SCATTER WASH

LETTER OF MAP REVISION

INDEX NO. ST - 951350

TECHNICAL DOCUMENTATION

BOOK 1 OF 2

PREPARED BY:

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PREPARED FOR:

City Of Phoenix
Engineering And Architectural
Services Department

October 6, 1995

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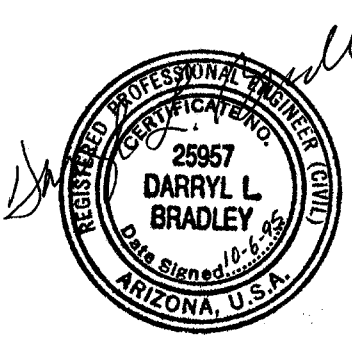

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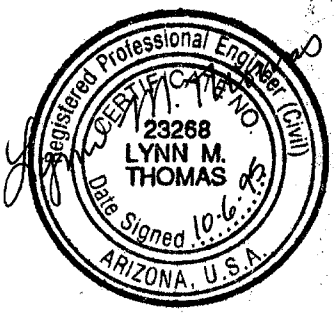

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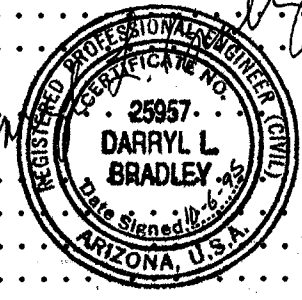

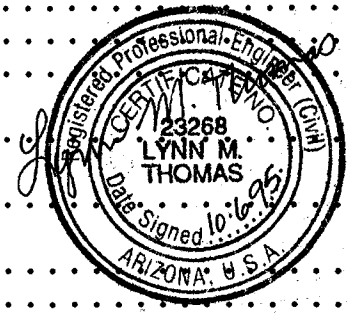

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LIST OF APPENDICES

SECTION 1 - GENERAL DOCUMENTATION AND CORRESPONDENCE

1.1 Special Problem Reports

No information for this section.

1.2 Contact (Telephone) Reports

No information for this section.

1.3 Meeting Minutes Or Reports

No information for this section.

1.4 General Correspondence

The following documentation and correspondence exhibits are provided in Appendix A of this notebook.

1.4.1 Community

a) City of Phoenix - Letter dated November 24, 1992 to the Flood Control District of Maricopa County.

b) City of Phoenix - Letter dated January 26, 1993 to the Flood Control District of Maricopa County.

c) City of Phoenix - Letter dated February 10, 1993 to the Federal Emergency Management Agency.

d) City of Phoenix - Letter dated June 15, 1993 to the Federal Emergency Management Agency.

1.4.2 State Coordinator

No information for this section.

1.4.3 Other Agencies

Arizona Department of Transportation - Letter dated September 15, 1994 to Kaminski-Hubbard Engineering, Inc.

1.4.4 FEMA Regional Office

No information for this section.

1.4.5 FEMA Washington

a) FEMA letter dated November 15, 1993 to the City of Phoenix.

b) FEMA letter dated October 27, 1994 to the City of Phoenix.

c) FEMA letter dated November 14, 1994 to the City of Phoenix.

1.4.6 FEMA Technical Consultant

Michael Baker Jr., Inc. phone call report dated August 10, 1994 to Kaminski-Hubbard Engineering, Inc.

1.5 Contract Documents

A copy of the Kaminski-Hubbard Engineering, Inc. **Scope of Work** dated May 22, 1995 that was developed by the City of Phoenix for the **Scatter Wash Letter Of Map Revision** is provided in Appendix A.

SECTION 2 - MAPPING AND SURVEY INFORMATION

2.1 Description

The Scatter Wash watershed was flown as part of the Arizona Canal Diversion Channel (ACDC) Area Drainage Master Study (ADMS), Phase 1 for the Flood Control District of Maricopa County (FCDMC). The watershed was flown for the purpose of obtaining contour and aerial mapping. The maps were prepared at a scale of 1" = 400' with 2 foot contour intervals. These maps were flown between July, 1990 and August, 1991. These maps were used to establish the sub-basin drainage delineations, flow patterns, and detention storage calculations. The aerial maps were also utilized to provide land use information for existing conditions.

The City of Phoenix Storm Drain Maps were used to provide a schematic location of storm drains and culverts within the study area. The City of Phoenix Zoning Maps were used to provide zoning designations and boundaries within the area. The above maps are at a scale of 1 inch = 400 feet.

Selected as-built plans for drainage related structures were reviewed and incorporated into the analysis to determine their impacts within the study area. Such structures included: (1) Concrete box culverts and pipe culverts along Interstate 17 (I-17); (2) Roadway plans for the Deer Valley Road and I-17 Traffic Interchange (TI); (3) Detention Basins B and C; and (4) The Interceptor Drain for the Outer Loop Highway (OLH).

As part of this Letter of Map Revision (LOMR), new topographic mapping was prepared for Scatter Wash from its confluence with Skunk Creek to an area east of I-17 along the North Branch and South Branch as depicted on the Flood Insurance Rate Maps (FIRM's). This mapping was necessary to update the topography along Scatter Wash to reflect new channelization, concrete box culverts, and detention basins previously under construction during the aerial mapping of the ACDC ADMS. The revised floodplain and floodway delineations will be provided on the new mapping to reflect the recently approved Scatter Wash Hydrology.

2.2 Index Of Maps

The *Hydrologic and Hydraulic Analysis Maps* are not included within this notebook, but are bound together and submitted along with the notebook.

The *Hydrologic Analysis Maps* contain the original hydrologic work maps used to revise the existing condition hydrology for the Scatter Wash watershed.

The *Hydraulic Analysis Maps* contain the new topographic mapping flown for this LOMR. These topographic work maps were used to identify HEC-2 cross-section locations for floodplain and floodway analysis.

The *Central Arizona Project Canal Storage Volume Work Map* was used to develop storage volume calculations upstream of the canal. The work map is presented in Appendix B of this notebook.

As part of the topographic mapping for this LOMR, an Aerial Map was developed for Scatter Wash. This Aerial Map is presented in Pocket 2 of Appendix C of this notebook.

2.3 Survey Field Notes

A field survey was performed by Kaminski-Hubbard Engineering, Inc. to set horizontal and vertical control along the North Branch and South Branch of Scatter Wash for aerial topographic mapping purposes. Figure 2 in Appendix D of this notebook shows the location of horizontal and vertical control points used for topographic aerial mapping. The field survey notes, raw unadjusted traverse, adjusted traverse to closure, and level circuit run by conventional spirit level notes are contained in Appendix D.

All horizontal control points are referenced to the U.S. Coast and Geodetic Survey State Plane Coordinate System North American Datum of 1927 (NAD). All elevations are referenced to the National Geodetic Vertical of Datum 1929 (NGVD).

2.4 Hydrologic Analysis Maps

The delineation of the Scatter Wash watershed was developed using 1 inch to 400 feet topographic mapping flown as a part of the ACDC ADMS. This new topographic mapping had 2 foot contour intervals and was an improvement over the U.S.G.S. 7.5 minute quadrangle maps used by the U.S. Army Corps of Engineers (COE) for the original drainage delineation. The following hydrologic work maps were used from the ACDC ADMS mapping to delineate the Scatter Wash watershed - Sheet Nos. 48, 49, 57-61, 61A, 71-74, 87 and 88. These maps were renumbered as a part of this LOMR project beginning with Sheet No. 6 through Sheet No. 19, respectively. These maps are submitted separately under the title, *Hydrologic Analysis Maps*.

The *Scatter Wash Watershed Hydrology Report* exhibits for the HEC-1 Schematic Diagram, Land Use Map, Soils Map and Flow Routing Map were included with the *Hydrologic Analysis Maps*. These exhibits were labeled as Sheet Nos. 2 through 5, respectively. The HEC-1 Schematic Diagram provides the HEC-1 modeling effort used to analyze the watershed. The Land Use Map provides the overall land use and zoning boundaries for the watershed. The Soil Map provides the soil unit boundaries for the watershed. The Flow Routing Map provides the sub-basin flow paths used to determine the basin lag parameters and the flow paths used to route a sub-basin hydrograph through another sub-basin.

The following is a list of the U.S.G.S. 7.5 minute quadrangle maps used as a reference for drainage delineation purposes: Hedgepeth Hills, New River SE, and Union Hills, Arizona. The horizontal scale is 1 inch = 2,000 feet and the contour interval is 20 feet. These maps were photo revised in 1981.

2.5 Hydraulic Analysis Maps

The floodplain and floodway delineations along the North Branch and South Branch of Scatter Wash was developed using 1" = 200' topographic mapping flown as a part of the Scatter Wash LOMR. This new topographic mapping had 2 foot contour intervals. These maps are not included within this notebook, but are submitted under the title, *Hydrologic and Hydraulic Analysis Maps*. There are a total of four sheets within this package labeled *Hydraulic Analysis Maps, Topographic Work Map*.

2.6 FIRM, FHBM Draft Maps

No information for this section.

2.7 Community Maps

No information for this section.

2.8 Miscellaneous Maps

The *Central Arizona Project Canal Storage Volume Work Map* developed by Kaminski-Hubbard Engineering, Inc. for the ACDC ADMS is included in Pocket 1 of Appendix B of this notebook. This 1" = 200' topographic work map was used to develop water surface areas for storage volume calculations.

SECTION 3 - HYDROLOGIC ANALYSIS

3.1 Method Description

The Scatter Wash watershed was analyzed using the U.S. Army Corps of Engineers (COE) HEC-1 hydrologic computer simulation model. The May, 1991, large array version of HEC-1 was used for this analysis. The rainfall-runoff parameters for this study were determined using the methods and procedures described in the *Drainage Design Manual For Maricopa County, Arizona, Volume I, Hydrology* hereinafter referred to as the *Drainage Design Manual*. The *Drainage Design Manual* was prepared by the Special Projects Branch, Hydrology Division, Flood Control District of Maricopa County (FCDMC) and George V. Sabol Consulting Engineers, Inc. to establish a common basis for drainage management in all jurisdictions within Maricopa County, Arizona.

The S-graph method was used to represent runoff characteristics for the watershed. The Phoenix Valley S-graph was used for this study and converted to a unit hydrograph for use in the HEC-1 computer model. The Green-Ampt loss rate method was used to estimate rainfall losses within the watershed. The Muskingum-Cunge method was used for channel routing. The Modified Puls method was utilized for reservoir routing. The HEC-1 flow diversion option was used to analyze culverts having insufficient conveyance and flow split areas.

The report titled *Scatter Wash Watershed Hydrology Report* was originally submitted to FEMA by the City of Phoenix on February 10, 1993, as technical documentation to support a change in the FIRM's along Scatter Wash. This hydrology report was dated May 4, 1992, and originally developed by Kaminski-Hubbard Engineering, Inc. (KHE) to analyze the existing condition hydrology for the Scatter Wash watershed using the FCDMC's new *Drainage Design Manual*. This hydrology report has since been updated to include the future condition hydrology for the Scatter Wash watershed. The report, *Scatter Wash Watershed Hydrology Report*, dated February, 1995 is submitted with the TDN as supportive technical documentation for the existing condition hydrology. Unless otherwise stated in the TDN, the hydrologic parameters used to develop the hydrology in this report are the same as presented in the *Scatter Wash Watershed Hydrology Report* for the existing conditions.

The FEMA review comments concerning the Scatter Wash watershed hydrology are presented in Section 1.4.5 of this notebook. The KHE responses to those review comments are presented in Appendix E of this notebook. The majority of KHE responses are contained in a letter dated July 6, 1994 addressing the FEMA review comments detailed in a letter to the City of Phoenix on November 5, 1993. The second KHE response to FEMA review comments are also presented in Appendix E and contained in a letter dated September 12, 1994. These two KHE response letters will be referred to at the appropriate time throughout the Hydrologic Analysis discussion to support the technical documentation for this LOMR.

3.2 Parameter Estimation

3.2.1 Drainage Area Boundaries

The Scatter Wash watershed is located in the rapidly developing area of Northwest Phoenix as outlined on Figure 1. Scatter Wash has a watershed area of approximately 14.3 square miles above its confluence with Skunk Creek, which is located southwest of the Beardsley Road and 43rd Avenue intersection. The watershed extends northeasterly from the confluence of Scatter Wash and Skunk Creek to the Union Hills ridgeline.

Significant man-made features that affect drainage patterns within the watershed are the Central Arizona Project (CAP) Canal, Black Canyon Highway (I-17), Outer Loop Highway (OLH) and Adobe Dam. The CAP Canal parallels the Union Hills and limits the amount of upstream runoff continuing southwesterly through pipe culverts. The I-17 highway bisects the watershed in a north-south direction and limits the westward flow of runoff through existing culvert crossings. The OLH is located along the alignment of Beardsley Road and is currently under construction from the west watershed boundary to I-17. Adobe Dam is located in the southwestern portion of the watershed along Skunk Creek.

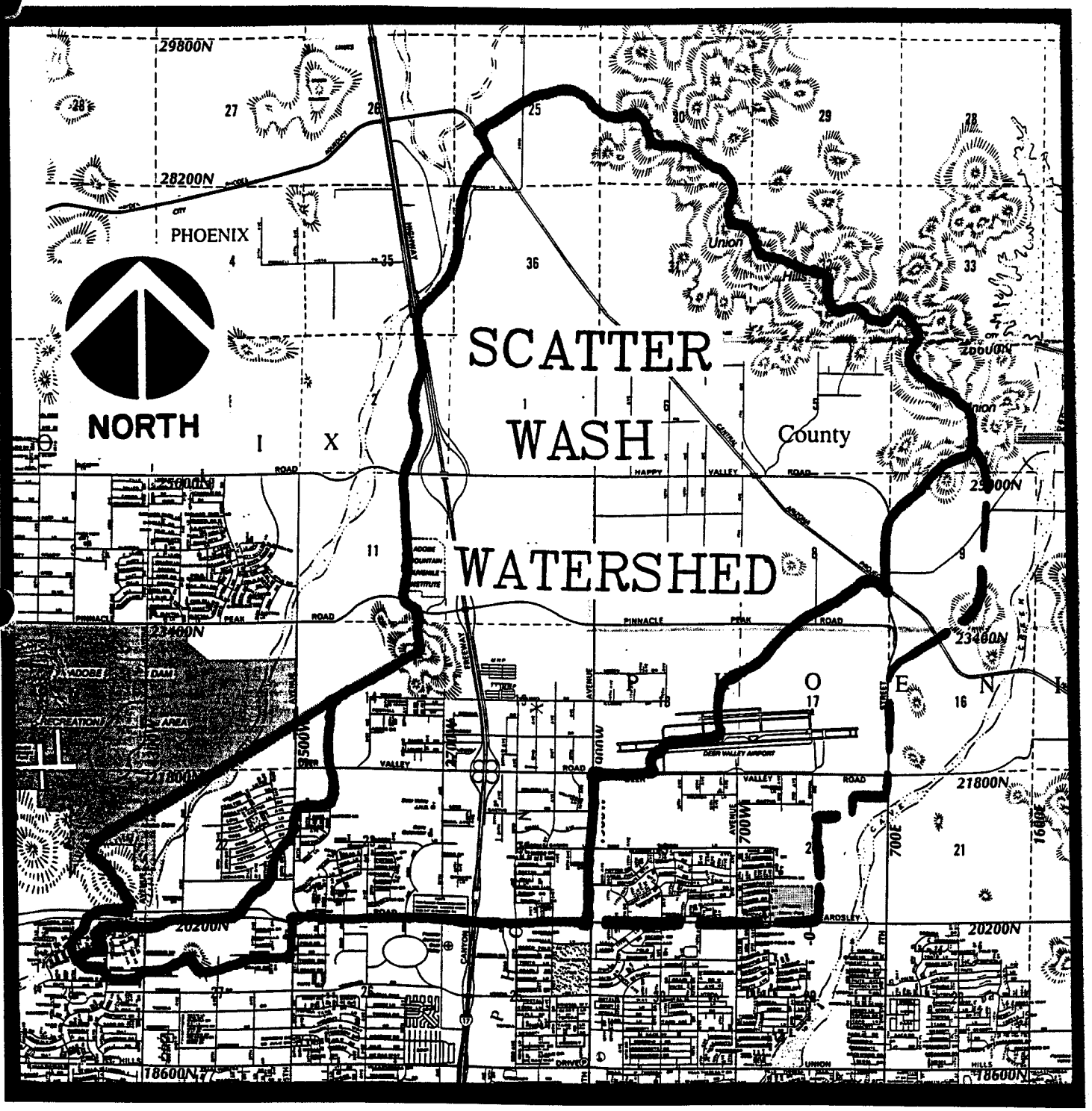


FIGURE 1 - VICINITY MAP

The watershed is comprised of well defined natural channels upstream of the CAP Canal that emanate from the Union Hills. The area downstream of the CAP Canal to the confluence of Skunk Creek and Scatter Wash are comprised of poorly defined channels having very little conveyance capacity on fairly uniform and gentle slopes. Runoff typically "sheet flows" southwesterly across the watershed, except along the east side of I-17 where flow is north to south, and north of Beardsley Road where flow is east to west from I-17 to Scatter Wash.

The watershed north of Williams Drive is predominantly undeveloped desert valley and hills with single family residences on large parcels of land located above and below the CAP Canal. Currently, industrial and commercial development is primarily adjacent to I-17 and Deer Valley Road. The majority of residential development has occurred west of 27th Avenue in the southwest portion of the study area.

In conjunction with the OLH project, a system of detention basins, open channels and storm drains were constructed by the Arizona Department of Transportation (ADOT) to provide storm runoff protection for the roadway. Detention basins were constructed at the northeast corner of I-17 and Rose Garden Lane (Detention Basins D) and the northeast corner of 35th Avenue and Beardsley Road (Detention Basin C). Detention Basin C was built in conjunction with the OLH Interceptor Drain to convey stormwater runoff westerly to Scatter Wash.

The sub-basin boundaries were delineated using 1 inch = 400 feet topographic and aerial mapping, which was flown as a part of the ACDC ADMS. Particular attention was given to existing drainage structures such as the CAP Canal, I-17 alignment and OLH improvements and their effects on flow characteristics within the watershed. In-house drainage delineation was also supplemented by as-built drawings of major collector streets, freeways, and drainage structures.

The initial delineation was then verified or revised based on field investigations. This field investigation included driving major mile and half mile streets to distinguish flow patterns and possible flow split locations. These flow patterns were recorded and later referred to in determining lag times for each sub-basin. The field investigations also included the determination of on-site retention locations within the watershed.

The sub-basins were delineated such that concentration points were provided at major street intersections, impoundment areas and stream confluences. Concentration points were also located such that comparisons could be made to previous investigations. The sub-basin areas were limited to a maximum of two square miles; however, most of the sub-basins had areas less than one square mile.

3.2.2 Physical Parameters

The sub-basin delineations and flow paths were digitized into a Geographic Information System (GIS) data base. The Arizona State Land Department provided KHE with the soil unit data base in GIS format for the Soil Conservation Service (SCS) *Soil Survey of Maricopa County, Arizona, Central Part* and *Soil Survey of Aguila - Carefree, Parts of Maricopa and Pinal Counties, Arizona*. The land use data base for the study area was developed by KHE in GIS format using information provided on the City of Phoenix Zoning Maps. The sub-basin area, flow path length, slope, soil unit distribution and land use makeup were determined from this data base. The hydrologic sub-basin characteristics such as the area, flow path length, slope and roughness coefficient (Kn) are summarized for the 2-, 10-, and 100-year storm frequencies in Tables 12, 13 and 14, respectively, in Section III of the *Scatter Wash Watershed Hydrology Report*. The sub-basin characteristics developed for the 100-year storm frequency was utilized for the 50-year and 500-year storm frequency.

The Green-Ampt loss rate method in HEC-1 was used to estimate rainfall losses for each sub-basin based on the soil characteristics, vegetative cover, and land use makeup. The Green-Ampt parameters were determined using the procedure outlined in the FCDMC's *Drainage Design Manual*. The average Green-Ampt parameters for each sub-basin are presented in Table 10 in Section II of the *Scatter Wash Watershed Hydrology Report*.

The basin lag time parameter for this S-graph method was estimated using the procedure recommended in the FCDMC's *Drainage Design Manual*. A major disadvantage of the Lag equation is that the roughness coefficient must be selected which is very subjective and introduces significant uncertainty into the lag prediction. Also, the roughness coefficient is not necessarily a constant for each sub-basin for all rainfall depths and requires some adjustment to account for the different storm frequencies. Therefore, Manning's roughness coefficients were estimated for each sub-basin using the guidelines established in the *Scatter Wash Watershed Hydrology Report*. The roughness coefficient calculations for the 2-, 10-, and 100-year storm frequencies are presented in Section V and summarized in Tables 12, 13 and 14, respectively, in Section III of the *Scatter Wash Watershed Hydrology Report*. The Kn values developed for the 100-year storm frequency were utilized for the 50-year and 500-year storm frequency.

For this study, the Muskingum-Cunge method was used to route a hydrograph through a downstream sub-basin. Channel cross-section information, slopes, and Manning's roughness coefficients were estimated using topographic mapping and observations made during the field investigation. Channel routing flow paths are presented on Plate 4 and channel routing work sheets are presented in Section IV of the *Scatter Wash Watershed Hydrology Report*. The routing flow paths are also included on Sheet No. 5 of the *Hydrologic Analysis Maps*.

There are a total of eleven reservoir routing operations modeled for the existing condition in the Scatter Wash watershed. The hydrologic analysis utilized the Modified Puls Method. Four of these operations (HEC-1 I.D. 311RR, 315RR, 317RR & 320RR) are for detention facilities associated with the CAP Canal drainage structures as shown on Sheet No. 2 of the *Hydrologic Analysis Maps*. Storage volumes upstream of the CAP Canal were determined using 1 inch = 200 feet topographic mapping. This analysis is summarized under Section 3.4.1 of this notebook.

Two reservoir routing operations (HEC-1 I.D. 314RR & 322RR) were obtained from the report *Scatter Wash Drainage And Storm Drain Study Conceptual Plan* prepared by Greiner, Inc. The first operation (HEC-1 I.D. 314RR) modeled the inefficiency of double 8'x7' CBC's under Pinnacle Peak Road just east of I-17 to convey the 100-year peak discharge. The second operation (HEC-1 I.D. 322RR) also models the inefficiency of double 8'x7' CBC's under I-17 located approximately 0.25 miles north of Williams Drive to convey the 100-year peak discharge. The rating curve calculations for the two operations are presented in Appendix A and Appendix C, respectively, in a letter dated July 6, 1994 in Appendix E of this notebook.

Three reservoir routing operations (HEC-1 I.D. 343 RR, 344RR, & 349RR) were obtained from the *Drainage Report, Scatter Wash Hydrology And Outer Loop Highway Interceptor Drain, 39th Avenue to 7th Street*. The first operation (HEC-1 I.D. 343RR) modeled the impact of Detention Basin D which is located north of Rose Garden Lane just east of I-17. The second operation (HEC-1 I.D. 344RR) was developed for Detention Basin C which is located at the northeast corner of 35th Avenue and Beardsley Road. The rating curve computations and as-built drawings for the two facilities are presented in Appendix E and Appendix F, respectively, in a letter dated July 6, 1994 in Appendix E of this notebook.

The storage volume and discharge relationships for detention facilities located at the northeast corner of Pinnacle Peak Road and 19th Avenue (HEC-1 I.D. 323RR), and the Deer Valley Road TI (HEC-1 I.D. 332RR) were determined from the ACDC ADMS topographic mapping. These detention storage calculations are presented in Section IV of the *Scatter Wash Watershed Hydrology Report*. These calculations are also included in Appendix B and Appendix D in a letter dated July 6, 1994 in Appendix E of this notebook.

3.2.3 Statistical Parameters

Not applicable for this study.

3.2.4 Precipitation

The climate of Phoenix, Arizona is warm and arid with mean annual precipitation around 7 inches. Elevations within the drainage area range from 2,200 feet in the Union Hills to 1,300 feet at the confluence of Scatter Wash and Skunk Creek.

The point precipitation values for the 10-, 50-, and 100-year, 24-hour duration storms were determined from isopluvial maps for Maricopa County, Arizona as published in FCDMC's *Drainage Design Manual*. These maps are presented in Appendix F and labeled Figure 3 through Figure 5, respectively. The PREFRE computer program was used to determine the 500-year 24-hour duration storm precipitation depth. The PREFRE output file is included in Appendix F. The point precipitation values are presented in Table 4 of Appendix F. The SCS Type II rainfall distribution was used for the 24-hour duration storm.

The desired rainfall depth-drainage area relationship for the Scatter Wash watershed was developed using the JD Record for the HEC-1 Input Description. A total of five rainfall depth - drainage area pairs were included in the HEC-1 simulation model. These rainfall depth - drainage area pairs are presented in Table 5 of Appendix F. This revision was made to the original HEC-1 model presented in the *Scatter Wash Watershed Hydrology Report* to address the FEMA comment made in a letter to the City of Phoenix dated November 15, 1993, concerning the rainfall depth and area distribution relationship. This FEMA letter is included in this notebook under Section 1.4.5 and KHE response letter dated July 6, 1994 is included in Appendix E.

3.2.5 Gage Data

Not applicable for this study.

3.3 Calibration

Not applicable for this study.

3.4 Special Problems/Solutions

3.4.1 Storage Capacity Upstream of CAP Canal

A number of concrete and steel pipe overchutes convey upstream runoff across the CAP Canal in the Scatter Wash Watershed. The Bureau of Reclamation provided Kaminski-Hubbard Engineering, Inc. with locations and pipe geometry data as well as stage-storage data for the ponding area behind the overchute inlets. The Bureau developed only one stage-storage-discharge relationship for the entire ponding area behind the canal embankment through the study area.

Based on the sub-basin delineation contributing to each pipe overchute upstream of the CAP Canal, storage volume calculations were developed by KHE using 1" = 200' topographic mapping. We have included in Appendix B the 1" = 200' topographic work map used to generate water surface areas for volume calculations. The stage-storage-discharge tables for each pipe inlet are presented in Section IV of the *Scatter Wash Watershed Hydrology Report*.

3.4.2 Flow Split At 19th Avenue And Deer Valley Road

A flow split was analyzed at the intersection of 19th Avenue and Deer Valley Road to determine the magnitude of flows continuing west along Deer Valley Road and south along 19th Avenue. The flow continuing south of Deer Valley Road along 19th Avenue will leave the Scatter Wash watershed for existing conditions. Based on this analysis, a rating curve was developed and is presented in Section V of the *Scatter Wash Watershed Hydrology Report*. A letter dated September 12, 1994 in Appendix E of this notebook also includes these calculations.

The flow continuing west of 19th Avenue along Deer Valley Road was also analyzed for flow splitting. Flows for the southern half of Deer Valley Road were included as contributing to Detention Basin D. The flow split calculations are provided in Section V of the *Scatter Wash Hydrology Report*. A letter dated September 12, 1994 in Appendix E of this notebook also includes these calculations.

3.4.3 I-17 And Deer Valley Road Interchange

The I-17 and Deer Valley Road interchange was modeled as a detention basin. Storage volume within the depressed interchange was determined using City of Phoenix 1" to 200' topographic mapping. A stage-discharge relationship was developed to determine the breakout flows from the depressed section. Surveys were developed along an approximate weir overflow section west of and southwest of the interchange to determine the breakout flows. The ADOT pumping station within the interchange was previously analyzed in the *I-17 Drainage Design Study* which concluded that the pump would fail during the 100-year storm event. Therefore, pumping from the depression was not considered. The rating curve calculations are included in Section IV of the *Scatter Wash Watershed Hydrology Report*. These calculations are also included in Appendix D of a letter dated July 6, 1994 in Appendix E of this notebook.

3.4.4 Outer Loop Highway Improvements

The drainage improvements constructed with the OLH project will provide 100-year storm runoff protection for the roadway, but limit the system's 100-year existing conditions discharge into Scatter Wash. One basin, Detention Basin D, is located north of Rose Garden Lane just east of I-17 as shown on the as-built drawing (See Appendix E in a letter dated July 6, 1994) in Appendix E of this notebook. Outflow from this basin is conveyed by a 36-inch pipe to the Interceptor Drain that runs east to west and parallels the OLH. This outflow eventually drains into Detention Basin C, which is located at the northeast corner of Beardsley Road and 35th Avenue as shown on the as-built drawings (See Appendix F in a letter dated July 6, 1994) in Appendix E of this notebook. The Interceptor Drain will discharge flow in excess of 250 CFS into Detention Basin C using a side flow weir. The detention basin has a 33-inch orifice outlet. The reservoir routing parameters were obtained from the *Drainage Report, Scatter Wash Hydrology And Outer Loop Highway Interceptor Drain, 39th Avenue to 7th Street*.

3.5 Final Results/Computer Runs

The 10-year, 50-year, 100-year and 500-year, 24-hour duration peak discharges were determined for Scatter Wash above its confluence with Skunk Creek. This hydrologic analysis has been a compilation of new topographic mapping observations, ongoing construction improvements, increased urbanization factors, previous hydrologic investigations and FEMA review comments. The peak discharge results for selected locations within the watershed and the above storm frequencies are presented in Table 1.

The CAP Canal embankment was found to sufficiently detain the 100-peak discharge from the upstream watershed. Outflow from the corresponding detention basin pipe culverts was routed downstream and did not significantly contribute to the downstream peak discharges.

The I-17 culverts located between Deer Valley Road and Pinnacle Peak Road do not have the capacity to convey the 100-year peak discharge as previously concluded in the *Scatter Wash Drainage And Storm Drain Study Conceptual Plan*. This lack of capacity results in extensive ponding along the east side of I-17. The culvert overflows are eventually detained in the Deer Valley Road T.I. The break out flow from the Deer Valley Road T.I. for the 100-year 24-hour storm was found to be 311 CFS according to our hydrologic analysis. This analysis included new storage volume computations for the Deer Valley Road T.I. based on current topographic mapping.

The HEC-1 computer input and output files are contained in Book 2, Appendix J of this submittal. The following HEC-1 filenames were used for the various storm events: (1) 344-10.DAT for the 10-year 24-hour duration storm; (2) 344-50.DAT for the 50-year 24-hour duration storm; (3) 344-100.DAT for the 100-year 24-hour duration storm; and (4) 344-500.DAT for the 500-year 24-hour duration storm.

3.6 Final Modeling Results On Diskette

The final HEC-1 computer input files discussed in Section 3.5 are contained on 3-½-inch diskettes in Appendix I of this submittal.

TABLE 1

Scatter Wash Peak Discharges

Location	HEC-1 Command	Drainage Area (mi^2)	Q_{10} (cfs)	Q_{50} (cfs)	Q_{100} (cfs)	Q_{500} (cfs)
North Branch Scatter Wash @ I-17	HC322	8.89	930	2,149	2,642	4,472
South Branch Scatter Wash @ 23rd Avenue	HC326	1.00	333	779	1,071	2,103
Deer Valley Road T.I.	HC332	1.84	263	560	674	2,468
Outflow From Deer Valley Road T.I.	332RR	1.84	0	0	311	2,441
North Branch Scatter Wash @ Deer Valley Road	HC334	10.08	1,425	2,231	2,411	2,780
Confluence of North & South Branch of Scatter Wash	HC335	12.38	1,407	2,221	2,410	4,912
Scatter Wash At OLH	HC345	13.92	1,538	2,545	2,760	5,148
Scatter Wash Above Confluence w/Skunk Creek	HC346	14.32	1,517	2,531	2,756	5,016
Scatter Wash & Skunk Creek	HCSKB	15.58	3,032	4,309	4,715	6,726

SECTION 4 - HYDRAULIC ANALYSIS

The Scatter Wash study reach is located within the City of Phoenix, Maricopa County, Arizona. Scatter Wash drains an approximate 16 square mile watershed from Union Hills to Skunk Creek. The study reach is characterized by ephemeral streams draining intense rainfall events in combined wide shallow flooding and well defined channels. In the approximate vicinity of 33rd Drive and Rose Garden Lane, Scatter Wash splits into two streams and has been known as the North and South Branch of Scatter Wash. Recent developments, roadway improvements and revised hydrology precipitates the need to revise effective Flood Insurance Rate Maps. The purpose of this request is to revise floodplain and floodway delineations and base flood elevations for the approximate 17 miles of the Scatter Wash study reach.

4.1 Method Description

Detailed analyses of hydraulic characteristics of the study reach were prepared using the U.S. Army Corps of Engineer's HEC-2 Water Surface Profiles computer model (1991 Version). These analyses were evaluated for the existing 10-, 50-, 100- and 500-year recurrence intervals to provide estimates of flood elevations within the study reach. The 100-year floodplain boundary and base flood elevations are shown on the Topographic Work Maps based on results of the HEC-2 analysis.

Starting water surface elevations used in the HEC-2 analyses were taken from HEC-2 results prepared by Dibble and Associates for the Skunk Creek Flood Insurance Study. It should be noted that their study used the same peak discharge value for both the 100-year and 500-year recurrence intervals. The second and subsequent cross sections used in this study were analyzed using the new peak discharge values.

4.2 Parameter Estimation

Several types of loss coefficients are used by the HEC-2 computer program to evaluate head losses. The following describes the losses used for each condition encountered.

4.2.1 Manning's "n" Value

Based on engineering judgement and field observations, Manning's "n" values were chosen for the channel and overbanks along the study reach. These values are summarized in Table 2. Photographs and aerial maps are included in Appendix C. It should be noted that left and right overbanks as described under the photograph are the same as defined in the HEC-2 input data requirements.

4.2.2 Contraction And Expansion Coefficients

Coefficients are used to compute energy losses associated with changes in the shape of cross-sections. The contraction and expansion coefficient values used in the HEC-2 analyses are summarized as follows:

	Contraction	**Expansion**
No transition loss computed	0.0	0.0
Gradual transitions	0.1	0.3
Bridge sections	0.3	0.5
Abrupt transitions	0.6	0.8

The maximum value for the expansion coefficient would be one (1.0).

4.2.3 Hydraulic Jump/Drop Analysis

Cross-sections were selected immediately upstream and downstream of drop structures within the study reach. In addition, expansion and contraction coefficients were chosen for abrupt transition conditions.

4.3 Cross-Section Description

Cross-sections used in the HEC-2 analyses were digitized from the topographic mapping flown in June of 1995. This mapping was prepared at a scale of 1" = 200' with 2 foot contour intervals. Cross-sections were selected at an average interval of 500'. All elevations used are referenced to the National Geodetic Vertical Datum of 1929 (NGVD).

TABLE 2

Summary of 100-year HEC-2 Results

HEC-2 Section No.	Flow	Manning's "n" Values			Water Survace Elevations	Critical Water Surface	Velocity	Top Width	Depth	FEMA HEC-2 Section I.D.
		Left Overbank	Channel	Right Overbank						
10.000	8450.00	.00	45.00	.00	1308.41	1303.87	3.91	306.20	8.41	317.5
15.600	2760.00	.00	45.00	45.00	1309.03	1304.18	2.39	186.89	7.03	N/A
16.000	2760.00	.00	15.00	.00	1309.01	1307.03	4.15	178.92	4.51	N/A
20.500	2760.00	.00	45.00	.00	1309.16	1308.45	6.29	159.91	3.16	0.52
24.200	2760.00	.00	45.00	.00	1311.18	1308.83	4.73	128.12	5.18	N/A
25.000	2760.00	.00	15.00	.00	1311.26	1308.85	5.14	104.38	5.26	N/A
25.300	2760.00	.00	45.00	.00	1312.54	1212.54	8.76	132.50	2.54	1.03
28.700	2760.00	.00	45.00	.00	1314.54	1311.78	2.36	296.57	4.54	1.35
32.500	2760.00	.00	45.00	.00	1315.07	1314.31	4.33	299.85	3.07	N/A
36.200	2760.00	.00	45.00	.00	1317.00	1315.94	3.57	345.05	3.20	N/A
36.900	2760.00	.00	15.00	.00	1317.44	1317.44	6.35	352.46	1.44	2.14
38.100	2760.00	.00	15.00	.00	1319.73	1319.73	6.57	316.70	1.73	N/A
43.300	2760.00	.00	45.00	.00	1321.77	1320.05	4.07	204.57	3.77	N/A
43.800	2760.00	.00	45.00	.00	1323.39	1323.39	7.70	198.84	2.89	N/A
49.000	2760.00	.00	45.00	.00	1326.96	1325.31	3.22	287.48	4.96	N/A
54.000	2760.00	.00	45.00	.00	1328.09	1326.44	3.05	331.37	4.09	3.73

TABLE 2

Summary of 100-year HEC-2 Results

HEC-2 Section No.	Flow	Manning's "n" Values			Water Survace Elevations	Critical Water Surface	Velocity	Top Width	Depth	FEMA HEC-2 Section I.D.
		Left Overbank	Channel	Right Overbank						
59.400	2760.00	.00	45.00	.00	1329.42	1327.85	3.85	227.34	3.42	N/A
60.000	2760.00	.00	45.00	.00	1329.70	1329.65	7.01	239.97	1.70	4.27
64.000	2760.00	.00	30.00	.00	1331.91	1330.36	4.15	226.62	3.91	4.80
69.500	2760.00	.00	30.00	.00	1332.95	1331.91	4.99	194.77	2.95	5.28
75.500	2760.00	.00	30.00	.00	1334.39	1333.15	5.42	151.08	3.79	5.81
79.300	2760.00	.00	30.00	.00	1335.36	1334.77	7.65	111.38	3.36	N/A
83.700	2760.00	.00	15.00	.00	1336.77	1335.33	7.09	84.79	4.77	N/A
84.200	2760.00	.00	30.00	.00	1337.42	1337.42	8.90	125.31	3.42	N/A
86.200	2760.00	.00	30.00	.00	1339.25	1338.54	6.69	138.55	3.25	N/A
92.700	2760.00	.00	30.00	.00	1341.15	1339.88	3.00	382.54	2,65	N/A
93.200	2760.00	.00	30.00	.00	1342.44	1342.44	6.05	403.88	1.14	N/A
98.300	2760.00	.00	30.00	.00	1344.83	1343.91	2.88	520.11	2.63	N/A
99.400	2760.00	.00	30.00	.00	1347.86	1347.86	5.22	629.52	.86	N/A
103.900	2760.00	.00	15.00	15.00	1349.98	1349.88	5.17	543.16	1.98	N/A
104.400	2760.00	45.00	45.00	45.00	1350.39	1349.54	3.35	636.77	2.39	8.92
109.400	2760.00	45.00	45.00	45.00	1352.14	1350.98	3.00	443.32	4.14	9.45

TABLE 2

Summary of 100-year HEC-2 Results

HEC-2 Section No.	Flow	Manning's "n" Values			Water Survace Elevations	Critical Water Surface	Velocity	Top Width	Depth	FEMA HEC-2 Section I.D.
		Left Overbank	Channel	Right Overbank						
114.400	2760.00	.00	45.00	.00	1353.98	1353.21	3.57	426.30	3.98	N/A
119.400	2760.00	.00	45.00	.00	1357.69	1357.20	4.80	372.25	5.69	N/A
123.700	2760.00	45.00	45.00	45.00	1359.98	1358.78	3.99	329.11	5.98	N/A
130.400	2642.00	45.00	45.00	45.00	1362.89	1362.57	7.02	207.29	4.89	1.049
135.400	2642.00	45.00	45.00	45.00	1365.63	1363.73	3.76	368.07	5.63	1.569
139.100	2642.00	.00	45.00	.00	1367.24	1367.24	7.66	195.45	3.24	N/A
144.100	2642.00	.00	45.00	.00	1371.46	1369.40	4.33	175.01	5.46	N/A
148.600	2642.00	.00	45.00	.00	1372.68	1370.30	3.90	160.54	4.68	N/A
152.100	2642.00	.00	45.00	.00	1373.55	1371.62	5.56	121.47	5.55	N/A
152.800	2642.00	15.00	15.00	15.00	1374.82	.00	8.32	111.30	6.82	N/A
153.100	2642.00	.00	45.00	45.00	1375.79	1372.65	3.71	157.50	5.79	N/A
154.900	2642.00	.00	45.00	.00	1375.96	1373.94	5.97	98.47	5.96	N/A
156.800	2642.00	.00	15.00	.00	1376.85	.00	8.64	48.79	6.85	N/A
162.700	2642.00	45.00	45.00	45.00	1379.63	1378.36	4.84	253.31	5.63	N/A
167.700	2642.00	45.00	45.00	45.00	1382.22	1381.96	8.17	191.01	6.22	4.699
172.700	2642.00	45.00	45.00	45.00	1385.63	1384.40	4.69	236.74	5.63	5.189

TABLE 2

Summary of 100-year HEC-2 Results

HEC-2 Section No.	Flow	Manning's "n" Values			Water Survace Elevations	Critical Water Surface	Velocity	Top Width	Depth	FEMA HEC-2 Section I.D.
		Left Overbank	Channel	Right Overbank						
177.700	2642.00	45.00	45.00	45.00	1388.02	1387.31	6.22	234.18	4.02	N/A
181.200	2642.00	.00	45.00	.00	1391.42	1391.42	10.02	85.49	5.42	N/A
184.000	2642.00	.00	45.00	.00	1395.48	1394.22	4.04	298.59	8.48	N/A
189.000	2642.00	45.00	45.00	45.00	1396.36	1396.15	3.64	413.41	7.36	N/A
194.000	2642.00	.00	45.00	.00	1398.42	1396.49	2.99	269.23	4.42	N/A
199.000	2642.00	45.00	45.00	45.00	1400.03	1400.03	8.58	286.61	8.03	7.819
204.500	2642.00	45.00	45.00	.00	1405.54	1403.88	8.47	72.93	9.54	8.349
205.100	2642.00	45.00	45.00	45.00	1406.75	1400.85	1.79	292.82	10.75	N/A
208.000	2642.00	45.00	45.00	45.00	1406.75	1404.22	3.90	162.19	6.75	N/A
-123.700	2642.00	45.00	45.00	45.00	1359.98	.00	3.82	329.11	5.98	N/A
305.000	311.00	.00	45.00	.00	1362.46	1362.46	3.62	214.02	.46	N/A
310.000	311.00	.00	45.00	.00	1366.60	1366.28	1.29	425.88	.60	N/A
315.000	311.00	45.00	45.00	45.00	1370.14	1370.11	1.78	985.89	.64	N/A
320.000	311.00	.00	45.00	45.00	1373.67	1373.36	1.06	702.39	.87	N/A
325.000	311.00	45.00	45.00	.00	1374.16	1373.02	.72	697.92	1.76	N/A
330.000	311.00	.00	15.00	.00	1382.33	1382.33	3.20	308.67	.33	N/A

TABLE 2

Summary of 100-year HEC-2 Results

HEC-2 Section No.	Flow	Manning's "n" Values			Water Survace Elevations	Critical Water Surface	Velocity	Top Width	Depth	FEMA HEC-2 Section I.D.
		Left Overbank	Channel	Right Overbank						
335.000	311.00	.00	15.00	15.00	1384.44	1384.41	3.34	216.36	.44	N/A
340.000	311.00	.00	15.00	.00	1385.97	1385.89	2.80	259.53	.67	N/A
342.000	311.00	.00	15.00	.00	1387.62	1387.62	3.20	311.52	.62	N/A
345.000	311.00	.00	45.00	.00	1388.83	1388.37	1.28	369.45	.83	15.23
350.000	311.00	.00	45.00	.00	1391.61	1391.49	2.45	337.06	1.21	15.76
355.400	311.00	.00	45.00	.00	1396.61	1396.25	1.46	439.27	.98	N/A
372.000	674.00	45.00	45.00	.00	1406.74	1406.46	3.17	291.85	2.04	17.96
377.000	674.00	45.00	45.00	.00	1408.08	1407.04	1.35	433.18	2.08	N/A
382.000	674.00	45.00	45.00	45.00	1408.72	1407.76	1.58	395.14	2.12	N/A
387.000	674.00	45.00	45.00	45.00	1410.03	1409.63	3.26	362.64	2.03	N/A
392.000	674.00	45.00	45.00	.00	1412.96	1412.49	1.93	436.90	.97	N/A
397.000	1071.00	45.00	45.00	45.00	1413.17	1408.16	1.30	1200.00	9.17	N/A
402.000	1071.00	45.00	45.00	.00	1413.28	1410.75	3.45	269.32	7.28	N/A
407.000	1071.00	.00	45.00	.00	1415.32	1413.57	2.53	261.85	5.32	N/A
412.000	1071.00	.00	45.00	.00	1417.25	1416.19	4.48	101.99	3.25	N/A
417.000	1071.00	.00	45.00	.00	1419.09	1416.99	3.50	89.70	5.09	N/A

4.3.1 Channel And Overbank

The left and right channel stations were selected where the velocity will be uniformly distributed in the HEC-2 results. Many cross-sections have well-defined channel and overbank locations. Many cross-sections do not. These cross-sections are located in areas where Manning's "n" values do not vary from channel and overbank areas. Therefore, channel and overbank subdivision is not critical in these locations.

4.3.2 Bridges Or Constrictions

Box culverts located within the study reach were analyzed using the four cross-section approach outlined in the HEC-2 User's Manual. Field observation, surveys, design drawings and record documents were used to obtain structural geometry and elevation data for the box culverts. The HEC-2 analysis was based on assuming these structures remain unobstructed and operate properly.

4.3.3 Grade Control Structures

Several locations in the study reach have been analyzed for effects of grade control structures. Cross-sections have been selected both upstream and downstream of these structures.

4.4 Calibration

The HEC-2 analyses were evaluated for reasonable results. Water surface elevations, top widths, velocities and depth of water were calibrated using topographic mapping and HEC-2 cross section plots (See Appendix K of Book 2).

4.5 Special Problems/Solutions

Detailed hydraulic analyses were conducted for the Scatter Wash study reach. The analyses consisted of matching the effective Flood Insurance Rate Maps (FIRM) published in 1989 at the beginning study limits. This study paid particular attention to matching the floodplain width and water surface elevation.

Digitized cross-sections were analyzed using the HEC-2 computer model. Results of the analysis determined a Zone AO designation for the South Branch of Scatter Wash. A Zone AE designation has been determined for the other portions of Scatter Wash. Base flood elevations are shown in the Zone AO and Zone AE areas (See Topographic Work Maps).

The North Branch of Scatter Wash detailed study limit terminates at HEC-2 cross-section X1 205.10. At this location the floodplain matches the effective FIRM. This area has been designated as a Zone A. The 500-year floodplain analysis resulted in a break out of flow beyond the mapping limits. This area has been designated as a Zone X.

The Black Canyon Highway depressed traffic interchange at Deer Valley Road was surveyed to determine the outflow condition. This cross-section was used in the HEC-2 analysis. This data and analysis are included in Appendix G of this submittal. In addition, the box culvert under the Black Canyon Highway, approximately 500 feet north of Williams Drive, was analyzed to determine the highwater. Results of this analysis indicated that water does not overtop the northbound roadway. Results of this analysis are also included in Appendix G of this submittal.

The special bridge routine was used in hydraulic modeling of the box culvert crossings located at 45th Avenue, Beardsley Road, Deer Valley Road and 31st Avenue. Results of the HEC-2 analysis indicated normal depth flow conditions for the 45th Avenue and Beardsley Road structures. The structure in Deer Valley Road is in a pressure flow condition and the structure in 31st Avenue is in a combined pressure and weir flow condition. The HEC-2 results are included in Appendix L of this submittal.

Pipe culvert crossings are located under dip roadway crossings in 43rd Avenue, 27th Avenue in the North Branch of Scatter Wash and 27th Avenue in the South Branch of Scatter Wash. These culverts were not modeled in HEC-2 analyses since they do not influence results of larger flooding events.

4.6 Floodway Modeling

Encroachment on floodplains, such as artificial fill, reduces the flood-carrying capacity, increases the flood heights of streams, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 100-year flood is divided into a floodway and a floodway fringe.

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment in order that the 100-year flood may be carried without substantial increases in flood heights. Minimum standards of the Federal Emergency Management Agency limit such increases in flood heights to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this report are presented to local agencies as minimum standards that can be adopted or that can be used as a basis for additional studies.

The floodways presented in this study were computed on the basis of equal-conveyance reduction from each side of the floodplain with a rise in water surface not to exceed one foot. A summary of the floodway data results are shown on Table 3. Floodway boundaries are shown on the Topographic Work Maps and results are included in Appendix M of this submittal.

4.7 Final Results/Computer Runs

The HEC-2 final results with full input and output listings are included in Appendix L and M of this submittal.

4.8 Final Modeling Results

Copies of the HEC-2 input and output data files are included on computer diskettes in Appendix I of this notebook.

TABLE 3

Floodway Data

Flooding Source		Floodway			Base Flood Watuer Surface Elevation			
Cross-Section	Feet Above Beginning Cross-Section Distance	Width (Feet)	Section Area (Square Feet)	Mean Velocity (Feet Per Second)	Regulatory	With Floodway	Without Floodway	Increase
						(Feet NGVD)		
10.000	---	306.0	2180.0	3.9	1308.4	1308.4	1308.4	.0
15.600	560	178.0	1152.0	2.4	1309.0	1309.0	1309.0	.0
16.000	600	179.0	662.0	4.2	1309.0	1309.0	1309.0	.0
20.500	1050	160.0	437.0	6.3	1309.2	1309.2	1309.2	.0
24.200	1420	128.0	585.0	4.7	1311.2	1311.2	1311.2	.0
25.000	1500	112.0	537.0	5.1	1311.3	1311.3	1311.3	.0
25.300	1530	133.0	315.0	8.8	1312.5	1312.5	1312.5	.0
28.700	1870	297.0	1172.0	2.4	1314.5	1314.5	1314.5	.0
32.500	2250	300.0	634.0	4.4	1315.1	1315.1	1315.1	.0
36.200	2620	345.0	775.0	3.6	1317.0	1317.0	1317.0	.0
36.900	2690	352.0	435.0	6.4	1317.4	1317.4	1317.4	.0
38.100	2810	317.0	420.0	6.6	1319.7	1319.7	1319.7	.0
43.300	3330	205.0	679.0	4.1	1321.8	1321.8	1321.8	.0
43.800	3380	199.0	359.0	7.7	1323.4	1323.4	1323.4	.0
49.000	3900	287.0	857.0	3.2	1327.0	1327.0	1327.0	.0
54.000	4400	331.0	904.0	3.1	1328.1	1328.1	1328.1	.0
59.400	4940	227.0	716.0	3.9	1329.4	1329.4	1329.4	.0
60.000	5000	240.0	395.0	7.0	1329.7	1329.7	1329.7	.0
64.000	5400	227.0	665.0	4.1	1331.9	1331.9	1331.9	.0
69.500	5950	195.0	551.0	5.0	1332.9	1332.9	1332.9	.0
75.500	6550	151.0	509.0	5.4	1334.4	1334.4	1334.4	.0
79.300	6930	111.0	361.0	7.7	1335.4	1335.4	1335.4	.0
83.700	7370	95.0	390.0	7.1	1336.8	1336.8	1336.8	.0

TABLE 3

Floodway Data

Flooding Source		Floodway			Base Flood Watuer Surface Elevation			
Cross-Section	Feet Above Beginning Cross-Section Distance	Width (Feet)	Section Area (Square Feet)	Mean Velocity (Feet Per Second)	Regulatory	With Floodway	Without Floodway	Increase
						(Feet NGVD)		
84.200	7420	125.0	310.0	8.9	1337.4	1337.4	1337.4	.0
86.200	7620	139.0	413.0	6.7	1339.2	1339.2	1339.2	.0
92.700	8270	383.0	920.0	3.0	1341.1	1341.1	1341.1	.0
93.200	8320	404.0	456.0	6.0	1342.4	1342.4	1342.4	.0
98.300	8830	520.0	960.0	2.9	1344.8	1344.8	1344.8	.0
99.400	8940	630.0	529.0	5.2	1347.9	1347.9	1347.9	.0
103.900	9390	458.0	525.0	5.3	1350.0	1350.0	1350.0	.0
104.400	9440	411.0	807.0	3.4	1350.4	1350.4	1350.4	.0
109.400	9940	405.0	926.0	3.0	1352.1	1352.1	1352.1	.0
114.400	10440	426.0	770.0	3.6	1354.0	1354.0	1354.0	.0
119.400	10940	373.0	576.0	4.8	1357.7	1357.7	1357.7	.0
123.700	11370	147.0	571.0	4.8	1360.0	1360.3	1360.0	.3
130.400	12040	133.0	436.0	6.1	1362.9	1363.5	1362.9	.6
135.400	12540	168.0	660.0	4.0	1365.6	1365.7	1365.6	.1
139.100	12910	197.0	370.0	7.1	1367.2	1367.3	1367.2	.1
144.100	13410	173.0	595.0	4.4	1371.5	1371.4	1371.5	-.1
148.600	13860	160.0	673.0	3.9	1372.7	1372.7	1372.7	.0
152.100	14210	121.0	474.0	5.6	1373.6	1373.6	1373.6	.0
152.800	14280	48.0	227.0	11.6	1374.8	1373.0	1374.8	-1.8
153.100	14310	148.0	662.0	4.0	1375.8	1375.1	1375.8	-.7
154.900	14490	94.0	388.0	6.8	1376.0	1375.4	1376.0	-.6
156.800	14680	49.0	260.0	10.2	1376.8	1375.9	1376.8	-.9
162.700	15270	150.0	526.0	5.0	1379.6	1379.7	1379.6	.1

TABLE 3

Floodway Data

Flooding Source		Floodway			Base Flood Watuer Surface Elevation			
Cross-Section	Feet Above Beginning Cross-Section Distance	Width (Feet)	Section Area (Square Feet)	Mean Velocity (Feet Per Second)	Regulatory	With Floodway (Feet NGVD)	Without Floodway (Feet NGVD)	Increase
167.700	15770	58.0	268.0	9.8	1382.2	1382.5	1382.2	.3
172.700	16270	151.0	625.0	4.2	1385.6	1386.3	1385.6	.7
177.700	16670	109.0	389.0	6.8	1388.0	1388.1	1388.0	.1
181.200	17120	88.0	287.0	9.2	1391.4	1391.7	1391.4	.3
184.000	17400	293.0	631.0	4.2	1395.5	1395.4	1395.5	-.1
189.000	17900	152.0	547.0	4.8	1397.4	1397.8	1397.4	.4
194.000	18400	273.0	1025.0	2.6	1398.4	1398.9	1398.4	.5
199.000	18900	94.0	283.0	9.3	1400.0	1400.9	1400.0	.9
204.500	19450	64.0	362.0	7.3	1405.6	1406.4	1405.6	.8
205.100	19510	162.0	1351.0	2.0	1406.8	1407.3	1406.8	.5
208.000	19800	131.0	705.0	3.7	1406.8	1407.3	1406.8	.5

SECTION 5 - EROSION/SEDIMENT TRANSPORT ANALYSIS

The Scatter Wash study reach was not evaluated for erosion nor sediment transport potential. The downstream reaches of Scatter Wash have constructed channel improvements with grade control or drop structures to minimize erosive velocities. In addition, these improvements have included a minimum of one foot of freeboard to account for sediment transport and debris. The upstream reaches of both the North and South Branches of Scatter Wash are in natural conditions with lush vegetation as shown on the photographic documentation in Appendix C. Erosion and sediment transport are not considered a key factor in the hydraulic analyses.

SECTION 6 - REFERENCE MATERIAL

6.1 Other Published Flood Studies

Arthur Beard Engineers, Inc. *Northwest Storm Drainage Study, Volume I & II*. City of Phoenix Project No. ST-74206.00. April, 1977.

Baker Engineers and Wood/Patel & Associates, Inc. *Deer Valley Municipal Airport Master Storm Drainage Plan*. City of Phoenix Project No. A-911362. January, 1993.

Coe & Van Loo Consulting Engineers, Inc. *Hydrology Report, Skunk Creek Between Arizona Canal Diversion Channel & Central Arizona Project*. November 9, 1990.

CRS Sirrine, Inc. *Final Drainage Report, Outer Loop Highway Section 6, (OLH/I-17 Interchange) Phase II*. ADOT Project No. RBM-600-0-306. July, 1989.

CRS Sirrine, Inc. *Final Drainage Report For 23rd Avenue Roadway Improvements, Utopia Road To Rose Garden Lane*. March, 1989.

CRS Sirrine, Inc. *Revised Concept Drainage Design Hydrology, I-17 To Cave Creek, Outer Loop Highway*. November 4, 1988.

DeLeuw, Cather & Company. *Drainage Report, Scatter Wash Hydrology And Outer Loop Highway Interceptor Drain, 39th Avenue To 7th Street*. November, 1989.

Greiner Engineering Sciences, Inc. *Outer Loop Highway, Bell Road To C.A.P. Canal Crossing, Section B, Hydrology Report*. August, 1986.

Greiner Engineering Sciences, Inc. *Scatter Wash Drainage And Storm Drain Study Conceptual Plan, Volumes I and II*. September, 1989.

Kaminski-Hubbard Engineering, Inc. *Scatter Wash Watershed Hydrology Report, Volume 1.4, Arizona Canal Diversion Channel Area Drainage Master Study*. February, 1995.

PRC Engineering. *I-17 Drainage Design Study*. March, 1987. Preliminary Drainage Report.

SCI Consulting Engineers, Inc. *North Central Master Storm Drainage Study (West Half)*. City of Phoenix Project No. ST-79185.01. May, 1981.

U.S. Army Corps Of Engineers. *Gila River Basin, New River and Phoenix City, Streams, Design Memorandum No. 2, Hydrology Part 2*. Los Angeles District, 1982.

6.2 Previous FEMA Studies

Federal Emergency Management Agency. *Flood Insurance Study For Maricopa County, Arizona And Incorporated Areas*. Revised September 29, 1989.

6.3 Other Applicable Studies

CRSS Commercial Group, Inc. *Floodplain Delineation For 19th Avenue At Beardsley Road*. December, 1987.

Engineering Alliance, Inc., Consulting Engineers. *Drainage Study And Structure Concept Report 43rd Avenue Crossing Scatter Wash*. June, 1990.

Greiner Engineering Sciences, Inc. *Bell Road Project Drainage Study*. October, 1987.

U.S. Army Corps of Engineers. *Gila River Basin, Arizona, New Mexico, and Phoenix City Streams, Design Memorandum No. 1, Hydrology Part 1*. Los Angeles District, 1974.

6.4 Published/Unpublished Historical Flood Information

U.S. Department of Commerce, National Oceanic And Atmospheric Administration, National Weather Service. *NOAA Atlas 2, Precipitation - Frequency Atlas at the Western United States, Volume III - Arizona*. Silver Springs, MD, 1973.

U.S. Department of Commerce, National Oceanic And Atmospheric Administration, National Weather Service. *NOAA Technical Memorandum NWS HYDRO-40, Depth-Area Ratios in the Semi-Arid Southwest United States*. Silver Springs, MD, August, 1984.

6.5 Methodology References

City of Phoenix, Arizona, Engineering Department. *Storm Drain Design Manual, Storm Drains With Paving Of Major Streets*. August, 1975, Revised: July, 1987.

City of Phoenix, Arizona, Engineering Department. *Storm Drain Design Manual, Subdivision Drainage Design*. September, 1985.

Flood Control District of Maricopa County. *Uniform Drainage Policies And Standards For Maricopa County, Arizona*. February 25, 1987.

Flood Control District of Maricopa County. *Drainage Design Manual For Maricopa County, Arizona, Volume I, Hydrology*. June, 1992.

George V. Sabol Consulting Engineer. *Flood Control District Of Maricopa County, S-Graph Study*. Contract FCD 86-36. November, 1987.

U.S. Army Corps of Engineers, The Hydrologic Engineering Center. HEC-1 Flood Hydrograph Package, Users Manual. September, 1990.

U.S. Army Corps of Engineers, The Hydrologic Engineering Center. HEC-2 Water Surface Profiles, Users Manual. September, 1990.

U.S. Department of Agriculture, Soil Conservation Service. Soil Survey of Maricopa County, Arizona, Central Part. September, 1977.

U.S. Department of Agriculture, Soil Conservation Service. Soil Survey of Aguila - Carefree Area, Parts of Maricopa and Pinal Counties, Arizona. April, 1986.

U.S. Department of Transportation, Federal Highway Administration. Hydraulic Design of Highway Culverts, Hydraulic Design Series No. 5. September, 1985.

U.S. Geological Survey, Water Resources Division. Estimated Manning's Roughness Coefficients For Stream Channels And Flood Plains In Maricopa County, Arizona. April, 1991.

SECTION 7 - CROSS-REFERENCING AND LABELING INFORMATION

The cross-sections used in the HEC-2 analysis were digitized from topographic mapping prepared in June of 1995. A hydraulic base line was established from the topographic mapping to best fit a channel centerline. Cross-sections were chosen from the hydraulic baseline at an average interval of 500 feet or at drainage structures. The HEC-2 cross-sections are looking downstream with the hydraulic base line station equal to 600.0 as shown in the input data. Cross-section identification beginning at the down stream limits of the mapping is equal to 10.00. Subsequent cross-section labeling represents the total distance in feet from the beginning section equal to a distance of 1,000 feet for the North Branch of Scatter Wash. The confluence of the South Branch with the North Branch of Scatter Wash represents a beginning identification of 300.00. Subsequent cross-section labeling represents the total distance in feet from the confluence along the south branch of Scatter Wash equal to a distance of 30,000 feet. These HEC-2 cross-sections are cross-referenced to HEC-2 cross-sections shown in results of the effective topographic work maps prepared by Dibble & Associates dated 1974 in Table 2 of this report.

APPENDIX A

General Correspondence For Section 1

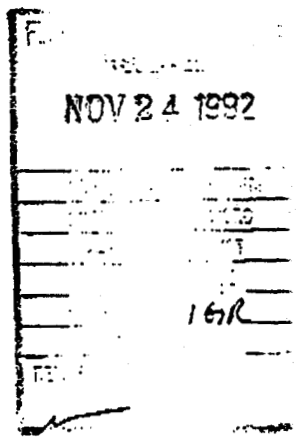
SECTION 1.4

GENERAL CORRESPONDENCE

FOR

SECTION 1.4.1 COMMUNITY

City of Phoenix
STREET TRANSPORTATION DEPARTMENT



November 24, 1992

Mr. Greg Rodzenko
Water Resources Planner
Flood Control District of Maricopa County
2801 West Durango
Phoenix, Arizona 85007

Dear Greg:

RE: SCATTER WASH HYDROLOGY STUDY BY KAMINSKI HUBBARD

The Arizona Department of Transportation and their engineer, WLB Group, have requested that the City of Phoenix review, approve, and forward subject Hydrology Study to FEMA. Apparently the study is part of ADOT's defense in a current lawsuit. We have contacted our attorneys' and requested guidance concerning this issue.

In the meantime, in order to speed things along we would be pleased to review the Kaminski Hubbard Hydrology Study if you so desire. In order to assist us in doing this, we would need copies of the following:

1. Scope of work and consultant's contract.
2. Minutes of all meetings held between the District and its consultant.
3. Copies of all correspondence between the consultant and the District.
4. Copies of all HEC-1 submittals which were revised at the Districts' request, and the reasons for the requested changes.
5. A full scale mylar copy of the watershed area. We have a xerox copy, however it is not readable.

We have a copy of the study which Jim Hubbard of Kaminski Hubbard Engineering, Inc. transmitted to us on November 9, 1992.

If you have any questions concerning this, please contact me.

Sincerely,

James H. Matteson, P.E.
Street Transportation Director

Paul

Paul E. Kienow, P.E.
Floodplain Management Engineer

JHM/PEK/aff/921120b

c: Mr. Jordan, ADOT
Mr. Landis, WLB Group
Mr. Van Skike
Mr. Miller

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City of Phoenix
STREET TRANSPORTATION DEPARTMENT

January 26, 1993

Mr. Greg Rodzenko
Flood Control District of Maricopa County
2801 West Durango
Phoenix, Arizona 85009

Dear Greg:

RE: SCATTER WASH HYDROLOGY REPORT PREPARED BY
KAMINSKI HUBBARD ENGINEERING, INC.

Thank you for forwarding subject hydrology report and associated documents to us on January 13, 1993.

We have completed our review of the report and we would like to submit it to FEMA in its present form. Please advise us in writing if it is acceptable to the District that we forward this report to FEMA for review and approval.

If you have any questions concerning this, please contact me at 262-4960.

Sincerely,

James H. Matteson, P.E.
Street Transportation Director

Paul E. Kienow, P.E.
Floodplain Management Engineer

JHM/PEK/aff/930126b

c: Mr. Van Skike
Mr. Goodall
Kaminski Hubbard Engineering, Inc.

#46C

City of Phoenix

STREET TRANSPORTATION DEPARTMENT

February 10, 1993

Mr. William R. Locke
Chief, Risk Studies Division
Federal Insurance Administration
Federal Emergency Management Agency
500 C Street, S.W.
Washington, D.C. 20472

Dear Mr. Locke:

RE: SCATTER WASH HYDROLOGY REPORT, 1992 KAMINSKI HUBBARD

Attached please find a copy of the "Scatter Wash Watershed Arizona Canal Diversion Channel (ACDC) Area Drainage Master Study, Phase I", dated May 4, 1992 prepared by Kaminski Hubbard Engineering, Inc. It is requested that FEMA review and comment on this hydrology for its possible use in a new Flood Insurance Study (FIS) for Scatter Wash.

In keeping with our letter of February 3, 1993 to the Arizona Department of Water Resources (ADWR), this watershed is entirely within the City of Phoenix, and the ADWR does not have any jurisdiction and their review and approval is not required.

If you have any questions concerning this, please contact me at (602) 262-4960.

Sincerely,

James H. Matteson, P.E.
Street Transportation Director

Paul Kienow

Paul E. Kienow, P.E.
Floodplain Management Engineer

JHM/PEK/aff/930209d

Attachment: 1) Report
2) FCD letter approving Hydrology

c: Mr. Van Skike
Mr. Hubbard, Kaminski Hubbard Engineering, Inc.
Mr. Rodzenko, Flood Control District of Maricopa County
Mr. Jordan, Arizona Department of Transportation
Mr. Miller, Jones, Skelton & Hochuli
Ms. Miller, Arizona Department of Water Resources

146 C

City of Phoenix
STREET TRANSPORTATION DEPARTMENT

June 15, 1993

Mr. William R. Locke
Chief, Risk Studies Division
Federal Insurance Administration
Federal Emergency Management Agency
500 C Street, S.W.
Washington, D.C. 20472

Dear Mr. Locke:

RE: SCATTER WASH HYDROLOGY REPORT, 1992 KAMINSKI HUBBARD; REQUEST OF STATUS

On February 10, 1993 this office submitted subject hydrology report to FEMA for review and approval.

As of this date we have not received a response concerning this submittal. Please advise the status of your review. If your review is not required, then it is requested that the floodplain be revised by eliminating the A4 zone for Scatter Wash (South Branch) on panel 1195D, and the AE zone for Scatter Wash (South Branch) on panel 1215F. Panel 1215F is scheduled to be updated this year, and an immediate review and approval of this hydrology would make it possible to eliminate the Scatter Wash (South Branch) on panel 1215F. A "Best Available Data Letter" could be issued to remove the Scatter Wash South Branch as shown on panel 1195D.

Since this hydrology has been approved by the City of Phoenix, the Flood Control District of Maricopa County, and the Arizona Department of Transportation, it would seem that we can anticipate a FEMA approval. The floodplain will then have been eliminated by the construction of Interstate 17, the large amount of detention provided by the Deer Valley Underpass under Interstate 17, the construction of dikes along Skunk Creek at the upper end of the watershed by the Corps of Engineers, and the construction of the Central Arizona Project Granite Reef Aqueduct.

Your early attention to this matter would be appreciated. If you or your staff have any questions, I can be contacted at (602) 262-4960.

Sincerely,

James H. Matteson, P.E.
Street Transportation Director

Paul Kienow

Paul E. Kienow, P.E.
Floodplain Management Engineer

JHM/PEK/aff/930615a

c: Mr. Van Skike
Ms. Miller, Arizona Department of Water Resources
Mr. Nelson, Sage Engineering
Mr. Hubbard, Kaminski Hubbard Engineering, Inc.
Mr. Rodzenko, Flood Control District of Maricopa County
Mr. Jordan, Arizona Department of Transportation

SECTION 1.4

GENERAL CORRESPONDENCE

FOR

SECTION 1.4.3 OTHER AGENCIES

#269

ARIZONA DEPARTMENT OF TRANSPORTATION

HIGHWAYS DIVISION

206 South Seventeenth Avenue - Phoenix, Arizona 85007-3213

September 15, 1994

Mr. Darryl L. Bradley, P.E.
Kaminski-Hubbard Eng., Inc.
4550 N. Black Canyon Highway, Ste. C
Phoenix, AZ 85017

Dear Mr. Bradley:

In response to your request of September 9, 1994, we have researched the design of the detention basins on the Out Loop Highway as you requested. A 100-year, 24 hour storm of 3.9 inches of rain was used to design basins D and C of ADOT's Outer Loop storm drainage system. These basins were designed to alleviated the impact during flood events of the highway on adjacent property and not increase discharges into Scatter Wash.

Detention basin "D" is situated to provide "off-line" storage for flows collected at 23rd Avenue and Rose Garden Lane. The basin has a capacity of 25.4 acre-feet at the design highwater elevation of 1396.0. However, as the basin is constructed below the existing, natural ground and is bordered by highway embankment on its south and west sides, it has a far greater capacity than the design capacity. For flows greater than the design volume, the excess would simply not get into the basin. The maximum flow that can get to the basin is limited by the backwater effects on the inlet collection system. Rather, excess flows would continue along the flow paths to the south of Rose Garden Lane.

Detention basin "C", at 35th Avenue and Beardsley Road, is also situated "off-line." Runoff is collected by a channel, east of the basin, and thru a sideflow weir inlet flow in excess of 250 cfs are diverted into the basin. The basin has a design storage volume of 34 acre-feet, all of the storage is below existing grade. The low point in the basin is elevation 1337.5, the existing ground is at elevation 1350.3, and the weir is at elevation 1349.0. Flows greater than the design volume would continue along the channel and not enter the basin.

The Arizona Department of Transportation does not have specific funds dedicated solely for the maintenance of its stormwater program. there are, however, several sources available for adequate funding of the stormwater facilities. Stormwater issues related to maintenance will be covered under our Highway Maintenance Program. The issues and costs are identified and submitted for approval each year. Currently, we receive approximately $63 million in this program.

Sincerely,

George Lopez-Cepero

George Lopez-Cepero
Bridge Drainage Leader
Bridge Group

GLC:nb
(drain/bradley)

SECTION 1.4

GENERAL CORRESPONDENCE

FOR

SECTION 1.4.5 FEMA WASHINGTON

Federal Emergency Management Agency

Washington, D.C. 20472

NOV 15 1993

Mr. Raymond U. Acuña, P.E.
Floodplain Management Engineer
City of Phoenix
125 East Washington Street
Phoenix, Arizona 85004

Dear Mr. Acuña:

In a letter dated February 10, 1993, Mr. Paul E. Kienow, former Floodplain Management Engineer for the City of Phoenix, Arizona, requested that we review and comment on a hydrology report for Scatter Wash for its possible use in a new Flood Insurance Study (FIS) for Scatter Wash. He submitted a report entitled "Scatter Wash Watershed, Arizona Canal Diversion Channel, Area Drainage Master Study, Phase I, Hydrology Report," dated May 4, 1992, prepared by Kaminski Hubbard Engineering, Inc. (KHE). In a follow-up letter dated June 15, 1993, Mr. Kienow requested that, if our review of the hydrology report is not required, the floodplain of Scatter Wash shown on the Flood Insurance Rate Map (FIRM) be revised by eliminating the A4 and AE zones for the South Branch on panels 1195 D and 1215 F, respectively. Mr. Kienow stated that the KHE hydrology report has been approved by the City of Phoenix, the Flood Control District of Maricopa County (FCDMC), and the Arizona Department of Transportation. On July 8, 1993, we informed Mr. Kienow that as a result of his submission, we determined that our review of the hydrologic analysis prepared by the U.S. Army Corps of Engineers (USACE), that was used to produce the base (100-year) flood elevations (BFEs) and delineate Special Flood Hazard Area (SFHA) boundaries on FIRM panels 1195 D and 1215 F, is necessary for us to determine if the KHE report is an improvement on the USACE hydrologic analysis used in the effective FIS.

After review, we have determined that the KHE hydrologic analysis is not an improvement of the USACE hydrologic analysis, and therefore a revision of the 100-year discharges for the North Branch and South Branch of Scatter Wash and a revision of the SFHA of the South Branch is not warranted at this time. Our determination is based on our review of the USACE reports entitled, "Gila River Basin, New River and Phoenix City Streams, Arizona, Design Memorandum No. 2, Hydrology, Part 1," (DM-1) dated October 1974; "Gila River Basin, Phoenix, Arizona and Vicinity (including New River), Hydrology, Part 2, Design Memorandum No. 2," (DM-2), dated 1982; "Hydrology for Flood Insurance Studies, Maricopa County Streams, Arizona," dated June 1985 and revised May 1985; and "Draft Report, Flood Insurance Study, New River and Scatter Wash, Maricopa County, Arizona," dated September 1985. Our determination is also based on our discussion with the USACE and our cursory review of a report entitled, "Scatter Wash Drainage and Storm Drain Study, Conceptual Plan, Volumes I and II," prepared for the City of Phoenix Engineering Department, Floodplain Management, by Greiner, Inc., dated September 1989. For your information, the Greiner report was submitted by Mr. Kienow on May 21, 1992, in support of the City's request that we revise the SFHA delineation on FIRM Panel 1205 of Scatter Wash east of Interstate 17. On September 18, 1992, FEMA issued the City a Letter of Map Revision (LOMR) for the redelineation of an area of

Scatter Wash upstream of Interstate 17 on FIRM panel 1205. The basis of issuing this LOMR was the previously mentioned USACE FIS report dated September 1985.

Our comments on the KHE report that support our determination are presented below. For the sake of clarity, Scatter Wash, Scatter Wash North Branch, and Scatter Wash South Branch are identified as labeled on FIRM Panels 1195 D and 1215 F. The KHE report identifies North Branch Scatter Wash as the wash that enters the double 8' x 7' box culverts located under Interstate 17. Scatter Wash is identified as the wash that flows through the 6' x 7' box culvert located under Interstate 17 and continues to its confluence with Skunk Creek. The Greiner report identifies the North Branch of Scatter Wash as the wash that enters the double 8' x 7' box culverts, and South Branch of Scatter Wash as the wash that enters the 6' x 7' box culvert. The FIRM identifies Scatter Wash North Branch as the wash that flows through the two sets of culverts described above and into the South Branch. The Scatter Wash South Branch is identified as the wash that begins from Williams Drive downstream of the water impoundment located east of Interstate 17 and north of Williams Drive. This wash continues flowing southward along the Interstate 17 embankment, and southwest from the Dear Valley Road interchange. The North and South Branches combine in the vicinity of Rose Garden Lane where it is identified as Scatter Wash to its confluence with Skunk Creek.

- Segmentation of Scatter Wash Basin into Sub-basins

  The KHE report subdivided the Scatter Wash basin, within the drainage area bounded by Interstate 17 and Williams Drive and the Central Arizona Project Canal (CAPC), into nine sub-basins. Peak flows were determined for each sub-basin using the USACE HEC-1 hydrologic model. These flows were routed and combined to produce peak flows at various concentration points (CPs). The topographic configurations of the entire basin as shown on the U.S. Geological Survey 7.5-minute quadrangle map for the area and the amount of KHE peak flows in various flow paths in the sub-basins indicate that such subdivision may not be appropriate. The Scatter Wash basin, within the boundary previously mentioned, is characterized by braided and undefined channels. Field observation by the USACE determined that, during flooding events, the type of flow within the basin is sheet flow. Shallow flows are collected and eventually concentrated in the impoundment area located east of Interstate 17 and north of Williams Drive where the flows split into the North and South Scatter Wash. The KHE peak flows for each sub-basin demonstrate the sheet flow phenomena. For example, peak flows for sub-basins 312 and 316 are 1,423 and 761 cubic feet per second (cfs), respectively. (See Plate 4, Flow Routing Map of the KHE report). Computed flow depth and width for each flow path of the sub-basins demonstrates that the flow within the two sub-basins is shallow and interconnected. This would suggest that the two sub-basins should be considered as one sub-basin in the HEC-1 model. Further, it would appear that if the KHE subdivision of the basin into sub-basins is appropriate, then SFHAs along their flow paths should exist. For example, KHE sub-basins 312, 316, 314, and 321, which yield peak flows of 1,423, 761, 836, and 894 cfs, respectively, would indicate that the flows for each sub-basin are separated from one another and would indicate the existence of SFHAs. Our concern in the KHE division of the basin into sub-basins is that the peak flows in various CPs are artificially reduced. This reduction is accomplished by adding

hydrographs of different peak times that are originated from sub-basin flows or routed flows within the basin. Therefore, because the flow paths of sub-basins may not have enough channel and floodplain capacity to contain such flows, we believe that subdividing the basin into sub-basins may not represent the actual flow condition in the basin. For this reason, the USACE considered the entire Scanes Wash basin, previously defined as one sub-basin, and computed the flow at the CP located at the impoundment area. As previously mentioned, the LOMR dated September 18, 1992, to revise the SFHA of Scanes Wash on panel 1205 was based on the USACE determination of flow type in the basin (shallow flow) and that all flows are conveyed by sheet flow across the basin to the impoundment area as stated in the 1985 USACE FIS report.

- HEC-1 Model Parameters

As previously mentioned, the KHE hydrologic analysis of the Scanes Wash watershed was performed using the USACE HEC-1 model. FCDMC hydrologic design criteria and guidelines were used to select the model's functions and parameters. No information was submitted to indicate that selection of parameter values are based on model calibration using observed data. The USACE hydrologic analysis that was used in the effective FIS also utilized the HEC-1 model. However, model parameters were estimated based on model calibration using observed data and flood hydrograph reconstitution of gage watersheds in the area. In the following paragraphs, we discuss various functions and parameters that are sensitive to peak flow values that support our determination that the KHE hydrologic analysis is not an improvement of the USACE hydrologic analysis.

- Rainfall Depth and Distribution

The KHE report used a 100-year point rainfall depth of 4.00 inches. An areal reduction coefficient of 0.93 was applied that yields a spacially reduced rainfall of 3.72 inches for each sub basin in the HEC-1 model. (See PB record of the KHE HEC-1 input data). This reduction coefficient was computed based on the Scanes Wash total watershed area of 15.58 square miles at Skunk Creek confluence. (See Table 5 of the KHE report). Because the Scanes Wash basin is divided into sub-basins that are modeled as separate watersheds, and their drainage area ranges from 0.05 to 1.35 square miles, reduction of the point rainfall of 4.00 inches is not appropriate.

Regarding the rainfall distribution, the KHE report used the SCS type II distribution for the 24-hour storm. This type is general hypothetical distribution and may not represent rainfall distribution of actual storms in the area. It should be noted that while the KHE report selected the SCS type II distribution, the Greiner report selected different hypothetical storm distribution (SCS type II A) that is more severe, as can be seen in the PC records of the HEC-1 input data of the KHE and Greiner reports.

As documented in the USACE DM-1 and DM-2 reports, which are the basis of the Scanes Wash hydrologic analysis, rainfall distribution pattern was selected based on an actual severe storm that produced major flooding in the area.

Loss Rate Estimation

The Green-Ampt loss rate function was used in the KHE HEC-1 model. The values of the parameters were estimated as recommended by FCDMC based on the soil type of the sub-basins. No information was submitted to indicate that these parameters were selected based on HEC-1 model calibration. The USACE used the HEC loss rate function in the HEC-1 model. The loss rate parameters were derived automatically using calibration process by reconstitution of 22 observed flood events in the Phoenix area. It should also be noted that the Greiner report use the SCS curve number loss rate by selecting curve number value in the LS record in the HEC-1 model. While the three loss rate functions mentioned above are listed in the HEC-1 model user's manual as options and, therefore, using any of these functions is acceptable. The important point is that selection of the values of the parameters of any loss function selected should be based on calibration of the model using observed flow data of gaged watershed(s) in the area.

Detention and Diversion of Flows

In the KHE HEC-1 model, 100-year peak flows were attenuated at several detention facilities in the basin downstream of the CAPC. Examples are, as shown on Plate 1, Drainage Area Map & HEC-1 Schematic of the KHE report, detention facilities at Stations 323 RR, 343 RR (detention facility "D"), and 344 R (detention facility "C"). The peak flows were attenuated, due to routing the flows through the facility's storage, from 149 cfs to 30 cfs, 620 cfs to 127 cfs, and 690 cfs to 96 cfs, respectively. No as-built drawings and design data were submitted to support that these facilities were designed for the 100-year flows. In addition, the peak flow attenuation at Station 332 RR, the depressed section at Deer Valley Road interchange of Interstate 17, may not be reasonable. At this location the inflow hydrograph peak is 674 cfs and the outflow hydrograph peak from the depressed area is 1 cfs. No topographic information was provided to support the KHE computations used in the HEC-1 reservoir routing input data for the depression at the Deer Valley Road interchange (RS, SV, SE, and SQ records). It should be noted that, in the Greiner report, the inflow hydrograph peak at the same location is 2,383 cfs and the outflow hydrograph peak is 2,279 cfs. (See HEC-1 output and Figure 3, Volume 1, of the Greiner report).

Finally, at station 314 RR of the KHE HEC-1 model, the flow was routed through Pinnacle Peak Road double 8' x 7' box culverts. The inflow hydrograph peak is 2,709 cfs and the outflow hydrograph peak after attenuation is 2,188 cfs. The input data used in the KHE HEC-1 model for routing the flow through the culverts (SV, SE, and SQ records) was obtained from the Greiner report. According to the Greiner report, the 100-year discharge exceeds the culverts' capacity, which is 1,900 cfs (see Figure 5), therefore, an impoundment upstream of the culverts is expected and overtopping of the roadway will occur. Because no data was provided in the KHE report to support that the roadway will not be overtopped and the embankment will not fail during the 100-year flood event, attenuation of the flows may not be appropriate. The inflow hydrograph peak flow of 2,709 cfs at this location may remain unchanged.

5

Regarding flow diversion, in the KHE report, flow is diverted out of the Scatter Wash basin at Station 341 D. along 19th Avenue at Deer Valley Road, and out at Station BEARD at the Beardsley Road interchange. Diverted peak flow at these locations are 212 cfs and 531 cfs, respectively. No as-built drawings and design data were provided to support that the diversion at these locations could occur during the 100-year event and to support the diversion input data used in DI and DQ records of the HEC-1 model.

This concludes our comments on the City's request that we review the KHE hydrologic analysis for Scatter Wash. As previously mentioned, in making our determination of no revision to the hydrologic analysis used in the FIS, we consulted with the USACE. If you wish to further discuss and reconcile the differences between the KHE and the USACE hydrologic analysis, you may contact Mr. Dennis J. Marfice, USACE, Los Angeles District, by telephone at (213) 894-4733.

We apologize for the delay in presenting our comments and regret any inconvenience this delay may have caused. If you have any questions regarding this matter, please contact Mr. Karl F. Mohr of my staff in Washington, DC, either by telephone at (202) 646-2770 or by facsimile at (202) 646-3445.

Sincerely,

William R. Locke, Chief
Risk Studies Division
Federal Insurance Administration

Enclosure

cc: Mr. Joseph B. Evelyn
Chief, Hydrology and Hydraulics Branch
U.S. Army Corps of Engineers
Los Angeles District

The Honorable Paul Johnson
Mayor, City of Phoenix

Mr. James H. Matteson, P.E.
Street Transportation Director
City of Phoenix

Federal Emergency Management Agency
Washington, D.C. 20472

OCT 27 1994

Mr. Raymond U. Acuña, P.E.
Floodplain Management Engineer
City of Phoenix
125 East Washington Street
Phoenix, Arizona 85004

Dear Mr. Acuña:

This letter is to update you on the status of our review of the report entitled, "Scatter Wash Watershed, Arizona Canal Diversion Channel, Area Drainage Master Study, Phase 1, Hydrology Report," prepared by Kaminski-Hubbard Engineering, Inc. The City had requested that we review and comment on the hydrology report for its possible use in a new Flood Insurance Study for Scatter Wash. In a letter dated July 6, 1994, Kaminski-Hubbard responded to our initial review comments provided in a letter dated November 15, 1993.

We reviewed the July 6 letter with Kaminski-Hubbard in telephone conversations on August 10, August 31, and September 9, 1994, to clarify information submitted with the letter and request additional necessary information. Kaminski-Hubbard followed up with a letter dated September 12, 1994, enclosing the following data:

> Calculations for determining split flows at the intersection of 19th Avenue and Deer Valley Road; split flow calculations for Deer Valley Road; calculation for the I-17 and Beardsley Road interchange stage-storage-discharge relationship; excerpts from a revised HEC-1 model showing the revised diversions for HEC-1 I.D. 341D and 343D; the HEC-1 I.D. 349RR2 to model the detention at I-17 and Beardsley Road; and a revised peak discharge summary.

In addition, on September 19, 1994, Kaminski-Hubbard transmitted by facsimile a copy of a letter it had received from the Arizona Department of Transportation discussing information about the design of the detention basins.

We are reviewing these additional data and materials and will provide a response within 30 days of the date of this letter. We appreciate the cooperation of Kaminski-Hubbard during this review process. If you have any questions regarding this matter, please contact Mr. Karl Mohr of my staff in Washington, DC, either by telephone at (202) 646-3403 or by facsimile at (202) 646-4596.

Sincerely,

Michael K. Buckley, P.E., Chief
Hazard Identification Branch
Mitigation Directorate

cc: Mr. Darryl L. Bradley, P.E.
Kaminski-Hubbard Engineering, Inc.

The Honorable Paul Johnson
Mayor, City of Phoenix

Mr. James H. Matteson, P.E.
Street Transportation Director
City of Phoenix

#269

Federal Emergency Management Agency

Washington, D.C. 20472

NOV 14 1994

Mr. Raymond U. Acuña, P.E.
Floodplain Management Engineer
City of Phoenix
125 East Washington Street
Phoenix, Arizona 85004

Dear Mr. Acuña:

This is in response to a request by the City of Phoenix that the Federal Emergency Management Agency (FEMA) review and comment on the hydrology report entitled, "Scatter Wash Watershed, Arizona Canal Diversion Channel, Area Drainage Master Study, Phase 1, Hydrology Report," prepared by Kaminski-Hubbard Engineering, Inc. In a letter dated July 6, 1994, Kaminski-Hubbard responded to the initial review comments we provided in a letter dated November 15, 1993, to you. With the July 6 letter, Kaminski-Hubbard submitted as-built drawings and supporting data for detention facilities used in the hydrologic analysis, hydrologic work maps (scale: 1" = 400'), and a revised HEC-1 model.

We reviewed the July 6 letter and submittals with Kaminski-Hubbard during telephone conversations on August 10, August 31, and September 9, 1994, to clarify the data and request additional information. Kaminski-Hubbard responded with a letter dated September 12, 1994, in which the following additional data were enclosed: Calculations for determining split flows at the intersection of 19th Avenue and Deer Valley Road; split flow calculations for Deer Valley Road; calculation for the I-17 and Beardsley Road interchange stage-storage-discharge relationship; excerpts from a revised HEC-1 model showing the revised diversions for HEC-1 I.D. 341D and 343D; the HEC-1 I.D. 349RR2 to model the detention at I-17 and Beardsley Road; and a revised peak discharge summary.

On September 19, 1994, Kaminski-Hubbard transmitted by facsimile a copy of a letter it had received from the Arizona Department of Transportation discussing information about the design of the detention basins.

After reviewing these additional data, we determined that the hydrologic analysis represents the existing condition of the Scatter Wash watershed; therefore, we concur with the results of the analysis. Because the submitted hydrologic work maps reflect revised Scatter Wash flow paths from those indicated on the effective Flood Insurance Rate Map (FIRM) for the City of Phoenix, we will consider these work maps as the basis of our review of a request for a map revision for this area. To request a map revision, the City must incorporate the results of this hydrologic analysis, represented by the final HEC-1 model and the hydrologic work maps used to develop the analysis, in the hydraulic analysis and submit the data to FEMA under the provisions of Part 65 of the National Flood Insurance Program (NFIP) regulations.

Because several detention basins are included in the hydrologic analysis, a map revision request also must include evidence that the storage areas within each basin shall be maintained. Such evidence must include the entity that is responsible for maintenance, the maintenance activities to be performed, and the frequency of performance of these activities.

Thank you for giving us the opportunity to review the hydrology report for the Scatter Wash watershed. If you have any questions regarding this matter, please contact Mr. Karl Mohr of my staff in Washington, DC, either by telephone at (202) 646-3403 or by facsimile at (202) 646-4596.

Sincerely,

Michael K. Buckley, P.E., Chief
Hazard Identification Branch
Mitigation Directorate

cc: Mr. Darryl L. Bradley, P.E.
Kaminski-Hubbard Engineering, Inc.

The Honorable Paul Johnson
Mayor, City of Phoenix

Mr. James H. Matteson, P.E.
Street Transportation Director
City of Phoenix

SECTION 1.4

GENERAL CORRESPONDENCE

FOR

SECTION 1.4.6 FEMA TECHNICAL CONSULTANT

MICHAEL BAKER JR., INC.
PHONE CALL REPORT

PROJECT/LOCATION: Maricopa County, AZ	S.O. NO.: 18877-370-3407 DATE: August 10, 1994 CONTRACT NO.:
To: Darryl Bradley Repres.: Kaminski Hubbard Engineering Phone No.: (602) 242-5588	From: Adnan Saad/Patti Sexton Repres.: Michael Baker, Jr. Phone No. (703) 960-8800

SUBJECT: Scatter Wash Hydrology resubmittal

We called to discuss the report that was submitted in response to the 11/15/93 FEMA letter. We asked him if it was required by the FCDMC to use their hydrology manual. He said the FCDMC required it. We responded that FCDMC Hydrology Manual has been used in many revision cases and studies. This is the basic issue of the request. We told him that we would discuss using FCDMC Hydrology Manual for this particular case with FEMA. However, we did have the following additional questions:

•Can he certify that the detention facilities will not fail and be washed away in the 100-year event?

Darryl said that he would send this certification. We added that this certification could be based on the county's certification since the facilities are county projects.

•We questioned the diversion located at Beardsley and I17. (see HEC-1 Flow Routing Map, Plate 4) What happens to the 567 cfs that is diverted at CP BEARD?

Darryl explained that construction has not been completed east of this interchange. It will not be constructed for 5-10 years. At that time a pipe will be constructed to carry away the flow. The flow is routed now to the interchange depression. Darryl will submit stage-storage-elevation curves to show the attenuation in the depression at the interchange similiar to what was done at the interchange to the north. The HEC-1 does not need to be revised. Calculations showing very little flow escapes the watershed is sufficient.

•Deer Valley Road Diversion (CP 341D)

He will submit technical data to support his flow splits of 40%/ 60% at the Deer Valley Diversion.

•By dividing the drainage area into many subbasins additional flowpaths with high flows are defined that were not previously shown on the FIRM. Will there be new floodplain delineations or will all the flooding be shallow?

Darryl feels the latter is the case but this question goes into the area of hydraulics. He is only responsible for the hydrology but agreed that the FCDMC should be aware of this issue. He will contact the FCDMC to discuss this and find out who will be responsible for this floodplain delineation. We told him that this issue is of major concern and that FEMA may raise this issue in their response to the City. We also discussed the impact of the mismatch of the flows & BFEs downstream of the confluence of Scatter Wash and Skunk Creek as a result of revising the hydrology.

Darryl will submit the additional information by late Thursday or Friday (8/11 pr 8/12).
He asked if we will send another letter. We told him that FEMA will send a letter to the City of Phoenix based on our review of the report and all of that data that he will send.

PREPARED BY: Patti Sexton TITLE: AEZ PAGE 1 OF 1

SECTION 1.5

CONTRACT DOCUMENTS

City of Phoenix
ENGINEERING & ARCHITECTURAL SERVICES DEPARTMENT
200 West Washington Street
Phoenix, Arizona 85003-1611

Winner of the
Carl Bertelsmann
Prize

May 22, 1995

Mr. Daniel L. Kaminski, P.E., R.L.S.
KAMINSKI-HUBBARD ENGINEERING INC.
4550 N. Black Canyon Hwy., Suite C
Phoenix, Arizona 85017

Dear Mr. Kaminski:

SCATTER WASH - PREPARATION OF LETTER OF MAP REVISION
INDEX NO. ST-951350

Here is your executed copy of City of Phoenix Contract No. 70998, covering professional services for the above project. This is your Notice to Proceed with the work effective as of the date of this letter. Please acknowledge receipt below by signing the enclosed copy of this letter and returning it to me.

This contract will be administered by Ray Acuna, Floodplain Manager, of the Street Transportation Department. Please coordinate the authorized contract work and submit all invoices through him. You may contact Ray Acuna at 262-4026.

It is important you show the index number on all documents, letters and drawings relating to the project. Payment requests require both an index number and a contract number to assure proper handling. These and other City forms will be provided by the Street Transportation Department.

Very truly yours,

Linda L. Houston

LINDA L. HOUSTON
Contracts Administration

THIS ACKNOWLEDGES RECEIPT OF CONTRACT

NO. 70998 ON May 26, 1995

BY: Daniel L. Kaminski
KAMINSKI-HUBBARD ENGINEERING INC.

LLH:sv

Enclosures

c: Ray Acuna (w/contract)

INDEX NO. ST-951350

CITY OF PHOENIX, ARIZONA
ENGINEERING & ARCHITECTURAL SERVICES DEPARTMENT

STREET TRANSPORTATION DEPARTMENT

SCATTER WASH - PREPARATION OF LETTER OF MAP REVISION

CONTRACT NO. 70998

THIS AGREEMENT, made and entered into by and between the CITY OF PHOENIX, ARIZONA, a municipal corporation, hereinafter called the "CITY", and KAMINSKI-HUBBARD ENGINEERING, INC., hereinafter called the "ENGINEER",

WITNESSETH:

THAT WHEREAS, the City Manager of the City of Phoenix, Arizona, is authorized and empowered by provisions of the City Charter to execute contracts for professional services,

NOW, THEREFORE, for and in consideration of the mutual covenants and considerations hereinafter contained, it is agreed by and between the City and the Engineer as follows:

SECTION I - SERVICES OF THE ENGINEER

That the Engineer shall perform the following professional services to the satisfaction of the Street Transportation Director and in accordance with the degree of care and skill which a registered professional engineer in Phoenix, Arizona would exercise under similar conditions:

A. The Engineer shall provided engineering services related to the preparation of a Letter of Map Revision (LOMR) for Scatter Wash. Limits of the project extend from Scatter Wash's confluence with Skunk Creek to east of I-17. The Engineer's services will include field reconnaissance, field surveys, topographic mapping, hydrologic and hydraulic analysis, floodway delineation, flood insurance rate, and preparation of a technical documentation report. The Engineer's "Scope of Services" is attached (labeled Exhibit "A") and incorporated into this Contract by reference.

SECTION II - PERIOD OF SERVICE

SECTION I services shall be performed upon receipt of an executed contract and Notice to Proceed with the work and shall be completed within 90 calendar days, exclusive of City review time. Failure on the part of the Engineer to adhere to this work schedule shall be sufficient grounds for termination of the contract by the City.

SECTION III - PAYMENTS TO THE ENGINEER

For all services described under SECTION I of this Agreement, the City shall pay the Engineer as follows:

A. The Engineer's fee shall be lump of $27,500.

B. Request for monthly payments shall be accompanied by a detailed invoice and progress report prepared and submitted by the Engineer. Payment request shall be submitted to the Project Manager, who shall submit for review and approval to the Street Transportation Department for work completed through the last day of the preceding calendar month. However, no more than

ninety percent (90%) of the total contract price shall be paid before the work is completed and accepted by the Street Transportation Department. The Street Transportation Department will pay Engineer's final invoice within forty-five days from the date the Street Transportation Department has accepted the Engineer's work.

C. The Engineer agrees that no charges or claims for damages shall be made by him for any delays or hindrances beyond the control of the City during the progress of any portion of the services specified in this Agreement. Such delays or hindrances, if any, shall be compensated for by an extension of time for such reasonable period as may be mutually agreed between parties. It is understood, however, that permitting the Engineer to proceed to complete any services, or any part of them, after the date to which the time of completion may have been extended, shall in no way act as a waiver on the part of the City of any of its legal rights herein.

SECTION IV - THE CITY'S RESPONSIBILITIES

The City shall furnish the Engineer, at no cost to the Engineer, the following information or services for this project:

A. One copy of its maps, records, laboratory tests, survey ties, and bench marks, or other data pertinent to the work. However, the Engineer shall be responsible for searching the records and requesting specific drawings or information.

B. Printing, binding, and issuance of the plans, specifications, and contract documents to the bidders and contractor.

C. Reproduction and distribution of copies of the final plans to utility companies and other bona fide agencies which will be involved in this project.

D. All available data relative to policies, standards, criteria, studies, etc.

E. The necessary title searches, prepare legal descriptions, and detailed condemnation maps to the end that the City may proceed with the right-of-way acquisition.

F. Designate the name of a City employee who will serve as Project Manager during the term of this agreement. The Project Manager has the authority to administer this Contract, but does not have the authority to modify the Contract. The Street Transportation Department shall administer this Contract and shall insure that the Engineer complies with all the terms and conditions stated herein. The Engineer shall be entitled to rely only on written responses to his requests for information or decisions signed by an Engineering Supervisor or Street Transportation Department Director.

SECTION V - GENERAL CONDITIONS

A. Surveying that Restricts Traffic

Surveys performed by the Engineer shall comply with the regulations contained in Sections III, IV, and VIII of the Traffic Barricade Manual, Phoenix, Arizona, dated January, 1989. Survey that restricts traffic is not permitted at signalized intersections or on major or collector streets during peak traffic hours:

1) 6 - 8:30 a.m. and 4 - 7 p.m. weekdays;
2) 9 a.m. - 10 p.m. Saturday, in the vicinity of major shopping centers.

B. Records

Records of the Engineer's direct personnel payroll expense, reimbursable expenses pertaining to this project, and records of accounts between the City and the Engineer shall be kept on a generally recognized accounting basis and shall be available to the City or its authorized representative for audit during normal business hours. In addition, the records shall be subject to audit by the City of Phoenix and/or the appropriate Federal Agency if the project is federally funded.

C. Alteration in Character of Work

Whenever an alteration in the character of work results in a substantial change in the nature of the design, thereby materially increasing or decreasing the cost of the performance, the work shall be performed in accordance with the Contract and as directed. Before such work is started however, a Contract Change Order or Amendment shall be executed by the City and the Engineer, such Contract Change Order or Amendment shall not be effective until approved by the Street Transportation Department Director. Additions to, modifications, or deletions from the project provided herein may be made and the compensation to be paid to the Engineer may accordingly be adjusted by mutual agreement of the contracting parties. It is distinctly understood and agreed that no claim for extra work done or materials furnished by the Engineer will be allowed by the City except as provided herein, nor shall the Engineer do any work or furnish any materials not covered by this Agreement unless such work is first authorized in writing. Any such work or materials furnished by the Engineer without such written authorization first being given shall be at his own risk, cost, and expense, and he hereby agrees that without such written authorization he will make no claim for compensation for such work or materials furnished.

D. Termination

The City and the Engineer hereby agree to the full performance of the covenants contained herein, except that the City reserves the right, at its discretion, to terminate or abandon the services provided for in this Agreement, or abandon any portion of the project for which services have been performed by the Engineer.

1. In the event the City shall abandon the service or any part of the services as herein provided, the City shall notify the Engineer in writing, and immediately after receiving such notice, the Engineer shall discontinue advancing the work under this Agreement and proceed to close said operations under the Agreement.

2. Upon such termination or abandonment, the Engineer shall deliver to the City all work entirely or partially completed, together with all unused materials supplied by the City. If the City elects to complete any of the Engineer's work which is only partially complete at termination, it will require the completing engineer to affix his seal to the work in accordance with the rules and regulations of the Arizona Technical Registration Board for Architects and Engineers.

3. The Engineer shall appraise the work he has completed and submit his appraisal to the City for evaluation. The City shall have the right to inspect the Engineer's work to appraise the work completed.

4. The Engineer shall receive a fee for the percentage of the work actually completed as compensation in full for services performed to the date of such termination. This fee shall be a percentage of the Engineer's fee described in this Contract under SECTION III, and shall be in an amount to be agreed upon mutually by the Engineer and the City. If there is no mutual agreement, the final determination shall be made in accordance with Section V, Paragraph L "Disputes". However, in no event shall the fee ever exceed that set forth in Section III of this document. The City shall make this final payment within sixty (60) days after the Engineer has delivered the last of the partially completed items.

5. When work detail covers only the preparation of preliminary plans, there shall be no limitation upon the City as to the subsequent use of the plans or ideas incorporated therein for the preparation of final construction plans."

E. Additional Work

Additional work, when authorized by executed Contract Change Order or Amendment shall be compensated for by a fee mutually agreed upon between the City and the Engineer.

F. Ownership of Documents

All documents including, but not limited to: plans, specifications, tracings, drawings, estimates, field notes, investigations, design analyses, and studies which are prepared in the performance of this Agreement are to be and remain the property of the City and are to be delivered to the Street Transportation Department Director before the final payment is made to the Engineer. However, if the Engineer wishes, he may retain copies of drawings and supply the City with originals on cloth or mylar. The Engineer shall endorse by his professional seal all plans, special provisions, and engineering data furnished by him. In the event these documents are reused without further consultation with the Engineer, the City agrees to hold the Engineer harmless from any claim arising from the reuse of the documents.

G. Completeness and Accuracy of the Engineer's Work

The Engineer shall be responsible for the completeness and accuracy of his survey work, plans, supporting data, and special provisions prepared or compiled under his obligation for this project and shall correct, at his expense, all errors or omissions therein which may be disclosed. The cost of the design necessary to correct those errors attributable to the Engineer and any damage incurred by the City as a result of additional construction costs caused by such engineering errors shall be chargeable to the Engineer. The fact that the City has accepted or approved the Engineer's work shall in no way relieve the Engineer of any of his responsibilities.

H. City's Right of Cancellation

All parties hereto acknowledge that this agreement is subject to cancellation by the City of Phoenix pursuant to the provisions of Section 38-511, Arizona Revised Statutes.

I. Claims Against the City

The Engineer hereby agrees to defend, indemnify and hold harmless the City, any of its departments, agencies, officers, or employees from all damages, claims or liabilities and expenses (including Attorney's fees) arising out of or resulting in anyway from the performance of professional services for the City in the Engineer's capacity as an Engineer, and caused by any error, omission, or negligent act of the Engineer or any person employed by him, or of any others for whose acts the Engineer is legally liable.

J. Insurance

The Engineer shall secure and maintain during the life of this Contract insurance coverage to include Workmen's Compensation, Employers' Liability, General Liability (including Contractual Liability coverage), Automobile Liability, and Professional Liability. The General Liability shall be, on an occurrence made basis, no less than $1,000,000. The minimum amounts of coverage for the Engineer's Professional Liability shall be $1,000,000 per claim, on a claims made basis with annual aggregate of no less than $1,000,000. The existence of this coverage shall be evidenced on a Certificate of Insurance (ACORD form or equivalent approved by the City). The City of Phoenix, a municipal corporation, its officers, employees, and designated volunteers, are to be additional insureds on the Certificate of Insurance (except on Workmens Compensation and Professional Liability).

The Engineer shall submit a Certificate of Insurance to the Contract Administration Section evidencing the required coverage and limits stated above within 10 days after the signing of the Contract by the Engineer.

Certificates shall be renewable annually. If any insurance policy is due to expire during the life of this Contract, the Engineer shall provide a Certificate of Renewal evidencing the required insurance coverage to the City not less than 15 calendar days prior to the expiration date.

K. Successors and Assigns

The City and the Engineer shall each bind himself, his partners, successors, assigns, and legal representatives to the other party to this agreement and to the partners, successors, assigns, and legal representatives of such other party in respect to all covenants of this agreement. Neither the City nor the Engineer shall assign, sublet, or transfer his interest in this Agreement without the written consent of the other. In no event shall any contractual relationship be created between any third party and the City.

L. Disputes

In any dispute concerning a question or interpretation of fact in connection with the work not disposed of by Agreement between the Engineer and the City, the final determination at the administrative level shall be made by the Street Transportation Department Director.

M. Covenant Against Contingent Fees

The Engineer warrants that no person has been employed or retained to solicit or secure this Contract upon an agreement or understanding for a commission, percentage, brokerage, or contingent fee; and that no member of the City Council or any employee of the City of Phoenix has any interest, financially or otherwise, in the Engineering firm. For breach or violation of this warranty, the City shall have the right to annul this Contract without liability, or at its discretion to deduct from the Contract price or consideration, the full amount of such commission, percentage, brokerage, or contingent fee.

N. Equal Opportunity/Affirmative Action

The Engineer shall comply with the provisions of this Agreement, including the requirements of Chapter 18, Phoenix City Code, pertaining to discrimination and accepting applications or hiring employees. The Engineer shall not discriminate against any worker, employee or applicant, or any member of the public, because of race, color, religion, gender, national origin, age or disability nor otherwise commit an unfair employment practice. The Engineer will take affirmative action to

ensure that applicants are employed, and employees are dealt with during employment, without regard to their race, color, religion, gender or national origin, age or disability. Such action shall include but not be limited to the following: employment, promotion, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship as well as all other labor organizations furnishing skilled, unskilled and union labor, or who may perform any such labor or services in connection with this contract. The Engineer further agrees that this clause will be incorporated in all subcontracts, job-consultant agreements of this Agreement entered into by the Engineer.

The City of Phoenix extends to each individual, firm, vendor, supplier, contractor, and subcontractor an equal economic opportunity to compete for City business and strongly encourages voluntary utilization of Disadvantages and/or Minority-owned or Woman-owned business to reflect both the industry and community ethnic composition.

O. Independent Contractor

The Engineer is and shall be an independent contractor. Any provision in this Contract that may appear to give the City the right to direct the Engineer as to the details of accomplishing the work or to exercise a measure of control over the work means that the Engineer shall follow the wishes of the City as to the results of the work only. These results shall comply with all applicable laws and ordinances.

P. Project Staffing

Prior to the start of any work under this Contract, The Engineer shall submit to the City detailed resumes of key personnel that will be involved in performing services prescribed in the Contract. The City hereby acknowledges its acceptance of such personnel to perform services under this Contract. At any time hereafter that the Engineer desires to change key personnel while performing under the Contract, the Engineer shall submit the qualifications of the new personnel to the City for prior approval. Key personnel shall include principals-in-charge, project manager, resident project representative and lead inspector.

The Engineer will maintain an adequate and competent staff of qualified persons, as may be determined by the City, throughout the performance of this Contract to ensure acceptable and timely completion of the Scope of Services. If the City objects, with reasonable cause, to any of the Engineer's staff, the Engineer shall take prompt corrective action acceptable to the City and, if required, remove such personnel from the project and replace with new personnel agreed to by the City.

Q. Subconsultants

Prior to beginning the work, the Engineer shall furnish the City for approval the names of subconsultants to be used on this Project. Any subsequent changes are subject to the approval of the Street Transportation Department.

R. Force Majeure

If either party shall be delayed or prevented from the performance of any act required under this agreement by reason of acts of God or other cause beyond the control and without fault of the party (financial inability excepted), performance of that act shall be excused, but only for the period of the delay. The time for performance of the act shall be extended for a period equivalent to the period of delay.

S. Immigration Reform and Control Act of 1986

The Engineer understands and acknowledges the applicability of the Immigration Reform and Control Act of 1986 to him. The Engineer agrees to comply with the IRCA in performing this Agreement and to permit the City to verify such compliance.

T. Non-Waiver Provision

The failure of either party to enforce any of the provisions of this Agreement or to require performance of the other party of any of the provisions hereof shall not be construed to be a waiver of such provisions, nor shall it affect the validity of this Agreement or any part thereof, or the right of either party to thereafter enforce each and every provision.

U. Jurisdiction

It is mutually understood and agreed that this Contract shall be governed by the laws of the State of Arizona, both as to interpretation and performance. Any action at law, suit in equity or judicial proceeding for the enforcement of this Contract or any provision thereof shall be instituted only in the courts of the State of Arizona.

This Contract shall be in full force and effect only when it has been approved by the duly authorized City officials.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement on May 19, 1995.

CITY OF PHOENIX, ARIZONA
FRANK FAIRBANKS, City Manager

By _____
James H. Matteson, P.E., Director
Street Transportation Department

ATTEST:

_____
ACTING City Clerk

By Daniel L. Kaminski
KAMINSKI-HUBBARD ENGINEERING, INC.

APPROVED AS TO FORM:

Michael D. Hall
City Attorney
ACTING

APPROVED BY CITY COUNCIL:

DATE: APRIL 12, 1995

SCOPE OF WORK

SCATTER WASH - PANEL NOS. 1195, 1205 & 1215
LETTER OF MAP REVISION
INDEX NO. ST-951350

The hydrology work maps used for the Flood Control District of Maricopa County's Arizona Canal Diversion Channel (A.C.D.C.) Area Drainage Master Study (A.D.M.S.) project illustrates the need to update the mapping along Scatter Wash. All of the area north of Beardsley Road was mapped as part of the City of Phoenix C & D planning area and integrated into the A.D.M.S. work maps. Concrete box culverts and detention basins along Scatter Wash previously under construction are now existing. Mapping services are included to update the topography where required. Limits of the project extend from Scatter Wash's Confluence with Skunk Creek to east of I-17 along the North Branch and South Branch as depicted on the FIRMs. The following is the Engineer's understanding of the scope of work:

I. Field Reconnaissance

Field investigate the floodplain to verify mapping and floodplain conditions. Document Mannings' roughness coefficients and all pertinent hydraulic parameters.

II. Field Surveys

Perform field surveys to set control for updating aerial mapping along Scatter Wash.

III. Topographic Mapping

Kenney Aerial Mapping will provide aerial mapping services for hydraulic analysis. The existing mapping prepared as part of the A.D.M.S. will be used where it is possible. Mapping will be prepared in DTM format with mapping requirements per FEMA standards.

IV. Hydrologic Analysis

Utilize the previously approved hydrologic analysis to determine the 50-year and 500-year peak discharges. The 100-year Kn (S-graph) values will be used for the 50-year and 500-year model.

V. Hydraulics Analysis

Perform hydraulic analysis using HEC-2. Determine the 100-year water surface elevation and delineate the floodplain.

VI. Floodway Delineation

Develop the floodway limits in accordance with FEMA criteria. Tabulate results and delineate on work map.

VII. Flood Insurance Rate

Determine the 10-year storm event water surface elevation. Determine the difference in depth between the 10-year and 100-year storm events. Tabulate the AE and/or A1-A30 Zone.

VIII. Technical Documentation Report/Submittals

Prepare a technical documentation report in accordance with ADWR guidelines and provide three copies to the City of Phoenix. Material will be ready for forwarding to FEMA by the City of Phoenix.

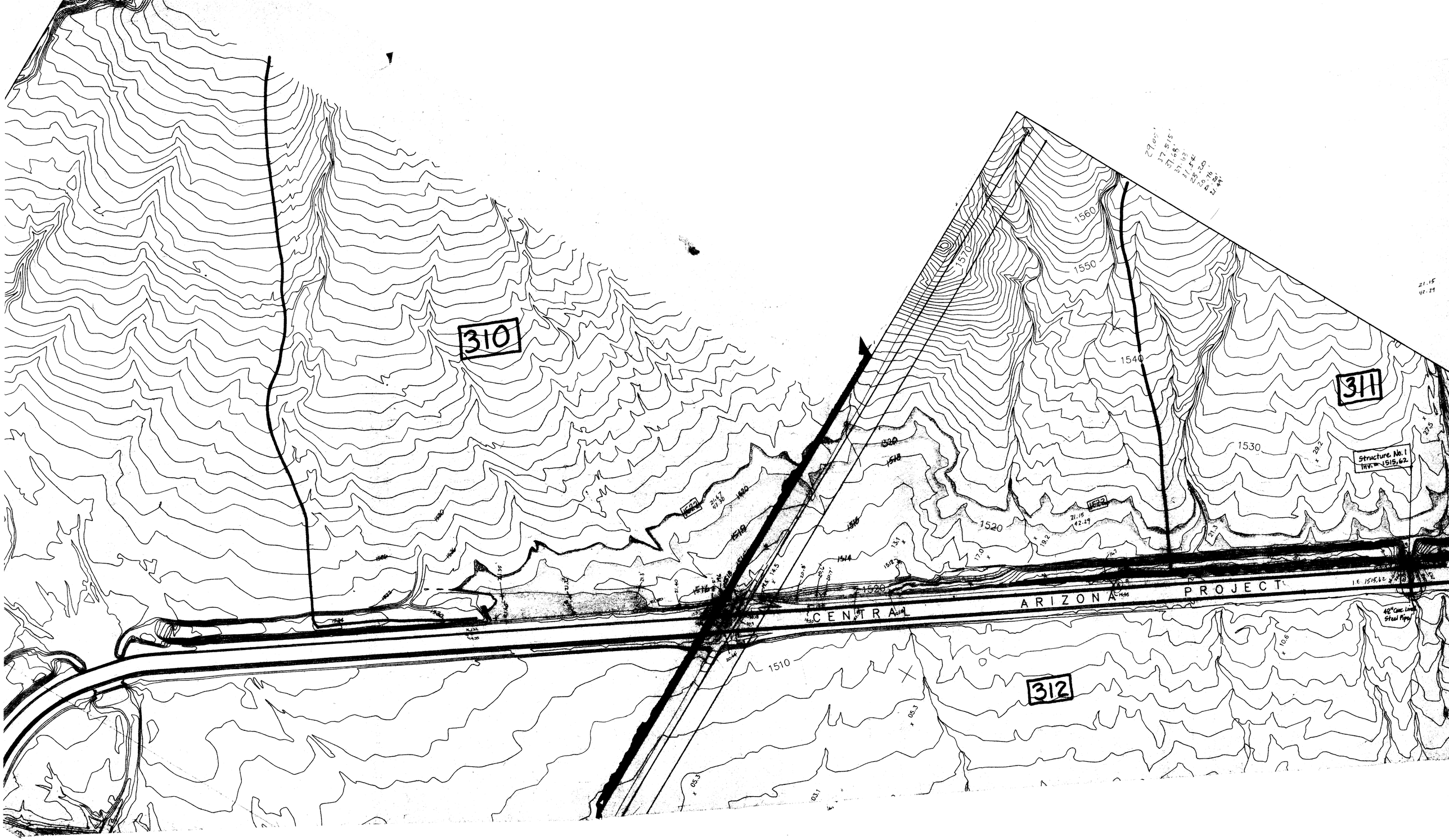
IX. Reproduction

Bluelines and reproduction.

"EXHIBIT A"

APPENDIX B

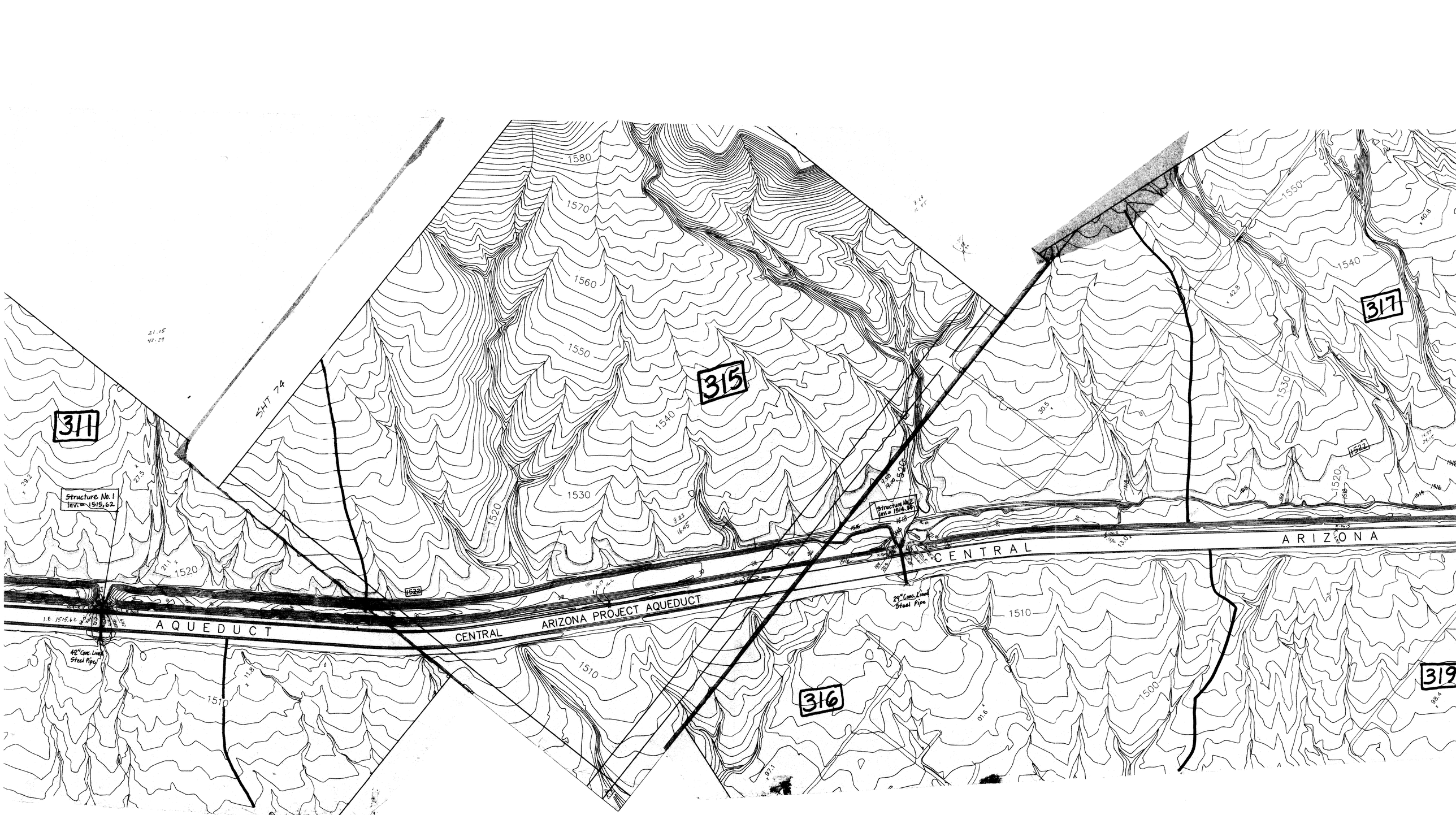
Central Arizona Project Canal Storage Volume Work Map



1" = 200' HMM2

CENTRAL ARIZONA PROJECT CANAL
STORAGE VOLUME WORK MAP

Sheet 1 of 4



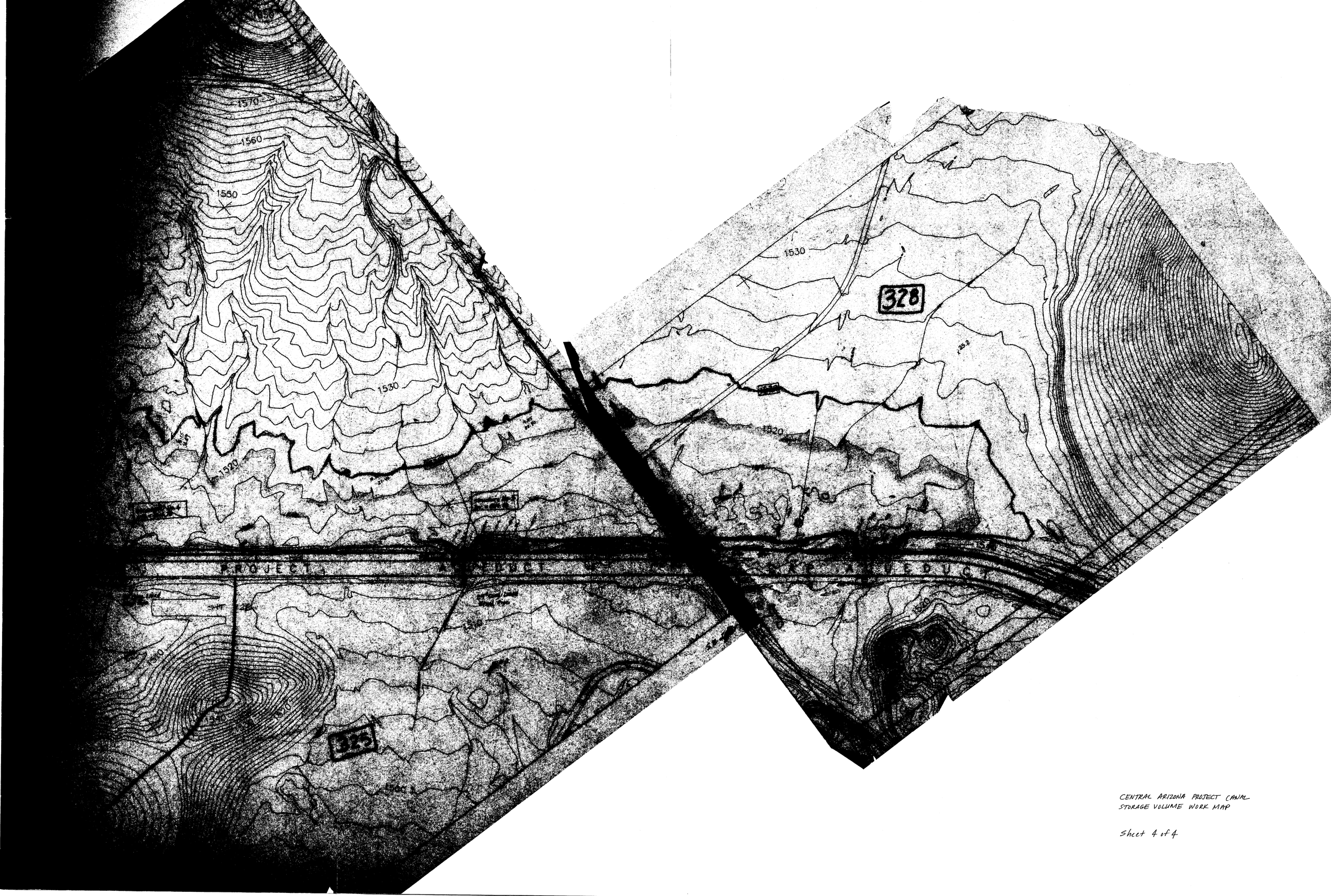
1" = 200' Horiz

CENTRAL ARIZONA PROJECT CANAL
STORAGE VOLUME WORK MAP

Sheet 2 of 4

CENTRAL ARIZONA PROJECT CANAL
STORAGE VOLUME WORK MAP

Sheet 3 of 4



CENTRAL ARIZONA PROJECT CANAL
STORAGE VOLUME WORK MAP

Sheet 4 of 4

APPENDIX C

Aerial Maps w/Photographs

1. Confluence Of Skunk Creek And Scatter Wash
Looking Upstream At The Drop Structure In Skunk Creek.

2. Confluence Of Skunk Creek And Scatter Wash
Looking Upstream At The Drop Structure In Scatter Wash.

3. Confluence Of Skunk Creek And Scatter Wash Looking Upstream At The Right Overbank.

4. Confluence Of Skunk Creek And Scatter Wash Looking Upstream At The Drop Structure At The Channel.

5. Scatter Wash At 45th Avenue
Looking Downstream At The Left Overbank.

6. Scatter Wash At 45th Avenue
Looking Downstream At The Right Overbank.

7. Scatter Wash At 45th Avenue Looking At The Upstream Side Of The Box Culvert With Drop Structure.

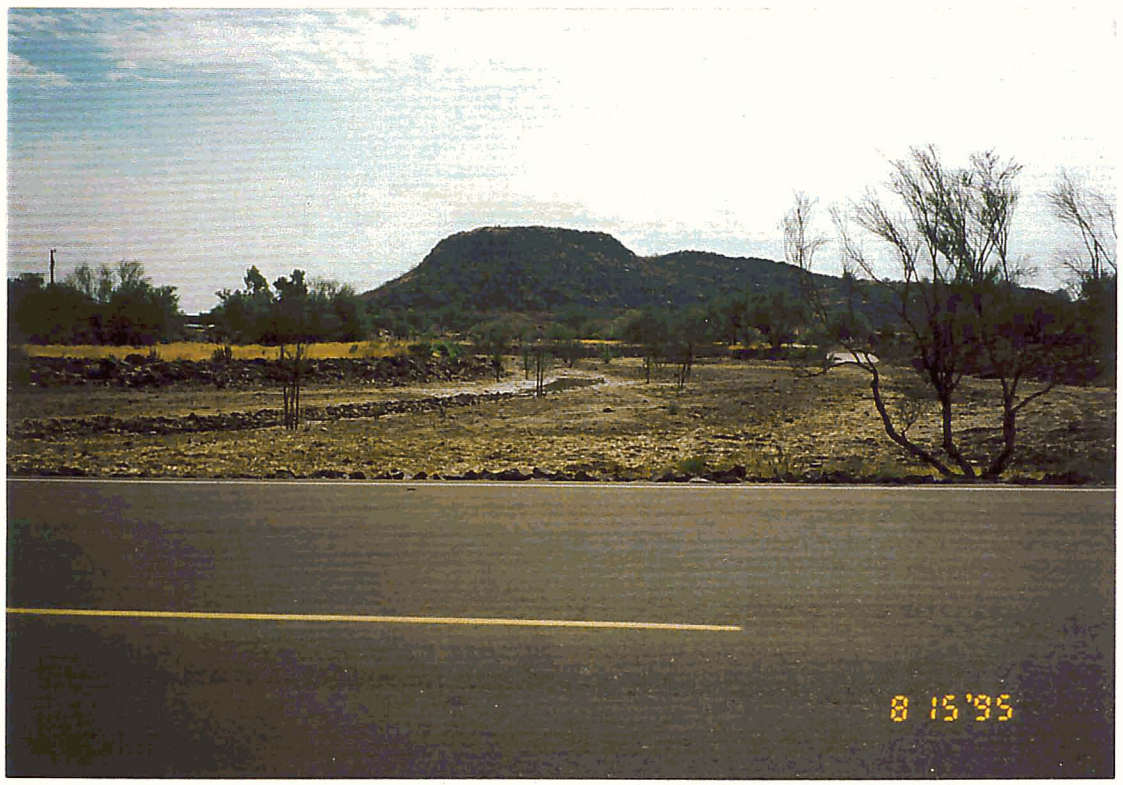
8. Scatter Wash At 45th Avenue
Looking Upstream At The Right Overbank.

9. Scatter Wash At 45th Avenue
Looking Upstream At The Left Overbank.

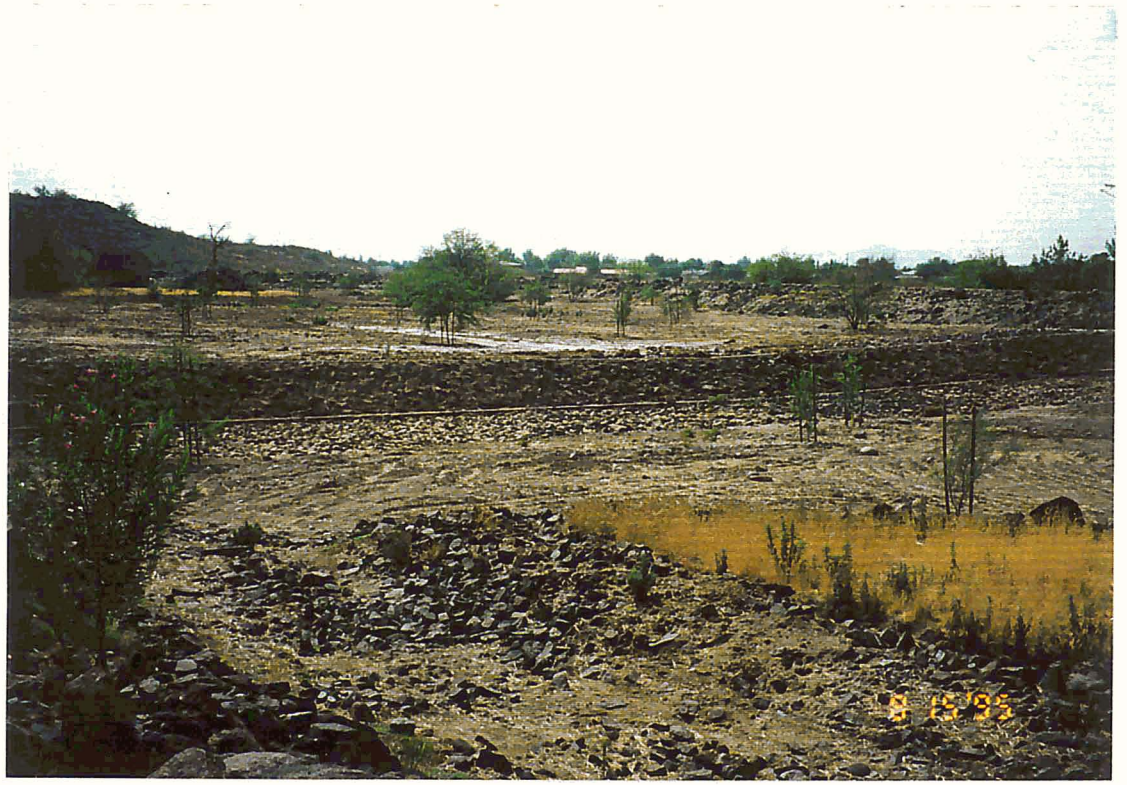
10. Scatter Wash At 43rd Avenue
Looking Downstream At The Left Overbank.

11. Scatter Wash At 43rd Avenue
Looking Downstream At The Channel.

12. Scatter Wash At 43rd Avenue
Looking Downstream At The Right Overbank.

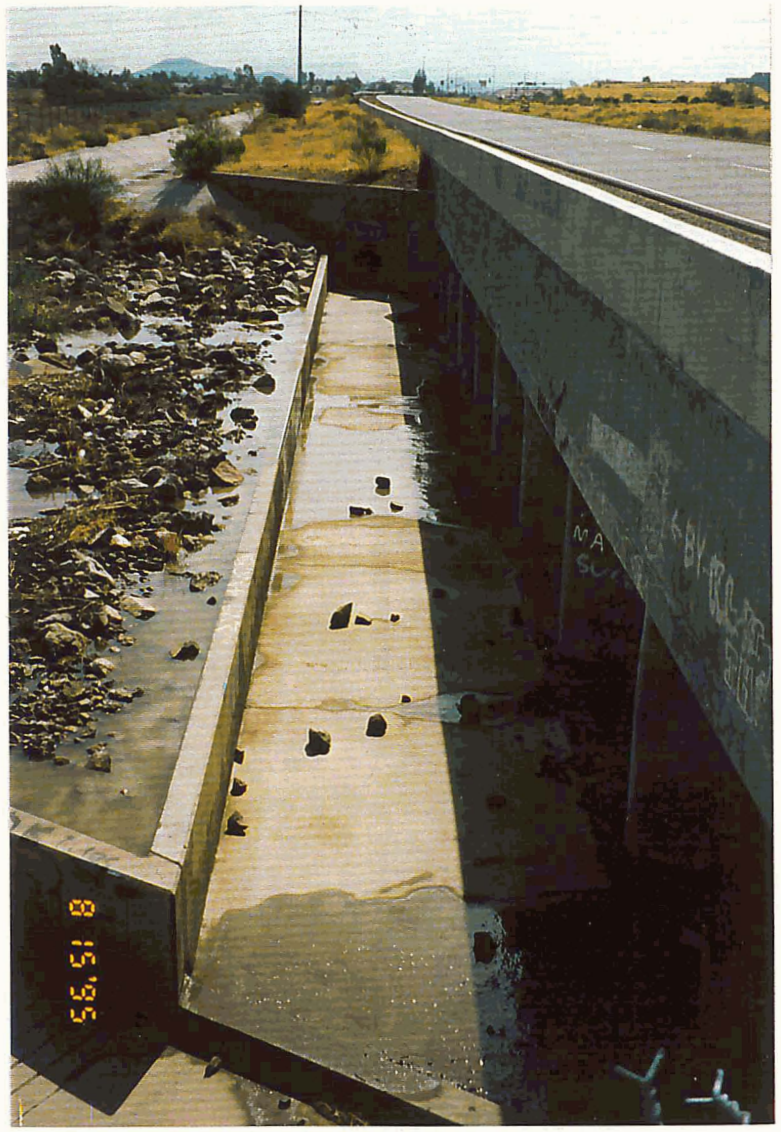


13. Scatter Wash At 43rd Avenue
Looking Upstream At The Channel.



14. Scatter Wash Approximately 550 Feet East Of 43rd Avenue Looking Upstream At The Drop Structure.

15. Scatter Wash At Outer Loop Highway Looking Downstream At The Channel.



16. Scatter Wash At Outer Loop Highway Looking At The Upstream Side Of The Box Culvert And Drop Structure.

17. Scatter Wash At The Outer Loop Highway Looking Upstream At the Right Overbank.

18. Scatter Wash At The Outer Loop Highway Looking Upstream At The Left Overbank.

19. Scatter Wash At 35th Avenue
Looking Upstream At The Channel.

20. Scatter Wash At 35th Avenue
Looking Downstream At The Channel.

21. Confluence Of The North Branch And South Branch Of Scatter Wash Looking Upstream At The North Branch Channel.

22. Confluence Of The North And South Branch Of Scatter Wash Looking Upstream At The South Branch Channel

23. South Branch Of Scatter Wash Upstream Of The Confluence With North Branch Looking Upstream At The Channel.

24. South Branch Of Scatter Wash Looking Upstream At The Goldwater High School Field.

25. South Branch Of Scatter Wash
Looking Downstream At The Goldwater High School Parking Lot

26. South Branch Of Scatter Wash At 27th Avenue
Looking North At The Dip In The Roadway.

27. South Branch Of Scatter Wash At 27th Avenue Looking Upstream At The Channel.

28. South Branch Of Scatter Wash At Black Canyon Highway T.I. Looking East At The Depressed Interchange Overflow Location

29. South Branch Of Scatter Wash At Black Canyon Highway T.I. Looking Southeast At The Depressed Interchange Overflow Location

30. South Branch Of Scatter Wash At Black Canyon Highway T.I. Looking South At The Upstream Location Of The Depressed Interchange.

31. South Branch Of Scatter Wash
Approximately 400 Feet North Of Williams Drive
Looking Downstream At The Channel.

32. South Branch Of Scatter Wash Approximately 400 Feet North Of Williams Drive Looking Upstream At The Channel.

33. South Branch Of Scatter Wash And 23rd Avenue Looking Downstream At The Channel.

34. North Branch Of Scatter Wash At Deer Valley Road Looking Downstream At The Left Overbank.

35. North Branch Of Scatter Wash And Deer Valley Road Looking Downstream At The Right Overbank.

36. North Branch Of Scatter Wash And Deer Valley Road Looking Upstream At The Box Culvert In 31st Avenue

37. North Branch Of Scatter Wash And Deer Valley Road Looking Downstream At The Box Culvert.

38. North Branch Scatter Wash And 31st Avenue Looking Upstream At The Channel.

39. North Branch Of Scatter Wash And 27th Avenue Looking Upstream At The Channel.

40. North Branch Of Scatter Wash And 27th Avenue Looking Downstream At The Channel.

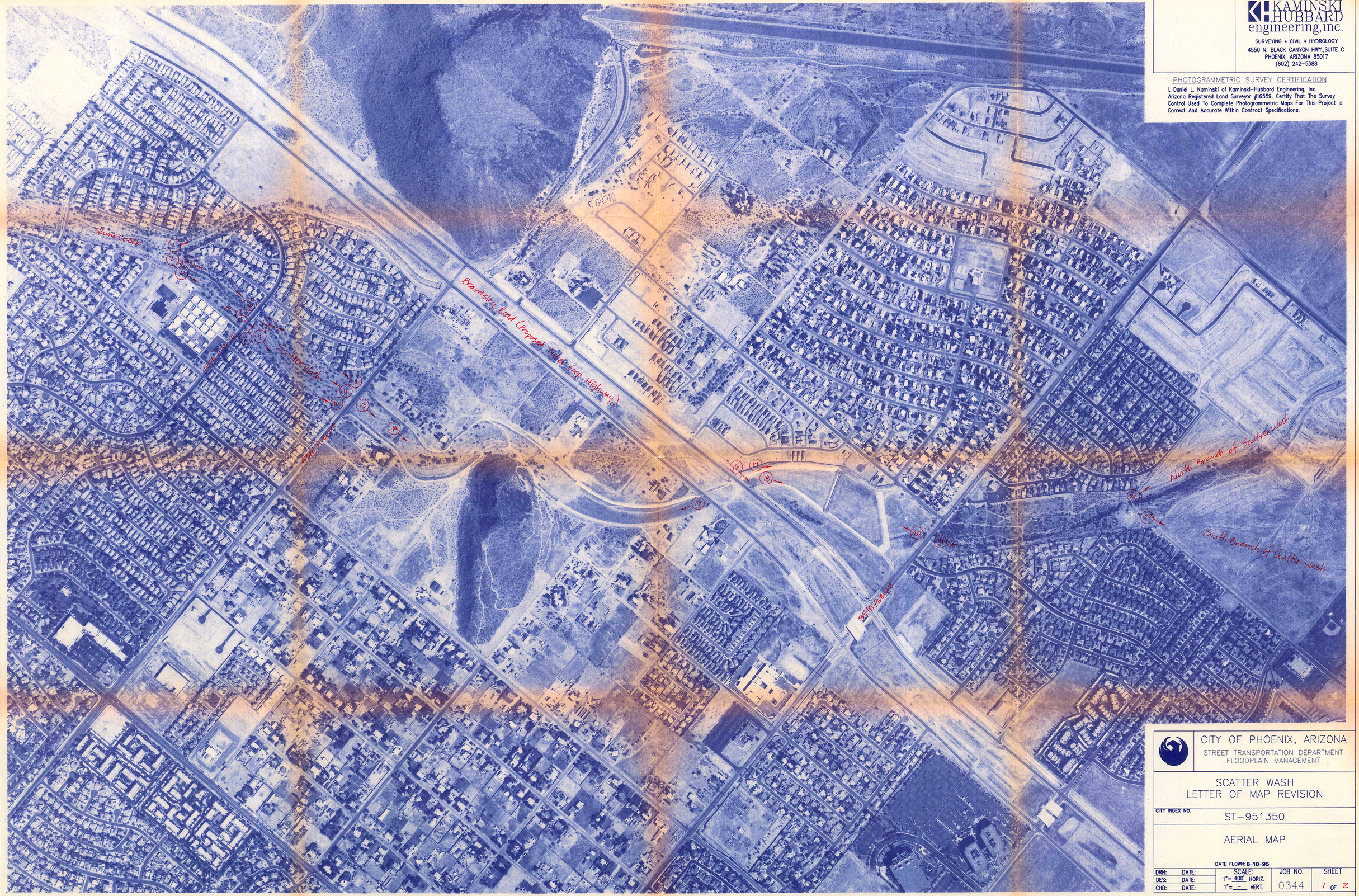
41. North Branch Of Scatter Wash And Williams Drive Looking Downstream At The Channel.

42. North Branch Of Scatter Wash And West Of Black Canyon Highway Looking Upstream At A Man-Made Breached Earthen Fill.

KAMINSKI HUBBARD engineering, inc.
SURVEYING • CIVIL • HYDROLOGY
4550 N. BLACK CANYON HWY., SUITE C
PHOENIX, ARIZONA 85017
(602) 242-5588

PHOTOGRAMMETRIC SURVEY CERTIFICATION

I, Daniel L. Kaminski of Kaminski-Hubbard Engineering, Inc. Arizona Registered Land Surveyor #16559, Certify That The Survey Control Used To Complete Photogrammetric Maps For This Project is Correct And Accurate Within Contract Specifications.



CITY OF PHOENIX, ARIZONA
STREET TRANSPORTATION DEPARTMENT
FLOODPLAIN MANAGEMENT

SCATTER WASH
LETTER OF MAP REVISION

CITY INDEX NO. ST-951350

AERIAL MAP

DATE FLOWN: 6-10-95

DRN: DATE:	SCALE:	JOB NO.	SHEET
DES: DATE:	1"= 400' HORIZ.	0344	1 OF 2
CHD: DATE:	1"= --- VERT.		

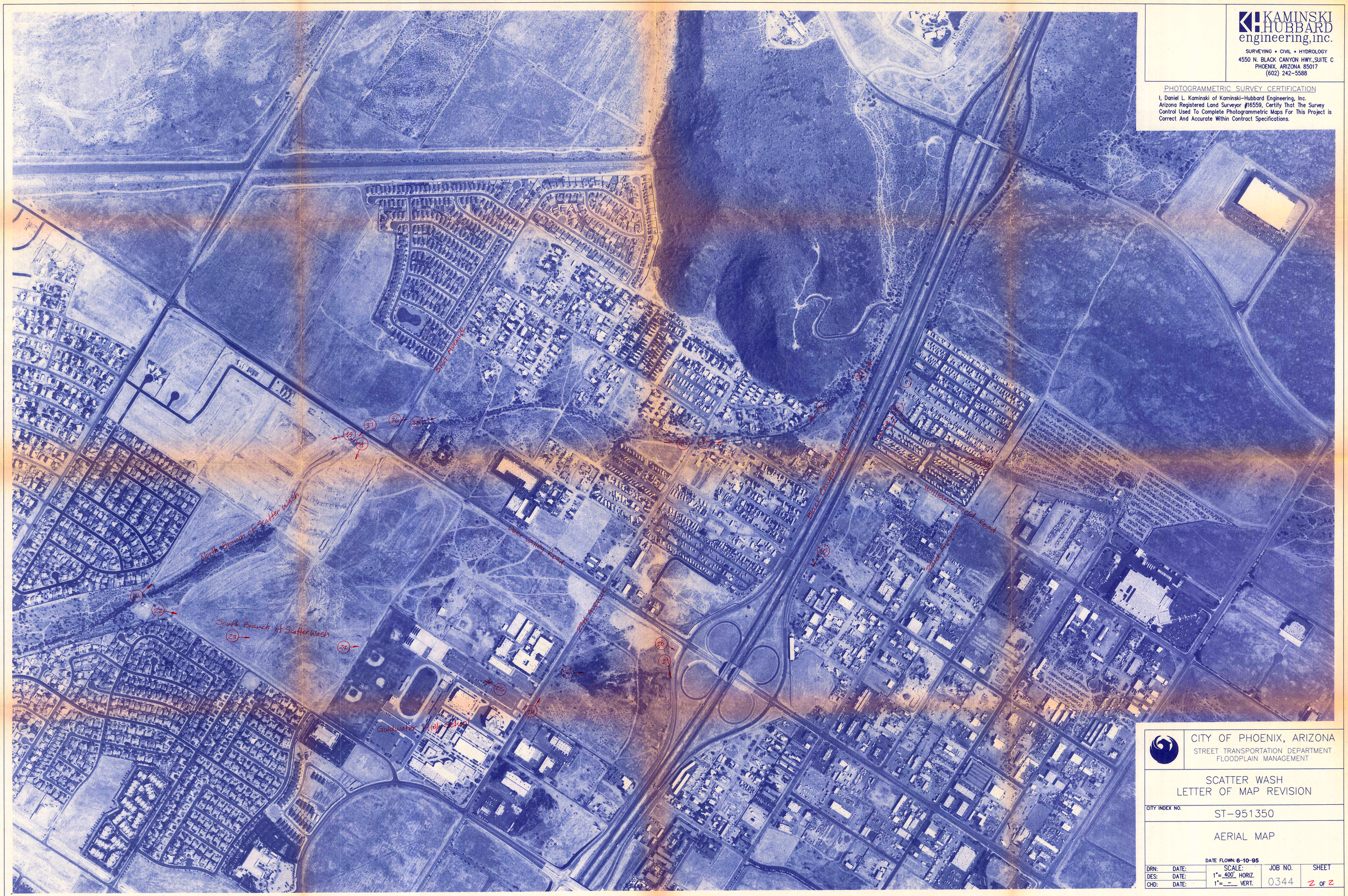
○ Key to Photograph 1

KENNEY AERIAL MAPPING

KAMINSKI HUBBARD engineering, inc.
SURVEYING • CIVIL • HYDROLOGY
4550 N. BLACK CANYON HWY., SUITE C
PHOENIX, ARIZONA 85017
(602) 242-5588

PHOTOGRAMMETRIC SURVEY CERTIFICATION

I, Daniel L. Kaminski of Kaminski-Hubbard Engineering, Inc. Arizona Registered Land Surveyor #16559, Certify That The Survey Control Used To Complete Photogrammetric Maps For This Project is Correct And Accurate Within Contract Specifications.



CITY OF PHOENIX, ARIZONA
STREET TRANSPORTATION DEPARTMENT
FLOODPLAIN MANAGEMENT

SCATTER WASH
LETTER OF MAP REVISION

CITY INDEX NO. ST-951350

AERIAL MAP

DATE FLOWN: 6-10-95

DRN: DATE:	SCALE: 1"= 400' HORIZ.	JOB NO.	SHEET
DES: DATE:	1"= ___ VERT.	0344	2 OF 2
CHD: DATE:			

(1) Key to Photograph 1

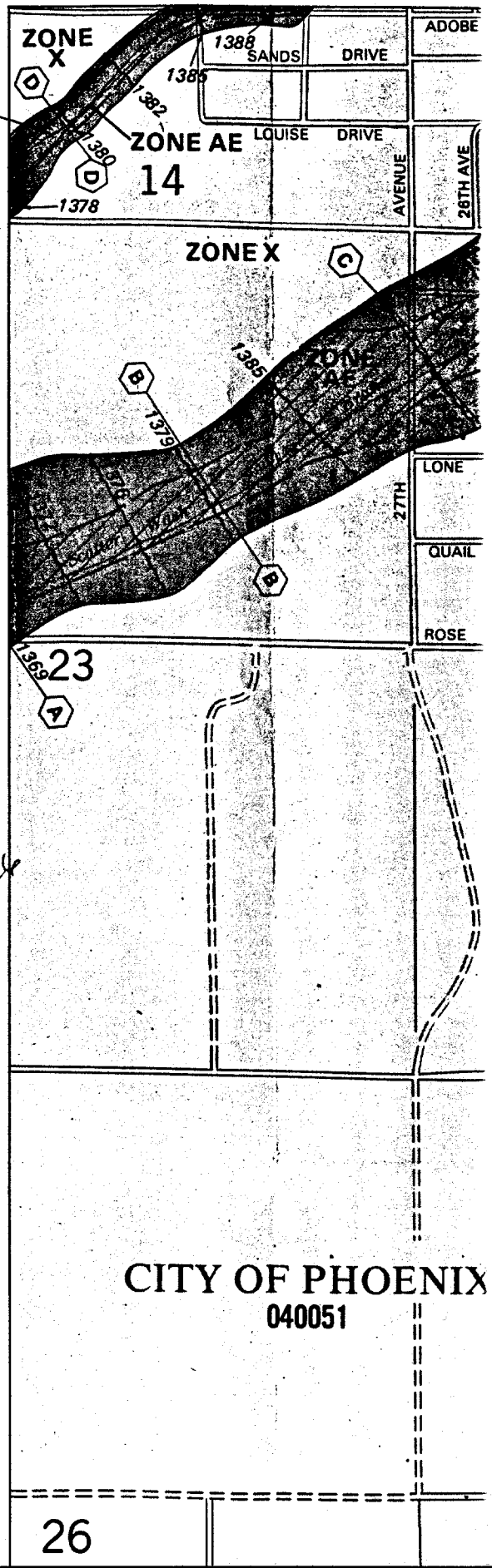
KENNEY AERIAL MAPPING

APPENDIX D

Survey Notes

ELEVATION REFERENCE MARKS

REFERENCE MARK	ELEVATION (FT. NGVD)	DESCRIPTION OF LOCATION
RM962	1339.53	This station is located at the centerline P.C. of Tierra Buena Lane just east of bridge over Cave Creek. The mark is a City of Phoenix brass cap flush.
RM963	1322.39	This station is located at the intersection of 23rd Avenue and Greenway Road. The mark is a City of Phoenix brass cap in handhole.
RM964	1369.11	This station is located on the west end on south side of bridge on Bell Road over Cave Creek. The mark is a Maricopa County Highway Department brass cap.
RM965	1381.15	This station is located on Grovers Avenue between 8th Avenue and 8th Drive on subdivision line to north. The mark is a Maricopa County Highway Department brass cap flush.
RM966	1401.90	This station is located at the intersection of Central Avenue and Union Hills Drive. The mark is a City of Phoenix brass cap flush.
RM967	1416.40	This station is located at the intersection of Central Avenue and Kristal Way. The mark is a City of Phoenix brass cap flush.
RM968	1428.60	This station is located near the intersection of 5th Avenue and Beardsley Road. The mark is an Arizona Department of Transportation aluminum cap stamped "CAVE 1983". It is set in the top of a 10 inch concrete monument, 500 feet east of 5th Avenue, 60 feet west of Phoenix Memorial Park cemetary, 22 feet north of the centerline of Beardsley Road.
RM969	1470.13	The station is located at the intersection of Deer Valley Road and 7th Street. The mark is a City of Phoenix brass cap flush.
RM970	1438.85	This station is located at the southwest corner of the intersection of 7th Street and Beardsley Road. The mark is a U.S. Corp of Engineers brass cap on the northeast corner of a concrete vault, marked " CAVE 114 1978".
RM 1125	1332.66	This station is located at the intersection of 16TH Drive and Greenway Parkway. The mark is a City of Phoenix brass cap flush.
RM 1126	1336.40	This station is located at what would be the intersection of 15Th Avenue and Greenway Road. It is approximately the North quarter corner of section 7, T3N, R3E. The mark is a brass cap in concrete 0.3 feet below ground. Brass cap is stamped L.S. 17146.
RM 1127	1353.28	This station is located at the intersection of 7Th Avenue and Greenway Parkway. The mark is a City of Phoenix brass cap in handhole.
RM 1128	1367.05	This station is located at the intersection of Bell Road and 7Th Avenue. The mark is a Maricopa County Highway Department brass cap in handhole.
RM 1129	1404.08	This station is located at the intersection of 5TH Street and Union Hills Drive. The mark is a City of Phoenix brass cap flush.
RM 1130	1459.32	This station is located at the intersection of Deer Valley Road and Central Avenue. The mark is a City of Phoenix brass Cap flush.
RM 1131	1454.74	This station is located on 7TH Street approximately 0.5 miles north of Beardsley Road. The mark is a City of Phoenix brass cap flush. It is the East quarter corner of section 10, T4N, R3E.



~LEGEND~

▲ Exist. Horz. control

▲ (100) Horz. control

● (200) Vert. control

• (1) Traverse control

FIGURE 2

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HIGHEST POINT NUMBER USED        =       1132
HIGHEST PROFILE NUMBER USED      =          0
NUMBER OF DESCRIPTIONS           =          1

START OF JOB  1 344 344

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*          TRAVERSE TO PT 103

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103 4 50 94 00 39 880.43
* COORDINATES CHANGED *
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51 50 103 89 50 58 1254.48
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              NEW  N    970986.1123,  E    432594.2685

304 103 51 101 02 10 996.19
  POINT   304      N    971184.6921,  E    431618.0715

INVERSE BEARINGS  4 304
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Final unadjusted

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NUMBER OF DESCRIPTIONS           =          1

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*            TRVERSE TO PT 25 = 108

*

LOCATE ANGLE  108 19 20 94 11 01 2584.11
  POINT   108      N    980394.3720,  E    441860.7808

317 20 108 91 37 27 1397.88
  POINT   317      N    978998.1328,  E    441793.0699

INVERSE BEARINGS  317 17
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Final unadjusted 344PC.DAT

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1'/ 59,112.72' do not adj.

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NUMBER OF DESCRIPTIONS           =          1

START OF JOB  1 344 344

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*            TRAVERSE TIES TO PTS 106 107

*

LOCATE ANGLE  106 9 8 178 38 04 3879.49
 POINT   106      N    973382.9287,  E    436532.3204

27 8 106 358 06 35 1753.53
  POINT    27      N    975134.8615,  E    436457.4931

105 106 27 80 59 28.5 1284.88
 POINT   105      N    974879.6989,  E    435198.2041

29 27 105 238 42 25 372.93
  POINT    29      N    975153.5609,  E    434945.0710

30 105 29 235 11 22.5 1066.17
  POINT    30      N    976194.6911,  E    435174.7802

307 29 30 172 25 04.5 934.62
* COORDINATES CHANGED *
  POINT   307 OLD  N    976327.9806,  E    436523.9425
              NEW  N    977125.9508,  E    435253.9625

INVERSE BEARINGS  307 7
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** PRINTER HAS BEEN TURNED OFF
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Final unadjusted

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NUMBER OF DESCRIPTIONS = 1

Final / Unadjusted

START OF JOB 1 344 344

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* TRAVERSE TIE TO PTS 100 101

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LOCATE ANGLE 31 102 2 273 04 15 1328.95
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32 2 31 261 51 20 372.08
POINT 32 N 968767.7171, E 427266.2348

100 31 32 94 34 40 1087.75
POINT 100 N 968739.6583, E 426178.8468

34 32 100 183 02 29 795.74
POINT 34 N 968761.3666, E 425383.4029

35 100 34 244 18 55 748.69
POINT 35 N 969444.6819, E 425077.4341

36 34 35 242 24 36 424.52
POINT 36 N 969777.8878, E 425340.4760

37 35 36 209 01 56 628.79
POINT 37 N 970020.3314, E 425920.6467

101 36 37 123 44 32 291.81
POINT 101 N 970306.7186, E 425976.6415

39 37 101 222 14 45 1145.14
POINT 39 N 970990.9417, E 426894.8922

40 101 39 217 44 57 1678.40
POINT 40 N 970959.9512, E 428573.0061

302 39 40 267 05 54 1030.88
POINT 302 N 969929.6049, E 428606.1723

INVERSE BEARINGS 302 102

FROM 302 TO 102, S 24 45 31.008 E, .7133

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** PRINTER HAS BEEN TURNED OFF

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NUMBER OF DESCRIPTIONS           =          1

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*              TRAVERSE TIE TO PT 104

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             NEW  N    971378.7405,  E    431456.5653

304 5 4 258 01 21 252.45
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INVERSE BEARINGS  104 304
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END OF JOB
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** PRINTER HAS BEEN TURNED OFF
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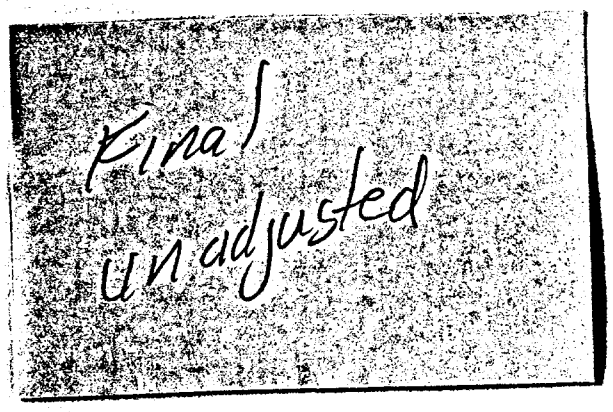

344ADJ.DAT
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NUMBER OF DESCRIPTIONS = 1

START OF JOB 1 344 344 * 344ADJ.DAT

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* TRAVERSE ADJUSTMENT

* SCATTER WASH PHOTO CONTROL

*

ADJUST OPEN TRAVERSE 19 139 268 57 19 90 10 06 1 20000

1132 91 09 50 1 2618.655 1

2 178 53 55 1 1579.85 1

102 248 20 51.5 1 3262.945 1

4 174 50 38 1 2586.315 1

5 117 58 07.5 1 3763.075 1

6 233 46 42 1 1652.585 1

7 209 46 27 1 1248.045 1

8 97 04 29 1 1076.355 1

9 269 18 23 1 1318.52 1

11 180 10 45 1 1318.94 1

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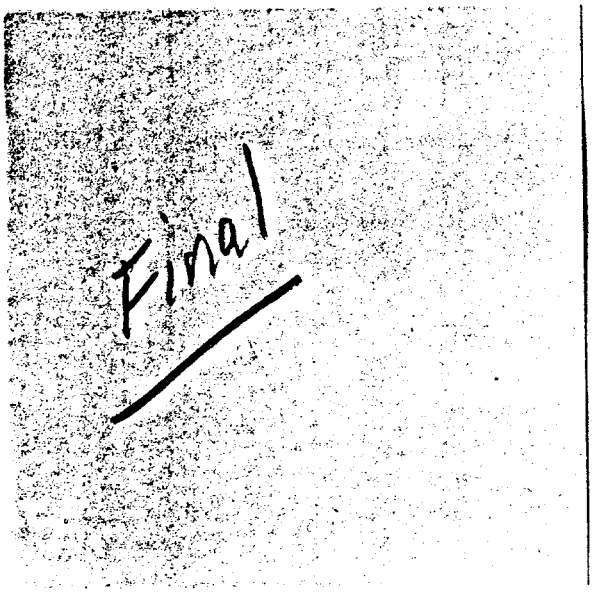
13 97 53 37 1 1425.595 1

14 160 41 08 1 550.88 1

15 144 45 55 1 1016.70 1

16 136 50 36 1 1912.445 1



344ADJ.DAT
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18 177 31 46 1 708.045 1

19 88 33 24 1 1357.415 1

20 184 23 54 1 1264.63 1

21 268 47 53 1
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CLOSURE BEFORE ANY ADJUSTMENT:
ANGULAR CLOSURE = -0 01 00.000
CLOSURE DISTANCE = 1.0435
CLOSURE RATIO = 1/ 31254.5
CLOSURE DIRECTION = S 38 37 39.023 E

CLOSURE AFTER ADJUSTING ANGLES:
ANGULAR CLOSURE = 0 00 00.000
CLOSURE DISTANCE = 1.5518
CLOSURE RATIO = 1/ 21016.5
CLOSURE DIRECTION = N 40 29 40.075 W

** TYPE OF TRAVERSE ADJUSTMENT IS: COMPASS RULE

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		NEW	N	968349.2814,	E	428633.5560
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POINT	4	OLD	N	971184.5380,	E	431618.1616
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* COORDINATES CHANGED *						
POINT	5	OLD	N	972390.3746,	E	433906.1702
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* COORDINATES CHANGED *						
POINT	6	OLD	N	976153.4314,	E	433917.8794
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POINT	7	OLD	N	977125.8085,	E	435254.1129
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344ADJ.DAT

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END OF JOB
*JOB      1   344   344 SCATTER WASH PHOTO CONTR ENDED   14:58:25  07-17-95

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HIGHEST POINT NUMBER USED        =       1132
HIGHEST PROFILE NUMBER USED      =          0
NUMBER OF DESCRIPTIONS           =          1

*** END OF BATCH INPUT HAS BEEN REACHED ***
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6/7 - 6/8 1995

DAS / NT

4

Panel Locations & Descriptions

- Set nail & Paper Panel 1/4 mi S. of Anna Park & 1/2 west of 19th Ave & NW Cor. of Junkyard
- COP BC FLUSH @ Williams & 20th AVE
- Set PK E side I-17 End of MEDIAN @ Deer Valley & 24th Ave Align
- Set PK @ 29th AVE & Foothill
- SET PK on 31st Ave. South of Rose Garden 20839 31st Ave
- Set pk @ 35th AVE & Mohawk West
- Set PK @ 33rd Ave & Quail AVE
- Set PK @ Beardsley & 39th Ave N side Beardsley
- Set PK on 43rd Ave 150' +/- North of Behrend Dr.
- COP BC FLUSH @ 47th AVE & WAHALLA LN
- COP BC FLUSH @ ORAIBI & 47th AVE North
- COP BC FLUSH @ 37th Ave & Behrend

257.50

6/8/95
DAS/NT

Panel Traverse

@ TP #1

BS #128 (AC DC) 0-00-30

FS #132 (AC DC)

D1 0-00-30 6-00-29

D2 0-00-28

R1 180-00-53 180-00-54

R2 180-00-55

D1 178-20-24 178-19-55 m=178-20-05

R1 358-20-59 178-20-05

HD 1-128 2569.81

HD 1-132 = 2582.69

DESC

Set Nail

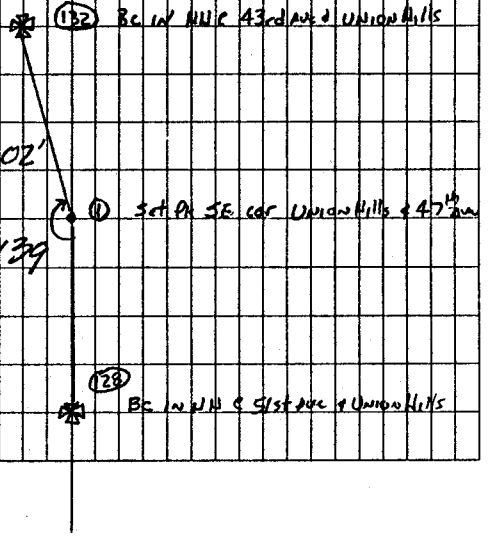
BC in HH

BC in HH

M = 178 20 00

SP = 2569.40

SP = 2582.28



6/8/95
DAS/NT

6

PANEL Traverse

TC 132 ACDC

BS TP # 1 0-00-30

FS TP # 2

D1 0-00-30 0-00-31

D2 0-00-32

R1 180-01-03 180-01-04

R2 180-01-05

D: 91-10-22 91-09-51 M = 91-09-50

R: 271-10-53 91-09-49

HD 132-1 = 2582.67

HD 132-2 = 2619.09

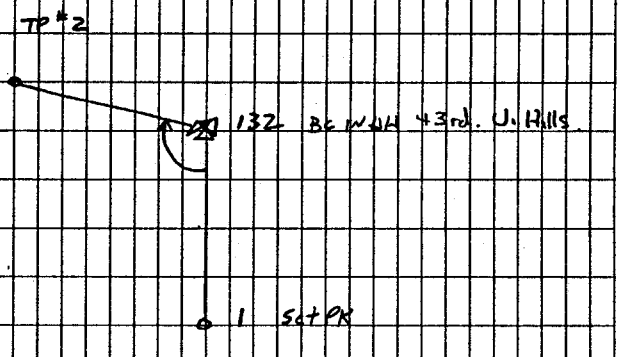
BC in MH @ 43rd Ave & Ubiquity Hills

Set PK SE RTN 47th Ave & Ubiquity Hills

Set PK SE RTN 43rd Ave & Yorkshire

SP = 2582.26 2582.27

SP = 2618.67



Panel Traverse

TP 2

BS TP 132 AZMC 0-00-30

FS TP 3 = 102

D1 0-00-30 0-00-30

D2 0-00-30

R1 180-00-~~44~~ 56 180-00-~~43~~ 54

R2 180-00-~~42~~ 57

D1 178-54-~~02~~ 21 178-53-~~32~~ 51 M 178-53-55

R1 358-54-~~88~~ 55 178-53-59

HD Z-132 = 2619.06

HD Z-3 = 1580.09

C18/95

DAS/WT

7

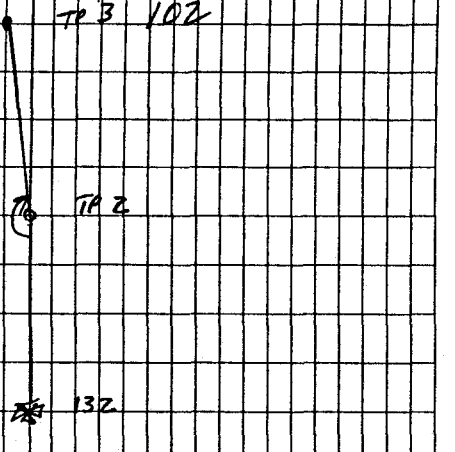
Set PK SF cor 43rd Ave & Yorkshire

BL in MH E 43rd Ave & UNION HILLS

Panel PK on 43rd Ave +/- 150' N. of Behrend Dr

SPE 2618.64 2618.655

SPE 1579.84



6/8/95

DAS/NT

8

PANEL TRAVERSE

TC TP 3

BS TP 2 0-00-20

FS TP 4

D1 0-00-20 → 0-00-205

D2 0-00-21

R1 180-00-51 → 180-00-505

R2 180-00-50

D1 248 21 12 248 20 52

R1 68-21-41 248 20 51

HD 3-2 = 1580.11

HD 3-4 = 3263.45

Panel Set PK on 43rd Ave. +/- 150' North of Bethel

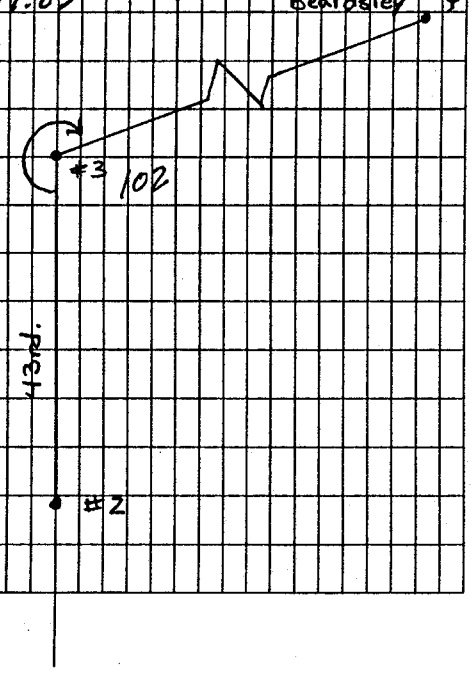
Set PK SE cor 43rd Ave & Yorkshire

Set Nail & Dirt Hub

M = 248-20-515

SP = 1579.86 · 1579.85

SP = 3262.93



Panel Traverse

π = TP 4

BS TP 3 : 0-00-20

FS TP 5 = 200

D1	0.00.20	0.00.175
D2	0.00.15	
R1	180.00.42	180.00.435
R2	180.00.45	
D1	174.50.56	174.50.39
R1	354.51.20	174.50.37

4-3 HD 3263.46

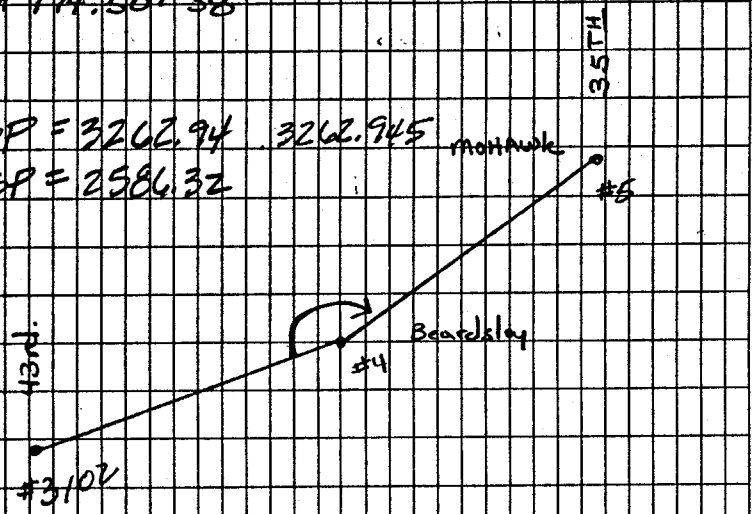
4-5 HD 2586.73

T TRAV. Point on dirt mound @ Med. of Beardsley 300± East 250'± of 38TH Drive. Set PK. @ 35TH AVE. & Mohawk.

M 174.50.38

SP = 3262.94 3262.945

SP = 2586.32



DAS/NT

6 19 95 10

	Tie 5		
	BS. 4	0.00.20	
	F.S 6		
	D1 0.00.20		0.00.175
	D2 0.00.15		
	R1 180.00.53		180.00.51
	R2 180.00.49		
	D1 117.58.30		117.58.13.
	R1 297.58.53		117.58.02
HORIZ	5-4	2586.72	
DIST.	5-6	3763.67	

Tie 35TH & MOHAWK Pk & Panel

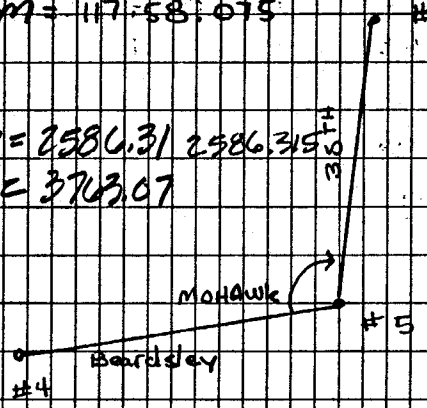
Set TRAV. Pt (Nail) 150 ± So. of D. Valley

East side of 35TH AVE.

M = 117.58.075

SP = 2586.31 2586.315

SP = 3763.07



	PT @ 6		
	BS. 5	0.00.20	
	F.S. 7		
	D1	0.00.20	0.00.225
	D2	0.00.25	
	R1	180.00.49	180.00.495
	R2	180 00 50	
	D1	233.47.01	233.46.39
	R2	53.47.54	233.46.45
HORIZ.	6-5	3763.68	
DIST.	6-7	1652.83	

DRAFT

6 19 95 11

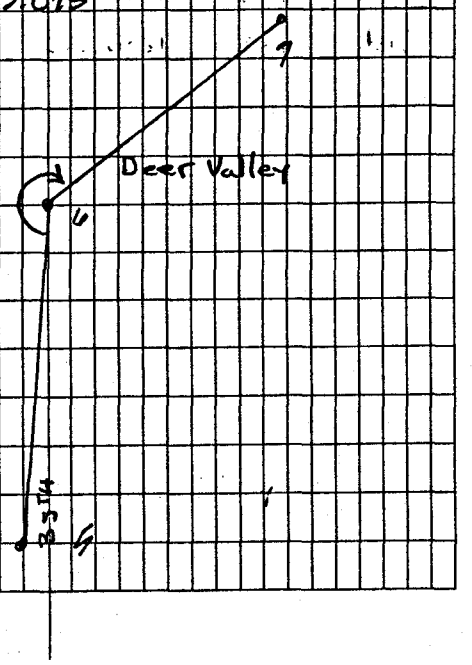
TRAV. PT Nail 150'± So. of D. Valley Rd. on East side of 35TH AVE.

Set (Nail) in Field 1/4 mi. E. of 35TH & 500'± No. of D. Valley Rd.

M = 233,46',42

SP = 3763.08 3763.075

SP = 1652.57



	Ref		
	BS. 6	0.00.20	
	F.S. 8		
	D1	0.00.20	0.00.20
	D2	0.00.20	
	R1	180.00.47	180.00.45
	R2	180.00.43	
	D1	209 46 49	209.46.29
	R2	29 47 10	209.46.25
Horiz.	7-6	1652.86	
Dist	7-8	1248.23	

DIS/INT 6 15 95 12

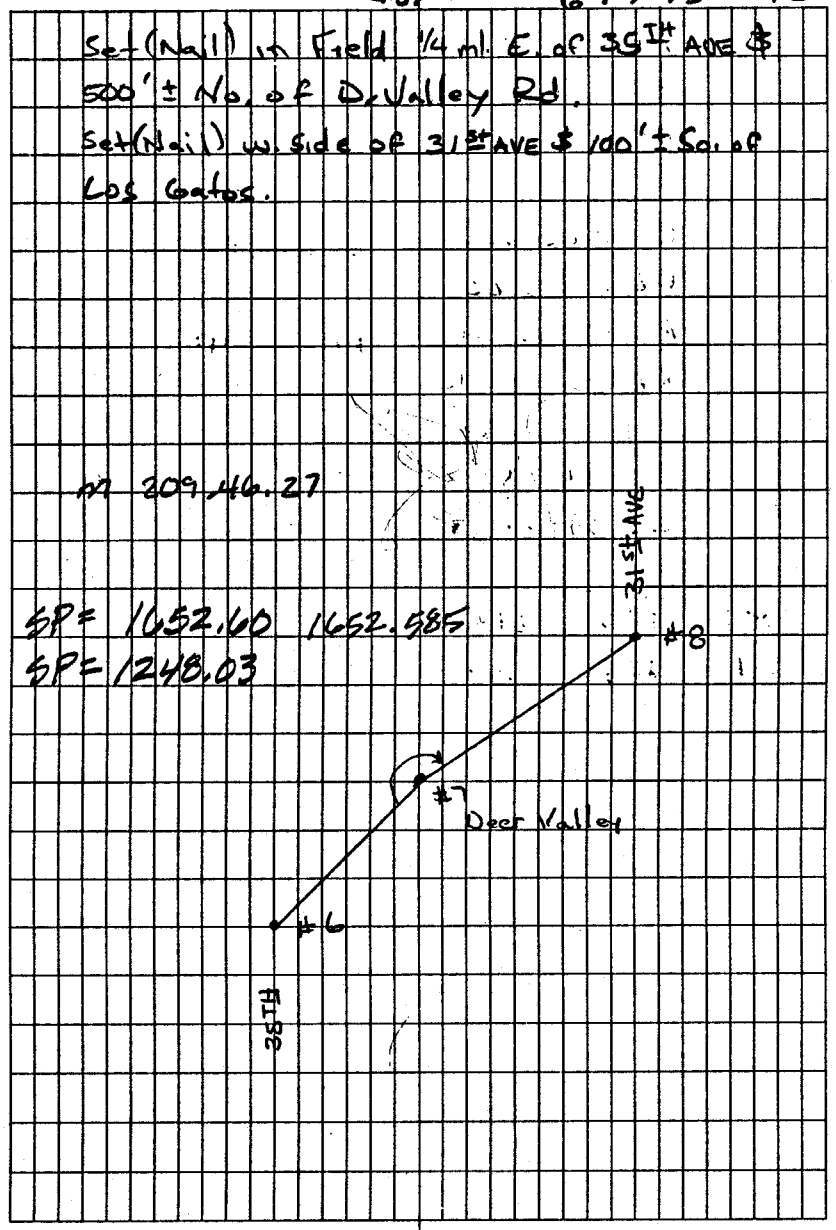
Set (Nail) in Field 1/4 mi. E. of 35th Ave & 500' ± No. of D. Valley Rd.

Set (Nail) w. side of 31st Ave & 100' ± So. of Los Gatos.

M 209.46.27

SP = 1652.60 1652.585

SP = 1248.03



	T@ 8			
	B.S. 7	0.00.20		
	F.S. 9			
	D1	0.00.20	0.00.21	
	D2	0.00.22		
	R1	180.00.44	180.00.42	
	R2	180.00.40		
	D1	97.04.47	97.04.26	
	R2	277.05.13	97.04.31	
HORIZ	8-7	1248.26		
Dist.	8-9	1076.50		

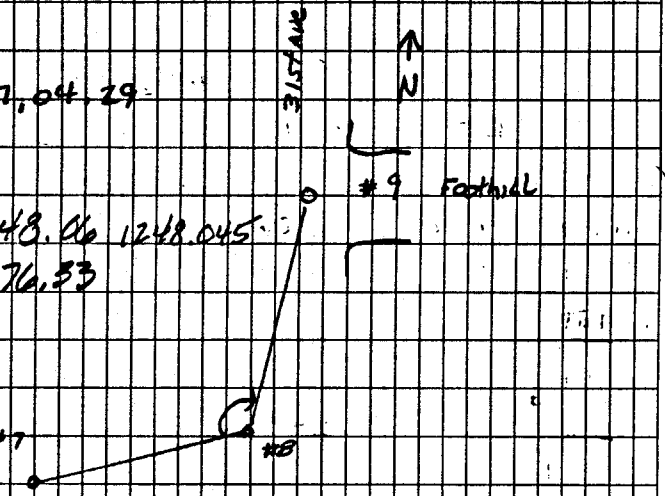
(No. 11) 31st & Los Gatos.

Fd. B.C. @ 31st AVE & Foothills.

M1 97.04.29

EP = 1248.06 1248.045

EP = 1076.53



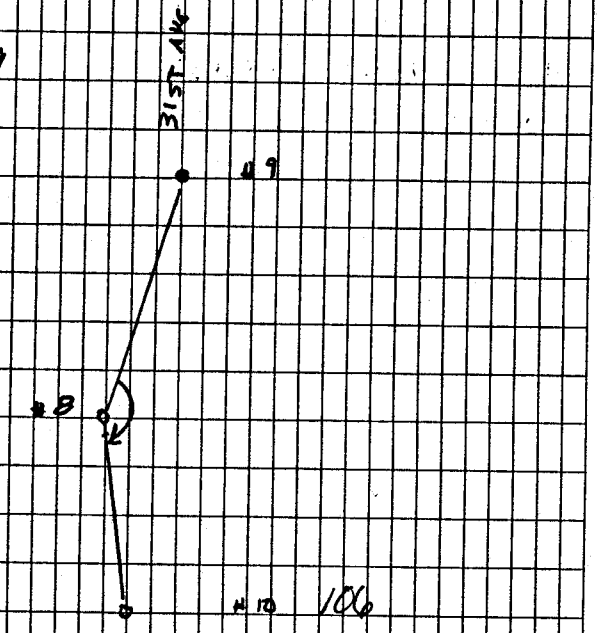
	TEB		
	BS. 9	0.00.20	
	FS. 10	106	
	D1	0.00.20	0.00.21
	D2	0.00.22	
	R1	180.00 52	180.00.51
	R2	180.00 49	
	D1	178.38.31	178.38.10
	R2	358.38.49	178.37.58
Hor. L	9-10	3880.11	
Dist.			

DAS/NT 6 19 95 14

PK. & Pancl e.

M 178.38.04

SP = 3879.49



	TP 9		
	B.S. 8	0.00.20	
	F.S. 11		
	D1	0.00.20	0.00.175
	D2	0.00.15	
	R1	180.00.50	180 00 505
	R2	180 00 49	
	D1	269.18.46	269.18.29
	R2	89 19 08	269.18.18
Horiz	9-8	1076.55	
Dist.	9-11	1318.72	

DASLWT 6 19 95 15

'PK' & Panel @ of Foothills & 29TH AVE

M= 269.18.23

1076.38

SP = 1076.38

SP = 1318.51

#9

#8

#11 Panel PT

Foothills

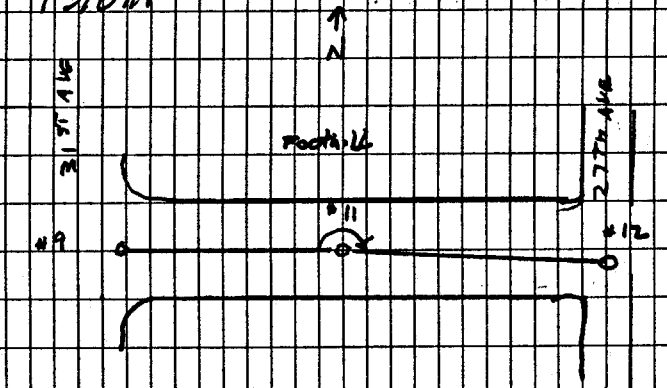
	T @ 11			
	B.S. 9	0.00.20		
	F.S. 12			
	D1	0.00.20	0.00.19	
	D2	0.00.17		
	R1	180.00.48	180.00.43	
	R2	180.00.38		
	D1	180.10.55	180.10.36	
	R2	0.11.37	180.10.54	
Horiz.	11-9	1318.74		
Dist.	11-12	1319.12		

Fd. BC Flush 27TH AVE. & Foothills.

M 180.10.45

EP 1318.53 1318.52

SP 1318.91



DAS NT AM

6-21 95

17

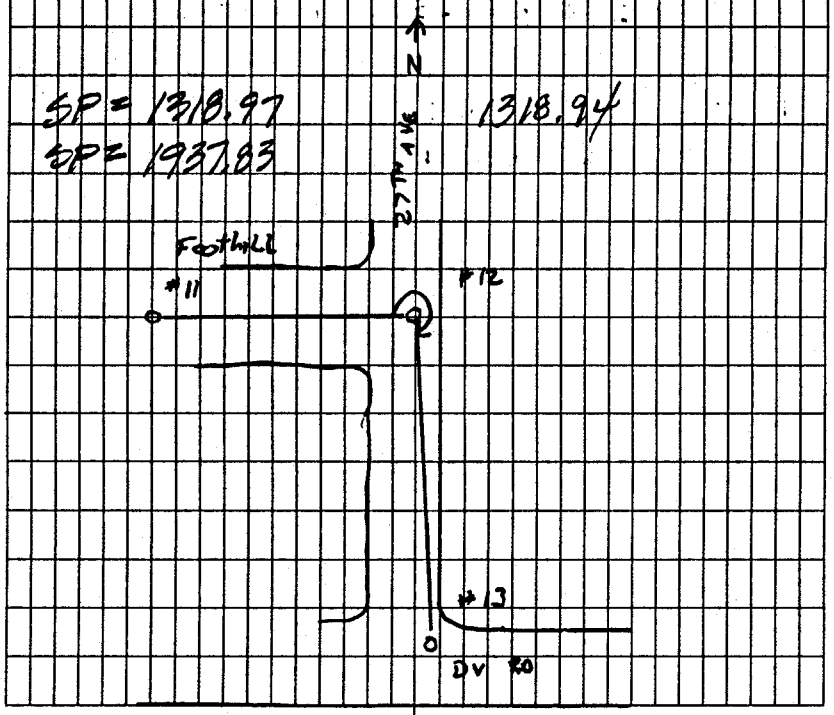
Set 'PK' NE Cor 27TH & D. Valley Road.

	Pt.			
	Ae 12			
	BS 11	0.00.20		
	F.S. 13			
	D1 0.00.20		0.00.195	
	D2 0.00 19			
	R1 180.00.41		180.00.405	
	R2 180.00 40			
	D1 268.48 10		268 47 51	
	R2 88.48.39		268 47 59	
Horiz.	12-11	1319.18		
Dist.	12-13	1938.14		

MJ 268.47.55

SP = 1318.97 1318.94

SP2 = 1937.83



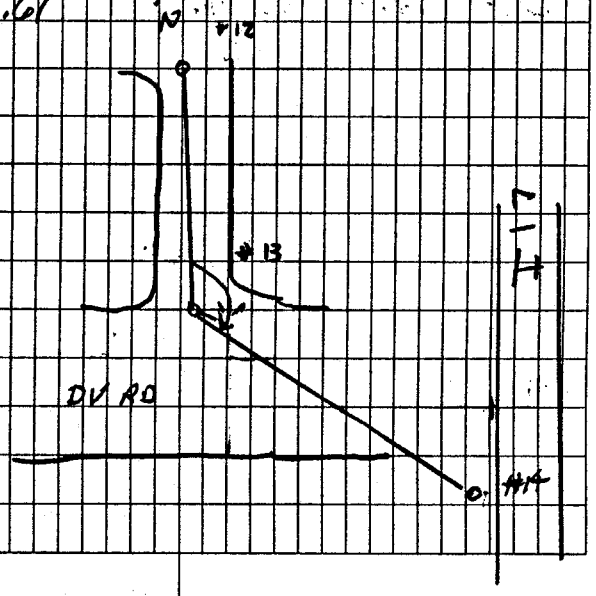
	π e 13				
	B.S. 12	0.00.20			
	F.S. 14				
	D 1 0.00.20		0.00.18		
	D 2 0.00.16				
	R 1 180.00.36		180.00.40		
	R 2 180.00.43				
	D 1 97.53.49		97.53.31.		
	R 2 277 54 23		97 53 .43		
Horz	13-12	1938.13			
Dist	13-14	1425.84			

Nail 5' ± w. of E. Bound Ramp So. Bound I-17 So. Endo over Pass.

M= 97:53.37

SPE 1937.82 1937.805

SPE 1425.61



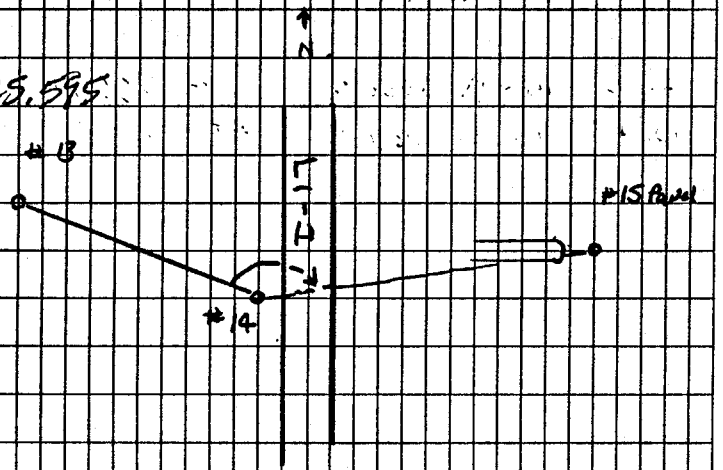
	π @ 14			
	B.S. 13	0.00.20		
	F.S. 15			
	D1	0.00 20	0.00.205	
	D2	0.00 21		
	R1	180.00.48	180.00.47	
	R2	180.00.46		
	D1	160.41.26	160.41.06	
	R1	340.41.56	160.41.09	
Horiz	14-13	1425.81	SP=	1425.58
Dist	14-15	550.96	SP=	550.87

DAY NT AM 6.21-95 19

Panel Point E. of Blk. Canyon Hwy. 300'± @ E. D. Valley.

M=160.41.08

1425.595



	Pt 15		
	BS. 14	0.00.20	
	ES. 16		
	D1 0.00.20		0.00 23
	D2 0.00.25		
	R1 180.00 45		180.00 45
	R2 180.00.45		
	D1 144.46.16		144.45 53.
	R2 324.46.41		144 45 56
Horiz	15-14	550.98	SP= 550.89
Dist.	15-16	1016.87	SP= 1016.71

DAS
ST
DM

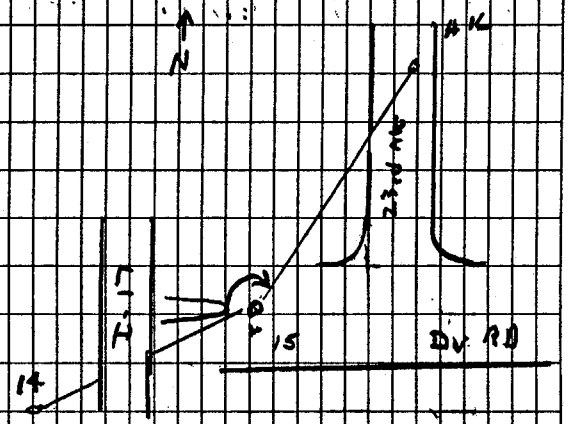
6 21 95 20

Point

Set PK E. side driveway 41- 350' N. of NW cor 237 Ash Ave

M = 144.45.65

550.88



	@16		
	BS. 15	0.00 20	
	FS. 17		
	D1	0.00.20	0.00.18
	D2	0.00.16	
	R1	180.00.42	180.00.41
	R2	180.00.39	
	D1	136.50.50	136.50.32
	R	316.51.20	136.50.39
Horiz	16-15	1016.85	SP = 1016.69
Dist.	16-17	1912.77	SP = 1912.46

Set Nail No. Side of Williams. @ @ of 23rd AVE.

M 136.50.36

N

1016.70

#17

#16

#15

#14

	TE 17			
	BS. 16	0.00.20		
	FS. 18		107	
	D1	0.00 20	0.00 19	
	D2	0.00 17		
	R1	180 00 46	180 00 47	
	R2	180 00 47		
	D3	271.35.52	271 35 33	
	R3	91 .36 .16	271 35 29	
HORIZ	17-16	1912.74	SP = 1912.43	
Dist.	17-18	2015.84	SP = 2015.52	

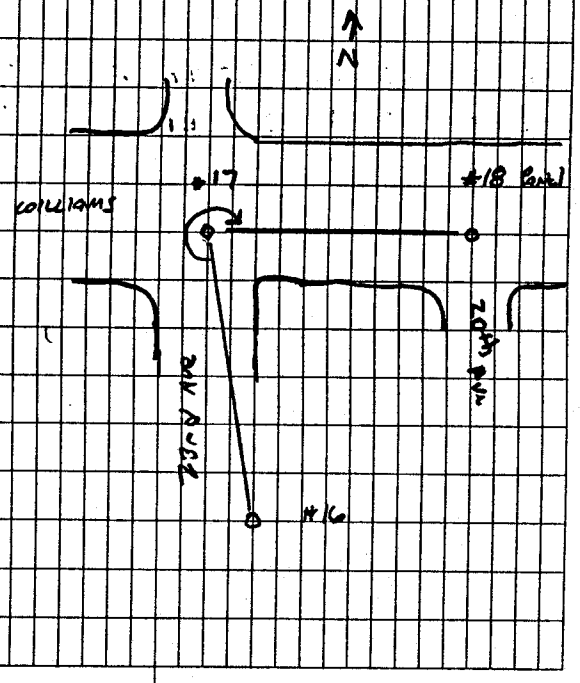
DATUM

C 2195

Panel point B.C. Flush Williams @ 20TH AVE

N 271.35.31

1912.445



	℄ @ 18			
	B.S. 17	0.00.20		
	FS: 19			
	D1	0.00.20		0.00.19
	D2	0.00.18		
	R1	180.00 39		180 00.38
	R2	180.00 37		
	D3	177 32 03	177 31 44	
	R3	357 32 26	177 31 48	
Horiz	18-17	2015.81	SP=	2015.49
Dist.	18-19	708.17	SP=	708.06

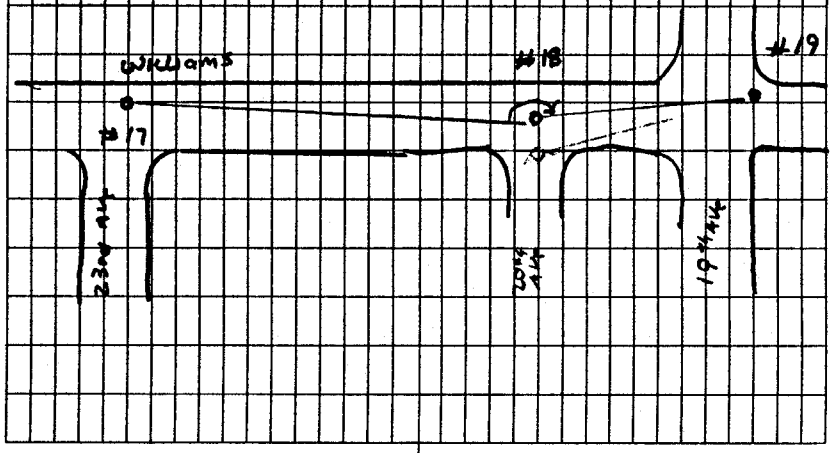
DAS NT OM

6 21.95 23

Set (Pk.) NE. Cor 19TH & Williams. near Valley Gutter.

M = 177.31.46

2015.506

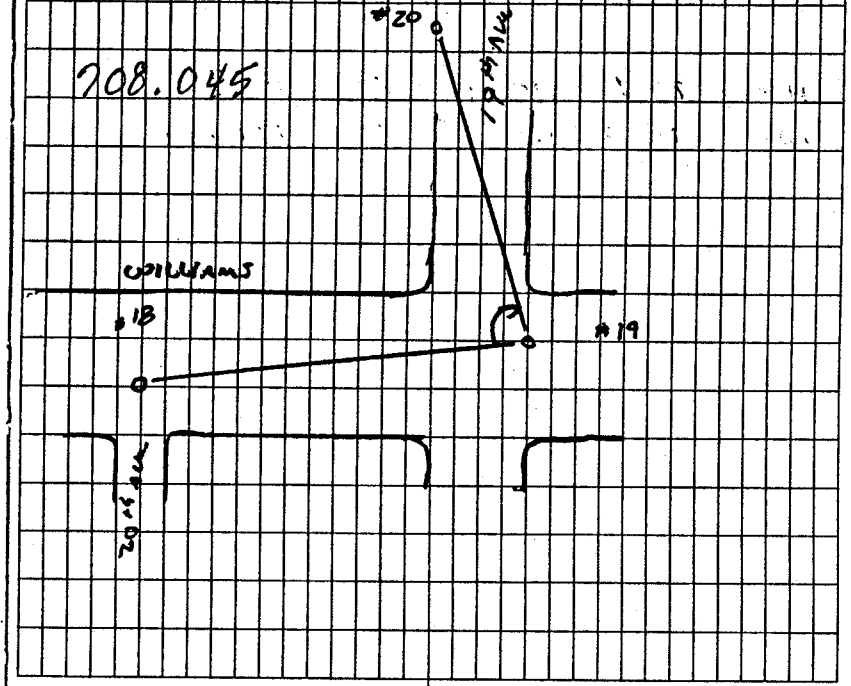


	T@19		
	BS. 18	0.00.20	
	FS. 20		
	D1	0.00.20	0.00.19
	D2	0.0017	
	R1	180.00.43	180.00.40
	R2	180.00.37	
	D3	88.33.40	88.33.21
	R3	268 34 06	88 33.26
Horiz	19-18	708.14	SP = 708.03
Dist.	19-20	1357.64	SP = 1357.42

Set Nail w. side 19 T 1/4 mi. ± No. of Williams.

M 88.33.24

708.045



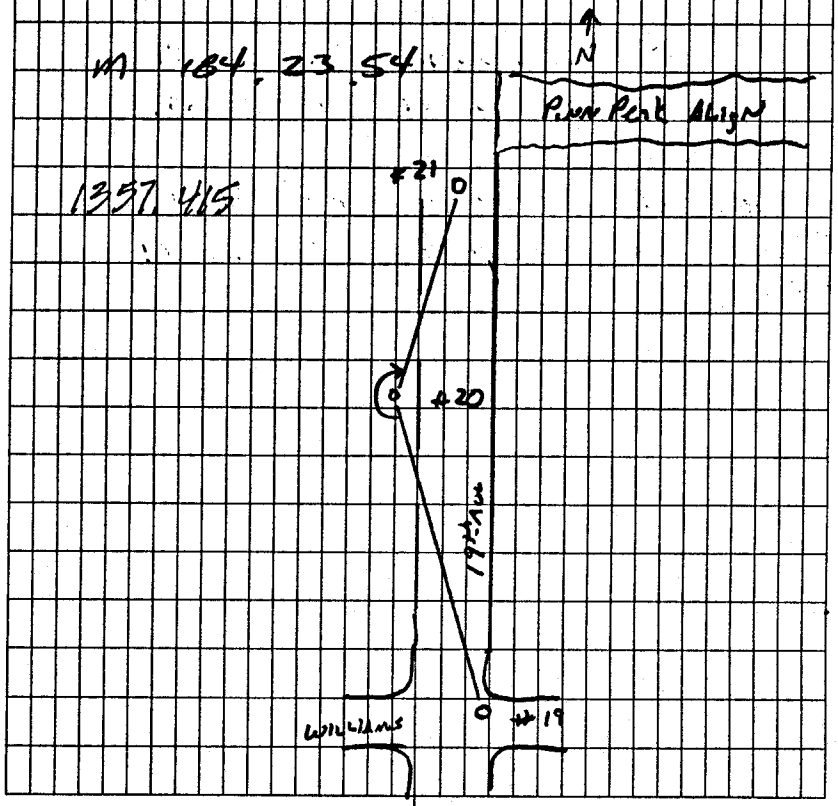
DAS NT DM 6.21.95

	At 20			
	B.S. 19	0.00.20		
	F.S. 21			
	D1	0.00 20	0.00.21	
	D2	0.00 21		
	R1	180 00 53	180.00.53	
	R2	180.00.53		
	D3	184 24 16	184 23.65	
	R3	04.24.45	184 23 52	
Horiz	20.19	1357.63	SP=	1357.41
Dist.	20.21	1264.85	SP=	1264.65

ACDC Point # 139 19TH & P. Peak Rd.

M1 184 23.54

1357.465



	π@21			
	B.S. 20	0.00.20		
	F.S. 22			
	D 1	0.00.20	0.00.18	
	D 2	0.00.16		
	R 1	180.00.47	180 00.46	
	R 2	180 0045		
	D 3	268 53.37	268 53.19	
	R 3	88 53.57	268 53.11	
HORIZ	21-20	1264.81	SP =	1264.61
DIST.	21-22	2670.64	SP =	2670.21

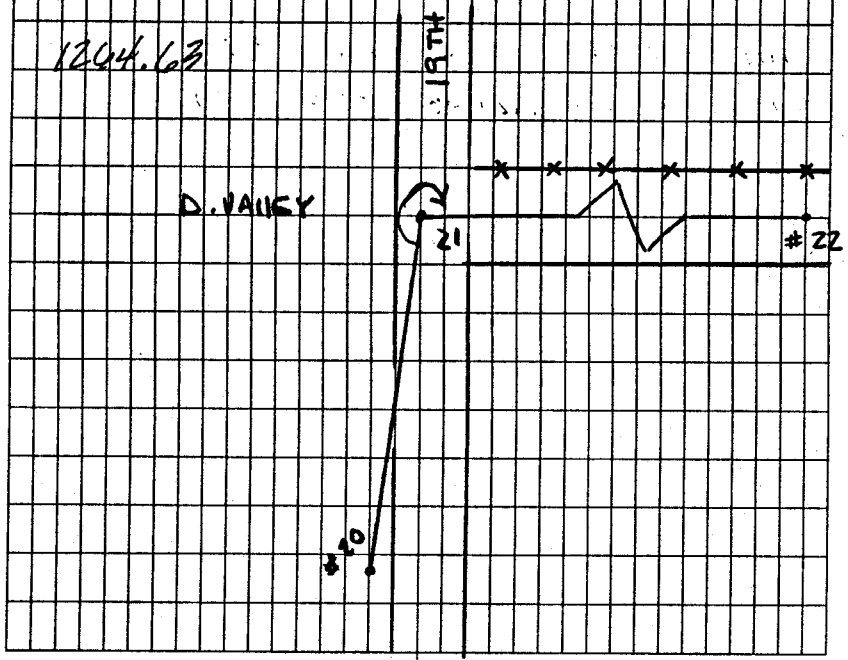
MAG NT KM

6 2195 26

Set Nail 2670' ± E. of 19TH 50' ± So. of Fence line E.-W.

M = 268 53 15

1264.63



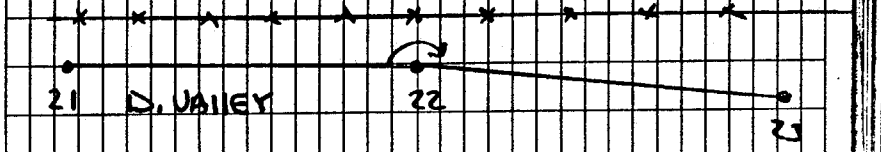
	T@22			
	BS 21	0.00.20		
	FS 23			
	D1	0.00.20	0.00.21	
	D2	0.00.21		
	R1	180.00.49	180 00 48	
	R2	180.00.46		
	D3	190.25.27	190 25 06	
	R3	10.25.52	190 25.04	
Horiz	22-21	2670.61	SP =	2670.18
Dist.	22-23	1929.40	SP =	1929.09

DAS NT AM

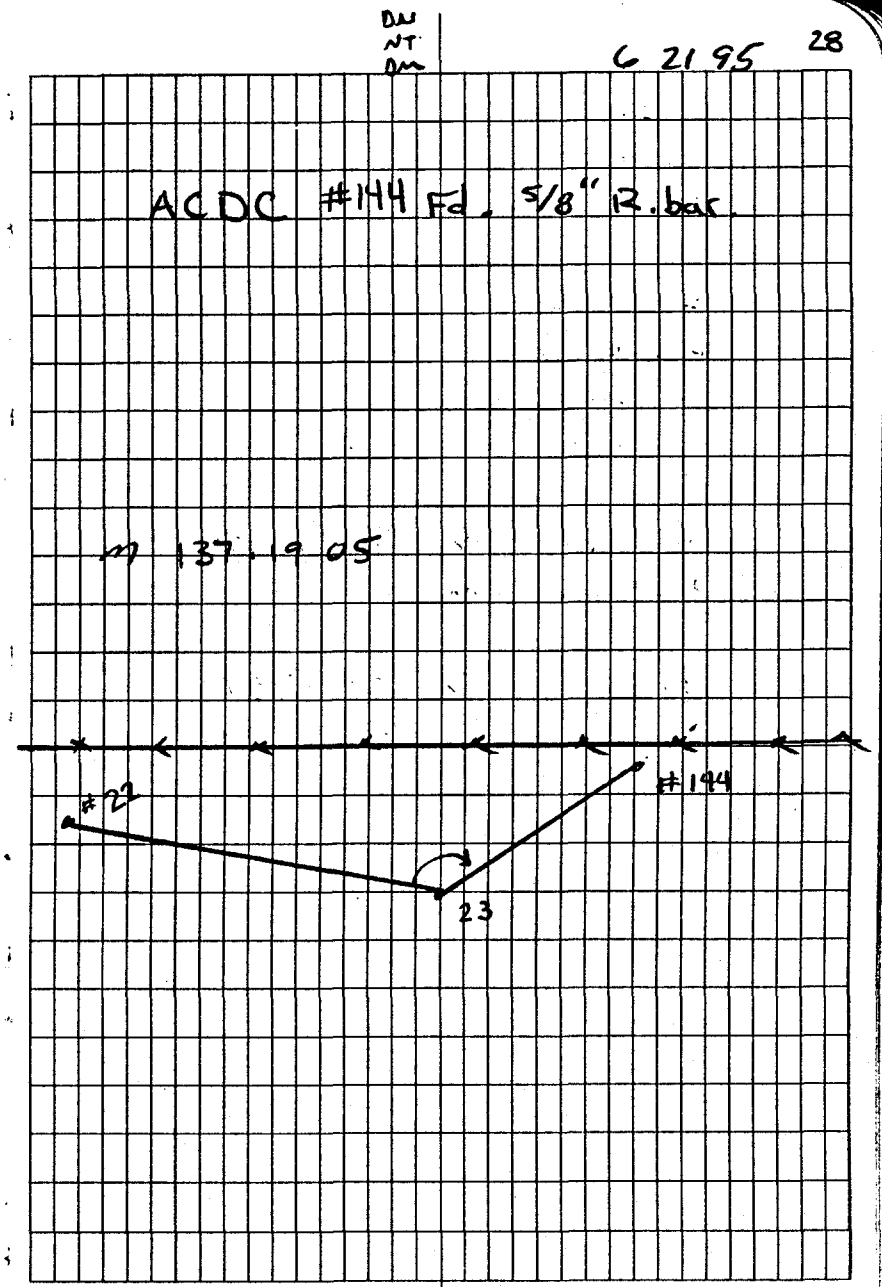
6 2195 27

Set Nail 3/4 mi. ± E. of 19TH 300' ± So. of Prop. Fence. E. & W.

M = 180.25.05



	TE 23			
	BS. 22			
	FS. 24			
	D1 0 00 20		0 00 23	
	D2 0 00 25			
	R1 180 00 52		180 00 53	
	R2 180 00 53			
	D3 137 19 34		137 19 11	
	R3 317 19 52		137 18 59	
Horiz	23-22	1929.40	SP=	1929.09
Dist	23-24	668.61	SP=	668.50



SIDE TRAV

TC: 20

BS 19 0-00-30

FS: 25

D1 0-00-30 0-00-31

D2 0-00-32

R1 180-01-07 180-01-06

R2 180-01-05

D1 94-11-31 94-11-00 m: 94-11-005

R1 274-12-07 94-11-01

19-18 1357.65 GP=1357.43

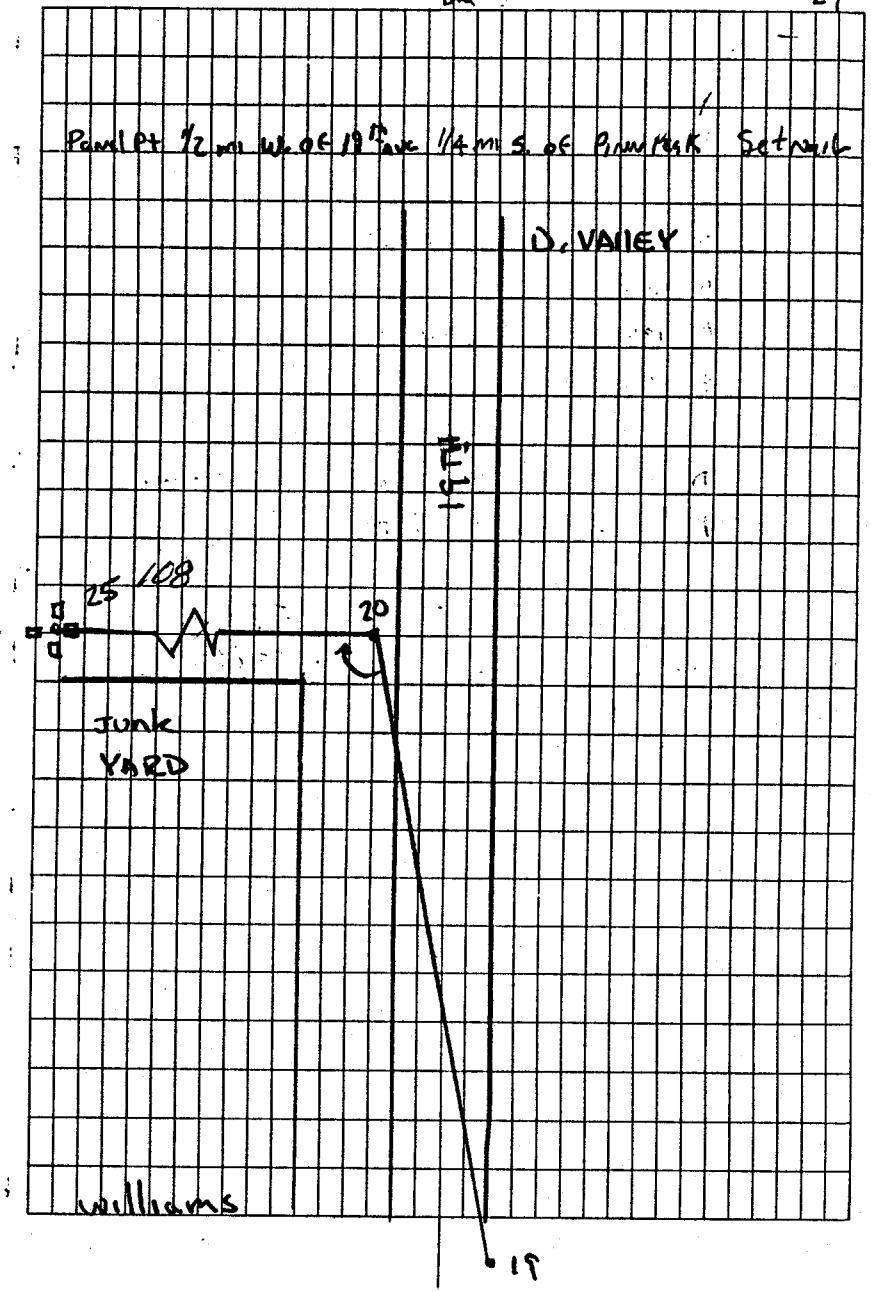
19-25 2584.52 GP=2584.11

4/22/95
DAS
JT
Dm

29

Panel Pt ½ mi W. of 19th Ave 1/4 mi S. of Pinnacle Setback

D. VALLEY



Trav. Cont

TP 25

BS 20

FS 17

D1 0-00-30 0-00-30

D2 0-00-30

R1 180-01-05 180-01-04

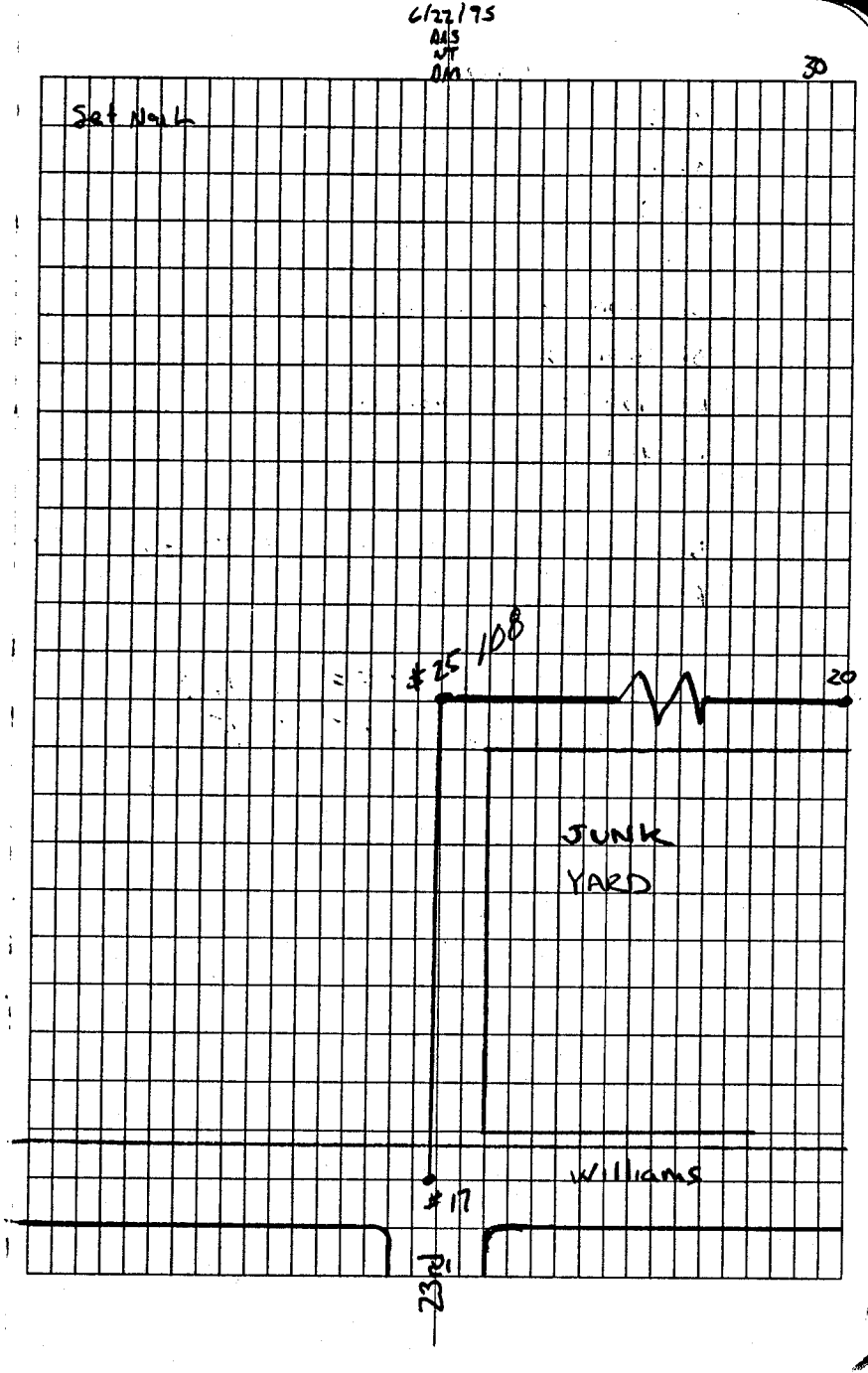
R2 180-01-01

D1 91-37-58 91-37-28 91-37-27

R1 91-38-30 91-37-26

25-20 2584.51 SP = 2584.10

25-17 1398.10 SP = 1397.88



Trav Cont

Π 17

BS 25

FS 18

D1 0-00-30 0-00-29

D2 0-00-28

R1 180-00-51 180-00-53

R2 180-00-55

D1 88-06-43 88-06-14 88-06-Ke

R1 268-07-11 88-06-18

17-25 1398.08 SP= 1397.86

17-18 2015.84 SP= 2015.52

6/22/95
OGS
NT
DM

31

OK @ 24th and Williams

Panel

Panel @ Williams @ 20th Ave

#25

JUNK YARD

#17

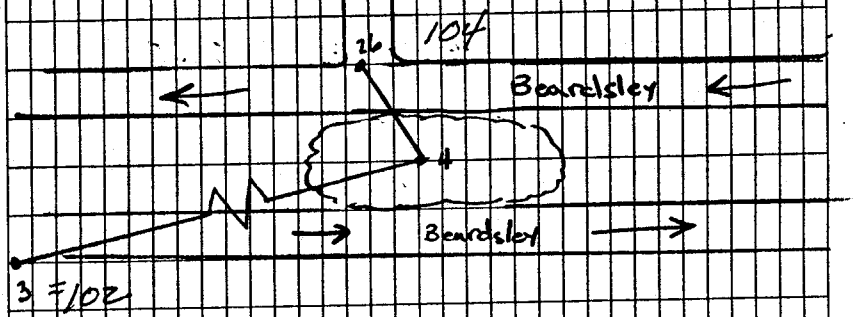
18

6/22/95
OBS
AT
AM

Trav Cont

TC 1			
BS 3	0-00-30	Left.	
FS 26	104		
D1	0-00-30	0-00-305	
D2	0-00-31		
R1	180-01-04	180-01-025	
R2	180-01-01		
D1	72-52-26	71-51-56	~~71-52-005~~
R1	252-53-01	72-52-05	72-52-01
4-26	252.49	SP=252.45	

Nail on MTN in M/C e Beardsley & 39th Ave
Pk
Pencil e Beardsley & 39th Ave

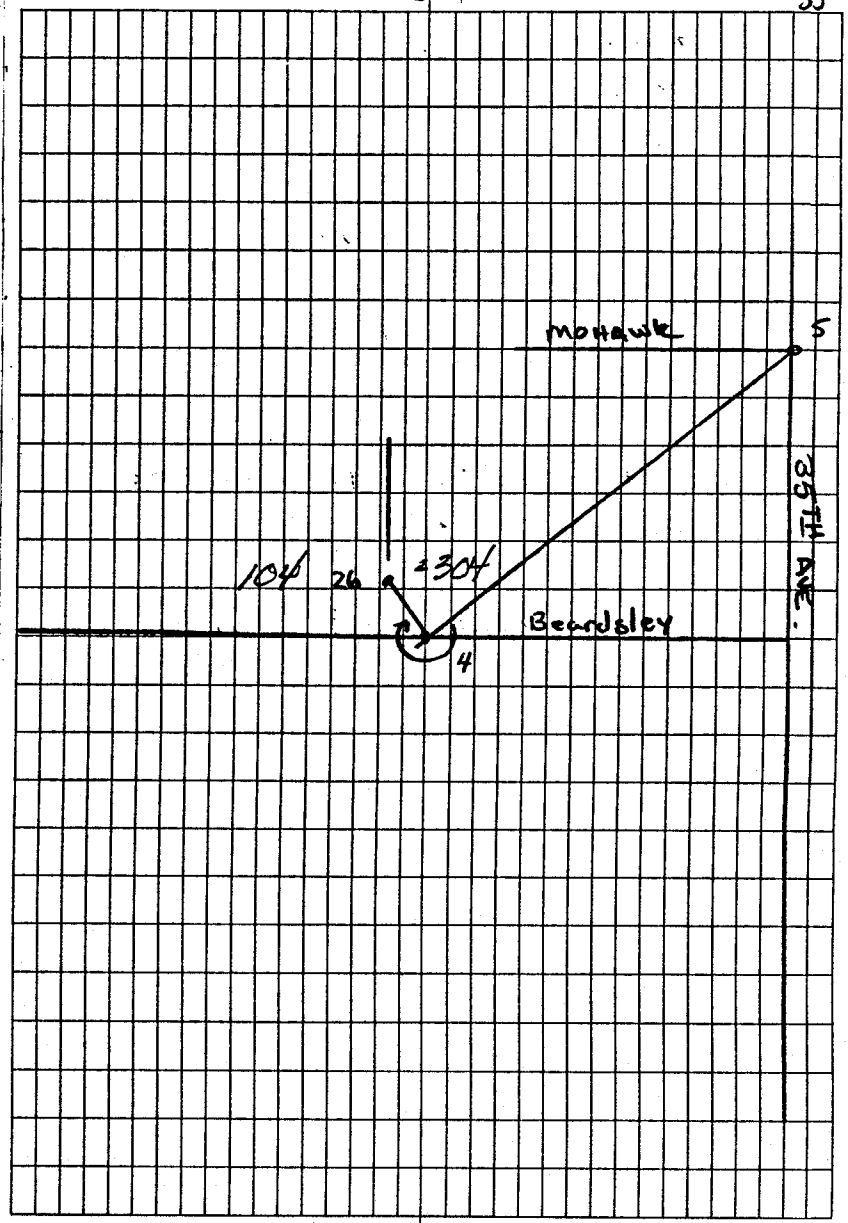


Trav Cont

HI	4		
BS	5		
FS	26		
D1		0-00-30	0-00-31
D2		0-00-32	
R1		180-01-08	180-01-065
R2		180-01-05	
D1		258-01-39	258-01-28 258-01-21
R1		78-02-20	258-01-14
4	26	252.49	SP = 252.45

6/22/95
DAS
MT
DA

33



Side Trav

TP 10 106

BS B

FS 27

D1 0-00-30 > 0-00-29

D2 0-00-28

R1 180-01-00 > 180-01-01

R2 180-01-02

D1 358-07-09 358-06-40 358-06-35

R1 178-07-31 358-06-30

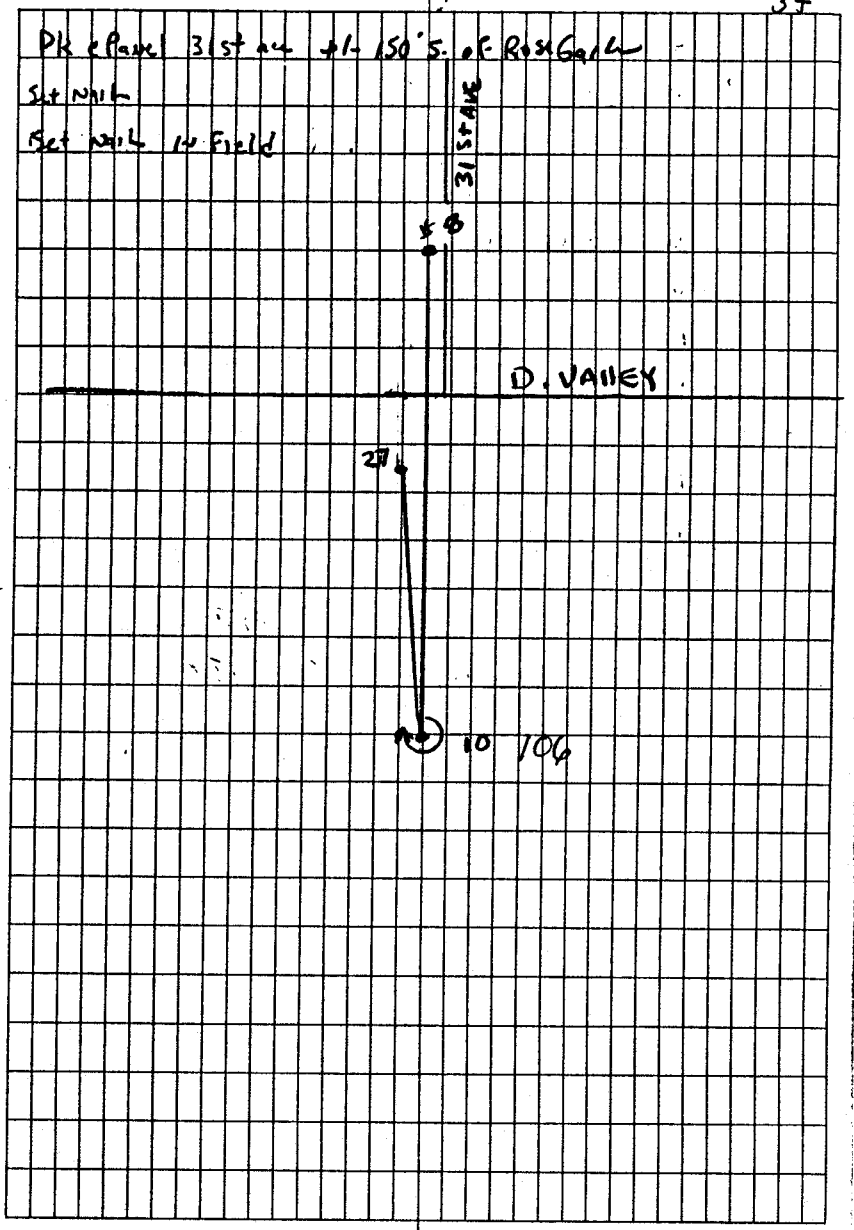
NO 10-8 3880.11 SP= 3879.49

10-27 1753-81 SP= 1753,53

PK & Pave | 31st Ave +/- 150' S. of Rose Gold

Set Nail

Set Nail in Field



Trav Cont

Tie 27

BS 10

FS 28 105

D1 0-00-30 0-00-29

D2 0-00-28

R1 180-00-55 180-00-54

R2 180-00-53

D1 81-00-00 80-59-31 80-59-28.5

R1 261-00-20 80-59-26

HD 27-10 1753.83 SPC 1753.55

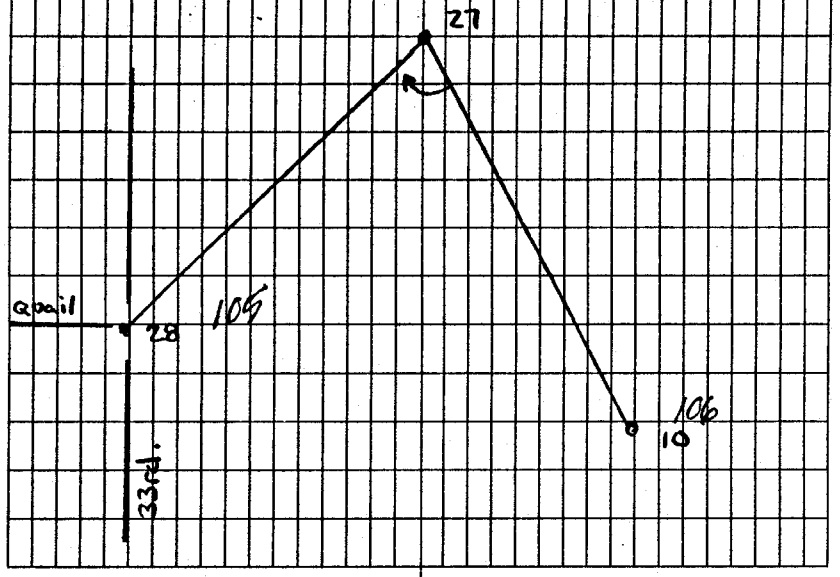
27-28 1286.09 SPC 1286.80

6/29/95
D03
Dn

35

Set Nail
Found Set PK
Set PK Found

C Quail & 33rd Ave

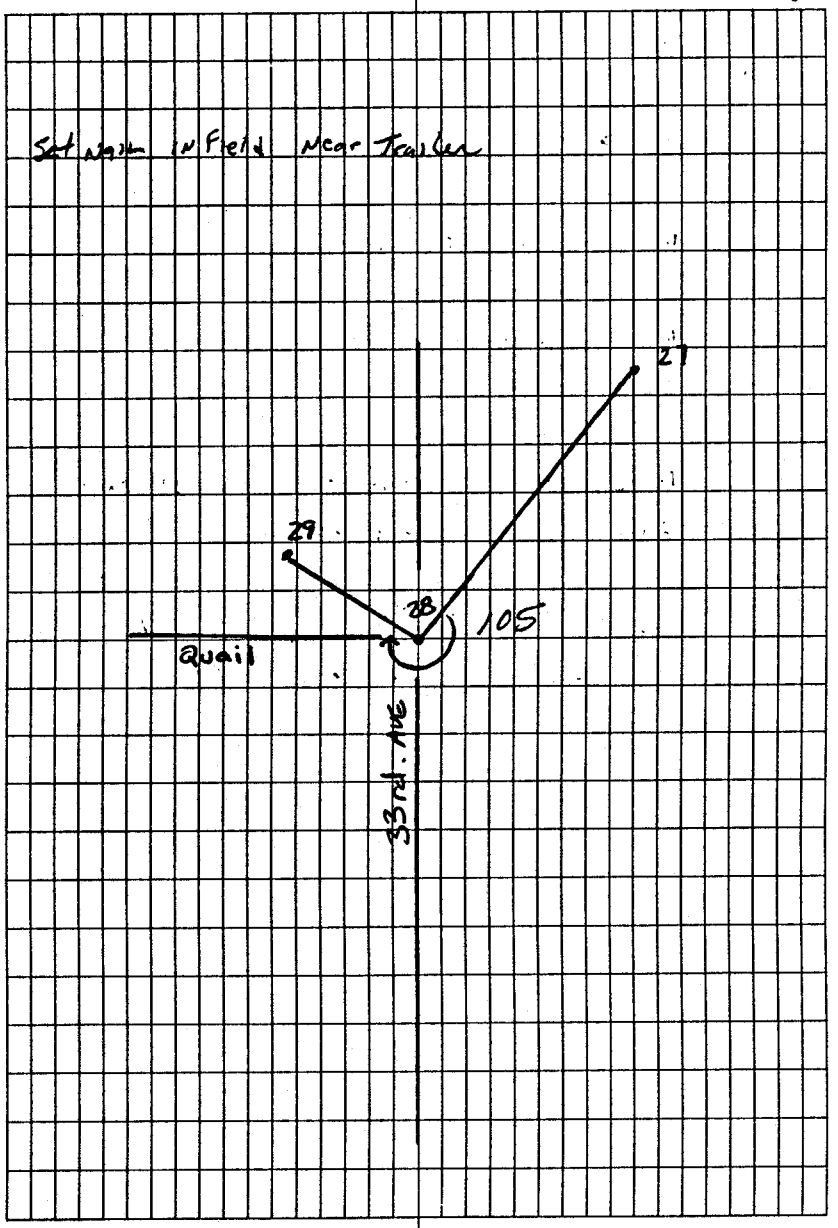


4/23/95
DLJ
DM

86

At 28	105		
BS 27			
FS 29			
D1	0-00-30	0-00-30	
D2	0-00-29		
R1	180-00-53	180-00-51	
R2	180-00-49		
D1	238-42-57	238-42-27	238-42-25
R1	58-43-14	238-42-23	
ND	28-27	1285.18	SPC 1284.97
	28-29	372.99	SPC 372.93

Set Mag. Nail in Field Near Trailer



6/23/95
DAS
DM

37

TP 29

BS 28 105

FS 30

D1 0-00-30 0-00-31

D2 0-00-32

R1 180-01-02 180-01-02

D2 180-01-02

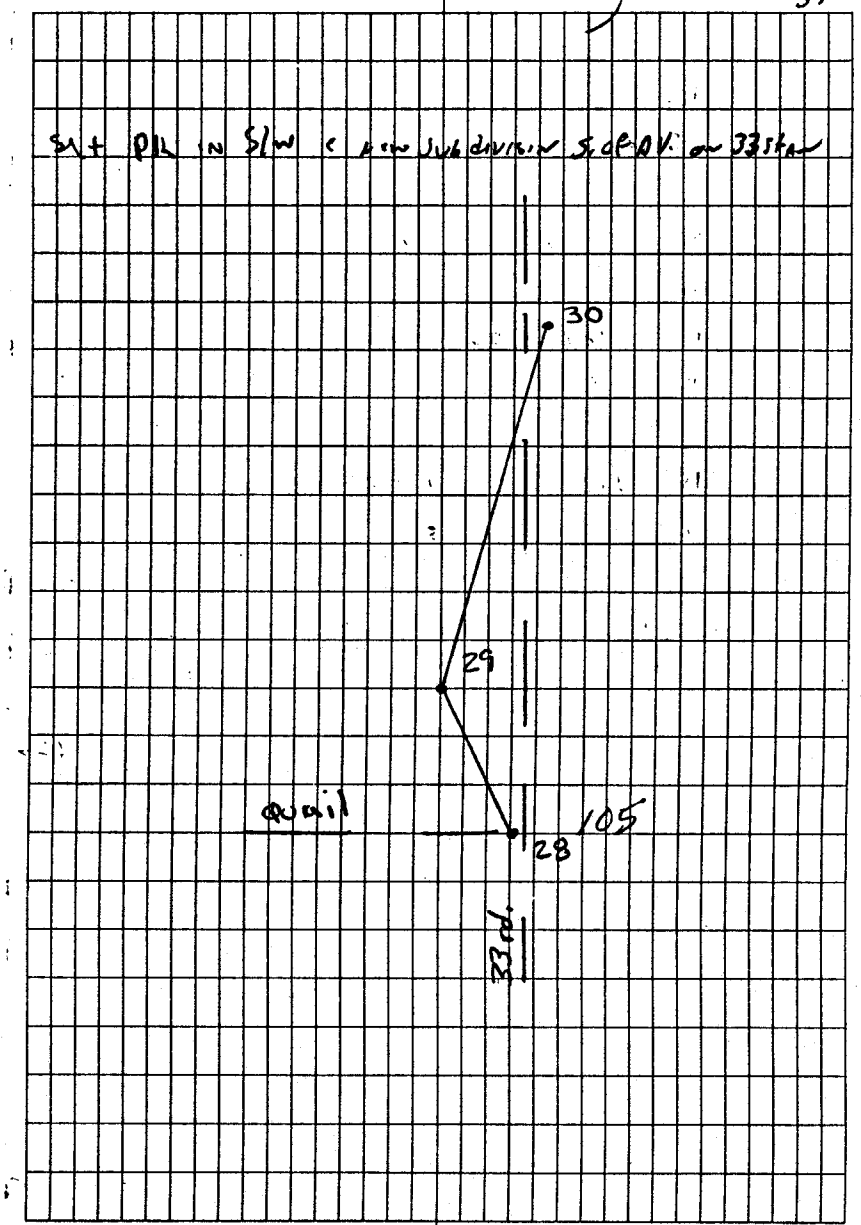
D1 235-11-56 235-11-25 235-11-22.5

R1 55-12-22 235-11-20

DD 29-28 373.02 SP = 372.96

29-30 1066.34 SP = 1066.17

Set up PIL in SW corner of subdivision & set BM on 33rd Ave

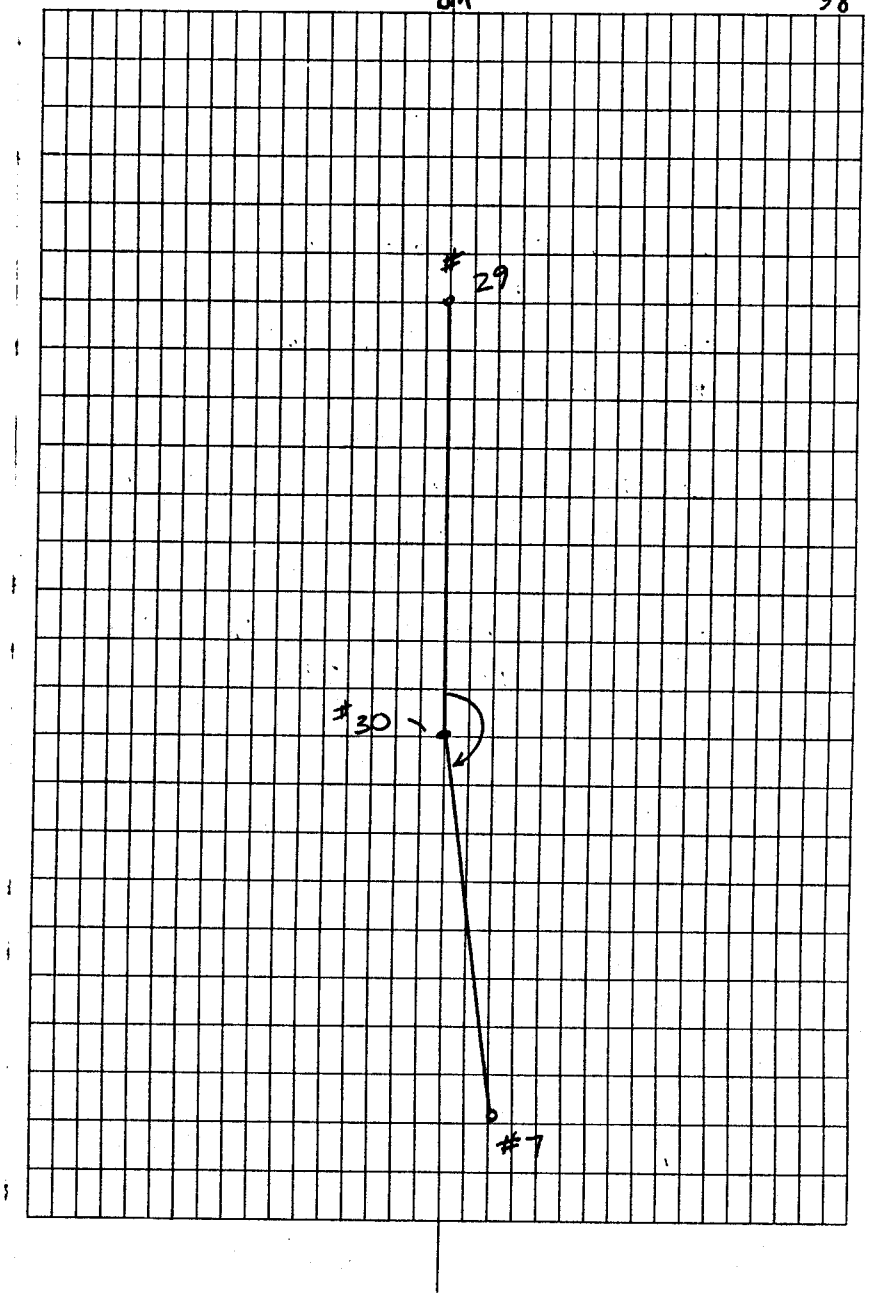


6/23/95
DAS
DM

Pt 30
BS 29
FS 7

D1	0-00-30	0-00-30	
D2	0-00-30		
R1	180-01-05	180-01-06	
R2	180-01-07		
D1	172-25-29	172-24-59	172-25-045
R1	352-26-16	172-25-10	

HD 30-29 1066.35 SP = 1066.18
HD 30-7 934.77 SP = 934.62



6/23/95
DMS
DM

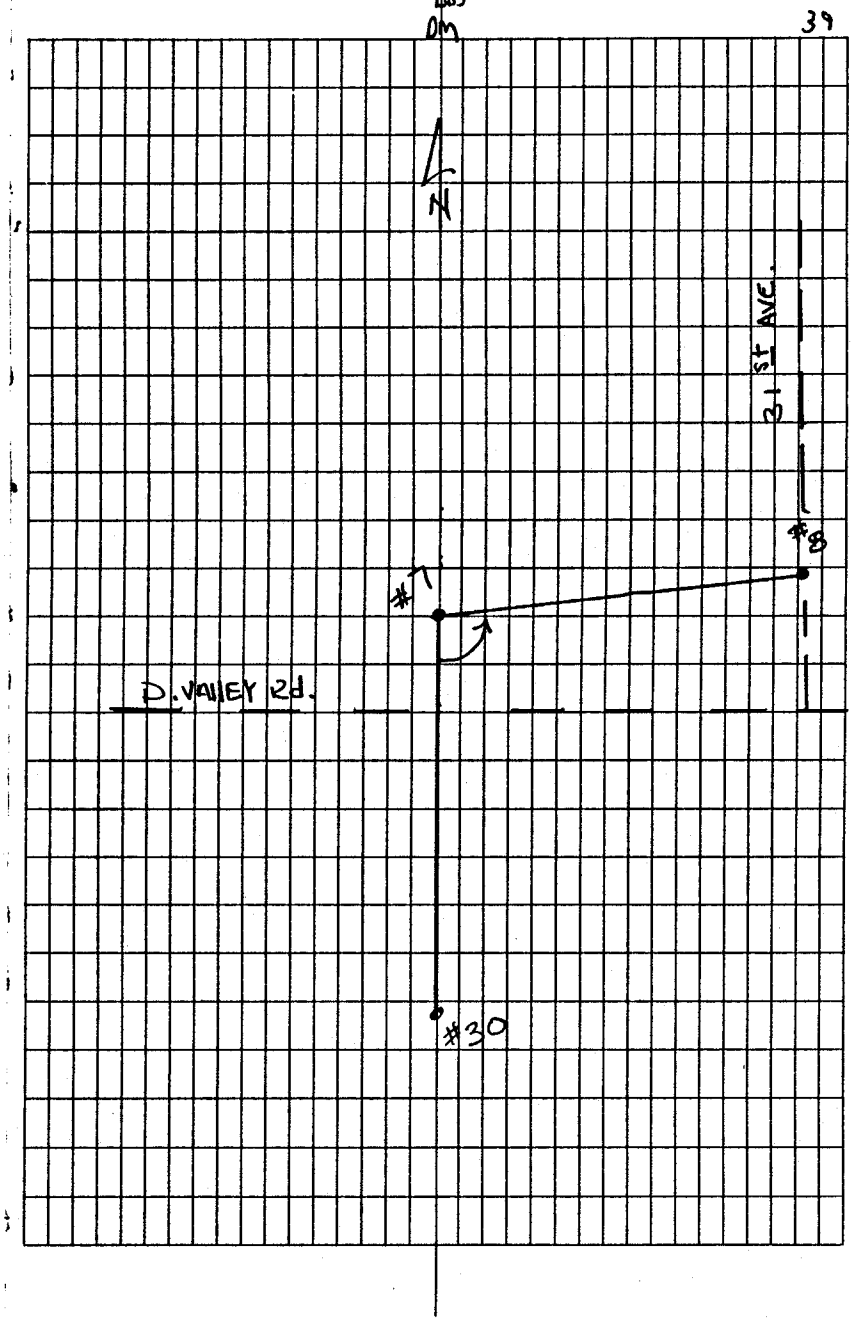
39

Pt 7
BS 30
FS 8

D1 0-00-30 0-00-31
D2 0-00-31
R1 180-00-59 180-00-58
R2 180-00-57

D1 258-52-40 258-52-09 258-52-08.5
R1 78-53-06 258-52-08

AD 7-30 934.78 SP=934.63
7-8 1248.27 SP=1248.07



7-19-95
MX DS DM

TC 3
BS P.K.
FS 5

D1 0-00-30 }
D2 0-00-28 } 0-00-29
R1 180-01-09 }
R2 180-01-07 } 180-01-08
D1 320-43-14 – 320-42-45 } 320-42-46
R1 140-43-55 – 320-42-47 }
HD to PK 796.35 M = 996.35

{ Closure * SEE Pg 80 }

Level Loop Pt. 128 to 132 ACDC

	+	HI	−	ELEV.
ACDC Pt. 128	6.70	1295.60		1288.90
L1			3.79	1291.81
	6.79	1298.60		
L2			3.07	1295.53
	8.15	1303.68		
Cont. 1			4.24	1299.44
	6.00	1305.44		
L3			3.67	1301.77
	6.63	1308.40		
L4			2.72	1305.68
	7.62	1313.30		
ACDC # 132			4.10	[redacted]
	3.95	1313.15		
L4			7.45	1305.70
	2.84	1308.54		
L.3			6.75	1301.79
	4.15	1305.94		
Cont. 1			6.48	1299.46
	3.59	1303.05		
L.2			7.50	1295.55
	2.91	1298.46		
L.1			6.63	1291.83
	4.15	1295.98		
Pt. 128			7.06	1288.92

D.S. 6/9/95
N.T.

50

Fd. B.C. in H.H. 51st & Union H.H's.
So. T/C E. End of west Dlw 4901 W. U.H.H's.
So. T/C @ Catch basin
HZ Cont Pt #1 "PK" SE Cor - E. Ret 47TH AVE & U.H.H's.
So. T/C @ H. Cap Ramp 45TH AVE.
So. T/C 50' E. of Pt.
Fd. B.C. in H.H 43rd. & U. H.H's. [redacted]

6/16/95 DAS NT

Loop Started @ 19th & DV To 43rd Ave

#	+	HI	-	ELEV	
139				1436.15	BC
	5 87	1442.02			BC in NH @ DV Rd & 19th Ave
[illegible]			6 49	1435.53	W. EP @ 5th PP
	4 44	1439.97			
L-2			4 86	1435.11	W EP @ 50 mph Sign
	2 25	1437.36			
L-3			4 17	1433.24	No Rim HH @ 19th & Williams
	3 42	1436.66			
L-4			7 49	1429.17	Panel PT FH BK @ 20th & Williams (107)
	2 25	1431.42			
L-5			8 72	1422.70	N T/C @ 2155 W. Williams
	2 23	1424.93			
L-6			9 12	1415.81	N Rim HH @ 23rd & Williams
	4 52	1420.33			
L-7			5 71	1414.62	S. T/C @ PP # 25853

#	+	HI	−	EL
	3 3+	1417.96		
L-8			5 48	1412.48
	4 41	1416.89		
L-9			6 16	1410.73
	4 64	1415.37		
L-10			14.99	1400.38
L.10	9.29	1409.67		
L.11			12.19	1397.48
	3.14	1400.62		
L.12			7.91	1392.71
	6.08	1398.79		
L.13			5.67	1393.12
	8.55	1401.67		
L.14			8.11	1393.56
	9.34	1402.90		
L.15			6.31	1396.59
	3.60	1400.19		
TP.11			7.39	1392.80
	3.73	1396.53		
L.16			7.79	1388.74
	3.15	1391.89		
L.17			6.50	1385.39
	3.02	1388.41		
L.18			8.09	1380.32

D.S.
N.T.
D.M.

Desc. 6/19/95 52

W EP 22032 W. 23rd AVE

W EP 150' N. of Deer V.

Panel Point 24TH & D. Valley E. of Blk. Canyon Hwy. (202)
Top Conc. Bank NW Ref. Blk Canyon Frontage Road & D. Valley.
PK NE Cor. D Valley & 27TH

(P.S.) P&V E. EP 27TH & Louise St.

BC Flush Foothill & 27TH Ave.

(P.S.) W. EP Foothill @ 28TH Ave

Panel Point (PK) 29TH & Foothill (201)

(P.S.) No. EP Foothill & 30TH Ave.

TRAV. Pt. #9 Foothills & 31ST Ave. BC Flush

TRAV. Pt. #8 (Nail)

#	+	HI	−	EL.
L.18				1380.32
	3.18	1383.50		77.68
L.19			5.82	1377.50
	1.76	79.44 1376.26		
L.20			5.67	73.77 1370.59
	3.38	1373.97		
L.21			8.09	69.06 1365.88
	4.33	73.39 1370.21		
L.22			4.97	68.42 1365.24
	5.10	73.52 1370.34		
L.23			9.11	64.41 1361.23
	3.69	68.10 1364.92		
L.24			5.25	62.85 1359.67
	8.19	71.04 1367.86		
L.25			3.11	67.93 1364.75
	5 50	73.43 1370.25		
L-26			6 09	67.34 1364.16
	5 73	73.07 1369.87		
L-27			7 63	65.44 1362.26
	3 58	69.02 1365.84		
L-28			6 73	62.29 1359.11
	3 47	65.76 1362.58		
L-29			7 41	58.15 1354.97
	1 28	59.43 1356.25		
L-30			10 10	49.33 1346.15

No. Rim MH. 200'± So. of D. Valley & 31st

No Rim 6th MH. to South 31st Ave.

TRAV. Pt. # 10 31st & 200'± So. of Rose Garden. (106)

No. E.P. 350'± W. of 31st

E. E.P. @ 2105 N. 33rd.

P.K. Panel Point 33rd & Quail (105)

4/22/95

N Rim MH +/- 500' E. of 35th Ave in New Sub Division

T/C W side 35th End Curb +/- 150' S. of Abraham Ln

EP NW RTN 35th Ave & Rose

EP W side 35th Ave 20834 Ave

TP #5 PK Panel @ 35th Ave & Mohawk West (200)

6/22/95

#	+	HI	−	EL	DESC
	6 17	55.50 1352.32		1349.33	64
L-31			4 37	51.13 1347.15	Beg T/C w. side 35th ave +/- 200 N. of Boardsley
	4 22	55.35 1352.17			
L-32			6 12	49.23 1346.03	End T/C w. side 35th ave +/- 200 S. of Boardsley
	3 89	53.12 1349.94			
L-33			6 31	46.81 1343.63	Beg T/C S. side Bchrend @ 35th Ave
	2 78	49.59 1346.47			
L-34			8 29	41.30 1338.12	T/C S. side Bchrend @ 36th
	4 46	45.76 1342.58			
L-35			6 19	37.57 1336.39	Set PK (Paint) E Bchrend @ 37th Ave (103)
	6 29	45.90 1342.28			
L-36			0 73	45.23 1342.06	N Rim WW S. side Boardsley @ 37th Ave
	0 81	46.04 1342.86			
L-37			7 09	38.95 1335.77	Panel on PK N. side Boardsley @ 38th Dr (104)
	2 04	40.99 1337.81			
L-38			5 69	35.30 1332.12	Top Rock S. side W. end Boardsley across from Lutheran church
	2 22	37.52 1334.34			
L-39			8 03	29.49 1326.31	Top Cone Drill at end SW car. +/- 100 E of Skunk Creek Bridge
	2 72	32.21 1329.03			
L-40			10 04	22.17 1318.99	Bridge Pt. PK +/- 150 N. of Bchrend on 43rd Ave (102)
	5 41	27.58 1324.40			
L-41			9 33	18.25 1315.07	Set PK TP #2 SE RTN EP @ 43rd Ave & Yorkshire
	2 80	21.05 1317.87			
L-42			8 35	12.70 1309.52	E side 43rd Ave in EP @ Bridge 4 TP 100' N. of Marrow Dr
	4 69	17.39 1314.21			
			7 34	13 10.05 1306.87	(1307.87)

BEGINNING @ 43rd & UNION

6/29/95
DAS
NT
AM

PT #	+	HI	−	EL	DESC
				1310.05	BC in NW c 43rd Ave & Union Hills
	7 00	1317.05			
L-42			4 34	12.71	E side 43rd c EP & Fog Ln
	7 74	20.45			
L-41			2 21	18.24 ✓	AK SE cor 43rd & Yorkshire TP
	6 35	24.59			
L-50			2 43	22.16	EP MB - 19617 43rd Ave
	3 93	26.09			
L-40			3 94	22.15 ✓	Panel PK +/- 150' N. of Bellevue on 43rd (102)
	6 36	28.51			
L-51			2 55	25.96	SE cor EP 43rd & Beardsley
	7 05	33.01			
L-52			2 53	30.48	N. EP S. side Beardsley w. of church
	9 29	39.77			
L-53			5 84	33.93	N EP S. side Beardsley E of church
	6 89	40.82			
L-37			1 88	38.94 ✓	PK Panel + 38' Dn & Beardsley N. side RD (104)
	6 57	45.51			
L-54			1 74	43.77	EP Ent To Mountain Baptist Church S. side Beardsley
	6 46	50.23			
L-36			4 99	45.24 ✓	N. Rim MH E 35th Ave & S. side Beardsley
	10 80	56.04			
L-55			7 48	48.56	TPC & Bay Turn LN S. side Beardsley E 35th Ave
	7 61	56.17			
L-32			6 89	49.28	End TPC +/- 200' S. of Beardsley

6/29/95
DAS
27T
DM

PT #	+	HI	−	EL	DESC.
	6 76	56.04			
L-56			3 56	52.48	S. Side Broadway T/C & 40 MPH Sign
	7 33	59.81			
L-57			3 00	56.81	T/C S. Side Broadway & 40 MPH Sign E. of 3rd Ave
	7 87	64.68			
L-58			2 70	61.98	T/C S. Side Broadway & By-4H Sign/Poles
	7 82	69.80			
L-59			1 50	68.30	T/C S. Side Broadway
	6 61	74.91			
L-60			3 75	70.96	T/C NEW RTN N. Side Broadway & 29th Ave
	8 46	79.42			
L-61			1 53	77.89	T/C RTN END FENT RD N. Side Broadway & 27th Ave
	7 22	85.11			
L-62			3 91	81.20	T/C E Side 27th Ave
	6 17	87.37			
L-63			3 75	83.62	T/C E Side 27th Ave
	6 25	89.87			
L-64			2 76	87.11	END T/C NE RTN 27th Ave & Rose Garden
	6 61	93.72			
L-65			5 62	88.10	E Side 27th Ave. END T/C
	5 26	93.36			
L-66			3 20	90.16	END T/C D/W W Side 27th
	6 36	96.52			
L-12			3 76	92.76	PK NE Corp. Point 27th & DV
	FF				

PT	+	HI	-	EL	
	7 15	1400.21			
L-67			11 03	1389.18	
	0 19	89.37			
L-68			0 86	88.51	
	14 84	1403.35			
L-10			2 92	1400.43	
	13 86	14.29			
L-69			3 38	10.91	
	5 99	16.90			
L-70			4 87	12.03	
	6 27	18.30			
L-71			5 15	13.15	
	7 88	21.03			
L-72			5 81	15.22	
	5 41	20.63			
L-6			4 82	15.81 ✓	15.81
	7 91	23.72			
L-73			2 91	20.81	
	7 99	28.80			
L-74			3 26	25.54	
	7 02	32.56			
L-4			3 38	29.18 ✓	29.17
	8 73	37.91			
L-75			5 59	32.32	

C/L 29/95
ONE
UNIT
ON

DESC

57

T/C OF Rpt to DV & S. side

T/C NB ON Ramp to 37

PK Panel @ 24th Ave Hi/d & END OF MED & side L-17 (202)

TP EXIST ENT OFF 23rd Ave & DV

T/C E side 23rd Ave END T/C

T/C @ DVW N. OF DOOR ON 23rd Ave

T/C W side 23rd Ave @ DOOR Truck Scales

N Ramp HH @ @ 23rd Ave & Williams

T/C S. side Williams E 22 Ave

T/C N. side Williams E. of 21st Ave

BC EXIST Panel @ Williams & 20th Ave (107)

T/C W side 19th Ave @ ENT To AZ Republic

PT#	E	N	—	EL	
	7 49	39.81			
L-76			4 27	35.54	
	4 97	40.51			
L-77			3.51	37.00	
	4 79	41.79			
139			5 64	36.15 ✓	(36.15)

6/29/95 ONS AT Nth

Desc

58

T/C E side 19th Ave N. of Knudsen

EP E side 19th Ave & Siskin

BC NNW C 19th Ave & Siskin Rock

#	+	HI	-	EL.	Desc.
	Pt. 139	to Pt. 144			
Pt. 139	8.86	45.01		1436.15	BCHH 19TH & Pinnacle Peak (AC&DC)
TP-1			2.05	42.96	Rock 2½ PP to East.
	7.11	50.07			
TP-2			1.88	48.19	Rock. 300'± East.
	10.49	58.69			
TP-3			4.39	54.29	Rock. 350'± East
	8.71	63.00			
TP-4			2.81	60.19	Rock 350'± East.
	10.73	70.92			
TP-5			2.03	68.89	Rock 350'± East
	8.29	77.18			
# 144			6.11	(M) 1471.07 (P) 1471.11	Fd. 7/8 R. bars. NE Cor Sec. 18 (AC&DC) TWP 4N R3E. 7TH AVE & Pinn. P

#	+	HI	−	El.
L-6	6.91	22.72		1415.81
TP-1			3.56	1419.16
	3.33	22.49		
L-6			6.68	1415.81

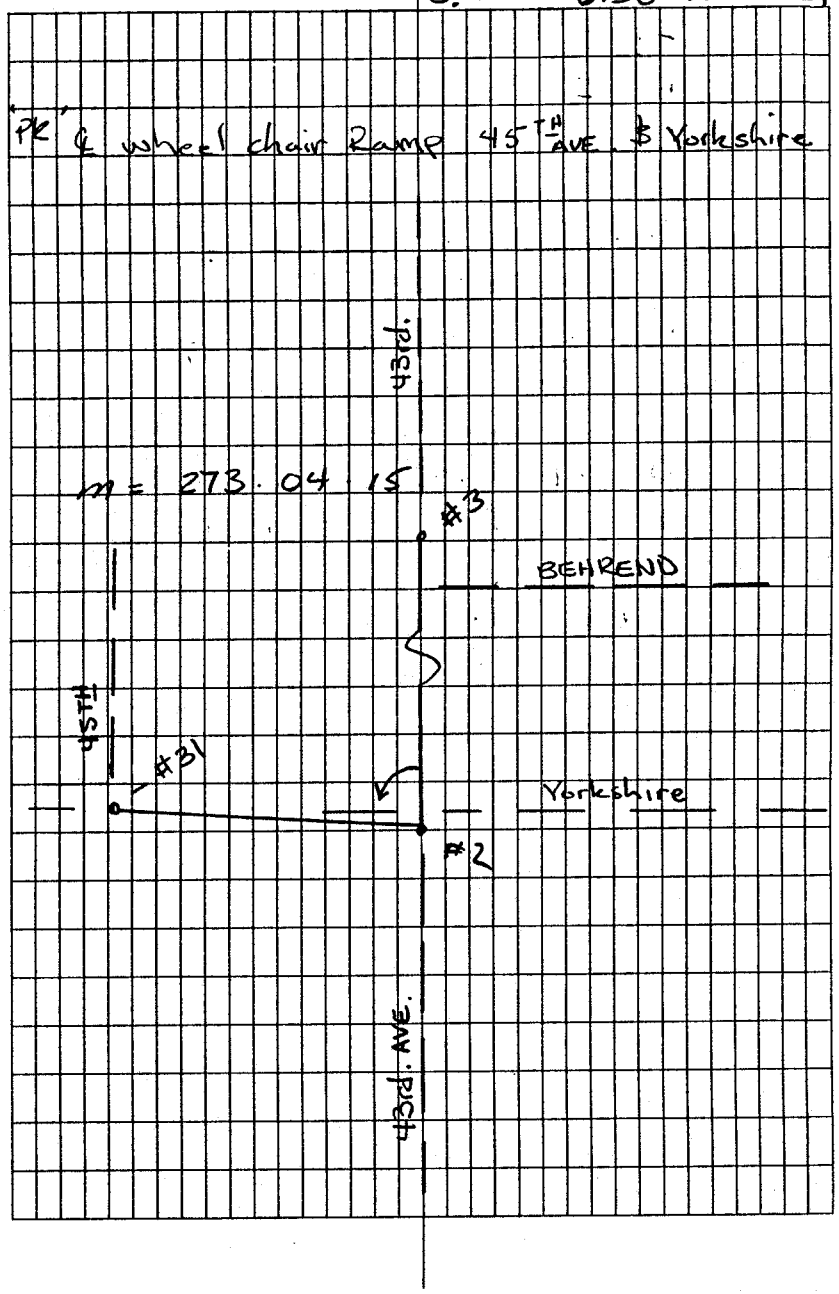
Desc.

No. R.m. H.H. 23rd. B williams (L-6)
(Nail) Panel point. 1/4 mi. North of williams
& 23rd. (108)
No. R.m

	T@ 2			
	B.S. 3	0.00.20		102
	F.S. 31			
	D1	0.00.20	0.00.22	
	D2	0.00.23		
	R1	180.00.48	180.00.49	
	R2	180.00.50		
	D3	273.04.34	273.04.12	
	R3	93.05.06	273.04.17	
HD.	2 to 30	1329.16	GPE =	1328.95

D.S.
N.T.
D.M 6.30.95 61

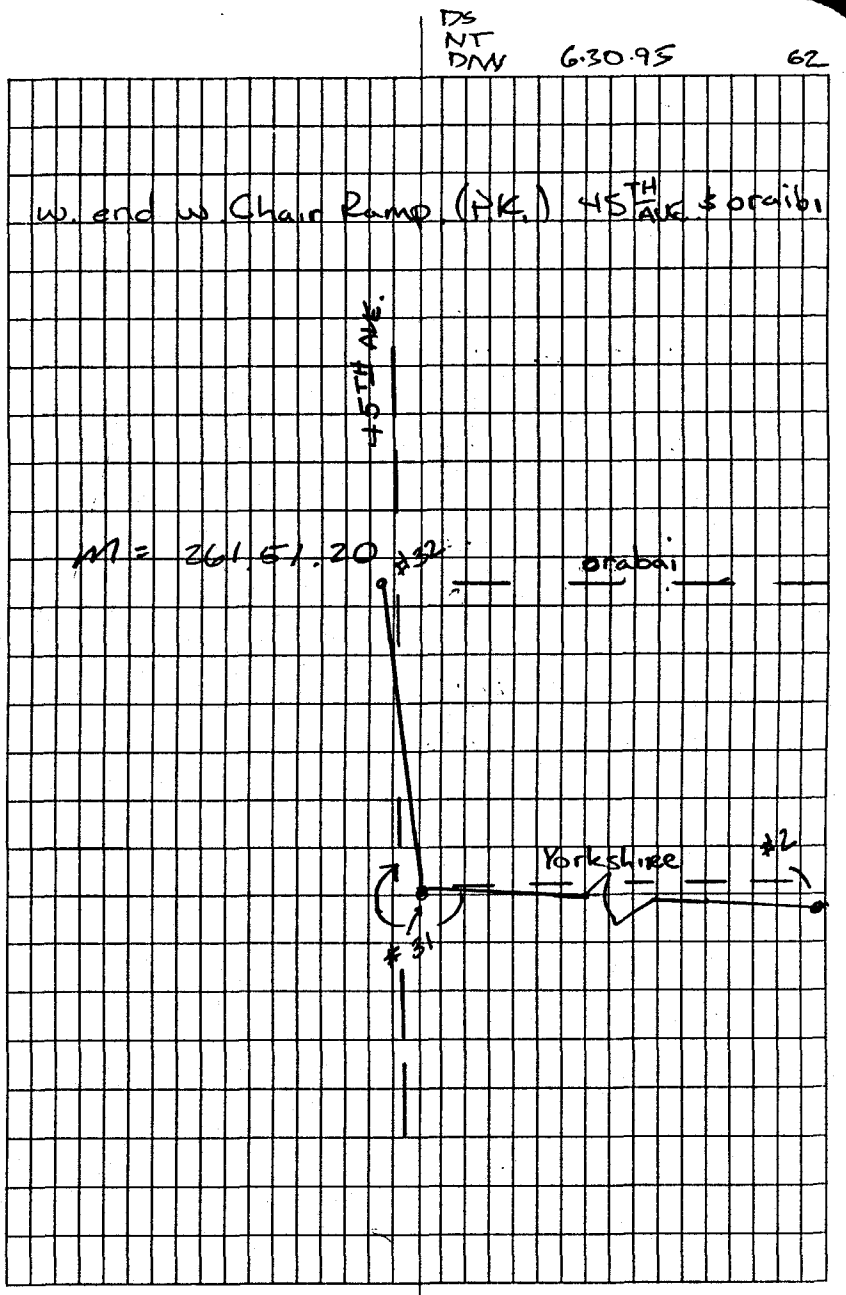
"PK" & wheel chair Ramp 45TH AVE. & Yorkshire



DS
NT
DNW 6.30.95 62

TC 31

BS 2	0.00.20		
FS 32			
D	0.00.20	0.00.19	
D	0.00.17		
R	180.00.36	180.00.37	
R	180.00.38		
D	261 51 29	261 51 10	
R	81 52 08	261 51 31	
HD	31 to 2	1329.15	
	31 to 32	372.14	



	Re 32			
	B.S. 31	0.00.20		
	F.S. 33	100		
	D	0.00.20	0.00.12	
	D	0.00 03		
	R	180.00 43	180 00 42	
	R	180 00 41		
	D	94 34 47	94 34 35	
	R	274 35 27	94 34 45	
HD.	32-31	372.13	SP = 372.08	
	32-33	1087.94		

D.S.
INT
DM 6.30.95 63

(B.C.) 47TH AVE & Oraibi Panel Point.

M 94.34.40

#47

#33 100 ORAIBI

#32

#34.57

#31

DS
NT
DM 6.30.95 64

	T@ 33	100	
	BS, 32	0.00 20	
	ES, 34		
	D 0,00 20		0.00.19
	D 0.00 17		
	R 180 00 44		180.00 47
	R 180 ,00 49		
	D 183 02 53		183 02 34
	R 3 03 20		183 02 23
HD	33-32	1087.89	SP=~~1087.92~~ 1087.75
	33-34	795,89	

PK. NE. Cor 48TH & ORaibi B/C

N = 183 .02.29

48TH

47TH

ORABAI

100

	Te 34		
	B.S. 33	0.00.20	
	FS 35		
	D 0.00 20	0.00 18	
	D 0.00.16		
	R 180 00 53	180.00.53	
	R 180.00 52		
	D 244 19 14	244.18 56	
	R 64 19.46	244 18 53	
HD	34-33	795.84	SP= ~~795.87~~ 795.74
	34-35	748.82	

DS
NT
DM

65

6.30.95

NW. Cor 48TH AVE & TONTO Dr. PK'

M= 244.18.55"

TONTO

#35

#34

ORACAI

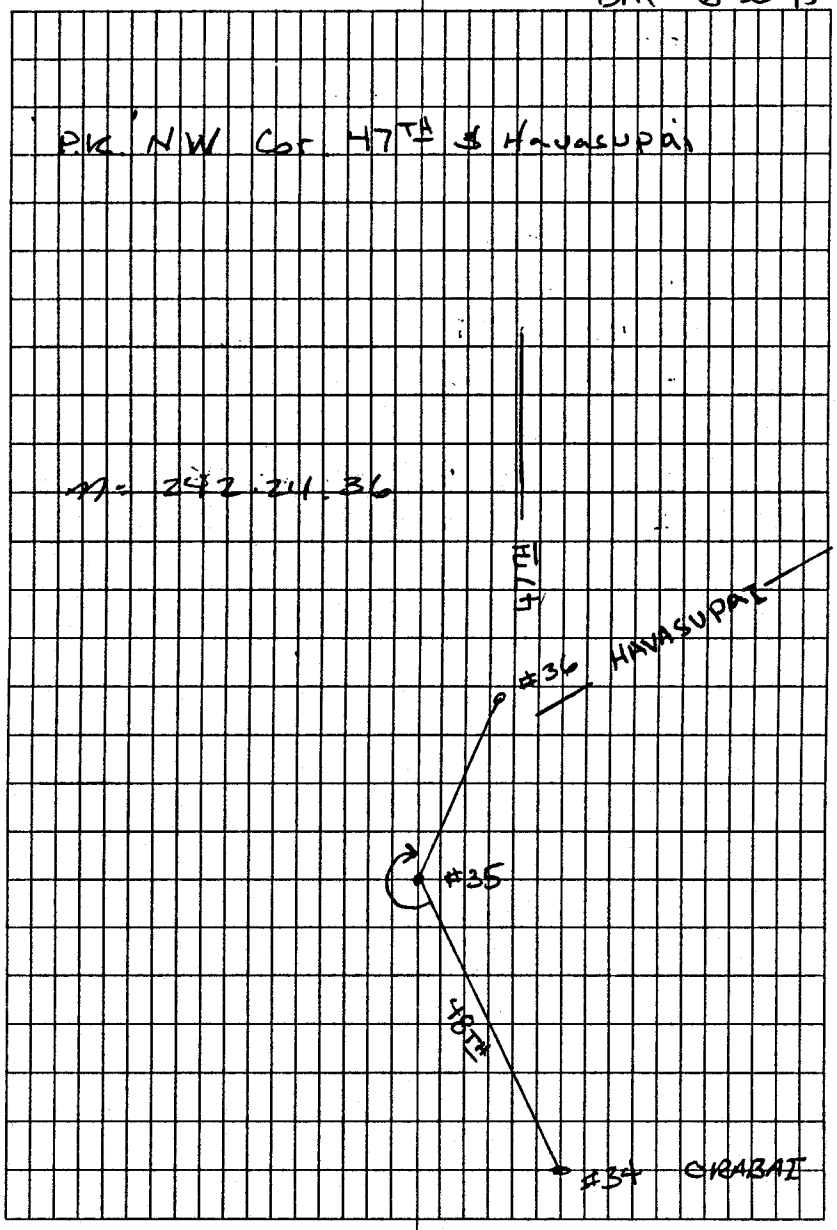
#33

100

DS
NT
DM 6.30.95

66

	T@ 35			
	BS. 34	0.00 20		
	FS. 36			
	D 0.00 20		0.00 19	
	D 0.00 17			
	R 180 00 45		180 00 42	
	R 180 00 38			
	D 242 24 49		242.24.30	
	R 62 25 23		242 24 41	
HD.	35-34	748.79	SP= ~~748.81~~	748.69
	35-36	424.59		

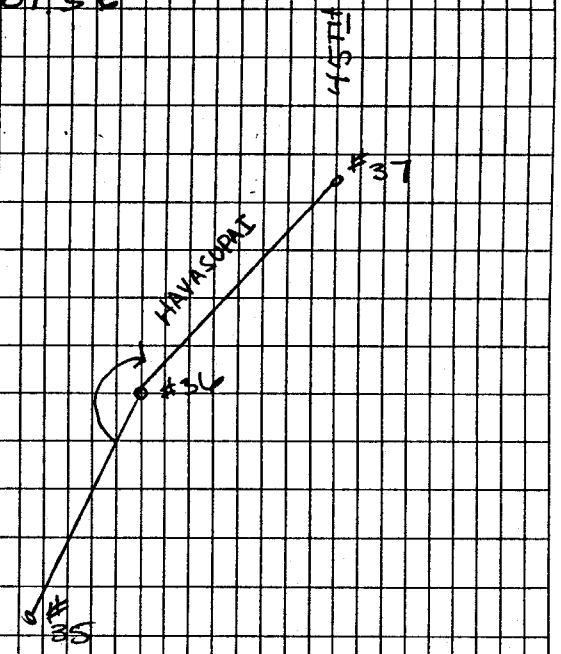


DS
NT
DM 6.30.95

	K @ 36			
	BS. 35	0.00 20		
	FS. 37			
	D	0.00 20	0.00 18	
	D	0.00 16		
	R	180.01.07	180.01.05	
	R	180.01.03		
	D	209 02 14	209.01 56	
	R	29 03 01	209 01 56	
HD	36-35	424.58	SP= ~~424.59~~	424.52
	36-37	628.92		

S.W. Cor. 45TH & Havasupai (P.K.)

PI = 209.01.56

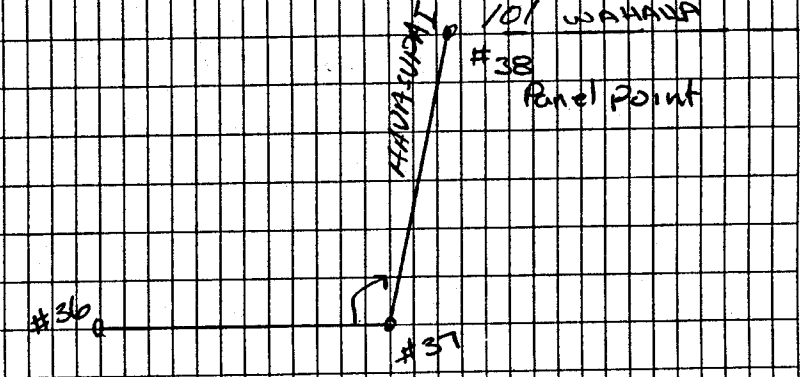


DS
NT
DMA 6.30.95

	RE 37			
	BS. 36			
	FS. 38	101		
	D 0.00.20		0.00.20	
	D 0.00.20			
	R 180.00.52		180 00 57	
	R 180 01.02			
	D 123 44 45		123 44 25	
	R 303 45 36		123 44 39	
HD	37-36	628.86	SP = ~~628.84~~	628.79
	37-38	291.88		

Panel Point B.C. Flush WAHALUA
Havasupai

M = 123.44.32

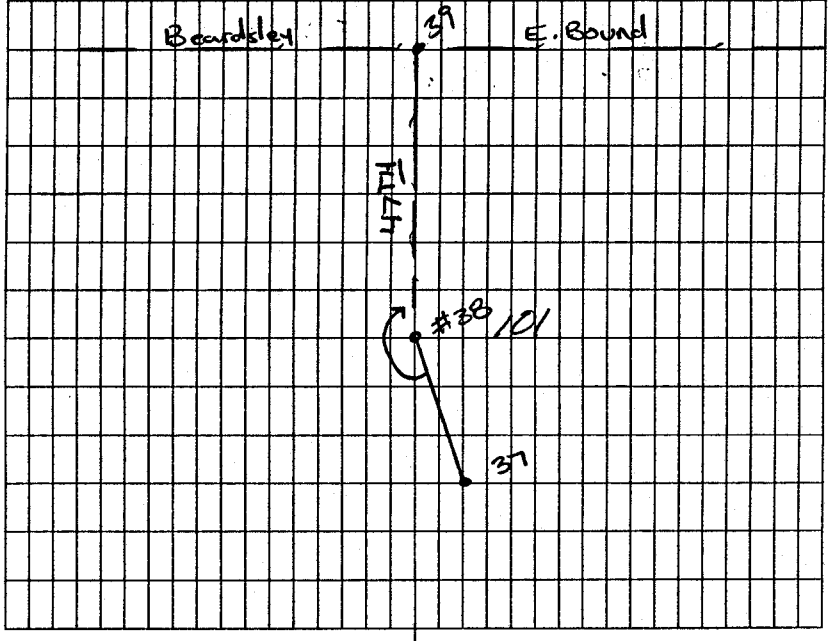


DS
NT
DM 6.30.95

	TP 38	101	
	BS. 37	0.00 20	
	FS. 39		
	D 0.00 20		0.00 21
	D 0 00. 22		
	R 180	01.02	180 01 02
	R 180	01.01	
	D 222	15 03	222 14. 42
	R 42.	15.49	222 14 47
HD	38-37	291.83	GP ~~291.86~~ 291.81
	38-39	1145.33	

Nail So. side Beardsley

m = 222.14.45



DS
NT
DM 6.30.95

	T@ 39			
	B.S. 38	0	00 20	101
	F.S. 40			
	D @ .00.20		0.00 18	
	D 0.00 15			
	R 180 01 09		180 01 06	
	R 180 01.02			
	D 217 45 14		217 44.56	
	R 37 46 04		217 44 58	
HD	39-38	1145.32	SP 1145.14	
	39-40	1678.68		

SW Cor 43rd & Beardsley

M= 217 44 57

43rd

Beardsley

#40

#39

101

DS
NT
DM 6.30.95

71

	TE 40			
	BS 39	0.00 20		
	FS 03			
	D	0.00 20	0.00 23	
	D	0.00.25		
	R 180	01 11	180 01 10	
	R 180	01.08		
	D 267	06 19	267 05 56	
	R 87	07 02	267 05 52	
HD.	40-39	1678.66	SP 1678.40	
	40-03	1031.04	SP 1030.88	

Panel Point

267 05 54

#39

#40

#3

Behrend.

15

#	+	HI	−	ELEV.
B.M.	5.45	1323.70		1318.25
TP-1			6.24	1317.46
	4.72	22.18		
TP-2			6.58	1315.60
	7.73	23.33		
TP-3			11.51	1311.82
	5.05	16.87		
TP-4			6.59	1310.28
	3.76	14.04		
TP-5			6.80	1307.24
	4.51	11.75		
TP-6			7.05	1304.70
	8.25	12.95		
TP-7			4.19	1308.76
TP-7	6.69	15.45		
TP-8			5.06	1310.39
	5.31	15.70		
TP-9			4.90	1310.80
	7.38	18.18		
TP-10			2.92	1315.26
	5.55	20.81		
TP-11			4.75	1316.06
	6.19	22.25		
TP-12			6.10	1316.15
	5.98	22.13		
			6.52	1315.61

N.T. Level Loop for Panel Points. 72
D.M. 7/10/95

T.P. SE. Corner 43rd. & Yorkshire. Bk-1 Pg 54

(W) T/C 100' ± w. of 44TH AVE & Yorkshire

TP 31 45TH & Yorkshire T/C NE Cor & Ramp.

(N) T/C w. End D/w west Entrance shadow Mnt. ELEM. School.

Panel point 47TH AVE & ORAIBI (100)

(N) T/C Add. 4742 w. ORAIBI

E. T/C Add. 19659. N. 48TH

PK Top wall @ Ref. TP #36 47TH LN & Hawasupai

TP 37 46TH AVE. & Hawasupai SW. Cor.

Panel point E. Wahalla & Hawasupai (101)

E. end prop. So. T/C 4547 w. Wahalla

E. T/C Add. 19847 N Wahalla.

W T/C 300' ± So. of Behrend & 45TH AVE.

TP-2 NE. Cor. 45TH AVE Yorkshire

#	+	HI	−	EL.	
	6.48	22.09			
TP-1			4.61	1317.48	
	6.64	24.12			
BM.			5.86	1318.26	1318.25

N.T. Level Loop
D.M. 7/10/95 73

TRAV. Point #2 43rd & Yorkshire

TIE 5

BS 4

FS 5A 305

D1 0-00-30 0-00-31

D2 0-00 32

R1 180-01-19 0-00-20

R2 180-01-21

D1 118-30-17 118-29-46 M = 118-29-49

R1 298-31-12 118-29-52

HD 5-5A = 1322.21

CMS X 40'N of Rotten Brick TIC on 30th Ave.

SP = 1321.99

7/17/95

75

BC WDR N. Punch @ 35° Rad @ DV

SP = 1321.99

π @ SA 305

BS S

FB GA 306

D1 0-00-30 → 0-00-30

D2 0-00-30

R1 180-01-02 180-01-03

R2 180-01-04

D1 178-21-A4 178-21-14 178-21-16.5

R 358-22-22 178-21-19

HD SA-5 = 1322.20 HD = 1322.205

HD SA-GA = 2645.37

7/17/95
MK
DAS

REGA	306	
BS SA	305	
FS 7A	307	
D1	0-00-30	0-00-30
D2	0-00-29	
R1	180-01-16	180-01-15
R2	180-01-14	
D1	271-34-37	271-34-07 M 271-34-01
R1	91-35-10	271-33-55
HD	GA-SA = 2645.38	M = 2645.375
HD	GA-7A = 2645.48	

S side AV e 31st Ave

SP = 2644.95

7-17-95

77

	PC 7A	307		
	BS 6A	306		
	FS 73.	313		
	D1	0-60-30	0-00-31	
	D2	0-00-31		
	R1	180-01-05	180-00-05	
	R2	180-01-04		
#13	D1	177-59-53	177-59-22	
	R1	358-00-28	177-59-23	M = 177-59-22.5
	HD 7A-6A : 2645.50			M = 2645.49
	HD 7A-13 = 2655.15			
	PC 7M			
	BS 6A			
	FS 10			
	D1	269-12-41	269-12-10	
#10	R1	89-13-15	269-12-10	M = 269+12-10
	HD 7A-10 = 2945.39			

SP = 2645.07

7/17/95

At 13

BS 7A

FS 14

D1 0-00-30 M = 0-00-31

D2 0-00-32

R1 180-01-14 M = 180-01-16

R2 180-01-18

D1 188-22-26 188-21.55

R1 8-23-14 188-21.58

HD 13-7A = 2655.12 M = 2655.13.5

HD 13-14 = 1425.84

M = 188-21-56.5

SP = 2653.71

T@ 4
BS 5
FS NAIL 38+4 & BENCHMARK 50

D1 0-00-30 } 0-00-29
D2 0-00-28
R1 180-01-13 } 180-01-13
R2 180-01-13

D1 114-24-04 - 114-23-35
R1 294-24-40 - 114-23-27

HD - 1446.38 SP 1446.15

T@ NAIL 50
BS 4
FS 103 B/C 37+4 & BENCHMARK

D1 0-00-30 } 0-00-34
D2 0-00-38
R1 180-01-14 } 180-01-12
R2 180-01-10

D1 94-01-11 - 94-00-37
R1 274-01-53 - 94-00-41

HD 880.58 HD to 4 1446.38
M = 1446.38

M = 114-23-31

M = 94-00-39

80 7-19-95

		MK DS	DM
T @ 103			
BS	NAIL 50		
51 FS	PK 50' +/- to Brandsky on 37th Ave E. Side		
D1	0-00-30		
D2	0-00-32	0-00-31	
R1	180-01-07		
R2	180-01-09	180-01-08	
D1	89-51-32	- 89-51-01	
R1	269-52-04	- 89-50-56	89-50-58
TO P.K. HD	1254.68	HD TO NAIL 880.57 M = 880.575	
T @ PI 51			SP 880.43
BS	103		
FS	4		
D1	0-00-30		
D2	0-00-28	0-00-29	
R1	180-01-11		
R2	180-01-09	180-01-10	
D1	101-02-38	- 101-02-09	
R1	281-03-22	- 101-02-12	101-02-10
HD. to 4	996.35	SP = 996.19	
HD to 103	1254.68	M = 1254.68	
			SP = 1254.48

Closing & SEE Pg 49

INDEX OF CURVE AND REDUCTION TABLES

APPENDIX E

KHE Response Letters To FEMA Comments

Dated July 6, 1994

KAMINSKI HUBBARD
engineering inc.
SURVEYING • CIVIL • HYDROLOGY

Daniel L. Kaminski, P.E., R.L.S.
James O. Hubbard, P.E.

July 6, 1994

Mr. William R. Locke
Chief, Risk Studies Division
Federal Insurance Administration
Federal Emergency Management Agency
500 C Street, S.W.
Washington, D.C. 20472

Re: Scatter Wash Watershed
Arizona Canal Diversion Channel
Area Drainage Master Study
Phase I, Hydrology Report

Dear Mr. Locke:

We are addressing comments received from the Federal Emergency Management Agency (FEMA) in a letter dated November 15, 1993 to Raymond Acuna, Floodplain Management Engineer, City of Phoenix, concerning the report entitled "Scatter Wash Watershed, Arizona Canal Diversion Channel, Area Drainage Master Study, Phase I, Hydrology Report," prepared by Kaminski-Hubbard Engineering, Inc. Our response to FEMA's comments are presented below.

Segmentation of Scatter Wash into Sub-Basins

The delineation of the Scatter Wash Watershed east of Interstate 17 (I-17), north of Williams Drive and downstream of the Central Arizona Project Canal (CAPC) into nine sub-basins was developed using 1 inch to 400 feet topographic mapping flown as a part of this study. This new topographic mapping had 2 foot contour intervals which allowed us the opportunity to develop concentration points at meaningful locations such as major street intersections, impoundment areas and stream confluences. This topographic detail was not available on U.S.G.S. 7.5 minute quadrangle maps, which was used for the original U.S. Army Corps of Engineers (USACE) Scatter Wash delineation. We are submitting separately, our 1 inch to 400 feet hydrologic work maps (Sheets 48, 49, 57-61, 61A, 71-74, 87 and 88) for your review as supportive documentation for the Scatter Wash sub-basin delineation for existing conditions.

The Scatter Wash Watershed sub-basin delineation was similar to Greiner's delineation in the report entitled, "Scatter Wash Drainage and Storm Drain Study, Conceptual Plan, Volumes I and II," prepared for the City of Phoenix Engineering Department, Floodplain Management. The Greiner sub-basin delineation was also followed in a report submitted to the Flood Control District of Maricopa County (FCDMC) entitled "Skunk Creek, Between Arizona Canal Diversion Channel & Central Arizona Project, Hydrology Report," dated November 9, 1990 by Coe and Van Loo Consulting Engineers, Inc. Our intent was to be consistent with previous sub-basin delineations in the Scatter Wash Watershed in order to compare peak discharge results at similar locations.

The delineation of Sub-Basin Nos. 316 and 319 were developed to determine the magnitude of storm runoff impacting Happy Valley Road west of 19th Avenue and at its intersection with 19th Avenue. The magnitude of flows at these locations will allow the City of Phoenix an opportunity to size future storm drainage facilities to accommodate a desired storm frequency. Sub-Basin No. 323 is an area that contributes to an existing detention basin located at the northeast corner of Pinnacle Peak Road and 19th Avenue. Sub-Basin No. 325 was developed to determine the magnitude of flow contributing to a dip section along 19th Avenue just south of Pinnacle Peak Road.

The effects of interconnected flows between adjacent sub-basins is minimal because flows will re-converge in the next downstream sub-basin. Our HEC-1 model was developed for storm water planning purposes, and therefore, greater detail was placed on subdividing the watershed when compared to previous studies. Our intent was to develop an estimated peak discharge contributing to major streets and street intersections based on existing conditions for future storm water management planning purposes.

HEC-1 Model Parameters

As a consultant working for the Flood Control District of Maricopa County, we were directed to use the "Drainage Design Manual for Maricopa County, Arizona, Volume I, Hydrology" (hereinafter referred to as the "Hydrology Manual"), to determine the rainfall-runoff parameters for the Scatter Wash Watershed. The "Hydrology Manual" was prepared by the Special Projects Branch, Hydrology Division, Flood Control District of Maricopa County and George V. Sabol Consulting Engineers, Inc. to establish a common basis for drainage management in all jurisdictions within Maricopa County.

We also reviewed the "Documentation/Verification Report for the Drainage Design Manual for Maricopa County, Arizona, Volume I, Hydrology," as prepared by George V. Sabol Consulting Engineer, Inc. and the Flood Control District of Maricopa County for additional information concerning the development and technical justification for the procedures in the "Hydrology Manual". This report also presents a summary of the testing and verification analysis for the hydrologic methodology to assure a reasonable degree of hydrologic accuracy.

The report entitled "S-Graph Study, Contract FCD 86-36," as reported by George V. Sabol Consulting Engineers, Inc. for the Flood Control District of Maricopa County was reviewed for technical support in the determination of S-Graph parameters. A review of the U.S. Geological Survey, Water Resources Division report "Estimated Manning's Roughness Coefficients For Stream Channels and Floodplains in Maricopa County, Arizona," that was prepared for the Flood Control District of Maricopa County was undertaken to develop an understanding of the effects different storm magnitudes have on the hydraulic efficiency of a watershed. These two reports were integral in estimating the watershed resistance coefficient for all channels within a sub-basin when estimating the sub-basin lag time parameters.

If further discussion is necessary concerning the hydrologic methodology, please contact Amir Motamedi, Flood Control District of Maricopa County, at (602) 506-1501. Mr. Motamedi will shortly submit a written discussion concerning the Kaminski-Hubbard Engineering results for Scatter Wash and their acceptance of our results.

Rainfall Depth and Distribution

As recommended in the "Hydrology Manual", the 100-year 24-hour duration point rainfall depth of 4.00 inches was obtained from NOAA Atlas isopluvial maps for Maricopa County. This point rainfall depth was approximately centered in the Scatter Wash Watershed. As directed by the Flood Control District of Maricopa County, the SCS Type II rainfall distribution for the 24-hour duration storm was used.

The desired rainfall depth-drainage area relationship for the Scatter Wash watershed was developed using the JD Record for the HEC-1 Input Description. A total of five rainfall depth - drainage area pairs were included in the HEC-1 simulation model. These rainfall depth - drainage area pairs were recommended by the Flood Control District of Maricopa County. This revision was made to the original HEC-1 model to address the FEMA comment concerning the rainfall depth and area distribution relationship.

Loss Rate Estimation

The principal method recommended in the "Hydrology Manual" for the estimation of rainfall losses in Maricopa County is the Green and Ampt infiltration equation along with a surface retention loss. Surface retention loss values for various land uses and surface cover conditions in Maricopa County are recommended in the "Hydrology Manual."

The application of the Green and Ampt Method is presented in the "Hydrology Manual." To increase the reproducibility of the procedure, the equivalent XKSAT for various mapping units in Maricopa County are listed in Appendices A, B, and C of the "Hydrology Manual." These equivalent XKSAT values were logarithmically areal-averaged for each of the major and minor soils in a mapping unit. The rainfall loss selection procedure is discussed in depth in the report entitled "Documentation\Verification Report for the Hydrology Manual."

Detention and Diversion of Flows

Pinnacle Peak Road & I-17 (HEC-1 I.D. 314RR)

The Pinnacle Peak Road embankment east of I-17 was found to act as a detention structure based on a hydraulic analysis performed by Greiner, Inc. for the City of Phoenix. The double 8'x7' concrete box culverts under Pinnacle Peak Road were inadequate to convey the a 100-year peak discharge. Flows in excess of culvert capacity pond north of Pinnacle Peak Road and eventually overtop the road.

In Appendix A, we are submitting the City of Phoenix 1 inch to 100 feet topographic mapping for the area along with the original computations performed by Greiner, Inc. to determine the stage-storage-discharge relationship. These calculations were verified by Kaminski-Hubbard Engineering (KHE) and incorporated into our hydrology model.

Pinnacle Peak Road & 19th Avenue (HEC-1 I.D. 323RR)

The embankment northeast of Pinnacle Peak Road and 19th Avenue was found to function as a detention structure based on 1 inch to 400 feet topographic mapping and field reconnaissance. This structure was found inside of the western banked portion of a test track facility. The basin was drained through 3-16"x25" corrugated metal pipe arch culverts. This basin was found to collect the 100-year peak discharge without overtopping south along the road track facility. In Appendix B, we are submitting 1 inch to 400 feet topographic mapping and stage-storage-discharge calculations for this detention facility.

Double 8'x7' CBC (HEC-1 I.D. 322RR)

Significant ponding was found to occur behind the double 8'x7' CBC located approximately 0.25 miles north of Williams Drive. Greiner, Inc. analyzed the hydraulic characteristics of the box culverts and determined that there were two overflow areas: one to the south along I-17 and one to the west, across the I-17 frontage road. Separate rating curves were developed for the culverts and both overflow weirs. The HEC-1 flow diversion option was used to divert the weir overflows southward and westward. The south weir was diverted first before the west weir.

In Appendix C, we are providing the City of Phoenix 1 inch to 100 feet topographic mapping of the area and the original computations performed by Greiner, Inc. to determine the various rating curves. These calculations were verified by KHE and included within our hydrologic model.

I-17 & Deer Valley Road Interchange (HEC-1 I.D. 332RR)

The I-17 and Deer Valley Road interchange was modelled as a detention basin. Storage volume within the depressed interchange was determined using City of Phoenix 1 inch to 200 feet topographic mapping. A stage-discharge relationship was developed to determine the breakout flows from the depressed section. Surveys were developed along an approximate weir overflow section west of and southwest of the interchange to determine the breakout flows.

In Appendix D, we are submitting the City of Phoenix topographic mapping of the interchange, which also shows the approximate location of the overflow weir section. We are also including our stage-storage-discharge calculations for your review. The ADOT pumping station was previously analyzed by another consultant in the report "I-17 Drainage Design Study" which determined that the pump would fail during the 100-year storm event. Therefore, pumping from the depression was not considered.

Detention Basin D (HEC-1 I.D. 343RR)

Detention Basin D is located north of Rose Garden Lane just east of I-17 and was constructed as part of the Outer Loop Highway off-site drainage plan to provide up to 100-year flood protection. Detention Basin D collects runoff from a drainage area north of Rose Garden Lane and west of 19th Avenue. This basin was not completed at the time of aerial mapping.

In Appendix E, we are submitting as-built drawings for Detention Basin D (Sheets 90 and 91 of 206) and stage-storage-discharge parameters as technical support. The detention basin parameters were obtained from the report entitled "Final Drainage Report, Outer Loop Highway Section 6 (OLH/I-17 Interchange), Phase II," prepared July, 1989 by CRS Sirrine, Inc.

We are submitting as-built drawing, Sheet 80 of 206, for a 78-inch storm drain along Rose Garden Lane which collects runoff from a sump south of 23rd Avenue and outfalls into Detention Basin D. We are also submitting as-built drawings (Sheets 81-84) for the I-17 mainline storm drain that conveys outflow from Detention Basin D and collects pavement drainage from the I-17 East Frontage Road. This storm drain eventually outfalls into the Outer Loop Highway Interceptor Drain.

Detention Basin C (HEC-1 I.D. 344RR)

Detention Basin C is located at the northeast corner of 35th Avenue and Beardsley Road. This basin was constructed to limit the 100-year peak discharge into Scatter Wash from Outer Loop Highway Improvements to pre-existing conditions. The Interceptor Drain will discharge flow in excess of 250 CFS into Detention Basin C using a side flow weir. The detention basin has a 33-inch orifice outlet.

This basin was not completed at the time of aerial mapping. In Appendix F, we are submitting construction drawings for Detention Basin C (Sheet 102 thru 105 of 235) as support. These drawings have yet to be as-builted and are the latest information. The stage-storage-discharge relationship for Detention Basin C was obtained from the report entitled "Drainage Report, Scatter Wash Hydrology and Outer Loop Highway Interceptor Drain, 39th Avenue to 7th Street," prepared November, 1989 by DeLeuw, Cather and Company.

Interceptor Drain for the Outer Loop Highway

The Interceptor Drain for the Outer Loop Highway will collect and convey storm runoff from the north through a series of detention basins, channels and closed conduits to Scatter Wash. The Interceptor Drain System was designed for the 100-year 24-hour duration storm. The Interceptor Drain has been completed from Scatter Wash to I-17 and will extend further east in the near future.

In Appendix G, we are submitting as-built drawings for the Interceptor Drain beginning just west of 33rd Avenue and continuing east to I-17. These drawings were obtained from two sets of construction plans. Sheets 60 thru 62 of 165 were construction plans for the open channel portion and Sheets 77 thru 79 of 206 were for the closed conduit portion.

Deer Valley Road at 19th Avenue Diversion (HEC-1 I.D. 341D)

A flow split location was found to occur at the intersection of Deer Valley Road and 19th Avenue. A valley gutter runs through the northern half of this intersection conveying low flows west along Deer Valley Road. However, based on field surveys of the intersection, the northern half street capacity of Deer Valley Road was calculated to be approximately 70 CFS. Once the capacity is exceeded, flow breaks out southerly along 19th Avenue to Beardsley Road.

In Appendix H, we are submitting our half street capacity calculations for Deer Valley Road for your review. It was assumed that 40% of the flow greater than the half street capacity continued westerly along Deer Valley Road and 60% proceeded southerly along 19th Avenue. This assumption was based on the fact that the majority of flow reaching this intersection comes from the north and therefore, would require more energy to turn 90 degrees right to proceed west along Deer Valley Road than to proceed south along 19th Avenue.

Detention Basin at I-17 & Beardsley Road

A small detention basin at the northeast corner of I-17 and Beardsley Road collects runoff west of 19th Avenue, south of Rose Garden Lane, east of I-17, and north of Beardsley Road. After the aerial mapping was flown for this area, construction of the new I-17 East Frontage Road associated with the Outer Loop Highway improvements resulted in the regrading of the existing detention basin. The new stage-storage-discharge relationship was obtained from the report entitled "Drainage Report, Scatter Wash Hydrology and Outer Loop Highway Interceptor Drain, 39th Avenue to 7th Street," prepared November, 1989 by DeLeuw, Cather and Company.

Storm runoff in excess of the basin capacity will overflow into the Beardsley Road and I-17 interchange. This occurrence will continue until the Outer Loop Highway improvements are completed in this area, which includes a detention basin at the northwest corner of 19th Avenue and Beardsley Road.

Central Arizona Project Canal

A number of concrete and steel pipe overchutes convey upstream runoff across the CAP Canal in the Scatter Wash Watershed. The Bureau of Reclamation provided Kaminski-Hubbard Engineering, Inc. with locations and pipe geometry data as well as stage-storage data for the ponding area behind the overchute inlets. The Bureau developed only one stage-storage-discharge relationship for the entire ponding area behind the canal embankment through the study area.

Based on the sub-basin delineation contributing to each pipe overchute upstream of the CAP Canal, volume calculations were developed using 1 inch to 200 feet topographic mapping. We are submitting separately, the 1 inch to 200 feet topographic work maps used to generate water surface areas for volume calculations. The stage-storage-discharge tables are presented in the original drainage report.

In closing, the Greiner inflow hydrograph peak of 2,383 cfs at the Deer Valley Road interchange was developed using a simulation interval of two minutes and number of ordinates of 300, which resulted in a total simulation time of approximately 10 hours. The total simulation time (number of ordinates times the simulation interval) must be long enough to go to the end of the duration of the rainfall. If not, the total depth of rainfall is distributed into the precipitation pattern that occurs during the simulation period, which results in more intense rainfall than desired.

We took the Greiner HEC-1 data input file and increased the number of ordinates to 1000 using the Large Array Version of HEC-1. This revision results in a hydrograph peak of 856 cfs at the Deer Valley Road Interchange and outflow hydrograph peak of 529 cfs. These results are comparable to the KHE peak discharge results of 703 cfs into the interchange and outflow of 348 cfs.

This concludes our response to comments received from FEMA concerning the hydrologic analysis performed for the Scatter Wash Watershed. We are submitting an updated HEC-1 data file for the 100-year 24-hour storm event to address revisions made to the stage-storage-discharge relationship for the Deer Valley Road Interchange and corrections to the rainfall depth-area reduction relationship. If you have any questions or require any additional information, please call me.

Very truly yours,

KAMINSKI-HUBBARD ENGINEERING, INC.

Darryl L. Bradley

Darryl L. Bradley, P.E.

APPENDIX A

Detention Structure At Pinnacle Peak Road & I-17

HEC-1 I.D. 314RR

E 440000

E 441000

680
1425.7

1421

(Interpolated)

1420

1421

1420

N 9

1420

1420

(I-17) INTERSTATE 17

PINNACLE PEAK ROAD

1430

1420

1420

1410

2-8'x7' CBC

HEC-1 I.D. 314RR

2-8'x7' CBC Under
Pinnacle Peak Road
East of I-17

1420

N 9

1410

E 440000

E 441000

688
1420.2
E 441793.87
N 981613.99

NOTE:
MAP HAS BEEN COMPUTER GENERATED FROM DTM DATA COLLECTED ON 50' GRIDS.
CONTOURS HAVE BEEN INTERPOLATED USING GWN SYSTEMS INC. SOFTWARE.
ONLY FOUND QUARTER CORNERS HAVE X,Y AND Z COORDINATES SHOWN.
COORDINATES BASED ON NAD 27.

CITY OF PHOENIX
45-23

SCALE 1"= 100' CONTOUR INTERVAL 2'
GRID TO GROUND FACTOR 1.00016355
DATE FLOWN: 10-29-90
KENNEY AERIAL MAPPING INC.

Greiner

Greiner Engineering Sciences, Inc.

Tucson 602 887-1800
Phoenix 602 275-5400

Job E171134 SCATTER WASH

Description STAGE - STORAGE
2-8x7 RCBC UNDER PINNACLE PEAK RD.

Calculated by RHF Date 2-28-89 Sheet No. 1

Checked by _____ Date _____ of 3

STAGE (FT.)	PLANIMETER READING (IN^2)	AVERAGE READING (IN^2)	AREA (Ac)	VOLUME (Ac-FT)	STORAGE VOL. (Ac-FT.)
1411	Ø	Ø	Ø		Ø
				0.048	
1412	0.403 0.837 1.240	0.413	0.095		0.048
				1.121	
1414	4.464 9.021 13.408	4.469	1.026		1.169
				7.881	
1416	29.653 59.691 89.575	29.858	6.855		9.050
				26.583	
1418	86.025 85.886 85.901	85.937	19.728		35.633
				58.849	
1420	170.516 170.392 170.330	170.413	39.121		94.482
				44.869	
1421	220.411 219.992 221.062	220.488	50.617		139.351

1" = 100'

LOW PT. ACTUALLY 1417.60
WEIR LENGTH = 265' @ 1418.0
WEIR LENGTH = 772' @ 1420.0
WEIR LENGTH = 1000' @ 1421.0

} REFER TO COMPUTER PRINTOUT FOR WEIR RESULTS

Greiner

Greiner Engineering Sciences, Inc.

Tucson 602 887-1800
Phoenix 602 275-5400

Job E171134 SCATTER WASH

Description STAGE DISCHARGE
2-8'x7' RCBC UNDER PINNACLE PEAK RD

Calculated by RHF Date 2-28-89 Sheet No. 2

Checked by _____ Date _____ of 3

ELEVATION (FT.)	HW (FT.)	D (FT.)	HW÷D (FT.)	INLET Q (cfs)	OUTLET Q (cfs)	CONTROL Q (cfs)
1411	Ø	7	Ø	Ø	Ø	Ø
1412	1	7	0.14	42	—	42
1414	3	7	0.43	254	—	254
1416	5	7	0.71	528	—	528
1418	7	7	1.00	864	880	864
1420	9	7	1.29	1152	1210	1152
1421	10	7	1.43	1296	1330	1296

Greiner

Greiner, Inc.
Tucson 602 887-1800
Phoenix 602 275-5400

Job E171134 SCATTER WASH
Description STAGE - VOLUME - CULVERT - QUEIR
2-8x7 RCBC UNDER PINNACLE PEAK RD.
Calculated by EHF Date 3-2-89 Sheet No. 3
Checked by _____ Date _____ of 3

SE SV SQ

STAGE (FT)	STORAGE VOLUME (Ac-Ft)	CULVERT DISCHARGE (cfs)	WEIR * DISCHARGE (cfs)	TOTAL DISCHARGE (cfs)
1411	∅	∅	∅	∅
1412	0.048	42	–	42
1414	1.169	254	–	254
1416	9.050	528	–	528
1418	35.633	864	72	936
1420	94.462	1152	4126	5278
1421	139.351	1296	9105	10401

*REFER TO COMPUTER OUTPUT FOR WEIR RESULTS

1419 65 1024 1320 2344

Greiner Engineering Job No.

Computed by: RHF Checked by: _____ Date 2-28-89

ARIZONA DEPARTMENT OF TRANSPORTATION

CULVERT COMPUTATION RECORD

PROJECT: E171134 INLET CONTROL DESIGNER: RHF

STATION: PINNACLE PK. RD. DATE: _____

HYDROLOGIC AND CHANNEL INFORMATION

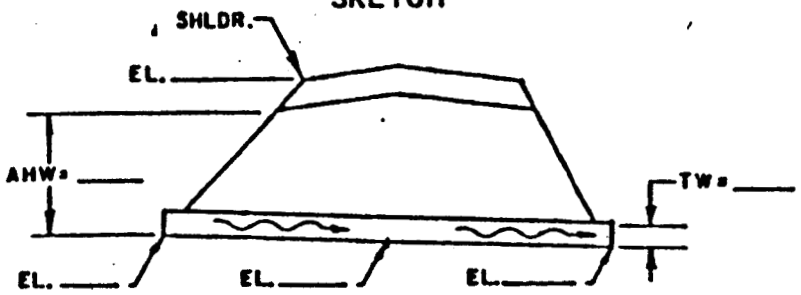
DRAINAGE AREA _____

Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25})
(Q_2 = CHECK DISCHARGE, SAY Q_{50})

SKETCH



S_o = 0.45% L = 75' L/100 S_o = 0.34

MEAN STREAM VELOCITY = _____

CULVERT DESCRIPTION				HEADWATER COMPUTATION														
				INLET CONT.		OUTLET CONTROL $HW = H + h_o - LS_o$												
SIZE	ENTR. TYPE	Q / 2Q	CAP. CHART HW	$\frac{HW}{D}$	HW	K_e	H	d_c	$\frac{d_c + D}{2}$	TW	h_o	LS_o	HW	CONTROL HW	OUTLET VELOCITY	COST	DHW ELEV.	COMMENTS
2-8x7 RCBC	45° WING.	21 / 42		0.14*	1	0.4												
		127 / 254		0.43	3	0.4												
		264 / 528		0.71	5	0.4												
		432 / 864		1.00	7	0.4												
		576 / 1152		1.29	9	0.4												
		648 / 1296		1.43	10	0.4												

SUMMARY & RECOMMENDATIONS

1 BOX / 2 BOXES

* AN $\frac{HW}{D}$ OF 0.14 IS LESS THAN THE CHART READS. THE Q WAS DETERMINED FROM $E_G = Y_c + (1+k_e)\left(\frac{V_c^2}{2g}\right)$

THROUGH SUBSTITUTION THE ABOVE EQUATION BECOMES:

$$E_G = \left(\tfrac{1}{g}\left(\tfrac{Q}{B}\right)^2\right)^{1/3} + \left(\frac{1+K_e}{2g}\right)\left(\frac{Q}{B}\right)^2\left(\left(\tfrac{1}{g}\left(\tfrac{Q}{B}\right)^2\right)^{1/3}\right)^{-2/3}$$

Greiner Engineering Job No.

Computed by: _____ Checked by: _____ Date _____

ARIZONA DEPARTMENT OF TRANSPORTATION

CULVERT COMPUTATION RECORD

PROJECT: _____

STATION: _____

OUTLET CONTROL

DESIGNER: RHF

DATE: 3-2-89

HYDROLOGIC AND CHANNEL INFORMATION

DRAINAGE AREA _____

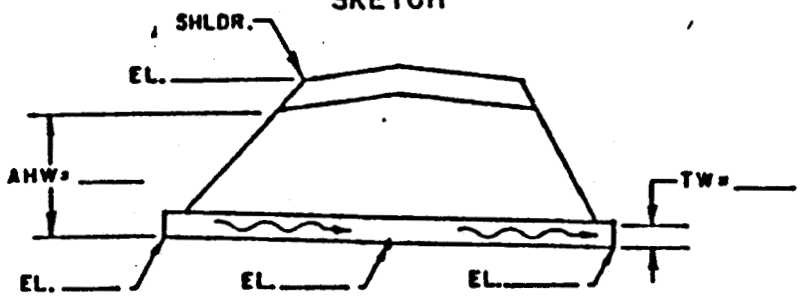
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

2.0'

(Q_1 = DESIGN DISCHARGE, SAY Q_{25})
(Q_2 = CHECK DISCHARGE, SAY Q_{50})

SKETCH



S_o = 0.45% L = 75' L/100 S_o = 0.34

MEAN STREAM VELOCITY = _____

CULVERT DESCRIPTION SIZE	CULVERT DESCRIPTION ENTR. TYPE	Q	CAP. CHART HW	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW = H + h_o − LS_o: K_e	H	d_c*	$\frac{d_c + D}{2}$	TW	h_o	LS_o	HW	CONTROL HW	OUTLET VELOCITY	COST	DHW ELEV.	COMMENTS
		X				0.4	X	0.7	3.85	Ø	3.85	0.34	1					
		X				0.4	X	2.0	4.50	Ø	4.5	0.34	3					
		X				0.4	0.24	3.2	5.10	Ø	5.1	0.34	5					
		440/880				0.4	1.54	4.5	5.75	—	5.8	0.34	7					INLET CONTROL
		605/1210				0.4	3.04	5.6	6.3	—	6.3	0.34	9					INLET CONTROL
		665/1330				0.4	3.74	6.1	6.6	—	6.6	0.34	10					INLET CONTROL

SUMMARY & RECOMMENDATIONS

$H = HW - h_o + LS_o$

* d_c BASED ON INLET CONTROL Q AND THEN ADJUSTED SUCH THAT OUTLET CONTROL Q = Y_c BY $Y_c = \sqrt[3]{\frac{1}{2}(9/5)^2}$

Sht _____ of _____

SESCALSESCALSESCALSESCALSESCALSESCALSESCALSESCALSESCALSESCALSESCALSESCALSESCAL

USER : RON FERGUSON

****

SCATTER WASH E171134: IRREGULAR WEIR RATING @ PINNICLE PK. RD.

****

IRREGULAR WEIR GEOMETRY
COEFFICIENT = 3.00

ELEVATION 1421.0 1420.0 1418.0 1417.6 1418.0 1420.0 1421.0

STATION 0.00 77.00 250.00 420.00 517.00 848.001000.00

WEIR FLOW ELEVATION-DISCHARGE CURVE

DISCHARGE	EG	DISCHARGE	EG
0.00	1417.60	12.66	1417.80
71.65	1418.00	207.39	1418.20
399.35	1418.40	647.66	1418.60
953.90	1418.80	1220.24	1419.00
1740.39	1419.20	2241.06	1419.40
2799.84	1419.60	3427.22	1419.80
4125.79	1420.00	4969.90	1420.20
5887.44	1420.40	6880.63	1420.60
7952.19	1420.80	9104.69	1421.00
10357.61	1421.20	11679.72	1421.40

El.	Q
1418	72
1420	4126
1421	9105

07:44:39 2-MAR-89

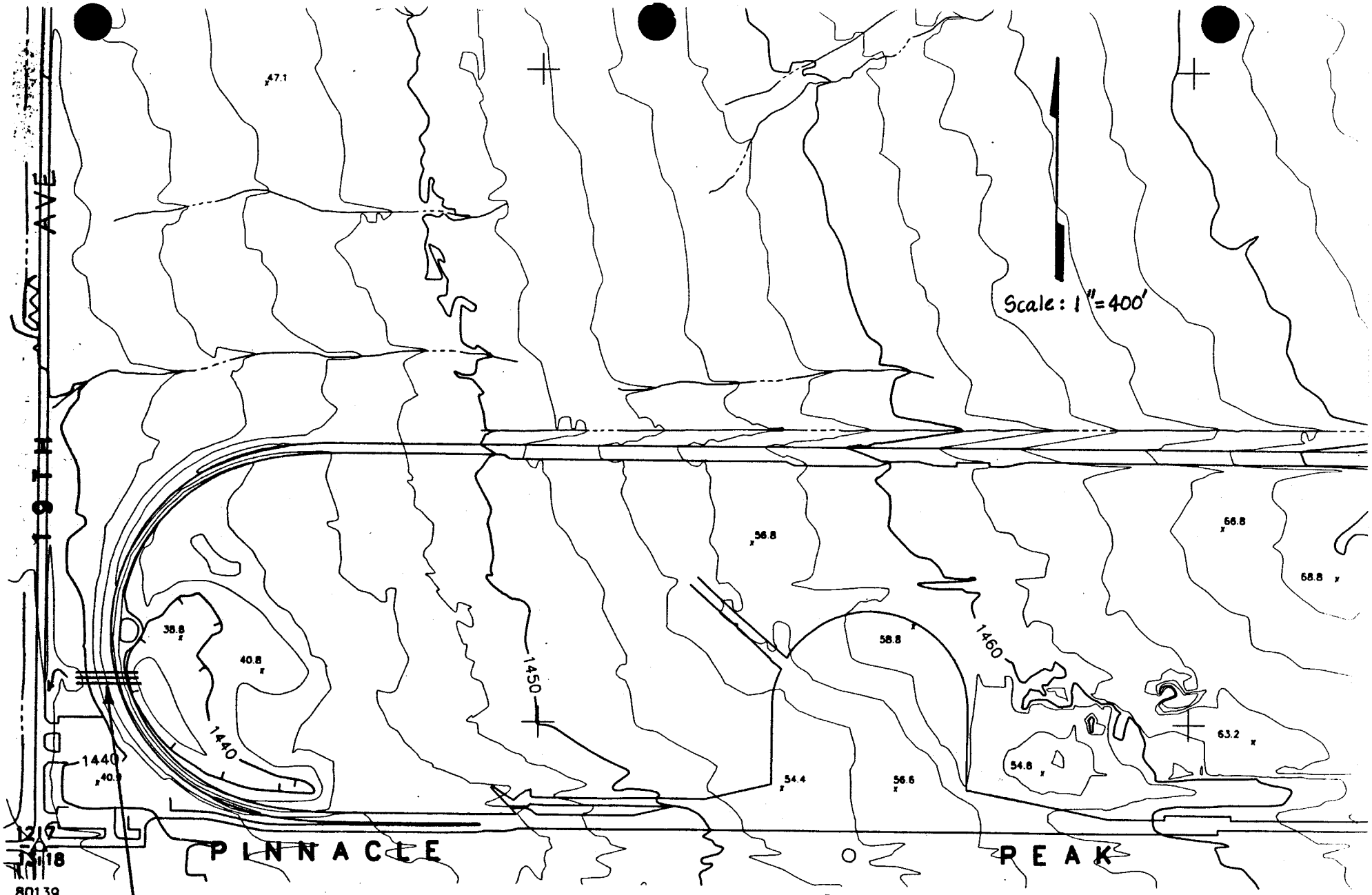
SESCALSESCALSESCALSESCALSESCALSESCALSESCALSESCALSESCALSESCALSESCALSESCALSESCAL

USER : RON FERGUSON

APPENDIX B

Detention Basin At Northeast Corner Of Pinnacle Peak Road & 19th Avenue

HEC-1 I.D. 323RR



Detention Basin at Northeast Corner of 19th Avenue & Pinnacle Peak Road

KAMINSKI HUBBARD engineering inc. • Surveying • Civil • Hydrology

Made by DLB	Date 1-8-92	Job No. 0146
Checked by	Date	Sheet No.
For HEC-1 I.D. 323RR		

STAGE-STORAGE VALUES FOR DETENTION BASIN AT THE NORTHEAST CORNER OF 19TH AVE. & PINNACLE PEAK RD.

Stage (Ft.)	Planimeter Reading (in^2)	Average Reading (in^2)	Area (Ac.)	Volume (Ac-Ft)	Storage Volume (Ac.-Ft.)
1436.10	ϕ	ϕ	ϕ		ϕ
				0.51	
	0.15				
1438	0.30	0.147	0.54		0.51
	0.44			3.34	
	0.77				
1440	1.53	0.763	2.80		3.85
	2.29			8.90	
	1.65				
1442	3.31	1.660	6.10		12.75
	4.98			16.58	
	2.86				
1444	5.70	2.853	10.48		29.33
	8.56			28.49	
	4.92				
1446	9.80	4.903	18.01		57.82
	14.71				

LOW LEVEL OUTLET

Diameter = 3 - 16" x 25" CMP Arch
Area = 3 x 2.2 ft^2 = 6.6 ft^2
Centerline Elevation = 1437.65
Coefficient of Discharge = 0.6
Exponent of Head = 0.5

SPILLWAY

Crest Elevation = 1445
Length = 100
Weir Coefficient = 3.0
Exponent of Head = 1.5

APPENDIX C

Double 8'x7' CBC At I-17 North Of Williams Drive

HEC-1 I.D. 322RR

INTERSTATE 17 (I-17)

PINNACLE PEAK ROAD

2-8'x7' CBC

2-8'x7' CBC Under
I-17 North of
Williams Drive

1" = 100'

HEC-1 I.D. 322RR

2-8'x7' CBC Under
I-17 North of
Williams Drive

Greiner

Greiner Engineering Sciences, Inc.
Tucson 602 887-1800
Phoenix 602 275-5400

Job E171134 SCATTER WASH
Description STAGE - STORAGE
2-8x7 RCBC UNDER I-17
Calculated by RHF Date 2-28-89 Sheet No. 1
Checked by _____ Date _____ of 3

STAGE (FT.)	PLANIMETER READING (IN^2)	AVERAGE READING (IN^2)	AREA (Ac)	VOLUME (Ac-FT)	STORAGE VOLUME (Ac-FT.)
1403.77	Ø	Ø	Ø		Ø
				0.001	
1404	0.047 0.093 0.140	0.047	0.011		0.001
				0.219	
1406	0.930 1.796 2.713	0.904	0.208		0.220
				0.942	
1408	3.209 6.371 9.595	3.198	0.734		1.162
				7.280	
1410	28.427 56.839 85.545	28.515	6.546		8.442
				8.556	
1411	45.958 92.055 138.074	46.025	10.566		16.998
				12.749	
1412	65.240 64.868 65.038	65.049	14.932		29.747
				19.006	
1413	100.595 100.425 100.570	100.530	23.079		48.753
				18.258	
1413.70	126.961 126.542 126.604	126.702	29.087		67.011
				8.726	
1414	—	—	29.087		75.737

WEIR CREST EL. = 1411.2
WEIR LENGTH @ 1412 = 40'
WEIR LENGTH @ 1413 = 235'
WEIR LENGTH @ 1413.7 = 280'

REFER TO COMPUTER PRINTOUT FOR WEIR RATING

Greiner

Greiner, Inc.
Tucson 602 887-1800
Phoenix 602 275-5400

Job E171134 SCATTER WASH
Description STAGE - DISCHARGE
7-6x7 RCBC UNDER I-17
Calculated by RHF Date 2-28-89 Sheet No. 6
Checked by _____ Date _____ of 6

ELEVATION (FT.)	HW (FT.)	D (FT.)	HW÷D (FT)	INLET Q (cfs)	OUTLET Q (cfs)	CONTRO Q (cfs)
1403.77	Ø	7	Ø	Ø	Ø	Ø
1404.00	0.23	7	0.03	13	—	1
1406.00	2.23	7	0.32	176	—	176
1408.00	4.23	7	0.60	414	—	414
1410.00	6.23	7	0.89	736	680	680
1411.00	7.23	7	1.03	896	880	880
1412.00	8.23	7	1.18	1072	1060	1060
1413.00	9.23	7	1.32	1184	1220	1184
1413.70	9.93	7	1.42	1296	1320	1296
1414.00	10.23	7	1.46	1312	1380	1312

Greiner Greiner, Inc.
Tucson 602 887-1800
Phoenix 602 275-5400

Job E171134 SCATTER WASH
Description STAGE - STORAGE · CULVERT & WEIR & TC
2-8'x7' RCBC AT I-17
Calculated by RHF Date 3-2-89 Sheet No. 3
Checked by _____ Date _____ of 3

SE SV SQ

STAGE (FT)	STORAGE VOLUME Ac.-Ft.	CULVERT DISCHARGE cfs	WEIR * DISCHARGE cfs	WEIR ** DISCHARGE cfs	TOTAL DISCHARGE (cfs)
1403.77	Ø	Ø	Ø	Ø	Ø
1404	0.001	1	—	—	1
1406	0.220	176	—	—	176
1408	1.162	414	—	—	414
1410	8.442	680	—	—	680
1411	16.998	880	—	—	880
1412	29.747	1060	31	—	1091
1413	48.753	1184	409	—	1593
1413.7	67.011	1296	1167	215	2678
1414	75.737	1312	1594	840	3746

* REFER TO COMPUTER PRINTOUT FOR WEIR RESULTS WEIR DIRECTING FLOW TO THE SOUTH

** REFER TO COMPUTER PRINTOUT FOR WEIR RESULTS WEIR DIRECTING FLOW TO THE WEST ACROSS THE FRONTAGE ROAD.

Greiner Engineering Job No.

Computed by: RHF Checked by: _____ Date 2-28-89

ARIZONA DEPARTMENT OF TRANSPORTATION

CULVERT COMPUTATION RECORD

PROJECT: E171134

STATION: SCATTER WASH @ I-10

INLET CONTROL

DESIGNER: RHF

DATE: 2-28-89

HYDROLOGIC AND CHANNEL INFORMATION

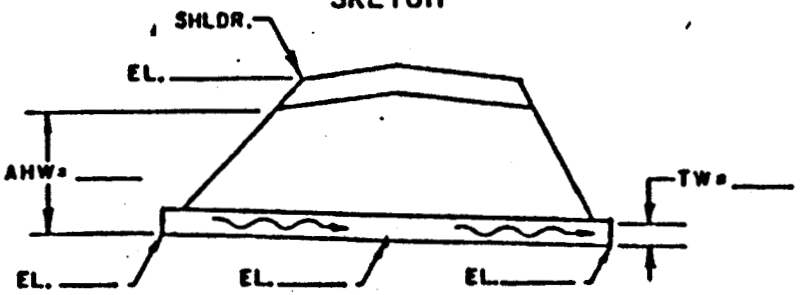
DRAINAGE AREA _____

Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25})
(Q_2 = CHECK DISCHARGE, SAY Q_{50})

SKETCH



S_0 = _____ L = _____ L/100 S_0 = _____

MEAN STREAM VELOCITY = _____

CULVERT DESCRIPTION		Q	CAR CHART HW	HEADWATER COMPUTATION										CONTROL HW	OUTLET VELOCITY	COST	DHW ELEV.	COMMENTS
				INLET CONT.		OUTLET CONTROL $HW = H + h_o - LS_o$												
SIZE	ENTR. TYPE			HW/D	HW	K_e	H	d_c	$\frac{d_c + D}{2}$	TW	h_o	LS_o	HW					
2-8X7 RCBC	45° WING	0.5 / 1		0.03*	0.23	0.4												
"	"	88 / 176		0.32	2.23	"												
"	"	207 / 414		0.60	4.23	"												
"	"	368 / 736		0.89	6.23	"												
"	"	448 / 896		1.03	7.23	"												
"	"	536 / 1072		1.18	8.23	"												
"	"	592 / 1184		1.32	9.23	"												
SUMMARY & RECOMMENDATIONS																		
"	"	648 / 1296		1.42	9.95	"												
"	"	656 / 1312		1.46	10.23	"												

* AN $\frac{HW}{D}$ OF 0.03 IS LESS THAN THE CHART READS. THE Q WAS DETERMINED FROM $EG = Y_c + (1+K_e)\left(\frac{V_c^2}{2g}\right)$. THROUGH SUBSTITUTION THIS EQUATION BECOMES:

$$EG = \left(\tfrac{1}{3}\left(\frac{Q}{B}\right)^2\right)^{1/3} + \left(\frac{1+K_e}{2g}\right)\left(\frac{Q}{B}\right)^2\left(\left(\tfrac{1}{2}\left(\frac{Q}{B}\right)^2\right)^{1/3}\right)^{-2/3}$$

Greiner Engineering Job No.

Computed by: RHF Checked by: _____ Date 3-2-89

ARIZONA DEPARTMENT OF TRANSPORTATION

CULVERT COMPUTATION RECORD

PROJECT: SCATTER WASH

STATION: PINNACLE PK. RD.

OUTLET CONTROL

DESIGNER: RHF

DATE: 3-2-89

HYDROLOGIC AND CHANNEL INFORMATION

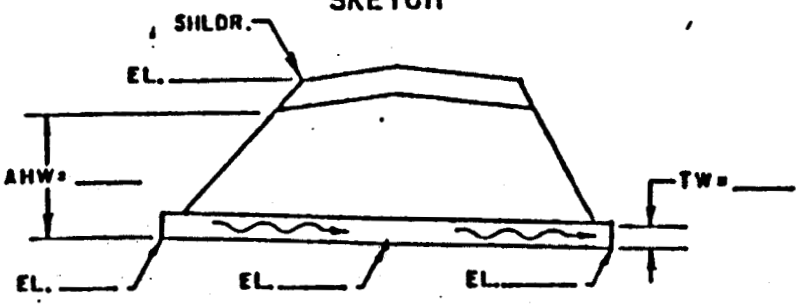
DRAINAGE AREA _____

Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}; Q_2 = CHECK DISCHARGE, SAY Q_{50})

SKETCH



S_o = 0.04% L = 267' L/100 S_o = 0.1

MEAN STREAM VELOCITY = _____

CULVERT DESCRIPTION SIZE	CULVERT DESCRIPTION ENTR. TYPE	Q	CAP. CHART HW	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW = H + h_o − LS_o: K_e	H	d_c*	$\frac{d_c + D}{2}$	TW	h_o	LS_o	HW	CONTROL HW	OUTLET VELOCITY	COST	DHW ELEV.	COMMENTS
2-8x5		X				0.4	X	0.3	3.70	—	3.7	0.1	0.23					INLET CONTROL
		X				0.4	X	1.6	4.3	—	4.3	0.1	2.23					INLET CONTROL
		X				0.4	X	2.7	4.9	—	4.9	0.1	4.23					INLET CONTROL
		340/680				0.4	0.93	3.9	5.5	—	5.4	0.1	6.23					OUTLET CONTROL
		440/880				0.4	1.53	4.5	5.8	—	5.8	0.1	7.23					OUTLET CONTROL
		530/1060				0.4	2.23	5.1	6.1	—	6.1	0.1	8.23					OUTLET CONTROL
		610/1220				0.4	3.03	5.7	6.3	—	6.3	0.1	9.23					INLET CONTROL
		660/1320				0.4	3.53	6.0	6.5	—	6.5	0.1	11.93					INLET CONTROL
		690/1380				0.4	3.83	6.0	6.5	—	6.5	0.1	10.23					INLET CONTROL

SUMMARY & RECOMMENDATIONS

$H = HW + LS_o - h_o$

* d_c BASED ON INLET CONTROL Q AND THEN ADJUSTED SUCH THAT CONTROL Q FROM $H = HW + LS_o - h_o$ = Y_c BY $Y_c = \sqrt[3]{\frac{Q^2}{32.2}}$

Sht ____ of ____

USER : DON BERGLUND

SCRATCH WASH DIP 1041 IRREGULAR WEIR RATING FOR I-17 BOXES
DIRECTING FLOW TO ONE BOTH TO SCRATCH WASH BOX

IRREGULAR WEIR GEOMETRY
DISCHARGE = 3.00

ELEVATION	1414.0	1413.7	1413.0	1412.0	1411.2	1410.0	1410.0	1413.7	1414.0
DEPTION	0.00	0.01	0.00	12.00	31.00	51.01	242.01	297.00	313.00

WEIR FLOW ELEVATION-DISCHARGE CURVE

DISCHARGE	ELEV	DISCHARGE	ELEV
0.00	1411.00	0.10	1411.05
0.01	1411.01	7.00	1412.00
11.15	1411.01	25.10	1411.01
40.02	1412.01	11.01	1411.01
100.01	1411.10	107.10	1411.50
200.78	1411.20	113.71	1411.00
311.11	1411.10	287.07	1411.11
110.72	1411.21	211.07	1411.41
1101.05	1411.30	1025.10	1411.71
1201.11	1411.01	1110.07	1411.05

STAGE	Q
1412.0	31
1413.0	409
1413.7	1167
1414	1594

USER : DON BERGLUND

15:22:21 [illegible]

USER : BEN FERGUSON

[illegible]
[illegible]
[illegible]

IRREGULAR AREA GEOMETRY
COEFFICIENT = 0.60

ELEVATION 1414.0 1413.8 1413.6 1413.3 1413.7 1414.0

QUATION 0.01 217.00 424.00 631.00 838.001025.00

[illegible]

WEIR FLOW ELEVATION-DISCHARGE CURVE

[illegible]	[illegible]	[illegible]	[illegible]
0.10	[illegible]	1.02	14.03
0.20	[illegible]	10.01	1413.15
30.01	[illegible]	60.00	1413.55
[illegible]	[illegible]	121.51	1413.77
[illegible]	[illegible]	201.04	1413.75
801.01	1413.80	478.72	1413.85
603.11	1413.90	703.45	1413.95
807.62	[illegible]	897.22	14.4.05
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	1414.20	[illegible]	1414.21

STAGE	Q
1413.7	215
1414	840

15:22:21 2-MAR 89

[illegible]

USER : BEN FERGUSON

APPENDIX D

Detention Structure At I-17 & Deer Valley Road Interchange

HEC-1 I.D. 332RR

N 977000

N 977000

(I-17) LI

N

1"=200'
2'C.I.

DEER

VALLEY

ROAD

697
1393.2
E 439154.87
N 976339.90

698
1411.2

Overflow
Weir Section

INTERSTATE

N 976000

1390

1400

1410

I-17 & Deer Valley Road
Interchange

KAMINSKI HUBBARD engineering inc. • Surveying • Civil • Hydrology

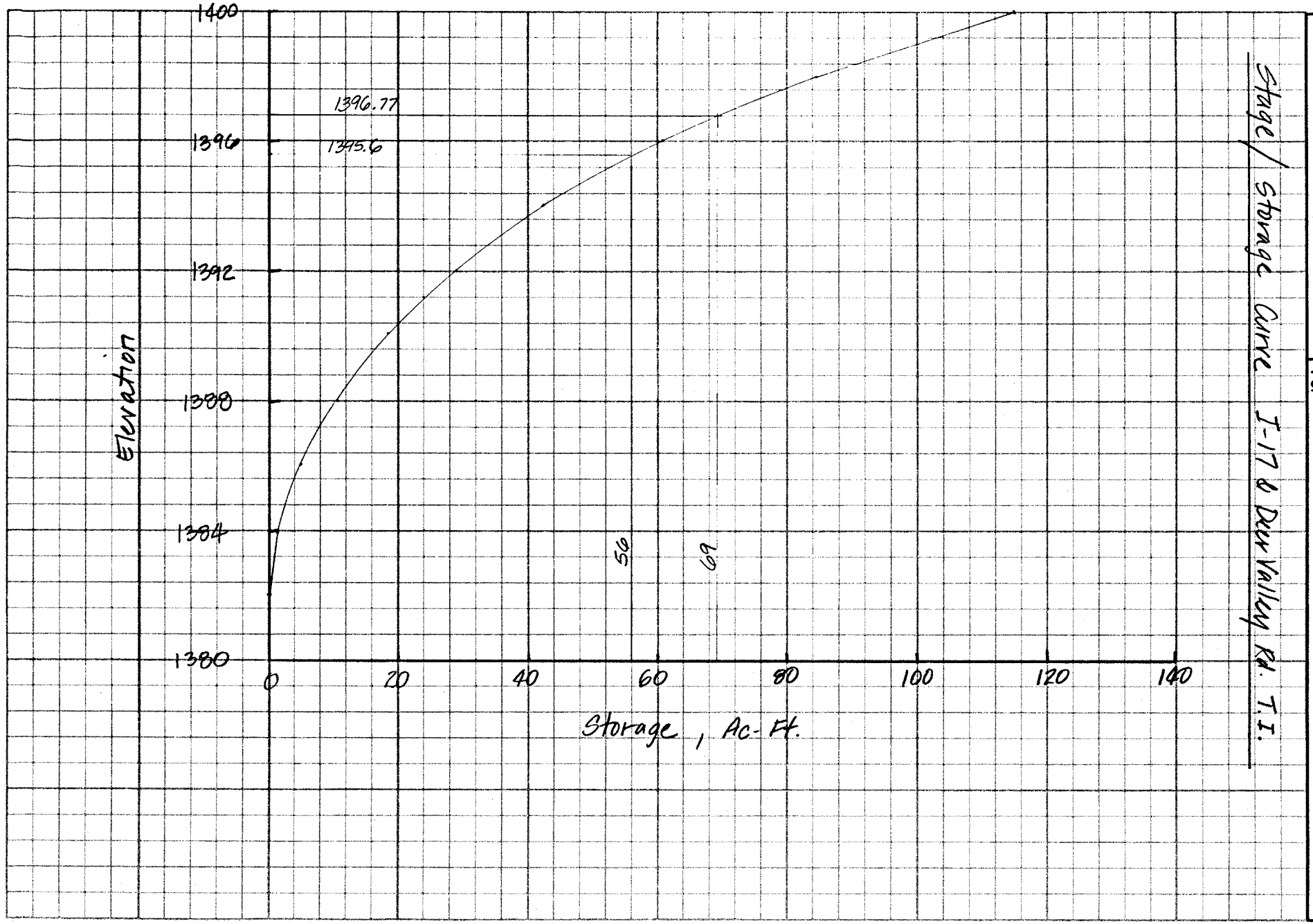
Made by DLB	Date 2-11-94	Job No. 146
Checked by	Date	Sheet No.
For		

Reservoir Routing at I-17 & Deer Valley Road

1"=200' contour mapping

Stage (Ft)	Planimeter Reading (in^2)	Average Reading (in^2)	Area (Ac.)	Volume (Ac-Ft)	Storage Volume (Ac-Ft)	Outflow Discharge (cfs)
1382	0	0	0	1.39	0	0
1384	1.52 3.04 4.54	1.513	1.390	3.71	1.39	0
1386	2.53 5.07 7.58	2.527	2.320	5.64	5.10	0
1388	3.60 7.22 10.85	3.617	3.320	7.81	10.74	0
1390	4.89 9.79 14.68	4.893	4.493	10.36	18.55	0
1392	6.39 12.78 19.18	6.393	5.871	13.57	28.91	0
1394	8.40 16.77 25.16	8.387	7.701	18.24	42.48	0
1395.6					Interpolated 56	1
1396	11.48 22.97 34.45	11.483	10.54	23.80	60.72	56
1396.77					Interpolated 69	1,428
1398	14.45 28.89 43.32	14.44	13.26	30.30	84.52	7,646
1400	18.58 37.15 55.68	18.56	17.04		114.82	26,741

ME101-0374-20M



KAMINSKI HUBBARD engineering inc.
• Surveying
• Civil
• Hydrology

Made by DLB | Date 2-11-94 | Job No. 146
Checked by | Date | Sheet No.
For

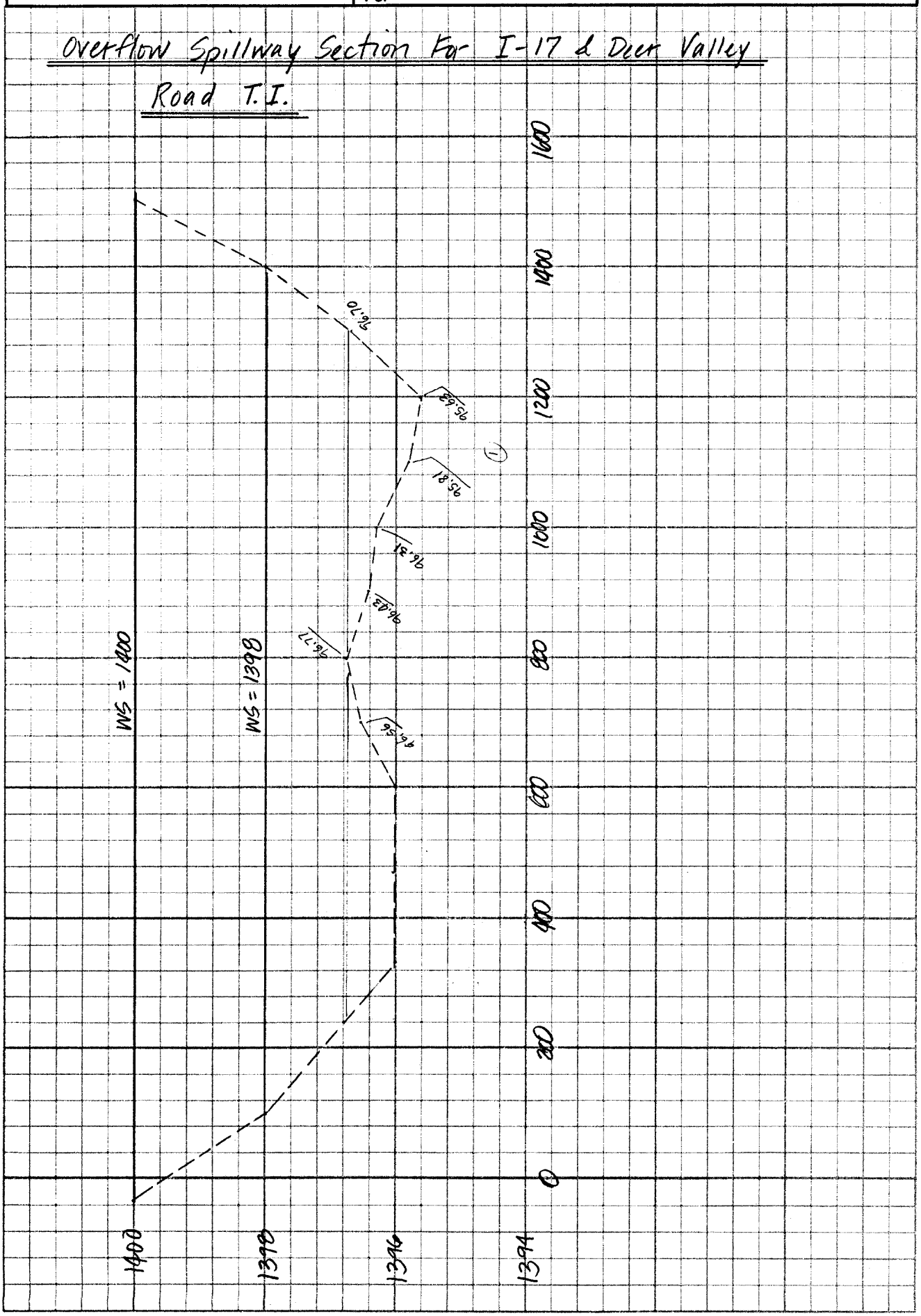
Stage / Storage Curve I-17 & Dew Valley Rd. T.I.

KAMINSKI HUBBARD engineering inc.

- Surveying
- Civil
- Hydrology

Made by DLB	Date 2-11-94	Job No. 146
Checked by	Date	Sheet No.
For		

Overflow Spillway Section For I-17 & Deer Valley Road T.I.



ME101-0374-20M

KAMINSKI HUBBARD engineering inc.
• Surveying
• Civil
• Hydrology

Made by DLB	Date 2-11-99	Job No. 146
Checked by	Date	Sheet No.
For		

Overflow Spillway Calculations

Elev. = 1396

$$Q = (3.0)\left[(40)(0.19/2)^{1.5} + (100)\left(\frac{0.19+0.37}{2}\right)^{1.5} + (35)(0.37/2)^{1.5}\right]$$

$$= 56 \text{ CFS}$$

Elev. = 1396.77

$$Q_1 = (3.0)\left[(100)(0.34/2)^{1.5} + (100)\left(\frac{0.34+0.46}{2}\right)^{1.5} + (100)\left(\frac{0.46+0.96}{2}\right)^{1.5} + (100)\left(\frac{0.96+1.14}{2}\right)^{1.5} + (100)(1.07/2)^{1.5}\right]$$

$$= 717 \text{ CFS}$$

$$Q_2 = (3.0)\left[(85)(0.77/2)^{1.5} + (265)(0.77)^{1.5} + (100)\left(\frac{0.77+0.21}{2}\right)^{1.5} + (100)(0.21/2)^{1.5}\right]$$

$$= 711 \text{ CFS.}$$

Total $Q = 717 + 711 = 1{,}428$ CFS

Elev. = 1398

$$Q = (3.0)\left[(230)(2/2)^{1.5} + (265)(2)^{1.5} + (100)\left(\frac{2+1.44}{2}\right)^{1.5} + (100)\left(\frac{1.44+1.23}{2}\right)^{1.5} + (200)\left(\frac{1.23+1.69}{2}\right)^{1.5} + (200)\left(\frac{1.69+2.37}{2}\right)^{1.5} + (200)(2.37/2)^{1.5}\right]$$

$$= 7{,}646 \text{ CFS}$$

Elev. = 1400

$$Q = (3.0)\left[(130)(2/2)^{1.5} + (230)\left(\frac{2+4}{2}\right)^{1.5} + (265)(4)^{1.5} + (100)\left(\frac{4+3.44}{2}\right)^{1.5} + (100)\left(\frac{3.44+3.23}{2}\right)^{1.5} + (200)\left(\frac{3.23+3.69}{2}\right)^{1.5} + (200)\left(\frac{3.69+4.37}{2}\right)^{1.5} + (200)\left(\frac{4.37+2}{2}\right)^{1.5} + (100)(2/2)^{1.5}\right]$$

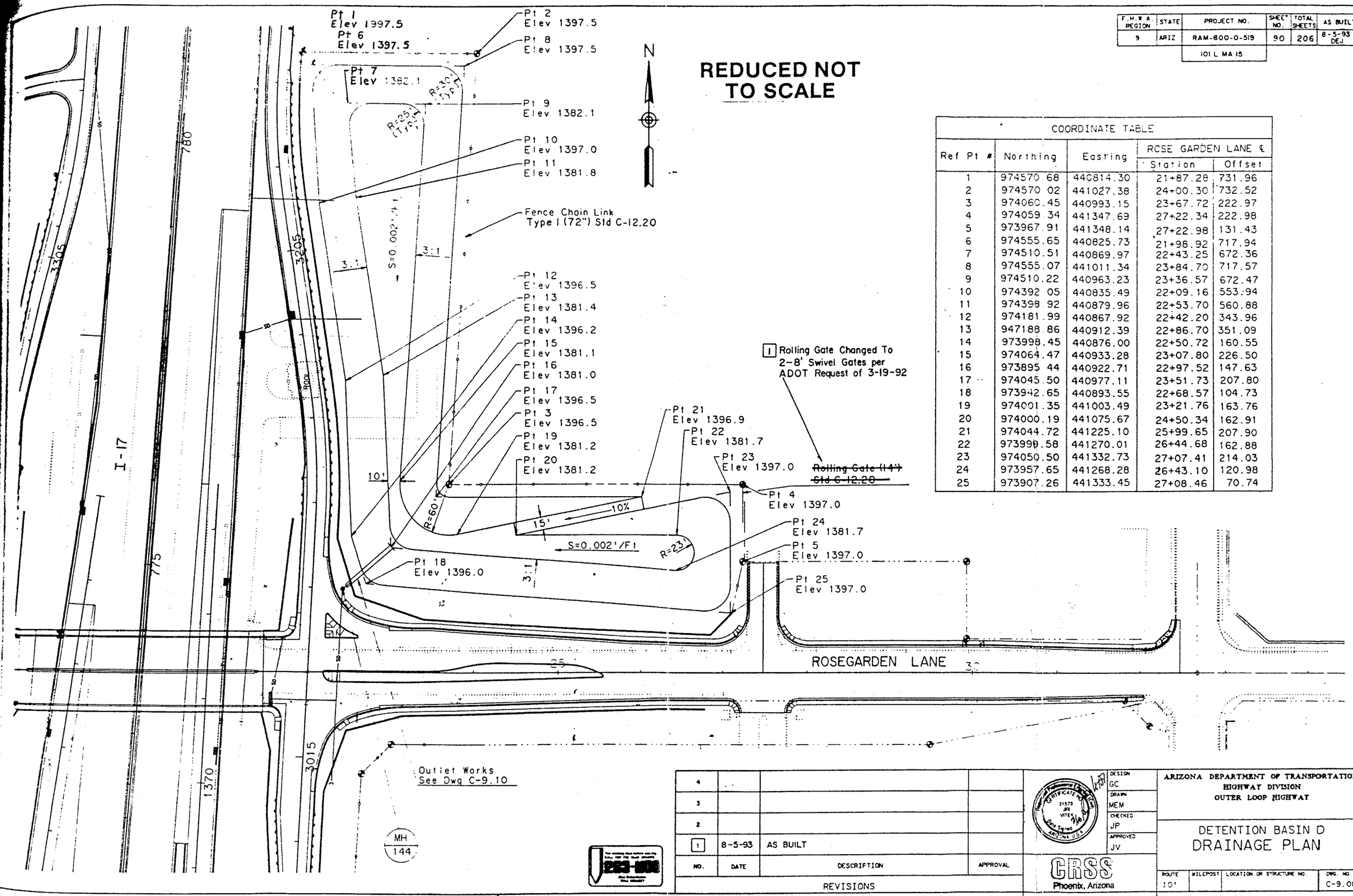
$$= 26{,}741. \text{ CFS}$$

APPENDIX E

Detention Basin D

HEC-1 I.D. 343RR

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ	RAM-600-0-519	90	206	8-5-93 DEJ
		101 L MA 15			



REDUCED NOT TO SCALE

COORDINATE TABLE				
Ref Pt #	Northing	Easting	ROSE GARDEN LANE ℄ Station	Offset
1	974570.68	440814.30	21+87.28	731.96
2	974570.02	441027.38	24+00.30	732.52
3	974060.45	440993.15	23+67.72	222.97
4	974059.34	441347.69	27+22.34	222.98
5	973967.91	441348.14	27+22.98	131.43
6	974555.65	440825.73	21+98.92	717.94
7	974510.51	440869.97	22+43.25	672.36
8	974555.07	441011.34	23+84.70	717.57
9	974510.22	440963.23	23+36.57	672.47
10	974392.05	440835.49	22+09.16	553.94
11	974398.92	440879.96	22+53.70	560.88
12	974181.99	440867.92	22+42.20	343.96
13	947188.86	440912.39	22+86.70	351.09
14	973998.45	440876.00	22+50.72	160.55
15	974064.47	440933.28	23+07.80	226.50
16	973895.44	440922.71	22+97.52	147.63
17	974045.50	440977.11	23+51.73	207.80
18	973942.65	440893.55	22+68.57	104.73
19	974001.35	441003.49	23+21.76	163.76
20	974000.19	441075.67	24+50.34	162.91
21	974044.72	441225.10	25+99.65	207.90
22	973999.58	441270.01	26+44.68	162.88
23	974050.50	441332.73	27+07.41	214.03
24	973957.65	441268.28	26+43.10	120.98
25	973907.26	441333.45	27+08.46	70.74

[1] Rolling Gate Changed To 2-8' Swivel Gates per ADOT Request of 3-19-92

NO.	DATE	DESCRIPTION	APPROVAL
4			
3			
2			
1	8-5-93	AS BUILT	

REVISIONS

Professional Engineering Registration Certificate No. 21579 JOHN R. VITEK Date Signed 4/16/93 Arizona U.S.A.

DESIGN GC
DRAWN MEM
CHECKED JP
APPROVED JV

CRSS
Phoenix, Arizona

TRACS No. H2445 06C

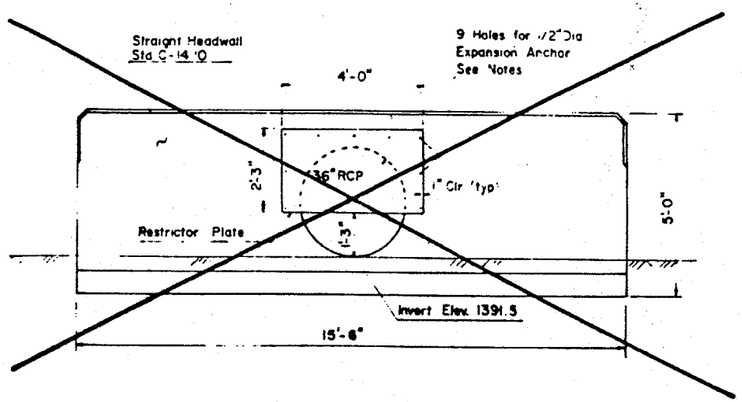
ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAY DIVISION
OUTER LOOP HIGHWAY

DETENTION BASIN D
DRAINAGE PLAN

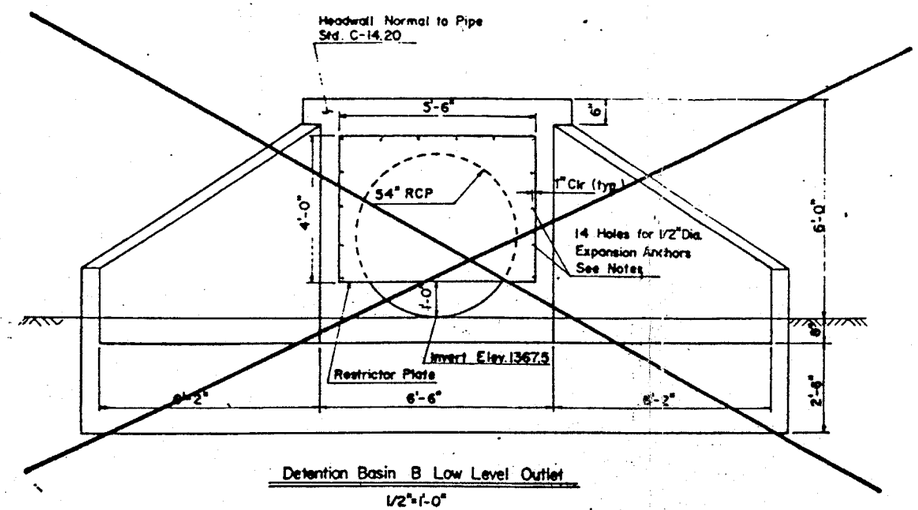
ROUTE	MILEPOST	LOCATION OR STRUCTURE NO.	DRG. NO.
101			C-9.08

RAM-600-0-519 SHEET 90 OF 206

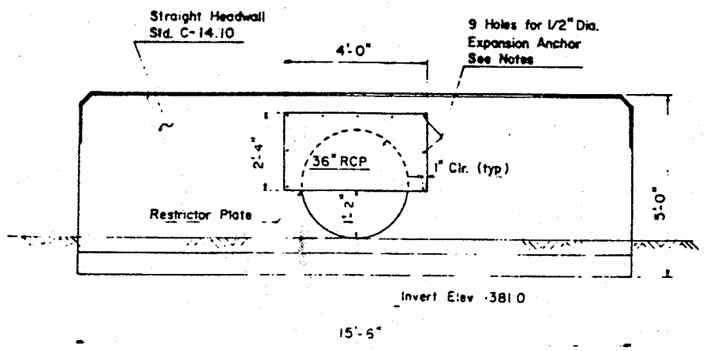
FHWA REGION	STATE	PROJECT NO	SHEET NO	TOTAL SHEETS	AS BUILT
9	ARIZ	RAM-600-0-519	91	206	8-5-93 DEJ
		101 L MA 15			



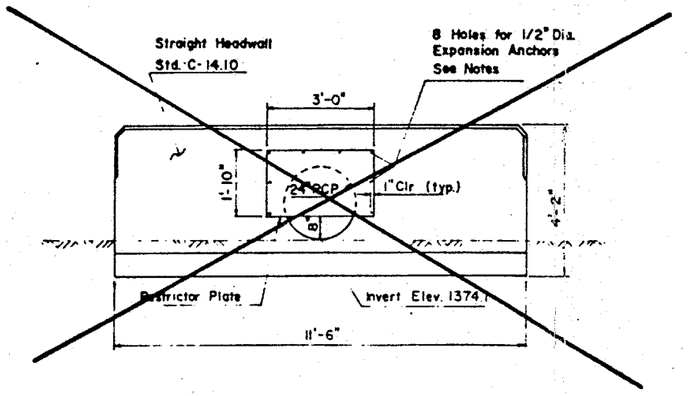
Detention Basin A Outlet
1/2"=1'-0"



Detention Basin B Low Level Outlet
1/2"=1'-0"



Detention Basin D Outlet
1/2"=1'-0"



Detention Basin E Outlet
1/2"=1'-0"

NOTES:

1. Expansion Anchors Shall Be Through Fastener Type.
2. Expansion Anchors Shall Be Equally Spaced Across Top And Along Sides.
3. Restrictor Plate Shall Be Corrosion Resistant. Acceptable Materials Include:
   - 1/4" Steel - Galvanized Assembly
   - 1/16" Rusting Steel - ASTM A588
   - 1/4" Aluminum

REDUCED NOT TO SCALE

811 Arizona

DESIGN	GKC
DRAWN	DUF
CHECKED	GKC
APPROVED	JV

CRSS
Phoenix, Arizona

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAY DIVISION
OUTER LOOP HIGHWAY

OUTER LOOP HIGHWAY
DRAINAGE DETAILS
DETENTION BASIN OUTLET WORKS

ROUTE	MILEPOST	LOCATION OR STRUCTURE NO	DWG NO
			C-9.10

TRACS No. H2445 06C

TABLE 6
LEVEL POOL ROUTING PARAMETERS

Location	Outlet Elevation	Area	Discharge Coefficient	Discharge Exponent	Spillway Crest Elevation	Length	Discharge Coefficient	Exponent
CAP Structure	1515.00	4.9	0.7	0.5	1521.00	100	3.0	1.5
Basin A	1392.00	2.64	0.6	0.5	1412.00	100	3.0	1.5
Basin B	Rating Curves Used - See Figure 7							
Basin D	1381.00	2.41	0.6	0.5	1397.00	100	3.00	1.5

CRS SIRRINE

PROJECT: OLH/I-17 TI	JOB NO.: 86755		NO. / OF
CLIENT: Arizona DOT	~~DESIGNED BY~~ GKC	DATE 2/27/89	
SUBJECT: Stage / Storage Curve Basin D	CHECKED BY	DATE	

Stage	1381.0	1382.5	1396.0	1398.0
Storage	0.0	0.7	25.4	30.0

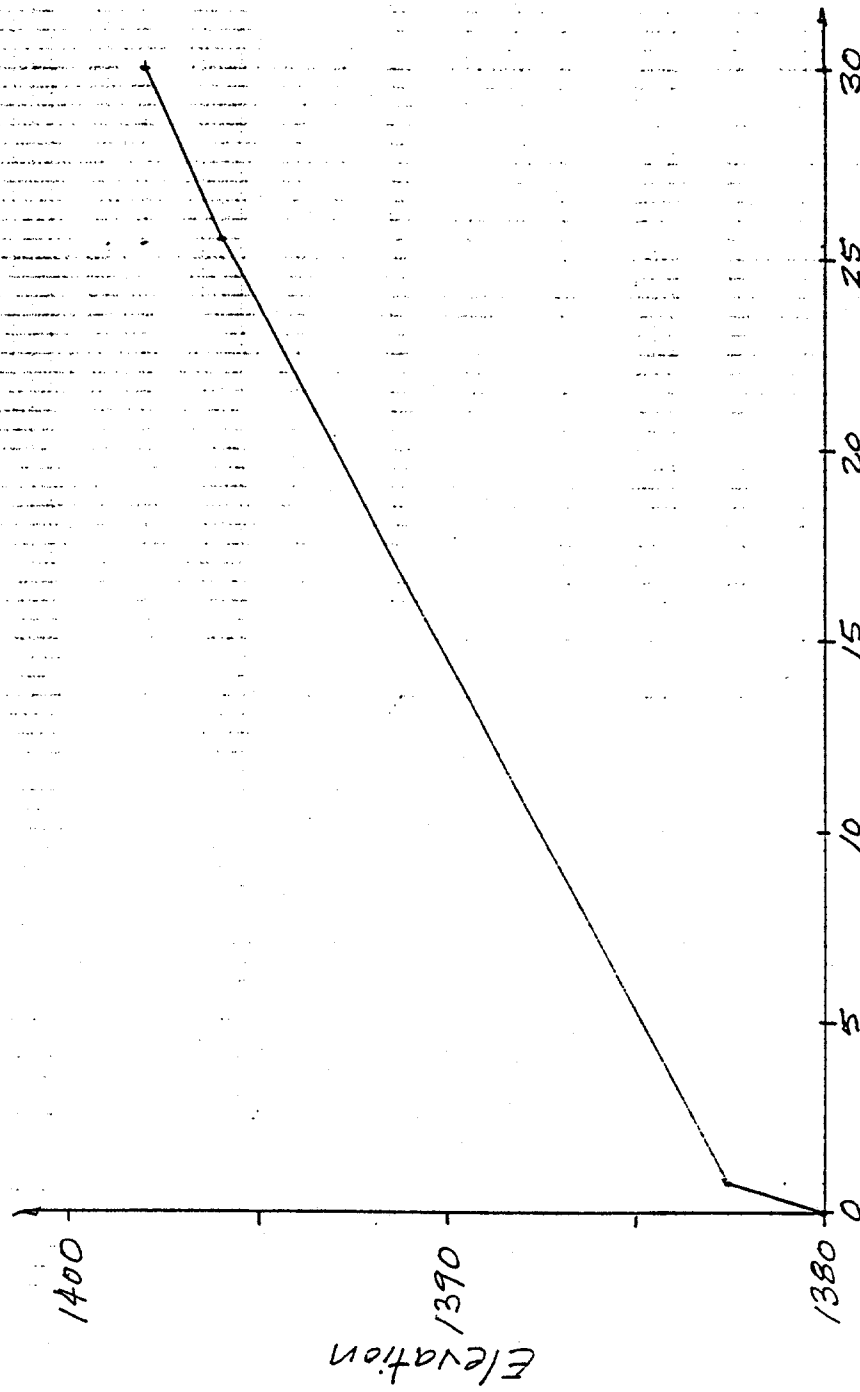
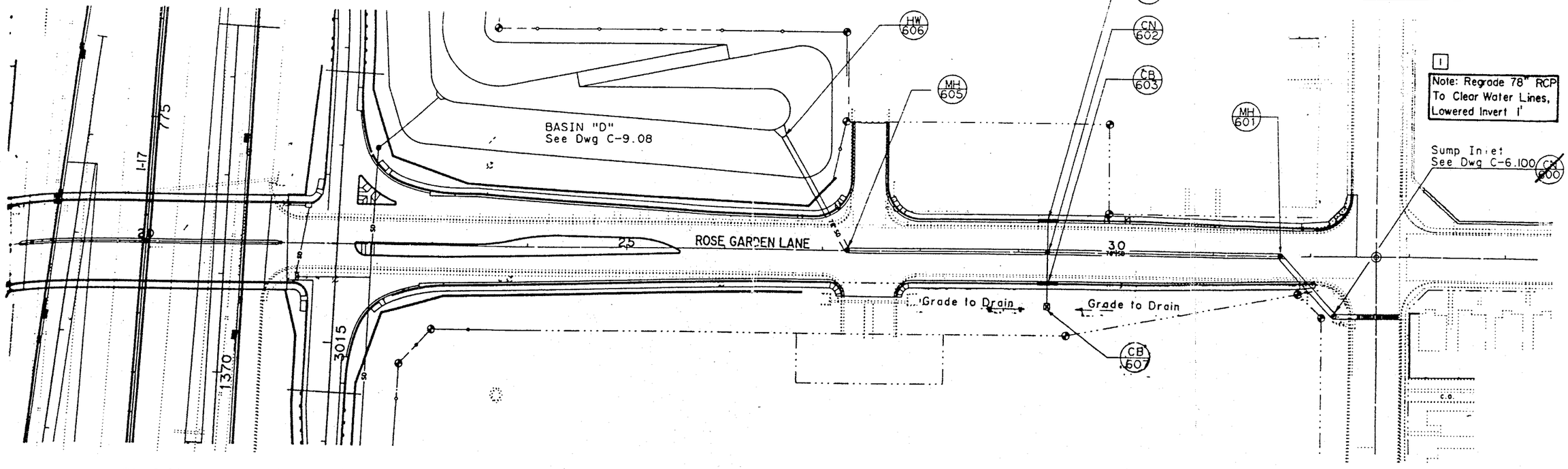
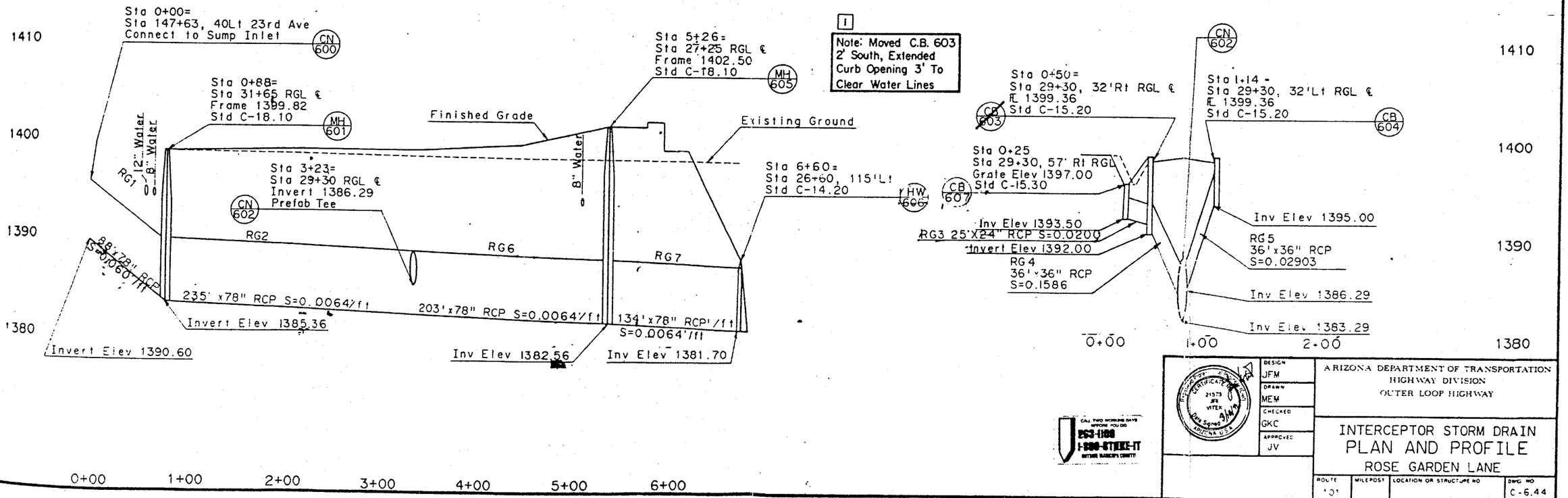


Figure 11. Stage / Storage Curve - Detention Basin D

REDUCED NOT TO SCALE

FHWA REGION	STATE	PROJECT NO	SHEET NO	TOTAL SHEETS	AS BUILT
9	ARIZ	RAM-600-0-519	80	206	8-5-93 DEJ
		101 L MA 15			





CALL TWO WORKING DAYS BEFORE YOU DIG
263-1100
1-800-STAKE-IT
(OUTSIDE MARICOPA COUNTY)

DESIGN	JFM
DRAWN	MEM
CHECKED	GKC
APPROVED	JV

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAY DIVISION
OUTER LOOP HIGHWAY

INTERCEPTOR STORM DRAIN
PLAN AND PROFILE
ROSE GARDEN LANE

ROUTE	MILEPOST	LOCATION OR STRUCTURE NO	DWG NO
101			C-6.44

TRACS NO. H 2445 06C

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ	RAM-600-0-519	81	206	8-5-93 DEJ

101 L MA 15

BM P-9 S1/4 Cor Sec 24
T4N, R2E Maricopa County
Brass Cap In Hand Hole
Elev 1392.12

N 971900
E 440100
N 972450
E 440150

Cst ℄ S-W Ramp

Cst ℄ 96" SD
(See Dwg C-6.38)

REDUCED NOT TO SCALE

Cst ℄ S-E Ramp
(Future)

Cst ℄ Ramp RGA
(Future)

Cst ℄ W Frt Rd

Cst ℄ I-17

Cst ℄ E Frt Rd

Cst ℄ Ramp RGB

Cst ℄ E-N Ramp
(Future)

Cst ℄ W-N Ramp
(Future)

6017
6018
6163
6164
6165
MH 79
MH 101
MH 111
MH 155
JS 80a
CB 113a
CB 113b
CN 112

2305
2220
2222
2215
3105
3110
3111
1350
1355
1360
1820
1825
3000
3005
5181

54" SD
48" SD
Grade To Drain
Grade To Drain

PI Sta 10+00.0 ℄ 54" SD=
Sta 163+06.4 ℄ 96"/84" SD=
Sta 753+75.0, 130.0' Rt ℄ I-17
Defl 26°33'54" Lt
(See Dwg C-6.101)

PT Sta 11+58.9 ℄ SD

PI Sta 11+33.1 ℄ SD=
Sta 754+34.5, 249.0' Rt ℄ I-17
Defl 68°49'58" Lt

PI Sta 18+39.0 ℄ SD=
Sta 761+45.7, 181.8 Rt ℄ I-17
Defl 18°43'34" Rt

E 440800
N 971600

Cst ℄ 84" SD (Future)
(See Dwg C-6.38)

Curve Data ℄ SD
R = 50'
Δ = 68°49'58"
L = 60.07'
T = 34.26'

750
755
760

MATCH LINE
SEE DWG C-6.68

NO.	DATE	DESCRIPTION	APPROVAL
4			
3			
2			
1			

REVISIONS

CRSS, INC.
Phoenix, Arizona

TRACS NO. H2445 06C

DESIGN JFM
DRAWN PMP
CHECKED GKC
APPROVED JV

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAY DIVISION
OUTER LOOP HIGHWAY

I-17 MAINLINE
DRAINAGE PLAN
STA 750+00 TO STA 764+00

ROUTE	MILEPOST	LOCATION OR STRUCTURE NO	DWG NO
101			C-6 67

RAM-600-0-519 SHEET 81 OF 206

F.H.W.A. REGION	STATE	PROJECT NO	SHEET NO	TOTAL SHEETS	AS BUILT
9	ARIZ	RAM-600-0-519	82	206	8-5-93 DEJ
		101 C MA 15			

BM P-5 Center Of Sec 24
T4N, R2E City Of Phoenix
Brass Cap Flush
Elev 1400.64

PI Sta 18+49.0, 60'Lt
Cst ℄ Rose Garden Lane
CURVE DATA ℄ AL2
R = 20'
Δ = 90°
L = 31.42'
T = 20.00'

N

E 440250
N 973550

Cst ℄ Ramp RGA (Future)
R/W
6021
6019
6020
ROSE GARDEN LANE
Cst ℄ W Frt Rd
6034
R/W
3115
3301
MATCH LINE STA 3304+00
Cst ℄ S-E Ramp (Future)
Cst ℄ W Frt Rd
CB 126
CB 125
AL1
AL2
CB 124
Grade to Drain
Cst ℄ I-17
765
770
775
MATCH LINE SEE SHEET C-6.67
Cst ℄ E-N Ramp (Future)
Cst ℄ W-N Ramp (Future)
MATCH LINE SEE SHEET C-6.69
CB 134
CN 133
CB 141a
CB 143
Grade To Drain
CB 145a
AP2
CB 145b
Cst ℄ E Frt Rd
MATCH LINE STA 3204+00
3015
AP1
3201
AK
AM
AQ
48" SD
42" SD
36" SD
Y
CN 142
6162
R/W
E 440900
N 973550
6161
6160
CN 144
36" SD
Sta 32+73.0 ℄ SD=
Sta 775+51.0, 288.5' Rt ℄ I-17
HW 147
PI Sta 21+56.4 ℄ SD=
Sta 764+54.6, 255.0' Rt ℄ I-17
Defl 14°28'27" Lt
MH 114
Sta 24+44.0 ℄ SD=
Sta 767+42.1, 249.3' Rt ℄ I-17
MH 141
PI Sta 31+89.6 ℄ SD=
Sta 774+87.6, 234.4' Rt ℄ I-17
Defl 41°39'56" Rt
MH 146

CALL TWO WORKING DAYS BEFORE YOU DIG
253-1000
1-800-STAKE-IT
OUTSIDE MARICOPA COUNTY

REDUCED NOT TO SCALE

NO.	DATE	DESCRIPTION	APPROVAL
4			
3			
2			
1			

REVISIONS

CERTIFICATE 21573 JAMES R. VITEK ARIZONA U.S.A.

CRSS, INC.
Phoenix, Arizona

TRACS NO H2445 05C

DESIGN	JFM
DRAWN	PMP
CHECKED	GKC
APPROVED	JV

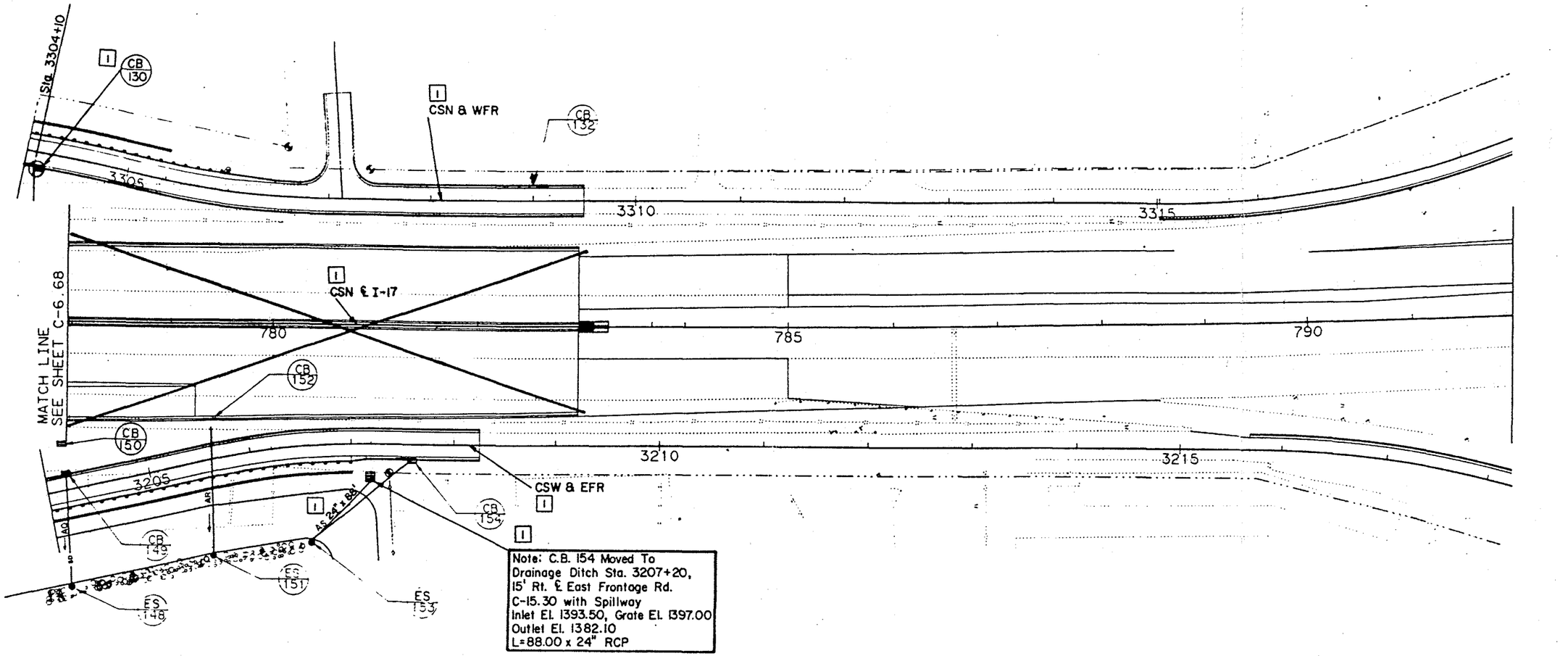
ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAY DIVISION
OUTER LOOP HIGHWAY

I-17 MAINLINE
DRAINAGE PLAN
STA 764+00 TO STA 778+00

ROUTE	MILEPOST	LOCATION OF STRUCTURE NO	DRG NO
101			C-6.68

RAM-600-0-519 SHEET 82 OF 206

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO	TOTAL SHEETS	AS BUILT
9	ARIZ	RAM-800-0-519	83	206	8-5-93 DEJ
		101 L MA 15			



REDUCED NOT TO SCALE

NO.	DATE	DESCRIPTION	APPROVAL
4			
3			
2			
1	8-5-93	AS BUILT	

REVISIONS

DESIGN JFM
DRAWN MEM
CHECKED GKC
APPROVED JV

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAY DIVISION
OUTER LOOP HIGHWAY

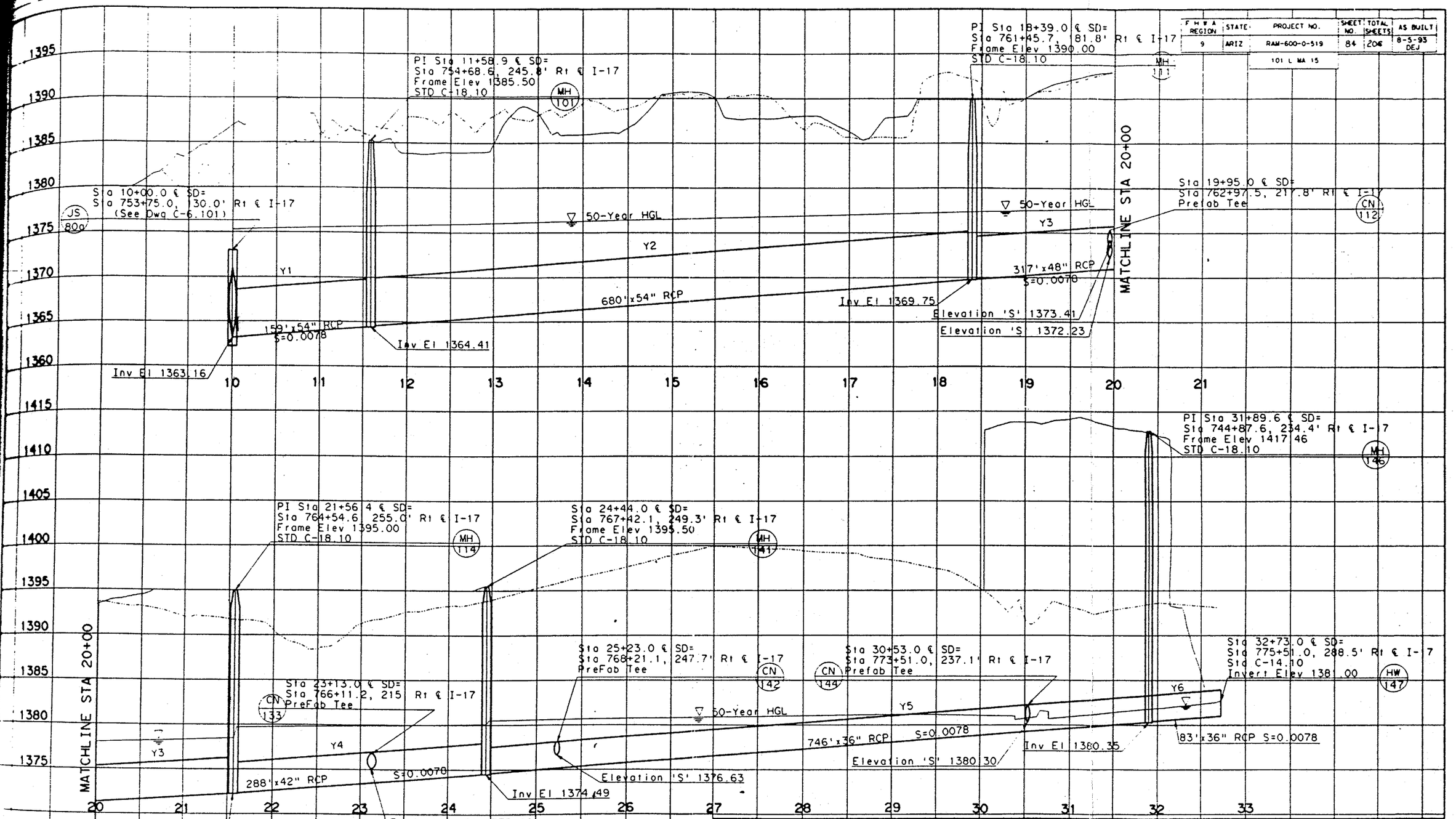
I-17 MAINLINE
DRAINAGE PLAN
STA 778+00 TO STA 792+00

ROUTE	MILEPOST LOCATION OR STRUCTURE NO	DWG. NO
101		C-6.69

TRACS NO. H 2445 06C

RAM-600-0-519 SHEET 83 OF 206

F H W A REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ	RAM-600-0-519	84	206	8-5-93 DEJ
		101 L MA 15			



REDUCED NOT TO SCALE

NO.	DATE	DESCRIPTION	APPROVAL
4			
3			
2			
1			

REVISIONS

DESIGN JFM
DRAWN PMP
CHECKED BBL
APPROVED JV

CRSS, INC.
Phoenix, Arizona
TRACS NO. H2445 060

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAY DIVISION
OUTER LOOP HIGHWAY

DRAINAGE PROFILE
Y

ROUTE	MILEPOST	LOCATION OR STRUCTURE NO	DRG NO.
101			C-6.73

RAM-600-0-519 SHEET 84 OF 206

APPENDIX F

Detention Basin C

HEC-1 I.D. 344RR

REDUCED NOT TO SCALE

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	RBM-600-0-504	102	235	
		101 L MA 16			

283-H00

41st AVE ℄

43'

21.5' 21.5'

NFR Sta 1164+26.62, 44.5' Lt

TW 1331.77

TW 1331.77

See DH1 D-6 Dwg C-5.33

℄ 1329.37

Flow Line

2- 36" RCP Class II x 44'

Inv 1326.77

Inv 1326.96

Flow Line

Drop Inlet Headwall Std C-14.30

5-0.0044'/ft P-71, P-72

Fill Sump w/ Conc to Drain

NFR Sta 1164+10.37 44.5' Lt

NFR Sta 1164+48.37 44.5' Lt

SECTION A-A

N

T4N ⊕ R2E

Sct 22

DRAINAGE EASEMENT

Begin Channel Sta 87+37.37 Cst & Sta 203+14.49 55' Rt (See Drainage Detail D-1, Dwg No. C-5.31)

Scatter Wash Channel See Dwg No. C-6.5 to C-6.7

Drainage Channel Sta 91+58.50 NFR Sta 1191+57.00 64' Lt

Scatter Wash (C-5.14) (1)

Drainage Channel PC Sta 94+10.60

41st Ave

NFR Sta 1164+48.37 Cst Drop Inlet Headwall Std C-14.30

P-71 P-11 MH-11 P-72 P-10 MH-9 C-13 44.5' C-14 14 MH-10 P-12 C-15 P-20 C-95 P-18 MH-16 P-19 MH-17

1165 1170 1175 1180 1185 1190 1195

N 89°33'24.8" E

Beardsley Road

NFR Sta 1164+04.87 Cst Headwall See Drainage Detail D-6 Dwg No. C-5.33

C-85 C-84 P-42 MH-38 C-82 P-46 P-13 MH-41

37th Ave

Scatter Wash Channel See Dwg No. C-6.5 to C-6.7

Med Cst ℄ Sta 1186+20 Construct CBC See Dwgs 5-5.1 Thru 5-5.5

*NOTE:

1) Concrete Shall be Class "S" f'_c = 3000 psi

2) Reinforcing Steel Shall be Grade 60 Conforming to Section 605.

N Frt Rd ℄

44.5'

24'

Profile Grade (See "Ditch Left" N Frt Rd Profiles Dwg No. C-2.18 & C-2.21

4' 4' 5.5'

Grade To Drain

Hinge Point (See FR Typ)

3'

1/4 1'

SECTION B-B

Channel Cst ℄

Top of Bank, Lt

2'

10:1

Exist Gnd **

#4's @ 12" OC

#4's @ 16" OC

Channel Profile Grade

20'

Top of Bank, Rt

2'

10:1 Max

Finished Grade

Exist Gnd

4' 4'

6" (Typ)

36" (Typ)

2'

2'

3' Clr

Cst Weep Holes D-9, Dwg No. C-5.34

* Concrete Channel Lining

** Top of Lining to be Field Adjusted to pick up Off site Flows.

SECTION C-C

STANLEY CONSULTANTS OF ARIZONA, INC

DESIGN	M.A.L.
DRAWN	P.R.R.
CHECKED	G.L.
APPROVED	R.E.J.

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAY DIVISION
OUTER LOOP HIGHWAY
RBM-600-0-504 59TH AVE TO 35TH AVE

DRAINAGE PLAN

STA 1165+00 TO STA 1195+00

ROUTE	MILEPOST	LOCATION OR STRUCTURE NO.	DWG. NO.
SR-101L			C-5.11

TRACS NO. H0797 06C

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	RBM-600-0-504	103	235	
		101 L MA 16			

263-600

REDUCED TO SCALE

Q_{100} = 250 cfs

Q_{100} Varies (250 - 532 cfs)

Q_{100} = 532 cfs

Scatter Wash Cst ℄ Sta 202+35.13

Top of Lining, Lt Elev 1330.00

Top of Bank, Rt Elev 1340.0

Top of Lining, Rt ℄ Lt Elev 1340.06

Top of Lining, Rt ℄ Lt

Exst Gnd @ Cst ℄

10 yr HGL Elev 1337.5

Top of Lining, Rt ℄ Lt Elev 1342.47

Top of Lining, Rt ℄ Lt Elev 1342.47

Top of Lining, Rt ℄ Lt Elev 1345.36

Top of Lining, Rt ℄ Lt Elev 1346.60

Top of Lining Rt ℄ Lt Elev 1341.80

Top of Lining Rt ℄ Lt Elev 1347.97

Channel Cst ℄ Sta 104+17.38 - 35th Ave ℄ Sta 17+14.24

Top of Lining Rt ℄ Lt Elev 1349.72

Top of Bank Lt Sta 108+00 Elev 1350.3

Top of Bank Rt Sta 108+00 Elev 1351.3

Top of Bank Lt Sta 108+17.4 Elev 1350.3

Top of Bank Lt Sta 110+26.6 Elev 1352.62

Top of Bank Lt Sta 111+40.86 Elev 1352.05

Profile Grade @ Channel Cst ℄

2:1

2:1

Match Drainage Channel Part C

S=0.0014 '/Ft

S=0.0100 '/Ft

S=0.0010'/Ft

S=0.0044 '/Ft

S=0.0043'/Ft

100 yr HGL

C-47 Inv 1342.0

Begin Channel Sta 97+37.37 Inv El 1335.18 +.00

Begin CBC Sta 99+35.08 Inv El 1338.47

End CBC Sta 99+30.06 Inv El 1336.67

Transition Level Bottom to 2% Cross Slope

8' Bottom 2% Cross Slope Lt

20'

20'

2-6'x4'x44' CBC

Transition 8'-12'-8' Bottom

Transition 12'-8'- 8' Bottom

Transition Level Bottom to 2% Cross Slope

Begin CBC Sta 103+35.36 Inv El 1342.14

8' Bottom 2% Cross Slope Lt

8'x5'x164' CBC

End CBC Sta 104+99.36 Inv 1342.30

20'

Trns 8' - 16' Bottom Level

Channel Weir Sta 108+00 Inv 1345.3

Inv 1346.3

Begin Side Weir Lt Sta 108+20 Elev 1349.0

End Side Weir Lt Sta 110+20 Elev 1349.92

End Project Sta 111+40.86 Inv 1346.80

20' Bottom 2% Cross Slope Left

Side Weir - North Bank

See Plans - Part C

Top of Bank Lt

Top of Bank Rt

1350

1340

1330

1360

1350

1340

1330

7 8 9 90 1 2 3 4 95 6 7 8 9 100 1 2 3 4 105 6 7 8 9 110 1 2 3 4 115

Outlet Through CBC Wing Wall

Scatter Wash

10yr HGL Elev 1337.5

MH # 16 Sta 13+30= NFR 1189+92.51, 32.3' Lt Rim Elev 1341.5

100 yr HGL

MH # 17 Sta 16+60= NFR 1193+21.22, 29.6' Lt Rim Elev 1347.50

Exst Gnd @ ℄ Pipe

MH # 18 Sta 19+42= NFR 1196+00, 46.6' Lt Rim Elev 1346.0

MH # 19 Sta 22+20= NFR 1198+72.94, 69.8' Lt Rim Elev 1347.3

Finished Grade @ ℄ Pipe

MH # 20 Sta 25+50= NFR 1201+99.68, 111.5' Lt Rim Elev 1340.5

MH # 45 Sta 27+52.83= 35th Av Sta 16+26.76 16' Lt Rim Elev 1351.2

35th Ave

MH # 61 Sta 28+20.94= NFR 1204+31.06 87' Lt Rim Elev 1354.0

MH # 47 Sta 31+09.98 = NFR 1207+10.82, 86' Lt Rim Elev 1352.2

Pipe Inlet Sta 31+56.98 See Detail D-4 Dwg C-5.32

100 yr W.S. Elev 1349.0

C-7.5 Inv 1340.00

12"W Inv 44.25

12"W Inv 39.8

18"S Inv 33.72

Inv 1335.59

Inv 1336.09

Inv 1336.33

Inv 1336.42

Inv 1336.52

Inv 1336.85

Inv 1336.91

P-18 36"x27.7' S=0.0024 '/Ft

P-19 36"x 330' S=0.0020'/Ft

P-20 36"x282' S=0.0020'/Ft

P-21 36"x278' S=0.0020'/Ft

P-22 36"x330' S=0.0020'/Ft

P-23 29"x45"x203' S=0.0012 '/Ft

P-74 36"x78' S=0.0016'/Ft

P-75 36"x280' S=0.0012 '/Ft

P-76 36"x47' S=0.0012 '/Ft

Inv 1332.65

Inv 1333.31

Inv 1333.87

Inv 1334.43

Sta 101+53 Inv Elev 1331.99

1350

1340

1330

1320

10 1 2 3 4 5 6 7 8 9 20 1 2 3 4 5 6 7 8 9 30

NFR Sta 1186+00, Lt to Sta 1210+00, Lt

DESIGN	M.A.C.
DRAWN	C.T.
CHECKED	G.L.
APPROVED	R.E.J.

STANLEY CONSULTANTS OF ARIZONA, INC

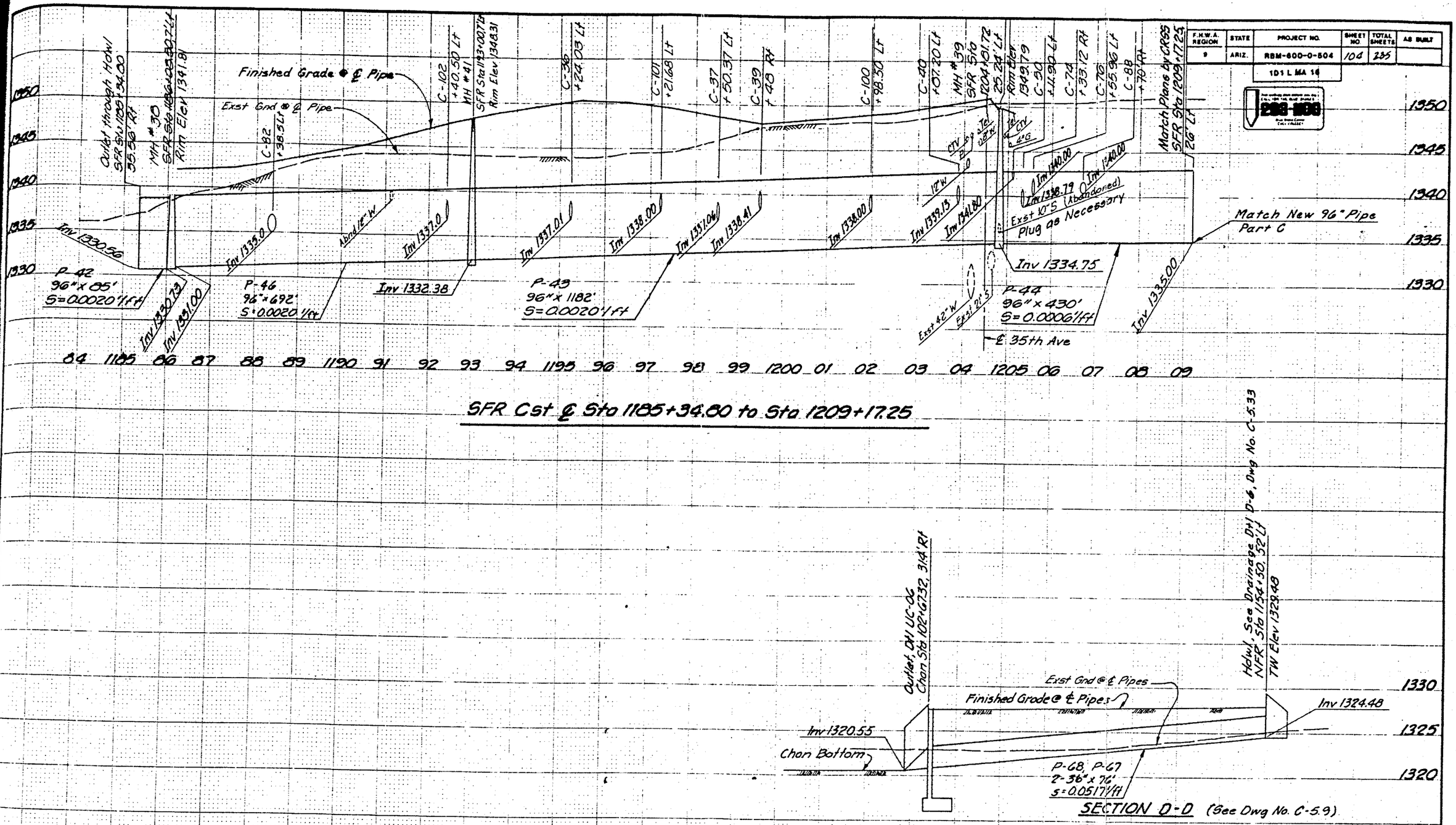
ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAY DIVISION
OUTER LOOP HIGHWAY
RBM-600-0-504 59TH AVE TO 35TH AVE

35TH AVE DRAINAGE
CHANNEL PROFILE
SCATTER WASH TO 111+00

ROUTE	MILEPOST	LOCATION OR STRUCTURE NO.	DWG NO.
SR-101L			C-5.12

TRACS NO. H0797 08C

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	RBM-600-0-504	104	235	
		101 L MA 16			



SFR Cst ℄ Sta 1185+34.80 to Sta 1209+17.25

SECTION O-O (See Dwg No. C-5.9)

REDUCED NOT TO SCALE

	DESIGN	MAL.
	DRAWN	LR
	CHECKED	GL
	APPROVED	REJ

STANLEY CONSULTANTS OF ARIZONA, INC.

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAY DIVISION
OUTER LOOP HIGHWAY
RBM-600-0-504 59TH AVE TO 35TH AVE

DRAINAGE PROFILE

ROUTE	MILEPOST	LOCATION OR STRUCTURE NO.	DWG NO.
SR-101L			C-5.13

TRACS NO. H0797 06C

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	RBM-600-0-504	105	235	
		101 L MA 16			

Channel Cst ℄ Sta 104+17.36 = 35th Ave ℄ Sta 17+14.24
Construct 8'x5'x164'
Concrete Box Culvert
Skewed 16°38'47"
(See Dwg No. C-5.36)

Sta 95+08.06 =
NFR 1195+00, 78' Lt
Construct 2-6'x4'x44'
Concrete Box Culvert
(See Dwg No. C-5.37)

10' Maintenance Access Ramp
See D-10, Dwg No. C-5.34

Drainage Channel
PT Sta 103+03.23 =
NFR 1202+84.88, 73.9' Lt

CHANNEL CURVE DATA

No	R	Δ	T	L
1	2853.57'	17°55'23"	450.00	892.63
2	1000.00'	16°17'48"	143.18	284.43

N

T4N ⊕ R2E

Sct 23

Elev 1351.9
Elev 1334.0
Elev 1337.5
Elev 1338.0
Elev 1337.5
Elev 1350.3

20' (Typ)
Bottom Detention Basin
R/W
Chain Link Fence Type "I" (72")
Channel Bottom Transition 20' to 8'
NFR Sta 1207+51.24
118.85' Lt
Detention Outlet
See Detail D-4
Dwg No. C-5.32

75.00' ROW
33rd Ave
57'
33rd Pl

Detail A

Pontiac Drive

Drainage Channel
PT Sta 111+40.86 =
NFR Sta 1211+22.95, 63.93' Lt
Prairie Drainage Channel
Part C

54'

Beardsley Road

Slope Protection

END CONSTRUCTION

1195 1200 1205 1210 1215 1220 1225

S 73°35'22.6"E

S 75°30'13.6"E

S 89°53'10.9"E

Drainage Channel
PC Sta 108+36.42 =
NFR Sta 1209+33.42, 54.3' Lt

96" Storm Drain
PT SFR Sta 1199+27.47
7' Lt

Match 96" Storm Drain
Part C
S Frt Rd Sta 1209+17.26
26.10' Lt

35th Ave

Escuda Dr

33rd Drive

Weir Control Gr
Varies
24'
2'
10'
10'
Channel Cst ℄
Channel Profile Gr
Finished Gnd
Conc Slope Protection
(See Profile, Dwg No. C-5.12)
2(H):1(V)
2%
See Profile
6"
12"
3" clear
Cst Jt
#4 @ 10" OC
#4 @ 16" OC
Concrete Channel Lining
*Varies Sta 104+99.36 to Sta 108+00

SECTION A-A

See Dtl D-8, Dwg No. C-5.34 for Additional Dtls

12'-0"
3'-0"
6"
#4 @ 16" OC
#4 @ 12" OC
Cut-Off Wall

NOTE:
1) Concrete Shall be Class "S" f'c = 3000 psi
2) Reinforcing Steel Shall be Grade 60 Conforming to Section 605.

Exst Gnd
Varies 10' Varies
2%
3:1
3:1

SECTION B-B

Maintenance Access Ramp
10:1
3:1 (Typ)
10'
20'
3:1
Elev 1352.0
Top of Basin

DETAIL A

2" clear
6"
#5 @ 12" Each Way
Elev 1346.30
6'-0"
Elev 1345.30
7-#5 Equally Spaced
½" Premold Expansion Joint

SECTION D-D

Channel Cst Sta 108+00 ℄
D
10' 9' 9' 10'
Elev 1349.1
2%
Channel Weir Structure
6'-0"
Elev 1346.3

SECTION C-C

REDUCED NOT TO SCALE

DESIGN	MAL
DRAWN	P.R.R.
CHECKED	GL
APPROVED	REJ

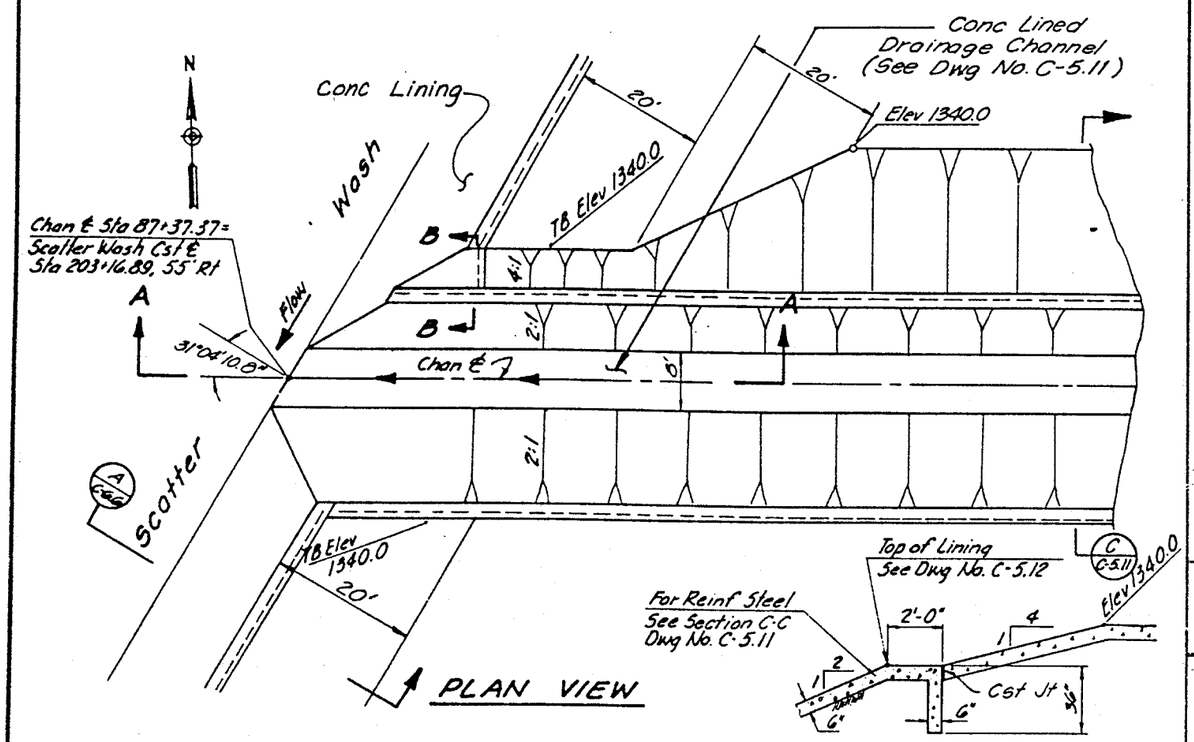
STANLEY CONSULTANTS OF ARIZONA, INC

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAY DIVISION
OUTER LOOP HIGHWAY
RBM-600-0-504 59TH AVE TO 35TH AVE

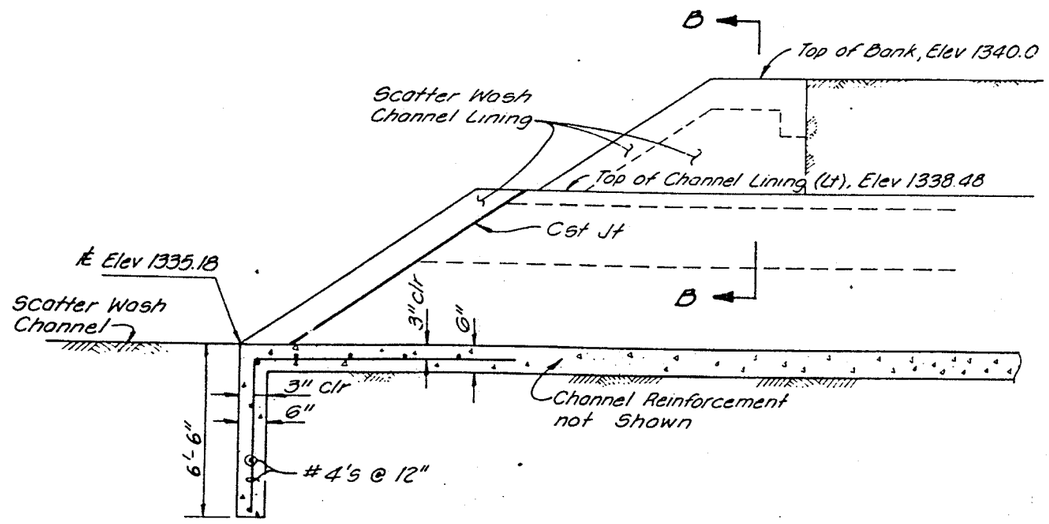
DRAINAGE PLAN
STA 1195+00 TO STA 1210+00

ROUTE	MILEPOST	LOCATION OR STRUCTURE NO.	DWG. NO.
SR-101L			C-5.14

TRACS NO. H0797 08C



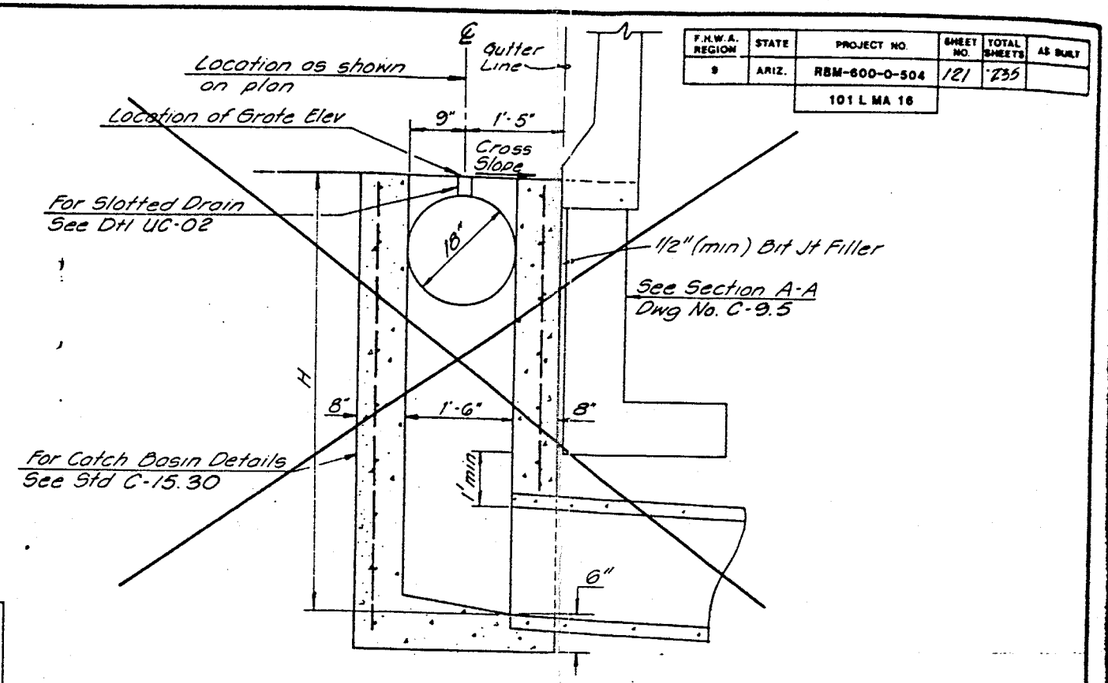
SECTION B-B



SECTION "A-A"

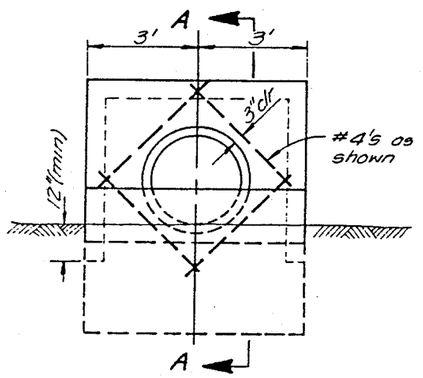
REDUCED NOT TO SCALE

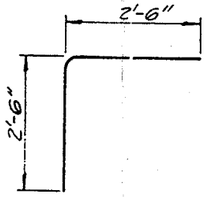
D-1



D-2

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	RBM-600-0-504	121	235	
		101 L MA 16			



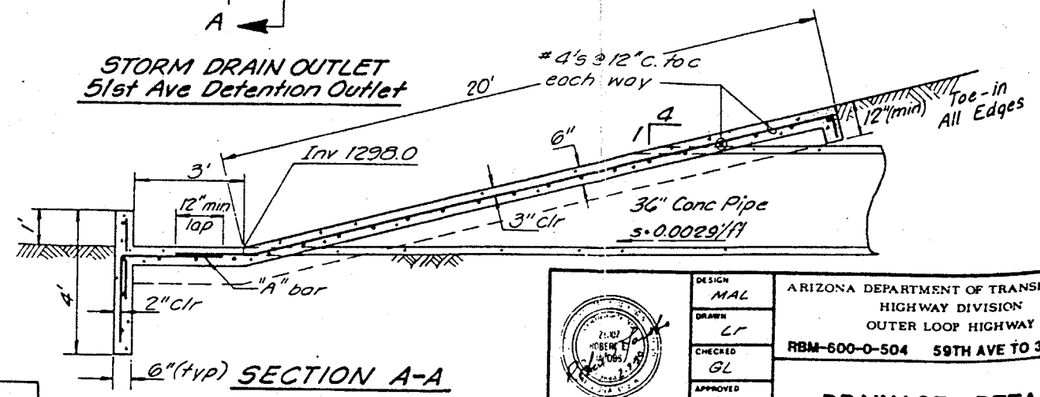


"A" BAR

Notes:

1) All Concrete Shall be Class "S"
2) f'_c = 3000 psi
3) All Reinforcing Steel Shall be Grade 40, Conforming to Section 609

STORM DRAIN OUTLET
51st Ave Detention Outlet



SECTION A-A

P-47 STORM DRAIN OUTLET TO 51ST AVE DETENTION BASIN

D-3

DESIGN	MAL
DRAWN	LR
CHECKED	GL
APPROVED	REJ

STANLEY CONSULTANTS OF ARIZONA, INC.

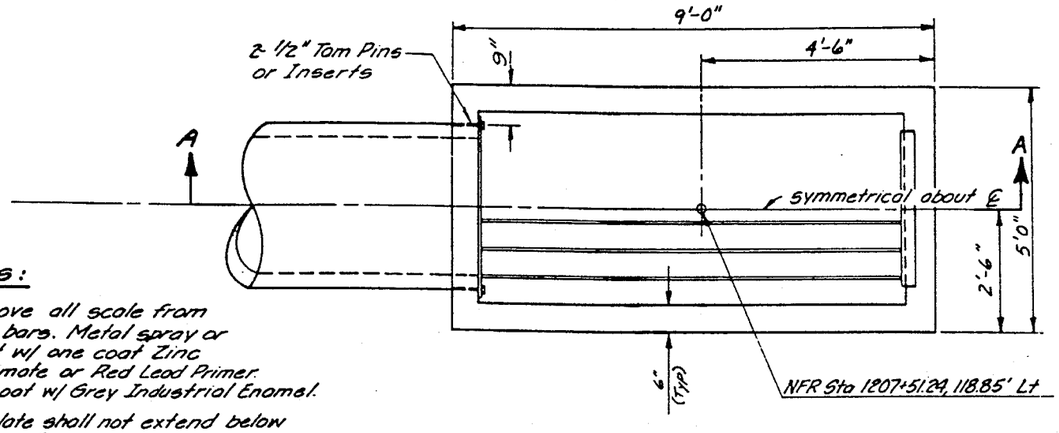
ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAY DIVISION
OUTER LOOP HIGHWAY
RBM-600-0-504 59TH AVE TO 35TH AVE

DRAINAGE DETAILS
D-1, 2, 3

ROUTE	MILEPOST	LOCATION OR STRUCTURE NO	SHEET NO.
SR-101L			C-531

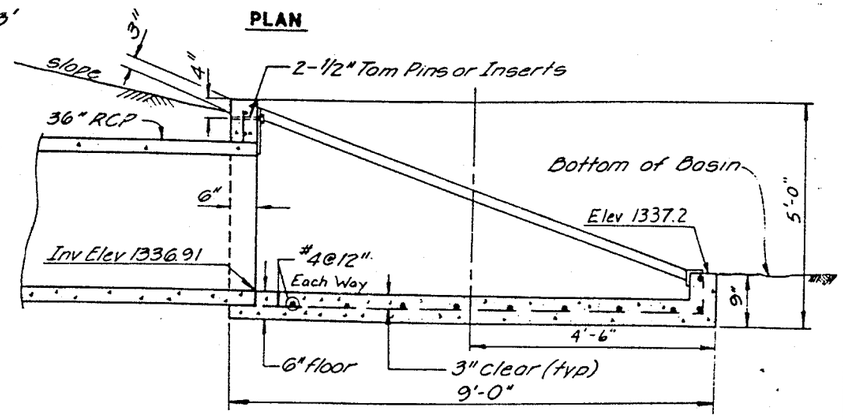
TRACS NO. H0797 06C

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	RBM-600-0-504	122	235	
		101 L MA 16			

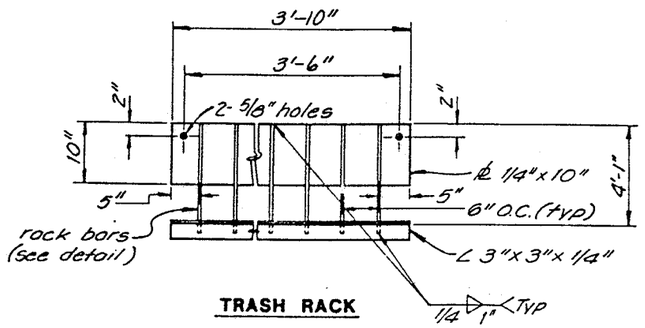


Notes:

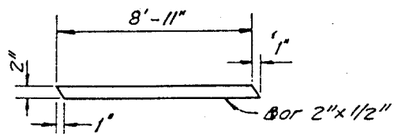
1) Remove all scale from rock bars. Metal spray or paint w/ one coat Zinc Chromate or Red Lead Primer. Overcoat w/ Grey Industrial Enamel.
2) Top plate shall not extend below crown of pipe.
3) Concrete shall be Class 'B' f'c = 3000 psi
4) Reinforcing steel shall be GR 40 conforming to Section 605.
5) Steel shall be ASTM A36.



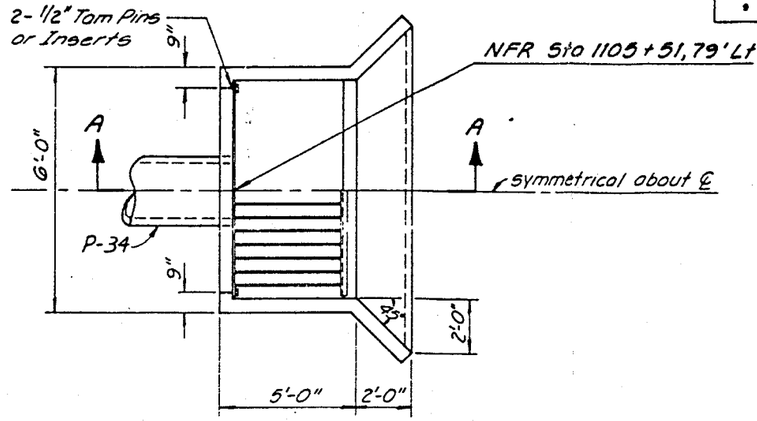
SECTION A-A



TRASH RACK



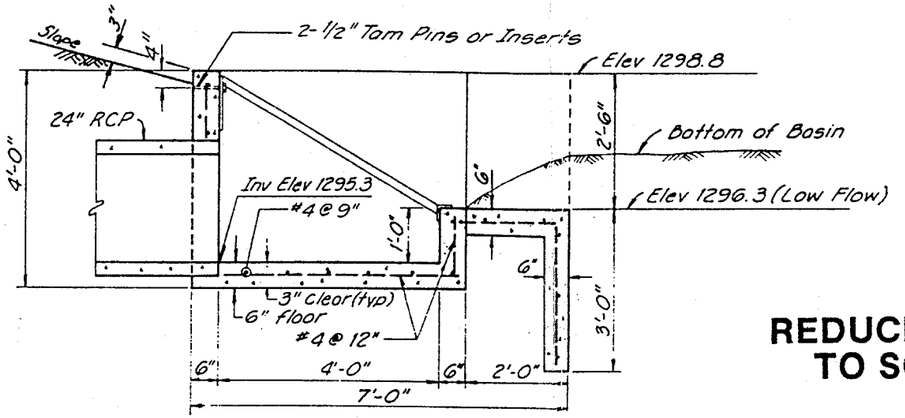
RACK BARS



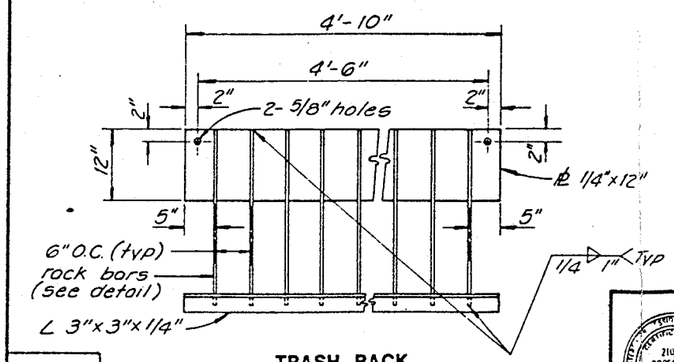
PLAN

Notes:

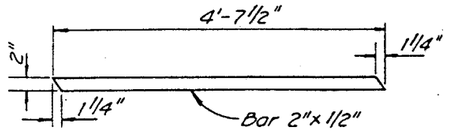
1) See Notes D-4



SECTION A-A



TRASH RACK



RACK BARS

REDUCED NOT TO SCALE

D-4

35TH AVE
DETENTION BASIN OUTLET STRUCTURE

D-5

51ST AVE
DETENTION BASIN OUTLET STRUCTURE

DESIGN	MAL
DRAWN	LF
CHECKED	GL
APPROVED	REJ

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAY DIVISION
OUTER LOOP HIGHWAY
RBM-600-0-504 59TH AVE TO 35TH AVE

DRAINAGE DETAILS
D-4,5

STANLEY CONSULTANTS OF ARIZONA, INC.

ROUTE	MILEPOST	LOCATION OR STRUCTURE NO	DWG NO
SR-101L			C-5.32

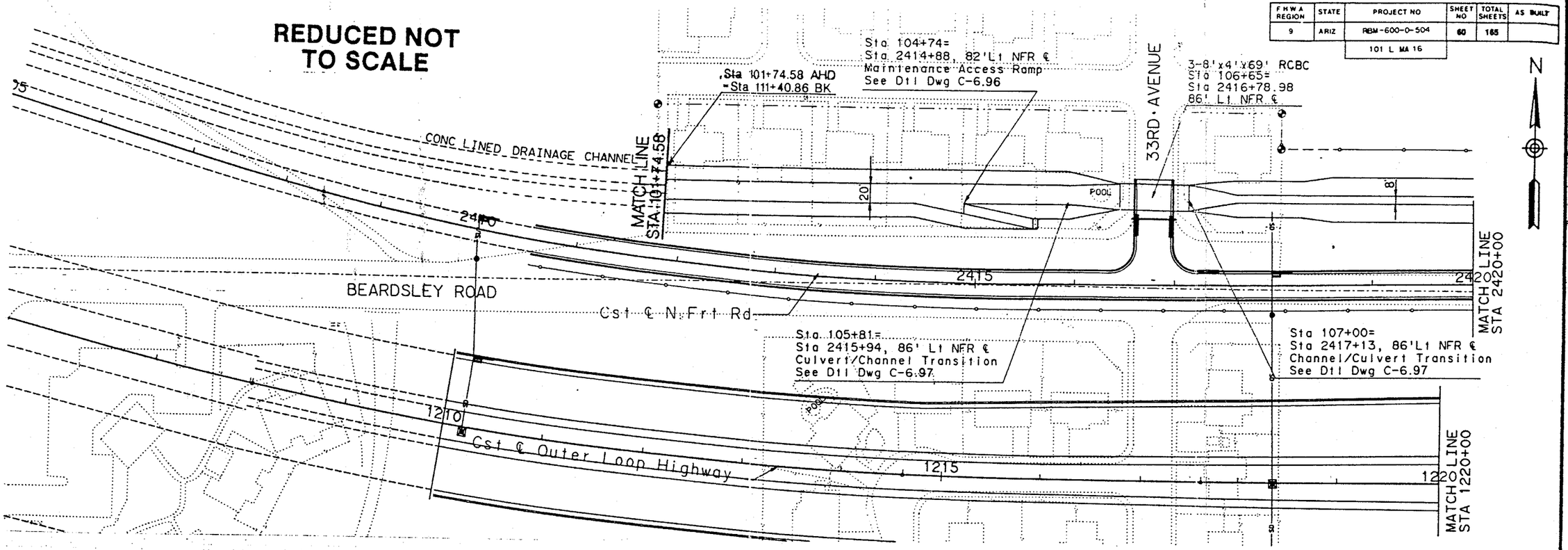
TRACS NO. H0797 06C

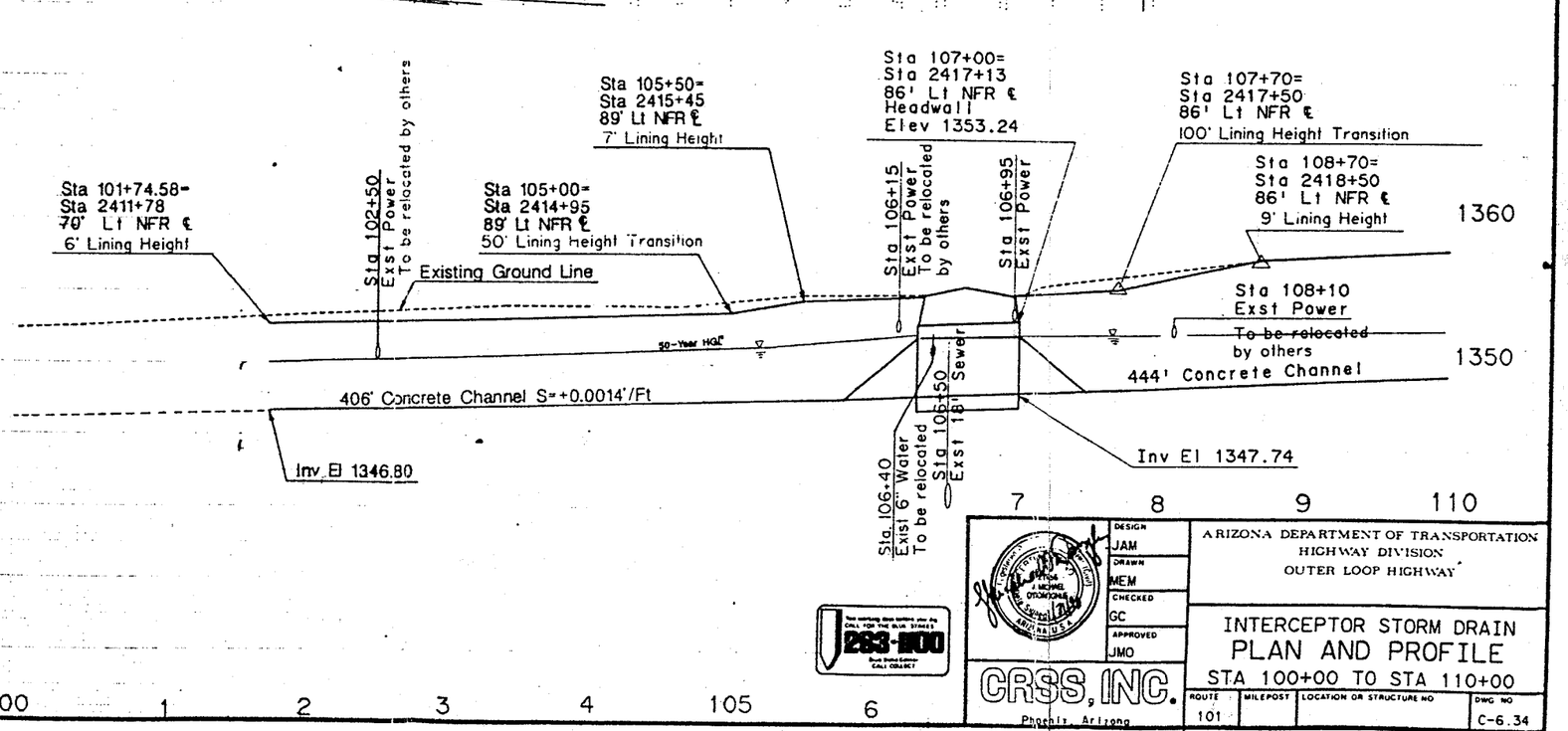
APPENDIX G

Interceptor Drain For The Outer Loop Highway

REDUCED NOT TO SCALE

FHWA REGION	STATE	PROJECT NO	SHEET NO	TOTAL SHEETS	AS BUILT
9	ARIZ	RSM-600-0-504	60	165	
		101 L MA 16			





Curve Data
Delta = 16°
T = 250
R = 1778.8'
PC = 2407+34 NFR ℄ 50' Lt
PI = 2409+86 NFR ℄ 34' Lt
PT = 2412+50 NFR ℄ 76' Lt

CALL FOR THE BLUE STAKES
CALL 263-1100

DESIGN	JAM
DRAWN	MEM
CHECKED	GC
APPROVED	JMO

CRSS, INC.
Phoenix, Arizona

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAY DIVISION
OUTER LOOP HIGHWAY

INTERCEPTOR STORM DRAIN PLAN AND PROFILE
STA 100+00 TO STA 110+00

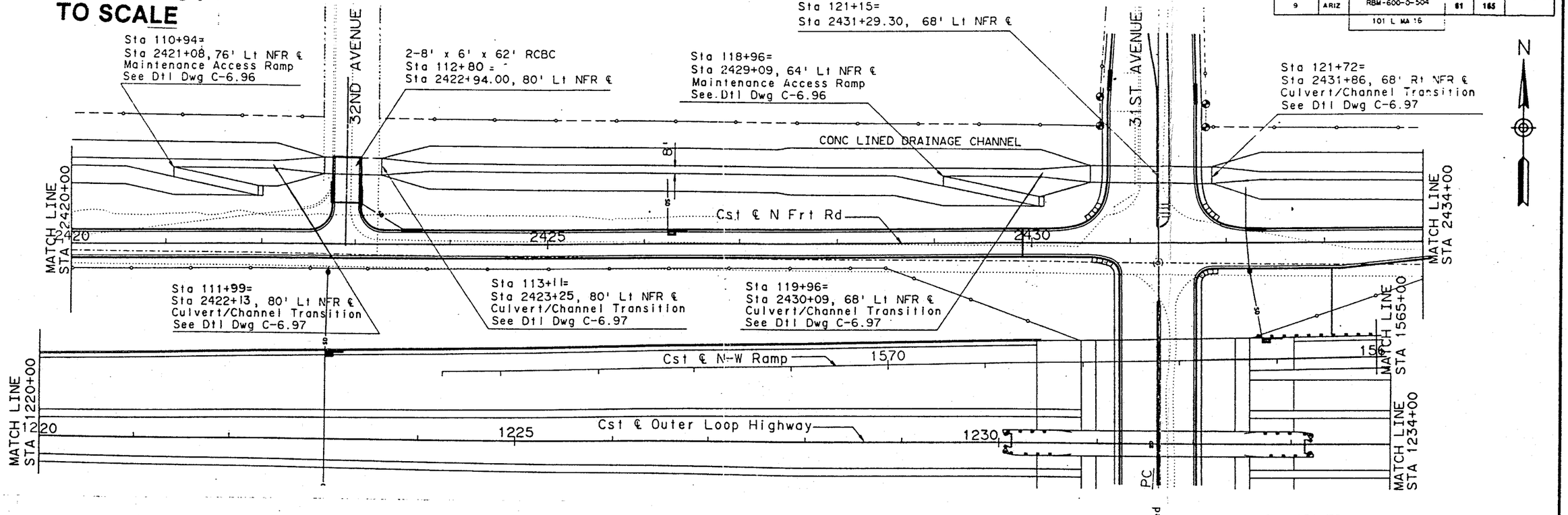
ROUTE	MILEPOST	LOCATION OR STRUCTURE NO	DWG NO
101			C-6.34

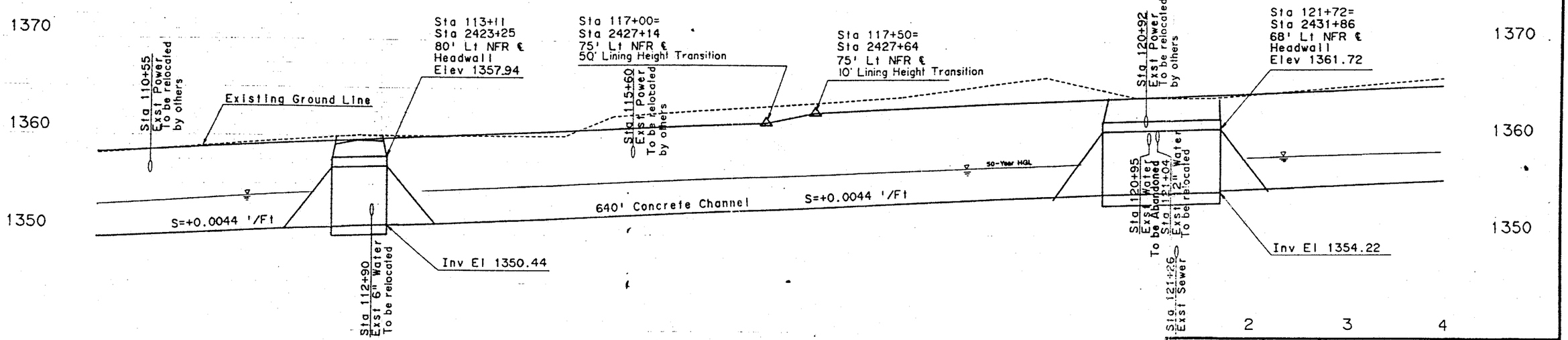
TRACS NO. H0797 06C

PLOT DATE 6-[illegible] DESIGN FILE UDA2:[217012]PP1.101

REDUCED NOT TO SCALE

FHWA REGION	STATE	PROJECT NO	SHEET NO	TOTAL SHEETS	AS BUILT
9	ARIZ	RBM-600-D-504	81	165	
		101 L MA 16			





PLOT DATE 6-5-89 DESIGN FILE U0A2:[217012]PP2.101

DESIGN	JFM
DRAWN	MEM
CHECKED	GKC
APPROVED	JMO

CRSS, INC.
Phoenix, Arizona

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAY DIVISION
OUTER LOOP HIGHWAY

INTERCEPTOR STORM DRAIN
PLAN AND PROFILE
STA 110+00 TO STA 124+00

ROUTE	MILEPOST	LOCATION OR STRUCTURE NO	DWG NO
101			C-6.35

TRACE NO. H0707 05C

REDUCED NOT TO SCALE

FHWA REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ	RBM-600-0-504	82	165	
		1CT L MA 16			

Sta 129+11 =
Sta 2439+25
55' Lt NFR ℄
Maintenance Access Ramp
See Dtl Dwg C-6.96

Sta 130+62 =
Sta 2440+76, 58' Lt NFR ℄
Straight Headwall
Modified Std C-14.10
See Dtl Dwg C-6.99

Plug Line (CN 63)

(CN 42)

Deep (Typ)
Triangular
Roadside Channel
6:1 Side Slopes

R/W

CONC LINED DRAINAGE CHANNEL

8'

36"

96" SD

150'

Plug Line
Dtl
See Dwg C-6.57 (CN 63)

Cst ℄ N Frt Rd

MATCH LINE STA 2434+00

MATCH LINE STA 2448+00

2435

2440

2445

MATCH LINE STA 2518+00

Cst ℄ Ramp 27A

MATCH LINE STA 1565+00

65

1560

Cst ℄ N-W Ramp

1555

2515

MATCH LINE STA 1551+00

MATCH LINE STA 1234+00

1235

1240

Cst ℄ Outer Loop Highway

1245

MATCH LINE STA 1248+00

1310

Sta 125+00 =
Sta 2435+14
66' Lt NFR ℄
50' Lining Height Transition

Sta 125+50 =
Sta 2435+64
66' Lt NFR ℄
11' Lining Height

Sta 130+62 =
Sta 2440+76
58' Lt NFR ℄
Headwall
Elev 1368.13 (CN 42)

Invert
Roadside Channel

Sta 135+02
Sta 2445+16
33' Lt NFR ℄
Plug Line/End Construction
Std Dtl UC-66

50-Year HGL

1370

1360

1350

840' Concrete Channel S = +0.0044'/Ft

x 96" RCP S=+0.00152

Inv El 1359.24

5' X 96" RCP S= +0.00152 '/ft
Inv El 1358.57

Sta 130+67=
Sta 2440+81
58' Lt N Frt Rd ℄
Plug Line,End Cst
Std Dtl UC-66

4 125 6 7 8 9 130 1 2 3 4 135 6 7 8

N

263-1100
Call Before You Dig

DESIGN	JAM
DRAWN	MEM
CHECKED	GC
APPROVED	JMO

CRSS, INC.
Phoenix, Arizona

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAY DIVISION
OUTER LOOP HIGHWAY

INTERCEPTOR STORM DRAIN
PLAN AND PROFILE
STA 124+00 TO STA 138+00

ROUTE	MILEPOST	LOCATION OR STRUCTURE NO	DWG NO
101			C-6.36

TRACS NO. H0797 06C

PLOT DATE 6-[illegible] DESIGN FILE UDA2::[21701211]PP3.101

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ	RAM-600-0-519	77	206	8-4-93 DEV
		101 L MA 15			

Sta 26+41.27 ℄
BM P-2 S ¼ Cor Sec 23
T4N R2E City of Phoenix
Brass Cap in Pot Hole
Elev. 1364.38

Scaled with Permission of
Jiri Vitek 1-30-92
Sta. 133+86, 28' Lt.
℄ S. D. 1369.24
1

Sta 134+94, 28.0' Lt ℄ SD=
Sta 40+14.6, 159.0' Lt ℄
CB 46

3' Deep (Typ)
Triangular
Grader Ditch
6:1 Side Slope

29TH AVE

Sta. 130+62±
~~Existing~~ Headwall
New 1
CN 42

6006

R/W

N 971350
E 437400

5'
36"

E 438100
N 971350

MATCH LINE
STA. 138+00

N

CONC LINED DRAINAGE CHANNEL (EXISTING)

Cst ℄ N Frt Rd

Sta 134+94 ℄ SD=
Sta 40+17.3, 131.1' Lt ℄
CN 46

Cst ℄ N Frt Rd (Future)

2435
2440
2445
200

REDUCED NOT TO SCALE

Monument Line(℄)

Cst ℄ Ramp 27A (Future)

2515

1560
1555

Cst ℄ N-W Ramp (Future)

Cst ℄ Outer Loop Highway (Future)

E 437400
N 971050

E 438100
N 971050

1235
1240
1245

1370
1360
1350

Sta 130+62±
Headwall (Exst)
CN 42

Invert Roadside Channel

50-Year HGL

1187' x 96" RCP S = +0.0015'/ft

Concrete Channel S = +0.0044'/ft

Sta 130+62±
Inv El 1358.57

Sta 130+67±
Remove Pipe Plug And
Match Existing 96" Pipe

130

1 2 3 4 135 6 7 8

NO.	DATE	DESCRIPTION	APPROVAL
4			
3			
2			
1	8-4-93	AS BUILT	

REVISIONS

Registered Professional Engineer
CERTIFICATE NO. 21578
JOHN A. MITEK
Date Signed 7-30-93
ARIZONA, U.S.A.

CRSS, INC.
Phoenix, Arizona
TRACS NO H2445 06C

DESIGN	JAM
DRAWN	PMP
CHECKED	GC
APPROVED	JV

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAY DIVISION
OUTER LOOP HIGHWAY

INTERCEPTOR STORM DRAIN
PLAN AND PROFILE
STA 130+67 TO STA 138+00

ROUTE	MILEPOST	LOCATION OR STRUCTURE NO	DWG NO.
101			C-6.36

RAM-600-0-519 SHEET 77 OF 206

To Accompany Addendum No 1

F.H.W.A. REGION	STATE	PROJECT NO	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ	RAM-600-0-519	78	206	8-4-93 DEJ

101 L MA 15

N

E 438500
N 971500

3' Deep (Typ)
Triangular
Grader Ditch
6:1 Side Slope

PI Sta 142+54.4 ℄ SD=
Sta 47+74.2, 204.4' Lt ℳ
Defl 1°33'28" Rt

MH 65

6007

R/W

5'

36"

96" SD

MATCH LINE
STA 138+00

Cst ℄ N Frt Rd (Future)

2455

2460

2520

Cst ℄ S-W Ramp (Future)

Cst ℄ Ramp 27A (Future)

45

50

2320

1540

2325

1545

1550

Monument Line (M)

Cst ℄ N-W Ramp (Future)

CB 72a

Sta 148+73, 28.8' Lt ℄ SD=
Sta 53+90.7, 275.7' Lt ℳ

27TH AVENUE

G

W

55

6014

E 439500
N 971500

3' Deep (Typ)
Triangular
Grader Ditch
6:1 Side Slope

MB

36"

96" SD

150

MATCH LINE
STA 152+00

CN 72

Sta 148+73 ℄ SD=
Sta 53+92.5, 246.9' Lt ℳ

Note: 96" RCP Pipe
Collar Sta. 146+90
2

Note: New Manhole
C-18.10 Sta. 147+70
2

BEARDSLEY ROAD

Sta 52+84.38 ℳ
BM P-6 SW Cor Sec 24
T4N, R2E City of Phoenix
Brass Cap in Hand Hole
Elev 1378.40

Sta 142+54.4
Frame
Elev 1376.61
MH 65

Invert
Roadside Channel

Existing Ground Line

Sta 147+84
Exist 12" Water

Sta 148+73
Grate Elev 1376.57
Std C15.30, Type 4
CB 72A

50 - Year HGL

Sta 147+30
Exist 4" Gas

Invert
Grader Ditch

Sta 147+70
Exist 8" Sewer.

1380
1370
1360

S = +0.0015'/ft

Inv El 1360.38

956' x 96" RCP

S = +0.0015'/ft

145 6 7 8 9 150 1 2

8 9 140 1 2 3 4

REDUCED NOT TO SCALE

NO.	DATE	DESCRIPTION	APPROVAL
4			
3			
2	8-4-93	AS BUILT	
1	4/23/91	⚠ Add Existing Utilities to Plan	J.V.

REVISIONS

DESIGN JFM
DRAWN PMP
CHECKED GKC
APPROVED JV

CRSS, INC.
Phoenix, Arizona

TRACS NO. H2445 06C

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAY DIVISION
OUTER LOOP HIGHWAY

INTERCEPTOR STORM DRAIN
PLAN AND PROFILE
STA 138+00 TO STA 152+00

ROUTE	MILEPOST	LOCATION OR STRUCTURE NO.	DWG. NO.
101			C-6.37

RAM-600-0-519 SHEET 78 OF 206

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO	TOTAL SHEETS	AS BUILT
9	ARIZ	RAM-600-0-519	79	206	8-5-93 DEJ
		101 L MA 15			

Sta 52+84.38 ℄
BM P-6 SW Cor Sec 24
T4N, R2E City Of Phoenix
Brass Cap In Hand Hole
Elev 1378.40

Replace Exst Concrete Channel

PI Sta 159+76.4 ℄ SD=
Sta 753+75.0, 208.0' Lt ℄ I-17
Defl 58°40'37" Rt

N 971700 + E 439900

REDUCED NOT TO SCALE

Cst ℄ S-W Ramp
(Future)

PI Sta 155+56.9 ℄ SD=
Sta 60+71.2, 324.6'Lt ℄
Curve Data ℄ SD
R = 80'
Δ = 45°35'46"
L = 63.66'
T = 33.63'

[1] Note: 96" RCP 2 Sack Cement Slurry Full Encasement For 60'

PI Sta 152+10.0 ℄ SD =
Sta 57+28.8, 268.6' Lt ℄
Defl 5°35'56" Lt

MH 78

6015

96" SD

MATCH LINE STA 152+00

Sta 749+73.5, 280'Lt ℄ I-17
End Grader Ditch
El 1381.50

Cst ℄ S-E Ramp
(Future)

Cst ℄ I-17 (Future)

PT Sta 160+13.32 ℄ SD=
Sta 753+75.00, 163.03' Lt ℄ I-17

MH 79

90°

96" SD

Sta 161+76.4 ℄ SD=
Sta 753+75.0 ℄ I-17

12'x84"SD

Cst ℄ 54" SD
(See Dwg C-6.67)

Curve Data ℄ SD
R = 80'
Δ = 58°40'37"
L = 81.93'
T = 44.96'

Curve Data ℄ SD
R = 70'
Δ = 84°36'08"
L = 103.36'
T = 63.70'
(Future)

PI Sta 164+10.0 ℄ SD=
Sta 753+75.0, 233.6' Rt ℄ I-17
Defl 84°36'08" Rt
(Future)

Cst ℄ 84" SD
(Future)

E 441000
+N 971700

Curve Data ℄ SD
R = 70'
Δ = 68°24'04"
L = 83.57'
T = 47.57'
(Future)

Sta 163+06.4 ℄ 96"/84" SD=
PI Sta 10+00.0 ℄ 54" SD=
Sta 753+75.0, 130.0' Rt ℄ I-17
(See Dwg C-6.101)

JS 80b

Cst ℄ W-N Ramp
(Future)

Cst ℄ E-N Ramp
(Future)

PT Sta 167+16.0 ℄ SD=
Sta 68+08.1, 331.3' Lt ℄
Sta 750+69.0, 307.0' Rt ℄ I-17
(Future)

MH 155

PI Sta 171+61.9 ℄ SD=
Sta 72+27.2, 178.9' Lt ℄
Defl 14°34'20" Lt
(Future)

MH 156

PI Sta 166+80.0 ℄ SD=
Sta 67+83.4, 347.6' Lt ℄
Sta 750+82.3, 261.3' Rt ℄ I-17
Defl 68°24'04" Lt
(Future)

Cst ℄ Ramp 27-C
(Future)

Cst ℄ N Frt Rd
(Future)

2465 2470 2475

1350 750 225 180 170

PT Sta 160+13.3
Frame El 1387.50'
STD C-18.10

MH 79

℄ MH Sta 63+08.4, 2' Rt
Frame E 1381.14

PI Sta 152+10.0
Frame El 1382.00
STD C-18.10

MH 78

Invert Grader Ditch

Existing Ground Line

PC Sta 155+23.3

PT Sta 155+87.0

PC Sta 159+31.4

50-Year HGL

JS 80a See Dwg C-6.101

Sta 163+36±
84" Pipe Plug
Dt UC-66

803'x96" RCP S = +0.0012'/ft

Inv El 1362.70

292'x96" RCP S = +0.0012'/ft

Inv El 1363.18

12'x84" RCP, S= +0.0012 '/ft

Inv El 1361.84'

S = +0.0015'/ft

Inv El 1362.29

Inv El 1362.21

Inv El 1362.80

Inv El 1363.14

1390 1380 1370 1360

2 3 4 155 6 7 8 9

160 2 3 4 165

NO.	DATE	DESCRIPTION	APPROVAL
4			
3			
2			
1	8-5-93	AS BUILT	

REVISIONS

CERTIFICATE 21579 JR VITEK Not Signed Jr Not Valid ARIZONA U.S.A.

CRSS, INC.
Phoenix, Arizona

DESIGN	JFM
DRAWN	PMP
CHECKED	BBL
APPROVED	JV

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAY DIVISION
OUTER LOOP HIGHWAY

INTERCEPTOR STORM DRAIN
PLAN AND PROFILE
STA 152+00 TO STA 163+36

ROUTE	MILEPOST	LOCATION OR STRUCTURE NO.	DWG. NO.
101			C-6.38

RACS NO. H2445 06C

RAM-600-0-519 SHEET 79 OF 206

FOLD HERE FOR PLOTTING ON

APPENDIX H

Deer Valley Road At 19th Avenue Diversion

HEC-1 I.D. 341D

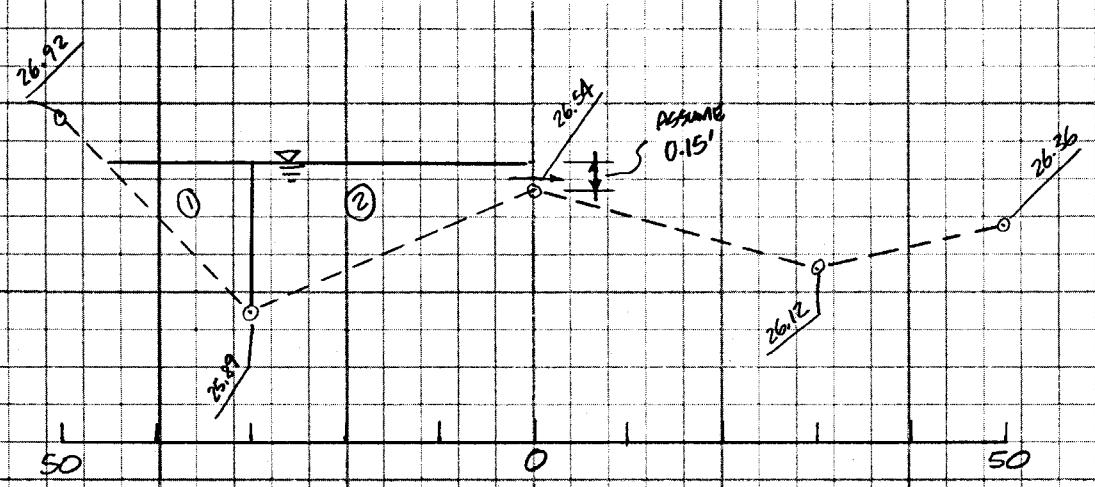
ME101-0374-20M

KAMINSKI HUBBARD engineering inc.
• Surveying
• Civil
• Hydrology

Made by DLB | Date 2-7-94 | Job No. 0146
Checked by | Date | Sheet No.
For

CAPACITY OF DEER VALLEY ROAD AT APPROXIMATELY 19TH AVENUE FLOWING WEST IN STREET AND SHOULDER. THE REMAINDER OF FLOW BREAKS OUT SOUTH

DEER VALLEY RD. - LOOKING EAST OF 19TH AVENUE



$A_1 = \frac{1}{2}(0.80)(15.53) = 6.21$ S. Ft.

$P_1 = 15.53$ Ft.

$R_1 = \frac{6.21}{15.53} = 0.400$ Ft.

$n_1 = 0.025$

$A_2 = \frac{1}{2}(30)(0.65) + (0.15)(30) = 14.25$ Ft.

$P_2 = 30$ Ft.

$R_2 = \frac{14.25}{30} = 0.475$ Ft.

$n_2 = 0.016$

$$Q = (1.486)(0.0045)^{1/2}\left[(0.400)^{2/3}\left(\frac{6.21}{0.025}\right) + (0.475)^{2/3}\left(\frac{14.25}{0.015}\right)\right]$$

$= 71.1$ CFS

Use $Q = 70$ CFS FOR HALF STREET CAPACITY

APPENDIX E

KHE Response Letters To FEMA Comments

Dated September 12, 1994

KAMINSKI
HUBBARD
engineering inc.

SURVEYING • CIVIL • HYDROLOGY

Daniel L. Kaminski, P.E., R.L.S.
James O. Hubbard, P.E.

September 12, 1994

Mr. Adnan Saad
Michael Baker Jr., Inc.
3601 Eisenhower Avenue, Suite 600
Alexandria, VA 22304

Dear Adnan:

We are submitting additional technical documentation for your review of the Scatter Wash hydrology as requested in a telephone conversation on August 10, 1994. Enclosed are calculations for the determination of split flows at the intersection of 19th Avenue and Deer Valley Road. These split flow calculations have revised the original divert parameters (HEC-1 I.D. 341D) included in our July 6, 1994 submittal. We are also including split flow calculations for Deer Valley Road (HEC-1 I.D. 343D).

Enclosed are calculation for the I-17 and Beardsley Road interchange stage-storage-discharge relationship. This interchange is below grade and collects the diversion of 567 cfs (HEC-1 I.D. BEARD). This diversion was reservoir routed through the depressed interchange using the HEC-1 program. There was sufficient storage to collect the diverted flow with no "break out" from the interchange.

We are including excerpts from our revised HEC-1 model showing the revised diversions for HEC-1 I.D. 341D and 343D, the inclusion of HEC-1 I.D. 349RR2 to model the detention at I-17 and Beardsley Road, and a revised peak discharge summary.

The Arizona Department of Transportation (ADOT) is currently reviewing the necessary technical documentation to develop a letter for FEMA that addresses the intent, design criteria, and maintenance plan for Detention Basins C and D (HEC-1 I.D. 344RR and 343RR). Once we received this letter, we will fax this you.

If you have any questions, please call me.

Very truly yours,

KAMINSKI-HUBBARD ENGINEERING, INC.

Darryl L. Bradley

Darryl L. Bradley, P.E.

4550 N. BLACK CANYON HWY., SUITE C • PHOENIX, ARIZONA 85017 • (602) 242-5588

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

 413      UI    40.   152.   232.   336.   466.   328.   231.   143.    68.    44.
 414      UI    18.    12.    12.     0.     0.     0.     0.     0.     0.     0.
 415      UI     0.     0.     0.     0.     0.     0.     0.     0.     0.     0.

 416      KK  DT327
 417      KM  THROW AWAY 10-YR 2-HR RETENTION VOLUME:  1) 1.7 AC-FT FROM SUB-BASIN 327
 418      KM                                             (Hydrograph identified as OR327)
 419      KM                                          2) Balance of runoff continues on.
 420      KM                                             (Hydrograph identified as DT327)
 421      DT  OR327    1.7
 422      DI     0  10000
 423      DQ     0  10000

 424      KK  HC327
 425      KM  COMBINE HYDROGRAPHS FROM SUB-BASIN 327 WITH OVERFLOW FROM 326
 426      HC    2

 427      KK  327RE
 428      KM  DIVERT FLOW ACROSS I-17 THROUGH 65"x40" CMP AT ADOBE DR.
 429      KM  SOURCE:  Scatter Wash Drainage and Storm Drain Study - Conceptual Plan
 430      KM           Prepared for the City of Phoenix Engineering Dept., Floodplain
 431      KM           Management, ST-886366, September 1989, by Greiner, Inc.
 432      DT  334D1
 433      DI     0    115    116   1000   3000
 434      DQ     1    115    115    115    115

 435      KK   330S
 436      KM  RUNOFF GENERATED ON SUB-BASIN 330
 437      KM   THE FOLLOWING PARAMETERS WERE PROVIDED FOR THIS BASIN
 438      KM   L= 1.67 mi.  Lca= 0.87 mi.  S= 28 ft/mi  Kn= .024  LAG= 21.15 min.
 439      KM   PHOENIX VALLEY S-GRAPH WAS USED FOR THIS BASIN
 440      BA   .310
 441      LG   .192   .272   3.77   .325   36.43
 442      UI    49.   153.   259.   341.   517.   541.   390.   288.   197.    96.
 443      UI    69.    43.    15.    15.    15.     0.     0.     0.     0.     0.
 444      UI     0.     0.     0.     0.     0.     0.     0.     0.     0.     0.

 445      KK  DT330
 446      KM  THROW AWAY 10-YR 2-HR RETENTION VOLUME:  1) 1.9 AC-FT FROM SUB-BASIN 330
 447      KM                                             (Hydrograph identified as OR330)
 448      KM                                          2) Balance of runoff continues on.
 449      KM                                             (Hydrograph identified as DT330)
 450      DT  OR330    1.9
 451      DI     0  10000
 452      DQ     0  10000

 453      KK  330R1
 454      KM  DIVERT FLOW SOUTH ALONG 19TH AVENUE AT DEER VALLEY RD.
 455      DT   341D
          * DI     0     70    100    200    300    400    500
          * DQ     0      0     20     80    140    200    260
 456      DI     0   145   418  2248  4002
 457      DQ     0     0   121   550  1220
```

Revised Diversion @ 19th Avenue & Deer Valley Rd.

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
  458     KK  330R2
  459     KM  DIVERT FLOW SOUTH INTO SUB-BASIN 343.  THIS DIVERT IS USED TO SIMULATE
  460     KM  THE CROWN OVERTOPPING OF DEER VALLEY RD.
  461     DT   343D
          * DI    0     70    100    200    300    400
          * DQ    0      0     20     80    140    200
  462     DI      0     55    328    746
  463     DQ      0      0    241    487

  464     KK  RM330
  465     KM  MUSKINGUM-CUNGE ROUTE OVERFLOW FROM SUB-BASIN 330 THROUGH 331
  466     KM          1) Reach Length = 3850 ft.
  467     RD
  468     RC  .020   .020   .030   3850   .0057
  469     RX    0     .5   45.5   45.5   50.5   55.5   60.5   60.5
  470     RY    5     3    2.3    2.8    2.8     3      4      5

  471     KK   331S
  472     KM  RUNOFF GENERATED ON SUB-BASIN 331
  473     KM   THE FOLLOWING PARAMETERS WERE PROVIDED FOR THIS BASIN
  474     KM   L= 1.25 mi.  Lca= 0.32 mi.  S= 35 ft/mi.  Kn= .027  LAG= 13.97 min.
  475     KM   PHOENIX VALLEY S-GRAPH WAS USED FOR THIS BASIN
  476     BA    .22
  477     LG   .141   .171   8.28   .078   68.37
  478     UI    77.   256.   409.   596.   384.   228.    94.    46.    16.    16.
  479     UI     0.    0.    0.     0.     0.     0.     0.     0.     0.     0.
  480     UI     0.    0.    0.     0.     0.     0.     0.     0.     0.     0.

  481     KK  DT331
  482     KM  THROW AWAY 10-YR 2-HR RETENTION VOLUME:  1) 1.6 AC-FT FROM SUB-BASIN 331
  483     KM                                             (Hydrograph identified as OR331)
  484     KM                                           2) Balance of runoff continues on.
  485     KM                                             (Hydrograph identified as DT331)
  486     DT  OR331    1.6
  487     DI      0  10000
  488     DQ      0  10000

  489     KK  HC331
  490     KM  COMBINE HYDROGRAPHS FROM SUB-BASIN 331 WITH OVERFLOW FROM 327 & 330.
  491     HC      3

  492     KK  331RE
  493     KM  DIVERT FLOW ACROSS I-17 THROUGH 6x3 RCBC AT LOUISE DR.
  494     KM  DI REPRESENTS TOTAL FLOW TO DEPRESSED INTERCHANGE AT DEER VALLEY RD.
  495     KM  SOURCE:  Scatter Wash Drainage and Storm Drain Study - Conceptual Plan
  496     KM           Prepared for the City of Phoenix Engineering Dept., Floodplain
  497     KM           Management, ST-886366, September 1989, by Greiner, Inc.
  498     DT  334D2
  499     DI      0      1    156    157   1000   3000
  500     DQ      0      1    156    156    156    156
```

Revised Divert Option

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

 854      KK   HC348
 855      KM   COMBINE HYDROGRAPHS FROM SUB-BASIN 348 WITH ROUTED FLOW FROM 347
 856      HC      2

 857      KK   HCSKB
 858      KM   COMBINE HYDROGRAPHS FROM SKUNK CREEK WITH SCATTER WASH
 859      HC      2
 860      ZW    A=SKUNK CREEK  B=HCSKB  C=FLOW  F=SCATTER WASH

 861      KK    R330
 862      KM   RETRIEVE DIVERTED HYDROGRAPH FROM DEER VALLEY ROAD AND 19TH AVENUE.   THIS
 863      KM   HYDROGRAPH WILL BE STORED IN FILENAME:  CCW324.DSS FOR RETRIEVAL AS PART OF
 864      KM   THE WATERSHED CONTRIBUTING TO SKUNK CREEK.
 865      DR    341D
 866      ZW    A=SKUNK CREEK  B=R330  C=FLOW  F=SCATTER WASH

 867      KK  RBEARD
 868      KM    RETRIEVE DIVERTED FLOW INTO BEARDSLEY ROAD - I-17 INTERCHANGE
 869      DR    BEARD

 870      KK  349RR2
 871      KM    ROUTE FLOW THROUGH BEARDSLEY ROAD & I-17 INTERCHANGE
          * KO     1
 872      RS       1    STOR       0
 873      SV       0      .5     3.5     8.3    23.1    46.0    62.3    82.1
 874      SE    1367    1368    1370    1372    1376    1380    1382    1384
 875      SQ       0       0       0       0       0       0    5804   31500
 876      ZZ
```

I-17 & Beardsley Rd. Stage - Storage - Discharge Relationship

Revised Peak Discharge Summary

9-9-94

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

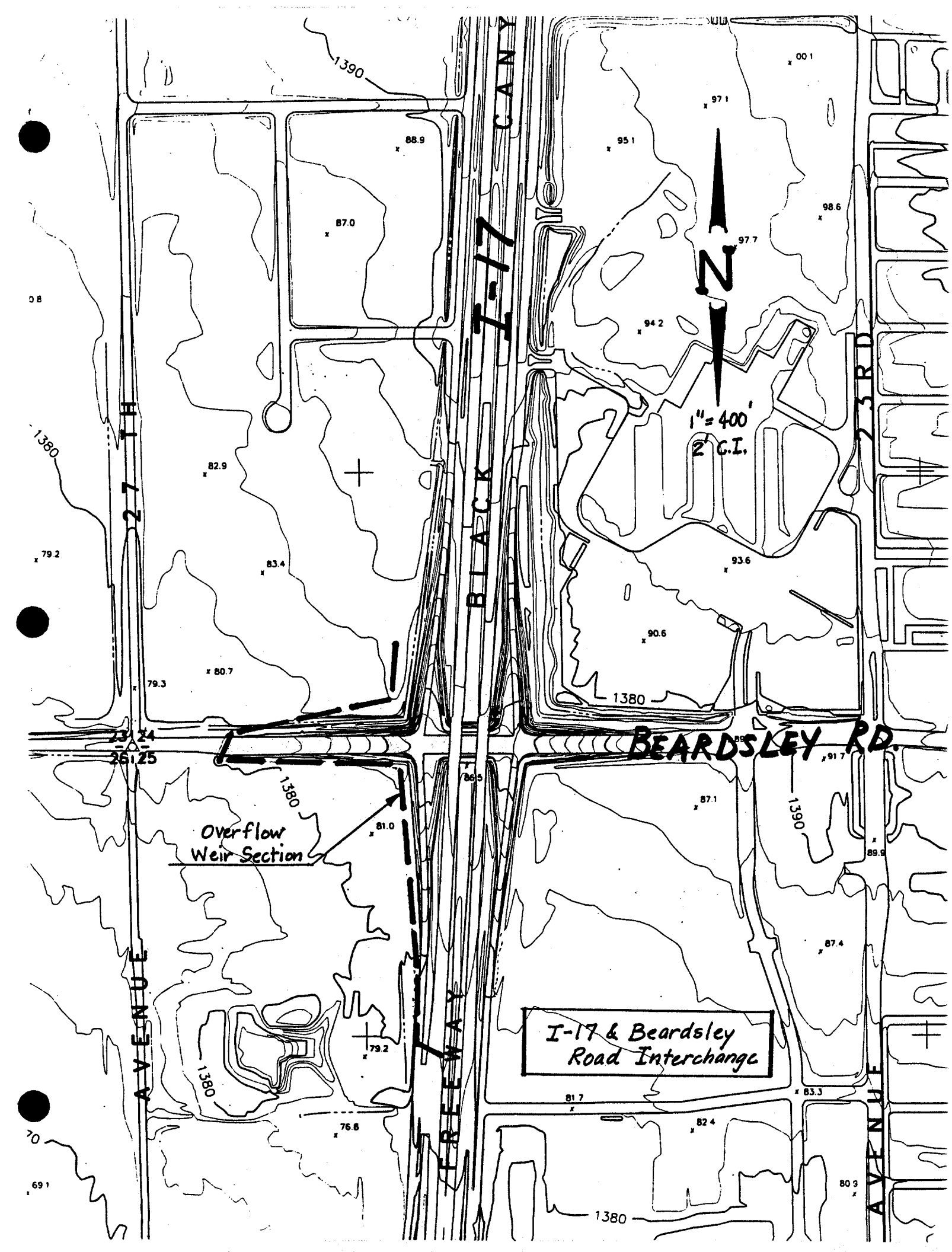
OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
HYDROGRAPH AT	310S	994.	12.13	125.	32.	11.	0.68		
HYDROGRAPH AT	311S	754.	12.20	93.	24.	9.	0.57		
2 COMBINED AT	HC311	1737.	12.20	217.	56.	20.	1.25		
ROUTED TO	311RR	214.	12.93	110.	51.	18.	1.25		
ROUTED TO	RM311	213.	13.47	110.	51.	18.	1.25		
HYDROGRAPH AT	312S	1529.	12.33	218.	55.	20.	1.35		
2 COMBINED AT	HC312	1525.	12.33	312.	105..	38.	2.60		
ROUTED TO	RM312	1497.	12.73	311.	105.	38.	2.60		
HYDROGRAPH AT	315S	811.	12.07	87.	23.	8.	0.51		
ROUTED TO	315RR	55.	12.87	51.	22.	8.	0.51		
ROUTED TO	RM315	58.	12.53	51.	22.	8.	0.51		
HYDROGRAPH AT	316S	827.	12.20	94.	23.	8.	0.67		
2 COMBINED AT	HC316	825.	12.20	137.	45.	16.	1.18		
ROUTED TO	RM316	798.	12.67	136.	46.	16.	1.18		
HYDROGRAPH AT	317S	968.	12.13	115.	31.	11.	0.70		
HYDROGRAPH AT	318S	626.	12.33	90.	24.	9.	0.54		
2 COMBINED AT	HC317	1543.	12.20	204.	54.	20.	1.25		
ROUTED TO	317RR	100.	13.13	92.	49.	18.	1.25		
ROUTED TO	RM317	100.	13.40	92.	49.	18.	1.25		
HYDROGRAPH AT	319S	433.	12.13	43.	11.	4.	0.34		
2 COMBINED AT	HC319	430.	12.13	125.	60.	22.	1.59		
ROUTED TO	RM319	406.	12.80	123.	60.	22.	1.59		
HYDROGRAPH AT	314S	912.	12.27	108.	28.	10.	0.85		
4 COMBINED AT	HC314	2866.	12.67	647.	233.	84.	6.21		
ROUTED TO	314RR	2336.	12.93	646.	233.	84.	6.21		
ROUTED TO	RM314	2297.	13.00	646.	233.	84.	6.21		
HYDROGRAPH AT	320S	1369.	12.27	178.	47.	17.	1.11		
DIVERSION TO	OR320	4.	7.67	3.	1.	0.	1.11		
HYDROGRAPH AT	DT320	1369.	12.27	178.	46.	17.	1.11		

ROUTED TO	320RR	112.	13.07	103.	44.	16.	1.11
DIVERSION TO	325D	46.	13.07	43.	18.	7.	1.11
HYDROGRAPH AT	320RE	66.	13.07	61.	25.	9.	1.11
ROUTED TO	RM320	68.	13.13	61.	25.	9.	1.11
HYDROGRAPH AT	321S	978.	12.40	133.	34.	12.	1.12
2 COMBINED AT	HC321	975.	12.40	180.	59.	21.	2.23
ROUTED TO	RM321	960.	12.60	179.	59.	21.	2.23
HYDROGRAPH AT	323S	162.	12.07	18.	5.	2.	0.11
ROUTED TO	323RR	51.	12.33	18.	5.	2.	0.11
ROUTED TO	RM323	51.	12.87	18.	5.	2.	0.11
HYDROGRAPH AT	322S	443.	12.07	45.	12.	4.	0.34
DIVERSION TO	OR322	4.	11.00	2.	1.	0.	0.34
HYDROGRAPH AT	DT322	443.	12.07	45.	11.	4.	0.34
4 COMBINED AT	HC322	2642.	12.93	867.	304.	110.	8.89
ROUTED TO	322RR	2360.	13.20	867.	304.	110.	8.89
DIVERSION TO	333D1	1263.	13.20	712.	265.	96.	8.89
HYDROGRAPH AT	322RE	1097.	13.20	155.	39.	14.	8.89
DIVERSION TO	332D	152.	13.20	14.	3.	1.	8.89
HYDROGRAPH AT	326D	945.	13.20	141.	35.	13.	8.89
HYDROGRAPH AT	325RD	46.	13.07	43.	18.	7.	1.11
ROUTED TO	RM320	62.	13.20	43.	18.	7.	1.11
HYDROGRAPH AT	325S	570.	12.20	64.	17.	6.	0.50
2 COMBINED AT	HC325	570.	12.20	96.	35.	13.	0.50
ROUTED TO	RM325	566.	12.47	95.	35.	13.	0.50
HYDROGRAPH AT	326S	467.	12.33	65.	18.	7.	0.50
DIVERSION TO	OR326	103.	11.80	8.	2.	1.	0.50
HYDROGRAPH AT	DT326	467.	12.33	61.	16.	6.	0.50
3 COMBINED AT	HC326	1071.	13.13	288.	84.	30.	9.89
DIVERSION TO	333D2	510.	12.20	201.	62.	23.	9.89
HYDROGRAPH AT	326RE	561.	13.13	87.	22.	8.	9.89
HYDROGRAPH AT	327S	347.	12.07	45.	15.	5.	0.22
DIVERSION TO	OR327	5.	6.13	3.	1.	0.	0.22
HYDROGRAPH AT	DT327	347.	12.07	45.	14.	5.	0.22

2 COMBINED AT	HC327	578.	12.40	130.	35.	13.	10.10
DIVERSION TO	334D1	115.	11.80	45.	14.	5.	10.10
HYDROGRAPH AT	327RE	463.	12.40	85.	21.	8.	10.10
HYDROGRAPH AT	330S	452.	12.13	59.	18.	7.	0.31
DIVERSION TO	OR330	5.	6.27	4.	1.	0.	0.31
HYDROGRAPH AT	DT330	452.	12.13	59.	17.	6.	0.31
DIVERSION TO	341D	129.	12.13	10.	2.	1.	0.31
HYDROGRAPH AT	330R1	323.	12.13	49.	15.	5.	0.31
DIVERSION TO	343D	237.	12.13	23.	6.	2.	0.31
HYDROGRAPH AT	330R2	87.	12.13	26.	9.	3.	0.31
ROUTED TO	RM330	87.	12.27	26.	9.	3.	0.31
HYDROGRAPH AT	331S	407.	12.00	58.	19.	7.	0.22
DIVERSION TO	OR331	6.	4.33	3.	1.	0.	0.22
HYDROGRAPH AT	DT331	407.	12.00	58.	18.	7.	0.22
3 COMBINED AT	HC331	684.	12.27	164.	47.	17.	10.63
DIVERSION TO	334D2	156.	11.73	70.	24.	9.	10.63
HYDROGRAPH AT	331RE	528.	12.27	94.	23.	8.	10.63
HYDROGRAPH AT	R332	152.	13.20	14.	3.	1.	8.89
HYDROGRAPH AT	332S	177.	12.00	24.	7.	3.	0.09
DIVERSION TO	OR332	2.	2.80	1.	0.	0.	0.09
HYDROGRAPH AT	DT332	177.	12.00	24.	7.	3.	0.09
3 COMBINED AT	HC332	674.	12.00	130.	34.	12.	10.73
ROUTED TO	332RR	311.	13.33	21.	6.	3.	10.73
ROUTED TO	RM332	273.	13.87	21.	6.	3.	10.73
HYDROGRAPH AT	R322	1263.	13.20	712.	265.	96.	8.89
HYDROGRAPH AT	R326	510.	12.20	201.	62.	23.	9.89
HYDROGRAPH AT	333S	504.	12.40	78.	21.	8.	0.53
3 COMBINED AT	HC333	2050.	12.53	1007.	357.	129.	0.53
ROUTED TO	RM333	2031.	12.73	1005.	357.	129.	0.53
HYDROGRAPH AT	R327	115.	11.80	45.	14.	5.	10.10
ROUTED TO	RM327	122.	12.13	45.	14.	5.	10.10
HYDROGRAPH AT	R331	156.	11.73	70.	24.	9.	10.63
ROUTED TO	RM331	156.	12.80	70.	24.	9.	10.63

HYDROGRAPH AT	334S	1182.	12.00	142.	42.	15.	0.66
DIVERSION TO	OR334	7.	1.00	2.	0.	0.	0.66
HYDROGRAPH AT	DT334	1182.	12.00	142.	42.	15.	0.66
4 COMBINED AT	HC334	2411.	12.67	1221.	433.	158.	1.19
ROUTED TO	RM334	2399.	12.87	1220.	433.	158.	1.19
HYDROGRAPH AT	335S	756.	12.07	93.	25.	9.	0.46
DIVERSION TO	OR335	72.	11.60	8.	2.	1.	0.46
HYDROGRAPH AT	DT335	756.	12.07	89.	23.	8.	0.46
3 COMBINED AT	HC335	2410.	12.87	1276.	442.	161.	12.38
ROUTED TO	RM335	2404.	13.07	1274.	442.	161.	12.38
HYDROGRAPH AT	343S	570.	12.07	83.	25.	9.	0.32
DIVERSION TO	OR343	23.	10.60	10.	3.	1.	0.32
HYDROGRAPH AT	DT343	570.	12.07	82.	22.	8.	0.32
ROUTED TO	343RR	80.	12.80	45.	22.	8.	0.32
ROUTED TO	RM343	79.	12.87	45.	22.	8.	0.32
HYDROGRAPH AT	349S	658.	12.07	105.	32.	12.	0.37
DIVERSION TO	OR349	34.	10.47	12.	4.	1.	0.37
HYDROGRAPH AT	DT349	658.	12.07	103.	29.	10.	0.37
ROUTED TO	349RR	657.	12.07	103.	29.	10.	0.37
DIVERSION TO	BEARD	567.	12.07	49.	12.	4.	0.37
HYDROGRAPH AT	349RE	90.	11.87	54.	17.	6.	0.37
2 COMBINED AT	HC349	167.	12.87	95.	39.	14.	0.69
ROUTED TO	RM344A	162.	13.00	95.	39.	14.	0.69
ROUTED TO	RM344B	162.	13.07	95.	39.	14.	0.69
HYDROGRAPH AT	344S	805.	12.20	144.	41.	15.	0.55
DIVERSION TO	OR344	31.	10.53	9.	3.	1.	0.55
HYDROGRAPH AT	DT344	805.	12.20	143.	38.	14.	0.55
2 COMBINED AT	HC344U	925.	12.27	234.	76.	28.	1.25
DIVERSION TO	344RE	250.	11.73	157.	57.	21.	1.25
HYDROGRAPH AT	344D	675.	12.27	77.	19.	7.	1.25
ROUTED TO	344RR	92.	12.93	67.	18.	7.	1.25
HYDROGRAPH AT	R344RE	250.	11.73	157.	57.	21.	1.25
2 COMBINED AT	HC344D	342.	12.93	218.	75.	27.	1.25

ROUTED TO	RM344	342.	12.93	218.	75.	27.	1.25
HYDROGRAPH AT	345S	470.	12.07	57.	18.	6.	0.30
3 COMBINED AT	HC345	2750.	13.07	1510.	524.	191.	13.92
ROUTED TO	RM345	2730.	13.47	1509.	524.	191.	13.92
HYDROGRAPH AT	346S	509.	12.20	69.	20.	7.	0.40
2 COMBINED AT	HC346	2742.	13.47	1547.	541.	197.	14.32
HYDROGRAPH AT	AD1	1730.	0.07	1730.	1730.	1730.	0.10
ROUTED TO	RMAD1	1730.	0.07	1730.	1730.	1730.	0.10
HYDROGRAPH AT	347S	1305.	12.20	173.	50.	18.	1.11
2 COMBINED AT	HC347	3035.	12.20	1903.	1780.	1748.	1.21
ROUTED TO	RM347	3020.	12.33	1903.	1780.	1748.	1.21
HYDROGRAPH AT	348S	58.	12.00	6.	2.	1.	0.05
2 COMBINED AT	HC348	3039.	12.27	1909.	1782.	1749.	1.25
2 COMBINED AT	HCSKB	4715.	12.60	3424.	2313.	1943.	15.58
HYDROGRAPH AT	R330	129.	12.13	10.	2.	1.	0.31
HYDROGRAPH AT	RBEARD	567.	12.07	49.	12.	4.	0.37
ROUTED TO	349RR2	0.	0.07	0.	0.	0.	0.37


1390
88.9
87.0
95.1
97.1
00.1
98.6
97.7
94.2
82.9
79.2
83.4
80.7
79.3
93.6
90.6
1380
N
1" = 400'
2' C.I.
27TH AVENUE
BLACK CANYON FREEWAY I-17
23RD AVENUE
BEARDSLEY RD.
23
24
26
25
1380
1390
Overflow Weir Section
81.0
86.5
87.1
91.7
89.9
87.4
79.2
76.8
81.7
83.3
82.4
80.9
69.1
70
1380
I-17 & Beardsley Road Interchange

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Made by DLB	Date 9-2-94	Job No. 146
Checked by	Date	Sheet No. 1
For Reservoir Route @ I-17 & Beardsley Rd.		

RESERVOIR ROUTING AT I-17 & BEARDSLEY ROAD

1" = 400'
Contour Mapping

Stage (Ft)	Planimeter Reading (in^2)	Average Reading (in^2)	Area (Ac.)	Volume (Ac-Ft)	Storage Volume (Ac-Ft)	Outflow Discharge (cfs)
1367	0	0	0		0	0
				0.50		
	0.27					
1368	0.55	0.273	1.004		0.50	0
	0.82			2.98		
	0.53					
1370	1.07	0.537	1.971		3.48	0
	1.61			4.85		
	0.79					
1372	1.58	0.783	2.877		8.33	0
	2.35			14.72		
	1.19					
1376	2.41	1.220	4.481		23.05	0
	3.66			22.97		
	1.90					
1380	3.81	1.907	7.003		46.02	0
	5.72			16.24		
	2.52					
1382	5.00	2.513	9.232		62.26	5,804
	7.54			19.88		
	2.92					
1384	5.80	2.900	10.652		82.14	31,500
	8.70					

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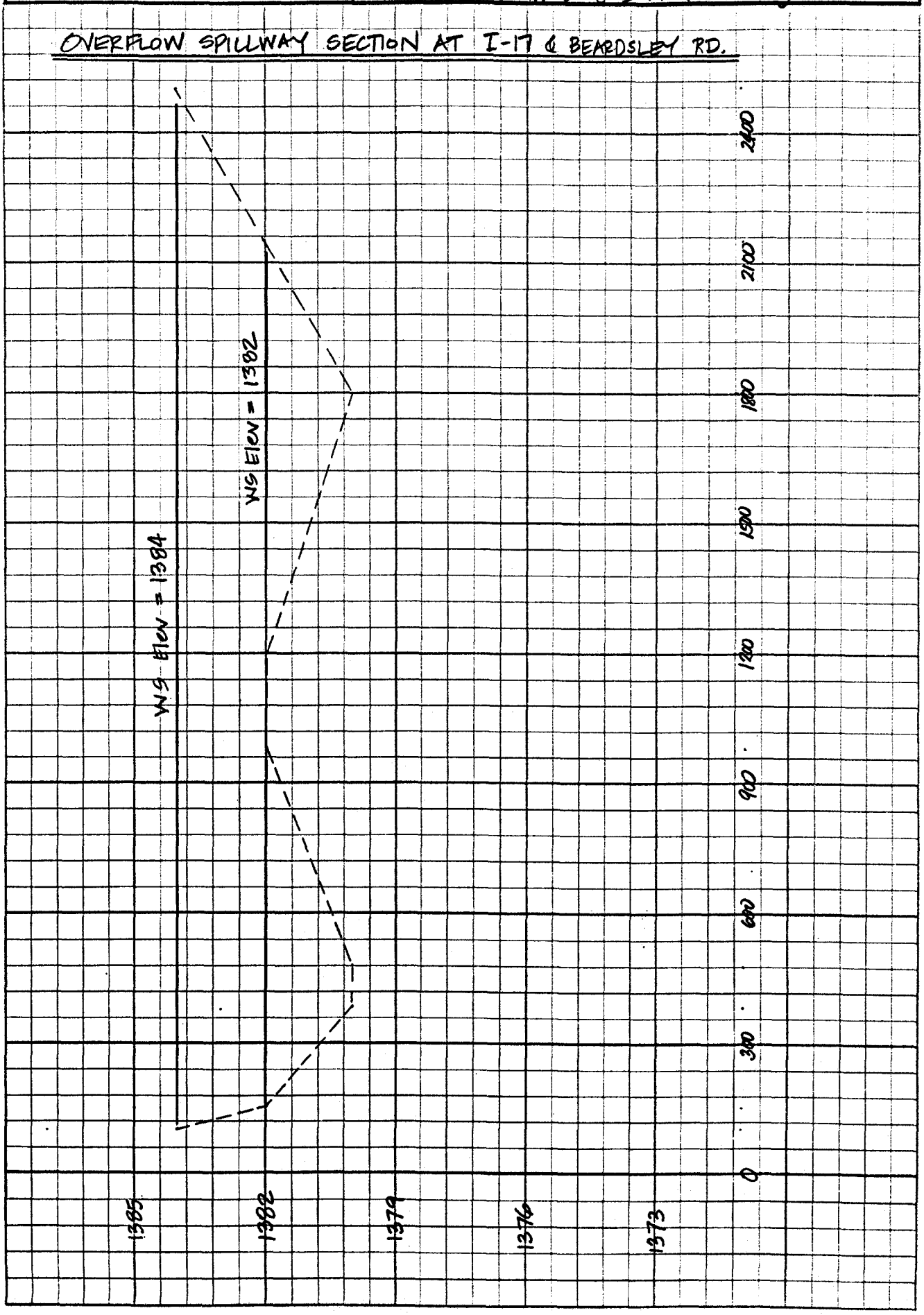
For Reservoir Route @ I-17 & Beardsley Rd.		

OVERFLOW SPILLWAY SECTION AT I-17 & BEARDSLEY RD.



ME101-0374-20M

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Made by DLB	Date 9-2-94	Job No. 146
Checked by	Date	Sheet No. 3
For Reservoir Route @ I-17 & Beardsley Rd.		

Overflow Spillway Calculations

WS Elev. = 1382

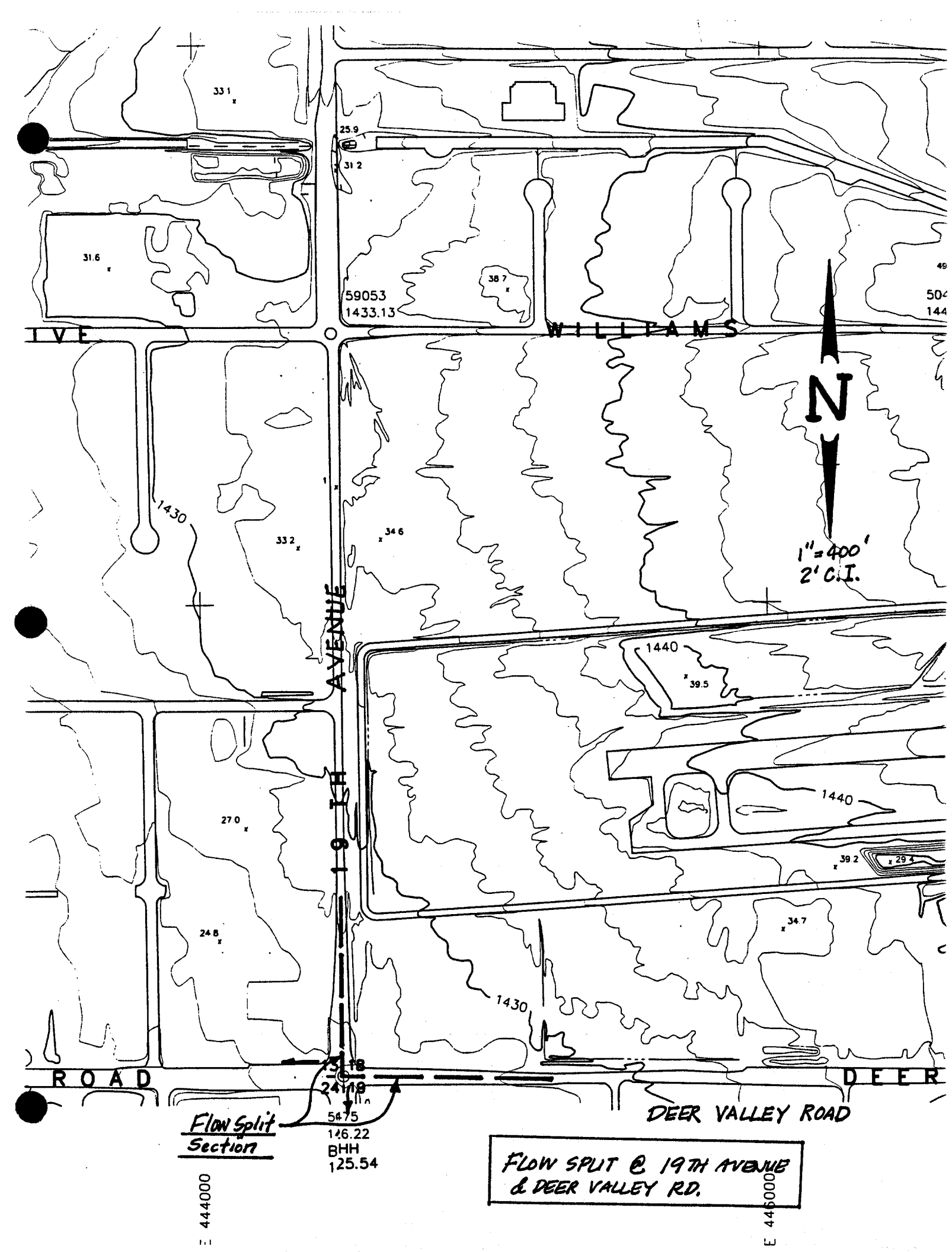
$$Q = (3.0)\left[(230)\left(\tfrac{2}{2}\right)^{1.5} + (90)(2)^{1.5} + (500)\left(\tfrac{2}{2}\right)^{1.5} + (600)\left(\tfrac{2}{2}\right)^{1.5} + (350)\left(\tfrac{2}{2}\right)^{1.5}\right]$$

$$= 5{,}804 \text{ cfs}$$

WS Elev. = 1384

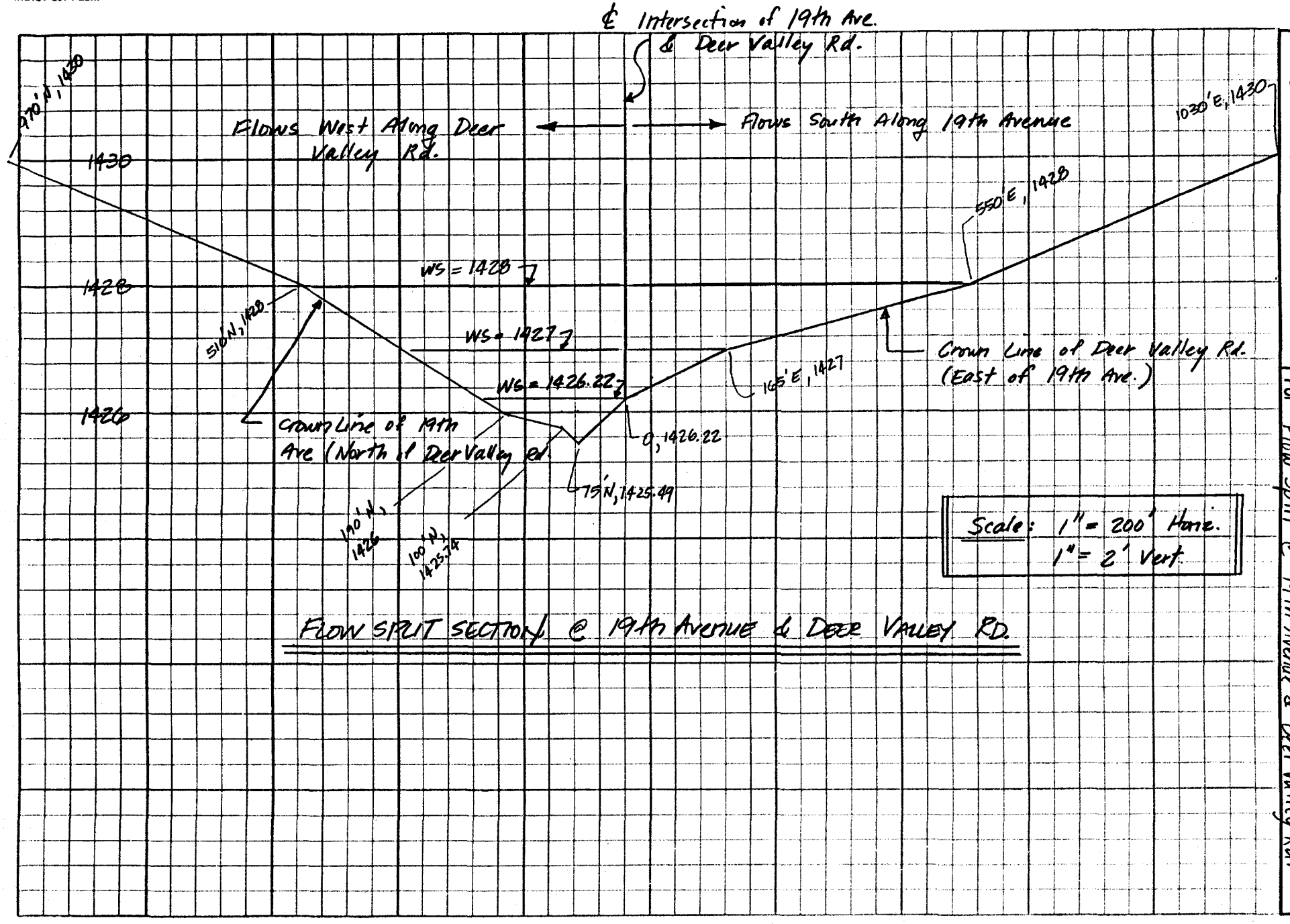
$$Q = (3.0)\left[(50)\left(\tfrac{2}{2}\right)^{1.5} + (230)\left(\tfrac{2+4}{2}\right)^{1.5} + (90)(4)^{1.5} + (500)\left(\tfrac{4+2}{2}\right)^{1.5} + (230)(2)^{1.5} + (600)\left(\tfrac{2+4}{2}\right)^{1.5} + (350)\left(\tfrac{4+2}{2}\right)^{1.5} + (350)\left(\tfrac{2}{2}\right)^{1.5}\right]$$

$$= 31{,}500 \text{ cfs}$$



FLOW SPLIT @ 19TH AVENUE & DEER VALLEY RD.

ME101-0374-20M



FLOW SPLIT SECTION @ 19th Avenue & Deer Valley RD.

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Checked by	Date	Sheet No. 1
For Flow Split @ 19th Avenue & Deer Valley Rd.		Job No. 146

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Made by DLB	Date 9-7-94	Job No. 146
Checked by	Date	Sheet No. 2
For Flow Split @ 19th Avenue & Deer Valley Rd.		

19th Avenue & Deer Valley Road Flow split Calculations

$Q = CLH^{1.5}$ use $C = 3.0$

(1) WS Elev. = 1426.22

$$Q = \Sigma CLH^{1.5} = (3.0)\left[(35)\left(\frac{0.22}{2}\right)^{1.5} + (90)\left(\frac{0.22+0.48}{2}\right)^{1.5} + (25)\left(\frac{0.48+0.73}{2}\right)^{1.5} + (75)\left(\frac{0.73+0}{2}\right)^{1.5}\right]$$

$Q = 145$ cfs (Flow West on Deer Valley Rd.)

$Q = 0$ cfs (Flow South on 19th Avenue)

(2) WS Elev. = 1427

$$Q = (3.0)\left[(160)\left(\frac{1}{2}\right)^{1.5} + (90)\left(\frac{1+1.26}{2}\right)^{1.5} + (25)\left(\frac{1.26+1.51}{2}\right)^{1.5} + (75)\left(\frac{1.51+0.78}{2}\right)^{1.5}\right]$$

$Q = 297$ cfs (Flow West)

$$Q = (3.0)\left[(165)\left(\frac{0.78}{2}\right)^{1.5}\right]$$

$Q = 121$ cfs (Flow South)

(3) WS Elev = 1428

$$Q = (3.0)\left[(320)\left(\frac{2}{2}\right)^{1.5} + (90)\left(\frac{2+2.26}{2}\right)^{1.5} + (25)\left(\frac{2.26+2.51}{2}\right)^{1.5} + (75)\left(\frac{2.51+1.78}{2}\right)^{1.5}\right]$$

$Q = 2782$ cfs (Flow West)

$$Q = (3.0)\left[(165)\left(\frac{1.78+1.00}{2}\right)^{1.5} + (385)\left(\frac{1}{2}\right)^{1.5}\right]$$

$Q = 1220$ cfs (Flow South)

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Made by DLB	Date 9-7-94	Job No. 146
Checked by	Date	Sheet No. 3
For Flow Split @ 19th Avenue & Deer Valley Rd.		

(4) WS Elev = 1427.5

$$Q = (3.0)\left[(240)\left(\frac{1.5}{2}\right)^{1.5} + (90)\left(\frac{1.5+1.76}{2}\right)^{1.5} + (25)\left(\frac{1.76+2.01}{2}\right)^{1.5} + (75)\left(\frac{2.01+1.28}{2}\right)^{1.5}\right]$$

$Q = 1698$ CFS (Flow West)

$$Q = (3.0)\left[(165)\left(\frac{1.28+0.50}{2}\right)^{1.5} + (357.5)\left(\frac{0.50}{2}\right)^{1.5}\right]$$

$Q = 550$ CFS

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Made by DLB	Date 9-9-94	Job No. 146
Checked by	Date	Sheet No. 1
For Crown Overtopping - Deer Valley Rd.		

FLOW SPLIT ALONG DEER VALLEY ROAD WEST OF 19TH AVENUE

A flow split was analyzed at the intersection of 19th Avenue and Deer Valley Road to determine the magnitude of flows continuing west along Deer Valley Road and South along 19th Avenue from Sub-Basin No. 330. The flow proceeding south along 19th Avenue leaves the Scatter Wash watershed.

The flow continuing west along Deer Valley Road was analyzed for flow splitting because the half street capacity was found to be approximately 55cfs. This flow split was analyzed inorder to determine the magnitude of storm runoff reaching the I-17 and Deer Valley Road Interchange.

A cross-section approximately 200 feet west of 19th Avenue was developed from field surveys to determine the magnitude of flow splits. The cross-section was assumed to be no wider than the street right-of-way, where the sides were extended vertically. Flows north of the Deer Valley Rd. crownline were assumed to continue westerly towards the I-17 interchange. Flows south of the crown line would turn south and proceed to Detention Basin D located within Sub-Basin No. 343.

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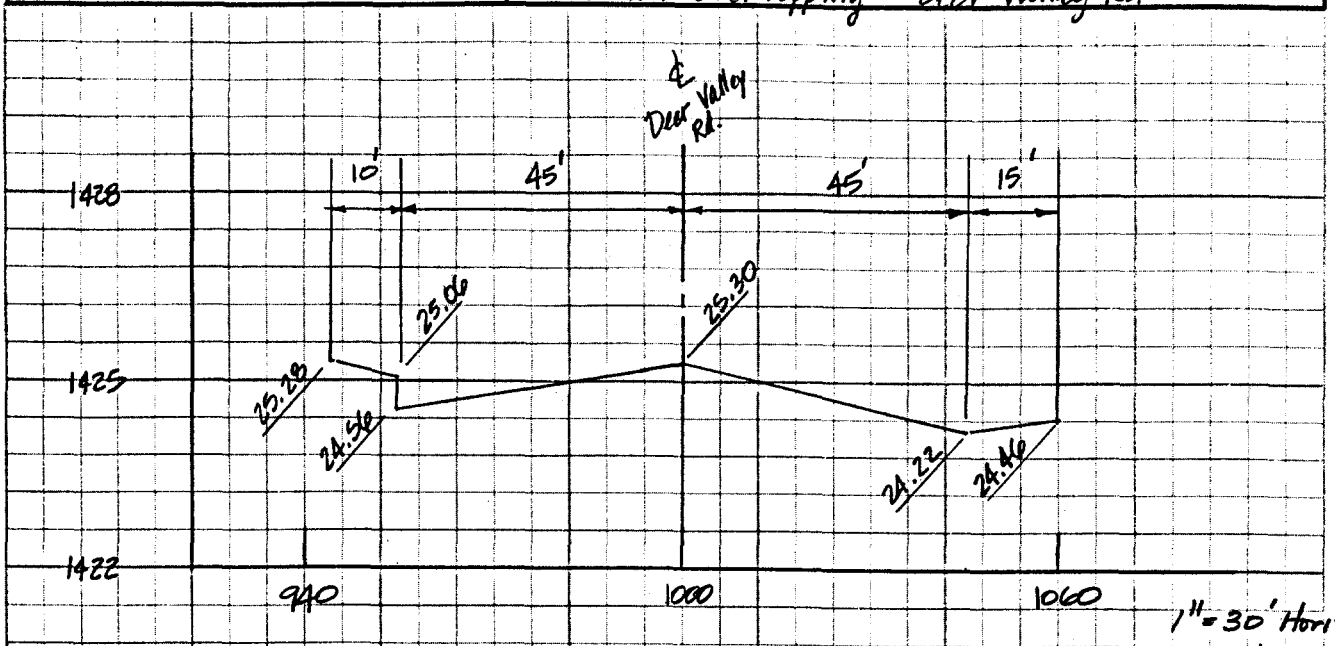
Checked by	Date	Sheet No. 2
For Crown Overtopping - Deer Valley Rd.		



1" = 30' Horiz.
1" = 3' Vert.

DEER VALLEY RD. 200' WEST OF 19TH AVENUE

Channel Slope = 0.0050 ft/ft
Mannings n = 0.016

WS Elev = 1425.30 (Also Half Street Capacity before Crown Overtopping)

Area = $\frac{1}{2}(0.24)(10) + \frac{1}{2}(0.74)(45) = 17.85\ ft^2$
P = 55.5 ft.
R = A/P = 0.32 ft

$Q = \frac{1.486}{0.016}(17.85)(0.32)^{2/3}(0.0050)^{1/2} = 55$ CFS

WS Elev = 1425.80

Flow West: Area = $17.85 + (0.5)(55) = 45.35\ ft^2$
P = 56.0 ft.
R = 0.81 ft

$Q = \frac{1.486}{0.016}(45.35)(0.81)^{2/3}(0.0050)^{1/2} = 259$ CFS

Flow South: Area = $\frac{1}{2}(45)(1.08) + \frac{1}{2}(15)(0.24) + (15)(0.84) + (60)(0.5) = 68.70\ ft$
P = 60 + 1.34 = 61.34 ft
R = 1.12 ft.

$Q = \frac{1.486}{0.016}(68.70)(1.12)^{2/3}(0.0050)^{1/2} = 487$ CFS

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Made by DLB	Date 9-9-94	Job No. 146
Checked by	Date	Sheet No. 3
For Crown Overtopping - Deer Valley Rd.		

WS Elev = 1426.40

Flow West

$Area = 17.85 + (0.1)(55) = 23.35\ ft^2$

$P = 55.6\ ft$

$R = 0.42\ ft$

$Q = \frac{1.486}{0.016}(23.35)(0.42)^{2/3}(0.0050)^{1/2} = 87\ cfs$

Flow south

$Area = \frac{1}{2}(45)(1.08) + \frac{1}{2}(15)(0.24) + (15)(0.84) + (60)(0.1)$

$= 44.70\ ft^2$

$P = 60.1\ ft$

$R = 0.74\ ft$

$Q = \frac{1.486}{0.016}(44.70)(0.74)^{2/3}(0.0050)^{1/2} = 241\ cfs$

Total Flow, Q_I	0	55	328	746
Diverted Flow South	0	0	241	487

APPENDIX F

Rainfall Hydrologic parameters

TABLE 4

Point Precipitation Values For Scatter Wash Study Area (Inches)

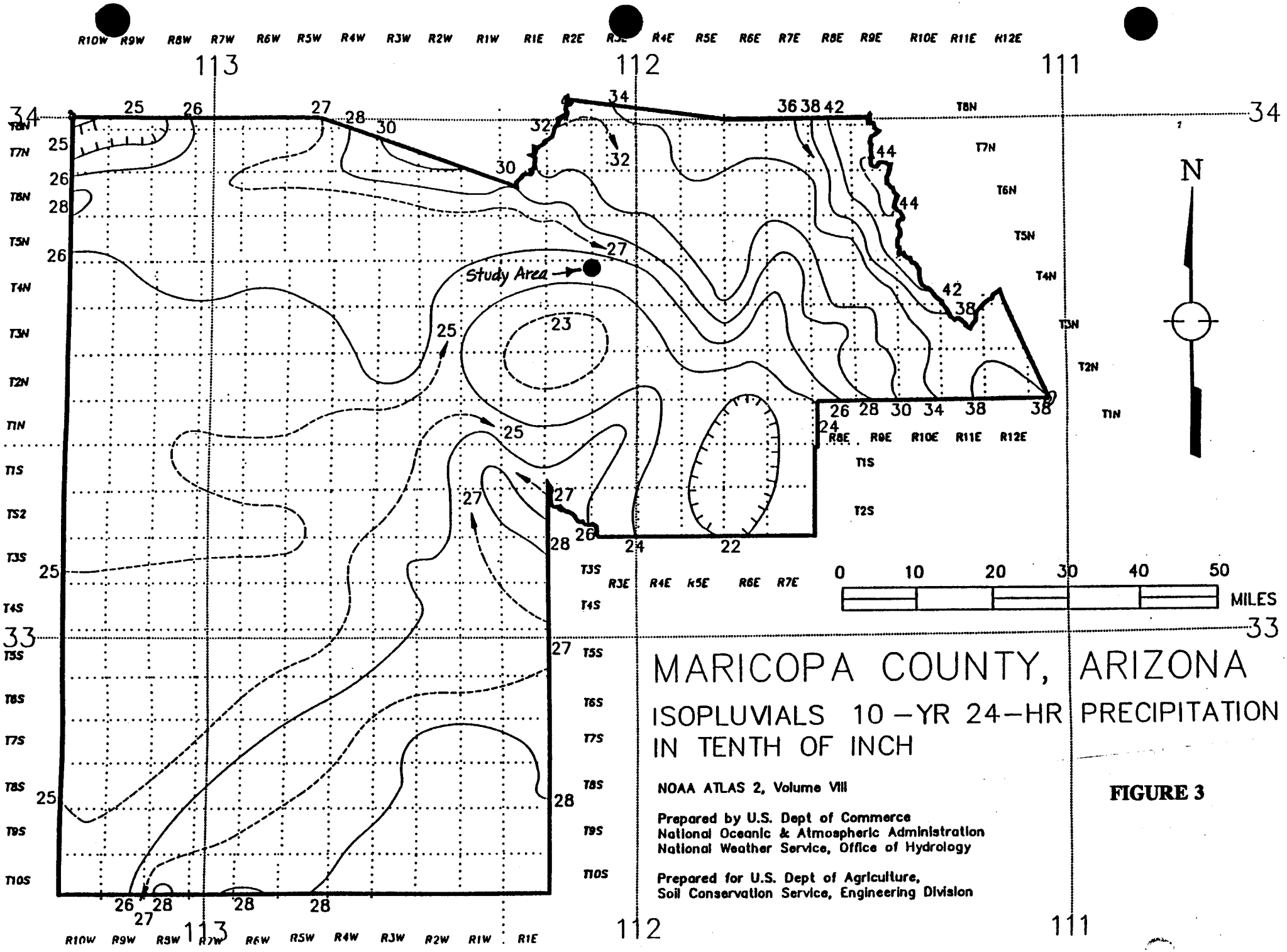
Return Period (Years)	Storm Duration	
	6-Hr.	24-Hr.
10	2.03	2.54
50	2.85	3.56
100	3.20	4.00
500	4.01	5.02

TABLE 5

Depth-Area Reduction Factors For 24-Hour Duration Rainfall (1)

Area (Sq. Mi.)	Ratio To Point Rainfall
0	1.00
3	0.98
10	0.96
20	0.92
30	0.90

(1) Obtained from *Scatter Wash Watershed Hydrology Report*.



MARICOPA COUNTY, ARIZONA

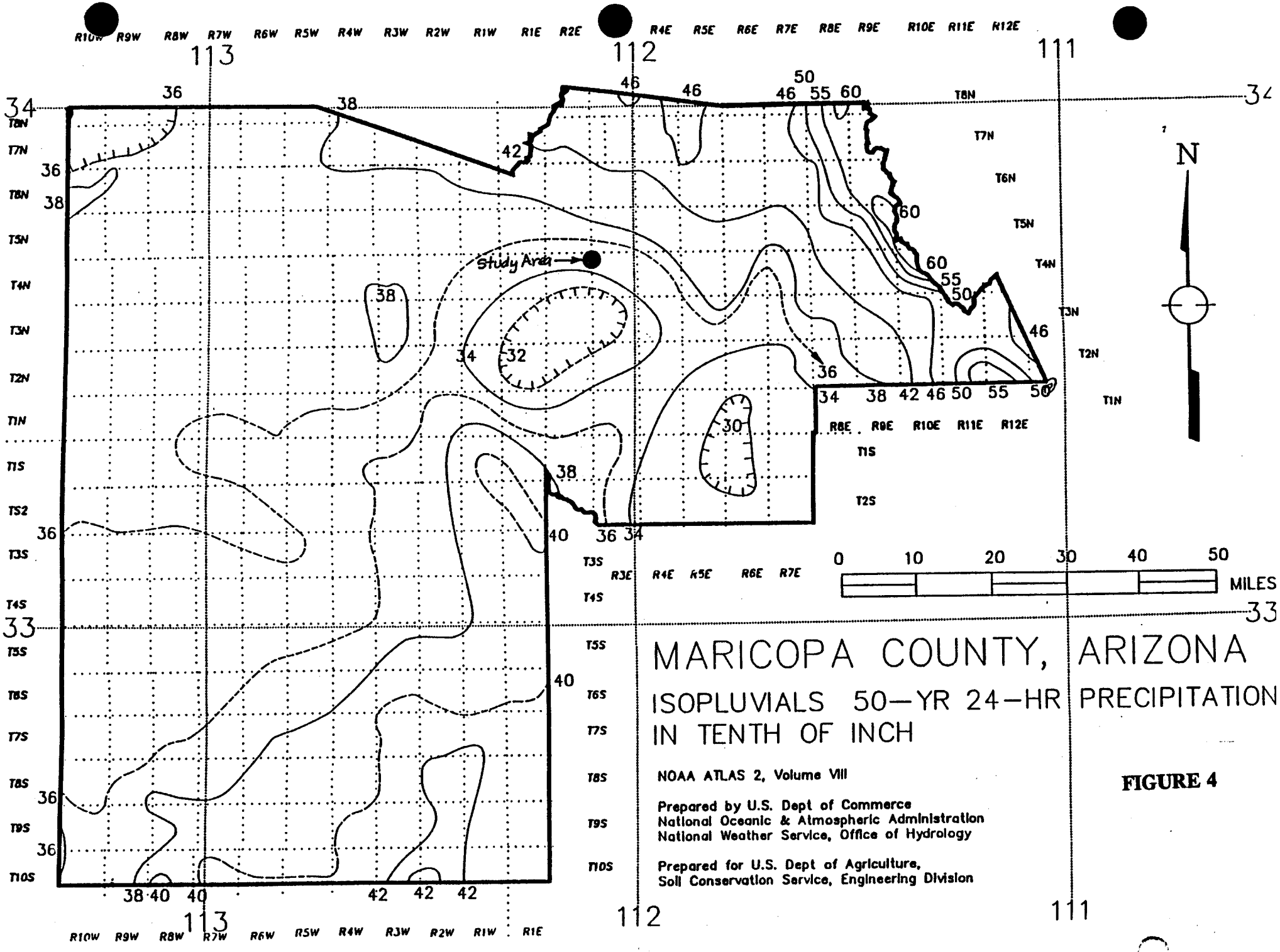
ISOPLUVIALS 10-YR 24-HR PRECIPITATION IN TENTH OF INCH

NOAA ATLAS 2, Volume VIII

Prepared by U.S. Dept of Commerce
National Oceanic & Atmospheric Administration
National Weather Service, Office of Hydrology

Prepared for U.S. Dept of Agriculture,
Soil Conservation Service, Engineering Division

FIGURE 3



MARICOPA COUNTY, ARIZONA

ISOPLUVIALS 50—YR 24—HR PRECIPITATION IN TENTH OF INCH

NOAA ATLAS 2, Volume VIII

Prepared by U.S. Dept of Commerce
National Oceanic & Atmospheric Administration
National Weather Service, Office of Hydrology

Prepared for U.S. Dept of Agriculture,
Soil Conservation Service, Engineering Division

FIGURE 4

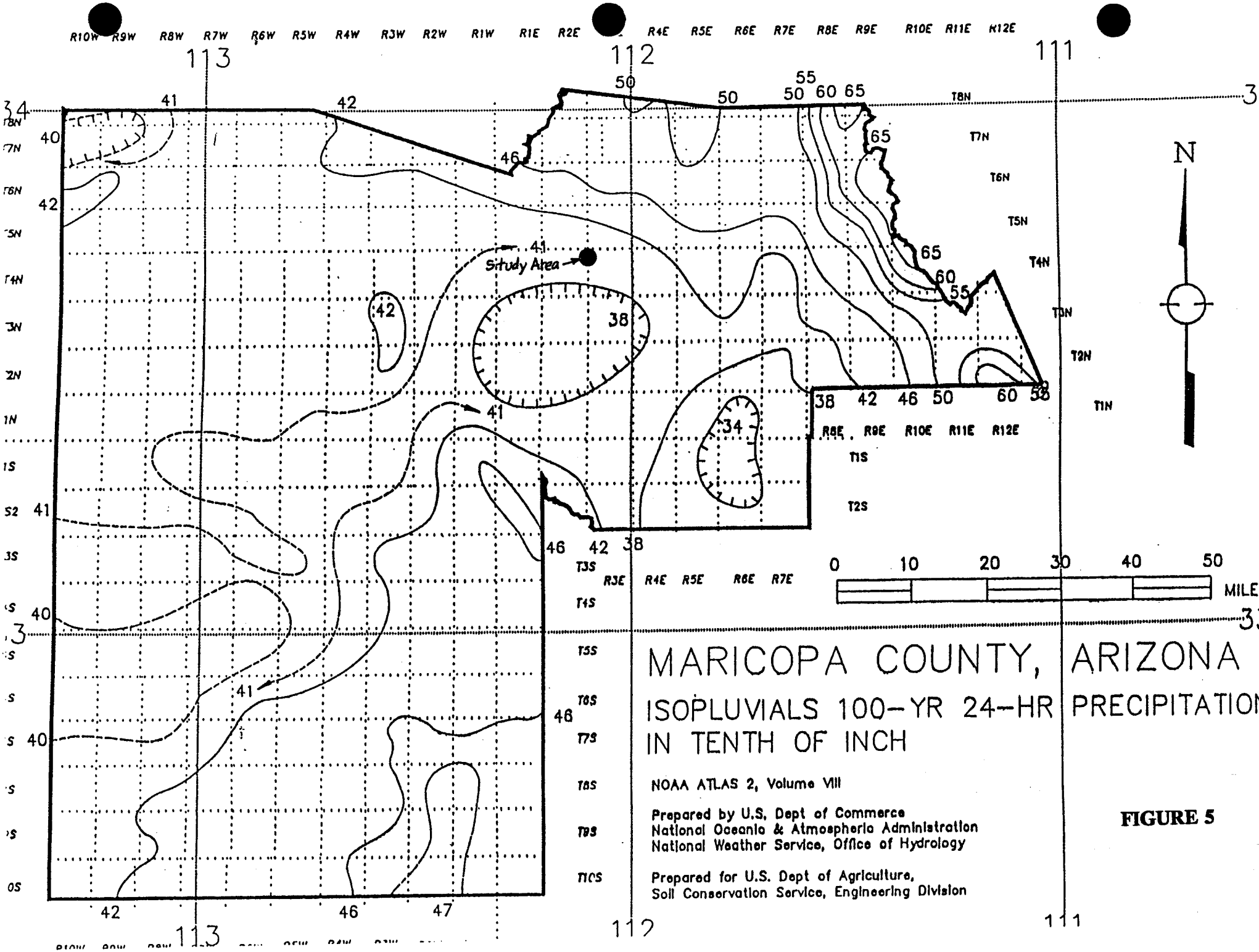

Study Area
N
0 10 20 30 40 50
MILE
MARICOPA COUNTY, ARIZONA
ISOPLUVIALS 100-YR 24-HR PRECIPITATION
IN TENTH OF INCH
NOAA ATLAS 2, Volume VIII
Prepared by U.S. Dept of Commerce
National Oceanic & Atmospheric Administration
National Weather Service, Office of Hydrology
Prepared for U.S. Dept of Agriculture,
Soil Conservation Service, Engineering Division

FIGURE 5

PREFRE Computer Output File

*** O U T P U T D A T A ***
REVISED JUNE 1988 TO UPDATE COMPUTATION OF SHORT-DURATION VALUES

PRECIPITATION FREQUENCY VALUES FOR SCATTER WASH, PHOENIX, ARIZONA
PRIMARY ZONE NUMBER= 7
SHORT-DURATION ZONE NUMBER= 8

POINT VALUES

DURATION	RETURN PERIOD 2-YR	5-YR	10-YR	25-YR	50-YR	100-YR	500-YR	
5-MIN	.30	.41	.48	.58	.65	.73	.90	5-MIN
10-MIN	.46	.62	.73	.88	1.00	1.12	1.39	10-MIN
15-MIN	.55	.77	.92	1.12	1.28	1.43	1.79	15-MIN
30-MIN	.73	1.03	1.24	1.51	1.73	1.94	2.43	30-MIN
1-HR	.89	1.28	1.53	1.89	2.16	2.43	3.05	1-HR
2-HR	1.00	1.42	1.70	2.09	2.39	2.69	3.38	2-HR
3-HR	1.07	1.52	1.82	2.23	2.55	2.87	3.60	3-HR
6-HR	1.20	1.70	2.03	2.49	2.85	3.20	4.01	6-HR
12-HR	1.35	1.91	2.29	2.80	3.20	3.60	4.52	12-HR
24-HR	1.50	2.12	2.54	3.12	3.56	4.00	5.02	24-HR

* IF YOUR SITE IS IN ARIZONA OR NEW MEXICO, PLEASE CONSULT THE
FOLLOWING PAPER FOR REVISED DEPTH-AREA VALUES:
DEPTH-AREA RATIOS IN THE SEMI-ARID SOUTHWEST UNITED STATES
NOAA TECHNICAL MEMORANDUM NWS HYDRO-40
ZEHR AND MYERS
AUGUST 1984

INPUT DATA

PROJECT NAME=SCATTER WASH, PHOENIX, ARIZONA
ZONE= 7 SHORT-DURATION ZONE= 8
LATITUDE= .00 LONGITUDE= 100.00 ELEVATION= 0
2-YR, 6-HR PCPN= 1.20 100-YR, 6-HR PCPN= 3.20
2-YR, 24-HR PCPN= 1.50 100-YR, 24-HR PCPN= 4.00

* * * * E N D OF R U N * * * *

APPENDIX G

Miscellaneous Hydraulic Analysis

PROJECT: Scatter Wash LOMR
ST-951350

STATION: I-17 N 500LF North of Williams Drive

SHEET 1 OF 1

CULVERT DESIGN FORM

DESIGNER / DATE: LThomas / 10/95

REVIEWER / DATE: _____ / _____

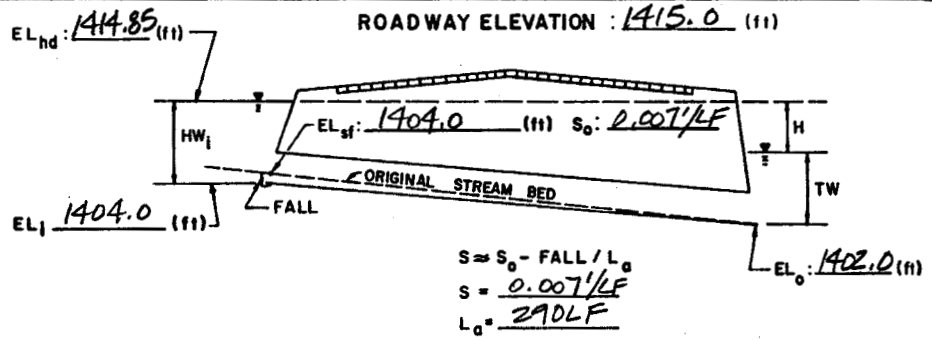
HYDROLOGICAL DATA

SEE ADD'L. SHTS.

- ☐ METHOD: _____
- ☐ DRAINAGE AREA: _____ ☐ STREAM SLOPE: _____
- ☐ CHANNEL SHAPE: _____
- ☐ ROUTING: _____ ☐ OTHER: _____

DESIGN FLOWS/TAILWATER

R.I. (YEARS)	FLOW (cfs)	TW (ft)
100-Year	510	7.0



$S \approx S_o - FALL / L_a$

$S = 0.007'/LF$

$L_a = 290LF$

CULVERT DESCRIPTION: MATERIAL - SHAPE - SIZE - ENTRANCE	TOTAL FLOW Q (cfs)	FLOW PER BARREL Q/N (1)	HEADWATER CALCULATIONS: INLET CONTROL HW_i/D (2)	HW_i	FALL (3)	EL_hi (4)	OUTLET CONTROL TW (5)	d_c	(d_c+D)/2	h_o (6)	k_e	H (7)	EL_ho (8)	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	COMMENTS
1 Barrel - 6'X7' C.B.C.	510	510	1.55	10.85	—	14.85	7'	6.2	6.6	7	0.2	4.21	06.21	14.85	12.14	INLET CONTROL

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS

(2) HW_i/D = HW /D OR HW_t/D FROM DESIGN CHARTS

(3) FALL = $HW_i - (EL_{hd} - EL_{sf})$; FALL IS ZERO FOR CULVERTS ON GRADE

(4) $EL_{hi} = HW_i + EL_i$ (INVERT OF INLET CONTROL SECTION)

(5) TW BASED ON DOWN STREAM CONTROL OR FLOW DEPTH IN CHANNEL.

(6) h_o = TW or $(d_c + D/2)$ (WHICHEVER IS GREATER)

(7) $H = \left[1 + k_e + (29n^2 L)/R^{1.33}\right] V^2/2g$

(8) $EL_{ho} = EL_o + H + h_o$

SUBSCRIPT DEFINITIONS:

a. APPROXIMATE
f. CULVERT FACE
hd. DESIGN HEADWATER
hi. HEADWATER IN INLET CONTROL
ho. HEADWATER IN OUTLET CONTROL
i. INLET CONTROL SECTION
o. OUTLET
sf. STREAMBED AT CULVERT FACE
tw. TAILWATER

COMMENTS / DISCUSSION:

CULVERT BARREL SELECTED:

SIZE: 1- 6'X7' C.B.C

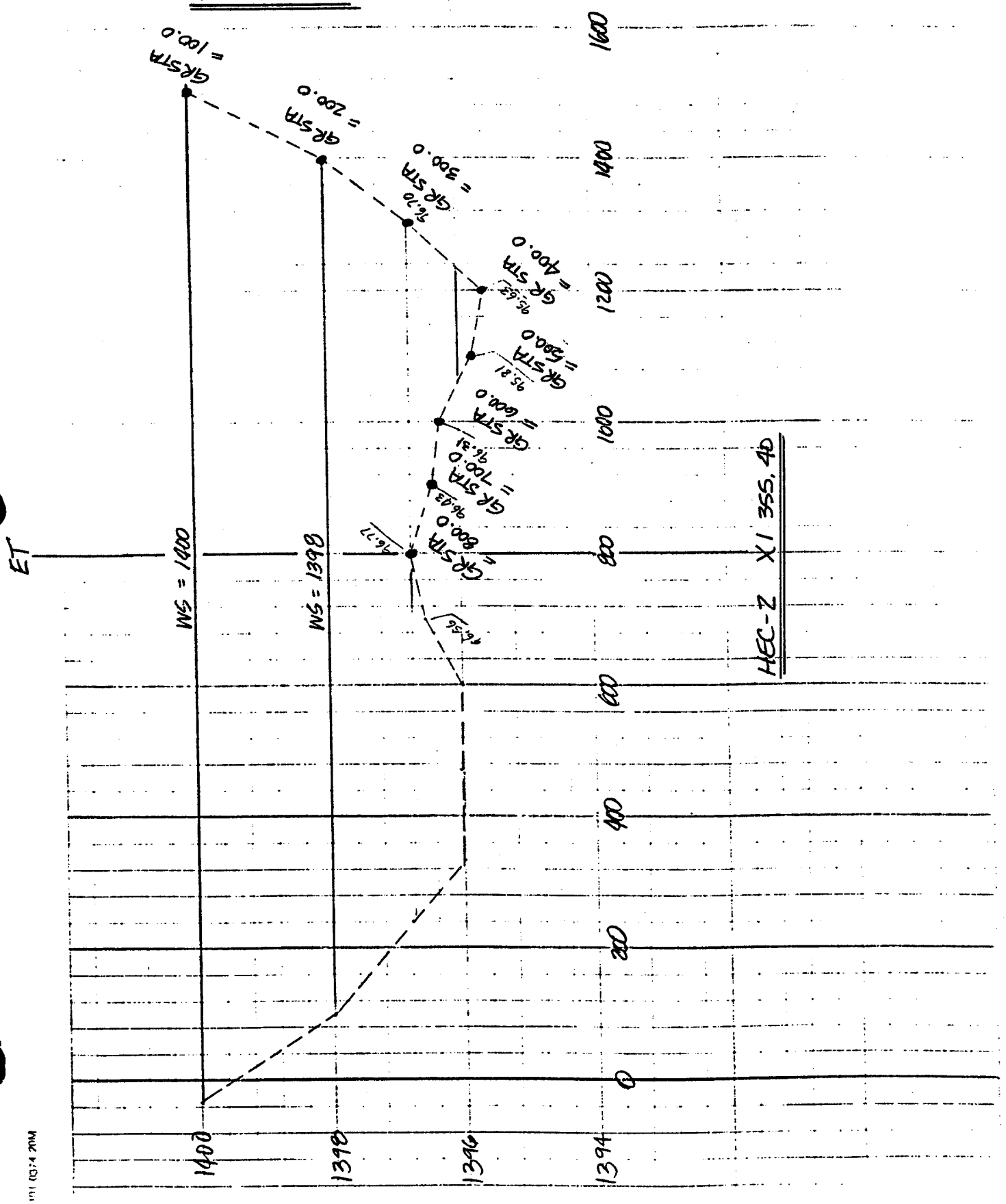
SHAPE: Rectangular Box

MATERIAL: Concrete n 0.012

ENTRANCE: 30 to 75° Wingwall Flare

KAMINSKI HUBBARD engineering inc. • Surveying • Civil • Hydrology	Made by DLB	Date 2-11-94	Job No. 146
	Checked by	Date	Sheet No.
	For HEC-2 Cross-Section	X1 355.40	

Overflow Spillway Section For I-17 & Deer Valley Road T.I.



APPENDIX H

Letter Of Map Revision Forms

FEDERAL EMERGENCY MANAGEMENT AGENCY **REVISION REQUESTOR AND COMMUNITY OFFICIAL FORM**	*O.M.B. Burden No 3067-0148* *Expires July 31, 1994*	*FEMA USE ONLY*

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 2.13 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden, to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

1. OVERVIEW

1. The basis for this revision request is (are): *(check all that apply)*
   - ☒ Physical change
     - ☒ Existing
     - ☐ Proposed
   - ☒ Improved methodology
   - ☒ Improved data
   - ☒ Floodway revision
   - ☐ Other _____

   Explain _____
2. Flooding Source: Scatter Wash
3. Project Name/Identifier: Scatter Wash LOMR ST-951350
4. FEMA zone designations affected: Zone A, Zone AH & Zone AE
   (example: A, AH, AO, A1-A30, A99, AE, V, V1-30, VE, B, C, D, X)
5. The NFIP map panel(s) affected for all impacted communities is (are):

Community No.	Community Name	County	State	Map No.	Panel No.	Effective Date
EX: 480301	Katy,City	Harris, Fort Bend	TX	480301	0005D	02/08/83
480287	Harris County	Harris	TX	48201C	0220G	09/28/90
040051	Phoenix	Maricopa	AZ	04013C	1195	4/15/88
040051	Phoenix	Maricopa	AZ	04013C	1195D	4/15/88
040051	Phoenix	Maricopa	AZ	04013C	1215G	12/3/93
040051	Phoenix	Maricopa	AZ	04013C	1205E	12/3/93

6. The area of revision encompasses the following types of flooding, structures, and associated disciplines: *(check all that apply)*

Types of Flooding	Structures	Disciplines*
☒ Riverine	☒ Channelization	☒ Water Resources
☐ Coastal	☒ Levee/Floodwall	☒ Hydrology
☐ Alluvial Fan	☒ Bridge/Culvert	☒ Hydraulics
☒ Shallow Flooding *(e.g. Zones AO and AH)*	☐ Dam	☒ Sediment Transport
☐ Lakes	☐ Coastal	☒ Interior Drainage
	☐ Fill	☐ Structural
Affected by wind/wave action	☐ Pump Station	☐ Geotechnical
☐ Yes	☐ None	☒ Land Surveying
☒ No	☐ Channel Relocation	☐ Other *(describe)*
	☐ Excavation	
	☐ Other *(describe)*	

☐ Other(describe) _____ _____ _____

*** Attach completed "Certification by Registered Professional Engineer and/or Land Surveyor" Form for each discipline checked. (Form 2)**

2. FLOODWAY INFORMATION

7. Does the affected flooding source have a floodway designated on the effective FIRM or FBFM? ☒ Yes ☐ No
8. Does the revised floodway delineation differ from that shown on the effective FIRM or FBFM ☒ Yes ☐ No

   If yes, give reason: New Hydrology and New Hydraulic Analyses

Attach copy of either a public notice distributed by the community stating the community's intent to revise the floodway or a statement by the community that it has notified all affected property owners and affected adjacent jurisdictions.

9. Does the State have jurisdiction over the floodway or its adoption by communities participating in the NFIP? ☒ Yes ☐ No

If yes, attach a copy of a letter notifying the appropriate State agency of the floodway revision and documentation of the approval of the revised floodway by the appropriate State agency.

3. PROPOSED ENCROACHMENTS

10. With floodways:

1A. Does the revision request involve fill, new construction, substantial improvement, or other development in the floodway? ☒ Yes ☐ No

1B. If yes, does the development cause the 100-year water surface elevation to increase at any location by more than 0.000 feet? ☐ Yes ☒ No

11. Without floodways:

2A. Does the revision request involve fill, new construction, substantial improvement, or other development in the 100-year floodplain? ☒ Yes ☐ No

2B. If yes, does the cumulative effect of all development that has occurred since the effective SFHA was originally identified cause the 100-year water surface elevation to increase at any location by more than one foot (*or other surcharge limit if community or state has adopted more stringent criteria*)? ☐ Yes ☒ No

If the answer to either Items 1B or 2B is yes, please provide documentation that all requirements of Section 65.12 of the NFIP regulations have been met, regarding evaluation of alternatives, notice to individual legal property owners, concurrence of CEO, and certification that no insurable structures are impacted.

4. REVISION REQUESTOR ACKNOWLEDGMENT

12. Having read NFIP Regulations, 44 CFR Ch. I, parts 59, 60, 61, and 72, I believe that the proposed revision ☒ is ☐ is not in compliance with the requirements of the aforementioned NFIP Regulations.

5. COMMUNITY OFFICIAL ACKNOWLEDGMENT

13. Was this revision request reviewed by the community for compliance with the community's adopted floodplain management ordinances? ☒ Yes ☐ No

14. Does this revision request have the endorsement of the community? ☒ Yes ☐ No

If no to either of the above questions, please explain: _____

Please note that community acknowledgment and /or notification is required for all requests as outlined in Section 65.4 (b) of the NFIP Regulations.

6. OPERATION AND MAINTENANCE

15. Does the physical change involve a flood control structure (e.g., levees, floodwalls, channelization, basins, dams)? ☒ Yes ☐ No

If yes, please provide the following information for each of the new flood control structures:

A. Inspection of the flood control project will be conducted periodically by City of Phoenix, AZ (entity) _____ with a maximum interval of 12 months between inspections.

B. Based on the results of scheduled periodic inspections, appropriate maintenance of the flood control facilities will be conducted by City of Phoenix (entity) to ensure the integrity and degree of flood protection of the structure.

C. A formal plan of operation, including documentation of the flood warning system, specific actions and assignments of responsibility by individual name or title, and provisions for testing the plan at intervals not less than one year, ☐ has ☒ has not been prepared for the flood control structure.

D. The community is willing to assume responsibility for ☒ performing ☐ overseeing compliance with the maintenance and operation plans of the Scatter Wash Floodplain & Floodway (Name)

flood control structure. If not performed promptly by an owner other than the community, the community will provide the necessary services without cost to the Federal government.

Attach operation and maintenance plans

7. REQUESTED RESPONSE FROM FEMA

16. After examining the pertinent NFIP regulations and reviewing the document entitled "Appeals, Revisions, and Amendments to Flood Insurance Maps: A guide for Community Officials," dated January 1990, this request is for a:

_____a.	CLOMR	A letter from FEMA commenting on whether a proposed project, if built as proposed, would justify a map revision *(LOMR or PMR)*, or proposed hydrology changes *(see 44 CFR Ch. I, Parts 60, 65, and 72)*.
__X__b.	LOMR	A letter from FEMA officially revising the current NFIP map to show changes to floodplains, floodways, or flood elevations. LOMRs typically depict decreased flood hazards. *(See 44 CFR Ch. I Parts 60 and 65.)*
_____c.	PMR	A reprinted NFIP map incorporating changes to floodplains, floodways, or flood elevations. Because of the time and cost involved to change, reprint, and redistribute an NFIP map, a PMR is usually processed when a revision reflects increased flood hazards or large-scope changes. *(See 44 CFR Ch. I, Parts 60 and 65.)*
_____d.	Other:	Describe_____

8. FORMS INCLUDED *(See Detailed Technical Documentation Notebook)

17. Form 2 entitled, "Certification By Registered Professional Engineer and/or Land Surveyor" must be submitted.

The following forms should be included with this request if (check the included forms):

• Hydrologic analysis for flooding source differs from that used to develop FIRM	☒ Hydrologic Analysis Form (Form 3)
• Hydraulic analysis for riverine flooding differs from that used to develop FIRM	☒ Riverine Hydraulic Analysis Form (Form 4)
• The request is based on updated topographic information or a revised floodplain or floodway delineation is requested	☒ Riverine /Coastal Mapping Form (Form 5)
• The request involves any type of channel modification	☒ Channelization Form (Form 6)
• The request involves new bridge or culvert or revised analysis of an existing bridge or culvert	☒ Bridge/Culvert Form (Form 7)
• The request involves a new revised levee/floodwall system	☐ Levee/Floodwall System Analysis Form (Form 8)
• The request involves analysis of coastal flooding	☐ Coastal Analysis Form (Form 9)
• The request involves coastal structures credited as providing protection from the 100-year flood	☐ Coastal Structures (Form 10)
• The request involves an existing, proposed, or modified dam	☐ Dam Form (Form 11)
• The request involves structures credited as providing protection from the 100-year flood on an alluvial fan	☐ Alluvial Fan Flooding Form (Form 12)

9. INITIAL REVIEW FEE

18. The minimum initial review fee for the appropriate request category has been included. ☐ Yes ☐ No

Initial fee amount: $ _____

METHOD OF PAYMENT (Check one box)

☐ PAYMENT ENCLOSED ☐ VISA ☐ MASTERCARD

Check or money order only.
Make payable to
National Flood Insurance Program

CARD NUMBER

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

EXP. Date

_____ Signature

or

19. This request is for a project that is for public benefit and is intended to reduce the flood hazard to existing development in identified flood hazard areas as opposed to planned floodplain development. ☒ Yes ☐ No

or

20. This request is to correct an error or to include the effects of natural changes within the areas of special flood hazards. ☐ Yes ☐ No

Note: I understand that my signature indicates that all information submitted in support of this request is correct.

Lynn M. Thomas
Signature of Revision Requester

Professional Civil Engineer
Printed Name and Title of Revision Requester

Kaminski-Hubbard Engineering, Inc.
Company Name

October 6, 1995
Date

Note: Signature indicates that the community understands, from the revision requester, the impacts of the revision on flooding conditions in the community.

_____
Signature of Community Official

_____
Printed Name and Title of Community Official

_____
Community Name

_____
Date

Does this request impact any other communities? ☐ Yes ☒ No

If yes, attach letters from all affected jurisdictions acknowledging revision request and approving changes to floodway, if applicable.

Note: Although a photograph of physical changes is not required, it may be helpful for FEMA's review.

FEDERAL EMERGENCY MANAGEMENT AGENCY **CERTIFICATION BY REGISTERED PROFESSIONAL ENGINEER AND/OR LAND SURVEYOR FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1994*	*FEMA USE ONLY*

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average . 23 hour per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden, to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067- 0148), Washington, DC 20503.

1. This certification is in accordance with 44 CFR Ch. I, Section 65.2
2. I am licensed with an expertise in Water Resources
   [example: water resources *(hydrology, hydraulics, sediment transport, interior drainage)** structural, geotechnical, land surveying.]
3. I have 11 years experience in the expertise listed above.
4. I have ☒ prepared ☒ reviewed the attached supporting data and analyses related to my expertise.
5. I ☒ have ☐ have not visited and physically viewed the project.
6. In my opinion, the following analyses and /or designs, is/are being certified:
   Hydrology, Hydraulic and survey analyses
7. Base upon the following review, the modifications in place have been constructed in general accordance with plans and specifications.

   Basis for above statement: (check all that apply)

   a. ☐ Viewed all phases of actual construction.
   b. ☐ Compared plans and specifications with as-built survey information.
   c. ☒ Examined plans and specifications and compared with completed projects.
   d. ☐ Other _____
8. All information submitted in support of this request is correct to the best of my knowledge. I understand that any false statement may be punishable by fine or imprisonment under Title 18 of the United States Code, Section 1001.

Name: Lynn M. Thomas, P.E.
(please print or type)

Title: Professional Civil Engineer
(please print or type)

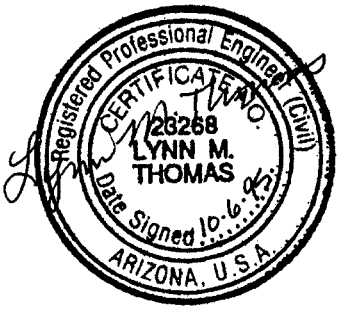
Registration No. 23268 Expiration Date: 9-30-98

State Arizona

Type of License Registered Professional Engineer

Lynn M. Thomas
Signature

10-6-95
Date



Seal
(Optional)

*Specify Subdiscipline

Note: Insert not applicable (N/A) when statement does not apply.

APPENDIX I

Computer Diskettes