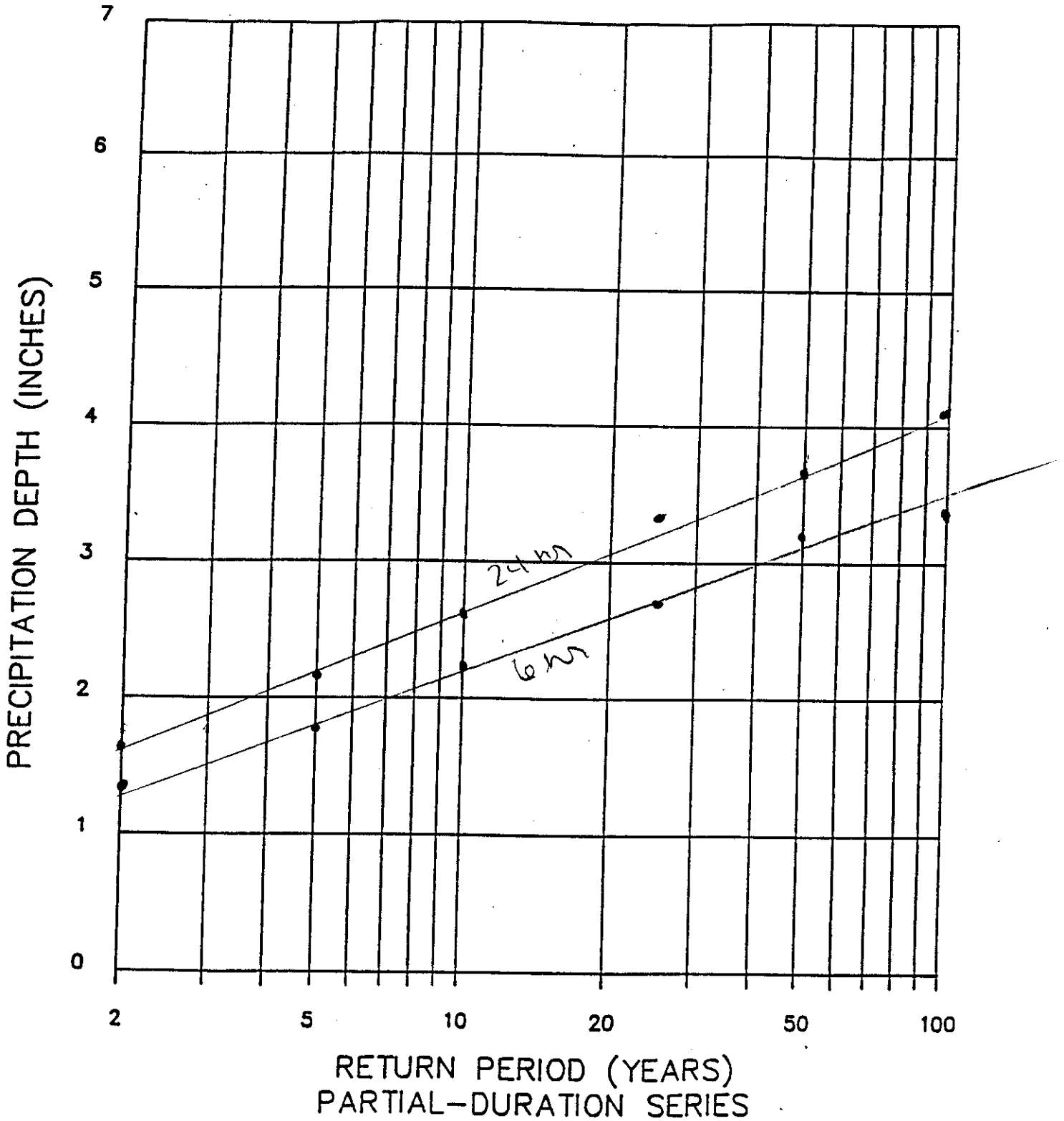

Figure 2.14
Precipitation Depth versus Return Period for Partial-Duration Series

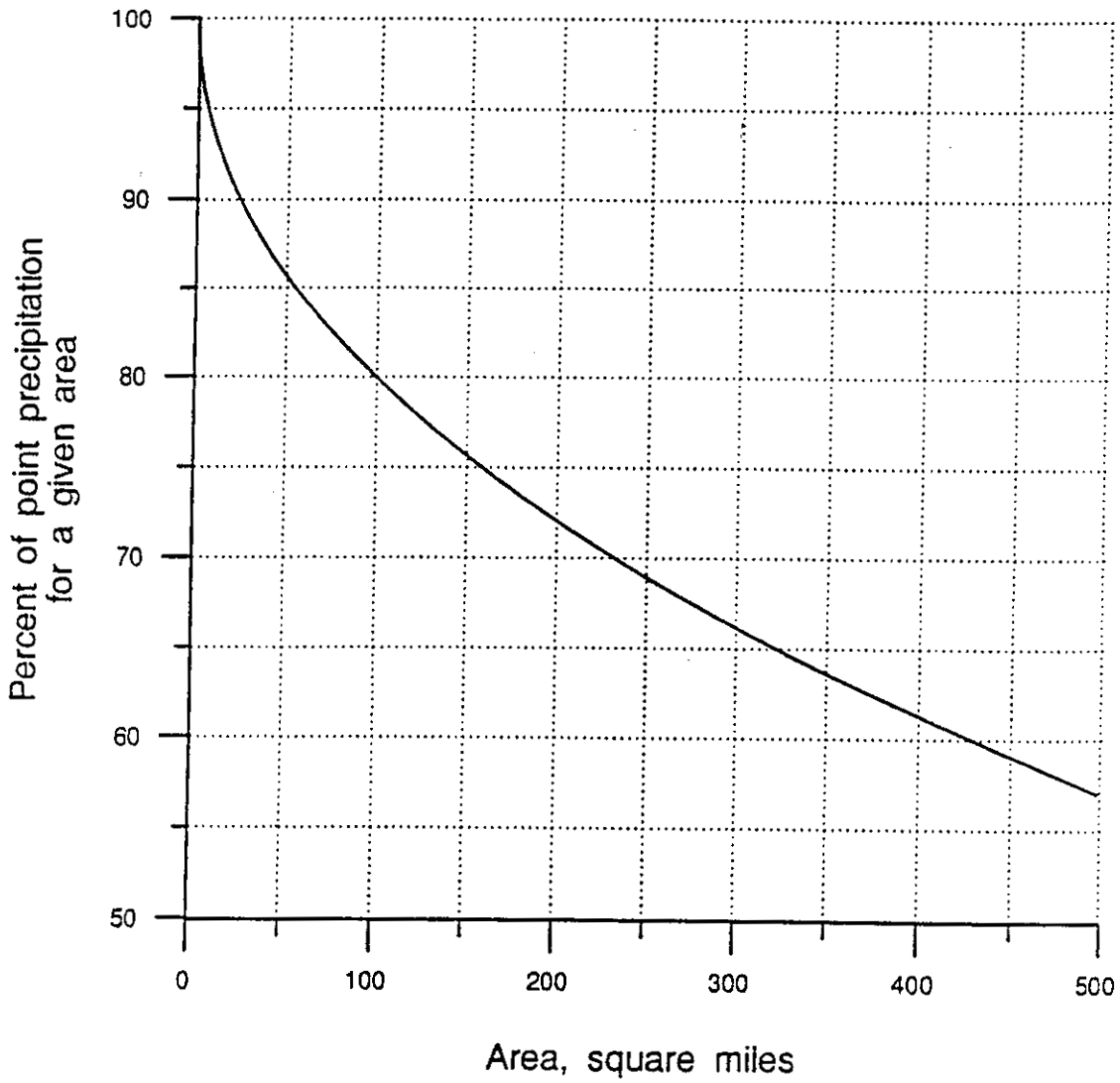

Figure 2.14
Depth-Area Curve for Maricopa County 6-hour Storm

Table 2.2
Depth-Area Reduction Factors
for 6-Hour Duration Rainfall

Area, Square Miles	Ratio to Point of Rainfall
0	1.0
1	0.987
5	0.96
10	0.94
20	0.91
30	0.89
40	0.87
50	0.86
100	0.80
200	0.72
300	0.66
400	0.61
500	0.57

Use the depth-area reduction values from Figure 2.14 or Table 2.2 to correct the 6-hour point rainfall depth from the isopluvial maps (Figures 2.2 through 2.7) for all flood studies in which the 6-hour local storm is the design rainfall criteria (see Table 2.1).

If the flood study is for the design of a retention/detention facility for a small drainage area and the design rainfall criteria is the 100-year, 2-hour storm, then the point rainfall depths from Figure 2.1 are not to be reduced for area. This is because local retention/detention basins will be provided only for very small drainage areas and the point rainfall from Figure 2.1 is representative of the equivalent uniform depth of rainfall over the entire contributing area.

If a general storm is the accepted design rainfall criteria (as opposed to the 6-hour local storm as defined in this manual), then the appropriate depth-area reduction curve will need to be defined to correspond with the rainfall duration and the temporal distribution of the general storm. Usually the general storm for use in Maricopa County is the SCS Type II 24-hour design rainfall. Areal reductions for point rainfall for this 24-hour storm should be performed using Table 2.1a. The data for Table 2.1a have been taken from Figure 15 of the NWS HYDRO-40 (Zehr and Myers, 1984). For other general storms, the depth-area reduction and temporal distribution will need to be performed on a case-by-case basis depending on the purpose of the study, location of the watershed, and other meteorological and hydrological factors.

2.3.1 Procedure for Depth-Area Adjustment

The following procedure is to be used with the 6-hour local storm rainfall depths (Figures 2.2 through 2.7):

1. Determine the size of the drainage area.

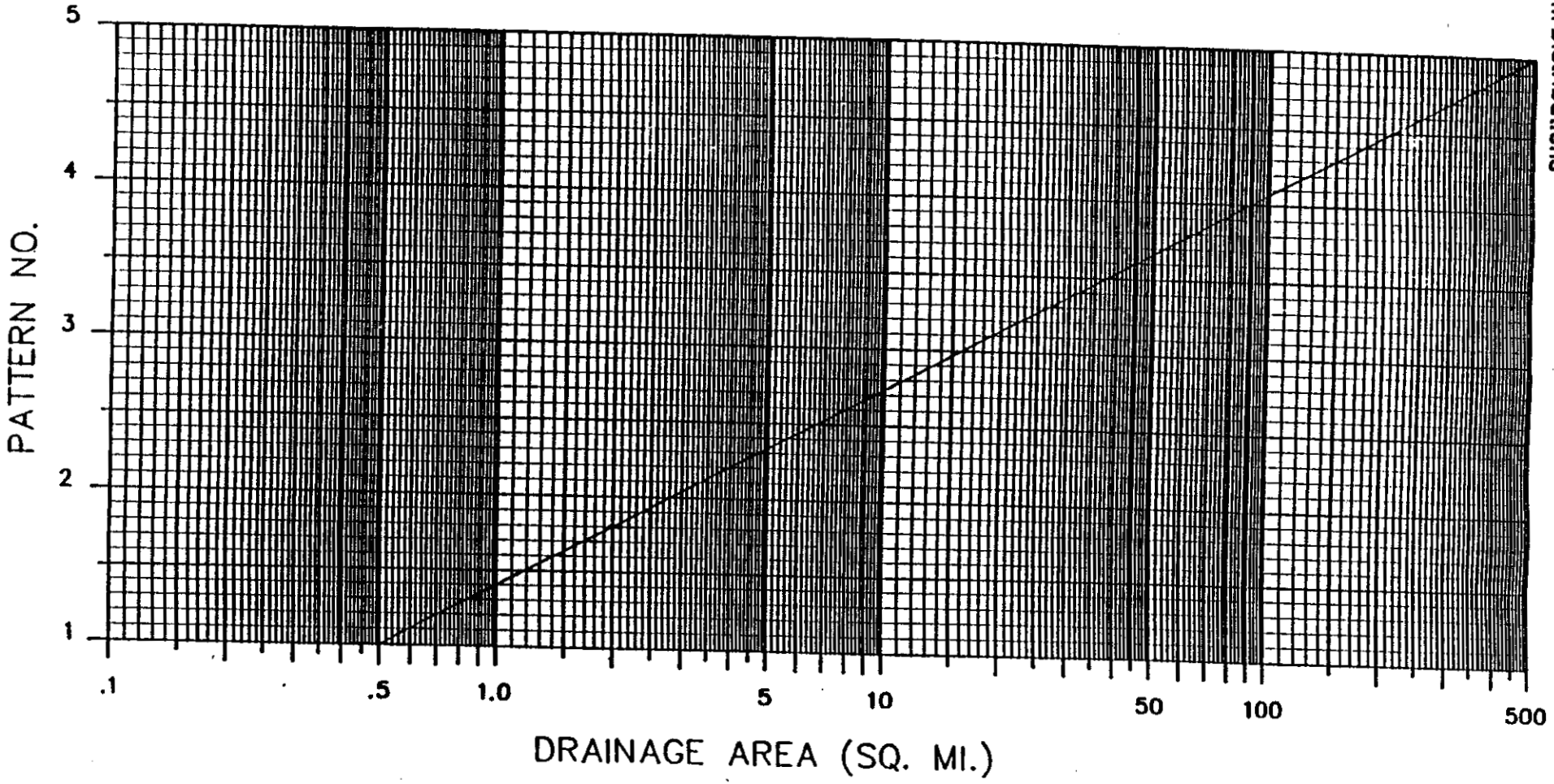

Figure 2.17
Area Versus Pattern Number for Maricopa County

Table 2.4
6-Hour Distributions*

Time (hrs)	Pattern 1	Pattern 2	Pattern 3	Pattern 4	Pattern 5
0:00	0.0	0.0	0.0	0.0	0.0
0:15	0.8	0.9	1.5	2.1	2.4
0:30	1.6	1.6	2.0	3.5	4.3
0:45	2.5	2.5	3.0	5.1	5.9
1:00	3.3	3.4	4.8	7.1	7.8
1:15	4.1	4.2	6.3	8.7	9.8
1:30	5.0	5.1	7.6	10.5	11.9
1:45	5.8	5.9	9.0	12.5	14.1
2:00	6.6	6.7	10.5	14.3	16.2
2:15	7.4	7.6	11.9	16.0	18.6
2:30	8.7	8.7	13.5	17.9	21.2
2:45	9.9	10.0	15.2	20.1	23.9
3:00	11.8	12.0	17.5	23.2	27.1
3:15	13.8	16.3	22.2	28.1	32.1
3:30	21.6	25.2	30.4	36.4	40.8
3:45	37.7	45.1	47.2	50.0	51.5
4:00	83.4	69.4	67.0	65.8	62.7
4:15	91.1	83.7	79.6	77.3	73.5
4:30	93.1	90.0	86.8	84.1	81.4
4:45	95.0	93.8	91.2	88.8	86.4
5:00	96.2	95.0	94.6	92.7	90.7
5:15	97.2	96.3	96.0	94.5	93.0
5:30	98.3	97.5	97.3	96.4	95.4
5:45	99.1	98.8	98.7	98.2	97.7
6:00	100.0	100.0	100.0	100.0	100.0

*Pattern represents percent Rainfall Depth.

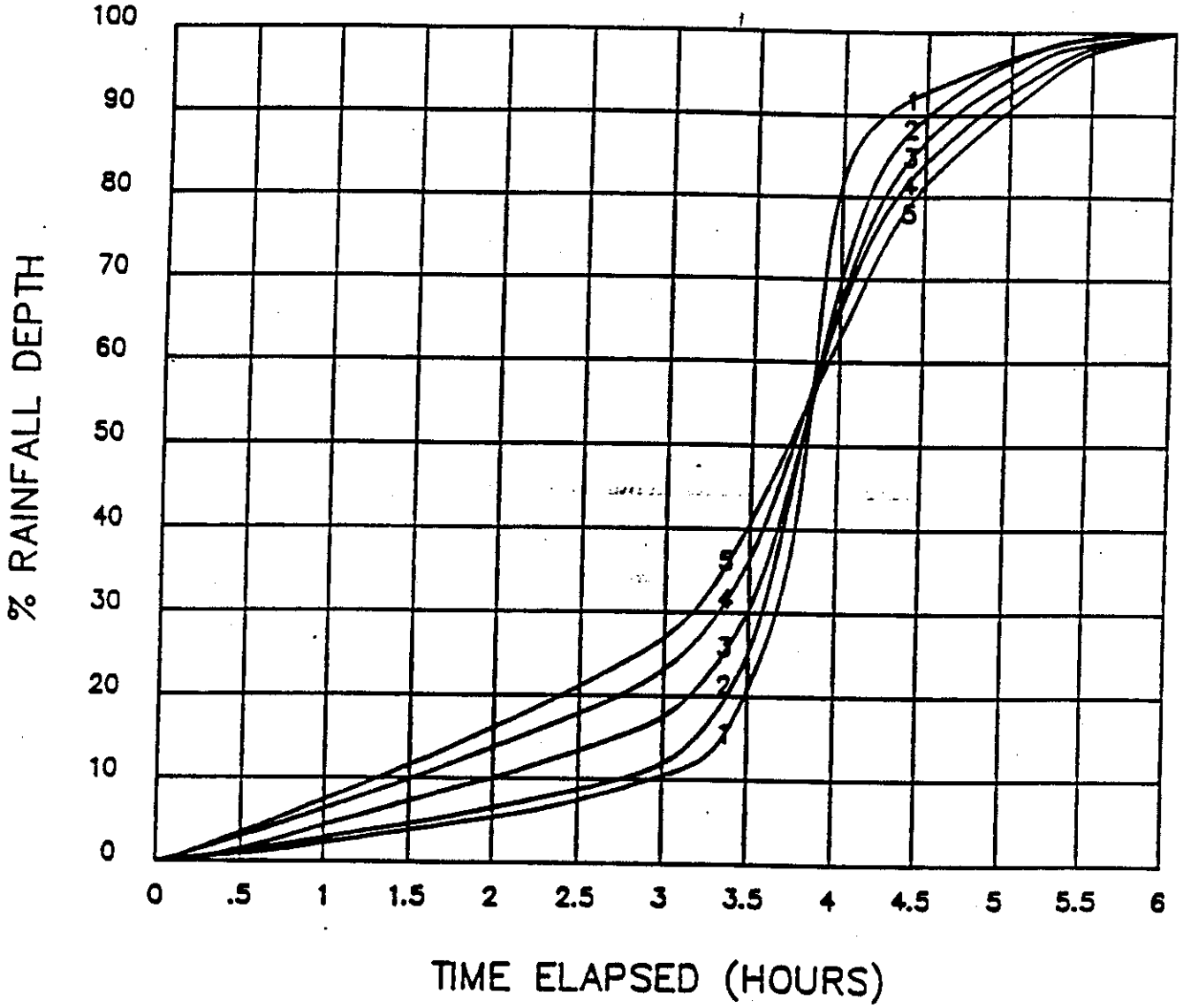

Figure 2.16
6-Hour Mass Curves for Maricopa County

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Project Casa Grande Wash CLOMR

Job No. 3660.2 Sht. 2 of
Calc. MCH Chk. B'chk.
Date 6-13-96 Date Date

Losses

- Soil Classifications

- From Soil Survey Aguila-Carefree Area, Parts of Maricopa and Pinal Counties, AZ (USDA, SCS, 1986)

From Drainage Planning & Watershed Delineation Map from Soil Survey

Subbasin 230 total area = 438

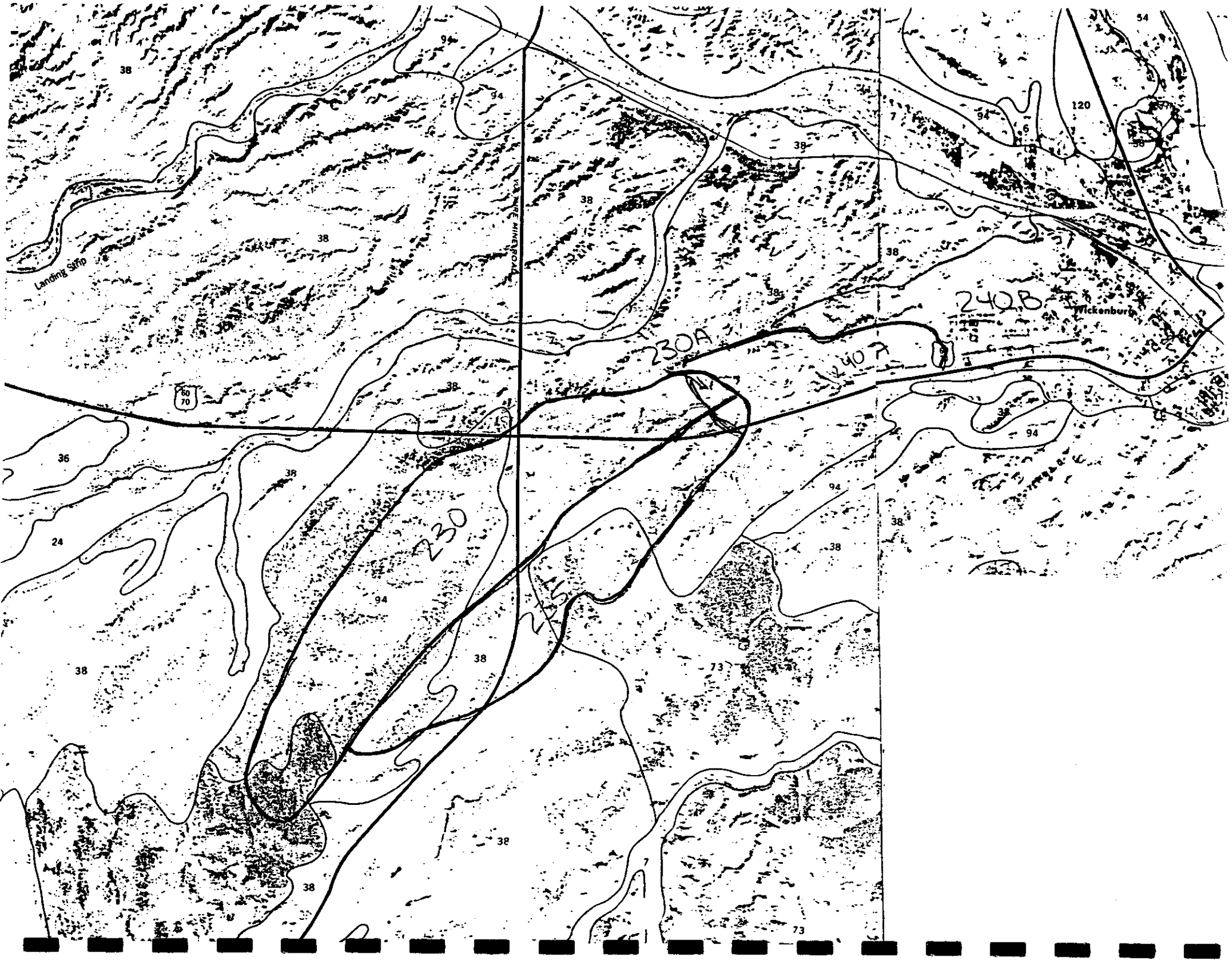
Soil Classification	Area (Acres)	Percentage	Adj
94	259	59.0	59.5
73	30	6.9	6.6
38	154	35.1	34.6
	443 acres	101.0	

Subbasin 235 total area = 247 acres

Soil Classification	Area (Acres)	Percentage	Adj
94	44	17.8	17.7
73	55	22.2	22
38	150	60.7	60.3
	249 acre	100.7	

230A
240A
240B
240C
240D
240E
240F
240G
240H
240I - 240L

100% SC 38


Landing Strip
Wickenburg
230
230A
240A
240B
60
70
38
94
36
24
120
54
73

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Project CLOMR Casandro Wash

Job No. 3600.2 Sht. 3 of
Calc. MLH Chk. B'chk.
Date 6-17-96 Date Date

Land Use Zoning

Sub-basin 230 Plan/Profile of From Wickenburg General Plan
total area = 438 acres

Land Use	Acres	Classification
Rural Residential	224.3	Low Dens Res
Low Density Residential	44	Low Den Res
Medium Dens Residential	50.2	mid dens Res
Park/Open Space	Ø	Park
Public/Semi-Public	14	Desert
Major Street Commercial	50.4	Commercial
High Density Residential	55.6	High dens Res

SubBasin 235 From Wickenburg General Plan
total area = 242 acres

Land Use	Acres	Classification
Rural Residential	28	low Dens Res
Low Density Res	48	low Dens Res
Medium Dens Res	54	Mid Dens Res
High Dens Res	—	High Dens Res
Park/Open Space	52.1	Park
Public/Semi Public	27	Desert
Major Street Comm	38	Comm

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Project Cascadia Wash CLOMR

Job No. 3660.2 Sht. 4 of
Calc. MH Chk. B'chk.
Date 6-17-96 Date Date

From Wickenburg Gen Plan

Subbasin 230-A A= 27.5 acres

Land Use	Area (Acres)	Classification
Low Dens Res	13.8	Low Dens Res
High Dens Res	13.8	High Dens Res

Subbasin 240-A From: Cascadia Wash Watershed Below the Proposed Dam, Land Use from Natural Subbasin, Maricopa County FCD
A= 79 acres

Land Use	Area	Classification
R1-35	51.25	Low Dens Res
R1-12	18.4	Low Dens Res
C-3	4.68	Commercial
RM-1	3.67	High Dens Res

Subbasin 240B From same as above
A= 71 acres

Land Use	Area	Classification
R1-35	34.3	Low Dens Res
R1-12	32.1	Low Dens Res
C-3	2.02	Commercial
RM-1	2.30	High Dens Res

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Project Casandro Wash CLOMR

Job No. 36160.2 Sht. 5 of
Calc. MCH Chk. B'chk.
Date 6-17-96 Date Date

Subbasin 240C

A = 23 acres

Land Use	Acres	Classification
C-3	3.5	Commercial
R1-6	19.54	Med Dens Res

Subbasin 240D

A = 23.7 acres

Land Use	Acres	Classification
C-3	2.78	Comm
R1-6	20.9	Med Den Res

240 E

A = 13.4 acres

Land Use	Acres	Class
RM-1	2.16	High Dens Res
R1-6	9.2	Medium Res
C-3	1.5	Commercial

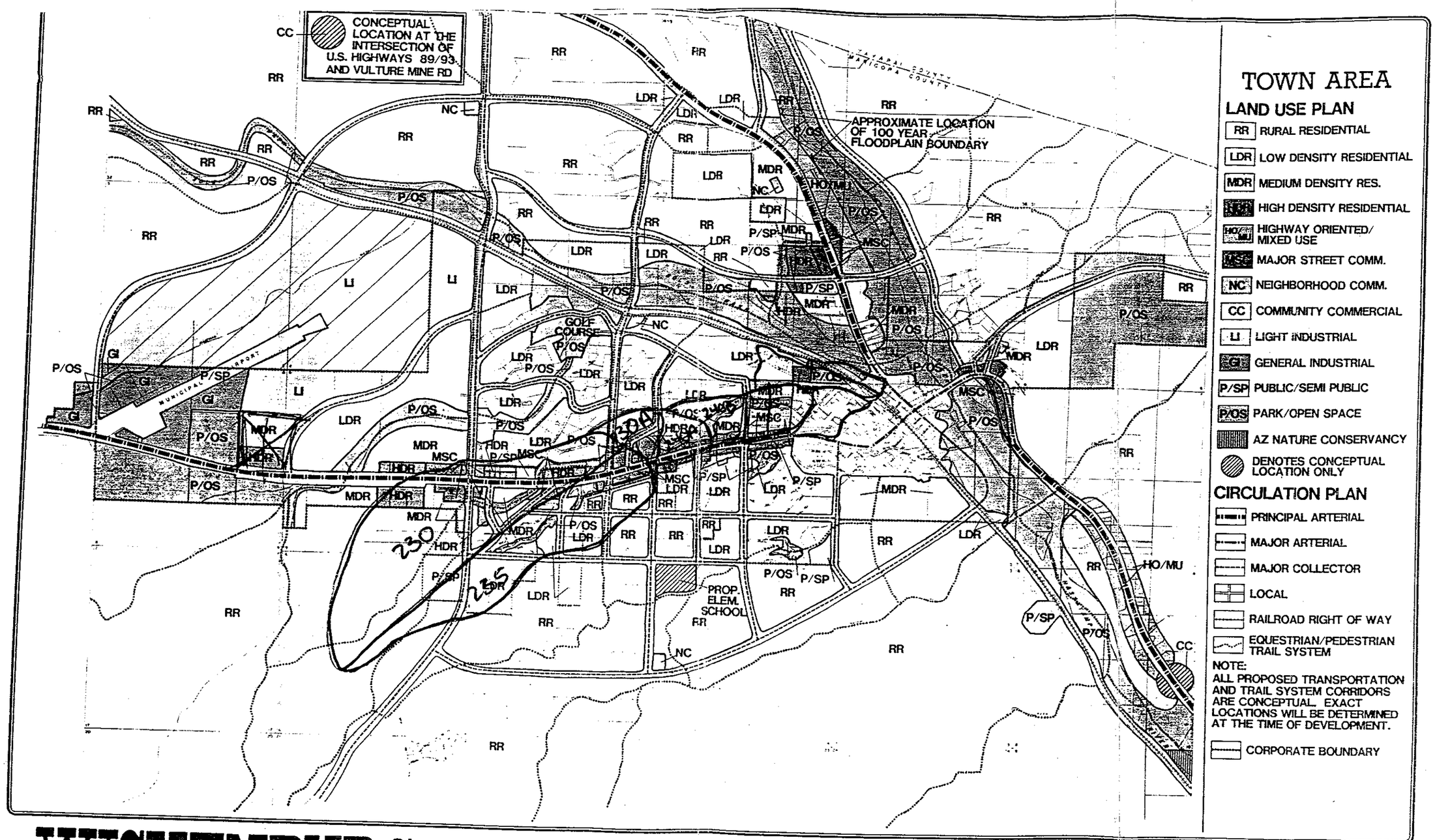
240 F - 240H, 240J

R1-6 is 100% → medium dens Res

240 I

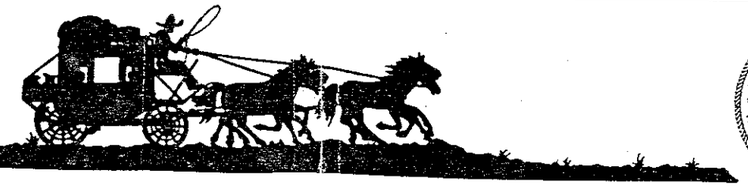
A = 67.2 acres

RM1	20.8	high dens res
R1-35	25.6	low dens res
R1-6	20.7	Med Dens Res



WICKENBURG GENERAL PLAN

Town of Wickenburg, Arizona



WICKENBURG, ARIZONA — INCORPORATED JUNE 18TH 1909

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BRW, INC 2700 N CENTRAL SUITE 1000 PHOENIX ARIZONA 85004

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Consulting Engineers, Inc.

Cascado Wash Channel

Job No. 3600.2 Sht. 6 of
Calc. MCH Chk. Sheet
Date 6-17-96 Date Date

- IA, RTIMP and Vg Cover

$$\overline{IA} = \frac{\sum IA_i \cdot A_i}{A_T} \qquad \overline{RTIMP} = \frac{\sum RTIMP_i \cdot A_i}{A_T}$$

$$\overline{V_g\ Cov} = \frac{\sum V_g\ Cov_i \cdot A_i}{A_T}$$

230 Vg Cover = table 4.2a

$$\overline{IA} = \frac{\sum (.3 \cdot 268.3) + (.25 \cdot 50.2) + (.25 \cdot 55.6) + (.10 \cdot 50.4) + (.50 \cdot .4)}{438}$$

$= .26$ in

$$\overline{RTIMP} = \frac{\sum (.15 \cdot 268.3) + (.25 \cdot 50.2) + (.45 \cdot 55.6) + (.20 \cdot 50.4) + (.50 \cdot .4)}{438}$$

$= .28$

+ Because soil type is a 30% impervious its .06 + .02

.02 + .06 = .02 impervious

.28 + .02 = .30 impervious

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FAX (520) 884-5278

Job No. [illegible] Sht. 6 of
Subject [illegible] CLOUD
Date MKH Chk. Sheet
Date 6-17-96 Date Date

Veg Cover = $\frac{[illegible] (.50 \cdot [illegible] - [illegible] \cdot 502) + (50 \cdot [illegible]) + (.75 \cdot 5[illegible]) + (.50 \cdot [illegible]}{436}$

= .54 + 1-RT [illegible] .54

Soil [illegible] 235-247

[illegible] 235 RT[illegible]

Soil [illegible] 30 [illegible]

[illegible] $\frac{65}{247}$ [illegible] .23 x .30 = .067

[illegible] .72 + [illegible] = .79 [illegible]

No [illegible] adjustments for rock outcrops

Table 4.2a IA, RTIMP, and Percent Vegetation Cover for Representative Land Uses in Maricopa County

Land Use Category	IA (inches)	RTIMP ** (percent)	Percent ** Veg. Cover	Gilbert Zoning Unit	Gilbert Description	Chandler Zoning Unit	Chandler Description	Mesa Zoning Unit	Mesa Description	Tempe Zoning Unit	Tempe Description	County Zoning Unit	County Description	Phoenix Zoning Unit	Phoenix Description
Agriculture	0.5*	0*	85*	AG	Agriculture	AG-1	Agriculture	AG	Agriculture	AG	Agriculture				
Very Low Density Residential	0.3*	5*	30*					R1-90	Single Residence			RURAL-190	190,000 sq. ft./dwelling unit	S-1	Ranch or Farm Residential. > 1 ac
								SR	Suburban Ranch			RURAL-70	70,000 sq. ft./dwelling unit	S-2	Ranch or Farm Commercial
				R1-43	Rural							RURAL-43	one acre/dwelling unit	RE-43	Single Family, 1 acre minimum
Low Density Residential	0.3*	15*	50*	R1-35	Rural Residential	SF-33	Single Family	R1-35	Single Residence			R1-35	Single Family Residential, 35,000 sq. ft./dwelling unit	RE-35	SF, 35,000 sq.ft min.
				R1-20	SF, Residential	SF-18	Single Family							RE-24	SF, 24,000 sq.ft min.
				R1-15	" "			R1-15	Single Residence	R1-15	One Family Residential	R1-18	SFR, 18,000 sq. ft./unit	R1-18	SF, 18,000 sq.ft min.
Medium Density Residential	0.25*	30*	50*	R1-10	" "	SF-10	Single Family	R1-9	Single Residence	R1-10	One Family Residential			R1-14	SF, 14,000 sq.ft min.
				R1-8	" "					R1-8	One Family Residential	R1-10	SFR, 10,000 sq. ft./unit	R1-10	SF, 10,000 sq.ft min.
				R1-7	" "	SF-7	Single Family	R1-7	Single Residence	R1-7	One Family Residential	R1-8	SFR, 8,000 sq. ft./unit	R1-8	SF, 8,000 sq.ft min.
								R1-6	Single Residence	R1-6	One Family Residential	R1-6	SFR, 6,000 sq. ft./unit	R1-6	SF, 6,000 sq.ft min.
Multiple Family Residential	0.25*	45*	50*					TCR-1	Town Center, Single Family	RO	Residence/Office			R-O	Res. Office
				R-2	Duplex	MF-1	Medium Density	R-2	Restricted Multiple Resid.	R-2	Multi-Family Residential	R-2	2 Family Residence	R-2	MF, 4,000 sq.ft./unit
				R-3	Multi-Family, Apartments	MF-2	Multi-Family	R-3	Limited Multiple Resid.	R-3R	Multi-Family Restricted	R-3	Multiple Family, Residential	R-3	MF, 3,000 sq.ft./unit
				R-4	Multi-Family, General	MF-3	High Density	R-4	General Multiple Resid.	R-3	Multi-Family Limited	R-4	Multiple Family, Residential	R-4	MF, 1,500 sq.ft./unit
				R-5	Townhouse Residential					R-4	Multi-Family General	R-5	Multiple Family, Residential	R-4A	MF, 1,000 sq.ft./unit
										R-Th	Townhouse			R-5	MF, 1,000 sq.ft./unit
				MH	Mobile Home	MH-1	Mobile Homes	TCR-2	TC, Restricted Multi-Res.	RMH	Mobile Home Residence	MHR	Manufactured Housing, Resid.	CP/BP	Business Park
				CTP	Commercial Trailer Park			TCR-3	TC, General Res.	MHS	Manufactured Housing Subd.			R-H	Resort District
										TP	Trailer Park				
Industrial	0.15*	55*	60*	I-1	Garden Type Industrial			M-1	Limited Industrial	I-1	Light Industrial			IND PARK	Industrial Park
				I-2	Light Industrial	I-1	Light Industrial			I-2	General Industrial	I-2	Light Industrial	A-1	Light Industrial
				I-3	General Industrial	I-2	General Industrial	M-2	General Industrial	I-3	Heavy Industrial	I-3	Heavy Industrial	A-2	Heavy Industrial
Commercial	0.1*	80*	75*	C-1	Light Commercial	C-1	Neighborhood Commercial	C-1	Neighborhood Comm.	CCR	Convenience Commercial	C-1	Neighborhood Commercial	C-1	Neighborhood Commercial
				C-2	General Commercial	C-2	Community Commercial	C-2	Limited Comm.	C-1	Neighborhood Commercial	C-2	Intermediate Commercial	C-2	Intermediate Commercial
				C-3	Central Commercial	C-3	Regional Commercial	C-3	General Comm.	C-2	General Commercial	C-3	General Commercial	C-3	General Commercial
				RS	Residential Services			OS	Office-Sercives	CCD	Central Comm. District	C-O	Commercial Office	C-O	Commercial Office
				RCC	Residential Conveniences			TCC	TC,High Intensity Mixed Use					HR	High Rise District
								TCB-1	TC, Limited Comm./General Manufacturing						
								TCB-2	TC, General Comm./ Light Manufacturing						
				MISCELLANEOUS CATEGORIES: These zoning units should be evaluated on a case by case basis.											
				PAD	Planned Area Development	PAD	Planned Area Development			S	Private School	PD	Planned Development Overlay	PAD	Planned Area Development
				PSC-1	Planned Neighborhood Shopping										
				PSC-2	Planned Shopping Center							CS	Planned Shopping Center	PSC	Planned Shopping Center
				IB	Industrial Buffer										
						PCO	Planned C Offices	PEP	Planned Employment Park						
								PF	Public Facilities						
												SU	Special Uses		
												SC	Senior Citizen Overlay	PCD	Planned Community Development
												NUP	Neighborhood Plan of Development		
												RUP	Residential Plan of Development		
												IUP	Industrial Plan of Development		
														R.O.W.	Right of Way
														P-1	Parking, Open
														P-2	Parking, Structures
														D.G	Dwelling Group

NOTES

* These values have been selected to fit many typical settings in Maricopa County. However, the engineer/hydrologist should ALWAYS evaluate the specific circumstances in any particular watershed for hydrological variations from these typical values.

** RTIMP = Percent Effective Impervious Area, Including R.O.W.

** Percent Veg. Cover = Percent vegetation cover for pervious area only

Sub	Tot Area	LDR	MDR	HDR	COMM	IND	PARK	DESERT	IA	RTIMP	VEG COV	ck	(xks		(xksat)adj
230	438	268.3	50	55	50.4			14	0.266393	0.274692	0.520434	1.467149		0.22	0.322773
235	247.1	76	54		38		52.1	27	0.242695	0.234723	0.595467	1.550519		0.14	0.217073
230A	27.6	13.8		13.8					0.275	0.3	0.5	1.444444		0.13	0.187778
240A	78	69.65		3.67	4.68				0.285647	0.203115	0.515	1.461111		0.13	0.189944
240B	70.72	66.4		2.3	2.02				0.292661	0.178323	0.507141	1.452379		0.13	0.188809
240C	23.04		19.54		3.5				0.227214	0.375955	0.537977	1.486642		0.13	0.193263
240D	23.68		20.9		2.78				0.23239	0.358699	0.52935	1.477055		0.13	0.192017
240E	13.3		9.2	2.6	1.5				0.233083	0.385714	0.528195	1.475773		0.13	0.19185
240F	8		8						0.25	0.3	0.5	1.444444		0.13	0.187778
240G	3.45		3.45						0.25	0.3	0.5	1.444444		0.13	0.187778
240H	4.38		4.38						0.25	0.3	0.5	1.444444		0.13	0.187778
240I	67.2		67.2						0.25	0.3	0.5	1.444444		0.13	0.187778
240J	8		8						0.25	0.3	0.5	1.444444		0.13	0.187778

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Job No. 3602 Sht. 7 of
Date 6-13-96 Date Date

Chk. Date

Demand Wash Cloner

- $\overline{XHSAT}$ Determination

From [illegible] Soil [illegible] Appendix A

Mg/L	XHSAT (mg/L)
[illegible]	.33
73	[illegible]
50	.13

Compute [illegible] $\overline{XHSAT}$

$$\overline{XHSAT} = \text{Exp}\left[\frac{\sum \text{[illegible]}}{CA_T}\right]$$

For 250

$$\overline{XHSAT} = \text{Exp}\left[\frac{\sum\left(.67 \cdot \text{[illegible]} + .066 \cdot \text{[illegible]} + .246 \cdot \text{[illegible]}\right)}{\text{[illegible]}}\right]$$

$\overline{XHSAT}$ = .22 mg/L

Correction for relative humidity $\overline{XHSAT}_{adj} = \overline{XHSAT} \cdot CH$

Veg Cover for 250 = 54 %

From Fig 4.4 in DDIA $CH = \frac{Vc - 10}{90} + 10$

CH = 1.52

.22 mg/L · 1.47 = .32 mg/L

[illegible] Engineers Inc.

Job No. 36602 Sht. 8 of [illegible]

[illegible] Chkd. MCH Chkd. [illegible]

Date 6-17-96 Date [illegible] Date [illegible]

For 235

XHEAT = [illegible] $\sum$ [illegible] = .22 in OR .005 [illegible]

[illegible]

[illegible]

[illegible] .60 [illegible]

XHEAT = [illegible] .217 [illegible]

[illegible] 240 $\overline{XHEAT}$ = [illegible]

$\overline{XHEAT}$ = .19 [illegible]

- [illegible]

[illegible]

The [illegible] (use [illegible] $\overline{XHEAT}$)

For 230 XHEAT = .22 inches

PSIF = 5.1 in
DTHETA = .25

For 235 $\overline{XHEAT}$ = .14 inches
PSIF = 6.2 in
DTHETA = .25

For 250A [illegible] $\overline{XHEAT}$ = .13 inches

PSIF = 6.4 in
DTHETA = .21

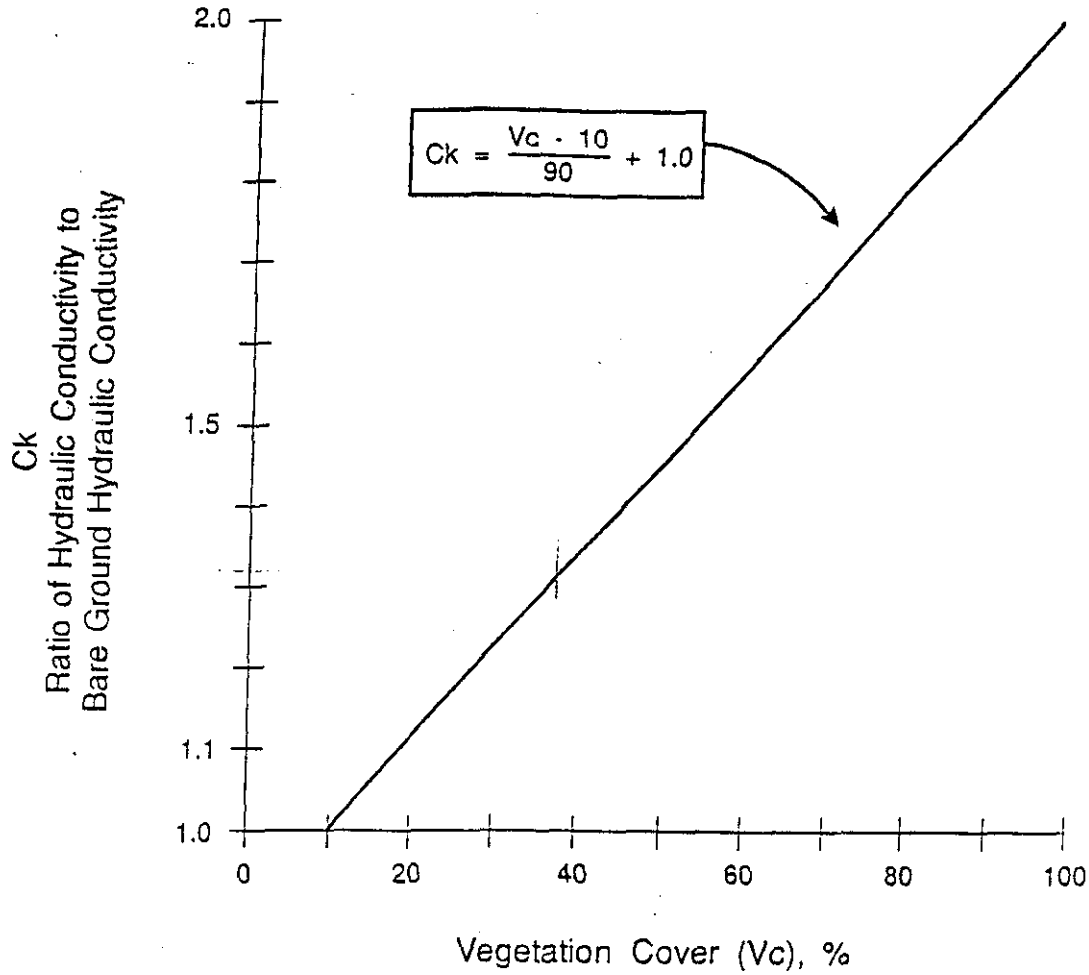

Figure 4.4
Effect of Vegetation Cover on Hydraulic Conductivity
For Hydraulic Soil Groups B, C, and D, and for all Soil Textures
***other than* Sand and Loamy Sand**

on canopy cover for trees and shrubs. Note that this correction can be applied only to soils other than sand and loamy sand.

The influence of tillage results in a change in total porosity and therefore a need to modify the three Green Ampt equation infiltration parameters. The effect of tillage systems on soil porosity and the corresponding changes to hydraulic conductivity, wetting front capillary suction, and water retention is available (Rawls and Brakensiek, 1983). Although this information is available, it is not presented in this manual, nor is it recommended that these adjustments be made to the infiltration parameters for design purpose use in Maricopa County, because for most flood estimation purposes it cannot be assumed that the soil will be in any particular state of tillage at the time of storm occurrence and therefore the base condition infiltration parameters, as presented, should be used for flood estimation purposes. However, appropriate adjustments to the infiltration parameters can be made, as necessary, for special flood studies such as reconstitution of storm events.

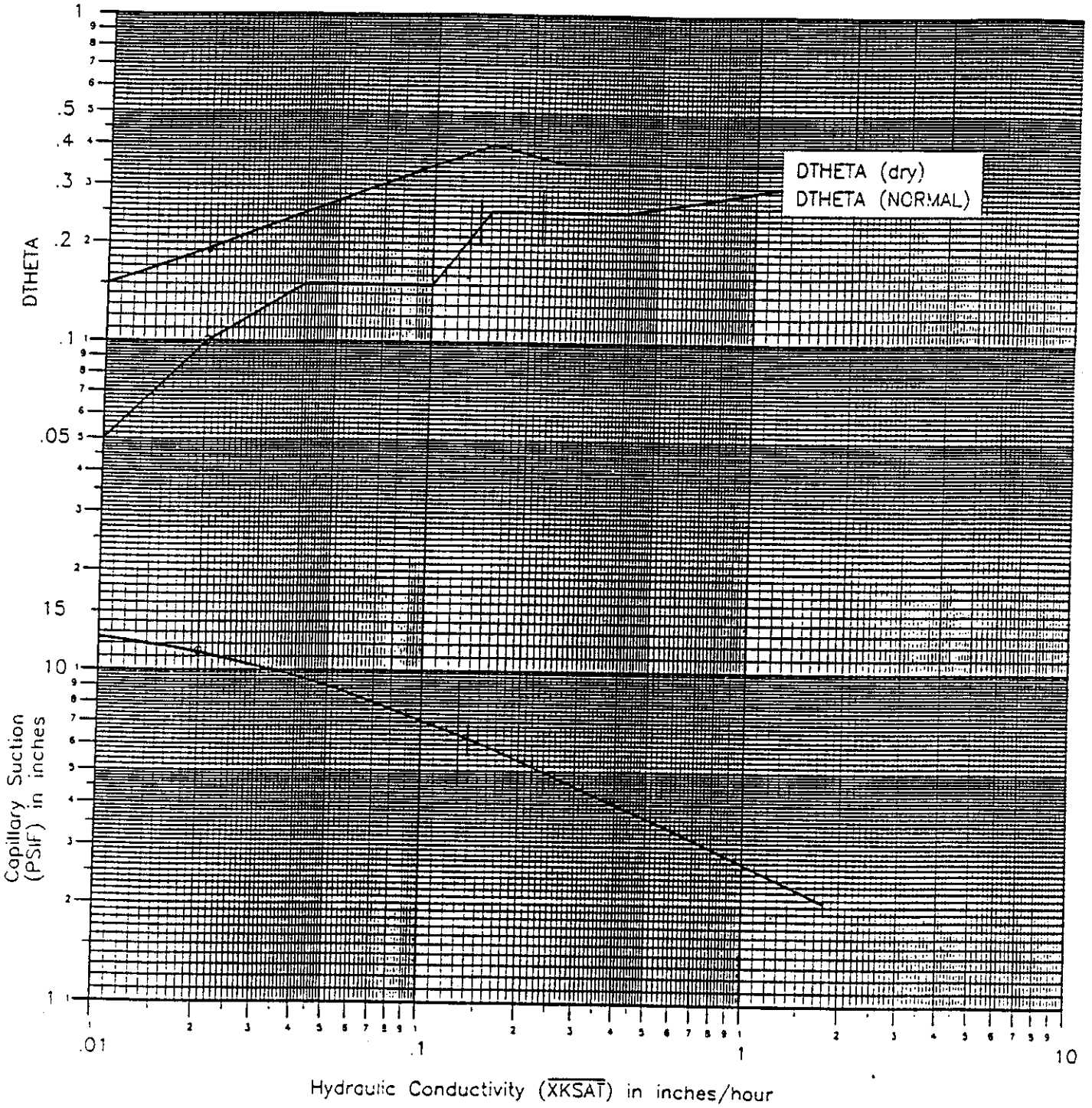

Figure 4.3
Composite Values of PSIF and DTHETA as a function of XKSAT
(To be used for area-weighted averaging of Green and Ampt parameters.)

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Job No. 3660.2 Sht. 9 of

Calc. MRE Chk. Check

Date 6-17-96 Date Date

- Kb determination

Table 5.1 in DDM

Equation in Drainage Design Manual Section 810.4

Kb Eq. Parameters

Load case	Type	m	b
Distributed Load	mid	-0.00625	0.04
Concentrated Load	low	-0.01375	0.08
Pavement	high	-0.025	0.15

See Table

- Well [illegible] to [illegible] m, b, Kb values

- Slope Correction Kb slope Dist 200 ft/mile

from table 5.4 in DDM

[illegible]

- Tc + R calculation

[illegible] for [illegible] process to Tc. I

[illegible]

Where [illegible] equation 5.5 in DDM

$Tc = 11.4 L^{0.90} Kb^{0.42} S^{-0.31} i^{-0.38}$

Where L = [illegible]

S = [illegible]

i = [illegible] Tc

Sub-bas	Tot Area	LDR	MDR	HDR	COMM	IND	PARK	DESERT	m	b	kb
230	438	268	50.2	55.6	50.4			14	-0.01289	0.075434	0.041377
235	247.1	76	54		38		52.1	27	-0.01497	0.088608	0.05279
230A	27.6	13.8		13.8					-0.01375	0.08	0.060188
240A	78	69.65		3.67	4.68				-0.0133	0.0776	0.052435
240B	70.72	66.4		2.3	2.02				-0.01354	0.078857	0.053822
240C	23.04		19.54		3.5				-0.01261	0.073924	0.056742
240D	23.68		20.9		2.78				-0.01287	0.075304	0.057616
240E	13.3		9.2	2.6	1.5				-0.0129	0.075489	0.060986
240F	8		8						-0.01375	0.08	0.067583
240G	3.45		3.45						-0.01375	0.08	0.072605
240H	4.38		4.38						-0.01375	0.08	0.07118
240I	67.2		67.2						-0.01375	0.08	0.054874
240J	8		8						-0.01375	0.08	0.067583

Sub-basin	high elev	low elev	DELT H	Slope (ft/m)	Slope (ft/ft)	Adj Slope
230	2542	2210	332	130.48	0.0247	
235	2430	2210	220	105.61	0.0200	
236	2236	2202	34	102.92	0.0195	
240a	2238	2140	98	203.50	0.0385	203
240b	2216	2110	106	151.55	0.0287	
240c	2155	2098	57	165.93	0.0314	
240d	2138	2086	52	181.24	0.0343	
240e	2132	2082	50	229.61	0.0435	223
240f	2130	2074	56	319.17	0.0604	267
240g	2120	2069	51	469.70	0.0890	300
240h	2123	2065	58	554.28	0.1050	317
240i	2164	2062	102	163.89	0.0310	
240j	2072	2053	19	69.88	0.0132	

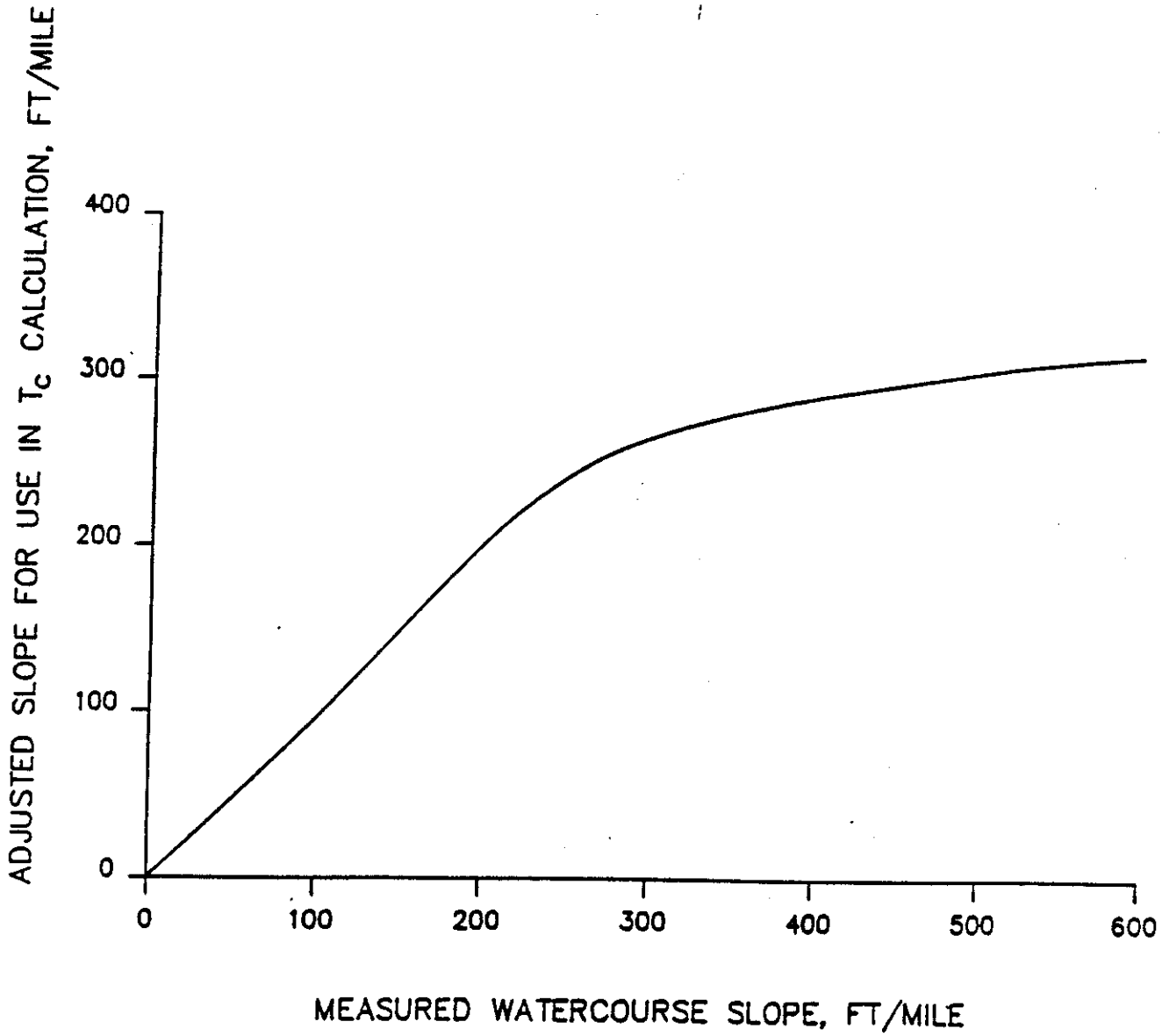

Figure 5.4
Slope Adjustment for Steep Watercourses in Natural Watersheds
(Source: *Drainage Criteria Manual*, Urban Drainage and Flood Control District, Colorado, May 1984.)

Job No. 2002 Sht. ___ of ___
Calculated By [illegible] Chkd. By [illegible] Rev. ___ Rev. ___
Date 7-12-96 Date ___ Date ___

Manning's Roughness Coefficient

Overbank Flow

From Hydraulic Resistance Data Base (FCDMC, 1991)

Table 5.11
Overbank = .040 (Cross-Brush, normal density)

Street Flow Curb & Gutter

From Estimated Manning's Roughness Coefficients for Stream Channels, (USGS, 1991)

Table
Concrete = .024
From SDM = .020
no obstructions, vegetation, smooth, [illegible]
no [illegible] to [illegible]
n = .022

Natural Channels
Bank & Channel = Clean, Straight

.026 – .028

N adjustment

Irregularity = minor = .002
Obstruction = minor .002
Vegetation small = .003
Degree of Meandering = minor = 1

$n = n_0 + n_1 + n_2 + n_3$

$n = .027 + .002 + .002 + .003 = .034$

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Hydraulic Calcs

Job No. 3660.2 Sht. 1 of
Calc. MCH Chk. Sheet
Date 7-10-96 Date Date

Dam

Pleasantering Chemstone Expansion Detention Basin

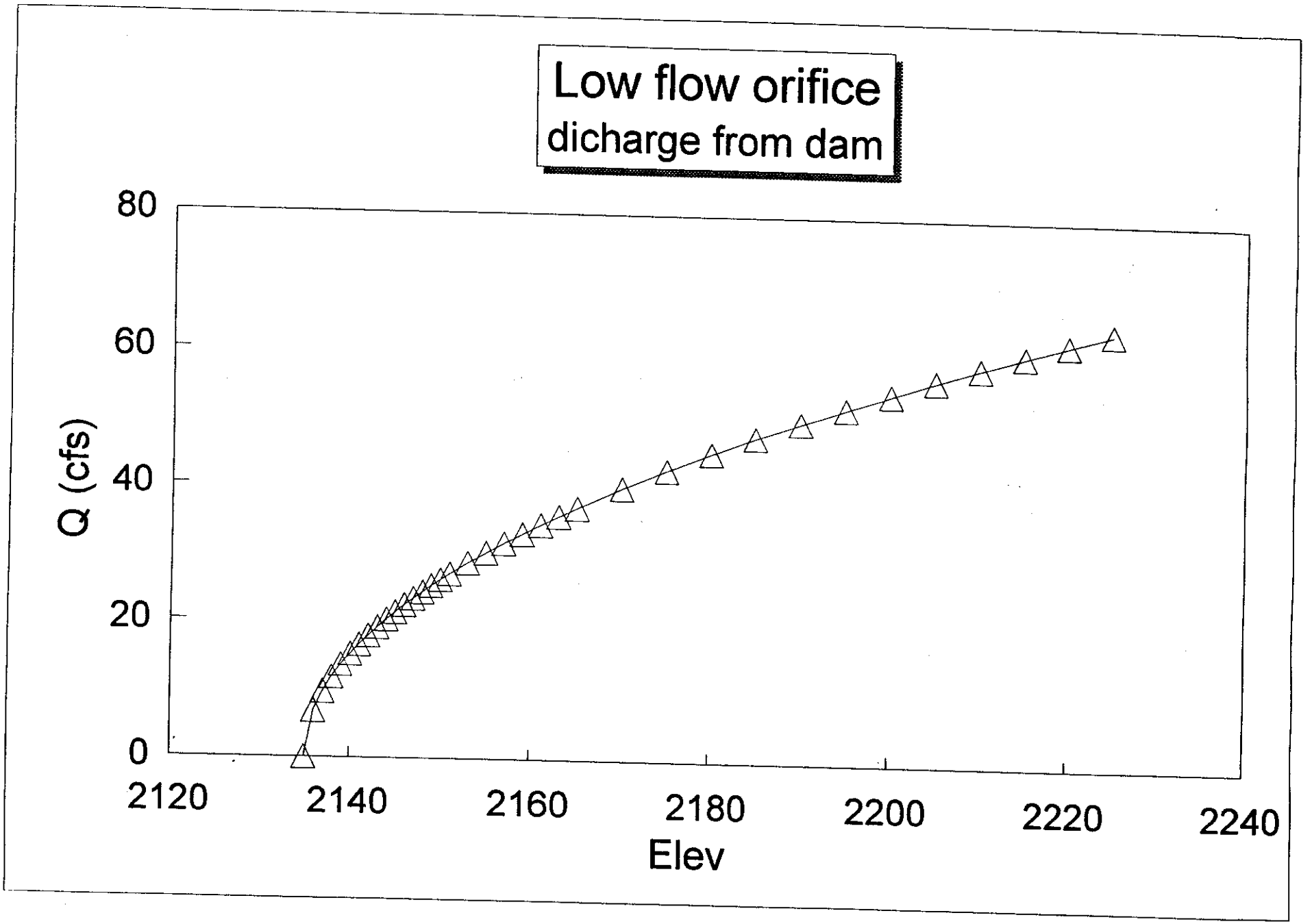
Elevation	Area (Acres)
2134	1.84
2135	2.05
2136	2.28
2138	2.72
2140	5.53
2142	6.25
2144	6.64
2146	7.74
2150	9.20
2160	12.22

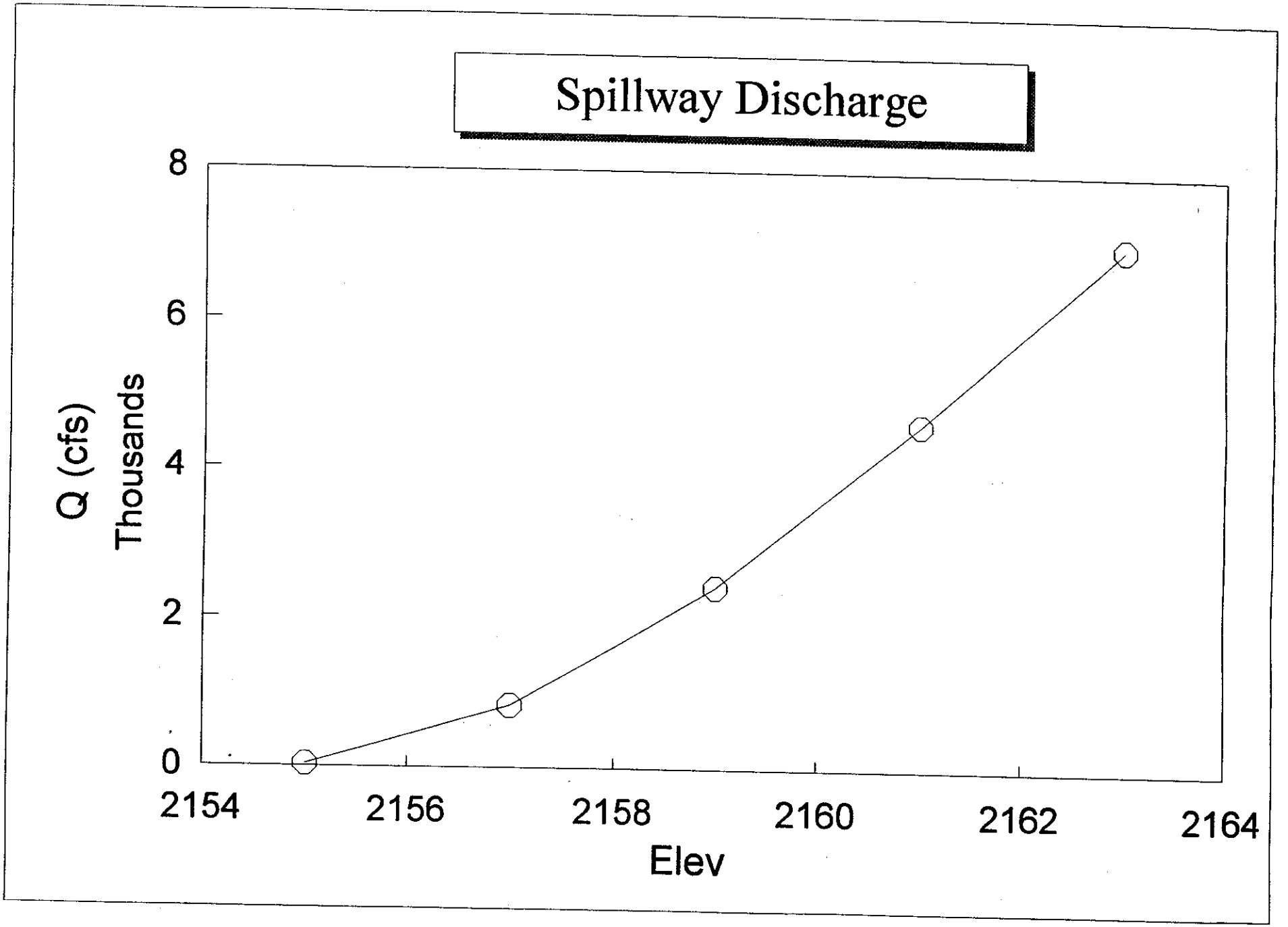
Low Flow Orifice Equation

$Q_{orifice} = C \times A \times (2 \times g \times H)^{0.5}$

A = 1.4 ft²
C = 0.6 (Brater-King)
Inlet Elevation = 2135 ft (Chemstone)
(see graphic results)

Emergency Discharge
Overflow Weir Control Section
(see graphic)


Low flow orifice
dicharge from dam
Q (cfs)
80
60
40
20
0
2120
2140
2160
2180
2200
2220
2240
Elev


Spillway Discharge
Q (cfs)
Thousands
8
6
4
2
0
2154
2156
2158
2160
2162
2164
Elev

Project CASSANDRA WASH OUTFALL

Hydraulic grade line computed for As-built storm sewer outfall.

2080.825

	Station	Elev. Inv	D	Elev H.G.L.	slope	R	N	area	Q	V	v2/2g	Sf	Avg Sf	L	hf	hb	hj	ht	hmh	Elev EGL
	145+64.33	2053.2	4	2068	0.005294	1	0.012	12.56	147	11.70382	2.12701	0.008944								2060
													0.008944	481	4.301896					
MH#5	140+83	2055.72	4	2062.175	0.005294	1	0.012	12.56	147	11.70382	2.12701	0.008944								2064.302
													0.009289	0	0				0.10635	
	140+83	2055.82	4	2061.521	0.009597	1.19	0.012	10.78	147	13.63636	2.887429	0.009633								2064.408
													0.009633	250	2.32213					
MH#4	138+40	2058.21	4	2063.843	0.009597	1.19	0.012	10.78	147	13.63636	2.887429	0.009633								2066.73
													0.00958	0	0				0.10635	
	138+40	2058.31	4	2063.949	0.009133	1.2	0.012	10.78	147	13.63636	2.887429	0.009527								2066.837
													0.009527	240	2.312014					
GRADE BR	135+40	2061.05	4	2066.261	0.009133	1.2	0.012	10.78	147	13.63636	2.887429	0.009527								2069.149
													0.009235	0	0				0	
	35+40	2061.05	4	2067.022	0.002944	1	0.012	12.56	147	11.70382	2.12701	0.008944					0			2069.149
													0.008944	180	1.714818					
MH#3	33+60	2061.68	4	2068.737	0.002944	1	0.012	12.56	147	11.70382	2.12701	0.008944								2070.864
													0.008944	0					0.144371	
	33+60	2061.78	4	2068.881	0.0035	1	0.012	12.56	147	11.70382	2.12701	0.008944								2071.008
													0.008944	320	2.861968				0	
MH#2	30+40	2062.9	4	2071.743	0.0035	1	0.012	12.56	147	11.70382	2.12701	0.008944								2073.87
													0.011685	0					0.10635	
	30+40	2063	4	2069.797	0.013938	1.16	0.012	8.96	147	16.40625	4.179581	0.014426								2073.976
													0.014426	480	4.292953				0	
MH#1	25+60	2069.69	4	2074.09	0.013938	1.16	0.012	8.96	147	16.40625	4.179581	0.014426								2078.269
													0.011685						0.10635	
	25+60	2069.79	4	2076.249	0.004792	1	0.012	12.56	147	11.70382	2.12701	0.008944								2078.376
													0.008944	48	0.692453					
BEND	25+12	2070.2		2076.941	0.004792	1	0.012	12.56	147	11.70382	2.12701	0.008944								2079.068
													0.010878	0	0	2.871463			0	
	13+20	2070.2	4	2078.142	0.012767	1.18	0.012	9.4	147	15.6383	3.797459	0.012813								2081.939
													0.012813	300	2.683095					
	10+20	2074.03	4	2080.825	0.012767	1.18	0.012	9.4	147	15.6383	3.797459	0.012813								2084.623

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[illegible] Consulting Engineers, Inc.

Job No. 3660.2 Sht. 2 of

Calc. MCH Chk. Bldg

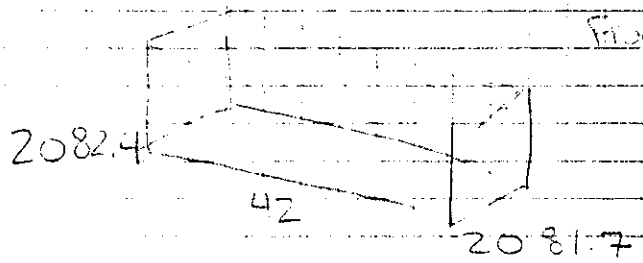
Date 7-10-96 Date Date

Cascade Mesa 10MR

Connection [illegible] Main Frame

- 2 10 x 5 CBC w/ [illegible] flange [illegible]

For Hanger Plate



From [illegible] HEC-2
[illegible] = 81.91

S: 0.0119
FHWA Class 3
[illegible] 1
[illegible] 0.2
[illegible] 0.012
(see [illegible] Analysis Sheet)

Determining Axial Loads on CBC
shelf is minimum 2086 ⇒ [illegible] Bundy

Elevation	Axial (Kips)
2085	.028
2086	.108
2086.7	.360
2086	.9834 ⇒ [illegible]

Lateral [illegible]

Elevation	Shear (Kips)	Moment (Kip-ft)	x2
2082.4	0	0	0
2082.0	0	0	0
[illegible]	0	0	0
[illegible]	[illegible]	10	10
[illegible]	.0975	90	180
2086	.106	100	200
[illegible]	[illegible]	300	[illegible]

BOX CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE
July 11, 1996

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Culvert Span (Width of Opening) (feet).....	10.00
Culvert Rise (Height of Opening) (feet).....	5.00
FHWA Chart Number (8,9,10,11,12 or 13).....	8
Scale Number on Chart (Type of Culvert Entrance).....	1
Manning's Roughness Coefficient (n-value).....	0.0120
Entrance Loss Coefficient of Culvert Opening.....	0.20
Culvert Length (feet).....	42.0
Culvert Slope (feet per foot).....	0.0019

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
10.0	1.42	0.48	2.58	0.37	0.31	1.42	0.70
20.0	1.42	0.77	2.67	0.58	0.50	1.42	1.41
30.0	1.42	1.02	2.75	0.74	0.65	1.42	2.11
40.0	1.42	1.23	2.83	0.89	0.79	1.42	2.82
50.0	1.42	1.44	2.90	1.03	0.92	1.42	3.52
60.0	1.42	1.63	2.97	1.16	1.04	1.42	4.23
70.0	1.42	1.81	3.03	1.28	1.15	1.42	4.93
50.0	1.42	1.44	2.90	1.03	0.92	1.42	3.52
80.0	1.42	1.98	3.10	1.40	1.26	1.42	5.63
90.0	1.42	2.14	3.17	1.51	1.36	1.42	6.34
100.0	1.42	2.30	3.23	1.62	1.46	1.46	6.85
110.0	1.42	2.46	3.29	1.73	1.55	1.55	7.08
120.0	1.42	2.61	3.36	1.83	1.65	1.65	7.28
130.0	1.42	2.76	3.42	1.93	1.74	1.74	7.48
140.0	1.42	2.90	3.49	2.03	1.83	1.83	7.67
150.0	1.42	3.04	3.56	2.13	1.91	1.91	7.85
160.0	1.42	3.18	3.62	2.22	2.00	2.00	8.02
170.0	1.42	3.31	3.69	2.32	2.08	2.08	8.18
180.0	1.42	3.45	3.76	2.41	2.16	2.16	8.34
190.0	1.42	3.58	3.83	2.50	2.24	2.24	8.49
200.0	1.42	3.71	3.90	2.59	2.32	2.32	8.64
210.0	1.42	3.83	3.97	2.68	2.39	2.39	8.78
220.0	1.42	3.96	4.04	2.77	2.47	2.47	8.91
250.0	1.42	4.32	4.26	3.03	2.69	3.03	8.24
300.0	1.42	4.90	4.66	3.45	3.03	3.45	8.69

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FAX (602) 234-[illegible]

[illegible] Consulting Engineers, Inc.

Job No. [illegible] Sht. 3 of
Calc. MCH Chk. Bchk.
Date 7-10-96 Date Date

Runoff Control Ba[illegible] under [illegible] RR [illegible]

[illegible] 2060.8

[illegible]

Height at outlet [illegible] 2064.0
tailwater depth - 5.2 ft

[illegible] Bond RR tracks - from planimeter 200'/inch scale, MCO

[illegible]	Storage (ac/ft)
2062	.007
2063	.124
[illegible]	.227
2066	6.90
[illegible]	13.03

Routing [illegible]

Elevation	Storage (ac/ft)	Flow [illegible] (cfs)
2061.5	0	0
2062	.004	0
2063	.124	0
[illegible]	[illegible]	0
2066	6.9	10
2067	10.0	155
2068	13.03	340

BOX CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE
July 10, 1996

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Culvert Span (Width of Opening) (feet).....	8.00
Culvert Rise (Height of Opening) (feet).....	10.00
FHWA Chart Number (8,9,10,11,12 or 13).....	8
Scale Number on Chart (Type of Culvert Entrance).....	1
Manning`s Roughness Coefficient (n-value).....	0.0120
Entrance Loss Coefficient of Culvert Opening.....	0.20
Culvert Length (feet).....	50.0
Culvert Slope (feet per foot).....	0.0140

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
10.0	3.20	0.56	4.48	0.23	0.36	3.20	0.39
20.0	3.20	0.89	4.59	0.36	0.58	3.20	0.78
30.0	3.20	1.17	4.68	0.46	0.76	3.20	1.17
40.0	3.20	1.42	4.76	0.55	0.92	3.20	1.56
50.0	3.20	1.65	4.84	0.64	1.07	3.20	1.95
60.0	3.20	1.87	4.91	0.71	1.20	3.20	2.34
70.0	3.20	2.07	4.98	0.79	1.33	3.20	2.73
80.0	3.20	2.27	5.05	0.86	1.46	3.20	3.13
90.0	3.20	2.46	5.11	0.93	1.58	3.20	3.52
100.0	3.20	2.64	5.18	0.99	1.69	3.20	3.91
110.0	3.20	2.82	5.24	1.06	1.80	3.20	4.30
120.0	3.20	2.99	5.30	1.12	1.91	3.20	4.69
130.0	3.20	3.16	5.36	1.18	2.02	3.20	5.08
140.0	3.20	3.32	5.42	1.24	2.12	3.20	5.47
150.0	3.20	3.48	5.48	1.30	2.22	3.20	5.86
160.0	3.20	3.64	5.54	1.35	2.32	3.20	6.25
170.0	3.20	3.79	5.59	1.41	2.41	3.20	6.64
180.0	3.20	3.94	5.65	1.47	2.51	3.20	7.03
190.0	3.20	4.09	5.71	1.52	2.60	3.20	7.42
200.0	3.20	4.24	5.77	1.57	2.69	3.20	7.8
210.0	3.20	4.38	5.82	1.63	2.78	3.20	8.2
220.0	3.20	4.52	5.88	1.68	2.86	3.20	8.5
230.0	3.20	4.66	5.94	1.73	2.95	3.20	8.9
240.0	3.20	4.80	6.00	1.78	3.03	3.20	9.3
250.0	3.20	4.93	6.05	1.83	3.12	3.20	9.7
260.0	3.20	5.07	6.11	1.88	3.20	3.20	10.1
270.0	3.20	5.20	6.17	1.93	3.28	3.28	10.2
280.0	3.20	5.33	6.22	1.98	3.36	3.36	10.4
290.0	3.20	5.46	6.28	2.03	3.44	3.44	10.5
300.0	3.20	5.59	6.34	2.08	3.52	3.52	10.6
350.0	3.20	6.21	6.63	2.31	3.90	3.90	11.2
400.0	3.20	6.81	6.93	2.54	4.27	4.27	11.7
450.0	3.20	7.38	7.23	2.77	4.61	2.77	20.3
500.0	3.20	7.94	7.55	2.98	4.95	2.98	20.9
550.0	3.20	8.48	7.87	3.20	5.28	3.20	21.5
600.0	3.20	9.00	8.21	3.41	5.59	3.41	22.0

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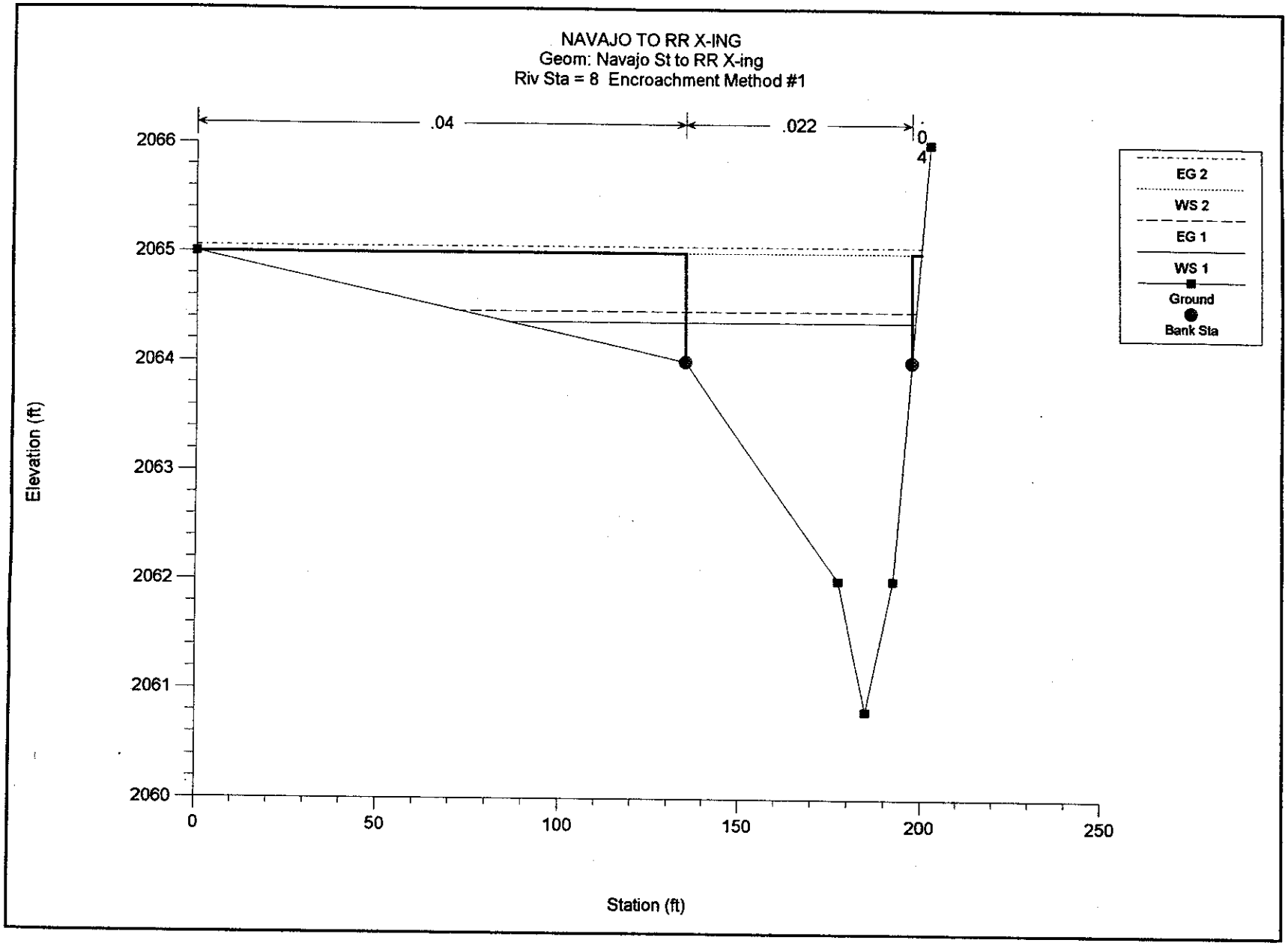
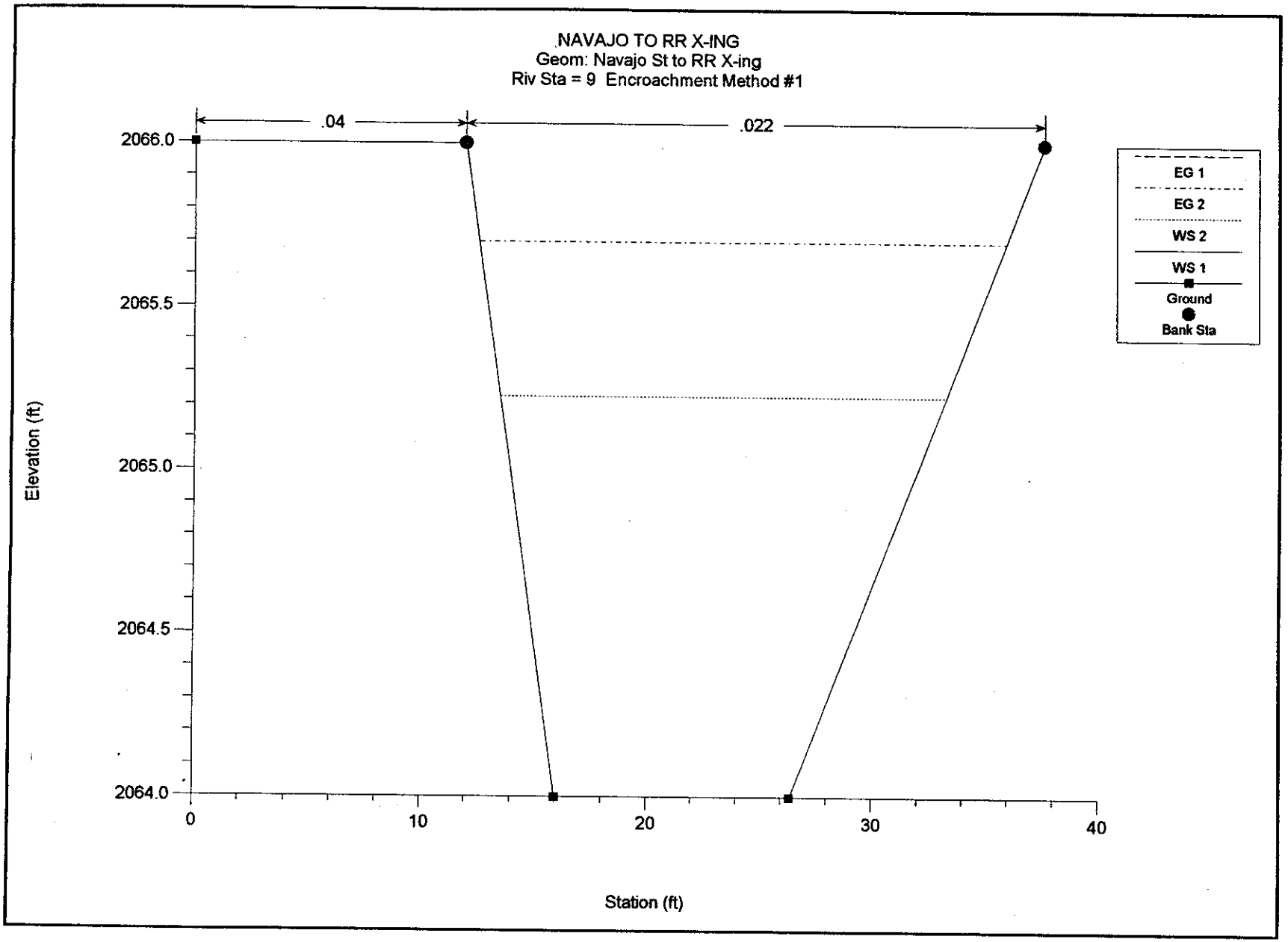
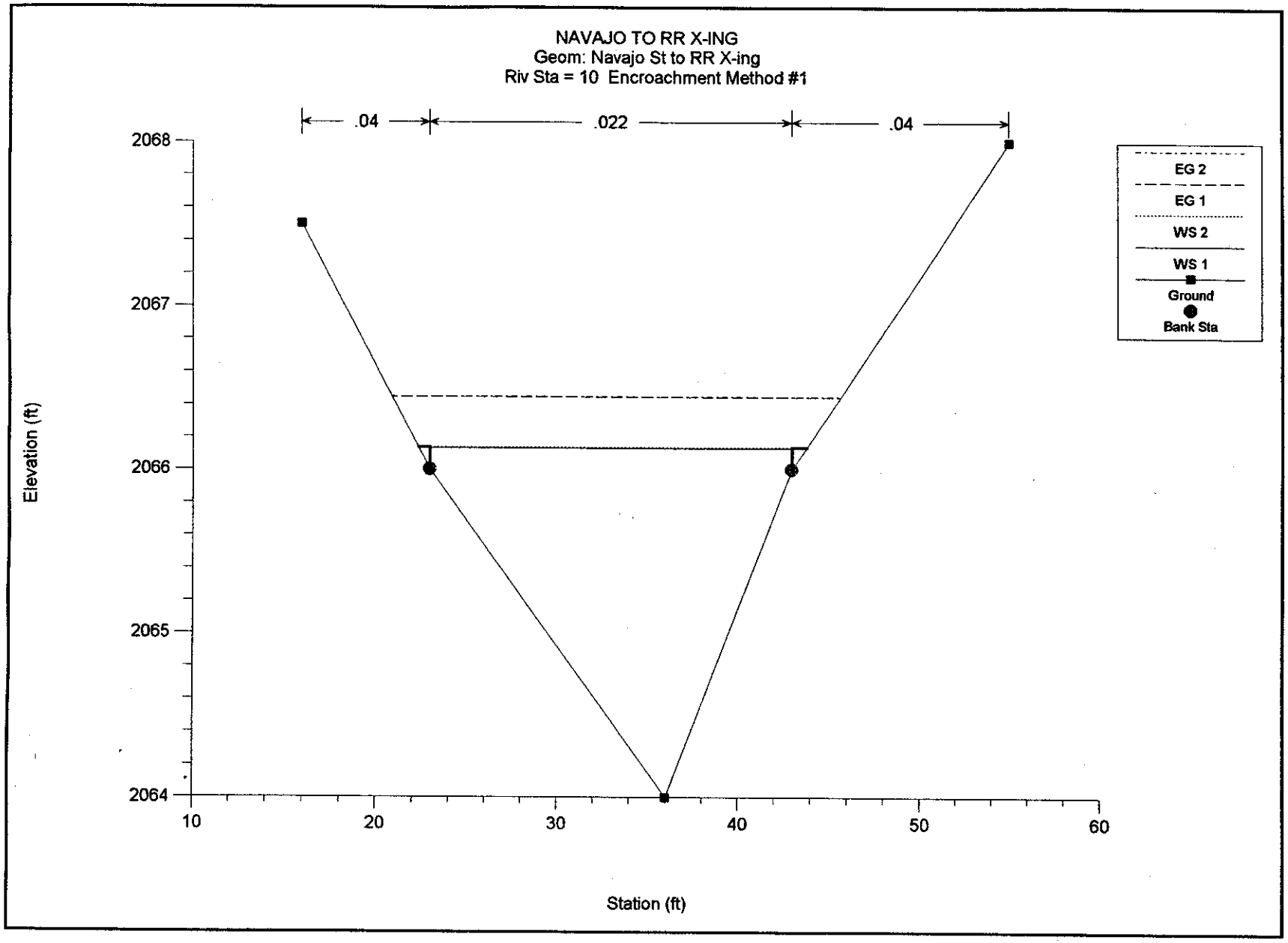
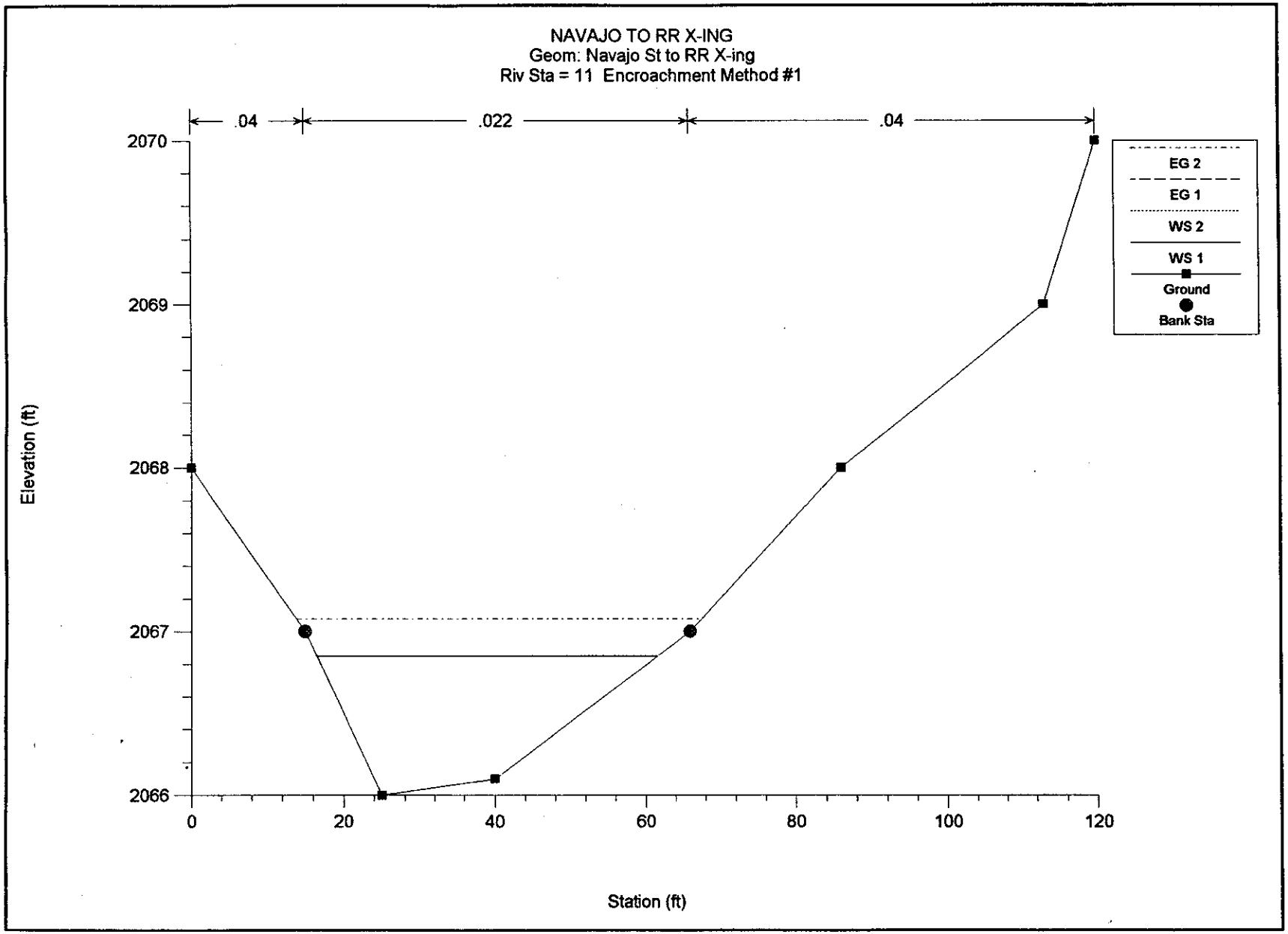
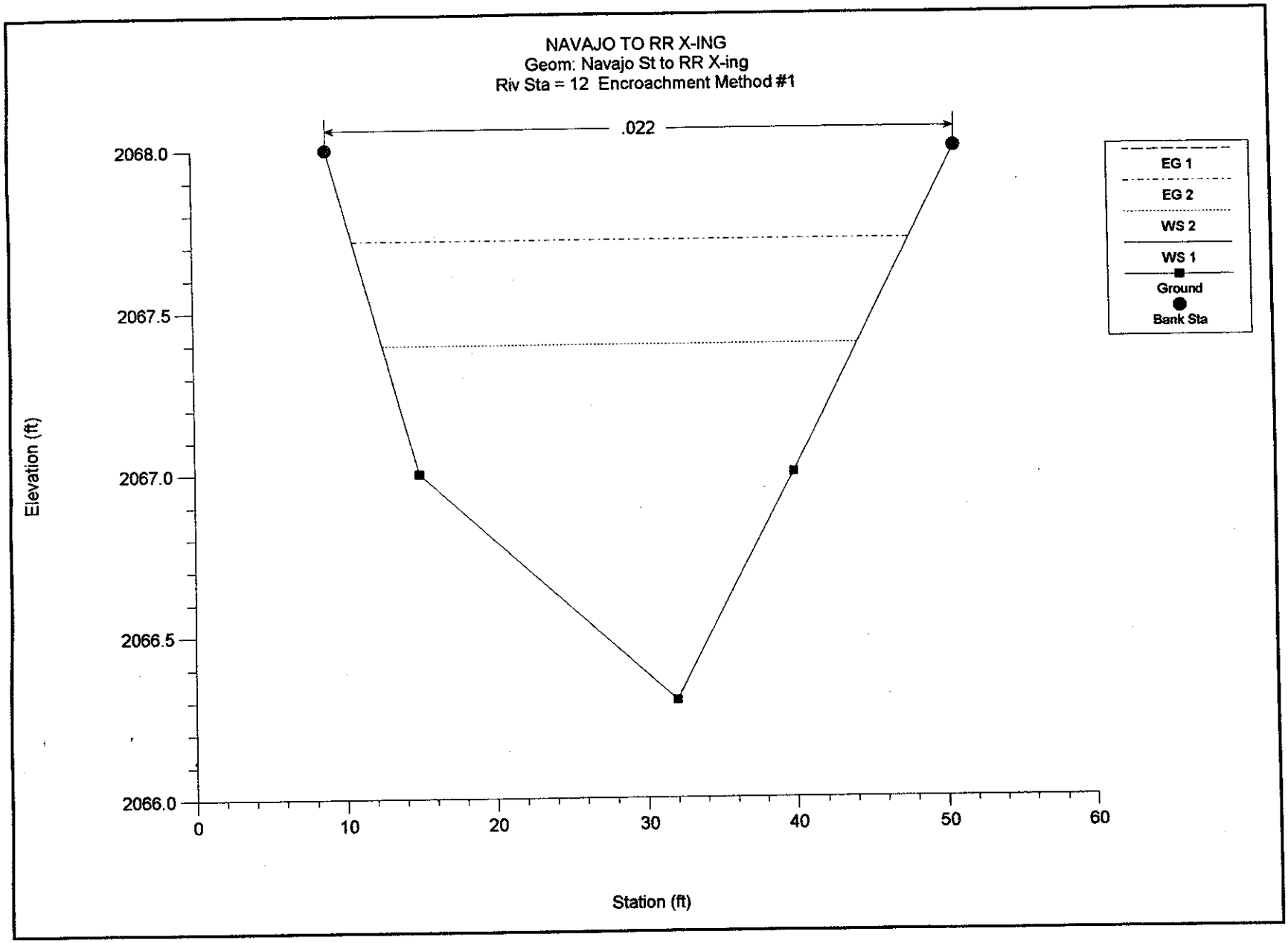
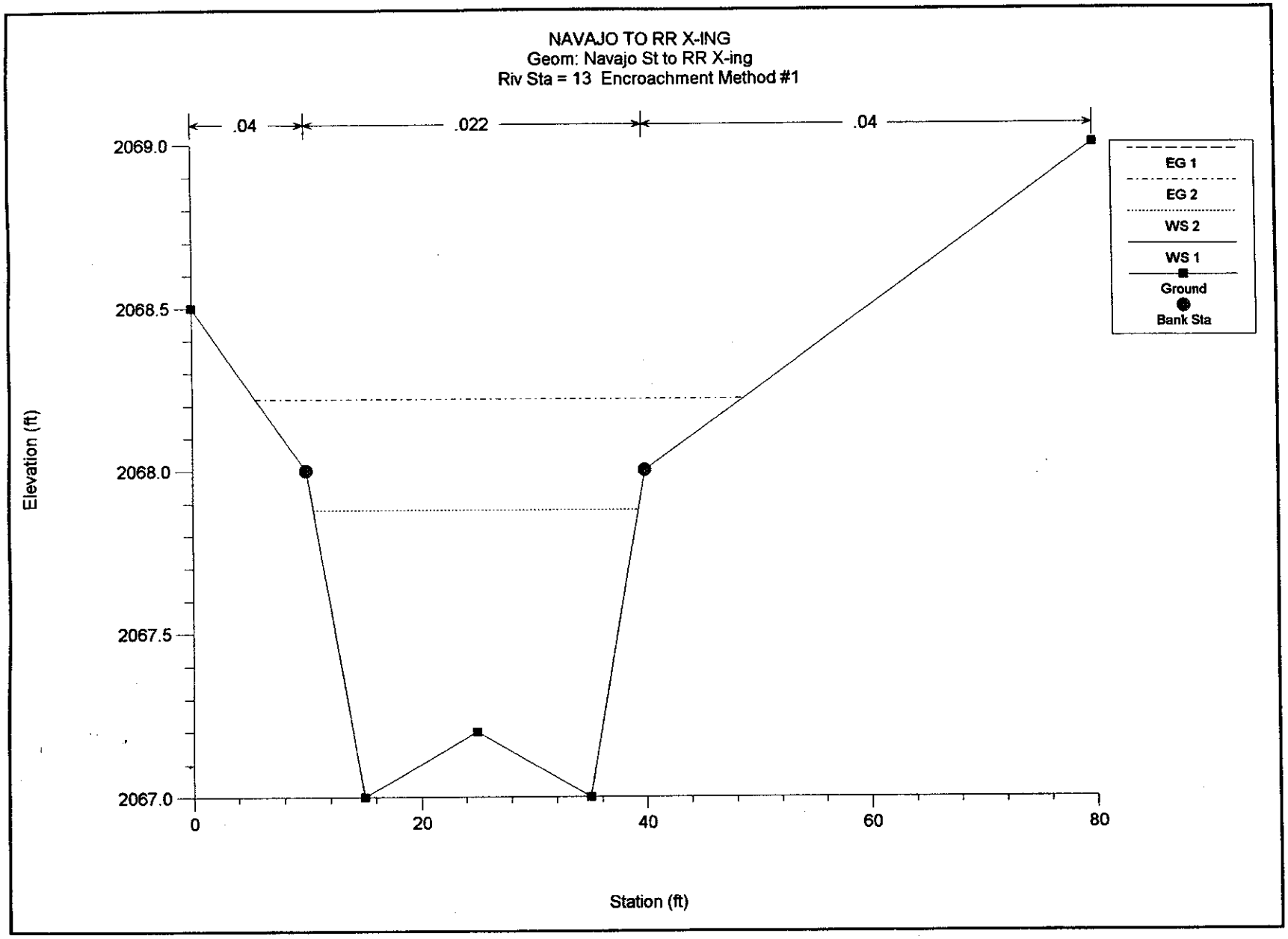

NAVAJO TO RR X-ING
Geom: Navajo St to RR X-ing
Riv Sta = 8 Encroachment Method #1
.04
.022
0.4
EG 2
WS 2
EG 1
WS 1
Ground
Bank Sta
Elevation (ft)
2066
2065
2064
2063
2062
2061
2060
0
50
100
150
200
250
Station (ft)

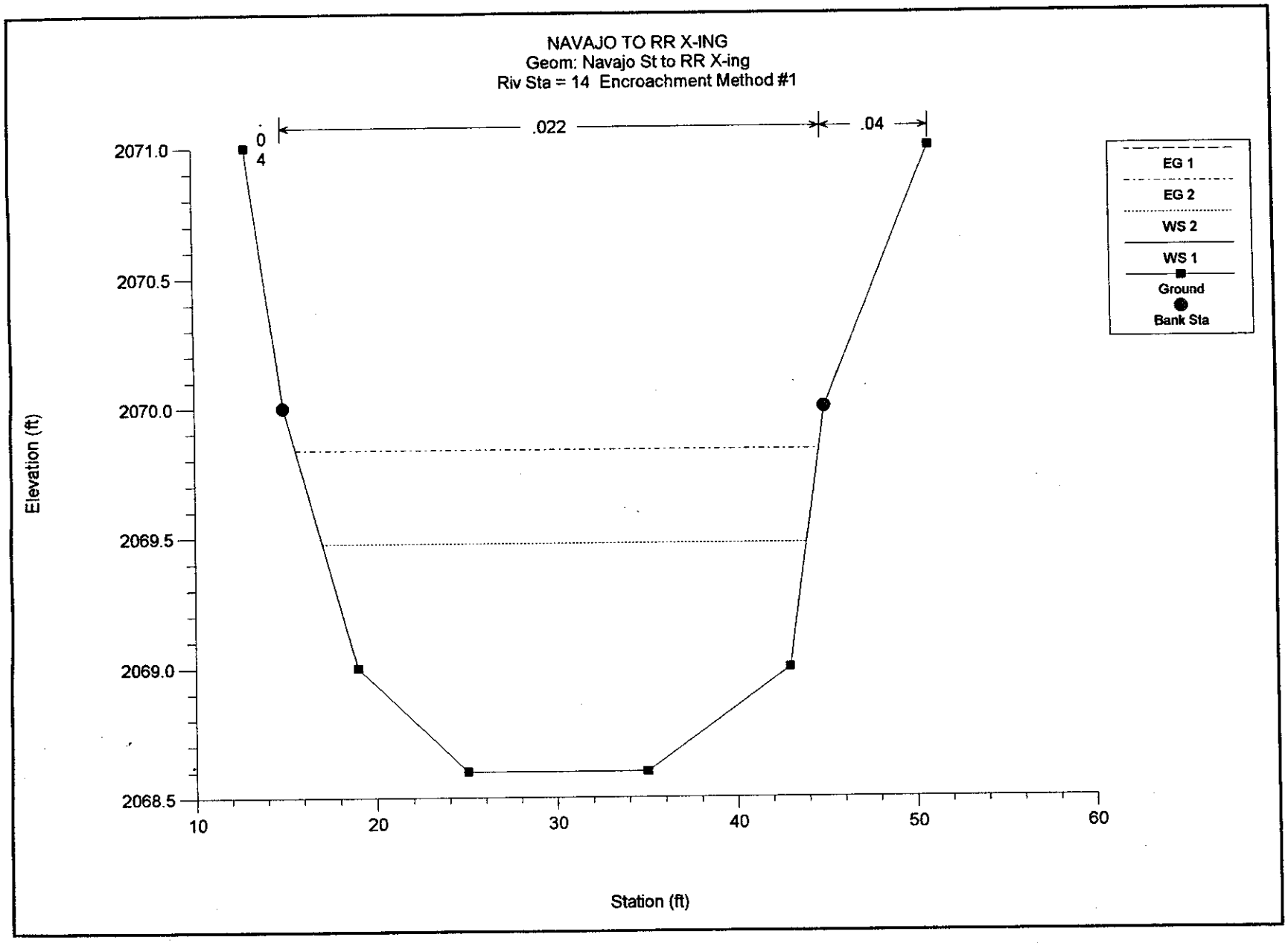

NAVAJO TO RR X-ING
Geom: Navajo St to RR X-ing
Riv Sta = 9 Encroachment Method #1
.04
.022
2066.0
2065.5
2065.0
2064.5
2064.0
Elevation (ft)
0
10
20
30
40
Station (ft)
EG 1
EG 2
WS 2
WS 1
Ground
Bank Sta

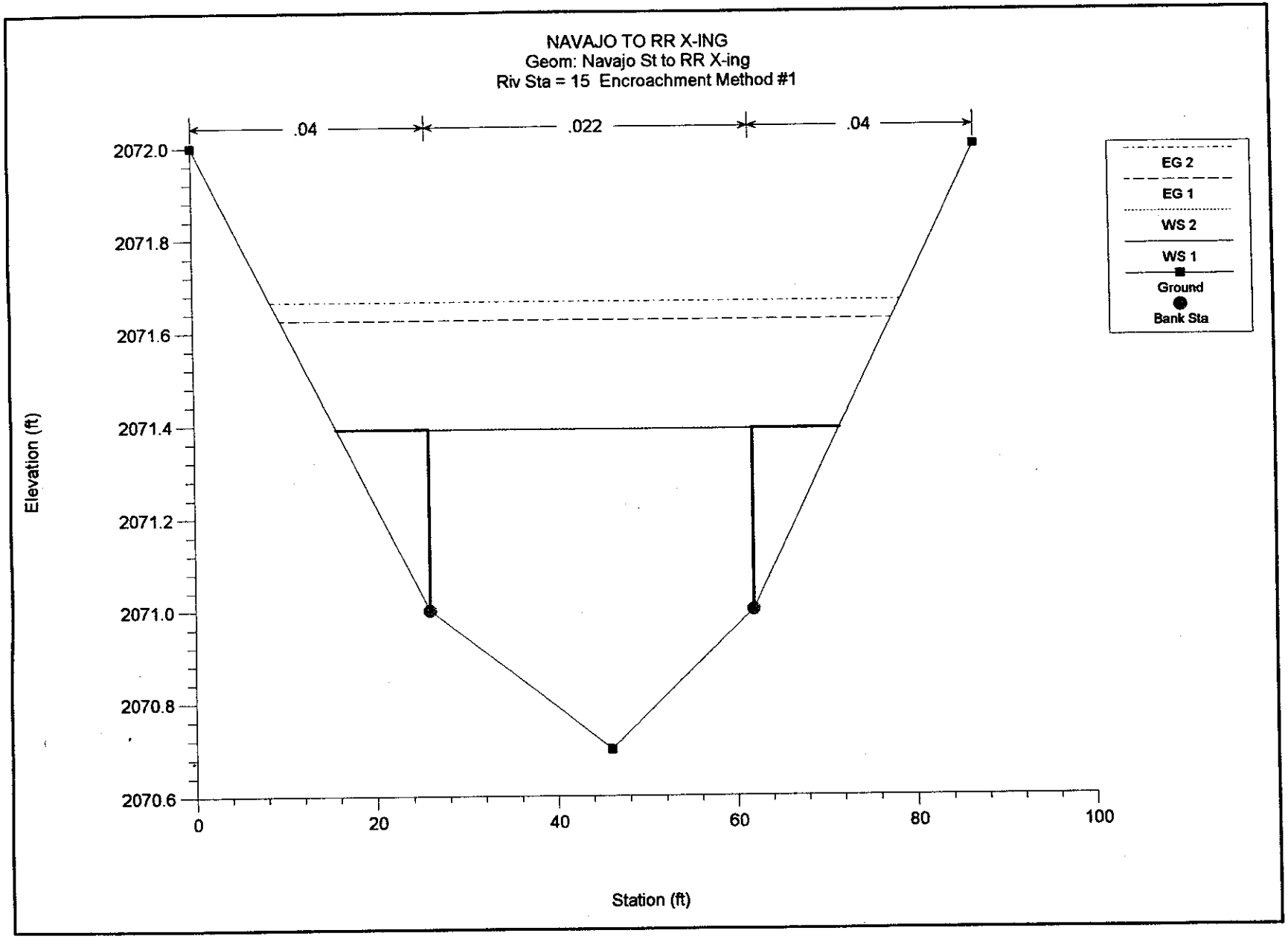

NAVAJO TO RR X-ING
Geom: Navajo St to RR X-ing
Riv Sta = 10 Encroachment Method #1
.04
.022
.04
2068
2067
2066
2065
2064
Elevation (ft)
10
20
30
40
50
60
Station (ft)
EG 2
EG 1
WS 2
WS 1
Ground
Bank Sta

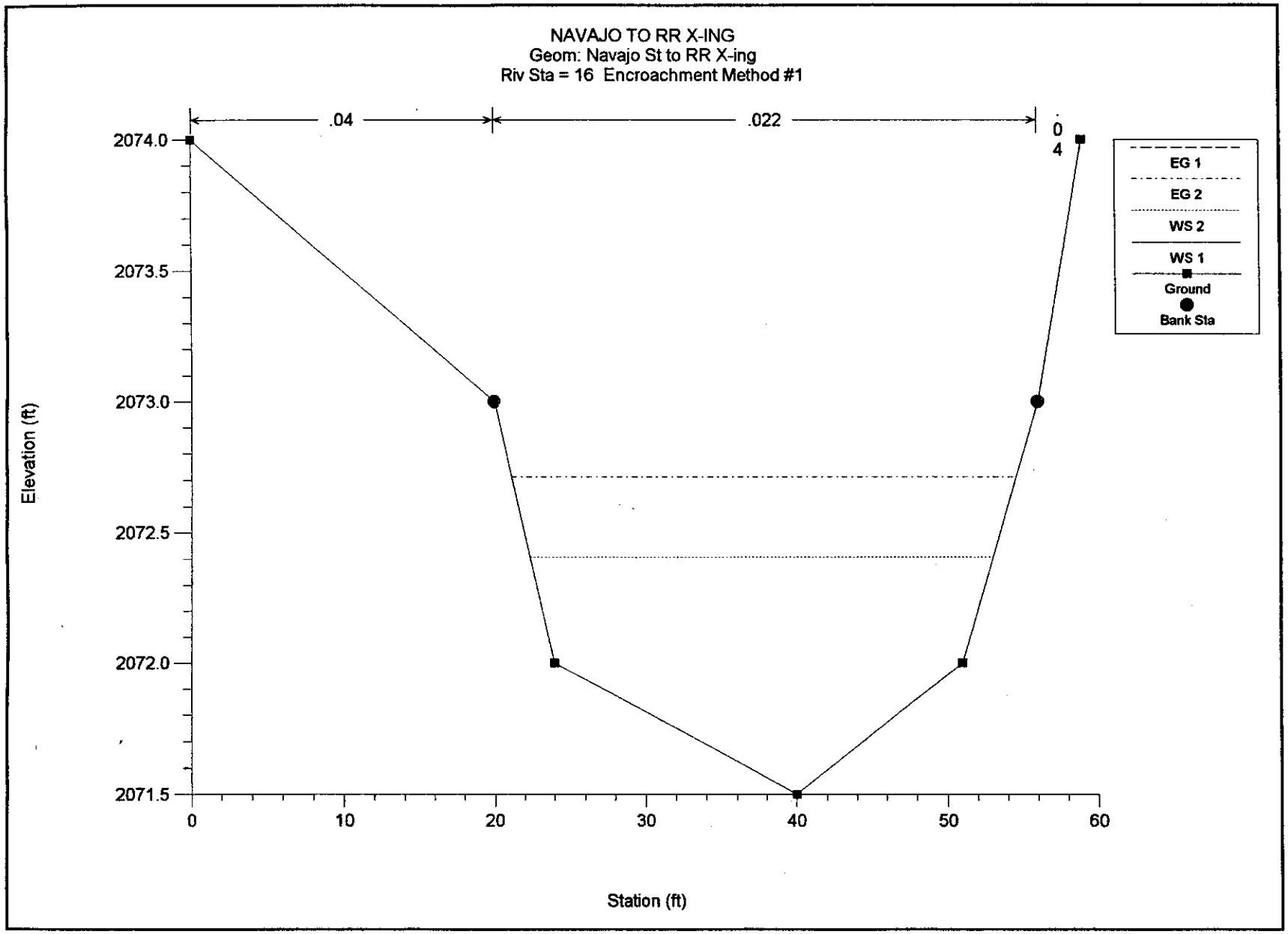

NAVAJO TO RR X-ING
Geom: Navajo St to RR X-ing
Riv Sta = 11 Encroachment Method #1
.04
.022
.04
2070
2069
2068
2067
2066
Elevation (ft)
0
20
40
60
80
100
120
Station (ft)
EG 2
EG 1
WS 2
WS 1
Ground
Bank Sta

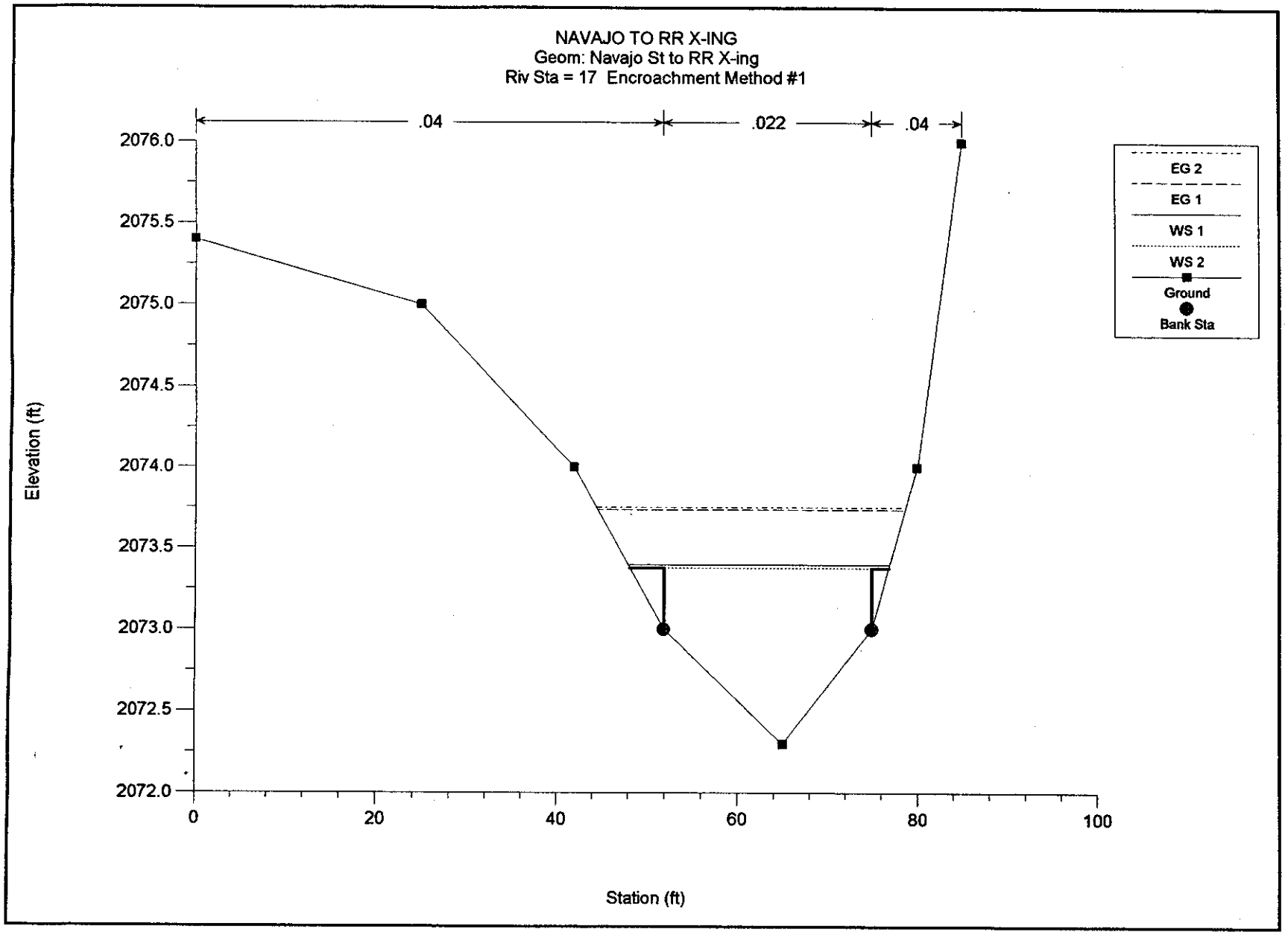

NAVAJO TO RR X-ING
Geom: Navajo St to RR X-ing
Riv Sta = 12 Encroachment Method #1
.022
2068.0
2067.5
2067.0
2066.5
2066.0
Elevation (ft)
0
10
20
30
40
50
60
Station (ft)
EG 1
EG 2
WS 2
WS 1
Ground
Bank Sta

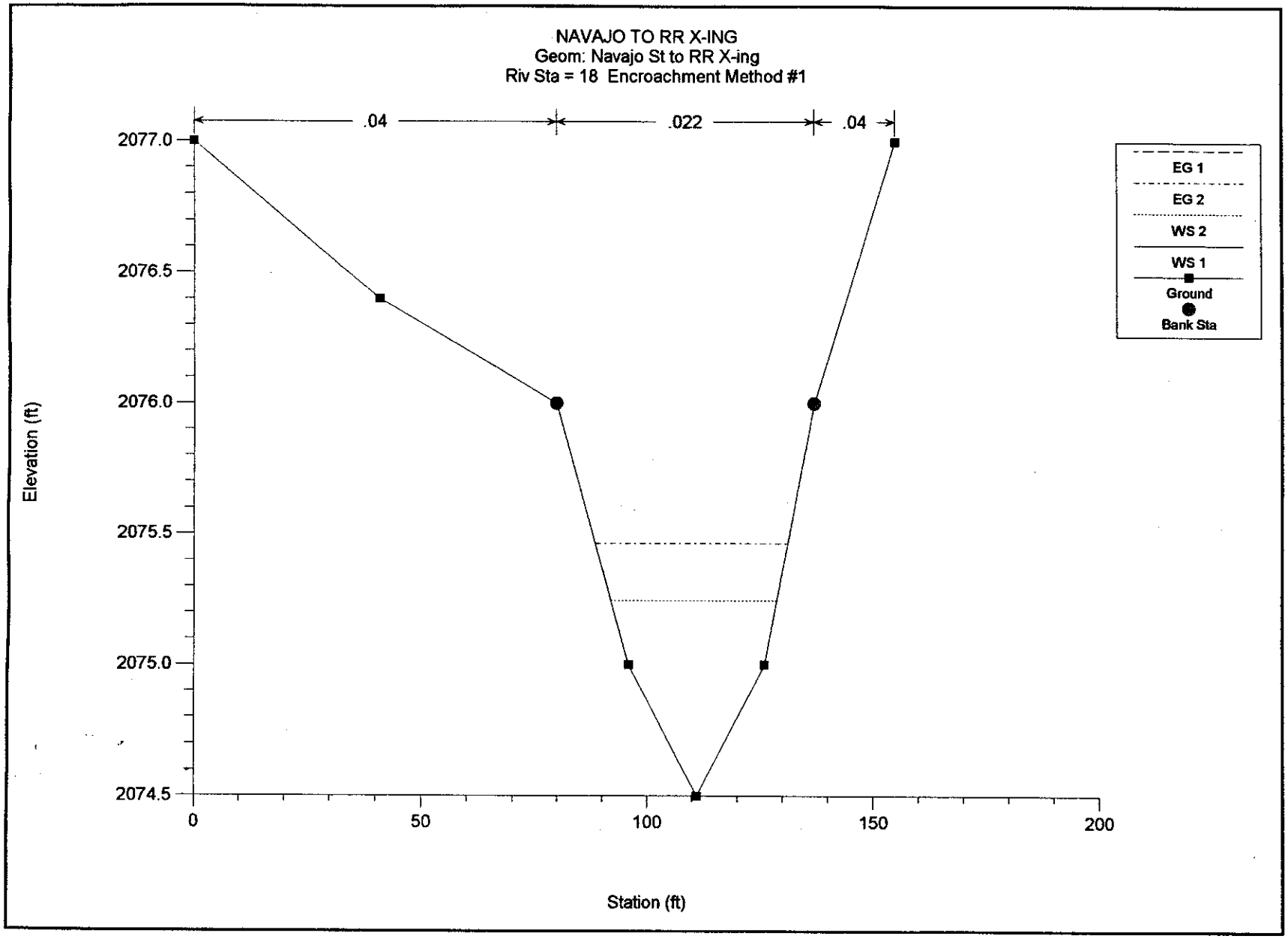

NAVAJO TO RR X-ING
Geom: Navajo St to RR X-ing
Riv Sta = 13 Encroachment Method #1
.04
.022
.04
2069.0
2068.5
2068.0
2067.5
2067.0
Elevation (ft)
0
20
40
60
80
Station (ft)
EG 1
EG 2
WS 2
WS 1
Ground
Bank Sta

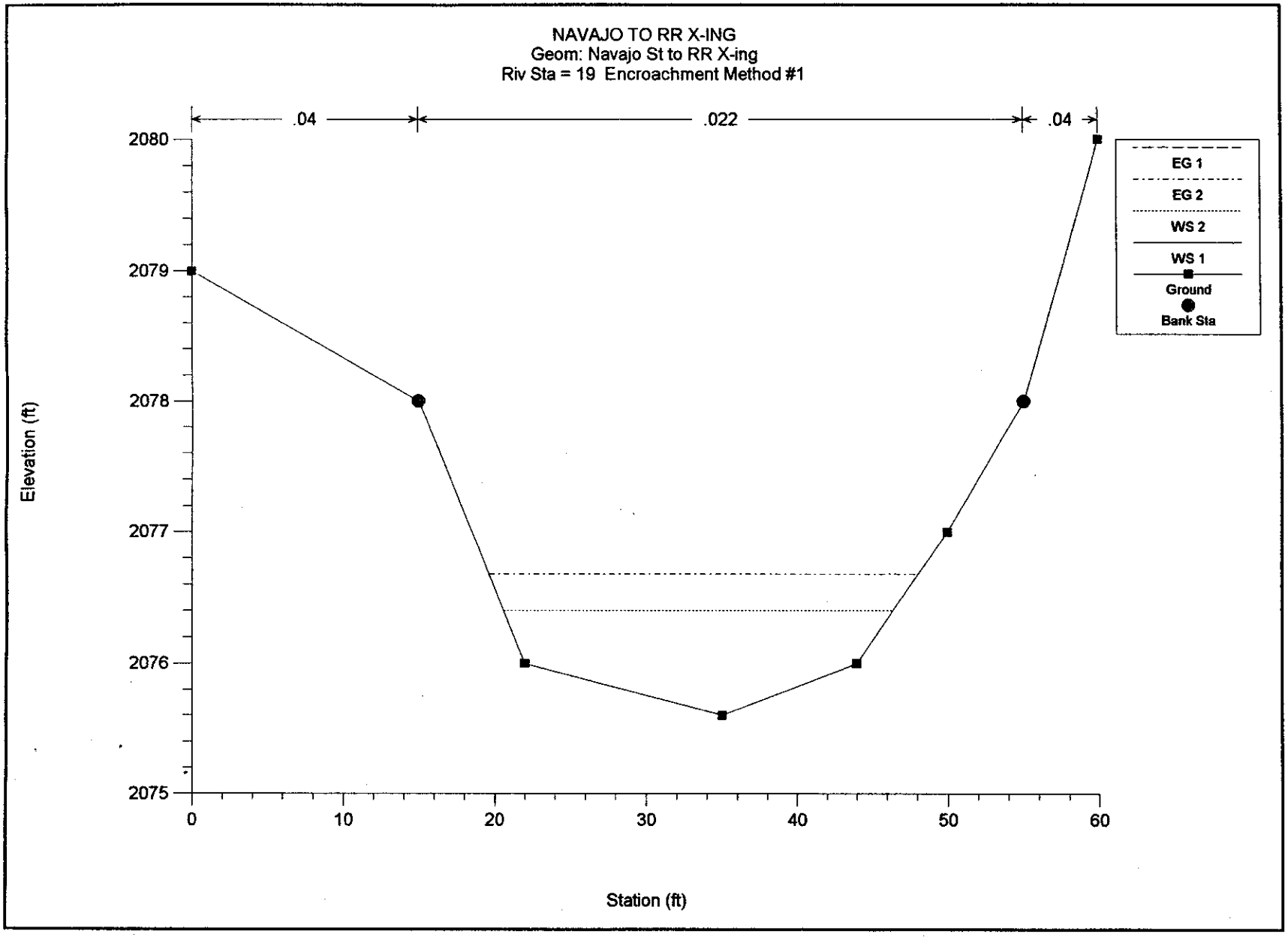

NAVAJO TO RR X-ING
Geom: Navajo St to RR X-ing
Riv Sta = 14 Encroachment Method #1
.022
.04
0
4
2071.0
2070.5
2070.0
2069.5
2069.0
2068.5
Elevation (ft)
10
20
30
40
50
60
Station (ft)
EG 1
EG 2
WS 2
WS 1
Ground
Bank Sta

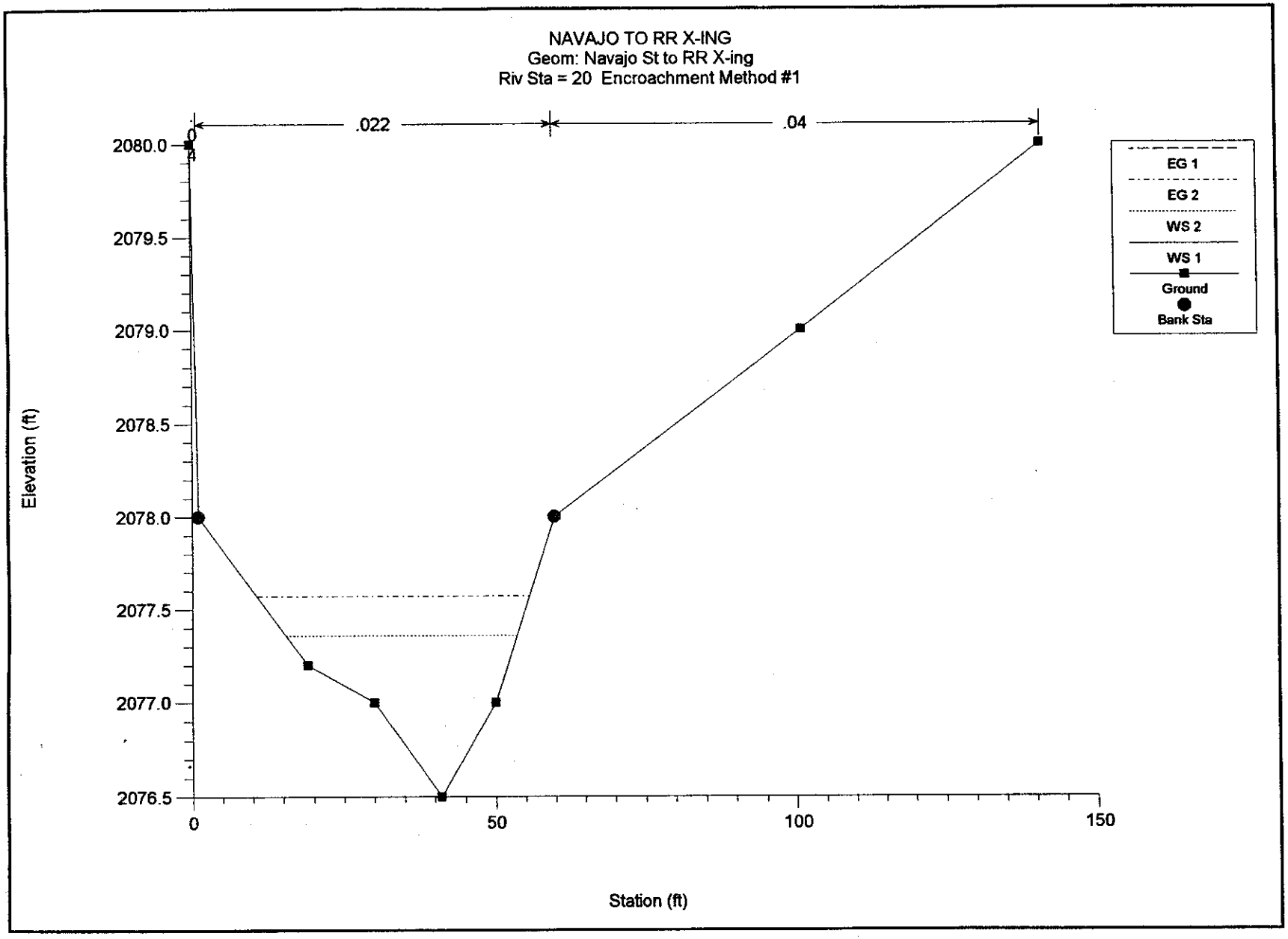

NAVAJO TO RR X-ING
Geom: Navajo St to RR X-ing
Riv Sta = 15 Encroachment Method #1
.04
.022
.04
2072.0
2071.8
2071.6
2071.4
2071.2
2071.0
2070.8
2070.6
Elevation (ft)
0
20
40
60
80
100
Station (ft)
EG 2
EG 1
WS 2
WS 1
Ground
Bank Sta

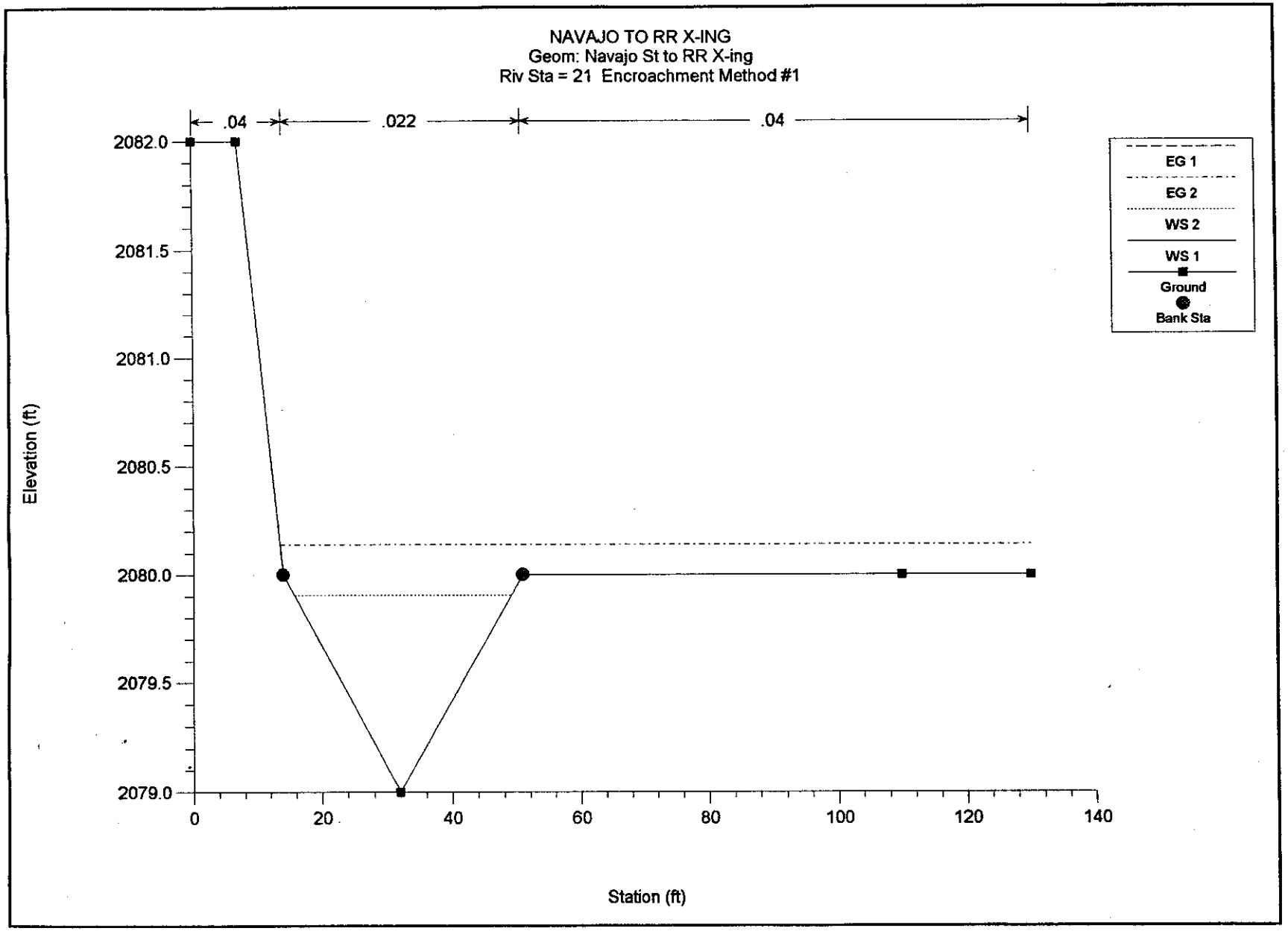

NAVAJO TO RR X-ING
Geom: Navajo St to RR X-ing
Riv Sta = 16 Encroachment Method #1
.04
.022
0
4
EG 1
EG 2
WS 2
WS 1
Ground
Bank Sta
Elevation (ft)
2074.0
2073.5
2073.0
2072.5
2072.0
2071.5
0
10
20
30
40
50
60
Station (ft)

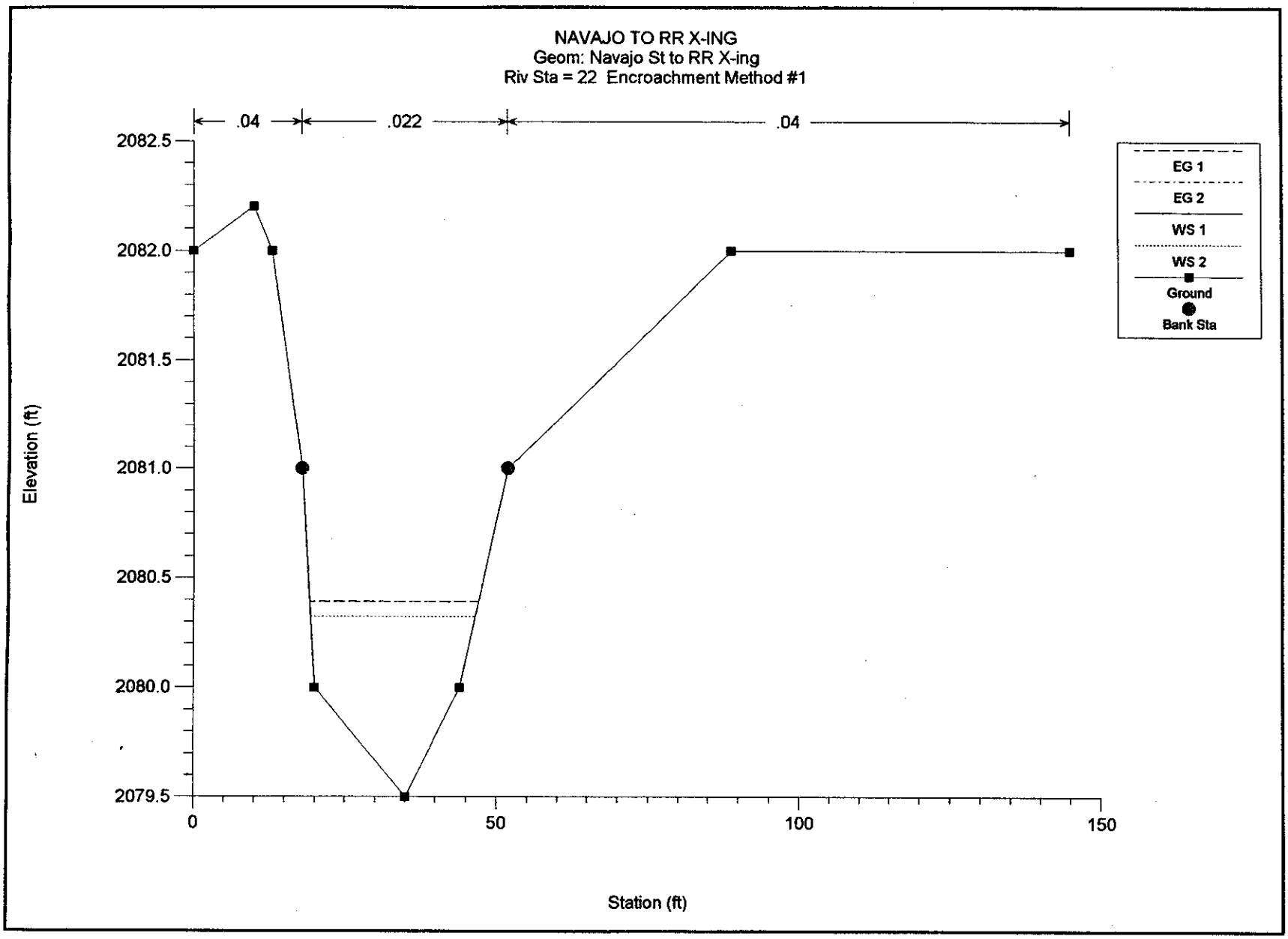

NAVAJO TO RR X-ING
Geom: Navajo St to RR X-ing
Riv Sta = 17 Encroachment Method #1
.04
.022
.04
2076.0
2075.5
2075.0
2074.5
2074.0
2073.5
2073.0
2072.5
2072.0
Elevation (ft)
0
20
40
60
80
100
Station (ft)
EG 2
EG 1
WS 1
WS 2
Ground
Bank Sta

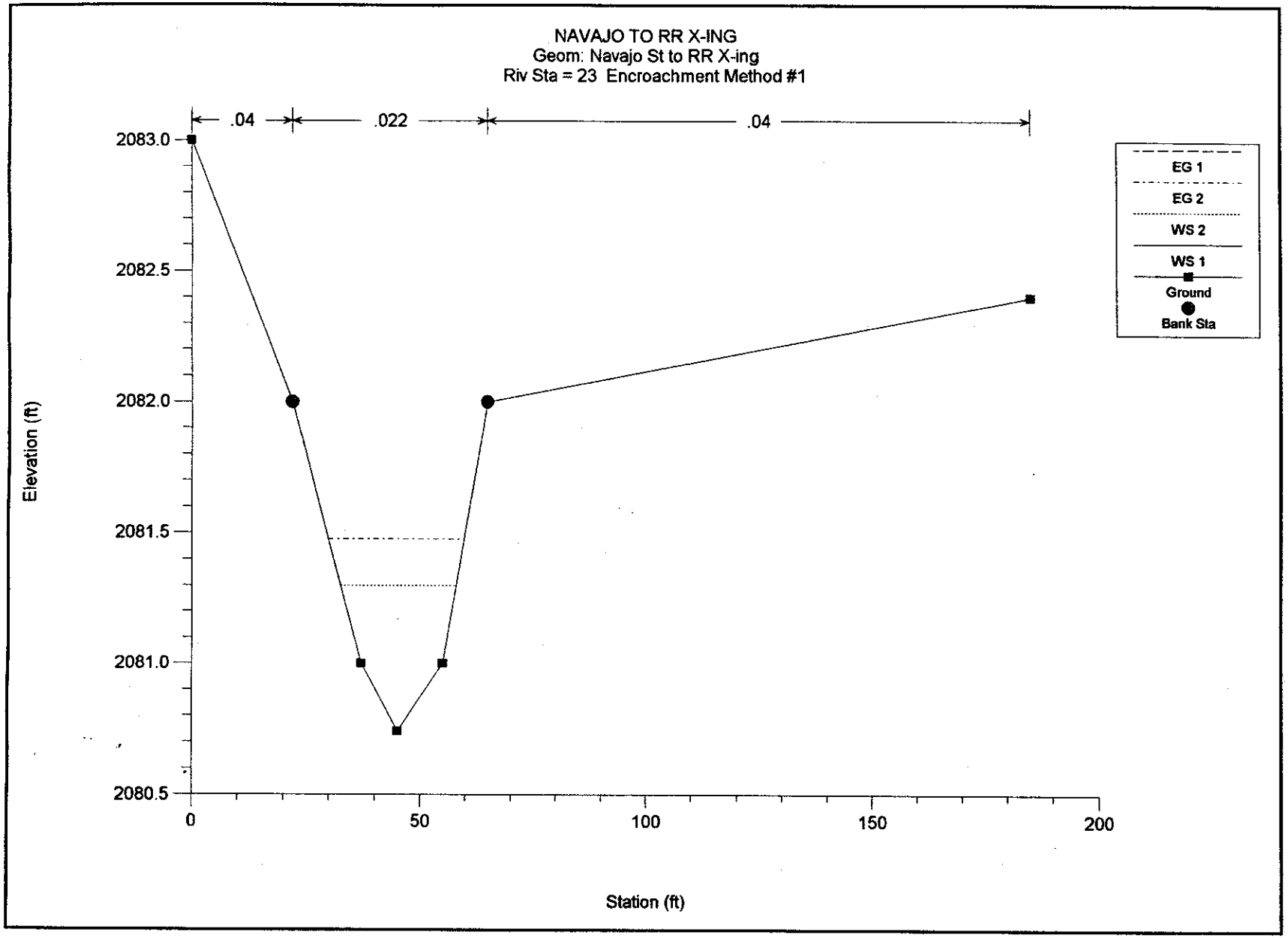

NAVAJO TO RR X-ING
Geom: Navajo St to RR X-ing
Riv Sta = 18 Encroachment Method #1
.04
.022
.04
2077.0
2076.5
2076.0
2075.5
2075.0
2074.5
Elevation (ft)
0
50
100
150
200
Station (ft)
EG 1
EG 2
WS 2
WS 1
Ground
Bank Sta

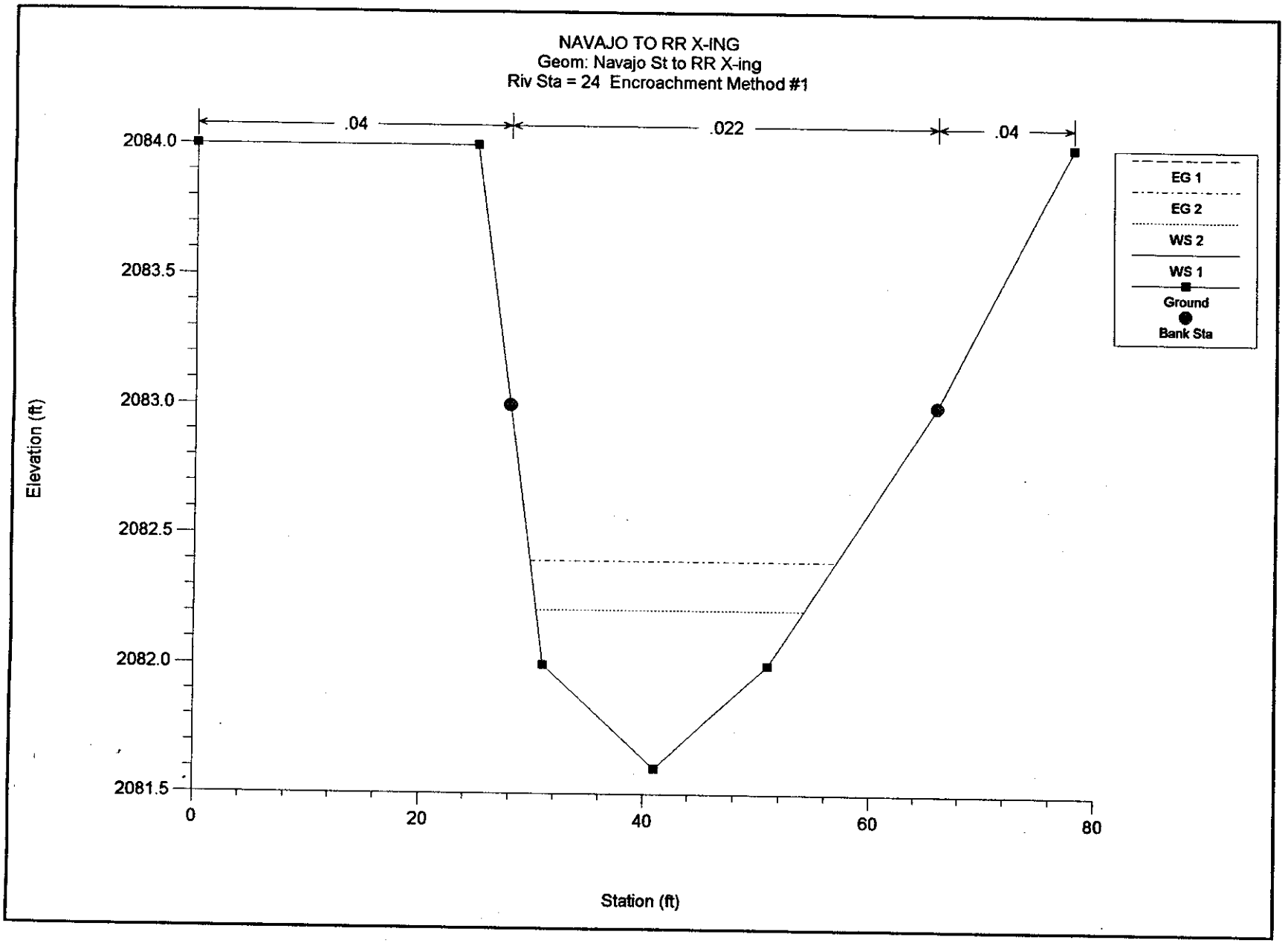

NAVAJO TO RR X-ING
Geom: Navajo St to RR X-ing
Riv Sta = 19 Encroachment Method #1
.04
.022
.04
EG 1
EG 2
WS 2
WS 1
Ground
Bank Sta
Elevation (ft)
2080
2079
2078
2077
2076
2075
0
10
20
30
40
50
60
Station (ft)

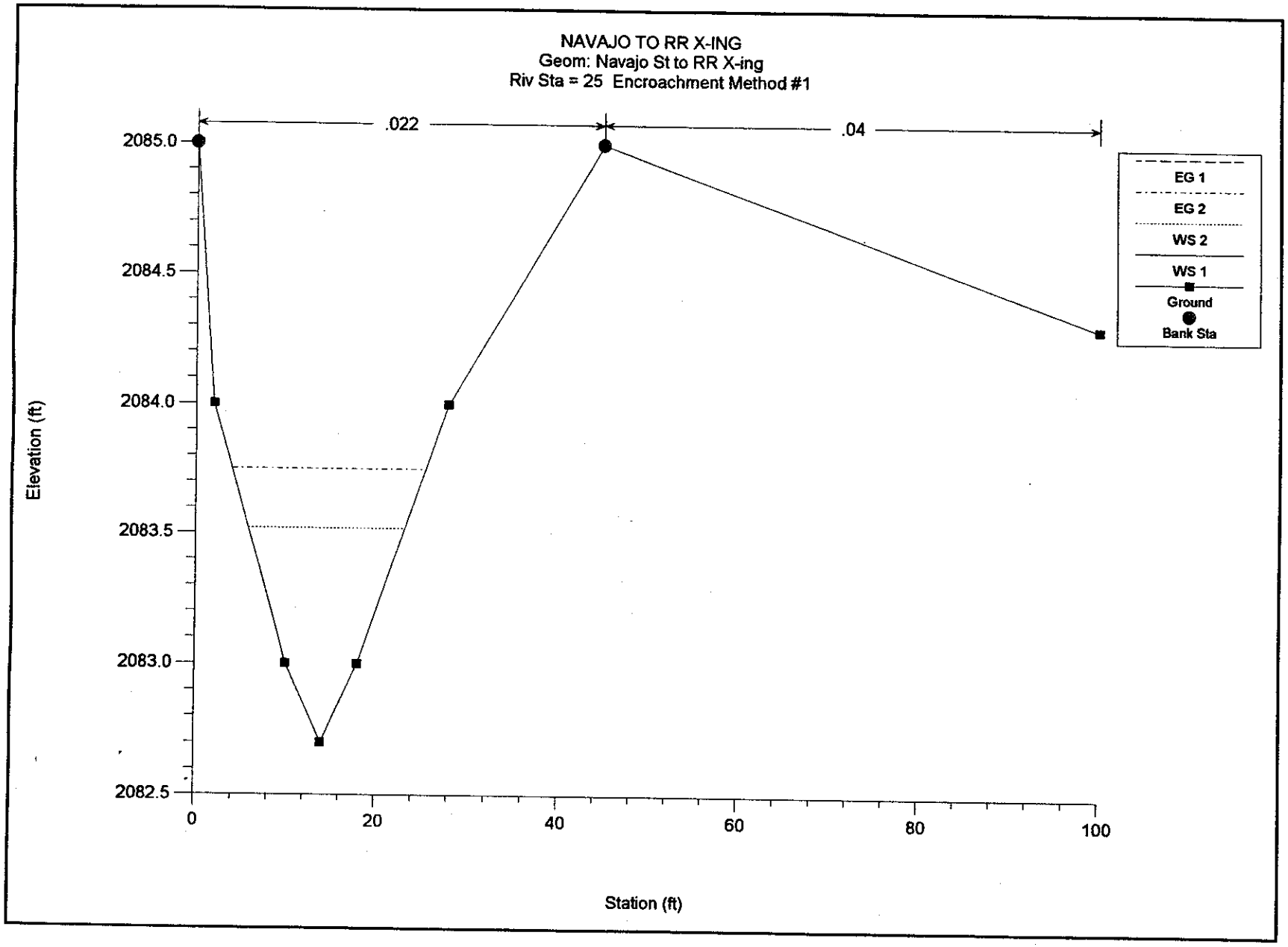

NAVAJO TO RR X-ING
Geom: Navajo St to RR X-ing
Riv Sta = 20 Encroachment Method #1
.022
.04
EG 1
EG 2
WS 2
WS 1
Ground
Bank Sta
Elevation (ft)
2080.0
2079.5
2079.0
2078.5
2078.0
2077.5
2077.0
2076.5
0
50
100
150
Station (ft)

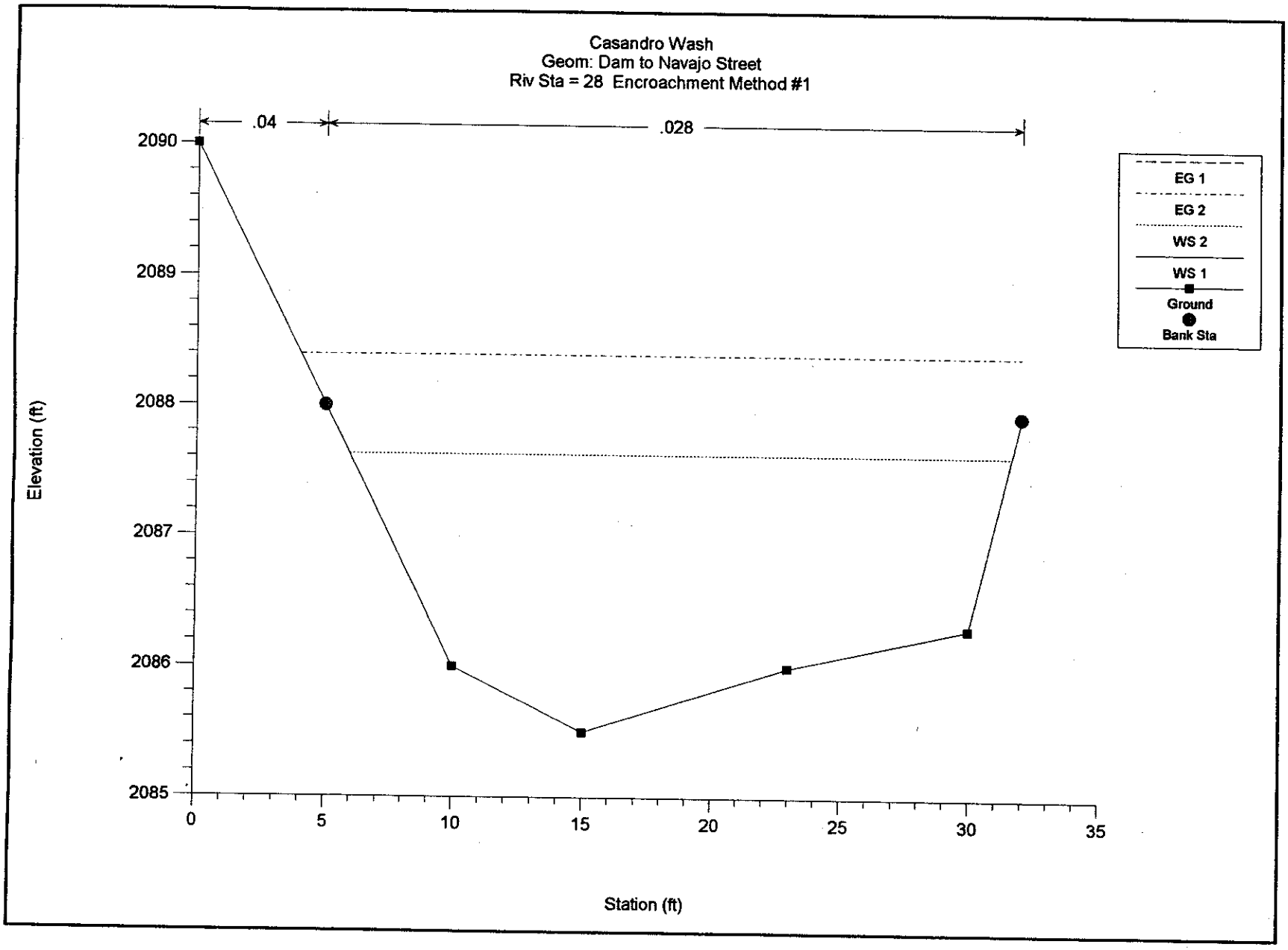

NAVAJO TO RR X-ING
Geom: Navajo St to RR X-ing
Riv Sta = 21 Encroachment Method #1
.04
.022
.04
EG 1
EG 2
WS 2
WS 1
Ground
Bank Sta
Elevation (ft)
2082.0
2081.5
2081.0
2080.5
2080.0
2079.5
2079.0
0
20
40
60
80
100
120
140
Station (ft)

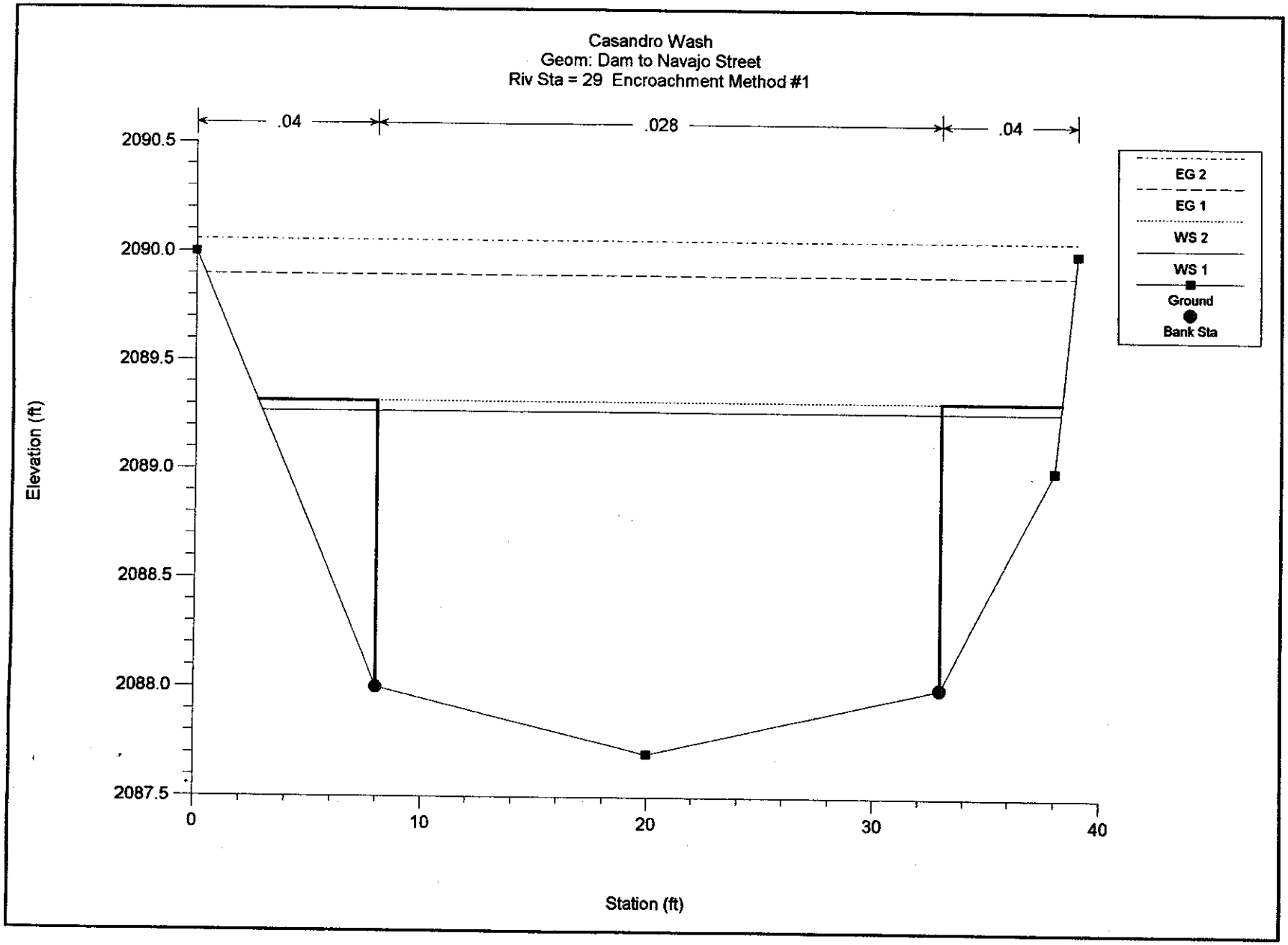

NAVAJO TO RR X-ING
Geom: Navajo St to RR X-ing
Riv Sta = 22 Encroachment Method #1
.04
.022
.04
2082.5
2082.0
2081.5
2081.0
2080.5
2080.0
2079.5
Elevation (ft)
0
50
100
150
Station (ft)
EG 1
EG 2
WS 1
WS 2
Ground
Bank Sta

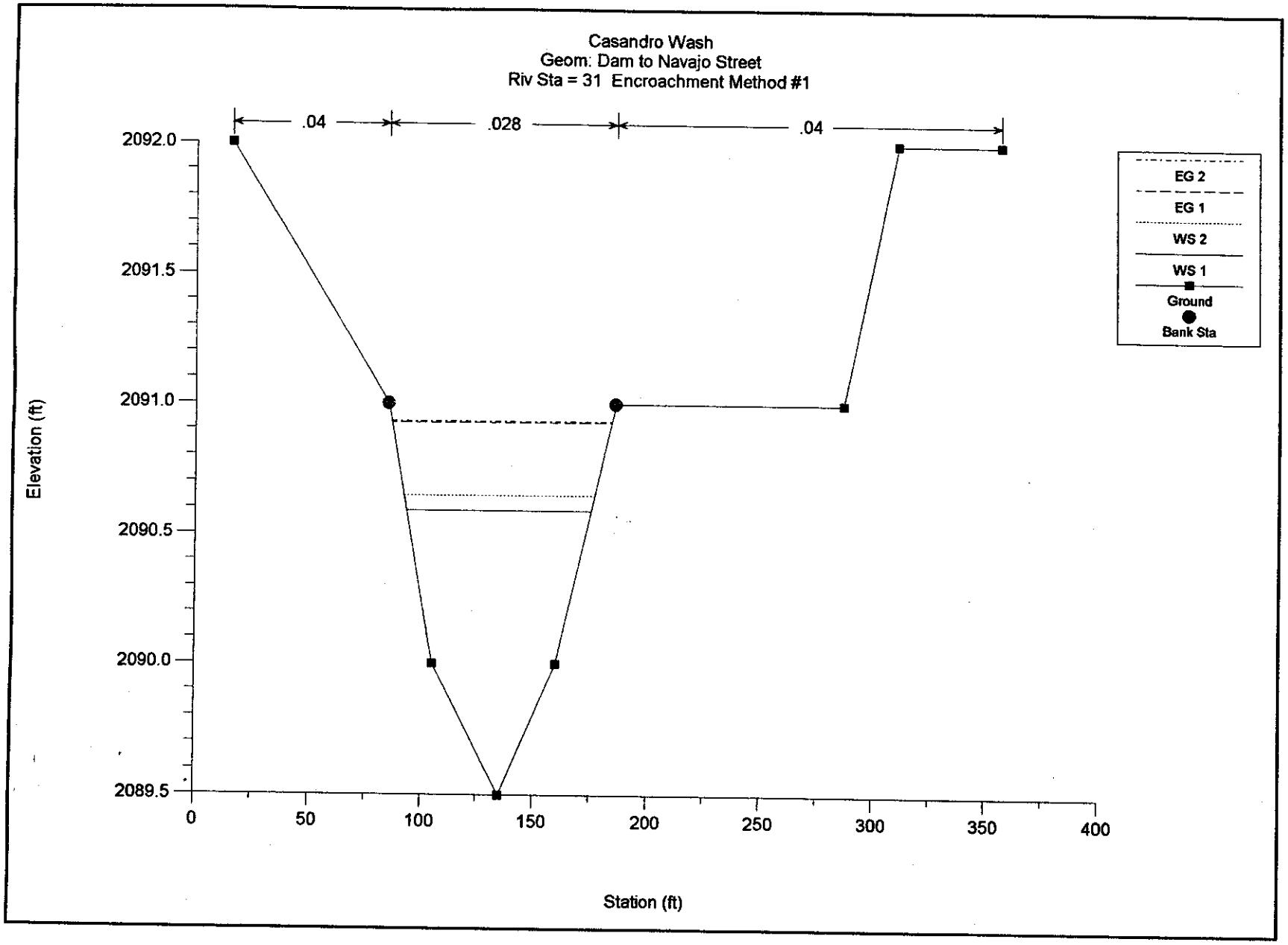

NAVAJO TO RR X-ING
Geom: Navajo St to RR X-ing
Riv Sta = 23 Encroachment Method #1
.04
.022
.04
2083.0
2082.5
2082.0
2081.5
2081.0
2080.5
Elevation (ft)
0
50
100
150
200
Station (ft)
EG 1
EG 2
WS 2
WS 1
Ground
Bank Sta

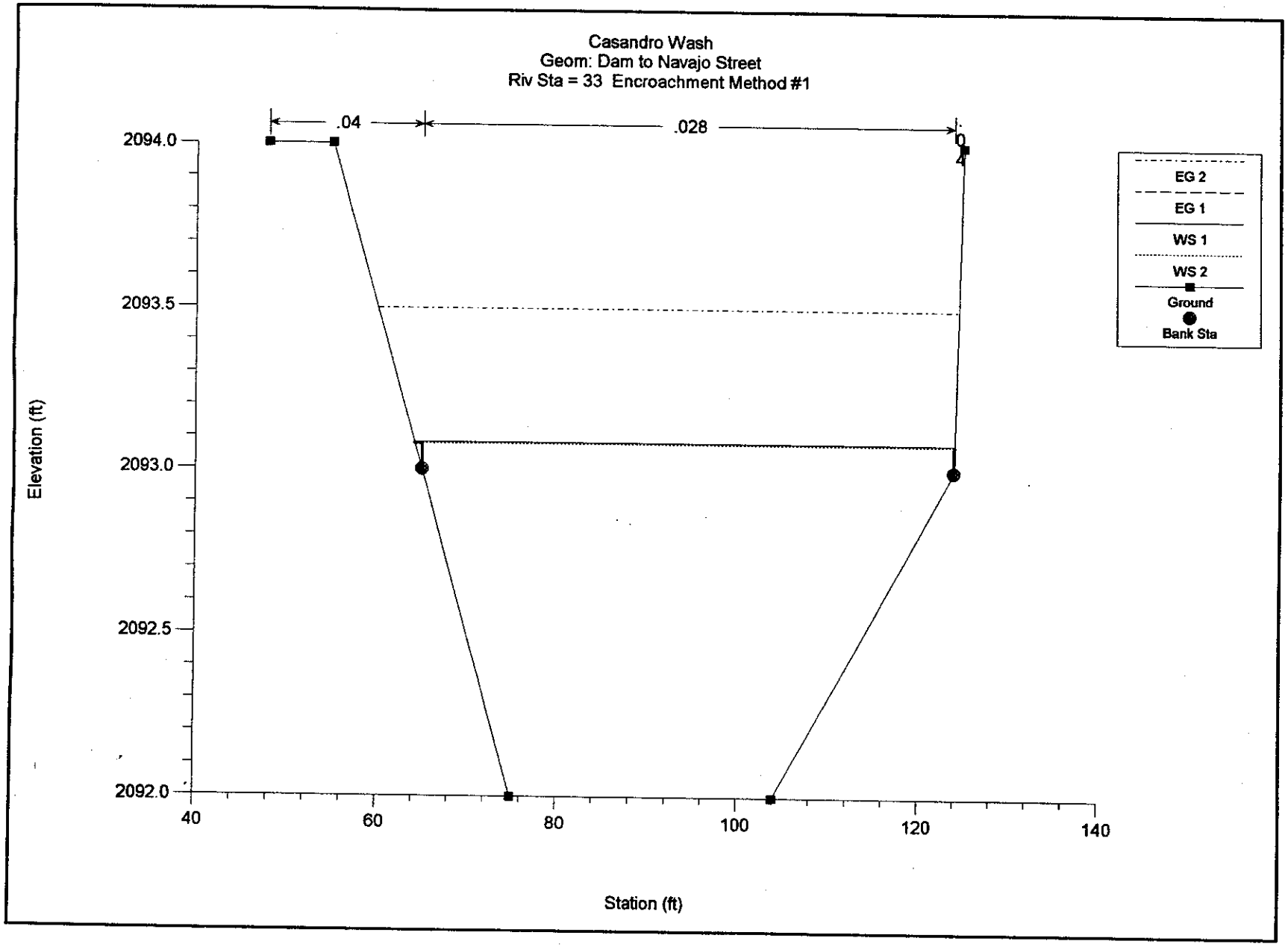

NAVAJO TO RR X-ING
Geom: Navajo St to RR X-ing
Riv Sta = 24 Encroachment Method #1
.04
.022
.04
2084.0
2083.5
2083.0
2082.5
2082.0
2081.5
Elevation (ft)
0
20
40
60
80
Station (ft)
EG 1
EG 2
WS 2
WS 1
Ground
Bank Sta

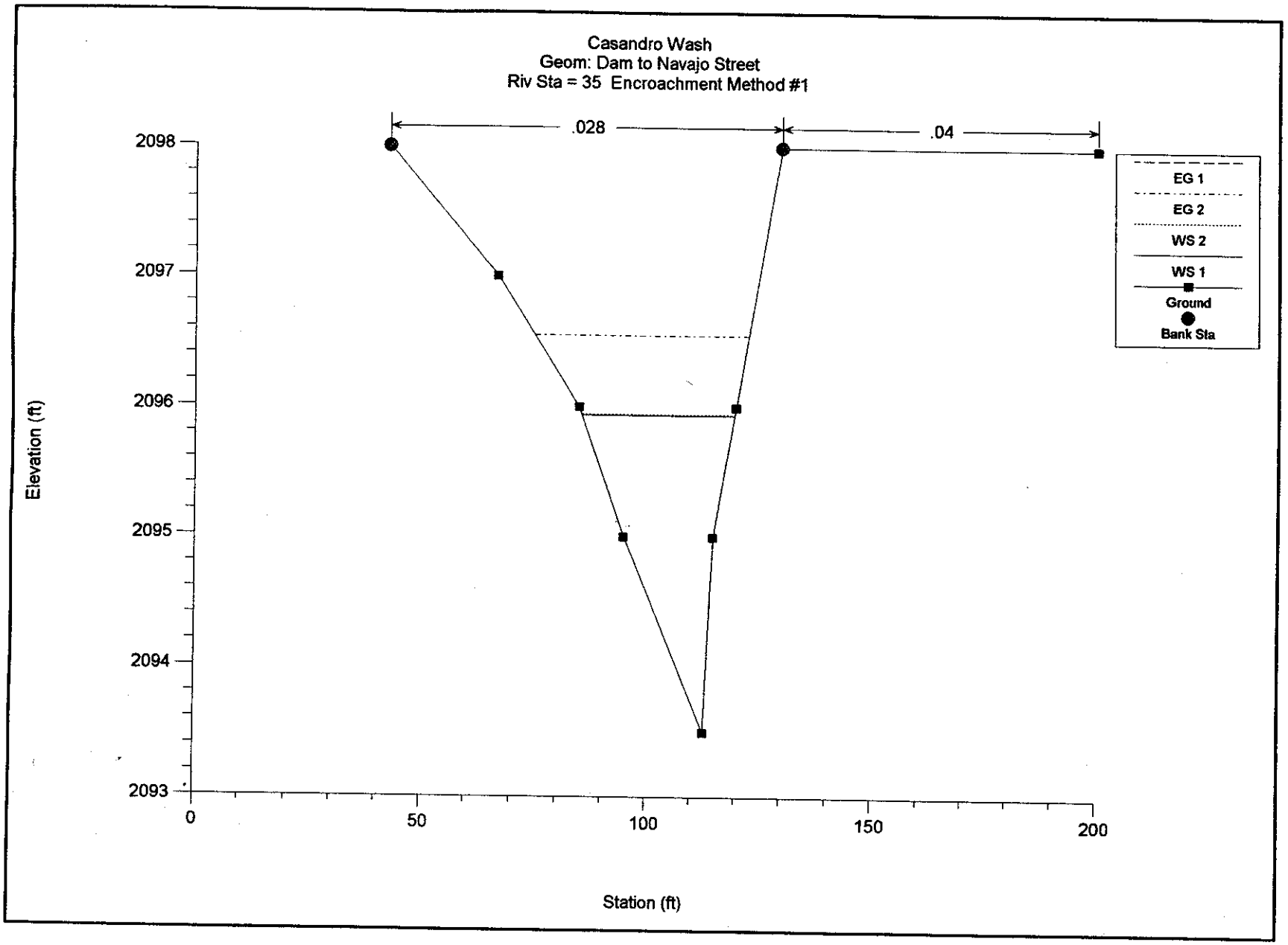

NAVAJO TO RR X-ING
Geom: Navajo St to RR X-ing
Riv Sta = 25 Encroachment Method #1
.022
.04
EG 1
EG 2
WS 2
WS 1
Ground
Bank Sta
Elevation (ft)
2085.0
2084.5
2084.0
2083.5
2083.0
2082.5
0
20
40
60
80
100
Station (ft)

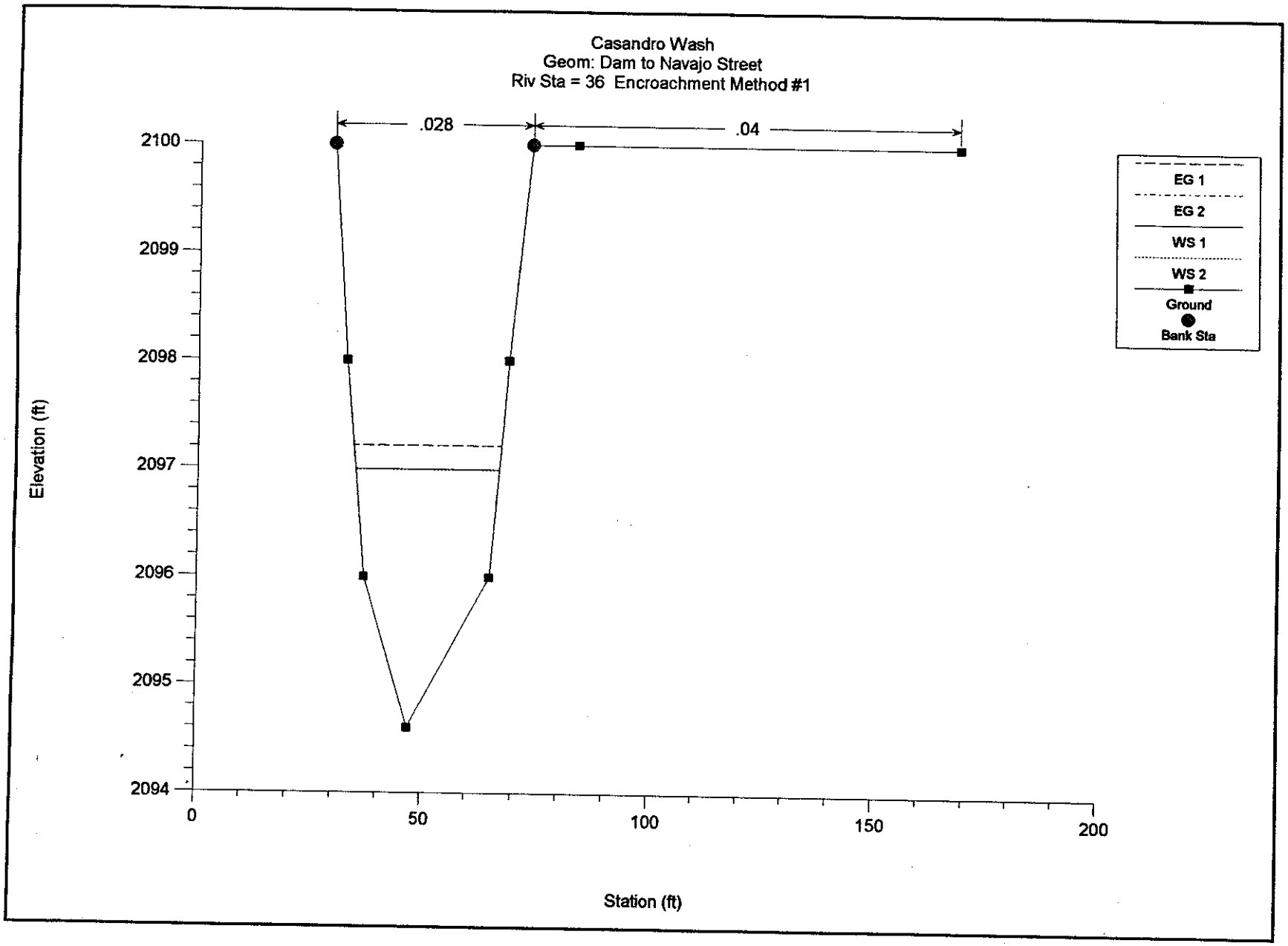

Casandro Wash
Geom: Dam to Navajo Street
Riv Sta = 28 Encroachment Method #1
.04
.028
EG 1
EG 2
WS 2
WS 1
Ground
Bank Sta
Elevation (ft)
2090
2089
2088
2087
2086
2085
0
5
10
15
20
25
30
35
Station (ft)

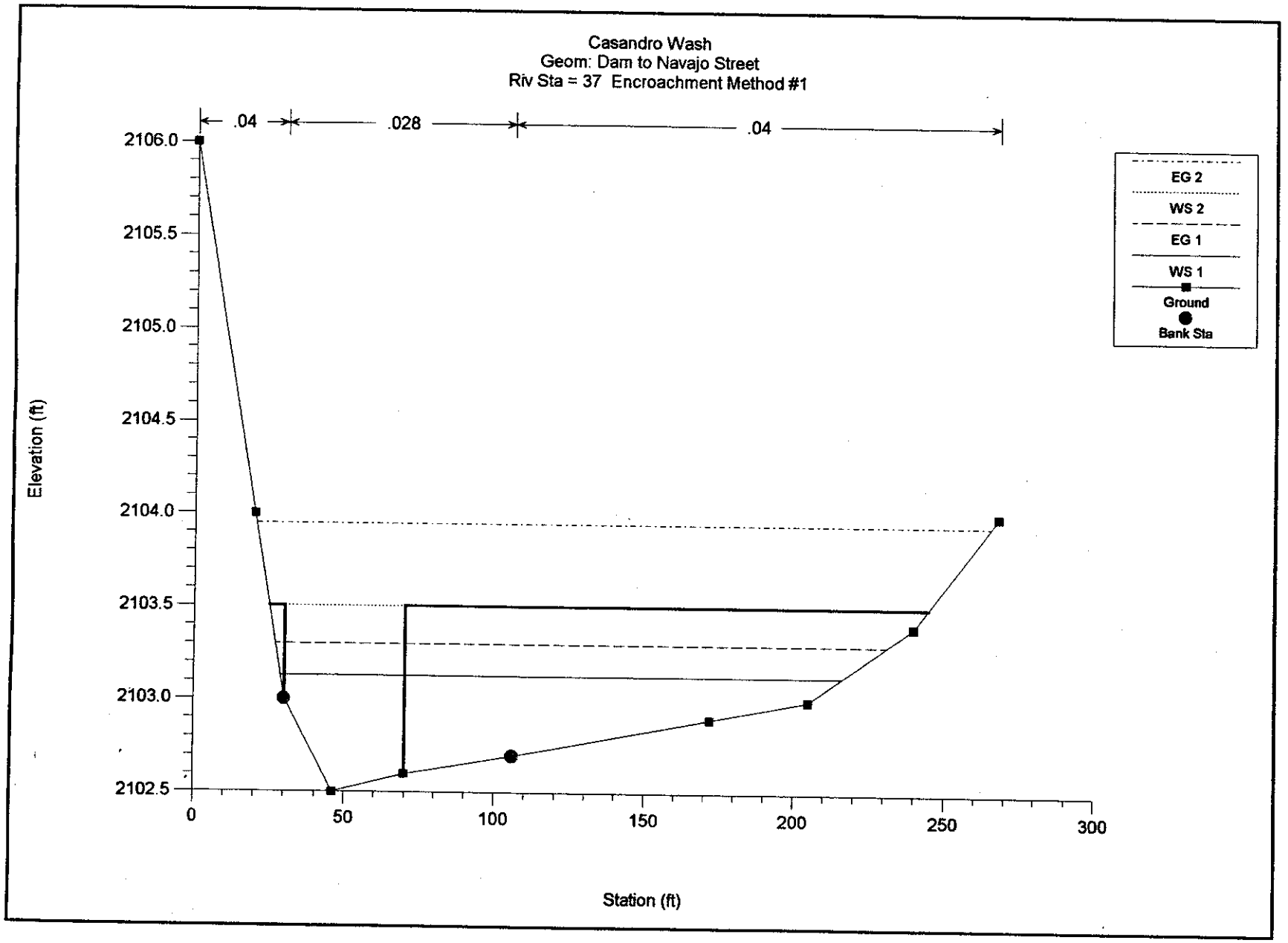

Casandro Wash
Geom: Dam to Navajo Street
Riv Sta = 29 Encroachment Method #1
.04
.028
.04
EG 2
EG 1
WS 2
WS 1
Ground
Bank Sta
Elevation (ft)
2090.5
2090.0
2089.5
2089.0
2088.5
2088.0
2087.5
0
10
20
30
40
Station (ft)

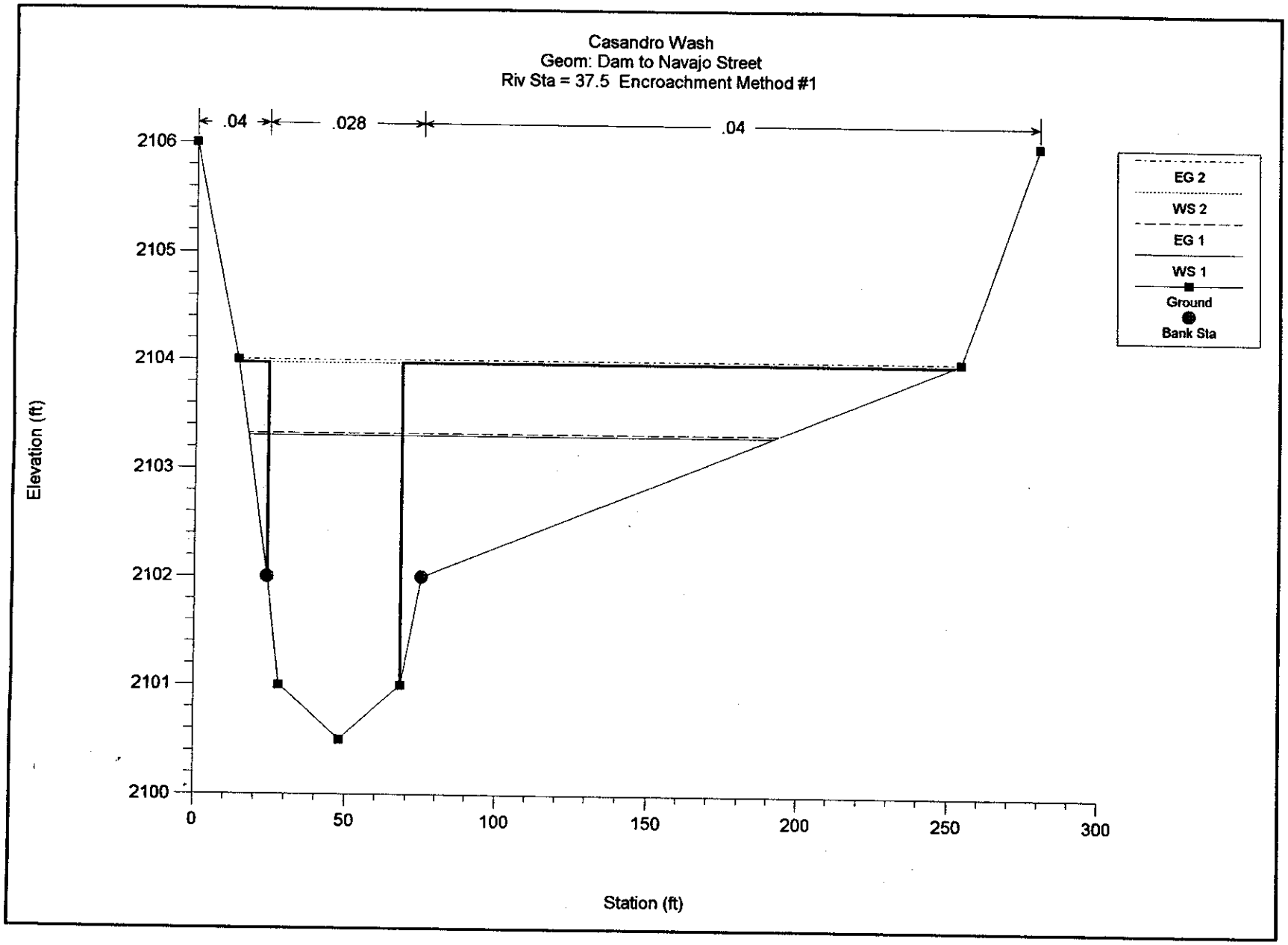

Casandro Wash
Geom: Dam to Navajo Street
Riv Sta = 31 Encroachment Method #1
.04
.028
.04
EG 2
EG 1
WS 2
WS 1
Ground
Bank Sta
Elevation (ft)
2092.0
2091.5
2091.0
2090.5
2090.0
2089.5
0
50
100
150
200
250
300
350
400
Station (ft)

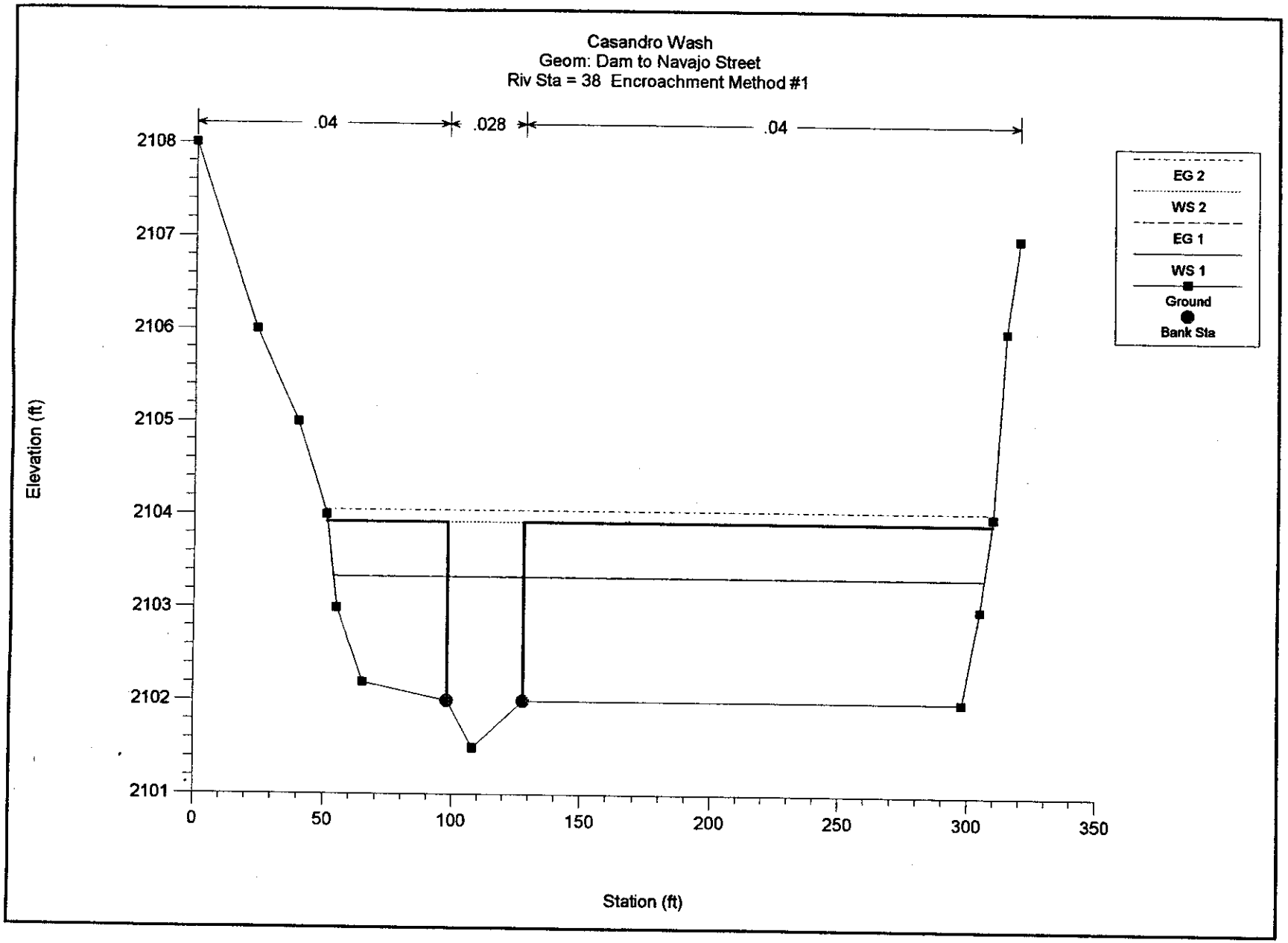

Casandro Wash
Geom: Dam to Navajo Street
Riv Sta = 33 Encroachment Method #1
.04
.028
0
2
2094.0
2093.5
2093.0
2092.5
2092.0
Elevation (ft)
40
60
80
100
120
140
Station (ft)
EG 2
EG 1
WS 1
WS 2
Ground
Bank Sta

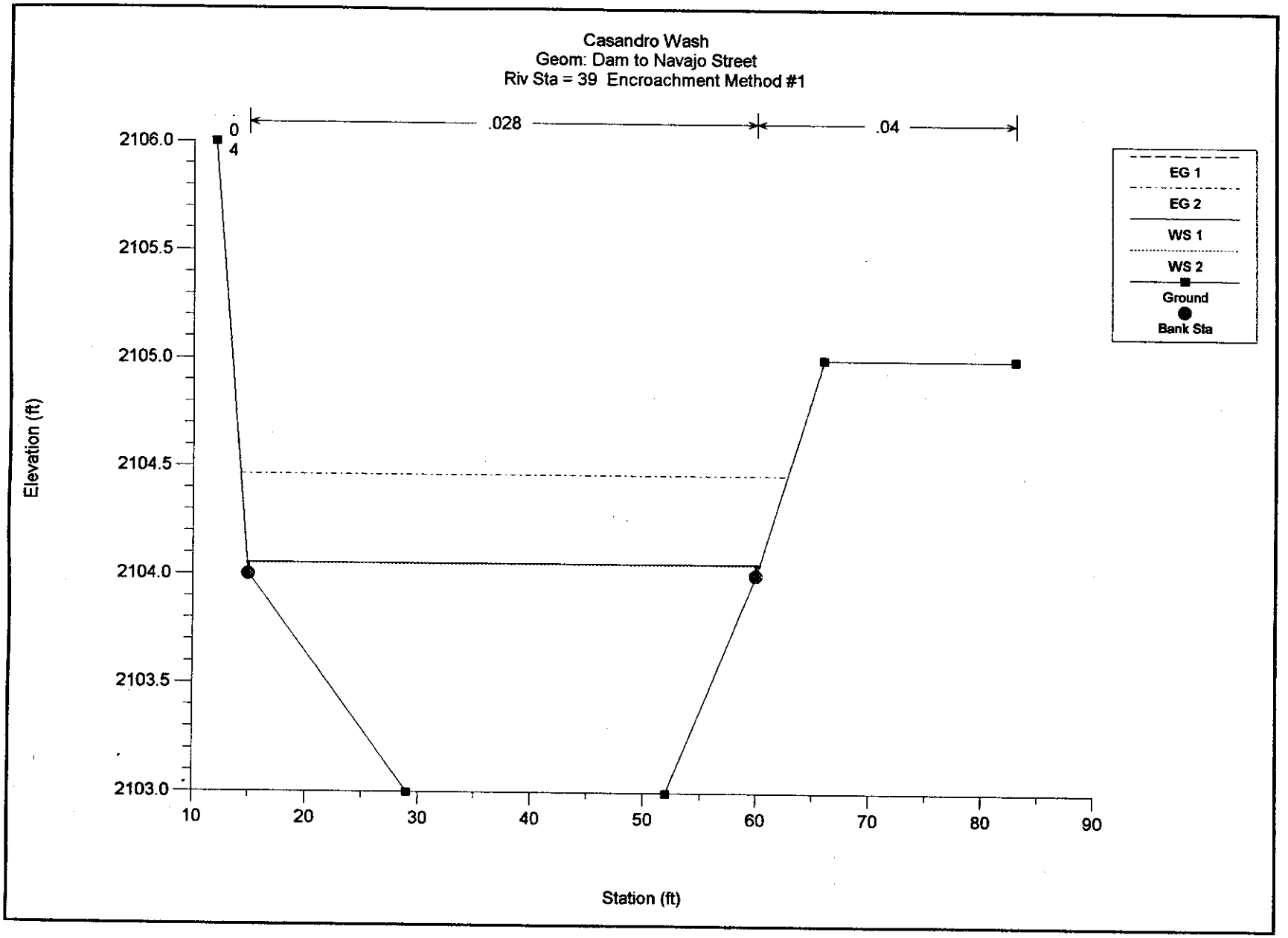

Casandro Wash
Geom: Dam to Navajo Street
Riv Sta = 35 Encroachment Method #1
.028
.04
EG 1
EG 2
WS 2
WS 1
Ground
Bank Sta
Elevation (ft)
2098
2097
2096
2095
2094
2093
0
50
100
150
200
Station (ft)

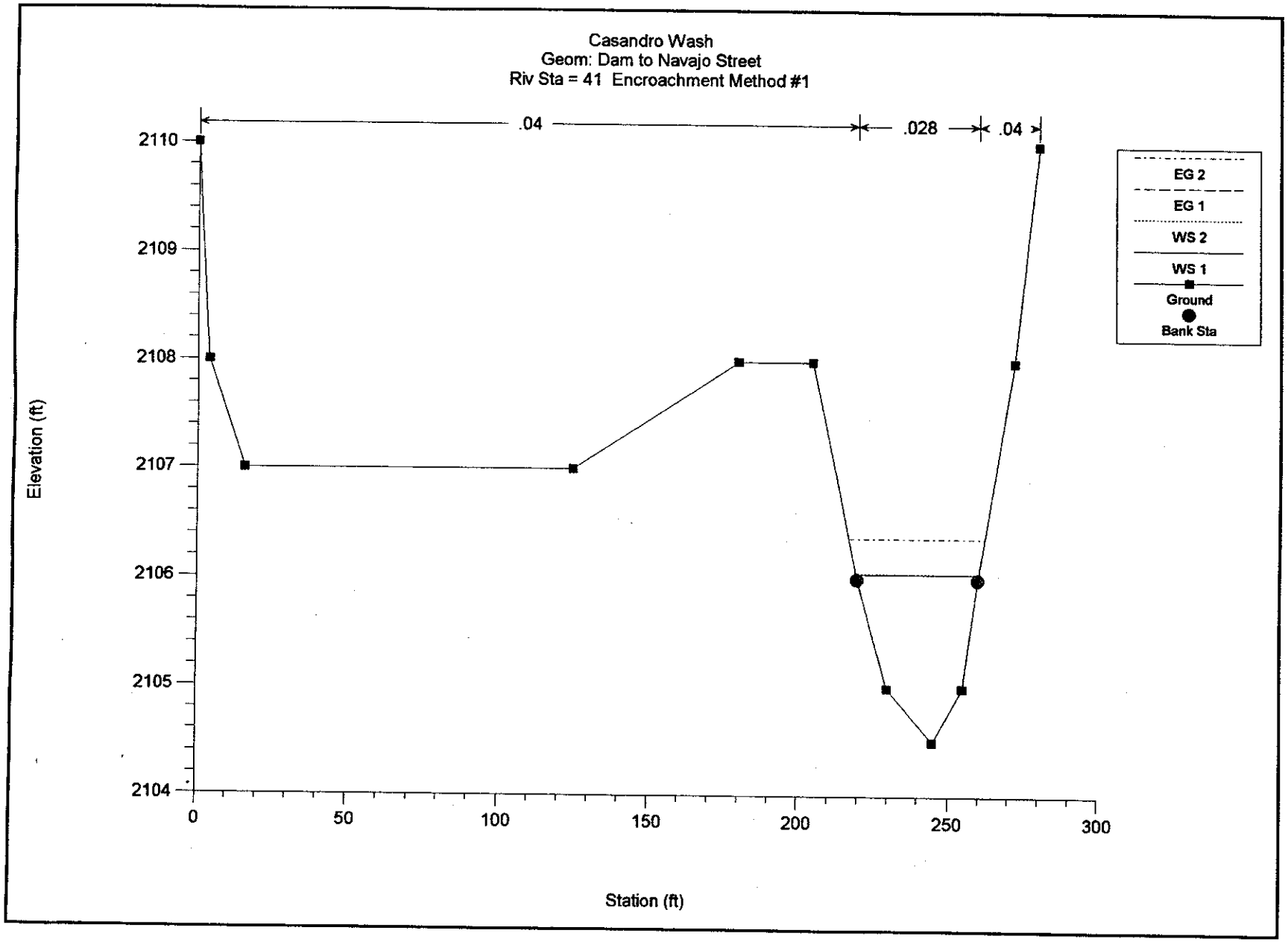

Casandro Wash
Geom: Dam to Navajo Street
Riv Sta = 36 Encroachment Method #1
.028
.04
EG 1
EG 2
WS 1
WS 2
Ground
Bank Sta
Elevation (ft)
2100
2099
2098
2097
2096
2095
2094
0
50
100
150
200
Station (ft)

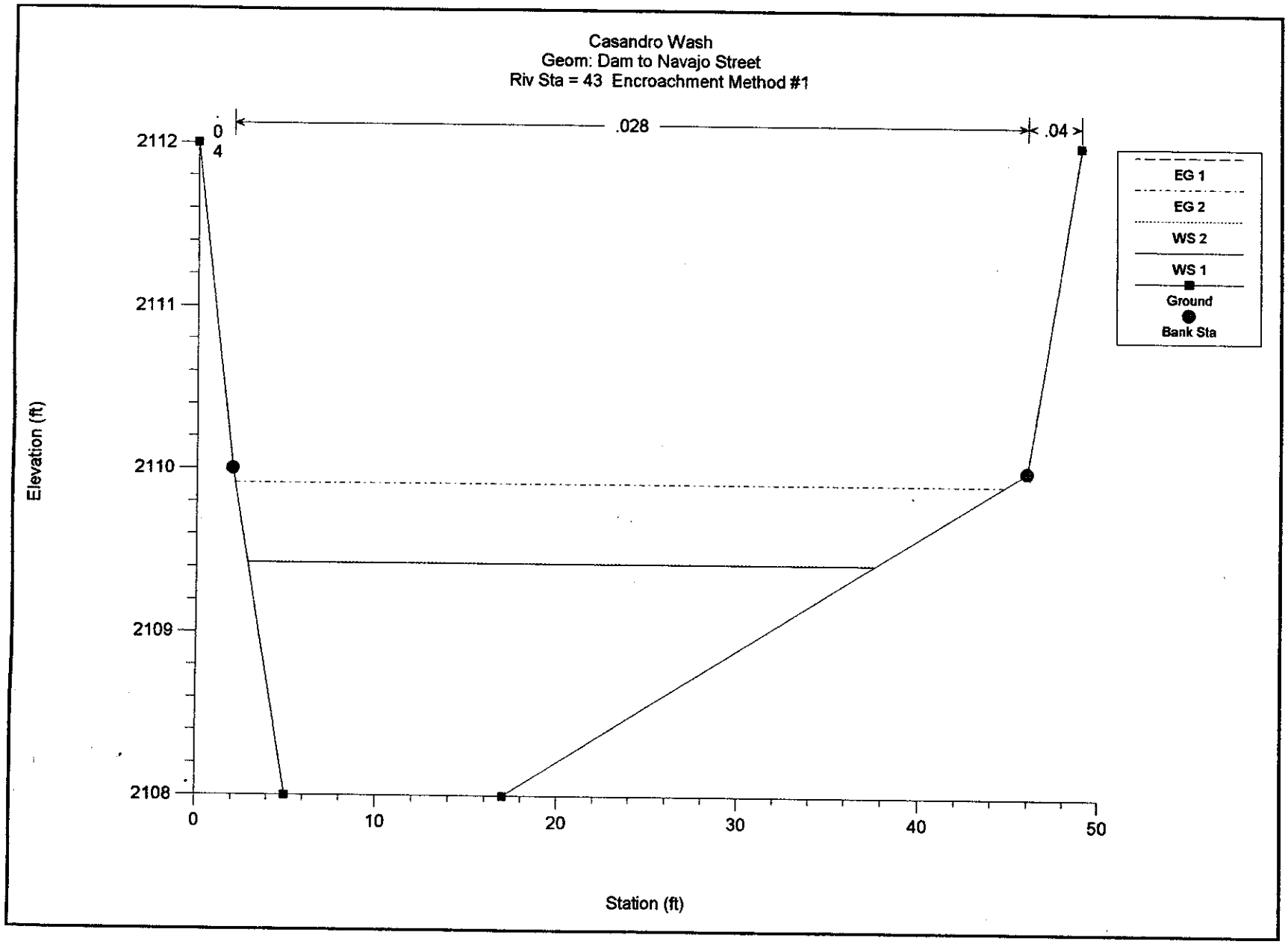

Casandro Wash
Geom: Dam to Navajo Street
Riv Sta = 37 Encroachment Method #1
.04
.028
.04
EG 2
WS 2
EG 1
WS 1
Ground
Bank Sta
Elevation (ft)
2106.0
2105.5
2105.0
2104.5
2104.0
2103.5
2103.0
2102.5
0
50
100
150
200
250
300
Station (ft)

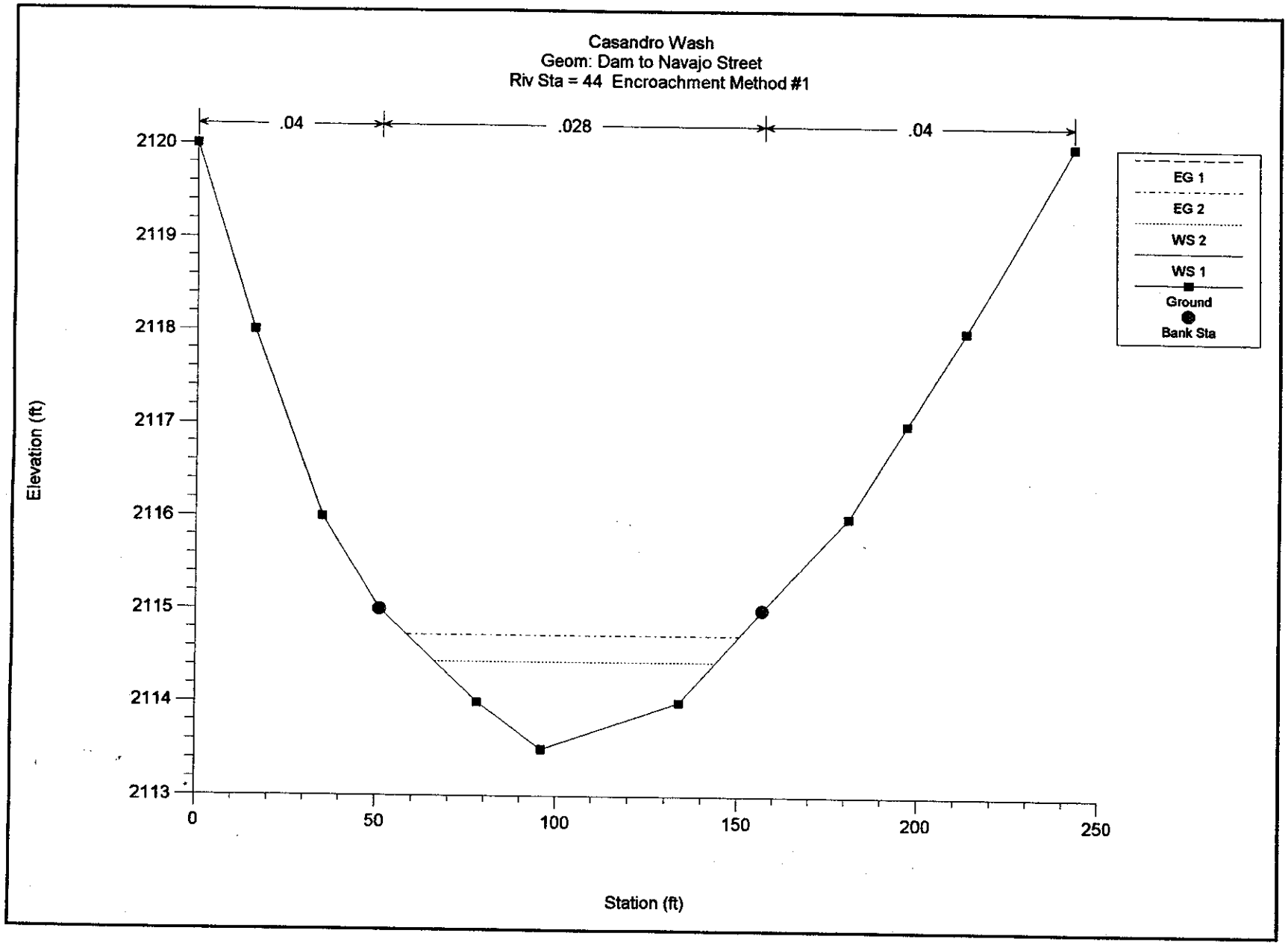

Casandro Wash
Geom: Dam to Navajo Street
Riv Sta = 37.5 Encroachment Method #1
.04
.028
.04
EG 2
WS 2
EG 1
WS 1
Ground
Bank Sta
Elevation (ft)
2106
2105
2104
2103
2102
2101
2100
0
50
100
150
200
250
300
Station (ft)

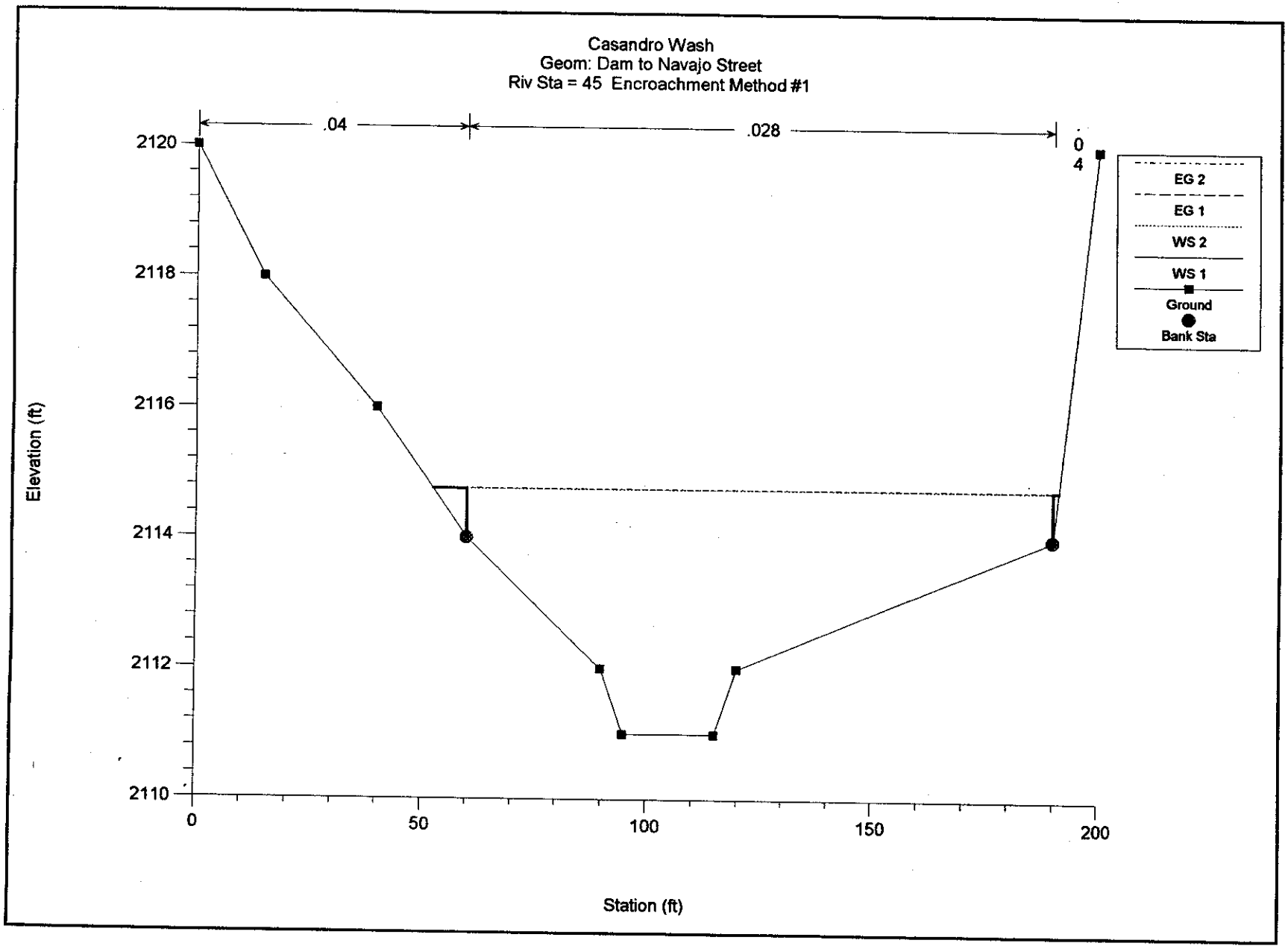

Casandro Wash
Geom: Dam to Navajo Street
Riv Sta = 38 Encroachment Method #1
.04
.028
.04
EG 2
WS 2
EG 1
WS 1
Ground
Bank Sta
Elevation (ft)
2108
2107
2106
2105
2104
2103
2102
2101
0
50
100
150
200
250
300
350
Station (ft)

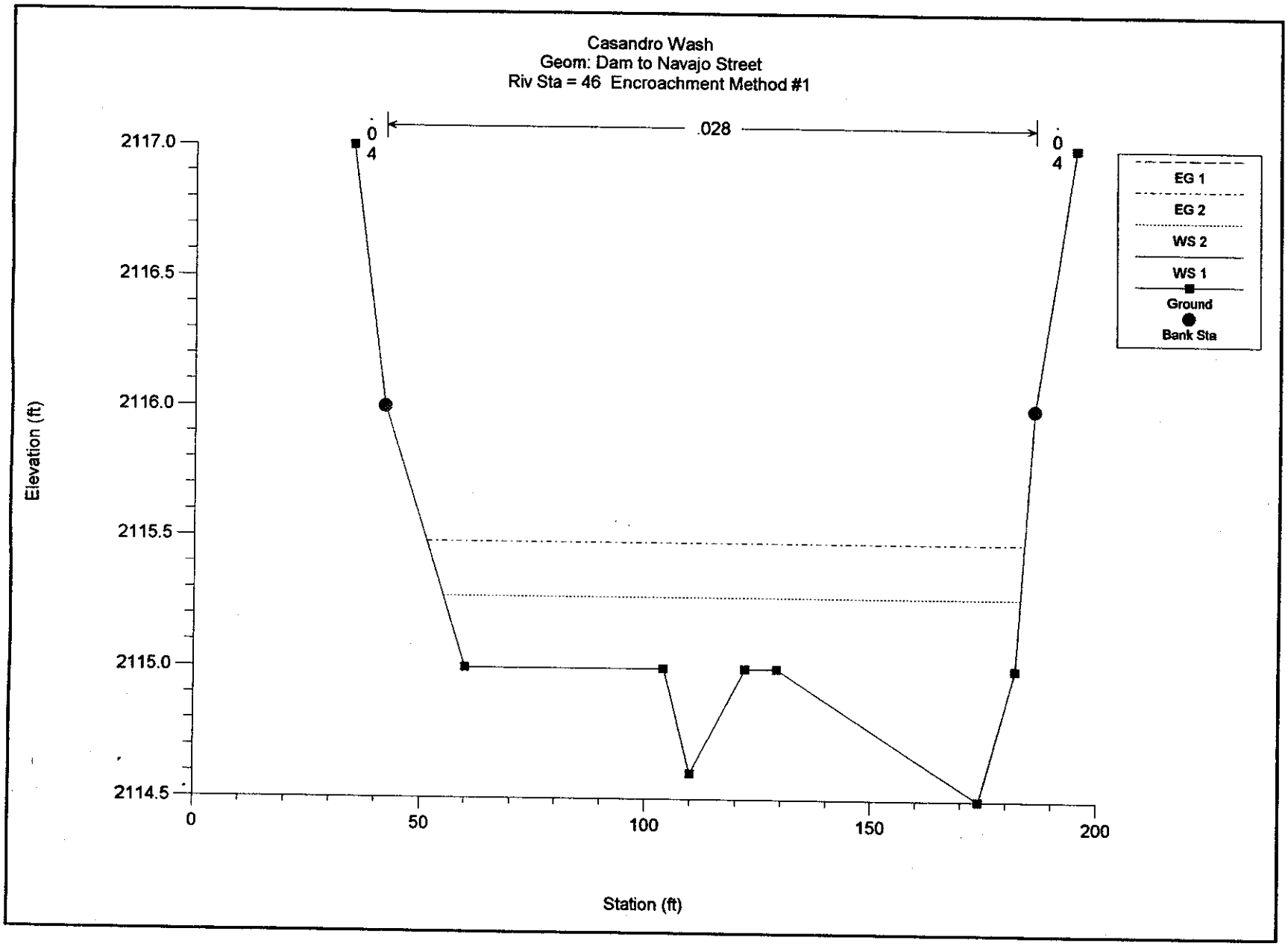

Casandro Wash
Geom: Dam to Navajo Street
Riv Sta = 39 Encroachment Method #1
.028
.04
0
4
EG 1
EG 2
WS 1
WS 2
Ground
Bank Sta
Elevation (ft)
2106.0
2105.5
2105.0
2104.5
2104.0
2103.5
2103.0
10
20
30
40
50
60
70
80
90
Station (ft)

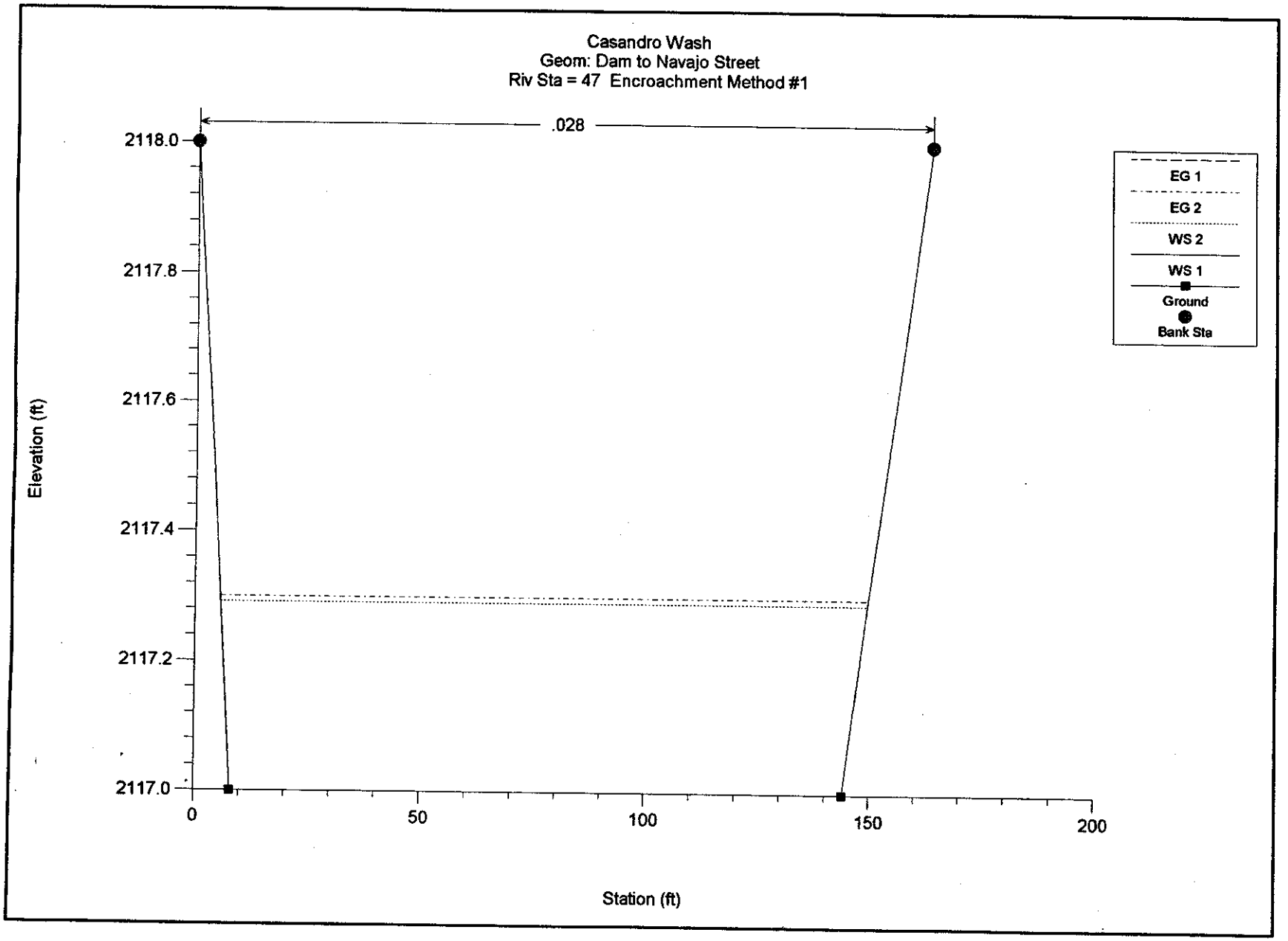

Casandro Wash
Geom: Dam to Navajo Street
Riv Sta = 41 Encroachment Method #1
.04
.028
.04
EG 2
EG 1
WS 2
WS 1
Ground
Bank Sta
Elevation (ft)
2110
2109
2108
2107
2106
2105
2104
0
50
100
150
200
250
300
Station (ft)

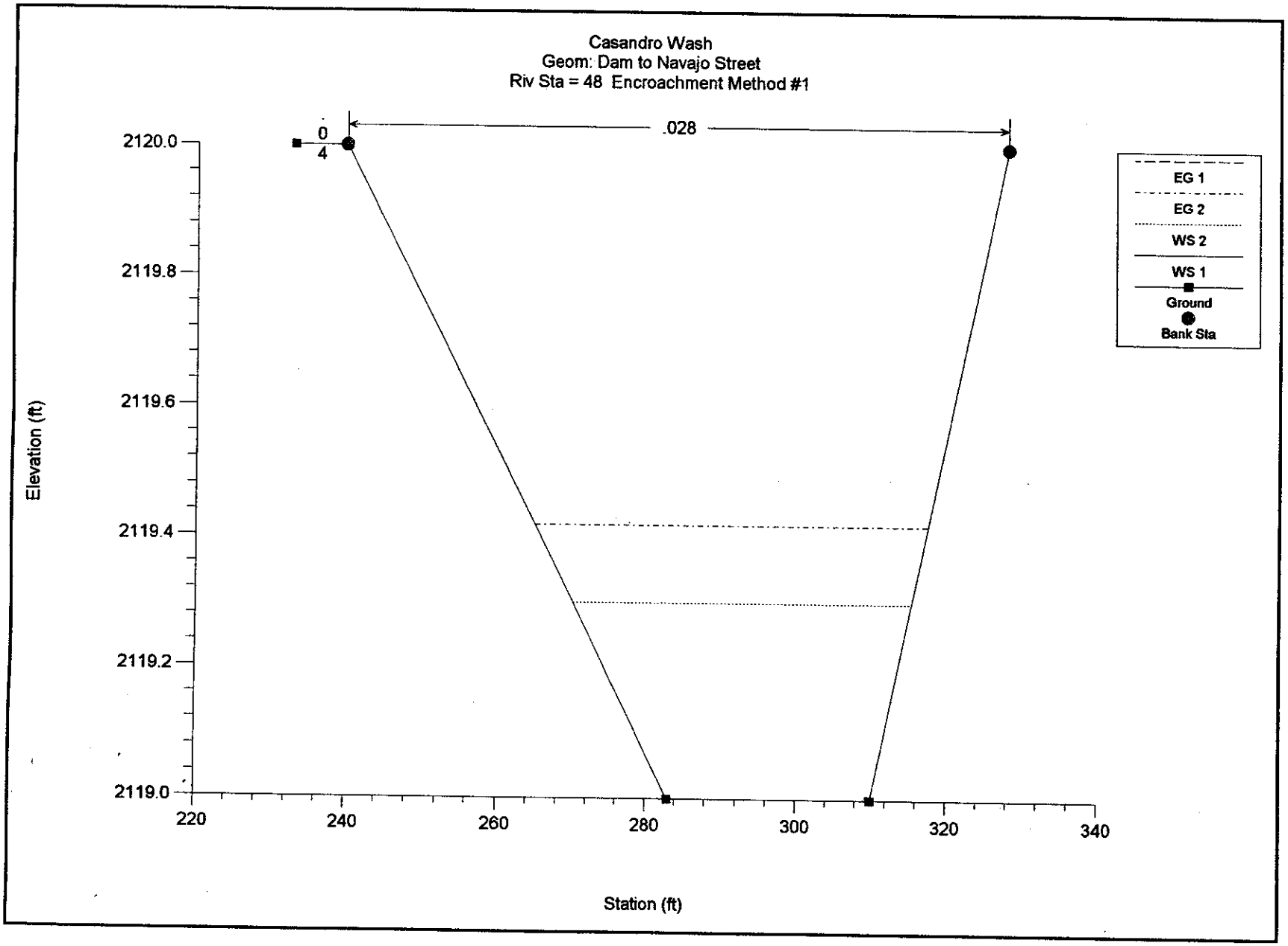

Casandro Wash
Geom: Dam to Navajo Street
Riv Sta = 43 Encroachment Method #1
.028
.04
0
4
2112
2111
2110
2109
2108
Elevation (ft)
0
10
20
30
40
50
Station (ft)
EG 1
EG 2
WS 2
WS 1
Ground
Bank Sta

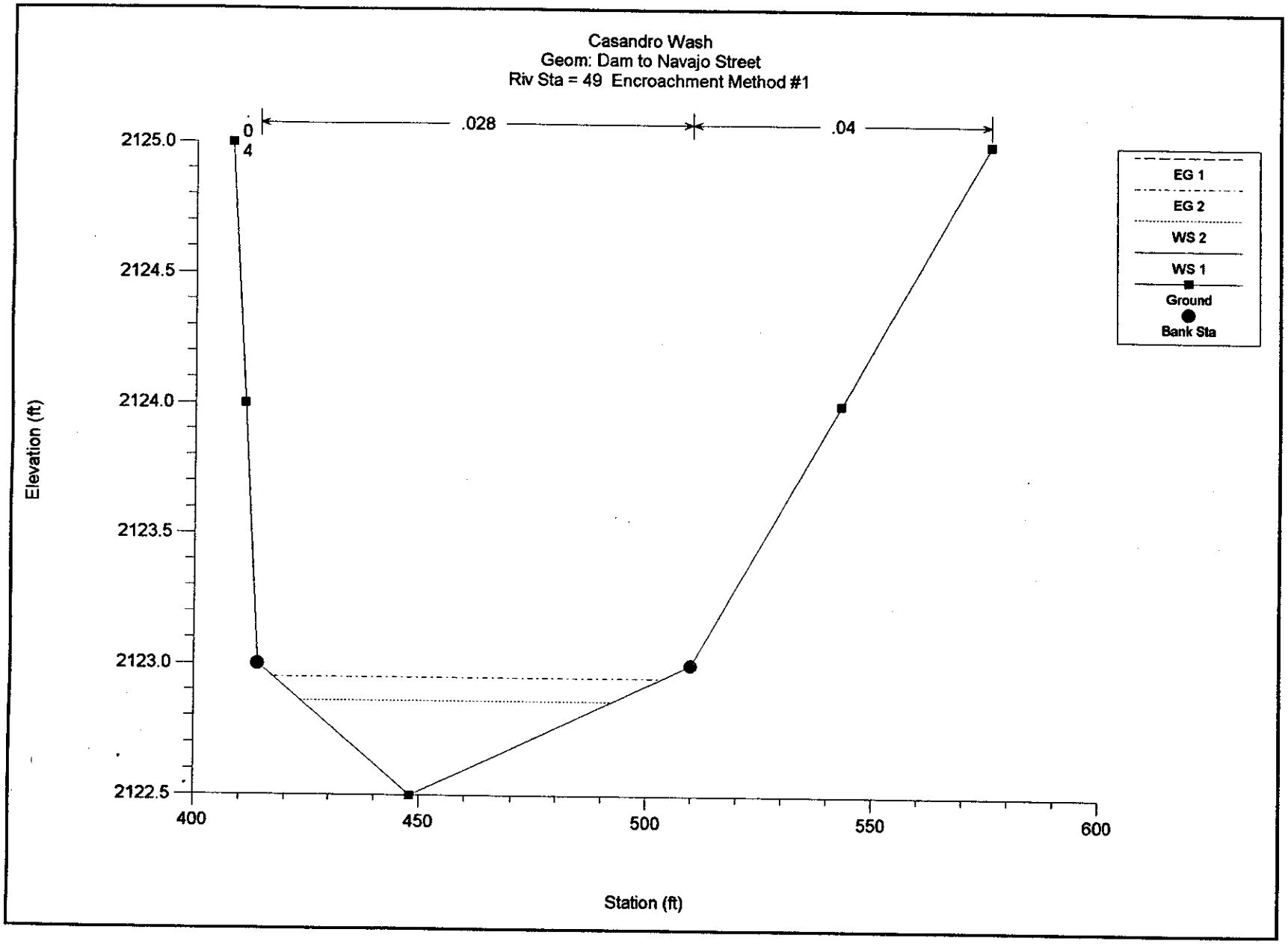

Casandro Wash
Geom: Dam to Navajo Street
Riv Sta = 44 Encroachment Method #1
.04
.028
.04
EG 1
EG 2
WS 2
WS 1
Ground
Bank Sta
Elevation (ft)
2120
2119
2118
2117
2116
2115
2114
2113
0
50
100
150
200
250
Station (ft)

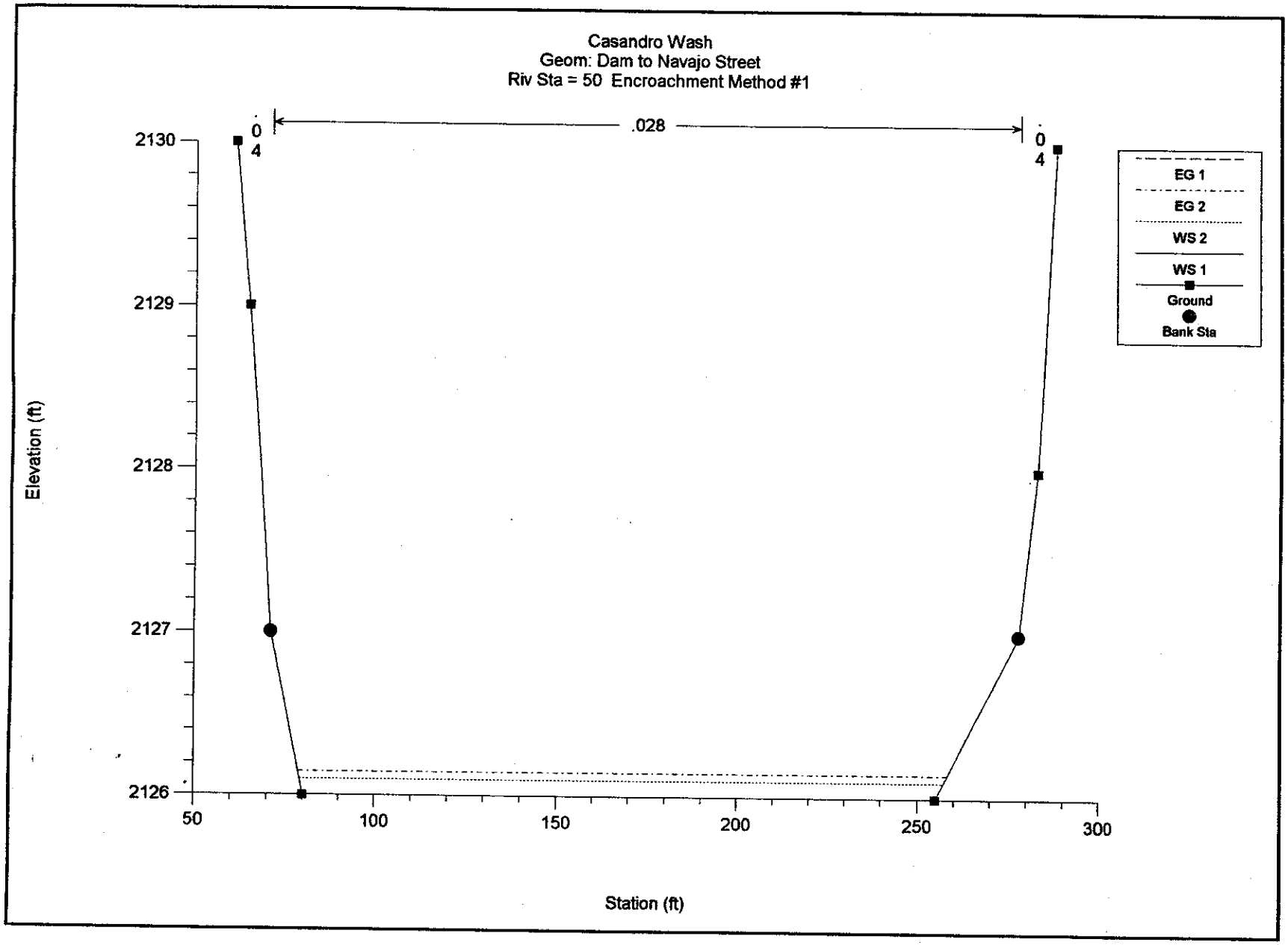

Casandro Wash
Geom: Dam to Navajo Street
Riv Sta = 45 Encroachment Method #1
.04
.028
0
4
EG 2
EG 1
WS 2
WS 1
Ground
Bank Sta
Elevation (ft)
2120
2118
2116
2114
2112
2110
0
50
100
150
200
Station (ft)

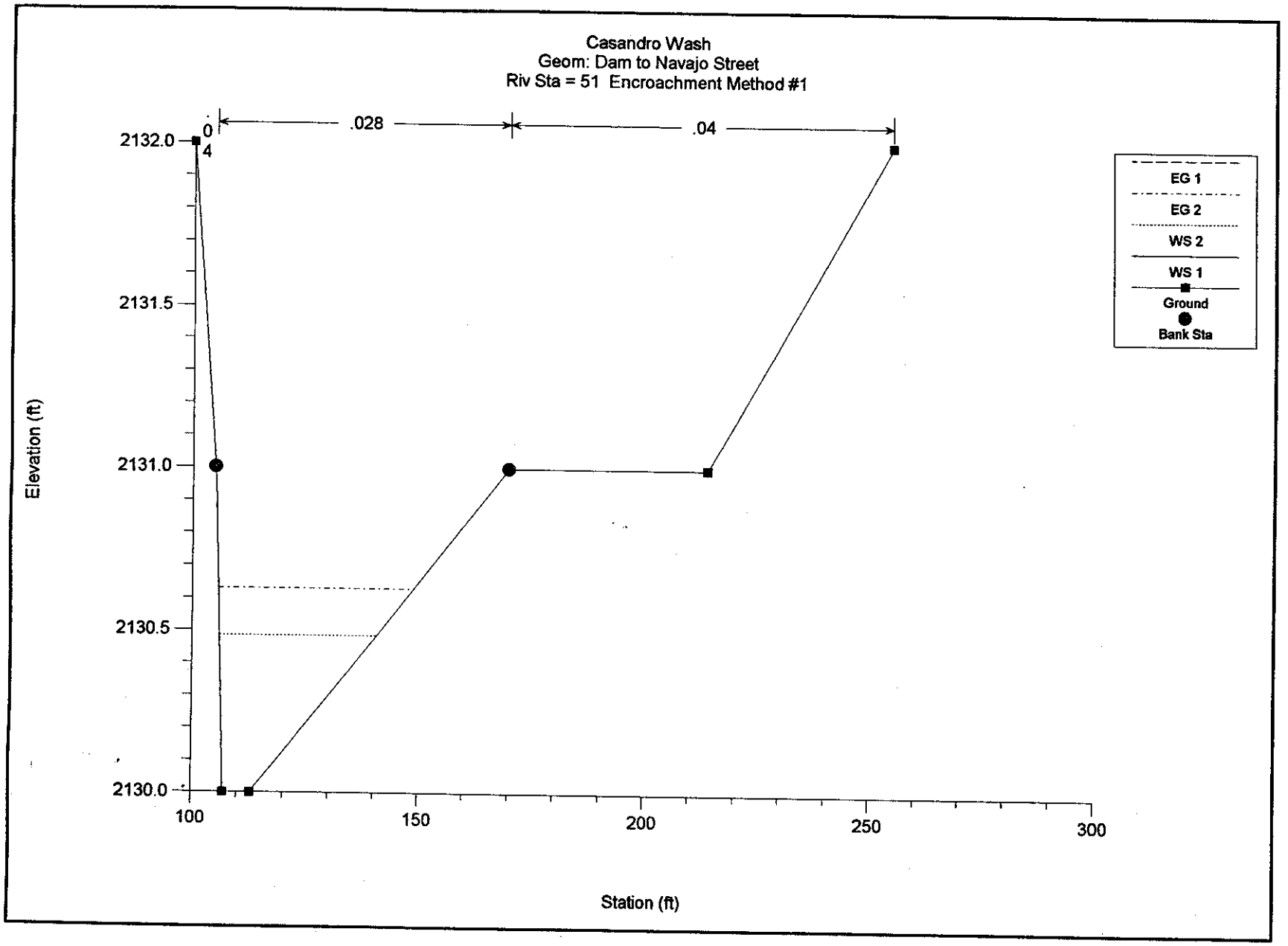

Casandro Wash
Geom: Dam to Navajo Street
Riv Sta = 46 Encroachment Method #1
.028
0
4
0
4
EG 1
EG 2
WS 2
WS 1
Ground
Bank Sta
Elevation (ft)
2117.0
2116.5
2116.0
2115.5
2115.0
2114.5
0
50
100
150
200
Station (ft)


Casandro Wash
Geom: Dam to Navajo Street
Riv Sta = 47 Encroachment Method #1
.028
2118.0
2117.8
2117.6
2117.4
2117.2
2117.0
Elevation (ft)
0
50
100
150
200
Station (ft)
EG 1
EG 2
WS 2
WS 1
Ground
Bank Sta


Casandro Wash
Geom: Dam to Navajo Street
Riv Sta = 48 Encroachment Method #1
.028
0
4
2120.0
2119.8
2119.6
2119.4
2119.2
2119.0
Elevation (ft)
220
240
260
280
300
320
340
Station (ft)
EG 1
EG 2
WS 2
WS 1
Ground
Bank Sta


Casandro Wash
Geom: Dam to Navajo Street
Riv Sta = 49 Encroachment Method #1
.028
.04
0
4
2125.0
2124.5
2124.0
2123.5
2123.0
2122.5
Elevation (ft)
400
450
500
550
600
Station (ft)
EG 1
EG 2
WS 2
WS 1
Ground
Bank Sta


Casandro Wash
Geom: Dam to Navajo Street
Riv Sta = 50 Encroachment Method #1
.028
0
4
0
4
EG 1
EG 2
WS 2
WS 1
Ground
Bank Sta
Elevation (ft)
2130
2129
2128
2127
2126
50
100
150
200
250
300
Station (ft)


Casandro Wash
Geom: Dam to Navajo Street
Riv Sta = 51 Encroachment Method #1
.028
.04
0
4
2132.0
2131.5
2131.0
2130.5
2130.0
Elevation (ft)
100
150
200
250
300
Station (ft)
EG 1
EG 2
WS 2
WS 1
Ground
Bank Sta